ISSN 2345-0282 ONLINE
http://doi.org/10.9770/w3284377977

ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES

13(4)
2026

Publisher
http://jssidoi.org/esc/home

Volume 13 Number 4 June 2026

ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES

2026
13(4)

JCR Category: Business in *ESCI* edition

Entrepreneurship and Sustainability Issues
Journal Impact FactorTM (2024) 1.3 Q3
Journal Citation IndicatorTM (2024) 0.26 Q4

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 14 Number 4 (June)
http://doi.org/10.9770/b3426987543

Publisher
http://jssidoi.org/esc/home

EUROPEAN DEFENCE AS A PUBLIC GOOD: ECONOMIC, POLITICAL AND STRATEGIC DIMENSIONS

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Received 11 December 2025; accepted 14 March 2026; published 30 June 2026

Abstract. This article analyses defence as a pure public good within the context of the European Union, arguing that its provision transcends the capabilities of individual states due to the inherent properties of non-excludability and non-rivalry. Adopting a multidisciplinary framework, the study employs a content and qualitative analysis of scholarly literature and policy documents, alongside a conceptual synthesis of economic, security, and political science approaches. The findings highlight persistent collective action problems—notably the "free-riding" phenomenon—the fragmentation of the European defence industry, and significant asymmetries in Member States' capabilities and expenditure. The paper demonstrates that political and institutional constraints, including subsidiarity, national sovereignty, and divergent strategic cultures, continue to hinder the transformation of defence into a genuine European public good, despite the introduction of frameworks such as the Strategic Compass and Readiness 2030. Furthermore, the economic analysis indicates that increasing defence spending without supranational coordination and targeted investment in research, development, and innovation fails to yield long-term security or economic dividends. The author underscores the necessity of strengthening collective financing, institutional consolidation, and strategic autonomy as essential prerequisites for the effective and efficient provision of defence in a multipolar and competitive global environment.

Keywords: Defence economics; European public good; collective action; fiscal federalism; EU defence policy

Reference to this paper should be made as follows: Ivančík, R., Andrassy, V. 2026. European defence as a public good: economic, political and strategic dimensions. *Entrepreneurship and Sustainability Issues*, 13(4), 10-24. http://doi.org/10.9770/b3426987543

JEL Classifications: F52, H41, H56, H77

Additional disciplines: Political Science, International Relations, Security

1. Introduction

The provision of defence is one of the fundamental functions of the state and is historically considered one of the purest forms of a public good. The concept of a public good, as defined by Samuelson (1954), is based on two core characteristics: non-excludability and non-rivalry. This implies that if a specific public good is provided, it is impossible to exclude any individual or group from its consumption; simultaneously, consumption by one individual does not reduce the availability of the good for others. Defence as a public good strictly satisfies these criteria. When a state ensures protection against external threats, all residents benefit from this security, and it is impossible for anyone to be excluded or for the increased security of one citizen to diminish that of another (Buti & Papacostantinou, 2022; Ivančík & Nečas, 2023).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 14 Number 4 (June)
http://doi.org/10.9770/b3426987543

Within the context of the European Union, this discussion acquires a new dimension. Given ongoing integration, the increasing interconnectedness of Member States, shared borders, and increasingly complex threats, defence is more frequently being identified not merely as a national public good, but as a European public good (Trifunović et al., 2021; Beetsma, Buti & Nicoli, 2024). This suggests that its provision and financing transcend the capacity and logic of individual states, requiring collective coordination, solidarity, and integration across the entire European area.

Defence holds a unique position among public goods. Unlike other public goods, such as education or healthcare, defence is indivisible and inherently collective (Atkinson & Stiglitz, 2015). Either the defence of a territory and its population is successfully guaranteed as a whole, or it fails for everyone. Consequently, its provision is associated with significant collective action problems. A quintessential example is the "free rider" phenomenon, where certain actors benefit from defence provided by others without contributing proportionately themselves (Olson & Zeckhauser, 1966). This issue is manifest not only at the level of individual states but also within alliances and integration blocs such as NATO or the EU.

A further specific feature of defence is its strategic and existential character. While other public goods enhance the quality of life or promote economic development, the absence of defence threatens the very survival of the state and its population. For this reason, the provision of defence carries a profound political and moral dimension that often transcends purely economic considerations (Atkinson & Stiglitz, 2015; Bergmann et al., 2022). The current geopolitical environment significantly reinforces the need to examine defence as a public good. Russia's armed aggression against Ukraine has revealed that the post-Cold War "peace dividend" led to a long-term underfunding of defence in Europe and a loss of capabilities and capacities that are now proving indispensable (López Vicente et al., 2024; Ivančík & Andrassy, 2025). The conflict in Ukraine clearly demonstrates that the security environment in Europe is not only unstable but also highly competitive and multipolar. In an environment where major powers such as Russia and China seek to assert their interests, the question of Europe's ability to collectively guarantee defence becomes an existential one (European Commission, 2024).

Furthermore, the significance of examining this issue is underscored by the fiscal and economic context. European states are simultaneously facing pressure to increase expenditure in areas such as energy transition, digitalisation, and an ageing population, while their public finances are already burdened by high levels of debt (Beetsma et al., 2024; Dušek, 2025; Ivančík & Dušek, 2026). Increasing defence spending, therefore, presents a dilemma: how to balance the necessity of strengthening defence with limited fiscal capacity?

Ultimately, defence as a public good is coming to the fore in the context of Europe's strategic autonomy. While NATO remains a key pillar of European security, uncertainty regarding the future engagement of the United States in the European theatre raises the question of the extent to which the EU should assume greater responsibility for its own defence (Hellemeier & Schilde, 2024; Jurčák & Ivančík, 2023). This shift requires not only political will but also new institutional and financial mechanisms.

Scientific discourse on defence as a public good has a long tradition, with its roots found in classical economic theories that addressed the role of the state in providing goods essential for social survival and stability. As early as 1954, Samuelson pointed out that certain goods, most notably defence, cannot be provided through market mechanisms because private actors lack the incentives to finance them (Samuelson, 1954). Samuelson's work was followed by several authors who highlighted the specific nature of defence as a good whose production is inherently linked to collective action and the redistribution of costs through public budgets (Olson & Zeckhauser, 1966; Kennedy, 1975; Stiglitz, 2000; Medveď & Nemec et al., 2011). Modern literature further emphasises new dimensions, such as the issues of efficiency, externalities, and the optimal level of financing within a multipolar geopolitical environment (Mikušová Meričková & Stejskal, 2014; Buti & Papacostantinou, 2022; Beetsma et al., 2024a).

In recent years, the concept of the "European public good" has become a significant contribution to the debate on this subject. Drawing on the theory of fiscal federalism, it asserts that, in the case of defence, national policies are not only insufficient but potentially counterproductive, as they lead to duplication and the inefficient use of

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 14 Number 4 (June)
http://doi.org/10.9770/b3426987543

resources (Wyplosz, 2024; Beetsma et al., 2024b). Numerous empirical analyses indicate that the fragmentation of the European defence industry and inconsistent decision-making by Member States result in both economic losses and the strategic weakening of Europe relative to other powers such as the United States, Russia, and China (Draghi, 2024; López Vicente et al., 2024). This discussion is further complemented by a growing interest in interdisciplinary approaches that combine economic, political science, and security studies, allowing for a more comprehensive understanding of defence as a public good.

This interdisciplinary approach serves as the foundation for the present article. Examining the issue of defence necessitates the integration of multiple perspectives: the economic dimension explains financing mechanisms, resource allocation efficiency, and issues of externalities; political science provides a framework for analysing institutional arrangements, coordination mechanisms, and political constraints; and security studies clarify the nature of threats, the dynamics of military power, and the strategic dilemmas facing Europe. Methodologically, the text relies on the content and qualitative analysis of existing scholarly literature and policy documents, the conceptual and theoretical synthesis of knowledge from various scientific disciplines, and the comparative and critical analysis of selected cases. This framework enables the identification of not only the strengths and weaknesses of current defence provision in Europe but also the formulation of recommendations for future development.

The introductory framework thus suggests that examining defence as a public good is not merely an academic exercise but a matter of exceptional practical and political relevance. The European Union faces a fundamental dilemma: it must either translate its declared will for deeper cooperation into concrete institutional and financial mechanisms, or remain reliant on fragmented, inefficient, and insufficiently effective systems that fail to provide an adequate level of defence. Consequently, this article seeks to contribute to the ongoing professional and academic debate through a systematic analysis of the economic, political, and strategic dimensions of defence as a public good within the context of the European Union, considering historical experience, current geopolitical challenges, and prospects for future development. Simultaneously, it identifies the key limitations of its collective provision.

2. Theoretical Foundations of Examining Defence as a Public Good

The discourse on defence as a public good holds a firm position in the history of economic thought, and its significance for understanding the roles of the state and the functioning of society is fundamental. Even classical economists such as Adam Smith pointed out that one of the primary functions of the state is the protection of the population from external threats and the maintenance of internal order—areas that cannot be left to spontaneous market mechanisms (Smith, 1776/2024). This perspective evolved gradually, and during the 19th and 20th centuries, theoretical concepts of public goods began to take shape as a specific category of goods that the market cannot efficiently provide. A decisive milestone was the work of Paul Samuelson (1954), who analytically defined the properties of public goods and laid the foundation for the modern understanding of defence as a pure public good. In his model, Samuelson demonstrated that, unlike private goods, which are rivalrous and excludable, public goods are characterised by the indivisibility of consumption and the impossibility of excluding individuals from consumption. Defence is a quintessential example of a public good; if a state is capable of guaranteeing protection against external threats, this security is enjoyed by all residents, regardless of whether they contributed to its financing (Samuelson, 1954).

During the second half of the 20th century, theoretical approaches to defence began to differentiate. On one hand, efforts emerged to classify defence among so-called pure public goods—goods that strictly satisfy the conditions of non-excludability and non-rivalry. On the other hand, some authors pointed out that defence also possesses certain elements of so-called mixed goods or club goods, as its provision may vary in quality and intensity depending on geographical location or specific population groups (Cornes & Sandler, 1996). Despite these nuances, the understanding of defence as a paradigmatic example of a pure public good has become established in the literature, its provision being associated with particular problems of collective action and political coordination.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 14 Number 4 (June)
http://doi.org/10.9770/b3426987543

From the perspective of economic theories, it is significant that defence has become a model example for the analysis of so-called market failures. Since there is no effective way to exclude an individual from the consumption of defence, private actors have no incentive to produce this good. Conversely, there is a strong incentive to act as a "free rider"—to benefit from the defence provided by others without the individual or state sharing the costs of its provision (Olson & Zeckhauser, 1966). This phenomenon is particularly important in the context of international relations, where it is evident that smaller states within defence alliances tend to rely on the capabilities and capacities of larger states while limiting their own defence expenditure. Empirical studies of NATO repeatedly confirm that this dynamic leads to an uneven distribution of costs and tension between allies, which in recent decades has been manifested primarily in the relationship between the United States and its European allies.

The elaboration of the theoretical aspects of defence as a public good has also introduced new concepts within modern defence economics. For instance, Sandler and Hartley (1995) analysed the limited possibilities for collective action and proposed mechanisms through which coordination between states can contribute to a more efficient provision of defence at a supranational level. Their models demonstrate that with a higher degree of integration and joint financing, the total volume of provided defence can be greater than if individual states were to rely exclusively on their own capacities. This argument is particularly salient in the current European context, where defence is being discussed as a European public good (Beetsma et al., 2024a). From this perspective, defence becomes not only a national but also a collective responsibility, necessitating new institutional arrangements and financing mechanisms.

Special attention should be paid to the characterisation of defence as a pure public good within the context of theoretical debates on efficient resource allocation. Samuelson's model of public goods was based on the premise that the optimal level of provision for such goods is determined by the equilibrium between the marginal benefit to individuals and the marginal costs to society. In the case of defence, however, this relationship is complicated by the fact that the assessment of the marginal benefit of defence is subjective and depends on threat perception, the geopolitical situation, or historical experience. For example, states on the EU's eastern flank, which directly border Russia, perceive a higher value in the marginal contribution to defence than countries in Western Europe, where these threats are viewed as less urgent (Malet & Hegewald, 2025; Krotz et al., 2025). This difference in perception leads to asymmetries in financing and political tensions, which complicate the establishment of a unified European defence policy.

One of the most fundamental issues associated with defence as a public good is the aforementioned "free rider" dilemma, which Olson and Zeckhauser elaborated upon in detail during the 1960s. According to their analysis, smaller states within defence alliances are motivated to contribute less, knowing that they will benefit from collective defence provision regardless. The costs of increasing capabilities and capacities are disproportionately borne by larger states, which have a greater interest in maintaining the stability of the system (Olson & Zeckhauser, 1966). Empirical evidence from NATO confirms this problem, particularly in the post-Cold War period, when European allies systematically reduced their defence expenditure while the United States continued to bear the burden of maintaining a global military presence and modernising defence capacities (Oma, 2012; Bogers et al., 2020).

This phenomenon is also manifest within the European Union, where significant differences exist in how individual Member States approach the issue of defence. Countries such as Estonia, Latvia, Lithuania, and Poland, located in the immediate vicinity of Russia, allocate defence expenditures exceeding 2% of GDP, while several Western European states still remain below this threshold (European Defence Agency, 2025). The free rider problem is, therefore, not merely a theoretical abstraction but a practical phenomenon that undermines solidarity and the effectiveness of collective security mechanisms.

The problem of collective action in the field of defence has further dimensions. From an economic perspective, it manifests as a reluctance of states to invest in joint projects if they are uncertain that other actors will contribute proportionately. The result is fragmentation, duplication, and the inefficient use of resources. The European Union currently possesses over 170 different weapon systems, whereas the United States uses approximately 30, illustrating immense losses in terms of economies of scale and interoperability (European

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 14 Number 4 (June)
http://doi.org/10.9770/b3426987543

Commission, 2024). The fragmentation of the defence industry is a direct consequence of insufficient coordination and collective action, resulting in a higher dependence on external suppliers—most notably the United States, which has become the dominant provider of arms and technology for the European area (McGerty et al., 2022).

The issue of public financing for defence, therefore, plays a pivotal role. Given that defence is not provided by the market, it is financed primarily through tax revenues and public budgets (Mikušová Meričková et al., 2017). This mechanism has several implications. Firstly, it entails constant political competition for the allocation of limited resources between defence and other public goods, such as healthcare, education, social affairs, and infrastructure. Secondly, it exerts pressure on fiscal discipline and public debt limits, particularly in Europe, where Member States are bound by the rules of the Stability and Growth Pact (European Union, 2012). In this regard, the European Commission, within the framework of the "Readiness 2030" initiative, has proposed a relaxation of fiscal rules to allow Member States to temporarily increase defence spending beyond prescribed fiscal paths (Clapp et al., 2025). This step clearly indicates that the provision of defence is regarded as a priority public good to which other budgetary rules must be subordinated.

Defence as a public good is simultaneously associated with significant externalities. If one state increases its defence expenditure, thereby strengthening collective defence capabilities, its allies benefit indirectly. However, this positive external effect leads to the aforementioned free-rider dilemma, as it motivates others to reduce their own contributions. Conversely, insufficient investment by a single state can generate negative externalities in the form of weakened collective security. Within the European Union, these externalities operate bidirectionally: countries that invest heavily in defence bear disproportionate costs, while those relying on the "protective umbrella" of others undermine the overall efficiency and effectiveness of the defence system (Beetsma et al., 2024c).

From the perspective of optimal resource allocation, it is problematic that, unlike private goods, no market mechanism exists to signal the "correct" level of defence. Political decision-making is therefore often derived from subjective threat perceptions, domestic political priorities, and the geopolitical context. This results in uneven spending levels and constant disputes over what constitutes a "fair" contribution to collective defence provision. Economic models suggest that increasing defence expenditure in the EU may have a positive impact on GDP but simultaneously increases pressure on public debt and fiscal sustainability (Bokan et al., 2025). Consequently, the question of efficient resource allocation in the field of defence is not merely a theoretical discussion but carries fundamental practical and political implications.

In this context, there is an increasing debate regarding the need to strengthen the European defence industry, which is currently fragmented and often inefficient (Andersson & Britz, 2025; Ivančík & Andrassy, 2025; Besch, 2025). Consolidation of production, joint investment in research and development, and the deepening of cross-border cooperation could lead to economies of scale and reduced dependence on external suppliers. From the perspective of economic theory, this is a mechanism that would enable more efficient resource allocation and a higher return on investment, as collective defence provision would replace uncoordinated and duplicative national initiatives. This approach is also consistent with the concept of defence as a European public good, which advocates for joint financing and shared responsibility (Beetsma et al., 2024b).

3. Political and Institutional Dimensions of Defence Provision in the European Union

The discourse on defence as a public good in Europe has naturally shifted from purely economic and theoretical frameworks towards political and institutional questions. While at the national level, the provision of defence is understood as an inherent component of state sovereignty, in the European context, this issue acquires new dimensions linked to the integration process, a multipolar geopolitical environment, and increasing demands for collective action. Over the past decade, the concept of defence as a European public good has been developed with increasing intensity. This approach emphasises that a fragmented approach to defence provision leads to inefficiencies, duplications, and a loss of strategic autonomy (Beetsma et al., 2024c). Hellemeier and Schilde (2024) point out that in an environment of escalating competition between major powers, the EU must decide whether to remain a merely complementary actor within NATO or to become an independent pillar of collective

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 14 Number 4 (June)
http://doi.org/10.9770/b3426987543

security. The debate on defence as a European public good has thus become not only an academic concept but also a political agenda directly linked to the future of the integration project.

A key framework for this discussion is the relationship between NATO and the European Union. Since its inception, NATO has been considered the primary provider of collective defence in Europe, with Article 5 of the Washington Treaty serving as the foundation for guaranteeing the security of Member States (Nečas & Kollár, 2018). However, following the end of the Cold War, it became evident that European states were gradually reducing their defence expenditure, relying instead on the military and technological superiority of the United States. This resulted in a deepening transatlantic asymmetry, which culminated in repeated calls from American leaders for Europe to assume a greater share of responsibility for its own security (Ivančík & Nečas, 2023). Meanwhile, the EU gradually developed its own instruments, such as the Common Foreign and Security Policy (CFSP) and the Common Security and Defence Policy (CSDP); however, these remained long in the shadow of NATO, limited by a lack of military capabilities and capacities.

The relationship between NATO and the EU is, therefore, ambivalent. On the one hand, the EU declares that it does not wish to create duplications and that its defence initiatives are intended to complement NATO capabilities. On the other hand, there is growing pressure to build so-called strategic autonomy, particularly in the context of uncertainty regarding future US engagement in Europe. Documents such as the EU Strategic Compass (2022) or the White Paper on European Defence – Readiness 2030 (2024) clearly highlight the need to strengthen European capacities so that the Union can act autonomously when the situation demands (European External Action Service, 2022; European Commission, 2024). However, this trend encounters political and institutional barriers, primarily the issues of subsidiarity, sovereignty, and coordination among Member States.

Subsidiarity in the field of defence implies that decisions should be taken as close to the citizens as possible—namely, at the national level—unless it is clearly demonstrated that more effective solutions can be achieved at the EU level. Yet, defence as a public good possesses a transnational character that transcends the capacities of individual states. This creates tension between the principle of subsidiarity and the need for centralised coordination. Furthermore, sovereignty in the realm of defence is one of the most sensitive areas of national policy. For several Member States, any transfer of competences in this sphere is perceived as a threat to their autonomy. This conflict between national sovereignty and European solidarity complicates the creation of common mechanisms, such as joint defence funds or the common procurement of military equipment (Lefebvre, 2021; Hellemeier & Schilde, 2024). Consequently, coordination problems represent one of the greatest obstacles to the effective provision of defence as a European public good.

Recent EU strategic documents illustrate a shift in the conceptualisation of defence. The Strategic Compass, adopted in 2022, defines defence as a key pillar of European security and sets specific objectives for building joint capabilities, including the establishment of a Rapid Deployment Capacity by 2025 (European External Action Service, 2022). Furthermore, the *Readiness 2030* document highlights the necessity for massive investment in European defence, the strengthening of the industrial base, and coordinated measures to replenish stockpiles and capacities that proved insufficient following the war in Ukraine (European Commission, 2024). These documents reflect the gradual assertion of the concept of defence as a European public good and represent an effort to overcome the historical constraints that have hindered European integration in the sphere of security and defence.

Current debates clearly demonstrate that guaranteeing defence in Europe is not merely a matter of economic rationality but, above all, a question of political will and institutional arrangements. Europe faces a dilemma: whether it can translate declarations of solidarity into concrete policies and mechanisms or remain in a state where its security is largely dependent on an external actor, specifically the United States (Fiott, 2023; Feng et al., 2025). The deepening of the political and institutional dimensions of defence provision is therefore an indispensable prerequisite for defence to truly become a European public good rather than a mere abstract concept (Brøgger, 2024).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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Finding a balance between levels of decision-making in the field of defence represents one of the greatest political and institutional challenges of the contemporary European Union. On one hand stands the national level, which retains a strong identity and competence in defence matters; on the other hand, is the need for collective action arising from the transnational nature of security threats. Classic examples include hybrid threats, cyberattacks, and disinformation campaigns, which transcend national borders and cannot be addressed in isolation. These new forms of threat underscore that defence has become a matter of European interest and that its provision can only be addressed effectively and efficiently through coordination at the supranational level (Van Der Togt, 2024; Kavan et al., 2025; Maher, 2025). Nevertheless, Member States repeatedly hesitate to transfer decision-making powers to Brussels, perceiving this as a limitation of their own sovereignty.

Another significant barrier is the differing political cultures and strategic traditions of the Member States. While France has long advocated for the idea of European strategic autonomy and the strengthening of shared European capacities, countries in Central and Eastern Europe rely more heavily on NATO and the United States as the guarantors of their security. These differences complicate the establishment of a unified line on issues of common procurement, joint planning, or the coordination of defence expenditure. This lack of unity is also evident in the implementation of strategic documents: while some states welcome ambitious plans like the Strategic Compass or *Readiness 2030*, others view them as a threat to national sovereignty or as unrealistic in terms of fiscal capacity (Vigilant, 2025; Scazzieri, 2025).

A fundamental problem remains the institutional architecture of the EU, which, in the field of defence, continues to be limited by the intergovernmental nature of decision-making. Unlike other EU policies where supranational powers and legislative instruments exist, decisions in the realm of defence require the consensus of Member States (Besch, 2020; Kompan & Hrnčiar, 2021). This mechanism often leads to the "lowest common denominator" and prevents the adoption of ambitious steps. Despite several attempts, such as the creation of Permanent Structured Cooperation (PESCO) or the European Defence Fund (EDF), the question of effective coordination remains open, and the results of these initiatives have, thus far, been limited.

Strategic documents aimed at overcoming these barriers serve as a vital signal of a shift in political discourse. The 2022 Strategic Compass was the first EU document to explicitly identify defence as a European public good and define specific measures to strengthen the Union's defensive capabilities. Its key objectives include the aforementioned creation of an EU Rapid Deployment Capacity, increased investment in research and development, and the strengthening of partnerships with NATO and the UN (European External Action Service, 2022). The *Readiness 2030* document, introduced in 2024, goes even further, emphasizing the need for a fundamental consolidation of the European defence industry, the introduction of common financing instruments, and the establishment of mechanisms for the effective management of supply chains within the defence sector (European Commission, 2024). Both initiatives aspire to transform how defence is discussed in Europe, shifting it from a national to a truly European level.

From a political perspective, these steps are a response to two fundamental realities. Firstly, the unprecedented deterioration of the security environment following the Russian aggression against Ukraine, which demonstrated that European defence capabilities and capacities are insufficient and that Europe cannot rely indefinitely on American support. Secondly, the increasing pressure from the public and political elites for the EU to assume greater responsibility for its own security and defence, becoming a global actor capable of acting autonomously when necessary (Hackett & Schreer, 2025). This shift reflects a broader trend in global politics, where multipolarity and great-power rivalry reduce predictability, increase uncertainty, and reinforce the need for regional blocs to secure their own defence.

At the same time, it is evident that realizing these ambitions requires overcoming long-standing barriers. These include not only the issue of financing but also the need to adapt the EU's institutional framework to enable rapid and effective decision-making. If the EU remains bound by unanimity on key defence issues, its ability to respond to crises will remain limited. In this context, proposals have emerged for a gradual transition toward qualified majority voting (QMV) in at least some areas of security and defence policy, which could enhance flexibility and strengthen the Union's capacity to act (Navarra et al., 2023; Blockmans et al., 2025).

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The political and institutional dimensions of defence provision in Europe thus represent a complex set of issues that transcend purely technical or economic levels. They lie at the core of the European integration project and serve as a test of its viability in an era of escalating threats. If Europe succeeds in translating the concept of defence as a European public good into concrete policies and institutional measures, it can become a stronger, more autonomous, and more respected security actor on the global stage. If not, the risk of persistent fragmentation and dependence on external security providers will remain high, undermining not only its pursuit of strategic autonomy but also the credibility of the integration process itself.

4. Economic Dimensions and Challenges of Defence Financing

The economic dimensions of providing defence as a public good are currently acquiring increasing significance, as they are inextricably linked to the sustainability of public finances, long-term economic growth, and the stability of the European Union's integration project. Defence expenditure represents a substantial item in public budgets, and its structure, dynamics, and efficiency have become subjects of extensive professional and political debate. Trends in recent years clearly indicate that the war in Ukraine marked a fundamental turning point in the European approach to defence (Genini, 2025; Jurčák & Ivančík, 2023; Ünaldilar et al., 2025). While prior to 2022, several EU Member States invested less than 1.5% of GDP in defence, the outbreak of the conflict prompted a significant increase in defence budgets.

According to data from the European Defence Agency (EDA), the total defence expenditure of the 27 EU Member States reached €343 billion in 2024, representing a 19% increase compared to 2023. As a percentage of Gross Domestic Product, defence spending rose to 1.9% of GDP—the highest level in history (EDA, 2025). Nevertheless, this remains a significantly lower amount compared to the United States, which invested nearly $1 trillion in defence in 2024, accounting for almost 3.5% of GDP (SIPRI, 2025). Furthermore, comparisons with other powers, such as China and Russia, demonstrate that European spending is fragmented and fails to exploit the full potential of economies of scale. While China possesses a relatively concentrated defence industry and a coordinated investment system, Europe remains divided into a multitude of national systems that unnecessarily duplicate capabilities and reduce overall efficiency.

In connection with the above, it is necessary to mention the phenomenon of the so-called "peace dividend". Following the end of the Cold War, most European states decided to reduce defence spending and redirect the saved resources into other areas, such as social policies, infrastructure, and economic modernisation. This trend was bolstered by the belief that, following the collapse of the bipolar world order and the fall of the Iron Curtain, Europe resided in a relatively secure environment where no imminent conventional military conflict was likely. Throughout the 1990s and the first two decades of the 21st century, a systematic underfunding of European armed forces occurred, manifesting in personnel reductions, the postponement of modernisation programmes, and a reliance on the United States for strategic capabilities and capacities (Bergmann et al., 2021; Ivančík & Nečas, 2023; López Vicente et al., 2024). The war in Ukraine demonstrated that this strategy was highly short-sighted and that the peace dividend has, in reality, become a deficit in security and defence readiness. Today, European governments are attempting to bridge this deficit; however, they face formidable fiscal constraints.

From a macroeconomic perspective, increasing defence expenditure is associated with a dilemma between short-term fiscal burdens and long-term positive effects. European Commission model estimates, based on the QUEST dynamic stochastic general equilibrium (DSGE) model, show that a 1% of GDP increase in defence spending in the EU can stimulate economic growth in the short term by boosting domestic demand and supporting industrial production; however, it simultaneously leads to an increase in public debt (European Commission, 2025). In the long run, the effect will depend on the expenditure structure: if resources are invested in research, development, and modernisation, they can generate positive externalities in the form of technological innovation and enhanced competitiveness. Conversely, if funds are predominantly used for operational costs, personnel maintenance, and the acquisition of off-the-shelf systems from abroad, the effect on economic growth is limited, and fiscal costs will dominate (Draghi, 2024).

The question of the efficiency of defence expenditure is therefore paramount. Europe currently faces significant fragmentation within its defence industry. As previously noted, EU Member States employ over 170 different

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weapon systems, resulting in duplication, low interoperability, and high maintenance costs. Simultaneously, a large proportion of European defence spending is directed towards acquisitions outside the EU, particularly to the United States, which provides technologically advanced weapon systems and guarantees compatibility with NATO. This dependency undermines Europe's strategic autonomy and ensures that a substantial portion of financial resources does not remain within the European economy. Initiatives such as the European Defence Fund (EDF) or common procurement programmes represent an attempt to reverse this trend, though their current scale is insufficient for a fundamental transformation (Koenig et al., 2023).

The efficiency of expenditure also depends on the extent to which investments are oriented towards research and development (R&D). Innovations in the defence sector often yield a significant multiplier effect, as new technologies are transferred to the civilian sector. Historically, the internet and satellite navigation can be cited as products of military research that have had a profound impact on the global economy. If the EU fails to increase the share of investment in innovation and remains dependent on importing off-the-shelf technologies, it risks not only economic losses but also the weakening of its strategic position within the global order (Cabelkova et al., 2021; European Defence Agency, 2025).

A vital aspect of the debate on the economic consequences of defence provision is the question of sustainability. In an environment where the public finances of Union Member States face mounting pressures due to population ageing, climate challenges, and the costs of energy transition (Dirma et al., 2024; Okunevičiūtė Neverauskienė et al., 2025a), defence enters into direct competition with other public goods. Policymakers must thus confront dilemmas regarding the allocation of limited resources between the necessity to invest in higher levels of defence and public demands for social security, healthcare, and education. In this context, the issue of "opportunity costs" is revisited—every euro invested in defence is a euro that cannot be invested in another area of public interest (López Vicente et al., 2024; Cepparulo et al., 2025). This heightens the requirement for transparency and efficiency in spending, as the public is only willing to accept a higher budgetary burden if they perceive concrete results in the form of enhanced security.

From a macroeconomic perspective, it is crucial to distinguish between the short-term and long-term effects of increased defence spending. In the short term, such spending can act as a stimulus for economic growth through increased demand for goods and services, particularly within the arms industry. However, this effect is largely dependent on whether these investments are made within the domestic market or directed abroad. If EU Member States purchase the majority of their military equipment from American suppliers, the positive multiplier effect on the European economy is significantly diminished. In the long term, the effects of defence expenditure depend on its structure. If a greater portion of funds is invested in R&D and industrial innovation, it may yield secondary positive externalities in the form of technological progress and increased competitiveness in civilian industry. This mechanism is well-established in the American context, where Department of Defense research programmes have generated innovations that subsequently found applications in the civilian economy. Europe has yet to exploit similar potential to a sufficient degree (Bokan et al., 2025; Wolff et al., 2025).

The question of spending efficiency is therefore inherently linked to the necessity for deeper integration of the European defence industry. Current fragmentation entails not only high costs but also insufficient interoperability and delayed crisis response. Several EU initiatives seek to address this issue. Permanent Structured Cooperation (PESCO) enables Member States to undertake joint projects, such as the development of new weapon systems or the sharing of logistical capacities. The European Defence Fund (EDF) provides financing for research and development, thereby aiming to bolster the Union's technological autonomy. Despite these steps, progress remains slow, and the scale of joint projects is limited (D'Aprile et al., 2025; Wolff et al., 2025).

A significant theme is Europe's dependence on the import of critical raw materials and components essential for a modern defence industry. The conflict in Ukraine and tensions within supply chains have demonstrated that Europe is insufficiently prepared for protracted crises and that its industry is vulnerable to trade disruptions with third countries. This dependency undermines not only economic efficiency but also the Union's strategic autonomy. Experts, therefore, highlight the need to develop domestic capacities in ammunition production,

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sophisticated weapon systems, and cyber technologies, as well as the necessity to diversify sources of critical raw materials (Draghi, 2024).

The current economic debate simultaneously emphasises the need for a fundamental shift in the structure of defence expenditure. Increasing the volume of spending is insufficient if it is not accompanied by a change in allocation and coordination methods. Without deeper integration and consolidation of the European defence industry, efficiency will remain limited, and Europe will continue to face problems associated with fragmentation, duplication, and import dependency. From a macroeconomic perspective, it is therefore essential to link increased defence spending with broader EU economic policy strategies, including innovation, digitalisation, and the green transition (Okunevičiūtė Neverauskienė et al., 2025b). Only then can defence as a public good contribute not only to enhanced security but also to the long-term competitiveness and prosperity of the European economy.

From an economic standpoint, defence in the European context is not merely a security issue but also a question of the integration project's future. Collective financing and joint investments represent not only a tool for increasing efficiency but also a symbol of European solidarity and the capacity to face common challenges. If the EU succeeds in establishing an effective system for providing defence as a public good, it can simultaneously strengthen its economic base and political cohesion. However, if these ambitions are not met, there is a risk of persistent imbalances, fiscal pressures, and continued dependence on external security providers.

Conclusion

The discourse on defence as a public good within the European context reveals a complex set of economic, political, security, and institutional factors that influence how the European Union and its Member States approach the guarantee of their security. From a theoretical perspective, it is evident that defence satisfies the fundamental characteristics of a pure public good, as defined by Samuelson; consequently, its provision cannot be efficiently ensured through market mechanisms. The absence of rivalry and the impossibility of exclusion imply that without state or collective intervention, a "free rider" problem emerges, undermining the incentives for individual actors to contribute to common defence. Within the European context, this dilemma is manifested not only in disparate spending levels among individual Member States but also in the asymmetry between the United States and its European allies within NATO.

From an economic standpoint, a key finding is that the question of defence financing cannot be reduced merely to the volume of allocated funds but must also account for their structure and efficiency. Analyses demonstrate that although European states have increased defence expenditure in recent years, the fragmentation of the defence industry and dependence on external suppliers significantly diminish the multiplier effect. Investments directed towards research, development, and technological innovation have the potential to generate long-term positive externalities, whereas a unilateral focus on the acquisition of foreign weapon systems and technologies increases the fiscal burden without providing an adequate benefit to the European economy. In this regard, the provision of defence as a public good is shown to be inextricably linked to the issues of economic competitiveness and technological sovereignty.

The political and institutional dimensions of the debate indicate that European security remains torn between a dependence on NATO and the ambition to build its own strategic autonomy. While the United States has long played a decisive role in guaranteeing the defence of the European continent, the war in Ukraine has once again reopened the question of the extent to which the Union is capable of acting independently. EU strategic documents, such as the *Strategic Compass* and *Readiness 2030*, signal a significant shift in the conceptualisation of defence—from a national to a European public good. However, this shift encounters barriers in the form of national sovereignty, the principle of subsidiarity, the differing strategic cultures of Member States, and the varying levels of capabilities and capacities they possess.

Reflecting on these findings shows that the provision of defence within the European Union cannot be analysed in isolation from the broader geopolitical context. A multipolar world, characterised by increasing great-power rivalry and a rise in hybrid threats, necessitates a new approach in which defence is not merely a national but,

above all, a collective responsibility. Theoretical models of collective action and economic analyses demonstrate that joint action yields higher benefits than uncoordinated national initiatives; however, its implementation requires political will and institutional innovation. The practical implications are therefore unequivocal: if the Union is to prevail in a competitive global environment, it must overcome the dilemma between sovereignty and solidarity and embrace defence as a genuine European public good.

The future of defence as a public good in the European Union will, therefore, depend on the ability to overcome long-standing barriers and adapt to a dynamically changing environment. The greatest challenge in this regard remains the question of political will and the readiness of Member States to share responsibility and sovereignty in an area traditionally considered the core of national identity. Without the strengthening of solidarity mechanisms and collective financing, there is a risk that declarations of European strategic autonomy will remain merely on paper. Another key challenge is the consolidation of the defence industry and its capacity to generate innovations that ensure not only military readiness but also the competitiveness of the European economy on a global scale.

In conclusion, it can be stated that providing defence as a public good is not merely an economic, political, or strategic concept, but a complex project that tests the European Union's ability to act collectively in an environment of increasing competition, rivalry, uncertainty, and instability. Although the challenges facing Europe are substantial, they simultaneously represent an opportunity to strengthen the Union's mutual solidarity, innovative potential, and political cohesion. Ultimately, whether the European Union can move beyond declarations towards the genuine provision of defence as a shared public good will be of fundamental importance—not only for the future of European integration but for the very security architecture of the 21st century.

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Data Availability Statement: More information and data can be obtained from the authors on a resonable request.

Author Contributions: The authors contributed equally, they have read and agreed to the published version of the manuscript.

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/x3348726554

Publisher
http://jssidoi.org/esc/home

IMPACT OF POWER DISTANCE ON DECISION QUALITY IN PROJECT MANAGEMENT: A CROSS-CULTURAL STUDY*

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Received 11 January 2026; accepted 17 March 2026; published 30 March 2026

Abstract. International projects increasingly rely on cross-cultural collaboration under conditions of uncertainty, time pressure, and incomplete information, making decision quality a critical but difficult-to-measure determinant of project performance. Despite its importance, comparable project-level indicators of decision quality are rarely available for cross-country analysis. This study addresses this gap by examining whether cross-national differences in hierarchy acceptance are systematically associated with decision-environment integrity, used as a proxy for comparable decision-quality conditions in international project contexts. Drawing on a conceptual framework that links power distance to decision quality through voice, information sharing, and challenge capacity, the study adopts a parsimonious, proxy-based cross-national design. Empirically, it uses a matched-country dataset of 69 countries combining Hofstede's Power Distance Index (PDI) and the Corruption Perceptions Index (CPI). The analysis applies distributional testing, Pearson correlation, ordinary least squares (OLS) regression, and cluster analysis. The results reveal a strong negative association between PDI and CPI ($r = -0.663$, $p < 0.001$) and a statistically significant regression relationship ($CPI = 88.850 - 0.601 \times PDI$; $R^2 = 0.439$), indicating that higher hierarchy acceptance co-occurs with weaker integrity conditions of the decision environment. Cluster analysis further identifies two stable decision-environment profiles combining hierarchy acceptance and integrity conditions. The findings do not imply cultural determinism but highlight a systematic vulnerability pattern: in higher-hierarchy contexts, decision quality becomes more dependent on compensatory governance mechanisms that preserve voice, escalation, documentation, and independent review. The study contributes by providing a transparent, reproducible macro-level test of a theoretically specified decision-quality mechanism and by translating cultural differences into governance-relevant insights for international projects.

Keywords: decision quality; project management; voice mechanisms; Power Distance Index (PDI); Hofstede's cultural dimensions; Corruption Perceptions Index (CPI).

Reference to this paper should be made as follows: Zhao, Sh., Pan, Y., Zhang, Ch., Kudiņš, J., Kokarēviča, A., & Čižo, E. 2026. Impact of power distance on decision quality in project management: A cross-cultural study. *Entrepreneurship and Sustainability Issues*, 13(4), 25-39. http://doi.org/10.9770/b3633688587

JEL Classifications: D81, D83, D91, M10, M14

Additional disciplines: Project management; Cross-cultural management; Organizational behavior; Decision sciences; International business.

* *The article has been developed and funded within the Daugavpils University's (Latvia) research project No 14-95/2026/16 "Human Resource Management in Cultural Diversity: Organizational Challenges and Strategies".*

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/x3348726554

1. Introduction

International projects increasingly depend on cross-cultural collaboration among partners who operate with different managerial routines, communication norms, and expectations about authority. Under these conditions, project performance is shaped not only by planning and execution practices, but also by the quality of decisions made when time is scarce, uncertainty is high, and information is incomplete (Lawani et al., 2023; Cantarelli, 2025; Sommer, 2024). In this article, decision quality is conceptualized as a process-level property, expressed through the completeness of relevant information, explicit consideration of risks, systematic comparison of feasible alternatives, and a traceable justification that remains defensible as project conditions evolve (Hjelle et al., 2024; Lukas et al., 2025). Because comparable project-level decision-quality metrics are not available for large-scale cross-country testing, this article approximates decision quality indirectly via decision-environment integrity, treating the Corruption Perceptions Index (CPI) (Transparency International, 2025) as a contextual indicator of the institutional conditions that enable transparent, accountable, and defensible decision-making. This proxy-based design supports cross-country comparability but does not constitute a direct or causal measurement of project-level decision quality.

In cross-cultural settings, decision quality is challenged by culturally specific assumptions about who may legitimately participate in decision-making and how openly concerns may be communicated. Power distance (Hofstede, 1984, 2001; Hofstede et al., 2010) is central because it captures whether hierarchical asymmetry and unequal authority are treated as normal and legitimate. High power distance typically corresponds to more centralized decision processes, indirect disagreement, and stronger status constraints on speaking up; lower power distance is more compatible with participative interaction and upward voice, potentially improving the informational basis of decisions (Adamovic, 2023; Kwan et al., 2024). Evidence shows that when employees fail to speak up under ambiguous threats, problems remain unnoticed and opportunities are overlooked, directly weakening decision quality (Park et al., 2024). The voice channel is also shaped by cultural moderation and by leader-follower fit in power distance orientations (Guzman & Fu, 2022; Toufighi et al., 2024). In this study, power distance is treated as cross-national variation in Power Distance Index (PDI) (Geerthofstede.com, n.d.) that project partners bring into cross-cultural collaboration, and the empirical test evaluates whether this variation is systematically associated with integrity conditions of decision environments.

Growing engagement in international project cooperation provides a relevant context for motivating the proposed mechanism, because many cross-border projects involve partners with systematically different expectations about authority and legitimate challenge. Thus, existing research on China's global project partnerships shows that hierarchical expectations constitute a durable source of coordination friction and performance variation in cross-border projects (Zhao & Kudiņš, 2025). However, the empirical test in this article is conducted strictly at the country level using a matched-country dataset (N = 69). In this context, China and Latvia are referenced not as focal cases for bilateral or region-specific comparison, but as analytically grounded illustrations of how different positions within the PDI–CPI space can generate distinct coordination expectations in international projects. Their inclusion serves to clarify the governance relevance of hierarchy acceptance differences identified in the results, rather than to support cultural or regional profiling. The analysis therefore deliberately avoids region-based generalizations and instead evaluates variation in power distance at the level of individual countries, spanning a broad range of hierarchy-acceptance and integrity configurations across the global cultural landscape.

Accordingly, this article examines whether cross-country variation in hierarchy acceptance, captured by Hofstede's Power Distance Index (PDI), is systematically associated with decision-environment integrity, which is used as a proxy for comparable decision-quality conditions in international project contexts. The contribution of the study is threefold. First, it specifies a theoretically grounded mechanism linking power distance to decision quality through constraints on voice, information sharing, and upward challenge. Second, it introduces a transparent, proxy-based operationalization that enables reproducible correlation, regression, and cluster analyses using publicly available country-level indicators. Third, it derives a two-profile typology of decision environments by jointly clustering PDI and the Corruption Perceptions Index (CPI, 2024), providing an analytically tractable way to anticipate governance frictions in cross-border projects. The remainder of the article is structured as follows: Section 2 reviews the relevant literature; Section 3 develops the hypotheses and

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/x3348726554

presents the research methodology; Section 4 reports the empirical results; Section 5 discusses implications for cross-cultural project governance; and Section 6 concludes with limitations and directions for future project-level validation.

2. Literature review

Decision quality is a major driver of project success because critical choices are routinely made under uncertainty, time constraints, and incomplete information. Evidence from complex-project research indicates that performance depends not only on execution but also on the quality of decision formation at the front end: teams must combine experience-based judgment with available evidence and translate it into a defensible course of action (Lawani et al., 2023). In project governance, the practical implication of Kahneman's work is primarily procedural: improving outcomes requires decision procedures that reduce systematic bias rather than ex post documentation of choices (Cantarelli, 2025). Experimental findings further suggest that justification pressure can alter project-selection behavior, implying that decision quality includes the transparency and defensibility of reasoning, not merely the final outcome (Lukas et al., 2025). Decision analytics research likewise shows that the structuring and visualization of information can change interpretation and choice even when the underlying data remain constant (Hjelle et al., 2024).

Studies of high-stakes multi-agency coordination show that decision quality often fails not due to lack of expertise but due to weak information sharing, unclear escalation, and fragmented accountability – exactly the process conditions that governance must standardize (Philpot et al., 2025).

For operationalization, decision quality can be approached through observable proxies such as informational completeness, explicit risk consideration, systematic comparison of alternatives, and traceability of rationale. At the organizational level, information sharing is positively associated with decision quality, while trust reduces defensive routines that otherwise limit learning and improvement (Alduais et al., 2023). These process-oriented proxies are particularly relevant for cross-cultural project research because they specify how decision quality can be diagnosed in practice, even when direct standardized cross-country decision-quality metrics are unavailable.

Power distance captures the extent to which unequal authority is treated as acceptable and legitimate. In Hofstede's framework, this country-level dimension shapes hierarchy acceptance, leadership patterns, and information flows within organizations (Hofstede, 1984, 2001; Hofstede et al., 2010). Although Hofstede-type indicators remain widely used, recent work emphasizes the need for careful interpretation in cross-national applications due to measurement and construct-use limitations (Jan et al., 2024; Ouyang, 2025). At the individual level, psychological power distance reflects subjective hierarchy acceptance and conditions reactions to leadership, with direct implications for project coordination and escalation behavior (Korkmazyurek, 2024; Li et al., 2023). In the present study, these insights justify treating the Power Distance Index (PDI) as a parsimonious, country-level baseline that is theoretically connected to how authority expectations shape decision processes.

The mechanism most relevant to decision quality is voice: whether team members raise concerns, surface weak signals, and challenge assumptions before commitments become costly. Under ambiguous threats, silence increases the likelihood that problems remain unnoticed and opportunities are missed, weakening the informational basis of decisions (Park et al., 2024). Cultural norms also condition whether participative leadership translates into speaking up, indicating that voice is culturally contingent rather than purely procedural (Toufighi et al., 2024; Zheng, 2025). At the dyadic level, leader–follower congruence in power distance orientation affects voice, particularly under conditions of trust and perceived organizational support (Guzman & Fu, 2022). These findings are consistent with evidence that high power distance suppresses behaviors required for accurate deliberation and effective challenge (Kwan et al., 2024). In engineering contexts, constrained upward communication is associated with unreported defects and costly rework (Alsanoosy et al., 2019). Cross-country studies in construction project management similarly report cultural effects on communication and coordination practices (Amoah, 2023; Eyiah et al., 2025). Where dissent carries social or career risk, teams may substitute deliberation with compliance and post hoc justification, limiting error detection and learning

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/x3348726554

(Mehmood et al., 2024; Imran et al., 2025). Misfit between leader and member behaviors can further translate into performance penalties (Hernaus et al., 2023).

Thus, evidence from team research shows that psychological safety supports upward voice, error reporting, and willingness to challenge assumptions, which improves the informational basis of collective decisions in iterative project settings (Alami et al., 2024). A broader organizational-culture perspective also supports the idea that shared norms shape how decisions are discussed, challenged, and legitimized, affecting whether corrective information is integrated before commitments escalate (Tadesse Bogale & Debela, 2024).

Cross-national project research faces an asymmetry in measurement: standardized cultural indices are available at the country level, whereas directly comparable numerical indicators of project decision quality are rarely available as ready-made cross-country metrics (Ouyang, 2025). To enable systematic testing, the present study links the Power Distance Index (PDI) to a compatible institutional proxy (CPI, 2024), allowing correlation, regression, and clustering rather than purely narrative inference (Geerthofstede.com, n.d.).

Cross-national studies increasingly use Hofstede's dimensions as macro-level predictors in matched-country designs, which supports the feasibility of country-level cultural operationalization when project-level metrics are not comparable (Zidkova et al., 2025).

This study avoids broad cultural profiling and deliberately focuses on a single cultural predictor to preserve a clear causal mechanism. Among Hofstede's dimensions, power distance is theoretically closest to the "voice/contestability" channel: it conditions whether subordinates question decisions, provide upward feedback, and trigger timely escalation before commitments become irreversible. Prior empirical work in cross-cultural project contexts has likewise emphasized hierarchy acceptance as a primary driver of decision-process openness and corrective feedback cycles (Zhao & Kudiņš, 2025; Zhao et al., 2025).

This study deliberately focuses on PDI as the only cultural predictor to preserve interpretability and keep the analytical "red line" on decision quality rather than cultural profiling. Power distance is the Hofstede dimension most directly tied to the proposed decision-quality mechanism in projects because it structures the legitimacy of upward influence, dissent, and escalation, thereby shaping whether weak signals and risk information enter decision preparation (Guzman & Fu, 2022; Adamovic, 2023; Park et al., 2024). Methodologically, PDI is also the only cultural metric in the study that is uniformly available, reproducible, and comparable across the countries included in the empirical dataset (Geerthofstede.com, n.d.). Prior exploratory evidence by the authors is retained only as contextual motivation for why authority norms matter in international cooperation and does not replace the peer-reviewed evidence that supports the mechanism (Zhao et al., 2025; Zhao & Kudiņš, 2025).

3. Research methodology

Because direct cross-national numerical measures of project decision quality are unavailable, the hypotheses are formulated in a way that remains consistent with the proposed mechanism while aligning with the feasible operational proxy approach. The formulated research hypotheses are as follows;
H1. Higher PDI is associated with lower decision quality relevant outcomes as captured by the study's operational proxy, consistent with reduced informational completeness and weaker challenge capacity under higher hierarchy acceptance (based on Alduais et al., 2023; Park et al., 2024; Li et al., 2023).
H2. Voice behavior provides the core mechanism linking PDI to decision quality: higher PDI reduces voice and open challenge, which weakens the informational basis and defensibility of decisions (based on Guzman & Fu, 2022; Park et al., 2024; Toufighi et al., 2024).

The study adopts a cross-national comparative design to examine whether hierarchy-related cultural expectations are systematically associated with decision-quality-relevant outcomes in international project contexts. The analytical strategy is deliberately parsimonious and proxy-based: decision quality is not observed directly at the project level but is approximated through decision-environment integrity, while culture is introduced solely as an explanatory condition rather than as a multidimensional profiling exercise. Empirically, the study relies on a single cultural indicator and a single institutional proxy, which enables transparent and

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/x3348726554

reproducible estimation using parametric correlation analysis, ordinary least squares (OLS) regression, and cluster-based classification on a matched-country dataset (N = 69). This design prioritizes interpretability and comparability over model complexity and is consistent with the study's non-causal, mechanism-testing orientation.

The cultural predictor is PDI (Geerthofstede.com, n.d.), taken from the Hofstede-based country comparison dataset, which captures the extent to which unequal distribution of authority and hierarchical asymmetry are accepted as legitimate at the national level. Decision-quality-relevant outcomes are operationalized using CPI 2024 (Transparency International, 2025), which serves as an institutional proxy for the integrity, transparency, and accountability conditions under which decisions are prepared, justified, and contested. In the correlation analysis, PDI and CPI are treated symmetrically as continuous variables to assess linear association. In the regression analysis, CPI is specified as the dependent variable and PDI as the explanatory variable, allowing a directional test consistent with the proposed mechanism linking hierarchy acceptance to weaker decision-environment integrity. This operationalization supports systematic cross-country testing while remaining explicit about the proxy nature and inferential limits of the outcome measure.

The empirical analysis uses a matched-country dataset (N = 69) in which PDI and CPI are both available for the same countries (Table 1). The analytical procedure includes four steps:
(1) To determine the appropriateness of parametric measures of association, the distributional properties of both variables were examined prior to analysis. Normality was assessed using the one-sample Kolmogorov–Smirnov test with Lilliefors significance correction, supplemented by Monte Carlo estimation of p-values. This procedure was applied to both indicators before selecting the correlation coefficient for subsequent analysis.
(2) Given continuous scaling and parametric assumptions, the study examines the linear association between PDI and CPI using a correlation-based approach. Because the two indicators are oriented in opposite evaluative directions–PDI capturing hierarchy acceptance and CPI capturing institutional integrity – the analysis accounts for this directional interpretation when assessing the relationship between the variables.
(3) To complement the correlation analysis with a directional test consistent with the proposed mechanism, the study applies a linear regression framework. An ordinary least squares (OLS) model is specified with CPI as the dependent variable and PDI as the explanatory variable. This specification allows the analysis to assess whether variation in hierarchy acceptance is systematically associated with variation in the integrity of the decision environment, while maintaining a parsimonious one-predictor design. The regression is estimated using standard OLS assumptions, and model outputs are reported in terms of coefficient estimates, statistical significance, and overall model fit.
(4) To move beyond a single linear association and to derive an interpretable typology applicable to global cross-national project contexts, the study applies cluster analysis using PDI and CPI simultaneously. A hierarchical agglomeration procedure is employed to explore the latent cluster structure and to inform the selection of an interpretable clustering solution, with results reported accordingly. This approach identifies recurring "decision-environment profiles" reflecting how hierarchy acceptance and integrity conditions jointly shape decision contexts across countries.

There are some methodological limitations in this study. First, the study does not observe project-level decision quality directly. Decision quality is operationalized indirectly through an institutional proxy (CPI), which captures integrity, transparency, and accountability conditions of the decision environment rather than the quality of specific project-team decisions. While this proxy is theoretically aligned with the proposed mechanism and allows systematic cross-national testing, it cannot substitute for direct measures of decision processes, informational completeness, or deliberative quality at the project level. Second, the empirical sample is constrained by the overlap of publicly available indicators and is defined by the matched-country set in Table 1 (N = 69). The results should therefore be interpreted as evidence within the observed overlap of PDI and CPI coverage, rather than as a universal country census.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/x3348726554

4. Research results

The empirical basis for the analysis is a matched dataset of PDI and CPI values across 69 countries (Table 1). This format provides a comparable cross-country framework for testing how hierarchy acceptance relates to decision-environment integrity, used here as a proxy for decision-quality conditions in international project contexts.

Descriptively, the dataset covers a wide spread of cultural hierarchy acceptance. The lowest PDI values are observed in Austria (11), Israel (13), and Denmark (18), while the highest values occur in Malaysia (104) and the Slovakia (100) (Geerthofstede.com, n.d.). CPI also varies substantially, ranging from very low scores such as Venezuela (10) and Russia (22) to very high scores such as Denmark (90) and Finland (88) (Transparency International, 2025). This dispersion is analytically important because it indicates that the sample contains both low- and high-hierarchy environments and both low- and high-integrity environments, enabling meaningful association testing rather than a narrow-range comparison.

Table 1. Cross-country values of PDI and CPI

No.	Country	Power Distance Index (PDI)	Corruption Perceptions Index (CPI)
1	Argentina	49	37
2	Australia	38	77
3	Austria	11	67
4	Bangladesh	80	23
5	Belgium	65	69
6	Brazil	69	34
7	Bulgaria	70	43
8	Canada	39	75
9	Chile	63	63
10	China	80	43
11	Colombia	67	39
12	Costa Rica	35	58
13	Croatia	73	47
14	Czech Rep	57	56
15	Denmark	18	90
16	Ecuador	78	32
17	El Salvador	66	30
18	Estonia	40	76
19	Finland	33	88
20	France	68	67
21	Germany	35	75
22	Great Britain	35	71
23	Greece	60	49
24	Guatemala	95	25
25	Hong Kong	68	74
26	Hungary	46	41
27	India	77	38
28	Indonesia	78	37
29	Iran	58	23
30	Ireland	28	77
31	Israel	13	64
32	Italy	50	54
33	Jamaica	45	44
34	Japan	54	71
35	Korea South	60	64
36	Latvia	44	59
37	Lithuania	42	63
38	Luxembourg	40	81
39	Malaysia	104	50
40	Malta	56	46
41	Mexico	81	26
42	Morocco	70	37

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43	Netherlands	38	78
44	New Zealand	22	83
45	Norway	31	81
46	Pakistan	55	27
47	Panama	95	33
48	Peru	64	31
49	Philippines	94	33
50	Poland	68	53
51	Portugal	63	57
52	Romania	90	46
53	Russia	93	22
54	Serbia	86	35
55	Singapore	74	84
56	Slovakia	100	49
57	Slovenia	71	60
58	Spain	57	56
59	Suriname	85	40
60	Sweden	31	80
61	Switzerland	34	81
62	Taiwan	58	67
63	Thailand	64	34
64	Trinidad and Tobago	47	41
65	Turkey	66	34
66	U.S.A.	40	65
67	Uruguay	61	76
68	Venezuela	81	10
69	Vietnam	70	40

Note: PDI refers to Hofstede's Power Distance Index, a country-level cultural indicator measuring the extent to which unequal distribution of power and hierarchical authority is accepted as legitimate. PDI values range approximately from 0 to 100, where higher scores indicate stronger acceptance of hierarchy and centralized authority, and lower scores indicate preferences for equality, consultation, and participative decision-making. CPI refers to Transparency International's Corruption Perceptions Index 2024, which measures perceived public-sector corruption as an indicator of institutional integrity. CPI scores range from 0 (highly corrupt) to 100 (very clean), with higher values reflecting stronger transparency, accountability, and integrity conditions relevant to contestable and auditable decision-making environments.

Sources: compiled by the authors based on the data from Geerthofstede.com, n.d.; Transparency International, 2025.

Table 1 provides the empirical foundation for the subsequent analysis by presenting matched country-level values of PDI and CPI for the full sample (N = 69). On this basis, the following section proceeds to assess the distributional properties of both variables and to evaluate their statistical relationship using correlation, regression, and cluster analyses.

Normality was assessed using the one-sample Kolmogorov–Smirnov test with Lilliefors significance correction and Monte Carlo estimation (10,000 samples). For PDI (N = 69), the test statistic was D = 0.070 with asymptotic p = 0.200 and Monte Carlo p = 0.539 (99% CI: 0.526–0.551). For CPI 2024 (N = 69), D = 0.095 with asymptotic p = 0.200 and Monte Carlo p = 0.125 (99% CI: 0.116–0.133). Because both distributions do not deviate significantly from normality ($p > 0.05$), Pearson's correlation coefficient is appropriate for testing linear association.

Pearson's correlation confirms a strong negative association between PDI and CPI ($r = -0.663$, $p < 0.001$). Because higher PDI indicates greater acceptance of hierarchical asymmetry while higher CPI indicates lower perceived public-sector corruption, the negative sign means that countries with higher power distance tend to display weaker integrity conditions of the decision environment. Importantly, the result is not driven by a narrow subset of cases: the dataset includes both high-PDI countries with low CPI (e.g., Russia: PDI 93, CPI 22; Venezuela: PDI 81, CPI 10) and low-PDI countries with high CPI (e.g., Denmark: PDI 18, CPI 90; Finland: PDI 33, CPI 88), which is consistent with the observed strong negative linear relationship.

Correlation does not establish direction or causality; therefore, to complement the association test with a directional estimate consistent with H1, an ordinary least squares (OLS) regression model was estimated with CPI as the dependent variable and PDI as the explanatory variable.

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Table 2. Regression coefficients

Model	Non-standardized coefficients		Standardized coefficients	t	Significance
	B	Standard error	β		
(Constant)	88.850	5.227	-	16.999	< 0.001
Power Distance Index (PDI)	-0.601	0.083	-0.663	-7.241	< 0.001

Note: dependent variable - Corruption Perceptions Index (CPI).
Source: calculated by the authors using IBM SPSS Statistics based on the data from Geerthofstede.com (n.d.) and Transparency International (2025).

The estimated regression equation is:

$$CPI = 88.850 - 0.601 \times PDI \quad (1)$$

Substantively, the regression results indicate a clear and statistically robust negative relationship between hierarchy acceptance and decision-environment integrity. As shown in Table 2 and Equation (1), the non-standardized coefficient for PDI is negative and highly significant ($B = -0.601$; $t = -7.241$; $p < 0.001$**),** indicating that higher power distance is systematically associated with lower CPI values, that is, weaker institutional conditions for transparent, contestable, and auditable decision-making. The standardized coefficient is also large ($\beta = -0.663$), confirming the strength of the association in standardized terms. The model explains a substantial proportion of cross-country variance ($R^2 = 0.439$), which is notable given the deliberately parsimonious one-predictor specification. Interpreting the slope, a one-point decrease in PDI is associated, on average, with a 0.601-point increase in CPI; equivalently, a reduction in hierarchy acceptance of approximately 1.66 PDI points corresponds to an average increase of one CPI point. In descriptive terms, this magnitude implies that even moderate cross-national differences in hierarchy acceptance are associated with non-trivial differences in integrity conditions of the decision environment, reinforcing the substantive relevance of power distance for decision-quality-related outcomes rather than indicating a marginal or purely statistical effect.

To classify countries simultaneously by PDI and CPI, a cluster analysis was conducted. The number of clusters was determined using the hierarchical agglomeration schedule (Table 3): the final merge is accompanied by a sharp increase in the agglomeration coefficient, indicating that combining the remaining clusters would substantially reduce within-cluster homogeneity. In the last steps, the coefficient rises from 2.896 to 6.252, which supports a two-cluster solution (i.e., retaining two clusters before the final merge).

Table 3. Agglomeration schedule (last steps) used to justify the number of clusters

Stage	Cluster 1	Cluster 2	Coefficient
66	1	4	2.587
67	2	5	2.896
68	1	2	6.252

Source: calculated by the authors using IBM SPSS Statistics based on the data from Geerthofstede.com (n.d.) and Transparency International (2025).

After selecting k = 2, cluster centers and membership distribution were computed (Table 4).

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Table 4. Final cluster centers for PDI and CPI

Variable	Cluster 1	Cluster 2
Power Distance Index (PDI)	74	43
Corruption Perceptions Index (CPI)	37	71

Note: Cluster 1 includes: Argentina, Bangladesh, Brazil, Bulgaria, China, Colombia, Croatia, Ecuador, El Salvador, Greece, Guatemala, Hungary, India, Indonesia, Iran, Malaysia, Malta, Mexico, Morocco, Pakistan, Panama, Peru, Philippines, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Suriname, Thailand, Trinidad and Tobago, Turkey, Venezuela, Vietnam. Cluster 2 includes: Australia, Austria, Belgium, Canada, Chile, Costa Rica, Czech Rep, Denmark, Estonia, Finland, France, Germany, Great Britain, Hong Kong, Ireland, Israel, Italy, Jamaica, Japan, Korea South, Latvia, Lithuania, Luxembourg, Netherlands, New Zealand, Norway, Singapore, Spain, Sweden, Switzerland, Taiwan, USA, Uruguay.
Source: calculated by the authors using IBM SPSS Statistics based on the data from Geerthofstede.com (n.d.) and Transparency International (2025).

The clustering yields two stable decision-environment profiles. Cluster 1 (n = 36; 52.2%) combines higher power distance with lower CPI scores (mean PDI ≈ 74; mean CPI ≈ 37), reflecting hierarchy-dominant contexts where integrity conditions for contestable and auditable decisions are comparatively weaker. Cluster 2 (n = 33; 47.8%) combines lower power distance with higher CPI scores (mean PDI ≈ 43; mean CPI ≈ 71), reflecting decision environments with stronger integrity conditions and greater procedural contestability.

The cluster solution confirms that the relationship between hierarchy acceptance and integrity conditions is not merely a statistical artifact but also produces an interpretable classification of country contexts. At the same time, the profiles are not reducible to a single geographic region. The high-PDI/lower-CPI profile includes substantial concentrations across South and Southeast Asia, much of Latin America, and several Eastern and Southern European cases, alongside selected Eurasian and Middle Eastern contexts. The low-PDI/higher-CPI profile concentrates in Northern and Western Europe and the Anglosphere and includes several high-income Asian economies.

The data also show that the association is systematic but not mechanically uniform across all cases. For example, some countries combine comparatively higher PDI with high CPI (e.g., Singapore: PDI 74, CPI 84; Hong Kong: PDI 68, CPI 74), indicating that stronger integrity conditions can coexist with higher hierarchy acceptance. Conversely, some mid-range PDI cases still fall into the lower-CPI profile, indicating that integrity conditions vary even among countries with comparable hierarchy scores. These patterns reinforce the empirical logic of using both dimensions jointly: PDI captures hierarchy acceptance, while CPI captures integrity conditions, and their combination yields profiles that better represent the diversity of cross-national decision environments than either indicator alone.

China and Latvia illustrate two distinct positions within the PDI–CPI space that are analytically relevant for understanding coordination dynamics in international projects. China combines a relatively high level of hierarchy acceptance (PDI = 80) with a moderate CPI score (43) (Table 1), placing it within the high-PDI/lower-CPI decision-environment profile (Table 4). This configuration implies that decision processes in Chinese project contexts are more likely to be authority-centred, with upward challenge and open contestation playing a weaker role unless explicitly institutionalised through formal procedures. Latvia, by contrast, exhibits a substantially lower PDI (44) alongside a higher CPI score (59) (Table 1), situating it closer to the low-PDI/higher-CPI profile (Table 4) characterised by stronger integrity and contestability conditions. In joint international projects, this asymmetry creates a structural interface problem rather than a bilateral "culture clash": Latvian partners may implicitly expect decisions to be justified through transparent reasoning and open discussion, while Chinese partners may rely more on hierarchical closure and role-based authority. The empirical association identified in ершы Section suggests that, without compensatory governance mechanisms, such projects face a heightened risk of misaligned expectations about voice, escalation, and legitimate dissent. Consequently, effective China–Latvia project cooperation depends less on cultural convergence and more on explicit procedural design—such as formal review gates, documented option comparison, and protected channels for issue escalation – that can bridge differences in hierarchy acceptance while preserving decision quality under shared international project governance.

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5. Discussion of results

Section 4 reports a consistent pattern across correlation, regression, and clustering: higher power distance is associated with weaker integrity conditions of the decision environment, operationalized by CPI. The discussion interprets this pattern in decision-quality terms, evaluates the proposed voice-based mechanism, and clarifies what the findings do and do not imply for cross-cultural project governance. The empirical results provide consistent support for H1 and indirect, mechanism-consistent support for H2, within the limits of the study's proxy-based and cross-sectional design.

H1 proposed that higher hierarchy acceptance, captured by PDI, is associated with weaker decision-quality-relevant outcomes, as approximated by the integrity conditions of the decision environment. This hypothesis is strongly supported by the evidence. Across the matched-country sample, PDI and CPI exhibit a strong negative Pearson association. The regression analysis further confirms this relationship in a directional specification: higher PDI is associated with significantly lower CPI scores, with the model explaining a substantial share of cross-country variance. The consistency of results across correlation, regression, and clustering indicates that the association is systematic rather than driven by outliers or narrow regional subsets. Substantively, this pattern supports the interpretation that greater acceptance of hierarchical asymmetry co-occurs with institutional environments in which transparency, accountability, and contestability of decisions are comparatively weaker—conditions that are directly relevant to the defensibility and robustness of project decisions under uncertainty.

H2 proposed that voice behavior constitutes the core mechanism linking power distance to decision quality, such that higher hierarchy acceptance constrains open challenge and upward communication, thereby weakening the informational basis and defensibility of decisions. While the study does not directly observe voice behavior at the project or organizational level, the empirical findings are consistent with this mechanism. CPI captures institutional conditions under which decisions are scrutinized, justified, and exposed to challenge; lower CPI values indicate environments where contestation and accountability are more difficult to sustain. The observed negative association between PDI and CPI therefore aligns with the expectation that higher hierarchy acceptance constrains voice and challenge capacity at scale. This interpretation is reinforced by the clustering results, which reveal two recurring decision-environment profiles combining hierarchy acceptance and integrity conditions, rather than a purely linear continuum. Importantly, the presence of countries with high PDI but relatively high CPI (e.g., Singapore, Hong Kong) suggests that the mechanism is conditional rather than deterministic: strong integrity conditions can coexist with higher hierarchy acceptance when compensatory governance arrangements are present.

Taken together, the findings support the hypothesized mechanism in a non-causal but analytically meaningful sense. The results do not claim that hierarchy acceptance directly causes lower decision quality, nor that cultural context mechanically determines project outcomes. Instead, they identify a robust vulnerability pattern: where hierarchy is more strongly accepted, decision quality becomes more dependent on explicit governance mechanisms that preserve voice, escalation, documentation, and independent review. This interpretation is consistent with prior micro-level research on voice and psychological safety and extends it to a macro-level, cross-national comparative context.

The substantive meaning of the negative association is that hierarchy acceptance tends to co-occur with institutional conditions where decision contestability is harder to sustain. Where authority asymmetry is more widely treated as legitimate, information is more likely to move upward selectively, disagreement is more likely to be expressed indirectly, and decisions are more likely to close through authority rather than through transparent comparison of alternatives. Under the article's decision-quality framing, this increases the probability of informational incompleteness and weaker traceability of justification (Alduais et al., 2023; Li et al., 2023).

At the same time, the results are not evidence of cultural determinism and do not establish causality. The CPI-based outcome is an institutional proxy capturing integrity conditions of the decision environment rather than the quality of any specific project-team choice. The contribution is therefore best read as an empirically visible

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vulnerability pattern: when hierarchy acceptance is higher, decision quality becomes more exposed to informal influence and authority-based closure unless governance arrangements preserve contestability and evidence-based justification (Cantarelli, 2025; Sommer, 2024).

The article's mechanism is anchored in the idea that voice and challenge capacity determine how much relevant information enters the decision process and whether weak signals are surfaced early. Recent evidence indicates that, under ambiguous threats, failure to speak up allows problems to remain unreported and opportunities to be missed, directly weakening the informational basis of decisions (Park et al., 2024). Hierarchy acceptance shapes this channel by changing the perceived legitimacy and personal risk of upward voice: in higher power-distance settings, challenging assumptions can be interpreted as disloyalty or disrespect, making self-censorship rational even when risks are known.

The mechanism is further reinforced by research showing that voice behaviour depends on leader–subordinate fit and on power distance orientations within dyads and teams (Guzman & Fu, 2022; Toufighi et al., 2024). This matters for cross-border projects because "power distance differences" appear not only between countries, but within multinational teams where members import expectations about authority and acceptable challenge. In this interpretation, the observed PDI–CPI association is compatible with a governance-relevant pathway: hierarchy acceptance constrains voice, which reduces the completeness and defensibility of decision rationales unless compensatory practices are deliberately designed.

Clustering in the joint PDI–CPI space adds interpretive value by translating a single linear tendency into two recurring decision-environment profiles. The typology does not replace the regression result; it complements it by offering a classification logic that is easier to use when anticipating governance frictions at project initiation. In particular, the cluster membership patterns reported in Section 4 illustrate that countries can share broadly similar governance-relevant configurations even when they differ in region or development level.

For project governance, the typology is useful because risk often arises from profile mismatch rather than from a marginal change in a single index. When partners come from different profiles, teams may disagree not only on outcomes, but on what constitutes legitimate challenge, how decisions should be justified, and whether procedural review is "normal control" or a face-threatening intervention. This aligns with broader evidence that cultural diversity in project teams requires explicit governance alignment to prevent coordination frictions from becoming systemic (Amoah, 2023; Eyiah et al., 2025).

The results imply governance consequences that follow directly from the mechanism. First, in higher-hierarchy contexts, decision quality becomes more dependent on preserving voice and challenge capacity. Practically, this requires escalation designs that make upward issue-raising legitimate and low-cost for status-distant actors, because informal norms alone do not reliably surface weak signals (Park et al., 2024; Toufighi et al., 2024). Framed this way, protected voice can be understood not only as a compliance safeguard but also as an element of an agile management ecosystem that supports organizational competitiveness under uncertainty (Rožman et al., 2023).

Second, traceable justification becomes a compensatory control. Where disagreement is indirect, decision logs, explicit option comparison, and review gates are often the only durable means to keep decisions contestable over time. This is consistent with the information-sharing logic: decision quality deteriorates when informational completeness falls, and can be protected when processes force the inclusion and documentation of relevant input (Alduais et al., 2023; Li et al., 2023). Related evidence from cross-organizational emergency management suggests that standard operating procedures can strengthen coordination and accountability, but their effectiveness depends on practical adoption conditions and inter-organizational buy-in (Steen-Tveit et al., 2024).

Third, when partners come from different decision-environment profiles, governance design should be treated as an interface agreement. Teams can reduce authority-anchored closure by negotiating, at project start, what counts as acceptable challenge, how dissent is recorded, and how independent review is triggered–thereby

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reducing the probability that disagreements become personal or status-coded rather than evidence-based (Guzman & Fu, 2022).

The findings are bounded by the study's proxy-based design. CPI captures perceived public-sector corruption and therefore reflects integrity conditions of decision environments, not project-level decision processes. The cross-sectional association may also embed omitted institutional and economic factors that correlate with both culture and integrity. Finally, using a single cultural predictor is a deliberate choice for parsimony and reproducibility, but it cannot represent the full multidimensionality of culture emphasized in the broader Hofstede-based tradition (Hofstede, 2001; Hofstede et al., 2010; Jan et al., 2024).

6. Conclusions

This study tested whether cross-country differences in power distance are systematically associated with decision-environment integrity, used as a proxy for comparable conditions of decision quality in international projects. Using a matched-country dataset (N = 69), the analysis shows a strong negative Pearson association between PDI and CPI ($r = -0.663$, $p < 0.001$) and a statistically significant OLS slope ($CPI = 88.850 - 0.601 \times PDI$; $R^2 = 0.439$). In other words, higher hierarchy acceptance tends to co-occur with weaker integrity conditions in which decisions are expected to be justified, challenged, and audited.

The substantive value of this evidence is not a claim that "high-PDI countries make poor decisions", but a comparative signal about vulnerability: where hierarchy is more accepted, the decision environment is more likely to exhibit weaker transparency and accountability conditions, and project decision quality may therefore become more dependent on compensatory governance design. The two-profile classification derived from PDI–CPI clustering further supports the idea that international projects frequently combine partners embedded in systematically different decision environments, which helps explain why the same governance routines produce uneven coordination frictions across countries.

At the same time, the proxy-based cross-sectional design imposes clear limits on inference: CPI captures institutional integrity conditions, not the quality of specific team decisions, and the analysis does not establish causality. Future research should therefore validate the proposed mechanism at the project level by combining cultural distance measures with direct indicators of voice, escalation effectiveness, alternative generation, documentation quality, and independent review. The next step is to extend the parsimonious model with additional institutional and socioeconomic controls, as well as multi-level designs that connect country context to project governance outcomes, while preserving transparency and reproducibility of the empirical procedure.

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Funding: The article has been developed and funded within the Daugavpils University's (Latvia) research project No 14-95/2026/16 "Human Resource Management in Cultural Diversity: Organizational Challenges and Strategies".

Author Contributions: Sh. Zhao developed the initial research idea and core conceptual framework on the basis of prior article-level work and conference theses; drafted the theoretical mechanism linking power distance to decision quality; and contributed to the comparative logic of the study; Y. Pan conducted and synthesized the relevant scientific literature, strengthening the theoretical background and clarifying key concepts and definitions; Ch. Zhang supported the operationalization and presentation of comparative evidence, contributed to the measurement logic (decision quality vs proxy indicators), and assisted in interpreting the results; J. Kudiņš contributed to the empirical and comparative design by supporting the cross-country framing, strengthening the economic data analysis logic, and assisting with the interpretation of comparative patterns in relation to decision quality; A. Kokarēviča strengthened the applied and policy-relevant dimension of the study, contributed to methodological framing and quantitative reasoning, and supported the integration of territorial/regional-development implications into the discussion and conclusions; E. Čižo (corresponding author) coordinated the study and supervised its conceptual and methodological development; finalized the research design, structure, and argumentation; ensured coherence between the title, abstract, results, and conclusions; and performed overall manuscript editing and preparation for submission.

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ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/x3348726554

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/r9768467687

Publisher
http://jssidoi.org/esc/home

USE AND PERCEPTION OF TECHNOLOGIES AT WORK BY GENERATION Z: EMPIRICAL STUDY*

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Received 11 January 2026; accepted 17 March 2026; published 30 June 2026

Abstract. New technologies are fundamentally transforming the work environment, influencing communication patterns, work processes, and information management. This article presents the results of an empirical study focused on the perception and use of technical systems and digital devices by Generation Z employees within Slovak organizations. Data were collected in the first half of 2025 from a sample of 98 respondents across large and medium-sized enterprises. The findings reveal that a vast majority (91.8% of respondents) use technology daily and perceive it as an indispensable tool for efficiency, flexibility, and information access. Statistical testing confirmed a significant positive correlation ($r_s = 0.412$, $p = 0.001$) between the frequency of technology use and the subjective feeling of self-fulfilment at work. Conversely, the study identified a significant negative correlation ($r_s = -0.394$, $p < 0.001$) between perceived insufficient management support for digitalization and the willingness of employees to retain in their positions upon reaching financial independence. Despite high adaptability, respondents expressed concerns regarding technological failures and the lack of systematic training. The results emphasize that for Generation Z, technology is not merely a tool but a catalyst for motivation, provided it is accompanied by adequate organizational support.

Keywords: Generation Z; technological adaptability; technology perception; work environment

Reference to this paper should be made as follows: Vraňaková, N., Babeľová, Z. G., Stareček, A. 2026. Use and perception of technologies at work by generation Z: empirical study. *Entrepreneurship and Sustainability Issues*, 13(4), 40-51. http://doi.org/10.9770/r9768467687

JEL Classifications: L2, L6, L8, M19, O3

Additional disciplines psychology; educology; information and communication; informatics

1. Introduction and theoretical background

The first chapter establishes the theoretical framework of the research, focusing on the dynamics of digital transformation and its impact on business processes. Subsequently, it analyses the specific characteristics and technological competencies of Generation Z as key actors in the contemporary labour market. The theoretical background concludes with a bibliometric analysis that identifies current scientific trends and maps the state of knowledge on digital technologies and generational behaviour in the Scopus database.

* *Funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I03-03-V05-00005.*

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/r9768467687

1.1 The impact of digital transformation on business processes

The emergence of modern technologies is changing the dynamics of the work environment, reflected in different communication patterns, work processes, and information processing. This shift is not merely a change in tools, but a fundamental digital transformation that redefines the relationship between human capital and technological infrastructure (Smerek, 2025). The introduction of digital tools brings greater efficiency, but at the same time requires the adaptation of skills and consideration of security and personal data protection. Furthermore, organizations must address the psychological impact of these changes, such as technostress and the increased cognitive load placed on employees navigating complex digital ecosystems (Silberg et al., 2021).

New technologies facilitate automation and optimization of business processes, leading to increased productivity and efficiency. Tools such as business analytics and digital platforms streamline operations and reduce the time required for routine tasks (Abdussamad et al., 2022; Rana et al., 2025). By offloading repetitive administrative burdens to automated systems, employees can pivot toward high-value activities such as strategic decision-making and creative problem-solving (Kucharčíková & Mičiak, 2018). The adoption of innovative technologies, such as IoT and AI, drives innovation within organizations, allowing them to stay competitive in rapidly evolving markets. These technologies enable the development of new products and services, often leading to the emergence of entirely new business models based on data-driven insights, thereby enhancing the organization's market position (Jokonya, 2015; Kim et al., 2024).

With the rise of remote and hybrid work models, technologies have become essential for maintaining business continuity and employee engagement. Tools that support remote work are crucial in adapting to global challenges and ensuring organizational resilience (Selimovic et al., 2021; Galanti et al., 2023). However, the transition to virtual environments necessitates a rethink of leadership styles and organizational culture, emphasizing trust-based management and asynchronous communication. The ability to foster a sense of belonging and maintain a unified corporate identity within a multigenerational workforce — where digital natives and seasoned professionals collaborate across different technological fluencies — has become a defining characteristic of successful modern enterprises.

1.2 Expected technical skills of Generation Z

These rapid changes in the work environment are also most impacting Generation Z. Generation Z is often referred to as “Digital Natives,” “Post-millennials,” or “Zoomers,” representing the first cohort that grew up in an environment of full digitalization and unlimited access to information (Żarczyńska-Dobiesz & Chomątowska, 2014). Unlike their predecessors (Generation Y), Generation Z does not know a world without the internet and perceives the virtual space as a complementary part of reality (Kiedik et al., 2023). Although minor deviations in temporal definition appear in the literature, there is a prevailing consensus that these are individuals born approximately between 1995 and 2010 (Jurenka et al., 2018; Andruszkiewicz et al., 2023). They grew up in a digital world and naturally expect modern technologies to be integrated into their work routines. Their familiarity and comfort with digital tools significantly shape how they approach work, collaboration, and career development.

Generation Z is characterized by a high level of comfort and engagement with AI and digital technologies. Unlike their predecessors (Generation Y), their relationship with technology is symbiotic rather than adoptive; they do not merely use digital tools, they integrate them into their cognitive processes (Starecek et al., 2018). These tools are not only enhancing productivity but also altering traditional work processes and environments (Hessari et al., 2024; Jo & Park, 2024). Organizations that strategically implement digital tools and provide training and support see higher engagement levels among Generation Z employees. These strategies help in fostering a culture of innovation and adaptability (Tursunbayeva & Chalutz-Ben Gal, 2024; Afrin et al., 2025). Based on the above theoretical foundations, it is important to examine how Generation Z perceives and uses new technologies in the workplace, as their digital prowess and expectations significantly affect the efficiency, collaboration and adaptability of organizations. The main aim of the article is therefore to present the results of a questionnaire survey that focused on the use and assessment of the impact of new technologies on Generation Z employees, thereby providing a practical perspective on the theoretically predicted trends and challenges. Ultimately, deciphering the interaction between Generation Z and the digital ecosystem is crucial for

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/r9768467687

organizational sustainability. As this generation gradually becomes the dominant force in the global labour market, their ability to leverage AI and advanced digital tools will likely dictate the pace of corporate evolution.

1.3 Bibliometric analysis

While theoretical foundations define Generation Z as technologically proficient, the breadth and complexity of the scientific scope in this field necessitate a systematic mapping of existing knowledge. The following analysis visualizes the interconnections among key concepts and reveals which areas of digital transformation are most emphasized within the scientific community. To further contextualize the current scientific discourse surrounding this research phenomenon, a bibliometric co-occurrence analysis of author keywords was conducted using the Scopus database. The resulting network visualization (Figure 1) maps the intellectual structure of the field, identifying 106 items organized into 5 distinct clusters with a total of 1,726 links.

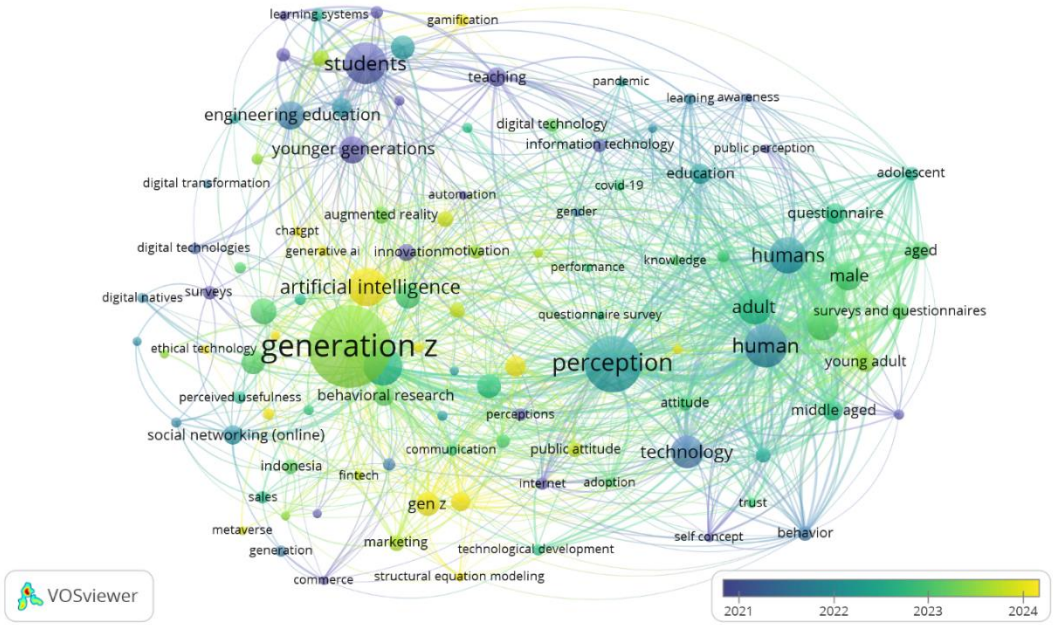


Figure 1. VOSviewer co-occurrence network of keywords related to Generation Z and digital technologies
Source: own elaboration

The analysis of this overlay visualization (Figure 1) reveals several critical insights based on the chronological development of the research field. The colour gradient represented in Figure 1 illustrates the average publication year of the keywords, where dark blue nodes indicate established foundations of research from around 2021, a period dominated by themes related to the pandemic, general technology adoption, and student education. The transition towards yellow nodes subsequently marks the most recent frontiers of research, which are fully emerging in 2024 and beyond.

The central position and significant size of nodes such as "Generation Z" and "perception" confirm that understanding the subjective attitudes and psychological framing of this cohort remains a consistent and primary objective of scientific interest throughout the entire observed period. Furthermore, the proximity and strong links between the terms "Generation Z", "artificial intelligence", and "digital technology" validate the symbiotic relationship mentioned earlier in this chapter and demonstrate how the academic discourse has shifted from general digitalization towards the specific integration of artificial intelligence. A significant cluster displayed in turquoise and green shades, typical for the 2022 to 2023 period, highlights terms such as "human", "behaviour", and "trust". This suggests that as the scientific discipline has matured, the transition into virtual environments has increasingly been viewed through the lens of behavioural research and human capital management rather than merely technical tool implementation. The latest trends, represented by the yellow-coded nodes from 2024 and later, point to an intensive specialization of research into generative AI, specifically ChatGPT, as well as the fields of Fintech and the Metaverse, which is in direct alignment with the rapid evolution of the current

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/r9768467687

digital ecosystem. Ultimately, deciphering the interaction between Generation Z and the digital ecosystem is crucial for organizational sustainability. As this generation gradually becomes the dominant force in the global labour market, their ability to leverage AI and advanced digital tools will likely dictate the pace of corporate evolution. This study seeks to bridge the gap between theoretical expectations and the lived professional reality of these employees, offering insights that can help managers harmonize technological advancement with human potential.

2. Methodology

The aim of the research was to find out how the use of technology affects the work of Generation Z employees and how members of Generation Z themselves perceive the impact of these technologies on their work. A total of 98 respondents (members of Generation Z) from large and medium-sized organizations in Slovakia participated in the empirical study. A questionnaire designed specifically for the purposes of the research was used as a research tool, distributed online during the first half of 2025. Respondents indicated how they use technical devices and systems in their work, assessed the overall impact of the technologies used, and evaluated the associated risks and benefits. For the statistical processing of the gathered data, descriptive and inferential statistics were applied. Categorical data were processed through absolute and relative frequencies, while subjective perceptions and attitudes were captured using ordinal Likert-type scales.

To examine the relationships between variables and verify the research hypotheses, Spearman's Rank Correlation Coefficient (rs) was employed, as the data exhibited an ordinal character and did not meet the assumptions of a normal distribution. This non-parametric approach allowed for a robust analysis of the dependencies between the frequency of technology use, self-fulfilment, and the impact of management support on employee retention. The overall structure of the research sample and its demographic characteristics are detailed in the following section. In order to meet the main objective of the article, the following research questions (RQ) were therefore defined:
RQ1: What is the frequency of use of technical devices/technical systems in the work activities of Generation Z?
RQ2: How does Generation Z evaluate the impact of technical devices/technical systems on their work?
RQ3: How Generation Z perceive concerns and positives resulting from the introduction of new technologies?

To meet the main objective of the article, the following research hypotheses (RH) were therefore defined.
RH1: There is a statistically significant relationship between the frequency of use of technical equipment/systems and the degree of subjective feeling of opportunity to do things at work in which the respondent excels.
RH2: Respondents who perceive insufficient management support for digitalization as a significant barrier show a lower willingness to remain in their jobs if they are financially independent.

Table 1 presents the basic demographic characteristics of the research sample, where AF represent absolute frequencies, and RF represent relative frequencies in percentages.

Table 1. Structure of the research sample

Demographic characteristics	Men		Women		Sum	
	AF	RF [%]	AF	RF [%]	AF	RF [%]
Job position						
Employee - specialist	21	21.43	11	11.22	32	32.65
Administrative position	11	11.22	27	27.55	38	38.78
Production position	6	6.12	3	3.06	9	9.18
Managerial position	4	4.08	6	6.12	10	10.20
Other	2	2.04	7	7.14	9	9.18
Level of education						
High school with graduation	22	22.45	15	15.31	37	37.76
Bachelor's degree	13	13.27	28	28.57	41	41.84
Master's degree	7	7.14	10	10.20	17	17.35
High school without graduation	1	1.02	1	1.02	2	2.04
Doctoral study program	1	1.02	0	0.00	1	1.02

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/r9768467687

Sector						
Industrial production	33	33.67	19	19.39	52	53.06
Services	9	9.18	32	32.65	41	41.84
Public administration	2	2.04	3	3.06	5	5.10
Sum	44	44.90	54	55.10	98	100.00

Source: own elaboration

Based on the data in Table 1, the research sample consisted of 98 Generation Z respondents, of whom 54 (55.10%) were women and 44 (44.90%) were men. In terms of job position, respondents were most often represented in administrative positions (38.78%) and employee-specialist positions (32.65%). Management (10.20%), production (9.18%) and other positions (9.18%) were less represented. In terms of education, respondents with a Bachelor's university education (41.84%) and with a high school with graduation (37.76%) prevailed. The largest part of respondents worked in the industrial production sector (53.06%), followed by the service sector (41.84%), while public administration was represented to a lesser extent (5.10%).

3. Results and discussion

The following section focuses on the presentation of the results of the empirical research. The obtained data are analyzed and interpreted in relation to the established research questions.

RQ1: What is the frequency of use of technical devices/technical systems in the work activities of Generation Z? The evaluation of the first research question is presented in Table 2.

Table 2. Frequency of use of technical devices/technical systems

Intensity of technology use	Men		Women		Sum	
	AF	RF [%]	AF	RF [%]	AF	RF [%]
Every day	42	42.86	48	48.98	90	91.84
Several times a week	1	1.02	4	4.08	5	5.10
Occasionally (irregularly)	0	0.00	1	1.02	1	1.02
Once a week	0	0.00	1	1.02	1	1.02
Never	1	1.02	0	0.00	1	1.02
Sum	44	44.90	54	55.10	98	100.00

Source: own elaboration

The evaluation of the first research question (Table 2) points to a very high level of technology use in the work activities of Generation Z. As many as 91.84% of respondents reported that they use technical devices or systems on daily basis, with this trend being significant for both men and women. Only a minimal part of respondents use technology less often or not at all, which indicates that technology is an integral part of the working life of Generation Z.

The digital native nature of Generation Z leads to continuous connectivity, where technology is used throughout the workday for various purposes, including communication, collaboration, and task management. This constant use of technology is a defining characteristic of their work style (Spencer, 2023).

RQ2: How does Generation Z evaluate the impact of technical devices/technical systems on their work? Table 3 includes the results of RQ2.

Table 3. The impact of technical devices and systems on the work activities of Generation Z

Technology impact assessment	Men		Women		Sum	
	AF	RF [%]	AF	RF [%]	AF	RF [%]
Necessity	30	30.61	39	39.80	69	70.41
Benefit	12	12.24	10	10.20	22	22.45
Partial improvement	2	2.04	2	2.04	4	4.08
None	0	0.00	3	3.06	3	3.06
Sum	44	44.90	54	55.10	98	100.00

Source: own elaboration, 2025

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/r9768467687

The results of the second research question, presented in Table 3, indicate that Generation Z perceives technology primarily as an indispensable part of their work. This option was mentioned by 70.41% of respondents, with a slightly higher representation of women. A significant proportion of respondents (22.45%) evaluate technology as a benefit, while only a small percentage perceive it as a partial improvement or do not evaluate its impact at all. Overall, the results indicate a predominantly positive and pragmatic perception of technology in the work environment of Generation Z.

Modern technologies serve as both motivators and facilitators of job satisfaction for Generation Z. These tools enable efficient task completion and enhance engagement by providing dynamic and interactive work experiences (Schmid and Dowling, 2022). Figure 2 presents the results of the evaluation of RQ3.

RQ3: How Generation Z perceive concerns and positives resulting from the introduction of new technologies?

As part of the evaluation of RQ3 (Figure 2 and Figure 3), responses to questionnaire questions were used, in which respondents had the opportunity to provide multiple answers.

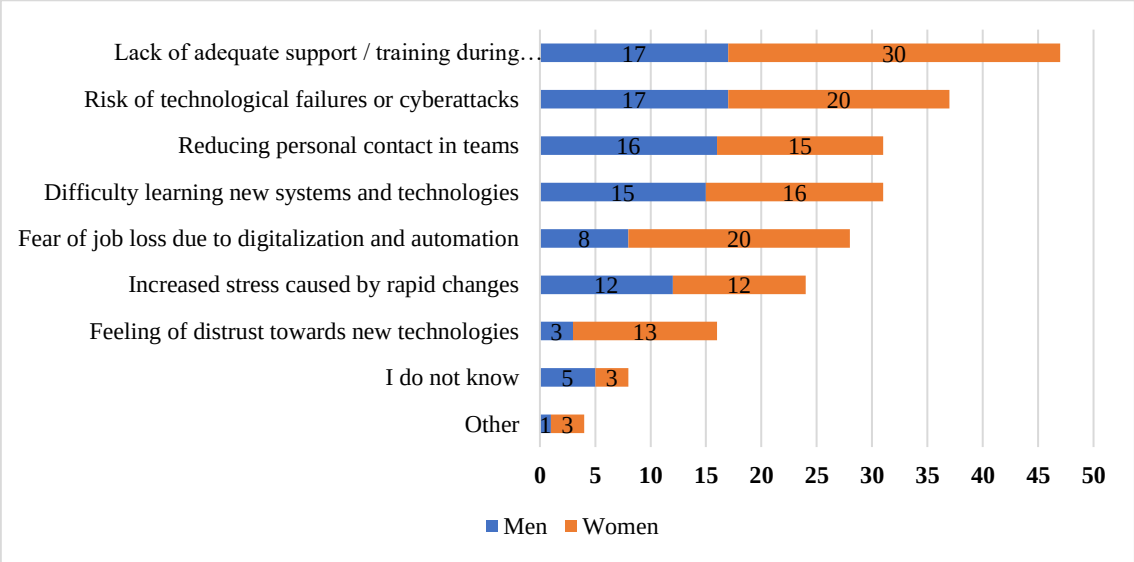


Figure 2. Concerns of Generation Z related to the introduction of new technologies
Source: own elaboration

The partial evaluation of the third research question (RQ3), presented in Figure 2, shows that Generation Z has the greatest concern about the lack of adequate support or training when implementing new technologies, with 17 men and 30 women reporting this possibility. Similar concerns were also identified in other research, where the authors defined that the need for continuous upskilling to keep pace with technological advancements is a challenge. Organizations must provide ongoing training and development opportunities to sustain engagement and competence (Luis Romero-Gazquez et al., 2022). The second most common concern is the risk of technological failures or cyberattacks, identified by 17 men and 20 women.

Other significant concerns include reduced personal contact in teams (16 men, 15 women) and the difficulty of learning new systems and technologies (15 men, 16 women). Fear of losing one's job due to digitalization was reported by 8 men and 20 women, while increased stress caused by rapid change was reported by 12 men and 12 women. A smaller proportion of respondents perceive a sense of distrust towards new technologies (3 men, 13 women) or are unable to express themselves (5 men, 3 women). Concerns classified as other were reported by 1 man and 3 women. Overall, the results suggest that concerns of Generation Z are mainly practical-organizational, with women more likely to perceive lack of support, fear of losing one's job and distrust of technology as problematic. Men are more likely to worry about technological disruptions and reduced contact in teams. Despite their tech-savvy nature, Generation Z faces challenges such as balancing work-life boundaries in an always-connected digital environment. The pressure to remain constantly available can lead to stress and

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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burnout (Trifan & Pantea, 2023). Figure 3 shows the evaluation of the second part of RQ3, i.e., the positives perceived by Generation Z resulting from the introduction of new technologies.

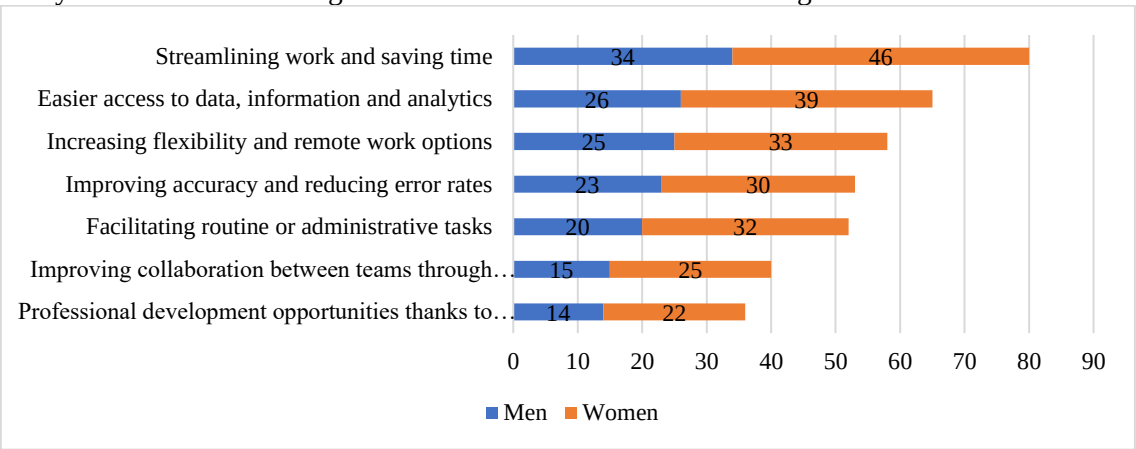


Figure 3. Positives according to Generation Z related to the introduction of new technologies
Source: own elaboration

The evaluation of the second part of the third research question (RQ3), presented in Figure 3, shows that Generation Z values work efficiency and time savings the most, with 34 men and 46 women citing this benefit. The second most frequently cited benefit is easier access to data, information and analytics (26 men, 39 women), followed by increased flexibility and remote work options (25 men, 33 women). Other significant benefits include improved accuracy and reduced error rates (23 men, 30 women), ease of routine or administrative tasks (20 men, 32 women), improved collaboration between teams through digital tools (15 men, 25 women), and opportunities for professional development thanks to technology (14 men, 22 women). Overall, the results indicate that women perceive the positive impacts of technology to a greater extent than men, especially in terms of saving time and making work more efficient, while men most value the practical benefits related to accuracy, flexibility, and availability of information. The integration of AI and automation into routine tasks is perceived positively, with Generation Z valuing the reduction in monotonous tasks and the opportunity to engage in more meaningful work (Palazzan, 2022). Table 4 contains an overall assessment of Generation Z's perception of technology.

Table 4. Evaluation of the overall perception of technology by Generation Z

Overall perception of technology	**Men**		**Women**		**Sum**	
	AF	**RF [%]**	**AF**	**RF [%]**	**AF**	**RF [%]**
Very positive – I consider them a significant contribution and improvement to me or my work	16	16.33	20	20.41	36	36.73
Rather positive – I see them as a useful tool to make work easier	21	21.43	26	26.53	47	47.96
Neutral – I have no strong opinion, neither positive nor negative	5	5.10	8	8.16	13	13.27
Rather negative – I am concerned about their impact on my work	2	2.04	0	0.00	2	2.04
Sum	44	44.90	54	55.10	98	100.00

Source: own elaboration

Table 4 contains an overall assessment of how Generation Z perceives new technologies. The results show that the majority of respondents have a positive attitude towards technology.

The most common answers were “Rather positive – I see them as a useful tool to make work easier”, which was given by 21 men (21.43%) and 26 women (26.53%), a total of 47 respondents (47.96%). The second most common answer was “Very positive – I see them as a significant benefit and improvement to me or my work”, which was given by 16 men (16.33%) and 20 women (20.41%), a total of 36 respondents (36.73%). A smaller part of the respondents are those who have a neutral attitude towards technology – 5 men (5.10%) and 8 women (8.16%), a total of 13 respondents (13.27%). A rather negative attitude, i.e., concerns about the impact of technology on work, was reported by only 2 men (2.04%) and no women. Overall, the results show that

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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Generation Z perceives technology mostly positively, with women slightly more often evaluating technology as very beneficial. Negative attitudes or concerns on the part of respondents are minimal, which indicates a high openness of this generation to the introduction of new technological tools. The results of the third cohort, as Generation Z is sometimes referred to, are consistent with previous research. Generation Z is generally receptive to new technologies, demonstrating high adaptability and comfort with digital tools. This generation upbringing in a digital era equips them with skills to seamlessly integrate technology into their work processes (Moravcova-Skoludova & Vlckova, 2018; Trifan & Pantea, 2023). Their preference for flexible, tech-driven work environments highlights the need for organizations to adopt digital workplaces that support remote and hybrid work models (de Moraes et al., 2022; Annapurna et al., 2020).

RH 1: There is a statistically significant relationship between the frequency of use of technical equipment/systems and the degree of subjective feeling of opportunity to do things at work in which the respondent excels.

Before testing the hypothesis, respondents who answered "I don't know" were removed from the research sample. Hypothesis testing examines the relationship between the frequency of use of technological devices and the opportunities that their work provides them to do what they do best, i.e., their opportunities for self-realization and application of their abilities (Table 5).

Table 5. Testing the relationship between the frequency of use of technical equipment/systems at work and the feeling of self-fulfillment

Spearman's rho	Coefficient	The frequency of use of technical equipment/systems	Personal fulfilment at work
The frequency of use of technical equipment/systems	Correlation Coefficient	1.000	**.412****
	Sig. (2-tailed)	-	.001
	N	84	84
Personal fulfilment at work	Correlation Coefficient	**.412****	1.000
	Sig. (2-tailed)	.001	-
	N	84	84

** Correlation is significant at the 0.05 level (2-tailed).

Source: own elaboration

As part of the research, the authors analyzed the relationship between the frequency of using technology and the subjective perception of self-fulfilment among members of Generation Z. Hypothesis H1 assumed the existence of a statistically significant positive correlation between the frequency of use of technical devices and the respondent's feeling that their work allows them to use their best abilities. Given the ordinal nature of the data (Likert scales and interval frequency), Spearman's correlation coefficient (Spearman's rho) was used to verify the relationship. The resulting correlation coefficient value of rs = 0.412 indicates a moderately strong direct linear dependence. The achieved significance level p = 0.001 is lower than the specified critical value of the alpha coefficient = 0.05, which allows us to reject the null hypothesis and accept hypothesis H1 (Table 5). The statistical testing the VH1 confirms that more frequent use of digital technologies among Generation Z correlates with higher job satisfaction and a feeling of effective use of one's own talent. This can be explained by the fact that the cohort studied consisted of representatives of Generation Z, for whom technology is not just a work tool, but a natural environment for achieving goals (results). Technological infrastructure in the workplace is becoming a critical factor for Generation Z, allowing them to hand over routine tasks to systems and focus on higher value-added activities where they can apply their potential. The results suggest that organizations that invest in modernizing and digitizing processes can indirectly increase the level of intrinsic motivation among young employees. The absence of technology or low frequency of its use can lead to a feeling of stagnation or untapped potential among this generation. However, when interpreting the results, it is also necessary to take into account the nature of the job positions – in this context, technology acts as a catalyst for self-fulfilment, not as its sole source.

RH 2: Respondents who perceive insufficient management support for digitalization as a significant barrier show a lower willingness to remain in their jobs if they are financially independent.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/r9768467687

Before testing the hypothesis, respondents who answered "I don't know" were removed from the research sample. As part of the statistical processing of data, we proceeded to test the second research hypothesis, which assumed the existence of a negative correlation between the perception of insufficient management support in the digitalization process and the level of internal motivation of respondents to remain in their current job. The hypothesis testing (Table 6) focused on demonstrating the relationship between the perceived lack of support from management in implementing digitalization and willingness to retain in employment once financial independence has been achieved.

Table 6. Testing the relationship between the insufficient management support and the feeling of self-fulfillment

Spearman's rho	Coefficient	Insufficient management support	Willingness to retain in employment once financial independence has been achieved
Insufficient management support	Correlation Coefficient	1.000	**-.394****
	Sig. (2-tailed)	-	.000
	N	95	95
Willingness to retain in employment once financial independence has been achieved	Correlation Coefficient	**-.394****	1.000
	Sig. (2-tailed)	.000	-
	N	95	95

** Correlation is significant at the 0.01 level (2-tailed)

Source: own elaboration

Given the ordinal nature of the data obtained and the violation of the assumptions of normal distribution, Spearman's correlation coefficient was used to determine the degree of association between the variables under study. The results of the analysis showed a statistically significant, moderately strong negative correlation (rs = -0.394. The achieved significance level (p = 0.001) is significantly lower than the predetermined critical value of the significance level (alpha = 0.01), which provides sufficient statistical basis for rejecting the null hypothesis of independence of the observed phenomena. The coefficient value found (-0.394**) indicates that as the perceived lack of management support for the implementation of digital technologies increases, respondents declared willingness to continue working in their current position if they become financially independent decreases significantly (Table 6). This inverted relationship confirms that management support is a critical determinant of employees' internal stability and their loyalty to the organization, which goes beyond purely economic motivation. Based on the results achieved in the table, we conclude that research hypothesis H2 has been confirmed.

4. Conclusions

Based on the research carried out, it can be stated that new technologies play a significant and stable role in the working life of Generation Z. Respondents use them extensively on a daily basis (91.84%) and perceive them as a natural and indispensable part of their work activities, with 70.41% of the sample identifying technology as a necessity. Technological tools are primarily a means for this generation to make work more efficient, save time and increase flexibility, which is also reflected in the positive assessment of remote work options and better availability of information. Statistical testing confirmed these observations, revealing a significant moderate positive correlation (rs = 0.412, p = 0.001) between the frequency of technology use and the subjective feeling of self-fulfilment at work (RH1), proving that technology acts as a catalyst for professional satisfaction.

At the same time, however, it turns out that the intensive use of technologies also brings certain challenges. The most frequently identified concerns include the risk of technical failures or the weakening of personal contact between members of work teams, but most importantly, the lack of professional support and training, which was identified as a major barrier. The research further demonstrated that organizational support is crucial for retention; a significant negative correlation (rs = -0.394, p < 0.001) was found between perceived insufficient management support for digitalization and the willingness of employees to remain in their jobs (RH2). The results also indicate slight differences in the perception of benefits and risks between men and women, which points to the need to take into account the diverse experiences of employees, especially

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regarding the higher fear of job loss due to digitalization observed in women. Overall, the results can be interpreted as confirming the high degree of adaptability of Generation Z to technological changes, which aligns with the bibliometric trends identified in the Scopus database showing a shift toward AI integration and human-centric digital management.

The originality of this study is based on the combination of the analysis of subjective work-related self-fulfilment and the intensity of technology use among Generation Z, as well as the investigation of the role of perceived organizational support in the context of digitalization. In contrast to previous studies that investigated technological adoption or attitudes toward digitalization in isolation, this study provides empirical evidence of the dual role of technology as both a source of professional satisfaction and a potential risk factor in the case of insufficient organizational support. Additionally, the findings related to gender differences in perceived digitalization risks, especially related to the fear of job loss, contribute to the understanding of the heterogeneous experiences of Generation Z, which are not yet explored in the existing literature.

This represents significant potential for organizations, especially if the introduction of technologies is accompanied by systematic education, clear communication and adequate support from the employer. These factors can contribute to better use of technological innovations and to strengthening employee satisfaction and engagement. The size and structure of the research sample, which was limited to 98 respondents operating in Slovakia, as well as the use of a questionnaire based on subjective assessment, can be considered a limit of the research. In the future, it would be appropriate to expand the research to include a larger number of respondents, or possibly qualitative methods. There is also space for further research by comparing Generation Z with other generations or analyzing the impact of specific technologies, such as generative AI or the Metaverse, in individual sectors. In summary, it can be stated that Generation Z perceives new technologies mainly as a benefit, while their effective use can significantly support a modern and flexible work environment. However, success depends on the ability of organizations to create conditions that will allow employees not only to use technologies, but also to fully develop their potential.

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ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/r9768467687

Acknowledgement: Funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I03-03-V05-00005.

Author Contributions: Conceptualization: *Natália Vraňaková, Zdenka Gyurák Babeľová*; methodology: *Natália Vraňaková, Augustín Stareček*; data analysis: *Natália Vraňaková, Augustín Stareček*, writing-original draft preparation: *Natália Vraňaková, Zdenka Gyurák Babeľová*, *Augustín Stareček*, writing; review and editing: *Zdenka Gyurák Babeľová*; visualization: *Natália Vraňaková, Augustín Stareček*. All authors have read and agreed to the published version of the manuscript.

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/d7745848262

Publisher
http://jssidoi.org/esc/home

EUROPEAN SECURITY, DEFENCE INDUSTRY AND SUSTAINABLE DEVELOPMENT: INSTITUTIONAL TRANSFORMATION TOWARDS STRATEGIC AUTONOMY AND LONG-TERM RESILIENCE

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Received 14 January 2026; accepted 18 March 2026; published 30 June 2026

Abstract. Security and stability constitute fundamental prerequisites for the long-term sustainable development of societies. The return of high-intensity interstate warfare to Europe following Russia's aggression against Ukraine has profoundly altered the European security environment and challenged long-established assumptions underpinning European integration and development. This article analyses the transformation of European security, the defence industry and the institutional role of the European Union in the context of efforts to strengthen strategic autonomy and long-term resilience. Drawing on a qualitative analytical approach based on the analysis of strategic documents, policy initiatives and academic literature, the article identifies structural weaknesses of the European defence technological and industrial base, assesses the growing involvement of the Union in defence industrial policy and defence financing, and highlights the broader implications of these processes for Europe's sustainable development. The findings indicate that security, the defence industry and institutional adaptation are increasingly interconnected, and that the ability to ensure security and defence, reduce strategic dependencies and strengthen industrial resilience represents a key condition for Europe's sustainable development in an increasingly unstable global environment.

Keywords: European security; defence industry; sustainable development; strategic autonomy; institutional transformation; resilience

Reference to this paper should be made as follows: Jurčák, V., Gubáš, F. 2026. European security, defence industry and sustainable development: institutional transformation towards strategic autonomy and long-term resilience. *Entrepreneurship and Sustainability Issues*, 13(4), 52-64. http://doi.org/10.9770/d7745848262

JEL Classifications: F52, H56, L64, O19

Additional disciplines: Security, International Relations, Political Science

1. Introduction

Security and stability constitute fundamental prerequisites for the sustainable development of modern democratic societies. The capacity of states to ensure the defence and protection of their territory, population, environment, and critical infrastructure establishes a necessary framework for long-term economic growth, a favourable business environment, technological innovation, and social cohesion. In this sense, security is not an antithesis to sustainability, but rather one of its fundamental premises. Consequently, contemporary security turbulence and geopolitical shifts fundamentally influence not only the sphere of defence but also the broader perspectives of sustainable development in Europe.

The Russian military aggression against Ukraine, which commenced in February 2022, represents a historical turning point in the European security environment and, simultaneously, a severe challenge to the long-

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/d7745848262

established model of European development based on the assumptions of stability, predictability, and peaceful cooperation (Borrell Fonteles, 2023; Jurčák & Ivančík, 2023; Andrassy & Ondruš, 2024). The return of high-intensity interstate armed conflict to Europe has called into question not only the post-war security order but also the basic foundations upon which the economic integration, industrial policy, and sustainable development of the European Union (EU) were constructed. The security crisis has thus become a catalyst for deeper structural changes (European Parliament, 2025; Gennini, 2025a) that transcend a narrowly defined military dimension.

In this context, issues concerning the securing of European defence and the support of the defence industry are coming to the fore as strategic factors with a direct impact on economic resilience, technological sovereignty, and the long-term sustainability of the European continent's development. Long-term underinvestment in defence capabilities, the fragmentation of the defence market, and the optimisation of production for peacetime conditions have led to a situation where the European Defence Technological and Industrial Base (EDTIB) was ill-prepared for the sudden surge in demand caused by the conflict in Ukraine (Barry et al., 2025; Ivančík & Majchút, 2026). These weaknesses are manifested not only in the sphere of guaranteeing European security but also carry significant economic and institutional implications, affecting supply chain stability, investment decisions, and Europe's ability to respond to systemic crises (European Union, 2025; Hellemeier, 2025).

The gradual transformation of the EU from a predominantly civilian integration project into an actor with an increasing role in defence and defence industrial development represents a broader process of institutional adaptation to new security and economic conditions. The development of European defence capabilities, the promotion of the defence industry, and the search for new models of defence financing are increasingly intertwined with discussions on strategic autonomy, economic resilience, sustainable development, and societal robustness (Riddervold & Rieker, 2024; Ivančík & Andrassy, 2025). Concurrently, the Union seeks to reduce its strategic dependencies in the fields of technology, energy, and critical raw materials, thereby linking defence policy with economic, energy, and environmental security (Chehabeddine et al., 2023), as well as the digital and green transitions (Dirma et al., 2024; Okunevičiūtė Neverauskienė et al., 2025; Churikanova et al., 2025) as key pillars of its long-term development strategy.

The aim of this article is to analyse the transformation of European security, the defence industry, and the EU's institutional framework within the context of efforts to strengthen strategic autonomy and long-term societal resilience as prerequisites for long-term sustainable development. The article focuses on identifying the primary structural challenges facing the European defence industry, analysing the Union's role in defence financing and industrial policy, and evaluating the broader implications of these processes for Europe's security, economic stability, and sustainable development.

From a methodological perspective, the article is based on a qualitative analysis of strategic documents, policy statements, academic articles, and professional literature focused on European security, defence, and the defence industry. The applied analytical-synthetic approach allows for the integration of the security, defence, industrial, and developmental dimensions of the issue under investigation, while comparative and institutional approaches contribute to understanding the dynamics of the relationship between national and European levels of governance. A limitation of the research remains the highly dynamic nature of developments in the global and regional security environment, which, however, underscores the significance of the subject matter for the future sustainable development of Europe.

2. The Transformation of Europe's Security Environment and New Requirements for Defence Capabilities

The post-war European security order, which took shape after 1945 and evolved into a relatively stable and predictable system following the end of the Cold War, was founded upon a combination of several pivotal assumptions. Most significant among these were the military security dominance of the United States in Europe, enshrined within the Alliance; the gradual integration of the Russian Federation into the broader framework of international institutions and norms; and the conviction that economic interconnectedness and the mutual dependence of major actors would serve as an effective deterrent against the resurgence of large-scale interstate

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/d7745848262

conflicts (Kazanský & Andrassy, 2019; Andor & Optenhögel, 2023; Ivančík & Dušek, 2026a). Within this framework, European states were able to concentrate on internal economic and political consolidation, while matters of collective defence were largely externalised through the transatlantic relationship. This model permitted a long-term reduction in defence budgets, the downsizing of armed forces, and a limitation of investment in the defence industry, without immediately jeopardising the fundamental security interests of the majority of European states (Jurčák & Martaus, 2021; Ellison et al., 2023; Götz & Ekman, 2024).

However, the gradual erosion of this order was evident well before 2022. The Russian military intervention in Georgia in 2008 (Roy, 2013), the annexation of Crimea and the destabilisation of eastern Ukraine after 2014 (Poli & Candura, 2023), and the increasing utilisation of hybrid instruments of influence represented clear signals that Europe's security environment was becoming less stable and less predictable. Despite these warnings, the response from most European states remained partial and often delayed. Although strategic documents identified emerging threats, their practical implementation was hindered by political compromises, budgetary constraints, and a lingering belief that a large-scale conventional war in Europe was improbable. This discrepancy between declared risk perceptions and actual readiness became fully manifest after February 2022, when the Russian invasion of Ukraine definitively shattered the illusion of the permanence of the post-war security order (Jurčák & Ivančík, 2023; European Council, 2024).

The war in Ukraine has acted as a catalyst for profound structural shifts in European security thinking. For the first time since the Second World War, Europe faces a protracted, high-intensity interstate armed conflict in which conventional armed forces, the mass employment of artillery, missile systems, and aviation, as well as the systematic destruction of critical infrastructure, play a decisive role. This conflict has demonstrated that technological superiority and modern weapon systems alone cannot substitute for the need for sufficient stockpiles, production capacities, and the ability to sustain a high tempo of military operations over the long term. For European states, this has necessitated a fundamental return to the core questions of collective defence, territorial security, and the capacity to defend sovereign territory in the event of an armed attack (Pynnöniemi & Parppei, 2024; Bocquillon et al., 2024).

A particularly significant aspect of the war in Ukraine is its character as a war of attrition, which places extreme demands on logistics, supply chains, and industrial manufacturing. The daily consumption of artillery ammunition, missiles, and spare parts reaches levels that far exceed the planning assumptions of most European militaries. As a result of massive military aid to Ukraine, the stockpiles of many NATO and EU member states have fallen to historically low levels, thereby exposing their limited ability to rapidly replenish exhausted capacities. This state of affairs is not merely a consequence of the current conflict, but also the result of a long-term approach that prioritised efficiency, lean inventories, and short production runs over redundancy and systemic resilience (Hofer, 2024; Mills, 2025).

3. The European Defence Industry: Structure, Capacities, and Systemic Weaknesses

The European defence industry represents one of the most complex and, simultaneously, most problematic segments of the European economic and security architecture. Its current form is the result of historical developments in which defence production was shaped predominantly at the national level, closely intertwined with concepts of national sovereignty, strategic autonomy, and political control over the armed forces. Unlike other industrial sectors, the defence industry in Europe has not undergone a full-scale integration process within the Single Market. This has led to the emergence of a highly fragmented environment characterised by parallel production capacities, duplicate programmes, and limited interoperability (European Union, 2025). Historically, this fragmentation was regarded as an acceptable price for maintaining national control over key military capabilities; however, within the context of the contemporary security environment, it increasingly appears to be a strategic weakness.

The fragmentation of the European defence market manifests at multiple levels. Historically, each member state of the European Union has constructed its own defence industrial base, tailored to specific doctrinal needs, political preferences, and industrial capacities. The result is the existence of a vast array of different types of weapon systems that perform similar tasks but differ in technical parameters, logistical requirements, and life

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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cycles (Clapp, 2025). This state of affairs leads to higher costs for development, production, and maintenance, limits the opportunities to achieve economies of scale, and complicates the joint deployment of forces within NATO or the European Union. While the United States possesses a relatively centralised defence market with large production runs, Europe remains divided into numerous smaller markets that often fail to generate sufficient demand to sustain competitive manufacturing (Andersson, 2023; Ilzetzki, 2025).

A pivotal concept in assessing the state of the European defence industry is the European Defence Technological and Industrial Base (EDTIB). This term refers to the collective of enterprises, research institutions, and technological capacities that ensure the development, production, and maintenance of military capabilities in Europe. The EDTIB is of strategic importance not only from an economic perspective but, primarily, from a security standpoint, as its existence and functionality determine the ability of European states to act autonomously in crisis situations (Mattelaer, 2023). Nevertheless, the EDTIB remains significantly fragmented and unevenly developed, with a concentration of high-end capacities in a few large member states, while smaller countries are often reliant on imports or participation in international programmes as subcontractors (Wilkinson, 2020; Wollf, 2024).

The war in Ukraine has dramatically exposed the limitations of the EDTIB regarding serial production and the ability to respond rapidly to a sharp surge in demand. For decades, the European defence industry was optimised for low-volume production, short production runs, and long lead times, reflecting an environment of peacekeeping operations and limited conflicts. Under the conditions of a war of attrition, however, this model has proven unsustainable. The production of artillery ammunition, missiles, and spare parts for armoured vehicles faces capacity limits that cannot be overcome without substantial investment in infrastructure, workforce, and technological equipment. Furthermore, the lack of long-term orders and uncertainty regarding future demand hinder the industry's willingness to invest in expanding production (Mattelaer, 2023; Clapp, 2025).

Furthermore, serial production within the defence industry is closely intertwined with the functioning of complex supply chains that transcend national borders. Modern weapon systems are dependent on a broad spectrum of components, including electronics, specialised metals, and chemical substances, the supply of which is often secured globally. In recent years, this dependency has emerged as a significant risk factor, as geopolitical tensions, disruptions to global trade, and increasing competition for strategic raw materials threaten the continuity of production. In this regard, the European defence industry is particularly vulnerable in the area of critical raw materials, where the EU is heavily reliant on imports from third countries, including actors that may prove to be politically or strategically unreliable in a crisis situation (Kollias & Tzeremes, 2025).

The issue of resource dependency carries not only an economic dimension but a strategic one as well. Ensuring stable access to critical materials is an indispensable prerequisite for sustainable defence-industrial production during a protracted conflict. The war in Ukraine has demonstrated that the capacity to conduct military operations is determined not only by the number of modern platforms but also by the availability of relatively simple yet essential components, such as fuels and lubricants, explosives, or spare parts (Kleczka et al., 2025). A shortage of these inputs can lead to production bottlenecks, which have a direct impact on the operational readiness of the armed forces.

Another fundamental characteristic of the European defence industry is the persistent tension between national sovereignty and the pursuit of deeper European cooperation. The defence industry is traditionally perceived as an integral component of national security, prompting governments to seek control over key production capacities and decision-making processes (Ivančík & Andrassy, 2025; Clapp, 2025). This logic is manifested in the preference for domestic suppliers, the protection of national 'champions', and a cautious stance toward supranational solutions that might diminish political control over defence capabilities. Simultaneously, however, the escalating costs of developing modern weapon systems and the necessity for interoperability create pressure for joint projects and the integration of production capacities at the European level (Wilkinson, 2020; Wollf, 2024).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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This tension is also reflected in the divergent priorities of member states, which possess differing strategic cultures, threat perceptions, and industrial interests. While some countries advocate for an ambitious vision of European defence-industrial integration, others remain sceptical, preferring bilateral or transatlantic solutions. The result is often a compromise-based approach that, while facilitating the emergence of joint initiatives, simultaneously constrains their scope and effectiveness. This fragmentation of political will subsequently translates into a limited capacity for the European defence industry to function as a truly unified and resilient system (Kollias & Tzeremes, 2025).

In the context of security of supply, the European defence industry finds itself at the centre of several fundamental dilemmas. On the one hand, there is a drive to ensure the highest possible degree of autonomy and resilience through domestic or European manufacturing. On the other hand, the reality of the globalised nature of modern industry is that complete self-sufficiency is economically demanding and technologically problematic (Kleczka et al., 2025). The extent to which it is possible and desirable to reduce dependence on external suppliers remains a subject of intense political and professional debate. However, the war in Ukraine has shifted this discussion from the realm of theoretical considerations to a level of urgent practical necessity.

In conclusion, it can be stated that the European defence industry has entered a period of fundamental transformation, in which its traditional structural weaknesses have become a strategic problem. Market fragmentation, limited production capacities, vulnerable supply chains, and the tension between national and European priorities create a complex challenge that cannot be addressed through isolated measures. These systemic weaknesses also explain why the European Union has become increasingly active in the sphere of the defence industry and defence financing in recent years. The analysis of this role and its implications for the future direction of European defence will be the subject of the following chapter.

4. The Role of the European Union in the Defence Industry and Defence Financing

The role of the European Union in the sphere of defence and the defence industry has undergone a fundamental transformation over the last two decades, a process that has accelerated significantly since 2022. While at the beginning of the 21st century, the security and defence dimension of integration was perceived as a peripheral and strictly intergovernmental domain, current developments demonstrate a gradual institutionalisation of EU defence policy and an expansion of its practical instruments. This process does not signify the emergence of a European defence in the classical state-centric sense; rather, it represents a significant shift towards a more systematic and coordinated approach to the development of defence capabilities and the defence industry. The institutional evolution of the EU in this field is the result of a combination of long-term trends and acute crisis impulses, among which the war in Ukraine plays a pivotal role (Hartley, 2024).

The gradual institutionalisation of EU defence policy relies on the expansion of competences and instruments that are primarily of a coordinating, stimulatory, and financial nature. Although the European Union does not possess its own armed forces, and decision-making in the field of defence remains formally in the hands of the member states, it is increasingly able to influence the shape of European defence capacities through industrial policy, research, and budgetary tools. This approach reflects the specific nature of the EU as a political entity which, instead of directly exercising military power, creates frameworks, incentives, and a regulatory environment for cooperation between states and industry. In this context, the defence industry has become one of the primary vectors through which the EU strengthens its role in the sphere of security (Pöllänen, 2025).

A key milestone in this development was the establishment of the European Defence Fund (EDF), which, for the first time, systematically utilises the EU budget to support research and development in the field of defence technologies. The European Defence Fund represents a tool aimed at reducing the fragmentation of defence research, fostering cooperation between enterprises from multiple member states, and strengthening the competitiveness of the European Defence Technological and Industrial Base (European Commission, 2025a). Although the EDF was not originally focused on serial production or procurement, it established an important precedent for the legitimisation of using common EU financial resources in the area of defence. This precedent proved crucial following the outbreak of the war in Ukraine, when the need for a rapid and large-scale response became an urgent political priority.

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This situation was followed by further initiatives that expanded the EU's scope from research and development toward supporting production and procurement. The Act in Support of Ammunition Production (ASAP) was designed as a temporary yet exceptionally significant instrument to stimulate the defence industry, with the aim of increasing the production of ammunition and key components in a short timeframe. ASAP responds to identified shortages in production capacity and seeks to remove certain bottlenecks through financial incentives, the simplification of administrative procedures, and support for infrastructure investment (European Commission, 2025b). Similarly, the European Defence Industry Reinforcement through Common Procurement Act (EDIRPA) represents an attempt to motivate member states toward joint purchases of military equipment, thereby achieving economies of scale, increasing interoperability, and strengthening European manufacturers (European Commission, 2025c).

A significant step in this direction is also the European Defence Industry Programme (EDIP), which signals an ambition to create a more long-term and systematic framework for supporting the defence industry at the EU level. EDIP has the potential to link individual initiatives into a more coherent strategy encompassing research, development, production, and procurement. Simultaneously, it creates space for the deeper integration of Ukraine's defence industry into European supply chains, thereby linking EU defence policy with its broader geopolitical and strategic objectives (European Commission, 2025c). A special role in this system is played by the European Peace Facility (EPF), which has enabled the EU to finance the delivery of military equipment to partner states, including Ukraine. The use of the EPF to support a country engaged in an active armed conflict represents a historical precedent that fundamentally alters the nature of the EU's engagement in the field of security (European Council, 2025).

However, joint procurement, which has become one of the primary pillars of the EU's new approach, encounters several limitations. Despite financial incentives, decision-making regarding procurement remains in the hands of member states, which possess differing operational requirements, budgetary capacities, and political priorities. The willingness to participate in joint projects is often contingent upon national industrial interests and the desire to ensure that a significant portion of the value chain remains within domestic territory. This factor constrains the scope and the pace at which joint procurement can establish itself as the dominant model. Furthermore, joint projects necessitate complex coordination, the harmonisation of technical requirements, and compromises that may prolong decision-making processes at a time when a rapid response is required.

The issue of defence financing represents another fundamental dimension of the EU's role. Traditionally, defence expenditure was exclusively a matter for national budgets, with investment levels reflecting the political priorities of individual states. However, the current security situation has exposed the limits of this approach, particularly in the case of states with constrained fiscal space (Ivančík & Dušek, 2026b). Discrepancies in the economic strength and indebtedness of member states lead to an uneven capacity to respond to new security requirements, which can undermine collective defence capabilities. In this context, there is increasing debate regarding the need to supplement national budgets with supranational financial instruments that would allow for more efficient and solidary resource mobilisation (De Lemos Peixoto et al., 2025).

In this regard, the ReArm Europe initiative represents an ambitious, yet controversial, attempt to strengthen European defence financing through a combination of national and European instruments. Its aim is to create the fiscal and legal space for a significant increase in defence investment, even at the cost of a temporary relaxation of budgetary rules. ReArm Europe highlights the EU's growing willingness to enter spheres long considered the core of national sovereignty, while simultaneously exposing the legal-institutional limits of the current integration framework. The use of existing treaty provisions to finance defence raises questions about the long-term sustainability of this approach and the potential necessity for treaty amendments (Santopinto, 2025; Clapp et al., 2025).

The legal-institutional challenges associated with the expansion of the EU's role in defence are therefore an inseparable part of this process. The tension between the intergovernmental nature of defence policy and the increasing role of European institutions creates uncertainty that may hinder more ambitious initiatives. Nevertheless, crisis situations such as the war in Ukraine demonstrate that the existing framework is capable of

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adaptation and that the EU can find pragmatic solutions even in legally sensitive areas. The question remains to what extent these solutions will become a permanent feature of the European defence architecture.

Overall, it can be stated that in the areas of the defence industry and defence financing, the EU is transforming from a peripheral actor into a key coordinating and stimulatory player. Through a combination of financial instruments, regulatory initiatives, and political coordination, it seeks to overcome the structural weaknesses of the European defence environment and strengthen the ability of member states to respond to new security challenges. However, this process remains unfinished, and its success will depend on the political will of the member states, the ability to align national and European interests, and the further evolution of the security environment. The perspectives of this development and the question of Europe's strategic autonomy will be the subject of the following chapter.

5. Strategic Autonomy and the Future Direction of European Defence

The concept of strategic autonomy has, in recent years, emerged as one of the central themes in the debate concerning the future of European defence and security (Michaels, & Sus, 2024; Ossa, 2025; Wrange, 2026). Initially formulated in a somewhat vague manner, often eliciting divergent interpretations among member states, the concept has acquired a more concrete and urgent significance since 2022. In its contemporary understanding, strategic autonomy does not imply European isolationism nor an attempt to replace existing security ties; rather, it signifies Europe's capacity to decide and act independently on pivotal issues of its security in situations where its interests so require. It is, therefore, a concept that combines political ambition with a suite of practical capabilities, without which any declaration of autonomy would remain mere empty rhetoric (Varma, 2024; Ivančík & Andrassy, 2025).

From a practical perspective, strategic autonomy is closely intertwined with Europe's ability to secure its own defence capabilities, maintain a functional defence industry, and possess mechanisms for rapid decision-making and financing. Without a sufficient industrial base, reliable supply chains, and adequate stockpiles of military materiel, it is impossible to speak of genuine autonomy in the sphere of defence (European Union, 2025). Simultaneously, however, strategic autonomy transcends a narrowly defined military dimension. An inseparable component is the strengthening of autonomy in the fields of economics, technology, and critical infrastructure. Within this context, the European Union strives to reduce strategic dependencies, promote digital transformation, develop its own technological capacities, and pursue a green transition based on the utilisation of renewable energy sources. These processes carry not only economic and environmental significance but also directly influence the EU's security resilience, as energy, technological, and industrial self-sufficiency reduce vulnerability to external pressure and crises (Kleczka et al., 2025; Möller, 2025).

The relationship between the Union's strategic autonomy and the Alliance remains one of the most sensitive issues in the European security debate. Critics of the autonomy concept frequently highlight the risk of capability duplication and the potential weakening of the transatlantic link, while its proponents emphasise the need for a more balanced burden-sharing between Europe and the United States. From an analytical standpoint, however, strategic autonomy is not necessarily at odds with the functioning of NATO. On the contrary, it can act in a complementary fashion if it leads to the strengthening of European capabilities, which are subsequently available for collective defence within the Alliance. A key prerequisite for this complementarity is transparency, coordination, and a clear demarcation of roles between European initiatives and Alliance structures (Ossa, 2025).

It is precisely in this context that strategic autonomy acquires a pragmatic dimension. Europe recognises that NATO remains the fundamental pillar of its collective defence, yet it simultaneously faces a reality in which the United States is increasingly orienting its strategic attention away from the European theatre. The strengthening of European defence capabilities should therefore not be perceived as an alternative to NATO, but as an essential supplement that enhances the overall resilience of the transatlantic security system. From this perspective, strategic autonomy is an instrument for strengthening the partnership rather than weakening it, provided it is implemented in close cooperation with Alliance allies (Mölling et al., 2023; Budginaite-Froehly, 2025).

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The risks of a partial American withdrawal from Europe represent one of the primary factors lending urgency to the discussion on strategic autonomy. Although a complete security decoupling of the United States from Europe is not a realistic scenario, repeated political signals regarding the need to shift American resources to the Indo-Pacific region increase uncertainty concerning the long-term extent of American engagement (Kandyuk, 2022; Pszczel, 2024). For European states, this implies they must be prepared to assume greater responsibility for their own defence, not only through political declarations but also through concrete investments in capabilities and industry. In this sense, strategic autonomy becomes a form of insurance against future strategic shocks that could disrupt the stability of the European security environment.

The support for Ukraine represents a long-term test of Europe's capacity to act as a strategically autonomous actor. The scale and duration of the conflict have revealed the extent to which European states are capable of coordinating their policies, mobilising resources, and maintaining political unity amidst rising costs and domestic political pressures. Simultaneously, it has become evident that the ability to support Ukraine is not merely a matter of solidarity but a direct indicator of Europe's own defensive capacity. Deficiencies in stockpiles, production capacities, or decision-making processes translate immediately into a limited ability to respond to the requirements of Ukrainian defence, thereby undermining Europe's credibility as a security actor (Vachudova & Koval, 2024).

In this context, strategic autonomy also possesses a normative dimension. Supporting Ukraine is not merely a reaction to a specific conflict but part of a broader effort to preserve a rules-based international order (Becker et al., 2024). In this way, Europe is testing its capacity to assert its own values and interests in an environment increasingly characterised by great power rivalry and the erosion of international norms. Success or failure in this endeavour will have long-term consequences for the perception of the EU as a global actor.

The perspectives for the further development of European defence will depend on several interconnected factors. Crucial will be the political will of member states to continue deepening cooperation even after the acute phase of the security crisis has subsided. Equally important will be whether temporary crisis instruments can be transformed into permanent mechanisms that ensure stable financing and the development of defence capabilities. Finally, it will be decisive to what extent the defence dimension of strategic autonomy can be aligned with other EU priorities, such as economic and environmental security (Chehabeddine et al., 2023), and the digital and green transitions (Dirma et al., 2024; Okunevičiūtė Neverauskienė et al., 2025), to create a coherent model of security, economic resilience, and technological development.

Overall, it can be stated that strategic autonomy is gradually evolving from an initially abstract political concept into a practical framework shaping the future direction of European defence. Its implementation, however, will inevitably be marked by compromises between national and European interests, between ambitions and real capacities, and between the pursuit of autonomy and the maintenance of strong transatlantic ties. It is precisely the ability to manage these tensions that will determine whether Europe can establish itself as a credible and resilient security actor in an increasingly unstable international environment.

Conclusion

The present article has analysed the transformation of European security, the defence industry, and the EU's institutional framework within the context of the fundamental shift in the security environment accelerated by Russian aggression against Ukraine. The return of high-intensity interstate armed conflict to the European continent has definitively terminated the era of strategic illusions upon which the post-war European security order was constructed for decades. Simultaneously, it has severely challenged the assumptions of long-term sustainable development based on stability, predictability, and external security guarantees. It has become evident that security is not an isolated domain existing outside of economic, technological, and social development, but rather one of its pivotal structural prerequisites.

The results of the analysis demonstrate that the war in Ukraine does not represent an isolated crisis but is a symptom of a deeper transformation of the international system, characterised by the return of power politics, rivalry, attritional warfare, and the increasing significance of hybrid and multi-domain threats. These changes

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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fundamentally redefine the requirements for the defence capabilities of European states, placing emphasis on the capacity to ensure the long-term protection of populations, critical infrastructure, and the economic foundations of society. The escalating demands from NATO – and particularly the USA – alongside the pressure for a more equitable burden-sharing in securing collective defence, have highlighted the necessity for the EU to strengthen its own capacity to act as a responsible and resilient security actor.

The second analytical section of the article has demonstrated that the European defence industry represents one of the key determinants of this capacity. The fragmentation of the defence market, limited production capacities, vulnerable supply chains, and a high degree of dependence on external inputs undermine not only the Union's military readiness but also its economic resilience and technological sovereignty. While the European Defence Technological and Industrial Base possesses significant innovative potential, this remains underutilised without coordinated demand, long-term planning, and institutional support. Thus, the defence industry emerges not only as a tool of security policy but as a strategic sector with direct implications for the sustainable development and stability of the European economy.

In this connection, the article has highlighted the increasing role of the EU as a coordinating, regulatory, and stimulatory actor in the field of the defence industry and defence financing. Through instruments such as the EDF, ASAP, EDIRPA, EDIP, and the EPF, the EU is gradually shifting from the position of a peripheral observer toward actively shaping the defence-industrial environment. This process represents a significant institutional transformation that simultaneously exposes the limits of the existing integration framework, particularly regarding the tension between national sovereignty, joint procurement, and the long-term fiscal sustainability of defence expenditure.

Particular attention was devoted to the concept of strategic autonomy as a framework linking the security, industrial, and developmental dimensions of European integration. The analysis confirmed that strategic autonomy does not represent an attempt to isolate Europe or weaken transatlantic ties but is a pragmatic response to changing geopolitical conditions and the increasing uncertainty of the global environment. Autonomy in the sphere of defence is inseparably linked to economic, technological, and energy autonomy, which is reflected in the EU's efforts toward digital and green transitions, the reduction of strategic dependencies, and the strengthening of the overall resilience of European society. In this context, the support for Ukraine appears as a long-term test of the Union's ability to act in a unified, sustainable, and strategic manner, and thus as a trial of its credibility as a global actor.

Based on the analysis conducted, it can be stated that the EU possesses significant potential to become a stable pillar of European security and sustainable development; however, the fulfilment of this potential will depend on the ability to transform crisis measures into permanent institutional mechanisms. It will be crucial to overcome the fragmentation of the defence market, ensure predictable financing for the defence industry, and align national priorities with long-term European objectives in the areas of security, economic stability, and societal resilience.

Regarding policy implications, the article points to the need for a systematic linkage of the EU's security, industrial, and developmental policies. For the defence industry, this necessitates adaptation to the requirements of long-term production cycles, a higher degree of integration into European value chains, and the increasing role of innovation. For the academic sphere, space is opened for further research into the relationships between security, economics, strategic autonomy, sustainable development, and the institutional capacity to respond to complex crises.

In conclusion, it may be added that the current security crisis has created a historical opportunity for the Union not only to strengthen its defence but also to reassess the very foundations of sustainable development under conditions of increasing uncertainty. Whether this opportunity is successfully seized will be a decisive test of political will, strategic vision, and the capacity to act collectively for the benefit of the long-term security, stability, and resilience of European society.

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/d7745848262

Data Availability Statement: More information and data can be obtained from the authors on a resonable request.

Author Contributions: The authors contributed equally, they have read and agreed to the published version of the manuscript.

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n6467378734

Publisher
http://jssidoi.org/esc/home

STARTUPS AS SOCIAL ACTORS IN SMALL OPEN ECONOMIES: EVIDENCE FROM THE BALTIC STATES*

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Received 12 October 2025; accepted 10 March 2026; published 30 June 2026

Abstract. Startups have become a central element of economic development strategies in small open economies, particularly in Central and Eastern Europe. Existing research predominantly conceptualizes startups as instruments of innovation, economic growth, and international competitiveness. However, this economocentric perspective tends to overlook the social functions of startups and their role in shaping institutional and relational environments. This article addresses this gap by conceptualizing startups as social actors embedded in networks of social, institutional, and communicative relations. The study aims to analyze how startups perform social roles in small open economies, using the Baltic States - Latvia, Lithuania, and Estonia - as an empirical case. Methodologically, the article combines a qualitative comparative approach with document analysis of policy frameworks, ecosystem reports, and secondary empirical studies. The analytical framework draws on insights from economic sociology, institutional theory, and the literature on entrepreneurial ecosystems. The findings demonstrate that startups in the Baltic States function not only as economic entities but also as intermediaries between the state, the market, and elements of civil society. They contribute to the formation of entrepreneurial communities, the accumulation of social capital, and the reproduction of hybrid institutional arrangements characteristic of small open economies. At the same time, the study identifies ambivalent effects of startup development, including risks of social and regional concentration. The article contributes to comparative economic research by integrating social and institutional dimensions into the analysis of startups and offers policy-relevant insights for the design of more inclusive startup support strategies in small open economies.

Keywords: startups; social actors; small open economies; entrepreneurial ecosystems; Baltic States; Central and Eastern Europe

Reference to this paper should be made as follows: Menshikov, V., Ruza, O., Simakhova, A., Bedianashvili, G. 2026. Startups as social actors in small open economies: evidence from the Baltic States. *Entrepreneurship and Sustainability Issues*, 13(4), 65-78. http://doi.org/10.9770/n6467378734

JEL Classifications: L26, J24, M13, I21

1. Introduction

Over recent decades, startups have come to occupy a central position in the discourse on economic development, innovation policy, and entrepreneurship. In academic and applied research, they are predominantly conceptualized as instruments of accelerated economic growth, innovation commercialization, and enhanced

* *The article was written as part of the project "The Role of Startups in the Transformation of Socio-Economic Order in Small Open Economies," funded by Daugavpils, Latvia.*

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n6467378734

national competitiveness (Stam, 2015; Audretsch & Belitski, 2017). This tendency is particularly evident in studies of small open economies, where startups are often presented as key resources for integration into global markets and for compensating structural constraints related to limited domestic demand and capital availability (Menshikov et al., 2025; Adner, 2017; Almotairy et al., 2020; Gupta, 2024; Lauterbach, 2019; Perry & Woolard; 2023; Truong, 2023). At the same time, such an economocentric approach significantly narrows the analytical perspective, leaving the social functions of startups and their role in transforming social relations largely underexplored. Startups operate not only as economic entities but also as participants in social interactions, shaping new forms of cooperation, entrepreneurial communities, professional identities, and channels of communication between the state, the market, and civil society. From the perspective of economic sociology, economic action is embedded in social relations and institutional contexts, which structure opportunities and constraints for actors (Granovetter, 1985; North, 1990; Ndofirepi & Steyn, 2025).

In small open economies - characterized by dense social networks, institutional hybridity, and dependence on external resources - the social role of startups becomes particularly salient. It should also be noted that in today's complex and dynamic global processes, it is especially important to identify and reflect the characteristics of small countries to promote the socio-economic development of these countries and ensure their macroeconomic and social stability (Bedianashvili & Kokhreidze, 2023).

The Baltic States - Latvia, Lithuania, and Estonia - represent a revealing example of small open economies in which startup ecosystems have developed with the active involvement of the state, universities, and international actors. A substantial body of research has been devoted to institutional conditions, policy frameworks, and the economic effects of startup development in the region, including comparative studies published in *Comparative Economic Research. Central and Eastern Europe* (Menshikov et al., 2025). However, the conceptualization of startups as social actors remains insufficiently developed. This creates a research gap between predominantly economic assessments of startup performance and analyses of their broader social and institutional impact.

This article seeks to move beyond traditional economic analysis by conceptualizing startups as social actors embedded in complex systems of social, institutional, and communicative relations. Such an approach makes it possible to reconsider the role of startups in the formation of social capital (Kai et al., 2024; Filippelli et al., 2025) in mediating interactions among key societal institutions, and in transforming patterns of social interaction in small open economies. By focusing on the Baltic States, the study contributes to the comparative research agenda concerned with the socio-institutional foundations of economic development in Central and Eastern Europe.

The aim of this article is to conceptualize startups as social actors in small open economies and to analyze the specific features of this role using the Baltic States as an empirical case.
To achieve this aim, the article addresses the following research objectives:

- to analyze existing theoretical approaches to the study of startups in the context of small open economies and to identify the limitations of economocentric interpretations (Stam, 2015; Audretsch & Belitski, 2017);
- to substantiate the application of the concept of the “social actor” to startup analysis based on insights from economic sociology and institutional analysis (Granovetter, 1985; North, 1990);
- to identify the key social roles performed by startups in the Baltic States, including the formation of entrepreneurial communities and social capital (Spigel, 2017);
- to examine the intermediary function of startups in interactions between the state, the market, and elements of civil society, as highlighted in comparative studies of Central and Eastern Europe (Menshikov et al., 2025);
- to determine the specific characteristics of small open economies that shape the social agency of startups, as well as to outline the limits and contradictions of this role.

The findings of the study contribute to a broader theoretical understanding of startups by complementing economic analysis with a social-institutional perspective and provide a foundation for a more comprehensive evaluation of startup policies in small open economies.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n6467378734

2. Literature review

Let us analyze the reflection of the concerns regarding "Startups as social actors" in the authoritative Scopus database. The number of publications reflecting this issue in scientific editions indexed in the Scopus scientometric database amounted to 65 articles. The number of publications in 2022 marks a dramatic spike to the peak value (12), from 2023 to 2025. According to the Scopus database, researchers from the United States (30 publications), Italy (24) and Brazil (22) and the Web of Science, researchers from the United States (12 publications), England (10) and Italy (10) were the most active ones in their consideration of the issues that are of interest There are no studies on startup ecosystems in Latvia, Georgia, or Ukraine, a case study in the SCOPUS database. In the Web of Science database, there is 1 study in Ukraine.

The data analysis demonstrates a pronounced asymmetry in the distribution. The highest values are observed in Brazil and the United States (9 each), followed by Germany (8), and France and Italy (7 each). These countries form a group of leaders with a high concentration of the observed indicator. Countries with a medium level include the United Kingdom (5) and Spain (3), indicating a noticeably more moderate representation compared to the leading countries. A value of 2 is characteristic of a limited group of countries (including Australia, Canada, Colombia, Indonesia, Iran, Japan, Norway, Poland, and Taiwan), whereas the majority of countries exhibit the minimum value (1). The latter group is highly numerous and includes both European and non-European states.

The analysis shows that the largest share of publications falls within the field of Business, Management and Accounting, which accounts for 34 publications (approximately 52% of the total). This indicates the dominance of managerial and business-oriented approaches in studies of startups and social actors. The second most represented field is Social Sciences, with 20 publications (around 31%), reflecting substantial scholarly interest in the social, institutional, and actor-oriented dimensions of the topic. A significant presence is also observed in Computer Science (17 publications, approximately 26%), highlighting the important role of digital technologies and information systems in startup-related research. More moderate but still notable contributions are found in Decision Sciences (8 publications), Economics, Econometrics and Finance (7 publications), and Environmental Science (6 publications). Smaller numbers of publications are recorded in Energy and Engineering (4 publications each), as well as Psychology (3 publications). Overall, the distribution confirms the interdisciplinary nature of the research field, with a clear predominance of economic–managerial and social science perspectives, reflecting the complex character of startup analysis as a socio-economic and technological phenomenon.

Recent highly cited studies emphasize the growing role of startups not only as economic entities but also as socially embedded actors contributing to sustainable development and entrepreneurial ecosystems. One of the most influential contributions is the study by Paschen (2017)**.** The author conceptualizes crowdfunding as a hybrid financial and social mechanism, highlighting the importance of trust, community engagement, and stakeholder interaction across different stages of startup development. This perspective aligns with sustainability-oriented entrepreneurship by framing startups as organizations whose growth depends on continuous social interaction and legitimacy within broader socio-economic systems.

A sustainability-focused strand of the literature is represented by Huynh (2022) (146 citations). The study demonstrates how digital innovation enables the emergence of circular and sustainable business models, positioning startups as agents of systemic transformation rather than mere adopters of existing market structures. Although sector-specific, the findings are particularly relevant for small open economies, where resource constraints and digitalization increase the importance of sustainability-driven entrepreneurial solutions.

The ecosystem perspective is further developed in Roundy (2017) (131 citations), where the author argues that social entrepreneurship should be viewed as an integral component of entrepreneurial ecosystems, rather than as a parallel or marginal phenomenon. This approach supports the interpretation of startups as social actors whose objectives extend beyond profit maximization to include social value creation and institutional change—an aspect especially salient in transition-oriented and small open economies such as the Baltic States.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n6467378734

3. Theoretical basis and methodology of the research

Beyond the Economic-Centric Approach to Startups. The academic literature on startups and entrepreneurial ecosystems has been dominated by an economic-centric perspective, in which startups are primarily analyzed through indicators of growth, innovation output, investment attraction, and contribution to GDP. This approach is particularly prevalent in studies of small open economies, where startups are frequently framed as instruments for accelerating modernization, increasing competitiveness, and integrating national economies into global markets (Audretsch & Belitski, 2021; Halberstadt et al., 2021; Matricano, 2022; Werbik, 2024). While such an approach provides valuable insights into economic performance, it significantly narrows the analytical scope of startup research. By focusing predominantly on measurable economic outcomes, it tends to overlook the social embeddedness of startups and their role in shaping social relations, norms, and institutional interactions. As a result, startups are often reduced to firm-level entities, detached from the broader social and institutional contexts in which they operate. This limitation becomes especially evident in post-socialist and Central and Eastern European economies, where entrepreneurial activity is deeply intertwined with institutional transformation, social networks, and historically shaped patterns of trust and cooperation. In such contexts, startups cannot be fully understood without considering their social functions and their participation in the reproduction and transformation of social structures.

Small Open Economies as a Socio-Institutional Context. The concept of small open economies is traditionally rooted in macroeconomic analysis, emphasizing openness to trade, capital mobility, and vulnerability to external shocks. However, from a socio-institutional perspective, small open economies exhibit distinctive characteristics that directly shape entrepreneurial activity.

These economies are typically characterized by limited domestic markets, high actor density, close interaction between public and private sectors, and a strong reliance on informal networks. The relative proximity of key actors - state agencies, universities, investors, and entrepreneurs - creates an environment in which economic activities are closely embedded in social relations. Institutional boundaries are often blurred, and personal networks play a crucial role in access to resources and opportunities (Estrin, Mickiewicz, & Stephan, 2013). In the Baltic States, these features are further reinforced by the post-socialist legacy and rapid institutional restructuring. Startups operate within ecosystems where state support schemes, academic institutions, and international actors are tightly interconnected. Consequently, startups function not only as economic units but also as nodes within dense social and institutional networks, influencing patterns of coordination and governance within the economy.

Startups as Social Actors: Conceptual Foundations. To overcome the limitations of economic-centric interpretations, this study adopts the concept of the social actor, drawn from economic sociology and institutional theory. A social actor is understood not merely as a rational economic agent, but as an entity embedded in networks of social relations, norms, and expectations that shape its behavior and agency (Granovetter, 1985).

Applying this concept to startups implies a shift from viewing them solely as profit-oriented firms to understanding them as participants in social processes. As social actors, startups contribute to the production and circulation of meanings related to innovation, risk-taking, and success, while simultaneously influencing institutional practices and expectations. This perspective aligns with relational approaches to entrepreneurial ecosystems, which emphasize the importance of networks, shared narratives, and social legitimacy over purely structural or resource-based explanations (Spigel, 2017; Van Rijnsoever, 2022; Kai et al., 2024; Filippelli et al., 2025). In small open economies, where formal institutions may be limited or rapidly evolving, such social dimensions become particularly salient.

Social Capital and Network Embeddedness of Startups. A key dimension of startups' social agency is their role in creating and transforming social capital. Social capital is commonly defined as the set of networks, norms, and trust that facilitate coordination and cooperation among actors. In entrepreneurial ecosystems, social capital plays a critical role in enabling access to information, finance, and markets.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n6467378734

Startups contribute to both bonding social capital, which strengthens ties within relatively homogeneous groups, and bridging social capital, which connects diverse actors across institutional and national boundaries. The latter is particularly important in small open economies, where access to international networks often determines the viability and scalability of startups. From a network perspective, startups frequently occupy intermediary positions that allow them to bridge structural and informational holes between different institutional spheres, such as academia, government, and business (Marcon & Ribeiro, 2021; Cavallo et al., 2021; Nunes et al. 2022; Kazantsev et al., 2024). In the Baltic context, accelerators, incubators, and university-based startup hubs institutionalize these bridging functions, reinforcing the social role of startups as connectors and facilitators within the ecosystem.

Startups as Institutional Intermediaries. Another crucial aspect of startups' role as social actors lies in their intermediary function between the state, the market, and civil society (Lana & Pimenta, 2022; Išoraitė et al., 2024; Mohamed et al., 2024; Cavallo et al., 2025). In small open economies, startups often emerge at the intersection of public policy initiatives, private investment strategies, and educational or civic projects. Research on Central and Eastern Europe highlights that the entrepreneurial ecosystem in the region is strongly shaped by state-led support mechanisms, including grants, innovation vouchers, and public accelerators (Menshikov et al., 2025). Startups translate these policy instruments into market-oriented activities, effectively mediating between public objectives and private incentives. At the same time, startups contribute to the diffusion of global business models and technological standards into local contexts, adapting them to specific institutional and social conditions. This intermediary position, however, also generates tensions related to dependency on public funding, unequal access to networks, and the potential reproduction of social inequalities within startup ecosystems. Conceptualizing startups as social actors provides a more comprehensive framework for analyzing their role in small open economies. This approach highlights that startups are not merely vehicles of innovation and growth, but also agents of social coordination, institutional adaptation, and network formation.

For the Baltic States and other Central and Eastern European economies, this perspective offers important insights into how startups contribute to broader socio-economic transformations beyond measurable economic outcomes. It also lays the theoretical foundation for empirical analysis aimed at identifying both the enabling and constraining conditions of startups' social agency within small open economies.

This study adopts a comparative qualitative research design aimed at conceptualizing startups as social actors within small open economies and examining how this role is articulated in the Baltic States - Latvia, Lithuania, and Estonia. A comparative approach is particularly suitable for this research, as it allows for the identification of both shared patterns and country-specific variations within structurally similar national contexts.

The research design is theory-driven and exploratory. Rather than testing predefined hypotheses, the study seeks to operationalize the concept of startups as social actors and to explore their social roles, interaction patterns, and institutional functions across national cases. Such an approach is consistent with institutional analysis and economic sociology, where qualitative and comparative methods are widely used to capture embeddedness, networks, and intermediary roles that cannot be adequately measured through quantitative indicators alone (Granovetter, 1985; North, 1990).

The Baltic States were selected as empirical cases based on a most-similar systems design, which is commonly applied in comparative research to control for structural similarities while allowing meaningful variation in outcomes (Menshikov et al., 2024).
The selection of Latvia, Lithuania, and Estonia is justified by several criteria:

1. Structural similarity: All three countries are small open economies with limited domestic markets and high exposure to global economic processes.
2. Shared historical and institutional background: The Baltic States underwent post-socialist transformation, which continues to shape entrepreneurial norms, institutional trust, and governance arrangements.
3. Policy relevance: Each country has implemented explicit startup and innovation policies, making them appropriate cases for analyzing interactions between startups, the state, and other institutional actors.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/n6467378734

4. Variation within similarity: Despite common structural features, the Baltic States differ in terms of startup ecosystem maturity, governance models, and degrees of international integration, enabling comparative insights.

This combination of similarity and variation provides a robust basis for identifying generalizable mechanisms while remaining sensitive to national specificities.

*Data Sources***.** The empirical analysis relies on secondary qualitative and institutional data, which is appropriate for a study focused on macro - and meso-level social roles rather than micro-level firm performance. The primary data sources include:

- national and regional startup and innovation policy documents;
- analytical reports produced by startup agencies, accelerators, and innovation hubs;
- official statistical data related to entrepreneurship and innovation;
- reports by international organizations and research institutions;
- peer-reviewed academic literature on startup ecosystems in the Baltic States and Central and Eastern Europe.

The use of multiple data sources enables methodological triangulation, enhancing the credibility and consistency of the findings.

Analytical Approach. The analysis follows a comparative thematic approach, combining elements of institutional analysis and economic sociology. Empirical materials were examined through iterative reading and thematic coding, guided by the theoretical framework developed in the preceding section.
Three analytical dimension's structure in the comparative analysis:

- Social roles of startups, such as community building, knowledge brokerage, and norm diffusion;
- Network embeddedness and social capital, focusing on startups' participation in entrepreneurial networks and ecosystem structures;
- Intermediary functions, examining how startups mediate interactions between the state, the market, and other societal actors.

These dimensions are treated as analytical lenses rather than fixed categories, allowing flexibility in capturing overlapping and context-dependent roles (Spigel, 2017). The approach emphasizes interpretation and pattern identification rather than causal measurement, in line with qualitative comparative methodology.

*Validity and Limitations***.** The study prioritizes analytical and theoretical validity over statistical generalization. By grounding the analysis in established theoretical concepts and systematically comparing multiple national contexts, the research enhances internal coherence and interpretative robustness.
Several limitations should be acknowledged. First, reliance on secondary data constrains the ability to capture micro-level perceptions and informal interactions among startup founders. Second, the focus on the Baltic States limits direct generalization to other regions. Nevertheless, given the shared characteristics of many small open economies in Central and Eastern Europe, the findings possess analytical transferability to similar institutional contexts.

*Ethical Considerations***.** The study is based exclusively on publicly available documents and published materials. No personal or sensitive data were used, and no ethical approval was required. The research adheres to standard principles of academic integrity, transparency, and responsible use of secondary data.

*Methodological Contribution***.** By combining a comparative qualitative design with a socio-institutional analytical framework, this methodology enables a nuanced examination of startups beyond economic performance indicators. It provides a structured basis for analyzing startups as social actors in small open economies and supports the subsequent empirical analysis of the Baltic States (see Table 1 below).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/n6467378734

Table 1. Structural Constraints of the Baltic Startup Ecosystem

Structural dimension	Empirical indicators	Evidence for Latvia, Lithuania, Estonia	Key sources
Limited domestic market size	Population size; limited internal demand	Combined population of the Baltic States ≈ 6 million inhabitants, placing the region among the smallest markets in the EU and limiting the scalability of B2C-oriented startups	Sifted (2024); Menshikov et al. (2025)
Early internationalization pressure	Share of startups targeting foreign markets at early stages	Baltic startups tend to pursue international markets from inception due to insufficient domestic demand	Menshikov et al. (2025); Stam (2015)
Restricted access to venture capital	Total VC funding; average deal size	By mid-2023, Baltic startups raised approx. €516 million in total, with a large share of rounds below €300,000, indicating limited late-stage funding	Dealroom (2023); Baltic VC Survey (2025)
Reliance on founders' own resources	Share of bootstrapped startups	Around 59% of startups report relying primarily on founders' personal funds at the launch stage	Baltic VC Survey (2025)
Investor caution and funding volatility	Founder perceptions; investment dynamics	Over 60% of founders report increased investor caution; funding availability remains unstable, especially for early-stage ventures	ArcticStartup (2024); Baltic VC Survey (2025)
High business vulnerability	Risk of closure	Between 30% and 40% of startups report having faced a serious risk of shutdown	Baltic VC Survey (2025)

Source: elaborated by the authors based on *secondary empirical data.*

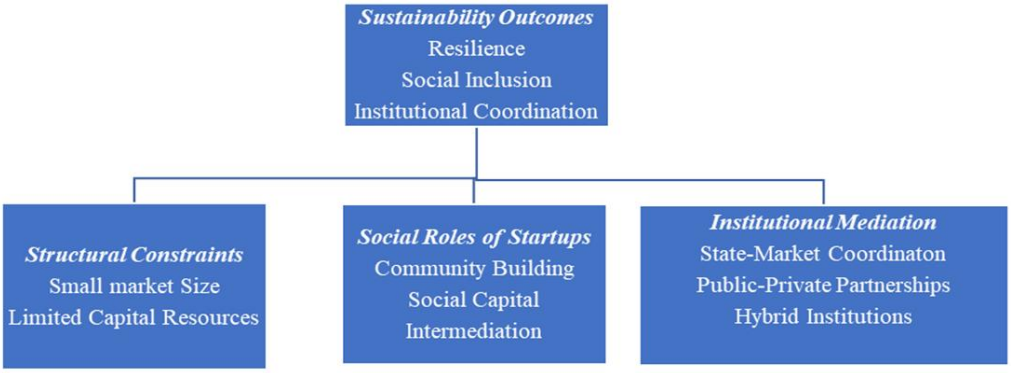


Figure 1. Startups as Social Actors in Small Open Economies
Source: elaborated by the authors

Figure 1 presents the conceptual framework developed in this study. It illustrates how startups in small open economies operate under structural constraints such as limited domestic markets, restricted access to capital, and institutional volatility. In response, startups perform distinct social roles, including community building, social capital formation, and knowledge brokerage. Through these roles, startups act as institutional intermediaries connecting the state, the market, and civil society, thereby contributing to sustainability outcomes such as ecosystem resilience, institutional adaptability, and inclusive development.

4. Empirical results

*Structural Constraints of the Baltic Startup Ecosystem***.** Empirical evidence indicates that startups in the Baltic States operate under a set of structural constraints that significantly shape entrepreneurial behavior and organizational strategies. These constraints—limited domestic markets, restricted access to capital, and heightened uncertainty—are characteristic of small open economies and systematically condition the forms of coordination available to economic actors (Menshikov et al., 2025).

First, the limited size of the internal market represents a fundamental constraint. The combined population of Latvia, Lithuania, and Estonia is approximately six million inhabitants, placing the Baltic region among the smallest consumer markets in the European Union (Sifted, 2024). For many startups, especially those operating in consumer-oriented segments, domestic demand is insufficient to sustain growth beyond the early stages. As

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n6467378734

a result, early internationalization is not a strategic choice but a structural necessity (Stam, 2015; Menshikov et al., 2025).

Second, empirical data reveal a persistent deficit of accessible external capital. Although the Baltic startup ecosystem has experienced growth in venture investment, total funding volumes remain modest by European standards. By mid-2023, Baltic startups had raised approximately €516 million in total, with a substantial proportion of investment rounds remaining below €300,000 (Dealroom, 2023). This funding structure reflects cautious investor behavior and limited availability of scale-up capital, particularly for ventures beyond the seed stage. Survey-based evidence further highlights the prevalence of self-financing and bootstrapping strategies. According to the Baltic Startup Survey, around 59% of startups rely primarily on founders' personal funds at the launch stage, while many continue to depend on internal resources even after market entry (Baltic VC Survey, 2024). This reliance on informal financial sources underscores the importance of trust-based relationships and close social ties in resource mobilization.

Third, the data indicate heightened vulnerability and uncertainty in the startup sector. More than 60% of founders report increased investor caution in recent years, reflecting broader macroeconomic instability and tightening financial conditions (ArcticStartup, 2024). At the same time, between one-third and two-fifths of surveyed startups indicate that their ventures have faced a serious risk of closure, highlighting the fragile nature of entrepreneurial activity in small open economies (Baltic VC Survey, 2024).

Social Embeddedness as a Compensatory Mechanism. Under these conditions, startups in the Baltic States increasingly rely on social embeddedness as a compensatory mechanism that partially substitutes for deficiencies in formal market and financial institutions. Dense entrepreneurial networks, accelerator communities, informal founder groups, and repeated interpersonal interactions facilitate access to information, capital, and international contacts. Such network-based coordination reduces transaction costs and mitigates uncertainty, particularly in environments characterized by limited institutional depth (Granovetter, 1985; North, 1990).

Importantly, empirical observations suggest that social embeddedness is not confined to the early survival phase. The need to access foreign markets, establish credibility with external investors, and navigate regulatory environments reinforces the structural role of networks throughout the startup life cycle. In this sense, social embeddedness in the Baltic context functions not as an auxiliary feature but as a structural condition of entrepreneurial viability. Overall, the empirical results support the central argument of this article: in the Baltic States, the combination of small domestic markets, constrained access to capital, and institutional uncertainty systematically amplifies the importance of informal coordination and network-based resource mobilization. These findings provide empirical grounding for the conceptualization of startups as social actors and reinforce the relevance of social and institutional perspectives in comparative analyses of entrepreneurship in Central and Eastern Europe. Below is a separate comparative Table 2 focused exclusively on the social indicators of startup ecosystems in the Baltic countries, constructed in line with the conceptual framework of this article, which treats startups as social actors rather than merely economic units.

Table 2. Social Indicators of Startup Ecosystems in the Baltic States

Social dimension	Indicator	Estonia	Lithuania	Latvia	Key sources
Social embeddedness	Density and cohesion of startup communities	**Very high**: long-established, highly networked communities with strong peer coordination	High: rapidly expanding communities, increasing cross-sector ties	Medium: fragmented but growing community	Baltic Startup Survey (2024); ArcticStartup (2024)
	Reliance on informal networks for resources (mentorship, early funding, hiring)	High but increasingly institutionalized	**Very high**, especially at early stages	**Very high**, compensating for market and capital constraints	Baltic VC Survey (2024); Menshikov et al. (2025)

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n6467378734

Social dimension	Indicator	Estonia	Lithuania	Latvia	Key sources
Social capital formation	Role of startups in creating professional identities and entrepreneurial norms	**Strong**: entrepreneurship as a normalized career path	Growing rapidly	Emerging	Stam (2015); StartupBlink (2024)
	Inter-startup cooperation and knowledge sharing	Strong and routinized	Strong but less formalized	Selective and project-based	ArcticStartup (2024)
Civic and societal engagement	Participation in education, mentoring, and skills development	**High**: systematic links with universities, coding schools, accelerators	High: strong involvement in fintech and cybersecurity education	Moderate: mainly event-based	Menshikov et al. (2025); national innovation agencies
	Engagement in socially oriented or civic-tech initiatives	Moderate to high (e-governance, digital public services)	Moderate (security, consumer protection, digital inclusion)	Low to moderate	OECD GovTech reports; Startup Estonia
Public legitimacy and visibility	Social legitimacy of startups in public discourse	**High**: startups perceived as national development actors	Increasing	Moderate	StartupBlink (2024); BalticVC (2024)
	Media and policy framing of startups	Integrated into national narratives ("e-Estonia")	Strongly innovation-focused	Primarily economic framing	BalticVC (2024); national policy documents
Social role maturity	Degree of institutionalization of social roles	**High**: social functions embedded in ecosystem design	Medium–high: transitioning toward institutionalization	Medium–low: largely informal	Authors' synthesis based on the above sources

Source: elaborated by the authors based on secondary empirical data

Estonia demonstrates the most mature form of startup social agency: social embeddedness is not compensatory in nature but is institutionally anchored through education, digital government, and public discourse. Lithuania is characterized by an accelerated formation of the social role of startups, where informal networks still play a central role but are gradually being complemented by formal institutions. Latvia exhibits an adaptive and compensatory pattern of startup social embeddedness, which increases the importance of network-based mechanisms under conditions of a limited market and capital availability.

5. Research results and discussion

Startups as Social Actors: Implications for the Embeddedness Perspective

Empirical evidence from the Baltic States strongly supports the theoretical assumption that startups in small open economies operate as socially embedded actors rather than isolated market units. This finding resonates with the embeddedness approach in economic sociology, which emphasizes that economic action is structured by networks of social relations, trust, and shared norms (Granovetter, 1985).

In the Baltic context, embeddedness appears not as a supplementary characteristic but as a structural condition of entrepreneurial survival. Limited domestic markets, constrained access to capital, and institutional volatility increase the importance of informal coordination and network-based resource mobilization. Similar patterns have been identified in comparative studies of transition and post-transition economies, where social capital compensates for institutional gaps (North, 1990).

At the same time, the findings extend embeddedness theory by demonstrating that startups are not merely embedded *in* networks but actively contribute to their reproduction. By initiating interactions, organizing community events, and participating in ecosystem governance, startups shape the very social structures on which they depend. This recursive relationship between agency and structure is particularly visible in small open economies, where the density of interactions amplifies individual and collective effects.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n6467378734

Startups and Entrepreneurial Ecosystems: From Structure to Agency. The results of the study contribute to the growing literature on entrepreneurial ecosystems by shifting analytical attention from ecosystem components to startup agency within ecosystems. While existing frameworks conceptualize ecosystems as configurations of institutions, actors, and resources (Stam, 2015; Audretsch & Belitski, 2017), the Baltic case illustrates how startups themselves function as relational integrators that connect these elements in practice. Comparative research on Central and Eastern Europe emphasizes that entrepreneurial ecosystems in the region are often characterized by institutional fragmentation and uneven development (Menshikov et al., 2025). Under such conditions, startups frequently assume intermediary roles, linking universities, public agencies, and private investors. This finding supports Spigel's (2017) argument that ecosystems are fundamentally relational phenomena sustained through ongoing interaction rather than static institutional arrangements. The discussion thus reinforces a dynamic interpretation of entrepreneurial ecosystems, in which startups act as institutional carriers of norms, expectations, and practices. This perspective is particularly relevant for CER, as it aligns ecosystem analysis with broader comparative and institutional approaches in economic research.

*Mediation Between State and Market in Small Open Economies***.** The intermediary role of startups between the state and the market observed in the Baltic States confirms theoretical insights from institutional economics and comparative political economy. In small open economies, the state often plays a proactive role in shaping innovation trajectories, whereas market mechanisms alone are insufficient to sustain entrepreneurial dynamics. The findings show that startups translate public innovation strategies into operational market practices, functioning as policy implementers and feedback providers. This mediation role has been documented in comparative studies of startup ecosystems in Latvia, Ukraine, and Georgia, where startups act as key transmission belts between public institutions and private economic activity (Menshikov et al., 2025). However, the discussion also highlights the ambivalent consequences of such mediation. While state support can accelerate ecosystem development, it may also create dependency and selective inclusion, privileging actors with better network access. This observation echoes broader debates in CER on the uneven effects of state intervention in post-socialist and transition economies.

*Professional Identities, Entrepreneurial Agency, and Precarity***.** The transformation of professional identities associated with startup participation connects the empirical findings to sociological theories of entrepreneurialization and labor market change. In the Baltic States, startup engagement increasingly represents a culturally legitimate and socially valorized career path, particularly among younger cohorts. This development supports theoretical arguments that entrepreneurship has become a dominant model of agency in contemporary capitalism, emphasizing flexibility, self-responsibility, and continuous self-investment. At the same time, critical perspectives caution that such models may normalize precarious employment and shift risks from institutions to individuals. The Baltic case illustrates this duality clearly. While startups expand opportunities for autonomy and innovation, access to entrepreneurial resources remains uneven, reinforcing existing social hierarchies. This aligns with comparative findings in Central and Eastern Europe, where entrepreneurial opportunities are often stratified along educational, regional, and network-based lines (Menshikov et al., 2025).

*Social Cohesion, Inequality, and the Limits of Startup-Led Development***.** The discussion of social cohesion and inequality highlights the limits of viewing startups as inherently inclusive engines of development. Although startup communities foster collaboration and trust at the meso level, they may simultaneously contribute to macro-level inequalities by concentrating resources in specific regions and social groups. This finding is consistent with comparative research published in CER, which emphasizes that innovation-driven growth in Central and Eastern Europe often exhibits spatial and social polarization. In the Baltic States, the concentration of startup activity in capital cities and major hubs reflects broader patterns of uneven development typical of small open economies. Theoretically, this suggests that the social agency of startups must be analyzed within broader structural contexts. Startups do not operate in a social vacuum; their effects on cohesion and inequality depend on institutional arrangements, policy design, and the distribution of social capital.

*Theoretical and Comparative Implications***.** The expanded discussion yields several theoretical implications. First, it reinforces the relevance of embeddedness and social capital for understanding entrepreneurship in small open economies. Second, it demonstrates that entrepreneurial ecosystem theory benefits from greater attention to startup agency and mediation. Third, it highlights the analytical value of the Baltic States as comparative

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n6467378734

cases for Central and Eastern Europe. By integrating insights from economic sociology, institutional economics, and ecosystem theory, the study contributes to the comparative research agenda of CER. It shows that startups are not merely objects of policy or outcomes of market processes, but active social actors shaping institutional change.

Conclusions

This article set out to expand the analytical framework for studying startups in small open economies by incorporating a social and institutional perspective. By conceptualizing startups as social actors rather than solely as vehicles of innovation and economic growth, the study addresses the limitations of predominantly economocentric approaches and offers a more comprehensive understanding of their role in the socio-economic development of the Baltic States.

Theoretical Contribution. The primary theoretical contribution of the article lies in the conceptualization of startups as social actors embedded in networks of social, institutional, and communicative relations. Unlike mainstream approaches that treat startups mainly as functional elements of entrepreneurial ecosystems, this study demonstrates that startups actively shape these ecosystems through their intermediary and relational roles. The article contributes to the literature on entrepreneurial ecosystems by shifting the focus from structural components and policy instruments to the agency of startups themselves. Startups are shown to function not merely as outcomes of supportive environments but as mediators connecting universities, public institutions, markets, and transnational networks. The study advances the concept of social embeddedness by illustrating that, in small open economies, startups' reliance on social networks is not incidental but structurally embedded in the logic of economic organization. Startups both depend on and actively reproduce social capital, contributing to the formation of entrepreneurial communities and shared norms. The article contributes to comparative economic research on Central and Eastern Europe by highlighting the analytical relevance of the Baltic States as cases for examining the interaction between entrepreneurship, institutions, and social structures in post-socialist and small open economies.

The study's findings have important implications for public policies related to startups in small open economies. Most notably, they point to the need to move beyond narrowly defined economic performance indicators—such as the number of startups, investment volumes, or high-growth firms—when designing and evaluating policy interventions.

Startup policies should explicitly recognize the social functions of startups, including their role in building entrepreneurial communities, fostering social capital, and mediating interactions between the state, the market, and civil society. Support for networking initiatives, educational and communicative platforms, and mechanisms of horizontal coordination may be as important as direct financial incentives. At the same time, the identified ambivalent effects of startup development—such as the risks of social and regional segmentation—underscore the importance of more inclusive policy approaches. For the Baltic States, this implies addressing the strong concentration of startup activity in capital cities and mitigating dependence on a limited set of institutional and network actors.

The article demonstrates that startups in small open economies should be understood not only as economic instruments but also as socially embedded actors that participate in shaping institutional environments, social networks, and modes of interaction. This perspective enhances the analytical capacity of comparative economic research and supports a more balanced and institutionally informed understanding of entrepreneurship in Central and Eastern Europe.

Directions for Future Research. Despite its contributions, the study has several limitations that point to promising directions for future research. Further studies could incorporate micro-level qualitative data, such as interviews with startup founders, accelerator managers, and public officials, to explore the mechanisms of social agency in greater depth. Extending the comparative scope beyond the Baltic States to include other small open economies in Central and Eastern Europe and Northern Europe would help to distinguish context-specific patterns from more general structural features. Future research could focus on digital and AI-driven startups as

emerging forms of social agency, particularly in relation to transformations of labor, communication, and trust in contemporary economies. Finally, integrating startup studies with research on social stratification and inequality would allow for a more critical assessment of the long-term social consequences of startup-oriented development strategies.

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Funding: The article was written as part of the project "The Role of Startups in the Transformation of Socio-Economic Order in Small Open Economies," funded by Daugavpils, Latvia.

Data Availability Statement: More information can be obtained on request from the corresponding author.

Author Contributions: Conceptualization: *V.M., O.R., A.S., G.B.*; methodology: *V.M., O.R., A.S., G.B.*; data analysis: *V.M., O.R., A.S., G.B.* writing - original draft preparation: *V.M., O.R., A.S., J.S.*; writing; review and editing: *V.M., O.R., A.S., G. B.*; visualization: *V.M., O.R., A.S., G.B.* All authors have read and agreed to the published version of the manuscript.

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/t5394436464

Publisher
http://jssidoi.org/esc/home

THE GEOECONOMIC TURN: EUROPEAN UNION ECONOMIC SECURITY IN AN ERA OF GLOBAL FRAGMENTATION

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Received 11 December 2025; accepted 19 March 2026; published 30 June 2026

Abstract. This article examines the current geoeconomic turn and the evolution of the European Union's economic security concept within the context of an increasingly fragmenting global order. It proceeds from the premise that economic security has emerged as a pivotal dimension of the Union's broader security and geopolitical framework, reflecting the deepening nexus between economic interdependence and strategic competition. Drawing on a qualitative analysis of EU strategic documents and relevant scientific and academic literature, the paper explores how economic security is conceptualised in European political discourse and identifies how this approach diverges from those of other major global actors. Particular attention is devoted to the architecture and primary instruments of the European Economic Security Strategy—including foreign direct investment screening, export controls, technological security, and supply chain protection—while highlighting the inherent tensions between openness, competitiveness, and security. Ultimately, the article interprets the concept of 'open economic security' as a specific European response to systemic risks and power asymmetries in the global economy.

Keywords: European Union; economic security; geoeconomics, de-risking; weaponised interdependence; strategic autonomy; global fragmentation

Reference to this paper should be made as follows: Ivančík, R., Dušek, J. 2026. The geoeconomic turn: European Union economic security in an era of global fragmentation. *Entrepreneurship and Sustainability Issues*, 13(4), 79-90. http://doi.org/10.9770/t5394436464

JEL Classifications: F13, F21, F52, O25

Additional disciplines: Political Economy, Political Science, International Relations, Security

1. Introduction

Over the last decade, the European Union (EU) has faced a fundamental transformation of both its external and internal economic environments, challenging the assumptions upon which the post-war liberal economic order was constructed. Rising geopolitical tensions, deepening great-power rivalry, and a deteriorating global and regional security environment (Ivančík & Andrassy, 2025; Palaios & Kapogiannis, 2025; Buryk et al., 2026), alongside multipolar competition, disruptions to global supply chains, technological fragmentation, and the increasing use of economic instruments to achieve security and political objectives, have led to a renaissance of the concept of economic security (Golea & Hideg, 2022; Sabayová, 2025). In a short space of time, this concept has moved from the periphery of academic discussion to the heart of the strategic thinking of governments and international organisations, with the EU being no exception. On the contrary, given its high degree of openness,

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/t5394436464

deep integration into the global economy, and limited traditional power instruments, the issue of economic security is particularly pressing for the EU (Hooghe & Marks, 2019; Schimmelfennig, 2021; Hauge et al., 2025).

In the European context, economic security is taking shape as a response to the experiences of recent years—most notably the COVID-19 pandemic, the energy crisis triggered by Russia's aggression against Ukraine, the escalating technological rivalry between the United States and China, and the growing frequency of cases involving economic coercion and the weaponisation of interdependencies. These events have exposed vulnerabilities stemming from excessive supply concentration, technological dependencies, asymmetric trade relations, and insufficient policy coordination among Member States. The EU, which has long positioned itself as a primary advocate for an open and rules-based international economic system, thus faces a dilemma: how to reconcile the preservation of openness with increasing security risks (European Commission, 2023; European Commission, 2024).

With the adoption of the European Economic Security Strategy in 2023 and its subsequent development through legislative and non-legislative initiatives in 2024 and 2025, the EU has explicitly acknowledged that economic instruments and policies can no longer be viewed solely through the lens of efficiency and growth but must also be seen as part of a broader security framework. This strategy represents a significant shift in European strategic thinking, as it systematically links trade policy, investment, industrial policy, research and innovation, digitalisation, technological regulation, and foreign policy into a single coherent framework aimed at managing the risks arising from economic linkages (Chimits et al., 2024; Fasulo et al., 2025). At the same time, however, it raises a multitude of theoretical, political, and practical questions concerning the very definition of economic security, its relationship to national security, the legitimacy and proportionality of the instruments employed, and the long-term implications for the functioning of the Single Market and the global economic system.

The objective of this article is to provide a comprehensive analysis of the concept and practice of European economic security within the context of the current geoeconomic transformation. The article focuses on three interconnected levels. The first is the conceptual level, which defines economic security and establishes its theoretical grounding within broader debates on geoeconomics, strategic autonomy, and 'weaponised interdependence'. The second is the analytical level, which examines the architecture, pillars, and instruments of the European Economic Security Strategy, including their inherent tensions and limitations. The third is the normative-strategic level, which evaluates the EU's position in global geoeconomic competition and discusses the prospects of the concept of 'open economic security' as a potential framework for future development.

The research problem of the article can be formulated as follows: How can the European Union effectively strengthen its economic security without undermining the foundations of the open economic model upon which its long-term prosperity is built? From this problem, the following main research questions arise: How is economic security conceptualised within European political and academic discourse, and how does this approach differ from those of other major global actors? To what extent are European economic security instruments capable of addressing identified risks without fragmenting the Single Market or incurring disproportionate costs to EU competitiveness? What is the strategic significance of the concept of 'open economic security' for the future direction of the EU amidst increasing global fragmentation?

Methodologically, the article adopts a qualitative research design. At the core of the study is a systematic analysis of primary EU policy and strategic documents, particularly the European Economic Security Strategy and subsequent documents from the European Commission and the European Parliament. This approach is supplemented by a critical analysis of secondary academic literature from the fields of International Political Economy (IPE), security studies, and European studies. Furthermore, the article employs a comparative approach, which allows the European model of economic security to be situated within a broader global context and its specificities identified in relation to the approaches of the United States, China, and other significant actors. The analytical framework is further enhanced by a conceptual analysis of terms and a normative reflection on the strategic implications of the identified trends.

The scientific contribution of the article lies in bridging theoretical discussions on geoeconomics with an empirical analysis of current European economic security policy. The article seeks to close the gap between

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rapidly evolving political practice and the slower-forming theoretical grounding of this phenomenon. Simultaneously, it offers a critical reflection on the limits of the EU's current approach and contributes to the debate on whether, and under what conditions, it is possible to reconcile economic security with openness and multilateralism in a changing global order.

2. Theoretical and Conceptual Foundations of European Economic Security

Economic security is among the concepts whose significance in international political and economic discourse has grown substantially due to deepening global crises and rising geopolitical rivalry. Despite its increasing popularity, it remains an ambiguously defined term. On the contrary, economic security is characterised by a high degree of conceptual plurality, reflecting the diverse historical experiences, political priorities, and power positions of individual actors within the international system. In the European context, this ambiguity is further compounded by the specific nature of the European Union as a supranational politico-economic entity that combines elements of state sovereignty with deep economic integration.

In the traditional sense, security has long been associated primarily with military threats and the defence of state freedom, independence, sovereignty, and territorial integrity (Attinà, 2016; Hirsch Ballin et al., 2020; Ivančík & Andrassy, 2023). The economic dimension was perceived more as a supporting factor of national power rather than a distinct field of security reasoning. This approach began to shift in the second half of the 20th century, as economic prosperity, access to strategic raw materials, and technological advancement gradually became key determinants of political and military power (Gagliano, 2018; Viana, 2025). Nevertheless, until recently, economic security remained an implicit component of broader strategies rather than an explicitly formulated policy objective (Ivančík & Dušek, 2026a,b).

The current debate on economic security is closely linked to the concept of geoeconomics, which emphasises the use of economic instruments to achieve geopolitical goals. Geoeconomics highlights the fact that trade, investment, technology, and financial flows have become means of power rivalry, where their use often follows the logic of relative gains and losses rather than the maximisation of collective welfare. In this context, economic security is understood as an actor's ability to protect themselves from vulnerabilities arising from economic interconnectedness while simultaneously leveraging this interconnectedness to strengthen their own position (Blackwill & Harris, 2016; Haroche, 2024; Sabayová, 2025; Chiki et al., 2025).

One of the key theoretical contributions to the contemporary debate is the concept of ‘weaponised interdependence’, which points to the asymmetric structures of global networks and the possibility of their strategic exploitation by dominant actors (Farrell & Newman, 2019). This concept is particularly relevant for the European Union, which is deeply integrated into global trade, financial, and technological networks, yet does not possess a level of centralised political and military power comparable to traditional great powers. From this perspective, EU economic security is inextricably linked to the management of mutual dependencies, which can be transformed into a source of pressure or coercion in times of crisis (Dür et al., 2025).

Academic literature identifies two fundamental approaches to defining economic security. The first approach understands economic security narrowly, as the protection of economic processes and outcomes from external shocks, disruptions, and hostile interventions. In this view, it is primarily about ensuring supply continuity, protecting critical sectors, and mitigating economic damage caused by geopolitical conflicts or economic coercion. The second approach views economic security more broadly, as the use of economic policies and instruments to achieve wider security and strategic objectives, including restricting the technological development of potential rivals or protecting sensitive areas of research and innovation (Chimits et al., 2024).

In its strategy, the European Union leans towards a hybrid conception of economic security, which combines both aforementioned approaches. On the one hand, it emphasises the need to protect the economy from specific risks, such as supply chain disruptions, energy dependency, or economic coercion (defensive dimension). On the other hand, it openly acknowledges that certain economic measures primarily pursue non-economic objectives, particularly in the areas of technological and research security (proactive dimension) (European Commission, 2023). This hybrid nature of European economic security reflects the EU's attempt to respond to

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the changing security environment without completely abandoning the principles of the open market and the multilateral order.

In this context, the relationship between economic security and the concept of strategic autonomy deserves particular attention. While strategic autonomy was originally formulated in European discourse primarily within the field of defence and security, it has gradually expanded into the economic and technological spheres. Economic security represents a more concrete and operational dimension of this broader concept, as it focuses on the identification and management of specific risks and vulnerabilities. At the same time, however, it raises concerns about a potential slide towards protectionism or the fragmentation of the Single Market, especially if security arguments are employed too broadly or ambiguously (Alcidi et al., 2023; Juncos & Vanhoonacker, 2024).

From a theoretical perspective, it is important to emphasise that economic security does not represent a binary state but rather a continuum upon which actors move depending on their preferences, capacities, and perception of threats. For the Union, whose identity is closely linked to openness and rules-based cooperation, the key challenge is to find a balance between strengthening resilience and preserving the open economic model. This balance is not static; it is subject to constant reassessment depending on the evolution of the global environment and internal political dynamics.

These theoretical and conceptual foundations of European economic security provide the basis for understanding the specific policy measures that the EU has adopted or proposed in recent years. Simultaneously, they allow for a critical evaluation of their legitimacy, effectiveness, and long-term consequences. In the following chapter, the focus will therefore shift from the theoretical level to an analysis of the European Economic Security Strategy itself—its structure, instruments, and the inherent tensions arising from the ambition to reconcile security, competitiveness, and openness in an increasingly fragmented global economy.

3. The European Economic Security Strategy: Architecture, Pillars, and Instruments

The emergence of the European Economic Security Strategy should not be understood as an isolated political decision, but rather as the culmination of a long-term process of the EU's gradual adaptation to a shifting global economic and geopolitical environment. Even prior to the official adoption of the strategy in 2023, the Union responded to mounting risks through sectoral and ad hoc measures, particularly in the areas of trade defence, foreign investment screening, and industrial policy. However, these measures often emerged reactively, lacking a unified strategic framework, which led to fragmented approaches and tensions among Member States. Simultaneously, experiences with the COVID-19 pandemic, energy dependency on Russia, and the technological rivalry between the US and China clearly demonstrated that risks associated with economic interdependencies are systemic in nature and require a coordinated response at the Union level (European Commission, 2023; European Commission, 2025).

The formal introduction of the European Economic Security Strategy represented an attempt to conceptually unify existing instruments and provide a framework for their further development. The strategy is built upon the conviction that the EU can remain a prosperous and competitive actor only if it can actively manage the risks stemming from global economic integration—without resigning from openness and multilateral cooperation. In this sense, the strategy does not represent a radical turn towards economic nationalism, but rather an effort toward a more precise and targeted use of policy instruments in areas where specific security vulnerabilities have been identified (Chimits et al., 2024; Korneev et al., 2025; European Commission, 2025).

The architecture of the strategy is built upon three interconnected pillars: promote, protect, and partner. This three-pillar framework is designed to ensure that economic security is not reduced solely to defensive measures but is perceived as part of a broader developmental and geopolitical project.

1. The 'promote' pillar emphasises the need to strengthen the EU's competitiveness, innovation capacity, and industrial base. It proceeds from the assumption that economic security is largely a function of the internal strength of the economy, its technological advancement, and its ability to generate high added value. In this

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context, economic security intersects with industrial policy, support for research and innovation, and the development of strategic technologies, which simultaneously bolsters EU autonomy in critical areas.

2. The 'protect' pillar constitutes the core of the strategy's security dimension and focuses on the identification and mitigation of specific risks. This primarily involves the protection of critical infrastructure, technologies, and supply chains, as well as the prevention of undesirable transfers of sensitive knowledge and technology. This pillar encompasses the largest portion of new or reinforced regulatory instruments and is also the source of the greatest political controversy, as it directly affects the functioning of the Internal Market and relations with third countries.

3. The 'partner' pillar, conversely, stresses that economic security cannot be ensured through internal measures alone. The EU therefore strives to deepen cooperation with like-minded partners, diversify trade and investment relations, and strengthen multilateral rules where still possible (European Commission, 2024; European Commission, 2025).

Among the most significant instruments of European economic security is the screening of Foreign Direct Investment (FDI). The introduction of the framework for screening foreign investments in 2019 represented the EU's first systematic step towards protecting strategic sectors from potentially risky acquisitions. However, experience with its implementation has revealed significant disparities between Member States, as well as regulatory gaps that allowed for system circumvention (Dür et al., 2025).

The proposed revision of this framework, therefore, aims at its harmonisation, the expansion of mandatory application across all Member States, and the strengthening of the European Commission's coordinating role (European Commission, 2024). Consequently, investment screening is gradually transforming from a supplementary tool into one of the pillars of European economic security.

Another key instrument is export controls, particularly in the field of dual-use technologies (Szczepański, 2025). In this area, the EU has traditionally relied on multilateral regimes and coordination with partners; however, deteriorating geopolitical relations and the blocking of decision-making processes within these forums have exposed the limitations of this approach. The European Economic Security Strategy thus places emphasis on strengthening the coordination of export controls at the EU level to prevent fragmentation of the Internal Market and the weakening of measure effectiveness. Simultaneously, the EU seeks to balance security interests with the need to maintain the technological competitiveness of its enterprises, making export controls one of the most sensitive instruments of the entire strategy (Evans et al., 2025).

The strategy devotes particular attention to technological and research security. In an environment of rising technological rivalry, research and innovation become not only sources of economic growth but also potential vectors for security risks. The EU has therefore identified a need to protect sensitive areas of research from unwanted access or misuse, without disrupting academic freedom and international cooperation. The proposed measures in research security are predominantly non-legislative in nature, based on awareness-raising, risk assessment, and the sharing of best practices; this reflects the EU's limited competences in this field, as well as an effort toward proportionality of interventions (Le Bret, 2025; Bercero & Poitiers, 2025).

A relatively new and simultaneously most controversial element of European economic security is the issue of outbound investments. Unlike FDI flowing into the EU, this concerns investments by European entities in third countries, which may lead to the transfer of sensitive technologies or know-how. Thus far, the EU has proceeded cautiously in this area, favouring an analytical and consultative approach over the immediate introduction of binding measures. This approach reflects both the political sensitivity of interfering with the freedom of capital flows and concerns regarding the negative impact on the competitiveness of European businesses (Dür et al., 2025; Fasulo et al., 2025).

Finally, the protection of critical supply chains represents a cross-cutting area that links all pillars of the strategy. The EU strives to identify strategic dependencies, diversify supply sources, and support domestic capacities in areas deemed critical (European Council, 2025). This approach, however, is accompanied by an effort to avoid wholesale import substitution, focusing instead on targeted, risk-assessment-based measures.

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The European Economic Security Strategy is thus characterised by an inherent tension between market openness and security interests. On the one hand, the EU declares its commitment to remaining one of the world's most open economies; on the other, it increasingly employs instruments that restrict or condition economic interactions. This tension cannot be entirely eliminated, but its management will be crucial for the legitimacy and long-term sustainability of European economic security. The manner in which the EU handles this balance will be the determining factor of its position in the global geoeconomic competition, which will be the focus of the following chapter.

4. The European Union in Global Geoeconomic Competition

European economic security cannot be analysed in isolation from the broader context of global geoeconomic competition, which has acquired a markedly confrontational character in recent years. The world's major economies are increasingly and more overtly employing economic instruments to advance strategic and security interests, with the differing approaches of the United States, China, and the European Union reflecting their distinct political systems, economic structures, and historical experiences. A comparison of these approaches is crucial for understanding the EU's specific position within the current global order.

The United States represents an example of an actor that has significantly intertwined economic and national security over the last decade. The American approach is characterised by a high degree of centralised decision-making, an explicit link between economic measures and security objectives, and a willingness to incur short-term economic costs in the interest of long-term strategic advantage. Instruments such as extensive export controls in the semiconductor sector, rigorous foreign investment screening, and industrial subsidies targeting strategic technologies illustrate the US's readiness to actively shape global economic flows in accordance with its security priorities. This approach is simultaneously accompanied by a willingness to apply extraterritorial measures, which bolsters American capacity to influence the behaviour of third countries but also contributes to tensions in international economic relations (Hillman et al., 2025; Clement & Traynham, 2025).

China, conversely, has long pursued a model in which economic security is closely linked to the concept of national self-reliance and strategic control over key sectors. The Chinese approach is characterised by a strong state role, the systematic use of industrial policy, and a readiness to restrict foreign access to sensitive areas of the economy. In the Chinese conception, economic security is an inseparable part of a broader national security strategy, legitimised by arguments for long-term stability and sovereignty. From the EU's perspective, this model is problematic not only regarding the disruption of level playing field principles but also because it creates new asymmetries and dependencies within global supply chains (Huang, 2024; Awan, 2024).

In comparison to these two actors, the European Union occupies a unique and, to some extent, paradoxical position. On the one hand, it possesses significant economic power, a vast internal market, and a regulatory capacity that provides it with the potential to act as a relevant geoeconomic actor. On the other hand, its ability to act swiftly and decisively is constrained by its complex institutional structure, the division of competences between the EU level and Member States, and the political heterogeneity of the Union itself. European economic security is therefore the result of a compromise between ambition and limitations, between the need to respond to global competition and the effort to maintain internal cohesion (Balfour et al., 2024).

As a geoeconomic actor, the EU wields a specific type of power, often referred to as regulatory or market power. By setting the rules for access to its extensive internal market, the EU can influence the behaviour of foreign actors even without the use of traditional coercive instruments. In the context of economic security, this regulatory capacity is gradually expanding to include elements of explicit strategic calculation, suggesting a shift towards so-called European geoeconomic power (Haroche, 2024). This shift, however, is neither linear nor without contradictions, as every expansion of the security framework encounters concerns regarding the fragmentation of the Single Market and the weakening of trust among foreign partners.

Global economic fragmentation represents one of the most significant contexts in which European economic security is taking shape. The deepening of geopolitical blocs, the reconfiguration of supply chains, and rising mistrust between major actors are leading to a gradual erosion of universal rules of global trade (Werner, 2024).

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This process of fragmentation creates a fundamental dilemma for the EU. On the one hand, it increases risks stemming from over-dependence on individual partners, bolstering arguments for diversification and de-risking. On the other hand, fragmentation weakens precisely the type of open, rules-based system from which the EU has historically profited most. Economic security thus becomes not only a reaction to fragmentation but also a factor that may further accelerate it (Demertzis et al., 2025).

A particular risk in this context is the politicisation of economic instruments. As the boundary between economic and security policy blurs, the probability increases that measures taken in the name of security will be perceived as tools of protectionism or political pressure. For the EU, which has long profiled itself as a champion of multilateral rules, this politicisation poses a serious challenge to its normative legitimacy. Any expansion of security exceptions to Internal Market or international trade rules must therefore be carefully justified, proportionate, and transparent to prevent the erosion of trust among Member States and towards external partners.

The concept of 'weaponised interdependence' provides an analytical framework for understanding the EU's vulnerabilities within the system of global economic networks. The EU is deeply integrated into global financial, technological, and trade flows, yet control over the key nodes of these networks is often concentrated outside its territory. This creates the potential for asymmetric pressure from actors who possess a greater capacity to influence or disrupt these networks (Farrell & Newman, 2019). Simultaneously, however, the EU itself possesses certain network advantages, notably through the central position of the Euro in global financial transactions and the attractiveness of its Internal Market.

The EU's position within the system of 'weaponised interdependence' is therefore ambivalent. On the one hand, it is vulnerable to external shocks and pressure; on the other, it has the potential to actively manage, and in some cases leverage, these dependencies. The European Economic Security Strategy represents an attempt to systematically address this ambivalence and transform vulnerabilities into a source of strategic resilience (Berg & Meyers, 2024). The success of this endeavour, however, will depend on the EU's ability to act in unison, the degree of coordination with partners, and the willingness to clearly define the boundaries between legitimate security protection and the unjustified politicisation of economic relations.

From the perspective of International Political Economy (IPE) theory, these findings suggest that the EU's power in the geoeconomic sphere is primarily structural and regulatory, rather than taking a classical coercive form. Economic security in the European context thus does not represent an exercise of hard power, but a specific form of conditional power arising from the EU's central position in global economic networks and its ability to set the rules of access to them. These issues, along with the concept of 'open economic security', will be the focus of the following chapter.

5. Open Economic Security and the Future Direction of the EU

The concept of 'open economic security' represents the European Union's attempt to formulate its own response to rising geoeconomic rivalry without abandoning the fundamental principles of openness, multilateral cooperation, and a rules-based economic order. Unlike approaches that emphasise self-sufficiency or the extensive restriction of economic ties, open economic security is based on the conviction that interconnectedness itself is not the problem, but rather a potential source of vulnerability that must be actively managed. In this sense, economic security is not interpreted as the opposite of openness, but as its necessary corrective in an environment of increasing risks.

Open economic security relies on the concept of de-risking, which has gained prominence in European discourse as an alternative to radical decoupling. De-risking does not entail a systematic disconnection from the global economy, but rather a targeted reduction of excessive and asymmetric dependencies in areas of strategic importance. This approach reflects the EU's effort to preserve the benefits of globalisation—such as efficient supply chains, technological exchange, and access to global markets—while simultaneously strengthening the capacity to respond to shocks and coercion. Open economic security is thus selective and based on risk assessment rather than wholesale restrictions (Garcia-Herrero, 2023; Pisani-Ferry et al., 2024).

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One of the main challenges of this approach is achieving a balance between three interconnected objectives: resilience, competitiveness, and openness. Strengthening resilience through diversification, building domestic capacities, or protecting strategic sectors may increase costs and weaken competitiveness in the short term. Conversely, maximising competitiveness through the global optimisation of production and investment can increase dependencies and vulnerabilities. Openness, as a fundamental principle of the European economic model, provides the framework within which these conflicting objectives must be constantly balanced (European Union, 2024; Demertzis et al., 2025).

The European Economic Security Strategy seeks to achieve this balance through a combination of defensive and offensive measures. On the one hand, it introduces instruments to protect against identified risks; on the other, it invests in strengthening the EU's innovation and industrial base. The success of this approach, however, depends on the ability to ensure that security measures are not perceived as disguised protectionism and do not disrupt the level playing field within the Internal Market. In this context, transparency, proportionality, and a clear definition of the objectives of individual measures play a crucial role (European Commission, 2023; Pisani-Ferry et al., 2024).

An integral part of open economic security is the emphasis on partnerships and alliances with like-minded states. The EU recognises that its ability to face global challenges is significantly bolstered when it acts in coordination with partners who share fundamental values and a common interest in preserving an open yet resilient economic order. Cooperation in supply chains, technological standards, export controls, and investment rules allows for the distribution of risks while reducing the costs associated with unilateral measures. Consequently, partnerships fulfill not only an economic but also a political and normative function (Di Carlo & Schmitz, 2023).

At the same time, however, this approach raises questions regarding the inclusivity and fragmentation of the global system. Building closer alliances may contribute to the stabilisation of relations between like-minded actors, but it also risks deepening dividing lines between states outside these frameworks. For the EU, which has long positioned itself as a bridge between various global regions, this dynamic presents a strategic dilemma. On the one hand, pressure for closer coordination with partners is necessary for security; on the other hand, there is a risk of undermining the universal character of multilateral rules (Müftüler-Bac et al., 2024; McNamara, 2024).

The implementation of open economic security also faces significant institutional, political, and economic challenges. Institutional constraints stem primarily from the division of competences between the EU level and Member States, complicating the uniform application of certain instruments. Political challenges relate to varying perceptions of risks and priorities among Member States, which possess different economic structures and relations with third countries. Economic challenges mainly concern the costs associated with strengthening resilience, which may be unevenly distributed across sectors and regions (Lavery, 2024; Riekeles & Świeboda, 2025).

Particular attention must be paid to the strategic dilemmas regarding the further development of European economic security. One such dilemma is the degree and pace of integrating new security instruments into the existing Internal Market framework. Rapid or uncoordinated implementation may lead to market fragmentation and weakened competition. Conversely, an overly cautious approach could leave the EU vulnerable to fast-evolving global risks. Another dilemma is the relationship between autonomy and dependency: while total elimination of dependencies is neither realistic nor desirable, tolerating them without adequate management may have severe security implications (Alcidi et al., 2023; Conzelmann & Vanhoonacker, 2025; Bercero & Poitiers, 2025).

Ultimately, open economic security represents the EU's attempt to redefine its economic model within the context of a new geoeconomic reality. It is not a static concept but an adaptive framework requiring constant reassessment as the global environment evolves. The future direction of European economic security will depend on the EU's ability to maintain internal cohesion, preserve the trust of its partners, and flexibly respond to new challenges. It is this ability to balance conflicting objectives that will determine whether economic security becomes a source of strength for the European project or, conversely, a factor in its fragmentation.

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Conclusion

This article focuses on the analysis of European economic security as one of the key concepts of the EU's current economic and strategic thinking. It proceeds from the premise that, in conditions of rising geopolitical rivalry, multipolar competition, global economic fragmentation, and the technological and green transformation, economic security has become an integral part of a broader security framework. As a deeply integrated and open economic actor, the Union is extremely sensitive to these changes, forcing it to reassess its previous approaches to trade, investment, and technological cooperation. Therefore, this contribution to the ongoing academic discourse moves beyond a mere analysis of relevant policies, framing the pursuit of enhanced economic security as a fundamental geoeconomic turn in the EU's strategic identity, while reflecting on the latest regulatory instruments that have yet to be systematically addressed in existing scientific literature.

The analysis of theoretical and conceptual foundations demonstrated that economic security is not a monolithically defined term but rather a dynamic framework where economic and security logics intersect. In the European context, this framework is hybrid in nature: it simultaneously focuses on protecting economic processes from external shocks and coercion, while legitimising the use of economic instruments to achieve wider strategic objectives. This hybrid approach reflects the EU's attempt to respond to novel threats without completely abandoning the principles of openness and multilateral cooperation.

The article also aimed to address three primary research questions. Based on the analysis, it can be concluded that all three questions formulated in the introduction have been answered through a combination of conceptual, analytical, and normative reflection.

Firstly, the analysis showed that the European conceptualisation of economic security differs from the approaches of the United States and China primarily through its emphasis on proportionality, the legal framework, and the linkage of security with internal competitiveness. Unlike the more centralised and explicitly confrontational American approach, or the state-directed Chinese model, the EU shapes its economic security through a combination of regulatory, coordinating, and partnership-based instruments, striving to minimise negative spillover effects on the Internal Market.

Secondly, the article highlighted that while European economic security instruments have the potential to address identified risks, they also carry significant limitations. FDI screening, export controls, research security measures, and the debate on outbound investments represent important steps toward strengthening resilience. However, their effectiveness depends on the degree of coordination among Member States, the clear definition of objectives, and the ability to prevent market fragmentation.

Thirdly, the article demonstrated that the concept of 'open economic security' provides a normatively and strategically significant framework for the future. It allows the EU to respond to global risks through de-risking rather than decoupling, thereby preserving the core benefits of economic interconnectedness. However, this approach requires sophisticated vulnerability assessments, high political coordination, and a willingness to incur short-term costs for long-term stability.

Regarding the evaluation of the European Economic Security Strategy itself, its main contribution lies in creating a coherent framework that links previously dispersed policies. The strategy explicitly acknowledges that economic openness and security are not automatically compatible and that their relationship must be actively managed. Nevertheless, the strategy faces limits, including ambiguous divisions of competence and the risk of over-politicisation.

Implications for further research include the need for deeper empirical analysis of the specific impacts of security measures on EU competitiveness and cohesion. For policymaking, the article emphasises the importance of transparency and proportionality to prevent an expansive "mission creep" of security measures beyond their intended scope.

Ultimately, economic security is likely to become a permanent feature of European economic discourse. The decisive factor will be the EU's ability to bridge security with openness and competitiveness, determining

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whether economic security becomes a source of strategic resilience or a factor in the further fragmentation of the European project.

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Data Availability Statement: More information and data can be obtained from the authors on a reasonable request.

Author Contributions: The authors contributed equally, they have read and agreed to the published version of the manuscript.

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/s9849866932

Publisher
http://jssidoi.org/esc/home

LEADERSHIP AND PERSONALITY CHARACTERISTICS IN THE ARMED FORCES: A COMPARISON OF THREE LEVELS OF MANAGERIAL EXPERIENCE

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Received 11 January 2026; accepted 22 June 2026; published 30 June 2026

Abstract. This study examines associations between the level of managerial experience in leading people and selected personality and motivational characteristics relevant to military leadership. A quantitative cross-sectional design compared three groups of members of the Armed Forces of the Slovak Republic: cadets without practical leadership experience (XX-I, n = 40), commanders with short-term managerial experience (XX-II, n = 40), and senior officers with long-term managerial experience (XX-III, n = 38). Personality characteristics were assessed using the Bochum Personality Inventory (BIP). Data were analyzed using descriptive statistics, between-group comparisons (analysis of variance with post-hoc tests), and correlational analyses between experience level and BIP dimensions. The results revealed small to moderate differences between groups, particularly in the domains of social competencies and work style. Sociability, decisiveness, and conscientiousness showed the most consistent positive associations with higher levels of managerial experience, whereas emotional stability and resistance to stress did not display a systematic linear pattern across career stages. Overall, the findings suggest that certain personality characteristics relevant to military leadership are associated with career progression and may differentiate across stages of professional development. From a practical perspective, the results may inform more targeted selection and development of commanders, with greater emphasis on socio-interactional competencies and the professionalization of work-related behaviors.

Keywords: Military leadership; Personality; Bochum Personality Inventory (BIP); Managerial experience; Social competencies; Armed Forces of the Slovak Republic

Reference to this paper should be made as follows: Šrobárová, S., Urban, P., Belan, L. 2026. Leadership and personality characteristics in the armed forces: a comparison of three levels of managerial experience. *Entrepreneurship and Sustainability Issues*, 13(4), 91-104. http://doi.org/10.9770/s9849866932

JEL Classifications: F51, F52, F62

Additional disciplines: Security, Defence, International Relations

1. Introduction

The current political, security, and economic situation in Europe—and consequently also in Slovakia—has in recent years been shaped by the ongoing high-intensity conflict in Ukraine, the deterioration of the global and regional security environment, and an unstable geopolitical context marked by increasing great-power rivalry (Jurčák & Ivančík, 2023). The causes can be sought in the context of a centuries-old struggle for power on a European and global scale (Ivančík & Dušek, 2026a,b; Andrassy et al., 2026).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/s9849866932

The causes can be sought in the context of a centuries-old struggle for power on a European and global scale. The real challenge today is how to mitigate contemporary security deficits in a way that legitimizes everyday social relations and satisfies fundamental human needs (Cieleszky, 2023). Historical analyses further show that political movements have long shaped conceptions of military organization, recruitment, training, and combat readiness. These developments underscore the need for states to maintain credible defense capabilities and, importantly, a professional and resilient military workforce. Within this context, leadership in the armed forces becomes a critical determinant of operational readiness and organizational effectiveness. From this perspective, the leader's person is of crucial importance, as the selection of leaders with appropriate competencies is essential not only for individual professional development but also for maintaining and increasing organizational effectiveness (Szabó Szabóné, 2024).

Military leadership represents a specific form of leading people conducted under conditions of formal hierarchy, high responsibility, and often heightened uncertainty, risk, and operational strain. Research on leadership in "dangerous" or extreme environments suggests that such contexts amplify demands for rapid decision-making, team coordination, emotion regulation, and sustained performance under resource constraints (Hannah et al., 2009). Consequently, leadership effectiveness in the military is not determined solely by professional and tactical expertise, but also by psychological dispositions that support adaptive functioning under pressure and enable leaders to shape the motivation and behavior of subordinates.

From the perspective of organizational and military psychology, individual differences in personality and motivation have repeatedly been linked to leadership outcomes. Meta-analytic evidence indicates that traits associated with work discipline and social engagement—most prominently conscientiousness and extraversion—show robust associations with leadership emergence and effectiveness (Judge et al., 2002; Nordmo et al., 2022). Electoral candidates and elected politicians demonstrate higher levels of both cognitive and non-cognitive abilities compared with the general population, indicating positive selection based on ability traits (Jokela et al., 2025). This pattern reinforces the argument that cognitive and personality characteristics play a crucial role in leadership emergence and selection, even in complex decision environments. In addition, trait emotional intelligence and Dark Tetrad traits (narcissism, Machiavellianism, psychopathy) explain additional variance in transformational leadership beyond traditional HEXACO personality factors (Schreyer et al., 2023). A higher level of proactive personality was associated with lower psychological withdrawal behaviors at work, and this negative relationship was stronger under high servant leadership (Song & Lee, 2020).

In military settings, these foundations are complemented by additional demands related to self-regulation, emotional stability, and the capacity to maintain functional judgment under stress (Hannah et al., 2009). Evidence from other high-risk occupational groups further indicates that personality traits are systematically related to perceived stress levels. For example, except for extraversion, personality traits were linked to levels of augmented stress among Indian marine engineers during the COVID-19 pandemic (Mitra, 2023). Personality traits show predictive validity for post-traumatic symptoms, with neuroticism amplifying symptom severity and extraversion offering a protective effect (Ryder et al., 2025). Hardiness was associated with successful admission to military leadership selection, with hardy candidates scoring higher on interview and field exercises and being less likely to withdraw from challenging field tasks (Nordmo et al., 2022). The results confirmed that decision-making processes are related to personal qualities and differ among representatives of various professions in the face of social instability, with rational strategies predominating but avoidance strategies also present (Hubal et al., 2024). Results suggested a specific profile of UK special forces operators composed of nine specific factors: resilience, adaptability, self-belief, perseverance, emotional regulation, self-control, drive, humility, and stubbornness (Breen & Cotterill, 2025). From an applied standpoint, achievement orientation, social competencies, and stress-related resources are therefore commonly considered key elements of a military leader's competency profile.

A central question, however, concerns the extent to which these characteristics differ across career stages and levels of managerial experience in leading people. Leader development research suggests that leadership-related capabilities evolve through cumulative experience, feedback, self-reflection, and role internalization (Day et al., 2014). Although basic personality traits tend to display relative stability, their expression in professional roles

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/s9849866932

may become more consistent over time as individuals adapt to role demands and organizational expectations. In the military domain, this process may be particularly salient because leadership responsibilities are systematically tested in situations with real consequences and high accountability.

The present study contributes to this line of research by examining associations between the level of managerial experience in leading people and personality characteristics relevant to military leadership. Using the Bochum Personality Inventory (BIP), a cross-sectional comparison is conducted across three groups of members of the Armed Forces of the Slovak Republic at different stages of professional development: cadets without practical leadership experience (XX-I), commanders with short-term managerial experience (XX-II), and senior officers with long-term managerial experience (XX-III). The study aims to identify whether selected personality-relevant dimensions differ across these stages and how they relate to increasing levels of experience, with implications for leader selection and development in the armed forces.

2. Leadership in the Armed Forces

Leadership in the military is typically conceptualized as a process of influencing individuals and groups to accomplish missions and sustain unit readiness under conditions that may involve elevated strain and risk. Unlike many civilian organizations, military leadership is embedded in a formal hierarchy with explicit normative expectations, role clarity, and standardized procedures. At the same time, contemporary perspectives emphasize that formal authority alone may be insufficient for sustained performance, particularly in complex and dynamic operational environments.

Current approaches to military leadership often draw on established leadership frameworks while acknowledging the specific demands of military contexts. Transformational leadership highlights the role of vision, inspiration, and follower development (Bass, 1990), which aligns with the military need to foster cohesion and motivation beyond compliance. Situational approaches emphasize adapting leadership behaviors to the competence and readiness of subordinates, a relevant consideration in heterogeneous units and changing operational conditions. Authentic leadership focuses on self-awareness, ethical conduct, and transparency, which may strengthen trust and cohesion (Avolio & Gardner, 2005; Vermetten et al., 2025). Across these perspectives, a shared assumption is that effective military leadership requires strong self-regulation and interpersonal effectiveness, particularly under psychologically demanding conditions. Psychological diagnostics plays a key role in maintaining the mental health of soldiers and supporting their operational readiness. Psychophysiological and psychological diagnosis of military personnel is a crucial preventive measure in medical and psychological rehabilitation, as it helps determine both fitness for service and the need for treatment or further rehabilitation (Klymenko et al., 2023).

Clinical evidence from military psychiatric settings indicates that targeted inpatient interventions can effectively reduce symptom severity associated with maladaptive personality traits. Specifically, inpatient psychiatric treatment targeting avoidant personality traits resulted in significant improvement in psychiatric symptoms among military personnel (Zimmermann et al., 2013). Higher trust in leadership was associated with a lower likelihood of endorsing barriers to accessing mental health support among military personnel following deployment (Born et al., 2024). “Strengths-based Leadership (SBL) is not formally part of standard leadership training programs within the FAS, nor is it explicitly embedded in the military leadership doctrine” (Díez et al., 2025, p. 2).

Research on leadership in extreme or high-risk environments further indicates that environmental “extremity” can alter both leadership requirements and the mechanisms through which leaders influence outcomes. Under such conditions, team coordination, morale maintenance, and the capacity to restore resources (including psychological energy) may become decisive (Hannah et al., 2009). Accordingly, managerial experience in the military may reflect not only accumulated practice in leading people but also gradual adaptation to the demands of responsible decision-making in high-stakes settings.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/s9849866932

Personality Prerequisites of Leaders and Their Development

Personality and motivational characteristics relevant to leadership commonly include achievement orientation, social competencies, self-confidence, stress-related resources, and self-regulatory capacity. Meta-analytic findings indicate stable associations between conscientiousness and extraversion and leadership indicators, while neuroticism (low emotional stability) tends to show negative associations with leadership effectiveness (Judge et al., 2002). In military contexts, these relationships may be particularly consequential due to the premium placed on disciplined work style, effective interpersonal coordination, and the management of stress and uncertainty. From a developmental perspective, it is important to differentiate the relative stability of broad trait dispositions from the development of competencies and role-related behavioral consistency. Leader development research emphasizes that leadership growth is supported by experience, training, feedback, and self-reflection and often unfolds cumulatively over time (Day et al., 2014). Entry into leadership roles may be accompanied by recalibration of self-evaluations and gradual consolidation of leadership behaviors. Less experienced individuals may therefore display greater variability in self-assessment and role-related expression, whereas more experienced leaders may show more consistent patterns aligned with role expectations and organizational standards.

Managerial Experience as a Developmental Factor

Managerial and command experience represents a central developmental input in military leadership. Repeated exposure to decision-making, accountability for subordinates, and feedback based on real outcomes can contribute to increased self-confidence, more accurate self-assessment, and more effective behavioral regulation. In this sense, experience may support the integration of the leadership role into an individual's professional identity and promote a more stable expression of leadership-relevant characteristics in day-to-day practice.

Conceptually, this process can be described as a transition from leadership potential to professionalized performance. Early in a career, achievement motivation and the need to prove competence may be more salient, whereas increasing experience may foster a stronger long-term orientation toward responsibility, team effectiveness, and institutional goals. This view is compatible with transformational leadership perspectives (Bass, 1990) as well as leader development frameworks emphasizing cumulative growth over time (Day et al., 2014). "Transactional leadership tends to accomplish what is expected and is based on legitimate authority within a bureaucratic organisation" (Stříbrný et al., 2022, p. 109). In military contexts, these developmental dynamics are further shaped by the demands of operational strain and high-stakes environments, which place sustained emphasis on self-regulation and adaptive functioning under pressure (Hannah et al., 2009). For example, perceptions of leadership style among military cadets vary by training and personality traits. Langdon and Collins (2025) found that "leaders with high defensive fight were viewed as more transformational by untrained rather than trained cadets, and leaders with high reward reactivity were viewed as transformational leaders with high levels of subordinate trust by trained rather than untrained cadets."

3. Methodology

The aim of the study is to examine associations between the level of managerial experience in leading people and personality characteristics relevant to leadership in the armed forces. Specifically, the study compares personality profiles of three groups of members of the Armed Forces of the Slovak Republic (XX-I, XX-II, XX-III) and investigates whether selected dimensions of achievement motivation, work style, social competencies, and psychological constitution, assessed by the Bochum Personality Inventory (BIP), differ across career stages and relate to increasing experience level.

Internal consistency of the analyzed BIP dimensions was estimated in the present sample using Cronbach's alpha (α) and McDonald's omega (ω) based on item-level scoring data extracted from the BIP protocols. Reliability coefficients for each dimension are reported in Table 1 (N varies across dimensions due to incomplete item-level availability in a subset of protocols).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/s9849866932

Table 1. Internal consistency of BIP dimensions (study sample)

BIP dimension	k	N	α	ω
Achievement motivation	14	115	0.763	0.823
Creative motivation	12	116	0.522	0.657
Leadership motivation	15	115	0.830	0.867
Conscientiousness	14	117	0.798	0.845
Flexibility	14	116	0.711	0.788
Decisiveness	14	116	0.820	0.860
Sensitivity	12	103	0.689	0.776
Contact ability	16	82	0.777	0.834
Sociability	15	80	0.728	0.797
Team orientation	13	80	0.827	0.866
Assertiveness	12	79	0.790	0.846
Emotional stability	16	79	0.867	0.893
Stress resistance	13	79	0.833	0.875
Self-confidence	16	80	0.776	0.828

Note. *k = number of items; N = number of cases with complete item-level data for the given dimension; α = Cronbach's alpha; ω = McDonald's omega (omega total). N varies across dimensions due to incomplete item-level availability in a subset of protocols.*

Internal consistency estimates suggested that most BIP dimensions demonstrated acceptable reliability in the present sample. Cronbach's alpha coefficients were generally above 0.70, with the exception of Creative motivation, which showed lower internal consistency. McDonald's omega coefficients indicated acceptable to good composite reliability across all analyzed dimensions. These results support the use of the BIP scales for examining individual differences in leadership-relevant personality characteristics.

Research Questions

- **RQ1:** Do the groups XX-I, XX-II, and XX-III differ in BIP dimensions?
- **RQ2:** What is the relationship between managerial experience and selected BIP dimensions?

Research Design and Sample

The study employs a quantitative, comparative, cross-sectional design. The sample consisted of three naturally occurring groups differentiated by their level of managerial experience in leading people: cadets without prior leadership experience (XX-I, $n = 40$), commanders with short-term leadership experience (XX-II, $n = 40$), and senior officers with long-term managerial and command experience (XX-III, $n = 38$). Data were collected in 2025 using the Bochum Personality Inventory (BIP), which assesses work-related personality and motivational characteristics across four domains: (a) achievement motivation, (b) work style, (c) social competencies, and (d) psychological constitution. BIP results were analyzed using standardized normative scores (approx. T-scores; normative mean ≈ 50, SD ≈ 10) for each dimension. Basic demographic characteristics (e.g., age, gender, and length of service) were not systematically collected in a form suitable for quantitative analysis. Consequently, these variables were not included in the present study. This limitation is acknowledged and addressed in the section on limitations.

Ethical considerations

Participation was voluntary. All respondents were informed about the purpose of the study, data processing procedures, and the intended use of results prior to data collection. Informed consent was obtained, anonymity was ensured, and data were processed and reported in aggregated form only, in accordance with applicable ethical and data protection standards.

Statistical analysis

Statistical analyses were conducted in three steps. First, descriptive statistics (means, M, and standard deviations, SD) were computed for each BIP dimension separately for groups XX-I, XX-II, and XX-III. Second, between-group differences were tested using one-way analysis of variance (ANOVA). Where statistically

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/s9849866932

significant omnibus effects were observed, Tukey's HSD post-hoc tests were used for pairwise comparisons, and η^2 was reported as an effect size. Third, the association between managerial experience level and BIP dimensions was examined using Spearman's rank correlation coefficient (ρ), because experience level was operationalized as an ordinal variable (XX-I = 0, XX-II = 1, XX-III = 2). Statistical significance was evaluated at $\alpha = .05$ (two-tailed). Assumptions for analysis of variance were evaluated prior to inferential testing. Homogeneity of variances was examined using Levene's test. In cases where the assumption of homogeneity was violated, Welch's ANOVA was used as a robustness check. Given the approximately balanced group sizes, ANOVA was considered sufficiently robust to moderate deviations from normality.

4. Descriptive Results of Empirical Findings for Individual Groups

Table 2 presents means (M) and standard deviations (SD) of standardized BIP scores of the Bochum Personality Inventory (BIP) in groups XX-I, XX-II, and XX-III. The results suggest distinct personality profiles that can be interpreted within the context of career development of military leaders.

Table 2. Descriptive statistics of BIP dimensions by group (standard scores; approx. T-scores)

BIP Dimension	XX-I M	XX-I SD	XX-II M	XX-II SD	XX-III M	XX-III SD
Achievement motivation	56.78	7.21	55.98	9.65	53.26	10.05
Creative motivation	43.02	6.77	41.82	5.11	42.18	6.81
Leadership motivation	55.10	10.15	55.60	8.68	52.71	13.40
Conscientiousness	57.32	9.44	63.92	7.44	59.21	13.13
Flexibility	45.78	6.84	44.32	4.97	43.42	9.52
Decisiveness	54.30	9.66	63.15	8.94	62.26	8.01
Sensitivity	54.57	10.41	53.60	10.29	51.58	11.43
Contact ability	50.53	8.82	52.75	8.51	54.24	11.59
Sociability	58.00	7.57	63.12	8.85	64.16	7.78
Team orientation	52.58	9.58	55.45	9.36	56.16	10.18
Assertiveness	52.95	10.35	51.15	10.28	50.37	11.49
Emotional stability	62.05	11.81	65.53	18.58	54.39	20.54
Stress resistance	54.72	7.90	59.65	9.21	52.89	9.11
Self-confidence	58.38	9.66	57.70	10.16	55.13	12.13

Note. *Values are standardized BIP scores (approx. T-scores; normative mean ≈ 50, SD ≈ 10). Higher scores indicate a higher level of the respective characteristic. XX-I = cadets without practical leadership experience (n = 40), XX-II = commanders with short-term managerial experience (n = 40), XX-III = senior officers with long-term managerial and command experience (n = 38). M = mean; SD = standard deviation.*

In the achievement motivation domain, mean scores were broadly comparable across groups, with XX-I showing the highest mean for achievement motivation (M = 56.78, SD = 7.21), followed by XX-II (M = 55.98, SD = 9.65) and XX-III (M = 53.26, SD = 10.05). Leadership motivation showed very similar means in XX-I (M = 55.10, SD = 10.15) and XX-II (M = 55.60, SD = 8.68), while XX-III displayed a slightly lower mean (M = 52.71, SD = 13.40). Standard deviations indicated moderate within-group variability across these dimensions. In work style, conscientiousness differed more clearly across groups, with higher means in XX-II (M = 63.92, SD = 7.44) and XX-III (M = 59.21, SD = 13.13) compared to XX-I (M = 57.32, SD = 9.44). Flexibility showed relatively similar low-to-moderate means across groups (XX-I: M = 45.78, SD = 6.84; XX-II: M = 44.32, SD = 4.97; XX-III: M = 43.42, SD = 9.52), without marked differences.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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Within social competencies, sociability increased across the three groups (XX-I: M = 58.00, SD = 7.57; XX-II: M = 63.12, SD = 8.85; XX-III: M = 64.16, SD = 7.78). Contact ability and team orientation also showed higher means in XX-III relative to XX-I. Assertiveness showed comparable mean values across groups (XX-I: M = 52.95, SD = 10.35; XX-II: M = 51.15, SD = 10.28; XX-III: M = 50.37, SD = 11.49).

In psychological constitution, emotional stability was highest in XX-II (M = 65.53, SD = 18.58) and lower in XX-I (M = 62.05, SD = 11.81) and XX-III (M = 54.39, SD = 20.54). Stress resistance was also highest in XX-II (M = 59.65, SD = 9.21) and lowest in XX-III (M = 52.89, SD = 9.11). Self-confidence showed relatively similar mean levels across groups (XX-I: M = 58.38, SD = 9.66; XX-II: M = 57.70, SD = 10.16; XX-III: M = 55.13, SD = 12.13).

Association between experience and BIP dimensions

The relationship between managerial experience and BIP dimensions was examined using correlational analysis. Because managerial experience was operationalized as an ordinal variable (XX-I = 0, XX-II = 1, XX-III = 2), associations were evaluated using Spearman's rank correlation coefficient (ρ). Correlation coefficients and p-values are reported in Table 3.

Table 3. Correlations between managerial experience level and BIP dimensions (N = 118)

BIP Dimension	**ρ**	**p**
Sociability	0.362	< .001
Decisiveness	0.352	< .001
Conscientiousness	0.230	.012
Team orientation	0.154	.095
Contact ability	0.124	.180
Emotional stability	0.027	.773
Creative motivation	0.013	.891
Sensitivity	-0.003	.972
Flexibility	-0.033	.721
Self-confidence	-0.065	.481
Assertiveness	-0.088	.344
Leadership motivation	-0.090	.330
Achievement motivation	-0.099	.287
Stress resistance	-0.109	.242

The strongest positive associations with experience level were observed for sociability ($\rho = 0.362$, $p < .001$) and decisiveness ($\rho = 0.352$, $p < .001$). A statistically significant but smaller association was found for conscientiousness ($\rho = 0.230$, $p = .012$). Associations for team orientation ($\rho = 0.154$, $p = .095$) and contact ability ($\rho = 0.124$, $p = .180$) were weak and not statistically significant. No statistically significant monotonic association was observed for emotional stability ($\rho = 0.027$, $p = .773$) or stress resistance ($\rho = -0.109$, $p = .242$). Other dimensions showed negligible correlations.

One-way ANOVA revealed statistically significant group differences in decisiveness, $F(2,115) = 11.89$, $p < .001$, $\eta^2 = .171$; sociability, $F(2,115) = 6.56$, $p = .002$, $\eta^2 = .102$; stress resistance, $F(2,115) = 6.26$, $p = .003$, $\eta^2 = .098$; conscientiousness, $F(2,115) = 4.42$, $p = .014$, $\eta^2 = .071$; and emotional stability, $F(2,115) = 4.19$, $p = .018$, $\eta^2 = .068$. Tukey's HSD post-hoc tests indicated that XX-II and XX-III scored higher than XX-I in decisiveness and sociability; XX-II scored higher than both XX-I and XX-III in stress resistance; XX-II scored higher than XX-I in conscientiousness; and XX-II scored higher than XX-III in emotional stability. No other tested BIP dimensions showed statistically significant group differences.

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Table 4. One-way ANOVA results for group differences in BIP dimensions (XX-I, XX-II, XX-III)

Dimension	XX-I M(SD)	XX-II M(SD)	XX-III M(SD)	F(2,115)	p	η^2	Post-hoc (Tukey)
Decisiveness	54.30 (9.66)	63.15 (8.94)	62.26 (8.01)	11.89	< .001	.171	XX-II > XX-I; XX-III > XX-I
Sociability	58.00 (7.57)	63.12 (8.85)	64.16 (7.78)	6.56	.002	.102	XX-II > XX-I; XX-III > XX-I
Stress resistance	54.72 (7.90)	59.65 (9.21)	52.89 (9.11)	6.26	.003	.098	XX-II > XX-I; XX-II > XX-III
Conscientiousness	57.32 (9.44)	63.92 (7.44)	59.21 (13.13)	4.42	.014	.071	XX-II > XX-I
Emotional stability	62.05 (11.81)	65.53 (18.58)	54.39 (20.54)	4.19	.018	.068	XX-II > XX-III

Note. *Values are standardized BIP scores (approx. T-scores; normative mean ≈ 50, SD ≈ 10). XX-I = cadets without practical leadership experience (n = 40), XX-II = commanders with short-term managerial experience (n = 40), XX-III = senior officers with long-term managerial and command experience (n = 38). η^2 = eta squared (effect size). Post-hoc comparisons were conducted using Tukey's HSD test. Only statistically significant post-hoc differences are reported. M = mean; SD = standard deviation*.

Group description

XX-I (Cadets).

Cadets displayed mean scores around the normative average in achievement motivation (M = 56.78, SD = 7.21) and leadership motivation (M = 55.10, SD = 10.15). Conscientiousness was lower than in the two more experienced groups (M = 57.32, SD = 9.44). In the domain of social competencies, sociability (M = 58.00, SD = 7.57) and contact ability (M = 50.53, SD = 8.82) were lower than in the more experienced groups. Emotional stability (M = 62.05, SD = 11.81) and stress resistance (M = 54.72, SD = 7.90) were in the moderate range.

XX-II (Commanders with short-term experience).

Commanders with short-term experience showed higher conscientiousness (M = 63.92, SD = 7.44) and decisiveness (M = 63.15, SD = 8.94) compared to cadets. Sociability (M = 63.12, SD = 8.85) and contact ability (M = 52.75, SD = 8.51) were also higher than in XX-I. This group exhibited the highest mean levels of emotional stability (M = 65.53, SD = 18.58) and stress resistance (M = 59.65, SD = 9.21) among the three groups.

XX-III (Senior officers with long-term experience).

Senior officers demonstrated the highest mean level of sociability (M = 64.16, SD = 7.78) and higher contact ability (M = 54.24, SD = 11.59) and team orientation (M = 56.16, SD = 10.18) compared to the other groups. Conscientiousness (M = 59.21, SD = 13.13) and decisiveness (M = 62.26, SD = 8.01) remained elevated. Emotional stability (M = 54.39, SD = 20.54) and stress resistance (M = 52.89, SD = 9.11) were lower than in XX-II.

Comparative Analysis of Results (XX-I vs. XX-II vs. XX-III)

Overall, the results indicated group differences primarily in decisiveness, sociability, and conscientiousness, as well as in selected indicators of psychological constitution (emotional stability and stress resistance) (Table 4). The pattern was partly monotonic for social-competence dimensions—most notably sociability, with higher mean scores in the more experienced groups—whereas psychological constitution dimensions did not follow a monotonic trend across the three career stages.

Compared with cadets (XX-I), commanders with short-term experience (XX-II) scored significantly higher in decisiveness, sociability, stress resistance, and conscientiousness. This group also exhibited the highest mean levels of emotional stability among the three groups. In contrast, senior officers (XX-III) scored significantly higher than XX-I in decisiveness and sociability, but their mean levels of stress resistance and emotional stability were lower than those observed in XX-II, with XX-II scoring significantly higher than XX-III on both indicators.

Taken together, the comparative results suggest that decisiveness and sociability differentiate cadets from both experienced groups, whereas conscientiousness and stress-related indicators show a more specific pattern in which the short-term commander group (XX-II) differs from either cadets (XX-I) or senior officers (XX-III). These findings are consistent with the correlational results, which showed the strongest associations between experience level and sociability and decisiveness, and a smaller but significant association with conscientiousness.

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5. Discussion

The aim of this study was to examine associations between the level of managerial experience in leading people and personality characteristics relevant to leadership in the armed forces. Across the three career-stage groups (XX-I, XX-II, XX-III), the results indicated differences primarily in selected social-competence and work-style dimensions, most consistently sociability, decisiveness, and conscientiousness. In contrast, indicators of psychological constitution (emotional stability and stress resistance) did not follow a monotonic pattern across the career stages and appeared to differentiate groups in a more complex way.

The most robust pattern concerned sociability and decisiveness. Both dimensions showed significant between-group differences, with post-hoc tests indicating that XX-II and XX-III scored higher than XX-I, and they also demonstrated the strongest positive monotonic associations with experience level in correlational analysis. This convergence across descriptive, ANOVA, and correlational results suggests that experience level is reliably associated with higher standing on interpersonal confidence and decision-related tendencies captured by the BIP. These findings align with evidence that in high-demand environments, leader effectiveness relies heavily on social influence processes and rapid decision-making under uncertainty (Hannah et al., 2009). They are also compatible with research indicating that leader behaviors which strengthen cohesion and collective functioning are particularly important in military teams (García-Guiu et al., 2016), implying that socio-interactional capacities may become more salient as individuals progress into roles with higher responsibility.

A smaller but consistent association was observed for conscientiousness. Conscientiousness differed significantly between groups (with XX-II higher than XX-I) and was positively associated with experience level. This pattern is consistent with the idea that professional role demands and accountability may be linked to more pronounced work-discipline and structured work behavior over time, which is in line with broader leadership evidence highlighting the relevance of conscientiousness-related characteristics for leadership outcomes (Judge et al., 2002). Importantly, given the cross-sectional design, the findings should be interpreted as differences across career-stage groups rather than within-person developmental change.

Results for psychological constitution were notably non-linear. While one-way ANOVA indicated significant group differences in stress resistance and emotional stability, the direction of differences did not reflect a simple increase with experience. Instead, XX-II displayed the highest mean levels on both indicators, scoring higher than XX-I in stress resistance and higher than XX-III in both emotional stability and stress resistance. Correlational analysis did not support a monotonic association between experience level and either dimension. This pattern suggests that stress-related resources captured by the BIP may be more sensitive to current role demands, selection into positions, or contextual factors than to experience length alone. Such a conclusion is consistent with the broader view that the relationship between personality-related characteristics and leadership outcomes is context-dependent and may be shaped by mediating behavioral processes and situational constraints (Javalagi et al., 2024). In practical terms, these findings caution against assuming that resilience-related characteristics automatically strengthen with seniority and instead support the need for ongoing monitoring and targeted support at different command levels.

Regarding motivational dimensions, achievement motivation did not show a strong increasing pattern across the groups in descriptive results, and it was not significantly related to experience level in correlational analysis. This is compatible with the notion that motivational and stress-related processes may operate relatively independently, particularly in early career phases (Sefidan et al., 2021), and reinforces the importance of distinguishing between motivation-oriented and stress-regulation-oriented aspects of leadership readiness. Overall, the observed pattern is compatible with leader development perspectives emphasizing cumulative exposure, feedback, and role internalization as career progresses (Day et al., 2014), while also indicating that not all leadership-relevant dispositions vary in the same direction across stages.

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Verification of Research Questions and Hypotheses

RQ1 (group differences). RQ1 was supported for a subset of BIP dimensions. One-way ANOVA showed statistically significant group differences in decisiveness, sociability, stress resistance, conscientiousness, and emotional stability, while other dimensions did not demonstrate significant between-group differences.

RQ2 (relationship between experience and BIP dimensions). RQ2 was addressed using correlational analysis with managerial experience operationalized as an ordinal variable. Statistically significant positive associations with experience level were confirmed for sociability, decisiveness, and conscientiousness, whereas emotional stability and stress resistance did not show significant monotonic associations. This suggests that experience level is most consistently related to selected socio-interactional and work-style dimensions, while stress-related characteristics may vary in a non-monotonic manner across career stages.

Tabular Evaluation of Hypotheses

Table 5. Evaluation of hypotheses – statistical tests (ANOVA + correlation)

Hypothesis	BIP dimension	F(2,115)	p	η^2	ρ	p (ρ)	Conclusion
H1	Sociability	6.56	.002	.102	0.362	< .001	supported
H1	Decisiveness	11.89	< .001	.171	0.352	< .001	supported
H1	Conscientiousness	4.42	.014	.071	0.230	.012	supported
H2	Emotional stability	4.19	.018	.068	0.027	.773	not supported (no monotonic association)
H3	Stress resistance	6.26	.003	.098	−0.109	.242	not supported (no monotonic association)

Table 5 summarizes the hypothesis tests combining between-group comparisons (one-way ANOVA) and monotonic associations with experience level (Spearman's ρ). Hypothesis H1 was supported for sociability, decisiveness, and conscientiousness: all three dimensions showed statistically significant group differences and significant positive associations with experience level. In contrast, H2 and H3 were not supported as monotonic hypotheses: although emotional stability and stress resistance differed between groups, their associations with experience level were non-significant, indicating that these dimensions do not follow a simple monotonic pattern across the three career stages.

Table 6. Post-hoc comparisons for significant ANOVAs (Tukey HSD)

Dimension	Significant comparison	Direction	p (Tukey)
Decisiveness	XX-II vs. XX-I	XX-II > XX-I	< .001
Decisiveness	XX-III vs. XX-I	XX-III > XX-I	< .001
Sociability	XX-II vs. XX-I	XX-II > XX-I	.015
Sociability	XX-III vs. XX-I	XX-III > XX-I	.003
Stress resistance	XX-II vs. XX-I	XX-II > XX-I	.035
Stress resistance	XX-II vs. XX-III	XX-II > XX-III	.003
Conscientiousness	XX-II vs. XX-I	XX-II > XX-I	.013
Emotional stability	XX-II vs. XX-III	XX-II > XX-III	.015

Post-hoc analyses using Tukey's HSD specified the group pairs responsible for the significant omnibus ANOVA effects. For decisiveness and sociability, both experienced groups (XX-II and XX-III) scored higher than cadets (XX-I). For stress resistance and emotional stability, the short-term commander group (XX-II) scored higher than senior officers (XX-III), and stress resistance was also higher in XX-II than in XX-I. Conscientiousness differed primarily between XX-II and XX-I, with higher scores observed in XX-II.

Link to Military Leadership Theories and Personality Development

The observed associations between experience level and sociability, decisiveness, and conscientiousness are consistent with models of military leadership emphasizing the importance of social influence, decisiveness, and disciplined work behavior in high-accountability environments (Hannah et al., 2009). They are also compatible with transformational leadership theory, which highlights the role of leaders in inspiring, motivating, and

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/s9849866932

guiding followers through interpersonal influence and exemplary conduct (Bass, 1990). These findings further align with broader evidence that traits related to social interaction and responsibility are among the more consistent correlates of leadership-related outcomes, while the strength of trait–leadership relationships can vary as a function of context and leadership level (Javalagi et al., 2024). Importantly, because the present study is cross-sectional, the results should be interpreted as differences across career-stage groups and experience levels rather than direct within-person developmental change.

Conclusion

This study examined associations between managerial experience in leading people and leadership-relevant personality characteristics in the Armed Forces of the Slovak Republic. By comparing three career-stage groups (XX-I cadets, XX-II commanders with short-term experience, and XX-III senior officers with long-term experience), the study identified systematic differences in selected Bochum Personality Inventory (BIP) dimensions and clarified which characteristics are most consistently linked to experience level.

Across analyses, the most consistent results concerned sociability, decisiveness, and conscientiousness. These dimensions showed significant between-group differences and significant positive monotonic associations with experience level. Post-hoc comparisons further indicated that decisiveness already differentiated cadets from the two more experienced groups, whereas sociability differentiated cadets from both experienced groups and reached the highest mean levels among senior officers. Together, these patterns suggest that experience level is most reliably associated with socio-interactional confidence, decision-related tendencies, and selected work-style characteristics relevant to military leadership. Kane and Tremble (2000) showed that while at lower levels of leadership transformational leadership has a stronger impact on subordinate motivation and individual performance, at higher levels its effect shifts toward managing social relationships, shaping climate, and coordinating complex organizational processes. This shift is consistent with the results of the present study, in which senior officers exhibited stronger socio-interactional competencies and a more stabilized work style.

In contrast, dimensions of psychological constitution—particularly emotional stability and stress resistance—did not display a simple monotonic pattern across career stages. While both variables differed significantly between groups, the short-term commander group (XX-II) showed the highest mean values, and correlational analysis did not support a monotonic association with experience. These findings indicate that resilience-related characteristics assessed by the BIP may depend not only on experience length but also on contextual and role-related demands, selection effects, and current workload. From an applied perspective, this supports treating resilience and self-regulation as ongoing developmental targets across command levels rather than assuming they increase automatically with seniority.

From a theoretical standpoint, the study contributes empirical evidence that leadership-relevant personality characteristics do not vary uniformly across career stages. Instead, some socio-interactional and work-style dimensions show clearer experience-related differentiation, whereas stress-related resources may fluctuate across roles. Practically, the results support a stage-sensitive approach to leader development: strengthening interpersonal competencies and decision-making confidence early in training, supporting disciplined work routines and decision-making processes during the transition into command roles, and ensuring systematic support for self-regulation and resilience in positions with higher responsibility.

The study is limited by its cross-sectional design, which precludes causal inferences and direct conclusions about within-person change over time. Future research should therefore employ longitudinal designs and combine self-report measures with external criteria of leadership effectiveness (e.g., supervisor ratings, 360-degree feedback, or performance indicators). Such work would help clarify the mechanisms through which experience relates to leadership-relevant characteristics and outcomes in military contexts.

Overall, managerial experience in the armed forces is associated with measurable differences in several personality dimensions closely linked to leadership functioning. The findings provide an empirical basis for refining selection and development practices and highlight priorities for further research on leadership dynamics in military settings.

Practical Implications

The results have implications for the selection, education, and development of leaders in the armed forces. Dimensions that show the most pronounced developmental trends (especially sociability, decisiveness, and conscientiousness) may serve as indicative markers when planning developmental programs and assessing readiness for command positions. At the same time, the findings suggest that not all personality characteristics increase automatically with experience, which supports the need for targeted and individualized work with leadership potential (e.g., training in interpersonal competencies, mentoring, decision-making under stress training).

Research Limitations and Directions for Future Research

The main limitation is the cross-sectional design, which does not allow conclusions about within-person change over time. Future research should employ longitudinal designs to examine whether the observed differences reflect developmental trajectories or cohort/selection effects. Further, expanding the sample to additional command levels and occupational specializations could clarify whether patterns differ across functional roles. Finally, combining self-report measures with multi-source assessments (e.g., supervisor ratings, peer ratings, 360-degree feedback, or performance indicators) would provide a more comprehensive picture of leadership development and its relationship to personality characteristics. A further limitation is the absence of systematically collected demographic data (e.g., age, gender, length of service), which prevents controlling for potential confounding effects of these variables.

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ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/s9849866932

Data Availability Statement: More information and data can be obtained from the authors on a reasonable request.

Author Contributions: The authors contributed equally, they have read and agreed to the published version of the manuscript.

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/z2766334336

Publisher
http://jssidoi.org/esc/home

FINANCIAL INCLUSION AND THE SAVINGS CULTURE OF LOW-INCOME EARNERS

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Received 10 January 2026; accepted 23 March 2026; published 30 June 2026

Abstract. The study examined the role of financial inclusion in building a savings culture among daily low-income earners in Enugu State, Nigeria. The survey period is from April 20 to May 25, 2025. The study population consisted of 510 registered tri-cycle operators. 241 tricycle operators were randomly selected from three suburban settlements in Enugu State, Nigeria: Emene, Ninth Mile, and Orba. The questionnaire was the primary instrument for data collection. Data were analysed by means of descriptive statistics– mean percentages, frequency counts and charts. Postulated hypotheses were tested using the chi-square test statistic at the 0.05% level of significance. Variables of interest were: bank account ownership, awareness created by financial institutions, proximity of banks, availability of credits, as they relate to the building of a savings culture among daily income earners. Results show that having a bank account was not sufficient to build a savings culture ($P \leq 0.05$). Secondly, the awareness created by banks aimed at financial inclusion did not positively influence the savings culture ($P \leq 0.05$). It was also found that the proximity of banks' branches did not enhance savings habits of daily income earners ($P \leq 0.05$). Most low-income earners, instead of using banks, used ubiquitous Point of Sale (POS) operators and other non-bank locations. Finally, credit advancements were not common among the daily income earners. Against this background, it is concluded that efforts toward financial inclusion by Nigeria's Apex bank and the commercial banks are not deep or all-encompassing, as the available banking opportunities do not enthuse low-income earners. It is thus recommended that the financial inclusion net be directed towards promoting a savings culture in general, including daily income earners in particular.

Keywords: banks; daily income earners; financial inclusion; savings; tricycle operators

Reference to this paper should be made as follows: Umoh, B., Miszczak, K., Kenechukwu, N., Krivins, A., Etalong, T. 2026. Financial inclusion and the savings culture of low-income earners. *Entrepreneurship and Sustainability Issues*, 13(4), 105-118. http://doi.org/10.9770/z2766334336

JEL Classifications: G21, D14, O16

1. Introduction

Savings are crucial for individuals and households, as they provide financial security, hedge against risks, and generate capital for investments, which, in turn, support national productivity and poverty reduction. While salaried workers are more easily integrated into the financial system due to mandatory bank accounts, many self-employed Nigerians, particularly daily income earners, remain financially excluded.

Daily income earners, such as tricycle operators in Enugu State, handle significant cash flows but are neither obliged to open bank accounts nor adequately reached by financial awareness campaigns. Although their

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/z2766334336

activities are government-regulated, a poor savings culture persists due to limited financial literacy, a preference for cash, and the weak impact of credit programmes. A significant challenge is that most assessments of financial inclusion emphasise supply-side indicators (e.g., bank branches, ATMs, fintech agents, loan disbursements) rather than actual usage and sustainability of savings (Kiran, 2018). Furthermore, despite interventions such as Sure-P, YouWin, and Conditional Cash Transfers, their long-term effect on building savings culture among small businesses remains questionable. Given these gaps, this study examines the role of financial inclusion in shaping the savings culture of daily income earners, with a focus on tricycle operators in selected suburban communities of Enugu State.

The following were the guiding research questions for the study:

1. To what extent has ownership of bank accounts affected the savings culture of daily income earners in select suburban areas of Enugu State, Nigeria?
2. To what extent has awareness of financial inclusion enhanced the savings capabilities of daily income earners in select suburban areas of Enugu State, Nigeria?
3. To what extent has the proximity of banks, agents, and other formal financial services providers enhanced the culture of saving among daily income earners in select suburban areas of Enugu State, Nigeria?
4. To what extent has access to credit facilities affected the savings habits of daily income earners in select suburban areas of Enugu State, Nigeria?

This study has both general and specific objectives. The overall aim of the study is to analyse the effect of financial inclusion on the savings culture of daily income earners in select suburban areas of Enugu State, Nigeria. The specific objectives are:

1. To determine the number of daily income earners in select suburban areas of Enugu State, Nigeria, who maintain a savings culture through ownership of a bank account.
2. To ascertain the number of daily income earners in select suburban areas of Enugu State, Nigeria, who maintain a savings culture, given the level of awareness resulting from financial inclusion drives.
3. To examine the number of daily income earners in select suburban areas of Enugu State, Nigeria, who maintain savings culture as a result of proximity to banks, and/or their agents.
4. To determine the number of daily income earners in select suburban areas of Enugu State, Nigeria, who maintain a savings culture, given their previous credit.

The following hypotheses are formulated to guide the study:

$H0_1$: There is no significant difference in the number of daily income earners in select suburban communities of Enugu State, Nigeria, who maintain a savings culture by owning accounts.

$H0_2$: There is no significant number of daily income earners in select suburban communities of Enugu State, Nigeria, who maintain a savings culture as a result of awareness of financial inclusion.

$H0_3$: There is no reasonable number of daily income earners in select suburban areas of Enugu State, Nigeria, who maintain a savings culture due to proximity to banks, and/or their agents.

$H0_4$: There is no significant difference in the number of daily income earners in select suburban areas of Enugu State, Nigeria, who maintain savings culture as a result of their previous credit experiences.

2. Review of Literature

Financial inclusion and a savings culture are key factors in the economic resilience of low-income groups, particularly in emerging economies. For households with unstable incomes and those employed in the informal sector, limited access to formal financial institutions significantly impacts their ability to accumulate savings and withstand financial shocks. Recent literature emphasises that the savings behaviour of these groups is shaped by a combination of economic, institutional, behavioural, and technological factors (Kum et al., 2024; Masha & Fihla, 2025).

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http://doi.org/10.9770/z2766334336

Research on financial shocks and savings in Africa shows that income instability negatively impacts savings rates even among the middle class. Using FinTech data, Abubakar et al. (2025) conclude that digital financial instruments can partially mitigate the impact of financial shocks by expanding access to savings products. In a macroeconomic context, Rehman et al. (2024) emphasise that gross domestic savings are an important prerequisite for long-term economic growth, and low household savings rates in developing countries reflect structural problems with financial inclusion.

The role of financial literacy in shaping a savings culture has received considerable attention in the literature. Using Ghana as an example, Adu and Peprah (2025) demonstrate that attitudes toward savings and financial literacy mediate the relationship between current poverty and the intergenerational transmission of economic vulnerability. Empirical studies in various contexts confirm a robust positive relationship between financial knowledge and the propensity to save. Ananda, Kumar, and Dalwai (2024) show that high levels of financial confidence and risk aversion enhance the impact of financial literacy on saving behaviour. Similar findings are reported in studies of farmers in India (Das & Maji, 2023) and of rural women entrepreneurs in Africa (Ogundare et al., 2024), where self-control and behavioural characteristics serve as essential mediators between knowledge and actual financial decisions. Harvey and Urban (2023) extend these results, confirming the long-term effect of financial education on savings behaviour, including retirement savings.

In recent years, digital technologies have played a vital role in expanding financial inclusion. A cross-country analysis by Başar et al. (2025) shows that digital financial literacy and FinTech adoption are positively associated with individual savings rates. These results are consistent with those of Abubakar et al. (2025), highlighting the potential of mobile financial services to reduce transaction barriers for low-income groups. For informal sector workers, digital channels often become the primary gateway to the financial system, enabling them to accumulate regular micro-savings even with low and unstable incomes.

In addition to formal institutions, informal and semi-formal mechanisms play a significant role in savings behaviour. Comola and Prina (2023) demonstrate, based on a field experiment, that combining formal savings accounts with networked and social financial mechanisms increases savings rates. The roles of cooperatives and savings and credit associations are examined in detail in the works of Flores-Chia and Mougenot (2023) and Kamau et al. (2024), who emphasise the importance of trust, member participation, and deposit structures for the sustainability of such institutions. Research on microsavings and self-help groups occupies a special place in the literature. A review by Rupa and Parimalarani (2025) shows that participation in microsavings groups not only promotes savings but also enhances financial stability, social cohesion, and households' ability to cope with unexpected expenses. These forms of savings are particularly popular among informal workers, who are often excluded from traditional banking products.

Along with economic and institutional factors, the literature emphasises the importance of behavioural and expectant aspects. Pavlo and Dariia (2023) show that ideological attitudes and trust in economic institutions influence long-term savings decisions. Jing et al. (2025) complement this approach, demonstrating that expectations of future consumption, including in retirement, shape not only the amount of savings but also the structure of household financial assets.

Many studies have examined the effects of financial inclusion, especially 'Savings', on poverty, economic growth, and overall development. Conversely, fewer works have been done on savings culture and its interplay with the various offerings of financial inclusion being studied, namely: account ownership, awareness creation, proximity, and credit. They are all reviewed hereunder to demonstrate the existing gap this work attempted to fill.

In recent decades, financial inclusion has emerged in the academic and applied economics literature as a key factor in economic development, poverty reduction, and increased social resilience, particularly among low-income populations. Financial inclusion is generally understood as the ability of broad segments of the population to obtain and use formal financial services - such as bank accounts, loans, payment instruments, and savings products - on affordable and sustainable terms. Recent research shows that expanding financial

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/z2766334336

inclusion not only improves household well-being but also has systemic impacts on macroeconomic dynamics, financial stability, and institutional development. From an economic growth perspective, financial inclusion is viewed as an essential transmission channel between financial development and the real economy. In this context, the study by Kanga et al. (2022) makes a significant contribution by analysing the relationship between the diffusion of financial technologies, financial inclusion, and per capita income. The authors demonstrate that the diffusion of fintech innovations enhances financial inclusion and has a positive long-term impact on income levels, particularly in countries with emerging financial markets. These results support the thesis that the digitalisation of financial services reduces transaction costs and entry barriers for low-income groups, thereby promoting more inclusive economic growth.

The link between financial inclusion and poverty reduction is one of the most consistently supported in the empirical literature. Huong and Ha (2021) demonstrate that increasing financial inclusion has a statistically significant impact on poverty reduction across different income thresholds. The authors emphasise that access to formal financial services allows households to more effectively smooth consumption, invest in human capital, and reduce vulnerability to economic shocks. Similar findings are presented in a more recent study by Saka, Gan and Hu (2025), which analyses the impact of financial inclusion not only on poverty but also on income inequality. Their results suggest that financial inclusion simultaneously reduces poverty and mitigates income inequality, particularly in low- and middle-income countries.

Using banking data from Asian countries (Vo et al., 2021) conclude that increased financial inclusion can enhance financial stability by diversifying the deposit base and increasing bank resilience to shocks. Similar results were obtained by Atellu and Muriu (2022) in an emerging economy, where increased financial inclusion is associated with improved financial stability indicators. These studies refute widespread concerns that including low-income clients necessarily increases systemic risks and demonstrate that, with adequate regulation, financial inclusion can be a stabilising factor.

Along with macroeconomic effects, the literature emphasises the importance of institutional and governance factors in shaping financial inclusion. Tran and Dinh (2021), using micro-level data from rural areas in Vietnam, demonstrate that the quality of provincial governance significantly influences household financial inclusion. This supports the more general conclusion that financial inclusion cannot be considered in isolation from the institutional environment. Along similar lines, Durguti et al. (2024) demonstrate that the quality of public governance and the rule of law significantly impact economic growth in developing economies, thereby creating favourable conditions for the successful implementation of financial inclusion programs.

The literature pays special attention to the determinants of financial inclusion. Mose and Thomi (2021) identify factors such as income level, education, infrastructure, and institutional quality, emphasising their complementary nature. These findings are also reflected in studies on informal financial institutions. Kamran & Uusitalo (2024) show that informal financial institutions play an essential role in expanding financial inclusion among the unbanked and low-income population by acting as a bridge between the formal financial sector and vulnerable groups.

Finally, contemporary research is increasingly addressing the cultural aspects of financial inclusion. Bertrand and Ghassem (2026) emphasise that cultural heterogeneity influences the degree of population participation in formal financial systems and, therefore, should be taken into account when developing financial inclusion policies. This finding complements economic and institutional approaches, underscoring the need for a more comprehensive, context-sensitive understanding of financial inclusion. Taken together, the studies reviewed confirm that financial inclusion is a powerful tool for promoting economic development and poverty reduction, particularly among low-income groups. However, its effectiveness depends on a combination of technological, institutional, governance, and cultural factors, underscoring the need for further interdisciplinary research in this area.

No doubt sound monetary and fiscal policies sustained over time lead to durable economic growth. This is why governments enact policies that ensure an inclusive economy. The various countries showed that, though

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http://doi.org/10.9770/z2766334336

financial inclusion may have become a general phenomenon, its nature, form, and challenges differ across jurisdictions and, as such, cannot be addressed by a single "one size fits all" product approach. They further reviewed past and present efforts to promote financial inclusion in Nigeria and found that there has been limited achievement of significant expansion in the level of financial inclusion. People's uniqueness in culture, environment, academic background, colour, institutions, and politics must be considered when formulating financial inclusion policies (Krivins & Vilks, 2013; Krivins, 2019).

Stiffer or poorly enforced regulations by the CBN on banks give rise to excessive charges on customers. There are existing statutory deductions imposed by the Central Bank, which affect the rates banks charge customers for loans and deposits. Victims of Internet fraud often lead counter-campaigns, which erode public confidence, in addition to the actual financial loss. It has profound reputational and security implications for countries' images. Studies have been carried out in the areas relating to the variables investigated in this study, namely: Bank Account ownership; Awareness creation through Financial Inclusion; Proximity of Financial services providers to people; and Access to Credits. First of all, to what extent can it be argued that ownership of a bank account is both necessary and sufficient for suburban dwellers to maintain a savings culture? Special focus should be given to the charges the banks take from customers' accounts. It will help to build a savings culture.

Regarding the effect of financial inclusion awareness on savings culture among suburban dwellers, the question is to what extent is financial inclusion knowledge sufficient to foster savings? Also, what are the dimensions of financial inclusion awareness (financial literacy)? Spontaneous decisions about which bank and its products, as well as the frequency of savings, can supersede sound financial knowledge. Factors such as proximity, convenience, celebrity endorsements, and weather conditions can guide clients' decisions. Regarding the effect of bank proximity on people's ability/willingness to save, it is established that reductions in the cost of finance and convenience can increase ability and willingness to save. Hence, banks, through their agents, also known as branchless and mobile banking, have played a key role in extending savings opportunities to people who are far removed from banks.

Branchless banking has significant potential to expand access to financial services for poor people who are not reached by traditional branch networks. It lowers the cost of delivery, including costs for the construction of the banks, the queuing period, and channel/account services (charges). However, it was observed that bank customers (Mehmeti et al., 2024) primarily make payments and send transfers, even when branches are close by or mobile banking is available. Many people either time their deposits to coincide with bill payments or cash withdrawals, leaving their accounts with a near-zero balance, or they do not even open a savings account at all. Hence, how much customers save by making branchless banking transactions is still an area under investigation.

The financial crises that resulted from those reforms, the reversals in several policy measures, and the general instability in the practical and economic environments had a very adverse impact on the functioning of the financial system, including difficulties in obtaining credit for poor credit users. The formal banking system still faces constraints in reaching dispersed poor clients due to a lack of improved service infrastructure. Formal lending is highly collateralised and attracts high interest rates. Due to poor credit bureaus (databases used to assess potential borrowers), formal institutions make credit inaccessible to people with low incomes by requiring collateral. However, with modern technology, customers can access loans online and without collateral; however, the amounts made available are based on customers' previous deposit activities in the bank (including salaries), thereby denying non-existent customers, such as daily income earners, the opportunity to improve their poverty situations. The studies reviewed demonstrate that savings culture among low-income groups is shaped by a complex interplay of financial literacy, access to financial services, digital technologies, social institutions, and behavioural factors. Despite the broad geographic scope of existing studies, the savings behaviour of informal transport sector participants remains understudied, underscoring the need for further empirical research in this area.

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3. Materials and Methods

The analytical cross-sectional survey research design was adopted for the study. The design choice is based on the fact that the research centres on people's behaviour and its relationship with job type and daily income.

The study population consisted of all daily income earners, represented by tricycle operators domiciled within the study area. The number of tricycle operators used includes Emene (250), Ninth Mile Ngwo (145), Orba (115).
Total = 510. Source: Associations' registers.

The study's sample size was 241 respondents. Specifically, 219 respondents were obtained using the Cochran's formula, while 22 respondents were added for 10% attrition:

$$n_0 = \frac{Z^2 p(1-p)}{e^2} = \frac{1.96^2 x\ 0.5(1-0.5)}{0.05^2} = 384.16 \cong 384\ student$$

Cochran formula correction for finite population

$n = \frac{n_0}{1+\frac{n_0-1}{N}} = \frac{384}{1+\frac{384-1}{509}} = 219.1 \cong 219\ respo$10% of 219 respondents (added for attrition) is approximately 22 respondents. The sample size for this research is therefore 241 respondents.
Where n_0 = sample size for a non-finite population
Z = Z-score associated with the 95% confidence interval
p = proportion of the population with an attribute of interest
e = error limit or margin of error, this is usually at 5% or 0.05.
N = Total population under study
n = sample size based on a finite population

A random sampling technique was used to select tricycle operators from Emene, Ninth Mile Corner, and Orba communities in Enugu State.

Questionnaires were used to gather primary information needed for the study. The questionnaire was designed with some questions open-ended and others closed-ended.

The data collection instrument was subjected to face and content validation by test and measurement experts and lecturers at the Institute for Development Studies (IDS), University of Nigeria, Enugu Campus. A Cronbach's Alpha Coefficient of 0.85 was obtained.

The chi-square test was used to test all the hypotheses at the 95% level of significance.
Mathematically, the chi-square was given thus:

$$X_c^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

Where: "c" is the degrees of freedom; "O" is the observed value, and "E" is the expected value.

4. Findings and Discussion

Demographic Characteristics of Respondents
The respondents were grouped by age, gender, marital status, educational level, location of operation, period in business, and ownership arrangement. These demographic characteristics are presented as follows (see Table 1 below).

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Table 1. Demographic Characteristics of the Daily Income Earners; n = 238

	Frequency	Percent	M±SD
Age			38.33±9.68
- 15-25	12	5.0	
- 26-35	90	37.8	
- 36-45	88	37.0	
- 46-55	33	13.9	
- 56 and above	15	6.3	
Gender			
- Male	231	97.1	
- Female	7	2.9	
Marital status			
- Married	164	68.9	
- Single	69	29.0	
- Divorced	3	1.3	
- Widowed	2	0.8	
Educational level			
- Primary	33	13.9	
- Secondary	143	60.1	
- Tertiary	55	23.1	
- No school	7	2.9	
Location of operation			
- Emene	117	49.2	
- Orba	65	27.3	
- 9th mile	56	23.5	
How long have you been in the business?			
- Less than a year	39	16.4	
- 2-5 years	123	51.7	
- 6 years and above	76	31.9	
Under what arrangement do you operate			
- Owned by you	154	64.7	
- Hire purchase	84	35.3	

Source: Field survey 2025

Table 1 shows the demographic characteristics of the daily income earners. The mean age was 38.33 years, with a modal age group of 26-35 years (37.8%). Most were male (97.1%) and married (68.9%), and 60.1% had secondary education. Most respondents (65%) owned a tricycle and had been in the business for 2-5 years (51.7%).

Bank account ownership and savings culture of daily income earners in select suburban areas of Enugu state, Nigeria

Table 2. Ownership of Account and the Savings Culture of Daily Income Earners; n = 238

	Frequency	Percent
Do you have a bank account		
- Yes	232	97.5
- No	6	2.5
What type of account do you have (n = 232)		
- Savings	216	93.1
- Current	36	15.5
- Fixed deposit	3	1.3
What kind of savings account do you operate (n = 232)		
- Individual	222	95.7
- Joint	8	3.4
- Household/family	4	1.7
How many years now have you owned a bank account (n = 232)		
- 5 years and below	56	24.1
- 6-10 years	66	28.4
- 11-15 years	56	24.1
- 16 years and above	54	23.3
How frequently do you use your bank account (n = 232)		
- Daily	71	30.6

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- Weekly	40	17.2
- Monthly	19	8.2
- Irregularly	102	44.0
What is your preferred banking operations channel (n = 232)		
- Visit to the bank	49	21.1
- Mobile/internet banking	34	14.7
- POS agent	188	81.0
Do you operate a separate personal savings account different from your business account (n = 232)		
- Yes	76	32.8
- No	156	67.2
How often do you set aside money as savings in the bank (n = 232)		
- Daily	70	30.2
- Weekly	62	26.7
- Monthly	17	7.3
- Irregularly	83	35.8
Are you satisfied with your savings plan (n = 232)		
- Greatly satisfied	76	32.8
- A bit satisfied	61	26.3
- Not satisfied	95	40.9
Does having a bank account help you to save money (n = 232)		
- Yes	208	89.7
- No	24	10.3
Which of these is true about your saving culture (n = 232)		
- Having a bank account has made me save more money	203	87.5
- Having a bank account has not necessarily made me save more money	29	12.5

Source: Field survey 2025

From data in Table 2, it is evident that nearly all daily income earners (97.5%) had a bank account. The types of accounts owned were mostly savings (93.1%) and individual (95.7%). The respondents had owned the accounts for more than 5 years (75.9%). The use of the account was irregular (44.0%). The most preferred banking channel among account owners was POS agents (81.0%). Not many had a separate personal savings account different from a business account (32.8%). Results of this study show that almost all daily income earners have bank accounts (97.5%), with savings accounts dominating (93%). The majority of them owned the accounts for over 5 years (75.9%). However, their account usage frequency was mainly irregular (44%), rather than daily, weekly, or monthly. This raises the question of the level of savings consciousness among the daily income earners. It further validates the view that financial inclusion may be focusing campaigns on account ownership. Still, the absence of policies that promote and sustain a savings culture at the individual, household, community, and national levels has adverse effects.

Awareness creation by Apex Government Banks of bank account ownership

Table 3. Awareness of Financial Inclusion Enhanced the Savings Capabilities of Daily Income Earners; n = 238

	Frequency	Percent
Would you say that banks/agents and the central bank (CBN) provide sufficient awareness of the need to operate a savings account		
- Yes	56	23.5
- No	171	71.8
- Can't say	11	4.6
Would you say that banks' staff/agents and the CBN provide enough awareness on the need to save regularly		
- Yes	52	21.8
- No	174	73.1
- Can't say	12	5.0
Do you think that the banks and their staff guide you through complicated areas of banking		
- Yes	83	34.9
- No	122	51.3
- Can' say	33	13.9
Does awareness or advertising of the need to have savings help you to maintain a savings culture		
- Yes	80	33.6
- No	158	66.4

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http://doi.org/10.9770/z2766334336

Which of these is true about your savings culture		
- Awareness of the need to save has made me save more	68	28.6
- Awareness of the need to save has not necessarily made me save more	170	71.4
What are your primary sources of awareness on the need to have a savings culture		
- Fliers	12	5.0
- Bank personnel/agent	40	16.8
- TV, radio, newspaper	21	8.8
- Social media/internet	30	12.6
- Friends and family	97	40.8
- Education	1	0.4
- Personal decision	2	0.8
- Work	7	2.9
- None	40	16.8

Source: Field survey 2025

Data in Table 3 show that the most common source of awareness of the need to save was friends and family (40.8%). Few daily income earners reported that banks/agents and the Central Bank of Nigeria (CBN) provided sufficient awareness of the need to operate a savings account (23.5%). Neither did banks and their staff guide customers through complicated areas of banking (34.9%). For the majority, awareness or an advert on the need to save never helped them maintain a savings culture (66.4%); awareness never necessarily made them save more (71.4%).

This agrees with the findings of Ilo (2020), who found in his study that only 17% of respondents aged 55 and above are aware of the availability and services of digital banks, while for those aged 41-54, the awareness rate stood at 31%. The linkage between awareness levels and account ownership, and, by extension, savings culture, is laid bare in this work. This aligns with the work of Adetunji and David-West (2019), who found that financial literacy influences savings patterns through both formal and informal financial institutions. Morgan and Trinh (2019) similarly found that financial literacy is positively associated with financial inclusion and savings.

Banks' proximity and savings habits of daily income earners in Enugu state, Nigeria

Table 4. Proximity of Banks, Agents and Other Formal Financial Services and Savings Habits of Daily Income Earners; n = 238

	Frequency	Percent
Has closeness to a bank branch or a bank agent made you open an account with that bank		
- Yes	87	36.6
- No	151	63.4
Has closeness to a bank branch or bank agent made you use banking services more than before, such as sending or receiving money		
- Yes	93	39.1
- No	145	60.9
Does the closeness of a bank branch help you save money		
- Yes	92	38.7
- No	146	61.3
Does the closeness of bank agents (POS) help you save money		
- Yes	179	75.2
- No	59	24.8
Which of these is true about your savings culture		
- Having a close bank branch/agent has helped me save more money	115	48.3
- Having a close bank branch/agent has not helped me save more money	123	51.7

Source: Field survey 2025

Findings in Table 4 show that closeness to a bank branch or bank agent led only a few to open accounts with that bank (36.6%) and to use banking services more than before (39.1%). Closeness to a bank branch also never helped the majority of them save money (38.7%), but closeness to a bank's Point of Sales (POS) did (75.2%). Having a close bank branch/agent never helped many to save more money (48.3%). Contrary to expectations, this work reveals that physical closeness of banks to people does not necessarily lead them to open an account with the bank, use banking services more or save. As many as 63.4% of respondents say the closeness of the bank's branches has not motivated them to open an account. While 60.9% maintain that the proximity of banks has not encouraged them to use banking services more, 61.3% insist that it has not helped them save more.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/z2766334336

This work reveals a greater embrace of alternative channels, such as POS. As high as 75.2% of the daily income earners reported that proximity to POS agents helped them save money. With POS agents able to provide quick turnaround and virtual microfinance offering basic banking services, such as account opening, transfers, savings planning and implementation, as well as speedy credit disbursements, it is not surprising that daily income earners have little regard for banks' proximity. This aligns with Findex (2021), which finds that Mobile money is driving growth in account ownership, particularly in Sub-Saharan Africa, where 33% of adults have a mobile money account. However, another angle to look at it is that people tend to adopt mobile banking when the bank's physical presence is also available. In conclusion, mobile banking increased the capacity of low-income earners to save.

Access to credit and the savings habits of daily income earners in Enugu, Nigeria

Table 5. Access to Credit Facilities Affects the Savings Habits of Daily Income Earners; n = 238

	Frequency	Percent
Have you ever had access to a bank's credit/loan		
- Yes	52	21.8
- No	184	77.3
- Not sure	2	0.8
If yes, did the access to credit/loan help you to save money (n = 52)		
- Yes	42	80.8
- No	10	19.2
Which of these is true about your savings culture		
- Having a bank credit/loan will make me save more money	108	45.4
- Having a bank credit/loan will not necessarily make me save more money	130	54.6
Do you consider the bank's credit as a necessity for your business growth		
- Yes	147	61.8
- No	64	26.9
- Not sure	27	11.4
Can you access a bank credit/loan		
- Yes	123	51.7
- No	56	23.5
- Not sure	59	24.8

Source: Field survey 2025

Table 5 shows that only a few daily income earners have had access to bank credit/loan (21.8%), and this access helped most of them save money (80.8%). Generally, not many, however, believed having a credit/loan would make them save more money (45.5%). Nevertheless, the majority considered bank credit as a necessity for their business growth (61.8%). About half of the daily income earners believed they could access bank credit/loan (51.7%).

The pervasiveness of online banking and its willingness to offer microcredits have made the above responses easier. Also contributing are various government intervention programmes, which have helped small businesses in no small measure. It aligns with Somer (2023), who found that one benefit of financial inclusion is that it promotes small businesses, which often need credit and face challenges accessing it from formal financial institutions. Traditional credit scoring metrics rarely favour those with limited credit history, primarily small business owners. 'Financial inclusion strives to explore alternative credit scoring methods that consider non-traditional data sources…' In this regard, utility and rental payment history can help in credit assessments.

Formal lending is highly collateralised and attracts high interest rates. Due to poor credit bureaus (databases used to assess potential borrowers), formal institutions make credit inaccessible to people with low incomes by requiring collateral.

Table 6. Personal Factors that affect the Savings Culture of Daily Income Earners; n = 238

	Frequency	Percent
Generally, I feel that building a savings habit can sustain my business and help my family have a stable income		
- Yes	222	93.3
- No	4	1.7
- Not sure	12	5.1

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/z2766334336

What are your hindrances to achieving your set personal savings goals?		
- Poor knowledge of banking operations	24	10.1
- Bank charges	53	22.3
- Internet fraud and cyber insecurity	27	11.3
- Distance from the bank	35	14.7
- Lack of infrastructure	3	1.3
- Frequent change in policies	24	10.1
- Cultural belief	3	1.3
- Bad economy/hardship	12	5.0
- Family issue	11	4.6
- Not enough money	13	5.5
- Time	28	11.8
- Personal decision	2	0.8
- Stress/poor service delivery	4	1.7
What do you normally save for		
- To meet personal/family need	132	55.5
- To meet business needs	111	46.6
- For unforeseen circumstances	68	28.6
- Future use	8	3.4
- Investment	13	5.5
What factors have influenced you the most to maintain a savings culture		
- Family	115	48.3
- School/peers	23	9.7
- Adverts and campaigns on savings	3	1.3
- Proximity to bank/bank agent	11	4.6
- Business purposes	45	18.9
- Unforeseen circumstance	12	5.0
- Future use	7	2.9
- Investment	12	5.0
- Personal use	2	0.8

Source: Field survey 2025

According to Table 6, the majority of daily income earners (93.3%) felt that building a savings habit can sustain their businesses and help their families maintain a stable income. Their perceived hindrance to achieving their set personal savings was mainly bank charges (22.3%), followed by distance to the bank (14.7%), time (11.8%), internet fraud and cyber insecurity (11.3%), and poor knowledge of banking operations (10.1%). The majority typically saved to meet personal/family needs (55.5%), and then for business needs (46.6%). They have been influenced primarily by their family to maintain a savings culture (48.3%).

5. Conclusions

Based on the empirical data obtained, financial inclusion, in its traditional sense, does not automatically lead to the development of a sustainable savings culture among low-income citizens in Enugu State. Despite the almost universal availability of bank accounts among daily-income earners, account ownership, account type, or account duration did not have a statistically significant positive impact on savings habits. Bank account use is largely irregular, suggesting a gap between formal financial inclusion and actual financial behaviour. This indicates that financial inclusion policies focus more on quantitative indicators (e.g., account openings) than on qualitative aspects such as developing sustainable savings habits and motivation.

The study findings also indicate that efforts by banks and financial regulators to raise public awareness have been ineffective. Respondents' primary sources of information on the need to save remain family and close contacts, while the role of banks, their agents, and the Central Bank of Nigeria in financial education is assessed as limited. Most respondents noted that advertising and information campaigns did not encourage them to save or increase their savings regularly. This confirms that financial literacy and trust in formal financial institutions remain low, significantly limiting the development of a savings culture.

The hypothesis that the physical proximity of bank branches plays a significant role in fostering savings habits was also not confirmed. Most workers with daily incomes indicated that the presence of banks nearby did not motivate them to open accounts, use banking services more actively, or increase their savings. Instead,

alternative financial channels, primarily POS agents, play a key role. Their accessibility, service speed, and flexibility better meet the needs of this population group. This indicates a structural shift toward agent and digital banking as more relevant financial inclusion tools for people with low and unstable incomes.

Access to bank loans remains limited among respondents, though those who did access them generally noted the positive impact of loans on savings and business development. At the same time, systemic barriers to formal lending persist—high collateral requirements, interest rates, and an imperfect lending infrastructure—which reduce the availability of loans for low-income entrepreneurs. Nevertheless, respondents are pretty aware of the importance of loans for business expansion and financial resilience, indicating potential demand for more tailored microfinance products.

Overall, the study reveals that the savings culture among daily income earners is shaped primarily by family and social factors, as well as the practical needs of households and businesses, rather than by institutional mechanisms for financial inclusion. The main barriers to savings remain bank fees, remoteness from financial institutions, time constraints, the risk of cyber fraud, and a lack of knowledge about banking services. Therefore, to sustainably develop a savings culture, it is necessary to move from formal expansion of access to financial services to a comprehensive strategy that includes improving financial literacy, reducing transaction costs, developing agency and digital channels, and creating products targeted at low-income groups that take into account their real economic and social conditions.

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Author Contributions: The authors contributed equally. All authors have read and agreed to the published version of the manuscript.

ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/z2766334336

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/q6758894333

Publisher
http://jssidoi.org/esc/home

THE GENDER-SUSTAINABILITY NEXUS IN THE EUROPEAN CONTEXT: A PANEL DATA ANALYSIS*

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Received 24 January 2026; accepted 23 March 2026; published 30 June 2026

Abstract. This study analyses the impact of female leadership on sustainable development indicators and environmental efficiency across 28 European countries (EU-27 and Türkiye) over the period 2015–2023. Utilising panel data and fixed-effects econometric models, the relationship between female representation in legislative bodies, government, and corporate governance (boards and executive positions) is investigated in relation to the Sustainable Development Goals Index (SDG Index) and carbon dioxide (CO_2) emissions. The results confirm a statistically significant positive correlation between the proportion of women in national parliaments and the achievement of systemic sustainability goals, thereby supporting theoretical premises regarding the more pronounced social and ethical orientation of female leaders. With regard to the environmental footprint, the role of corporate gender diversity in mitigating emissions is identified, although this effect remains strongly mediated by macroeconomic factors and the national energy profile. The observed *glass cliff* phenomenon – whereby women are appointed to senior leadership roles during periods of crisis or downturn – among female executives underscores the necessity for a more in-depth analysis of the institutional context in which leadership is exercised. The scientific novelty lies in the integrated examination of political and corporate power as determinants of sustainability amidst systemic crises. These findings have direct applicability to the formulation of public policies and Environmental, Social, and Governance (ESG) strategies, demonstrating that gender diversity is a critical instrument for accelerating the green transition and achieving socio-economic stability in Europe.

Keywords: female leadership; sustainable development goals; SDG performance; SDGs; carbon emissions; corporate governance; ESG; European Union

Reference to this paper should be made as follows: Todorova, A., Kostadinova, I., Venelinova, N., Kaya, T., Fleaca, E. 2026. *Entrepreneurship and Sustainability Issues*, 13(4), 119-141. http://doi.org/10.9770/q6758894333

JEL Classifications: J16, M14, Q56, G34

Additional disciplines: political sciences; sociology; ecology and environment; environmental engineering

1. Introduction

In the contemporary era of global environmental and social transformations, the question of managerial elites' capacity to generate sustainable solutions is of paramount relevance. The adoption of the 2030 Agenda and the Sustainable Development Goals (SDGs) by the United Nations established a new framework wherein achieving gender equality (SDG 5) is viewed not merely as a fundamental human right, but as a prerequisite for the

* *This research is funded by the European Union's Horizon Europe research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 101179323.*

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/q6758894333

realisation of the remaining 16 goals (UN Women, n.d.). Nevertheless, data indicate that the path towards parity in political representation remains protracted, necessitating a more profound analysis of the contribution of female leaders to national sustainability levels (UN Women, 2024; Joint Research Centre, 2025).

The theoretical foundation of this study is premised on the concept that women in senior leadership positions introduce a distinct leadership style, frequently oriented towards the long-term well-being of the community and ethical governance (Mirza et al., 2024). In the political sphere, the heightened presence of women in legislative bodies is associated with a more substantial commitment to the social pillars of sustainable development, including healthcare, education, and social protection (Toukabri & Jilani, 2023; Tarkovska et al., 2023). Research suggests that these leadership characteristics are essential for enhancing national performance regarding the SDG Index (World Bank, 2024; Roca et al., 2024).

Within the corporate sphere, the debate focuses on the role of women in governing bodies (boards) and executive positions regarding the integration of Environmental, Social, and Governance (ESG) factors (EcoActive Tech, 2024; Thawornlamlert et al., 2025; Hargrave et al., 2026). Critical mass theory posits that when female presence in corporate governance reaches a certain threshold, a qualitative shift occurs in organisational priorities – transitioning from a focus on short-term profit to strategies for decarbonisation and the reduction of carbon footprints (Yudiani et al., 2024; Kray et al., 2025; Pecher et al., 2025). This is particularly relevant in the context of the European Union's new regulatory framework concerning ESG reporting and corporate sustainability (Lindstrand et al., 2024; CFA Institute, 2024).

The present study aims to bridge a gap in the literature by comparing 28 European countries (EU-27 and Türkiye) over the period 2015–2023. Employing a rigorous econometric methodology, the work investigates how variations in female representation in parliament, government, and the corporate sector correlate with national levels of the SDG Index and CO_2 emissions (Elder & Grünewald, 2025; Piqueiras & Luoma-aho, 2025; Ozcelik et al., 2025). In a period of systemic crises, leadership that prioritises inclusivity and resilience emerges as a key factor for the sustainable future of the European region (Telleria, 2024; Ali *et al.*, 2025).

2. Literature review

Theoretical foundations of female leadership

Over the last decade, the global landscape of political leadership has undergone a visible, albeit uneven, transformation. The nexus between gender equality and sustainable development is fundamental, with female participation identified as a critical accelerator for the achievement of the SDGs and specifically Goal 5 (UN Women, n.d.). Nevertheless, progress remains slow and frequently fragmented. An analysis of World Bank data for the period 2015–2024 demonstrates a steady yet gradual upward trend in the proportion of women in national parliaments, with global figures still struggling to surpass the one-third threshold required to achieve a critical mass (World Bank, 2024).

By late 2025, data from the Inter-Parliamentary Union (IPU) revealed that, whilst certain nations have already attained or are approaching parity, on a global scale, women continue to be underrepresented at the highest levels of decision-making (Inter-Parliamentary Union, 2025). Empirical evidence indicates that only a small percentage of countries have female heads of state or government, and the pace of change is such that, should current rates persist, full gender equality in the highest echelons of power will not be achieved within the next 130 years (UN Women, 2024). This underscores the systemic barriers that continue to impede women's access to leadership positions, despite the proven benefits of their participation.

Within the context of the European Union, the situation exhibits greater dynamism; however, the trajectory towards full equality remains fraught with challenges. Reports by the Joint Research Centre (JRC) of the European Commission acknowledge improvements in female political representation yet emphasise that *the road to parity remains long*, even within the EU (Joint Research Centre, 2025). Data confirm that, despite the existence of progressive policies and quotas in certain Member States, structural inequalities persist. Women remain a minority in key spheres of economic and political influence, a factor which directly impinges upon the velocity of achieving sustainability goals (UN Women, 2024; Joint Research Centre, 2025).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/q6758894333

The evolution in the understanding of female representation is characterised by the concept of *critical mass*, shifting the locus of analysis from purely quantitative dimensions to the qualitative transformation of policies (Amo-Navas et al., 2025). Classical and contemporary interpretations of the theory, including the critiques by Sarah and Mona (2008), underscore that the mere presence of women (*descriptive representation*) does not automatically guarantee a shift in political outcomes (*substantive representation*). To overcome the effects of *tokenism* – in which women serve merely as a symbolic presence – it is necessary to reach a threshold that enables the minority to exert a tangible impact on group dynamics and decision-making processes.

Within the corporate context, empirical research unequivocally supports the proposition that attaining a critical mass – frequently defined as a minimum of three women on the board of directors – is a decisive determinant of the enhancement of Corporate Social Responsibility (CSR) (Boukattaya & Omri, 2021). Once women cease to function as isolated *tokens* and constitute a substantive cohort, their efficacy in enforcing ethical standards and socially oriented strategies is amplified, thereby directly elevating the CSR ratings of organisations (Toukabri & Jilani, 2023). Furthermore, the existence of a critical mass of female directors serves as a corrective mechanism against practices of *ESG decoupling* – the divergence between declared ESG policies and actual corporate conduct – thereby ensuring heightened transparency and accountability (Boukattaya & Omri, 2021; Roca et al., 2024).

The nexus between critical mass and environmental sustainability is particularly pronounced within the domains of innovation and carbon footprint management. Contemporary analyses indicate that boards characterised by balanced gender representation are significantly more inclined to initiate and fund eco-innovations, with female leaders introducing diverse cognitive perspectives and a lower tolerance for environmental risks (Mirza et al., 2024). This finding is corroborated by specific studies focusing on carbon efficiency, which demonstrate that, subsequent to surpassing a specific threshold of representation, female directors successfully enforce policies for carbon emission reduction, transforming sustainability from a peripheral concern into a strategic priority (Tarkovska et al., 2023).

Social role theory has traditionally distinguished between two primary modes of behaviour: *agentic*, characterised by assertiveness, competitiveness, and task orientation, stereotypically ascribed to men; and *communal*, associated with care, cooperation, and empathy, typically linked to women (Boukattaya & Omri, 2021). However, contemporary research nuances this dichotomy, demonstrating that female leaders increasingly exhibit flexibility by combining decisiveness with high emotional intelligence. This hybrid approach proves pivotal for effective management within the modern dynamic environment, enabling women to transcend traditional biases and construct more resilient organisational cultures (Kray et al., 2025; Ali et al., 2025).

In the context of corporate governance and industry, the communal style of women manifests itself through a pronounced focus on employee and stakeholder well-being. Empirical data indicate that women in managerial roles are more inclined to foster an inclusive environment and prioritise ethical behaviour over short-term financial performance (Amo-Navas et al., 2025). This leadership style not only enhances the internal organisational climate but also establishes the prerequisites for the more successful implementation of sustainability strategies, as it necessitates the balancing of diverse and frequently conflicting interests (Yudiani et al., 2024; Thawornlamlert et al., 2025).

Furthermore, the specific approach of women to decision-making frequently entails a more comprehensive risk assessment and broader consultation, thereby mitigating the likelihood of impulsive or hazardously aggressive corporate manoeuvres. The literature underscores that this *transformational* leadership model is particularly effective in crisis management and innovation deployment, as female leaders successfully transform their teams through personal example and the fostering of collective responsibility – attributes that are fundamental to achieving the SDGs (Hargrave et al., 2026).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/q6758894333

The sustainable development paradigm and the SDGs

The UN Agenda 2030 framework constitutes a fundamental paradigm shift in global development, transitioning from sectoral to systems thinking. In contrast to its predecessors, the SDGs are not isolated objectives but an integrated network of indivisible priorities, wherein social inclusion, economic growth, and environmental protection are mutually interdependent (Chenary et al., 2024; Thammaraksa et al., 2024). Contemporary futures studies underscore that the realisation of this ambitious agenda necessitates a holistic approach that regards planetary boundaries and human well-being as interconnected vessels rather than competing interests (Telleria, 2024; Sofiyah et al., 2025).

Occupying a central position within the scientific discourse is the concept of synergies and trade-offs between individual goals. Empirical research in the fields of the circular economy and resource management demonstrates that environmental measures (such as those concerning climate and clean energy) exert a multiplier effect on social indicators, provided they are managed with precision (Chenary et al., 2024). For instance, the transition towards a low-carbon economy possesses the potential to stimulate innovation and employment; however, it mandates meticulous planning to preclude the exacerbation of inequalities (Rieiro-García et al., 2023; Elder & Grünewald, 2025). In particular, at the level of urban planning and regional development, the nexus between social infrastructure and environmental sustainability is critical – sustainable cities (SDG 11) cannot function in the absence of robust institutions and social cohesion (García et al., 2025).

Notwithstanding the theoretical consensus regarding interconnectedness, practical implementation encounters challenges pertaining to communication and the corporate integration of the goals (Bose et al., 2023). The literature indicates that, to ensure efficacy, the framework must be translated into the language of business and local communities, whilst avoiding the fragmented treatment of issues (Thammaraksa et al., 2024). The role of technology and digitalisation emerges as a pivotal factor in accelerating this process, provided that they serve to bridge social deficits rather than merely fuelling technological optimism (Lindstrand et al., 2024). Ultimately, the success of Agenda 2030 is contingent upon the capacity of leaders to manage the complex interactions between economic aspirations and socio-ecological realities, thereby minimising conflicts between them (García-Sánchez et al., 2023; Piqueiras & Luoma-aho, 2025).

The European Union is establishing itself as a global leader in the regulatory institutionalisation of sustainable development, transitioning from voluntary initiatives to a stringent legislative framework. This process is driven by the ambition of the European Green Deal to reorient capital flows towards sustainable investments. The foundation of this ecosystem is constituted by three interconnected pillars: the Sustainable Finance Disclosure Regulation (SFDR), the EU Taxonomy Regulation, and the Corporate Sustainability Reporting Directive (CSRD). This complex architecture aims to eliminate *greenwashing* and establish a unified language for the classification of economic activities, which is of critical importance for investors and asset managers (The Global Legal Post, n.d.; CFA Institute, 2024; Cojocaru et al., 2025).

A pivotal element within this regulatory transformation is the introduction of CSRD and the accompanying European Sustainability Reporting Standards (ESRS), which fundamentally alter the reporting obligations of enterprises (Cojocaru et al., 2025). Central to these contemporary measurement methodologies is the concept of *double materiality*. This approach necessitates a bidirectional assessment of sustainability: financial materiality (pertaining to how external climate risks impinge upon enterprise value) and impact materiality (concerning how the company's own operations affect society and the environment). To operationalise this, the framework mandates the utilisation of precise quantitative metrics, such as Key Performance Indicators (KPIs), across the entire product and service life cycle (Bose et al., 2023). Ultimately, this expansion of scope transforms ESG data from a mere marketing instrument into a mandatory, auditable asset, commensurate in importance with traditional financial statements (CFA Institute, 2024; EcoActive Tech, 2024; Lexology, 2024; The Global Legal Post, n.d.).

Regulatory pressure is further intensified by the Corporate Sustainability Due Diligence Directive (CS3D), which extends corporate liability beyond internal operations to encompass the entire value chain. This legislation mandates large enterprises to identify and mitigate adverse impacts on human rights and the environment, including those occurring within their supply networks. Legal analyses indicate that this

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/q6758894333

establishes a new standard for corporate conduct, wherein risk management is no longer an isolated internal function but necessitates profound oversight and control of global supply chains (The Global Legal Post, n.d.; Lexology, 2024).

From both academic and practical perspectives, the integration of these regulations constitutes a formidable challenge, yet simultaneously offers a strategic avenue for innovation. Contemporary scholarship indicates that enterprises successfully embedding ESG principles within their business models exhibit enhanced operational efficiency and superior resilience to market volatility. Nevertheless, this transition necessitates substantial resources for data collection and verification, alongside a fundamental paradigm shift in managerial culture (Ionașcu et al., 2025; Pecher et al., 2025). Empirical data from 2025 corroborate that, whilst the regulatory burden is substantial, it functions as a catalyst for the deployment of clean technologies and circular models, thereby directly linking environmental performance with the long-term economic viability of enterprises (Ozcelik et al., 2025).

The operationalisation of the sustainable development concept necessitates a transition from abstract political objectives to concrete, measurable indicators. Within the European Union, this process is undergoing a fundamental transformation via the introduction of the European Sustainability Reporting Standards (ESRS), which aim to unify the hitherto fragmented methodologies. The primary challenge regarding measurement lies in the multidimensionality of sustainability, which encompasses heterogeneous variables – ranging from carbon emissions to social inclusion. To surmount this complexity, the scientific community and regulators increasingly rely upon composite indices and aggregated data, which facilitate comparative analysis and the assessment of progress relative to planetary boundaries (EcoActive Tech, 2024; Lexology, 2024).

Notwithstanding the progress in standardisation facilitated by the EU Taxonomy Regulation, which furnishes a classification system for *green* activities, the measurement of the social pillar of sustainability remains a formidable challenge. Whilst environmental indicators (such as greenhouse gas emissions) are readily quantifiable, social and governance aspects frequently necessitate more complex proxy variables. Academic scholarship underscores the imperative for integrated models capable of encompassing the synergies between technological innovation and social well-being, thereby eschewing the reductive treatment of data. Consequently, effective measurement depends on the ability to aggregate these disparate data streams into unified indices that serve as a robust foundation for strategic decision-making (Ionașcu et al., 2025; Ozcelik et al., 2025; Pecher et al., 2025).

The nexus of gender and sustainability

The nexus between female participation in governance and enhanced sustainability metrics is not coincidental; rather, it is underpinned by several key theoretical mechanisms that elucidate the transformation of corporate and political strategies. The primary and most frequently cited mechanism is *Cognitive Diversity Theory*. According to this theory, heterogeneous groups possess a broader spectrum of perspectives, knowledge, and problem-solving heuristics compared to homogeneous ones (Amo-Navas et al., 2025). Empirical evidence indicates that the inclusion of women on boards disrupts *groupthink* and stimulates *green* innovation (Babiker et al., 2025), as women frequently introduce unique experiences and heightened sensitivity to non-financial risks, a factor critical for the identification of environmental opportunities (Tarkovska et al., 2023; Mirza et al., 2024).

The second mechanism draws upon *Stakeholder Theory*. Whilst traditional governance models frequently prioritise shareholders, the literature reveals that female leaders are more inclined to perceive the organisation as an integral component of a broader social ecosystem (Bouaddi et al., 2023; Yorke et al., 2023). This mechanism is intrinsically linked to the *communal* leadership style, which fosters empathy and long-term community stewardship. Research corroborates that boards characterised by balanced gender participation are more active in CSR and more effectively reconcile economic objectives with the needs of employees, local communities, and the environment (Toukabri & Jilani, 2023; Yudiani et al., 2024).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/q6758894333

The third substantive mechanism pertains to ethics and the management of reputational risk. Female executives demonstrate a lower tolerance for unethical business practices and a heightened propensity for transparency (Babiker et al., 2025). This mechanism functions as a protective shield against *greenwashing*, as diverse teams exhibit greater rigour regarding accountability and regulatory compliance. Analyses indicate that this elevated ethical standard not only mitigates the likelihood of environmental litigation but also transforms sustainability from a peripheral public relations activity into a core strategic objective (Roca et al., 2024; Thawornlamlert et al., 2025; Ali et al., 2025).

The accumulated body of empirical research in recent years provides compelling evidence of a positive correlation between gender diversity within governing bodies and CSR performance (Yorke et al., 2023). Analyses of large panel datasets reveal that enterprises with a higher proportion of women on boards of directors consistently secure superior ESG ratings (Bouaddi et al., 2023). This is attributed to the fact that gender-diverse boards are more effective in the oversight of managerial strategies and more frequently initiate the establishment of specialised sustainability committees, which institutionalise the firm's CSR commitments (Toukabri & Jilani, 2023; Yudiani et al., 2024).

Another substantive aspect of the empirical evidence concerns the impact of women on the quality and transparency of non-financial disclosure. The literature establishes that the presence of female directors significantly attenuates information asymmetry between the entity and its stakeholders (Yorke et al., 2023). Empirical data indicate that such boards exhibit a higher propensity to voluntarily disclose information on carbon footprints and social impact, whilst simultaneously serving as a deterrent to reporting manipulation practices (greenwashing). This validates the thesis that gender diversity augments investor confidence via stricter adherence to ethical accountability standards (Roca et al., 2024; Thawornlamlert et al., 2025).

Beyond accountability, the data reveal a direct correlation between the feminisation of senior management and investment in eco-innovations. Research indicates that firms with a critical mass of women in governance do not merely comply with regulations but also proactively invest in green technologies and circular business models to gain competitive advantage (Babiker et al., 2025). This trend is particularly evident in energy-intensive industries, where female board representation correlates with the accelerated adoption of decarbonisation strategies and more effective management of environmental risks (Mirza et al., 2024; Tarkovska et al., 2023).

The nexus between female political empowerment and national environmental performance constitutes a subject of burgeoning academic scrutiny. Macroeconomic analyses and reports by international bodies such as the UN and the World Bank indicate the existence of a positive correlation between the proportion of women in national parliaments and the enactment of more stringent climate legislation. Nations with higher levels of female political leadership demonstrate a greater propensity to ratify international environmental treaties and to accelerate the integration of sustainability principles into national development strategies. This corroborates the thesis that female legislators frequently function as agents of change, prioritising long-term societal well-being over short-term political dividends (UN Women, n.d.; World Bank, 2024).

From a theoretical perspective, this phenomenon is explicated via the concept of substantive representation. According to this framework, an increase in the number of women in politics induces a shift in the agenda of legislative bodies, allocating greater attention to issues traditionally associated with quality of life, health, and the environment. Within the context of the European Union, data from the JRC support the observation that balanced political participation constitutes a critical prerequisite for the successful realisation of the Green Deal, as female leaders are more inclined to endorse policies ensuring the socially equitable distribution of the costs associated with the green transition (Joint Research Centre, 2025).

Empirical observations concerning the implementation of the SDGs indicate that political empowerment (SDG 5) exerts a synergistic effect upon goals pertaining to climate and resources. Analyses reveal that in nations where women possess substantive decision-making power, lower per capita carbon emissions and more efficacious management of natural resources are observed. This effect becomes statistically significant once representation transcends specific thresholds, enabling female politicians not merely to participate in the

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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discourse but to formulate and enforce environmental policies that might otherwise be disregarded (UN Women, n.d.; Inter-Parliamentary Union, 2025).

Based on the presented theoretical frameworks and the identified dependencies in the literature, the present study focuses on elucidating the relationship between female leadership and the achievement of sustainability goals within the European context. The logical extension of the analysed framework facilitates the formulation of the following research hypotheses:

Hypothesis 1 (H_1): The presence of a higher proportion of women in senior leadership positions (political and corporate) is positively associated with the overall level of a country's sustainable development, as measured by the SDG Index. This hypothesis is grounded in Social Role Theory and Ecofeminism. According to these perspectives, women are inclined to exhibit a more pronounced *ethical leadership style*, oriented towards the long-term well-being of the community rather than solely towards short-term gains. In the political sphere, women frequently endorse policies in the domains of social inclusion, education, and healthcare, which constitute fundamental pillars of the SDGs.

Hypothesis 2 (H_2): Higher female representation in corporate boards and executive positions leads to lower levels of carbon emissions per capita. The formulated hypothesis rests upon Critical Mass Theory and Stakeholder Theory. When women attain a critical mass in corporate governance (boards and CEOs), they shift corporate strategy from a purely shareholder-centric (profit-only) approach to one that accounts for the interests of society and the environment. Research indicates that female leaders are more prone to enforcing investments in *green* innovations and stricter pollution controls, which manifests at the national level as a reduction in the total carbon footprint (CO_2 emissions).

Before proceeding with the methodological framework, it is important to acknowledge a specific boundary condition of this study. While the SDG Index and levels of carbon emissions per capita provide robust, aggregated metrics for macro-level analysis, they may not reflect the entire spectrum of SDG facets and nuanced socio-environmental dynamics. The different approaches towards measuring SDG implementation and corporate sustainability remain a fertile ground for future research among scholars interested in this multidimensional topic.

3. Methodology

The present study employs a quantitative approach grounded in panel data analysis to investigate the empirical relationship between female leadership and the attainment of sustainability goals within the European context. The selection of this methodology is predicated on the necessity to control for both cross-country heterogeneity and dynamic temporal variations.

Sample and data sources

The empirical analysis encompasses the 27 Member States of the European Union (EU-27), with the sample augmented to include Türkiye. The inclusion of Türkiye is justified by its status as a key candidate country for accession and a strategic economic partner within the framework of the Customs Union with the EU. This enables the study to transcend the administrative boundaries of the Union and provides a comparative analysis within the broader European context.

A balanced panel covering the period 2015–2023 was utilised. The initial year coincides with the adoption of Agenda 2030, whilst 2023 was selected as the endpoint, representing the final year for which complete and validated data were available for all examined indicators and countries at the time of the research. Data were extracted from the official database of Eurostat (2026), thereby ensuring full methodological comparability.

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Definition of variables

The model incorporates three distinct categories of variables: *dependent* (sustainability performance metrics), *independent* (female leadership indicators), and *control* (economic and social factors).

A. Dependent variables (Sustainability performance)

To measure overall sustainability attainment, the study employs the SDG Index Score. Developed by the UN Sustainable Development Solutions Network (SDSN), this composite indicator evaluates the performance of each country on a scale ranging from 0 (lowest performance) to 100 (optimum performance) across all 17 SDGs. The utilisation of an aggregated index facilitates a holistic assessment that balances the economic, social, and environmental dimensions of sustainable development, thereby eschewing sectoral fragmentation.

To ensure the robustness of the results and to mitigate potential endogeneity concerns (given that gender equality indicators constitute a component of SDG 5), the analysis employs two complementary metrics:

1. *SDG Index Score* (SDG_Index): A composite indicator evaluating performance across all 17 UN goals. This metric permits a holistic assessment, equilibrating economic, social, and environmental dimensions;
2. *Annual CO_2 emissions* (tonnes per capita): Carbon dioxide emissions per capita. This indicator provides a scientifically validated metric for the environmental footprint and facilitates the testing of hypotheses within the context of decarbonisation.

B. Independent variables (Female leadership)

The primary focus of the study lies in the variables representing gender diversity within decision-making processes. The research scrutinises leadership across three pivotal loci of power, aiming to evaluate and compare the relative weight of legislative, executive, and corporate authority:

1. *Legislative Power* (Women_Parl %): Proportion of seats held by women in national parliaments.
2. *Political Executive Power* (Women_Gov %): Proportion of women in senior government positions (senior ministers).
3. *Corporate Governance* (Women_Board %): Proportion of women board members in the largest listed companies. This metric reflects the strategic and supervisory functions within the business sector.
4. *Corporate Management* (Women_Exc %): Proportion of women executives in the largest listed companies. This metric reflects operational authority within the business sector.

C. Control variables

To isolate the net effect of female leadership, the model controls for the following macroeconomic factors, which are empirically established determinants of sustainability:

- *Logarithm of GDP per capita* (LnGDP): The natural logarithm of GDP per capita is utilised to correct for distributional skewness and to measure economic elasticity relative to sustainability.
- *R&D Expenditure* (RD_Exp) (% of GDP): Controls for national innovation capacity.
- *Human Capital Quality* (Edu_Level): Tertiary educational attainment (%). The analysis employs the 25–34 age group, which constitutes the official EU headline indicator for monitoring educational targets. This selection is predicated on the fact that this younger cohort most accurately reflects the current qualification potential of the workforce and recent investments in human capital, in contrast to the general population, which encompasses historical legacy effects.

Empirical strategy and econometric model

To empirically test the formulated hypotheses, a Fixed Effects (FE) regression model is employed. This estimation strategy is preferred over Ordinary Least Squares (OLS) and Random Effects (RE) approaches, as it effectively controls for unobserved time-invariant country-specific heterogeneity (such as cultural norms, historical context, and geography). The selection of the FE specification is theoretically grounded in the anticipated correlation between these unobserved country effects and the independent regressors. However, for comparative purposes and to establish a baseline, pooled OLS regressions are initially estimated, followed by the rigorous FE models to isolate the net impact. The baseline regression equation is specified as follows:

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http://doi.org/10.9770/q6758894333

$$Y_{it} = \beta_0 + \beta_1 FemLead_{it} + \beta_2 Controls_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

Where:

- Y_{it} denotes the value of the dependent sustainability variable for country i in year t.
- $FemLead_{it}$ represents the vector of female leadership variables (Parliament/Boards).
- $Controls_{it}$ is the vector of control variables (GDP, R&D, Education).
- μ_i captures country-specific fixed effects which remain constant over time.
- λ_t denotes time fixed effects, absorbing common EU-wide shocks.
- ε_{it} is the stochastic error term.

To ensure the reliability of the results, the models are subjected to rigorous diagnostic testing. The Variance Inflation Factor (VIF) test is applied to identify potential multicollinearity, ensuring that values remain below the critical threshold of 5.0. Furthermore, the Breusch-Pagan test is conducted to detect heteroscedasticity in the residuals, thereby ensuring the accurate computation of standard errors and significance levels.

The validity of the econometric estimates is ascertained through a comprehensive series of diagnostic procedures, comprising tests for multicollinearity and heteroscedasticity. The employment of the FE specification is methodologically justified to mitigate biases arising from unobserved cross-country heterogeneity and non-constant error variance, thereby ensuring a high degree of robustness in the statistical inferences.

3. Results and discussion

The descriptive statistics presented in Table 1 furnish a systematic overview of the fundamental parameters of the studied population over the period 2015–2023, comprising a total of 252 observations. The values associated with the dependent variables elucidate essential characteristics of sustainable development within the sample. The Sustainable Development Goals Index (SDG_Index) exhibits a comparatively high mean value of 79.63 points, accompanied by a relatively low standard deviation of 3.53; this is indicative of a certain degree of convergence regarding the performance of the nations under review. Conversely, annual per capita CO_2 emissions vary across a broad spectrum – ranging from 3.02 to 16.39 tonnes – with a mean value of 6.41 tonnes. This significant dispersion in emissions reflects the heterogeneity inherent in the energy and industrial profiles of the included economies, thereby establishing the requisite statistical foundation for investigating the determinants influencing environmental outcomes.

Table 1. Descriptive statistics of indicators for female leadership, sustainable development and control variables (2015–2023)

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Women_Parl %	252	10,1000000000	49,6000000000	28,691269841270	9,7389186785031
Women_Gov %	252	,0000000000	72,4000000000	29,541269841270	14,0207062006570
Women_Board %	252	4,5000000000	46,1000000000	23,642857142857	10,3774036514558
Women_Exc %	252	4,1000000000	34,8000000000	17,906349206349	6,8304771205460
SDG_Index	252	68,83	87,10	79,6314	3,52859
Annual CO_2 emissions (per capita)	252	3,0220766	16,3886240	6,409312692	2,4816006493
Edu_Level	252	22,5000000000	63,0000000000	42,194444444444	9,1639889847402
RD_Exp	252	,4500000000	3,6400000000	1,652301587302	,8739138166215
LnGDP	252	8,81	11,59	10,1462	,62575
Valid N (listwise)	252				

Source: Authors' processing based on Eurostat data

With regard to the key independent variables, pronounced dynamics are observed in the levels of female representation across distinct power structures. The proportion of women in national parliaments averages 28.69%; the maximum value of 49.60% indicates that, within the studied period, no single country in the sample achieved full parity representation in legislative power. The highest volatility is established within the executive branch (Women_Gov %), wherein the share of female ministers ranges from 0.00% to 72.40%. The presence of zero values for this indicator, combined with the highest standard deviation (14.02), underscores that government compositions are subject to more frequent and radical alterations compared to parliamentary

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http://doi.org/10.9770/q6758894333

representation. In the corporate sector, the data reveal a hierarchical differentiation in female representation. The mean proportion of women on corporate boards (Women_Board %) is 23.64%, which is significantly higher than their presence in top operational positions (Women_Exc %), amounting to an average of 17.91%. The latter variable records the lowest mean levels among all examined leadership indicators, which may be interpreted as an indication of the persistence of structural barriers facing women at the executive level. The range of these data provides sufficient variation for the conduct of robust correlation and regression analyses.

The control variables complement the context of the economic and social environment. The educational attainment of the population (Edu_Level) shows a mean value of 42.19%, whilst Research and Development expenditure (RD_Exp) varies from a minimum of 0.45% to 3.64% of GDP. The economic level, represented by the logarithm of GDP per capita (LnGDP), maintains a stable distribution with a mean value of 10.15. The integrated review of descriptive statistics confirms that the dataset is balanced and meets the requisite statistical requirements for the application of a Fixed Effects model, thereby permitting the precise testing of the formulated hypotheses.

The results from the Pearson correlation analysis (Table 2) reveal a complex nexus of statistically significant dependencies between the examined leadership metrics and the sustainability indicators. Primarily, a strong and positive intercorrelation is established between female representation in national parliaments, government structures, and corporate boards. The correlation coefficients between Women_Parl % and Women_Gov % ($r = 0.758$, $p < 0.01$), as well as between parliamentary representation and corporate board presence ($r = 0.742$, $p < 0.01$), suggest the existence of coherent emancipation trajectories within both the public and private sectors. In stark contrast, the share of women in executive positions (Women_Exc %) demonstrates weak or even statistically insignificant associations with the other leadership indicators, which corroborates the hypothesis regarding the distinct barriers and dynamics involved in occupying the highest operational roles.

Table 2. Pearson correlation matrix for the studied variables

Correlations										
		Women_Parl %	Women_Gov %	Women_Board %	Women_Exc %	SDG_Index	Annual CO_2 emissions (per capita)	Edu_Level	RD_Exp	LnGDP
Women_Parl %	Pearson Correlation	1	,758**	,742**	,016	,598**	,108	,276**	,725**	,579**
	Sig. (2-tailed)		,000	,000	,797	,000	,087	,000	,000	,000
	N	252	252	252	252	252	252	252	252	252
Women_Gov %	Pearson Correlation	,758**	1	,664**	,193**	,505**	,013	,244**	,600**	,435**
	Sig. (2-tailed)	,000		,000	,002	,000	,839	,000	,000	,000
	N	252	252	252	252	252	252	252	252	252
Women_Board %	Pearson Correlation	,742**	,664**	1	,054	,577**	-,109	,176**	,630**	,459**
	Sig. (2-tailed)	,000	,000		,393	,000	,083	,005	,000	,000
	N	252	252	252	252	252	252	252	252	252
Women_Exc %	Pearson Correlation	,016	,193**	,054	1	,159*	-,353**	,115	-,130*	-,184**
	Sig. (2-tailed)	,797	,002	,393		,011	,000	,068	,040	,003
	N	252	252	252	252	252	252	252	252	252
SDG_Index	Pearson Correlation	,598**	,505**	,577**	,159*	1	-,035	-,013	,636**	,394**
	Sig. (2-tailed)	,000	,000	,000	,011		,583	,832	,000	,000
	N	252	252	252	252	252	252	252	252	252
Annual CO_2 emissions (per capita)	Pearson Correlation	,108	,013	-,109	-,353**	-,035	1	,181**	,179**	,435**
	Sig. (2-tailed)	,087	,839	,083	,000	,583		,004	,004	,000
	N	252	252	252	252	252	252	252	252	252
Edu_Level	Pearson Correlation	,276**	,244**	,176**	,115	-,013	,181**	1	,127*	,555**
	Sig. (2-tailed)	,000	,000	,005	,068	,832	,004		,045	,000
	N	252	252	252	252	252	252	252	252	252
RD_Exp	Pearson Correlation	,725**	,600**	,630**	-,130*	,636**	,179**	,127*	1	,551**
	Sig. (2-tailed)	,000	,000	,000	,040	,000	,004	,045		,000
	N	252	252	252	252	252	252	252	252	252
LnGDP	Pearson Correlation	,579**	,435**	,459**	-,184**	,394**	,435**	,555**	,551**	1
	Sig. (2-tailed)	,000	,000	,000	,003	,000	,000	,000	,000	
	N	252	252	252	252	252	252	252	252	252
**. Correlation is significant at the 0.01 level (2-tailed).										
*. Correlation is significant at the 0.05 level (2-tailed).										

Source: Authors' processing based on Eurostat data

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/q6758894333

With respect to the central dependent variable, SDG_Index, a significant positive correlation is observed with three of the four leadership indicators, with the connection to parliamentary representation ($r = 0.598$, $p < 0.01$) and board presence ($r = 0.577$, $p < 0.01$) being the most pronounced. These results provide preliminary validation of the theoretical expectations that higher female participation in strategic decision-making corresponds to superior levels of sustainable development. It is noteworthy that the relationship between Women_Exc % and the SDG_Index, whilst significant, is considerably weaker ($r = 0.159$, $p < 0.05$); this necessitates a more in-depth regression analysis to disentangle the direct effect from that of other macroeconomic factors.

The analysis of the environmental indicator unveils a specific and somewhat unanticipated dynamic. Whilst political and board representation do not exhibit a statistically significant linear relationship with CO_2 emissions, the share of female executives registers a moderate but highly significant inverse correlation ($r = -0.353$, $p < 0.01$). This finding is of particular salience, as it implies that female leadership at the operational business level is associated with lower carbon intensity within the economy. Concurrently, the strong positive correlations of emissions with LnGDP ($r = 0.435$, $p < 0.01$) and Edu_Level ($r = 0.181$, $p < 0.01$) underscore the complexity of environmental impact in developed economies, where a higher standard of living is frequently concomitant with elevated resource consumption.

The control variables – economic level (LnGDP) and investment in innovation (RD_Exp) – maintain stable positive correlations with the indicators of female leadership and the SDG_Index. The connection between Research and Development expenditure and female representation in parliament and boards is particularly pronounced, reflecting the synergy between social progress and innovation capacity. Whilst the high levels of correlation between certain independent variables justify the verification of multicollinearity via the VIF test in subsequent stages, the overall structure of the matrix confirms that the included factors capture distinct dimensions of socio-economic reality, which constitutes a prerequisite for the adequacy of the subsequent regression models.

Prior to testing the fundamental hypotheses, a verification of the diagnostic prerequisites of the models was conducted. The results from the analysis of the Variance Inflation Factor (VIF) for all independent variables are below the threshold of 4.0 (maximum VIF = 3.97), which unequivocally precludes the presence of multicollinearity and allows for the precise isolation of the effects of the various levels of female leadership. Additionally, the Breusch-Pagan test was applied to identify potential heteroscedasticity. The results for the SDG_Index model ($F = 24.82$, $p < 0.001$) and for the carbon emissions model ($F = 13.30$, $p < 0.001$) confirm the presence of non-constant error variance. In accordance with academic practice, these effects are addressed via the specification of FE models by country and year, thereby ensuring the robustness of standard errors and the validity of t-statistics. The full diagnostic tables are available from the authors and can be provided upon request.

Table 3. Results of the regression analysis on the impact of female leadership on the SDGs Index (SDG_Index)

Coefficientsa								
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	62,089	3,269		18,996	,000		
	Women_Parl %	,065	,031	,179	2,112	,036	,252	3,971
	Women_Gov %	-,014	,018	-,057	-,816	,415	,365	2,738
	Women_Board %	,058	,023	,171	2,577	,011	,408	2,451
	Women_Exc %	,148	,025	,287	5,999	,000	,785	1,273
	Edu_Level	-,115	,021	-,299	-5,435	,000	,594	1,683
	RD_Exp	1,488	,274	,369	5,424	,000	,390	2,564
	LnGDP	1,427	,380	,253	3,759	,000	,397	2,517
a. Dependent Variable: SDG_Index								

Source: Authors' processing based on Eurostat data

The results from the regression analysis, presented in Table 3, furnish empirical evidence regarding the significance of female leadership as a determinant of sustainable development. Firstly, the multicollinearity diagnostics confirm the reliability of the model, as the VIF values for all included variables are significantly

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/q6758894333

below the conventional threshold of 5.0, which precludes distortions in the coefficient estimates. The analysis reveals that three of the four indicators of female representation exert a statistically significant positive influence on the SDG_Index. The contribution of women in top executive positions (Women_Exc %) is particularly pronounced, registering the highest unstandardised coefficient among the leadership metrics ($\beta = 0.148$, $p < 0.001$). This finding suggests that direct operational control and female participation in the daily strategic management of the corporate sector possess the most strongly expressed transformative impact on sustainability levels.

A positive and statistically significant association is further corroborated regarding the levels of representation in national parliaments ($\beta = 0.065$, $p < 0.05$) and corporate boards ($\beta = 0.058$, $p < 0.05$). These data substantiate the theoretical proposition that the broader inclusion of women in legislative processes and business supervisory bodies contributes to the adoption of policies and strategies closely aligned with the UN's long-term SDGs. The sole variable in this domain that fails to demonstrate statistical significance is the share of women in government cabinets (Women_Gov %), which indicates that, within the studied sample, parliamentary and corporate representation possess superior explanatory power vis-à-vis overall sustainability compared to political executive power.

The control variables in the model underscore the critical importance of innovation capacity and economic level. Research and Development expenditure (RD_Exp) and the logarithm of GDP per capita (LnGDP) emerge as the most potent positive predictors of sustainable development; their high levels of significance ($p < 0.001$) substantiate the necessity of a robust economic foundation for the realisation of environmental and social objectives.

A distinctive finding within the model is the negative coefficient of educational attainment ($\beta = -0.115$, $p < 0.001$). Within the context of developed economies, this may reflect the effect of the so-called *development paradox*, wherein high levels of education are concomitant with intensive consumption and complex structural challenges that may temporarily impede progress on specific indicators of the SDG Index. Overall, the model demonstrates high predictive validity and confirms that leadership composition constitutes a pivotal factor in the attainment of sustainability, irrespective of the purely economic parameters of the nations.

The results from the second regression model, presented in Table 4, provide a detailed empirical assessment of the determinants of the ecological footprint, proxied by per capita CO_2 emissions. The verification of multicollinearity via Variance Inflation Factor (VIF) values reaffirms the statistical robustness of the estimates, with all indicators remaining within the bounds of permissible levels. The central finding derived from this model is the existence of a strongly pronounced and statistically significant negative impact of female corporate leadership on carbon emission levels. Specifically, female participation in corporate boards (Women_Board %) demonstrates a significant capacity for emission reduction ($\beta = -0.111$, $p < 0.001$), whilst the same trend is observed regarding women in top executive positions ($\beta = -0.082$, $p < 0.001$). These results provide compelling support for the hypothesis that the inclusion of women in the strategic and operational management of business is associated with more efficacious decarbonisation policies and more stringent control over the environmental impact of economic activities.

Table 4. Results of the regression analysis on the impact of female leadership on per capita carbon emissions (CO_2)

Coefficientsa								
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-11,281	2,745		-4,110	,000		
	Women_Parl %	,019	,026	,073	,727	,468	,252	3,971
	Women_Gov %	,008	,015	,045	,535	,593	,365	2,738
	Women_Board %	-,111	,019	-,464	-5,855	,000	,408	2,451
	Women_Exc %	-,082	,021	-,226	-3,954	,000	,785	1,273
	Edu_Level	-,012	,018	-,044	-,671	,503	,594	1,683
	RD_Exp	,222	,230	,078	,963	,337	,390	2,564
	LnGDP	2,085	,319	,526	6,540	,000	,397	2,517
a. Dependent Variable: Annual CO_2 emissions (per capita)								

Source: Authors' processing based on Eurostat data

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/q6758894333

In stark contrast to the corporate sector, the indicators for female political representation in national parliaments and governments do not reveal a statistically significant association with the volume of carbon emissions within the examined model. The coefficients for Women_Parl % ($p = 0.468$) and Women_Gov % ($p = 0.593$) remain outside the conventional levels of significance, suggesting that the direct effect of leadership on environmental sustainability is more pronounced within the corporate sphere than in broader political frameworks. This leads to the conclusion that micro-level decisions in energy-intensive industries and corporate sustainability strategies managed by women have a more immediate impact on actual emissions compared to national legislative initiatives in the short and medium term.

The analysis of the control variables in this model confirms the fundamental importance of economic scale as a primary predictor of environmental load. The logarithm of GDP per capita (LnGDP) registers the highest t-statistic ($t = 6.540$, $p < 0.001$) and a positive coefficient ($\beta = 2.085$), which unequivocally indicates that a higher economic level remains directly linked to elevated emission levels within the studied group of countries. Concurrently, the variables for education and R&D expenditure do not exert a significant influence on emissions in this model; this further isolates female corporate leadership as one of the few identified factors possessing the potential to counteract the negative environmental effects of economic growth. The results underscore the critical role of gender diversity in business management as a tool for achieving environmental SDGs.

The results from the applied Fixed Effects model, presented in Table 5, demonstrate exceptionally high predictive value and statistical significance for the overall research framework. The coefficient of determination ($R^2 = 0.993$) indicates that the model explains 99.3% of the variation in SDG_Index levels, providing evidence of very high precision in the specification of variables within the context of panel data. The high statistical significance of country effects (Country, $p < 0.001$) and time effects (Year, $p < 0.001$) confirms the methodological necessity of employing a Fixed Effects model, which successfully controls for unobserved country-specific heterogeneities and common temporal shocks.

The analysis of the primary independent variables reveals that female representation in national parliaments (Women_Parl) and their participation in top executive positions within the business sector (Women_Exc) constitute highly significant predictors of sustainable development ($p \leq 0.001$). These data provide robust empirical confirmation of the thesis that female leadership within the legislative sphere and the operational management of the corporate sector exerts a direct and substantive influence on progress toward the SDGs. Concurrently, the lack of statistical significance regarding representation levels in government cabinets and corporate boards is noteworthy; this suggests that, under fixed effects conditions, parliamentary and corporate executive power possess superior explanatory power vis-à-vis sustainability dynamics.

Table 5. Results of the Fixed Effects model test for the SDGs Index (SDG_Index)

Tests of Between-Subjects Effects					
Dependent Variable: SDG_Index					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3101,846a	42	73,853	661,240	,000
Intercept	22,678	1	22,678	203,044	,000
Country	1346,795	27	49,881	446,608	,000
Year	9,709	8	1,214	10,866	,000
Women_Parl	1,822	1	1,822	16,314	,000
Women_Gov	,004	1	,004	,034	,853
Women_Board	1,609E-6	1	1,609E-6	,000	,997
Women_Exc	1,352	1	1,352	12,103	,001
Edu_Level	,135	1	,135	1,205	,274
RD_Exp	1,008	1	1,008	9,026	,003
LnGDP	,006	1	,006	,054	,816
Error	23,343	209	,112		
Total	1601097,029	252			
Corrected Total	3125,189	251			
a. R Squared = ,993 (Adjusted R Squared = ,991)					

Source: Authors' processing based on Eurostat data

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/q6758894333

Among the control variables, Research and Development expenditure (RD_Exp) is established as a statistically significant factor (p = 0.003), underscoring the role of innovation as a key catalyst for sustainable development. It is noteworthy that, after accounting for fixed effects and the influence of leadership factors, the economic level (LnGDP) and educational attainment lose their statistical significance within this specific model. This leads to the conclusion that, for the improvement of SDG Index scores, institutional and leadership characteristics, alongside innovation capacity, assume a dominant role that transcends the purely economic wealth of nations. The overall results from the tests of between-subjects effects provide a reliable basis for the verification of the formulated hypotheses with a high degree of statistical confidence.

Table 6. Regression model coefficients (Parameter Estimates) for the SDGs Index (SDG_Index) with fixed effects

Parameter Estimates						
Dependent Variable: SDG_Index						
Parameter	B	Std. Error	t	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Intercept	69,871	4,905	14,246	,000	60,202	79,540
[Country=Austria]	7,964	1,049	7,594	,000	5,897	10,032
[Country=Belgium]	8,548	1,032	8,280	,000	6,513	10,584
[Country=Bulgaria]	5,883	,274	21,456	,000	5,343	6,424
[Country=Croatia]	11,804	,387	30,496	,000	11,041	12,567
[Country=Cyprus]	3,900	,775	5,030	,000	2,371	5,428
[Country=Czechia]	12,042	,583	20,666	,000	10,893	13,191
[Country=Denmark]	13,538	1,149	11,782	,000	11,273	15,804
[Country=Estonia]	10,187	,600	16,980	,000	9,004	11,369
[Country=Finland]	15,372	1,033	14,888	,000	13,337	17,408
[Country=France]	11,925	,949	12,572	,000	10,055	13,795
[Country=Germany]	12,105	1,019	11,882	,000	10,096	14,113
[Country=Greece]	8,469	,487	17,404	,000	7,510	9,428
[Country=Hungary]	11,599	,383	30,287	,000	10,844	12,354
[Country=Ireland]	8,202	1,304	6,289	,000	5,631	10,774
[Country=Italy]	9,422	,811	11,613	,000	7,823	11,021
[Country=Latvia]	11,055	,490	22,563	,000	10,089	12,020
[Country=Lithuania]	7,974	,595	13,399	,000	6,800	9,147
[Country=Luxembourg]	6,256	1,482	4,222	,000	3,335	9,177
[Country=Malta]	9,115	,772	11,801	,000	7,592	10,637
[Country=Netherlands]	8,718	1,082	8,059	,000	6,585	10,850
[Country=Poland]	10,891	,407	26,761	,000	10,089	11,694
[Country=Portugal]	9,519	,599	15,896	,000	8,339	10,700
[Country=Romania]	8,540	,355	24,057	,000	7,840	9,239
[Country=Slovakia]	11,117	,503	22,103	,000	10,125	12,108
[Country=Slovenia]	10,343	,667	15,511	,000	9,029	11,658
[Country=Spain]	9,555	,750	12,740	,000	8,077	11,034
[Country=Sweden]	14,147	1,131	12,508	,000	11,917	16,376
[Country=Türkiye]	0[a]	.	.	.	.	.
[Year=2015]	-1,268	,176	-7,192	,000	-1,616	-,921
[Year=2016]	-1,120	,164	-6,815	,000	-1,444	-,796
[Year=2017]	-1,055	,144	-7,327	,000	-1,338	-,771
[Year=2018]	-,976	,126	-7,767	,000	-1,224	-,728
[Year=2019]	-,729	,109	-6,697	,000	-,944	-,515
[Year=2020]	-,321	,112	-2,859	,005	-,542	-,100
[Year=2021]	-,388	,094	-4,136	,000	-,573	-,203
[Year=2022]	-,198	,091	-2,186	,030	-,376	-,019
[Year=2023]	0[a]	.	.	.	.	.
Women_Parl	,034	,008	4,039	,000	,017	,051
Women_Gov	,001	,003	,185	,853	-,006	,007
Women_Board	-2,612E-5	,007	-,004	,997	-,014	,014
Women_Exc	-,025	,007	-3,479	,001	-,039	-,011
Edu_Level	,014	,013	1,098	,274	-,011	,039
RD_Exp	,595	,198	3,004	,003	,205	,986
LnGDP	-,125	,539	-,233	,816	-1,187	,936
a. This parameter is set to zero because it is redundant.						

Source: Authors' processing based on Eurostat data

The parameter estimates, presented in Table 6, detail the direction and magnitude of the influence exerted by individual predictors on the SDG_Index within the Fixed Effects framework. Within the constructed regression model, the categories *Country* and *Year* are treated as factor variables. For the purposes of statistical

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/q6758894333

computation and in accordance with the standard algorithms of the software utilised (SPSS), the categories with the highest alphanumeric value – specifically Türkiye (for the *Country* factor) and 2023 (for the *Year* factor) – are automatically defined as the reference (baseline) categories. Consequently, the obtained B coefficients for the remaining factor levels reflect statistically significant deviations relative to these reference values; this follows the mathematical necessity of fixing a parameter at zero to preclude multicollinearity within the model, rather than suggesting a subjective selection of the comparative base.

The results reveal significant heterogeneity between individual nations, with all coefficients for country-specific fixed effects being statistically significant ($p < 0.001$) relative to the reference country (Türkiye). The high positive coefficient values for nations such as Finland (B = 15.372), Sweden (B = 14.147), and Denmark (B = 13.538) reflect their specific institutional and structural advantages, which position them at the forefront of sustainable development, irrespective of variations in leadership and economic indicators. Parallel to this, the negative coefficients for the years 2015 to 2022 relative to the reference year 2023 demonstrate a sustained trend of progressive improvement in the SDG Index across the entire sample, indicating systemic progression toward the SDGs throughout the period under review.

Central to the analysis is the statistically significant positive effect of female representation in national parliaments (B = 0.034, $p < 0.001$). This finding provides direct empirical evidence that an increase in the proportion of women within the legislative branch is directly associated with elevated levels of national sustainability; this supports theoretical propositions regarding the more pronounced social and ethical orientation of female leaders. Conversely, the results for women in top executive positions within the corporate sector (Women_Exc) reveal a statistically significant, yet negative, association (B = -0.025, p = 0.001). Within the context of a Fixed Effects model, this suggests that whilst the overall trend remains positive, the specific annual dynamics of female CEOs may be linked to periods of corporate restructuring or crisis management, which, in the short term, generates a different impact on national SDG indicators compared to long-term parliamentary influence.

Among the control variables, investment in Research and Development (RD_Exp, B = 0.595, p = 0.003) exerts the most significant positive impact. The high value of this coefficient underscores the critical role of innovation as a leading determinant in achieving sustainability, the effect of which exceeds that of traditional macroeconomic indicators. Concurrently, the lack of statistical significance regarding the logarithm of GDP per capita (LnGDP, p = 0.816) in this model indicates that, once country-specific fixed effects and leadership factors are controlled for, economic wealth alone is insufficient for improving sustainable development performance. These findings direct attention towards the necessity for targeted policies that promote female political leadership and innovation capacity as more efficacious instruments for the realisation of the 2030 Agenda compared to purely economic growth.

Table 7. Results of the between-subject effects test (Fixed Effects model) for per capita carbon emissions (CO_2)

Tests of Between-Subjects Effects					
Dependent Variable: Annual CO_2 emissions (per capita)					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1456,664[a]	42	34,682	81,373	,000
Intercept	8,127	1	8,127	19,068	,000
Country	865,431	27	32,053	75,203	,000
Year	33,381	8	4,173	9,790	,000
Women_Parl	1,919	1	1,919	4,502	,035
Women_Gov	,219	1	,219	,515	,474
Women_Board	,381	1	,381	,894	,345
Women_Exc	,917	1	,917	2,150	,144
Edu_Level	,023	1	,023	,054	,816
RD_Exp	,092	1	,092	,216	,642
LnGDP	10,579	1	10,579	24,821	,000
Error	89,080	209	,426		
Total	11897,725	252			
Corrected Total	1545,744	251			
a. R Squared = ,942 (Adjusted R Squared = ,931)					

Source: Author's processing based on Eurostat data

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/q6758894333

The results from the applied Fixed Effects model, presented in Table 7, confirm the high explanatory power of the research framework regarding the ecological footprint. The coefficient of determination (R^2 = 0.942) indicates that the model successfully captures 94.2% of the variation in per capita CO_2 emissions within the studied sample. The statistical significance of country effects (Country, $p < 0.001$) and time effects (Year, $p < 0.001$) underscores the structural stability of the model and the necessity of controlling for national specificities and temporal trends when analysing environmental indicators. These results indicate that differences in emission levels are largely determined by the long-term energy profiles of the nations and region-wide technological shifts.

Among the primary independent variables, only female representation in national parliaments (Women_Parl) demonstrates a statistically significant influence on carbon emission levels within this model ($p = 0.035$). This confirms the role of the legislative branch as an institutional channel through which female leadership can impact environmental outcomes at the national level. In contrast to the social dimensions of sustainability, corporate leadership (represented by boards and executive directors) does not exhibit direct statistical significance under fixed effects conditions. This finding suggests that environmental transformation and decarbonisation are processes driven more by macro-level political regulations than by individual dynamics in corporate management within the short-term period under review.

The control variables reveal the fundamental importance of economic factors. The logarithm of GDP per capita (LnGDP) is established as the strongest and most highly significant predictor of emissions ($F = 24.821$, $p < 0.001$), underscoring the persistent link between economic level and carbon intensity in the studied countries. Concurrently, the variables for educational attainment and R&D expenditure do not exert a statistically significant influence on emissions in this model. The aggregated results from the tests of between-subjects effects lead to the conclusion that while economic scale is the primary generator of emissions, female political representation in the legislature emerges as a significant institutional factor with the potential to modulate the ecological trajectory of nations.

The parameter estimates for the carbon emissions model, presented in Table 8, provide a detailed insight into the intensity and direction of the influence exerted by the examined factors on the ecological footprint. The analysis of country-specific fixed effects reveals substantial structural differences, with nearly all coefficients being statistically significant relative to the reference country. The negative values for nations such as Sweden (B = -11.155), Denmark (B = -10.097), and Ireland (B = -9.557) indicate lower per capita carbon intensity compared to the baseline; this reflects the specific impact of national energy mixes, geographical characteristics, and environmental regulations. Of paramount importance is the finding regarding temporal effects (Year), where a smooth and systemic reduction in the values of positive coefficients is observed – from 2.468 in 2015 to 0.544 in 2022 relative to the 2023 reference year. This trend constitutes undeniable evidence of the gradual and sustained decarbonisation of European economies throughout the period under review, irrespective of variations in leadership and economic variables.

Regarding the primary independent variables, the model identifies a statistically significant effect only for the representation of women in national parliaments (Women_Parl, B = 0.035, $p = 0.035$). The positive sign of this coefficient within the context of a Fixed Effects model indicates that the intra-country increase in the proportion of female legislators within the studied sample is accompanied by a slight elevation in emissions in the short term. This result may be interpreted as evidence of an initial focus of female political representation on improving social standards and living conditions – thereby stimulating resource consumption – before the long-term environmental benefits of *green* legislative initiatives manifest. Other indicators of female leadership in government and the corporate sector do not reach the threshold of statistical significance, suggesting that their direct influence on emissions is more limited compared to their impact on overall social sustainability.

The strongest and most dominant predictor in the environmental model remains the economic level, represented by the logarithm of GDP per capita (LnGDP). The high value of the coefficient (B = 5.242, $p < 0.001$) underscores that economic scale continues to be the primary factor generating carbon emissions, with its influence significantly outweighing the effects of leadership, educational, and innovation indicators. The lack of significance regarding *Research and Development* expenditure and educational attainment within this

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/q6758894333

specific model further accentuates the challenges inherent in achieving a complete decoupling of economic activity from the ecological footprint. In summary, the results from Table 8 confirm that whilst the studied region follows a clear trajectory towards the systemic reduction of emissions over time, the economic determinant remains dominant. Furthermore, the role of female leadership within the environmental sphere is institutionally mediated and necessitates a more extended period for its net positive effects to manifest.

Table 8. Regression model coefficients (Parameter Estimates) for per capita carbon emissions (CO_2) with fixed effects

Parameter Estimates						
Dependent Variable: Annual CO_2 emissions (per capita)						
Parameter	B	Std. Error	t	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Intercept	-43,289	9,581	-4,518	,000	-62,177	-24,401
[Country=Austria]	-7,012	2,049	-3,423	,001	-11,051	-2,973
[Country=Belgium]	-5,960	2,017	-2,955	,003	-9,936	-1,984
[Country=Bulgaria]	-,599	,536	-1,118	,265	-1,655	,457
[Country=Croatia]	-4,085	,756	-5,403	,000	-5,576	-2,595
[Country=Cyprus]	-5,929	1,515	-3,914	,000	-8,915	-2,943
[Country=Czechia]	-1,044	1,138	-,917	,360	-3,288	1,200
[Country=Denmark]	-10,097	2,245	-4,498	,000	-14,522	-5,672
[Country=Estonia]	-,796	1,172	-,679	,498	-3,106	1,515
[Country=Finland]	-7,217	2,017	-3,578	,000	-11,193	-3,240
[Country=France]	-8,594	1,853	-4,638	,000	-12,247	-4,941
[Country=Germany]	-5,589	1,990	-2,808	,005	-9,512	-1,666
[Country=Greece]	-3,397	,951	-3,573	,000	-5,271	-1,523
[Country=Hungary]	-3,618	,748	-4,836	,000	-5,093	-2,143
[Country=Ireland]	-9,557	2,548	-3,751	,000	-14,580	-4,535
[Country=Italy]	-6,980	1,585	-4,404	,000	-10,104	-3,856
[Country=Latvia]	-5,555	,957	-5,804	,000	-7,442	-3,668
[Country=Lithuania]	-5,126	1,162	-4,410	,000	-7,418	-2,834
[Country=Luxembourg]	-4,976	2,895	-1,719	,087	-10,683	,730
[Country=Malta]	-9,199	1,509	-6,096	,000	-12,173	-6,224
[Country=Netherlands]	-6,549	2,113	-3,100	,002	-10,715	-2,384
[Country=Poland]	-,229	,795	-,288	,774	-1,796	1,339
[Country=Portugal]	-6,284	1,170	-5,372	,000	-8,591	-3,978
[Country=Romania]	-3,811	,693	-5,496	,000	-5,178	-2,444
[Country=Slovakia]	-3,444	,983	-3,506	,001	-5,381	-1,507
[Country=Slovenia]	-4,458	1,303	-3,422	,001	-7,026	-1,890
[Country=Spain]	-6,879	1,465	-4,695	,000	-9,768	-3,991
[Country=Sweden]	-11,155	2,209	-5,049	,000	-15,510	-6,799
[Country=Türkiye]	0a	.	.	.	.	.
[Year=2015]	2,468	,344	7,165	,000	1,789	3,147
[Year=2016]	2,355	,321	7,336	,000	1,722	2,987
[Year=2017]	2,234	,281	7,943	,000	1,679	2,788
[Year=2018]	1,946	,246	7,925	,000	1,462	2,430
[Year=2019]	1,407	,213	6,613	,000	,987	1,826
[Year=2020]	,939	,219	4,284	,000	,507	1,371
[Year=2021]	,894	,183	4,882	,000	,533	1,255
[Year=2022]	,544	,177	3,077	,002	,195	,893
[Year=2023]	0a	.	.	.	.	.
Women_Parl	,035	,016	2,122	,035	,002	,067
Women_Gov	-,005	,007	-,717	,474	-,018	,008
Women_Board	-,013	,013	-,946	,345	-,039	,014
Women_Exc	,020	,014	1,466	,144	-,007	,048
Edu_Level	-,006	,025	-,233	,816	-,055	,043
RD_Exp	-,180	,387	-,465	,642	-,943	,583
LnGDP	5,242	1,052	4,982	,000	3,168	7,316
a. This parameter is set to zero because it is redundant.						

Source: Author's processing based on Eurostat data

The analysis of the obtained empirical data through the prism of the formulated hypotheses reveals a multifaceted picture of the interaction between gender diversity in management and national sustainability indicators. Regarding the first hypothesis (H_1), which predicts a positive relationship between the presence of women in senior positions and the SDG Index, the results provide substantial, albeit differentiated, support. The statistically significant positive coefficient for women in national parliaments in the fixed effects model ($B = 0.034$, $p < 0.001$) confirms that female legislative representation is a sustained driver for achieving the UN's

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/q6758894333

systemic goals. This finding is in direct alignment with Social Role Theory and Ecofeminism, according to which a female leadership style – oriented towards community care and social inclusion – materialises into concrete policies that improve the overall social sustainability of nations (Boukattaya & Omri, 2021). The fact that, in the Ordinary Least Squares (OLS) regression model, female executives also demonstrate a strong positive influence further supports the thesis that corporate female leadership contributes to systemic progress, although the specific annual dynamics in the fixed effects model necessitate a more nuanced interpretation of short-term versus long-term effects.

Concerning the second hypothesis (H_2), which examines the role of women in corporate governance in reducing the carbon footprint, the results demonstrate a high degree of sensitivity to the applied methodology. The OLS regression analysis provides categorical evidence in support of H_2, establishing that an increase in the proportion of women on boards ($B = -0.111$, $p < 0.001$) and in executive positions ($B = -0.082$, $p < 0.001$) is associated with a significant reduction in CO_2 emissions. This result corresponds with Stakeholder Theory and Critical Mass Theory, suggesting that the presence of women in corporate management transforms business strategies towards greater environmental responsibility and investment in *green* innovations. However, the transition to the more rigorous Fixed Effects (FE) model reveals that once the influence of specific national and institutional characteristics is eliminated, the direct influence of corporate leadership factors on emissions loses its statistical significance in favour of economic determinants. This indicates that the environmental effect of female leadership in business is likely mediated by long-term national structures and does not manifest as an immediate annual fluctuation.

An integrated view of the results permits the conclusion that female leadership possesses a more pronounced and direct capacity to influence the social and systemic aspects of sustainable development than it does immediate environmental indicators. The support for H1 through the political channel (parliament) proves robust across all statistical tests, establishing the legislative branch as the primary instrument for the realisation of the ethical leadership style postulated by ecofeminist theory. In the environmental sphere, although the initial data from the OLS model point in favour of H2 and the role of corporate representation, the fixed effects reveal that decarbonisation remains a process dominated by macroeconomic factors, where leadership variables require a more extended institutional period to unfold their potential. Thus, the study contributes to the scholarly debate by differentiating between sectors where gender diversity has an immediate transformative effect and those where its role is more long-term and structurally dependent.

The results of this study provide new empirical evidence that complements and extends the scientific debate regarding the role of gender diversification in management as a catalyst for sustainable development. The established strong positive correlation between female parliamentary representation and the SDG_Index supports theses in the literature suggesting that female legislators are more inclined to endorse holistic policies aimed at social inclusion and societal well-being (Toukabri & Jilani, 2023; Mirza et al., 2024). The finding that parliamentary presence maintains its statistical significance even within the rigorous fixed effects model validates the arguments that the institutional capacity of women to influence the sustainability agenda transcends specific national and economic contexts (Roca et al., 2024; Ionașcu et al., 2025). This result is in synchrony with the ecofeminist paradigm, which postulates that the female leadership style is closely linked to the ethics of care and long-term social responsibility (Tarkovska et al., 2023).

In the context of corporate governance, the data obtained regarding the influence of women on boards and in executive positions on decarbonisation offer an interesting contrast to classical studies. The negative association observed in the OLS model between female corporate presence and CO_2 emissions corroborates Stakeholder Theory, which posits that gender diversity in management leads to the consideration of societal and environmental interests (Thawornlamlert et al., 2025; Hargrave et al., 2026).

The results align with findings that a critical mass of women in leadership stimulates investment in green innovations and ecological efficiency (Pecher et al., 2025; Yudiani et al., 2024). However, the transition to the Fixed Effects model – wherein this association loses its immediate significance – introduces a nuance into the scholarly discussion, suggesting that the environmental contribution of women in business is mediated by macroeconomic structures and national energy profiles (García-Sánchez et al., 2023; Kray et al., 2025).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/q6758894333

Of particular significance to the literature is the contrast between the effects of women in executive positions (Women_Exc) and those in the legislature. While parliamentary presence consistently improves overall sustainability indicators, the negative association for female executives relative to the SDG_Index ($\beta = -0.025$, $p = 0.001$) necessitates a more nuanced reading of the optimistic forecasts regarding the role of women in operational management (Ali et al., 2025; Sofiyah et al., 2025). This result provides empirical confirmation of the *glass cliff* phenomenon, whereby women are frequently appointed to leadership positions during periods of economic or institutional uncertainty (Lindstrand et al., 2024; García et al., 2025). Within the European business sector, this implies that female leadership potential is often directed as a priority towards stabilising structures with already deteriorating performance, where an operational focus on short-term survival may temporarily dominate long-term sustainability goals. Thus, the present study enriches the debate by highlighting that while political representation serves as a foundation for social sustainability, corporate leadership requires a more extended adaptation period and closer integration with national economic policies to realise its full potential.

Research limitations

Despite the statistical significance of the findings, the study is subject to several primary limitations. Firstly, the examined period (2015–2023) encompasses significant global disruptions – notably the COVID-19 pandemic and the subsequent energy crisis – which may exert non-linear impacts on emissions and SDG indicators that are difficult to capture solely through time-fixed effects. Secondly, the presence of heteroscedasticity in the models, although methodologically addressed, indicates substantial structural disparities between nations (e.g., between Luxembourg and Türkiye) that an aggregated model may not consistently explicate in full. Thirdly, the research focuses on quantitative representation (the number of women) but does not measure qualitative dimensions such as leadership style, individual competencies, or political affiliation, which could further modulate the impact on sustainable development. Finally, the environmental footprint is measured exclusively via CO_2 emissions, thereby omitting other critical aspects such as biodiversity and water resource management.

Originality and contribution

The originality of this research lies in its integrated approach to analysing female leadership simultaneously within the political and corporate spheres as a determinant of sustainable development. Diverging from previous studies, the focus here is placed on the distinction between strategic power (boards) and operational power (executive directors) within the context of the European Green Deal. The study offers an innovative perspective on the *cost of sustainability*, establishing that while female representation in parliament serves as a universal driver for achieving the UN's social goals, environmental outcomes (decarbonisation) remain heavily dependent on national economic structures. A further contribution consists of the empirical confirmation that, within Europe, female political representation exerts a more direct and sustained impact on the SDG Index than corporate governance does in the short term.

Practical Implications

The findings of this study possess direct applicability for the formulation of public policies and human resource management strategies. The established positive correlation between women in parliament and the SDG Index serves as a robust argument in support of legislative initiatives aimed at promoting gender equality in politics, such as quota systems or mentorship programmes. Within the corporate sector, the proven role of women on boards in reducing emissions (within the OLS model) supports the implementation of the EU Women on Boards Directive. Organisations can utilise these data to substantiate their ESG strategies, recognising gender diversification not merely as a matter of social justice but as a strategic instrument for achieving specific environmental and governance objectives.

Conclusions

The present study has provided a comprehensive empirical analysis of the role of female leadership in the processes of sustainable development and decarbonisation within the European context for the period 2015–2023. The results corroborate the central thesis that gender diversification within power structures is not merely a matter of social justice but is also a critical factor in achieving the strategic objectives of the United Nations and the European Union. Through the application of fixed effects models, the net contribution of female leaders

was isolated, proving that their influence on national sustainability is statistically significant and resilient to economic fluctuations.

Regarding the first hypothesis (H_1), the data categorically indicate that higher female representation in national parliaments is directly and proportionally linked to an increase in the overall SDGs Index (SDG_Index). This result validates the ecofeminist paradigm and social role theory, highlighting that female legislators successfully transform ethical leadership principles into concrete policies for social inclusion, healthcare, and education. The surprising finding of a negative short-term association between women in senior corporate executive positions and the SDG Index does not refute their role; rather, it points to the complexity of corporate governance during transitional periods, where operational challenges may temporarily mask the strategic benefits of leadership diversity.

The second hypothesis (H_2), focused on environmental efficiency, received nuanced support. The analysis revealed that while the economic level (GDP) remains the primary predictor of carbon emissions, corporate female leadership on boards and at the executive level possesses the potential to reduce the ecological footprint, as demonstrated in the regression models. The fact that, in the more rigorous fixed effects specification, political representation emerged as the sole significant leadership factor influencing emissions underscores the leading role of the state and legislative regulations in driving environmental transformation. This suggests that female leadership in the corporate sector requires stronger institutional support to overcome dominant economic determinants.

In conclusion, the study proves that achieving gender balance in governance is a potent catalyst for social sustainability, while simultaneously offering new mechanisms for addressing environmental challenges. The primary findings point towards the necessity of continued efforts to dismantle structural barriers facing women in both political life and at the highest operational levels of business. The sustainable development of Europe requires leadership that integrates *empathy, long-term vision, and environmental responsibility* – qualities that this research identifies as inherent to increased female participation in decision-making processes.

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Funding: This research is funded by the European Union's Horizon Europe research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 101179323.

Disclaimer: Views and opinions expressed are however, those of the author(s) only and do not necessarily reflect those of the European Union or the Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Data Availability Statement: The primary data supporting the findings of this study are included within the article. Any additional datasets generated or analysed during the current study that are not explicitly described in the manuscript are available from the corresponding author upon reasonable request.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/q6758894333

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/k3946996882

Publisher
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MAPPING THE DIGITAL MARKETING HARD SKILLS OF UNIVERSITY STUDENTS IN THE VISEGRAD REGION*

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Received 18 January 2026; accepted 23 March 2026; published 30 June 2026

Abstract. The growing role of digital marketing and the increasing importance of data-driven tools are reshaping the labour market's expectations. Identifying the differences between labour market requirements and students' skills is essential for advancing university courses. Despite the increasing presence of digital marketing content in study programmes, there is still a lack of comparative empirical research assessing the level of digital marketing skills among students in Central Europe. The aim of this paper is to investigate and map the digital marketing hard skills of university students in the Visegrad region, with particular emphasis on their ability to use digital tools, their perceived proficiency and areas requiring further development to meet modern labour market expectations. Using purposive sampling, data were collected via an online survey administered between June 2025 and January 2026, among Hungarian, Polish and Slovak students. The total sample size consisted of 1200 respondents (400 from each country), aged 18 - 30, enrolled in study programmes incorporating marketing-related courses. The questionnaire included items regarding digital marketing skills and students' perceived proficiency in specific digital tools. The findings reveal a clear concentration of skills in domains that are highly visible within students' environments, like social media and AI, while automation and analytics skills remain comparatively underdeveloped. At the level of specific digital marketing tools, self-reported proficiency ranged predominantly from beginner to intermediate level. Significant differences between countries were also observed. These findings underscore the need to more closely align curricula with the requirements of the labour market.

Keywords: digital skills; marketing skills; higher education; AI proficiency; social media tools

Reference to this paper should be made as follows: Šedík, P., Śliwińska, I., Bajak, M., Janšto, E., Oravecz, T., Rimóczi, C. 2026. *Entrepreneurship and Sustainability Issues*, 13(4), 142-151. http://doi.org/10.9770/k3946996882

JEL Classifications: M31, J24, I23

1. Introduction

The modern world is increasingly characterised by rapid technological advancement, accelerating digitalisation, and continuously evolving labour market demands, which significantly reshape expectations about what people should know to be employable (Dickson, 2023). Marketing is one of the sectors most heavily influenced by the digital revolution. The integration of digital platforms, artificial intelligence, machine learning, and data-driven decision-making has fundamentally reshaped marketing strategies, customer interaction, and value creation

* *This research has been supported and this scientific paper was prepared within the project "Digital marketing: Theory & Practice in Visegrad region (Visegrad Grant no. 22420081)". The project is co-financed by the Governments of Czechia, Hungary, Poland, and Slovakia through Visegrad Grants from the International Visegrad Fund. The mission of the fund is to advance ideas for sustainable regional cooperation in Central Europe.*

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/k3946996882

processes (Dwivedi et al., 2021; Kumar et al., 2021). In today's fast-paced business world, companies are leaning heavily on digital tools to get to know their customers better. Instead of providing the same message to everyone, they utilise technology to learn what people like and create offers that feel personal (Paschen et al., 2019). Because of this shift, being good at "old school" marketing isn't enough anymore. Modern marketers need to be technologically savvy and able to solve problems. They have to be comfortable using new software, thinking on their feet, and quickly adjusting whenever a new technology changes the game (Herhausen et al., 2020; Van Laar et al., 2020). Higher education institutions play an important role in training future marketing professionals for the challenges of the digital economy. Universities are increasingly expected to provide students with appropriate skills that meet changing labour market demands, particularly in digital marketing contexts (Mabungela et al., 2025). This challenge is particularly relevant for Generation Z, who are defined as individuals born between 1995 and 2012. Generation Z has grown up in a fully digital environment and is highly familiar with digital technologies, social media and online communication platforms. However, being familiar with technology does not necessarily mean that someone is professionally competent in the digital sphere (Van Laar et al., 2020; Kovacs, 2021). Therefore, understanding the competencies required by future marketing professionals is essential for aligning educational programmes with labour market needs. Checking what marketing skills students actually have, it is a great way to see if they're truly ready for the job. It helps us spot the gap between what's being taught in class and what companies actually need right now.

2. Theoretical background

Nowadays, the ability to use digital tools effectively is no longer just an additional asset on the labour market, but rather a standard expectation of employers. Digitalisation increases the demand for non-routine work that requires information processing and problem-solving. New technologies increase the complexity of tasks performed by employees, requiring a diverse set of skills (Antonazzo et al., 2021; Antonazzo et al., 2025). Employees require an extensive range of skills, combining strong cognitive and socio-emotional skills with hard digital skills (OECD, 2019). At the same time, digital skills mean a broad array of competencies, including basic knowledge of technology, critical thinking, problem-solving skills, and more (Audrin & Audrin, 2022). However, their scope is changing in parallel with the development of specific technologies (e.g., artificial intelligence, automation, analytics). Emerging technologies create both opportunities and challenges for not only in industry but also in higher education, requiring curricula to be adapted to changing labour market requirements, including an increasing emphasis on the development of digital skills (OECD, 2019). From an educational perspective, the development of such competencies depends significantly on the curriculum design. Iqbal (2023) demonstrates that the structure of marketing curricula has a significant impact on graduates' career outcomes, especially when study programmes combine conceptual knowledge with practical, tool-based training.

Labour market research confirms that marketing positions increasingly require interdisciplinary skills, combining creativity, an analytical approach and technological fluency (Di Gregorio et al., 2019; Key et al., 2019). These patterns can be interpreted through the lens of value creation and delivery in marketing, both for the customer and other stakeholders in the organisation. In the context of digitalisation, the decision-making process is becoming increasingly complex, multidimensional, multi-channel and based on multiple customer touchpoints. Advanced information technologies, particularly tools based on artificial intelligence, are useful support in processing vast amounts of customer data (Cherednichenko et al., 2023). Today's consumers switch between real and virtual spaces, where interactions are spread across social media, e-commerce systems, e-mail and mobile channels. Each subsequent interaction generates data on the needs, preferences and behaviours of recipients, making the delivery of value strongly dependent on the information obtained and processed (Štefko et al., 2023). As a result, effective customer relationship management and value delivery become based on the ability to collect, analyse and interpret data, which emphasises the importance of hard digital skills in marketing practice.

The growing importance of digital proficiency raises questions about the extent to which higher education institutions equip students with business-relevant digital skills that meet the dynamic changes in industry expectations. In this context, there is a gap between the outcomes of education and the requirements of the labour market, particularly in areas subject to dynamic technological developments (OECD, 2019). This

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phenomenon can be interpreted as a skill mismatch resulting from the asymmetry between the pace of technological change and the organisational capabilities of educational institutions (Lichy & Khvatova, 2019). Although the labour market requires skills related to the use of modern tools, these changes are not always reflected in education programmes. In the case of digital marketing, this issue seems particularly important, as it is based on rapidly developing advertising systems, sales platforms and analytical software, whose functionalities are subject to constant modification (Gayatri & Az, 2021). Changing expectations relate not only to labour market requirements, but also to the needs of students who want curricula covering a wide range of practical digital skills and the use of digital marketing tools and platforms (Viana & Gomes, 2024).

In a broader perspective, therefore, debate arises not only about the general level of students' digital skills, but also about their structure and ability to use specific tools. Companies require not only general technological proficiency, but also the ability to work with data and specific platforms and systems (OECD, 2019; Beck et al., 2025). This means that the value of skills in the labour market is determined by their suitability for specific activities, rather than solely by their formal classification as "marketing" or "technological". As a result, skills associated with digital marketing are finding wider application in businesses, also fitting into e-commerce, product management and sales analytics. As a consequence, employment decisions are increasingly based on specific and measurable skills, rather than just on a formally acquired university degree in a particular field (Tomlinson, 2017). This implies that preparing students for employment should not be limited to a general introduction to digital competencies. Equally important is training in task-oriented skills that enable working with data and specific platforms and tools. Digital marketing skills can be seen as an example of specialised skills that are transferable and go beyond basic marketing roles. Therefore, it seems reasonable to examine the extent to which students enrolled in marketing-related courses develop hard digital skills considered essential for employment in marketing positions (Gayatri & Az, 2021; Cicha & Rizun, 2025).

3. Research objective and methodology

The aim of this paper is to investigate and map the digital marketing hard skills of university students in the Visegrad region, with particular emphasis on their ability to use digital tools, their perceived proficiency and areas requiring further development to meet modern labour market expectations. The following research questions were formulated:

- RQ1: Which digital marketing skills do students demonstrate across key marketing domains, and how do these skills vary among the selected countries?
- RQ2: What is the perceived level of students' digital marketing skills, and how does this level differ among the selected countries?
- RQ3: What are students' self-assessed proficiencies with specific social media tools, and are there significant differences among selected countries?
- RQ4: What are students' self-assessed proficiencies with specific AI tools, and are there significant differences among selected countries?
- RQ5: What are students' self-assessed proficiencies with specific email marketing tools, and are there significant differences among selected countries?

Data collection was performed using an online survey. The study was conducted between June 2025 and January 2026. We used a purposive sampling method. Our research sample consists of university students enrolled in study programmes that include marketing-related courses. The age range of the participants was 18 to 30 years. We have collected data from three countries from the Visegrad region: Hungary, Poland and Slovakia. The analyses presented in this paper were carried out based on answers provided by 400 respondents from each country, resulting in a total sample size of n=1200. The respondents' participation in the study was voluntary and anonymous. They were informed about the purpose of the research and that they could withdraw at any time.

The questionnaire consisted of questions related to digital marketing skills, covering students' abilities, competencies, and the use of specific tools. To identify students' digital skills in different marketing domains, we used dichotomous questions. To assess their perceived proficiency in various digital marketing tools, we

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used a 5-point scale. Each point of the scale was explained in the questionnaire to ensure that all respondents interpreted the categories in a consistent way: 1 - no skills at all (I have no experience or knowledge in this field); 2 - beginner (I am beginning to learn this topic/tool, I can perform simple tasks with guidance); 3 - intermediate (I know this tool/software, I can perform defined and routine tasks independently); 4 - advanced (I know the advanced functions of this tool/software, and I can perform various tasks independently); 5 - expert (I have full proficiency in using this tool/software, and I am able to share my knowledge with others).

The data analysis was performed using Jamovi software. Research questions were tested by applying non-parametric tests such as the Chi-square test of independence for categorical questions (yes/no), while the Kruskal-Wallis test was applied for ordinal data acquired from scaling questions. The specific differences across countries were identified by the Dwass-Steel-Critchlow-Fligner pairwise comparisons.

3. Results and discussion

The acquired results show a certain diversity in digital skills of selected marketing domains among university students. In general, the majority of students indicated no skills in Google Analytics, email marketing and user experience (UX) or user interface (UI), while a certain degree of skills was indicated in social media marketing and in AI in marketing. Furthermore, statistically significant differences were identified across countries in three domains: social media marketing, AI in marketing and email marketing. Based on Table 1, it can be stated that the declarations on skills in social media marketing were highest among Slovak students, followed by Hungarian students, while in Poland, more than half of the students indicated no skills in social media marketing. According to the results, 19% of Hungarian students declare having skills in email marketing, which is the highest number among the examined countries. In general, it can be stated that university students mostly have skills in AI in marketing and social media marketing.

Table 1. University students' digital skills in different marketing domains

Items	Answer	Hungary	Poland	Slovakia	p-value
Google analytics	yes	40,5%	38,5 %	32,8 %	0,063
	no	59,5%	61,5 %	67,3 %	
Social media marketing	yes	75,3 %	48,3 %	88,3 %	< 0,001*
	no	24,8 %	51,7 %	11,8 %	
AI in marketing	yes	94,8 %	99,0 %	99,3 %	< 0,001*
	no	5,3 %	1,0 %	0,8 %	
Email marketing	yes	19,0 %	8,3 %	10,3 %	< 0,001*
	no	81,0 %	91,8 %	89,8 %	
UX/UI	yes	12,0 %	8,5 %	9,3 %	0,219
	no	88,0 %	91,5 %	90,8 %	

* – Significant differences between countries according to Chi-square test of independence ($p < 0.05$).
Source: Own study

In addition, students across all three countries evaluated their perceived proficiencies in further marketing skills such as search engine optimisation, graphic software, pay-per-click marketing, content management system, customer relationship management, creating and managing e-shops and creating and managing websites. On average, students are more skilled in graphic software (3,28), followed by creating and managing websites (2,34), creating and managing e-shops (2,02) and search engine optimisation (2,01). Students' Pay-per-click marketing, CMS and CRM skills are between no skills to beginner level.

Based on the obtained results, it can be stated that there exist statistically significant differences across countries in all evaluated skills (Table 2). Hungarian students declare higher proficiency in comparison to Slovak and Polish students in the following skills: creating and managing websites (2,69), CMS and CRM (2,60), search engine optimisation (2,32), PPC marketing (2,30) and creating and managing e-shops (2,21). In the case of graphic software, Polish students indicated the highest proficiency (3,61).

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Table 2. Perceived proficiencies of university students' digital marketing skills

Item	Overall	Hungary	Poland	Slovakia	p-value
SEO (Search Engine Optimization)	2,01	2,32[a]	1,95[b]	1,76[b]	< 0,001*
Graphic software (Photoshop, Corel, Canva)	3,28	3,34[a]	3,61[a]	2,88[b]	< 0,001*
PPC marketing	1,72	2,30[a]	1,56[b]	1,55[b]	< 0,001*
CMS and CRM	1,82	2,60[a]	1,82[b]	1,57[b]	< 0,001*
Creating and managing e-shops	2,02	2,21[a]	1,97[b]	1,89[b]	< 0,001*
Creating and managing websites	2,34	2,69[a]	2,12[b]	2,23[b]	< 0,001*

* – Significant differences between countries according to Kruskal-Wallis test ($p < 0.05$). Means in the same row with different superscripts are statistically different according to Dwass-Steel-Critchlow-Fligner pairwise comparisons ($p < 0.05$).

Source: Own study

Across all three countries, students reported the highest perceived proficiency in using Facebook and Instagram tools. They also assessed their skills relatively high regarding TikTok, which can be classified as intermediate level or above (mean values ranging from 2,46 in Slovakia to 3,53 in Hungary). Clear cross-country differences emerge, although they vary by specific platform. Results show the highest scores in most tools among Hungarian students. An exception is observed for Facebook Ads, Instagram Ads, and Meta Business Suite, where Polish students' perceived level is slightly higher (3,60 for Facebook Ads and Instagram Ads; 2,89 for Meta Business Suite). In contrast, Slovak students obtained the lowest average scores in most social media tools. Across all countries, the lowest self-assessment of skills is reported for LinkedIn Ads (Table 3).

Table 3. University students' perceived proficiencies in social media tools

Item	Overall	Hungary	Poland	Slovakia	p-value
Facebook insights	2,84	3,70[a]	2,77[ab]	2,67[b]	< 0,001*
Instagram insights	3,06	3,20	2,91	3,20	0,054
Meta Business Suite	2,51	2,84[a]	2,89[a]	2,20[b]	< 0,001*
Facebook ads	2,98	3,47[a]	3,60[b]	2,52[c]	< 0,001*
Pinterest Ads	2,49	2,81[a]	2,34[b]	2,30[b]	< 0,001*
LinkedIn Ads	2,00	2,46[a]	1,96[b]	1,63[c]	< 0,001*
Instagram ads	3,15	3,57[a]	3,60[b]	2,85[b]	< 0,001*
TikTok ads	2,93	3,53[a]	2,85[b]	2,46[c]	< 0,001*

* – Significant differences between countries according to Kruskal-Wallis test ($p < 0.05$). Means in the same row with different superscripts are statistically different according to Dwass-Steel-Critchlow-Fligner pairwise comparisons ($p < 0.05$).

Source: Own study

Analysis of AI tools revealed an uneven distribution of skills across the platforms. ChatGPT achieves by far the highest average scores in all three countries (above advanced). This indicates that ChatGPT has become the dominant AI tool in the student environment, significantly outperforming all other platforms. In contrast, the remaining tools (Gemini, Writesonic, Copilot, Midjourney) average scores range from no skills to an intermediate level at most. This pattern demonstrates a strong concentration of skills around a single, widely adopted tool rather than a broad understanding of the AI ecosystem. Cross-country comparisons show that Hungary achieves the highest average scores in four out of five tools (Writesonic, Copilot, Midjourney, ChatGPT). These differences are statistically significant and suggest that Hungarian students may have a more diverse exposure to AI technologies compared to Polish and Slovak students. The only exception is Gemini, where Polish students obtain the highest scores (3,13), indicating relatively greater familiarity with this specific tool (Table 4).

Table 4. University students' perceived proficiencies in AI tools

Item	Overall	Hungary	Poland	Slovakia	p-value
Gemini	2,86	2,89[a]	3,13[a]	2,55[b]	< 0,001*
Writesonic	1,55	1,93[a]	1,41[b]	1,31[b]	< 0,001*
ChatGPT	4,32	4,48[a]	4,35[b]	4,13[c]	< 0,001*
Copilot	2,40	2,76[a]	2,14[b]	2,31[b]	< 0,001*
Midjourney	1,63	1,98[a]	1,52[b]	1,40[b]	< 0,001*

* – Significant differences between countries according to Kruskal-Wallis test ($p < 0.05$). Means in the same row with different superscripts are statistically different according to Dwass-Steel-Critchlow-Fligner pairwise comparisons ($p < 0.05$).

Source: Own study

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Compared with the findings on social media and AI tools, students' skills in email marketing overall are at a similarly beginner level, or slightly higher, with average scores ranging from approximately 2,06 (SmartEmailing) to 2,63 (Mailchimp). That may indicate limited integration of e-mail automation into marketing curricula and practical training. Hungarian students achieve the highest average scores in all of the analysed tools, demonstrating a systematic advantage in the area of e-mail automation. Poland and Slovakia show lower levels of skills, with Slovakia recording the lowest scores from all countries in several tools, such as MailerLite, AWeber, SmartEmailing and GetResponse (Table 5). In most cases, these cross-country differences are statistically significant. Overall, the results suggest that students do not develop proficiency in any specific e-mail marketing tool. Instead, their skills remain limited to basic operational tasks.

Table 5. University students' perceived proficiencies in e-mail marketing tools

Item	Overall	Hungary	Poland	Slovakia	p-value
Mailchimp	2,63	2,97[a]	2,27[b]	2,27[b]	0,004*
MailerLite	2,44	3,00[a]	2,30[b]	1,51[c]	< 0,001*
Ecomail	2,28	2,51	1,97	2,10	0,056
AWeber	2,06	2,59[a]	1,79[b]	1,29[b]	< 0,001*
SmartEmailing	2,09	2,49[a]	1,82[b]	1,59[b]	< 0,001*
GetResponse	2,15	2,53[a]	2,39[a]	1,24[b]	< 0,001*

* – Significant differences between countries according to Kruskal-Wallis test ($p < 0.05$). Means in the same row with different superscripts are statistically different according to Dwass-Steel-Critchlow-Fligner pairwise comparisons ($p < 0.05$).
Source: Own study

The findings indicate a pattern among university students in the Visegrad Region in the structure of digital marketing skills. The results reveal a clear dominance of tools that are currently popular and visible in the market, while students declare a weaker level of knowledge of tools related to analytics or automation. Findings align with the broader debate on digital skills in Europe, suggesting a reactive nature of skills development in the context of existing market trends (European Commission 2023; OECD, 2021). However, many of the earlier studies that broadly analysed ICT skills and digital literacy in the context of education (e.g., Verhoeven et al., 2020) did not explicitly address the marketing domain. In turn, studies devoted to marketing skills rarely focused on specific ICT tools and concentrated on labour market expectations rather than the skills actually possessed by students (e.g., Di Gregorio et al., 2019; Key et al., 2019; Kovács, 2021).

In this study, students' skills were examined both at the level of individual digital marketing domains (SEO, AI, PPC, UX/UI, Google Analytics) and their knowledge and ability to use specific tools (e.g., Photoshop, LinkedIn Ads, Mailchimp). Although a significant proportion of students declare having skills in general digital marketing domains, their self-assessment of proficiency in specific tools in their field is substantially lower and unevenly distributed. For example, students' skills in artificial intelligence are concentrated on a single dominant tool (ChatGPT), while their proficiency in using alternative applications remains limited (e.g., Gemini, Copilot, Writesonic, Midjourney). A similar pattern can be observed in the area of social media, where relatively high skills mainly concern the Meta ecosystem, with a lower level of knowledge of other advertising platforms. This suggests that skill development is concentrated around platforms, and it does not exhibit a systemic structure. As a result, perceived skills within a given domain do not necessarily translate into broad technical capabilities or the ability to transfer knowledge between different tools.

This discrepancy is consistent with the Dunning-Kruger effect (1999) and research on the perceived skill gap. Exposure to a tool does not necessarily translate into the ability to use it effectively in practice. Furthermore, previous studies have shown that declared digital skills may be overestimated when assessments are made at a general level (e.g., Porat et al., 2018). Declarations at the level of the digital marketing domain (e.g., I have skills in email marketing) may reflect conceptual awareness rather than demonstrated ability to operate multiple tools in this area. This observation is also consistent with the distinction between declarative and procedural competencies (Anderson, 1982). Students may possess declarative digital marketing skills (e.g., the ability to create social media sales funnels) without developing proficiency in diverse tool environments. This suggests that identifying skills at the domain level may reflect cognitive recognition of the subject, while proficiency at the tool level more accurately reflects the ability to use it in practice.

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The strong concentration of students' skills around social media and AI tools can be interpreted through the lens of the Theory of Diffusion of Innovation. According to this approach, technologies characterised by low perceived complexity, high observability of results and high compatibility with existing practices are adopted more quickly than solutions requiring in-depth analytical skills or systems thinking. This interpretation is further supported by technology acceptance models. For example, from the perspective of the Technology Acceptance Model (Davis & Granić, 2024) and UTAUT (Venkatesh et al., 2003), the perception of specific tools is shaped by factors such as perceived ease of use, usefulness, or social influence. Platforms such as Meta, ChatGPT, and Canva are widely present in the academic and media environment, which may contribute to their acceptance. Similar mechanisms are also indicated by other studies on technology (e.g., Kandoth & Shekhar, 2022), which show that users are more willing to develop skills in technological tools that are popular and widely used in their environment. This phenomenon can also be related to network effects and platform dominance, which tend to concentrate user competencies around technologies with the largest user bases. The findings suggest that this process leads to selective skill development. From an employability perspective, this implies a potential risk of a skills gap between education and the labour market (Aljohani et al., 2022). Industry reports suggest that there is a growing demand for analytical skills, marketing systems integration and data management (Deloitte, 2023; McKinsey, 2025). The results of the study, therefore, suggest a need to develop universal skills, in particular analytical and automation-related, which can be transferred across different platforms, while simultaneously exposing students to a broader variety of tools.

The advantage observed in Hungary suggests that the structure of the curricula and the resources available to the education process shape the level of digital marketing skills. This is consistent with Human Capital Theory as well as the literature on teaching and learning (e.g., OECD, 2021), which indicates that skill levels, including digital skills, are substantially influenced by educational institutions. In addition, digital technologies such as e-learning, online self-learning tools and virtual reality-based training methods can not only support the educational process itself, but also prepare individuals for future lifelong learning in online environments (Urbancová et al, 2021). The findings indicate that even within a relatively homogeneous age group, skill levels vary between countries. The observed differences concern not only access, but also the type of skills developed. This suggests the importance of education-related factors, such as the availability of computer labs, the scope of practical classes, the use of specific tools, or cooperation with the business sector. The differences observed between the countries studied can therefore be interpreted not only in terms of individual preferences or technological exposure, but also in terms of the study programme, which highlighted the need for further research into curricula design in shaping digital skills.

Conclusions

Our study has identified a competency gap among university students in Hungary, Poland, and Slovakia. This is characterised by a state of being digitally immersed, yet professionally unempowered. While students are generally comfortable with social media and trend-driven generative AI tools, they often lack the technical skills required for a career in marketing. Our findings suggest that current skills development is influenced more by personal exposure than by professional mastery. There has been a marked decline in skill levels in specialist areas such as data-driven analytics, CRM automation and UX optimisation. We found that self-assessed proficiency remains intermediate and varies significantly across borders, indicating a clear gap between casual technology use and the rigorous, highly specialised skills that are expected to be in demand in the labour market.

To implement these findings into professional practice, higher education should shift its focus from teaching individual social media platforms to developing broader, transferable digital marketing competencies. Curricula should place greater emphasis on analytical and automation skills, treating them as core components rather than optional additions. By encouraging students to move beyond basic familiarity with social media and generative AI, professional software suites can help them understand key principles, such as performance measurement, campaign optimisation, and customer journey automation. These skills remain valuable even as specific tools and technologies change. In practice, these skills can be supported through experiential learning, including practical case studies, simulations, and collaboration with industry partners, where students gain experience in analysing data and making strategic decisions. By integrating AI as a structured support tool for productivity

and decision-making, universities can better prepare graduates to use technology effectively and meet the evolving demands of the modern labour market.

This study faces several limitations. First, we used purposive sampling, which, while appropriate for targeting specific groups of university students, reduces the ability to extend our findings to a broader population. Second, the data presented in the paper are based on self-reported measures, which do not capture objectively validated skill levels. This approach may result in over- or underestimating students' actual competencies. Third, the geographical scope of the study includes only Hungary, Poland, and Slovakia, excluding the fourth Visegrad Country, the Czech Republic, which limits the completeness of cross-country comparisons. Future research should incorporate all V4 countries. Additionally, future studies could benefit from combining self-reported measures with objective assessments to obtain a more accurate picture of students' digital competencies.

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ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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Funding: This research has been supported and this scientific paper was prepared within the project "Digital marketing: Theory & Practice in Visegrad region (Visegrad Grant no. 22420081)". The project is co-financed by the Governments of Czechia, Hungary, Poland, and Slovakia through Visegrad Grants from the International Visegrad Fund. The mission of the fund is to advance ideas for sustainable regional cooperation in Central Europe.

Data Availability Statement: More information and data are available on reasonable request.

Author Contributions: Conceptualization: *Peter Šedík, Irena Śliwińska*; methodology: *Peter Šedík, Irena Śliwińska*; data analysis: *Peter Šedík*, writing—original draft preparation: *Peter Šedík, Irena Śliwińska, Maria Bajak, Erik Jančšto, Titanilla Oravecz, Csilla Rimóczi,* writing; review and editing: *Peter Šedík, Irena Śliwińska, Maria Bajak, Erik Jančšto*; visualization: *Peter Šedík*. All authors have read and agreed to the published version of the manuscript.

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/k2928634357

Publisher
http://jssidoi.org/esc/home

CURRENT TRENDS IN THE ADOPTION OF AI TECHNOLOGIES IN SMALL AND MEDIUM-SIZED ENTERPRISES IN THE EUROPEAN UNION*

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Received 11 January 2026; accepted 24 March.2026; published 30 June 2026

Abstract. This study analyses the rapid expansion of artificial intelligence (AI) adoption among small and medium-sized enterprises (SMEs) in the EU-27 during 2021–2025 and examines whether this diffusion leads to convergence or persistent disparities across countries. Using harmonised Eurostat indicators on enterprises employing at least one AI technology by size class (10–49 and 50–249 employees), the study combines descriptive analysis with σ-convergence (coefficient of variation) and β-convergence regressions linking average log growth to initial adoption levels. Club convergence analysis is additionally applied to identify heterogeneous dynamics across groups of countries. The results show rapid growth in SME AI adoption: the share of small enterprises using AI increased from 6.1% to 17.0%, while among medium-sized enterprises it rose from 12.6% to 30.4%. Relative dispersion declined (CV: 0.69→0.52 for small firms; 0.62→0.45 for medium-sized firms), indicating σ-convergence, while β-convergence is statistically significant in both segments ($\beta = -0.0815$, $p < 0.01$; $\beta = -0.0872$, $p < 0.001$). However, club convergence analysis shows that convergence is concentrated among high-adoption economies, whereas low-adoption countries display increasing internal divergence. These findings suggest that accelerated AI diffusion alone does not ensure balanced digital transformation, highlighting the importance of targeted SME capability-building in lagging ecosystems.

Keywords: artificial intelligence (AI) technologies; small and medium-sized enterprises (SMEs); AI adoption; adoption gap; convergence; divergence; European Union (EU)

Reference to this paper should be made as follows: Zhang, Ch., Čižo, E., Yang Zh., Danileviča, A., Boļakova, I., Komarova, V., Qi, J. (2026). Current trends in the adoption of AI technologies in small and medium-sized enterprises in the European Union. *Entrepreneurship and Sustainability Issues*, 13(4), 152-169. http://doi.org/10.9770/k2928634357

JEL Classifications: O33, L26, C23, O52

Additional disciplines: Innovation economics; SME studies; Digital transformation; Regional development; Econometrics

* *The article has been developed and funded within the Daugavpils University's (Latvia) research project No 14-95/2026/17 "AI-Based Enterprise Transformation and Its Impact on Managerial Decision Quality".*

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/k2928634357

1. Introduction

Recent statistical evidence indicates a rapid acceleration in the adoption of artificial intelligence (AI) technologies among small and medium-sized enterprises (SMEs) in the EU-27, forming an important empirical background for the present study. According to Eurostat data, the share of small enterprises (10–49 employees) using at least one AI technology increased from 6.1% in 2021 to 17.0% in 2025. Among medium-sized enterprises (50–249 employees), adoption levels were consistently higher, rising from 12.6% in 2021 to 30.4% in 2025 (Eurostat, 2025). These figures reflect a several-fold increase within a short time horizon and suggest that AI diffusion in the SME sector has entered an accelerated expansion phase (Shi & Shen, 2025; Calvino et al., 2026). At the same time, a persistent size-related adoption gap remains visible across the EU-27 (Eurostat, 2025).

International analytical assessments interpret this dynamic as part of a broader structural wave of digital transformation rather than a temporary fluctuation (OECD, 2025; Innovation, Science and Economic Development Canada, 2025; G7 Industry, Digital and Technology Ministers, 2025; Calvino et al., 2026). OECD analyses emphasise that the diffusion of cloud-based AI services and generative AI tools has reduced entry barriers for SMEs and expanded the scope of feasible business applications, particularly in process automation, customer interaction, and data analytics (OECD, 2025). However, adoption remains uneven across firms and countries due to persistent constraints related to skills shortages, limited data availability, implementation costs, regulatory uncertainty, and differences in national innovation ecosystems (Menshikov et al., 2025; Calvino et al., 2026).

Importantly, rapid growth in adoption rates does not automatically imply inclusive or balanced digital transformation. Empirical studies demonstrate that accelerated digitalisation may simultaneously strengthen technologically advanced firms while widening structural disparities within the SME sector (Čižo et al., 2024; Ruža et al., 2024; Muhammad et al., 2025). Analysing AI adoption during the COVID-19 crisis, Muhammad et al. (2025) show that technological factors (digital inertia, digital literacy), organisational characteristics (entrepreneurial mindset, innovation attitudes, resource constraints), and environmental pressures jointly determine whether AI adoption enhances resilience or contributes to a digital divide.

This perspective is particularly relevant in the EU context (UNDP, 2019; Grafström & Alm, 2025; Cimino et al., 2025). Although aggregate indicators point to dynamic growth (Eurostat, 2025), the qualitative and structural dimensions of adoption remain differentiated across countries and enterprise size groups. It is therefore not self-evident that faster AI diffusion automatically translates into sustainable productivity gains or long-term competitiveness, despite optimistic claims in parts of the literature (e.g., Papić, 2025; Cimino et al., 2025; Le Dinh et al., 2025). From a structural standpoint, the critical issue may lie not in the speed of adoption per se, but in its distribution. If AI technologies diffuse unevenly across Member States and enterprise size categories, structurally lagging firms and national ecosystems risk losing competitive positions within the Single Market and becoming marginalised in emerging digital value chains.

The question of convergence in AI adoption is thus not merely empirical but also strategically significant in the context of the European Union's digital cohesion agenda. The EU's Digital Decade Policy Programme 2030 explicitly aims to strengthen technological sovereignty, reduce digital disparities between Member States, and ensure that digital transformation contributes to balanced economic development across the Union (European Commission, 2021). SMEs are central to this objective, accounting for over 99% of all enterprises in the EU and a substantial share of employment and value added (European Commission & Joint Research Centre, 2023). Persistent divergence in AI adoption among SMEs may therefore undermine broader goals of economic, social and territorial cohesion enshrined in EU policy frameworks.

Theoretical approaches to regional development and cohesion suggest that technological change may act both as a convergence mechanism and as a source of divergence (Fagerberg, 1995; Hollanders et al., 1999; Sadik, 2007; Scuotto et al., 2023; Grafström & Alm, 2025). Lower entry barriers and scalable digital tools can facilitate catch-up processes. Conversely, knowledge intensity, complementary capabilities, institutional quality, and path dependency may reinforce first-mover advantages and cumulative inequalities. In the case of AI adoption

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/k2928634357

among SMEs, these mechanisms may operate simultaneously, producing differentiated trajectories across Member States.

Against this background, the research problem of this article can be formulated as follows: does the accelerated diffusion of AI technologies among SMEs in the EU lead to structural convergence in adoption levels across countries and enterprise size categories, or does it reproduce and potentially intensify existing digital disparities? The aim of this article is to analyse current trends in the adoption of AI technologies among small and medium-sized enterprises in the European Union, with particular attention to structural differentiation and convergence dynamics across EU countries and enterprise size groups in the period 2021–2025.

To investigate these dynamics, the study applies a convergence-oriented analytical framework. Convergence analysis, widely used in regional and socio-economic research, examines whether heterogeneous units become more similar or more divergent over space and time with respect to selected indicators (Marques & Soukiazis, 1998). This approach has been successfully applied in studies of regional development and digital inequality, where dispersion measures and longitudinal comparisons help identify processes of catch-up or persistent stratification (Clark et al., 2003; Boronenko et al., 2014; Čižo et al., 2024; Ruža et al., 2024). Applying this framework to AI adoption enables assessment not only of cross-sectional differences between countries and enterprise size categories, but also of their temporal evolution. The empirical analysis is based on harmonised Eurostat data covering all EU countries for the period 2021–2025 (Eurostat, 2025). The dataset includes the percentage of enterprises using at least one AI technology, disaggregated by size class (10–49 and 50–249 employees). This cross-country and longitudinal structure allows for simultaneous examination of growth dynamics and structural dispersion within the EU SME ecosystem.

Although the observed period is relatively short, it is analytically appropriate given the rapidly evolving nature of AI adoption. In such contexts, even a five-year window may capture meaningful divergence or convergence dynamics, particularly when the objective is to analyse relative positioning and dispersion across countries rather than long-run steady-state equilibria. For fast-growing digital indicators, short- to medium-term convergence analysis therefore provides valuable insight into the early formation of structural asymmetries within the European digital economy.

2. Literature review

The growing body of research on AI adoption in SMEs reflects both the accelerating diffusion of advanced digital technologies and the persistence of structural inequalities associated with their use. Existing literature spans multiple analytical levels, from firm-level determinants and organisational capabilities to macro-level processes of technological convergence and divergence. While these strands differ in focus, they converge on a common insight: the diffusion of AI is inherently uneven, shaped by heterogeneous capabilities, resources, and institutional environments, and therefore cannot be assumed to lead automatically to balanced or inclusive development.

Foundational contributions in the economics of technological change emphasise that diffusion processes are neither uniform nor self-equilibrating. Early work by Fagerberg (1995) demonstrates that convergence in technological development depends critically on countries' "social capability," including human capital, innovation systems, and institutional quality. Similarly, Hollanders et al. (1999) show that convergence is not a stable outcome but a contingent process that may shift toward divergence when new technological paradigms emerge and are unevenly adopted. This perspective is reinforced by Clark and Feenstra (2003), who argue that differences in productivity performance are driven less by access to technology than by the efficiency with which it is used. Sadik (2007) extends this reasoning by introducing a threshold model of technological adoption, where only economies below certain cost barriers are able to adopt new technologies, leading to convergence among adopters but persistent divergence between adopters and non-adopters. More recent empirical evidence suggests that, although some convergence in technological capabilities is observable, it is typically slow, partial, and conditioned by structural factors. Grafström and Alm (2025) identify gradual convergence in innovation indicators across EU Member States but emphasise the persistence of substantial gaps in technological capacity, while global analyses indicate that advanced technologies such as AI may

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/k2928634357

reinforce divergence even as basic digital access converges (UNDP, 2019). Taken together, this literature establishes that technological diffusion–particularly in the case of complex, knowledge-intensive technologies–is path-dependent and conditional, with a strong potential to generate divergence alongside, or even instead of, convergence.

At the firm level, a substantial body of research highlights the central role of organisational capabilities in shaping AI adoption. Early empirical studies indicate that SMEs tend to adopt AI incrementally, focusing initially on operational efficiency applications such as automation and data analytics before progressing to more advanced, strategic uses (Papić, 2025). This staged adoption pattern suggests that diffusion is not only uneven across firms but also differentiated in terms of depth and sophistication. Building on this insight, Cimino et al. (2025) demonstrate that dynamic capabilities–specifically the ability to sense, seize, and transform opportunities–are key determinants of both AI adoption intensity and its performance outcomes. Similarly, Scuotto et al. (2023) introduce a "crossvergence" perspective, arguing that digital transformation processes may simultaneously produce convergence through shared technologies and divergence through heterogeneous firm-level capabilities and strategic responses. More recent studies further highlight the functional heterogeneity of AI adoption within firms. Le Dinh et al. (2025) show that SMEs concentrate AI use in operational and analytical functions, while more advanced applications remain limited, reflecting differences in perceived usefulness and organisational readiness. Kopka and Fornahl (2024) provide additional evidence of heterogeneous outcomes, demonstrating that AI adoption affects firms differently depending on their size and position relative to the productivity frontier. Collectively, these findings indicate that AI adoption is not simply a matter of access to technology but a capability-driven process, where firms differ significantly in their ability to integrate, scale, and capitalise on AI.

A complementary stream of research focuses on structural inequalities in AI adoption, often framed through the lens of the digital divide and resource-based perspectives. Empirical studies consistently show that digital transformation may simultaneously enhance the performance of leading firms while widening gaps within the SME sector (Čižo et al., 2024; Ruža et al., 2024; Muhammad et al., 2025). At the firm level, adoption is constrained by a complex set of interrelated factors, including skills shortages, limited data availability, financial constraints, and organisational readiness (Ayinaddis, 2025; Sánchez et al., 2025). Qualitative evidence reinforces this view, identifying barriers such as insufficient data infrastructure, lack of specialised talent, and dependence on external expertise (Roa Baez & Igbekele, 2021). Recent research also highlights the importance of strategic alignment and leadership in shaping adoption outcomes. Ul Haq et al. (2025) show that AI contributes to firm performance primarily when supported by technological readiness and managerial vision, while Amanollahnejad et al. (2026) conceptualise AI adoption as a recursive socio-technical process shaped by continuous interactions between organisational, technological, and environmental factors. These studies collectively suggest that AI diffusion is structurally uneven because firms differ in their resource endowments, organisational capabilities, and institutional contexts. As a result, equal access to AI technologies does not translate into equal outcomes, reinforcing the distinction between input and output digital inequality.

At the macro level, a growing body of literature highlights the importance of national innovation systems and ecosystem conditions in shaping AI adoption. Cross-country analyses show that AI diffusion remains limited to a minority of firms and is strongly associated with complementary assets such as digital infrastructure, human capital, and prior digitalisation (Calvino et al., 2026). These findings are consistent with broader evidence on the role of national ecosystems in determining digital transformation trajectories (Menshikov et al., 2025) and with policy-oriented analyses emphasising structural barriers related to skills, data, and regulatory environments (OECD, 2025). Importantly, these factors vary significantly across EU Member States, contributing to persistent differences in adoption patterns. At the same time, the literature suggests that AI diffusion is embedded in broader processes of technological convergence and divergence. While some degree of convergence may occur through the diffusion of widely accessible technologies, advanced technologies such as AI are more likely to amplify existing inequalities due to their reliance on complementary capabilities and institutional support. This dual dynamic–simultaneous convergence in access and divergence in capability–has been identified as a defining feature of contemporary digital transformation (UNDP, 2019).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/k2928634357

Despite the richness of existing research, several important gaps remain. First, much of the literature focuses either on micro-level determinants of AI adoption or on macro-level patterns of technological convergence, with limited integration between these perspectives. As a result, the link between firm-level capabilities and cross-country convergence dynamics remains insufficiently explored. Second, while the uneven nature of AI diffusion is widely acknowledged, there is a lack of systematic empirical analysis of whether these disparities are increasing or decreasing over time within the EU SME sector. Existing studies tend to provide static snapshots of adoption levels or determinants, rather than examining the dynamic evolution of differences across countries and firm categories. Third, the literature pays limited attention to the role of enterprise size in shaping convergence processes, despite consistent evidence of a size-related adoption gap. In particular, there is a need to analyse whether smaller and medium-sized enterprises follow similar or divergent trajectories in AI adoption across different national contexts.

Against this background, the key research gap lies in the absence of a comprehensive empirical analysis that examines how differences in AI adoption among SMEs across EU Member States evolve over time, taking into account both cross-country variation and differences between small and medium-sized enterprises. Existing studies rarely assess whether countries with initially lower levels of AI adoption are catching up with more advanced ones, or whether the persistent adoption gap between small (10–49 employees) and medium-sized (50–249 employees) enterprises is narrowing or widening. Moreover, the dynamic aspect of these differences remains insufficiently explored, as most research focuses on static comparisons rather than changes over time. The present study addresses this gap by applying convergence approaches to harmonised Eurostat data for the period 2021–2025.

3. Conceptual framework of the study

The conceptual framework of the present study is based on the integration of several theoretical approaches that make it possible to explain both the mechanisms of AI adoption at the firm level and the structural differentiation and dynamics of disparities across EU countries. In particular, the framework combines the Technology Acceptance Model (TAM), Digital Divide Theory, the resource–asset–capital approach, and the convergence paradigm, complemented by an analysis of club convergence. Such a synthesis provides a multi-level explanation of AI diffusion processes among SMEs and makes it possible to link micro- and macroeconomic aspects of digital transformation.

At the micro-level, the conceptual foundation is provided by the Technology Acceptance Model (Davis, 1989), which explains technology adoption through perceived usefulness and perceived ease of use. In the context of SMEs, these perceptions are manifested at the organisational level through managerial decision-making and strategic orientation. Firms that perceive AI technologies as beneficial for performance enhancement and manageable in terms of implementation complexity are more likely to adopt them (Papić, 2025; Cimino et al., 2025). Conversely, perceived risks, lack of expertise, and organisational inertia may limit adoption. Thus, TAM explains the motivational and cognitive mechanisms underlying AI diffusion, particularly at the early stages of adoption.

However, individual or organisational acceptance alone does not explain the observed structural disparities in AI adoption. To address this limitation, the framework incorporates Digital Divide Theory (van Dijk, 2017), which conceptualises inequality in access to and use of digital technologies. The theory distinguishes between motivational, material, skills, and usage access, all of which are relevant in the SME context. Applied to AI adoption, these dimensions correspond to firms' willingness to adopt AI, availability of technological infrastructure, digital competencies, and the extent to which AI is effectively integrated into business processes. Importantly, this approach allows distinguishing between input inequality (differences in access to resources and capabilities) and output inequality (differences in the ability to generate value from AI adoption). Empirical studies confirm that even when access to digital technologies improves, disparities in outcomes persist due to differences in organisational capabilities and resource endowments (Čižo et al., 2024; Ruža et al., 2024; Muhammad et al., 2025).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/k2928634357

To further explain these differences, the framework draws on the resource–asset–capital approach (Meņšikovs, 2009; Komarova et al., 2022), which conceptualises development as a process of transforming resources into assets and, subsequently, into capital. Within this framework, technological resources–such as digital infrastructure, data availability, and AI-related competencies–play an increasingly important role. However, firms and national ecosystems differ not only in the availability of these resources but also in their ability to activate and capitalise on them. This implies that AI adoption is not merely a function of resource availability but of the efficiency with which these resources are transformed into productive and innovative outcomes (Calvino et al., 2026; ul Haq et al., 2025). As a result, structural differences in resource portfolios across countries and enterprise size groups may lead to differentiated trajectories of AI adoption. At the macro level, the framework is grounded in the convergence paradigm, which allows assessing whether differences in AI adoption across countries and enterprise size categories are decreasing or increasing over time. Following the classical approach (Barro & Sala-i-Martin, 1992, 1997), two main types of convergence are distinguished. β-convergence refers to a process in which units with lower initial levels of an indicator exhibit higher growth rates, implying a catching-up effect. In the context of this study, β-convergence would indicate that countries with initially low levels of AI adoption among SMEs are adopting AI more rapidly than more advanced countries. σ-convergence, in turn, refers to a reduction in dispersion of an indicator across units and is typically measured using the coefficient of variation (Marques & Soukiazis, 1998). A decline in dispersion indicates convergence, while an increase signals divergence.

At the same time, recent research suggests that convergence processes in the EU are often not uniform but occur within groups of countries with similar structural characteristics. This has led to the concept of club convergence, according to which economies form clusters (or "clubs") that converge internally but diverge from other groups (Barrios & Flores, 2019; Glawe, 2025). In the EU context, such clustering often reflects differences between more advanced and less developed economies, as well as variations in innovation capacity, institutional quality, and digital readiness. Applying this concept to AI adoption among SMEs implies that convergence may occur within groups of countries with similar levels of technological development, while divergence persists between these groups. This perspective is particularly relevant given empirical evidence that advanced digital technologies tend to reinforce existing inequalities due to their dependence on complementary capabilities (Sadik, 2007; UNDP, 2019).

The integration of these theoretical approaches provides a coherent analytical framework for the present study. TAM explains the motivational and organisational determinants of AI adoption; Digital Divide Theory highlights structural inequalities in access and use; the resource–asset–capital approach explains differences in the ability to transform technological resources into economic outcomes; and convergence analysis evaluates whether these differences are narrowing or widening over time. The addition of club convergence further allows capturing the possibility that AI adoption dynamics may differ systematically across groups of EU countries. Taken together, this framework allows analysing AI adoption not only as a process of technological diffusion but also as a structurally differentiated and potentially stratifying phenomenon. It enables a multi-level assessment of whether the rapid expansion of AI adoption among SMEs in the European Union leads to more similar adoption patterns across countries and between small and medium-sized enterprises, or whether it reinforces existing disparities and creates distinct clusters of technological development within the EU.

4. Research methodology

The empirical strategy of the present study is grounded in the convergence framework widely used in regional and socio-economic analysis to examine whether differences in key indicators across heterogeneous units decrease or increase over time. In contrast to approaches that focus solely on static comparisons of adoption levels, convergence analysis enables the assessment of the dynamic evolution of disparities across countries and enterprise size categories, making it particularly suitable for analysing the diffusion of rapidly evolving technologies such as AI (Marques & Soukiazis, 1998). In line with the research objective, the methodology is designed to capture both cross-country variation and differences between small and medium-sized enterprises, as well as their changes over time.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/k2928634357

The empirical analysis is based on harmonised Eurostat data covering all EU Member States for the period 2021–2025 (Eurostat, 2025). The dataset includes the percentage of enterprises using at least one AI technology, disaggregated by size class: small enterprises (10–49 employees) and medium-sized enterprises (50–249 employees). This structure allows for consistent cross-country comparison and for analysing differences between enterprise size groups. The longitudinal dimension of the dataset makes it possible to examine both growth dynamics and structural dispersion. Although the observed period is relatively short, it is analytically appropriate given the high growth rates and rapid structural changes characteristic of emerging digital technologies.

The analysis proceeds in several stages. First, descriptive statistical analysis is conducted to identify initial differences in AI adoption across countries and between small and medium-sized enterprises, as well as overall growth patterns during the period under study. This step provides the empirical foundation for subsequent convergence analysis.

Second, σ-convergence is assessed to evaluate changes in dispersion of AI adoption across countries. σ-convergence is measured using the coefficient of variation (CV), defined as:

$$CV = \sigma_t / x \quad (1)$$

where σt is the standard deviation of AI adoption levels across countries in year t, x is the corresponding mean value (Marques & Soukiazis, 1998). A decrease in CV over time indicates σ-convergence (a reduction in dispersion), while an increase indicates σ-divergence. In this study, the coefficient of variation is calculated separately for small and medium-sized enterprises, allowing for comparison of dispersion dynamics between these groups. Following conventional interpretation, values below 10% indicate low dispersion, 10–30% moderate dispersion, 30–60% high dispersion, and above 60% very high dispersion. Third, β-convergence analysis is applied to examine whether countries with lower initial levels of AI adoption exhibit higher subsequent growth rates. The standard regression specification is:

$$1 / T \ln ((y_{i,t} + T) / y_{i,t}) = \sigma_t + \beta \ln (y_{i,t}) + \varepsilon_i \quad (2)$$

where $y_{i,t}$ represents the level of AI adoption in country i in year t, and T is the time interval (Barro & Sala-i-Martin, 1992, 1997). A negative and statistically significant coefficient β indicates β-convergence, implying that countries with lower initial adoption levels grow faster (catch-up effect). A positive or insignificant coefficient suggests divergence or persistence of differences. The regression is estimated separately for small and medium-sized enterprises, allowing for identification of size-specific convergence patterns.

In addition to absolute β-convergence, the analysis conceptually allows for conditional convergence, where differences in structural characteristics–such as digital infrastructure, human capital, and institutional quality–may affect convergence dynamics. Although these factors are not explicitly modelled econometrically in the present study, their influence is considered in the interpretation of results (Calvino et al., 2026; OECD, 2025). Finally, the study incorporates elements of club convergence analysis to account for the possibility that convergence processes may occur within groups of countries rather than across the entire EU. The concept of club convergence suggests that economies with similar structural characteristics converge toward similar steady states, while divergence persists between groups (Fagerberg, 1995; Hollanders et al., 1999). Formally, this implies that:

$$\lim_{t \to \infty} |y_{i,t} - y_{j,t}| = 0 \text{ for } i,j \in C_k \quad (3)$$

where C_k denotes a specific convergence club (Alexiadis, 2012). In the context of this study, such clubs may correspond to groups of EU countries with similar levels of economic development, innovation capacity, or digital readiness. Empirically, club convergence is explored through comparative analysis of country groupings and the identification of patterns in adoption levels and growth rates that suggest clustering of trajectories. This

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approach allows capturing heterogeneous convergence dynamics that may not be observable through aggregate σ- and β-convergence measures.

Overall, the methodological framework combines descriptive analysis with σ-convergence, β-convergence, and elements of club convergence analysis, providing a comprehensive approach to examining AI adoption among SMEs in the European Union. This integrated methodology makes it possible to assess not only whether AI adoption is increasing, but also whether differences across countries and between small and medium-sized enterprises are narrowing, persisting, or widening over time, thereby offering a robust empirical basis for analysing the evolving structure of AI diffusion in the EU SME sector.

5. Research results

The results of the empirical analysis are presented in this section in order to identify key patterns in the adoption of AI technologies among SMEs across EU Member States and to assess whether these patterns indicate convergence or divergence over time. Building on the convergence-oriented methodological framework, the analysis focuses on three interrelated dimensions: overall growth dynamics, cross-country dispersion, and differences between small and medium-sized enterprises. Particular attention is given to whether countries with initially lower levels of AI adoption are catching up with more advanced economies, and whether the adoption gap between enterprise size groups is narrowing or persisting. The results are interpreted in light of the theoretical assumptions outlined earlier, including the role of organisational capabilities, resource constraints, and structural differences between national innovation systems, which may lead to heterogeneous adoption trajectories and the potential formation of convergence clubs within the EU.

The empirical analysis begins with a descriptive statistical examination of AI adoption across EU Member States in order to identify general trends, initial differences, and growth patterns over the period 2021–2025. This stage provides the empirical foundation for subsequent convergence analysis by revealing the scale and dynamics of adoption, as well as structural differences between countries and enterprise size groups. Particular attention is paid to the distribution of adoption levels across small (10–49 employees) and medium-sized (50–249 employees) enterprises, allowing for an initial assessment of whether observed growth is accompanied by persistent disparities or signs of alignment across countries (Eurostat, 2025).

Table 1. Enterprises using at least one of the AI technologies, % of small enterprises (10–49 employees), EU countries, 2021–2025

Country	2021	2023	2024	2025
Austria	7.14	8.94	17.83	26.18
Belgium	8.00	10.61	20.70	28.82
Bulgaria	2.60	2.96	5.45	7.17
Croatia	8.06	6.98	10.51	12.77
Cyprus	1.95	3.74	6.30	7.72
Czechia	2.75	4.00	8.72	13.38
Denmark	19.74	12.37	23.52	37.45
Estonia	1.80	4.12	12.14	20.74
Finland	12.37	11.48	20.02	33.51
France	5.03	4.72	8.51	15.04
Germany	8.90	9.68	16.92	23.06
Greece	1.97	3.54	8.20	7.33
Hungary	2.53	2.98	6.50	8.70
Ireland	6.05	5.27	11.75	16.75
Italy	5.35	4.36	6.89	14.23
Latvia	2.79	3.47	7.24	9.77
Lithuania	3.18	3.40	6.51	18.06
Luxembourg	11.53	12.26	21.12	30.48
Malta	8.34	10.75	14.31	17.89
Netherlands	10.10	11.75	19.96	28.76
Poland	1.88	2.25	3.93	5.79
Portugal	5.29	5.77	6.66	9.43
Romania	1.06	1.07	2.57	4.13
Slovakia	4.11	5.95	8.78	15.59
Slovenia	9.42	8.88	19.26	18.29
Spain	6.07	6.39	8.56	17.17
Sweden	7.63	8.69	22.05	30.74

Source: Eurostat, 2025

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The data presented in Table 1 demonstrate a rapid increase in the share of small enterprises using AI technologies across the EU during the period under study. Despite the overall upward trend, the distribution of adoption levels remains highly uneven across countries. For instance, countries such as Germany, Denmark, and the Netherlands exhibit relatively high and steadily growing adoption rates, while countries including Bulgaria, Romania, and Greece remain at significantly lower levels throughout the period. At the same time, the data indicate that countries with initially low adoption levels–such as Croatia, Slovakia, and Portugal–tend to experience faster relative growth, suggesting the presence of a catching-up process. However, the persistence of substantial differences between leading and lagging countries indicates that convergence remains partial and uneven. These patterns are consistent with the literature emphasising the capability-driven and non-uniform nature of digital technology diffusion (Calvino et al., 2026; Grafström & Alm, 2025).

Table 2. Enterprises using at least one of the AI technologies, % of medium-sized enterprises (50–249 employees), EU countries, 2021–2025

Country	2021	2023	2024	2025
Austria	14.57	16.91	29.10	44.56
Belgium	16.89	22.99	35.71	54.49
Bulgaria	5.19	5.53	9.99	13.30
Croatia	9.85	11.17	16.49	25.50
Cyprus	5.32	9.43	14.27	15.31
Czechia	7.63	9.79	16.91	28.79
Denmark	37.25	22.56	40.92	58.27
Estonia	5.32	8.06	19.34	33.10
Finland	26.66	26.40	37.67	51.35
France	13.07	10.16	14.52	30.81
Germany	14.80	16.21	28.22	35.56
Greece	7.53	5.68	15.91	15.18
Hungary	3.73	5.54	10.07	15.34
Ireland	13.19	17.79	24.85	28.02
Italy	10.02	7.30	14.71	27.62
Latvia	6.75	8.27	13.65	19.78
Lithuania	7.71	8.78	15.11	30.36
Luxembourg	14.88	19.65	31.86	43.68
Malta	17.82	21.01	25.58	30.69
Netherlands	21.44	19.75	31.19	46.62
Poland	4.96	6.49	10.41	14.77
Portugal	13.40	16.43	15.35	18.21
Romania	1.90	2.38	3.88	7.79
Slovakia	7.01	8.57	15.73	23.05
Slovenia	19.84	16.85	22.66	30.62
Spain	13.36	19.57	20.54	30.10
Sweden	18.09	13.51	34.53	49.60

Source: Eurostat, 2025.

The data for medium-sized enterprises presented in Table 2 reveal a similar but more pronounced pattern of AI adoption. Overall adoption levels are consistently higher than those observed among small enterprises, confirming the existence of a size-related adoption gap (Eurostat, 2025). Countries such as Germany, Finland, and Sweden demonstrate the highest levels of AI adoption among medium-sized enterprises, while Bulgaria, Romania, and Latvia remain among the lowest throughout the observed period. At the same time, countries including Poland, Hungary, and Spain show relatively strong growth dynamics, indicating a degree of catching-up. Compared to small enterprises, the dispersion of adoption levels appears somewhat lower, suggesting a higher degree of alignment among medium-sized firms. Nevertheless, persistent differences across countries indicate that adoption trajectories continue to be shaped by structural factors such as national innovation capacity, digital infrastructure, and organisational readiness. Overall, the descriptive analysis confirms that AI adoption is expanding rapidly across the EU, but remains unevenly distributed both across countries and between enterprise size groups, thereby justifying further convergence analysis.

To further assess whether the observed differences in AI adoption across EU countries are narrowing or widening over time, σ-convergence analysis is applied. This approach focuses on changes in the dispersion of adoption levels and allows evaluating whether countries are becoming more similar in terms of AI use among SMEs. The coefficient of variation (CV), calculated on the basis of country-level adoption data, is used as the main indicator of dispersion. By examining the evolution of this measure separately for small and medium-sized enterprises, it becomes possible to identify whether convergence dynamics differ across enterprise size

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groups and whether the rapid growth in AI adoption is accompanied by increasing alignment or persistent heterogeneity across the EU.

Table 3. σ-convergence parameters for SMEs in the EU countries using at least one of the AI technologies, 2021–2025

Parameters	2021	2023	2024	2025
Small enterprises (10–49 employees)				
Standard deviation of AI adoption levels across countries, %	4.22	3.46	6.40	9.31
Mean value, %	6.13	6.53	12.03	17.74
Coefficient of variation (CV), score from 0 to 1	0.69	0.53	0.53	0.52
Medium-sized enterprises (50–249 employees)				
Standard deviation of AI adoption levels across countries, %	7.83	6.54	9.69	13.77
Mean value, %	12.53	13.21	21.08	30.46
Coefficient of variation (CV), score from 0 to 1	0.62	0.50	0.46	0.45

Source: calculated by the authors based on the data from Tables 1–2 and using Formula 1.

The results presented in Table 3 indicate a gradual decline in the coefficient of variation for both small and medium-sized enterprises over the period 2021–2025, suggesting the presence of σ-convergence in AI adoption across EU countries. For small enterprises, the coefficient of variation decreases from 0.69 in 2021 to 0.52 in 2025, while for medium-sized enterprises it declines from 0.62 to 0.45 over the same period. This trend implies that, despite increasing absolute differences in adoption levels–as reflected in the rising standard deviation–the relative dispersion across countries is decreasing due to the rapid growth in average adoption rates. In other words, countries are becoming more similar in proportional terms, even though the gap in absolute values remains significant. At the same time, the lower and more steadily declining coefficient of variation for medium-sized enterprises indicates a higher degree of alignment within this group compared to small enterprises. This suggests that medium-sized firms follow more homogeneous adoption trajectories, while small enterprises remain more sensitive to country-specific conditions. Overall, the results point to partial convergence in AI adoption across the EU, but also highlight the persistence of structural differences, which may be further explored through β-convergence and club convergence analysis.

To further assess whether countries with lower initial levels of AI adoption are catching up with more advanced ones, β-convergence analysis is applied. Unlike σ-convergence, which captures changes in dispersion, β-convergence focuses on the relationship between the initial level of an indicator and its subsequent growth rate. In the context of this study, it allows evaluating whether countries with lower initial shares of enterprises using AI technologies demonstrate higher growth rates over the period 2021–2025. The analysis is conducted separately for small and medium-sized enterprises in order to identify potential differences in convergence dynamics across enterprise size groups. Table 4 presents the intermediate calculations used for estimating β-convergence for small enterprises, including initial levels of AI adoption, growth rates, and their logarithmic transformations.

Table 4. Intermediate calculations for β-convergence, small enterprises (10–49 employees) using at least one of the AI technologies, EU countries, 2021–2025

Country	y_2021	y_2025	Growth (p.p.)	Growth (log)	ln(y_2021)
Austria	7.14	26.18	19.04	0.325	1.966
Belgium	8.00	28.82	20.82	0.320	2.079
Bulgaria	2.60	7.17	4.57	0.254	0.956
Croatia	8.06	12.77	4.71	0.115	2.087
Cyprus	1.95	7.72	5.77	0.344	0.668
Czechia	2.75	13.38	10.63	0.396	1.012
Denmark	19.74	37.45	17.71	0.160	2.983
Estonia	1.80	20.74	18.94	0.611	0.588
Finland	12.37	33.51	21.14	0.249	2.515
France	5.03	15.04	10.01	0.274	1.615
Germany	8.90	23.06	14.16	0.238	2.186
Greece	1.97	7.33	5.36	0.329	0.678
Hungary	2.53	8.70	6.17	0.309	0.928

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Ireland	6.05	16.75	10.70	0.255	1.800
Italy	5.35	14.23	8.88	0.245	1.677
Latvia	2.79	9.77	6.98	0.313	1.026
Lithuania	3.18	18.06	14.88	0.434	1.157
Luxembourg	11.53	30.48	18.95	0.243	2.445
Malta	8.34	17.89	9.55	0.191	2.121
Netherlands	10.10	28.76	18.66	0.262	2.313
Poland	1.88	5.79	3.91	0.281	0.631
Portugal	5.29	9.43	4.14	0.145	1.666
Romania	1.06	4.13	3.07	0.340	0.058
Slovakia	4.11	15.59	11.48	0.333	1.413
Slovenia	9.42	18.29	8.87	0.166	2.243
Spain	6.07	17.17	11.10	0.260	1.803
Sweden	7.63	30.74	23.11	0.348	2.032

Note: Growth (log) is calculated as the average annual growth rate gi = (1/4) ln(y_2025 / y_2021); ln(y_2021) denotes the natural logarithm of the initial level of AI adoption.
Source: calculated by the authors based on the data from Table 1 and using Formula 2.

The data presented in Table 4 indicate substantial variation in both initial levels of AI adoption and subsequent growth rates across EU countries. Countries such as Romania, Estonia, Cyprus, and Czechia, characterised by relatively low initial adoption levels, exhibit notably high growth rates over the observed period. In contrast, countries with higher initial levels, including Denmark, Finland, and Luxembourg, tend to demonstrate more moderate growth dynamics. This pattern is consistent with the hypothesis of a catching-up process. To visualise the relationship between initial conditions and growth rates, Figure 1 presents a scatter plot with a fitted regression line, illustrating the direction and strength of the relationship underlying β-convergence.

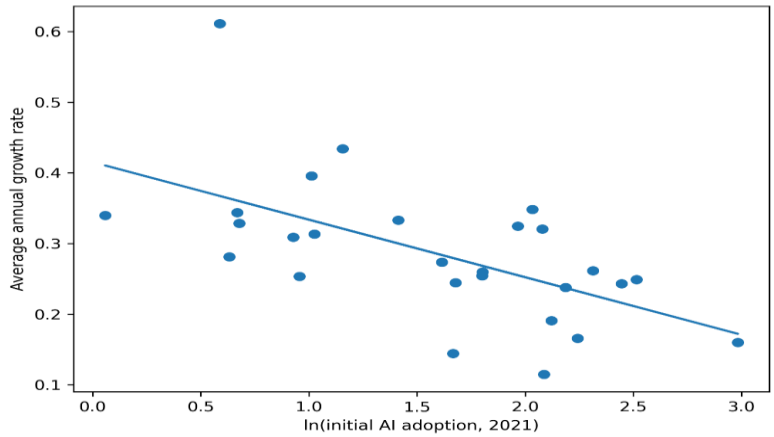


Figure 1. β-convergence in AI adoption among small enterprises in the EU countries, 2021–2025
Source: elaborated by the authors based on the data from Table 4 and using the software IBM SPSS Statistics.

As shown in Figure 1, a clear negative relationship can be observed between the logarithm of the initial level of AI adoption and the subsequent growth rate among small enterprises. Countries with lower starting levels are concentrated in the upper-left part of the graph, indicating higher growth rates, while countries with higher initial adoption are located in the lower-right part, reflecting slower growth. This visual pattern supports the presence of β-convergence, suggesting that countries with initially lower levels of AI adoption are catching up with more advanced economies. At the same time, the dispersion of points around the regression line indicates that convergence is not uniform and may be influenced by country-specific factors such as innovation capacity, digital infrastructure, and organisational readiness (Calvino et al., 2026; OECD, 2025).

This visual pattern is confirmed by the regression results. The estimated β coefficient is negative and statistically significant ($\beta = -0.0815$, $p < 0.01$) (calculated by the authors using the software IBM SPSS Statistics), indicating the presence of β-convergence among EU countries in AI adoption by small enterprises. The explanatory power of the model ($R^2 = 0.354$) suggests that initial conditions account for a substantial share of the variation in growth rates, although country-specific factors remain important.

To examine whether similar dynamics are observed among medium-sized enterprises, the β-convergence analysis is extended to this group. Table 5 presents the corresponding intermediate calculations.

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Table 5. Intermediate calculations for β-convergence, medium-sized enterprises (50–249 employees) using at least one of the AI technologies, EU countries, 2021–2025

Country	y_2021	y_2025	Growth (p.p.)	Growth (log)	ln(y_2021)
Austria	14.57	44.56	29.99	0.279	2.679
Belgium	16.89	54.49	37.6	0.293	2.827
Bulgaria	5.19	13.3	8.11	0.235	1.647
Croatia	9.85	25.5	15.65	0.238	2.287
Cyprus	5.32	15.31	9.99	0.264	1.671
Czechia	7.63	28.79	21.16	0.332	2.032
Denmark	37.25	58.27	21.02	0.112	3.618
Estonia	5.32	33.1	27.78	0.457	1.671
Finland	26.66	51.35	24.69	0.164	3.283
France	13.07	30.81	17.74	0.214	2.57
Germany	14.8	35.56	20.76	0.219	2.695
Greece	7.53	15.18	7.65	0.175	2.019
Hungary	3.73	15.34	11.61	0.354	1.316
Ireland	13.19	28.02	14.83	0.188	2.579
Italy	10.02	27.62	17.6	0.253	2.305
Latvia	6.75	19.78	13.03	0.269	1.91
Lithuania	7.71	30.36	22.65	0.343	2.043
Luxembourg	14.88	43.68	28.8	0.269	2.7
Malta	17.82	30.69	12.87	0.136	2.88
Netherlands	21.44	46.62	25.18	0.194	3.065
Poland	4.96	14.77	9.81	0.273	1.601
Portugal	13.4	18.21	4.81	0.077	2.595
Romania	1.9	7.79	5.89	0.353	0.642
Slovakia	7.01	23.05	16.04	0.298	1.947
Slovenia	19.84	30.62	10.78	0.108	2.988
Spain	13.36	30.1	16.74	0.203	2.592
Sweden	18.09	49.6	31.51	0.252	2.895

Note: Growth (log) is calculated as the average annual growth rate gi = (1/4) ln(y_2025 / y_2021); ln(y_2021) denotes the natural logarithm of the initial level of AI adoption.
Source: calculated by the authors based on the data from Table 2 and using Formula 2.

The results presented in Table 5 reveal a pattern broadly similar to that observed for small enterprises, but with some notable differences. Countries such as Romania, Hungary, Estonia, and Lithuania, which had relatively low initial levels of AI adoption, demonstrate comparatively high growth rates, indicating strong catch-up dynamics. At the same time, countries including Denmark, Finland, the Netherlands, and Sweden, characterised by higher initial adoption levels, show more moderate growth rates. Compared to small enterprises, the distribution of growth rates among medium-sized enterprises appears more consistent, suggesting a higher degree of alignment across countries. To further illustrate these relationships, Figure 2 presents the corresponding scatter plot with a regression line.

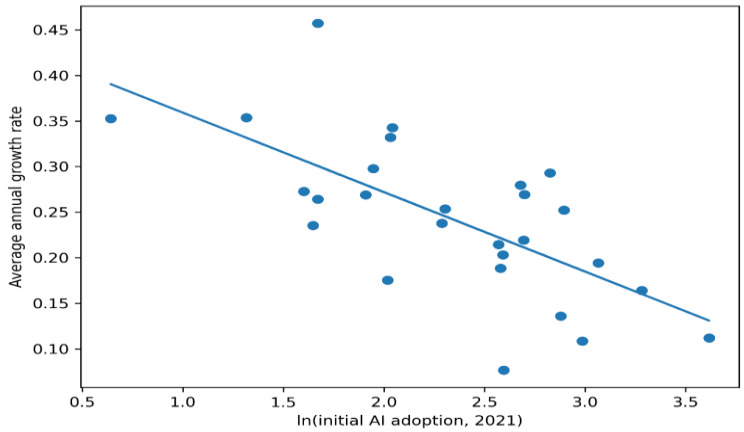


Figure 2. β-convergence in AI adoption among medium-sized enterprises in the EU countries, 2021–2025
Source: elaborated by the authors based on the data from Table 5 and using the software IBM SPSS Statistics.

Figure 2 confirms the presence of a negative relationship between the initial level of AI adoption and subsequent growth rates among medium-sized enterprises, indicating β-convergence across EU countries. Countries with lower starting levels of AI adoption–such as Romania, Bulgaria, Hungary, and Estonia–are located in the upper-

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left part of the graph, reflecting higher growth rates, while countries with higher initial adoption levels, including Denmark, Finland, the Netherlands, and Sweden, are concentrated in the lower-right part, indicating more moderate growth dynamics. This visual pattern is supported by the regression results, which reveal a negative and highly statistically significant β coefficient ($\beta = -0.0872$, $p < 0.001$) (calculated by the authors using the software IBM SPSS Statistics). The explanatory power of the model ($R^2 = 0.453$) suggests a relatively strong relationship between initial conditions and subsequent growth rates.

Compared to small enterprises, the more pronounced slope of the regression line, together with the larger absolute value of the β coefficient and higher R^2, indicates that convergence dynamics are stronger and more consistent among medium-sized firms. This suggests that medium-sized enterprises are better positioned to benefit from catch-up processes, likely due to greater resource availability, more developed organisational structures, and higher levels of digital readiness.

At the same time, the dispersion of observations around the regression line indicates that convergence remains incomplete and heterogeneous across countries. Differences in national innovation systems, digital infrastructure, and organisational capabilities continue to shape adoption trajectories, preventing full alignment. This implies that convergence may not occur uniformly across all EU Member States, but rather within groups of countries sharing similar structural characteristics. Such a pattern points to the potential existence of convergence clubs, which justifies the application of club convergence analysis in the next stage of the study.
To identify potential convergence clubs, EU countries were grouped into three categories based on their initial levels of AI adoption in 2021 using a distribution-based (tercile) approach (Alexiadis, 2012). The results reveal a largely consistent structure across small and medium-sized enterprises, with a clear distinction between low-adoption, intermediate, and high-adoption groups.

The low-adoption cluster includes countries such as Romania, Poland, Estonia, Cyprus, Greece, Hungary, Bulgaria, and Latvia, which are consistently characterised by low initial levels of AI use across both enterprise size groups. Similarly, the high-adoption cluster–comprising Denmark, Finland, the Netherlands, Luxembourg, Belgium, Germany, Slovenia, and Malta–remains highly stable across both groups, indicating a structurally advanced set of economies with strong digital capabilities.

At the same time, the intermediate group exhibits greater variability, with several countries–including Czechia, Slovakia, Croatia, and Sweden–shifting between clusters depending on enterprise size. This suggests that convergence dynamics are not fully uniform across firm categories and that some countries occupy transitional positions within the EU digital landscape.

To further examine whether convergence dynamics differ across groups of countries, σ-convergence was assessed within the previously identified convergence clubs. The results reveal a highly uneven pattern of convergence across clusters.

For small enterprises, divergence is observed within both the low- and medium-adoption groups. In the low-adoption cluster, the coefficient of variation increases from 0.264 in 2021 to 0.528 in 2025, indicating a substantial widening of differences among initially lagging countries. A similar pattern is observed in the medium group, where dispersion increases from 0.251 to 0.356. In contrast, the high-adoption group demonstrates a slight decrease in dispersion (from 0.346 to 0.317) (calculated by the authors based on the data from Table 1 and using Formula 1), suggesting weak convergence among leading countries.

A comparable but more pronounced pattern is observed for medium-sized enterprises. While the low-adoption group continues to exhibit divergence (CV increases from 0.328 to 0.411), and the medium group remains largely stable (0.232 to 0.235), the high-adoption group shows clear convergence, with the coefficient of variation decreasing significantly from 0.343 to 0.229 (calculated by the authors based on the data from Table 2 and using Formula 1).

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These results indicate that convergence in AI adoption among EU SMEs is not uniform across countries but is largely confined to a group of already advanced economies. At the same time, countries with initially low levels of adoption do not converge among themselves but instead exhibit increasing internal differentiation. This suggests that AI diffusion may reinforce structural stratification within the EU, leading to the emergence of distinct convergence clubs rather than a single, unified convergence process. This pattern suggests that AI diffusion in the EU follows a "dual-speed" trajectory, where convergence occurs among technologically advanced economies, while lagging countries become increasingly heterogeneous.

6. Discussion of results

The empirical results of this study provide robust evidence that the diffusion of AI technologies among SMEs in the EU follows a non-linear and structurally differentiated pattern. While β-convergence is observed for both small and medium-sized enterprises, indicating a general catching-up process, the σ-convergence and club convergence analyses reveal that this process is far from uniform. Instead of a single convergence trajectory, the results point to the emergence of distinct convergence clubs, within which dynamics differ substantially. The finding that convergence is primarily concentrated among countries with initially high levels of AI adoption, while low-adoption countries exhibit increasing internal divergence, aligns with the predictions of endogenous growth theory and the technology-gap approach. According to these frameworks, technological diffusion depends not only on access to innovation but also on absorptive capacity, human capital, and institutional conditions (Fagerberg, 1995; Sadik, 2007). In this context, the observed divergence within the low-adoption group suggests that the mere availability of AI technologies does not guarantee convergence; rather, countries differ significantly in their ability to integrate and scale these technologies. This is consistent with recent empirical studies highlighting the role of organisational capabilities, digital skills, and resource constraints in shaping AI adoption outcomes among SMEs (Calvino et al., 2026; OECD, 2025; Muhammad et al., 2025).

At the same time, the stronger and more consistent convergence observed among medium-sized enterprises suggests that firm size plays a critical role in shaping digital transformation trajectories. Medium-sized firms appear better positioned to benefit from AI adoption due to greater resource endowments, more developed organisational structures, and higher levels of digital maturity. This finding reinforces the argument that digital transformation is not neutral with respect to firm characteristics and may reproduce or even amplify structural inequalities within the SME sector.

The club convergence patterns identified in this study closely resonate with findings from the literature on innovation dynamics in Europe. In particular, the results are consistent with the evidence presented by Barrios et al. (2019), who identify multiple convergence clubs in innovation activity across European regions. Their study demonstrates that regions with similar initial levels of innovation capacity tend to converge towards distinct equilibria rather than a common steady state. Similarly, our findings suggest that EU countries form groups of AI adopters with different trajectories, reflecting underlying differences in technological capabilities and structural conditions. The presence of stable "high-adoption" and "low-adoption" clusters in both studies supports the hypothesis that technological development in Europe follows a centre–periphery pattern, where advanced regions maintain their leadership while lagging regions face persistent challenges in catching up.

However, an important difference emerges in the dynamics observed in this study. While Barrios et al. (2019) report some degree of convergence between clubs over time, our results indicate that, in the case of AI adoption among SMEs, divergence within lagging groups may be intensifying. This suggests that AI technologies, particularly in their current phase of rapid development, may act as a divergence force as much as a convergence mechanism. The dual nature of technological change–simultaneously enabling catch-up and reinforcing disparities–has been widely discussed in the literature (Roa Baez & Igbekele, 2021; Glawe, 2025), and our findings provide empirical support for this perspective in the context of AI diffusion.

From a policy perspective, these results have important implications for the European Union's digital cohesion agenda. The existence of convergence clubs implies that a uniform policy approach may be insufficient to address disparities in AI adoption. Instead, differentiated strategies tailored to the specific needs and capabilities

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/k2928634357

of different groups of countries may be required. For instance, while advanced economies may benefit from policies that support frontier innovation and scaling, lagging countries may require targeted investments in digital infrastructure, skills development, and institutional capacity to enhance their absorptive potential.

Overall, the findings of this study suggest that the current wave of AI diffusion in the EU SME sector follows a "multi-speed" pattern. While some countries and firms are rapidly advancing and converging towards higher levels of adoption, others remain on divergent trajectories. This highlights the importance of considering not only the pace but also the distribution of technological adoption when assessing the progress of digital transformation in the EU.

7. Conclusions

This study examined whether the rapid growth of AI adoption among EU SMEs in 2021–2025 is accompanied by convergence in adoption levels across Member States and size classes. Using harmonised Eurostat data and a convergence-oriented analytical framework, we find strong diffusion dynamics in both segments: the share of small enterprises (10–49 employees) using at least one AI technology increased from 6.1% in 2021 to 17.0% in 2025, while medium-sized enterprises (50–249 employees) increased from 12.6% to 30.4%. Although a persistent size-related adoption gap remains, the overall dispersion of adoption levels decreases in relative terms, indicating partial σ-convergence (CV: 0.69→0.52 for small firms; 0.62→0.45 for medium-sized firms).

β-convergence analysis further supports a catch-up process: countries with lower initial adoption levels tend to grow faster, with statistically significant negative β coefficients for both small ($\beta = -0.0815$, $p < 0.01$; $R^2 = 0.354$) and medium-sized enterprises ($\beta = -0.0872$, $p < 0.001$; $R^2 = 0.453$). Convergence is stronger and more consistent among medium-sized firms, suggesting that larger resource bases and organisational readiness facilitate faster diffusion. However, a club-convergence perspective reveals that EU-wide convergence is not uniform: while the high-adoption cluster shows convergence, the low-adoption cluster exhibits growing internal dispersion, implying that accelerated diffusion may coexist with increasing stratification among lagging ecosystems.

From a policy and managerial perspective, these results indicate that aggregate EU progress in AI uptake does not automatically translate into balanced digital cohesion. Targeted measures remain necessary to support SMEs in low-adoption environments, with an emphasis on capability-building (skills, data infrastructure, implementation support, and access to trustworthy AI services) rather than solely on access to technology. The study also has clear limitations: the observation window is short; the Eurostat indicator captures the use of at least one AI technology rather than adoption intensity or value creation; and the convergence framework does not establish causal mechanisms. Future research should extend the analysis by incorporating sectoral structure, complementary digitalisation measures, and institutional controls, and by linking country-level adoption dynamics to micro-level evidence on capabilities, deployment depth, and performance outcomes.

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Funding. The article has been developed and funded within the Daugavpils University's (Latvia) research project No 14-95/2026/17 "AI-Based Enterprise Transformation and Its Impact on Managerial Decision Quality".

Author Contributions: Chenqing Zhang developed the initial research idea and the core conceptual and analytical framework; designed the convergence-based empirical strategy; drafted the Introduction, conceptual framework and methodology; and prepared the initial full manuscript draft. Alina Danileviča conducted and synthesised the relevant scientific literature, strengthening the theoretical background and clarifying key concepts and definitions. Ieva Boļakova assembled, cleaned and verified the Eurostat dataset (2021–2025); performed the σ- and β-convergence calculations and estimations; and prepared the tables and figures. Vera Komarova contributed to the interpretation of cross-country patterns and strengthened the applied and policy-relevant dimension of the discussion and conclusions, including territorial and SME-capability implications. Zhongdong Yang contributed to the interpretation of results and manuscript revision, with a focus on the robustness and clarity of the empirical argumentation. Edmunds Čižo supported the conceptual and methodological development of the study; ensured coherence between the title, abstract, results and conclusions; and

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 3 (March)
http://doi.org/10.9770/s8222266759

Publisher
http://jssidoi.org/esc/home

INTERNATIONAL TEAM MANAGEMENT COMPETENCIES' DEVELOPMENT DURING BUSINESS STUDIES

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Received 15 January 2026; accepted 24 March 2026; published 30 March 2026

Abstract. In today's globalised business environment, effective team management competencies are fundamental. These competences represent a multidimensional framework that integrates knowledge, skills, abilities, and behavioural attributes necessary for guiding and coordinating collective efforts toward organisational goals. As organisations confront growing complexity, cultivating team management competencies has become a central priority in business education, especially in international and multicultural settings. This study examines the application of a Collaborative Online International Learning (COIL) project in fostering international team management competencies among undergraduate business students. The research was conducted through an online collaboration among higher education institutions in Lithuania, Ukraine, Kosovo, the Czech Republic, and Finland, in which students engaged in cross-cultural teamwork, structured discussions, and joint academic assignments. Qualitative and quantitative data were collected through semi-structured student interviews to explore participants' experiences and perceptions of international collaboration. The findings reveal that students significantly enhanced their international team management skills, intercultural awareness, and ability to function effectively in multicultural business environments. Moreover, participants broadened their understanding of foreign markets, international trade practices, and business strategies through sustained interaction with peers from diverse cultural and educational backgrounds. The results demonstrate that COIL represents an effective learning approach for strengthening intercultural competence, promoting collaborative problem-solving, and preparing students for professional careers in a globally interconnected economy. Integrating virtual international collaboration into business studies can therefore improve students' employability, cultural sensitivity, and adaptability to diverse professional environments, aligning with the Sustainable Development Goals.

Keywords: international team management; AI fluency; collaborative online international learning; sustainable development goals

Reference to this paper should be made as follows: Ambrusevič, N., Miniotienė, N., Kudinova (Chaikina), A. 2026. International team management competencies' development during business studies. *Entrepreneurship and Sustainability Issues*, 13(4), 170-184. http://doi.org/10.9770/x3228288593

JEL Classifications: M12, M16, M53, M54

1. Introduction

In the contemporary global business environment, effective team management competencies are paramount. These competences encompass a multidimensional construct involving integrated knowledge, skills, abilities, and behavioural attributes essential for leading and coordinating collective efforts toward organisational objectives. As organisations increasingly face complex challenges, the development of team management competencies has become a critical focus in business education, particularly in international and multicultural contexts.

The central **scientific problem** addressed in this study is formulated through the following research question: *How can international team management competences be enhanced within business studies programmes?*

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 3 (March)
http://doi.org/10.9770/s8222266759

This **research aims** to examine the implementation, challenges, and outcomes of the Collaborative Online International Learning (COIL) initiative at Vilniaus kolegija/Higher Education Institution, with particular emphasis on the development of international team management competences and practical professional skills among business students.

To achieve this aim, the study pursues the following **objectives**:

- To analyse the conceptual foundations and key dimensions of international team management competencies.
- To present the core principles and structure of the Collaborative Online International Learning (COIL) project.
- To evaluate the outcomes of COIL implementation through an analysis of semi-structured student interview data.
- To assess the impact of the COIL project on the development of international team management competencies and practical skills in business studies.
- To identify the main challenges and benefits associated with the implementation of the COIL project in business education.

2. Theoretical background

2.1. Defining team management competences

Team management competences represent a multidimensional construct comprising integrated knowledge, skills, abilities, and behavioural attributes required to lead, coordinate, and synchronise collective efforts toward organisational objectives. They are now conceptualised as integrated capabilities that synthesise frameworks with behavioural, social, artificial intelligence and emotional intelligence (Hwang, 2024). Furthermore, these elements function as integrated capabilities that synthesise behavioural and social frameworks with artificial intelligence (AI) and emotional intelligence. This integration is vital as AI emerges as a "teammate" necessitating new digital socialisation strategies within organisations (Deloitte, 2024; Lu, 2025). Team management competencies extend beyond mere task and resource optimisation. They encompass the relational capacity to cultivate synergy, mitigate interpersonal conflict, and sustain member motivation through adaptive leadership styles contingent upon situational demands. Unlike isolated functional skills, these competences are inherently socially constructed; they manifest and evolve through iterative interactions within specific organisational and cultural ecosystems. Recent analyses confirm this evolution, with demand for AI fluency – managing virtual tools collaboratively – surging sevenfold in job postings by mid-2025, underscoring the need for virtual team management competencies (Florea & Croitiru, 2025; McKinsey & Company, 2025).

The 2026 World Economic Forum underscores a pivotal shift in professional value, now defined by a balanced 50/50 synergy between AI fluency and human-centric "superpowers" (World Economic Forum, 2026). Success in the current landscape is determined by the intersection of technological proficiency and uniquely human attributes (World Economic Forum, 2025). Specifically, organisational excellence now rests on three core competency pillars: analytical and creative synergy, seamless AI-human collaboration, and adaptive resilience (Kelly, 2025).

In the sphere of international and multicultural management, these competences encounter a heightened layer of complexity. Managers are required to navigate the "intercultural friction" arising from divergent communication protocols, varying cultural value orientations, power distance, and heterogeneous work-related attitudes (Stahl & Maznevski, 2021). Consequently, contemporary academic discourse emphasises a dynamic, context-dependent perspective, viewing these competences as fluid capabilities rather than static individual traits, evolving post-mobility through returnees' professional adaptations (Hanley & Chankseliani, 2025).

2.2. Theoretical framework for team management competences development conceptualisation

An analysis of the scientific literature revealed diverse theoretical frameworks for conceptualising and categorising the dimensions of team management (Katz-Navon & Naveh, 2026).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 3 (March)
http://doi.org/10.9770/s8222266759

A foundational approach is the competency-based model, which categorises these attributes into distinct yet overlapping domains: cognitive competences (e.g., systems thinking and strategic reasoning), interpersonal competences (e.g., cross-cultural communication and empathy), leadership competences (e.g., vision articulation and empowerment), and emotional-social competences (e.g., self-regulation and social awareness) (European Commission, 2024).

Complementary to this view is the T-shaped competence model, which has gained significant traction in management education. In this framework, professionals possess deep vertical expertise in a specific discipline integrated with broad transversal competences, such as adaptability, interdisciplinary collaboration, and communication (World Economic Forum, 2025). Within this architecture, team management competences act as the critical horizontal link, enabling individuals to bridge functional, cultural, and organisational silos, especially in international, virtual and AI-augmented teams (McKinsey & Company, 2025).

Shifting from the individual to the systemic perspective, team effectiveness is a product of complementary skill sets, mutual accountability, and a shared purpose. Consequently, modern team management competences are no longer viewed as isolated individual proficiencies but as the capacity to foster collective efficacy, the shared belief in a team's joint capability to organise and execute the courses of action required to produce given levels of attainment (Chawla & Jain, 2021; Olaganathan, 2024).

Effective *communication* serves as the operational bedrock of team management. It transcends mere information transmission, encompassing active listening, formative feedback, and strategic message modulation for diverse stakeholders. In the context of international teams, this competence requires a high degree of linguistic and paralinguistic awareness, particularly regarding the tension between direct and indirect (low-context vs high-context) communication styles (Leigh et al., 2018). Managers must proactively mitigate “semantic noise” and cultural friction to prevent cognitive dissonance within the group (Leigh et al., 2018).

Coordination involves systematically aligning idiosyncratic contributions with overarching collective objectives. This requires robust mechanisms for role clarification, progress monitoring, and the institutionalisation of accountability (Weekes & Harvey, 2025). Coordination breakdowns rather than deficits in technical proficiency constitute the primary catalyst for team dysfunction and "process loss" in complex organisational settings, a finding echoed in recent virtual and AI-team studies (Olaganathan, 2024; Lu, 2025).

2.3. Team roles in competence development

The development of team management competences represents a core objective of contemporary business studies, particularly in programs that prepare students for work in international and multicultural environments (Tse, Wright & Burdett, 2024). Effective collaboration across cultural, organisational, and disciplinary boundaries requires not only technical knowledge but also well-developed interpersonal, leadership, and coordination skills (Mindeguia et al., 2021; Belbin & Brown, 2022; Abualfath & Messaadia & Ali, 2026).

Belbin and Brown (2022) propose a model identifying nine team roles, defined as recurring patterns of behaviour individuals exhibit when working in groups. Unlike role classifications based on formal organisational positions, roles in the suggested model emphasise behavioural contributions to team performance, making the framework particularly suitable for competence-based education.

From an international team management perspective, applying this model contributes to the development of several key managerial competencies. First, it supports self-awareness and interpersonal competence, as students learn to identify their preferred roles and recognise how these behavioural tendencies influence communication, collaboration, and leadership within diverse teams. In multicultural learning environments, such awareness is essential for reducing misunderstandings and enhancing mutual respect among team members. Second, this framework facilitates the development of team composition and coordination competencies. International teams benefit from a balanced distribution of roles that support idea generation, evaluation, implementation, and social cohesion. Exposure to this framework enables business students to allocate tasks strategically and to recognise potential gaps in team functioning, which is a critical managerial skill in global business settings (Mindeguia et al., 2021). Third, the model enhances leadership and decision-

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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making competencies. Roles such as Coordinator and Shaper illustrate different leadership orientations, ranging from facilitative and delegative to performance-driven and task-focused. Understanding these behavioural differences enables future managers to adapt their leadership approach to situational demands and cultural expectations, particularly in international and cross-cultural teams. Many teams' conflicts stem from incompatible working styles rather than personal disagreements (Schlaegel & Richer, 2021). By providing a shared, non-evaluative language for discussing behaviour, the model enables teams to address tensions constructively and supports the development of ethical and reflective management practices (Smith & Bond, 2022).

Through group projects, simulations, and reflective exercises, students develop transferable competences such as teamwork, leadership, adaptability, and cross-cultural sensitivity, as seen in competency-based MBA programs that emphasise real-world application (European Commission, 2024). Consequently, group work with role attribution functions as an effective pedagogical tool for preparing students to manage international teams in a globalised business environment.

2.4. Leadership, motivation, and modern challenges in team management

Team management competencies align with contemporary leadership paradigms. Perera (2025) discusses adaptive leadership as a critical competence in managing global teams and the role of education in developing these skills. Wang, Hae-Ryong & Byung-Jik (2021) highlight the importance of ethical leadership in fostering team cohesion and enhancing performance. Finally, transformational leadership theory, for instance, posits that effectiveness is derived from intellectual stimulation, individualised consideration, and the articulation of an inspiring vision (Siangchokyoo, Klinger, & Campion, 2020). This approach is particularly salient in heterogeneous, knowledge-intensive teams, where formal hierarchical authority is often less effective than cultivating shared meaning and psychological safety (Cahyono, 2024).

Motivational competences involve a sophisticated understanding of expectancy theory and the ability to foster an inclusive climate. Leaders must navigate diverse cultural expectations regarding power distance, reward allocation, and participatory decision-making. In international settings, this requires the capacity to identify and leverage diverse motivational drivers, ensuring that autonomy and recognition are dispensed in a culturally congruent manner.

Nowadays, business education must focus on the human ability to apply creative thinking to complex, unstructured problems. This remains a primary differentiator for students, allowing them to provide the strategic intuition that machines lack. Proficiency in a management context is no longer measured solely by digital literacy. Business studies must now cultivate AI fluency, the specific ability of a future manager to direct, audit, and refine AI-generated outputs to ensure they meet professional and organisational standards (McKinsey & Company, 2025). In a volatile global economy, agility and lifelong learning have evolved from extracurricular "perks" into essential survival skills (World Economic Forum, 2026).

The development of these modern skills directly influences traditional team dynamics. For example, conflict management is amplified within culturally diverse environments by divergent cognitive schemas. Consequently, team management competencies necessitate the diagnostic ability to differentiate between task-oriented (functional) conflict and relationship-oriented (dysfunctional) conflict.

Intercultural meta-competence serves as a core meta-competence. It is conceptualised as the capacity to negotiate meaning and interact effectively across cultural boundaries, grounded in a combination of cultural self-awareness, openness, and cognitive flexibility (Fantini, 2023; Huang, 2023; Hanley & Chankseliani, 2025). This includes "tolerance for ambiguity," the ability to remain effective in uncertain social environments, and the behavioural adaptability to switch codes as the context demands (Chen et al., 2026; Hanley & Chankseliani, 2025).

Ethical competence serves as a critical counterbalance, guiding managers through the "moral mazes" inherent in global operations. International leaders must reconcile pluralistic value systems while upholding organisational standards in a manner perceived as legitimate by all stakeholders.

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The development of these skills in future managers primarily occurs within higher education institutions, which act as key agents in their professional socialisation and identity development. Moving beyond the traditional role of "knowledge provider," modern business schools have embraced competence-based education (CBE) models. These frameworks focus on measurable learning outcomes that combine theoretical expertise with behavioural skills and ethical attitudes.

The development of these competences is facilitated through pedagogical scaffolding, which includes project-based learning (PBL), high-fidelity simulations, and problem-based inquiry. Furthermore, the internationalisation of the curriculum (IoC) manifested through student exchange programs, dual-degree initiatives, and COIL (Collaborative Online International Learning) exposes students to the techno-structural and cultural complexities of real-world teamwork. These immersive experiences are essential for developing reflective, adaptive, and ethically grounded leaders prepared for the volatility of the global market, integrating AI tools ethically and collaboratively (Cai & Leask, 2024; World Economic Forum, 2026).

3. Team management competences development during business studies: COIL project

The COIL project was centred around a real-world business case involving UAB "Maxima LT", the largest retail company in the Baltic region. International student teams will work together to develop innovative solutions that enhance Maxima's operations in four strategic areas: management, marketing, logistics, and e-commerce.

The main goal was to identify and address inefficiencies or growth opportunities by applying knowledge and skills in innovation, project management, international trade, supply chain management, and data-driven financial strategies. The project helped achieve the following learning outcomes:

1. *Effective international relationships.* Students demonstrate competence in building and maintaining international relationships through clear communication, cultural understanding, and adaptability. Beyond language skills, effective interaction requires intercultural awareness, sensitivity, and empathy. By collaborating virtually with international peers, students engage with diverse communication styles, work ethics, and decision-making approaches. They are expected to apply accurate communication, active social interaction, and cultural sensitivity to build meaningful relationships while identifying key elements of effective international collaboration.

2. *Understand cultural differences.* Collaborating with peers from diverse cultural backgrounds exposes students to varied perspectives, approaches, and ways of thinking. Frequent interaction helps students navigate differences in communication styles, attitudes, behaviours, and expectations. To demonstrate understanding, students engage in collaborative activities, show openness to diverse viewpoints, and describe cultural norms, values, and behaviours across nations. They recognise the importance of respect, open-mindedness, and adaptability in multicultural environments.

3. *Analyse innovations in the retail industry*. Students research retail innovations across countries and sectors, analysing and describing various applications and systems. They examine cross-border trade of retail technologies and components to identify international challenges and barriers (e.g., standards, data privacy, logistics, and regulation). Working on a real case study, students develop a proposal for a specific retail innovation and explain how market trends, government regulations, technological adoption, and societal perceptions shape outcomes. Finally, students reflect on how cultural contexts influence retail practices globally and how this learning broadens their understanding of cultural differences.

4. *Apply online project management skills*. Students formulate, plan, develop, and execute projects to achieve individual and group goals while working remotely. They demonstrate proficiency in using digital tools to communicate, collaborate, and complete tasks in an online environment. Key competencies include project and time management, communication, problem-solving, and organisational skills such as setting deadlines, creating project plans, prioritising tasks, and tracking responsibilities. Students also apply online project management techniques, including managing virtual meetings, allocating tasks, and monitoring progress.

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During the project, the students were obliged to:

- Form teams (5-7 members) consisting of students from Vilniaus kolegija/Higher education Institution (Lithuania), National University "Yuri Kondratyuk Poltava Polytechnic" (Ukraine), Universum International College (Kosovo), Mendel University (Czechia) and Seinäjoki University of Applied Sciences (Finland); exchange contact information and determine how to best communicate with each other.
- Conduct the research and exchange information to learn more about the market; spend time exchanging information with each other; come up with suggestions; based on results, provide suggestions for UAB "Maxima LT".
- Summarise learning experiences and business suggestions in a written report, along with the answers to the survey.

3. Research objective and methodology

The study employed a project-based, collaborative learning design to investigate the development of intercultural competence and innovation skills through Collaborative Online International Learning (COIL). A mixed-methods approach was used, combining quantitative self-assessment surveys with qualitative analysis of student reflections and project outputs.

The managerial intervention was structured around a real-world business challenge posed by UAB "Maxima LT", a major Baltic retailer. The project was grounded in Kolb's experiential learning theory (MacLeod, 2025) and in the principles of constructivism, in which students co-create knowledge through shared inquiry and social interaction. The COIL framework served as the primary vehicle for international collaboration, embedding intercultural exchange directly into the curriculum.

The study involved students from five partner higher education institutions:

- Vilniaus kolegija/Higher Education Institution, Lithuania (47 students);
- National University "Yuri Kondratyuk Poltava Polytechnic", Ukraine (7 students);
- Universum International College, Kosovo (6 students);
- Mendel University, Czechia (3 students);
- Seinäjoki University of Applied Sciences, Finland (5 students).

Students were organised into 11 international teams, each consisting of 5–7 members. The composition of each team was intentionally diverse in terms of nationality, academic discipline, and cultural background to maximise exposure to different perspectives.

The project was divided into four distinct phases over an 18-week semester:

1. Formation and orientation (week 1-2). Teams were formed and provided with a project brief. Students established communication protocols (e.g., Slack, Zoom, Microsoft Teams) and shared contact information.
2. Problem identification and research design (week 3-4). Each team selected one of the four strategic challenge areas: management, marketing, logistics, or e-commerce. They collaboratively formulated specific research questions to investigate inefficiencies or growth opportunities within Maxima's operations.
3. Collaborative research and analysis (week 5-12). Students conducted market research relevant to their chosen area, focusing on comparing practices in the Baltic region with those in their home countries. This phase involved:
   - Data collection on local consumer behaviour and retail trends.
   - Analysis of cross-border challenges (e.g., regulation, data privacy, supply chain logistics).
   - Regular virtual meetings to synthesise findings and co-develop preliminary recommendations.
4. Synthesis and reporting (Week 14-18). Teams consolidated their findings and recommendations into a joint project report. Additionally, each student submitted an individual reflective essay of approximately 500 words along with a post-project survey.

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Data collection instruments. To assess the project's effectiveness in achieving the stated learning outcomes, multiple data sources were used:

- Joint project reports. The final reports were evaluated using a rubric to assess the quality of the proposed innovations, the integration of diverse cultural perspectives, and the application of theoretical knowledge (e.g., supply chain management, marketing strategy).
- Individual reflective essays. The 500-word reflections were analysed using thematic analysis to identify key themes related to learning outcomes, cultural challenges, personal growth, and the application of theory. The reflections were guided by specific prompts (learning experiences, challenges, and future application).
- Post-project surveys. Students completed a survey at the end of the project. The survey measured self-perceived competence in intercultural communication and collaboration, digital and remote project management skills, and understanding of innovation in the retail sector.

Data analysis included a mixture of quantitative and qualitative data:

- Quantitative data from the post-project surveys were analysed using the sample size Taro Yamane formula when the population is known and finite:

$$n = \frac{N}{1+Ne^2} \quad [1]$$

where n – required sample size;
N – total population size;
e – margin of error (5%).

- Qualitative data from the reflective essays and project reports were coded and analysed using MAXQDA software. An inductive thematic analysis approach was used to identify recurring patterns, challenges, and evidence of intercultural learning.

Ethical considerations. All participants were informed of the research purpose and provided informed consent. Data were anonymised, with students identified by code numbers in all written analyses to ensure confidentiality. Participation in the research component was voluntary and did not affect students' project grades.

4. Results and discussion

The analysis of the collected data commenced with its systematic processing into a unified text document, following established qualitative analysis procedures: familiarisation with the provided information, data coding, thematic review, and the integration and definition of themes. The qualitative data derived from the iterative search process comprised participants' expressed thoughts and shared insights, supplemented by a semi-structured interview conducted in accordance with established guidelines (Ambrusevič, Išoraitė, 2025).

MAXQDA software was used, and qualitative thematic coding was applied, resulting in the identification of thematic clusters and their frequencies (from high to low-medium). Table 1 presents the main challenges faced by project participants, categorised into seven sub-categories.

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Table 1. Challenges faced by project participants

Category	Sub-category and its frequency	Empirical study statements	Empirical study summary
Challenges faced by project participants	Scheduling & time management issues (High frequency)	Difficulty finding common meeting times. Time zone differences. Different academic calendars. Meetings cancelled or rescheduled. Conflicts with personal commitments.	Scheduling was the most frequently coded challenge, indicating that coordination across institutions and countries required high flexibility.
	Technical & infrastructure problems (High frequency)	Electricity outages (Ukraine). Internet disruptions. Limited access to online meetings. Dependence on asynchronous communication.	External technical conditions significantly affected synchronous collaboration, forcing teams to rely on written communication.
	Communication limitations (Medium frequency)	Lack of face-to-face interaction. Misunderstanding emotions or intentions. Slower explanations through text. Need for clearer written instructions.	Purely online communication reduced emotional clarity and sometimes slowed teamwork efficiency.
	Different working styles & academic expectations (Medium frequency)	Different writing styles. Different task approaches. Different standards for formatting and structure. Need to unify the final document.	Cross-institutional cooperation required extra effort to harmonise outputs into one coherent academic product.
	Unequal participation & responsiveness (Medium frequency)	Some members are inactive or non-responsive. Withdrawal from the project. Increased workload for active members.	Uneven engagement affected task distribution and required stronger leadership and follow-up.
	Language & cultural barriers (Low-medium frequency)	Misunderstanding idioms. Different communication norms. Need for clarification.	Although not dominant, language and cultural differences occasionally caused confusion and required patience and adaptation.
	Personal responsibility & delays (Low-medium frequency)	Delays during holidays. Waiting for individual contributions. Impact on group progress.	Individual discipline and accountability were identified as critical factors influencing overall group performance.

The main challenges faced during the COIL project were related to coordination, communication, and differences in working conditions and styles. It was often difficult to schedule meetings that suited all participants because of different academic calendars, personal commitments, and time zone differences, which led to cancellations or rescheduling. In addition, electricity and internet disruptions, particularly in Ukraine, limited real-time communication and increased reliance on asynchronous collaboration. Text-based communication sometimes made it harder to understand emotions, intentions, and complex ideas, slowing feedback and clarification processes. Differences in task approaches, writing styles, formatting standards, and deadline habits across universities and countries required extra effort to harmonise the final document. Unequal participation also emerged as a challenge, as some members became less responsive, increasing the workload for others and complicating coordination. Minor misunderstandings due to language use, idioms, and varying communication norms required additional patience and clarification, while individual delays, especially during holiday periods, slowed overall progress and emphasised the importance of discipline and accountability in teamwork.

Overall, the key challenges centred on coordination, communication, scheduling, and consistency, rather than conflict – most teams overcame these issues through flexibility, written communication, and mutual support. Despite the challenges, participants reported several benefits, categorised into improved skills, strong international relationships, and increased flexibility. Table 2 highlights the main measures for building team cohesion across geographical divides, categorised into ten sub-categories.

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Table 2. Measures for building team cohesion across geographical divides

Category	Sub-category and its frequency	Empirical study statements	Empirical study summary
Measures for building team cohesion across geographical divides	Open & regular communication (Very high frequency)	Continuous interaction in Telegram / WhatsApp / Instagram groups. Sharing ideas, questions, and concerns freely. Regular online meetings (Zoom, Microsoft Teams). Transparent discussion of progress and problems.	Frequent communication emerged as the most dominant strategy for building cohesion, creating a sense of presence and shared responsibility among geographically distant members.
	Supportive & respectful team climate (High frequency)	Friendly and non-judgmental atmosphere. Empathy and mutual understanding. Absence of conflicts. Psychological safety in giving and receiving feedback.	A respectful communication culture reduced social and cultural distance and strengthened trust within the teams.
	Clear role distribution & shared responsibility (High frequency)	Transparent task allocation. Division of work based on strengths. Equal involvement in project activities. Collective problem-solving.	Role clarity ensured that each member felt valued and accountable, reinforcing a unified team identity.
	Early relationship building (Medium frequency)	Self-introductions and sharing personal backgrounds. Initial Zoom/online meetings. Getting to know each other informally.	Early socialisation created comfort and trust, which supported later academic collaboration.
	Inclusive decision-making & participation (Medium frequency)	Encouragement of open discussion. Equal voice in decisions. Democratic planning of tasks and schedules.	Inclusion promoted ownership of the project and strengthened team cohesion.
	Informal communication & social bonding (Medium frequency)	Casual conversations in group chats. Humour and friendly messages. Non-task-related interaction.	Informal exchanges helped humanise team members and foster interpersonal closeness despite physical distance.
	Recognition & positive reinforcement (Medium frequency)	Praise for completed tasks. Encouragement messages. Celebrating milestones.	Positive feedback increased motivation and contributed to a supportive team environment.
	Respect for cultural & academic diversity (Medium frequency)	Valuing different national identities. Acceptance of different writing styles. Learning from diverse academic traditions.	Diversity was reframed as a resource for collaboration rather than a barrier.
	Shared goals & common vision (Medium frequency)	Agreement on project objectives. Common deadlines and expectations. Collective sense of purpose.	A shared vision strengthened unity and alignment across institutions.
	Flexibility & understanding of local conditions (Low-medium frequency)	Patience regarding time zones and schedules. Sensitivity to technical problems. Adaptive coordination.	Flexibility reinforced trust and maintained cooperation under unequal local conditions.

Teams relied on group chats (Telegram, WhatsApp, Instagram) and regular online meetings to maintain constant interaction. These channels allowed members to freely share ideas, ask questions, discuss problems, and provide updates, creating transparency and a sense of presence despite distance. A respectful, non-judgmental

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communication climate was intentionally fostered. Members showed empathy, Encouragement, and mutual understanding, which reduced cultural and geographical distance and helped prevent conflicts. Tasks were distributed transparently and often based on individual strengths. This ensured that everyone felt involved and valued, strengthening accountability and trust within the group. Teams introduced themselves, shared personal backgrounds and interests, and used initial Zoom or online meetings to create familiarity and comfort before focusing fully on tasks. Coordinators encouraged open discussion and made sure all voices were heard. Democratic planning and joint problem-solving helped foster trust and a shared team identity. Casual conversations, humour, and friendly messages in group chats strengthened interpersonal relationships and created a psychologically safe space where members were not afraid of feedback. Celebrating milestones and giving positive feedback (e.g., "well done", "great job") increased motivation and reinforced a sense of unity and achievement. Differences in national identity, writing styles, and working approaches were treated as strengths rather than obstacles. Some teams intentionally highlighted each member's cultural style, thereby enriching collaboration and strengthening mutual respect. Teams agreed early on common objectives, deadlines, and expectations. This shared purpose helped maintain cohesion and alignment across institutions and countries. Members showed patience toward different schedules, technical problems, and local challenges (e.g., electricity or internet disruptions), which strengthened trust and cooperation.

Team cohesion across geographical divides was built through a combination of regular communication, mutual respect, inclusive collaboration, informal social interaction, and shared goals. These measures fostered a unified team identity and strong relationships, enabling students to function as a supportive, motivated international team despite physical distance.

Table 3 investigates the main measures for improving international teamwork, categorised into eight sub-categories.

Table 3. Measures for improving international teamwork

Category	Sub-category and its frequency	Empirical study statements	Empirical study summary
Measures for improving international teamwork	Meeting participation & accountability (High frequency)	Minimum two representatives attending meetings. Written updates from absent members. Stronger responsibility for shared progress.	Ensuring participation and accountability was coded as a key requirement for improving coordination and information flow.
	Clear communication rules (High frequency)	Early definition of communication expectations. Clear response norms and channels. Reduced message loss and misunderstandings.	Structured communication from the beginning was seen as essential for effective international teamwork.
	Unified digital workspace (Medium-high frequency)	One main communication platform (e.g., WhatsApp/Telegram). Shared project management or file repository. Centralised deadlines and meeting notes.	A single digital workspace increases transparency and accessibility for all team members.
	Regular short online meetings (Medium frequency)	Weekly or biweekly video meetings. Key-stage meetings for clarification. Improved personal connection.	More frequent short meetings support clarity, engagement, and relationship building.
	Clear leadership & role definition (Medium frequency)	Explicit task allocation. Defined standards for contributions. Stronger guidance from coordinators.	Clear leadership and role clarity reduce uncertainty and uneven workload distribution.
	Time management & fair scheduling (Medium frequency)	Use of scheduling tools (e.g., Doodle, When2Meet). Time-zone-sensitive planning. Fixed timelines.	Fair scheduling practices promote respect for international members' availability and improve consistency.

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	Informal interaction & team-building (Medium frequency)	Ice-breaker sessions. Virtual coffee breaks. Casual non-task communication.	Informal interaction was identified as a strong factor in building trust and interpersonal bonds.
	Continuous feedback & reflection (Low-medium frequency)	Regular reflection meetings. Constructive feedback loops. Shared evaluation of progress.	Ongoing feedback helps identify challenges early and supports continuous improvement.

Results show that to improve international teamwork, teams should ensure structured participation by requiring at least 2 representatives at each online meeting and written updates from absent members, to prevent information gaps and strengthen accountability. Clear communication rules, contact details, and expectations should be defined early to reduce confusion and misunderstandings, supported by the use of one main communication channel and a shared digital workspace for deadlines, files, and meeting notes. Task trackers with clearly assigned roles and deadlines can enhance transparency and coordination, while fixed weekly or biweekly video meetings help build clarity, engagement, and personal connection. Strong leadership with explicit task instructions and well-defined responsibilities reduces uncertainty and uneven workload distribution, and scheduling tools can support fair, time-zone-friendly meeting planning. In addition, informal activities such as virtual coffee breaks, ice-breaker sessions, and casual conversations about hobbies foster trust and interpersonal bonds, while introductory sessions that highlight members' backgrounds and working styles promote cultural understanding and mutual respect. Finally, periodic reflection meetings and stricter adherence to timelines and expectations enable teams to identify problems early, recognise achievements, and continuously improve collaboration.

Improving international teamwork requires a combination of structured coordination (clear tools, roles, and deadlines) and human-centred practices (trust-building, informal interaction, and intercultural understanding). Together, these measures can enhance clarity, accountability, engagement, and team cohesion in future cross-border collaborative projects.

For the qualitative analysis, 58 students out of 68 participants took part in a survey. It meets the requirements for 5% of margin of error in sample size according to Taro Yamane formula. The respondents were asked to indicate whether they agree or disagree with statements on the main international team management problems (1-strongly disagree; 2-disagree; 3-neither agree nor disagree; 4-agree; 5-strongly agree). The average evaluations are given in Table 4 below.

Table 4. Evaluation of international team management problems

No.	Statement	Average evaluations:
1.	While working with students from other higher education institutions, we did experience a language barrier (varying proficiency levels and idioms can cause misunderstandings).	2,33
2.	Scheduling meetings and ensuring timely feedback becomes difficult, leading to delays because of different time zones.	2,74
3.	Without non-verbal cues, emails and chats can be easily misinterpreted.	2,93
4.	Inconsistent access or skill with remote tools created issues.	2,77
5.	Due to different work styles, varying approaches to deadlines, hierarchy, and decision-making.	3,16
6.	Direct vs indirect communication, and differing comfort levels with giving feedback.	3,06
7.	Physical distance and lack of face-to-face interaction make building strong bonds harder.	3,61
8.	Remote members feel disconnected from the team and the project goal	2,91
9.	The measures applied to ensure team unity were not effective.	2,32
10.	Team members had varying cultural views on recognition and work-life balance	2,95

Overall, respondents showed moderate to low agreement with most problem-related statements, indicating that international teamwork was generally perceived as manageable and effective. The strongest agreement was with the statement that physical distance and lack of face-to-face interaction make building strong bonds harder (mean = 3.61). This suggests that social connection remains the most significant challenge in international virtual teams. Moderate agreement was observed for differences in work styles and approaches to deadlines and

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decision-making (mean = 3.16), and differences in direct vs indirect communication and comfort with feedback (mean = 3.06). Lower agreement scores were reported for language barriers (mean = 2.33), ineffective unity measures (mean = 2.32), time zone difficulties (mean = 2.74), tool-related issues (mean = 2.77).

These results indicate that technical and linguistic barriers were not perceived as major obstacles, while relationship-building and cultural communication differences posed more noticeable challenges.

Similarly, the respondents were asked to indicate which international team management competences, in their opinion, are most important for success in international project team management (1-not important; 2-slightly important; 3-moderately important; 4-important; 5-very important). The average evaluations are given in Table 5 below.

Table 5. Evaluation of international team management competencies

Competences	**Average evaluations:**
Solid grasp of scope, time, budget, and resource management.	4,54
Identifying, assessing, and mitigating risks in a global context.	3,88
Aligning diverse stakeholder needs and expectations across cultures.	3,82
Analysing complex situations and making well-grounded choices of possible decisions.	4,02
Clear, concise, culturally aware communication, overcoming language barriers, and using diverse tools (video, software).	3,93
Understanding cultural norms in communication, hierarchy, and decision-making.	4,14
Recognising and managing emotions within diverse teams.	4,02
Adapting leadership styles (democratic, analytical, etc.) to fit team cultures.	4,40
Adjusting approaches for different regions, time zones, and challenges.	4,16
Building trust, fostering collaboration, and resolving conflicts across cultures.	4,53

Respondents rated most competences as important to very important, highlighting the need for both managerial and interpersonal skills. The highest-rated competences were solid project management skills (scope, time, resources) (mean = 4.54), building trust, fostering collaboration, and resolving conflicts across cultures (mean = 4.53), adapting leadership styles to fit team cultures (mean = 4.40). Other highly valued competences included understanding cultural norms in communication and decision-making (mean = 4.14), adjusting approaches for different regions and time zones (mean = 4.16), recognising and managing emotions within diverse teams (mean = 4.02), clear and culturally aware communication (mean = 3.93).

These findings show that success in international teams depends not only on technical project management skills but strongly on cultural awareness, emotional intelligence, adaptive leadership, and trust-building abilities.

Conclusions

In the current global business landscape defined by volatility, uncertainty, and profound cultural heterogeneity, team management competencies have emerged as a cornerstone of managerial efficacy. These capabilities transcend rudimentary administrative coordination, evolving into a sophisticated repertoire of leadership, dialogic communication, intercultural dexterity, and ethical discernment. As organisational structures become increasingly fluid and decentralised, the ability to maintain cohesion across geographic and cognitive boundaries becomes a primary source of competitive advantage.

For institutions of higher education, the systematic cultivation of these competences represents both a pedagogical exigency and a strategic mandate. By embedding experiential team-based learning, cross-border collaborative initiatives, and structured reflective practice into the core curricula, business schools bridge the gap between theoretical abstraction and professional practice. Ultimately, this integrated educational approach is vital for developing a new generation of "global citizens" leaders who are equipped to navigate the complexities of international teamwork and drive sustainable, inclusive organisational success.

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Collaborative Online International learning (COIL) is a tool to enhance global and virtual teamwork, global learning and intercultural collaboration skills in global and virtual teams, which is aligned with Sustainable Development Goals (SDG):

- COIL strengthens relationships with our existing and valued partner network, aligning with SDG 17 (Partnerships for the Goals) to strengthen the means of implementation and revitalise global partnerships for sustainable development.
- COIL broadens the lecturers' and students' international networks, knowledge, and skill sets. This addresses SDG 4 (Quality Education) by ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all.
- COIL contributes to a sustainable and inclusive form of international collaborative education. This corresponds to SDG 10 (Reduced Inequalities) by reducing inequality within and among countries and ensuring equal opportunity for all students to access international experiences.
- COIL is a cost-efficient method of internationalisation that supports SDG 12 (Responsible Consumption and Production) by ensuring the sustainable management and efficient use of resources through digital-led educational alternatives.

The research results support the statement that improving international teamwork requires a balance between:

- Structured coordination (clear tools, roles, deadlines, and project management skills), and
- Human-centred practices (trust-building, informal interaction, emotional intelligence, and intercultural understanding).

While operational challenges such as language, tools, and time zones were rated relatively low, the data highlights that social and cultural dimensions of teamwork are the most critical factors for long-term effectiveness and cohesion in cross-border collaborative projects. Recognising that the human dimension is the most critical factor for success, this research paves the way for further investigation into cultural codes, offering a pathway to refine international management strategies in an increasingly digital and globalised workspace.

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ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 3 (March)
http://doi.org/10.9770/s8222266759

Author Contributions: Conceptualisation: *Ambrusevič, N., Miniotienė, N., Kudinova (Chaikina), A.*; methodology: *Ambrusevič, N., Miniotienė, N.*; data analysis: *Ambrusevič, N., Miniotienė, N.;* writing – original draft preparation: *Ambrusevič, N., Miniotienė, N., Kudinova (Chaikina), A.*; review and editing: *Ambrusevič, N., Miniotienė, N., Kudinova (Chaikina), A.*; visualisation: *Ambrusevič, N.* All authors have read and agreed to the published version of the manuscript.

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p3777582472

Publisher
http://jssidoi.org/esc/home

THE THEORY OF PLANNED BEHAVIOR IN THE CONTEXT OF CIRCULAR ECONOMY PRACTICES: A PATH TO SUSTAINABLE INDONESIAN ACCOMMODATION INDUSTRY

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Received 15 January 2026; accepted 25 March 2026; published 30 June 2026

Abstract. The world's transformation from linear to circular economies is a major issue today. The demand for goods and services also contributes to environmental damage. Through the Theory of Planned Behavior, this study demonstrates how human behavior influences the adoption of circular economy practices and sustainable business performance. This study examines the role of green intention and green innovation in mediating the relationship, as well as the moderating effect of barriers on this relationship. Data were collected through questionnaires completed by 447 respondents, who were employees in Indonesian accommodation companies. The Structural Equation Model was used to test the model using the Smart PLS 4 tool. The findings show a positive effect of the Theory of Planned Behavior on circular economy practices and sustainable business performance. The role of green intention and green innovation in mediating the relationship in the model also shows positive results. Barriers were found to both strengthen and weaken relationships within the model. The unexpected findings that circular economy practice fails to mediate the relationships in the model and barriers fail to moderate these relationships challenge further explanation. This study also offers theoretical and managerial implications to help accommodation providers address challenges and capitalize on opportunities in their sustainability efforts.

Keywords: circular economy; green innovation; green intention; sustainable business performance; Theory of Planned Behavior

Reference to this paper should be made as follows: Mamengko, R. P., Prasetyo, D. A., Lee, L. 2026. The Theory of Planned Behavior in the context of circular economy practices: a path to sustainable Indonesian accommodation industry. *Entrepreneurship and Sustainability Issues*, 13(4), 185-201. http://doi.org/10.9770/p3777582472

JEL Classifications: L66, L83, L84, Q53, Q56, Z31

1. Introduction

Environmental and climate issues are currently a significant concern. Global demand for goods and services has increased the risk of ecosystem degradation, leading the world to shift towards a circular model. The circular economy (CE) minimizes resource consumption, reuses products, and restores natural systems (Martinez-Cabrera and Lopez-del-Pino, 2021). CE can reduce material and energy costs, as well as improve production efficiency; therefore, many companies prioritize it. The accommodation industry, as part of the tourism sector, represents 8% of global greenhouse gas emissions, contributing to climate change (Lenzen et al., 2018). For instance, major hotels on Gili Trawangan, Indonesia, generated 3.27 kg of MSW per bed per day, accounting for 70% of the island's waste (Sekito et al., 2019). The Circular Economy is part of Indonesia's Vision 2045 and the National Medium-Term Development Plan 2020-2024. Indonesia's Circular Economy promotes the reduction, reuse, and recycling of materials to minimize waste. Indonesia aims to achieve a 50% reduction in waste by 2030. Furthermore, between 2010 and 2019, 895 companies received awards for their achievements in the green industry. This supports CE's environmental, business, and social goals.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p3777582472

Although CE adoption is a strategic decision for an organization, it does not occur automatically. The strategic decision needs organizational support and CE adoption by implementers. People at an organization are more willing to adopt CE if they perceive its benefits. A belief that peers, superiors, corporate headquarters, guests, and the community support CE adoption will strengthen subjective norms and increase the implementation of CE. Behavior influences innovation and intention within CE (Alvarez-Risco et al., 2021). The Theory of Planned Behavior (TPB) posits that attitude, subjective norm (SN), and perceived behavioral control (PBC) influence behavioral intention (Kuhl, 1985). An individual's disposition toward behavior is called attitude. Social pressure to act is denoted as subjective norm (SN), and the belief in one's capability to act is termed perceived behavioral control (PBC). The obstacles identified by Mishra et al. (2022) encompass knowledge and skills, technology, culture, finance, strategy, government and regulation, and market factors. Moreover, Guldmann and Huulgaard (2020) demonstrate that companies of the same size and sector may face different barriers, despite having different managerial ambitions regarding CE. Analyzing the challenges faced by firms with diverse operational backgrounds and formulating effective strategies to address them plays a critical role in advancing corporate entrepreneurship toward more sustainable practices through the implementation of Sustainable Business Performance (SBP). SBP aims to achieve a balanced integration of social, environmental, and economic objectives. The Circular Economy (CE) offers considerable potential to simultaneously stimulate economic growth and environmental responsibility, thereby strengthening SBP in a manner that aligns with long-term ecological and market goals. Khan et al. (2022) assert that CE enhances environmental and financial performance. Despite the extensive CE research, there is a dearth of literature on CE in specific sectors, such as the accommodation industry. Boiral et al. (2017) indicate that organizations have not responded isomorphically due to their failure to adopt a cognitive framework, thereby diminishing public and business awareness.

This study investigates the impact of the TPB, green intention, and green innovation on CE practices and SBP, with green intention and green innovation serving as mediating factors. This study also examines the moderating effects of Barriers on model interactions, identifies characteristics, and suggests solutions associated with the implementation of CE strategies. This study complements the lack of CE explanation in the accommodation literature, addresses previous research gaps, and elucidates inconsistencies in correlations. This study contributes to the body of knowledge by identifying key challenges in the adoption of CE practices and proposing strategic interventions to address them. By elucidating the underlying determinants that influence CE adoption, this study provides valuable insights that can guide companies in developing more targeted and effective promotional strategies. Additionally, it underscores the significance of green intention and green innovation in the adoption of CE practices, illustrating the relationship between CE practices and SBP and highlighting its relevance for sustainability. This study suggests that accommodation firms may consider the CE concept to attract investors and mitigate environmental damage associated with consumption.

2. Theoretical Background

2.1. The Theory of Planned Behavior

The Theory of Planned Behavior (TPB) elucidates the relationship between attitude, subjective norms (SN), and perceived behavioral control (PBC) in generating interest in an activity (Kuhl, 1985). This concept is significant in the CE as consumer and organizational behavior play a vital role in sustainable practices. Nasir and Yusof (2024) observed that positive sustainability attitudes can motivate enterprises and individuals to engage in sustainable practices. Hao et al. (2020) found that social expectations to participate in CE practices enhance the willingness to engage in such activities, as per subjective norms. Social influence helps entrepreneurs adopt sustainable practices, thereby improving corporate sustainability. Therefore, based on those theories, this study proposes:

H1. Employees' TPB-based behavior has a positive influence on Circular Economy practices in the accommodation industry.

H3 Employees' TPB-based behavior has a positive influence on Sustainable Business Performance in the accommodation industry.

Note. In this study, the term "Employees' TPB-based behavior" is used consistently across the hypotheses to refer to employee behavior explained through the Theory of Planned Behavior (TPB) framework.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p3777582472

2.2. Circular Economy Practices

CE practices, through resource efficiency, align with SBP's objective of minimizing waste and enhancing resource utilization. Ting et al. (2023) argue that CE business models enhance operational management, leading to more environmentally sustainable and resource-efficient production. Moreover, previous studies indicate that CE practices can serve as a mediator. Organizations that exhibit favorable attitudes toward corporate entrepreneurship are more likely to adopt sustainable practices that enhance performance. Furthermore, Obeidat et al. (2022) reveal the importance of green intention in CE activities for sustainability. Additionally, research indicates that CE practices mediate the relationship between Innovation and SBP. According to Suchek et al. (2021), organizations pursuing circularity must innovate their business strategies and engage with stakeholders to achieve economic, social, and environmental objectives. Using this theoretical foundation, this study proposes:

H2. Circular Economy practices have a positive influence on Sustainable Business Performance in the accommodation industry.

H8a. Employees' TPB-based behavior influences Sustainable Business Performance through Circular Economy practices in the accommodation industry.

H8b. Green Intention influences Sustainable Business Performance through Circular Economy practices in the accommodation industry.

H8c. Green Innovation influences Sustainable Business Performance through Circular Economy practices in the accommodation industry.

2.3. Green Intention

Green intention, influenced by personal values, social norms, and education, impacts a company's ability to achieve sustainable performance outcomes. Kim et al. (2022) observed that threats such as COVID-19 have increased customers' propensity to engage with sustainable companies through sustainable behaviors. This can encourage businesses to adopt more sustainable operations and strategies. Furthermore, researchers found that green intention is a mediator in effectively translating the TPB concept into the adoption of CE practices. Álvarez-Risco et al. (2021) found that attitude significantly influences behavioral intention related to the adoption of CE practices, underlining the role of intention as a mediating factor. Understanding consumer behavior in the context of CE enhances sustainable consumption. This study proposes, based on the above theories:

H4. Green Intention has a positive influence on Sustainable Business Performance in the accommodation industry.

H6. Employees' TPB-based behavior influences Circular Economy practices through Green Intention in the accommodation industry.

2.4. Green Innovation

Product, process, and business model innovation can affect corporate sustainability. Green innovation primarily improves SBP through increased operational efficiency. Efficiency reduces costs and minimizes waste, thereby improving environmental conditions. Yang and Jang (2020) asserted that business model innovation that adheres to sustainability standards can enhance financial performance. Furthermore, green innovation can act as a mediator. Stubbs (2019) demonstrated that green innovation mediates the relationship between attitude and CE practices, and that business model innovation is essential for sustainability. This study presents the following hypotheses based on the theory outlined.

H5. Green Innovation has a positive influence on Sustainable Business Performance in the accommodation industry.

H7. Employees' TPB-based behavior influences Circular Economy practices through Green Innovation in the accommodation industry.

2.5. Barriers

Organizations encounter numerous challenges in implementing a CE. The significant initial investment required to transition from linear to circular business models represents a major obstacle to adopting CE practices. In developing countries like Malaysia, businesses face constraints related to limited capital and high initial costs (Ting et al., 2023). Insufficient supportive policies and legislation may also hinder the transformation of CE.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/p3777582472

Garcés-Ayerbe et al. (2019) emphasized the significance of institutional support for CE initiatives. Moreover, consumer behavior plays a vital role in CE projects. Camacho-Otero et al. (2018) identified that consumer ignorance regarding circular solutions impedes their adoption. Furthermore, CE transitions frequently require advanced technology and methodologies. Numerous organizations lack the requisite technology and expertise. Kirchherr et al. (2018) highlighted that postponing technological advancements may obstruct circular practices, particularly within established industries. Supply chain complexity may complicate the installation of CE practices. Batista et al. (2018) emphasize the significance of stakeholder involvement in establishing a circular supply chain. This study examines the TPB, green intention, green innovation, and barriers related to CE practices. Barriers may influence the relationship between green intention and the TPB. Rojas-Córdova et al. (2020) assert that perceived obstacles influence a company's intentions for innovation. This asserts that companies must address these challenges to foster innovation and circularity. This study presents the following hypotheses derived from the aforementioned theories:

H9a. Barriers moderate the relationship between Employees' TPB-based behavior and Green Intention in the accommodation industry.
H9b. Barriers moderate the relationship between Employees' TPB-based behavior and Green Innovation in the accommodation industry.
H9c. Barriers moderate the relationship between Green Innovation and Circular Economy practices in the accommodation industry.
H9d. Barriers moderate the relationship between Green Intention and Circular Economy practices in the accommodation industry.

Based on the theoretical background above, Figure 1 below presents the conceptual research framework that will be examined in this study.

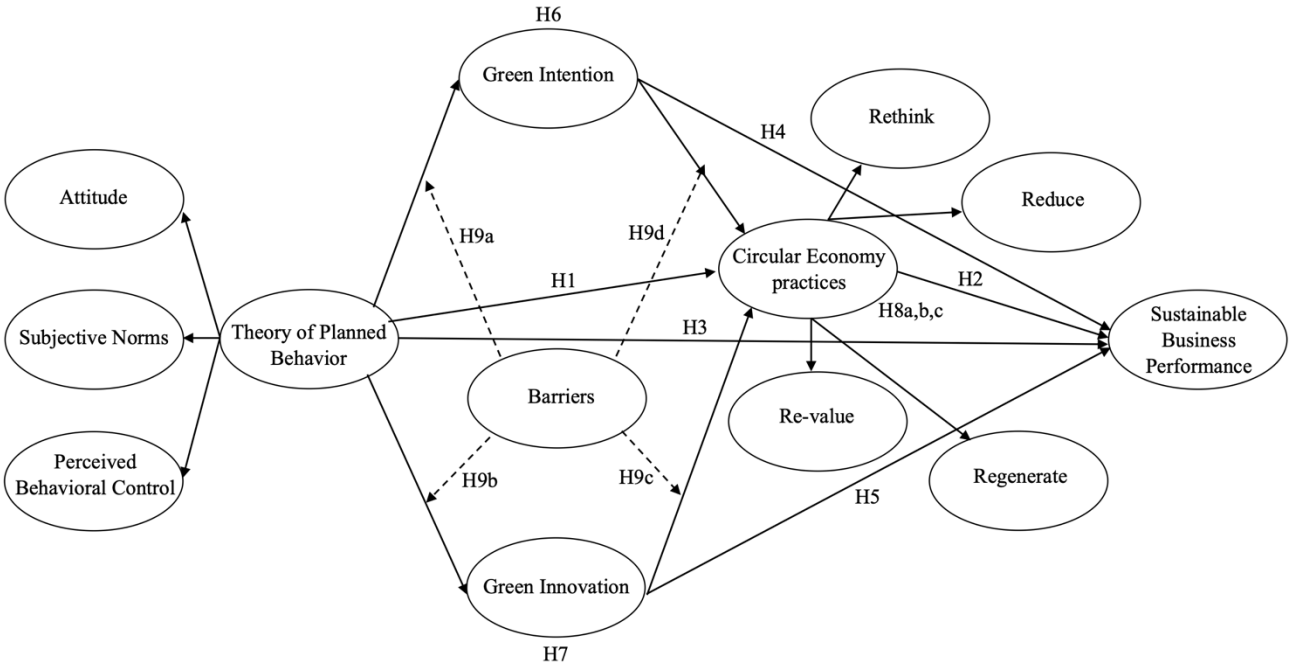


Figure 1. Conceptual Research Framework
Source: the authors

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p3777582472

3. Methodology

3.1. Sampling and Data Collection

This research employs a quantitative design to examine the relationship, utilizing a sample of employees from organizations that have implemented CE practices. A series of structural equation models (SEM) will be employed to examine the relationships among variables, focusing on the mediating role of green intention and green innovation, as well as the moderating effect of barriers. A pilot questionnaire was administered to 30 respondents to ensure clarity, and feedback was used to refine it. The finalized 58-question survey was distributed to 550 respondents in the Indonesian accommodation industry between March 3 and July 21, 2023. With two research assistants overseeing the process, 493 responses were collected, of which 46 were deemed inadequate. The final sample of 447 respondents, representing an effective response rate of 81.27%, was used for analysis. Collecting data from more than 400 participants can provide the statistical power needed to comprehensively explore mediation and moderation effects (Wang et al., 2022). The sample for this study consisted of 447 datasets, allowing for further processing. The demographic information of the respondents is presented in Table 1 below.

Table 1. Respondents' demographic data

Characteristics	*Frequency (n)*	*Percentage (%)*	*Accumulate (%)*
Gender			
Male	284	63.53	63.53
Female	163	36.47	100.00
Age			
Under 20 years old	48	10.74	10.74
21-30 years old	278	62.19	72.93
31-40 years old	80	17.90	90.83
41-50 years old	32	7.16	97.99
Above 50 years old	9	2.01	100.00
Education level			
Senior high school	291	65.10	65.10
Diploma	70	15.66	80.76
Bachelor	85	19.02	99.78
Magister	1	0.22	100.00
Work experience			
Under 2 years	225	50.34	50.34
2-5 years	129	28.86	79.20
5-10 years	56	12.53	91.73
10-15 years	21	4.70	96.43
15-20 years	7	1.57	98
Over 20 years	9	2.00	100.00
Job level			
Grassroots employee	376	84.12	84.12
Supervisor	41	9.17	93.29
Manager	24	5.37	98.66
Director/GM	6	1.34	100.00
Department			
Front Office	153	34.23	34.23
Housekeeping	74	16.55	50.78
Food and Beverage Service	58	12.98	63.76
Food Product	36	8.05	71.81
HRD	46	10.29	82.10
Sales Marketing	21	4.70	86.80
Finance	19	4.25	91.05
Information Technology	2	0.45	91.50
Engineering	8	1.79	93.29
Recreational and Entertainment	24	5.37	98.66
General Affairs	6	1.34	100.00
Hotel Rating Star			
1-star hotel	59	13.20	13.20
2-star hotel	113	25.28	38.48
3-star hotel	145	32.44	70.92
4-star hotel	91	20.36	91.28

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p3777582472

5-star hotel	39	8.72	100.00
Resident			
Northern Indonesia	84	18.79	18.79
Eastern Indonesia	49	10.96	29.75
Southern Indonesia	272	60.85	90.6
Western Indonesia	42	9.40	100.00

Source: the authors' data processing results

3.2. Measurement Variables

This research examines seven constructs: Theory of Planned Behavior, Green Intention, Green Innovation, CE Practices, Sustainable Business Performance, and Barriers. The TPB construct variable comprises three dimensions: Attitude, Subjective Norms (SN), and Perceived Behavioral Control (PBC) (Kuhl, 1985). The Attitude dimension, comprising five measurement items, was derived from Yeh et al. (2021). The SN and PBC dimensions, each comprising five measurement items, were derived from Nimri et al. (2020). The Green Intention construct variable, comprising five measurement items, was sourced from Nimri et al. (2020) and Yeh et al. (2021). The Green Innovation construct variable, comprising six measurement items, was derived from the works of Khan et al. (2022), Ghisellini et al. (2016), and Gusmerotti et al. (2023). The CE practices construct variable comprises four dimensions: Rethink, Reduce, Regenerate, and Revalue. This framework is derived from the works of Khan et al. (2022), Ghisellini et al. (2016), and Gusmerotti et al. (2023). Specifically, it includes five measurement items for Rethink, four for Reduce, five for Regenerate, and seven for Revalue. The five SBP construct variables, comprising five measurement items, were derived from Khan et al. (2022). The Barriers construct variable, consisting of six measurement items, was derived from Khan et al. (2022).

3.3. Data Analysis

A 7-point Likert scale was employed to evaluate the respondents' responses. The study used the PLS-SEM data analysis method (Ringle et al., 2024). This study employs a hierarchical component model approach, incorporating both higher-order constructs (latent variables) and lower-order constructs (dimensions) (Sarstedt et al., 2019). The outer model was evaluated using a distinct two-stage method. Figure 2 presents the findings of this analysis.

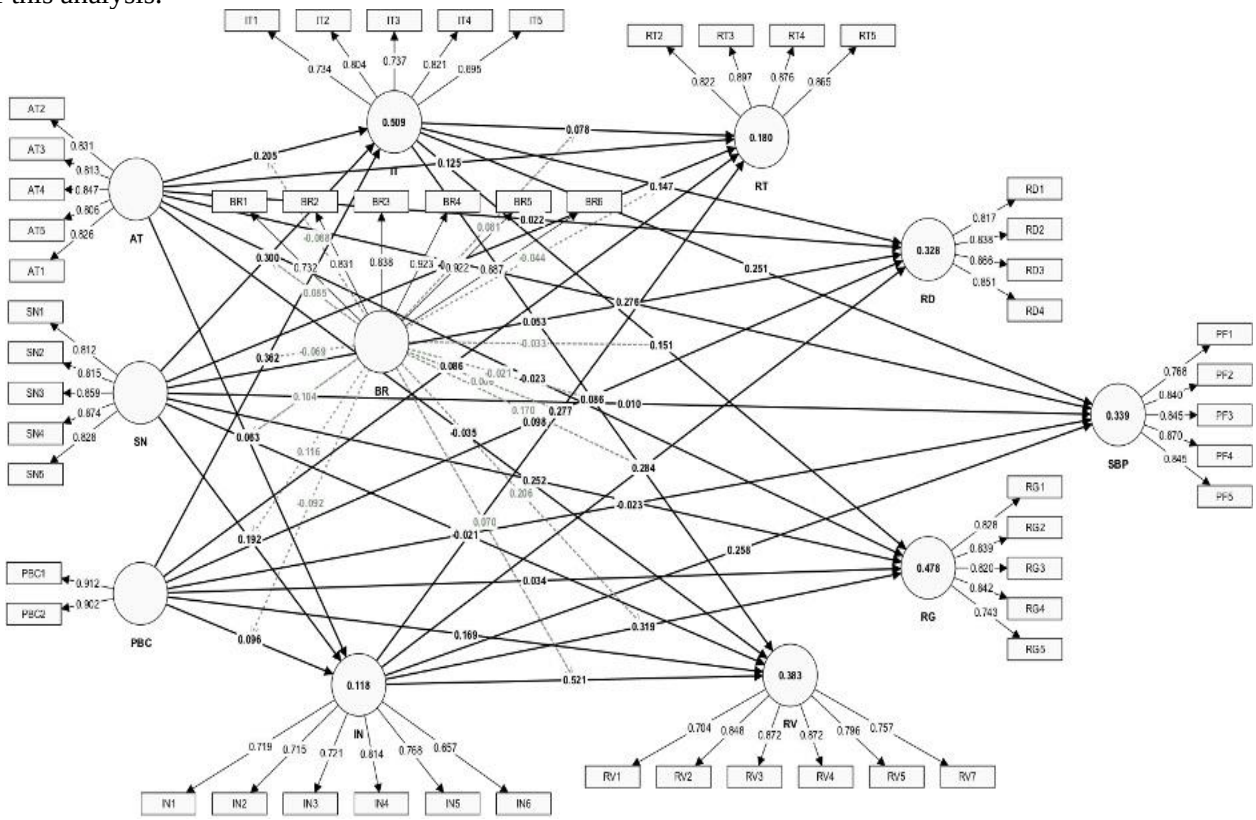


Figure 2. First-stage outer model data processing
Source: the authors

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/p3777582472

Findings indicate that PBC3, PBC4, PBC5, RT1, and RV6 failed to meet the factor loading criterion of 0.708. Consequently, these indicators were removed from the model. Items with low loadings may weaken relationships within the construct, and their removal may improve the construct's overall convergent validity. The remaining indicators met the criteria for further analysis. The Cronbach's alpha score and composite reliability for all variables exceed 0.7, signifying reliable and consistent measurements. The Average Variation Extracted (AVE) value for each construct exceeds 0.5, demonstrating that the construct accounts for more than 50% of the variation of the indicator, thereby confirming convergent validity. Table 2 presents the construct validity.

Table 2. Analysis of the measurement item's construct validity

Indicator	*Measurements Items*	*FL*	*Cronbach's Alpha*	*Composite Reliability*	*AVE*
AT1	Feelings of joy.	0.826	0.883	0.914	0.680
AT2	Feelings of comfort.	0.831			
AT3	Feelings of usefulness.	0.813			
AT4	Feelings of importance.	0.847			
AT5	Feelings of responsibility.	0.806			
SN1	Paying attention to the opinions of others who are respected.	0.812	0.894	0.922	0.702
SN2	Paying attention to the opinions of others who are important.	0.815			
SN3	Taking into account the expectations of others who are important.	0.859			
SN4	Following the actions of important people around.	0.874			
SN5	Following the actions of others who are respected.	0.828			
PBC1	Self-awareness about having self-capability.	0.912	0.784	0.903	0.822
PBC2	Self-confidence to make choices.	0.902			
PBC3	Self-confidence to make decisions.	(*)			
PBC4	Self-doubt in doing the job.	(*)			
PBC5	Self-confidence in doing the job.	(*)			
IT1	Willingness to work in a CE hotel.	0.734	0.816	0.872	0.577
IT2	Willingness to implement CE practices.	0.804			
IT3	Willingness to choose.	0.737			
IT4	Willingness to recommend.	0.821			
IT5	Willingness to provide positive comments.	0.695			
BR1	Lack of financial.	0.732	0.929	0.943	0.736
BR2	Lack of skills.	0.831			
BR3	Lack of knowledge.	0.838			
BR4	Lack of commitment.	0.923			
BR5	Lack of facilities.	0.922			
BR6	Lack of relationships.	0.887			
RT1	Using shared equipment and resources.	(*)	0.889	0.923	0.749
RT2	Think about repairing furniture and reusing it.	0.822			
RT3	Think about repairing electronic products and reusing them.	0.897			
RT4	Think about repairing machines and reusing them.	0.876			
RT5	Think about repairing computers and reusing them.	0.865			
RD1	Saving electricity.	0.817	0.865	0.908	0.711
RD2	Saving water.	0.838			
RD3	Restricting plastic usage.	0.866			
RD4	Reducing food waste.	0.851			
RG1	Branding hotels with environmental sustainability.	0.828	0.873	0.908	0.665
RG2	Providing training on environmental issues to employees.	0.839			
RG3	Providing more funds for environmental sustainability activities.	0.820			
RG4	Simplifying bureaucracy for environmental sustainability activities.	0.842			
RG5	Providing territorial marketing incentives to advance the local economy.	0.743			
RV1	Reuse of waste water.	0.704	0.894	0.920	0.657
RV2	Reuse of furniture waste.	0.848			
RV3	Reuse of paper waste.	0.872			

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RV4	Use of refill soap and shampoo.	0.872			
RV5	Utilization of organic waste for animal feed or compost.	0.796			
RV6	Reuse of leftover food for employee consumption or distribution to those in need.	(*)			
RV7	Recycle waste.	0.757			
IN1	Use of recycled materials.	0.719	0.828	0.875	0.539
IN2	Use of renewable energy (solar, wind, etc.).	0.715			
IN3	Use of energy-efficient products.	0.721			
IN4	Use of waste products.	0.814			
IN5	Use of secondary raw materials and by-products.	0.768			
IN6	Weather-adaptive building design.	0.657			
PF1	Reducing environmental impact.	0.768	0.891	0.920	0.697
PF2	Increasing hotel profits.	0.840			
PF3	Increasing service quality.	0.845			
PF4	Increasing hotel reputation.	0.870			
PF5	Increasing satisfaction and commitment.	0.845			

Source: the authors' data processing results

Additionally, the HTMT ratios were employed to assess discriminant validity. The findings confirmed that the HTMT ratio value of each construct is less than 0.85, indicating that each construct is distinct and exhibits minimal overlap with other variables. Table 3 below provides a detailed evaluation of discriminant validity in the initial stage.

Table 3. First stage discriminant validity – HTMT ratios

	AT	BR	IN	IT	PBC	RD	RG	RT	RV	SBP	SN
AT											
BR	0.196										
IN	0.277	0.107									
IT	0.624	0.114	0.303								
PBC	0.558	0.161	0.273	0.745							
RD	0.347	0.258	0.478	0.422	0.393						
RG	0.407	0.262	0.576	0.508	0.416	0.759					
RT	0.295	0.064	0.407	0.292	0.283	0.298	0.357				
RV	0.231	0.068	0.666	0.341	0.365	0.405	0.386	0.319			
SBP	0.526	0.089	0.450	0.537	0.380	0.375	0.449	0.256	0.412		
SN	0.615	0.074	0.307	0.675	0.562	0.317	0.494	0.236	0.265	0.407	

Source: the authors' data processing results

In the second stage of external model evaluation, we utilized the latent variable scores of the lower-order constructs to assess the higher-order constructs, re-applying dimensionality (Sarstedt et al., 2019). Figure 3 presents the results of the external model evaluation for the second stage.

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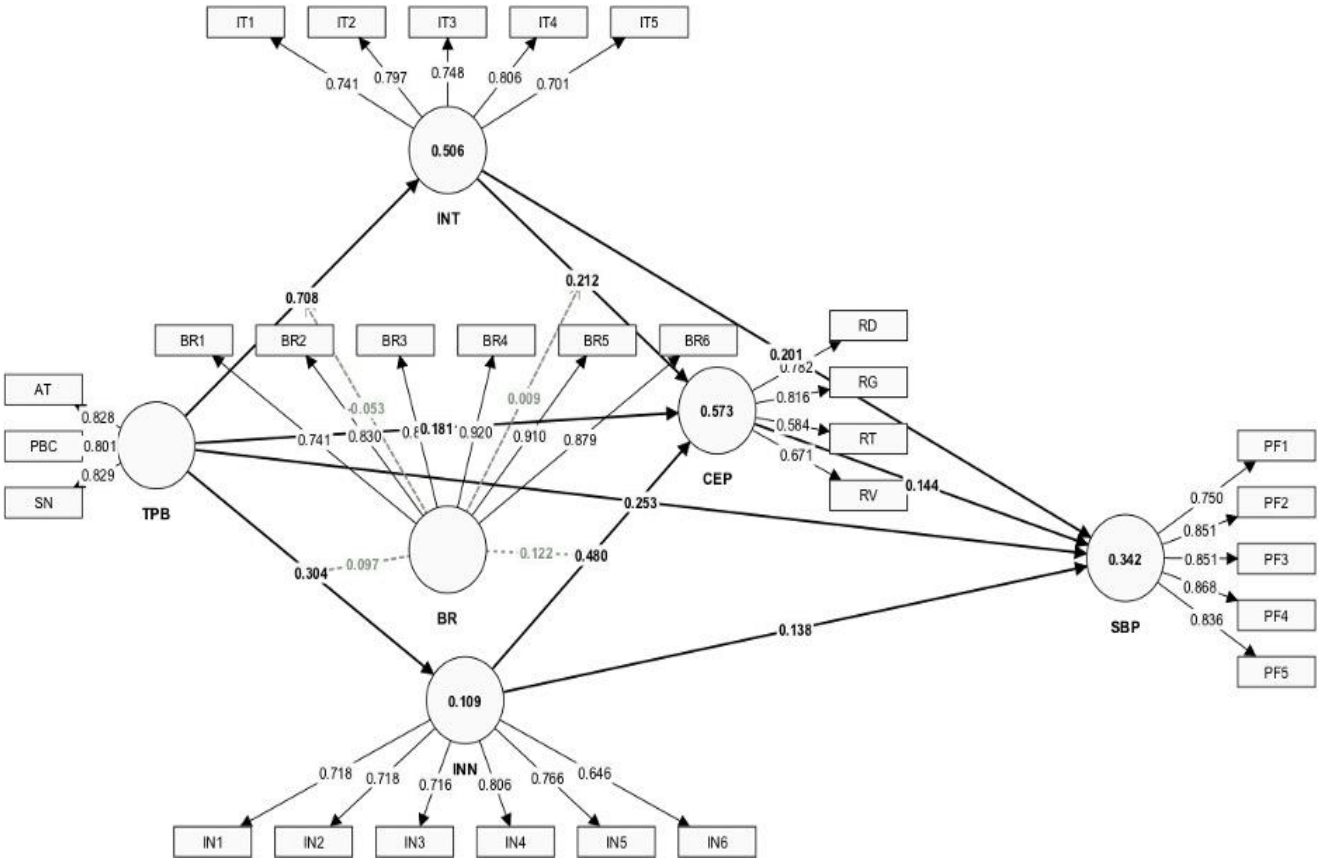


Figure 3. Second-stage outer model data processing

The findings indicate that the CR values for all variables exceed 0.7, meeting the criteria for construct reliability. The AVE value is greater than 0.5, confirming convergent validity. VIF scores below 5 indicate an acceptable level of multicollinearity. Table 4 below provides detailed information for the validity and reliability tests in the second stage.

Table 4. The second stage of factor loading, construct reliability, and convergent validity evaluation

HOC	***LOC***	***FL***	***VIF***	***Cronbach's Alpha***	***Composite Reliability***	***AVE***
TPB	AT	0.828	1.579	0.755	0.860	0.671
	SN	0.829	1.562			
	PBC	0.801	1.442			
CEP	RT	0.584	1.168	0.683	0.808	0.517
	RD	0.782	1.734			
	RG	0.816	1.766			
	RV	0.671	1.179			

Note: TPB=Theory of Planned Behavior; AT=Attitude; SN=Subjective Norms; PBC=Perceived Behavioral Control; CEP= CE Practices; RT=Rethink; RD=Reduce; RG=Regenerate; RV= Revalue; HOC=Higher Order Construct; LOC=Lower Order Construct; FL=Factor Loading; VIF=Variance Inflation Factor; AVE=Average Variance Extracted.

Source: the authors' data processing results

Furthermore, in the second stage, the findings also confirmed that the HTMT ratio value of each construct was less than 0.85, which met the requirements of discriminant validity. The assessment of discriminant validity in the second stage is presented in Table 5.

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Table 5. Second stage discriminant validity – HTMT ratios

	BR	CEP	INN	INT	SBP	TPB
BR						
CEP	0.280					
INN	0.116	0.822				
INT	0.127	0.644	0.301			
SBP	0.112	0.580	0.417	0.571		
TPB	0.178	0.710	0.389	0.839	0.623	

Source: the authors' data processing results

4. Results and Discussion

Next, we assessed the inner model. The bootstrapping method assessed the significance level of the coefficients using statistical estimates derived from 5,000 subsamples (Ringle et al., 2024). Table 6 presents the coefficients, t-values, and significance levels (p-values). The results show that Hypotheses 1 to 5 are all supported.

Table 6. Coefficients, t-values, and significance levels.

Hypothesis		***Path Coefficient***	***T-Value***	***P-Value***	***Result***
H1	TPB → CEP	0.181	3.337	***	Supported
H2	CEP → SBP	0.144	1.791	*	Supported
H3	TPB → SBP	0.253	3.587	***	Supported
H4	INT → SBP	0.201	3.062	***	Supported
H5	INN → SBP	0.138	2.047	*	Supported

Note: ***p<0.001; *p<0.05

Source: the authors' data processing results

Based on the results above, **first**, this study shows that employees' TPB-based behavior positively influences the adoption of CE practices, indicating that CE practices in the workplace are more likely to occur as awareness of sustainable behavior increases. This finding is supported by Mehta and Sharma (2021), who found that attitude increases the likelihood of implementing CE strategies. **Second**, implementing CE practices has a positive impact on SBP. This supports the research of Obeidat et al. (2022), which suggests that CE practices enhance operational efficiency and improve business performance by aligning with sustainable consumer preferences.

Moreover, this study identifies key managerial implications. **First**, the positive relationship between employees' TPB-based behavior and CE practices suggests that accommodation industries should develop a culture that supports sustainable attitudes and subjective norms, prioritizing employee environmental awareness and training. For instance, mandatory scenario-based sustainability training for mid-level managers should highlight the cost-saving benefits of CE. **Second**, the positive impact of CE practices on SBP suggests that implementing CE practices can enhance operational performance, indicating that waste reduction, resource efficiency, and recycling can collectively improve operational efficiency. Practically, this can be further addressed by implementing detailed waste sorting and tracking systems (e.g., using digital records) that mandate the separation of organic waste for on-site composting and partnering with specific local recycling businesses for non-organic materials such as linens and plastics. **Third**, the beneficial effects of employees' TPB-based behavior and SBP support the notion that managerial sustainability preferences have a positive impact on corporate success. Both can improve financial performance and stakeholder satisfaction by aligning their operations with sustainable goals.

Next, we quantified the explanatory power using statistical measures, including the coefficient of determination (R^2), effect size (F^2), and predictive relevance (Q^2), as presented in Table 7 below.

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Table 7. Explanatory and predictive power

Independent	*Dependent*	*F-Square*	*R-Square*	*Q-Square*
TPB	CEP	0.036	0.573	0.215
INT		0.051		
INN		0.472		
TPB	SBP	0.045	0.342	0.534
INT		0.029		
INN		0.017		
CEP		0.015		

Note: TPB=Theory of Planned Behavior; INT=Green Intention; INN=Green Innovation; CEP= CE Practices; SBP=Sustainable Business Performance

Source: the authors' data processing results

The R^2 value of CE practices is 0.573, indicating that TPB, INT, and INN account for 57.3% of the variance in CE practices, with the remaining 42.7% attributable to other variables not included in the model. The R^2 value of SBP is 0.342, indicating that TPB, INT, INN, and CE practices account for 34.2% of the variation in SBP. In comparison, 65.8% is attributed to other variables not considered in the model. Furthermore, the F^2 value reflects the extent of the predictor variable's contribution to the R^2 of the observed variable. The table indicates that the influence of CE practices, as determined by TPB, INT, and INN, yields an F^2 value of 0.036 for TPB, 0.051 for INT, and 0.472 for INN. Removing INN from the model will result in a substantial alteration in CE practices, leading to a significant decrease in the R^2 value of CE practices. In contrast to SBP, the F^2 value for TPB is 0.045, the INT value is 0.029, the INN value is 0.017, and CE practices value is 0.015. Removing any single variable from the model will result in a change in SBP, albeit an insignificant one. Finally, the predictive relevance of the endogenous construct (Q^2) exceeds 0. The results indicate that the Q^2 for CE practices is 0.215, while the Q^2 for SBP is 0.534. Next, this study also examined the mediation effect, as presented in Table 8 below.

Table 8. Mediation analysis result

Hypothesis	*Path*	*Direct Effect*		*Specific Indirect Effect*			*Conclusion*
		β	*t-value*	*Mediation*	*β*	*t-value*	
H6	TPB → CEP	0.181	3.337***	INT	0.150	3.862***	Partial Mediation
H7	TPB → CEP	0.181	3.337***	INN	0.146	5.699***	Partial Mediation
H8a	TPB → SBP	0.253	3.587***	CEP	0.026	1.576	No Mediation
H8b	INT → SBP	0.201	3.062***	CEP	0.030	1.706*	Partial Mediation
H8c	INN → SBP	0.138	2.047*	CEP	0.069	1.710*	Partial Mediation

Note: ***p<0.001; *p<0.05.

Source: the authors' data processing results

Based on the table above, the study's results indicate that all mediation relationships support the hypothesis except Hypothesis 8a. In Hypotheses 6 and 7, the roles of green intention and green innovation as mediators in the relationship between employees' TPB-based behavior and CE practices further underscore the importance of a sustainability culture. This supports the statement of Šimelytė et al. (2023) that green intention as a component related to TPB is essential for implementing sustainable practices. Furthermore, Arsawan et al. (2020) found that green innovation enhances organizational sustainability, particularly when adopting new technologies and practices. Moreover, for managerial suggestions, employees' TPB-based behavior influences CE practices through Green Intentions. Therefore, accommodation companies should foster strong green intentions among employees and management. One recommendation is to establish an internal "Green Champion" network, where successful CE initiators share their results and testimonials, thereby directly fostering positive attitudes and subjective norms among peers. Furthermore, the positive mediation of Green Innovation from employees' TPB-based behavior to CE practices suggests that encouraging green innovation can enhance sustainable behavior through creativity.

The result of Hypothesis 8a indicates that there is no mediation between employees' TPB-based behavior and SBP through CE practices, with the value of $\beta = 0.026$, $p > 0.05$. This unexpected finding may be attributed to the complexity and multifaceted nature of CE practices. While CE practices aim to enhance sustainability, their direct impact on business performance may be limited by factors such as differing stages of adoption among hotels, resource constraints, and institutional context. Research indicates that hotels at various stages of implementing CE practices exhibit varying levels of commitment and engagement with sustainability practices,

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which subsequently impact their business performance outcomes (Hernández et al., 2021). This variability may lead to inconsistent relationships with the SBP across sectors, as early-stage organizations may not have fully integrated CE practices into their operational frameworks, resulting in a misalignment with the sustainable practices necessary for effective mediation (Athamneh & Al-Ajlouni, 2024). Moreover, limited financial, human, and technological resources often prevent some hotels from adopting comprehensive CE practices, potentially hindering their performance and contradicting the positive behavioral intentions proposed by the TPB (Athamneh & Al-Ajlouni, 2024). Kurki & Lähdesmäki (2022) state that a culture that fosters sustainability will increase employee engagement and commitment to sustainable outcomes, strengthening behavioral intentions aligned with the TPB framework. Conversely, a gap between management and staff regarding sustainability goals can hinder the effectiveness of CE practices as a mediating factor, suggesting that employee perceptions and cultural acceptance are crucial. Furthermore, these challenges are exacerbated in environments characterized by regulatory and institutional constraints, which can vary significantly across different locations (Jellema et al., 2022). These barriers can suppress the mediating role of CE practices, meaning that even strong intentions (TPB) may not effectively translate into observable practices (CE practices) that lead to long-term SBP. Next, for managerial suggestions, the finding that CE practices do not mediate the relationship between employees' TPB-based behavior and SBP suggests that while the adoption of CE practices is beneficial, it is not the sole determinant of sustainability performance. Managers should also consider operational efficiency, customer engagement, and sustainable performance technologies.

Finally, this study also examines the moderating effect of the Barriers variable on the relationships between employees' TPB-based behavior and Green Intention, employees' TPB-based behavior and Green Innovation, Green Innovation and CE practices, and Green Intention and CE practices, as presented in Table 9 below.

Table 9. Moderation analysis

Hypothesis	***Path***	***β***	***t-value***	***p-value***	***Conclusion***
H9a	(TPBxBR) → INT	-0.053	1.730	*	Supported
H9b	(TPBxBR) → INN	0.097	2.001	*	Supported
H9c	(INNxBR) → CEP	0.122	3.868	***	Supported
H9d	(INTxBR) → CEP	0.009	0.201	>0.05	Not supported

Note: ***p<0.001; *p<0.05.

Source: the authors' data processing results

The table above reveals that hypotheses 9a, 9b, and 9c are accepted. An unexpected finding indicates that Barriers strengthen the relationship between Green Intention and CE practices, with a value of β= 0.009. Still, Barriers are not a moderating variable for that relationship because the p-value>0.05; therefore, this finding does not support hypothesis H9d. Moreover, the slope analysis is presented to enhance understanding of the nature of the moderation effect (Fig. 4, Fig. 5, Fig. 6, and Fig. 7). Figure 4 illustrates that the line exhibits increased steepness at elevated barrier levels. This suggests that at elevated levels of Barriers, the relationship between employees' TPB-based behavior and Green Intention is further diminished. Next, in Figure 5, the slope increases for elevated barriers. This suggests that the influence enhances the association between employees' TPB-based behavior and Green Innovation at elevated levels of barriers. In Figure 6, the line exhibits an increased steepness at elevated Barrier levels. This suggests that at elevated levels of Barriers, the influence enhances the connection between Green Innovation and CE practices. Conversely, Figure 7 illustrates that the line remains approximately linear for low and high barriers. While barriers may enhance the relationship between Green Intention and CE practices, the figure indicates that barriers do not serve as moderators for this relationship.

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http://doi.org/10.9770/p3777582472

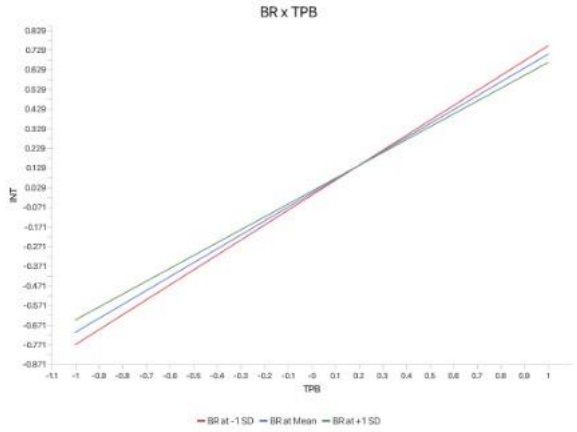


Figure 4. Slope analysis for hypothesis H9a

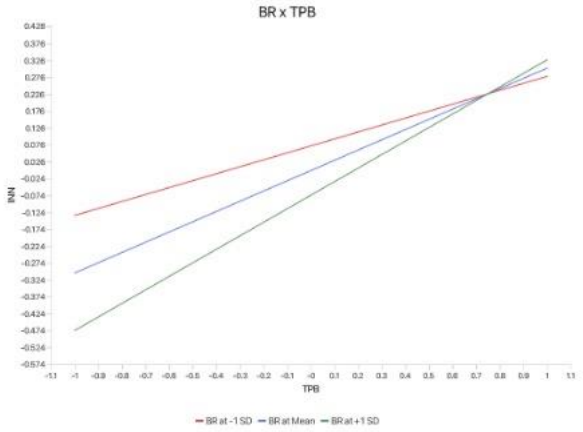


Figure 5. Slope analysis for hypothesis H9b

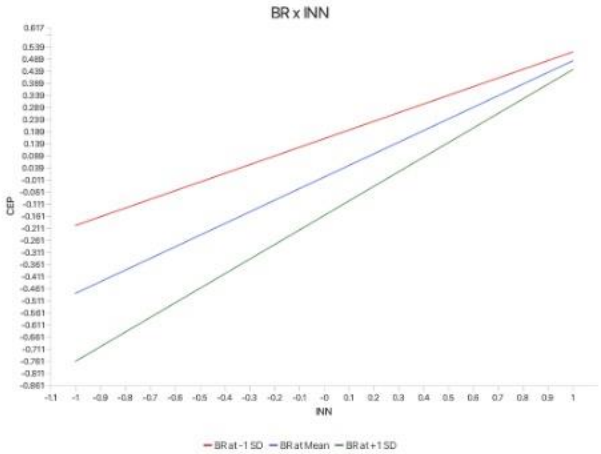


Figure 6. Slope analysis for hypothesis H9c

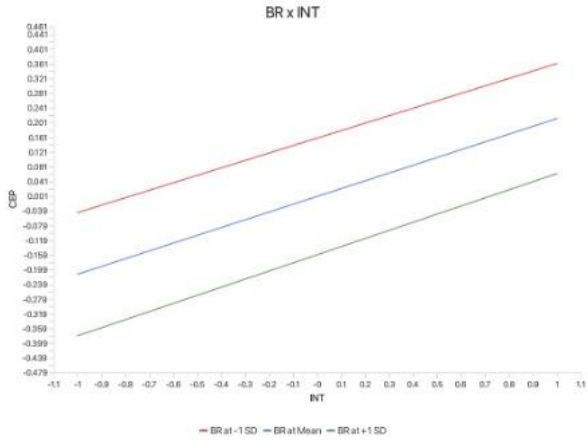


Figure 7. Slope analysis for hypothesis H9d

Based on the results above, **first**, organizational opposition, lack of resources, and inadequate knowledge may hinder the development of positive attitudes and PBC into intentions, thereby reducing the link between employees' TPB-based behavior and green intentions. According to Labella-Fernández et al. (2021), management and operational barriers can hinder the proactive environmental efforts and sustainable practices of TPB. **Second**, the positive moderation of obstacles in employees' TPB-based behavior & Green Innovation connection implies that barriers may initially seem harmful, but they can also spur inventive solutions when businesses attempt to overcome them. Torugsa and O'Donohue (2019) found that proactive problem-solving can enhance creativity and innovation despite barriers. **Third**, the positive moderation of Barriers to Green Innovation and CE practices suggests that overcoming barriers can enhance creative efforts to promote sustainable practices. Alshallaqi et al. (2022) found that agencies that aggressively remove innovation barriers are more likely to succeed with CE practices.

For managerial recommendations, this study **first** suggests that the moderation of negative Barriers to employees' TPB-based behavior and green intentions indicates that limitations, including limited resources, knowledge gaps, and inadequate organizational support, can hinder the intention to engage in sustainable practices. Therefore, managers need to develop targeted training, allocate resources effectively, strengthen leadership support, and establish cross-functional teams to increase employee engagement, creativity, and collaboration in the implementation of CE practices, which in turn will help overcome perceived barriers. **Second**, the moderation of positive Barriers to employees' TPB-based behavior and Green Innovation suggests that, although challenging, obstacles can serve as a catalyst for innovation. In practice, managers can adopt energy-efficient technologies or waste reduction strategies. CE challenges encourage creative problem-solving and sustainable hospitality practices. **Third**, the relationship between Green Innovation and CE practices is positively moderated by Barriers, supporting the premise that barriers can stimulate circular innovation. In

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practice, managers are advised to encourage creativity and establish hotel innovation labs or cross-functional teams to implement CE strategies.

Finally, an unexpected finding suggests that barriers enhance the relationship between green intention and CE practices but do not act as moderators. This can be understood through the work of Labella-Fernández et al. (2021), who suggest that individuals or organizations with strong green intentions are more likely to adopt sustainable practices, regardless of existing barriers. This may occur when the relationship between green intention and the implementation of CE practices is strong and direct. Additionally, barriers themselves can serve to motivate organizations to adopt. Nguyễn et al. (2025) stated that in contexts where firms perceive significant barriers, they may feel a greater urgency to adopt sustainable practices to meet compliance standards and excel in sustainability performance. Therefore, even in the presence of barriers such as financial limitations, regulatory challenges, or technological constraints, organizations with a firm commitment to sustainability are more likely to pursue CE practices initiatives. From a managerial perspective, it is recommended that managers and organizations prioritize cultivating strong employee green intentions in CE practices-related activities. At the organizational level, companies can demonstrate their commitment to sustainability by implementing motivational initiatives, such as annual or periodic green awards that recognize the most sustainable departments or individuals. This publicly celebrates success, transforming the desired behavior into an expected organizational norm.

5. Conclusions

This study found a complex relationship between employees' TPB-based behavior, green intention, green innovation, CE practices, and SBP in the accommodation industry. The effects of mediation on the relationship between employees' TPB-based behavior, CE practices, and SBP suggest that green intention and green innovation are critical to these dynamics. Green intention and green innovation promote the adoption of CE in the hotel industry. The unexpected lack of CE practices mediation shows that contextual factors could influence this association. The results underscore the need for a holistic approach that considers both internal organizational dynamics and external environmental factors to sustain the hospitality industry. In addition, various barriers moderate the interaction between employees' TPB-based behavior, green intention, green innovation, and CE practices. While barriers can negatively impact green intentions to engage in sustainable practices, they can also foster green innovation as organizations attempt to overcome these challenges. The unexpected result, where barriers did not moderate the relationship between green intention and CE practices, suggests that strong green intentions can mitigate the impact of barriers. This underscores the importance of fostering a strong commitment to sustainability within organizations, as it can empower them to overcome barriers and successfully implement CE practices. These findings underscore the sustainable journey of the hospitality industry, highlighting the need to identify goals, address barriers, and adopt innovative practices.

This study acknowledges several limitations that need to be considered and can be addressed in future research. **First**, this study examines the role of employees' TPB-based behavior on CE practices and their relationship to SBP within the context of various hotel categories, which may influence the adoption of CE practices and hotel SBP due to varying levels of commitment and engagement with sustainability practices. Further research could segment specific hotel categories to strengthen the findings related to employees' TPB-based behavior. **Second**, this study examines the accommodation industry model. Further research could expand the scope to include additional industry or organizational types, thereby highlighting the complexity of CE practices, enhancing the findings, or generating new concepts. **Third**, this study was conducted in the Indonesian context, which is characterized by a rich cultural and traditional background, as well as unique regulatory factors that may influence the results. For instance, the culture of communal cooperation in Indonesia, which can enhance subjective norms toward sustainability on the one hand, can also conflict with business profit motives. Furthermore, the current state of decentralized and often inconsistent environmental regulations related to waste management and CE initiatives in Indonesia may influence managers' perceived behavioral control, potentially explaining some of the nuances in our employees' TPB-based behavior results. Future research should address these contextual limitations to increase the generalizability of our findings. Conducting additional studies in other countries or engaging in cross-country comparative analysis could further validate

and expand the applicability of the results. **Finally**, this quantitative investigation presents statistical data. Further research could complement this study with a mixed-methods approach to obtain more in-depth results.

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Data Availability Statement: Additional information and data can be obtained from the authors upon reasonable request.

Author Contributions: Conceptualization: *R.P.M., L.L.*; methodology: *R.P.M., D.A.P., L.L.*; data analysis: *R.P.M., D.A.P.*, writing—original draft preparation: *R.P.M., D.A.P.*, writing; review and editing: *D.A.P., L.L.*; visualization: *R.P.M., D.A.P*. All authors have read and agreed to the published version of the manuscript.

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n4436887898

Publisher
http://jssidoi.org/esc/home

UTILIZING MULTIGENERATIONAL POTENTIAL IN ORGANIZATIONAL TALENT MANAGEMENT*

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Received 18 January 2026; accepted 26 March 2026; published 30 June 2026

Abstract. The current work environment is characterized by the coexistence of several generations, from Baby Boomers to Generation Z, which differ in their values, work preferences, and expectations of employers. This generational diversity creates complex dynamics that can present both challenges and strategic opportunities for human resource management, particularly in the area of talent management. Effective integration of multigenerational potential into HR processes can significantly contribute to increasing an organization's innovation capacity, improving team performance, and strengthening employee engagement. The aim of this article is to propose the direction of talent programs in organizations based on the research conducted and to define key talent competencies for talent programs. The research was conducted in selected Czech organizations (n = 100). The results confirm that the organizations surveyed perceive talent management as a strategic tool for securing knowledge capital and innovation. By seeking out talent, organizations reflect the need to adapt to changing market conditions and demographic changes. By identifying key competencies for organizations, it is possible to more effectively develop and retain talented employees regardless of their age.

Keywords: age diversity; key competencies; intergenerational cooperation; innovation; research; Czech Republic

Reference to this paper should be made as follows: Hudáková, M., Cibák, Ľ., Lelovský, M., Nebeský, Ľ. 2026. Utilizing multigenerational potential in organizational talent management. *Entrepreneurship and Sustainability Issues*, 13(4), 202-214. http://doi.org/10.9770/n4436887898

JEL Classifications: J24, M12, M54, J11, M14

1. Introduction and literature review

In today's dynamic environment, organizations face challenges associated with rapid technological progress, globalization, and changing demographic structures of the workforce (Mugunzva & Manchidi, 2024; Pandey & Singh, 2026). Talent management is becoming a key tool for ensuring the competitiveness and sustainable growth of organizations. However, given the growing age diversity, it is increasingly important to focus on leveraging the multigenerational potential that offers organizations a unique combination of experience, knowledge, new approaches, and adaptability (Piwowar-Sulej, 2024; Urbancová et al., 2025; Čirčová et al.,

* ***Funding:*** *This article is supported by the international project No. 4/2023-M, "The meaning and application of social responsibility in selected companies." Project duration: 2023–2027. The international project is funded by the Internal Grant Agency of the Bratislava University of Economics and Management. The data used in this article were obtained within the framework of the grant project of Czech University of Life Sciences Prague (CIGA No. 20141002) entitled "Building the Employer Brand Using New Strategic Trends in Organizations in the Czech Republic.*

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/n4436887898

2025). Each generation brings specific strengths. While older employees have deep expertise, high loyalty, and the ability to handle complex situations, the younger generation offers technological proficiency, creativity, and openness to innovation (Hans et al., 2023; Ma & Fang, 2024; Mas-Manchón et al., 2024; Nyusani & Mabungela, 2025; Mabungela et al., 2025; Shafiee & Goodarzi, 2026). Effective talent management in organizations should therefore be inclusive and flexible in order to identify, develop, and retain talent across the entire age spectrum. The key is to create development programs that take into account the different motivations, needs, and expectations of each generation.

Current research shows that age-diverse teams can bring higher levels of innovation and productivity to organizations if managed correctly (Collinson, Hodin, 2023; Napathorn, 2025; Urbancová, 2025; Chapman et al., 2025).

Effective talent management should therefore take into account the specific needs and motivations of each generation. For example, Generation Z prefers digital communication and flexibility, while Baby Boomers emphasize stability and personal contact. Organizations that adapt their talent management strategies to reflect these differences can achieve higher levels of employee engagement and satisfaction (Wang & Duan, 2025; Lassleben & Hofmann, 2023).

Although generational diversity brings many benefits, it can also lead to misunderstandings and conflicts. Chiwisa, Mpundu (2023), Rosen (2021) state that differences in values and work styles can cause tension in teams, which negatively affects teamwork. However, proper leadership and open communication can minimize these conflicts and leverage diversity as a competitive advantage (Vnoučková et al., 2018; Zellman et al., 2025).

When leveraging multigenerational potential in talent management within organizations, it is necessary to pay attention to generational differences and psychological contracts. Research shows that different generations perceive talent management differently. For example, Baby Boomers emphasize stability and loyalty, while Generation X and Millennials prefer opportunities for development and career growth. The study found that perceived talent management practices positively influence the fulfillment of the psychological contract, with the strength of this relationship varying across generations. Different generations also prefer different communication channels. For example, Baby Boomers prefer face-to-face meetings, while Generation Z prefers digital communication. These differences can lead to misunderstandings if not managed properly (Hovořáková & Pauknerová, 2024). This needs to be taken into account when creating talent pools for organizations, which are a strategic tool of modern human resource management, with the aim of identifying, developing, and retaining key employees with high potential for the future needs of the organization (Padney, Singh, 2026; Zellman et al., 2025; Griep et al., 2025). In the context of demographic changes and the lengthening of working life, it is increasingly important to approach talent management in an age-inclusive manner that reflects the potential of all generations of employees.

An age-balanced talent pool allows organizations to leverage the unique strengths of different generations, from the stability, experience, and deep expertise of older employees to the technological savvy, innovative thinking, and flexibility of younger colleagues. This approach not only eliminates the risk of age discrimination, but also strengthens organizational adaptability, intergenerational collaboration, and knowledge transfer.

Effective talent pool creation should therefore be based on objective selection criteria such as performance, work ethic, teamwork skills, willingness to learn, and potential for growth, rather than age. An important part of this is also an individual development plan that respects the needs of individuals at different stages of their careers and lives.

Organizations that consciously include employees of all age groups in their talent pools thus become more resilient, innovative, and better prepared to face the challenges of today's labor market. From a talent management perspective, inclusive talent management that takes into account the needs of all generations is therefore key to maintaining employee engagement. Organizations that implement programs such as reverse mentoring or flexible working conditions report higher satisfaction and productivity across generations (Urbancová et al., 2024; Upadhyay & Singh, 2024).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/n4436887898

Current research confirms that talent management based on age-neutral criteria such as professional skills, work ethic, ability to collaborate, and performance enables effective employee engagement across all age groups, especially when combined with appropriate leadership (Pauknerová et al., 2024). A significant trend is the shift from an age-oriented approach to the concept of multigenerational equality, which emphasizes the shared potential of all generations for growth and innovation.

Talent management is expected to become more closely linked in the coming years with the concepts of age management, sustainable HR, and strategic personnel work, which is based on mutual respect between generations and targeted skills development regardless of age. It will be key to support intergenerational learning (e.g., mentoring between younger and older employees), create adaptable development programs, and develop leadership that is sensitive to differences in life stages. In this way, organizations can become not only attractive employers for a wide range of talent, but also more resilient to demographic challenges and changes in the labor market.

The aim of this article is, therefore, to propose, based on the research conducted, the direction of talent programs in organizations and to define the key competencies of talent for talent programs.

2. Research objective and methodology

The objective of the research was to examine how organizations in the Czech Republic utilize multigenerational potential in talent management and whether selected organizational characteristics are associated with the use of specific talent management practices, particularly the use of a talent pool. Primary data was collected using a questionnaire-based data collection technique, the CAWI (Computer-Assisted Web Interviewing) method. The questionnaire was administered in selected organizations in the Czech Republic across all economic sectors and was distributed online via the Survio platform. Within each organization, only one representative was contacted, namely the director/manager of human resources or human resources specialist. Respondents were informed about the anonymity and purpose of the research at the beginning of the questionnaire. This approach was chosen because HR professionals are assumed to possess the most relevant information on organizational talent management policies and practices.

The sample consisted of 100 organization (n=100). The structure of the organizations that participated in the research was as follows:

- by economic sector: 1% from the primary sector, 26% from the secondary sector, 73% from the tertiary sector,
- by size of organization according to number of employees: 31% from small, 28% from medium, 41% from large organizations,
- by ownership of the organization: 79% Czech organizations, 4% Czech with foreign owners, 17% multinational organizations.

A non-probability purposive sampling strategy was applied, as the study intentionally targeted respondents responsible for or familiar with talent management processes. Although the sample is not statistically representative of all organizations in the Czech Republic, it provides relevant exploratory evidence across organizations of different sizes, sectors, and ownership structures.

The questionnaire survey was conducted with the aim of obtaining information about respondents' opinions and experiences in the area of utilizing multigenerational potential in talent management. The questionnaire contained a combination of closed and semi-closed questions. The instrument was structured into thematic sections covering organizational characteristics and selected talent management practices related to the management of employees from different generations. Some items were measured using a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree.

Before the main data collection, the questionnaire was reviewed with regard to content clarity and item relevance in order to ensure that the wording was understandable and aligned with the research objective. For the purposes of hypothesis testing, the key variable “use of a talent pool” was operationalized as a categorical variable based

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/n4436887898

on respondents' answers indicating whether this practice was used in the organization. Organization size and ownership structure were treated as grouping variables.

The data was exported to MS Excel and then analyzed using basic descriptive statistics. The analysis first focused on a basic description of the sample and the frequency distribution of responses. In the next step, dependence between selected categorical variables was tested. The following hypotheses were established:

- $H_0 1$: There is no difference between the size of the organization and the use of the talent pool.
- $H_0 2$: There is no difference between the type of ownership share of the organization and the use of a talent pool.

To test the hypotheses, the chi-square test of independence was used. This test was selected because both the dependent and independent variables were categorical in nature. Prior to the analysis, the data were checked to confirm that the assumptions for applying the chi-square test were met. The hypotheses were tested at the significance level of $\alpha = 0.05$. Where relevant, the interpretation focused not only on statistical significance but also on the substantive meaning of the identified relationships in the context of talent management and multigenerational workforce management.

The methodological limitations of the study should also be acknowledged. The study is based on self-reported data from a single respondent per organization, which may introduce subjective bias. In addition, the use of purposive sampling and the sample size do not allow broad generalization of the findings to the entire population of organizations in the Czech Republic. Nevertheless, the study provides useful empirical insight into current organizational practice and offers a basis for further, more extensive research.

3. Results and discussion

The main reasons why organizations implement talent management are primarily to increase knowledge (31.19%) and to search for key employees (30.28%). The need for constant innovation also plays a significant role (22.02%). On the other hand, flexibility limitations are not mentioned as a reason at all (0%). Less frequently cited reasons include a lack of the right skills and a declining workforce flexibility, both with the same share (8.26%). The results are shown in Figure 1.

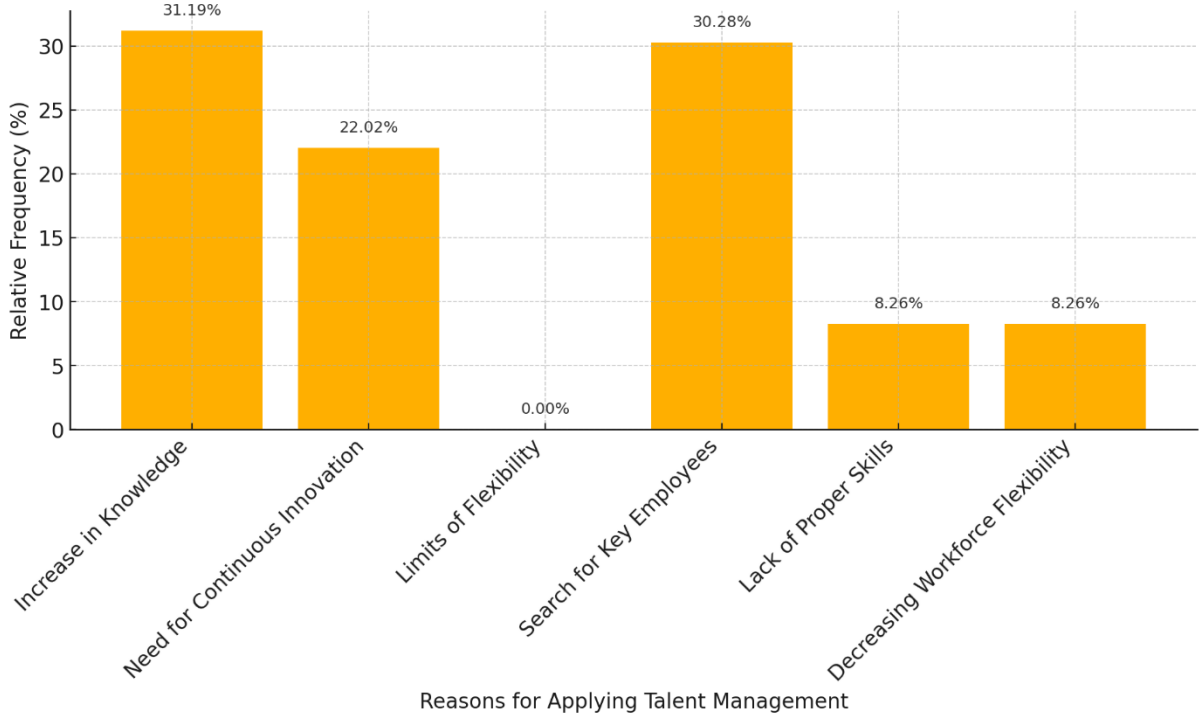


Figure 1. Reasons for Applying Talent Management in Organisations
Source: Own elaborate

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Organizations perceive the need for continuous knowledge enhancement as a key factor in improving organizational performance. Talent management in these organizations should therefore focus more on the development of professional competencies, lifelong learning, and internal training. Organizational leaders will decide whether to systematically invest in training programs and create a culture of learning. Innovation is also essential for organizations to remain competitive.

Talent management should focus on supporting creative thinking and recruiting employees with high innovation potential. In the future, we can expect to see a growth in the importance of programs to support innovation within organizational culture. Flexibility as a reason for applying talent management did not apply within the organizations surveyed. These organizations do not currently address flexibility primarily through talent management, which may mean that this area is underestimated. In the future, however, it can be expected that with the development of hybrid work and various forms of employment, flexibility will gain importance in talent management as well.

On the other hand, acquiring strategic employees is crucial for organizations. Talent management must focus on effectively identifying, recruiting, and retaining key talent. In the future, it will be necessary to further develop talent pooling programs and personalized career paths. A lack of specific skills can be a problem, but it is less common.

It can be concluded that organizations will have to analyze skill gaps and fill them in a targeted manner through training and development. The emphasis on reskilling and upskilling will play an increasingly important role for organizations. The problem of declining employee adaptability is also partially recognized. Organizations will need to promote openness to change and adaptability among their employees. Talent management should therefore work more with the concept of agility (the ability to respond quickly to change) and the development of soft skills.

It is also important to identify the driving forces of talent management in organizations, which are factors that motivate organizations to implement and develop systematic approaches to talent management. These forces reflect both the internal needs of organizations and external environmental pressures. The main driving forces identified are shown in Figure 2.

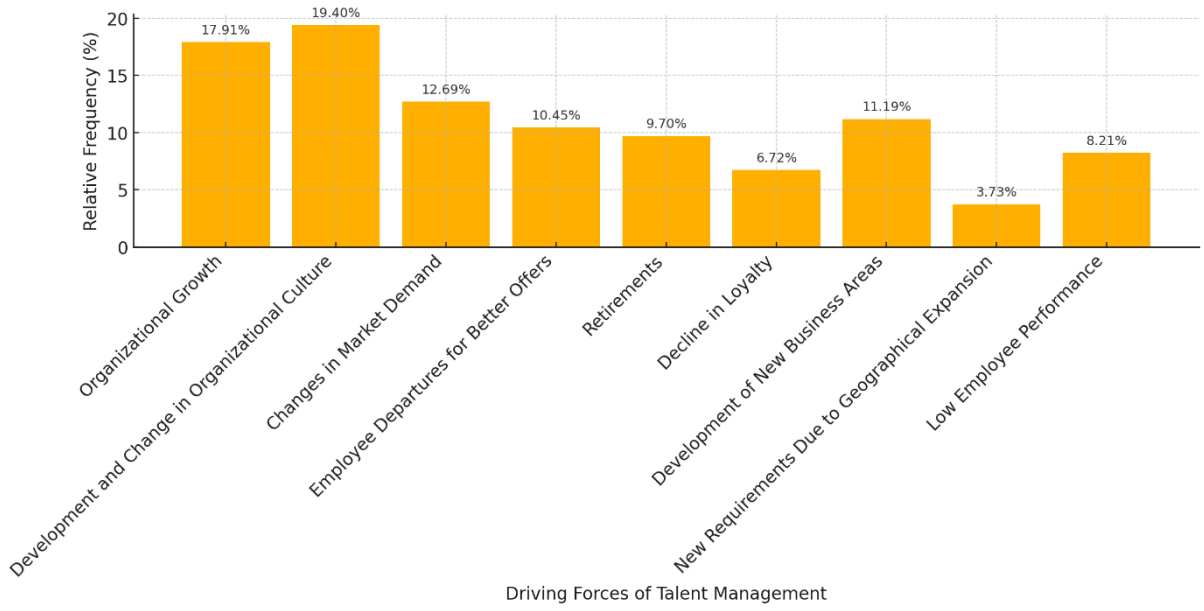


Figure 2. Driving Forces of Talent Management in Organisations
Source: Own elaborate

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/n4436887898

The most frequently mentioned driving force behind talent management is the development and change of organizational culture, which was mentioned in 19.40% of cases. Organizations are increasingly aware that a culture that supports development, innovation, and open communication is essential for successful talent management. Talent management will therefore be more closely linked to the values and internal standards of the organization in the future. There is expected to be a growing emphasis on building a strong organizational identity and strengthening employee engagement.

Organizational growth, mentioned in 17.91% of cases, naturally increases the need for a comprehensive approach to human resource management. Expansion brings with it higher demands for structured recruitment, development, and retention of employees. Organizations are therefore moving towards building robust strategies for talent planning and creating so-called talent reserves to ensure stability during further growth.

The need to adapt to changes in market demand is being addressed by 12.69% of organizations, which points to the need for greater flexibility in employee skills. Talent management will focus more on agility and the ability to quickly retrain in order to respond flexibly to new market needs.

Developing new business areas as a driving force, cited in 11.19% of cases, requires identifying and developing employees capable of functioning in a dynamic and often unfamiliar environment. Talent management will therefore focus more on so-called "future-ready" competencies, cross-functional collaboration, and adaptability to new challenges.

Employee departures due to more attractive offers represent a challenge for 10.45% of organizations. They face pressure to retain key talent, which requires enhancing the attractiveness of the work environment, internal mobility, and individual career planning. At the same time, the importance of positive employee experience and quality communication will grow.

The aging workforce and retirements, mentioned in 9.70% of cases, create a need for succession planning and effective knowledge transfer. Organizations will more often implement age management tools and mentoring programs to support intergenerational cooperation and the preservation of know-how.

Low employee performance, cited as a driving force in 8.21% of cases, requires targeted identification of weaknesses and support for individual development. There will be an increased emphasis on personalized training, regular performance reviews, and systematic motivation enhancement.

Declining loyalty, cited by 6.72% of organizations, points to the need to strengthen the bond between employees and the organization. This can be achieved through value alignment, meaningful work, and leadership development that promotes engagement and intrinsic motivation.

New requirements associated with geographic expansion, reported by 3.73% of organizations, emphasize the need to adapt talent management to cultural and local specifics. The importance of diversity, intercultural skills, and the ability to manage teams in a global context is growing.

This is related to the correct definition of talent, which is a key prerequisite for effective and fair talent management for organizations. Given that the labor market is characterized by growing demographic diversity and longer working lives across generations, it is essential for organizations to abandon simplistic notions of talent as exclusively young, dynamic, and rapidly advancing individuals. Instead, they should be based on a comprehensive concept of talent that emphasizes competencies, potential for development, work ethic, performance, willingness to learn, and ability to collaborate—attributes that can be achieved in all age categories.

If organizations define talent narrowly or unknowingly in a discriminatory manner, for example based solely on age, they risk not only violating the principles of equality and diversity, but above all losing a significant amount of valuable human capital. Older employees often have deep expertise, experience, stability, and the

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/n4436887898

ability to handle complex work situations. If they are not allowed to participate in talent programs, organizations lose the opportunity to leverage their full potential and transfer their know-how to younger generations.

Conversely, a definition of talent that is based on a competency framework and is age-neutral promotes an inclusive environment that motivates all employees to actively participate and develop over the long term. This approach not only contributes to fairness, but also increases employee engagement, improves intergenerational learning, and enhances organizational resilience.

As a result, it can be said that a properly formulated and inclusive definition of talent becomes not only an ethical but also a strategic priority that enables organizations to fully leverage multigenerational potential and successfully face the challenges of today's work environment. The identified key competencies of talent are shown in Figure 3.



Figure 3. Competencies of Key Talents in Organisations
Source: Own elaborate

Data analysis shows that organizations most often identify key talents based on specific competencies that are considered essential for their future development and contribution. The most frequently mentioned competencies include professional qualifications and skills (52.5%), overall performance (43.6%), work ethic (42.6%), communication and teamwork (31.7%), and flexibility and reliability (both 29.7%). These characteristics provide a stable basis for talent selection regardless of employee age, as professional skills and performance reflect not only long-term potential but also current work commitment. At the same time, competencies such as work ethic, teamwork, and flexibility support the ability to adapt to changing conditions across generations.

These findings have important implications for working with an age-diverse workforce. First and foremost, it is clear that effective talent identification should be based on a so-called ageless approach, which focuses on

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/n4436887898

the quality of an individual's contribution rather than their age. Key competencies can be achieved across all age categories if organizations create the right conditions for their development.

At the same time, it is advisable to systematically promote intergenerational cooperation. It appears that flexibility, willingness to learn (20.8%) and innovativeness (19.8%) are not exclusively the domain of the younger generation, but also have their place among more experienced employees. The targeted development of these competencies, regardless of the age of employees, promotes mutual learning, knowledge transfer, and team adaptability.

In the long term, it is also crucial to build a sustainable talent pipeline that is not solely dependent on short-term performance but is based on a combination of soft skills and professional qualifications. This approach allows for the involvement of both young talents with growth potential and experienced professionals who bring stability, professional maturity, and a strong ethical framework. Ultimately, an inclusive and competency-based approach to talent identification contributes not only to greater balance within teams, but also to the overall resilience and performance of the organization.

Two hypotheses were established to verify the influence of selected organizational characteristics on the use of talent pools. The first examined the relationship between the size of the organization and the use of talent pools, while the second focused on the connection between the type of ownership and this practice (see Methodology). The results showed that neither the size of the organization ($p = 1.000$) nor the type of ownership ($p = 0.731$) has a statistically significant impact on whether organizations use talent pools. In both cases, the null hypothesis was accepted, which means that the creation and management of talent pools does not depend on the size or ownership structure of the organization.

These findings lead to an important conclusion: talent management strategies and systematic talent identification can and should be implemented across all types and sizes of organizations. This opens up opportunities for equal access to talent development, regardless of organizational background. At the same time, these findings are linked to the importance of creating talent pools that reflect potential across age categories. Given that the main identification criteria (e.g., expertise, work ethic, performance, and teamwork) are not age-related, it is crucial that organizations do not limit talent programs to younger employees. All employees, regardless of age, can be carriers of valuable competencies, and therefore talent management should be seen as a tool for intergenerational development and long-term sustainability of human resources.

The results of the study are consistent with current international research, which emphasizes the importance of strategic talent management for maintaining the competitiveness of organizations. The presented research identified the main reasons for implementing talent management as increasing knowledge (31.19%), searching for key employees (30.28%), and supporting innovation (22.02%). These findings correspond with the results of the study by Alsakarneh et al. (2023), which showed that talent management practices such as recruitment, training, and compensation significantly affect employee retention and performance. Furthermore, the study by Shan and Wang (2024) emphasizes that in the era of the knowledge economy, strategic talent development is key to innovation and organizational adaptability. The authors point to the need to align talent initiatives with the dynamic demands of the global business environment, which is confirmed by research by Vnoučková et al. (2018); Collinson and Hodin (2023), Urbancová et al. (2024).

The results of this study provide a new perspective on age inclusion in talent management. While many studies focus on younger generations, Czech research emphasizes the importance of competencies such as professional skills, work ethic, and teamwork, which are achievable across all age groups. This approach promotes intergenerational cooperation and the utilization of employees' full potential regardless of age. A comparison with these studies confirms that the research expands existing knowledge by emphasizing the importance of an inclusive approach to talent management across age categories. While some studies focus on specific sectors or geographic areas, the Czech research provides an important perspective on the need for intergenerational cooperation and equal access to talent development.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n4436887898

Given demographic changes and the aging population across the European Union, talent management is a pressing issue not only in the Czech Republic but also in the broader European context. Future research in the EU context should focus on:

- Comparative studies across European countries to identify specific characteristics and common challenges in talent management.
- The long-term impacts of inclusive talent management on organizational performance and innovation.
- The impact of digital transformation and hybrid working models on talent development strategies.
- In this way, a comprehensive framework for effective talent management can be created that reflects the needs of a diverse workforce and supports the sustainable development of organizations in a dynamic environment.

Based on the research results, specific managerial implications can be formulated that support the implementation of talent development programs across all age categories. Age diversity is not an obstacle, but rather an opportunity to maximize the potential of employees in different stages of life through targeted development, while strengthening the innovative culture of the organization.

One effective tool for developing intergenerational cooperation is reverse mentoring. This approach enables mutual learning between younger and older employees, with younger colleagues contributing their digital knowledge (e.g., in the area of social networks) and older colleagues passing on their experience, career guidance, and value framework. Such two-way knowledge transfer strengthens mutual respect, reduces generational barriers, and contributes to the sharing of good practices.

Another recommendation is flexible career planning that reflects the different needs of employees depending on their life situation. Older employees can take advantage of career changes, transition to part-time work, or participate in second career programs, while younger generations will appreciate the opportunity for rapid growth through trainee programs and career accelerators. This type of planning helps keep employees motivated and engaged in the long term.

To develop managers of different age groups, organizations can use multigenerational leadership academies that combine elements of coaching, case studies, and cross-generational team projects. This approach promotes diversity in management styles, inspires through the sharing of experiences, and enables the creation of teams with a higher degree of empathy and adaptability.

To ensure the effectiveness of training, it is important to implement personalized training that takes individual learning styles into account. Younger generations prefer online platforms, microlearning, and gamification, while older employees appreciate face-to-face workshops, mentoring, and consultations. Advanced LMS systems with adaptive learning (e.g., Coursera for Business, Degreed, EdCast) are suitable tools that allow you to offer tailored content.

Intergenerational projects that promote cooperation on innovation and improvement initiatives are also an important element of development. Joint participation in teams composed of employees of different ages brings synergy between experience and new perspectives, develops creativity, and strengthens team cohesion. Innovation hubs, idea labs, or task forces focused on specific goals are a suitable format for such initiatives. Last but not least, it is also important to pay attention to work-life balance and wellbeing programs that reflect the different needs of employees at different stages of life. Offering tools for stress management, parental support, support for those caring for aging parents, or burnout prevention should be a standard part of any development strategy. These programs have a positive impact not only on employee health and satisfaction, but also on their loyalty and work performance.

For multigenerational development programs to be truly effective, it is recommended to conduct a needs analysis across generations and involve employees in creating their content. Inspirational stories and role models from all age groups strengthen motivation and a sense of belonging. It is also key to build an environment of open communication and respect, where intergenerational cooperation is a normal part of the organizational

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n4436887898

culture. The use of technology should be balanced by preserving space for personal contact and interpersonal relationships, which are the foundation of a sustainable organizational culture.

Conclusions

The implementation of talent management is increasingly perceived in today's organizations as a strategic necessity, not just a human resources tool. Organizations are motivated to implement it primarily by the need to increase knowledge levels, search for key employees, and support innovation potential. The most common drivers leading to the systematic search for and development of talent include organizational growth, changes in organizational culture, and adaptation to market dynamics. In this context, the ability to correctly identify and develop key competencies proves to be a fundamental prerequisite for maintaining competitiveness and the long-term success of an organization.

An important aspect of the current approach to talent management is the emphasis on age diversity and intergenerational cooperation. Organizations that actively promote cooperation between generations through mentoring, reverse mentoring, or team learning experience higher levels of innovation, better team dynamics, and stronger employee engagement. It appears that incorporating the principles of diversity, inclusion, and age management into talent management contributes significantly to the development of human capital across generations and is becoming a strategic priority with a long-term impact.

In terms of practical recommendations, it is important for organizations to ensure equal opportunities for entry into talent programs regardless of age. The key is to focus on the competencies and contributions of the individual, not on demographic characteristics. Professional skills, the ability to collaborate, work performance and morale, and competencies that are not age-limited play an important role here. Leveraging the experience of older employees in areas such as integrity, reliability, and strategic thinking should be balanced with the motivation and fresh perspectives of the younger generation. At the same time, it is desirable to develop personalized development programs that reflect the different needs across generations.

Proven approaches in organizations include the introduction of reverse mentoring, where younger employees share their digital skills with older colleagues, who in turn pass on their practical experience and knowledge. Another effective approach is to support a flexible working environment that offers work arrangements suitable for different generations, such as the option of working from home, part-time work, or flexible working hours. Open communication is also key, as it creates a trusting environment and allows employees to share their opinions, needs, and suggestions regardless of age. It should be noted that the conclusions presented are based on a questionnaire survey conducted in Czech organizations. Although the results can only be generalized directly to the analyzed research sample and certain territorial specifics must be taken into account, such as the structure of the Czech labor market, the cultural framework of organizations, and the nature of local personnel processes, the research represents a significant contribution to both practice and theory.

From a practical point of view, it offers specific insights into how organizations in real-world environments approach the identification and development of talent across age categories, what competencies they consider key, and what obstacles and motivations they perceive in implementing talent management. These findings can serve as inspiration for other organizations seeking to take a strategic approach to human capital development in the context of demographic and market changes. From a theoretical point of view, the research contributes to a deeper understanding of organizational behavior patterns in the areas of age management and inclusive talent management. It provides empirically based data that can be used to further develop the concept of intergenerational cooperation, equal opportunities, and a competency-oriented approach to working with talent.

Although the research was conducted in the Czech context, its conclusions go beyond the national framework, as they point to challenges that are relevant to other European countries in times of demographic change and the emergence of Generation Z. The issue of intergenerational talent management is a shared topic across the EU, and the results of this research can therefore be a valuable contribution to international expert discussions and a basis for comparative analyses. Organizations across the European Union are facing similar challenges,

with an aging population and Generation Z entering the labor market being a common trend. European institutions have long been highlighting the need to adapt HR policies to demographic changes, support active aging, and age management. The issue of effective and inclusive talent management is thus becoming a pan-European topic with implications for competitiveness, sustainability, and social cohesion. For these reasons, it is desirable that future research expand its focus not only geographically but also thematically. It is recommended to focus on comparative studies between different European countries, qualitative research on the motivation of employees of different ages to participate in talent programs, or the impact of age diversity on specific performance indicators of organizations. Such research could contribute to a deeper understanding of how to effectively utilize human potential across generations in the European context.

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Funding: This article is supported by the international project No. 4/2023-M, "The meaning and application of social responsibility in selected companies." Project duration: 2023–2027. The international project is funded by the Internal Grant Agency of the Bratislava University of Economics and Management. The data were obtained through collaboration with colleagues from the Czech Republic, who conducted research on this issue.

Author Contributions: All authors have read and agreed to the published version of the manuscript.

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ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n4436887898

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/m5742894539

Publisher
http://jssidoi.org/esc/home

STRUCTURAL PATTERNS OF HUMAN RESOURCE DEVELOPMENT PRACTICES IN SLOVAK ORGANIZATIONS*

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Received 18 January 2026; accepted 27 March 2026; published 30 June 2026

Abstract. This study examines the key factors shaping employee learning and development in Slovak organizations, focusing on the strategic and systemic orientation of Human Resource Development (HRD). A quantitative CAWI survey was conducted among 153 Slovak organizations. Exploratory factor analysis with Varimax rotation was used to identify core dimensions of employee development practices. Three main dimensions were identified: individual support through coaching and digital learning, formal talent management systems, and experiential career mobility. A dominant latent factor reflects an integrated, systematic, and flexible HRD approach. The choice of development tools is influenced by organizational size, sector, culture, and workforce demographics, including generational diversity and neurodiversity. Slovak organizations favor personalized and digitally supported development over isolated or short-term training. The study offers original empirical evidence from Slovakia and contributes to HRD research by linking integrated development systems with organizational change and global HRD trends. Managers are encouraged to implement long-term, integrated HRD frameworks that combine individualized learning, formal talent management, and experiential development while addressing workforce diversity and digitalization. The findings are limited by the sample size and national focus; future research should apply longitudinal and cross country approaches to assess HRD effectiveness and outcomes.

Keywords: employee development; neurodiversity; HRD; Slovak organizations; survey; talent management; digital learning; career mobility; workforce strategies; strategic HRM

Reference to this paper should be made as follows: Urbancová, H., Madzík, P., Vrabcová, P., Stachová, K., Stacho, Z. 2026. Use of artificial intelligence for business decision-making. *Entrepreneurship and Sustainability Issues*, 13(4), 215-231. http://doi.org/10.9770/m5742894539

JEL Classifications: M12, M53, J24

1. Introduction

Employee education and development are key instruments for maintaining organizational competitiveness in a dynamic labor market environment. The success of these processes depends not only on training quality but also on organizational characteristics such as culture, size, industry, and workforce structure, which influence how development strategies are implemented (Coculova & Svetozarovova, 2024; Havierniková et al., 2025; Burhan & Khan, 2025).

* *This article is supported by the international project No. 4/2023-M, "The meaning and application of social responsibility in selected companies".*

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/m5742894539

Trends in Human Resource Development (hereafter HRD) emphasize the growing importance of individualized learning and digital methods, including coaching, mentoring, and e-learning, enabling flexible, personalized, and continuous development of employee competencies (Adams, 2025). At the same time, organizations increasingly utilize formal talent management systems, such as assessment centers, succession planning, and structured development programs, supporting the identification and targeted development of key talents (Seo et al., 2024). A complementary dimension is experiential career mobility, encompassing job enrichment, on-the-job training, job rotation, and international assignments, which facilitates competency development directly in the work environment and enhances adaptability (Lee & Han, 2024; Barhate, Winton & Funderburk, 2024).

Effective employee development also requires consideration of age and neurodiversity composition of work teams, as these factors influence preferred learning approaches and motivation to participate in training activities. Organizations integrating these aspects into development strategies can achieve higher employee engagement, adaptability, and performance (Sniderman et al., 2024; Urbancová et al., 2024; Gottardello et al., 2025).

Although international HRD research exists, systematic evidence on implementation of development practices in small and medium-sized organizations in Central Europe, particularly Slovakia, remains limited, especially regarding how organizational culture, industry, and workforce demographics influence the selection and combination of development tools (Coculova & Svetozarovova, 2024; Havierniková et al., 2025; Kucharčíková & Tokarčíková, 2020).

The aim of this article is to address this knowledge gap by identifying the key factors influencing employee education and development in Slovak organizations, with particular emphasis on the integration of individual support, formal talent management systems, and experiential career mobility. The article provides an empirical basis for comparison with practices in the Czech Republic and the broader Central European context, thereby contributing to the expansion of both the theoretical foundation and practical understanding of HRD.

2. Theoretical Background

In this research, the structural dimensions of human resource development are understood as relatively stable organizational and institutional characteristics shaping approaches to employee education and development (Berg et al., 2023; Pathomphatthaphan et al., 2024). These dimensions include organizational size and sector, the degree of HR process institutionalization, cultural and value orientations, and the strategic management of development activities (Lorincova et al., 2022; Vrabcová & Urbancová, 2022; Begum & Swamy, 2025; Fu & Tan, 2025). Together, they form a framework guiding the selection of training methods and responses to workforce diversity and individual needs (Gonçalves et al., 2025; Talwar et al., 2025).

The literature emphasizes that HRD structures are dynamic and evolve in response to technological change, new forms of work, and turbulent environments. Strategic HRM agility enables flexible adaptation of development processes across the employee life cycle while maintaining strategic coherence (Pathomphatthaphan et al., 2024). HRD effectiveness is further shaped by the alignment of leadership with institutionally embedded HR structures supporting learning, innovation, and employee adaptability (Begum and Swamy, 2025; Fu & Tan, 2025). Technological infrastructure and HR digitalization, including AI-supported systems, increasingly enable personalized learning and targeted competency development, while raising demands for institutional readiness, ethical frameworks, and balancing technological and human aspects of HRD (Talwar et al., 2025; Khushk et al., 2026). Research on KSAO variables and organizational learning confirms that sustainable development requires systematic integration of training, talent management, and continuous learning across organizational and sectoral contexts (Berg et al., 2023; Gonçalves et al., 2025). This conceptualization provides a basis for examining specific organizational factors, addressed in the following section.

Employee education and development constitute core pillars of strategic human resource management (Urbancová et al., 2024; Štaffenová & Kucharčíková, 2024). Organizations face increasingly complex demands for workforce flexibility, innovation, and adaptability, which places emphasis on effective, targeted, and at the

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/m5742894539

same time integrated development activities (Lee and Han, 2024). Contemporary research increasingly points out that the effectiveness of training and development processes is not determined solely by their content or formal structure, but is fundamentally influenced by the broader organizational context, particularly organizational culture and leadership style (Arias & Morales, 2023; Kareem et al., 2025). Organizational culture creates a framework of values, norms, and beliefs that shape organizational approaches to learning, innovation, and knowledge sharing, thereby directly influencing employees' willingness to engage in development activities (Arias & Morales, 2023; Ahmad et al., 2023). Empirical studies in the field of educational organizations show that a culture supporting innovation, openness, and collaboration strengthens the characteristics of a learning organization and creates conditions for the systematic development of human capital (Ahmad et al., 2023; Kicir & Altunoglu, 2024). At the same time, organizational culture has been shown to play a significant mediating role between leadership and the development of learning within organizations, with transformational and participative leadership styles contributing to the creation of environments that support personal engagement, professional growth, and continuous improvement (Fenech et al., 2024; Kareem et al., 2025). In this sense, employee development can be understood not only as an individual process but also as the outcome of a dynamic interaction between managerial culture and individual development strategies. Although a wide range of studies focus on the importance of human capital development, many concentrate more on its outcomes than on a deeper understanding of the factors that shape organizational approaches to development (Gross-Gołacka et al., 2022; Coculova & Svetozarovova, 2024, Gross-Gołacka, 2024). Moreover, existing empirical studies predominantly focus on specific institutional and geographical contexts outside the Central European region (Arias & Morales, 2023; Ahmad et al., 2023; Fenech et al., 2024; Kicir & Altunoglu, 2024). From this perspective, there remains a lack of detailed analyses of what actually influences organizational decision-making regarding training and development practices, particularly in less explored Central European contexts such as Slovakia (Havierniková et al., 2025).

Findings from previous research indicate that organizational approaches to workforce development are fundamentally determined by structural and contextual factors. Organizational size influences available resources, organizational maturity, and the capacity to establish specialized HR departments (Hughes, 2019). The sector of operation also shapes preferred training methods; for example, industrial organizations often rely on experiential and practice-oriented forms, whereas the service sector may favor digital and blended learning approaches (Piwowar Sulej et al., 2024). In addition to these "hard" factors, organizational culture plays a significant role in determining whether training is perceived as an investment, whether employees are motivated to take initiative, and how innovative development forms are implemented (Leuhery et al., 2024; Tadesse Bogale & Debela, 2024; Barach, 2025). In this context, Kareem et al. (2025) empirically demonstrate that organizational culture mediates the relationship between leadership style, employee commitment, and the development of a learning organization. Their findings indicate that without a supportive culture based on shared values, trust, and openness to learning, formal training initiatives remain largely ineffective. Similarly, Arias and Morales (2023) emphasize that cultural characteristics in higher education environments determine the degree of willingness to adopt innovations in professional development. Even in the presence of formal structures and development tools, rigid or conservative cultural patterns can significantly constrain an organization's innovative potential. Conversely, an open and participative culture supports experimentation, knowledge sharing, and active employee engagement in development activities. The importance of organizational culture is further supported by the findings of Ahmad et al. (2023), who point to the consequences of underdeveloped learning cultures in higher education institutions. Their study shows that in environments where training is not firmly embedded in organizational values, professional development is perceived more as a formal obligation than as a long-term investment, which negatively affects employee motivation and the organization's ability to adapt to change. Taken together, these insights suggest that organizational approaches to training are not solely the result of structural and sectoral conditions, but are fundamentally shaped by organizational culture, raising the question of which specific factors influence organizations' approaches to employee education and development (RQ1).

Organizational culture is identified as a key driver of development processes. It determines whether employees are actively encouraged to learn, whether the organization invests in development, and whether a long-term or short-term approach to competency building is preferred (Leuhery et al., 2024; Tadesse Bogale & Debela, 2024;

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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Barach, 2025). This factor appears to be crucial for understanding how culture influences concrete decisions related to training and development.

In addition to organizational characteristics, the selection of training methods itself represents a critical factor in employee development, significantly affecting not only learning processes but also subsequent job performance and employee engagement (Vu et al., 2025). While some organizations continue to prefer traditional formal training, others increasingly focus on development approaches based on internal coaching, mentoring, team learning, or digital and technology-supported forms of education (Adams, 2025; Smith, 2025), which allow for greater flexibility and individualization of development (Tanveer et al., 2024; Megawaty et al., 2025). The choice of specific training methods is not random but is closely related to organizational philosophy, strategic orientation, available technologies, and particularly the competency levels of HR professionals and managers responsible for employee development (Park et al., 2023; Vu et al., 2025). Research further shows that organizations that combine multiple development approaches and integrate formal training with informal workplace learning achieve higher levels of adaptability, engagement, and long-term employee performance (Ferreira & Ferreira, 2025). In particular, participative and development-oriented methods such as coaching and mentoring contribute to better understanding of change, reduced resistance to organizational interventions, and a stronger sense of work meaningfulness, which is especially important in public and institutionally rigid organizations (Melaletsa et al., 2023; Vu et al., 2025). At the same time, effective implementation of training methods requires systematic leadership support, clear communication, and long-term human capital development aligned with organizational culture and strategic objectives (Bhatti et al., 2023; Park et al., 2023). This aspect opens space for research analyzing the most frequently used approaches and their combinations in the context of Slovak organizations (RQ2).

The tension between universal and individualized approaches to development is reinforced by the increasing diversity of work teams. Age, level of education, length of work experience, and employees' cognitive preferences significantly influence which training methods are effective and acceptable. For example, older workers often prefer experiential learning and practical training, whereas younger generations expect digitalization, flexibility, and personalized development formats (Hughes, 2019; Bury et al., 2023; Cherrington, 2024; Gottardello et al., 2025). Empirical research also confirms that employees' demographic and professional characteristics, including job type and career stage, significantly influence not only preferences for training methods but also levels of engagement in development activities and their perceived usefulness (Jansen, 2025). Differences in learning approaches are not limited to age but are also related to educational attainment, quality of the work environment, and expectations associated with career growth. Employees across different organizational and sectoral contexts perceive training not only as a means of developing professional skills but also as a tool for enhancing adaptability, job satisfaction, and the long-term sustainability of work performance (Alumran et al., 2025). Current research further suggests that individual employee characteristics, such as self-regulated learning ability, learning autonomy, and emotional intelligence, amplify the need for differentiated and flexible development approaches. Employees with higher levels of these competencies make more effective use of individualized and digitally supported training forms, while other groups require more structured and intensive organizational support (Sirk, 2025; Parthasarathy et al., 2025). These differences are particularly evident in heterogeneous and aging organizations, where workforce age composition affects organizational learning, technological adaptation, and employee turnover (Black et al., 2025). This perspective raises the question of the influence of demographic and individual factors on the selection of training methods.

Based on the theoretical foundations outlined above, the following research questions are formulated and addressed in the present study:

- RQ1: Which organizational and structural factors (size, sector, organizational culture) influence the approach of Slovak organizations to employee education and development?
- RQ2: Which education and development methods (coaching, mentoring, e-learning, formal training, experiential mobility) are most frequently used in practice, and how are they combined?

This framework links theoretical insights with empirical investigation and enables the interpretation of research findings in relation to the three-factor structure of development methods identified in our results.

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3. Materials and Methods

The research was conducted using a quantitative approach through a CAWI (Computer-Assisted Web Interviewing) questionnaire targeting Slovak organizations of various types and sizes. Respondents were selected from among representatives of middle and senior management, or owners in smaller organizations, who have direct oversight of education and development strategies within their organizations. In total, n = 153 respondents participated in the study, which corresponds to the recommended minimum sample size according to Krejcie and Morgan (1970). Organizations were included in the research using the snowball sampling method, whereby contacted entities were asked to recommend other relevant organizations. This approach was chosen due to the limited accessibility of the target population and the intention to capture a broader spectrum of organizations with diverse characteristics. Of the total number of organizations included, 103 (67%) were part of a broader organizational group (e.g., holdings or corporate groups), and 63 organizations (59%) had a standalone human resources (HR) department. These structural characteristics were taken into account in the analyses. This information made it possible to control for structural and contextual factors that could influence organizations' approaches to employee development.

The questionnaire consisted of a combination of items assessing organizational characteristics and specific education and development practices. Key variables included systematic assessments of training needs (TNE), the proportion of payroll costs allocated to training (TCR), experiential and formal development methods (e.g., JEN, OJT, EXT, DEV, FNP, FCP, ADC, SCP, RLM, HPP, INT), and methods of individual support and digital learning (COA, MEN, ELE, CCW) (Table 1).

Table 1. Coding of Variables Used in the Study

Variable	Cod
Do you systematically estimate the training needs of employees in your organization?	TNE
Approximately what share of annual wage costs is currently spent on training?	TCR
Job enrichment	JEN
External training (off-site)	EXT
On-the-job training	OJT
Developmental assignments/projects	DEV
Formal networking programs	FNP
Formal career plans	FCP
Assessment and development centers	ADC
Succession plans	SCP
Planned rotations and lateral moves	RLM
High-potential programs	HPP
International assignments	INT
Coaching	COA
Mentoring	MEN
E-learning and digital learning	ELE
Career counseling and/or workshops	CCW

Source: own elaboration

A combination of descriptive and multivariate statistical methods was used for data processing and analysis. Descriptive statistics were employed to analyze the basic characteristics of the dataset, particularly the distribution of values, means, and variability of individual variables. Subsequently, correlation analysis was conducted to identify the strength and direction of relationships among the observed variables and to assess their suitability for further multivariate analysis.

The aim of the factor analysis was to identify the latent structure of employee education and development practices in Slovak organizations and to reduce the set of observed variables to a smaller number of interpretable dimensions. The analysis was conducted as an exploratory factor analysis (EFA), as the structure of relationships among the variables had not been specified a priori. A total of p = 15 variables representing individual employee development tools were included in the factor analysis. The variables were measured on

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an ordinal scale expressing the extent of their use within the organization. Prior to the analysis, the variables were standardized to have a zero mean and unit variance:

$$z_{ij} = \frac{x_{ij} - \bar{x}_j}{s_j}$$

where: x_{ij}denotes the value of variable $j$for organization i, $\bar{x}_j$is the mean of the variable, and $s_j$is its standard deviation. The suitability of the dataset for factor analysis was assessed using the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. To enhance interpretability, an orthogonal Varimax rotation with Kaiser normalization was applied. Varimax maximizes the variance of the squared factor loadings within factors and minimizes their overlap:

$$V = \sum_{k=1}^{m} \left[\frac{1}{p} \sum_{j=1}^{p} (\lambda_{jk}^2 - \bar{\lambda}_k^2)^2 \right]$$

where:
$\lambda_{jk}$is the factor loading of variable $j$on factor k, and
$\bar{\lambda}_k^2$denotes the mean of the squared loadings of factor k.

The rotation resulted in a clear assignment of variables to individual factors and minimized cross-loadings (Anderson, 2013). The KMO value (0.879) and the statistically significant Bartlett's test of sphericity confirm an adequate correlation structure of the data and their suitability for exploratory factor analysis. The KMO value substantially exceeds the recommended threshold of 0.6, indicating a sufficient level of shared variance among the variables. All statistical analyses and computations were performed using IBM SPSS Statistics software, version 28.

5. Results

Descriptive analysis of the mean values reveals differences in the extent to which development tools are utilized across the surveyed organizations. The highest average scores are reported for methods such as formal career plans (FCP, 1.1963), job enrichment (JEN, 1.4766), and planned rotations and lateral moves (RLM, 1.1682), suggesting that these instruments are either most frequently used across organizations or perceived by respondents as relatively effective forms of development. In contrast, relatively lower values are observed for formal networking programs (FNP, 0.9065) and international assignments (INT, 0.9533), indicating weaker institutionalization, higher organizational demands, or more limited accessibility. An important finding is the relatively high dispersion of results (skewness and kurtosis) for most items, which points to substantial heterogeneity in approaches to employee development among organizations of different sizes and levels of HR system maturity.

From a managerial practice perspective, it is particularly noteworthy that individual development methods such as mentoring (MEN, 1.3925) and coaching (COA, 1.3832) rank among effective tools, as they exhibit not only relatively high mean values but also strong linkages to other development practices (see Figure 1). Investments in these methods may lead to higher employee motivation and more effective competence development, especially when they are embedded within a broader organizational development strategy. Furthermore, it is important to monitor and systematically evaluate training needs (TNE) and the share of training costs (TCR), which at this stage of the analysis serve as contextual variables. Although these factors are not directly examined, their monitoring is essential for strategic planning of learning and development activities. Managers should also consider increasing support for less widely adopted yet potentially valuable tools, such as formal networking programs or international experience, whose benefits may become particularly evident in long-term talent development and the enhancement of organizational adaptability.

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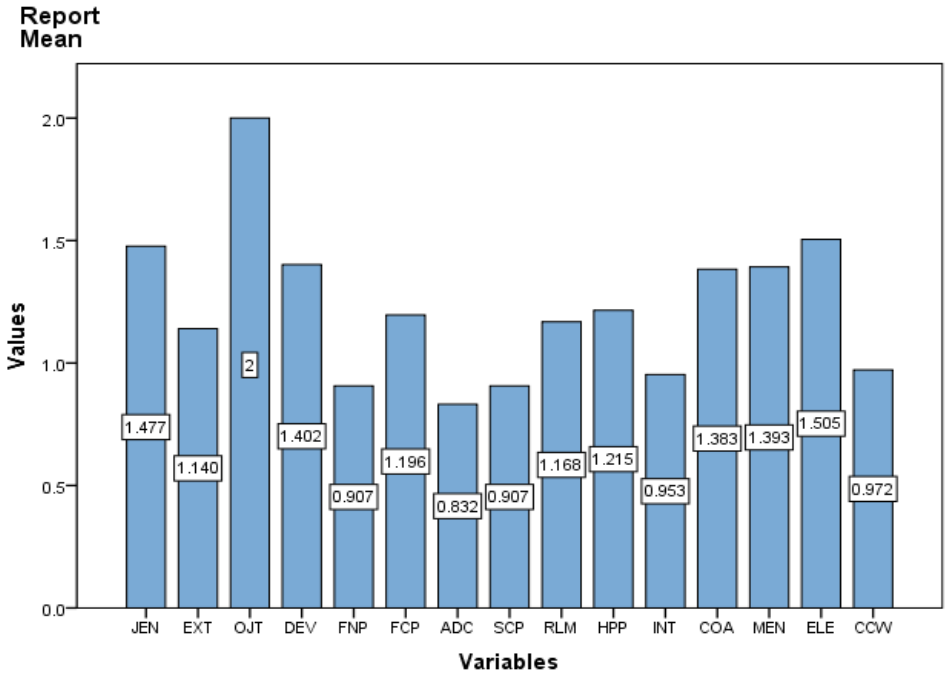


Figure 1. Report Mean of the variables
Source: own elaboration

Figure 1 illustrates the mean values of individual employee learning and development tools and methods across the surveyed organizations. The most salient feature is the high average score for on-the-job training (OJT), which reaches a value of 2.0, confirming its role as the most frequently used and preferred approach to employee development.

High values are also reported for job enrichment (JEN, 1.477) and e-learning and digital training (ELE, 1.505), which were identified as among the most widely used and effective methods. This convergence between tabular and graphical outputs enhances the consistency and robustness of the descriptive results.

In contrast, the low mean values for formal networking programs (FNP, 0.907) and international assignments (INT, 0.953) suggest that these tools are less widespread or are applied only within a limited number of organizations. This finding is important to consider when planning development activities.

The results of the correlation analysis (Figure 2) indicate that employee development and human resource management tools are not used in isolation within organizations but rather form a relatively coherent system of interrelated practices.

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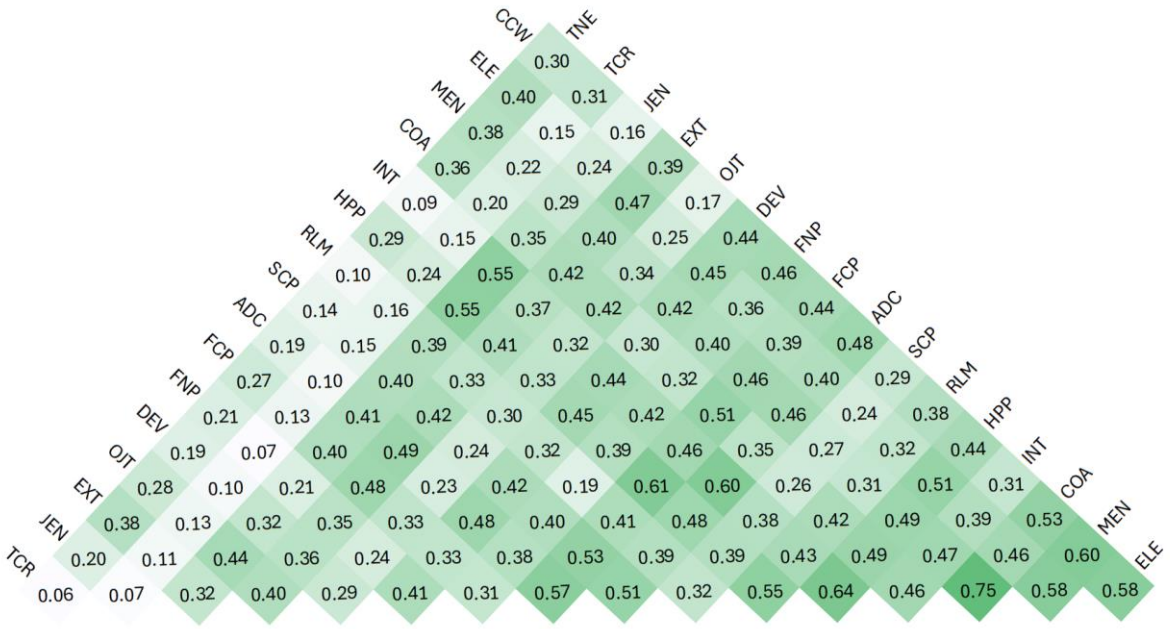


Figure 2. Results of the correlation analysis
Source: own elaboration

The highest relationship values in Figure 2 are concentrated primarily among developmentoriented tools, indicating that organizations that systematically invest in employee development tend to combine and integrate these activities over a longer time horizon.

Strong linkages are particularly evident among tools focused on talent management and career development, specifically succession planning (SCP), assessment and development centers (ADC), formal career plans (FCP), and high-potential programs (HPP). In organizational practice, these instruments are often implemented jointly as part of a comprehensive talent management system. The empirical data therefore support the assumption of complementarity among these approaches rather than their isolated use.

Pronounced relationships are also observed between mentoring (MEN), coaching (COA), and developmental projects or assignments (DEV). These tools share a strong emphasis on individualized and experiential learning, which may explain their interrelatedness and their significant role in the development of managerial and professional competencies. The findings suggest that the effects of supportive developmental relationships can be strengthened when they are linked to concrete work tasks and challenges.

By contrast, relatively weaker correlations are found for some more formal or administratively oriented instruments, such as systematic training needs estimation (TNE) or the share of payroll costs allocated to training (TCR). A higher volume of financial resources devoted to training does not necessarily translate into broader or more sophisticated use of development tools. From an analytical perspective, this highlights the importance of the structural and strategic embedding of employee development.

E-learning and digital training (ELE) exhibit moderate relationships with most other tools, suggesting their role as a supportive and complementary element of the development system. According to the results, digital forms of learning appear to be most effective when combined with mentoring, coaching, or on-the-job training (OJT), rather than when used as stand-alone development instruments.

The results of the principal component extraction (Table 2) demonstrate how individual employee learning and development tools contribute to explaining the overall variance in the data. The reported values indicate the extent to which each variable is represented by the extracted components. Instruments oriented toward individual support and digital learning, such as coaching (COA, 0.769), mentoring (MEN, 0.764), and career

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counseling and workshops (CCW, 0.729) show the highest proportions of explained variance, indicating their strong representativeness and central role in the overall structure of development practices. Similarly, systematic and formally structured talent management tools, particularly assessment and development centers (ADC, 0.655), succession planning (SCP, 0.659), e-learning (ELE, 0.621), and high-potential programs (HPP, 0.646), also achieve relatively high variance proportions, confirming their importance for structured employee development in the surveyed organizations.

Table 2. Extraction Method: Principal Component Analysis

Variables	Initial	Extraction
JEN	1.000	0.708
EXT	1.000	0.438
OJT	1.000	0.512
DEV	1.000	0.516
FNP	1.000	0.508
FCP	1.000	0.554
ADC	1.000	0.655
SCP	1.000	0.659
RLM	1.000	0.443
HPP	1.000	0.646
INT	1.000	0.601
COA	1.000	0.769
MEN	1.000	0.764
ELE	1.000	0.621
CCW	1.000	0.729

Source: own elaboration

By contrast, lower explained variance is observed for some external and experience-based methods, such as external training (EXT, 0.438), rotations and lateral moves (RLM, 0.443), and on-the-job training (OJT, 0.512). From the perspective of the data structure, these instruments are less homogeneous and may represent more specific or context-dependent approaches to employee development that are not fully captured by the principal component.

The first extracted component strongly reflects a combination of individualized, digital, and formally managed development tools, whereas experiential and external methods tend to follow a different structural logic. The results of the factor analysis indicate that the first factor explains the largest share of the data variance, namely 44.6%, and represents the dominant dimension of employee learning and development. The second factor accounts for 8.9% and the third factor for 7.3% of the total variance, with the three factors together explaining approximately 60.8% of the variability in the data (see Table 3). The data structure thus suggests the existence of one clearly dominant factor complemented by two additional, interpretatively relevant dimensions.

Table 3. Results of the factor analysis

Factor	Total	% of Variance	Cumulative %
1	6.687	44.581	44.581
2	1.337	8.910	53.491
3	1.098	7.322	60.813

Source: own elaboration

The choice of a three-factor solution is further supported by the scree plot (see Figure 3), which shows a pronounced drop in eigenvalues between the first and second components, followed by a clear leveling off of the curve for subsequent components.

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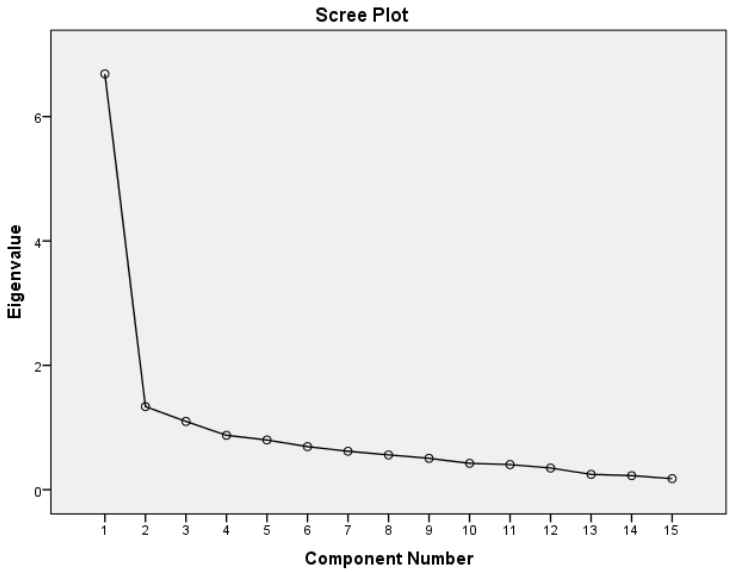


Figure 3. Scree Plot
Source: own elaboration

Figure 3 confirms that the first component explains a substantially larger proportion of data variability than the subsequent components, while the second component already makes a more limited, yet still meaningful, contribution to the total explained variance. The remaining components represent mainly supplementary or residual variability.

Based on a combination of the eigenvalue criterion, the shape of the scree plot, and the overall interpretability of the solution, a three-factor extraction was therefore adopted. To achieve a clearer and more unambiguous factor structure, orthogonal Varimax rotation with Kaiser normalization was subsequently applied. The rotated solution enabled a more distinct assignment of individual variables to factors, reduced cross-loadings, and enhanced the interpretative value of the resulting model. The results of the rotated factor analysis are presented in Table 4.

Table 4. Factor analysis by Varimax with Kaiser Normalization

Variables	Factor 1 **Support for Coaching and Digital Learning**	Factor 2 **Formal Talent Management Systems**	Factor 3 **Experiential Career Mobility**
MEN	0.800		0.304
CCW	0.765	0.378	
COA	0.716		0.506
ELE	0.713	0.294	
SCP		0.763	0.277
ADC	0.251	0.709	0.299
DEV	0.323	0.622	
FNP	0.386	0.599	
EXT	0.370	0.430	0.341
JEN		0.296	0.786
OJT	0.208		0.685
HPP	0.352	0.408	0.596
RLM	0.240	0.231	0.576
INT	0.219	0.478	0.570
FCP	0.312	0.469	0.487

Source: own elaboration

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http://doi.org/10.9770/m5742894539

The results of the exploratory factor analysis support the interpretation that the examined employee learning and development tools are organized into several interrelated dimensions, with one dominant factor explaining a substantial share of the variance in the data. The scree plot revealed a pronounced decline in eigenvalues between the first and second components, indicating the presence of a strong central factor complemented by smaller yet still interpretable dimensions. The first factor reflects a combination of individually oriented and digitally supported development activities, while the remaining two factors represent structured formal talent management systems and experiential career mobility.

Factor 1: "Support for Coaching and Digital Learning" primarily comprises variables focused on individual development through mentoring (MEN, 0.800), career workshops (CCW, 0.765), coaching (COA, 0.716), and e-learning (ELE, 0.713). This factor reflects personalized and technology enabled learning that enhances employee competencies and engagement.

Factor 2: "Formal Talent Management Systems" encompasses structured and organizationally driven processes, particularly succession planning (SCP, 0.763), assessment and development centers (ADC, 0.709), developmental tasks and projects (DEV, 0.622), and formal networking programs (FNP, 0.599). Supplementary items include external training (EXT, 0.430) and formal career plans (FCP, 0.469), underscoring a systematic and strategic HR approach to talent identification and development.

Factor 3: "Experiential Career Mobility" represents development activities based on hands on work experience and career mobility. The highest loadings are observed for job enrichment (JEN, 0.786), on-the-job training (OJT, 0.685), high-potential programs (HPP, 0.596), rotations and lateral moves (RLM, 0.576), and international assignments (INT, 0.570). This factor highlights the importance of active learning in real work settings and the strategic development of careers through experience.

4. Discussion

Our results indicate that three main dimensions of employee learning and development dominate in Slovak organizations: individual support and digital learning, formal talent management systems, and experiential career mobility. This three-factor model reflects both global and regional trends emphasizing flexible, personalized, and strategically integrated approaches to workforce development (Adams, 2025; Cherrington, 2024). In comparison with international literature, our findings confirm that coaching and mentoring significantly foster competence development, motivation, engagement, and organizational performance (Adams, 2025; Smith, 2025). At the same time, formal training and networking activities appear to be less prevalent, which is consistent with the findings of Coculova and Svetozarovova (2024), who report that small and medium-sized organizations in Central Europe tend to prefer digitalized and personalized methods over traditional workshops.

The importance of data-driven needs analysis is also supported in our context. Although training needs estimation and training cost ratios (TNE/TCR) were not directly measured, the latent structure of the development dimensions suggests a high level of systematicity and process maturity (Lee & Han, 2024). This result corresponds with international research emphasizing that effective HRD requires strategic integration, alignment among development tools, and adaptation to organizational and demographic conditions (Leuhery et al., 2024; Tadesse Bogale & Debela, 2024; Barach, 2025).

Our findings further confirm that organizational culture is a key determinant of successful employee development. Organizations that support learning and employee initiative demonstrate greater use of individualized and digital development methods, whereas organizations focused on short-term performance tend to favor more formal and administrative approaches (Barach, 2025; Urbancová et al., 2024; Havierniková et al., 2025; Gross-Gołacka et al., 2022; Tadesse Bogale & Debela, 2024; Greer, 2024). This conclusion is consistent with international studies highlighting the influence of organizational values and strategy on the implementation of HRD practices (Gross-Gołacka et al., 2022; Leuhery et al., 2024).

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Demographic and individual employee characteristics, such as age, experience, and cognitive preferences, also have a significant impact on the choice of learning methods. Practical and experiential approaches, such as job enrichment or on-the-job training, are preferred by older and more experienced employees, while younger generations value flexible and digitalized forms of learning (Cherrington, 2024; Hughes, 2019). These findings are further supported by literature on neurodiverse and heterogeneous work teams, which emphasizes that individual adaptation of development methods enhances HRD effectiveness (Lee, 2023; Sniderman et al., 2024; Smith & Bury et al., 2023; Horlin et al., 2024).

From a Central European comparative perspective, our results show that Slovak organizations favor digitalized and personalized learning formats more strongly than Czech organizations, which continue to rely more heavily on traditional training and internal workshops (Gross-Gołacka et al., 2022; Coculova & Svetozarovova, 2024). This difference can be explained by varying levels of digitalization, investment models, and organizational cultural preferences.

Based on the integration of our findings and comparisons with international studies, future research should focus on less frequently used tools, such as formal networking programs, international assignments, and the combination of digital learning with on-the-job training (Lee & Han, 2024). Greater attention should also be paid to data-driven needs analysis, which enables the optimization of training strategies and enhances HRD effectiveness. Moreover, adapting development methods to workforce diversity, including age, experience, cognitive preferences, and neurodiversity, is essential to ensure that learning initiatives reflect employees' actual needs (Bury et al., 2023; Sniderman et al., 2024).

Finally, the strategic integration of key HRD dimensions, individual support, formal talent management systems, and experiential mobility, allows for the creation of a coherent and systematic framework that maximizes the impact of development interventions (Urbancová et al., 2024; Leuhery et al., 2024; Greer, 2024; Barach, 2025).

Overall, the results demonstrate that Slovak organizations apply HRD practices in a systematic, modern, and strategic manner, providing an empirical basis for comparative studies within the Central European region and supporting the formulation of evidence-based recommendations for effective human resource development planning.

Conclusions

The approach of Slovak organizations to employee learning and development is determined by a combination of organizational characteristics, cultural preferences, and the demographic structure of the workforce. The three identified core factors, individual support through coaching and digital learning, formal talent management systems, and experiential career mobility, confirm that organizations favor integrated, systematic, and flexible development strategies (RQ1, RQ2). The selection of specific learning methods is closely linked to organizational size, sector, organizational culture, and the needs of different employee generations, including considerations of neurodiversity.

The results yield several managerial implications that are relevant both for strategic human resource management and for the day-to-day decision-making of managers and HR specialists:

1. *The need for an integrated and systemic approach to HRD*
Managers should strive for the strategic integration of individual support, formal talent management systems, and experiential career mobility into a unified development framework. Organizations that successfully connect these dimensions create a coherent and sustainable system for human capital development.

2. *Strengthening individualized and digitally supported forms of development*
The strong role of mentoring, coaching, career counseling, and e-learning suggests that employees increasingly expect personalized, flexible, and technologically accessible learning formats. Managers should therefore invest not only in digital infrastructure but also in the development of competencies among internal coaches and

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mentors. These tools enhance employee engagement, support self-regulated learning, and enable organizations to better respond to individual career needs.

3. The strategic role of formal talent management systems
The importance of factors such as succession planning, assessment centers, and structured development projects confirms that formal talent management remains a key pillar of HRD, particularly in larger and more structurally mature organizations. Managers should view these systems not as administrative instruments, but as strategic mechanisms that support the continuity of critical competencies, internal mobility, and long-term organizational stability.

4. Leveraging experiential career mobility as a development tool
Experiential forms of development, such as job enrichment, on-the-job training, planned rotations, and international assignments, emerge as important mechanisms for enhancing employee adaptability and professional flexibility. Managers should plan these tools systematically rather than using them on an ad hoc basis and deliberately link them to career planning and talent identification processes. This approach can increase the return on investment in development while simultaneously strengthening the retention of key employees.

5. The necessity of accounting for workforce diversity
The findings imply that the effectiveness of individual development tools is influenced by employees' age, experience, and individual preferences. Managers should therefore adopt a differentiated approach to HRD and create a portfolio of development methods that reflects generational, professional, and cognitive diversity within the workforce, including neurodiversity.

6. Shifting from short-term training to long-term development strategies
The relatively weak relationship between the level of investment in training and the structure of utilized development tools suggests that financial allocation alone is not the decisive factor in HRD success. For managers, it is crucial to focus on long-term development planning, systematic needs assessment, and the alignment of learning initiatives with organizational strategy, rather than merely on the volume of training delivered.

Among the theoretical limitations of the study are the limited generalizability of the results due to the sample size and the exclusive focus on Slovakia. The study also does not fully capture the long-term dynamics of HRD practice implementation, nor the direct impact of individual methods on employee performance and motivation. From a practical perspective, limitations arise from the heterogeneity of organizations in terms of resource availability, HR process maturity, and digitalization levels, which may affect the transferability of the recommendations to other organizational types or regions.

Future research should therefore focus on longitudinal analyses of the effectiveness of individual HRD methods, particularly combinations of digital and experiential learning, expand comparative analyses to the Czech Republic and other Central European countries to identify regional differences, examine in greater depth the influence of organizational culture and specific demographic factors (including neurodiversity) on engagement and development outcomes, and analyze the relationship between the level of HRD systematization and concrete organizational outcomes such as productivity, innovation, and talent retention.

Based on the results, it can be concluded that systematic and personalized approaches to employee learning and development represent a key pillar of effective human resource management and provide an empirical foundation for strategic decision-making and the optimization of development activities in a dynamic work environment.

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Funding: This article is supported by the international project No. 4/2023-M, “The meaning and application of social responsibility in selected companies”.

Author Contributions: Conceptualisation: *Urbancová, H.*.; methodology: *Stachová, K., Stacho, Z.*.; data analysis: *Madzík, P.;* writing—original draft preparation: *Urbancová, H.*, writing; review and editing: *Vrabcová, P.*; visualisation: *Madzík, P*. All authors have read and agreed to the published version of the manuscript.

ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/m5742894539

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p7382684759

Publisher
http://jssidoi.org/esc/home

TURKEY'S HOUSING MARKET: SALES, PRICES, AND THEIR LINKS TO INTEREST RATES, EXCHANGE RATES, AND COSTS (2013–2023)

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Received 18 January 2026; accepted 28 March 2026; published 30 June 2026

Abstract. This paper demonstrates that the relationships between sales (total and mortgage-backed) and the housing price index (RPPI) in the Turkish housing market operate within a regime-sensitive and time-dependent structure. Using monthly official data (CBRT, TÜİK) from the 2013–2023 period, a multi-layered econometric design was applied: exploratory correlations and rolling windows; VAR/VECM and Granger causality; ARDL (Bounds) for short-long term separation; Markov-Switching and Bai-Perron for regime/break detection; and finally, SARIMAX for short-term forecasting. Findings are grouped into three axes. (i) Credit-interest rate channel: ARDL long-term coefficients show that a 1-point increase in interest rates affects total sales ≈ −1.8% and mortgage sales ≈ −8.2% at the equilibrium level; error correction speeds are strong at $|\phi| \approx 0.60–0.70$. Granger tests reveal that interest rates predict both mortgage and total sales, with feedback from sales to interest rates. (ii) Price-cost/inflation channel: The RPPI is found to interact with the CPI and construction costs with short lags and in both directions; regime analysis shows that the CPI → RPPI link dominates in 2022, while the cost → RPPI link dominates in 2023. (iii) Regimes and breaks: Markov-Switching reveals the distinctiveness of high-credit regimes in mortgage sales (2019-08→2020-08; 2021-11→2022-06) and the high inflation regime in RPPI (2021-10→2023-12); Bai-Perron breaks historically confirm these episodes. In the forecasting layer, SARIMAX provides applicable short-term accuracy with sMAPE ≈ 5% for RPPI and ≈ 14% for sales. The results show that a policy reading based on single-period average coefficients is insufficient; instead, a regime-sensitive framework that jointly considers credit-price-supply channels and is calibrated with exogenous macro scenarios is necessary.

Keywords: housing market; real estate; regime change; ARDL–Bounds; VAR/VECM; Granger causality; Markov-Switching; Bai-Perron; SARIMAX; housing price index; mortgage sales

Reference to this paper should be made as follows: Peyravi, B., Uygur, M. R. Blaževičius, G., Çamlıbel, M. E. 2026. Turkey's housing market: sales, prices, and their links to interest rates, exchange rates, and costs (2013–2023). *Entrepreneurship and Sustainability Issues*, 13(4), 232-249. http://doi.org/10.9770/p7382684759

JEL Classifications: C22, E43, R31

1. Introduction

The housing market is both the social memory and the financial lifeline of an economy: it carries household wealth, sets the pace of credit, and transmits cost shocks and inflation waves across the country through its prices, sales volume, and permit dynamics.

In Turkey over the past decade, this rhythm has been observed to accelerate at times and undergo sharp regime shifts at others. The official housing price index (RPPI) has been compiled monthly by the Central Bank of the Republic of Turkey since 2012; global comparisons document that real housing price increases showed an

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p7382684759

extraordinary surge in Turkey in 2022. Construction costs reached triple-digit annual rates in the same year, leaving the supply side facing headwinds. These official series also form the backbone of the data universe used in this study (CBRT, 2025; BIS, 2024; TÜİK, 2022, 2025). Recent Turkey-focused studies also emphasize that mortgage conditions, housing inflation, regional convergence, and affordability pressures jointly shape post-2018 market dynamics (Yildirim & İvrendi, 2021; Kırca & Canbay, 2022; Özgüler, Büyükkara & Küçüközmen, 2023; Canöz & Kalkavan, 2024). The theoretical and empirical literature on the macroeconomic importance of such fluctuations focuses on the mortgageable asset nature of housing. Groundbreaking studies showing that the feedback mechanism between credit and prices intensifies financial cycles through collateral constraints emphasize that housing is not only a consumption or shelter item, but also a key vector of money-credit transmission (Kiyotaki & Moore, 1997; Iacoviello, 2005; Yildirim & Yildirim, 2025). The impact of external shifts based on credit supply regulation on housing prices is particularly evident during periods of mortgage market expansion (Favara & Imbs, 2015; Akgündüz et al., 2023). The interaction between household debt and the economic cycle reveals that increasing indebtedness can cast a significant negative shadow over growth and employment in subsequent years (Mian, Sufi, & Verner, 2017; Kayakus, Terzioglu & Yetiz, 2022). On the supply side, geography and regulatory intensity are persistent determinants of housing supply elasticity; this necessitates evaluating permit/occupancy and cost dynamics alongside prices and sales (Saiz, 2010; Sayin, Elburz & Duran, 2022; Gunduz, Çakir, & Cepni, 2025; Nasiboglu et al., 2025; Goekler, 2025).

In the case of Turkey, the intertwining of post-2020 credit conditions, exchange rate volatility, inflationary pressures, and divergences in construction costs suggests that economic relationships do not operate at the same pace over time. Indeed, the emphasis placed in recent years by international institutions (e.g., BIS) on borrower-based macroprudential frameworks to mitigate financial stability risks in housing markets also indicates that parameters cannot be captured by average effects from a single smoothed period (BIS, 2023). Recent evidence also shows that macroprudential tightening shapes housing-market expectations themselves, which further strengthens the case for regime-sensitive analysis (Kuang et al., 2026). In such periods, both Markov-switching approaches (Hamilton, 1989) that directly model regime shifts and Bai-Perron class structural break tests (Bai & Perron, 1998) that detect time-independent breaks are indispensable tools.

This article reinterprets the relationship between sales (total and mortgaged) and prices (RPPI) in the Turkish housing market within a regime-sensitive and dynamic framework through interest rates, exchange rates, inflation, costs, and permit/occupancy indicators. Our empirical strategy is built on a five-part architecture: (i) correlation and robustness in rolling windows; (ii) multiple dynamic interactions via VAR/VECM and Granger causality (Sims, 1980; Johansen, 1991); (iii) Short-long term separation via the ARDL-bounds test (Pesaran, Shin, & Smith, 2001); (iv) Regime/break detection via Markov-Switching and Bai-Perron (Hamilton, 1989; Bai & Perron, 1998); (v) Short-term forecasting with SARIMAX and the predictive power of exogenous macro variables. This composite approach allows us to test not only the signs and magnitudes of the coefficients, but also in which period they changed; it also allows us to test the question of "who predicts whom" under regime conditions.

Our data pool consists of monthly indicators compiled from official institutions: RPPI (CBRT), housing sales/mortgage sales, construction cost index, and permits/occupancy (TÜİK), in addition to mortgage interest rates, CPI, and USD/TRY exchange rate. The scope and methodology of the RPPI are detailed by the CBRT; housing sales, cost, and permit indicators are regularly published in TÜİK bulletins. This allows for the simultaneous monitoring of credit and income channels on the demand side, as well as cost and permit bottlenecks on the supply side. (CBRT, 2025; TÜİK, 2025).

Within this framework, the article aims to make three concrete contributions. First, it quantitatively identifies regime-specific coefficients and causality patterns by distinguishing between normal and crisis regimes in the Turkish housing market in a data-driven manner. Second, it cross-checks ARDL and VECM results with periods indicated by structural breaks and Markov regimes in terms of econometric consistency, thus enabling short-term shocks and long-term co-movements (cointegration) to be read within the same picture. Third, it conditions the short-term predictive power with SARIMAX estimates on external macro scenarios; it makes the possible reflections of interest rate/exchange rate/inflation paths used in policy discussions on sales and prices visible in a numerical language. Methodologically, we base the established nature of the references we use on seminal

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p7382684759

studies in the top quartile (Q1) journals of economics literature (Sims, 1980; Johansen, 1991; Pesaran et al., 2001; Hamilton, 1989; Bai & Perron, 1998; Iacoviello, 2005; Saiz, 2010; Favara & Imbs, 2015).

We focus on the following research questions:

Do interest rates, exchange rates, inflation, and costs have significantly different effects on sales and housing prices depending on the regime?

During periods of expansion/tightening of credit conditions, does the answer to the question "who predicts whom?" (Granger causality) change?

Is there a long-term relationship (cointegration) between sales/prices and key macro-financial variables; if so, what are the short-term adjustment speeds?

To what extent do short-term forecasts based on external macro indicators improve with models that incorporate regime/break information?

The rest of the article proceeds as follows: The next section discusses the international literature on housing-credit-price dynamics and the Turkish context, along with academic findings. The data and methods section then presents the details of the econometric architecture summarized above. The findings section reports regime/break detection, dynamic interactions, and short-long term decompositions in an integrated manner. Finally, the discussion and conclusion sections address policy implications—particularly recommendations regarding interest rates, the calibration of the macroprudential framework, and the stimulation of the supply side (BIS, 2023).

2. Literature Review

The housing market is both a mirror and an accelerator of the financial cycle. In theoretical terms, the interaction between credit constraints and asset prices explains how shocks are amplified and made persistent. Kiyotaki and Moore's (1997) collateral-constrained general equilibrium model shows that, because durable assets serve as both production inputs and collateral for debt, balance sheet-price feedbacks create a powerful transmission channel. Extending this framework to monetary economics, Iacoviello (2005) quantifies housing's role as a "financial accelerator" by documenting that demand shocks are markedly amplified, while supply shocks are partially dampened due to the nominal structure of debt, using a New Keynesian DSGE model incorporating the nominal debt-collateral link. Empirical evidence on the causal link between housing market expansion and credit supply is also supported by studies using bank branch deregulation in the US as an instrumental variable (Favara & Imbs, 2015). In the broader link between credit cycles and growth, multi-country panels have shown that increases in household debt suppress growth and employment in the medium term (Mian, Sufi, & Verner, 2017). Taken together, these findings emphasize that the impact of fluctuations in credit conditions on housing prices and sales is not only strong but also asymmetric and time-sensitive.

The effect of housing prices on household spending operates through two channels: the wealth effect and the easing of the borrowing constraint. The first is that an increase in housing wealth stimulates consumption; the second is that increased collateral value facilitates access to debt. Studies using UK microdata provide convincing empirical evidence for both channels (Campbell & Cocco, 2007). In the US, the 2006–2009 downturn showed that the loss of housing wealth sharply reduced consumption, with marginal consumption propensity being higher in low-income and highly leveraged areas (Mian, Rao & Sufi, 2013). These results indicate that changes in credit and collateral conditions strongly affect macro consumption dynamics through housing.

The design of mortgage contracts is decisive in the transmission power of monetary policy. As the prevalence of variable-rate mortgages increases, the impact of policy interest rate shocks on housing prices and housing investment grows; institutional parameters determining down payment ratios and maximum borrowing capacity also shape the magnitude of the impact (Calza, Monacelli & Stracca, 2013). European Central Bank research supports these findings by documenting at the institutional level how the housing finance architecture confers heterogeneous sensitivity to the monetary transmission mechanism (European Central Bank, 2009). More recent evidence also shows that housing activity measures can be substantially more sensitive to mortgage-rate changes

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p7382684759

than house prices, reinforcing the importance of treating mortgage sales as a distinct transmission channel (Časta, 2025).

In an open economy, the pass-through of exchange rate movements to import prices affects the trajectory of construction costs and overall inflation. Multicountry evidence distinguishes between the short- and long-term elasticities of pass-through from exchange rates to import prices, revealing the policy framework's effects on the expenditure-switching channel (Campa & Goldberg, 2005). For the cost-intensive construction sector with a high share of imported inputs, this channel provides an important background explaining why cointegration relationships between housing prices and cost indices may be strong. For Turkey, Kırca and Canbay (2022) likewise show that housing inflation responds to macro-financial variables in a horizon-dependent manner.

On the supply side, persistent determinants are geographical and regulatory constraints. Local land scarcity and topographical barriers limit supply elasticity, determining how much demand shocks are reflected in prices (Saiz, 2010; Yasar & Bulut, 2023; Muddasir & Dondas, 2023).

Multisectoral growth models have shown that the housing cycle is synchronized with the business cycle but is more volatile (Davis & Heathcote, 2005). The cumulative effect of regulatory constraints leads to market prices carrying permanent premiums relative to production costs, thereby transforming regional welfare and settlement patterns (Glaeser & Gyourko, 2018). In a broader macroeconomic context, it has been calculated that supply constraints in high-productivity cities reduce total output levels by distorting labor allocation and diminish long-term growth (Hsieh & Moretti, 2019). This literature methodologically justifies modeling permit/housing flows and the construction cost index alongside housing sales and prices.

The vector autoregression (VAR) approach, which addresses dynamic multivariate relationships without imposing structural constraints, has become standard in the literature (Sims, 1980). Cointegration and error correction models play a critical role in testing level relationships and distinguishing between short- and long-term periods (Engle & Granger, 1987; Johansen, 1991). The ARDL–Bounds approach (Pesaran, Shin, & Smith, 2001), which can be applied even with mixed integration degrees, is widely used in practice because it reduces the sensitivity of pre-tests and performs relatively well with small samples. The direction of causality and the assessment of predictive power are completed within the Granger (1969) framework. This fundamental methodological approach allows for the examination of both short-term and equilibrium relationships between the housing price index and sales with interest rates, exchange rates, inflation, and cost indicators under the same umbrella.

The fact that parameters are not constant over time suggests that relationships can change in sign and magnitude across different periods. Markov-switching structures apply models that allow for probabilistic transitions between regimes, where coefficients and shock variances can jump depending on the regime (Hamilton, 1989). Another line of research is the approach by Bai and Perron (1998; 2003), which tests for multiple structural breaks without prior knowledge of break dates. This allows for the derivation of “normal/crisis” periods from the data and the comparison of coefficients across periods. These two classes provide complementary tools for showing how the impact of credit and cost shocks in the housing market becomes asymmetric during periods of financial tightening and abundance.

The time-varying parameter VAR (TVP-VAR) literature, designed to capture regime shifts over time under the assumption of continuity, allows for modeling the temporal evolution of policy responses and shock propagation. Primiceri (2005) develops a TVP-SVAR framework where coefficients and innovation covariances are jointly time-dependent, enabling reliable estimation of both the temporal evolution of the systematic policy rule and shock volatility. This approach strengthens the empirical trace of the interest rate-housing price interaction, for example, during periods when inflation regimes or credit spreads change.

Answers to the question of who “predicts” whom in the housing market literature also vary depending on the period and institutional context. Studies showing that exogenous expansions in mortgage credit supply push up housing prices through causal designs (Favara & Imbs, 2015) should be considered alongside evidence highlighting the medium-term macro-outcomes of debt accumulation through credit conditions (Mian, Sufi, &

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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Verner, 2017). These results also require a regime-specific interpretation of Granger causality tests: the credit-price interaction may be directed toward prices in a "plentiful liquidity" regime and toward sales and credit flows in a "tightening/crisis" regime.

Factor models are widely used tools for forecasting and using high-dimensional indicator sets. Dynamic factor models, which summarize common movements in large data sets using a few diffusion indices, provide significant improvements in short-term forecasting (Stock & Watson, 2002), while the information-criterion approach of Bai and Ng (2002) remains a standard tool for determining the number of common factors. Forni, Hallin, Lippi, and Reichlin's (2000) generalized dynamic factor model, on the other hand, has developed a framework based on the dynamic covariance structure of the entire panel and offering one-sided estimation capabilities. BVARs reduced with Bayesian constraints in large-scale systems effectively manage the risk of overfitting, particularly in multivariate macro forecasts (Bańbura, Giannone & Reichlin, 2010). The use of scale-invariant and low-bias indicators is also recommended when comparing forecasts; Hyndman and Koehler (2006) discussed the shortcomings of MAPE-type measures and highlighted MASE. Recent Turkish applications using Bayesian time-varying VARs and deep-learning architectures further show that flexible forecasting frameworks can capture affordability dynamics and nonlinear price movements more effectively in fast-changing environments (Canöz & Kalkavan, 2024; Kütük, 2024).

In terms of diagnostic tools, generalized response functions that are insensitive to the order of shocks in structural VARs (Pesaran & Shin, 1998) are practical and order-invariant in application. This allows for the visualization of short-term shock dynamics between housing prices, sales, and financial/cost variables. However, it should be noted that in the presence of regime shifts, the course of responses may differ conditionally on the regime; therefore, it would be more appropriate to interpret the response functions on a period-by-period basis after performing a "regime mapping" using Markov-switching or breakpoint tests.

Data architecture and comparability directly affect the reliability of findings. At the international level, the BIS provides minimal standardization in an area where definitions are heterogeneous by publishing detailed and selected housing price series for approximately 60 countries on a nominal and real basis. Its published methodology notes detail differences in frequency, coverage, price unit, and compilation method (BIS, 2026). Specifically for Turkey, the Central Bank of the Republic of Türkiye's (CBRT) Residential Property Price Index (RPPI) data and methodology notes describe the transition to a quality-adjusted hedonic method since 2016 and the revision of the publication framework. For construction costs, the Turkish Statistical Institute's (TÜİK) Construction Cost Index and permit data, as well as Eurostat's building permits metadata, serve as references for tracking the current pulse of the supply side (CBRT, 2025; TÜİK, 2025; Eurostat, 2025). These official sources support the placement of domestic findings in an international context and robustness checks.

Applying this literature to Turkey requires addressing three axes together. First, the demand/financing axis: policy interest rates, mortgage interest rates, and the expansion-contraction cycles of credit taps; second, the price-cost axis: the long-term relationship between RPPI and the construction cost index and the cost channel of the pass-through from exchange rates to prices; and third, the supply axis: the simultaneous dynamics of permit/occupancy flows with housing sales and prices. VAR/VECM and ARDL models are suitable for decomposing these three axes into short- and long-term components and testing their causal directions; Markov-switching and Bai-Perron class approaches reveal how parameters are rewritten according to periods. Factor models and/or Bayesian large-scale VARs allow high-dimensional indicator sets (interest rates, exchange rates, inflation, costs, permits, external indicators) to be included in the estimation process in a parsimonious manner; estimation comparisons should also be made using scale-insensitive criteria. These guidelines directly inform a research framework that jointly models the variables Sales (Total/Mortgage), Housing Price Index, interest rate-exchange rate-inflation-cost, and permit/occupancy in datasets related to the Turkish housing market. Recent Turkey-specific studies on housing inflation, convergence, and affordability also suggest that national averages can mask important shifts across cities and over time, which makes a regime-sensitive empirical strategy particularly relevant (Yasar & Bulut, 2023; Muddasir & Dondas, 2023; Özgüler et al., 2023; Canöz & Kalkavan, 2024).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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Ultimately, international research converges around three common findings. First, credit conditions generate a bidirectional and self-reinforcing interaction with the housing market; second, supply constraints sharpen the transformation of this interaction into prices depending on the spatial and institutional context; and third, these links change over time in a regime-sensitive manner. In practice, it is therefore recommended to (i) test for the existence of cointegration and long-run coefficients, (ii) examine short-run adjustment dynamics and the direction of causality, (iii) disaggregate parameters according to regimes or structural breaks, and (iv) use high-dimensional data sets in a parsimonious manner for estimation. Such a design provides both policy and sector decision-makers with period-sensitive and empirically reliable roadmaps.

3. Method

The method of this study consists of five mutually compatible components designed to read a market (housing) that is dynamic, regime-sensitive, and multi-channel to an extent that cannot be confined within the limits of a single statistical framework, along with its transformations over time. The fundamental principle of the design is to proceed in a pre-data-determined and iterative sequence: first, to discover relationships; then, to test for causality and dynamic interaction; next, to separate short- and long-term components; to identify regimes in which relationships are rewritten according to periods; and finally, to measure predictive power in the short term. Therefore, the method follows a five-layer architecture consisting of (i) discovery and pre-processing, (ii) VAR/VECM and Granger multiple dynamic interaction, (iii) short- and long-term separation with ARDL–Bounds, (iv) regime and break analysis (Markov-switching and Bai-Perron), and (v) short-term forecasting with SARIMAX and evaluation of the predictive power of exogenous variables (Sims, 1980; Johansen, 1991; Hamilton, 1989; Pesaran, Shin & Smith, 2001; Bai & Perron, 1998, 2003).

Data and variables. The data universe compiled at monthly frequency consists of the residential property price index (RPPI), total residential property sales, mortgage sales, residential mortgage interest rate, USD/TRY exchange rate, CPI, and construction cost index, as well as building permit/occupancy indicators. The data coverage is 2012–2023; however, in series where the year-over-year (YoY) transformation is applied, the first 12 months of observation are naturally not used, and the main study period is reduced to 2013–2023. The definition and scope of official indicators are based on the methodological notes of the relevant institutions, thus ensuring consistency between definitions and international comparability (CBRT, 2025; TÜİK, 2025; BIS, 2026).

Pre-processing and transformations. Two types of transformations are used to reduce the risk of spurious correlation and co-trending in time series. The first is the logarithms of level series: $y_t^{tot} = \ln(S_t^{tot})$, $y_t^{mort} = \ln(S_t^{mort})$, $p_t = \ln(\text{RPPI}_t)$, $e_t = \ln(\text{USD/TRY}_t)$, $c_t = \ln(\text{CPI}_t)$, and $m_t = \ln(\text{Cost}_t)$. The second is annual change indicators: $\Delta_{12}\, x_t = 100 \times (\ln x_t - \ln x_{t-12})$ for percentage changes, and for interest rates the annual difference in percentage points is defined as $\Delta_{12}\, i_t = 100 \times (i_t - i_{t-12})$. During the discovery phase, correlations are reported via YoY transformation; in multivariate models, level-based (VAR/VECM, ARDL) and difference/log-difference-based (SARIMAX) representations are used together. In 2022, symmetric robustification is applied to prevent extreme values in some YoY indicators due to divisive base effects: trimming (winsorizing) at the ±300% limit applies only to the discovery phase; raw transformations are preserved in estimation and causality analyses. Missing observations are very limited; a common sample set is used in multiple models.

Exploration: Pearson/Spearman, rolling correlation, and cross-correlation. In the first layer, simultaneous linear and monotonic relationships between series are visualized using Pearson and Spearman correlations, while regime-sensitive changes in relationships over time are visualized using rolling correlations in 12- and 24-month windows. For the timing (lead-lag) structure, the cross-correlation function (CCF) is calculated within a ±24-month range. This step clarifies hypotheses that provide input for subsequent econometric stages—for example, "interest rate shocks appear first in mortgage sales, then in total sales," "exchange rate and CPI increases are reflected in the price index with a 1–2 month lag"—in a data-driven manner.

Multiple dynamic interactions: VAR/VECM, Granger, and IRF. Two blocks are defined in the second layer. Sales block: (y_t, y_t^m, i_t, c_t); and price block: (p_t, e_t, c_t, m_t). First, stationarity classification is performed in each series using ADF and KPSS tests; if most level series show I(1) findings and cointegration signals are observed

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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at levels, rank-r systems are estimated using the Johansen method (Johansen, 1991). VECM is estimated for cointegrated systems; otherwise, VAR is estimated for differences; the lag length p is determined by selecting an information criterion that considers AIC/HQ/BIC/FPE ratios together (Sims, 1980). To read dynamic responses, impulse response functions are reported over a 24-month horizon; the basic specification is done with Cholesky orthogonalization, while generalized response functions are also used as sensitivity checks to reduce ordering dependence (Pesaran & Shin, 1998). Granger causality tests are conducted bidirectionally through stationary representations (difference or VECM error correction); tests are evaluated in the 1–12 month lag band and at the 5% significance level (Granger, 1969). The purpose of this layer is to answer the question, who predicts whom, in a multivariate dynamic context and with explicit attention to the possibility of cointegration (Engle & Granger, 1987).

Short- and long-term distinction: ARDL–Bounds and UECM. In the third layer, ARDL class models are established for sales with two dependent variables (total and mortgage):

$$\ln S_t^{(k)} = \alpha_0 + \Sigma_{j=1}^{p} \alpha_j \ln S_{t-j}^{(k)} + \Sigma_{l=0}^{q_1} \beta_l i_{t-l} + \Sigma_{l=0}^{q_2} \gamma_l \ln(\text{USD/TRY})_{t-l} + \Sigma_{l=0}^{q_3} \delta_l \ln(\text{Cost})_{t-l} + u_t, \quad k \in \{\text{tot, mort}\}.$$

The lag orders are selected using AIC in the grid (p, q_1, q_2, q_3), with $p \leq 8$ and $q_k \leq 6$; the model is transformed into UECM form and the Pesaran–Shin–Smith bounds test (Case 3: constant, trendless) is applied (Pesaran et al., 2001). When the bounds test supports cointegration, the long-run coefficients are reported using the equation $\theta = -\beta/\varphi$ (where φ is the coefficient of the level term) and the error-correction speed $\varphi < 0$; the short-run effects are the coefficients of the terms marked Δ. The purpose of the ARDL layer is to disentangle how interest rates, exchange rates, and costs affect sales both immediately and at the equilibrium level.

Regime and break analysis: Markov-switching and Bai-Perron. The fourth layer tests the hypothesis that parameters are not constant over time using the data. With Markov-switching (MS) models, structures where regime-specific means and variances can jump are estimated in univariate annual change series; k = 2–3 regime candidates are compared using BIC, and smoothed probabilities are converted into episodes using the threshold $\pi \geq 0.6$ (Hamilton, 1989). In parallel, the Bai-Perron multiple break framework is applied with BIC minimization for a piecewise constant indicator model with at most two breaks (at least 12 months long) (Bai & Perron, 1998, 2003). Based on the obtained segments, regime-conditional OLS regressions are estimated with HC1 robust standard errors; the statistical significance of coefficient differences is tested using Wald tests in an interaction-term combined model. This layer quantitatively reveals, for example, why and to what extent the interest rate → mortgage sales relationship strengthened during periods of credit expansion, and why the CPI and cost → price relationship changed in sign and magnitude during shock years such as 2022 and 2023 (Hamilton, 1989; Bai & Perron, 1998, 2003).

Short-term forecasting: SARIMAX. In the fifth layer, short-term forecasts for Total Sales and RPPI are generated using univariate SARIMAX models (season 12). The external variable set (i_t, ln USD/TRY$_t$, ln CPI$_t$, ln Cost$_t$) is fed into the model with z-score standardization on the training sample; selection is made using AIC on the grids (p, d, q) and (P, D, Q, 12). The test horizon is 12 months; log-RMSE and sMAPE in the original scale are used as evaluation criteria (Hyndman & Koehler, 2006). The coefficients of the selected models are interpreted as a consistency check for the partial effects of the external variables; however, these coefficients are conditional relationships, not causal. Since the default forecast will be limited to carryover of the last value when external variable paths are not provided, the use of interest rate, exchange rate, inflation, and cost scenarios in policy applications is essential.

Specification, validation, and significance. The significance threshold for all tests is 5%; sensitivity to alternative thresholds (e.g., 1%) is considered. Order sensitivity in VAR/VECM IRFs is controlled using generalized responses (Pesaran & Shin, 1998). In the ARDL–Bounds test, the results are re-estimated with alternative deterministic components (Case 3) and lag bounds (8/6) to check for stability. In regime analysis, k-regime selection is performed using BIC; probability profiles and segment durations are reported for k=2/3. HC1 is used for sensitivity to heteroscedasticity in regime-conditional OLS outputs; the risk of multicollinearity

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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(especially the CPI-cost-exchange rate triad) is monitored using standardized beta coefficients and stepwise specifications.

Causality and interpretation principles. Granger causality is a conceptualization for forecasting purposes; it does not imply structural causality (Granger, 1969). VAR/VECM shocks can only be considered structural under the selected specification; therefore, final policy implications are based on overlapping findings from a multiple-model approach, including regime and break specifications. When cointegration is present, the VECM representation is reported along with short-run adjustment speeds (φ) and long-run level relationships (β) (Engle & Granger, 1987; Johansen, 1991).

Software and reproducibility. The analyses were conducted in an open-source scientific computing environment. All transformations, model selection rules, windows (12/24-month rolling; ±24 lag CCF), IRF horizon (24 months), ARDL and SARIMAX grids, and significance thresholds were pre-specified. Version control notes for the code and outputs have been archived in a reproducible workflow.

Limitations. Although data was obtained solely from official sources, annual change indicators are highly volatile during intense shock periods such as 2022–2023; therefore, trimming in the exploratory phase is for visualization and correlation purposes only. Regime-conditional regressions are subject to high uncertainty in short segments (N≈12); therefore, while Wald tests and standardized betas provide information on "direction and magnitude," robustness using more flexible frameworks such as MS-regression or TVP-VAR is recommended for definitive structural results (Hamilton, 1989; Primiceri, 2005).

4. Findings

The rhythm of the housing market is far from a simple rise-and-fall curve; the patterns we observe in the data show that relationships are rewritten over time, with the effects of some channels, which remain subdued during normal times, becoming pronounced during years of shock and credit expansion. We present the findings in a comprehensive flow, ranging from the discovery phase to multiple dynamic models, from long-short term distinctions to regime and break analysis and short-term forecasting performance. All analyses are monthly frequency and based on official statistics; the sample covers the period 2013–2023 (the first 12 months are excluded due to initial losses required by the annual change transformation).

4.1. Correlations, timing, and resilience

The table below (Table 1) shows the prominent simultaneous relationships based on year-over-year (YoY) changes. The meaning of the correlations is indicative: the sensitivity of mortgage sales to interest rate changes is negative and very strong; the residential property price index (RPPI) and inflation/costs are both positive and high.

Table 1. Static correlations (YoY)
(Pearson r / Spearman ρ; N ≈ 120–143 months; p < 0.01 unless otherwise stated)

Target (YoY)	Driver (YoY)	Pearson r	Spearman ρ	Comment
Mortgage Sales	Interest Rate (pp)	−0.786	−0.870	Very strong negative
Total Sales	Interest Rate (pp)	−0.420	−0.515	Moderately strong negative
Total Sales	Building Permit	+0.398	+0.123 (p≈0.10)	Medium, moving together
RPPI	CPI	+0.942	+0.398	Very strong positive (Pearson)
RPPI	Construction Cost	+0.918	+0.412	Very strong positive
RPPI	USD/TRY	+0.740	+0.445	Strong positive

Source: created by authors

The timing structure (which variable leads) was tested using the cross-correlation function (CCF). Table 2 reports the "best lag" where the highest absolute correlation is observed within a ±24-month band. The finding that the RPPI adjusts with a 1–2 month lag relative to CPI and costs, while the interest rate effect appears simultaneously in sales, is consistently repeated.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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Table 2. Best lag (±24 months) and correlation (YoY)

Target (YoY)	Driver (YoY)	Best lag (months)	Correlation	Comment
Total Sales	Interest Rate (pp)	0	−0.420	Strong negative correlation
Mortgage Sales	Interest Rate (pp)	0	−0.674	Simultaneous very strong negative
RPPI	USD/TRY	+2	+0.781	Exchange rate 2 months ahead
RPPI	CPI	+1	+0.951	Inflation 1 month ahead
RPPI	Cost	+2	+0.943	Cost 2 months ahead
Total Sales	Building Permit	0	+0.513	Simultaneous movement

Source: created by authors

Interim reading. While mortgage sales react instantly to interest rate changes, price dynamics "catch up" with cost and inflation shocks with short lags. This intuition has been tested more systematically in the following multi-dynamic framework (VAR/VECM).

4.2. Multivariate dynamic interaction: VAR/VECM, IRF, and Granger

Following stationarity tests on level series and lag selection, both blocks were specified as VECMs. Findings for the sales block (ln Total Sales, ln Mortgage Sales, i, ln CPI) and the price block (ln RPPI, ln USD/TRY, ln CPI, ln Cost) are summarized in Table 3.

Table 3. VAR/VECM selection and cointegration summary

System	Selected VAR lag (p)	Johansen rank (r)	Representation	Note
Sales block	12	3	VECM (k_diff=11)	Strong LR links
Price block	12	4	VECM (k_diff=11)	Near-full-rank link

Source: created by authors

Impulse Response Function (IRF) – summary: Interest rate shocks generate a negative response in mortgage and total sales; the intensity is higher in the mortgage channel. Exchange rate/CPI/cost shocks produce positive and significant effects on RPPI; the effect of CPI and cost shocks is particularly pronounced. Granger causality results (Table 4) provide a clear answer to the question "who predicts whom?": interest rates predict sales; there is a strong bidirectional predictive relationship between RPPI and CPI/cost/exchange rate.

Table 4. Granger causality summary (max. 12 months; lowest p-value and lag)

Direction (x → y)	Best lag	p-value	N	Comment
Interest → Mortgage Sales	11	1.53×10^{-5}	131	Strong forecast
Mortgage Sales → Interest	1	1.83×10^{-2}	131	Feedback
Interest → Total Sales	12	9.81×10^{-5}	131	Strong forecast
Total Sales → Interest	8	1.08×10^{-2}	131	Feedback
USD/TRY → RPPI	12	3.26×10^{-4}	142	Exchange rate
RPPI → USD/TRY	10	4.42×10^{-10}	142	Two-way
CPI → RPPI	12	1.28×10^{-19}	142	Very strong
RPPI → CPI	7	3.85×10^{-16}	142	Two-way
Cost → RPPI	12	1.54×10^{-25}	142	Very powerful
RPPI → Cost	5	2.19×10^{-16}	142	Two-way

Source: created by authors

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/p7382684759

Interim reading. The "bidirectional" Granger relationship in the sales–interest rate channel implies that credit conditions and sales are co-shaped; the bidirectional link between RPPI and macro price indicators suggests that simultaneous shocks prevail in inflationary regimes.

4.3. Short- and long-term distinction: ARDL–Bounds and ECM

ARDL models reliably provide both long-term coefficients and error-correction rates for sales. The null hypothesis of no cointegration was strongly rejected for both targets (Table 5).

Table 5. ARDL–Bounds tests (Case 3; 2013–2023)

Model	Selected ARDL	F_stat (Bounds)	p (upper/lower)	Decision
log(Total Sales)	(1,4,3,5)	13.77	1.53×10^{-9} / 4.05×10^{-11}	Cointegration exists
log(Mortgage Sales)	(1,2,3,5)	10.92	2.82×10^{-7} / 8.71×10^{-9}	Cointegration exists

Source: created by authors

Long-term coefficients and ECM rates (Table 6) provide a straightforward language for policy interpretation. A 1-point (0.01) increase in interest rates has an approximate effect of −1.8% on long-term Total Sales and approximately −8.2% on Mortgage Sales. The long-term effect of the exchange rate is positive on total sales and weakly negative on mortgage sales. The negative long-term effect of costs on total sales is noteworthy.

Table 6. ARDL long-term coefficients and error-correction rates

Target (log)	Interest Rate (level)	log(USD/TRY)	log(Cost)	ECM speed ϕ (y_{t−1})
Total Sales	−1.768	+0.598	−0.402	−0.675 ($p\approx6.1\times10^{-11}$)
Mortgage Sales	−8.238	−0.119	+0.314	−0.609 ($p\approx2.2\times10^{-9}$)

Source: created by authors

Comment. Long-term interest rate elasticity in the mortgage sales channel is approximately 4–5 times that of total sales. Error correction speeds are high ($|\phi|\approx0.6$–0.7): deviations from equilibrium close at a rate of 60–70% within one month.

Short-term effects (UECM) provide a "shock map." Table 7 summarizes the statistically significant short-run coefficients.

Table 7. Short-term (Δ) significant effects (UECM)

Model	Term	Coefficient	p
Total Sales	Δlog(USD/TRY)_t	+1.755	0.0039
	Δlog(Cost)_t	−2.931	0.0074
	ΔInterest_t−3	+3.965	0.0196
Mortgage Sales	ΔInterest_t	−6.448	0.0007
	Δlog(USD/TRY)_t	+1.419	0.0525
	Δlog(Cost)_{t−3}	−2.034	0.0516

Source: created by authors

Interim reading. In the short term, exchange rate shocks immediately boost total sales (forecast demand/substitution), while cost shocks immediately reduce them. As expected, interest rate shocks on mortgage sales produce an immediate negative effect.

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4.4. Regime and break analysis: Markov-switching and Bai-Perron

We tested the hypothesis that relationships do not remain constant over time using two complementary tools. We searched for regime-specific mean/variance in Markov-Switching univariate models and multiple breaks at unknown dates in the Bai-Perron framework. Probabilities obtained from MS classification were converted to episodes with a threshold ≥0.6; in BP, a minimum segment length of 12 months was assumed. Tables 8 and 9 report the Markov-switching regimes and Bai-Perron segments, respectively.

Table 8. Markov-switching regime structures (YoY, best k and regime means)

Series (YoY)	Best k (BIC)	Regime μ (approx.)	Regime episodes (≥0.6)
Total Sales	2	R1≈−1.6; R2≈+25.1	R2: 2019-11 → 2022-05
Mortgage Sales	3	Rlow≈−42.5; Rmid≈+14.1; Rhigh≈+151.6	Rhigh: August 2019 → August 2020; November 2021 → June 2022
RPPI	3	Rlow≈+11.1; Rmid≈+29.7; Rhigh≈+119.7	Rhigh: October 2021 → December 2023

Source: created by authors

Table 9. Bai-Perron (BIC) segments and average YoY

Series	Segment	Period	N	Average YoY (%)
Total Sales	1	2014-01 → 2019-10	70	+2.0
	2	November 2019 → June 2022	32	+25.1
	3	July 2022 → December 2023	18	−16.1
Mortgage Sales	1	January 2014 → July 2019	67	−9.1
	2	August 2019 → August 2020	13	+213.9
	3	September 2020 → December 2023	40	−15.5
RPPI	1	2013-01 → 2021-12	108	+15.1
	2	January 2022 → December 2022	12	+149.6
	3	January 2023 → December 2023	12	+105.6

Source: created by authors

Regime-conditional coefficients (OLS-HC1) are reported in Tables 10, 11, and 12 for total sales, mortgage sales, and RPPI, respectively. The same model was re-estimated on BP segments in different periods. Standardized beta coefficients allowed us to compare the relative strength of the effects.

Table 10. Regime-conditional coefficients: Total Sales (YoY)

Segment	Period	Interest Rate (pp)	USD/TRY (%)	CPI (%)	Cost (%)	Building Permit (%)	Note
1	2013/02–2021/12	−159.8 (p=0.003; β*) −0.50	+0.26 (p=0.058)	−0.01 (ns)	−0.11 (ns)	+0.062 (p=0.025; β*≈+0.25)	"Normal"
2	2022/01–2022/12	−664.3 (p<1e-7; β* −0.83)	+0.29 (p=0.10)	−3.93 (p=0.047; β* −1.32)	+3.81 (p<0.001; β* +2.07)	+0.277 (p≈2e-14; β* +0.65)	"Crisis-warming"
3	2023/01–2023/12	+235.7 (p<0.001; β* +1.27)	−0.98 (p=0.001; β* −1.83)	−3.08 (p<0.001; β* −2.98)	+3.22 (p<0.001; β* +5.02)	−0.228 (p<0.001; β* −0.54)	"Crisis-cooling"

Source: created by authors

Note. The sign change in the interest rate coefficient in 2023 should be interpreted as a regime-specific correlation under high inflation and cost shocks, policy adjustments, and possible multiple connections, rather than as a claim of structural causality.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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Table 11. Regime-conditional coefficients: Mortgage Sales (YoY)

Segment	Period	Interest Rate (pp)	USD/TRY (%)	CPI (%)	Cost (%)	Building Permit (%)
1	2014/01–2019/07	−851.7 ($p\approx6.2\times10^{-18}$; β* −0.89)	ns	ns	ns	ns
2	August 2019–July 2020	−3714 (p=0.064; β* −0.37)	−11.89 (p=0.0015)	ns	ns	+1.50 ($p\approx1.3\times10^{-10}$)
3	August 2020–December 2023	−395.8 (p=0.0069; β* −0.38)	ns	ns	ns	ns

Source: created by authors

Does the interest rate coefficient differ across regimes? Wald joint test in the interactive model: $\chi^2=101.62$, $p\approx8.6\times10^{-23}$ → yes, the interest rate effect is significantly different in the 2019–2020 window.

Table 12. Regime-conditional coefficients: RPPI (YoY)

Segment	Period	CPI (%)	Cost (%)	Interest Rate (pp)	USD/TRY (%)
1	2013/01–2021/12	−1.55 (p=0.00072)	+1.21 ($p\approx4.5\times10^{-11}$)	−69.1 (p=0.00036)	weak/uncertain
2	January 2022–December 2022	+3.30 ($p\approx1.5\times10^{-4}$)	−0.59 (ns)	unstable	unstable
3	2023/01–2023/12	~0 (ns)	+2.04 ($p\approx7.4\times10^{-6}$)	−239.1 ($p\approx8.6\times10^{-4}$)	weak/uncertain

Source: created by authors

Coefficient difference tests (Wald):
– CPI interactions (Seg-2 and Seg-3): $\chi^2=63.93$, $p\approx1.3\times10^{-14}$ → significant difference between regimes.
– Cost interactions (Seg-2 and Seg-3): $\chi^2=69.29$, $p\approx9.0\times10^{-16}$ → significant difference between regimes.
Interim reading. In normal periods, cost → price channel is dominant; in 2022, CPI → price relationship comes to the fore; in 2023, cost becomes dominant again. This finding is consistent with the long-term price-cost links indicated by the VAR/VECM and ARDL results.

4.5. Short-term forecast: SARIMAX performance and partial effects of exogenous variables

SARIMAX models measure short-term forecasting power with seasonal differencing and ARMA components alongside exogenous variables. One-step-ahead test performance over the last 12 months is shown in Table 13.

Table 13. SARIMAX model selection and test performance (12 months)

Target (log)	(p,d,q)	(P,D,Q,12)	AIC	RMSE (log)	sMAPE (%)
Total Sales	(0,1,2)	(1,0,0,12)	3.79	0.339	14.07
RPPI	(1,1,0)	(0,0,0,12)	−732.82	0.109	4.85

Source: created by authors

The external coefficients (partial effects) in the selected models are consistent with expectations: in the sales model, interest rate (−0.077; p≈0.011) and cost (−0.856; p≈0.032) are negative; CPI (+1.001; p≈0.020) is positive; USD/TRY is insignificant. In the RPPI model, the USD/TRY coefficient is small but significant (−0.044; $p<10^{-7}$); CPI and cost are marginally significant; interest rate is insignificant. These coefficients represent conditional relationships; they should be read in conjunction with VAR/VECM-ARDL findings for structural interpretations.

4.6. Synthesis of findings and policy implications

The overall picture converges on three axes. First, the impact of credit conditions (especially interest rates) on sales is strong, immediate, and significantly larger in the mortgage channel; in the long term, interest rate elasticity is 4–5 times greater in mortgage sales than in total sales. Second, on the pricing side, cost and inflation

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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shocks and exchange rate dynamics are reflected in the RPPI with short lags; CPI dominated in 2022, while costs regained dominance in 2023. Third, these relationships are regime-sensitive: the sign/magnitude of the coefficients may change during credit expansion/shock periods; therefore, single-period average coefficients are insufficient for policy calibration. Regime-conditional readings reveal both the asymmetry of the credit-interest rate response and the year-specific nature of the price-cost link. In short-term forecasting, low error values for RPPI (sMAPE ≈ 5%) and reasonable error values for sales (sMAPE ≈ 14%) indicate that scenario analyses based on exogenous variables are feasible.

5. Discussion

The findings of this study show that the Turkish housing market is too multi-layered and sensitive to periods to be explained by a single average effect. On one side of the link between sales and prices are credit conditions and interest rates, and on the other side are exchange rates, inflation, and cost dynamics; however, these links do not always operate in the same direction and with the same intensity. When discussing the resonance of the findings with the literature and their relationship to our research questions, it is necessary to consider both the dynamic-multivariate results (VAR/VECM, Granger) and the long-short term decompositions (ARDL–Bounds, UECM) and regime/break diagnoses (Markov-Switching, Bai-Perron) together.

Our first research question was whether the effects of interest rates, exchange rates, inflation, and costs differ significantly depending on the regime. The idea that parameters are not fixed in a non-stationary cycle is a fundamental insight of the Markov-switching and structural break literature (Hamilton, 1989; Bai & Perron, 1998, 2003). The picture we found is fully consistent with this insight: mortgage sales respond strongly and negatively to interest rates during "normal" periods, while the intensity of this response increases markedly during credit expansion episodes (e.g., late 2019–mid-2020); During the price level shock in 2022 and the cooling period in 2023, the magnitude and even the sign of the coefficients can vary in terms of total sales. This fluctuation aligns closely with models that theoretically ground the "financial accelerator" role of housing through the nature of the credit contract and the leverage it carries (Kiyotaki & Moore, 1997; Iacoviello, 2005): collateral values, borrowing capacity, and interest rate dynamics make the reflection of shocks on the market regime-dependent. The finding that the impact of monetary policy on housing increased as the share of variable-rate mortgages and mortgage architecture grew in the European experience (Calza, Monacelli, & Stracca, 2013) bears a meaningful resemblance to the fact that the interest rate elasticity of mortgage sales in Turkey is much higher than that of total sales. Our findings show that this channel operates permanently and strongly in normal periods and exceptionally strongly during credit expansion episodes.

Our second research question was whether the answer to "who predicts whom?" varies depending on the regime. In a multivariate setting, Granger causality, while not claiming structural causality (Granger, 1969), provides a clear window into timing and predictive power. Finding a bidirectional Granger relationship in the sales–interest rate pair shows that credit conditions and sales are co-shaped: interest rate shocks predict sales, while unexpected movements in sales also produce feedback on credit conditions. This finding, when considered alongside empirical evidence (Favara & Imbs, 2015) that regulatory-driven externalities in credit supply have significant effects on housing prices and activity, implies that the opening and closing of credit taps in the Turkish case also periodically reset the predictive direction. On the price side, the two-way Granger relationships between CPI, costs, exchange rates, and RPPI—particularly in 2022—suggest the simultaneity of supply-demand shocks in inflationary regimes. This is consistent with the mechanism documented in studies (Campa & Goldberg, 2005) that strengthen the short-term cost channel of the pass-through from the exchange rate to import prices.

Our third research question concerned long-term relationships and error correction dynamics. The presence of cointegration (Johansen, 1991; Engle & Granger, 1987) is strong in our findings and confirmed by ARDL–Bounds tests (Pesaran, Shin, & Smith, 2001). The long-term coefficients we obtained for sales indicate that an interest rate increase reduces total sales by approximately 1.8% at the equilibrium level and mortgage sales by 8.2%; error correction speeds imply that 60–70% of the deviation is closed within one month. This is consistent with theoretical evidence suggesting that housing's collateral function shapes long-term behavior (Iacoviello, 2005) and findings pointing to the medium-term shadow effect on growth in the household leverage cycle

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/p7382684759

literature (Mian, Sufi, & Verner, 2017). On the price side, the strength of the long-term link between costs and inflation resonates with key findings in the supply elasticity literature: geographic and regulatory constraints limit the supply response, making the pass-through of cost shocks to prices persistent (Saiz, 2010; Davis & Heathcote, 2005). The short-term transmission of exchange rate changes to the CPI through the cost and inflation channels is also consistent with the transition findings in the open economy framework (Campa & Goldberg, 2005). In the regime analysis, the dominance of the CPI → price link in 2022 and the return of the cost → price link to prominence in 2023 suggests that cost dynamics regained control over pricing behavior after the year in which the inflation shock peaked.

Our fourth question was the contribution of regime/break information to short-term forecasting. SARIMAX results confirmed low error for RPPI (sMAPE ≈ 5%) and reasonable error for sales (≈ 14%), indicating that forecasting based on exogenous macro series is feasible. However, two caveats are important here. First, the exogenous coefficients in univariate models are conditional and partial relationships; multivariate frameworks should be preferred for structural interpretations (Sims, 1980). Second, structures such as TVP-SVAR or MS-AR (Primiceri, 2005; Hamilton, 1989), which embed regime/break information directly into the forecasting mechanism, can improve forecast performance, especially in short but intense episodes such as 2022–2023. Therefore, in an economy where regime shifts are becoming more frequent, it is possible to say that forecasts built on the assumption of parameter stability may increasingly show weaker performance; conversely, regime-sensitive frameworks will gain value.

When discussing the policy implications of the findings, two levels of results stand out. First, the credit-interest rate channel: the interest rate elasticity of mortgage sales is many times higher than that of total sales; this implies that the measured and targeted use of borrower-based macroprudential tools (maturity limits, LTV/DTI caps) during periods of credit expansion can preemptively soften the severity of the cycle. The excessively strong impact of interest rate shocks during credit expansion episodes is consistent with findings in the literature explaining why the acceleration in housing prices and activity is higher during periods of exogenous credit supply expansion (Favara & Imbs, 2015). Second, the price-cost channel: the CPI dominance in 2022 and the return of cost dominance in 2023 show that pricing behavior is sensitive to the type of shock in the short term; which points to the need to discuss supply-side policies targeting cost components and the share of imported inputs (cost frictions in input imports, supply chain bottlenecks, local supply constraints) alongside price stability. In an environment of low supply elasticity, demand-side factors are expected to be reflected in prices more quickly and more significantly (Saiz, 2010). Ultimately, all these results are consistent with the macroprudential framework emphasized by the BIS and similar institutions in recent years: a policy mix targeting not just one instrument, but the trio of credit, price stability, and supply (BIS, 2023).

Of course, there are limitations. In segments as long as 12 months, such as 2022 and 2023, the standard errors of regime-conditional coefficients are relatively large; sign changes (e.g., a positive sign for interest rates in total sales in 2023) may indicate not a causal transformation, but simultaneous policy steps, data revisions, or an increase in multiple linkages in price components. Therefore, even if the Wald tests for coefficient differences are highly significant, the results should be interpreted as regime-specific correlations with a wider confidence interval. Furthermore, our framework does not include designs that use natural experiments or instrumental variables to strengthen causality; the approach of studies in the literature that instrumentalize regulatory shocks such as branch deregulation (Favara & Imbs, 2015) could also be tested in the Turkish context, provided that appropriate data is available. Likewise, extensions such as TVP-SVAR and MS-regression, which track parameter migration continuously, will offer a more flexible scheme for “short but intense” periods such as 2022–2023 (Hamilton, 1989; Primiceri, 2005).

In summary, we provide positive and discriminative answers to all of our research questions: (i) Yes, interest rate/exchange rate/inflation/cost effects differ significantly across regimes; (ii) Yes, Granger directions reshape themselves according to episodes; (iii) Yes, there are long-term relationships in sales and prices, and the error correction mechanism is fast; (iv) Yes, single-variable forecasts fed by regime/break information are applicable and provide a usable framework for policy discussions. When the housing market is read this way, it becomes clear that not only “today” but also which regime we are in determines the conditions for policy success: when the rhythm of cost dynamics matches the opening and closing of credit taps, price stability can slip away even

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p7382684759

as the economy expands; conversely, even if costs stabilize, the credit channel may continue to exert pressure. Therefore, the decision set—interest rates, macroprudential calibration, and supply-side easing—must be regime-conditional, data-calibrated, and time-sensitive.

Conclusions

This study shows that the Turkish housing market is governed by regime-sensitive interactions rather than stable average relationships. Interest rates exert the strongest effect through the mortgage-sales channel; exchange-rate, inflation, and construction-cost shocks feed into prices with short lags; and the strength and even the sign of some relationships change across expansion, shock, and cooling episodes.

The main novelty of the study is the integration of rolling correlations, VAR/VECM, Granger causality, ARDL–Bounds, Markov-switching, Bai-Perron, and SARIMAX within a single empirical framework built on official monthly data for 2013–2023. This design makes it possible to identify not only whether variables are related, but also when the relationship changes, how quickly equilibrium is restored, and which channels dominate under different macro-financial conditions.

The findings imply that policy calibration in Turkey's housing market should be regime-conditional. Measures targeting credit conditions, mortgage affordability, construction costs, and supply bottlenecks need to be coordinated rather than used in isolation, and scenario-based monitoring is especially important when inflation, exchange rates, and financing conditions shift simultaneously.

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Data Availability Statement: The data used in this study are publicly available from the Central Bank of the Republic of Türkiye (CBRT), the Turkish Statistical Institute (TÜİK), and the BIS Data Portal.

Author Contributions: Conceptualization: *Bahman Peyravi and Mehmet Recai Uygur*; methodology: *Bahman Peyravi, Mehmet Recai Uygur, and Mehmet Emre Çamlıbel*; formal analysis and data curation: *Bahman Peyravi and Gediminas Blaževičius*; writing, original draft preparation: *Bahman Peyravi and Mehmet Recai Uygur*; writing, review and editing: *all authors*; visualization: *Gediminas Blaževičius and Mehmet Emre Çamlıbel*; supervision: *Mehmet Recai Uygur*. All authors have read and agreed to the published version of the manuscript.

ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p7382684759

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ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/y7694967765

Publisher
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INFLUENCE OF SOCIAL MEDIA USE ON HR MARKETING TOOLS IN RECRUITMENT

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Received 18 January 2026; accepted 29 March 2026; published 30 June 2026

Abstract. This quantitative study examines the impact of social media on the use of HR marketing tools within organizational recruitment processes. Understanding the growing significance of digital platforms and their impact on recruitment strategies is essential, requiring the adaptation of HR marketing approaches to dynamic work environment. Employing a quantitative research design, data were collected through a questionnaire survey and subsequently analysed using descriptive statistics, Chi-square tests, Cronbach ´s α and Cramér´s V to identify relationships between the use of social media and the application of other HR marketing tools. The study involved 215 organizations of varying sizes and sectors operating in the Czech Republic and Slovakia. The findings revealed distinct trends in the use of digital versus traditional recruitment methods. Organizations that utilize social media tend to employ online advertising and company websites, while the application to traditional methods was less common. The results further highlight the importance of social media as a component of employer branding, particularly in engaging younger generations of job seekers. Overall, the active integration of social media into HR marketing strategies appears to be a key factor in enhancing the effectiveness of recruitment processes and improving organizational adaptability to evolving labour market conditions.

Keywords: HR marketing; employer branding; social media

Reference to this paper should be made as follows: Procházková, M. 2026. Influence of social media on the use of HR marketing tools in recruitment. *Entrepreneurship and Sustainability Issues*, 13(4), 250-264. http://doi.org/10.9770/y7694967765

JEL Classifications: M12, M50, O15

1. Introduction

Current trends in human resource management reflect a pronounced transformation of traditional practices, driven primarily by digitalization and the growing importance of information and communication technologies (ICT). In this context, HR marketing has emerged as a strategic tool for enhancing employer attractiveness, strengthening employee engagement, and effectively reaching prospective job candidates. By integrating principles of HR management and marketing, HR marketing redefines the conventional understanding of the customer, the external customer is viewed as a potential employee, while the internal customer is the organization´s current workforce. Rising competition in the labour market, particularly in sectors with a high demand for qualified professionals (IT, engineering, healthcare), is prompting organizations to adopt more proactive strategies for talent acquisition and retention. As highlighted in numerous recent studies, employee loyalty, engagement, and willingness to contribute to the long-term success of an organization can no longer be assumed. In this context, cultivating an appealing and credible employer image, the so-called employer branding, has become a key component of gaining a competitive edge. Effective HR marketing must therefore address not only the substance of job offers, but also the communication

[*] *This paper has been prepared with support with the support of the VSTE Institute of Corporate Strategy, Department of Human Resource Management, Czech Republic.*

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/y7694967765

style and employer approach, ensuring alignment with the expectations, values, and lifestyles of the target audience.

In recent years, recruitment processes have undergone a significant shift towards digitalization. Online HR marketing tools, including corporate websites, professional platforms (e.g., LinkedIn), and social media (such as Facebook, Instagram, YouTube, and TikTok), are being increasingly used as primary channels for communication with target applicant groups. This transformation is largely driven by generational changes in the labour market, as younger generations (particularly Generation Z) spend a substantial portion of their time in digital environments. Generation Z thus expects a similar standard of communication from prospective employers.

Organizations in the Czech Republic and Slovakia have recently shown growing interest in the implementation of HR marketing tools. However, the extent and depth of their adoption, particularly of online channels, vary considerably across industries. Small and medium-sized enterprises (SMEs), as well as family-owned businesses, often encounter obstacles such as a lack of expertise, limited internal capacity, and the absence of a clear strategic vision for digital HR marketing. Further regional specificity is the dominance of local job portals, such as *Pracuj.cz* or *Profesia.sk*, which play a central role in shaping employers´ recruitment practices and serve as alternatives to global platforms like LinkedIn. The Czech and Slovak labour markets are also marked by demographic aging, a persistent outflow of talent to Western countries (especially Germany and Austria), and constrained HR budgets in many organizations. These factors jointly contribute to a unique and challenging environment for the development of HR marketing.

Although HR marketing has been the focus of many international studies, research specifically focused on the Central European context remains limited. This research gap is particularly significant given that the Czech Republic and Slovakia are shaped by a unique combination off demographic, economic, and institutional factors that distinguish these markets from more developed Western ones. As a result, current scholarship does not fully capture how HR marketing strategies evolve in this specific environment, nor which tools prove most effective. This study seeks to address this research gap by offering empirical insights into the use of social media and its relationship with other HR marketing practices in the Central European context.

The objective of this study is to examine the role of social media platforms in the recruitment processes of organizations in Central Europe and to assess their potential influence on the implementation of other HR marketing tools. The analysis is based on quantitative data collected from a representative sample of organizations and investigates statistical correlations between the use of social networks and the application of selected recruitment methods. The findings contribute to a more nuanced understanding of the diversity of recruitment strategies in the digital era and may serve as a basis for designing more targeted and effective HR marketing initiatives tailored to the specific conditions of the Central European labour market.

2. Theoretical background

The current labour market is characterised by intense competition, which significantly influences the processes of attracting and retaining qualified employees. Attracting high-quality employees is no longer a given. It demands a systematic approach and the implementation of proactive recruitment strategies. As a result, organizations increasingly seek to position themselves as attractive employers and to distinguish their employer brand from competitors. In this context, HR marketing emerges as a strategic instrument that can enhance an organization´s competitive advantage and reinforce its distinct identity in the labour market.

CSR has significantly improved employee perception and engagement. CSR strengthens social support, diversity, health and safety, and equal treatment at both levels of management (Haque et al., 2020). In small and micro enterprises, there is more room for creating a creative corporate culture that is based on interpersonal relationships and shared values. These values are mainly the knowledge of the meaning of work, communication, passion and support. Values associated with the organization of work, such as creating a safe working environment, cooperation and responsibility, gain in importance as the business entity grows (Balková et al. 2022).

In other countries, and increasingly in the Czech Republic and Slovakia, more attention is being paid to attracting and retaining talented employees. Employee loyalty and the impact of the use of HR marketing tools have been examined in numerous studies. Organizations need to hire employees with expert knowledge, skills, and abilities

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/y7694967765

(Gilch & Sieweke, 2021). It is not uncommon for talented and high-performing employees to be actively recruited across different business sectors. The first step in recruitment is to attract job seekers and motivate them to apply for a position (Giannakis et al., 2015). HR departments are the core of the organization and reflect all expectations in terms of performance, motivation, and business sustainability. In light of this, HR managers need to adopt marketing techniques to attract future employees.

The way human resources are managed plays a crucial role in determining an organization's overall performance. A company's success, resilience, and ability to respond effectively to the challenges of a competitive labor market depend not only on securing sufficient human capital but also on the efficiency with which it is utilized. The human factor remains a key determinant of organizational quality, and investments in the development of human resources are widely recognized as contributing to long-term performance and sustainability.

Traditional recruitment methods, which were predominant until the late 1990s, are now gradually being replaced by more modern approaches that increasingly leverage emerging technologies (Ahmed, 2018). Recruitment can be classified as either external or internal, depending on the scope of the activity. However, it is also essential to consider the time aspect of recruitment, as organizations may face urgent hiring needs due to unforeseen circumstances (such as the sudden departure of an employee or a serious breach of discipline), or they may engage in planned recruitment over a longer time horizon. In both cases, the recruitment process is structured to provide employers with as much relevant information as possible about applicants´ qualifications and characteristics (Gerxhani & Koster, 2015). Human resources represent one of the key sources of a company´s competitiveness. To gain a competitive advantage through human capital, organizations must utilize all available tools, including marketing models. Companies that successfully apply HR marketing principles tend to rely heavily on social media promotion. Given the diversity of available platforms, HR professionals can choose from a broad range of channels. The effectiveness of employer branding communication can be significantly enhanced through the strategic selection of appropriate social media platforms (Shen, 2023).

The traditionally adopted recruitment process model, which assigns recruitment quotas across different stages of the process, is often considered a highly subjective approach. As a result, satisfactory recruitment outcomes may not be achieved due to the absence of robust quantitative analysis (Miao et al., 2022). To ensure a quality recruitment process, it is essential to approach each hiring with creativity and flexibility (Negrin et al., 2022). HR marketing experts emphasize the importance of addressing multiple dimensions during recruitment, from organizational structure, workplace culture, and environment, to effectively reaching the right target groups of potential candidates (Van Dierendonck et al., 2016; Van Esch et al., 2019). Ongoing changes in technological, socioeconomic, and cultural environments have intensified competition for talent, making human resources a crucial factor in creating and maintaining a competitive organization. The ability to attract high-quality human capital depends largely on the effective use of HR marketing tools, particularly those related to employer branding.

Social networks are increasingly being used in both personal and professional spheres. Numerous studies confirm the benefits of social media application for enhancing engagement, communication, and reach within human resource management (Nyusani & Mabungela, 2025). Social networks can also serve as tools for analysing the behaviour of customers, employees, and even entire organizations (Panuš, 2023). Research indicates that the vast majority of employees believe that social media not only improves workplace relationships but also significantly supports decision-making processes (Bizzi, 2018).

Social platforms provide the digital infrastructure for social and economic activities and play a transformative role in shaping both business operations and social interactions. Social platforms also facilitate access to valuable resources for individuals and groups, thus contributing to the protection and promotion of public interests. Understanding the role of the platforms in supporting the common good in the context of HR marketing requires attention to the complex interplay of market dynamics, state influence, and civil society engagement (Chang & Zhang, 2024). For instance, LinkedIn enhances labour market transparency, enabling candidates to better understand job requirements and opportunities. This increased transparency helps reduce information asymmetry between employers and job seekers (Kostrzewska, 2024).

Negrin et al. recommend adopting a multimodal recruitment strategy to enhance the engagement of job seekers. A comprehensive approach integrating both active and passive recruitment methods has been shown to yield greater

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success, not only in attracting applicants but also in facilitating their registration (Negrin, et al., 2022). Small and medium-sized enterprises (SMEs) demonstrate a high capacity for adapting their human resources practices, combining cost-effective measures with increased flexibility, often through the application of relatively recent and proactive approaches to HR decision-making. Furthermore, current research indicates a growing tendency among SMEs to adopt new developmental trends, including the rising demand for multitasking, highly skilled workers, and professionals. This evolving demand is reflected in HR practices that prioritize efficiency and seek to balance operational flexibility with the strategic management of talent (Li et al., 2024).

In external labour markets, knowledge related to human resources and marketing is primarily disseminated through social networks, educational institutions, and business consultancy services (Conrad & Mayer-Ohle, 2024). At the theoretical level, the application of social identity theory is an important aspect in examining the relationship between HR marketing and innovative work behaviour. At the managerial level, raising awareness among managers concerning the strategic role of HR marketing contributes to fostering innovation within organizations. This is also related to the extent to which social media platforms are used as tools to present and shape the organizational image (Zekri et al., 2024). To maintain and enhance their competitiveness in the labour market, organizations are recommended to observe and benchmark the practices of other entities. They should learn to compare the applicability of HR marketing tools across various industry sectors. Changes in HR marketing, particularly those involving the use and application of social media, contribute to the continuous development of organizational knowledge. Existing studies in this field support the view that effective knowledge management enhances marketing competencies among employees, boosts customer satisfaction, and ultimately improves both H marketing practices and overall employee performance (Palanivelu & Saranya, 2020).

Bejtkovský (2020) examines the relationship between the organization size and the extent of social media utilization. His study builds on previous research in this area, confirming that there is no statistically significant correlation between the size or an organization and its active use of social media platforms as HR marketing tools. However, the author identifies a significant relationship between the application of social media as tools for external communication with general public, including public relations, promotion, and recruitment activities conducted by HR professionals. The research further highlights the importance of IT competence and the proactive use of IT technologies in the field of HR management (Bejtkovsky, 2020). The integration of artificial intelligence (AI) into recruitment processes is transforming talent acquisition by enhancing efficiency, promoting fairness, and enabling data-driven decision-making (Kulal et al., 2024).

The results indicate a correlation between innovative organizations, recognized for their technological advancement and financial stability, and their attractiveness to potential employees. Such companies are often perceived as offering better career development opportunities, competitive compensation, and enhanced job security. This dynamic may be particularly appealing to individuals with financial obligations, such as loans, due to the promise of long-term stability and professional growth.

Similarly, certain racial and ethnic communities perceive technology-driven companies as frequently associated with innovation, progressiveness, and inclusive workplace cultures. This perception reinforces their appeal as desirable employers. To capitalize on these advantages, organizations may implement digital recruitment strategies aimed at optimizing both hiring and onboarding processes. These strategies not only facilitate the replacement of traditional procedures but also enable the deployment of digital tools and resources, thereby enhancing operational efficiency and employee engagement (Bou Hatoum & Nassereddine, 2025).

Employees tend to perceive their employer´s brand as more attractive when the organization is viewed as successful, its products or services are highly regarded, and its external image is considered appealing. The application of branding principles to human resources fosters a system in which managers are encouraged to engage in internal communication that cultivated employee pride in being associated with a desirable and reputable employer (Grigore et al., 2023).

Employer branding (EB) significantly influences an organization´s performance across multiple dimensions, such as HRM, finance, innovations, and quality. A well-developed EB benefits both employees and employers in multinational corporations, especially during periods of crisis (Stor & Haromszeki, 2025). AI is being increasingly integrated into HR management, particularly in recruitment. Candidates generally respond positively to AI,

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appreciating especially its role in promoting innovations and development. The use of AI in combination with professional and personal data, however, may elicit reservations, with some candidates choosing not to apply for certain positions as a result. Over time, organizations have begun to expand AI applications beyond recruitment, incorporating it into broader HR marketing efforts to maintain transparent and timely communication with candidates. Consequently, AI-based strategies are increasingly oriented towards human-centered design and foster relational dynamics with applicants (Tursunbayeva et al., 2025).

3. Research objective and methodology

The objective of the paper, which draws on both quantitative and qualitative data analysis, is to investigate the impact of social media use in HR marketing. The study seeks to examine whether organizations that utilize social media also tend to implement a broader range of HR marketing tools and how they evaluate the effectiveness of these tools when used in combination. The main research question is formulated as follows:

Is there a significant relationship between the use of social media and the perceived effectiveness of individual HR marketing tools?

In line with the research question, alternative and null hypotheses are formulated as follows:
Null hypothesis (H0): The use of social media by companies does not significantly influence the use of other HR marketing tools.

Alternative hypothesis (H1): There is a significant relationship between the use of social media and utilization of other HR marketing tools.

Data were collected between autumn 2023 and spring 2024 using a questionnaire survey involving 215 companies of various size categories operating in the Czech Republic or Slovakia. A non-probability sampling method was employed to determine the core sample of respondents. The selected companies were categorized by size into micro, small, medium-sized, and large enterprises. The companies were further differentiated based on their sector of activity. This broad sample aimed to ensure reliability and relevance of the results. The final sample included only companies that had been economically active within the past five years and whose data could be verified. Preference was given to organizations that had demonstrably implemented HR marketing tools in their operations.

For the purposes of this research, a total of 303 questionnaires were distributed. Out of these, 231 questionnaires were returned, resulting in a gross response rate of approximately 76%. After verifying the completeness and validity of the responses, 16 questionnaires were excluded from the analysis. As a result, 215 duly completed questionnaires were included in the final analysis. The resulting net response rate was therefore 71%.

Gross response rate $$\frac{231}{303} * 100 = 76.2\ \% \quad (1)$$

Net response rate $$\frac{231-16}{303} * 100 = 70.90\ \% \quad (2)$$

The mathematical and statistical analyses were conducted using IBM SPSS 29 software (Statistical Package for Social Sciences). Key factors were summarized using descriptive statistics, providing an overview of current trends in the use of social networks in HR marketing practice. Following the analysis of the data collected, comparative tests were conducted using the chi-square test to determine whether significant relationship existed between categorical variables within the sample.

To assess the reliability of the scales used, internal consistency was measured using Cronbach's alpha coefficient. This coefficient is based on the variance analysis of individual items and their total score. The value of Cronbach's alpha ranges from 0 to 1, with higher values indicating greater internal consistency. Generally, values above 0.7 are

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considered acceptable, values above 0.8 are considered good, and values above 0.9 are considered excellent (George & Mallery, 2023). The practical application of Cronbach´s α lay in its ability to determine whether individual items within a given scale could be aggregated (e.g., summed or averaged) and subsequently treated as a single composite indicator. A low reliability o score would indicate weak internal consistency of the items, suggesting the need to revise, reduce, or divide them into separate scales. In the present study, Cronbach´s α was used to verify the reliability of a group of questions related to the use of internal and external human resource marketing tools. This practice ensured the validity of the subsequent statistical analyses that used these constructs.

Formula for calculating Cronbach ´s α

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum_{i=1}^{k} \sigma 2_i}{\sigma 2_t}\right) \quad (3)$$

where:

k = number of items within a scale,
σ^2_i = variance of individual items,
σ^2_t = variance of the total score (the sum of all items).

The above formula indicates that the value of Cronbach´s α depends both on the number of items and on their internal homogeneity (correlations). The higher the correlations and the greater the number of items in the scale, the higher the resulting value of α.

To assess the strength of the identified relationships between categorical variables, Cramér´s V effect size was used. This coefficient is derived from the result of the chi-square test and enables determining the degree of dependence between variables independently of the sample size (Cohen, 2013). Given that the analysed contingency tables were in a 2×2 format, a simplified formula was applied:

$$V = \sqrt{\frac{x^2}{n}} \quad (4)$$

Where:
$\chi 2$ = value of chi-square test,
n = number of valid cases.

The value of Cramér´s V ranged between 0 and 1, with higher values indicating a stronger relationship between the variables. The interpretation of the effect size usually follows Cohen´s (1988), where values around 0.10 indicate a weak effect, values around 0.30 a medium effect, and values above 0.50 a strong effect. Including the effect size in the analysis enabled not only assessing the statistical significance of the results but also their practical relevance, thereby enhancing the overall robustness and explanatory value of the research. To test the main hypotheses, binary logistic regression was applied, enabling the modelling of the probability of a specific dichotomous dependent variable based on the values of independent predictors (Hosmer et al., 2013). This method was suitable in cases where the dependent variable was categorical and had two possible outcomes (e.g., uses/does not use social networks). In the model, the dependent variable was "use of social networks" (0 = does not use, 1 = uses). The independent variables included selected HR marketing tools, specifically, the use of corporate websites, online advertising, and supervising student work (all coded as dichotomous variables). The model´s suitability was evaluated through the statistical significance of the model (χ^2 test), the degree of explained variance (Nagelkerke´s R^2), and classification accuracy. To assess the effect of individual predictors, odds ratios (Exp(B)) were interpreted, indicating how many times the likelihood of social network usage increased (or decreased) based on the presence of a given factor.

4. Research outcomes

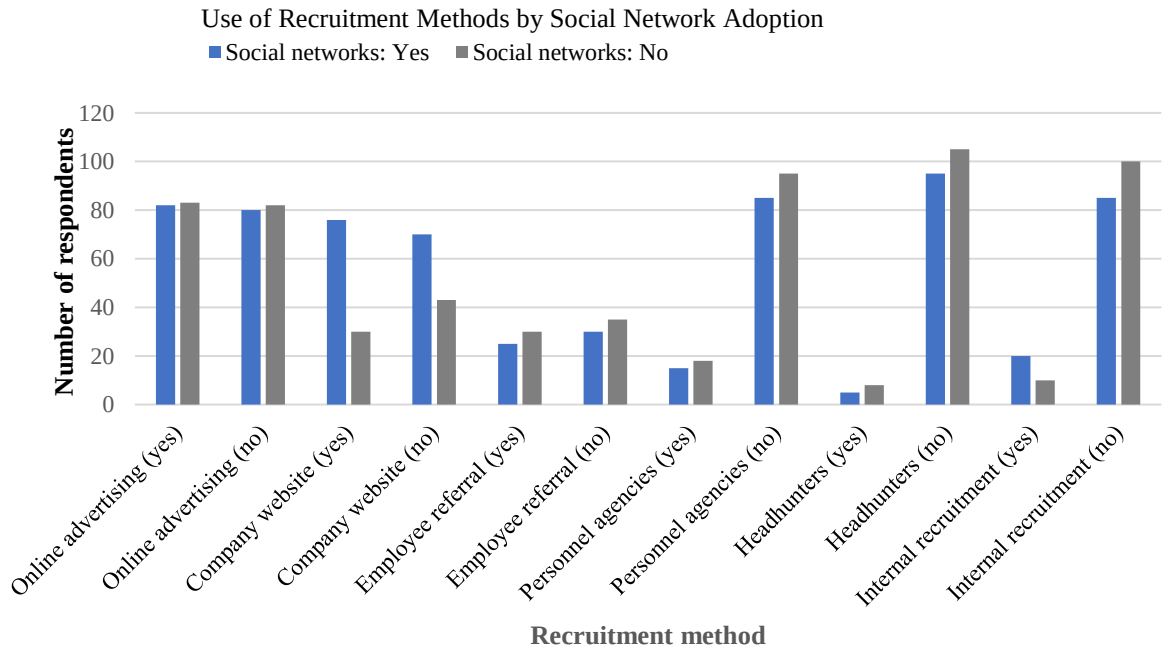
The statistical analysis examined the relationship between social media engagement and the use of specific HR marketing tools. Results are presented in sequence according to the analytical methods applied, with each table and figure referenced in the text. Results summarize the relationship between the use of social networks and other

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recruitment methods. Among the 215 organizations, 102 reported social media activity. The data indicate that firms using social media are more likely to apply online advertising (80 out of 102) and to operate corporate websites (79 out of 102). Conversely, traditional tools such as recruitment agencies, head hunters, or direct marketing appear less connected to digital engagement.

The results suggest that even non-users of social media often apply some online forms of recruitment, but active users systematically combine multiple digital channels. The relationship between social media activity and internal recruitment proved statistically significant ($p < 0.05$), implying that organizations with active online presence are also more likely to develop internal talent pipelines. Other relationships, for instance, with employee referrals, were not significant.

The findings discussed above and summarised in the graph (Figure 1) are derived from a single comprehensive cross-tabulation. This table facilitates the examination of interactions between social media use and various recruitment aspects, including online advertising, partnerships with recruitment agencies, employee referrals, internal recruitment, and contact with headhunters. While some relationships were found to be statistically significant (e.g., internal recruitment), others were not (e.g., employee referrals). As such, the data provide a valuable foundation for gaining deeper insight into how digital engagement may influence organizational recruitment strategies.



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Figure 1. Comparison of the use of recruitment methods according to social media engagement
Source: own procesing

The chi-square analysis confirmed a significant relationship between overall social media engagement and respondents' recruitment preferences ($\chi^2 = 4.682$, $p = 0.030$). Fisher's exact test ($p = 0.038$) supported this conclusion, allowing rejection of the null hypothesis. Thus, social media activity correlates with the choice of recruitment practices, suggesting that digitally active firms shape their HR marketing accordingly. In contrast, results show that social media engagement and supervision of student work are not significantly related ($\chi^2 = 1.680$, $p = 0.195$). Both the likelihood ratio and Fisher's exact test ($p = 0.232$) confirmed independence between these variables. Consequently, cooperation with educational institutions does not depend on social media usage. Similarly, results also report no statistically significant link between social media activity and the use of online advertising ($\chi^2 = 0.993$, $p = 0.319$). Although these channels often coexist, the correlation is not strong enough to be significant within this

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dataset. The independence of variables indicates that online advertising and social media can function as parallel but separate recruitment strategies.

A statistically significant association was found between social media engagement and website ownership ($\chi^2 = 6.057$, $p = 0.014$). Organizations that maintain corporate websites are considerably more active on social media, reflecting integrated digital behaviour. This result underscores that online visibility through a corporate website often coincides with an active social media presence. Results demonstrate that referrals from current employees are not influenced by social media usage ($\chi^2 = 0.020$, $p = 0.887$). Hence, recommendations remain a traditional internal recruitment mechanism independent of digital activity.

The analysis of interactions with recruitment agencies yielded no significant relationship ($\chi^2 = 0.485$, $p = 0.486$). Whether a company engages external agencies appears unaffected by its social media activity, suggesting that these services fulfil distinct recruitment functions. A significant relationship was observed between social media engagement and cooperation with headhunters ($\chi^2 = 4.515$, $p = 0.034$). Although the absolute number of cases is small, Fisher's test ($p = 0.049$) supports this association. Active use of social networks thus tends to accompany professional networking and contact with specialized recruiters, even if the overall prevalence is limited.

Finally, results confirm a significant relationship between social media engagement and internal recruitment ($\chi^2 = 5.168$, $p = 0.023$). Companies active on social networks more frequently conduct internal recruitment, which may reflect stronger internal communication and employer branding consistency. Figure 1 and Table 1 jointly show that social media presence complements, rather than replaces, internal HR processes. Reliability testing using Cronbach's α demonstrated high internal consistency for both scales: $\alpha = 0.93$ for external and $\alpha = 0.79$ for internal HR marketing tools. These results confirm that the items measured coherent constructs suitable for further statistical interpretation. Effect sizes calculated through Cramér's V ranged from 0.06 to 0.17, corresponding to weak associations. Even when significance was observed, practical effects remained small. This pattern indicates that HR marketing tools operate as largely independent components adopted selectively according to company needs.

Table 1. Results of binary logistics regression: relationship between recruitment methods and social media engagement

	B	**S.E.**	**Wald p**	**OR**	**CI 95% low**	**CI 95% high**
Const	-8.953	7.424	0.2278	0	0	269.73
Online_rev	2.375	0.95	0.0124	10.76	1.67	69.18
Internal_recruit_rev	-0.122	1.754	0.9447	0.89	0.03	27.54
Headhunters_rev	1.61	2.121	0.448	5	0.08	319.68
N	212	-	-	-	-	-
Model χ^2	47.404	-	-	-	-	-
Nagelkerke R^2	0.882	-	-	-	-	-
Accuracy (0.5)	0.991	-	-	-	-	-
B – estimated logistic regression coefficient						
S.E. – standard error of the coefficient						
Wald p. – Wald test						
Exp(B) – exponential coefficient B						
95% C.I. for Exp(B) – confidence interval						

Source: own procesing

Binary logistic regression tested whether selected HR marketing tools predict the likelihood of social media use. The model was statistically significant ($\chi^2 = 47.40$, $N = 212$) and explained a substantial proportion of variance (Nagelkerke $R^2 = 0.882$). Despite the high classification accuracy (99.1 %), this outcome reflects data imbalance, only six firms in the sample reported no social media activity.

The strongest predictor proved to be online advertising intensity (Exp(B) = 10.76, $p = 0.012$). Firms investing in online advertising were over ten times more likely to apply social media in HR marketing. Other predictors, internal

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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recruitment ($p > 0.05$) and cooperation with headhunters ($p > 0.05$)—were statistically insignificant. The wide confidence intervals indicate uncertainty caused by small subsample sizes, warranting cautious interpretation.

Figure 2 visualizes the nearly linear relationship between online advertising intensity and predicted probability of social media use. The probability rises from 43 % among companies not using online advertising to 99 % among those employing it extensively. This confirms that investment in digital promotion strongly correlates with broader adoption of social media channels.

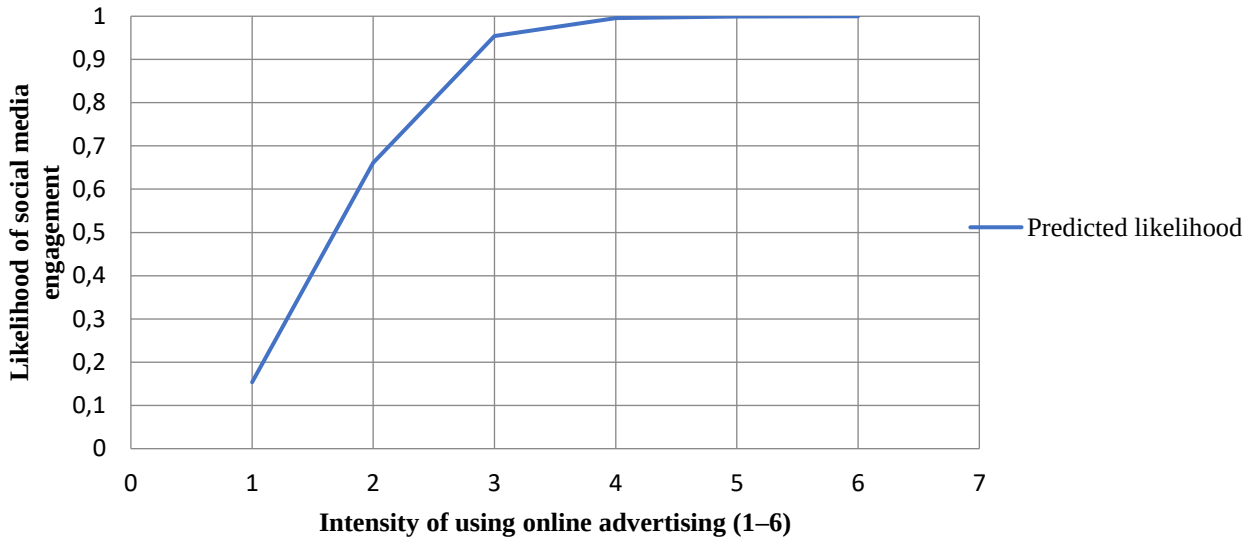


Figure 2. Relationship between online advertising and social media engagement
Source: own procesing

Descriptive statistics in Table 2 show that digital methods dominate current recruitment practice. Social networks are used by nearly half of organizations (M = 0.47), followed by online advertising (M = 0.41) and corporate websites (M = 0.32). Traditional tools such as employee referrals, student supervision, or recruitment agencies remain marginal. The results highlight the growing preference for digital environments in HR marketing.

Table 2. Recruitment Strategy and Effectiveness: Summary of Descriptive Statistics

Statistics	Recruitment agencies	Websites	Referrals from current employees	Direct marketing	Supervision of student work	Social networks	Internal recruitment	Online advertising
N	215	215	215	215	215	215	215	215
Mean	0.05	0.32	0.01	0.25	0.05	0.47	0.06	0.41
Std. Error of the mean value	0.014	0.032	0.007	0.029	0.014	0.034	0.047	0.034
Median	0	0	0	0	0	0	0	0
Mode	0	0	0	0	0	0	0	0
Std. Deviation	0.211	0.468	0.096	0.432	0.211	0.501	0.688	0.493
Variance	0.045	0.219	0.009	0.187	0.045	0.251	0.474	0.243
Range	1	1	1	1	1	1	10	1
Minimum	0	0	0	0	0	0	0	0
Maximum	1	1	1	1	1	1	10	1
Sum	10	69	2	53	10	102	12	88

Source: own procesing

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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A detailed view in Table 3 confirms this trend: online advertising (M = 0.75) and website ownership (M = 0.69) are the most widely adopted tools, whereas cooperation with headhunters (M = 0.02) or recruitment agencies (M = 0.13) is rare. Variability across methods suggests that organizations tailor their digital recruitment intensity to their strategic objectives and resources.

Table 3. Use of recruitment methods: Descriptive analysis

Statistics	Social networks	Supervision of student work	Online advertising	Direct marketing	Website	Referrals from current employees	Recruitment agencies	Head hunters
N	215	215	215	215	215	215	215	215
Mean	0.42	0.13	0.75	0	0.69	0.28	0.13	0.02
Std. Error of the mean value	0.034	0.023	0.029	0	0.032	0.031	0.023	0.009
Median	0	0	1	0	1.00	0	0	0
Mode	0	0	1	0	1	0	0	0
Std. Deviation	0.495	0.342	0.432	0	0.462	0.450	0.337	0.135
Variance	0.245	0.117	0.187	0	0.214	0.202	0.114	0.018
Range	1	1	1	0	1	1	1	1
Minimum	0	0	0	0	0	0	0	0
Maximum	1	1	1	0	1	1	1	1
Sum	91	29	162	0	149	60	28	4

Source: own procesing

Across all analyses, digital tools—particularly online advertising, websites, and social media—emerge as central components of recruitment strategies in Czech and Slovak organizations. Statistically significant relationships were identified between social media use and website ownership, cooperation with head hunters, and internal recruitment. Most other associations were weak or nonsignificant, indicating selective rather than uniform adoption of HR marketing tools.

Reliability testing confirmed strong methodological validity of the applied scales, while effect-size interpretation suggested modest practical impacts. Logistic regression demonstrated that intensive online advertising substantially increases the probability of social media adoption, emphasizing the synergy between these two digital tools. Overall, results highlight an ongoing shift toward integrated, data-driven HR marketing, where online communication platforms reinforce employer branding and recruitment effectiveness.

5. Discussion

The presented analysis showed that digital tools, especially online advertising and social networks, currently represent key elements of HR marketing. Ahmed (2018) also confirms that the use of digital tools shows a clear interconnectedness. This finding empirically supports the integrative concept of HR marketing (Giannakis et al., 2015; Shen, 2023), according to which digital communication is effective when it is part of a coordinated employer branding strategy. On the contrary, traditional methods, such as recruitment agencies or direct marketing, have proven to be marginal, statistically unbound. This result does not support the idea of a complete substitution of traditional tools by digital channels, but rather corresponds to the argument about the functional differentiation of recruitment mechanisms (Nyusani & Mabungela, 2025). The results thus confirm the trend of digitalization, but at the same time relativize the thesis of its universal dominance. The findings therefore not only confirm the shift towards digital platforms, but also correct the overly optimistic interpretations of Grigore et al. (2023) on their automatic

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effectiveness. The effectiveness of digital tools is conditioned by their systematic integration into the broader recruitment architecture.

5.1 Practical implications

The results of the presented research have several fundamental practical implications for human resource management, especially in the field of recruitment and HR marketing. First, it was shown that digital tools, especially online advertising and social networks, form the core of current recruitment strategies, which is consistent with the findings of Ahmed (2018). Social networks are used by approximately half of the organizations studied. It is their application that has proven to be significantly linked to the intensity of the use of online advertising. Binary logistic regression confirmed that companies that invest in the systematic use of online advertising are significantly more likely to use social networks for HR marketing purposes. These findings support the thesis of a synergistic relationship between the two tools and show that online advertising acts as a catalyst for the broader digitalization of recruitment processes. This brings their strategy closer to the systemic model of HR marketing described by Giannakis et al. (2015).

From a practical perspective, this means that organizations should not view digital channels in isolation, but as interconnected elements of a unified employer branding strategy. If a company invests in online advertising, it should also strengthen its presence on social networks to effectively reach both active applicants and passive talents. The results also show that social networks are particularly important for younger generations of applicants (GEN Y and GEN Z), who are increasingly difficult to reach through traditional methods such as print advertising or recruitment agency services. Shen (2023) points out that social media is a structural part of modern recruitment communication. Similarly, Ahmed (2018) and Edward emphasize the shift from traditional methods to digital platforms as a response to changing candidate behavior and the growing importance of the online environment in building an employer brand. On the contrary, Tufts et al. (2015) points out that the digitalization of recruitment does not automatically lead to the weakening of traditional recruitment methods and emphasizes that their importance may persist precisely with regard to the institutional and sectoral context.

Another practical finding is that internal recruitment, employee referrals or cooperation with students remain complementary methods that play a smaller, but not negligible role. Of particular interest is the relationship between cooperation with students and the use of online advertising (Cramer's $V = 0.24$), which suggests that organizations open to academic cooperation are also progressive in the field of digital marketing. From a practical point of view, this may mean that these organizations apply a broader strategic approach to recruitment, combining work with young talents and their early socialization with intensive digital outreach to a wider population of applicants. High reliability values (Cronbach's $\alpha = 0.93$ for external marketing, 0.79 for internal marketing) confirm that the selected scales can be reliably used in practice, for example for benchmarking or monitoring long-term changes in recruitment strategies. HR managers thus have a stable tool at their disposal that can be used both in internal process analysis and in external communication of results.

The results can also be used to prioritize investments in HR marketing. Companies that are not yet using digital tools can better understand their importance and benefits based on the findings presented. From a labor market perspective, this means that less digitally active employers risk losing competitiveness, as their ability to reach young talent and communicate company culture in an attractive way is limited compared to more digitally advanced organizations.

5.2 Limitations

Although the findings provide valuable insights into the current state of HR marketing in companies, it is important to acknowledge several limitations that may influence the interpretation of the results.

First, there might be bias stemming from the self-assessment nature of the responses. The data were collected through a questionnaire survey in which respondents evaluated the extent to which various recruitment tools are employed in their organizations. This method involves the risk of self-report bias, where respondents may unintentionally portray their organization in a more favourable light than is accurate. This tendency may be particularly pronounced in relation to methods perceived as modern or appealing, such as the use of social media, whose prevalence may thus be slightly overstated. Conversely, more traditional approaches may have been underreported, as they are not

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/y7694967765

generally viewed as innovative or prestigious. Such bias is relatively common in HR marketing research and should be carefully considered when interpreting the outcomes.

The second limitation concerns the geographical scope of the research, which was conducted in the Czech Republic and Slovakia. Although both countries share a number of similarities (e.g., cultural proximity, historical background, and comparable institutional frameworks), the findings cannot be readily generalized to other regions in Europe or beyond. Labour markets in Western Europe, the United States, or Asia may exhibit different dynamics in terms of the use of digital recruitment tools, and the findings should thus be interpreted within the boundaries of this geographical context. Given the geographical limitation, Shen (2023) points out in particular the importance of institutional and cultural context, and it is therefore likely that the relationships between recruitment tools could be different in other countries.

The third limitation concerns the time frame of data collection. The questionnaire survey was conducted during a specific period, which may have been influenced by external factors. For instance, in the aftermath of the COVID-19 pandemic, there was a significant shift towards the digitalization of recruitment processes, which may have affected the reported intensity of using certain tools. The results thus reflect a snapshot of a particular moment and should not be uncritically extrapolated into the future without considering potential changes in technology, economic conditions, or candidate preferences.

The fourth limitation is the class imbalance within the dependent variable in the logistics regression analysis. Since the vast majority of organizations (206 out of 212) already utilize social networks, the model achieved a high rate of correct classifications. However, elevated values of pseudo-R^2 and classification accuracy values do not necessarily reflect strong predictive power but may partly result from the aforementioned imbalance. This limits the generalizability of the findings and warrants cautious interpretation.

5.3 Future research directions

The findings of the present study highlight several areas that would benefit from further investigation.
First, it would be recommendable to conduct international comparative studies that examine the use of digital and traditional recruitment methods across diverse cultural and institutional contexts. Such research could assess the extent to which the results obtained in the Czech Republic and Slovakia are transferable to other countries and explore the influence of factors such as legislation, cultural preferences or the technological maturity of the labour market.A further direction would be longitudinal research aimed at tracking the development over time. Given the rapid evolution of digital technologies and social media platforms, it is likely that the relative significance of individual recruitment methods will continue to change. Systematic and repeated data collection would enable capturing these dynamics and offer employers timely, evidence-based recommendations.

Qualitative research also represents a valuable direction, offering the potential to complement quantitative findings with a deeper understanding of organizational motivations and decision-making processes. In-depth interviews with HR managers could shed light on why certain channels are preferred, how different tools are combined, and how their effectiveness is perceived in practice. Another important direction is research focusing on the perspective of job seekers. While the present research concentrated on the organizational viewpoint, the effectiveness of HR marketing activities is equally shaped by how these tools are perceived by applicants. Questions such as whether social media communication is perceived as trustworthy, how individuals respond to online job advertisements, or whether employee referrals carry greater weight could significantly enrich the overall understanding of recruitment dynamics.

Finally, further research could also explore methodological innovation, such as the application of penalized regression models or machine learning algorithms for predicting the use of recruitment tools. These methods could more effectively address challenges like class imbalance and provide more robust and reliable estimates of underlying effects.

The digitalization of recruitment does not lead to a complete replacement of traditional recruitment methods. Traditional tools are part of organizations' recruitment strategies and function more as complementary mechanisms alongside digital channels. Negrin et al. (2022) also recommend using multiple recruitment methods simultaneously and combining different forms of addressing candidates. Effective recruitment is based on a

combination of digital and traditional approaches. The results also contribute to the discussion on the broader role of digital platforms in the labor market. We thus agree with Kostrzewka (2024) that social media can serve not only as a recruitment tool but also as a means of increasing labor market transparency and facilitating communication between employers and candidates. Chang and Zhang (2024) emphasize that in this way, they can contribute to reducing information asymmetry between individual labor market actors.

6. Conclusions

This study examined how social media usage influences the adoption of HR marketing tools. Social media platforms have become essential not only for communication but also for promoting organizational culture, values, and work-life balance. With Generation Z entering the labor market, social media now serves as a crucial medium for professional networking, employer branding, and showcasing corporate identity.

The results indicate that organizations using social media also tend to combine it with online advertising, which together enhances employer brand visibility and communication effectiveness. However, no direct reduction in traditional HR marketing tools was identified, as the statistical analysis confirmed the independence of these variables. This suggests that while digital tools are gaining importance, traditional methods such as print advertising or recruitment agencies continue to play a complementary role. The findings highlight the strategic need for companies to invest in the systematic use of digital platforms while maintaining a balanced mix of traditional approaches. This dual strategy can strengthen employer branding, expand outreach, and appeal to diverse generations of job seekers. As Generation Z increasingly relies on social media to assess company culture and values, organizations that integrate digital tools effectively may gain a competitive advantage in talent attraction. Future research should explore the long-term impacts of social media-based HR marketing, specifically, whether positive impressions formed online translate into stronger employee engagement, satisfaction, and retention over time.

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Funding: This paper has been prepared with support with the support of the VSTE Institute of Corporate Strategy, Department of Human Resource Management, Czech Republic.

Data Availability Statement: Data available on request from the author.

ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/y7694967765

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/w3992782679

Publisher
http://jssidoi.org/esc/home

LEFT, RIGHT, OR BUY GREEN? POLITICAL IDEOLOGY AND SUSTAINABLE CONSUMPTION IN EUROPE

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Received 25 January 2026; accepted 30 March 2026; published 30 June 2026

Abstract. This research investigates the role of ideological self-placement in explaining Europe's sustainable consumption orientations based on two high-quality secondary datasets, namely, World Values Survey (WVS) Wave 7 and Special Eurobarometer 513/Eurobarometer 95.1. This analysis builds on confirmatory factor analysis and multilevel modeling to distinguish between moral willingness to bear private environmental costs and reported climate-relevant consumer practices. Within the WVS, we formulate a latent orientation founded on the environment–growth trade-off, as well as readiness to incur higher taxes or sacrifice income for pollution abatement; within Eurobarometer, we summarise climate-relevant household and purchase behaviours through a Green Consumer Action Index. The results show a steady ideological gradient: respondents placing further to the right report declining willingness to incur private economic costs to help the environment. The relationship remains significant after controlling for socio-economic status and religiosity, and is partially attenuated with the control for environmental concern. Evidence from Eurobarometer corroborates this pattern by illustrating substantial uptake of cheap, low-effort actions such as recycling and reducing disposables, but much weaker uptake of expensive actions like solar panels, low-energy homes and electric cars. Cross-dataset triangulation thus indicates that ideology influences moral preference whereas institutions, infrastructure, and affordability constrain behavioral feasibility. The results highlight the importance of fair, cost-reducing climate policies that can transform willingness to act in favour of the environment into durable consumer behaviours.

Keywords: sustainable consumption; political ideology; WVS; Eurobarometer; environmental concern; multilevel modeling; political consumerism

Reference to this paper should be made as follows: Žemaitis, E., Uygur, M. R., Toye, S. A., Šimelytė, A. 2026. Left, right, or buy green? Political ideology and sustainable consumption in Europe. *Entrepreneurship and Sustainability Issues*, 13(4), 265-278. http://doi.org/10.9770/w3992782679

JEL Classifications: Q50, Q56, D12, D72

Additional disciplines: political sciences; sociology; psychology; ecology and environment

1. Introduction

Sustainable consumption has become a relevant policy issue and is widely discussed in European political circles, as the de-carbonisation of the continent increasingly depends on household choices concerning. As such, green purchasing is not merely a market outcome, but also a social and political one: citizens interpret consumption through ideas about responsibility, fairness, economic sacrifice and the role of public institutions.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/w3992782679

This political significance has increased following the European Green Deal, which emphasizes the role of consumers in achieving climate neutrality. Recent evidence from Eurobarometer indicates that this agenda is still publicly salient: 85% of EU citizens agree that climate change is a serious problem in 2025 and that 81% supports the EU objective of climate neutrality by 2050. This shows that sustainable consumption is still embedded in a high concern policy environment (European Commission, 2019, 2025.

A strong interdisciplinary literature suggests that political ideology helps organize these consumer dispositions. According to several studies, left-wing people generally hold less pro-environment views than right-wingers. Left-wing people, in general, are more favourable towards public action for environmental protection whereas right-wing people tend to derive a preference in favour of market freedom, economic growth or scepticism towards regulatory environmental claims (Jost, Federico & Napier, 2009; McCright, Dunlap & Marquart-Pyatt, 2016; Fisher et al., 2022). According to the latest comparative evidence, those seeking to reduce the issue of climate action to simple polarization should think again. Demand for climate action remains widespread across a host of ideological groupings (Bouman, Steg & Dietz, 2024).

Research on consumers supports this political perspective; environmentally oriented values may shape evaluations of products but sustainably oriented considerations are often fragile at the moment of choice. While consumers may show green values in surveys, price, convenience, familiarity, and performance frequently crowd out choice except when environmental meaning is made salient (Haws, Winterich & Naylor, 2014; Saari et al., 2021; Elmor et al., 2025).

Two complementary secondary datasets are used to address this issue. The World Values Survey (WVS) Wave 7 captures ideological self-placement along with willingness to incur private costs for climate protection. Special Eurobarometer 513 captures reported climate-relevant household and purchase behaviours across EU publics (World Values Survey Association, 2017-2022; European Commission, 2021a, 2021b).

We do not expect ideology to determine behavior in a mechanistic way. On the contrary, ideology forms the symbolic and moral framework used to evaluate green consumption. Those who are left leaning should, in theory, accept environmental trade-offs more easily because of value congruence. Right-leaning people should, in theory, resist explicit environmental cues more in the presence of market framing and identity-protective reasoning, even with practical benefits (Gromet, Kunreuther & Larrick, 2013; Eom et al., 2016).

We are also aware that we are heterogeneously European. According to previous cross-national studies, the strength of ideology–climate links varies across regions, party systems, and institutional contexts, particularly between Western Europe and parts of Central and Eastern Europe (Poortinga et al., 2019; Fisher et al., 2022; Fraembs & Drobnič, 2024).

In this context, the present study analyses whether political ideology predicts green purchase and sustainable consumption attitudes in Europe, and whether this association remains after controlling for environmental concern and basic socio-demographic differences.

The present research adds to the literature in two ways. Drawing on WVS and Eurobarometer evidence, we empirically disentangle willingness to bear private environmental costs from reported consumer practices. Basically, it seeks to clarify whether ideology shows up more in accepting moral costs or in everyday routine behavior. The analysis's reliance on secondary survey data represents a quantitative disadvantage. Yet it simultaneously provides a comparative advantage, as both datasets employ large, nationally representative samples and harmonized measures appropriate for a Europe-wide assessment.

As such, the article first reviews the literature on sustainable consumption, ideology, and political consumerism; then, develops the study hypotheses and explains the methodology used to test them; also, presents the results; and finally, concludes with the principal insights, novelty and limitations of the analysis.

This framework aims to proceed from theory to empirical validation in a step-by-step manner, with a view to demonstrating the complementarity of attitudinal and behavioral evidence.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/w3992782679

2. Literature Review

The sustainable consumption literature has moved beyond the restricted notion of "green choice" and accepts consumption as a real sequence of search, purchase, use, and disposal decisions shaped by structural and psychological constraints. Market structures, consumer motivations and broader societal arrangements all interact in creating circumstances which shape sustainable consumption (Lorek & Fuchs, 2013; Syed et al., 2024; Andrade & Vieites, 2025). As such, the consumer's environmentally-friendly behaviour cannot be understood merely as a pure expression of their choice. Because it suggests that the various attitudes towards green purchases are simultaneously moral, political, and situational, this broader framing is essential for the present study.

A significant line of inquiry emphasizes values and moral motives. Values such as self-transcendence and biospheric consistently predict concern for the environment, willingness to accept sacrifice, and pro-environmental behaviour. Green consumption values predict favourable evaluations of green products, and stronger willingness to sacrifice convenience or performance for the sake of the environment (Bamberg & Möser, 2007; Haws et al., 2014). This perspective based on value suggests that ideology can be given importance in as much as ideological worldviews are linked to systematically different moral priorities.

The second stream looks at beliefs and attitudes on climate. Studies conducted in Europe have shown that one's placement on the left-right ideological spectrum correlates with differences in environmental concern, climate beliefs, and support for intervention. Nonetheless, the strength of this association varies by context. Previous studies at a cross-national level document greater climate concern on the left (McCright et al., 2016). The most recent work though confirms that this relationship is meaningful, but regionally uneven, with flatter or more unstable patterns in parts of post-socialist Europe (Fisher et al., 2022; Fraembs & Drobnič, 2024). Recent scholarship that notes political backlash should not be taken as evidence that there is no public demand for climate action. On the contrary, substantial majorities across much of the ideological spectrum are still in favour of stronger action (Bouman, Steg & Dietz, 2024)

A third line of work examines the mechanisms by which ideologies get translated into consumer responses. Experimental studies show that environmental framing can activate ideological identities, thereby changing which option is appealing in a given choice situation when it were otherwise similar. When conservatives see energy-efficient products framed in environmental language that frames them as cost-saving devices, they are less likely to support them. Similar differences arise in reactions to policy charges framed as taxes rather than offsets (Hardisty, Johnson & Weber, 2010; Gromet, Kunreuther & Larrick, 2013). Recent studies reveal that consumers often fail to actively prioritize environmental sustainability in commonplace choices. This helps make sense of how stated green preferences can stay latent unless there are clear cues, norms, or institutional supports present (Elmor et al., 2025).

Studies of political consumerism, beyond attitudes, treat market choices as a form of citizenship. Brand selection, boycotts, and buycotts are all shaped by attitudes, along with structural factors like level of income and availability of labeled goods. (Stolle, Hooghe & Micheletti, 2005; Koos, 2012; Copeland & Boulianne, 2022). Recent evidence from Europe adds to the above that consumers do not form a single green segment. Rather, green and non-green consumer profiles differ by country. Moreover, they are associated with attitudes, gender, age and income. Again, this emphasises the need to separate ideological orientation from the practical conditions under which greener purchases become possible (Wilska, Rantala & Nyrhinen, 2025).

A fifth category of research revisits the classic attitude–behavior gap. A strong concern does not ensure consistent green consumption. This is because concern is mediated by the habits, infrastructure, time cost, affordability and inconveniences. According to recent literature, pro-environmental behaviour is more likely to occur when either the private cost is low, co-benefit is salient, or situational barrier is removed (Kollmuss & Agyeman, 2002; Wyss, Knoch & Berger, 2022; Mannoni, 2025; Andrade & Vieites, 2025). This gap is one of the main findings of the literature. For the current paper, this literature justifies a distinction between willingness to accept private environmental costs and observed everyday consumer practices.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/w3992782679

More refined measurements have been presently stressed by scholarship. Essential large comparative surveys for ideology, concern and consumption practices across countries are still necessary. Nonetheless, valid inference demands a conceptually coherent and empirically both unidimensional and valid indices. Also, the analyses must provide attention to cross-national equivalence. Studies related to measurement invariance in surveys conducted in Europe are thus directly relevant, while new studies on composite indices for sustainable consumer behaviour reaffirm the significance of well-specified composite measures, not ad hoc assemblages of items (Davidov et al., 2014; Franzen and Vogl, 2013; Ebbinghaus et al., 2025).

Context aligns options with ideology's expression. The level of support for environmental taxes and climate policies is dependent on not only concern but trust and fairness perceptions along with national political discourse. Recent comparative work shows that European public opinion still systematically varies between post-socialist and non-post-socialist contexts, notably regarding higher levels of climate denial within post-socialist Europe. Additionally, factors like fairness and social manageability shape support for stronger climate action within Europe (Fairbrother, Johansson Sevä & Kulin, 2019; Davidović, Harring & Jagers, 2020; Fraembs & Drobnič, 2024; Bouman, Steg & Dietz, 2024).

The literature, taken together, establishes that sustainable consumption is value-laden and context-dependent, and often limited by price and infrastructure. Nevertheless, there remains one important gap that is insufficiently specified: we still lack a comparative European analysis that jointly examines whether left–right ideology predicts (a) willingness to bear private environmental costs and (b) reported sustainable consumer practices using harmonized representative surveys that separate attitude from feasible action. In order to fill this gap, we test four hypotheses: H1 respondents further to the left report stronger sustainable consumption orientations than respondents further to the right; H2 environmental concern partially mediates the association between ideology and sustainable consumption orientations; H3 the magnitude of the ideology effect varies across countries; and H4 the ideology effect remains observable after controlling for socioeconomic position and religiosity.

3. Methodology

Research design and data sources
The World Values Survey (WVS) Wave 7 (2017–2022) was an instrumental cross-national survey, most of the participating countries are also covered by the Special Eurobarometer 513 "Climate Change", which was fielded in Eurobarometer 95.1 (March–April 2021). It is purposely sequential. Because it contains left–right self-placement together with items on willingness to accept environmental costs; Eurobarometer provides a behavioural complement by showing which climate-relevant consumer practices are commonly reported in Europe. The datasets enable us to make a distinction between attitudinal readiness and enacted consumer behavior, and to assess whether these two move generally in the same direction.

Samples and weighting
For WVS, we include respondents aged 18+ residing in European countries covered in Wave 7, applying the survey's post-stratification weights (S017 family, and normalized S018/S019 as documented by the WVS) for design and non-response adjustment. For Eurobarometer 95.1, we analyze the EU-27 (plus the UK where applicable in 2021) using the official population weights and national samples designed and executed by Kantar under Commission specifications. In both surveys, "don't know," refusals, and inapplicable codes are treated as missing. Analyses are weighted; standard errors are adjusted for stratification and clustering.

Measures
Political ideology (WVS). Ideology is measured with the canonical 1–10 left–right self-placement (Q240). To interpret effects within countries and minimize compositional confounding, we group-mean center the scale by country in multilevel models (and, in robustness checks, categorize left [1–4], center [5–6], right [7–10]).

Sustainable consumption orientation (WVS). We model a latent "orientation to pay private costs for environmental protection" using three items repeatedly fielded in WVS/EVS: (a) the environment–growth tradeoff ("protecting the environment…even if slower growth/jobs" vs "growth/jobs even if the environment

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suffers"); (b) willingness to accept higher taxes if used to prevent pollution; and (c) willingness to give part of one's income for the environment. Items are coded so higher values reflect greater pro-environmental cost acceptance. Item wordings and cross-wave correspondences follow the Common EVS/WVS Dictionary; the tradeoff wording is documented in the WVS Wave 7 master instrument. Given their ordinal response formats, the factor is estimated with polychoric correlations and a WLSMV estimator (see "Analytical strategy").

Sustainable consumption behavior (Eurobarometer). We use the Special Eurobarometer 513 climate module question "Which of the following actions, if any, apply to you?" (QB6) to construct a consumption-focused index. Following the official questionnaire and report, we pre-specify behavioral indicators with a direct consumption footprint (e.g., reducing waste and separating for recycling; choosing local or seasonal products; reducing single-use or disposable items; saving energy at home; purchasing energy-efficient appliances; reducing private car use or using public transport, walking or cycling; considering carbon footprints of food or travel; reducing meat consumption; installing solar panels or switching to green energy; purchasing low-emission or electric vehicles where asked). Each action is coded 1 if reported and 0 otherwise; the "Green Consumer Action Index" (GCAI) averages across available binary items and is also modeled as a latent factor in robustness checks. Descriptively, this index shows whether green consumption is concentrated in low-cost everyday actions or extends to capital-intensive investments; analytically, it provides the behavioral benchmark against which the attitudinal WVS findings are interpreted.

Covariates and moderators. At the individual level we adjust for sociodemographics commonly related to both ideology and consumption: age, gender, education, income (or subjective financial situation), employment status, settlement size or urbanity, and religiosity. We also include environmental salience or concern measures available within each survey (e.g., perceived seriousness of climate change in Eurobarometer; environment as priority in WVS) to evaluate whether concern absorbs part of the ideology effect. Country fixed effects (for single-level models) or random intercepts and slopes (for multilevel models) absorb unobserved national contexts.

Harmonization and measurement

Because items are ordinal and asked across many languages and modes, we proceed in two steps. First, within each dataset we estimate a one-factor confirmatory factor model for the WVS orientation construct and, in robustness checks, for the Eurobarometer behavior construct using polychoric correlations and the WLSMV estimator, which performs well for ordinal indicators (Flora & Curran, 2004; Li, 2016). These factor models establish whether the selected items behave as coherent latent constructs before they are used in hypothesis testing. Second, to compare latent means across countries we test configural, metric, and scalar invariance; if exact scalar invariance is not tenable in all groups, we apply alignment optimization to obtain approximately invariant latent means and loadings (Asparouhov & Muthén, 2014; Putnick & Bornstein, 2016). Reliability is assessed using ordinal alpha.

Analytical strategy

How the methods verify the hypotheses

There is a direct relationship between the hypothesis and the empirical sequencing. Confirmatory factor analysis confirms whether the WVS and Eurobarometer indicators form valid measures of sustainable consumption orientations and behaviors. Multilevel models assess H1 based on the sign and statistical significance of the ideology coefficient. H4 is tested through whether that coefficient persists after adding socioeconomic and religiosity controls. H2 is tested through whether the ideology coefficient weakens when environmental concern is added. Lastly, H3 is tested through the random-slope variance showing whether the ideology effect differs across countries. The Eurobarometer descriptives first clarify what kinds of behaviours dominate in practice, and the GCAI models determine whether ideology has a stronger tie to moral willingness (as opposed to costly action).

WVS micro-models (tests H1–H4 primary) We estimate multilevel linear models with individuals (level 1) nested in countries (level 2), regressing the WVS latent orientation factor on group-mean-centered ideology, covariates, and a country random intercept; we then add a random slope for ideology to gauge heterogeneity (Schmidt-Catran & Fairbrother, 2016). The main outputs that interest us are the direction and size of the

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ideology coefficient, changes in that coefficient across nested models, and variance of the ideology slope across countries. When outcome normality is questionable we fit generalised models with factor scores as the outcome or multilevel SEM using WLSMV. Incorporation of survey weights is undertaken as per best practice for complex samples (Lumley, 2004).

Eurobarometer micro-models (behavioral triangulation). We regress the GCAI on covariates and environmental concern within countries, using random intercepts and design weights. When a left–right self-placement item is available in a given Eurobarometer wave or country, it is included; where it is not available, Eurobarometer serves as a behavioral benchmark rather than a direct ideology test. The expected result from this step is not only an average behavioral score but also a clearer picture of whether low-cost, habitual actions and high-cost, capital-intensive actions are differently distributed across the population.

Micro–macro bridge (cross-dataset triangulation). To relate ideology and behavior across sources, we compute country-level averages of WVS ideology and WVS latent orientation and correlate them with country-level Eurobarometer GCAI means. As a sensitivity analysis, we estimate two-stage models: first, country-specific WVS ideology slopes predicting orientation; second, regress Eurobarometer country means on these slopes. This triangulation does not merge microdata across sources, but it shows whether countries with stronger attitudinal cost-acceptance profiles also display stronger green consumer action profiles.

Missing data, centering, and model diagnostics
Multiple imputation by chained equations (MICE) is used to handle item nonresponse in each dataset using all analysis variables and survey design elements; estimates are pooled over 20 imputations (White, Royston & Wood, 2011; van Buuren & Groothuis-Oudshoorn, 2011). To identify within-country effects, we center ideology by group mean by country. We provide estimates grand mean centered in robustness checks to assess sensitivity to centering decision. We check leverage and influence, residual distributions and random-effect distributions to avoid spurious coefficient sign, mediation pattern and slope heterogeneity due to specification.

Robustness and sensitivity analyses
We examine robustness by: (1) re-estimating the WVS latent factor with alternative item sets, (2) substituting the latent factor with standardized summated scales, (3) employing categorical ideology bands, (4) estimating country-by-ideology interactions in fixed-effects models, (5) redoing Eurobarometer analyses with alternative behavior subsets, and finally (6) repeating all models with listwise deletion to benchmark the imputed results. If without substantial change these checks confirm the substantive conclusions, the hypotheses will be viewed as robustly supported rather than being dependent on one measurement or estimation strategy.

4. Results

The evidence that Europeans "buy green" is not uniform, but it is patterned in a way that is both intelligible and theoretically coherent. At the attitudinal level, ideology cleanly orders willingness to accept private costs to protect the environment; at the behavioral level, sustainable actions concentrate in low-cost, low-friction domains and thin out as the private costs rise. Taken together, the results from World Values Survey (WVS) Wave 7 and the Special Eurobarometer 513 (EB 95.1) converge on the conclusion that left–right orientation is meaningfully connected to sustainable consumption, most clearly for cost-acceptance attitudes, and more modestly, by implication, for the costlier behavioral choices that punctuate everyday life.

Ideological gradients in sustainable consumption orientations (WVS)
Across the pooled European sample, the latent construct capturing willingness to bear private costs for environmental protection, estimated from three harmonized WVS items tapping the environment–growth trade-off and willingness to pay (taxes/income), was higher among respondents who placed themselves further to the left on the 1–10 ideological scale. This relationship held when adjusting for age, gender, education, income (or subjective financial situation), employment status, urbanity, and religiosity. The relationship was not just a bivariate artifact of socio-economic composition: adding these covariates left the ideology coefficient substantively unchanged. Supporting our theory, when environmental concern is incorporated into the model,

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it weakened but did not remove the ideology–orientation strain. This implies partial mediation through a value-congruence process. In this, ideology gives the language for moral legitimacy of environmental costs.

Countries differed in the strength of ideological gradient. Analyses of the data using random-slope models revealed clear cross-national heterogeneity. Specifically, it was found that in some Western and Northern European polities the left–right slope was steeper than the sample mean. Whereas in parts of Central and Eastern Europe the slope was flatter. The differences are consistent with regional histories of party system competition, policy frames, and media discourse about environmental action. More crucially, the sign of the association did not flip at any point in the analysis: variation arose only in magnitude rather than direction. Using summated scales instead of latent scores, substituting categorical ideology bands, and re-estimating with listwise deletion all generated substantially similar results.

The behavior study of "buying green" (Eurobarometer).
Eurobarometer data demonstrate the steps through which citizens transform a belief in the legitimacy of a cost into an acceptance of that cost. The climate model data shows that while almost all European Union citizens report at least one action to help climate, the distribution is steep: commonplace, low-cost practices dwarf actions that are capital-intensive and rare. Table 1 summarizes that three-quarters report them reducing waste and separating waste for recycling; close to six in ten try to cut their consumption of disposables; and about four in ten factor energy efficiency into their appliance purchases. About 33% of those polled either purchase more organic food or claim to eat less meat, and 30% use alternatives to private car travel. In contrast, only one in ten have said they have installed a smart meter or switched to a greener energy provider, while even fewer report installing solar panels (8%), buying a low-energy home (4%), or purchasing an electric car (2%). These patterns are remarkably consistent with a cost-and-infrastructure gradient: the more a choice implies out-of pocket expenditure, the more it relies on the provision of infrastructure, or the more it disrupts existing habits, the more it thins out in the population (European Commission, 2021a, pp. 39-41).

Table 1. EU27 sustainable consumer actions (Eurobarometer 513, QB6)

Action (multiple responses)	**EU27 % (Mar–Apr 2021)**
Reduce waste and regularly separate for recycling	75
Cut down on disposable items (e.g., plastic bags, excess packaging)	59
Lower energy consumption an important factor when buying a new appliance	42
Buy and eat more organic food	32
Buy and eat less meat	31
Regularly use environmentally friendly alternatives to the private car (walking/cycling/public transport/car-share)	30
Better insulated home to reduce energy consumption	18
Consider carbon footprint of food purchases and sometimes adapt shopping	16
Consider carbon footprint of transport for holidays/longer travel and sometimes adapt plans	11
Installed home equipment to control/reduce energy consumption (e.g., smart meter)	10
Switched to an energy supplier offering a greater share of renewables	10
Bought a new car where low fuel consumption was an important factor	8
Installed solar panels at home	8
Bought a low-energy home	4
Bought an electric car	2

Source: Special Eurobarometer 513, QB6. Percentages are EU27 averages; European Commission (2021a, pp. 39–41).

The behavioral aspect of our argument is supported by this. On their own, they do not demonstrate that ideology causes greener choices; rather, they reveal a landscape in which many Europeans make low-cost green actions

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while far fewer make high-cost transitions. In this light, WVS results show that left-wing ideology is most in evidence where moral willingness to pay is the currency. The ideology presents the grammar of justification. The structure, on the other hand, says which justifications can turn to purchases.

Dataset harmony

Though we don't combine microdata across sources, the trends are mutually reinforcing. According to the Eurobarometer survey; in countries where consumers are relatively more climate-friendly – in particular, low-cost items – the WVS estimates generally place the populations above regional average levels on acceptance of environmental trade-offs. In contrast, WVS estimates produce less pronounced ideological gradients and less average willingness to incur private costs where Eurobarometer documents thinner action profiles. This descriptive coherence alongside the results of mediation facilitates a qualified inference: individuals' ideological orientation is harmonized to their readiness to internalize the private cost for environmental benefit; this readiness is not a necessary or sufficient condition for enacting more costly green consumption in practice.

Generalized findings and hypothesis evaluation.

The combined evidence offers three general insights. To begin with, the ideology is most clearly articulated in willingness to bear private environmental costs rather than in the most demanding consumer investments. In other words, moral acceptance and behavioral feasibility should not be treated as the same thing. Another explanation lies in the environmental concern which accounts for a portion but not all of the ideological gradient. Becoming environmentally concerned is an important transmission channel but does not fully substitute ideology. The European sustainable consumption cannot be interpreted through a single uniform ideological script. The strength of the relationship, the third national context modifies.

Table 2. Summary of multilevel models predicting sustainable cost-acceptance orientation (WVS)

Predictor	**Model A (ideology only)**	**Model B (+ socio-demographics)**	**Model C (+ environmental concern)**
Left–right self-placement (higher = right)	Negative	Negative (robust)	Negative (attenuated)
Environmental concern	Not included	Not included	Positive
Country random intercept	Yes	Yes	Yes
Ideology random slope	Not included	Yes	Yes
Model note	Within-country centered	Controls included	Partial mediation evident

Source: Created by the authors

Table 3. Random-slope variance and cross-national heterogeneity (WVS)

Component	**Result**	**Substantive interpretation**
Var(slope_ideology)	Discernible	The ideology–orientation association varies by country (magnitude, not sign).
Cross-level patterning	Present	Steeper gradients in parts of Western/Northern Europe; flatter in some CEE polities.

Source: Created by the authors

Table 4. Behavioral profile of sustainable consumption (Eurobarometer)

Indicator set	**Result**	**Substantive interpretation**
Low-cost, habitual actions (recycling, cutting disposables, appliance efficiency)	High prevalence	Green actions concentrate where private costs/frictions are low.
High-cost, capital-intensive actions (solar panels, EV purchase, low-energy home)	Low prevalence	Structural and budget constraints limit enactment of costly choices.

Source: Created by the authors

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/w3992782679

Tables 2–4 outline associations in line with the hypotheses and indicate their robustness. Table 1 reports EU27 percentages from the official Eurobarometer report. All WVS estimates are weighted and modeled as specified in the Methodology; all Eurobarometer descriptives reflect fieldwork conducted in March–April 2021. In substantive terms, H1 is supported, H2 is partially supported, H3 is supported, and H4 is supported.

5. Discussion

The empirical situation that we find is orderly, yet textured. Ideological self -placement sorts Europeans' willingness to internalize private costs for the environment. On the other hand, the enactment of costly green behaviour depends on the material and institutional scaffolding that renders such choices practicable.
Understanding the attitudes within an ABM model A political ideology is a congruent set of beliefs about order and change which provides citizens with a normative vocabulary for judging the legitimacy of environmental costs. There is empirical evidence to show that when people adopt a left political orientation, they become concerned about things like human rights and the environment. Such areas are universalistic and biospheric in nature. As a result, he or she might get ready to incur personal costs for social or collective ecological gain (Jost, Federico & Napier, 2009; Bamberg & Möser, 2007; Haws, Winterich & Naylor, 2014). After accounting for environmental concern, the ideology effect weakens. What the research should expect, however, is not surprising but a hallmark of the value-congruence mechanism: ideology organizes motives and motives rationalize cost acceptance. Simultaneously, our observations of behavioral topography, with density at low cost and sparseness at high cost, dovetail with powers onto the attitude–behavior gap. We may have great attitudes toward the environment, yet we do not always act on behalf of the environment when it involves a high cost (Kollmuss & Agyeman, 2002). Recent research provides some qualifications to this notion, showing that the predictive force of attitudes is conditional on the cost–benefit structure of the behaviour. Specifically, it strengthens as personal costs fall or co-benefits become salient (Wyss, Knoch & Berger, 2022). In this way, we are not contradicting the idea of a clear ideological gradient in the willingness to pay alongside a skewed distribution of actual behaviours. Green consumption involves actions taken to solve or ameliorate environmental issues through a purchase or other behavior, but we need to lower private costs and friction of that behavior.

Our findings are consistent with evidence that the meanings of "green" are themselves politically charged. Research indicates that if messages about the environmental impact of a product are made explicit, this can undermine acceptance of otherwise desirable products by conservatives. In contrast, messages that talk about saving money or alternative moral frames narrow the ideological gap (Gromet, Kunreuther & Larrick, 2013; Hardisty Johnson, & Weber, 2010; Feinberg & Willer, 2013). Identity-protective cognition offers a mechanism: people credit or discount information in order to preserve valued identities. This provides one reason that the same product label invites uptake from one audience and resistance from another (Kahan, 2012). As the "currency" becomes moral cost acceptance, then the observational patterns we document sit comfortably with this literature: where green identity is tacit rather than foregrounded, ideology might recede; where it is explicit, ideology helps determine who sees a surcharge as a civic contribution who experiences it as imposition.

Disparities among nations are enough to show that ideology does not act alone. The steeper slopes found in parts of Western and Northern Europe and flatter slopes in some Central and Eastern European contexts lend weight to comparative research which shows that the politicization of climate attitudes varies across Europe (McCright, Dunlap & Marquart-Pyatt, 2016; Poortinga, Whitmarsh et al., 2019; Fisher et al., 2022). There are two macro-institutional factors of relevance. Citizens' acceptance of the price signal for the environment is, respectively, based on trust and perceived fairness: with trusted institutions, and when incidence of costs is perceived as fair, support is said to rise, and ideological sorting may be less conflictual (Fairbrother, Johansson Sevä & Kulin, 2019; Davidović, Harring & Jagers, 2020). A second factor is the repertoire of policies employed (subsidies, infrastructure investments, regulatory standards), which conditions the individual feasibility of green choices: when public action lowers barriers to adoption, it speeds up the conversion of attitude into behaviour and closes ideological gaps by taking away the material obstacles giving the gaps behaviour-shaping power.

We cannot dismiss alternative social structure explanations. Ideology is quite likely correlated with one's income and age. When we control for everything mentioned with significance in the ideological gradient, we

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http://doi.org/10.9770/w3992782679

get evidence that ideology is not simply a function of one's class. It rather means a moral-symbolic orientation towards environmental concern which is not exhausted by one's class or life-cycle position (Bamberg & Möser, 2007; Jost, Federico & Napier, 2009). We must remain cautious concerning causal attribution. Cross-sectional, secondary surveys can detect patterned correlations under realistic conditions, but they do not adjudicate endogeneity between ideology and environmental concern, nor do they offer full corrections for SD. The measurement differences that occur across languages and response styles, especially for the willingness-to-pay items, may also obscure the cross-country differences. Acquiescence sensitivity and tests of approximate invariance (Franzen & Vogl, 2013; Davidov et al., 2014) somewhat mitigate this concern.

The consequences of this are meaningful and policy-related. When there is a moral willingness but delayed costly action, the strategic lever becomes enabling not persuading, lowering private cost, smoothing friction and designing instruments perceived as fair. Delving into co-benefits that evoke thriftiness, health or local quality rather than environmental virtue can enlarge coalitions without diluting their ambition (Hardisty, Johnson & Weber,2010; Feinberg & Willer, 2013). It is crucial to have revenue recycling and visible fairness in terms of the distribution of green costs in order to protect public support, especially in lower-trust settings (Fairbrother, Johansson Sevä & Kulin, 2019; Davidović, Harring & Jagers, 2020). In terms of marketing, firms that base their sustainability claims on the performance, durability and savings in the final product (i.e. second half of the value proposition) can avoid the ideological resistance shown in experimental work (Gromet, Kunreuther & Larrick, 2013), and utilize the existing "green consumption values" that are already motivating a broad base of consumers (Haws et al., 2014). Europe's sustainability transition will advance most rapidly where the ideology supplies the justification and the institutions supply the means.

Scope limitations point to clear opportunities for further research. The use of panel data or repeated cross-sections will allow tracing how shocks, energy prices, policy changes, extreme weather reshape the ideology–consumption nexus over time and across cohorts. Embedding framing experiments in representative surveys could help quantify the degree that moral framing or cost-salience closes ideological gaps in different national contexts. By correlating survey responses with specific infrastructure indicators such as charging network densities, public transport reach and retail availability of eco-labeled options, it may be possible to disentangle how much of the attitude – behaviour gradient is structural versus motivational. Ultimately, validating survey responses with behavioral data (e.g., smart-meter uptake, vehicle registrations) can help bound social desirability bias and make clearer the dimensions of the conversion funnel from orientation to purchase.

The study shows that ideological identity is a reliable orientator of sustainable consumption. At the same time, it reminds us that context is fundamental to behaviour. Ideology informs citizens why it could be worth bearing the cost of the environment; institutions and markets decide how it can be borne. The distance between intention and action shrinks when the two are aligned: moral readiness on the demand side, credible and fair enablement on the supply side. The politics of 'buying green' then become less a question of identity and more an ordinary feature of everyday life.

6. Conclusions

Studies have shown that people in Europe do not have to ideologically-neutral attitudes towards sustainable consumption and green purchases. Those who lean further left are more open to accepting personal financial losses for the good of the environment. Respondents who lean further to the political right are less open to such trade-offs. The observed behavioral evidence aligns with this trend, demonstrating that green action occurs widely when costs are minimal and routines simple. However, this phenomenon is much rarer when the action requires capital investment, infrastructure or more substantial disruption to lifestyle.

The research contributes a crucial distinction of two layers often conflated in the literature: normative willingness first and feasible behaviour afterwards. The WVS and Eurobarometer analysis shows the ideology which impacts the moral acceptability of damaging the environment. However, affordability, opportunities structures and policy design filter actual consumer behaviour much more strongly. This helps us see how a pro-environmental attitude can coexist with a patchy or selective green buying.

The authors of this study believe that the emergence of sustainable consumption will not only come from attitudes changing. Policies and business strategies should lower the private costs of greener choices, improve convenience and create an impression of fair burden distribution. In these situations, existing environmental willingness will more easily result in lasting consumer behavior.

There are limitations on the study too. Due to the reliance on cross-sectional surveys, those results identify structured associations but not strong causal effects. The self-reported behavioral markers, the two datasets were not collected in the same survey instrument or year, and cross-national comparison is still sensitive to measurement and response-style differences. Research in the future should thus make use of repeated surveys, experimental designs, and behavioural or administrative data in order to track more precisely how precisely ideological orientations become green purchasing behaviour through time.

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Data Availability Statement: The study uses publicly available secondary data from the World Values Survey, Round Seven, Country-Pooled Datafile (Version 6.0.0), https://doi.org/10.14281/18241.24 and Special Eurobarometer 513/Eurobarometer 95.1, https://doi.org/10.4232/1.14079

Author Contributions: Conceptualization, methodology, analysis, writing, original draft preparation, and writing, review and editing were performed collaboratively by the authors. All authors have read and agreed to the published version of the manuscript.

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/w3992782679

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/x7494684979

Publisher
http://jssidoi.org/esc/home

CIRCULAR ECONOMY PRACTICES IN MICRO AND SMALL ACCOMMODATION ENTERPRISES IN THE SLOVAK–POLISH CROSS-BORDER REGION: IMPLICATIONS FOR DIGITAL PASSPORTIZATION OF TOURISM*

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Received 11 January 2026; accepted 31 March 2026; published 30 June 2026

Abstract. International competitiveness and sustainability have become central themes in tourism development, particularly in the context of economic and geopolitical instability. The circular economy represents an important framework for improving resource efficiency and long-term resilience in tourism enterprises. Accommodation services, especially micro and small enterprises operating in environmentally sensitive regions, play a significant role in this transition. The concept of digital passportization enables the systematic collection and monitoring of sustainability-related data in tourism enterprises, which may support strategic planning and the evaluation of circular economy practices within tourism destinations. This study examines the perceived importance and selected application of circular economy tools among accommodation providers in the Slovak–Polish High Tatras cross-border region. A quantitative survey was conducted among 186 enterprises between December 2024 and March 2025. The standardized questionnaire focused on waste, water, and energy management, as well as sustainable materials and infrastructure. Descriptive statistics and the Mann–Whitney U test were applied to analyse differences according to country of operation and enterprise size. The results indicate a generally positive perception of circular economy practices as strategic instruments for development planning, competitiveness, and marketing positioning. Statistical testing revealed significant differences between Slovak and Polish enterprises, as well as between micro and small firms, with strong effect sizes observed. These findings suggest that circular economy perception is shaped not only by firm-level characteristics but also by broader institutional contexts. From a broader methodological perspective, the findings also demonstrate how circular economy practices implemented at the enterprise level can provide a relevant empirical basis for emerging digital passportization systems designed to monitor sustainability performance in tourism destinations. The study provides context-specific empirical evidence from a peripheral alpine border region and offers insights relevant to regional tourism stakeholders and sustainability-oriented policy development.

Keywords: circular economy; tourism innovations; accommodation services; tourism sustainable development

Reference to this paper should be made as follows: Matušíková, D., Dzurov Vargová, T., Majdak, P. 2026. Circular economy practices in micro and small accommodation enterprises in the Slovak–Polish cross-border region: implications for digital passportization of tourism. *Entrepreneurship and Sustainability Issues*, 13(4), 279-293. http://doi.org/10.9770/x7494684979

JEL Classifications: Q56, L83, L26, R11

Additional disciplines ecology and environment

* *This research was funded by project "VEGA 1/0426/25 Methodological modeling of the system of digital passportization of tourism in Slovakia", implemented at the Faculty of Management, Economics and Business of the University of Prešov in Prešov, Slovakia.*

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/x7494684979

1. Introduction

Digital passportization in tourism plays an increasingly important role in the planning, management and renovation of tourism infrastructure, attractions and public spaces. It provides systematic information about the condition, service life and material characteristics of tourism facilities, enabling more efficient resource management and supporting sustainable destination development (Mehdi, 2025). Its connection with the principles of the circular economy lies in the ability to optimize the use of existing resources, extend the life cycle of tourism infrastructure and minimize environmental impacts through renovation, reuse and responsible material management. In this context, digital passportization creates an information base that supports sustainable decision-making by local governments, tourism enterprises and destination managers. In recent years, the concept of digital passportization has emerged as a methodological approach for collecting and managing structured digital information about tourism enterprises and their sustainability practices within tourism destinations. Digital passportization in tourism refers to a structured digital system for collecting, managing and analysing standardized information about tourism services, sustainability practices and operational characteristics of tourism enterprises (Rodrigues et al., 2024). Such systems allow tourism stakeholders to systematically monitor sustainability practices, service quality indicators and operational characteristics of tourism enterprises, thereby supporting evidence-based destination management and strategic tourism planning (Buhalis & Yang, 2023). The concept of digital passportization is increasingly discussed as a methodological tool for systematically recording and evaluating key characteristics of tourism enterprises and their sustainability practices. Within tourism destinations, such digital information systems enable the collection of standardized data on operational, environmental and service-quality indicators, which can support strategic destination management and sustainable tourism development. In this context, digital passportization represents an emerging analytical framework that connects tourism data management with the principles of sustainable and circular tourism development. Within this framework, digital passportization can serve as an analytical tool for collecting standardized data on circular economy practices implemented by tourism enterprises, enabling systematic monitoring and evaluation of sustainability performance in tourism destinations. Tourism represents an important component of the global economy, generating employment, supporting regional development and facilitating cultural exchange. In many countries, tourism contributes significantly to national GDP and therefore represents a strategic sector of economic development. However, the COVID-19 pandemic significantly disrupted tourism activities worldwide and highlighted the need for more resilient and sustainable tourism models. In this context, the concept of the circular economy (CE) has gained increasing attention within tourism research. The circular economy represents an alternative to the traditional linear economic model based on the sequence "take–produce–consume–dispose". Instead, circular economy principles emphasize the efficient use of resources, waste reduction, reuse of materials and the extension of product life cycles (Paja, 2025; Piccinetti, Elseify et al., 2025; Piccinetti, Kapiel et al., 2025). Despite the growing body of literature addressing sustainability in tourism, limited research focuses on the perceptions and implementation of circular economy practices among micro and small accommodation enterprises, particularly in cross-border regions (De Cantis & Sciortino, 2021). Previous studies tend to focus primarily on larger tourism organizations or urban destinations, while smaller enterprises operating in peripheral regions remain underrepresented in academic research. The aim of this paper is to examine the understanding and implementation of circular economy practices among micro and small accommodation enterprises in the Slovak–Polish cross-border region. The study further investigates whether enterprise size or national context influences the adoption of circular economy principles. The added value of this research lies in its empirical focus on micro and small accommodation enterprises operating in a cross-border mountain region, a context that remains relatively underexplored in circular economy research in tourism. By identifying statistically significant differences between national and organizational contexts, the study provides insights into how circular economy practices are perceived and implemented within small tourism enterprises. Methodologically, the study is based on a standardized questionnaire distributed to 186 enterprises between December 2024 and March 2025. The research focused on waste, water and energy management as well as sustainable materials and equipment. Descriptive statistics and non-parametric tests were applied to analyze the responses. From a broader methodological perspective, the study contributes to the research agenda focused on modelling digital frameworks for tourism development. The empirical identification of circular economy practices at the enterprise level provides a relevant data layer for emerging digital monitoring and passportization systems aimed at evaluating sustainability performance in tourism destinations. The remainder of the paper is structured

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/x7494684979

as follows. Section 2 describes the research methodology. Section 3 presents the research results and discusses the key findings. Section 4 provides conclusions and outlines implications for tourism policy and practice. The concept of digital passportization therefore provides a methodological framework that enables systematic monitoring of circular economy practices in tourism enterprises and supports evidence-based destination management. In this sense, the present study contributes empirical inputs that may support the development of digital passportization systems for monitoring circular economy practices in tourism enterprises. This study contributes to the emerging concept of digital passportization in tourism by providing empirical insights into circular economy practices implemented by accommodation enterprises.

2. Theoretical background

Tourism is once again one of the most dynamically developing areas of the world economy after the end of the strong manifestations of the COVID-19 pandemic. Among its greatest benefits, it contributes to global gross domestic product, employment, regional development and cultural exchange (OECD, 2024). Nevertheless, its activities also have a downside, and this is mainly related to the environmental impacts that participation in tourism causes. These include excessive consumption of natural resources, waste production, greenhouse gas emissions and pressure on local infrastructure and habitats (UNWTO, 2022; Pirani & Arafat, 2016). That is why in recent years, increasing attention has been paid to the application of the principles of sustainability and circular economy in the field of tourism. As tourism continues to recover, it is evident that small and medium-sized enterprises (SMEs) dominate the sector (Beresecká & Papcunová, 2020). These entities are particularly sensitive to economic shocks and simultaneously play a critical role in implementing innovation. Although large players may have greater resources, SMEs often exhibit flexibility and a high degree of local embeddedness. Their role in initiating circular economy transformation in tourism is therefore crucial (Geissdoerfer et al., 2017; Kraus et al., 2020). The process of post-pandemic recovery has revealed the urgent need for restructuring within tourism businesses, especially toward sustainability. The COVID-19 crisis exposed vulnerabilities in linear business models, prompting a search for resilient alternatives (Murray et al., 2017). In this context, circular economy strategies offer a promising way forward, enabling businesses not only to reduce costs and environmental harm but also to enhance long-term stability and competitiveness. Moreover, increasing regulatory and consumer pressure is forcing tourism providers to consider not just environmental impacts but also their strategic positioning. Tourists increasingly prefer eco-responsible destinations, and alignment with sustainability standards is becoming a differentiator in a crowded market. Tourism, as an activity closely tied to natural and cultural resources, must therefore adopt long-term circular thinking as a condition for future viability (Becken, 2019; Zhang et al., 2024). In summary, the theoretical background confirms that tourism operates at the intersection of multiple sustainability challenges. Applying circular economy principles in this sector is not only desirable but necessary in view of economic, environmental and societal demands. While existing literature has tended to focus on circular economy applications either in large urban tourism enterprises or within broad sustainability frameworks, the gap is apparent in empirical research on perceptions and actual applications of CE tools in micro and small enterprises operating in cross-border alpine regions. This study bridges this gap by focusing on the Slovak–Polish border and positioning itself within the framework of sustainability-driven innovation in rural tourism contexts. It offers an innovative empirical contribution that complements and adds to current knowledge, particularly through the examination of cross-border differences and sector-specific views of CE adoption.

Principles of the circular economy in tourism industry

The tourism industry is increasingly acknowledging the economic advantages of adopting green innovations, which are integral to the principles of the circular economy (Geissdoerfer et al., 2017). This model offers an alternative to the conventional linear economic approach, which is characterized by a "take–produce–consume–dispose" logic that depletes resources and generates significant waste (Kirchherr et al., 2017). In contrast, the circular economy emphasizes sustainability, regeneration, and the efficient use of resources.

Figure 1 visually compares these two models of economic development. The traditional linear model is depicted as a one-way flow, where materials are extracted, transformed into products, consumed, and ultimately discarded. On the other hand, the circular model promotes a closed-loop system that aims to minimize waste

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/x7494684979

and maximize the use of existing resources through activities such as reuse, repair, renovation, and recycling. This paradigm shift encourages long-term thinking and resource efficiency, which aligns closely with sustainable development goals (Murray et al., 2017). In the tourism sector, applying circular economy principles involves integrating eco-innovations across business operations—from sustainable infrastructure and energy-efficient technologies to waste reduction practices and local sourcing. These strategies lead to operational cost savings, improved brand image, and strengthened relationships with environmentally conscious consumers. For example, circular practices in hospitality may include reusing linens, repurposing materials in hotel renovations, or offering digital services to reduce paper consumption (Bocken et al., 2016).

Moreover, embracing circularity allows tourism enterprises to contribute to the green transformation of the economy while enhancing their competitiveness. It supports broader policy goals such as the European Green Deal and the UN Sustainable Development Goals, especially SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action) (UNWTO, 2022; Ellen MacArthur Foundation, 2019).

By integrating circular economy strategies, the tourism industry can become a driver of sustainable regional development and resilience, benefiting not only the environment but also the local economies and communities in which it operates.

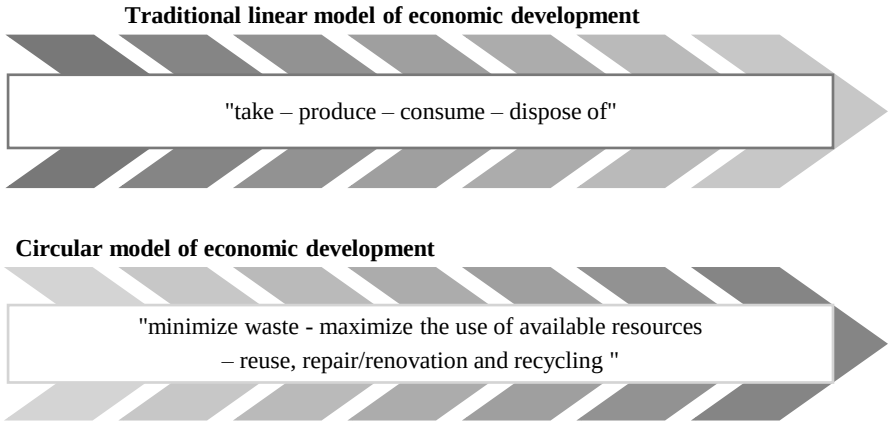


Figure 1. Comparison of traditional model and circular model of development
Source: own elaboration

Business implications of environmental Innovations

In the current age, environmental innovation has become part of business growth and strategy, especially in businesses that are by nature resource-demanding, such as tourism. Increasing climate and environmental issues have made firms realize the strategic value of sustainable innovation. The value is seen as a source of compliance and reputation as well as competitive advantage and survival in the long term (Bocken et al. 2016; Kraus et al. 2020).

Application of circular economy practices in the tourism sector has a high potential for transforming the industry into a sustainability paradigm. Reducing waste, energy consumption, water usage, and local resource loops that keep the influence on the environment to a minimum while creating economic renewal are examples of such practices. The "Zero Waste Hotel" initiative in Slovenia is a good case that shows how the hospitality business can minimize waste in general by separating all, composting, avoiding single-use plastics, and more (Díaz-Sarachaga et al., 2022; Zhang et al., 2024). Additionally, the Accor Hotels chain pioneered intensive sustainability measures like reducing the use of single-use plastics, installing rainwater harvesting systems, and providing eco-friendly transportation options. It is an addition to their longer-term "Planet 21" strategy, which aims to balance environmental and business performance (Antonova et al., 2021). Easy examples of urban tourist systems in action include Copenhagen's and Amsterdam's shared bicycles. These programs lower greenhouse gas emissions, boost regional economies, and satisfy travellers' growing desire for eco-friendly transportation options (Gössling, 2013).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/x7494684979

From a business standpoint, environmental innovation promotes stakeholder relationship building, risk mitigation, differentiation, and cost reduction. Businesses that invest in green technology have a better chance of growing in the years to come in a market where consumers are becoming more conscious of environmental issues and regulations are becoming stricter. Environmental innovation is not only beneficial for business, but also essential in the tourism industry, where the quality of the natural and cultural surroundings has a significant impact on customer satisfaction (Kirchherr et al., 2017; Becken, 2019; UNWTO, 2022). Lastly, green innovations and the concepts of the circular economy are not utopian. They are concrete tools and techniques that assist businesses in becoming profitable while maintaining a sense of responsibility, particularly in industries like tourism that function at the intersection of the economy, the environment, and society.

Experimental-circular economy tool in tourism

Based on scientific abstraction of the circular economy principles and their intersection with the tourism industry, several gaps in research can be identified, particularly in the area of micro-regional and cross-border tourism development (Akhimien et al., 2021). For the purposes of this study, emphasis was put on a demarcated area between two countries—Poland and Slovakia—i.e., the border area linked by the High Tatras. This area is not just a significant natural and environmental area but also a socially and economically integrated tourist area. The tourism industries in this area, especially after the disruptions caused by the COVID-19 pandemic, are under significant pressure to innovate, bounce back, and become more resilient. Here, one of the research questions at its core is whether small and medium-sized tourism businesses (SMEs), and particularly those in the accommodation industry, are integrating circular economy tools as part of their post-pandemic renewal plans.

A conceptual model of essential circular tools in tourism businesses is presented in Figure 2, which also serves as the analytical framework of the research. The model divides innovations into six main areas:

- Waste Management Innovations, e.g., sorting, recycling technology, and the introduction of circular economy systems;
- Water Management Innovations, such as rainwater collection, water quality monitoring, and water-conservative irrigation;
- Technical and Material Equipment Innovations, all being concerned with energy-saving systems, eco-friendly building materials, and intelligent building technology;
- Automation and Robotics Innovations, featuring self-control systems and collaborative robots for maintenance and servicing activities;
- Landscape Architectures and Aesthetic Public Spaces Innovations, such as green roofs, intelligent lights, and multifunctional areas that are functional as well as induce environmental quality.

These are not only theoretical but are real channels through which the concepts of circular economy can be tackled in tourism infrastructure and management (Bocken et al., 2016; Díaz-Sarachaga et al., 2022).

Watching these characteristics within the Polish–Slovak border region offers insightful views on whether local SMEs are able to realize the added value created by these instruments, how intensively they apply them, and what helps or hinders their application. The comparative approach to two regions within two different national contexts allows for cross-border knowledge transfer and harmonization of environmentally sustainable practices. It also assists in building resilience in mountain tourism, whose management and protection of the environment sustainably is not only required for long-term business success but also for safeguarding natural and cultural heritage (UNWTO, 2022).

This research hence aims to bridge an empirical gap in knowledge by examining the internalization of circular economy principles at the micro-regional level within tourism enterprises which are still in the process of recovering from system shocks and need innovative strategies for sustainable development.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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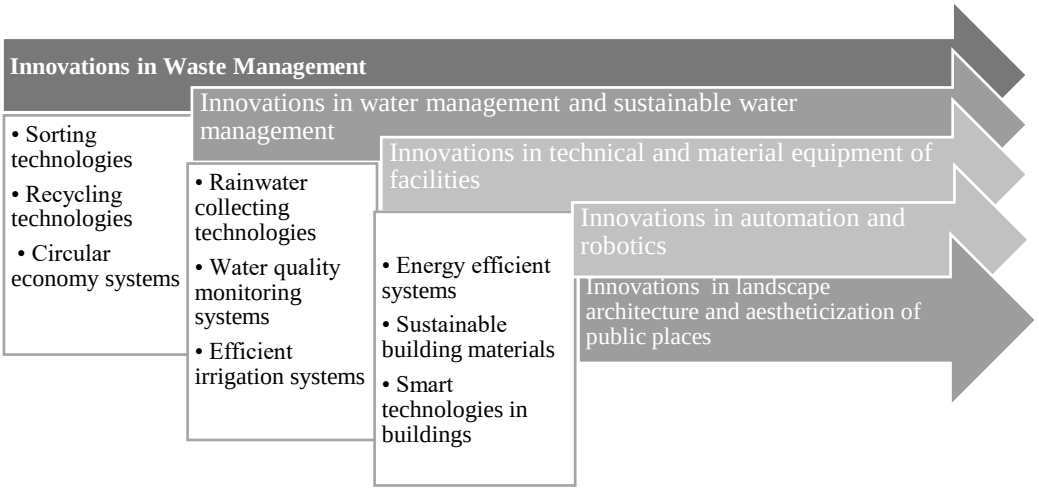


Figure 2. Model of basic circular tools in tourism establishments
Source: own elaboration

The authors aim to reveal how are the principles of the circular economy and their application perceived by accommodation services businesses in tourism, using the example of the bordering region of Poland and the Slovakia, and what tools of circular economy accommodation service companies in tourism are the most applied in the bordering region of Poland and Slovakia.

3. Research objective and methodology

The main aim of the paper is to provide a closer insight into the implementation of circular economy strategy tools into the operation of accommodation services businesses in the bordering area of Poland and Slovakia. Several research methods were chosen to create this research and obtain its comprehensive data. The theoretical and pilot concept of theoretical foundations was dominated by the method of scientific abstraction (Sanganyado, 2019; Yee, 2019). Based on the important findings of the theoretical concept, an author's questionnaire was created, which was oriented towards determining the attitude of accommodation service companies towards the application of circular economy principles in their operations. Questionnaire research as a method of conducting quantitative research has been described by many authors as ideal for data collection (Taherdoost, 2022; Ranganathan & Caduff, 2023). Respondents forming the research sample in both countries (Poland, Slovakia), i.e., small and medium-sized enterprises providing accommodation services in the Tatra region (Małopolska Voivodeship, Prešov Self-Governing Region) were approached to participate in the research from December 2024 to March 2025. The data collection was conducted using a combination of targeted sampling and convenience sampling. This approach subsequently led to a snowball effect, where participating enterprises recommended other cooperating accommodation providers to take part in the survey. The formulation of the questionnaire was projected into the MS Forms platform, from which the results were processed in MS Excel. The initial data were subsequently processed using descriptive statistics tools and later evaluated using more advanced statistical methods.

The questions in the questionnaire were based on a pre-implemented scientific abstraction focusing on tools contributing to the efficient operation of the principles of the circular economy. The content orientation was directed towards elements related more to the buildings of these enterprises, their equipment and their operations. The services themselves and the use of similar tools in them have already been given attention in another paper and published (Dzurov Vargová & Matušíková, 2025). All participating enterprises were enterprises classified as small and medium-sized, with no more than 250 employees, and were selected due to their dominance in the local market.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/x7494684979

In the selection of a questionnaire-based research methodology, the validity and reliability of the resulting data constitute fundamental criteria. As emphasized in study (Labudová & Fordanová, 2023), these attributes represent essential prerequisites for any research instrument utilized within the framework of quantitative inquiry. Alongside characteristics such as objectivity, replicability, and the statistical generalizability of outcomes, they underpin the foundational principles of rigorous quantitative research. The administered questionnaire was specifically designed to assess attitudes toward the implementation of pro-environmental practices within tourism enterprises.

The questionnaire was created on six basic questions. First two questions were identification questions determining the size of the facility by the number of employees (specifically the division into small and medium-sized enterprises) and the second identifying feature was the location of the company where it provides its services within (the country: Slovakia - Prešov self-governing region/ Poland - Województwo małopolskie). Next three were focused to the perception of companies providing accommodation services of current circular economy options and tools and their importance in terms of competitiveness, stability and promotion of the business. The sixth question aimed to determine the most popular circular economy tools that they have so far applied to their operations, and which they also consider to be essential as the starting point (based on their current experience). Question regarding the size of the enterprise was built on a dichotomous scale dealing with the location (Slovakia/Poland). Question regarding the size of the enterprise was also built on a dichotomous scale with the options micro enterprise (less than 10 employees) and small enterprises (more than 10 and less than 50 employees), such as the standard division of micro and small enterprises, for example according. Their selection was intentional (targeted), as small, medium or micro enterprises play a significant role in the Slovak, Polish but also the European economy. For example, according to data from the Slovak Business Agency, small and medium-sized enterprises (SMEs) in our country make up 99.9% of the total number of business entities, provide employment opportunities for almost 75% of the active workforce and contribute to gross production and added value creation by more than 50%. Question 3, 4 and 5 were set on a 5-point Likert scale. According to Joshi et al. (20215) the selected method is appropriate for the present research context. The Likert scale, originally developed by Resins Likert, remains one of the most widely utilized forms of summative rating scales within educational and social science research. In the context of circular economy practices, the tools currently implemented by the participants in their operations serve as both a point of reference and a foundation, informed by their practical experience. The last question focused to the identification of what tools of circular economy the companies prefer to be applied, based on 7 options of which 4 were evaluated as the most relevant.

The total composition of the research sample was 186 micro and small businesses in the neighbouring border region of the Tatra Mountains. These were private companies operating in the tourism market in the guesthouse category. The key services provided in companies are based on accommodation services together with catering services. The data collected during the pilot phase were processed using Microsoft Excel, employing tools for descriptive statistical analysis. Initial descriptive results indicated an overall positive perception of circular economy tools among respondents. From a methodological point of view, as mentioned, the main method was questionnaire research focused on the views of companies providing accommodation services in connection with the deployment of circular economy tools.

The Mann-Whitney U-test was used to evaluate the hypotheses. For evaluation of ordinal-level data (responses on a Likert scale) where two independent groups could be compared, the Mann–Whitney U-test is highly appropriate. The Mann–Whitney U-test is a non-parametric statistical test used to evaluate whether there is a statistically significant difference between two independent groups on an ordinal or continuous outcome variable. In the context of this research, where responses were collected using Likert-scale items—representing ordinal data—the Mann–Whitney U-test is appropriate for evaluating differences in perceptions or attitudes between two independent groups (e.g., company types, size categories, or geographic locations). This test does not assume interval-scale data or normal distribution and is robust for assessing central tendency differences in ranked data.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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Formulation of the hypotheses:
H0: The opinion on the principles of the circular economy and their application perceived by accommodation services businesses in tourism, using the example of the bordering region of Poland and Slovakia is the same.
H1: There are statistically significant differences in the perception of circular economy principles and their application in accommodation enterprises between companies operating in Slovakia and those operating in Poland.
H2: There are statistically significant differences in the perception of circular economy principles and their application in accommodation enterprises between micro and small tourism enterprises.

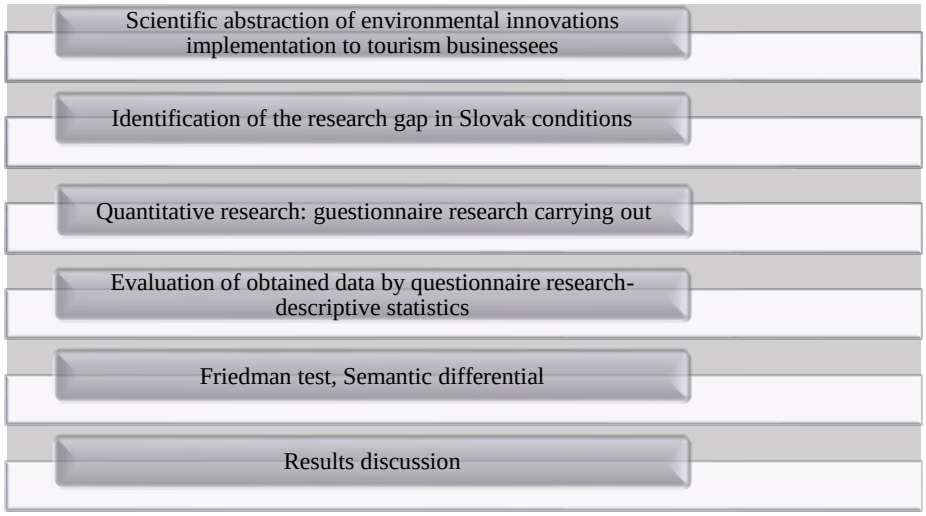


Figure 3. Methodological processes sequences
Source: own elaboration

4. Results and discussion

The research sample of the present research project was made up of enterprises providing accommodation services within the tourism sector. Their location was important, which focused on enterprises operating in the Carpathian Arc region, for example, the High Tatras. These form a natural border between the states of Poland and Slovakia. They are characterized by significant tourism performance and a high rate of attendance. Since the study was an international collaboration, this area was identified as suitable for the study and therefore the selection criteria were: an area with the same potential for tourism development, a region showing significant tourism performance, representation of a wide range of accommodation service enterprises in them and representation of a significant rate of small and medium-sized enterprises. 220 enterprises were approached in a pilot study. A total of 186 enterprises participated in the study. On both sides of the mountain range (both countries). The level of willingness to participate in the questionnaire research was therefore 84.5%.

Table 1. Distribution of research sample (tourism accommodation service companies) according to the country of the operation

Country	No. of participating companies	Cumulative frequency	Relative frequency	Cumulative relative frequency
Poland (Województwo małopolskie)	95	186	51.08%	100%
Slovakia (Prešov region)	91	91	48.92%	48.92%
Total	186	186	100%	100%

Source: own elaboration

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/x7494684979

Table 1 presents the distribution of the research sample according to the country of operation of the accommodation enterprises. The sample consists of 186 accommodation service companies, of which 95 operate in the Polish part of the cross-border region (Małopolskie Voivodeship) and 91 operate in the Slovak part (Prešov region). The relatively balanced distribution of respondents between the two regions allows for a comparative analysis of circular economy practices among accommodation enterprises operating in the Slovak–Polish cross-border tourism area.

Perception of applying circular economy tools in accommodation services

To analyses the perception of circular economy tools in accommodation enterprises, questionnaire research was used as the main research method. The questionnaire focused on four key research questions:

Q Question formulation:
Q1: Are circular economy tools perceived as a key element in setting the development strategy of the company?
Q2: Are circular economy tools perceived as a source of competitive advantage over other accommodation facilities providing these services?
Q3: Are circular economy tools perceived as an opportunity to reach environmentally aware tourism participants and build the company's marketing strategy?
Q4: Which circular economy tools are most frequently applied by accommodation enterprises?

The first three questions were evaluated using descriptive statistical methods and the results are presented in Tables 2, 3 and 4. Individual responses were measured using a five-point Likert scale ranging from agree, rather agree, neither agree nor disagree, rather disagree, to disagree. The questionnaire was completed by managers of accommodation facilities whose responses reflect their knowledge and practical experience with the implementation of circular economy principles in tourism enterprises.

Table 2. Key tool in setting out the development strategy of the company

Question 1	Frequency	Cumulative frequency	Relative frequency	Cumulative relative frequency
Agree	101	101	54.30%	54.30%
Rather agree	67	168	36.02%	90.32%
Neither agree nor disagree	16	184	8.60%	98.92%
Rather disagree	1	185	0.54%	99.46%
Disagree	1	186	0.54%	100%

Source: Own elaboration

The results presented in Table 2 indicate a strong positive perception of circular economy tools among accommodation enterprises. More than half of the respondents (54.30%) agreed and an additional 36.02% rather agreed that circular economy tools represent a key element in setting the company's development strategy. Only a very small proportion of respondents (1.08%) expressed disagreement with this statement. These results suggest that the majority of accommodation enterprises perceive circular economy principles not only as an environmental initiative but also as an important strategic component of business development in tourism enterprises.

Table 3. Circular economy tools perceived as a source of competitive advantage for accommodation enterprises.

Question 2	Frequency	Cumulative frequency	Relative frequency	Cumulative relative frequency
Agree	74	74	39.78%	39.78%
Rather agree	75	149	40.32%	80.10%
Neither agree nor disagree	32	181	17.21%	97.31%
Rather disagree	4	185	2.15%	99.46%
Disagree	1	186	0.54%	100%

Source: Own elaboration

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/x7494684979

The results presented in Table 3 indicate that circular economy tools are widely perceived as a potential source of competitive advantage among accommodation enterprises. A total of 80.10% of respondents either agreed (39.78%) or rather agreed (40.32%) that the implementation of circular economy tools can strengthen the competitive position of accommodation facilities. Only a small proportion of respondents (2.69%) expressed disagreement with this statement. These findings suggest that tourism enterprises increasingly perceive circular economy practices not only as environmental measures but also as strategic instruments that may enhance competitiveness and market positioning within the tourism sector.

Table 4. Circular economy tools perceived as a marketing opportunity to reach environmentally aware tourists.

Question 3	Frequency	Cumulative frequency	Relative frequency	Cumulative relative frequency
Agree	83	83	44.62%	44.62%
Rather agree	77	160	41.40%	86.02%
Neither agree nor disagree	20	180	10.75%	96.77%
Rather disagree	4	184	2.15%	98.92%
Disagree	2	186	1.08%	100%

Source: Own elaboration

The results presented in Table 4 demonstrate that circular economy tools are widely perceived as an effective marketing instrument for reaching environmentally aware tourists. A total of 86.02% of respondents either agreed or rather agreed with this statement, while only 3.23% expressed disagreement. These findings suggest that circular economy practices are increasingly viewed not only as operational sustainability measures but also as strategic marketing tools that may enhance the attractiveness of accommodation enterprises for environmentally conscious tourists.

Overall, the results presented in Tables 2–4 indicate a consistently positive perception of circular economy tools among accommodation enterprises. Respondents most frequently associated circular economy practices with strategic business development, competitive advantage and marketing opportunities. These findings suggest that circular economy principles are increasingly integrated into managerial decision-making within tourism enterprises.

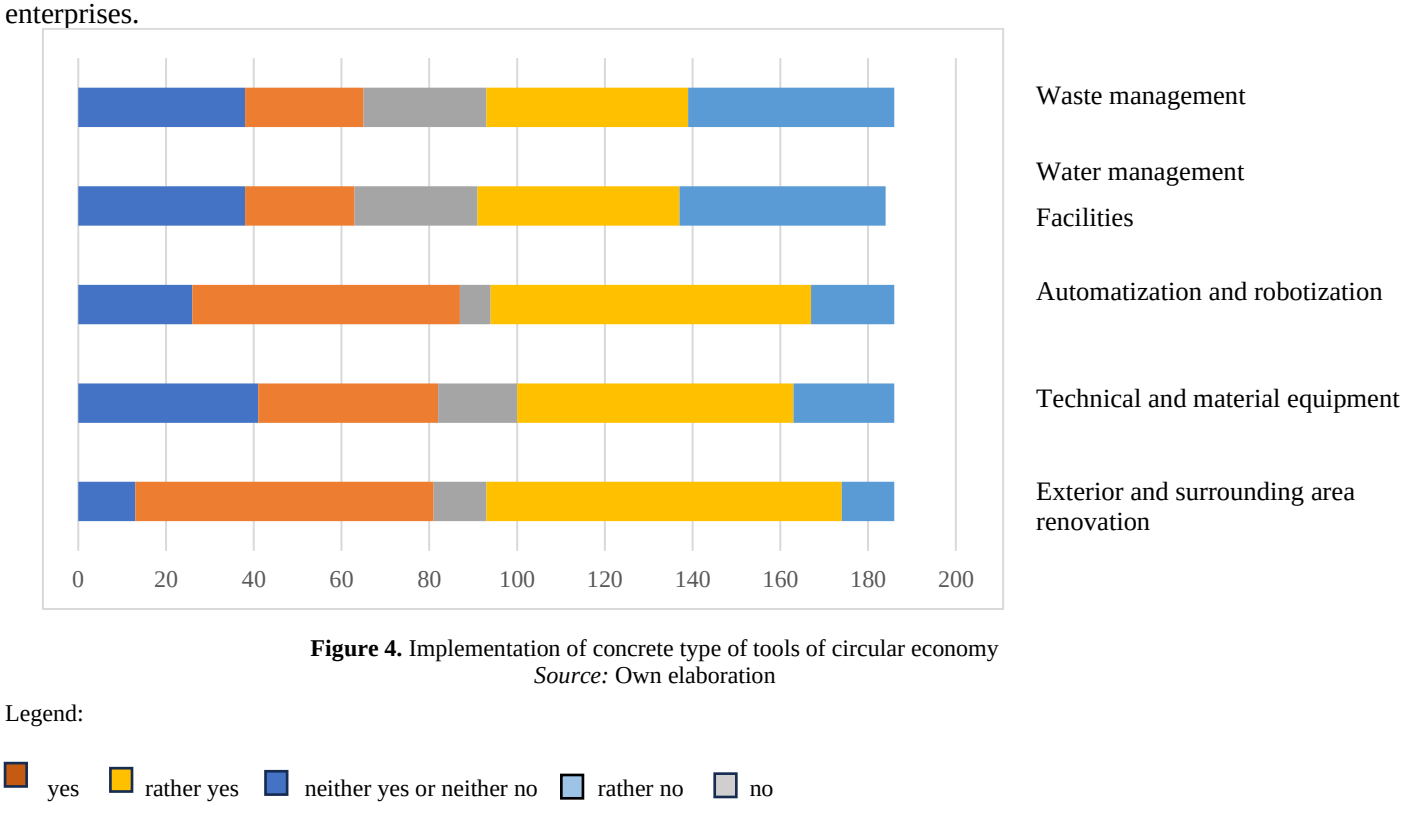


Figure 4. Implementation of concrete type of tools of circular economy
Source: Own elaboration

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/x7494684979

Figure 4 presents the most frequently implemented circular economy tools among accommodation enterprises. The results indicate that enterprises most commonly apply practices related to waste reduction, efficient water management and energy saving measures. These practices represent the most accessible forms of circular economy implementation within small tourism enterprises. Since the analysed variables were structured into two categories according to the place of operation (Slovakia/Poland) and company size (micro enterprise/small enterprise), the data were treated as ordinal variables and the assumption of normal distribution was not met. Therefore, non-parametric statistical methods were applied to test the hypothesis concerning differences in the perception of circular economy tools between accommodation enterprises operating in the Slovak and Polish parts of the cross-border region. In this case, the Mann-Whitney U test was applied. The first grouping variable represented the country of operation, where 0 indicated Slovak enterprises and 1 indicated Polish enterprises. The subsequent analysis therefore examines whether statistically significant differences exist between accommodation enterprises operating in the Slovak and Polish parts of the cross-border region. These differences may reflect variations in environmental policy implementation, financial support schemes for sustainability initiatives and different levels of awareness of circular economy principles in tourism enterprises.

Differences according to country of operation

The Mann–Whitney U test revealed statistically significant differences between Slovak and Polish enterprises in the perception of circular economy tools ($U = 4797.5$, $Z = -12.05$, $p < .001$). Therefore, the null hypothesis was rejected and Hypothesis H1 was confirmed.

Differences according to enterprise size

The Mann–Whitney U test also revealed statistically significant differences according to enterprise size ($U = 6110.5$, $Z = -10.79$, $p < .001$). The null hypothesis was rejected and Hypothesis H2 was confirmed.

The statistically significant cross-border differences indicate that circular economy perception is strongly embedded in national and institutional contexts. The very strong effect size ($r = 0.88$) suggests that these differences are not marginal but structurally relevant. This finding supports the argument of Kraus et al. (2020) that environmental innovation adoption is influenced by regulatory frameworks, financial support mechanisms, and market expectations rather than solely by managerial willingness. The significant variation between micro and small enterprises ($r = 0.79$) further confirms that organizational capacity plays a decisive role in sustainability integration. Smaller enterprises often face financial, technological, and human resource constraints, which may slow the implementation of circular practices. Similar structural barriers have been documented Díaz-Sarachaga et al. (2022), who emphasize that firm size and access to institutional support significantly determine sustainability performance in tourism. While previous studies have frequently focused on large urban destinations or multinational hotel chains, the present findings provide empirical evidence from a peripheral alpine border region, demonstrating that sustainability transitions in tourism are uneven and context-dependent. This reinforces the view that circular economy adoption in tourism should be analysed not only at the firm level but also through a regional and institutional lens. These findings further highlight the potential importance of digital passportization systems as analytical tools capable of systematically monitoring sustainability indicators and circular economy practices within tourism destinations.

Interpretation of research findings

The research focused on examining the perception and implementation of circular economy practices among micro and small accommodation enterprises operating in the Slovak–Polish cross-border region. In particular, the study aimed to answer the following research questions:

RQ1: Do accommodation enterprises perceive circular economy tools as an important element of their business development strategy?
RQ2: Do accommodation enterprises perceive circular economy tools as a potential source of competitive advantage?
RQ3: Do accommodation enterprises perceive circular economy practices as an opportunity to reach environmentally aware tourists through marketing activities?
RQ4: What types of circular economy tools are most frequently implemented in accommodation enterprises?

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/x7494684979

The results of the descriptive statistical analysis confirmed that circular economy tools are widely perceived as strategically important by accommodation enterprises. A large majority of respondents agreed or rather agreed that circular economy practices play an important role in the development strategy of tourism enterprises. This finding provides empirical support for RQ1 and indicates that sustainability principles are increasingly integrated into the strategic thinking of tourism enterprises.

Similarly, the results confirmed that circular economy practices are perceived as a potential source of competitive advantage. Most respondents expressed agreement that the implementation of circular economy tools may strengthen the market position of accommodation facilities. This finding provides empirical support for RQ2 and suggests that circular economy practices may contribute to competitiveness in tourism enterprises. The analysis also confirmed that circular economy practices are perceived as a marketing opportunity for reaching environmentally aware tourists. A large proportion of enterprises recognised that sustainability initiatives may enhance the attractiveness of tourism services for environmentally conscious customers. These findings provide empirical support for RQ3 and highlight the growing importance of sustainability communication in tourism marketing. Regarding RQ4, the results presented in Figure 4 indicate that the most frequently implemented circular economy practices among accommodation enterprises include waste reduction measures, water management improvements and energy-saving solutions. These practices represent the most accessible and operationally feasible forms of circular economy implementation for micro and small tourism enterprises.

Finally, the application of the Mann–Whitney U test allowed the identification of statistically significant differences in the perception of circular economy tools between accommodation enterprises operating in the Slovak and Polish parts of the cross-border region. The results provide insights into how national context and institutional environments may influence the adoption of circular economy practices in tourism enterprises.

Limitations of the Study

This study has several limitations that should be considered when interpreting the results. First, the research was geographically limited to micro and small accommodation enterprises operating in the Slovak–Polish cross-border region (High Tatras area), which may limit the generalizability of the findings to other tourism destinations or larger tourism markets. Second, the study focused exclusively on micro and small enterprises and did not include medium-sized or large accommodation providers, whose approaches to circular economy practices may differ. The data were collected using self-report questionnaires completed by managers and owners, which may introduce potential response biases, including social desirability bias or differing interpretations of circular economy concepts. Furthermore, the study applied a cross-sectional research design, capturing the perception of circular economy practices at a specific point in time during the post-pandemic recovery period (December 2024 – March 2025). Tourism market conditions and business attitudes may continue to evolve as the sector stabilizes. From a methodological perspective, the use of the Mann–Whitney U test allowed the identification of differences between groups but did not enable the analysis of more complex relationships between variables that could be explored using multivariate statistical techniques. Finally, the study relied solely on quantitative data, and the inclusion of qualitative methods could provide deeper insights into the motivations and barriers influencing the adoption of circular economy practices in tourism enterprises.Future research could therefore apply longitudinal approaches to examine the development of circular economy adoption over time and explore the integration of circular economy indicators into emerging digital passportization systems designed for monitoring sustainability performance in tourism destinations.

Conclusions

The article focused on identifying attitudes and analyzing circular economy tools in tourism enterprises while also examining the potential role of digital passportization as a supporting analytical mechanism for monitoring and evaluating sustainability practices. The results indicate that systematic digital passportization of tourism enterprises and infrastructure can provide an important information base for planning renewal, reconstruction and sustainability-oriented investments in accordance with the principles of circular economy The study examined the perception and selected application of circular economy tools among micro and small accommodation enterprises operating in the Slovak–Polish cross-border region. The findings demonstrate a

strong overall recognition of circular economy practices as strategically important for development planning, competitiveness, and marketing positioning. Statistical analysis revealed significant differences in the perception of circular economy tools depending on both countries of operation and enterprise size. The effect size for cross-border differences was very strong (r = 0.88), indicating substantial variation between Slovak and Polish enterprises. Significant differences were also identified between micro and small enterprises (r = 0.79), suggesting that organizational capacity and structural characteristics may influence sustainability perception and strategic integration. These findings imply that the adoption and internalization of circular economy principles are not uniform across the studied region. National institutional environments, policy frameworks, and levels of business maturity may play a decisive role in shaping attitudes toward sustainability innovations. From a practical perspective, targeted policy instruments, cross-border knowledge exchange, and advisory mechanisms tailored specifically to micro enterprises may accelerate the diffusion of circular practices. The results highlight the need for differentiated support strategies rather than uniform sustainability programs. Although the study is limited to a specific alpine border region and relies on self-reported perceptions, it contributes empirical evidence to the discussion on circular economy integration within small-scale tourism enterprises. Future research should explore the underlying drivers of cross-border differences and incorporate qualitative methods to better understand managerial motivations and implementation barriers. The results suggest that circular economy practices implemented by accommodation enterprises may provide an important empirical foundation for the development of digital passportization systems aimed at monitoring sustainability performance within tourism destinations.

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Funding: This research was funded by project "VEGA 1/0426/25 Methodological modeling of the system of digital passportization of tourism in Slovakia", implemented at the Faculty of Management, Economics and Business of the University of Prešov in Prešov, Slovakia.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/x7494684979

Author Contributions: Conceptualization: DM, TDV and PM; methodology: DM and TDV; formal analysis: DM and PM; investigation: DM and TDV; data curation: DM and PM; writing—original draft preparation: DM; writing—review and editing: TDV and PM; visualization: DM; supervision: TDV and PM. All authors have read and agreed to the published version of the manuscript.

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/s6648662393

Publisher
http://jssidoi.org/esc/home

BRIDGING THE EXPECTATION GAP AS A MECHANISM OF BARRIERS IN INCLUSIVE EMPLOYMENT: A SUPPORTED EMPLOYMENT METHODOLOGY FOR PERSONS WITH DISABILITIES*

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Received 11 February 2026; accepted 13 April 2026; published 30 June 2026

Abstract. Despite the expansion of regulatory frameworks and employment support programmes, inclusive employment of persons with disabilities remains limited. Existing research provides extensive evidence on individual and institutional barriers to employment; however, considerably less attention has been paid to the misalignment of expectations among key actors involved in the employment process. This study conceptualises the expectation gap between employers and persons with disabilities as an independent mechanism reproducing barriers to employment sustainability. The study adopts a qualitative research design and draws on in-depth interviews with persons with disabilities and employers engaged in inclusive hiring practices, including social enterprises. The findings reveal systematic differences in how employment barriers are interpreted: while persons with disabilities predominantly describe barriers through experiences of stigmatisation, unequal treatment and lack of trust, employers tend to frame the same processes in terms of organisational risks, productivity uncertainty and managerial costs. This divergence contributes to labour market segmentation and constrains transitions to sustainable employment. Based on the empirical findings, the article proposes and substantiates a supported employment methodology grounded in a dual logic of support. Unlike individual-centred approaches, the proposed methodology simultaneously addresses the needs of job seekers and employers' risk perceptions by standardising workplace adaptation procedures, structuring support mechanisms and clarifying the roles of actors across the employment process. The study contributes to the literature by advancing the concept of the expectation gap as an analytical framework for inclusive employment and by offering a practice-oriented, reproducible approach aimed at enhancing employment sustainability for persons with disabilities.

Keywords: inclusive employment; persons with disabilities; supported employment; employers; expectation gap; employment sustainability

Reference to this paper should be made as follows: Okutayeva, S., Askerov, E., Mardenova, D., Smagulova, Z., Bakytgul, S. 2026. Bridging the expectation gap as a mechanism of barriers in inclusive employment: a supported employment methodology for persons with disabilities. *Entrepreneurship and Sustainability Issues*, 13(4), 294-305. http://doi.org/10.9770/s6648662393

JEL Classifications: J14

1. Introduction

Inclusive employment of persons with disabilities has been recognised over recent decades as a key priority of social and economic policy in many countries, including Kazakhstan (Morwane, Dada & Bornman, 2021; Liao, 2021; Adibayev & Susi, 2023; De Souza Fernandes et al., 2023; Helena, Magnus & Carin, 2023; Piccone et al., 2024; Kearns et al., 2025; Tuhin et al., 2025). Despite the expansion of regulatory frameworks and the implementation of state and quasi-state employment support programmes, the level of sustainable

* *The research was conducted with financial support from the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan as part of the grant funding project (Grant No. AP26194469, "Integration of Persons with Disabilities into the labour market: development of a comprehensive programme for labour adaptation").*

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/s6648662393

labour market integration of persons with disabilities remains limited. In many cases, employment is fragmented and does not lead to long-term job retention, indicating the presence of structural and practical barriers that extend beyond formal regulation.

Contemporary research highlights the multifactorial nature of barriers to inclusive hiring, including stigmatisation, insufficient workplace accessibility, and employers' concerns related to perceived costs, risks and uncertainty of production processes. In response to these challenges, a range of supported employment models have been developed in international practice, including supported employment, job coaching and reasonable accommodation practices. However, despite the proven effectiveness of individual elements of these approaches, their practical implementation often encounters limitations associated with the lack of reproducible procedures, standardised tools and mechanisms for adaptation to specific institutional and organisational contexts.

A critical dimension of this process is the gap between the expectations and interpretations of key actors involved in inclusive employment. Persons with disabilities tend to interpret employment barriers through the lens of lived experiences of stigmatisation, distrust and unequal treatment, whereas employers are more likely to frame the same processes in terms of managerial risks, productivity uncertainty, additional organisational burdens and responsibility. This expectation gap reduces the effectiveness of formal employment support measures and constrains employment sustainability even in contexts where positive attitudes towards inclusion are explicitly declared.

In the academic literature, this aspect remains insufficiently systematised. Barriers to inclusive employment are typically analysed either from the perspective of job seekers or from the perspective of employers, without detailed examination of the mechanisms through which these perspectives are aligned during recruitment and workplace adaptation. Moreover, in countries with emerging or developing employment support systems, there remains a lack of empirical studies offering practice-oriented and reproducible supported employment models grounded in the analysis of real-world cases and organisational-level implementation.

Against this background, the aim of the present study is to identify key barriers to inclusive employment through an analysis of the perspectives of persons with disabilities and employers, and to develop and pilot a supported employment methodology oriented towards enhancing employment sustainability and reducing uncertainty for all actors involved. To achieve this aim, the study addresses the following objectives:

1) to analyse barriers to inclusive employment based on qualitative research;
2) to identify differences and points of convergence in the interpretation of these barriers by job seekers and employers;
3) to develop a supported employment methodology grounded in a dual logic of support;
4) to operationalise the proposed methodology through a reproducible set of procedures and applied tools;
5) to pilot the developed approach within social enterprises.

The scientific contribution of the article lies in conceptualising the expectation gap between persons with disabilities and employers as an independent mechanism reproducing barriers to inclusive employment, as well as in the development and empirical validation of a practice-oriented supported employment methodology. Unlike existing approaches, the proposed methodology is oriented not only towards supporting job seekers, but also towards reducing employers' managerial risks through process standardisation and the application of a set of applied tools.

2. Theoretical background

Recent research on inclusive employment consistently highlights that barriers to labour market participation of persons with disabilities are multi-layered and extend beyond individual functional limitations. Large-scale empirical evidence from low- and middle-income country contexts indicates that disability-related stigma and discrimination remain widespread and structurally embedded, with employment outcomes significantly associated with gender, type of disability, and labour market status (Jeyam et al., 2025). At the same time,

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/s6648662393

several studies underline the importance of institutional and organisational contexts in shaping employment outcomes. Profiling approaches that classify unemployed individuals based on employment barriers rather than socio-demographic characteristics enable more targeted and cost-effective employment support, particularly for socially vulnerable populations. Similarly, research on entrepreneurial intentions and labour market participation demonstrates that education, institutional support, infrastructure, and policy environments play a decisive role in enabling sustainable employment trajectories (Hathroubi et al., 2025).

A growing body of literature emphasises the importance of participatory and relational approaches in addressing these barriers. Involving people with intellectual disabilities as co-evaluators of services has been shown to enhance trust, empathy, and the quality of evaluation outcomes, while simultaneously creating meaningful employment opportunities and challenging professional assumptions rooted in deficit-based models (O'Brien et al., 2025). These findings align with research on psychological and support services, which shows that inclusive practices often require the involvement of broader support networks, introducing additional ethical, organisational, and relational complexities that necessitate structured decision-making and professional training (Surley et al., 2024).

From a policy perspective, systematic reviews and policy-oriented studies reveal persistent limitations in disability employment frameworks. Employment policies remain fragmented and predominantly focused on formal regulatory instruments and individual capacity-building, while insufficiently addressing systemic discrimination, employer attitudes, and the coordination of support mechanisms across the employment process (Myshbayeva et al., 2022; Lawrence et al., 2025). Evidence from policy evaluations further suggests that coordinated labour market interventions can yield measurable macro-level effects, such as reductions in unemployment rates, yet these effects do not automatically translate into sustainable employment for socially vulnerable groups without targeted and differentiated support (Sokira & Myshbayeva, 2021). As shown by Vale and Hanisch (2025), even in welfare-oriented policy systems, the discourse of inclusive employment may remain normatively ambitious while being operationally narrowed to workforce management concerns, thereby reinforcing the discrepancy between formal commitments to inclusion and the actual conditions of labour market access for persons with disabilities.

These barriers should also be considered in relation to the wider institutional and regulatory environment that shapes access to formal employment. Ben-Salha et al. (2025) demonstrate that the employment exclusion of persons with disabilities is also shaped by regulatory conditions, as barriers in credit markets, business environments, and the broader formal economy may push them into informal and insecure forms of work. Complementing this macro-level perspective, Ozel et al. (2026) demonstrate that growth in the number of employed persons with disabilities does not automatically reflect genuine inclusion, as employment may remain concentrated in low-paid, physically demanding, and low-status jobs created primarily to satisfy formal legal obligations.

The role of employers and organisational practices is particularly salient in the literature. Case-study evidence from Norway shows that employers are more willing to provide workplace adaptations for existing employees who acquire disabilities than for new job applicants, indicating that perceived risks, organisational routines, and managerial attitudes outweigh formal policy obligations or adaptation costs (Kuznetsova & Bento, 2018). Complementary research confirms that workplace adaptations aimed at removing architectural and environmental barriers not only facilitate access to employment but also enhance long-term participation by improving overall organisational accessibility and safety (Tylutki et al., 2024). At the same time, psychometric studies demonstrate that negative attitudes toward persons with disabilities remain a measurable and multidimensional factor in work contexts, underscoring the persistent influence of implicit biases and organisational culture on employment-related interactions (Chávez-Castillo et al., 2024). Francis and Glasgow (2026) further show that barriers to inclusive employment arise through the combined effect of employer bias, limited accommodations, weak legal enforcement, unequal educational access, and the cumulative discouragement experienced by persons with disabilities after repeated exclusion from the labour market.

Research on recruitment practices suggests that barriers to inclusive employment are reproduced not only through formal exclusion, but also through the communicative dynamics of hiring itself. Vedeler (2024)

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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shows that even within diversity-oriented organisations, disability may still be addressed in job interviews through a person-deficit perspective, which shifts attention from competence to impairment and reinforces barriers to inclusive hiring at the interactional level. Moreover, recent research suggests that even where inclusion-oriented initiatives are introduced, their effectiveness may be limited if they are not embedded across organizational culture and institutional processes, thereby sustaining a gap between formal commitments to inclusion and participants' actual experiences (de Lima et al., 2026).

Recent qualitative evidence further demonstrates that barriers to inclusive employment persist not only at the stage of labour market entry but also throughout workplace participation itself. Nguyen, Alexander, and Bellon (2025) show that inclusive employment barriers continue beyond hiring and are reproduced within everyday workplace participation through inaccessible environments, weak accommodations, discriminatory attitudes, and the exclusion of employees with disabilities from communication, development, and support structures. In this context, sustainable inclusion cannot be reduced to mere access to employment; it also depends on the quality of participation, the availability of support, and the degree to which workplace structures respond to actual employee needs.

At the same time, the literature increasingly shows that inclusive employment must be analysed as a continuous transition process rather than as a single hiring event. Lopez-Gavira, Orozco, and Perez-Lopez (2025) show that the successful employment inclusion of graduates with disabilities depends on a combination of personal capabilities and external supports, including disability services, workplace accommodations, prior work experience, and employer awareness across the transition from higher education to work. These challenges become especially visible when employment inclusion is examined not only as access to work, but also as a process of transition between support environments. Research on the transition from supported to open employment further shows that labour market inclusion cannot be ensured without coordinated organisational and policy support. Joyce et al. (2025), based on interviews with employees with intellectual disabilities, supported employment staff, and open employers in Australia, found that transition to open employment is constrained by inflexible funding arrangements, insufficient employer knowledge and confidence, weak career preparation, and the lack of sustained workplace support. Their findings suggest that even when persons with disabilities express a clear preference for more community-based and inclusive employment options, these aspirations may remain unrealised in the absence of structured pathways, gradual job adaptation, and institutional mechanisms capable of supporting movement between protected and open labour market settings. This highlights that barriers to inclusive employment are reproduced not only through exclusion from hiring, but also through the failure to organise transition processes in ways that align support systems, employer practices, and individual employment trajectories.

Recent policy-oriented research further confirms that disability employment barriers persist across recruitment, accommodation, retention, and career development because policy efforts remain overly focused on individual capacity-building while insufficiently addressing deficit-based attitudes, fragmented systems, and structural discrimination (Lawrence, Mellifont & Bulkeley, 2026). Taken together, these findings suggest that sustainable inclusion cannot be achieved through fragmented policy instruments alone and instead requires coordinated, person-centred, and workplace-responsive support mechanisms.

In this context, social entrepreneurship and the non-profit sector are increasingly discussed as intermediate spaces for inclusive employment. Studies focusing on Kazakhstan show that inclusive business models integrating social and economic value creation can generate employment opportunities for socially vulnerable groups, including persons with disabilities; however, their sustainability depends on strategic clarity, managerial capacity, and institutional support. Process-oriented management of business activities has been identified as a key condition for balancing social objectives with economic efficiency and ensuring long-term organisational viability (Tuyakova, 2021).

Finally, a number of studies highlight the relevance of conceptual and methodological frameworks that shift the focus from medical diagnosis to functional capacities and environmental factors. Applying the ICF-based biopsychosocial model in employment support facilitates the identification of contextual barriers and enablers, thereby reducing the gap between individual abilities and actual work performance (Caruso & Messina, 2025).

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Cross-cultural validation of standardised instruments, such as the Work Rehabilitation Questionnaire, further supports the use of structured assessments to enhance vocational rehabilitation and promote sustainable employment outcomes for persons with disabilities (Fernandes et al., 2023). Complementary qualitative research on assistive technologies illustrates how socio-technical arrangements can reframe disability, reduce experienced ableism, and expand participation by enhancing agency and redefining norms of bodily performance (Cherrington & Brighton, 2024). Recent cross-country evidence also suggests that the future of inclusive employment is increasingly shaped by technological transformation: Omri and Afi (2025) demonstrate that the effect of artificial intelligence on the employment of persons with disabilities is conditional and nonlinear, as AI may initially intensify exclusion, but under stronger economic and institutional governance its longer-term impact may become more inclusive. At the same time, qualitative studies demonstrate that strengths-based employment services can foster inclusive workplaces by cultivating shared hope, aligning individual and collective goals, and challenging deficit-oriented assumptions through everyday organisational practices (Carr-Kirby et al., 2025). As such, strengths-based and context-sensitive support models provide an important conceptual basis for supported employment approaches that seek to align individual capacities, workplace demands, and adaptive support mechanisms in a more personalised and sustainable way.

3. Research objective and methodology

A qualitative research design was employed to achieve the objectives of the study, focusing on the analysis of subjective perceptions and practical experiences of key actors involved in inclusive employment. The choice of a qualitative methodology was conditioned by the multi-dimensional nature of the phenomenon under study, which encompasses institutional, organisational and individual components that cannot be adequately captured through quantitative methods alone.

The empirical basis of the study was formed through semi-structured in-depth interviews with two groups of respondents. The first group comprised employers with practical experience in hiring and supporting employees with disabilities. In total, nine interviews were conducted with representatives of organisations operating in different sectors of the economy. Experts were selected based on their demonstrated experience in implementing inclusive practices and their direct involvement in workplace adaptation processes for employees with disabilities. Interview questions addressed perceptions of key barriers to inclusive hiring, available support measures, assessments of existing state employment policies, and prospects for expanding inclusive practices. The second group of respondents included 53 persons with disabilities representing different types of impairments, including physical, sensory and cognitive disabilities. Interviews with this group focused on individual experiences of job search, recruitment and interview processes, interactions with employers and human resource services, as well as working conditions and workplace adaptation. Interview formats were adapted to respondents' needs: written questionnaires were used for participants with hearing impairments, while oral interviews were conducted with respondents with visual impairments and cognitive disabilities.

Data collection was carried out both in person (Astana) and remotely using the Zoom platform for participants from other regions. To enhance the credibility of the findings, data triangulation was applied by comparing information obtained from different respondent groups and multiple sources, including oral interviews, written questionnaires and expert assessments.

All participants were informed about the aims and objectives of the study and provided informed consent prior to participation. Anonymity and confidentiality were guaranteed. Interviews were audio-recorded only with participants' consent and subsequently transcribed in Russian or Kazakh, depending on respondents' language preferences.

Data analysis was conducted using thematic analysis, enabling the identification of recurring themes, key categories and stable patterns in perceptions of inclusive employment. Particular attention was paid to comparing the perspectives of employers and persons with disabilities, which allowed for the identification of

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both areas of convergence and divergence in the interpretation of barriers and conditions of inclusive employment.

Several limitations of the study should be acknowledged. First, the geographic scope of the fieldwork predominantly covered urban centres, which limits the representation of rural contexts. Second, the sample size does not allow for statistical generalisation; however, it enables the identification of robust trends and typical situations. Third, the voluntary nature of participation may have resulted in selection bias towards employers already interested in inclusive practices. Despite these limitations, the findings demonstrate high analytical and practical relevance and provide a solid foundation for further research and the development of supported employment models.

4. Results and discussion

Sample Structure and Research Context

The empirical basis of the study comprises data obtained from in-depth interviews with persons with disabilities and employers implementing inclusive hiring practices. The characteristics of the employers who participated in the study are presented in Table 1**.**

Table 1. Characteristics of employers participating in the study

Participant group	N	Gender	Age (range)	Mean age	Location	Type of enterprise	Status
Employers / business owners	48	Male, female	32–47	43	Astana, Almaty, Shymkent, other cities of Kazakhstan	Catering (social cafés), sewing and carpentry workshops, car washes, furniture production, educational and rehabilitation centres	59% registered social entrepreneurs; 41% non-registered

Source: created by the authors

The sample covers representatives from various sectors of economic activity and reflects the diversity of organisational contexts in which inclusive employment is implemented.

Sectoral Structure of Employment of Persons with Disabilities

The analysis of the distribution of persons with disabilities across employment sectors reveals pronounced heterogeneity in access to different segments of the labour market. As shown in **Figure 1**, respondents' employment is predominantly concentrated in social enterprises and selected segments of the open labour market, while participation in the public sector remains limited.

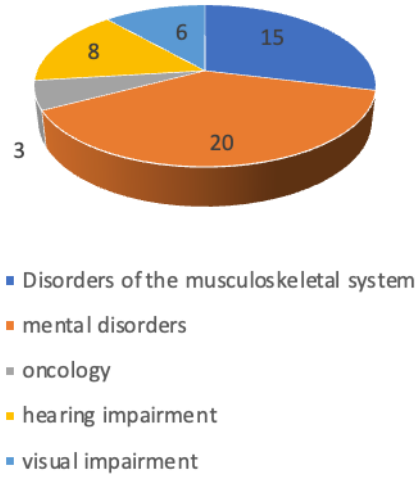


Figure 1. Distribution of Persons with Disabilities by Type of Disability and Employment Sector
Source: created by the authors

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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This distribution indicates the presence of institutional and organisational factors shaping employment opportunities beyond the individual characteristics of job seekers. In this context, social enterprises function as a key channel for labour market inclusion, particularly for the most vulnerable groups.

Sectoral Segmentation of Employment by Type of Impairment
A more detailed analysis presented in Figure 2 reveals a stable association between the type of functional impairment and the sector of employment.

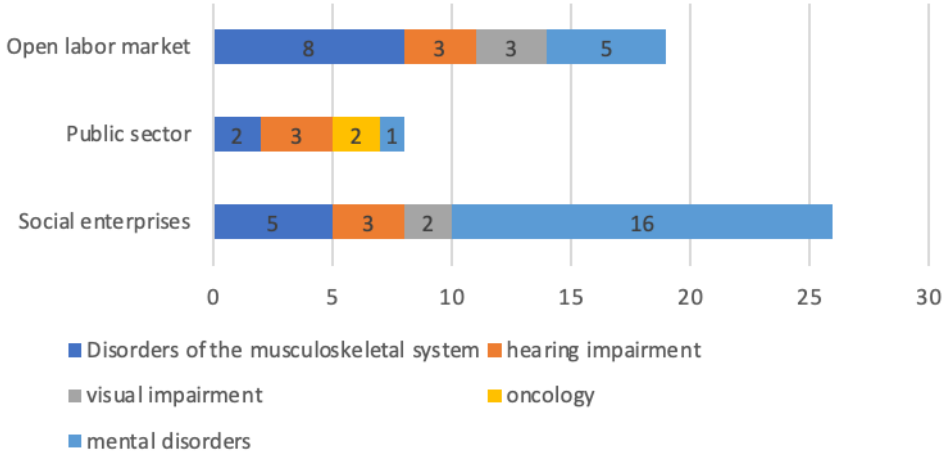


Figure 2. Distribution of Employment Sectors by Type of Disability
Source: created by the authors

Respondents with mental and intellectual disabilities are predominantly employed in social enterprises, whereas persons with physical and sensory impairments are more frequently represented in the open labour market. Across all groups, participation in the public sector remains minimal.

The findings indicate the existence of a segmented labour market in which access to specific sectors is determined not only by professional skills, but also by the type of impairment and the willingness of organisations to adapt workplaces and work processes. Such segmentation constrains labour mobility and limits transitions between sectors.

Interpretation of Barriers from the Perspective of Persons with Disabilities
Interviews with persons with disabilities indicate that employment barriers are predominantly perceived through experiences of stigmatisation, distrust and unequal treatment. Respondents report difficulties at the stages of job search, recruitment and workplace adaptation, largely associated with opaque requirements and lowered expectations on the part of employers. An additional constraint is the limited flexibility of working conditions and the lack of individualised solutions, which complicates both entry into employment and job retention. At the same time, high motivation for work and the presence of individual adaptation strategies suggest that the identified barriers are systemic in nature and primarily rooted in the organisational environment.

Employers' Perspective: Risks and Conditions of Feasibility of Inclusive Hiring
From the employers' perspective, key barriers to inclusive hiring are articulated in terms of managerial risks and organisational costs. Respondents highlight productivity uncertainty, the need to adapt work processes, additional burdens on management teams, and the absence of standardised support tools. Particular importance is attributed to sensitivity to the type of functional impairment: while adaptation is perceived as relatively feasible for certain impairments, it is viewed as requiring specialised resources and infrastructure for others. According to employers, employment sustainability largely depends on the availability of mentors, a supportive organisational culture, and clearly regulated stages of workplace adaptation.

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The Expectation Gap as an Integrative Analytical Outcome

The comparison of data obtained from persons with disabilities and employers allows the expectation gap to be identified as a key integrative outcome of the study. While job seekers predominantly interpret barriers as a deficit of trust and equal treatment, employers frame the same situations through the lens of manageability and risk. The main differences in interpretations and expectations between the two groups are systematised in Table 2**.**

Table 2. Expectation gap in inclusive employment: perspectives of persons with disabilities and employers

Analytical dimension	Persons with disabilities	Employers
Interpretation of employment barriers	Stigmatization, distrust, unequal treatment, lack of recognition of capabilities	Organisational risks, uncertainty of productivity, additional managerial and financial costs
Key concerns at the hiring stage	Fair access to employment, transparency of requirements, stability of employment	Predictability of performance, manageability of work processes, legal and operational responsibility
Perception of adaptation needs	Individualised accommodations and flexible work arrangements as a prerequisite for inclusion	Adaptation as a source of additional workload and resource allocation
Understanding of support mechanisms	Expectation of continuous support and mediation during adaptation	Need for clear procedures, guidelines, and external expertise
Factors of sustainable employment	Trust-based relationships, inclusive organisational culture, long-term security	Standardised processes, mentoring systems, and reduction of uncertainty
Dominant risk perception	Risk of discrimination and job loss	Risk of inefficiency and operational disruption

Source: created by the authors

The identified expectation gap constrains the effectiveness of employment support measures and reduces employment sustainability, as it impedes the alignment of requirements and forms of support at the stages of recruitment and workplace adaptation.

The findings of this study provide a renewed understanding of the nature of barriers to inclusive employment by shifting the analytical focus from isolated constraints to the mechanisms through which such barriers are reproduced in interactions between key labour market actors. Unlike approaches that examine barriers primarily from the perspective of persons with disabilities or employers in isolation, this study demonstrates that persistent constraints emerge within the zone of misaligned expectations, interpretations and managerial logics.

The Expectation Gap as a Mechanism of Barrier Reproduction

One of the key contributions of the study is the conceptualisation of the expectation gap between persons with disabilities and employers as an independent mechanism reproducing barriers to inclusive employment. Empirical evidence indicates that identical challenges—such as workplace adaptation, task performance pace and the need for additional support—are interpreted by the two sides through fundamentally different frames of reference. For job seekers, these challenges are associated with experiences of stigmatisation, distrust and unequal treatment, whereas employers tend to interpret them in terms of risk, productivity uncertainty and additional organisational costs. This divergence in interpretations reduces the effectiveness of even formally well-designed employment support measures, as it prevents the alignment of expectations during recruitment and adaptation processes. As a result, inclusive employment remains unstable: positive attitudes towards inclusion do not translate into sustainable employment practices, while emerging difficulties reinforce mutual doubts between the parties involved.

Sectoral Segmentation and the Limited Scope of Employment Channels

The results further confirm the presence of pronounced sectoral segmentation in the labour market for persons with disabilities. Social enterprises function as the primary employment channel for persons with mental and intellectual disabilities, while access to the open labour market and the public sector remains limited and selective. This segmentation reflects not only differences in individual capacities, but also structural features of the organisational environment, including employers' readiness to adapt workplaces and the availability of structured support mechanisms. In this context, social enterprises perform a compensatory function by

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lowering entry barriers to employment for the most vulnerable groups. However, the concentration of persons with disabilities within this sector simultaneously points to the limitations of existing inclusion models, which fail to facilitate meaningful transitions to the open labour market. This underscores the need to develop intermediary and bridging mechanisms capable of linking social enterprises, the open labour market and public institutions.

Limitations of Individual-Centred Support Models

The empirical findings allow for a critical reassessment of individual-centred supported employment models that focus primarily on preparing and supporting the job seeker. While such approaches remain important, they prove insufficient in contexts where key barriers are located at the level of organisational processes and managerial decision-making. The absence of standardised adaptation procedures, uncertainty in the distribution of responsibilities, and a lack of tools to support employers intensify perceived risks and reduce organisational readiness for inclusive hiring. In this sense, the findings support the need to move from a one-sided logic of support towards dual-sided models that take into account the interests and constraints of both parties. Supported employment should therefore encompass not only assistance to the job seeker, but also the reduction of managerial uncertainty for employers through the regulation of recruitment, adaptation and performance evaluation stages.

Implications for the Development of a Supported Employment Methodology

The identified empirical patterns define key requirements for a supported employment methodology aimed at enhancing employment sustainability. Such a methodology should simultaneously address socio-psychological and organisational–institutional barriers by facilitating the alignment of expectations among participants in the employment process. Core elements include profiling tools and task–ability matching instruments, regulated adaptation pathways, mentoring systems and structured feedback points, as well as standardised formats of interaction between employers, job seekers and support professionals. Within this framework, the methodology proposed in the article is conceptualised not as an alternative to state employment policies, but as an applied mechanism that complements existing measures and enhances their implementability at the organisational level.

Study Limitations and Directions for Future Research

Despite the analytical and practical relevance of the findings, several limitations should be acknowledged. First, the empirical base predominantly reflects urban contexts, which limits consideration of rural-specific conditions. Second, the voluntary participation of employers may have introduced selection bias towards organisations already inclined towards inclusive practices. Third, while the qualitative research design does not allow for statistical generalisation, it enables the identification of stable mechanisms and typical situations. Future research may focus on quantitative validation of the identified patterns, expanding the geographic scope of analysis, and assessing the effectiveness of the proposed methodology across different institutional settings and economic sectors.

5. Conclusion

The present study aimed to analyse barriers to inclusive employment and to develop a supported employment methodology for persons with disabilities oriented towards enhancing employment sustainability. Based on a qualitative analysis of the perspectives of persons with disabilities and employers, the study demonstrates that key constraints to inclusive hiring are formed not only at the level of individual characteristics or institutional conditions, but also within the zone of misaligned expectations and interpretations among actors involved in the employment process.

The central conclusion of the study is the substantiation of the expectation gap between persons with disabilities and employers as an independent mechanism reproducing barriers to inclusive employment. While job seekers tend to interpret employment-related difficulties primarily through experiences of stigmatisation, distrust and unequal treatment, employers are more likely to frame the same situations in terms of managerial risks, productivity uncertainty and additional organisational costs. As shown by the empirical findings, this

divergence reduces the effectiveness of formal employment support measures and constrains employment sustainability even in contexts characterised by positive attitudes towards inclusion.

The empirical evidence also indicates pronounced sectoral segmentation in the employment of persons with disabilities. Social enterprises function as the primary channel of labour market inclusion for the most vulnerable groups, particularly persons with mental and intellectual disabilities, while access to the open labour market and the public sector remains limited. This structure reflects a lack of reproducible adaptation and support mechanisms and underscores the need to develop intermediary and bridging employment models.

The practical significance of the study lies in the development and piloting of a supported employment methodology grounded in a dual logic of support. Unlike individual-centred approaches, the proposed methodology addresses not only the needs of job seekers, but also employers' managerial constraints by reducing uncertainty and perceived risks through process standardisation, regulated adaptation stages and a set of applied tools. This allows the proposed approach to be considered a reproducible and scalable mechanism that complements existing employment policy measures.

From the perspective of future research and practice, the findings point to the need to shift the analytical and policy focus from isolated support for specific groups towards the development of support systems that facilitate the alignment of expectations and the distribution of responsibility among actors involved in the employment process. Expanding the empirical base through quantitative studies, assessing the effectiveness of the proposed methodology across different institutional contexts, and examining pathways from social entrepreneurship to the open labour market represent promising directions for further research.

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Funding: The research was conducted with financial support from the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan as part of the grant funding project (Grant No. AP26194469, "Integration of Persons with Disabilities into the labour market: development of a comprehensive programme for labour adaptation").

Acknowledgments: The authors express their sincere gratitude to all participants for agreeing to be interviewed and for their openness in sharing their experiences and perspectives.

Author Contributions: Conceptualization: *S.O., E.A., D.M., Z.S., S.B.*; methodology: *author, author S.O., E.A.*.; data analysis: *E.A., D.M., Z.S., S.B.*, writing—original draft preparation: *S.O., E.A., D.M., Z.S., S.B*, review and editing: *S.O., E.A., D.M., Z.S., S.B*; visualization: *author*, *author*. All authors have read and agreed to the published version of the manuscript.

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n2489259566

Publisher
http://jssidoi.org/esc/home

INITIATIVES IN SUSTAINING THE INDIVIDUAL ECONOMIC SUSTAINABILITY AMONG THE ABSOLUTE URBAN POOR COMMUNITIES*

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Received 15 February 2026; accepted 16 April 2026; published 30 June 2026

Abstract. Rapid urbanization and industrialization contribute to a new socioeconomic stratum, namely the urban poor. Absolute urban poverty refers to the situation where urban poor people are unable to cover necessities like clothing, food, and housing. In 2022, the percentage of urban poverty in Malaysia increased. The New Economic Policy (NEP) has largely been responsible for Malaysia's notable progress in lowering overall poverty rates across all ethnic groups. However, the absolute urban poor challenges are still an important topic discussed until today. The absolute urban poor community still struggles to survive due to some challenges such as high living costs, insecurity job, and social issues. Thus, the objective of this study is to understand the initiatives taken by all stakeholders involved in reducing the challenges faced by the urban poor communities. Semi-structured interviews were conducted with the urban poor communities and community leaders at the People's Housing Program (PPR) in the Northern region, Malaysia. The findings analyzed using thematic analysis indicated that some initiatives have been implemented, such as dual working, skill development, working together with the communities and local authorities, awareness programs, and financial and basic necessity aid. This initiative helps in reducing the burden faced by the community. The result acknowledges all stakeholders in sustaining the economic among the urban poor, which is in line with the National Urbanisation Policy, the Twelfth Malaysia Plan (2021-2025), and Goals 1, 8, and 10 of SDG 2030.

Keywords: Urban poor; challenges; initiative; economic; sustainability

Reference to this paper should be made as follows: Ramli, F.R., Senin, A.A., & Majid, M. 2026. Initiatives to hinder the difficulties faced by the absolute urban poor communities in sustaining the individual economic sustainability. *Entrepreneurship and Sustainability Issues*, 13(4), 306-319. http://doi.org/10.9770/n2489259566

JEL Classifications: I32, I138, O15, R23, R11

1. Introduction

The term "economic sustainability" describes actions that safeguard social, cultural, and environmental aspects of a country or business while simultaneously promoting long-term economic growth (Joseph & Bish, 2021). In the meantime, the requirement to support humanity's ongoing financial flow is a common characterization to describe sustainable development (Spangenberg, 2005). Economic sustainability is significant because it explains how societies may continue operating within their current financial frameworks and what actions may be required to improve the system's long-term viability. The term "individual economic sustainability" in this study refers to a person's capacity to sustain an adequate and steady income and financial security over the long term. A person's lifestyle decisions, professional growth, and efficient money management are necessary to

* *This research was funded by the Ministry of Higher Education Malaysia through the Fundamental Research Grant Scheme - Early Career (FRGS-EC) (FRGS-EC/1/2024/SS10/UITM/02/24).*

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n2489259566

achieve individual economic sustainability. The vulnerability of impoverished individuals to poverty is further increased by their lack of financial resources and incapacity to secure outside funding (Samat et al., 2018). Urban communities' difficulties are among the topics covered by the National Urbanisation Policy. It strongly emphasizes inclusive and sustainable urbanization, considering the needs of all citizens, especially the urban poor. Besides, it contributes to SDG 1 (No Poverty), SDG 8 - Decent Work and Economic Growth, and SDG 10 - Reduced Inequality. Besides, RMK12's (2021–2025) - Priority Area A: Strategy A4 (Addressing Quality of Life of Urban) focuses on raising income and raising the poor's standard of living, enhancing access to essential services, tackling urban poverty, fortifying the service delivery system, and reducing household inequality.

As a result of rapid urbanization and industrialization, a notable rural-urban migration created a new socioeconomic stratum known as the "new poor" or "urban poor". Urban poverty in Malaysia is a growing problem, threatening people's quality of life (Alias & Che Sulaiman, 2023). The Department of Statistics Malaysia (2023) reports that the percentage of absolute poverty in Malaysia's urban areas has increased from 3.8% in 2019 to 4.5% in 2022. Bumiputera represents 85.2% of all impoverished households in Malaysia, according to the country's absolute poverty statistics. Chinese and Indian ethnic groups make up 3.9% and 9.4% of the population, respectively (Department of Statistics Malaysia, 2023).

Studies on the economic sustainability of individuals in Malaysia's absolute urban poverty community are still limited. The majority of past studies addressed alleviation techniques (Khoo et al., 2018), community empowerment (Dass et al., 2022), and social resilience (Alias & Che Sulaiman, 2023). Furthermore, according to Gopal (2013), the majority of research was conducted in Kuala Lumpur, and until recently, similar patterns were noted (Dass et al., 2022; Alias & Che Sulaiman, 2023; Abd Wahab et al., 2022). In addition, as mentioned by Mohd Taib (2011), there has been much discussion on Malaysia's poverty eradication tactics, particularly in the country's rural districts. However, not as much focus has been placed on urban poverty eradication measures. Md Nor et al. (2025) pointed out the urgent need to address some challenges among the urban poor community, such as a lack of savings, unstable employment, and low-income levels. Thus, this study was conducted to understand the initiatives taken by all stakeholders in order to face challenges among the urban poor community, which focused primarily on the urban poor at PPR located in the Northern region of Malaysia. Besides, this study also focused on understanding the community's awareness and accessibility regarding the initiatives offered by the external stakeholders.

The findings are based on in-depth interviews with relevant stakeholders, such as the urban poor community and community leaders. The new knowledge comes from different perspectives, such as individual urban poor experiences. Thus, it helps to develop a new strategy or approach to sustain the individual absolute urban poor economy in the future. Thus, they have enough finances to enjoy a high quality of life in this era. In addition, this study may serve as input for related ministries and government agencies towards individual economic sustainability. This study is also expected to improve the existing guidelines for absolute urban poverty, achieving individual economic sustainability.

2. Literature Review

Absolute poverty is when a household's income is insufficient to cover essential expenses like clothes, housing, and food. According to this study, an individual is considered completely impoverished if their earned income falls below the current benchmark, where the poverty line is established by considering the least amount of money required to meet basic needs. This poverty level will fluctuate because the cost of necessities is a moving target. Furthermore, the truly impoverished people are the ones most impacted by increases in the price of commodities and the economy. The minimum income threshold, or Poverty Line Income (PLI), was established to quantify absolute poverty. There are two categories in this PLI component: food PLI and non-food PLI. The calorie requirement for a household is used to calculate the food PLI value. The average poverty line income (PLI) of the urban areas in Malaysia increased from RM2210 in 2019 to RM2660 in 2022. The state with the highest average PLI among urban areas in 2022 is Sarawak (RM2860), followed by Selangor (RM2848) and Kuala Lumpur (RM2816). Meanwhile, Perlis recorded the lowest PLI (RM2199) (Department of Statistics Malaysia, 2023).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/n2489259566

Urban poverty can have negative effects on the community's health, environment, and social well-being (Anatasha Faiza & Muhamad, 2010). There are some difficulties faced by the urban poor community, such as increasing standard of living costs (Md Nor et al., 2025). The cost to purchase necessities such as food, house, education, health care and transportation increased. This contributes to reducing purchasing power among the community and increases the financial burden. Low household income in urban areas with many commitments is a challenging that needs to be overcome. As mentioned by Sulaiman et al. (2011), due to high cost for child education and insufficient income, they will reduce the expenses for purchase food that contributes to food insecurity, reduce purchase high quality and expensive items and contribute to the risk of poor dietary habits (Sulaiman et al., 2011).

In addition, the urban poor community also faced the issue of income instability or limited access to secure employment (Md Nor et al., 2025). It is due to an increase in urban-rural migration (Md Nor et al., 2025), population growth (Dianti & Primandhana, 2025), the level of education (Faturohim et al., 2023; Dianti & Primandhana, 2025), and a lack of skills (Md Nor et al., 2025). These factors contribute to increasing the unemployment rate among the urban poor community. A study conducted among PPR in Kuala Lumpur determined that the community within 20 – 39 years old has a high unemployment rate, which emphasizes the difficulties of the younger generation to have steady work. The result highlights the significance of focuses intervention, such as providing skill development for the young generation, employment access and income generation (Md Nor et al., 2025). A study conducted by Faturohim et al. (2023) determined that the level of education as the important factor contributing to unemployment and poverty. It may be inferred that education has a significant impact on lowering unemployment and poverty; investing in education is crucial. Investing in education contributes to improving access and the quality of education, thus providing people with more options for respectable employment. As suggested by Dianti and Primandhana (2025), to reduce the poverty rate, it is important to consider improvement on the quality of education and control population growth.

According to a study by Kaiser et al. (2024), low salaries and unemployment keep urban poor communities trapped in a cycle from which they are unable to escape. The problems of inadequate income or financial crisis are exacerbated by low household income and unemployment in impoverished communities. As a result, it increases anxiety in the population and leads to a poor diet. The cost of living is too high for urban poor communities, and the rising cost of food makes it impossible to purchase daily necessities. Difficulty in purchasing enough food and consuming unhealthy food contributes to health problems such as malnutrition, illness, and a decline in well-being among the urban poor community. Due to limited access to healthcare, dependence on informal providers, and delay in receiving medical treatment, people suffer from chronic diseases. Consequently, it becomes challenging to maintain a consistent job or finish tasks that demand high productivity, leading to unemployment. The urban poor community's inability to escape the cycle of poverty is a result of this.

In addition, previous studies also determined the relations between poverty and crime among urban poor communities (Kambon & Henderson, 2008; Graif et al., 2014; Wang & Li, 2024). There have some crimes or social issues related to poverty mentioned by previous studies, such as drug (Keshav & Komaraiah, 2015; Ghulam et al., 2016), alcohol (Keshav & Komaraiah, 2015), and theft (Bjerk, 2009; Papaioannou, 2017). Due to financial burden and low income, the communities find other ways to survive, such as theft. Instead of that, past studies also determine that poverty has a relationship with health issues (Alqassim & El-Setouhy, 2022; Lleras-Muney et al., 2024). It is because financial burden leads the community to consume unhealthy foods such as instant foods or processed foods, which are much cheaper. As supported by Alqassim and El-Setouhy (2022), the poor community's lack of food and unhealthy food contribute to malnutrition issues.

Due to the above difficulty faced by the urban poor communities, there have some actions taken by the communities, external parties such as the government, Non-Governmental Organization (NGO), and the private sector in order to reduce the challenges faced by these urban poor communities. In Malaysia, one of the initiatives introduced by the Ministry of Domestic Trade and Cost of Living is Payung Rahmah. Payung Rahmah assists low-income household to reduce their burden on increasing living costs (Sinar Harian, 2023), such as Jualan Rahmah, which offers discount up to 10 to 30% for basic needs (The Sun, 2025). Besides, the government also provides financial assistant to low-income families in order to reduce the financial burden. The introduction

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/n2489259566

of Bantuan Sara Hidup (BSH), Sumbangan Asas Rahmah (SARA), and Sumbangan Tunai Rahmah (STR) also helps to support the increasing living cost especially among low-income families. SARA provides cashless aid and helps low-income families to purchase necessities (Bernama, 2025).

In addition, the government also introduces holistic national initiatives such as Sejahtera MADANI in the form of financial assistant, skill development, job opportunities, entrepreneurship support and social welfare. Besides, the People's Housing Program (PPR) is also one of the good initiatives to provide housing need which target poor communities or low household income (Ministry of Housing and Local Government Malaysia, 2020). The public needs to pay low monthly rental costs, which helps them to survive in an urban area with low wages. In addition, to help the urban poor community gain income, Skim Pembiayaan Mikro (SPM) was also introduced by TEKUN to provide micro financial for business expansion. Besides, the Malaysia Digital Economy Corporation's e-entrepreneur program enables urban business owners to use digital platforms to generate revenue (Md Nor et al., 2025).

Private sectors and the NGO also play important roles in reducing the burden on the urban poor community. There are some programs organized that focus on food assistance and necessities, education such as free tuition, skill development, job marketability, empowerment of women and single mothers, and PPR community development. This is supported by Md Nor et al. (2025), the NGO focused on social services such as education, healthcare and food assistance. For example, Kechara Soup Kitchen (KSK) provides daily food to the urban poor community, a food bank program, skill development program and economic empowerment program. SOLS Foundation focuses on free education, skill development, and employment support, which aims to help the community move out of the poverty cycle. Another example, Reach Out Malaysia provides monthly food assistance, education support, basic healthcare and living necessities assistance. Additionally, Moga Dass and Sabri (2017) noted that to provide urban poor communities with a source of income, private businesses should offer locals more employment chances than foreign workers, hence reducing the limited job opportunities among these groups.

By combining the government initiatives with partnerships involving the private sector, NGO and community-based initiatives, the urban poor can be empowered, resilient, and have sustainable livelihoods (Md Nor et al., 2025). The initiatives taken can help to reduce the financial crisis faced by the urban poor communities, thus helping to enhance the quality of life.

Some literature gaps were identified, such as Olajide et al. (2018), who showed a significant disconnection between urban development policies and the realities and needs of the urban poor, as they state policy frameworks are not centered around inclusive development and livelihood aspects. Research shows that while both urban poverty and urban violence have been studied extensively, major silences remain around their conjuncture, and the impact of a large number of measures aimed at lessening the degree of insecurity and the poverty of the inhabitants of medium and low-income cities remains unassessed (Muggah, 2012). Said et al. (2021) pinpoint the lack of studies on the impact of anti-poverty measures on community well-being in Malaysia. Adib et al. (2018) stated that the current initiatives targeting homelessness, which is a brutal face of urban poverty, are more short-term efforts rather than sustainable long-term solutions. Furthermore, Malek and Yusof (2022) state that further studies in Malaysia are needed on the urban poor's psychological and social aspects of their well-being. These gaps describe the urban poor in Malaysia, the effectiveness of initiatives, sustainability, and a comprehensive impact assessment of initiatives.

3. Research Design

This study is based on a qualitative method in order to understand the initiatives taken by the urban poor communities in order to face the current challenges. Instead of individual initiatives, in depth interview conducted to examine the roles of external parties, such as the government, the private sector, and NGO in reducing the burden faced by the absolute urban poor community. Semi-structured interviews were conducted among the absolute urban poor community and community leaders. The research questions were prepared and adjusted according to the responses given by the target informants. Interviews were conducted over 2-3 months based on the availability of the respondents. The interview sessions were conducted face-to-face, with

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/n2489259566

approximately 15-30 minutes for each interview session to understand the coping strategies, challenges, and the effectiveness of initiatives implemented by communities and external stakeholders.

As mentioned by the Department of Statistics Malaysia (2023), the absolute urban poor refers to the community who lived in the urban area with an average poverty line income (PLI) of RM2660. Thus, the inclusive criteria in selected target informants in this study are (1) live in an urban area, (2) average income of RM2660. This study is based on purposive sampling, which focused specific target group, where data is gathered from the absolute urban poor communities. The information gathered from the target group will provide better information and generate more precise results that represent the absolute urban poor community in this country.

This study involved eight absolute urban poor communities and two community leaders from PPR in the Northern Region, Malaysia. PPR Perlis and PPR Kedah were chosen in this study. This is in line with Creswell (2013), in a qualitative study, four to five informants are considered enough. All the data gathers form the informants are transcribed and analyzed using NVivo 12 software. The research objectives were answered by using the thematic analysis. The six steps of thematic analysis outlined by Dawali (2020) were followed in this study. The first step is to become familiar with the data. It establishes what types and how many themes might emerge from the data. The second step is code generation, then theme finding, theme review, theme definition and naming, and report writing. The thematic analysis's final thematic map (thought map) shows both core and subthemes.

This study has some limitations, even though it provides some insightful analysis. The small sample size and the purposive sampling method mean the study cannot be applied to the urban poor population in Malaysia as a whole. The second limitation is that the study is limited to a specific aspect of urban poverty in Malaysia, particularly the Northern region, and therefore overlooks the diversity of urban poverty across the different states in Malaysia, as they differ in terms of the cost of living and socio-economic conditions. Another limitation is that the study had to rely on cross-sectional data, which means that it could not assess the impact of governmental and non-governmental programs aimed at poverty alleviation in the long run. In terms of initiatives, the study describes what was done but leaves out the measurement of initiatives in terms of effectiveness and sustainability over time. Lastly, limited time and access to the informants meant that the interview sessions covering the stakeholders, especially governmental and corporate representatives, were not extensive.

4. Results and Discussion

4.1 Informants' Profiles

Table 1 below shows the informants' profiles, which consist of 8 absolutes urban poverty communities from Northen Region in Malaysia. All 8 informants, coded as CN1 – CN8, live in the urban areas and have a household income of less than RM2660. In addition, all of them live at the People's Housing Program (PPR) in Malaysia. In addition, 2 informants are community leaders, coded as LN1 – LN2.

Table 1. Informants' profiles

Region	Roles/Position	Gender	Codes
Northen Region: PPR (Perlis)	Community leader	Male	LN1
	Community	Female	CN1
Northen Region: PPR (Kedah)	Community leader	Female	LN2
	Community	Male	CN2
	Community	Female	CN3
	Community	Female	CN4
	Community	Female	CN5
	Community	Female	CN6
	Community	Female	CN7
	Community	Female	CN8

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4.2 Difficulties Faced by the Absolute Urban Poor Communities

According to the urban poor communities and community leaders' feedback, there are three main difficulties faced by them, which are the increasing cost of living, limited job opportunities, and crime or social issues. Increase cost of living due to the increase in the cost to buy necessities such as food, child education, utilities, health care, and transportation. For example, in child education, the community cannot afford to send the child to school because of the tuition fees. Meanwhile, increasing the necessities like food also enhance burden for them to survive due to a lot of monthly commitments. For limited job opportunities, the informants mentioned about increase competition among the job seekers. This is because the increase in migration from villages to urban areas contributes to their difficulty in competing. Besides, the informant also mentions the level of education as the reason for unemployment or difficult to find a job. Some of the urban poor communities do not have certificates and do not meet the company's high requirements. Thus, it is difficult for them to get a proper job and receive low monthly wages. The last issue discovered by the informants is crime or social issues among the urban poor community. The issues informed by the informants are drugs, theft, vandalism and alcohol. Due to unemployment or low monthly income, and addicted to drugs, it contributes to another social issue, such as thief among the community. As informed by the informant, drug issues have reduced but still exist in the community; they feel unsafe staying in the PPR.

4.3 Initiatives Taken by the Urban Poor Communities

Table 2 explains the summary of findings from the informants on the initiatives taken by the communities to reduce the three difficulties faced by the absolute urban poor communities, such as increasing living costs, limited job opportunities and crime or social issues.

Table 2. Informants' feedback on the initiative taken by the communities

No.	Difficulty	Initiatives
1	Increase living cost	Extra work to increase monthly income because the child's education is high (CN1). The community has a side income to generate extra income (LN1). National Information Dissemination Centre (NADI) organized a program related to the website and TikTok to promote the community business (LN1). Need to do part-time or find extra work if there is demand/opportunities (CN2). Both husband and wife need to work and find more income (CN3). Plan to open a home-based small business, and at the same time do extra work/part-time to help husband (CN4). Help husband such as part time job by selling homemade traditional snacks, because RM1500 income per month is not enough (C5). Work extra hours, move out of town to sell the product (CN6). Find a new location to sell the product (CN6). Try to apply for financial aid from the government, such as the Social Welfare Department (JKM) (CN7). Work part-time to support monthly expenses (CN8). Need to manage financial effectively (budget), focused on the important part such as child education (LN2). Work part-time to enhance financial (LN2).
2	Limited Job opportunity	Collaborated with Job Malaysia, organized an open interview to provide job opportunities to the community (LN1). Act as a platform to share information with the community on job opportunities. Rukun Tertangga (RT) will share the information through the community group (LN1). Need to self-working such as opening a small business to support monthly expenses (CN3). Increase skills and self-improvement to meet the job requirement (CN5). Move out of the town to find a job from other nearby location/area (CN8).
3	Crime/social issue	For thief issue, work together with neighbors for monitoring (CN1). Every neighbor participates in the drug problem and reports any drug-related activity to the police (CN1). Install CCTV, advise and punishment to those who are involved in vandalism. Sekreteriat Muafakat Komuniti will take actions (LN1). Collaborate with local authorities to solve the drug issues (LN1) Thief issue, report to the police to take action (C2). Monitor child and family member, monitor their daily activities (CN3). Work together with neighbors to monitor the social issues and install CCTV (CN4).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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		Establish Rukun Tertangga (RT) to share all the information if there is an increase in the thief issue. RT advised on how to avoid/reduce this issue, such as increasing community awareness and lock house properly (CN4). Work together with the community to monitor the PPR area to reduce the thief issue in the community (CN5). Advise the community and report to the police (CN6). Advise the child not to be influenced or involved in social issues (CN7). Monitor child and control socializing with outsiders in the community (CN8). Advised the child on the negative effects of drug addicts and theft (LN2). Install CCTV to reduce theft issues (LN2). The most important thing is that neighbors need to work together to reduce crime/social issues in the community (LN2).

The results show that urban impoverished communities engage in multiple strategies to combat the main problems they have to deal with, such as the rising cost of living, scarcity of viable employment opportunities, and prevalent social problems. To cope with the rising cost of living, the majority of respondents carried out strategies that involved income diversification, including part-time employment, additional working hours, and small home-based business ventures. As supported by Jamil et al. (2020), usually urban poor communities have dual income family, both husband and wife are working. People work for two or more jobs basically due to some reason such as increasing cost of living, generate extra money, debt repayment, business startup, leisure, financial problem and low monthly salaries (Baharudin et al., 2022). However, this contributes to absenteeism, fatigue, poor performance, and conflict (Baharudin et al., 2022).

Some people sought out government benefit programs and employed tighter financial controls, while, in numerous instances, both partners (husband and wife) did household budgeting and financial planning.This is supported by Khoo et al. (2018), who emphasized the necessity of "spending within their means" and focusing primarily on the necessities, as well as the necessity of being cautious or even conservative in daily spending. A study conducted by Moga Dass and Sabri (2017) indicates that the urban poor community in Kuala Lumpur has a moderate level of financial literacy, less effective financial behavior, significant financial strain, and a moderate level of personal well-being. A person's personal well-being, including divorce, job loss, health problems, and relationship problems, may be impacted by unhealthy financial ways of thinking, including careless financial management. To attain a higher degree of personal well-being and lessen financial strains, a sound approach to money management is essential. Promoting financial education to the urban poor community is crucial because having the necessary information, abilities, and resources will enable them to make wise financial decisions that will improve their financial well-being. Non-governmental organizations like Credit Counselling and Debt Management Agency (AKPK) are credible in enforcing appropriate financial education on the impoverished urban population. In addition, the respondents felt that financial counselling was crucial for managing their finances because financial constraints also directly affect consumers' well-being.

Furthermore, digital initiatives like the National Information Dissemination Centre (NADI) training programs helped community members promote their businesses online. According to Khoo et al. (2018), the majority of respondents requested financial capital and product technology as types of assistance. The government has undoubtedly created financial capital and product technology assistance initiatives. An improvised allocation of this aid is required to extend attention to the proper and suitable target groups, taking into account contributing elements such as experience and the recipients' physical capabilities, like owning the operational premises used to produce the goods. However, if assistance is provided inappropriately, it may be misused or abused. The recipient group's self-readiness comes first (recipient groups with business experience or groups that rely entirely on the business), then financial capital and product technology (target groups with strong financial ability and technology, as well as target groups with a good marketing network). Thirdly, it is essential to offer the target population mental strength development and motivational guidance. According to the majority of respondents, the right kind of support should be given to the right target group, which includes those with total business capital assets, entirely dependent on business, and have previous company experience.

Due to a lack of job prospects, the community focused on both institutional and personal strategies. On the other hand, external partners' job-matching and info-sharing initiatives boosted employment access. Meanwhile, self-

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/n2489259566

reliance focused on skill enhancement, self-employment, and job opportunities searching beyond the residential area. As supported by Khoo et al. (2018), one of the practical ways to reduce poverty would be to work hard and explore more job opportunities. The study also suggested doing more jobs. In addition, the community leader helps by collaboration with external parties to organized career fair for the community. Besides, the leader also encourages the community to work for themselves by opening a small business to survive. There are some studies discussed involving entrepreneurship to enhance the income among the poor community (Mohd Taib, 2011; WestriKekalih et al., 2014; Samat et al., 2021) or reduce poverty (Mascarenhas et al., 2013). Entrepreneurship contributes to economic growth, employment development and technology advancements (Samat et al., 2023). Thus, it has the potential to disperse income and alleviate poverty among the urban poor community. In opening a business, training is crucial and able to provide more accurate information or knowledge regarding chances to enhance poor community income (WestriKekalih et al., 2014). Khoo et al. 2018 also agreed on course or training are beneficial to the target participant. As mentioned by Mohd Taib (2011), entrepreneurship is a strategy that has a lot of promise to improve the lives of the urban poor community through generating better income. However, in order to succeed, this effort must be coupled with training. A financial assistant will be ineffective if they are provided without a thorough understanding of the knowledge and skills that should be applied.

The community also believed that improving their skills is an advantage to compete and gain a job offer. In Malaysia, the poorest households often have a greater rate of informal employment, with the B40 households accounting for more than half of all informal workers (Rahman et al., 2024). Thus, it limits access to employment security, social protection and skill improvement pathways. As mentioned by Rahman et al. (2025), the main requirements for this group are better work matching systems, secure and inexpensive housing, and easily accessible and reasonably priced skills development that is in line with the industry standards. By providing reasonably priced upskilling courses offered in online, mixed, and part-time learning format encourage skill advancement and meet the changing market demands.

The results center upon effective socially based approaches. Strong sentiments existed regarding the responsibility of the entire community, per the residents. Monitoring the community, working with local government, and involvement with community groups were noted. Preventative actions, including incident reporting to the police and the installation of CCTV, have been increasing, along with community awareness. Additionally, parental supervision and guidance were identified as effective strategies for reducing the negative social involvement of youth. As mentioned by Talha (2008), the creation of sustainable neighborhoods and the communities that reside there must be a priority. Creating clean, safe spaces, good education, foster relationship between the generation, families sharing information, and having the common ability to step in for local safety all contribute to a positive social good that benefits all locals. In addition, local authorities and police can be partners in crime prevention (Talha, 2008). A study conducted in Malaysia by Abdul Karim and Abdul Rashid (2017) believed that RT has contribute good relationship among the community. In turn, the urban people feel less fear and more secure, which improves the overall quality of life.

Overall, the findings indicate that although the urban poor communities demonstrate resilience to the challenges posed by their environment, there are limits to their self-managed adaptive strategies, which are largely informal, community-supported, and survival-focused. This highlights the need to focus more on structured interventions, especially in the areas of income, employment, and community development, for sustainable and enduring poverty alleviation.

4.4 Initiatives Taken by the External Parties

Some initiatives have been taken by the external parties, such as the government, NGO, and universities, in order to reduce the difficulty faced by the urban poor communities. The summary of initiatives taken by the external parties is shown in Table 3 below.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/n2489259566

Table 3. Informants' feedback on the initiative taken by the communities

No.	External Parties	Initiatives
1	Government	The National Anti-Drugs Agency (AADK) organized a program in the PPR to create awareness on the drug issue (CN1). Government initiatives such as Jualan Rahmah, STR, and SARA help the urban poor community to support daily expenses (CN1). Provide free health screening to the community (LN1) SARA is a good short-term initiative, enabling the poor community to purchase (LN1). Government provides financial assistant such as SARA, sometime is not enough (CN2). Received financial assistance from the government, such as SARA, which helps to reduce the burden, but the product price nowadays is high (CN3). Government assists with necessity needs. Besides, government initiatives on the Bantuan Rakyat, SARA, and Jualan Rahmah help to reduce financial burden (CN4). AADK on the anti-drug program and the Ministry of Health for dengue. An anti-drug program to create awareness on drug among the community (C5). The government provides a free health care program to the community (CN5). Initiatives from the government, such as SARA and Jualan Rahmah, help to meet the necessity need (CN5). Government initiatives help reduce the financial burden to purchase the necessity needs (CN6). The dental clinic provides a talk and a free dental consultation (CN7). The government initiative, such as financial assistance (SARA), helps the community (CN8). The government organized a program to provide the budget required (LN2) Government initiatives such as MySARA, Jualan Rahmah, and STR help cash flow, to reduce the cash withdrawal for monthly expenses (LN2). Jualan Rahmah by sell product in lower price is a good initiative to reduce financial burden (LN2).
2	NGO	NGO organized a program to increase awareness (CN1). NGO and volunteers organized a program related to education (LN1). NGO provides assistance, for example, necessary needs like food (CN2). NGO provide basic needs such as sugar and rice, but in limited quantities, a few times per year, and not all people receive them (CN3). NGO organized activities such as a motivation program, assistance with the necessity needs, child milk and diapers (CN4). Program for income generation through recycle activities (CN5). Received necessity need assistance, such as rice and milk from the NGO (CN5). NGO provides a program to increase community motivation and counselling (CN6). Organized a program related to entrepreneurship to generate the community income (CN7). NGO provide necessity need like rice, but have not received any financial assistance from them (CN7). Received the necessary supplies, like rice, from NGO (CN8). NGO organized a program related to Technical and Vocational Education and Training (TVET) for students (LN2).
3	University	University creates awareness program, cleanliness, education and civic awareness among the community (CN1). The university also organized a motivation program with the community (CN5).

Instead of the communities' initiatives to face the challenges, there are some initiatives implemented by external parties to help the urban poor communities. As mentioned by the communities, the financial assistance and programs introduced by the government, such as STR, SARA, BSH, and Payung Rahmah, contribute to reducing the financial burden among the community due to the increasing cost of living. To face the high cost of living, the Ministry of Domestic Trade and Cost of Living, Malaysia, introduced the Payung Rahmah Program to the low-income community (Berita Harian, 2023). The BSH initiative also helps reduce the communities' financial burden and contributes to improving public life. In addition, the government also revised the minimum wages in Malaysia, from RM1500 to RM1700, to cope with public pressure on the increasing cost of living (New Straits Times, 2024). This initiative helps to improve the standard of living among Malaysians (Nur Adlina et al., 2023). One way to alleviate people's financial difficulties and strains could be for the government to raise the basic salary or provide welfare allowances (Moga Dass & Sabri, 2017).

Besides, the roles taken by the local authorities, such as police and AADK, through a create awareness program in order to educate the community on social issues like drugs. For example, in 2019, AADK, through a pilot project that involves PPR areas, will focus more on preventing drug abuse among the community through close collaboration with the diverse agencies. In addition, the People's Housing Program (PPR) model, for instance, is one of AADK's four primary models. It works with governmental and non-governmental organizations to

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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implement programs for former drug addicts, such as support groups, recovery coaches, and psycho-education, as well as to mobilize the community for a healthy lifestyle (Bernama, 2020). Besides, according to Bernama (2024), police also organized a program enhancing community safety by involving them as sub-committee members, educating the community on the crimes and acknowledging how to report the information. Involving the community as partners is significant for crime reduction. As mentioned by Geshina et al. (2014), conducting a community program contributes to providing or sharing knowledge on how to reduce the opportunities for crime to happen, thus leading to promoting crime prevention among the community.

In addition, NGO also play crucial roles in helping the urban poor communities. As mentioned, many programs organized by the NGO to reduce the challenges of the urban poor community, such as provide necessity need, such as food, child milk and Pampers. In addition, the community also discussed the effort by NGO and universities to organize education, counselling, motivation and awareness program to the community. Education is an important factor to be considered for moving out from poverty cycle (Khoo et al., 2018). Those with a low level of education are more susceptible to poverty (Siwar et al., 2016; Azhar & Mohd, 2020). As mentioned by Khoo et al. (2018), the necessity of providing their kids with an adequate education is to prevent future generations from becoming trapped in the poverty cycle. As suggested by Weng (2023), organizing extracurricular and psychological counseling for urban poor children can help them develop a positive attitude. By providing extracurricular activities with lower fees contribute to enriching the child's extracurricular life in a way that maximizes their physical and emotional well-being. Through involving with extracurricular activities, the urban poor child may effectively express their feelings and make more friends, which serves as a useful guide for the ongoing improvement of the physical and mental health of the urban poor. In addition, media-based motivational counselling programs that connect religion have demonstrated that putting positive beliefs into practice can lead to change (Khoo et al., 2018).

Overall, the findings show that community initiatives and support from the government, NGOs, and universities are crucial in assisting urban poor communities to deal with the high costs of living, lack of employment, and social problems. Communities show resilience through self-employment, income diversification, and social cooperation. Though these efforts demonstrate resilience, the initiatives are still short-term and survival-oriented. External initiatives, especially government funding, financial assistance, and cost-of-living programs, provide great relief and are supplemented by social support, education, and skills development from NGOs and universities. These programs, however, are often inconsistent, limited, and, in relation to the urban poor, inadequate to address the structural problems in the long term. This highlights the need for a greater integrated, sustainable, and multi-faceted approach in dealing with the long-term alleviation of poverty.

Conclusion

In conclusion, this study emphasized the considerable resilience that urban poor communities in Northern Malaysia exhibit in the face of economic challenges, as exemplified by the populations' discipline in finances, ability to diversify incomes, and the cooperation present in the communities. Nevertheless, the aforementioned strategies are largely survival-oriented and short-term, ultimately demonstrating the individuals' and populations' limited ability to realize economically sustainable outcomes in the long run. It is clear that the constraining factors of rising living costs, unstable employment, social problems, and prevailing bottom-line factors of the aforementioned issues limit economic upward mobility in the poor urban population communities and continue to reinforce the existing poverty cycle. Community efforts, such as small business development and part-time employment or collaborative work in the neighbourhood, offer temporary and short-term relief, as will the prevailing bottom-line factors have reinforced by the social structure maintaining dominant poverty. There is a distinct lack of bottom-line factors to alleviate and dominant poverty to facilitate social structure and upward economic mobility.

The study acknowledged the specific need for new, integrated, and targeted methods for alleviating urban poverty. Existing measures, such as government financial assistance and measures aimed at offsetting the cost of living for the poor, provide needed assistance; however, their effectiveness is often limited due to rising costs, and aid delivery is often random. Instead of focusing on immediate and short-term relief, policymakers should focus on building long-term sustainable systems by establishing adequate and affordable skills training,

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n2489259566

effective job matching based on market demand, and sustainable business development. Additionally, urban poor assistance and program delivery are more effective when coordination and cooperation among ministries and program implementing agencies are strengthened.

Other interested parties, NGOs, the private sector, and the educational sector, illustrated the necessity for sustained and collaborative partnerships in the findings. NGOs can go beyond simple aid and offer empowerment programs, financial literacy, and ongoing skills training. The private sector can aid inclusive job creation and support community enterprises, and universities can facilitate inclusive job creation and support community enterprises. Lastly, a collaborative approach is needed to go beyond survival-based coping strategies to achieve long-term economic sustainability, thus improving the urban poor communities' quality of life.

This research study provides new knowledge by examining the economic sustainability of urban poor communities in Malaysia's Northern region, which is a region of study that is significantly understudied in comparison to the economic sustainability of the urban poor overall. The research study shows that although a number of the coping strategies the urban poor implemented, such as part-time employment, small-scale entrepreneurship, and community collaboration, are short-term survival strategies, these coping strategies are not survival strategies based on the means or resources that the economic support systems are relying on. The research study encouraged individual efforts to work in a more comprehensive articulation with systemic constraints, the external support from the state, NGOs, and individual economic sustainability. Regarding future research, larger-scale studies and mixed-methods research are preferable in terms of generalizability for longitudinal studies by assessing the prolonged implications of the interventions. Further research could also focus on interventions, such as programs targeting skill acquisition, financial literacy, and digital entrepreneurship, and the research conducted in different geographically or socio-economically distinct regions or countries, to develop more effective and sustainable poverty alleviation interventions.

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Funding: This research was funded by the Ministry of Higher Education Malaysia through the Fundamental Research Grant Scheme - Early Career (FRGS-EC) (FRGS-EC/1/2024/SS10/UITM/02/24).

Data Availability Statement: More information and data can be obtained from the authors on a reasonable request.

Author Contributions: Conceptualization: *Mohamad Faizal Ramli*; methodology: *Mohamad Faizal Ramli*; data analysis: *Mohamad Faizal Ramli*, writing—original draft preparation: *Aslan Amat Senin*, writing; review and editing: *Mohamad Faizal Ramli*, *Aslan Amat Senin*, *Muhammad Majid*; visualization: *Mohamad Faizal Ramli*. All authors have read and agreed to the published version of the manuscript.

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/m7777756382

Publisher
http://jssidoi.org/esc/home

MANAGEMENT OPPORTUNITIES FOR THE WELL-BEING OF GENERATION Z STUDENTS IN HIGHER EDUCATION: THE CASE OF LITHUANIA*

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Received 22 February 2026; accepted 25 April 2026; published 30 June 2026

Abstract. In the context of scientific literature, this article presents an assessment of the factors determining the well-being of Generation Z students in higher education and discusses the possibilities for managing student well-being. The authors understand the management of Generation Z students' well-being in higher education as a unified process of planning, organising, implementing, and controlling, based on institutional coordination, participatory decision-making, and cooperation between the higher education institution and students. Such an approach creates preconditions for systematically reducing psychosocial risks and increasing students' engagement in the study process, considering the views of Generation Z learners. Research aim: to investigate the factors determining the well-being of Generation Z students in higher education and to identify the possibilities for its management. Analytical descriptive, quantitative, and statistical methods were applied. Using a quantitative research strategy, the attitudes of respondents (n=290) towards the factors determining Generation Z students' well-being in higher education were identified, and, based on participants' assessments, possibilities for managing the well-being of Generation Z students in the study process were outlined. The results showed that although more than two-thirds (74.1%) of respondents rated their well-being at their higher education institution as relatively high (scores 6–8) or very high (scores 9–10), one-quarter (25.9%) indicated feeling unwell, rating their well-being between 1 and 5 on a 10-point scale. Data analysis revealed that the organisation of the study process – clear and accessible study information provided through various channels, appropriate study pace and workload (alignment of tasks and time), and study content (lecture topics, materials, methods, etc.) – as well as good, collaborative relationships between teachers and students, are among the key factors determining the well-being of Generation Z students in higher education. The research found that diverse communication forms with teachers, attractive study methods, flexible opportunities to combine studies with work, and a modern, innovative study environment may be effective ways to enhance Generation Z students' well-being in higher education. Furthermore, clearly presented study process information, comprehensible teaching materials and assessment requirements, as well as clear and flexible assessment organisation (including timing and volume) and appropriate distribution of study workload, were evaluated by participants as essential measures for ensuring the well-being of Generation Z students. The study results provide valuable insights into the factors influencing the well-being of Generation Z students within the study process at the organisational level of higher education institutions. They also offer lasting value for academic discourse by outlining potential directions for managing the well-being of Generation Z students in higher education.

Keywords: generation Z; students; well-being; higher education; management; opportunities

Reference to this paper should be made as follows: Samašonok, K., Patackaitė, J., Paraukienė, L. 2026. Management opportunities for the well-being of generation z students in higher education: the case of Lithuania. *Entrepreneurship and Sustainability Issues*, 13(4), 320-337. http://doi.org/10.9770/m7777756382

JEL Classifications: A2, E02

Additional disciplines educology, psychology, management

* *This research was funded by Vilniaus kolegija/Higher Education Institution, Applied Sciences, Lithuania*

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/m7777756382

1. Introduction

Preparing members of society for professional activity is one of the indicators of successful societal development; therefore, in today's dynamic educational environment, it is crucial to understand the state and transformation of the higher education system and to continuously seek effective and efficient measures to ensure educational quality. Today's students belong to the new Generation Z, born after 1995 and often associated with rapid advances in information and communication technologies (Pečiuliauskienė, Valantinaitė & Malonaitienė, 2013). According to researchers, technological development has not only provided this generation with broad opportunities to develop and obtain relevant information using modern technologies (Pečiuliauskienė, Valantinaitė & Malonaitienė, 2013), shaped generational traits and behavioural patterns, but has also influenced learning habits, information search behaviour, comprehension of visual and audio-visual media, communication styles, and tendencies toward individualism (Pečiuliauskienė, Valantinaitė & Malonaitienė, 2013), as well as significant differences in attitudes, interests, and capabilities compared to previous X and Y generations (Hauschildt et al., 2024). Thus, Generation Z is evidently different, and the traditional educational model is no longer suitable for preparing them for professional activities. Meanwhile, the fast pace of life and the abundance of information increase stress and negatively affect individuals' quality of life, emotional state, and well-being. Therefore, in the context of technological development and globalisation, modelling the management perspective of Generation Z's learning quality and improving the functioning of the educational system requires continuous monitoring and analysis of the situation, identification of the learning environment and its processes, and the search for ways to ensure this generation's well-being. This is becoming increasingly important for every educational institution, including higher education institutions.

The conducted studies indicate that ensuring the quality of study process organization (study pace, workload, etc.) and the quality of relationships within the higher education community (students, lecturers, and administration) (Behr et al., 2020), together with the physical conditions for studying, a comfortable and safe learning environment, the accessibility and sufficiency of material resources used in the study process, and a coherent study structure (Černikovaitė, 2021), as well as the application of modern teaching methods and information technologies and software (Kazlauskienė, Jakubkytė & Ruzgailaitė, 2024), and the provision of knowledge and skills needed for professional preparation (Mouton, Zhang & Ertl, 2020), not only enhance the attractiveness of studies and promote active student engagement but also represent factors influencing study satisfaction and learning motivation (Samašonok, 2024). These aspects may also form prerequisites for managing the well-being of Generation Z students in the study process. Other authors link students' well-being during studies to their successful adaptation, particularly in the first year of study (Yu & Downing, 2012; Wu, Occhipinti & Watson, 2023; Rossato, Veloso Morotti & Scorsolini-Comin, 2024).

Equally significant are insights confirming the connection between the attractiveness of studies, well-being during studies, and success in preparing for future professional activities. Researchers argue, based on empirical findings, that perceiving studies as attractive and meeting students' expectations may lead not only to active engagement in the study process, increased learning motivation (Samašonok, 2024), or higher academic achievement (Casanova et al., 2018; Kehm, Larsen & Sommersel, 2019), as well as satisfaction with one's career choice and more successful preparation for professional, but may also contribute to ensuring students' well-being and emotional balance throughout their studies. Conversely, unmet expectations are identified as one of the factors associated with lower study attractiveness and dissatisfaction with studies (Mouton, Zhang & Bernhard, 2020), which may lead to passive engagement in learning when preparing for professional activity, lower academic performance (Kehm, Larsen, & Sommersel, 2019), and even an increased risk of dropping out (Behr et al., 2020; Samašonok, Kamienas & Juškevičienė, 2023), and may be a cause of poor well-being and emotional strain in higher education.

From a theoretical perspective, managing student well-being in higher education encompasses study policy, leadership decisions, resource allocation, and the shaping of organizational culture, all of which may directly contribute to reducing psychosocial risks experienced by Generation Z students and increasing their engagement in the study process. Therefore, the management of Generation Z student well-being in higher education can be conceptualized through the main management functions—planning, organizing, leadership, implementation,

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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and control—which allow systematic integration of well-being objectives into study policy, everyday organizational processes, and decision-making practices. It can be concluded that purposeful management of Generation Z student well-being requires an integrated approach, in which academic, administrative, and social decision-making are coordinated at the institutional level, and responsibility for students' emotional well-being becomes a shared organizational commitment (Khatri et al., 2024). From a public governance perspective, ensuring student well-being in higher education is seen as the result of collective responsibility and coordinated actions involving institutional leadership, academic staff, administration, student unions, and external partners (Swindell et al., 2023).

In this context, managing Generation Z student well-being transcends traditional hierarchical management boundaries and is based on networked collaboration and participatory decision-making models (Kallunki, Viseu & Silvén, 2025). For these reasons, identifying the factors that determine Generation Z student well-being in higher education, as well as searching for measures and/or opportunities to manage their emotional well-being, remains relevant and increasingly important. Although analyses of various aspects of Generation Z are not new, it must be acknowledged that, as generations change and higher education institutions prepare Generation Z youth for professional life, theoretical grounding on this topic remains insufficient, and there is still no consensus regarding the identification and evaluation of factors that determine well-being. Moreover, there is currently no single answer regarding the components and domains for evaluating well-being management in higher education studies, and the proposed evaluation indicators differ.

Research *problem*: what factors determine the well-being of Generation Z students in higher education? What are the possible ways to manage the well-being of Generation Z students during their studies?

The object of the study: factors determining the well-being of Generation Z students in higher education and the possibilities for its management.

The study aims to investigate the factors determining the well-being of Generation Z students in higher education and to identify the possibilities for its management.

The objectives of the study:

1. To conduct a theoretical analysis of the factors determining student well-being in higher education.
2. To empirically substantiate the factors determining the well-being of Generation Z students in higher education.
3. To compare the perspectives of students of different year levels and study modes on the factors determining well-being in higher education.
4. To identify management opportunities for enhancing the well-being of Generation Z students in higher education.

Originality / relevance of the study. Given the relevance and practical significance of this topic, this article applies quantitative data collection and ANOVA analysis to identify problematic areas and examine the expression of factors determining well-being in the study process among different year-level and study-mode groups of Generation Z students. This not only supplements previous research but also enables a more comprehensive understanding of the phenomenon and facilitates outlining directions for managing Generation Z students' well-being in higher education based on essential generational characteristics.

2. Theoretical Insights

Today's higher education students belong to the new Generation Z; therefore, analysing the learning characteristics of this generation in preparing young people for professional activity has received considerable scholarly attention. Looking retrospectively, it should be acknowledged that although Generation Z is widely examined from multiple perspectives, and discussions on the possibilities of managing this generation's learning in higher education are gaining increasing importance, the scientific literature still lacks research on the factors determining the well-being of Generation Z students at the organisational level of higher education institutions and on opportunities for managing that well-being. In this context, there is a growing need to explore the factors

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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that shape Generation Z's well-being in higher education, to analyse the possibilities for managing student well-being, and to seek solutions for ensuring students' positive emotional state and well-being during their studies.

Analysing the factors influencing well-being in the learning process and the phenomenon of well-being management in higher education, researchers increasingly emphasise that student well-being is *not* solely a matter of academic performance or mental health. According to international research, student well-being in higher education is shaped by multiple interconnected factors, including personal resources, social support, the learning environment, study content, workload, flexibility, access to information, and institutional support mechanisms. This is confirmed by international studies that identify key determinants of student well-being such as the quality of the learning environment, support from teachers and peers, clarity of study content, workload organisation, and opportunities to adapt to individual learning needs (Khatri et al., 2024; Paiva et al., 2025). A review of scientific literature also demonstrates that environmental conditions – teacher–student contact, access to information, and teaching quality – along with study workloads and available resources can improve student well-being, whereas excessive or uneven workload and limited support can diminish it. Financial difficulties increase stress and reduce students' ability to focus on learning, while flexible study modes are often associated with better well-being, though they may also present additional challenges (Muja et al., 2024; Konstantinidis, 2024). Meanwhile, data from the EUROSTUDENT international research consortium (2024) show that student well-being varies significantly across countries – students in Iceland report the highest overall well-being, whereas in other countries it is lower. Moreover, social and demographic factors (younger age, female gender, disability, limited family financial resources) are often associated with poorer well-being. Summarising the research findings, it becomes clear that understanding which factors have the greatest impact on student well-being and emotional state requires attention to three key areas: the learning environment and academic context (associated with the management function of planning), study content, workload, and access to information (associated with organisation, implementation, and control), and social relationships and sense of community (associated with leadership).

Learning Environment and Academic Context. Research analysing Generation Z students' experiences in higher education shows that the learning environment and organisation of the study process are key factors determining student well-being. Behr et al. (2020) note that well-structured studies, use of educational software and digital technologies, and lecturers' professionalism – combined with a shift away from strictly structured teaching – enhance study attractiveness, satisfaction, motivation, and student well-being. Other researchers emphasize additional aspects of study process organisation. Kehm, Larsen and Sommersel (2019) highlight the links between study structure and exam organisation and student well-being. According to Behr et al. (2020), institutional academic requirements can significantly influence not only student motivation but also their emotional state and overall well-being. Further studies identify the learning environment as a precondition for well-being management. Research indicates that not only academic demands but also the physical, social, and institutional environment directly affect students' psychological well-being. For example, research in Finnish universities showed that informal and flexible learning environments – spaces enabling independent work, collaboration, and adaptable use – positively affect student well-being and motivation (Valtonen et al., 2021). Students especially value campus infrastructure, technological resources, and the ability to choose where and when to study.

European analyses similarly show that physical conditions, social context, support systems, and institutional culture strongly influence student and staff well-being. Researchers emphasize that the learning environment, including infrastructure and organisational and social dimensions, directly correlates with psychological and academic well-being (Šćukanec Schmidt, Skledar Matijević & Anić, 2023; Olsson et al., 2024). Valtonen et al. (2021) also highlight a trend: modern students increasingly prefer flexible, informal learning environments that allow autonomy, freedom of choice, and social collaboration. They value opportunities to learn in different physical and virtual settings, combining individual and group work. Such environments not only improve learning quality but also contribute positively to well-being by giving students greater control over their learning process and encouraging meaningful social interactions. Conversely, traditional static classrooms no longer meet contemporary student needs; instead, students require flexible scheduling, accessible learning materials,

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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and versatile learning spaces, all of which are associated with higher motivation and engagement (Valtonen et al., 2021).

Study content, workload, and access to information. Research on Generation Z's well-being in higher education underscores the importance of study content, workload organisation, and information accessibility. European studies show that clearly structured courses, balanced workloads, and well-distributed tasks reduce stress and enhance motivation and well-being. Similar findings emerge from Nordic studies showing that student well-being depends on workload, living conditions, and the learning environment. Bumbacco and Scharfe (2020) highlight that heavy physical and emotional workloads contribute to burnout and poor well-being and may even increase the likelihood of dropping out. Other scholars (Mostert & Pienaar, 2020) note that burnout during studies undermines both well-being and satisfaction with studies. The research of Mouton, Zhang and Ertl (2020) and Behr et al. (2020) confirms that excessive academic demands that exceed students' competencies diminish emotional well-being, while unevenly distributed workload is linked to elevated stress. Information accessibility is another major factor influencing well-being. Researchers point out that clear, reliable, and easily accessible information about courses, schedules, assessments, and administrative requirements improves satisfaction and reduces stress (Kümmel et al., 2020). Other studies emphasize the importance of digital technologies, particularly when working with Generation Z students, as access to study materials through various IT tools increases satisfaction and well-being (Urbonienė, Bartuševičienė & Puidokaitė-Savickienė, 2019). Meanwhile, Lehnchen et al. (2025) highlight the significance of clarity in content and teaching methods, showing that students who perceive study material as clear, relevant, and well-structured report greater engagement and higher self-esteem.

Social relationships and community in higher education. Social relationships with peers, teachers, and administrative staff, as well as a sense of community, are consistently identified as crucial determinants of student well-being. A UK study found that social integration and a sense of belonging enhance self-esteem and reduce stress (Tett et al., 2025). Finnish studies indicate that mentorship programmes and peer support significantly improve engagement and well-being (Valtonen et al., 2021; Skaniakos, Penttinen & Lairio, 2014). Research evidence shows clear links between the quality of interpersonal relationships in the academic community and students' well-being and engagement. Supportive and positive relationships with lecturers, inclusion in group work and collaborative projects contribute to positive attitudes towards studies, satisfaction, and improved well-being. A UK study confirmed that lecturer–student relationships, course engagement, and intercultural integration help create a supportive environment for student well-being, and Tett et al. (2025) highlight that lecturer well-being and student well-being are interrelated. European research indicates that student integration, interpersonal connections, and community support are directly associated with better psychological well-being. Data from the EUROSTUDENT Report (2024) similarly show that social support – from peers, teachers, and institutions – is a key determinant of student well-being, with Icelandic students reporting the highest overall well-being. Other authors underline that both academic support and material support (Behr et al., 2020) are crucial for well-being management. Studies by Fourie (2017, 2020), Larmuseau, Desmet and Depaepe (2019), and Mostert and Pienaar (2020) indicate that support from lecturers and peers significantly affects satisfaction with studies and well-being.

In summary, factors such as the quality of social relationships and sense of community, a supportive learning environment, optimal study workload, and accessible information across channels are essential for student well-being in higher education. According to EUROSTUDENT (2024), student well-being is strongly linked to accessible and flexible study environments, adequate academic and financial support systems, living costs, and the ability to balance studies with work. Therefore, a supportive learning environment, appropriate workload, accessible information, strong community ties, mentorship initiatives, and peer-support structures can all serve as foundational elements for managing the well-being and emotional state of Generation Z students in higher education.

3. Research Methodology

Sample size. The study involved Generation Z students from a Lithuanian higher education institution (n=290). Most respondents were first-year students (n=217; 74.8%), while the smallest groups consisted of third-year

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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(n=27; 9.3%) and fourth-year students (n=7; 2.4%). The quantitative study aimed to include students from different modes of study. The distribution shows that the majority were full-time students (n=225; 77.6%), while a smaller share consisted of part-time (session-based) students (n=50; 17.2%) and part-time students (n=15; 5.2%). The substantial differences in the number of respondents across year levels and study modes represent a limitation of the study. Nevertheless, the data are analysed and presented both for the total sample and through comparative analysis across groups of students of different year levels and study modes. For future research, in order to achieve greater representativeness and formulate statistically significant conclusions regarding the examined phenomenon, it would be advisable to repeat the study with an expanded sample. Additionally, future studies could apply mixed methodologies and supplement the findings with other data collection methods (e.g., interviews, focus groups).

Research organisation. The study was organised following a systematic logic: 1) analysis of scientific and methodological literature relevant to the research topic, as well as a review and synthesis of prior empirical studies. This step informed the construction of the research instrument. 2*)* implementation of a diagnostic study**,** which examined participants' perspectives on the factors influencing student well-being in higher education and identified potential management strategies for Generation Z student well-being. The questionnaire was administered online using Office 365. Quality control procedures were applied during data collection, including checks for completeness, internal consistency, and duration of completion. Questionnaires that were incomplete or filled out carelessly (e.g., identical responses in all items) were excluded from analysis. A total of 290 questionnaires were deemed suitable for statistical analysis. 3) formulation of conclusions based on the literature review and empirical findings, identifying the factors influencing Generation Z students' well-being in higher education and outlining management opportunities at the institutional level.

Research ethics. The study adhered to the principles of social research ethics. The introduction to the questionnaire informed participants about the purpose of the study, its organisers, and the intended use of the collected data. Participation was anonymous, and results were processed and presented in an aggregated form. No identifying information (such as name or surname) was collected, thus ensuring confidentiality and data protection. Participation was voluntary. Completion of the questionnaire was considered consent to participate. Respondents were informed that they could withdraw at any stage by requesting the exclusion of their data from further analysis. For confidentiality reasons, the name of the higher education institution where the study was conducted is not disclosed.

Research Methods. Analytical descriptive method. This method was applied to theoretically examine the factors influencing Generation Z students' well-being in higher education and analyse the possibilities for managing well-being within the study process. *Quantitative method.* A quantitative survey was conducted. The questionnaire was developed based on theoretical insights and criteria identified in the scientific literature. The instrument assessed: 1) students' self-evaluation of their well-being during studies; 2) attitudes towards factors determining well-being in higher education; 3) evaluation of management possibilities for enhancing Generation Z students' well-being. Responses were measured using a five-point Likert scale, where 5 indicated strong agreement and 1 indicated strong disagreement. Results were obtained by summing the numerical values of responses. *Validity and reliability.* Cronbach's alpha was calculated for each subscale. The overall internal consistency of the 27-item scale was high (Cronbach's alpha = 0.9045), with values ranging from 0.9058 to 0.8979. The subscale Attitudes towards factors determining well-being (11 items) demonstrated good internal consistency (Cronbach's alpha = 0.8037; range 0.7765–0.7981). The subscale Evaluation of well-being management opportunities (16 items) demonstrated very high consistency (Cronbach's alpha = 0.9272; range 0.9257–0.9210). Given that Cronbach's alpha values above 0.60 are considered suitable for research (Pakalniškienė, 2012), the obtained values indicate coherent item groups and confirm that the questionnaire items appropriately reflect the constructs under analysis. *Statistical Data Analysis.* Statistical analysis was performed on the collected data. Since the questionnaire included ordinal and nominal scales, absolute and percentage frequencies as well as mean scores of scales were calculated. Likert-scale variables were described using means (M) and standard deviations (SD). Differences in means across more than two groups were examined using analysis of variance (ANOVA, F-test). Differences were considered statistically significant when $p < 0.05$. Data analysis was performed using SPSS (Statistical Package for Social Sciences), version 17, and MS Excel 2016.

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http://doi.org/10.9770/m7777756382

4. Analysis of Research Results

When analysing how participants generally assessed their well-being in higher education, the results (see Figure 1) show that more than half of the respondents belonging to Generation Z (51.4%) rated their well-being at a *moderate* level (6 to 8 points out of 10). Slightly fewer than one-quarter (22.7%) evaluated their well-being with the *highest scores* (10 points – 11.7%; 9 points – 11.0%). Meanwhile, as many as one-quarter (25.9%) of Generation Z students participating in the study rated their well-being between 1 and 5 points, indicating *poor well-being.* The overall mean score was M=6.81 out of a maximum of 10.

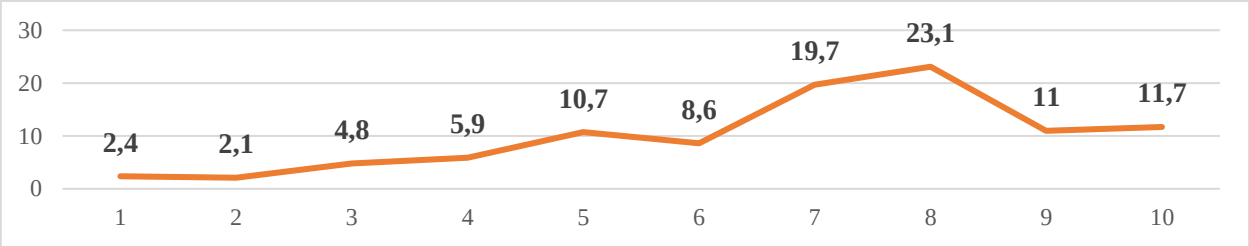


Figure 1. Evaluation of Generation Z Students' Well-Being in Higher Education (n=290; %)

In summary, although more than two-thirds of respondents evaluated their well-being in higher education as moderately high or high, the participants' assessments also show that one-quarter of Generation Z students feel unwell during their studies**.** Considering that poor well-being during studies may lead to a lack of learning motivation, dissatisfaction with studies, and may even become a risk factor contributing to intentions to drop out, the results highlight the need to identify measures and interventions that could improve the well-being of Generation Z students in higher education**.**

Factors determining generation Z students' well-being in higher education: student evaluation. When examining the features of the educational process and their importance for individual well-being, scientific literature most frequently emphasises the external environment and the learning conditions created within it. Based on this, the present study sought to explore Generation Z students' perspectives on the factors influencing their well-being in the study process and to identify opportunities for improvement. The questionnaire therefore covered key elements such as: organisation of the study process, study environment and access to necessary equipment and resources, quality of relationships with peers and academic staff, etc.

Analysis of the overall sample revealed the highest mean scores (see Figure 2), showing that, according to Generation Z students, their well-being in the study process is most strongly influenced by: **c**larity and accessibility of information provided by the higher education institution (emails, websites, social media, etc.) (M=4.64), study pace and workload organisation (timetable, assignments and time allocated, assessments) (M=4.60), study content (subjects, lecture topics, materials, teaching methods, etc.) (M=4.58). Additionally, relatively high mean values indicate that students associate their well-being with personal characteristics, such as self-confidence and self-esteem (M=4.47), as well as financial situation (M=4.37). Relationships with lecturers and study coordinators were also identified as an important factor (M=4.39) influencing Generation Z students' well-being. Thus, the results suggest that students' professional or personal expectations related to the organisation of the study process, study pace and workload, and the quality and relevance of study content – along with supportive lecturer–student relationships and collaboration, personal traits, and available financial resources – are perceived as key determinants of improved well-being among Generation Z students in higher education. These findings suggest that balanced and well-distributed study workload**,** clear communication across various channels, and study content aligned with labour market needs, as well as the use of diverse and innovative teaching methods**,** could contribute to improved well-being among Generation Z students.
The results also show that: **s**tudy equipment and resources (computers, software, printed/digital books) (M=3.90), and relationships with administrative staff (study department, heads of units, deans, vice-deans) (M=3.81) are not strongly associated with factors determining well-being. These variables had the lowest mean scores (see Figure 2).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/m7777756382

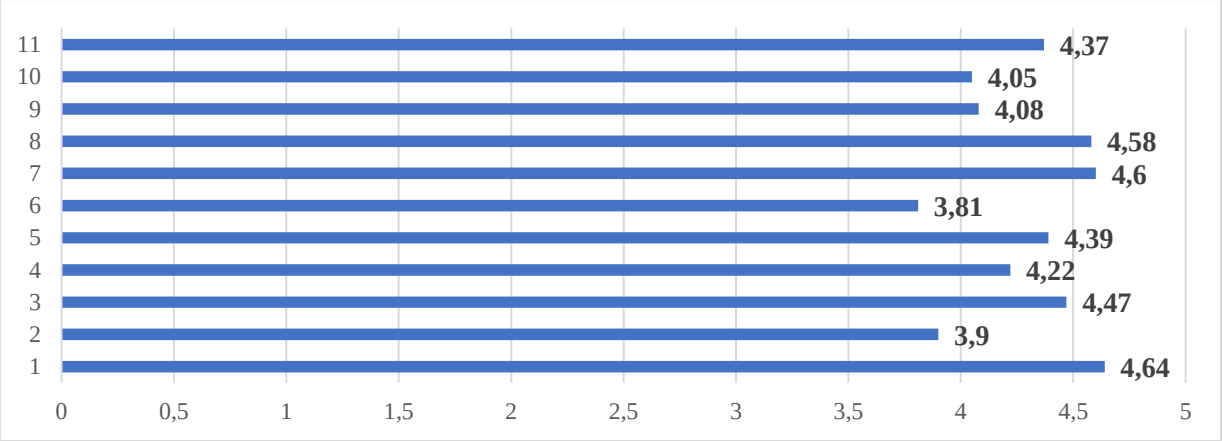


Figure 2. Evaluation of Factors Determining Generation Z Students' Well-Being in Higher Education (n=290; M (mean values); max=5)

Note:

1. Clarity and accessibility of information at the higher education institution (emails, websites, social networks)
2. Study equipment and resources (computers, software, printed and digital books)
3. Self-confidence and self-esteem (level of knowledge and skills, professional and personal expectations, etc.)
4. Relationships with peers
5. Relationships with lecturers and study coordinators
6. Relationships with administrative staff (heads of study departments and academic units, deans, vice-deans, etc.)
7. Study pace and workload organisation (timetable, study tasks and time allocated, assessments)
8. Study content (subjects, lecture topics, materials, teaching methods, etc.)
9. Changed lifestyle (new place of residence, homesickness, planning time for studies and leisure)
10. Study environment (lecture rooms, laboratories, leisure spaces, lighting, ventilation)
11. Financial situation (personal funds for studies and living expenses)

A more detailed data analysis confirmed that the vast majority of Generation Z participants identified several factors as very important or important for their well-being in higher education (see Table 1). Students most frequently emphasised the clarity and accessibility of information provided by the higher education institution, with 69.7 percent of respondents considering this factor very important and 26.9 percent considering it important. The organisation of study pace and workload was also highlighted as significant, with 66.6 percent of respondents rating it as very important and 27.2 percent as important. Another strongly emphasised factor was study content – which includes study subjects, lecture topics, learning materials and teaching methods – with 64.1 percent identifying it as very important and 30.7 percent as important. Only a small share of respondents considered these factors unimportant or not important at all for ensuring well-being in higher education (see Table 1).

Further analysis showed that some factors were considered less important for ensuring the well-being of Generation Z students. Study equipment and resources – such as computers, software and printed or digital books – were rated as very important by 33.1 percent of respondents and important by 38.3 percent. Relationships with administrative staff, including heads of study departments, deans and vice-deans, were considered very important by 27.6 percent and important by 40.0 percent of participants. Likewise, the study environment – which includes classrooms, laboratories, leisure spaces, lighting and ventilation – was rated very important by 41.0 percent and important by 35.9 percent. Since a smaller proportion of respondents associated these elements with ensuring their well-being in higher education, it can be assumed that these factors are perceived as less essential for Generation Z students compared to those related to information accessibility, study pace and study content.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/m7777756382

Table 1. Evaluation of Factors Determining Generation Z Students' Well-Being in Higher Education (n = 290; number of respondents (%))

	Very important	Important	Neither important nor unimportant	Unimportant	Not important at all	I don't know / cannot answer
Clarity and accessibility of information at the higher education institution (emails, websites, social networks)	202 (69.7)	78 (26.9)	7 (2.4)	2 (0.7)	-	1 (0.3)
Study equipment and resources (computers, software, printed and digital books)	96 (33.1)	111 (38.3)	56 (19.3)	17 (5.9)	5 (1.7)	5 (1.7)
Self-confidence and self-esteem (level of knowledge and skills, professional and personal expectations, etc.)	164 (56.6)	102 (35.2)	22 (7.6)	1 (0.3)	1 (0.3)	-
Relationships with peers	134 (46.2)	103 (35.5)	41 (14.1)	8 (2.8)	3 (1.0)	1 (0.3)
Relationships with lecturers and study coordinators	154 (53.1)	106 (36.6)	23 (7.9)	4 (1.4)	1 (0.3)	2 (0.7)
Relationships with administrative staff (heads of departments, deans, vice-deans, etc.)	80 (27.6)	116 (40.0)	66 (22.8)	19 (6.6)	4 (1.4)	5 (1.7)
Study pace and workload organisation (timetable, study tasks and time allocated, assessments)	193 (66.6)	79 (27.2)	17 (5.9)	-	1 (0.3)	-
Study content (subjects, lecture topics, materials, teaching methods, etc.)	186 (64.1)	89 (30.7)	13 (4.5)	1 (0.3)	1 (0.3)	-
Changed lifestyle (new place of residence, homesickness, planning time for studies and leisure)	129 (44.5)	99 (34.1)	40 (13.8)	8 (2.8)	5 (1.7)	9 (3.1)
Study environment (classrooms, laboratories, leisure spaces, lighting, ventilation)	119 (41.0)	104 (35.9)	49 (16.9)	7 (2.4)	3 (1.0)	8 (2.8)
Financial situation (personal funds for studies and living expenses)	173 (59.7)	75 (25.9)	28 (9.7)	7 (2.4)	3 (1.0)	4 (1.4)

Summarising the results, it can be stated that Generation Z students associate their well-being in higher education with the organisation of the study process, particularly when information about studies is presented clearly and is accessible through various channels. According to the participants' evaluations, study pace and workload organisation – when assignments and the time allocated for their completion are well balanced – together with study content, including lecture topics, learning materials and selected teaching methods, as well as positive and collaborative relationships between lecturers and students, are among the key factors influencing well-being in higher education. The findings therefore reveal that organising the study process in a way that meets the needs and expectations of Generation Z students, ensuring high-quality communication and providing comprehensive study-related information, along with aligning study content with the current labour market, and coordinating assessments, tasks and the time required for their completion, may constitute essential approaches to managing student well-being in higher education.

When analysing the expression of factors influencing well-being across different year-levels of Generation Z students, statistically significant differences were observed in only one of the eleven statement categories (see Table 2). The results of the analysis of variance showed that the study environment – classrooms, laboratories, leisure spaces, lighting and ventilation – was significantly associated with students' year of study ($F=4.34$, $p=0.005$). Based on these results, it can be concluded that the learning environment provided by the higher education institution, including well-equipped classrooms, laboratories and leisure areas, is a factor influencing the well-being of first-year students ($M=4.18$, $SD=0.96$) to a greater extent than it is for second-year ($M=3.69$, $SD=1.44$) and third-year students ($M=3.56$, $SD=1.31$). Meanwhile, comparative analysis across year-level groups showed that clarity and accessibility of information (emails, websites, social networks) ($F=0.38$, $p=0.767$), study equipment and resources (computers, software, printed and digital books) ($F=0.563$, $p=0.64$),

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/m7777756382

relationships with peers (F=0.339, p=0.797), relationships with lecturers and study coordinators (F=0.391, p=0.759), and relationships with administrative staff (heads of departments, deans, vice-deans, etc.) (F=1.308, p=0.272) did not differ significantly across study years. This indicates that these factors are viewed similarly by Generation Z students regardless of their year of study (see Table 2). In addition, ANOVA results showed that variables such as study pace and workload organisation (timetables, assignments and time allocated for their completion, assessments) (F=0.805, p=0.492), study content (study subjects, lecture themes, materials, teaching methods) (F=0.258, p=0.855), financial situation (personal funds for studies and living expenses) (F=0.536, p=0.658), and changes in lifestyle (new place of residence, homesickness, planning time for studies and leisure) (F=1.635, p=0.218) are evaluated at similar levels by students across different study years. These factors are therefore not statistically associated with the students' year of study (see Table 2).

Table 2. Evaluation of Factors Determining Well-Being During Higher Education Studies Across Generation Z Student Groups by Year of Study, Mean Scores (M; max = 5), Standard Deviations (in parentheses), and ANOVA Results ($p < 0.05$) (n = 290)

	1st year (n=217)	2nd year (n=39)	3rd year (n=27)	4th year (n=7) *	F	p
Clarity and accessibility of information at the higher education institution (emails, websites, social networks)	4.65 (0.63)	4.59 (0.72)	4.67 (0.48)	4.86 (0.38)	0.38	0.767
Study equipment and resources (computers, software, printed and digital books)	3.91 (1.05)	3.72 (1.36)	4.0 (0.96)	4.14 (1.07)	0.563	0.64
Self-confidence and self-esteem (level of knowledge and skills, professional and personal expectations, etc.)	4.46 (0.72)	4.59 (0.55)	4.37 (0.56)	4.57 (0.53)	0.655	0.581
Relationships with peers	4.21 (0.9)	4.15 (1.06)	4.33 (0.73)	4.43 (0.53)	0.339	0.797
Relationships with lecturers and study coordinators	4.41 (0.76)	4.31 (1.2)	4.3 (0.61)	4.57 (0.53)	0.391	0.759
Relationships with administrative staff (heads of departments, deans, vice-deans, etc.)	3.08 (1.09)	3.72 (1.12)	3.78 (0.8)	4.57 (0.79)	1.308	0.272
Study pace and workload organisation (timetable, study tasks and time allocated, assessments)	4.58 (0.66)	4.69 (0.57)	4.56 (0.58)	4.86 (0.38)	0.805	0.492
Study content (subjects, lecture topics, materials, teaching methods, etc.)	4.56 (0.66)	4.62 (0.59)	4.63 (0.49)	4.71 (0.49)	0.258	0.855
Changed lifestyle (new place of residence, homesickness, planning time for studies and leisure)	4.12 (1.11)	4.18 (1.12)	3.63 (1.45)	3.86 (1.46)	1.635	0.218
Study environment (classrooms, laboratories, leisure spaces, lighting, ventilation)	4.18 (0.96)	3.69 (1.44)	3.56 (1.31)	4.0 (1.53)	4.343	**0.005**
Financial situation (personal funds for studies and living expenses)	4.33 (1.05)	4.51 (0.68)	4.48 (0.64)	4.29 (1.5)	0.536	0.658

*Note: * excluded from data analysis due to the small number of respondents*

Discussing the expression of students' attitudes towards the factors determining well-being in higher education among Generation Z participants enrolled in different study modes, the statistical analysis showed (see Table 3) that only three out of the eleven examined factors are associated with the study mode. The analysis revealed that the clarity and accessibility of information at the higher education institution (emails, institutional website, social networks), as a factor influencing well-being in the study process, is significantly associated with students' study mode (F=5.205, p=0.006). The findings indicate that clearly presented information that can be accessed through various channels – for example, via email – is more strongly associated with the well-being of students in the full-time (session-based) study mode (M=4.9, SD=0.3) than for students in the full-time (M=4.59, SD=0.67) or part-time studies (M=4.6, SD=0.51). A statistically significant higher mean score was also identified in the full-time (session-based) study mode group (F=3.211, p=0.042), suggesting that for these students, the pace of studies and workload organisation (timetables, study tasks, time allotted for their completion, assessments) (M=4.8, SD=0.45) is a more pronounced factor influencing well-being in higher education compared to students in full-time or part-time studies, whose mean scores were lower (M=4.55, SD=0.67 and M=4.6, SD=0.51, respectively). Meanwhile, the analysis of variance (ANOVA) revealed a statistically significant difference (F=16.853, p=0.001) showing that students enrolled in the full-time study mode (M=4.24, SD=0.88) more strongly associate the study environment – classrooms, laboratories, leisure spaces, lighting, and ventilation – with their well-being in higher education than students in the part-time studies (M=3.8, SD=1.01) or full-time (session-based) (M=3.3, SD=1.59) study modes.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/m7777756382

When comparing mean scores across study modes using ANOVA, it was found that study equipment and resources (computers, software, printed and digital books) (F=2.027, p=0.134), relationships with peers (F=2.162, p=0.117), relationships with lecturers and study coordinators (F=0.077, p=0.926), and relationships with administrative staff (heads of departments, deans, vice-deans, etc.) (F=1.113, p=0.33) are evaluated similarly regardless of the study mode and are therefore not statistically associated with it (see Table 3). Furthermore, the study results indicate that several other factors determining well-being in higher education are also unrelated to study mode. These include study content (subjects, lecture topics, materials, teaching methods) (F=0.806, p=0.448), self-confidence and self-esteem (level of knowledge and skills, professional and personal expectations) (F=0.125, p=0.882), financial situation (personal funds for studies and living expenses) (F=1.226, p=0.295), and changes in lifestyle (new living arrangements, homesickness, planning time for studies and leisure) (F=1.387, p=0.251). These factors are evaluated at similar levels across study mode groups and are not statistically associated with study mode (see Table 3).

Table 3. Evaluation of Factors Determining Well-Being During Higher Education Studies Across Generation Z Student Groups by Study Mode, Mean Scores (M; max = 5), Standard Deviations (in parentheses), and ANOVA Results ($p < 0.05$) (n = 290)

	Full-time studies (n=225)	Full-time (session-based) studies (n=50)	Part-time studies (n=15)	F	p
Clarity and accessibility of information at the higher education institution (emails, websites, social networks)	4.59 (0.67)	4.9 (0.3)	4.6 (0.51)	5.205	**0.006**
Study equipment and resources (computers, software, printed and digital books)	3.96 (0.95)	3.62 (1.59)	4.0 (0.93)	2.027	0.134
Self-confidence and self-esteem (level of knowledge and skills, professional and personal expectations, etc.)	4.46 (0.69)	4.5 (0.71)	4.53 (0.52)	0.125	0.882
Relationships with peers	4.27 (0.85)	3.98 (1.19)	4.27 (0.46)	2.162	0.117
Relationships with lecturers and study coordinators	4.38 (0.79)	4.38 (0.99)	4.47 (0.52)	0.077	0.926
Relationships with administrative staff (heads of departments, deans, vice-deans, etc.)	3.78 (1.01)	3.82 (1.34)	4.2 (0.77)	1.113	0.33
Study pace and workload organisation (timetable, study tasks and time allocated, assessments)	4.55 (0.67)	4.8 (0.45)	4.6 (0.51)	3.211	**0.042**
Study content (subjects, lecture topics, materials, teaching methods, etc.)	4.56 (0.66)	4.68 (0.51)	4.6 (0.51)	0.806	0.448
Changed lifestyle (new place of residence, homesickness, planning time for studies and leisure)	4.13 (1.11)	3.92 (1.38)	3.73 (1.1)	1.387	0.251
Study environment (classrooms, laboratories, leisure spaces, lighting, ventilation)	4.24 (0.88)	3.3 (1.59)	3.8 (1.01)	16.853	**0.001**
Financial situation (personal funds for studies and living expenses)	4.41 (0.9)	4.22 (1.28)	4.13 (1.06)	1.226	0.295

Summarising the research findings, it is evident that the study environment – classrooms, laboratories, leisure spaces, lighting and ventilation – may serve as a key factor in ensuring the well-being of first-year students and those enrolled in the full-time study mode. Furthermore, the analysis of variance (ANOVA) revealed that the clarity and accessibility of information provided by the higher education institution (emails, websites, social networks), as well as the pace of studies and the organisation of workload (timetables, study tasks and allotted time, assessments), are more strongly expressed as factors influencing well-being among students in the full-time (session-based) study mode compared to students enrolled in full-time or part-time study modes. This suggests that when working with full-time (session-based) students, it is particularly important to ensure high-quality information dissemination through multiple channels and to distribute the pace and workload of studies in a way that reflects students' needs and capabilities.

Management Opportunities for Enhancing the Well-Being of Generation Z Students in Higher Education. To identify opportunities for managing the well-being of Generation Z students during the study process, responses were summarised into several categories: organisation of the study process, creation of a supportive study environment and provision of necessary study resources, ensuring high-quality communication with academic

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/m7777756382

actors (lecturers and administration), and opportunities for informal (extracurricular) activities that promote communication and self-awareness.

According to participants' evaluations, the highest mean scores (see Figure 3) indicate that clearly provided information about schedules and study subjects (M=4.38), along with clearly presented teaching materials (lecture recordings, assignments) and information about assessments (M=4.32), are among the most effective ways to ensure the well-being of Generation Z students in higher education. Clearly and flexibly organised assessments – through coordinated timing, appropriate distribution of workload and reasonable volume of assessments – were similarly evaluated as important opportunities for managing student well-being (M=4.32). Respondents also emphasised that a diversity of communication forms with lecturers – such as electronic communication or individual consultations (M=4.16) – as well as attractive study formats, including guest lectures, interactive sessions and visits to organisations (M=4.17), and flexible opportunities to balance work and studies (M=4.14), may contribute to improved well-being in the study process. Analysis of well-being management opportunities further showed that the study environment is considered an important factor. A modern, innovative study environment – comprising classrooms, equipment and other material resources (M=4.13) – as well as spaces for resting during breaks, working individually or completing group assignments (M=4.13), may serve as tools for ensuring student well-being. The results indicate that a large share of respondents prioritise high-quality communication with those involved in the study process and the creation of a supportive study environment. Participants also linked well-being management opportunities with effective organisation of the study process, clearly presented information about ongoing studies (timetables, subjects) and lecturer professionalism in presenting teaching materials and assessment information clearly. By contrast, certain elements were evaluated with lower mean scores. Entertainment or activities during breaks – such as background music or film screenings (M=3.49) – regular student debates aimed at addressing emerging issues or discussing relevant topics (M=3.45), and extracurricular activities (such as student organisation events) (M=3.67) were least associated with opportunities for managing Generation Z students' well-being, as reflected in the lowest mean values (see Figure 3).

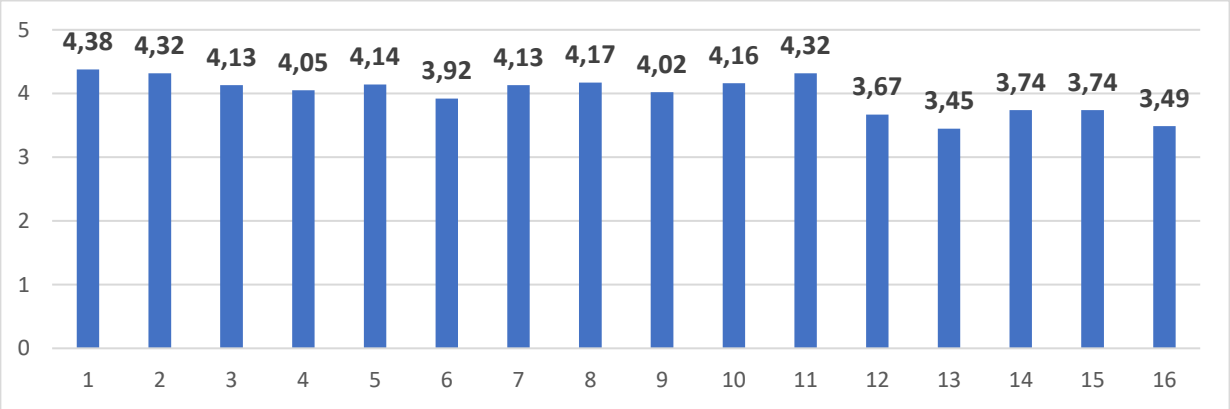


Figure 3. Evaluation of Management Opportunities for Enhancing Generation Z Students' Well-Being in Higher Education (n=290; M (mean values); max=5)

Note:

1. Clearly presented information (timetables, study subjects)
2. Clearly presented teaching materials (lecture video recordings, assignments) and information about assessments
3. Modern, innovative study environment (classrooms, equipment and other material resources)
4. Regularly updated study resources (learning materials, literature, library collections, etc.)
5. Flexible opportunities to combine studies and work
6. Informal interaction with classmates (joint events, excursions, team-building activities, etc.)
7. Spaces for resting during breaks, independent study or group work ("quiet" rooms, swings, etc.)
8. Attractive study formats (guest speakers, interactive lectures, visits to organisations)
9. Opportunities for monitoring personal and professional progress (support from psychologists, mentors, career counsellors, etc.)
10. Diversity of communication forms with lecturers (electronic communication, individual consultations, etc.)
11. Clear and flexible organisation of assessments (coordination of timing and number of assessments, appropriate workload distribution, etc.)
12. Interesting extracurricular activities (variety of student organisations)
13. Regular student debates (for addressing student issues or discussing other relevant matters)
14. Virtual advisor for first-year students to discuss study-related or other relevant questions
15. Extended opening hours of independent study spaces (libraries, IT rooms)
16. Variety of activities during breaks (background music, film screenings, etc.)

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/m7777756382

Summarising the empirical findings from the overall sample, a clear tendency emerges: Generation Z students associate the management opportunities for ensuring their well-being during studies with factors existing at the institutional level, the specifics of study process organisation, and the quality of relationships with members of the higher education community. These variables received the highest mean scores. The results also showed that respondents link the possibilities for managing Generation Z students' well-being with a professionally and clearly administered study process. Furthermore, the diversity of communication forms with lecturers and the importance of flexible study arrangements that enable students to balance studies and work were highlighted as key ways to ensure student well-being in higher education. Additionally, the results revealed the significance of the material and methodological resources available at the institution, a modern and innovative study environment, and the use of contemporary teaching methods and attractive study formats – such as guest lectures, interactive sessions and visits to organisations – as means of fostering the well-being of Generation Z students. By contrast, students did not associate well-being management opportunities with informal extracurricular activities, regular debates aimed at addressing student issues or other relevant matters, or the variety of activities offered during breaks.

When analysing differences in mean scores related to the evaluation of Generation Z well-being management opportunities across student groups enrolled in different study modes, the data are presented in Table 4. Statistical analysis (see Table 4) revealed a significantly higher mean score ($F=2.855$, $p=0.05$) in the group of students in full-time studies ($M=4.0$, $SD=1.05$), suggesting that these students more strongly associate well-being management opportunities with informal interaction with classmates, joint events, excursions, team-building activities and similar forms of engagement than students in full-time (session-based) ($M=3.64$, $SD=1.14$) or part-time studies ($M=3.67$, $SD=1.11$). Moreover, a significantly higher mean score ($F=9.311$, $p=0.001$) among full-time students ($M=4.26$, $SD=0.93$) indicates that they more strongly identify well-being management opportunities with the creation of spaces where students can rest during breaks, study independently or complete group assignments (such as quiet rooms or relaxation areas), compared to students in full-time (session-based) ($M=3.66$, $SD=0.98$) and part-time studies ($M=3.73$, $SD=1.22$). Meanwhile, clear and flexible organisation of assessments – through coordinated timing, distribution of workload and volume of assessments – was rated higher by students in full-time ($M=4.36$, $SD=0.86$) and full-time (session-based) ($M=4.32$, $SD=1.08$) study modes, while students in part-time studies assigned a lower mean score ($M=3.73$, $SD=1.16$). ANOVA results showed that the evaluation of this factor as a potential prerequisite for managing well-being in higher education is statistically significantly associated with the chosen study mode ($F=3.351$, $p=0.036$). At the same time, the comparative analysis across study modes revealed that attractive extracurricular activities (such as the variety of student organisations) ($M=3.76$, $SD=1.0$) and extended opening hours of independent study spaces (libraries, IT rooms) ($M=3.84$, $SD=1.0$) were evaluated with higher mean scores in the full-time student group. In contrast, these variables were assigned significantly lower scores among students in full-time (session-based) studies (respectively: $M=3.34$, $SD=1.27$; $M=3.44$, $SD=1.03$) and part-time studies (respectively: $M=3.47$, $SD=0.83$; $M=3.33$, $SD=1.05$) (see Table 4).

The ANOVA analysis also showed that clearly presented information (timetables, study subjects) ($F=0.334$, $p=0.716$), clearly presented teaching materials (lecture recordings, assignments) and assessment information ($F=0.184$, $p=0.832$), a modern, innovative study environment (classrooms, equipment, material resources) ($F=1.551$, $p=0.214$), and regularly updated study resources (learning materials, literature, library collections) ($F=0.449$, $p=0.6392$) were evaluated at similar levels regardless of the chosen study mode. The differences were minor and not statistically significant. Additionally, the results showed that regardless of study mode, respondents evaluated factors such as attractive study formats (guest lectures, interactive lectures, organisational visits) ($F=1.806$, $p=0.166$), diversity of communication forms with lecturers (electronic communication, individual consultations) ($F=0.35$, $p=0.705$), opportunities for monitoring personal and professional development (psychological, mentoring or career counselling support) ($F=0.059$, $p=0.943$), and the possibility to combine studies with work flexibly ($F=2.529$, $p=0.082$) at similar levels. Furthermore, analysis across study modes revealed no statistically significant differences in how students evaluated regular student debates (aimed at solving problems or discussing relevant issues) ($F=2.088$, $p=0.126$), a virtual adviser for first-year students ($F=0.301$, $p=0.74$), and activities during breaks (background music, film screenings) ($F=1.963$, $p=1.42$). This suggests that the evaluation of these factors remains consistent across study modes and does not significantly

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/m7777756382

depend on the type of studies respondents are enrolled in. The mean values for well-being management opportunities across study modes are presented in Table 4.

Table 4. Evaluation of Management Opportunities for Generation Z Students' Well-Being in Higher Education Across Study Mode Groups, Mean Scores (M; max = 5), Standard Deviations (in parentheses), and ANOVA Results ($p < 0.05$), (n = 290)

	Full-time studies (n=225)	Full-time (session-based) studies (n=50)	Part-time studies (n=15)	F	p
Clearly presented information (timetables, study subjects)	4.4 (0.81)	4.3 (1.02)	4.33 (0.82)	0.334	0.716
Clearly presented teaching materials (lecture video recordings, assignments) and information about assessments	4.33 (0.76)	4.32 (1.02)	4.2 (1.01)	0.184	0.832
Modern, innovative study environment (classrooms, equipment and other material resources)	4.17 (0.87)	4.04 (0.86)	3.8 (1.01)	1.551	0.214
Regularly updated study resources (learning materials, literature, library collections, etc.)	4.03 (0.89)	4.16 (0.98)	4.07 (0.88)	0.449	0.639
Flexible opportunities to combine studies and work	4.11 (0.93)	4.4 (1.01)	3.87 (1.3)	2.529	0.082
Informal interaction with classmates (joint events, excursions, team-building activities, etc.)	4.0 (1.05)	3.64 (1.14)	3.67 (1.11)	2.855	**0.05**
Spaces for resting during breaks, independent study or group work ("quiet" rooms, swings, etc.)	4.26 (0.93)	3.66 (0.98)	3.73 (1.22)	9.311	**0.001**
Attractive study formats (guest speakers, interactive lectures, visits to organisations)	4.22 (0.92)	4.04 (1.14)	3.8 (1.08)	1.806	0.166
Opportunities for monitoring personal and professional progress (psychologist, mentor or career counsellor support, etc.)	4.03 (0.95)	3.98 (1.08)	4.0 (1.2)	0.059	0.943
Diversity of communication forms with lecturers (electronic communication, individual consultations, etc.)	4.16 (0.89)	4.22 (0.86)	4.0 (1.13)	0.35	0.705
Clear and flexible organisation of assessments (coordination of timing and volume, appropriate workload distribution, etc.)	4.36 (0.86)	4.32 (1.08)	3.73 (1.16)	3.351	**0.036**
Interesting extracurricular activities (variety of student organisations)	3.76 (1.0)	3.34 (1.27)	3.47 (0.83)	3.627	**0.028**
Regular student debates (to address student issues or discuss relevant topics)	3.52 (1.04)	3.18 (1.22)	3.33 (1.11)	2.088	0.126
Virtual adviser for first-year students (for study-related or other relevant questions)	3.74 (1.07)	3.78 (1.23)	3.53 (0.99)	0.301	0.74
Extended opening hours of independent study spaces (libraries, IT rooms)	3.84 (1.0)	3.44 (1.03)	3.33 (1.05)	4.462	**0.012**
Variety of activities during breaks (background music, film screenings, etc.)	3.56 (1.2)	3.24 (1.13)	3.2 (1.01)	1.963	0.142

Summarising the results of the comparative analysis across groups of respondents who had chosen different study modes, it was found that the evaluation of factors determining the well-being of Generation Z students in higher education is significantly associated with study mode for five out of the sixteen variables examined. The ANOVA results revealed that factors such as attractive extracurricular activities (the variety of student organisations), spaces available for resting during breaks, independent study or group work (such as quiet rooms or relaxation areas), informal interaction with classmates (joint events, excursions, team-building activities), extended opening hours of independent study spaces (libraries, IT rooms), as well as clear and flexible organisation of assessments (coordination of timing and volume, appropriate distribution of workload), were more strongly associated with well-being management opportunities by students in full-time studies. These factors were evaluated with significantly lower scores by students in full-time (session-based) and part-time studies. However, the comparative analysis also revealed that the evaluation of eleven out of the sixteen variables did not differ significantly across study modes. This indicates that most factors related to the management of Generation Z students' well-being in higher education are assessed at similar levels, with only minor differences, regardless of the study mode chosen.

Drawing on the scientific literature and empirical findings, it can be concluded that the management of Generation Z students' well-being in higher education is a complex phenomenon encompassing various

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/m7777756382

dimensions: the learning environment and academic context, the organisation of the study process, the conditions provided, and the quality of study content; as well as access to information, the quality of social relationships, and the implementation of a sense of community. At the same time, after categorising the factors influencing well-being into management functions, these factors appear through the functions of planning, organising and implementation, leadership, and control. The planning function includes clear and flexible organisation of assessments, appropriate distribution of study workload, and structuring of study content. The organising and implementation functions include attractive extracurricular activities, such as the variety of student organisations, extended opening hours for independent study spaces, and suitable places for rest or group work, such as quiet rooms or relaxation areas. The leadership function is reflected through informal communication with classmates, joint events, excursions, and team-building activities, all of which enhance student engagement and support well-being. The control function includes monitoring the accessibility of resources and evaluating the effectiveness of organisational decisions, for example through student feedback on study spaces or workload, in order to adjust measures and ensure an optimal study experience. Overall, the factors identified at the institutional level stand out as significant components in ensuring the emotional well-being of Generation Z students and constitute key prerequisites for managing well-being in the study process.

Conclusions

1. The theoretical analysis of scientific literature showed that a supportive learning environment and academic context, an appropriate study workload, and convenient access to information through modern technologies and up-to-date software, as well as systematically developed and maintained institutional community-building and peer-support structures, may serve as important prerequisites for managing the well-being and emotional state of Generation Z students in higher education.

2. The highest mean scores indicate that clarity and accessibility of information in higher education (emails, institutional websites, social networks, etc.), the pace and organisation of the study workload (timetables, study tasks and time allocated, assessments), study content (subjects, lecture topics, materials, teaching methods, etc.), and relationships with lecturers and study coordinators are among the key factors determining the well-being of Generation Z students in higher education. Meanwhile, study equipment and resources (computers, software, etc.) and relationships with administrative staff were least associated with students' well-being during their studies.

3. ANOVA results revealed that first-year students and those enrolled in full-time studies associate the study environment (classrooms, laboratories, leisure spaces, lighting, ventilation) with good well-being in higher education. Furthermore, clarity and accessibility of information (emails, websites, social networks) and the pace and organisation of study workload (timetables, study tasks, time allocated, assessments) were among the key factors influencing well-being for students in full-time (session-based) studies.

4. Clearly presented information about study process organisation, well-structured teaching materials and assessment requirements, as well as flexible and coherent assessment planning – including coordinated timing, reasonable volume of assessments, and balanced workload distribution – were evaluated by the overall sample as essential study process management measures for ensuring the well-being of Generation Z students in higher education. According to respondents, a diversity of communication forms with lecturers (electronic communication, individual consultations, etc.), student-centred teaching methods (interactive lectures, guest speakers, visits to organisations), flexible opportunities to balance studies and work, and strategic investments in a modern and innovative study environment may be considered meaningful study process management practices contributing to the well-being of Generation Z students in higher education.

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Funding: This research was funded by Vilniaus kolegija/Higher Education Institution, Applied Sciences, Lithuania

Data Availability Statement: More information can be obtained from the authors on a reasonable request.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/m7777756382

Author Contributions: Conceptualisation: *Samašonok, K., Patackaitė, J., Paraukienė, L*., methodology: *Samašonok, K., Patackaitė, J., Paraukienė, L.*, data analysis: *Samašonok, K*., writing—original draft preparation: *Samašonok, K., Patackaitė, J., Paraukienė, L.*, writing; review and editing: *Samašonok, K., Patackaitė, J., Paraukienė, L*., visualisation: *Samašonok, K., Patackaitė, J., Paraukienė, L*. All authors have read and agreed to the published version of the manuscript.

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p8538646793

Publisher
http://jssidoi.org/esc/home

THE ROLE OF GDP AND THE MACROECONOMIC ENVIRONMENT IN SHAPING INTERNATIONAL TRADE AND AGRI-FOOD SECTOR RESTRUCTURING IN EUROPE*

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Received 18 February 2026; accepted 25 April 2026; published 30 June 2026

Abstract. Mergers and acquisitions represent a key strategic tool for growth and restructuring among leading companies on a global scale. This trend is especially evident in the agri-food sector, which has experienced significant consolidation over recent decades. Consolidation processes are occurring with remarkable intensity across all stages of the agri-food supply chain, from primary production and processing to distribution and retail. The aim of this paper is to investigate the relationship between macroeconomic factors and cross-border M&A activity in the agri-food sector within European countries over the period from 1998 to 2023. More specifically, the study focuses on quantifying the impact of gross domestic product on the volume of cross-border mergers and acquisitions. Using panel data and advanced econometric models, the research examines whether countries with higher economic performance tend to engage more actively in M&A transactions. The findings demonstrate a statistically significant positive correlation between the percentage growth of GDP and the percentage increase in cross-border M&A volume, suggesting that economically strong European countries are more likely to pursue and complete mergers and acquisitions within the agri-food industry. This relationship underscores the critical role of economic growth as a driver of consolidation and expansion strategies in this sector, providing valuable insights for policymakers and business leaders aiming to understand and influence market dynamics.

Keywords: mergers and acquisitions; agri-food sector; consolidation; international trade; European area

Reference to this paper should be made as follows: Kravčáková Vozárová, I., Košíková, M., Chapčáková, A., Dizaye, H., Smatana, J., Stanko, V. 2026. The role of GDP and the macroeconomic environment in shaping international trade and agri-food sector restructuring in Europe. *Entrepreneurship and Sustainability Issues*, 13(4), 338-350. http://doi.org/10.9770/p8538646793

JEL Classifications: G34, 011, Q13

1. Introduction

Mergers and acquisitions (M&As) are critical strategies for enhancing company competitiveness and fostering sustainable growth in the global economy. They involve combining enterprises to integrate resources, streamline

* *This research was funded by the Cultural and Educational Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic under grants KEGA 031PU-4/2025; KEGA 012PU-4/2023", also by the Scientific Grant Agency of the Ministry of Education, Science, Research, and Sport of the Slovak Republic and the Slovak Academy of Sciences, grant number VEGA 1/0461/23; and by Grant Agency for Research in Management, Faculty of Management and Business, University of Prešov in Prešov, grant number GAMA 25/2; and by the Academia aurea Grant Agency, grant number GAAA/2023/29".*

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p8538646793

operations, and improve profitability. M&As enable firms to access new markets, resources, and capabilities, achieve synergies such as productivity gains, cost reductions, and enhanced management quality, and diversify risk. In addition, the results of the research on the issue in question show that, from a macroeconomic point of view, cross-border M&As are an important determinant of transfers and the subsequent distribution of production from one country to another, they support technological transfer, the transfer of know-how and other capacities between different countries, which has a positive impact not only on the companies themselves, but also on the entire economies of the countries involved in these transactions (Wang et al., 2022; Hitt et al. 2016). The macroeconomic conditions of individual countries play a significant role in shaping merger and acquisition activities, as broader economic growth dynamics and structural characteristics influence investment decisions and corporate expansion strategies (Pekarčíková et al., 2025). Changes in interest rates, inflation, exchange rates, and gross domestic product growth can greatly influence companies' willingness to carry out planned M&A transactions. These differences suggest that firms' financial resources and strategic approaches vary depending on the level of economic development of the respective country. Overall, it can be said that macroeconomic factors have a diverse and often context-specific impact on the volume and success of M&A transactions, which is important to consider when planning strategies and developing policies that support business activities in different economic environments (Kumar et al., 2023; Chovancová et al., 2024; Pálka et al., 2025). Recent literature suggests that cross-border M&A activity cannot be fully explained by traditional macroeconomic variables alone, particularly in the agri-food sector (Hu et al., 2025). Institutional quality, regulatory frameworks, and the level of financial market development play an increasingly important role in shaping investment decisions and transaction feasibility. As highlighted by Boateng et al. (2014) and Kumar et al. (2023), factors such as governance quality, investor protection, and capital market maturity significantly influence both the volume and success of cross-border M&A transactions.

In addition, growing financial integration and globalization have made M&A activity more responsive to macroeconomic conditions. As noted by Moschieri et al. (2014), regional integration—particularly within the European Union—reduces transaction costs and uncertainty, thereby facilitating cross-border corporate restructuring. This effect is especially evident in the agri-food sector, where regulatory harmonization under the Common Agricultural Policy (CAP) provides a relatively stable and predictable institutional environment for investment.

According to Hernández et al. (2023), the issue of market concentration and the associated potential use of market power play a significant and long-standing role in the agri-food sector. It remains a central topic of interest not only for researchers, but also for policymakers and various stakeholders, including producers, processors, distributors, and consumer organizations. As consolidation within the industry continues to grow, concerns arise regarding the balance of power among actors in the supply chain, as well as the impact of market concentration on competition, pricing, and fairness in trading practices. This topic becomes even more critical in the context of ensuring food security, the stability of rural areas, and the sustainability of agricultural production.

2. Theoretical background

Effective company management requires the ability to respond promptly to dynamic changes in the external environment, which include economic, political, legal, and social factors. These changes can significantly impact on the business landscape and thus influence a company's stability and performance. One strategic response to such external challenges is through mergers and acquisitions. These are forms of corporate restructuring that enable companies to adapt to new conditions, enhance their competitiveness, expand market share, or improve internal efficiency (Masron & Subramaniam, 2018; Kolesnikov & Kolesnikova, 2018). The need to comprehensively assess the impacts of concentration within the agri-food sector has never been more urgent. Although concentration has long been a characteristic of the agricultural sector, it has dramatically increased since the 1980s. While market concentration manifests in various ways, its most visible form is highly publicized mergers and acquisitions, that is, when companies decide to merge horizontally or vertically, allowing them to capture larger market shares. Across all economic sectors, the total volume of merger and acquisition activity represents the most visible consolidation trend (Mooney, 2017). Mergers and acquisitions, as a form of growth, are used to restructure leading companies worldwide. To meet rising domestic and global

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p8538646793

demand, companies aggressively expand their capacity primarily through M&A (Gupta & Raman, 2022). Also, according to Hernández et al. (2023), in recent years, the agri-food sector has experienced significant market concentration and consolidation, primarily driven by mergers and acquisitions, as well as the transformation of supply chains themselves. A key contributing factor has also been the global expansion of retail chains, particularly supermarkets. While increasing horizontal and vertical integration can lead to greater efficiency, for example, through economies of scale or improved coordination, in cases where such benefits are lacking, it may also result in the abuse of market power, tacit collusion among firms, or other anticompetitive practices. The agri-food sector represents a vital segment of the primary industry, playing a crucial role in sustaining human life through food production. Beyond its basic function, it also contributes significantly to both domestic and international economic growth. According to the World Bank, agriculture accounts for approximately 4% of global GDP, with this figure exceeding 25% in some of the world's least developed countries. Additionally, the sector is a major source of employment worldwide. Data from the Food and Agriculture Organization (FAO) indicates that agriculture is the second-largest employment sector globally, providing work for 26.7% of the global labor force (Huang & Scrimgeour, 2024).

Agricultural land plays an important role in land use patterns across Europe. Grassland and cropland together make up 39% of Europe's land cover. Agriculture is an inherent part of food systems, and the range of food produced in the EU is diverse. The EU is broadly self-sufficient in most primary agricultural commodities. It is also the single largest exporter of agri-food products, which include processed food. The development of the agricultural sector is strongly influenced by the EU's Common Agri-cultural Policy (CAP). Ever since its creation in the mid-20th century, EU agricultural policy has had a strong economic dimension. Yet, over the last 50 years, there has been a shift in the type of subsidies provided and a move from a primarily sector-oriented policy to a more integrated rural development policy with structural and agri-environmental measures (EEA, 2024). Agriculture and food-related industries and services provide over 44 million jobs in the EU, including regular work for 20 million people within the agricultural sector itself. Thanks to its varied climate, fertile soil, the technical skills of its farmers, and the quality of its products, the EU is one of the world's leading producers and exporters of agricultural products (EU Agriculture, 2023).

According to Muehlfeld et al. (2011), studying M&A determinants for the agri-food sector is important for two reasons. The first reason is that agri-food M&As typically rank among the largest in size and make up a large proportion of the total M&A activity. Second, the agri-food industry has many characteristics that differentiate it from other industries, and therefore determinants explaining the success and failure of M&As in other industries are not necessarily relatable to the agri-food industry. For example, in the agri-food industry there is a comparatively large number of small players.

According to Ollinger et al. (2005), for many years, mergers and acquisitions in the food industry have been viewed with scepticism. The primary concern was that mergers, by reducing the number of firms and increasing industry concentration, were promoting anticompetitive pricing behavior. Across all sectors, M&As are considered a primary means to survive and thrive in highly competitive, large, or even globalized markets—where the competition itself is increasingly consolidated. Corporations tend to justify M&A deals in the agri-food sector in order to (Ramamurthy & de Lavigne, 2017; Mooney, 2017):

- maximize shareholder value;
- increase and/or protect market share;
- expand to new geographical markets;
- acquire new technologies/services/intellectual property;
- gain control over supply chains.

Consolidation occurs when many different business units merge into fewer larger units. Although consolidation is a complex topic, the structure that consolidation creates is relatively straightforward. Numerous interrelated factors drive consolidation. Financial considerations that favor large operations underline patterns of consolidation in agriculture. The technological, social, and political drivers of this pattern have made it more difficult for smaller farms to survive. One aspect of the financial considerations that favor larger consolidated operations is the cost and importance of agricultural technology. Advances in technology have greatly increased agricultural production in certain sectors over the last century and have become vital to the success of some

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p8538646793

mod-ern farming operations. However, there are high barriers to using this technology. Technology needed to keep up with the economic scale of production requires both capital and knowledge. Purchasing technology typically requires large, fixed investments. Due to the cost of capital and knowledge investment, larger farms with more resources are more likely able to purchase new technology (Hannah, 2022). By pooling the necessary capital to develop technologies, many business leaders further believe M&As pro-vide the means to address the challenges of sustainability, climate change, population growth, and shifting consumer demand (Mooney, 2017).

Although the agricultural production sector has historically been much more fragmented than other stages of the food and agricultural industry, it has been transitioning for decades from modestly sized, independent businesses to increasingly larger-scale businesses more tightly aligned across the value chain. The important features of consolidation and structural change in that industry are according to Langemeier & Boehlje (2017) economies of scale. Economies of scale exist when average cost per unit de-clines as output expands. In production agriculture, technology adoption can foster economies of scale and competitive advantages for a couple of reasons. First, early adopters of technology often reap above average net returns. Second, in a sector with rapidly changing technology such as production agriculture, firms that do not adopt technology become increasingly inefficient. Another potential source of economies of scale are advantages associated with buying inputs or selling outputs in relatively large quantities (specifically, pecuniary economies of scale). In addition, larger companies may be in a better position to negotiate with buyers.

Given that the share and value of M&As in the agri-food sector is the second highest after the financial sector, an increasing number of studies have been devoted to this issue from various perspectives. As a strategic part of national economies and food security systems, the agri-food sector has become an increasingly attractive target for investment activities, with consolidation processes taking place at multiple levels of the supply chain. Some studies evaluate the effects of M&As at the national level (Boateng et al. 2014; Aleksandrov et al. 2020; Ostapchuk et al., 2021; Honcharenko & Honcharenko, 2023; Blundell et al., 2025), while others examine the motivations of multinational corporations (Langemeier & Boehlje 2017; Mooney, 2017), the environmental impacts (Huang et al., 2024), the impact of R&D input as an influential factor in the success (Hong & Chen, 2022) or examine the failure factors (Meliá-Martí, 2021).

The economic situation measured by GDP changes, as well as the conditions in the capital market, reflected in returns on assets, may affect the activity around mergers and acquisitions. GDP growth can be taken as a sign of future growth in aggregate de-mand, which justifies the need to increase production capacity. Internal investment and M&As are the two options for increasing production capacity. The advantage of the latter is that the increase in production capacity occurs much faster than in the case of the former. Before the peak point of the business cycle is reached, growth in most branches of production is weakened, and the aggregated activity in M&As starts to de-crease. Similarly, during a recession, the decline in demand results in the appearance of excess capacity in the sector, we must deal with the tendency of reducing production potential (Figiel & Kupel, 2014).

3. Research objective and methodology

Macroeconomic factors such as GDP growth, interest rates, and inflation are inherently unpredictable and difficult to forecast. Due to this uncertainty, companies tend to be cautious when considering mergers and acquisitions, as economically unstable periods carry increased risks, particularly related to the fluctuating valuation of target firms. The main purpose of this paper is to evaluate the relationship and, above all, to quantify the impact of GDP on the volume of cross-border mergers and acquisitions in the agri-food sector for the period 1998–2023.

Based on the aim of the study, the following hypothesis is proposed:
H1: GDP affects the growth of the volume of cross-border mergers and acquisitions in the agri-food sector.
The analysis focuses on 12 countries within the European area (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, Spain, and the United Kingdom), covering a period of 24 years (from 1998 to 2023). Panel data were used, applying regression models specifically designed for the analysis of

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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such structu-red data, namely: the pooled regression model (PRM), the random effects model (REM), and the fixed effects model (FEM). These methods are constructed as follows:

PRM: $M\&Ait = \alpha + \beta1*GDP\ it1 + \varepsilon it$ (1)
REM: $M\&Ait = \beta1*GDP\ it1 + (\alpha + ui) + \varepsilon it$ (2)
FEM: $M\&Ait = \alpha + \beta1*GDP\ it1 + \varepsilon it;\ \alpha t=\alpha t1+\alpha t2+...+\alpha te$ (3)

Where M&As represent the volume of realized cross-border mergers and acquisitions in the agri-food sector in the countries of the European area (in mil. EUR). This variable is expressed by a natural logarithm (dependent variable). GDP (annual gross domestic product from Eurostat in mil. EUR at current prices) represents the independent variable. GDP was also expressed by a natural logarithm. The dataset containing records of implemented cross-border mergers and acquisitions in the European Area was based on data from the Zephyr and Orbis database (Bureau Van Dijk, 2024). The dataset consists of individual cross-border equity deals between the home country of the acquirer and the host country where the target firm is domiciled. The source of other used statistical data is Eurostat (Eurostat, 2025).

Before each separate regression analysis, we assessed the stationarity of the dependent and independent variables using the ADF or KPSS test for the presence of unit roots. Before constructing the regression models, we carried out correlation analysis. To determine the appropriateness of one of the three regression models mentioned above, we used the joint significance test of the averages of different groups, the Breusch-Pagan test, or the Hausman test statistic. All three methods were only used for the analysis of the complete dataset for the purpose of visualization and comparison.

4. Results and discussion

After determining the existence of unit roots using the ADF test and KPSS test, we can confirm the stationarity of the indicators; therefore, it was not necessary to perform any correction (difference) of the indicators. Subsequently, we proceeded with the correlation analysis, the results of which are shown in Table 1.

Table 1. Correlation analysis – M&A – GDP

Correlation	Pearson correlation coefficient	Coefficient of determination	p-value
M&A – GDP	0.4299	0.1848	0.0000***

Source: own processing
*** represent the statistical importance of 10%.

As part of this analysis, assumptions about a positive correlation between GDP and the volume of cross-border mergers and acquisitions in the agri-food sector were con-firmed. Although there is a weak but directly proportional relationship between the mentioned indicators, the growth of the economy thus affects the growth of the volume of cross-border mergers and acquisitions in the agri-food sector. The results of the sub-sequent regression analysis by applying three panel regression methods are shown in Table 2.

Table 2. Comparison of regression models

	PRM	REM	FEM
Constant	-21.2129	-18.7175	38.3237
	[0.0000] ***	[0.0007] ***	[0.0559] *
lnGDP	2.3228	2.1346	-2.1673
	[0.0000] ***	[0.0000] ***	[0.1510]
Adjusted R^2	0.1820		0.0075
S.E. of regression	5.0402	5.0352	4.8647

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Schwarz criterion	1758.2760	1758.7050	1788.8650
Rho	0.2516	0.1467	0.1467
Akaike criterion	1750.9500	1751.3790	1741.2460
Hannan-Quinn	1753.8860	1754.3150	1760.3290
Durbin-Watson	1.3583	1.5201	1.5201

Source: own processing

To choose between PRM and FEM models, we used the test of joint significance of differing group means. A low p-value counts against the null hypothesis that the pooled OLS model (PRM model) is adequate, in favour of the fixed effects alternative. The Breusch-Pagan test statistic is used to choose between PRM and REM models. A low p-value counts against the null hypothesis that the pooled OLS model is adequate, in favor of the random effects alternative. To choose between the FEM and REM models, the Hausman specification test is used. The null hypothesis assumes that the parameter estimates of the generalized least squares method in the REM model and the least squares method in the FEM model are consistent, and thus the least squares estimation is not efficient. In the alternative hypothesis, only the method of least squares is consistent (Lukáčik et al. 2011). The results of the individual mentioned tests are shown in Table 3. Based on the test of joint significance of the means of different groups, and of the Breusch-Pagan test statistic and Hausman test statistic (Table 3), we prefer the fixed effects model.

Table 3. The results of the individual-mentioned tests

Panel test	F/LM/H	p-value
Test of joint significance of differing group means	2.9093	0.0012
Breuch-Pagan test statistics	4.0681	0.0437
Hausman test statistics	8.9211	0.0028

Source: own processing

Since the GDP was not significant in the FEM model, we should calibrate the model by including another variable. This area therefore represents the limits of our research as well as an area for future investigation. But in this work, we prefer to include the time dummies. The most appropriately chosen model was again the FEM model (Table 4).

Table 4. The results of FEM model.

	Coefficient	Std. Error	t-ratio	p-value	
Const	−130.958	52.4388	−2.497	0.0132	**
lnGDP	10.0589	3.87789	2.594	0.0100	**
dt_1	7.62790	3.12783	2.439	0.0154	**
dt_2	11.6436	2.95414	3.941	0.0001	***
dt_3	10.8455	2.76938	3.916	0.0001	***
dt_4	11.9710	2.64027	4.534	<0.0001	***
dt_5	11.4341	2.53846	4.504	<0.0001	***
dt_6	8.85396	2.46887	3.586	0.0004	***
dt_7	10.5822	2.34915	4.505	<0.0001	***
dt_8	9.93164	2.25698	4.400	<0.0001	***
dt_9	10.3589	2.14298	4.834	<0.0001	***

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http://doi.org/10.9770/p8538646793

dt_10	8.13796	2.04671	3.976	<0.0001	***
dt_11	8.82132	2.02090	4.365	<0.0001	***
dt_12	5.76472	2.08901	2.760	0.0062	***
dt_13	5.76727	2.04392	2.822	0.0052	***
dt_14	5.63481	2.02214	2.787	0.0057	***
dt_15	5.42704	2.01414	2.694	0.0075	***
dt_16	6.99030	2.00719	3.483	0.0006	***
dt_17	6.75528	1.97492	3.421	0.0007	***
dt_18	4.29954	1.93368	2.224	0.0271	**
dt_19	3.68575	1.91641	1.923	0.0556	*
dt_20	6.72260	1.89280	3.552	0.0005	***
dt_21	1.93926	1.87506	1.034	0.3020	
dt_22	4.25985	1.86504	2.284	0.0232	**
dt_23	4.54737	1.88090	2.418	0.0163	**

Adjusted R	0.199
S.E. of regression	4.5635
Schwarz criterion	1857.132
Rho	0.109625
Akaike criterion	1725.2660
Hannan-Quinn	1778.1100
Durbin-Watson	1.6269

Source: own processing

The above values show that the percentage growth of GDP has a significant impact on the percentage growth of the volume of cross-border mergers and acquisitions in the agri-food sector. The obtained model is statistically significant, and thus we can confirm the established hypothesis. However, the resulting model explains only a small part of the variability of the variables.

The empirical findings confirm a statistically significant relationship between GDP growth and M&A activity. However, the model's limited explanatory power suggests that GDP should be interpreted as an enabling factor rather than a sole determinant. Economic growth creates favorable conditions—such as increased liquidity, higher firm valuations, and stronger investor confidence—but does not independently drive transaction decisions (Chen et al., 2025). This result is consistent with the broader literature, which emphasizes that M&A activity is inherently multidimensional, shaped by sector-specific dynamics, firm-level strategies, and institutional frameworks.

In the agri-food sector, this relationship is further influenced by structural characteristics, including supply chain fragmentation, dependence on natural resources, and exposure to external shocks (Iannaccone et al., 2025). Unlike high-technology industries, where innovation is a primary driver, M&A activity in the agri-food sector is more commonly motivated by economies of scale, vertical integration, and risk diversification. Consequently, GDP growth may influence M&A activity indirectly by increasing demand for food products and encouraging investment in supply chain efficiency and resilience (Gavura et al., 2025).

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There is no doubt that in the 21st century the market for corporate control activities has been largely inducted by significant economic initiatives such as globalization, deregulation, regional agreements, trade and financial liberalization, government policies, elimination of bureaucrat barriers, establishment of international accounting standards and shareholding systems, corporate governance and capital market development [Aquaro et al., 2021; Reddy, 2015; Moschieri, 2014). In many cases, mergers and acquisitions are driven by a key trend within a given industry, such as rapidly changing technology, which is driving many of the deals in high technology and gaining technological synergies (Suo, et al. 2023; Manne et al. 2022; Hitt et al., 2016).

Fierce competition, which is driving many of the deals in many industries. The pressure to control costs is driving in many of the deals in the agri-food sector. Some transactions are motivated by the need to transform a firm's corporate identity or even to be transformative for the buyer overall, where the target company may lead the buyer in a new direction or add significant new capability. Many deals are fuelled by the need to spread the risk and cost of developing new technologies, research into new gaining access to new sources of energy etc. The global environment has forced many companies to explore mergers and acquisitions as a means of developing an international presence and expanding their market share by producing synergies. This market penetration strategy is often more cost-effective compared to greenfield investment (Ahsan & Musteen, 2011). The reallocation of capital through M&A is one of the most significant phenomena of recent decades on a global as well as a European scale. Cross-border mergers and acquisitions thus represent an important phenomenon of globalisation affecting the competitiveness of entire states (regions) and redistributing economic forces in the world (Štefko et al., 2022; Jassó et al., 2025). The agri-food sector is an important component of the primary industry and plays a fundamentally crucial role by helping to sustain life through the provision of food necessary for human survival (Alkathiri et al., 2024). According to Mooney (2017), mergers are sparking unprecedented consolidation across food systems, and new technologies represent a powerful new driver. For decades, firms in the agri-food sector have pursued M&A and other forms of consolidation as part of their growth strategies. However, the recent spate of mega-mergers has taken this logic to a new scale

While many sectors across the market saw deal volumes nearly pause entirely for much of 2020, M&A activity in the food and agriculture market recorded a slight increase compared to 2019. Much of the focus among strategic players, and the motivation for M&A, has been to achieve enhanced scale and better control over their supply chains. The sector has also seen significant crossover, especially among foodservice players, who increasingly sought acquisitions in the grocery and retail end markets following drastic declines in restaurant sales during the height of the pandemic (Boyle, 2022).

Langemeier and Boehlje (2017) also examined the most likely drivers of consolidation for the next few years and discussed the implications of changes in the structure of production agriculture for agribusinesses. Key drivers influencing farm consolidation will include capital and land market access, cost economies, government payments and limits, managerial resources, off-farm employment opportunities, profitability and growth focus, risk, and value-chain alliances. Current trends in these key drivers favour continued farm consolidation. Due to anticipated changes in technology and production practices, required managerial expertise, and the value chain, production agriculture is during a major transformation. Forces driving this transformation are many and widespread, including increased quality, safety, and traceability demands of food processors and consumers; implementation of information and process control technologies; adoption of technologies and business practices that exploit economies of scale; increased use of leasing and other outsourcing strategies to foster growth, etc.

Agricultural commodity trading plays a vital role in the functioning of the global food system and significantly shapes international price dynamics. The study of Lianos et al. (2024) suggests that increasing consolidation in this sector may enhance market dominance, disrupt market stability, and lead to higher prices for end consumers. At the same time, farmers are likely to face declining profits, while new and smaller firms may struggle to enter the market, reducing overall competition. Such consolidation may also hinder innovation, slow down sustainability efforts, and have negative implications for food security and the resilience of food systems. Also, according to Hernández et al. (2023), recent global crises, such as the COVID-19 pandemic and the Russian invasion of Ukraine, have caused significant disruptions in agri-food supply chains and sharp increases in input prices, further intensifying concerns about market concentration and its consequences. Nevertheless, the

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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relationship between market concentration and the exercise of market power is not straightforward, it is a complex phenomenon that depends on numerous specific factors and market conditions.

Huang et al. (2024) examined the effect of agricultural determinants in cross-border M&As in the global agricultural and food sector over the 1996–2018 period. Based on country pairs in the agricultural and food sector, they found that, specifically, countries with better agricultural resources, better agricultural productivity, and better environ-mental performance are less likely to engage in cross-border M&As as acquirers but are more likely to be targeted. Countries with inadequate agricultural resources and productivity, and worse environments, are more likely to engage in cross-border M&As as acquirers but are less likely to be targeted. Better resources, productivity, as well as environmental performance, are undoubtedly factors that also determine the GDP of the countries themselves and reflect broader environmental and socio-economic conditions influencing economic systems (Al Khouri et al., 2025). Our research also confirmed that the percentage growth of GDP has a significant impact on the per-centage growth of the volume of cross-border mergers and acquisitions in the agri-food sector; that is, EU countries that are economically more efficient also implement more M&A deals, which is consistent with findings on the transformation potential of resource-based territories and their economic utilization (Iannaccone et al., 2024). Further research will therefore identify other determinants that have an impact on the implementation of M&A in the agri-food sector from the point of view of natural and climatic conditions, as well as the geographical proximity of countries.

From a policy perspective, the results suggest that promoting economic growth alone is insufficient to ensure effective and sustainable consolidation in the agri-food sector. Policymakers should also prioritize strengthening institutional quality, improving access to finance, and maintaining competitive market structures. In addition, appropriate regulatory oversight is essential to mitigate the risks associated with excessive market concentration, including reduced competition and potential negative impacts on small producers and consumers.

The study by Lakra (2024) suggests that strong GDP growth is associated with higher merger and acquisition activity. This phenomenon is linked to increased business optimism regarding the economic situation and expectations of future growth. Higher GDP can also raise company valuations and profitability, making M&A transactions financially more attractive. Conversely, during recessions or periods of slower GDP growth, M&A activity tends to decline, as firms prioritize stabilizing their operations. The research thus confirms a significant relationship between the volume and frequency of M&A and the overall state of the economy.

4. Conclusions

The conducted empirical analysis confirms the presence of a positive relationship between GDP growth and the volume of cross-border mergers and acquisitions in the European agri-food sector over the period 1998–2023. The correlation analysis revealed a weak but statistically significant positive association between GDP and M&A activity, supporting the hypothesis that economic growth encourages increased consolidation activity through cross-border M&As. Subsequent regression analyses applying pooled regression (PRM), random effects (REM), and fixed effects models (FEM) provided deeper insights into this relationship.

Despite the statistical significance, the relatively low adjusted R^2 suggests that GDP alone explains only a modest portion of the variation in cross-border M&A activity. This indicates the influence of additional factors beyond macroeconomic growth, such as regulatory environments, sector-specific policies, market structure, and geopolitical conditions, which warrant further exploration. In summary, this study underscores the important role of economic growth as a driver of cross-border consolidation in the European agri-food sector but also highlights the complexity of factors shaping M&A dynamics. Future research should aim to incorporate other relevant determinants and extend the analysis to capture these multifaceted influences comprehensively. These in-sights are valuable for policymakers and business leaders aiming to foster sustainable growth and competitiveness in the agri-food industry.

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Funding: This research was funded by the Cultural and Educational Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic under grants KEGA 031PU-4/2025; KEGA 012PU-4/2023", also by the Scientific Grant Agency of the Ministry of Education, Science, Research, and Sport of the Slovak Republic and the Slovak Academy of Sciences, grant number VEGA 1/0461/23; and by Grant Agency for Research in Management, Faculty of Management and Business, University of Prešov in Prešov, grant number GAMA 25/2; and by the Academia aurea Grant Agency, grant number GAAA/2023/29".

Data Availability Statement: More primary data can be obtained from the corresponding author on a reasonable request.

Author Contributions: All authors contributed equally. All authors have read and agreed to the published version of the manuscript.

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p8538646793

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/j5529249258

Publisher
http://jssidoi.org/esc/home

ARTIFICIAL INTELLIGENCE AS A DRIVER OF CORPORATE SUSTAINABILITY METRICS AND TRIPLE BOTTOM LINE ENGAGEMENT IN SUPPLY CHAINS

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Received 18 February 2026; accepted 26 April 2026; published 30 June 2026

Abstract. Despite global attention and increased investment, the implementation of digital technologies, for instance, artificial intelligence (AI), and its impact on sustainability metrics (SMII) and triple bottom line awareness (SEI) within large global supply chain companies, remains unclear. Digitization does not always promote sustainability due to high energy use and social inequality; ESG goals may also pose hurdles to further digital transformations. In contrast, long-term digitization is a driver of achieving sustainable goals. Due to a lack of consensus, this study researches the impact of implemented AI technology on SMII (operational level) and SEI (strategic level) within large, global supply chain firms. The study includes a literature review of 817 sources on the main theories and possible variable relationships. Secondary data from Fortune 500 industrial companies and their integrated, annual, and sustainability reports were collected and analyzed, yielding 10 digital technologies and 12 sustainability metrics as a basis for the subsequent survey of 106 participants. PLS-SEM modeling is used to test and interpret two hypotheses and to validate results. This study reveals a positive and significant relationship in implementing AI and a global supply chain company's SEI. This is explained by Institutional theory - external pressures and competition, also, that the large international companies have greater resource availability per the Resource Orchestration theory. Further studies could examine why AI affects sustainability at the strategic level but has little impact on the operational level.

Keywords: Artificial Intelligence; Digital Transformation, Sustainability; Triple-Bottom Line; Global Supply Chain Management; PLS-SEM

Reference to this paper should be made as follows: Bitinė, G., Meidutė-Kavaliauskienė, I. V. 2026. Artificial intelligence as a driver of corporate sustainability metrics and triple bottom line engagement in supply chains. *Entrepreneurship and Sustainability Issues*, 13(4), 351-366. http://doi.org/10.9770/j5529249258

JEL Classifications: O33, M11, M14, Q56

1. Introduction

Even though global spending and attention on the symbiosis of digitization and sustainability are growing, perceptions of digital transformation (DX) towards sustainability are mixed. It is expected that spending on digital transformation will increase from 2,58 trillion US dollars in 2025 to 3,88 trillion US Dollars by 2028 globally, as digital transformation includes technological advancements such as cloud computing and artificial intelligence (AI) (*Global Digital Transformation Spending 2028| Statista*, n.d.).

In Industry 4.0, digital technologies are the core for advancing manufacturing and the production of goods, and include AI, additive manufacturing, robotics, the internet of things (IoT), and virtual and augmented reality (VR/AR), and other technological advancements (*Industry 4.0: In-Depth Market Analysis | Statista*, n.d.).

Industrial manufacturing is mentioned as a primary industry that has been investing in digital transformation since 2021 (*Global Investment in Industrial Digital Transformation 2021| Statista*, n.d.). Digital transformation

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/j5529249258

does not necessary brings sustainability, there are concerns about high energy usage and social inequality associated with it. Actually, meeting ESG goals for environmental, social, and governance is one of the most common hurdles preventing global digitization initiatives (*Factors Preventing Digital Transformation Worldwide 2023| Statista*, n.d.).

However, previous research also shows that, when it comes to long-term organizational sustainability goals, digital and emerging technologies are believed to accelerate them significantly or play a largely positive role (*Companies' Sustainability Impact of Technology 2024| Statista*, n.d.).

As there is no clear consensus in past research and the arguments are quite contradictory, this study aims to provide insights into whether the implementation of digital transformation tools, such as artificial intelligence, can be considered as a positive driver of corporate sustainability measurement adoption and engagement in the triple bottom line within global supply chain companies. The research hypotheses are the following:

- H1: Artificial intelligence, if implemented within the company, may positively impact the use of sustainability metrics.
- H2: Artificial intelligence, when implemented within the company, positively impacts sustainability awareness by increasing engagement across all three pillars: environmental, social, and economic.

To reach this objective and test the hypotheses, the main research questions (RQ1-RQ4) are the following:

1. What are the most common digital transformation initiatives being implemented or already have been implemented within the global supply chain companies, based on the information provided in their integrated, annual, or sustainability reports?
2. What are the most common sustainability metrics within global supply chain companies, based on the information provided in their integrated, annual, or sustainability reports?
3. How does the most common digital transformation tool (AI) relate to the sustainability engagement within global supply chain companies, based on the survey results of 106 participants?
4. How does the most common digital transformation tool (AI) relate to sustainability measurement within global supply chain companies, based on survey results from 106 participants?

This study seeks to broaden the contemporary literature on the interplay between digital transformation, particularly artificial intelligence, and sustainability, while focusing on the adoption of the triple bottom line and sustainability measurement within global supply chain companies. It suggests a novel approach by providing insights into international, large-scale supply chain companies, analyzing 106 survey responses that will guide future research on the topic.

The article is structured in several sections. Section 1 begins with an introduction and provides the rationale, objective, hypotheses, and four research questions (RQ1-RQ4) regarding the implementation of digital transformation tools (artificial intelligence), the possible impact on corporate sustainability measurement adoption, and organizational engagement in the triple bottom line within global supply chain companies. Section 2 analyzes the theoretical background and recent literature analysis on digital transformation, sustainability, and supply chains, which serve as the basis for the hypotheses analyzed further. Section 3 provides details on the methodology and procedural steps taken, including: literature review; secondary data collection and analysis; survey design and data collection; PLS-SEM modeling and hypothesis testing; and interpretation and validation of the results. Section 4 provides results and discussion on RQ1-RQ4 and testing the hypotheses (H1, H2). Finally, the article concludes with suggestions for further research in Section 5.

2. Literature analysis

Based on the literature analysis, both digital transformation and sustainability are multidimensional. However, the results did not provide a dominating theory. At the end of 2024, the Web of Science (WOS) Core Collection and Scopus databases were analyzed for keywords related to supply chain, digital transformation, sustainability, and their implementation.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/j5529249258

Dynamic capability theory is mentioned a few times for analyzing digital transformation and green supply chains in Egypt (Hamdy, 2024); digital transformation and corporate sustainability within listed companies in China (Ji et al., 2023); as well as big data, green lean six sigma, sustainable supply chains, and economic performance (Fayyaz et al., 2025). The Dynamic capability theory relates organizations' attention to internal and external competencies to a response to a dynamic environment (Alkaraan et al., 2024).

Other authors research dynamic capabilities together with manufacturing, sustainability, digital transformation, sustainable competitive advantage, economic, environmental, and social aspects (Felsberger et al., 2022). This could be used to explain the successful implementation of digital transformation tools such as artificial intelligence and the use of sustainability metrics as an operational task within the company (H1).

Wang et al. base digital transformation, sustainability in manufacturing, and motivation for adopting green supply chains on Institutional theory, which is mainly concerned with external factors (Wang et al., 2023). Institutional theory is commonly used for digital transformation topics and driving forces analysis, but less so for supply chains (Tiwari et al., 2024). However, institutional normative, mimetic, and coercive pressures could be sufficient for large, global companies to increase sustainability engagement and measure their sustainability indicators, as this became an international standard (Saida & Hasbaoui, 2024; Petera et al., 2021).

This theory could be used to explain the implementation of digital transformation technologies such as AI in response to external pressures from competitors and the market, while also influencing sustainability awareness under regulatory or stakeholder demands, as a strategic move within the company (H2).

Resource orchestration theory is used to analyze digital transformation, supply chain capabilities (such as agility, adaptability, and alignment), and sustainable performance (Mohaghegh et al., 2025). Sharma et al. provide positive relations with lean practices and sustainable operational outcomes (Sharma et al., 2024). In some cases, sustainability is mentioned only as secondary to digital transformation across operations, production, manufacturing, sourcing, customers, and sales in the oil and gas industry (Panduru et al., 2021). The theory of Resource orchestration could also explain whether increasing digital capabilities through AI positively impacts the company's sustainability awareness as a strategic orientation (H2).

Even though the digital transformation and sustainability engagement relationships are mentioned, they are not specifically aligned. For instance, there is focus on broader topics such as supply chain, sourcing, production, digital transformation, digitization barriers, and sustainability, as per the Sustainable Development Goals (SDGs) (Dadsena et al., 2024). The SDGs are also studied alongside digitization, digital accessibility, sustainability, and sustainable transformation in production as the digitization sustainability matrix (Gupta et al., 2020).

The circular economy is mentioned in the publications in relation to supply chain and production, digital transformation and the impact of digitization on circularity (Agnusdei et al., 2023). Giudice et al. analyze data-driven decision-making based on big data in circular supply chains and logistics as the moderating effect (Del Giudice et al., 2020). Or energy saving, sustainability, digitization, and digital documentation in railway infrastructure (Raco, 2023). Also, production, manufacturing, digital transformation, digitalization, and sustainable digital economic growth receives scholarly interest as well (Yin et al., 2022).

Bashynska et al. focuses on analyzing digital transformation and sustainability, and the outcomes of digital smartization projects across the supply chain, factories, industrial enterprises, production, and supplier dimensions (Bashynska et al., 2023). It is followed by waste production and conscious resource usage, digital planning and digital manufacturing, digital transformation, digitization, and sustainability (Nölle, 2020). Also, authors focus on lean manufacturing, production, and digital transformation, digitization, and sustainability by integrating digital twins and artificial intelligence to optimize production (Piras et al., 2024).

González Chávez et al. use a specific term, twin transition or twin transformation, that encompasses both digital and sustainable aspects across manufacturing, production, the supply chain, and the value chain (González Chávez et al., 2023). Or twin transformation for circular supply and value chains, smart manufacturing, and

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/j5529249258

digital transformation for reaching sustainability goals within production (Hong et al., 2024). Other researchers, such as Patalas-Maliszewska & Łosyk, focus on transition to digital production, sustainable solutions, sustainable development, and supply chain management, production, sales, digital manufacturing, followed by sustainable supply chain management practices, sustainable supplier selection (SSS), and resilient manufacturing strategy (RMS) while incorporating additive manufacturing (Patalas-Maliszewska & Łosyk, 2024).

There are some mentions of the relationship between digital transformation and sustainability metrics. It includes Industry 5.0-4.0, supply chain, manufacturing, production, digital transformation, sustainability, circular economy, ESG, and circularity indicators (Payer et al., 2024) or decision-making models on technology selection (Erbay & Yıldırım, 2019).

These topics cover a variety of industries, including digital transformation, digitalization, and the sustainability objectives of organizations within shipbuilding supply chains (Diaz et al., 2020). IoT is followed by big data models, cloud computing, precision technologies, and sustainability (including environmental footprint) in food production (Moysiadis et al., 2020).

Digital transformation tools related to sustainability and supply chains are provided, including additive manufacturing, automation, digital retrofitting, the Internet of Things, building information modeling, geographic information systems, machine learning, big data, cloud computing, virtual and augmented reality, artificial intelligence, and more. For instance, additive manufacturing is mentioned as a way to enhance the digital value chain and sustainability in manufacturing, industrial production, the digital supply chain, logistics, inventory management, and decentralized manufacturing (Araújo et al., 2021).

As for other common digital transformation tools, automation is mentioned alongside production, manufacturing, sustainable manufacturing, value chain, supply chain, suppliers, and sustainability (Cerezo-Narváez et al., 2018). Digital retrofitting of legacy industrial machines, Industrial Internet of Things (IIoT), and manufacturing include such topics as sustainable manufacturing, production, lean production, purchasing, logistics, and sales (Tantscher & Mayer, 2022). Combined effects of digitization (e.g., digital twin, BIM, and GIS), sustainability (e.g., zero energy district, renewable energy systems for sustainable mobility), and energy efficiency measures are explored within zero energy port areas (Agostinelli et al., 2022).

Detailed digital transformation tools (e.g., digital twin, enabled by cloud computing, artificial intelligence, machine learning, big data, and BIM) and sustainability within the supply chain are also mentioned by scholars (Ruperto & Strappini, 2021). It is followed by BIM and GIS, automation, urban sustainability within the construction supply chain, procurement, suppliers, warehousing, and production processes (Uzairuddin & Jaiswal, 2022).

Digital twins, together with topics of manufacturing, production, supply chain, supplier, consumers, and economic, environmental, and social sustainability performance indicators within the ceramic industry (Contini et al., 2023). In some cases, 3D printing is also mentioned as a technology in construction, manufacturing, and production projects (Chang & Antwi-Afari, 2023).

Based on the literature analysis, a structural equation model is developed, positing that artificial intelligence may affect the use of sustainable metrics within large, global supply chain companies (H1), grounded in the Dynamic Capability Theory. While the second hypothesis (H2) proposes that artificial intelligence may foster greater strategic sustainability awareness within large global supply chain companies, it is grounded in Institutional theory and Resource orchestration theory.

3. Methodology

This chapter provides information based on the research procedures conducted in this study. The main objective of this study is to analyze the implementation of digital transformation tools, such as artificial intelligence, which can be considered as a positive driver of corporate sustainability measurement adoption and engagement

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/j5529249258

in the triple bottom line within global supply chain companies. Therefore, a mixed-methods approach combining secondary (company report analysis) and primary quantitative data (survey results) is chosen. The research phases and related tasks are presented in a procedural diagram and are summarized in Figure 1 (Moubarac et al., 2012).

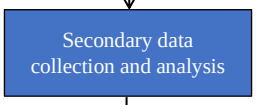
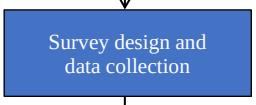
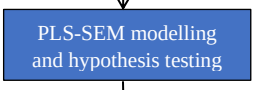
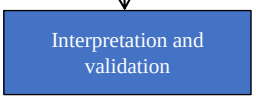
Phase	Steps	Procedures	Products
1.		Literature review of Web of Science and Scopus databases publications. (n = 817). Content analysis of academic publications.	Extracted data and annotated references.
2.		Secondary data: 14 industrial company annual, sustainable or integrated reports, companies selected based on Fortune 500 report(*Fortune Global 500 – The Largest Companies in the World by Revenue | Fortune*, n.d.). (n = 103) Content analysis of secondary data (company reports), descriptive statistics. *Digital transformation tools (n=10); sustainability metrics (n=12)*	Extracted, coded and categorized data with MAXQDA software, annotated references. The diagrams with most common digital transformation tools and sustainability metrics created with MAXQDA software.
3.		Survey questionnaire distributed through Linkedin: public post (n=1) and private messages (n = 2409). Obtained sample size: 106, including: 1) quota for employees of fourteen industrial companies based on the Fortune 500 report (for data triangulation), 2) similar company employees (for a broader understanding of the phenomenon). (n = 106, with the response rate of 4,4%)	Survey dataset collected via Google Forms.
4.		Testing hypotheses significance by using partial least squares structural equation modeling (PLS-SEM)	Tested significance of H1 and H2, and mediation by using SmartPLM 4 software.
5.		Concluding the findings, validation of the model.	Validated model.

Figure 1. A Procedural diagram of research activities.
Source: authors

In the first phase, the Web of Science Core Collection and Scopus databases are used for the literature review. The specific keywords used for the search are: supply chain ("supply chain" OR "operation*" OR "procur*" OR "production" OR "inventory" OR "sale"), followed by digitization ("twin transition" OR "twin transformat*" OR "digital transition" OR "digital transformat*" OR "digitization" OR "digitalization"); sustainability ("green transition" OR "green transformat*" OR "sustainable transition" OR "sustainable transform*" OR "sustainab*" OR "triple bottom line" OR "ESG") and implementation ("project" OR "invest*" OR "CAPEX" OR "capital expenditur*"). Comparing similar publications yielded a final list of 817 sources.
In the second phase, as per the Procedural diagram (Figure 1), the secondary data sample is selected from Fortune Global 500 companies in the Industrial sector, as this sector primarily relates to supply chain management. Each company's website is searched for integrated, annual, or sustainability reports from 2020 to

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/j5529249258

2024, resulting in total of 103 reports for further content analysis. The reports are analyzed by using MAXQDA software for data extraction, coding, and categorization. The data is coded by one of the authors according to literature analysis and provides information on the most commonly used 10 digital transformation technologies: Internet of Things (IoT), Cloud computing, Blockchain, Big data, Artificial Intelligence (AI), Digital twin, Building information modeling (BIM), Geographic information system (GIS), Life cycle analysis (LCA), and Data analytics.

Also, the most common 12 sustainability metrics are extracted, coded by one of the authors and categorized by the MAXQDA software, into such groups as: Water withdrawal, Energy consumption (GWh), Renewable energy consumption (%), GHG emissions scope 1 and 2 (kilotons CO2e), Total waste sent to landfill (kilotons), Number of nationalities, Women in workforce (%), Women in senior management positions (%), Lost-time injury frequency rate, Average hours of training per year and employee, Employee engagement score, and Community spending (volunteering). Both digital technologies (n=10) and sustainability metrics (n=12) were included as survey options (Table 1).

Table 1. The questions distributed via online survey

No.	Question	Options
1.	How many employees does your organization have?	○ 1–9 employees ○ 10–49 employees ○ 50–249 employees ○ 250+ employees ○ Not applicable / Don't know ○ Other
2.	Please select all the regions where your company operates. *(Select all that apply)*	○ North America ○ South America ○ Europe ○ Africa ○ Asia ○ Oceania ○ Not applicable / Don't know ○ Other
3.	Three pillars of sustainability are environmental, economic, and social. Please select in which sustainability aspects your company is actively engaging in. *(Select all that apply)*	○ Environmental - my company focuses on protecting the natural environment, conserving resources, and minimizing pollution ○ Social - <…> emphasizes the well-being of people and communities ○ Economic - <…> focuses on creating long-term economic prosperity and stability ○ Not applicable / Don't know ○ Other
4.	Please indicate which of the following digital transformation activities are currently being implemented or have been implemented in your company. *(Select all that apply)*	○ Internet of Things (IoT) ○ Cloud computing ○ Blockchain ○ Big data ○ Artificial Intelligence (AI) ○ Digital twin ○ Building information modeling (BIM) ○ Geographic information system (GIS) ○ Life cycle analysis (LCA) ○ Data analytics ○ Not applicable / Don't know ○ Other
5.	Which of the following sustainability metrics does your company currently calculate or track? *(Select all that apply)*	○ Water withdrawal ○ Energy consumption (GWh) ○ Renewable energy consumption (%) ○ GHG emissions scope 1 and 2 (kilotons CO2e) ○ Total waste sent to landfill (kilotons) ○ Number of nationalities ○ Women in workforce (%) ○ Women in senior management positions (%) ○ Lost-time injury frequency rate ○ Average hours of training per year and employee ○ Employee engagement score ○ Community spending (volunteering) ○ Not applicable / Don't know ○ Other

Source: authors

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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As for the third phase of the Procedural diagram (Figure 1), the survey was distributed by one of the authors to 2409 participants via private LinkedIn messages and one public LinkedIn post in August-December 2025. As per Table 1, the questionnaire includes questions on the organization's demographics, such as company size (the primary interest is large companies with 250+ employees) and the regions in which the company operates (the primary interest is global companies - companies that operate in more than one continent - are considered global).
It is followed by questions related to RQ1 - digital transformation activities being implemented or successfully implemented in the past (as the primary interest is to figure out the pattern with the report results of 14 companies). Then RQ2 and RQ4 - sustainability metrics calculated within the companies (as the primary interest is to figure out the pattern with the report results of 14 companies). And finally, about the RQ3 - pillars of sustainability that the company engages in (as the primary interest is all three triple bottom line pillars).

The main focus of phase four is on developing the structural model for the PLS-SEM (Figure 2). Partial least squares structural equation modeling (PLS-SEM) is chosen and relevant for understanding complex interactions among AI and SEI, AI and SMII, and SEI and SMII (Y. Chen et al., 2024). PLS-SEM analysis method, which is commonly found in the social sciences research, allows researchers to assess the relationships among latent variables, also the direct and indirect effects between variables by performing calculations with SmartPLS software, which is considered reliable by the scholars (Salam et al., 2017; Gelashvili et al., 2022).

First, artificial intelligence (AI) is used as an independent variable, and the triple bottom line pillars serve as a sustainability engagement index (SEI), followed by the sustainability metric index (SMII). Second, the company size (LARGE_COMPANY) and operating across more than one continent (GLOBAL) are treated as latent variables.

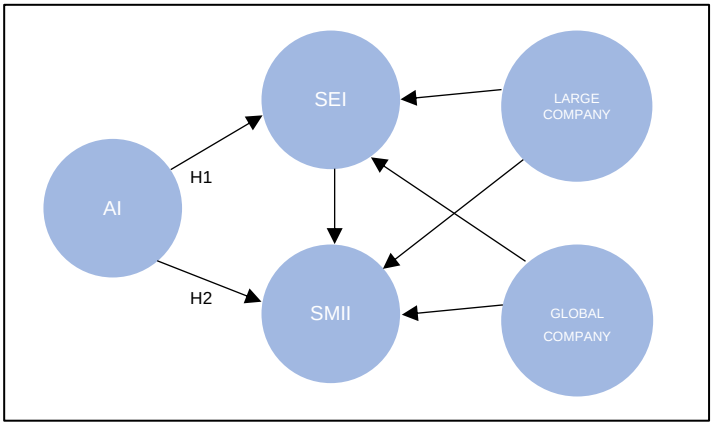


Figure 2. Structural model of the PLS-SEM.
Source: authors

In this research, SmartPLS 4 software and the PLS-SEM method are used to analyze data from 106 respondents, as PLS-SEM is sufficient for small sample sizes (100-150) (Saeed et al., 2019). First, the data is manually cleaned in the Excel spreadsheet by assigning binary values to each variable: 1 is assigned as “yes” and 0 is assigned as “no”. The separate columns are created in order to indicate whether the organization has engaged in activities related to environmental, social, or economic sustainability or only two, one or none of triple bottom line activities.
The numerical values are also assigned to the sustainability metric results (12 variables), each are listed as a separate column with binary values as well. New columns are created with calculated sums for SEI and SMII each by using the previously mentioned simplification of data by assigning binary values and creating separate columns. The cleaned data were loaded into SmartPLS, and latent variables and connections were assigned, allowing the use of the calculation function (with standard parameters).

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The last phase (phase five) is closely related to the bootstrapping function used for non-normal data and to testing the hypotheses (H1 and H2) (Sadeli et al., 2023). According to the standardized path coefficient (β), values greater than zero indicate a positive effect, values less than zero indicate a negative effect, and values equal to zero indicate no effect (Salam et al., 2017). According to the p-value, results are statistically significant if the p-value is < 0.05; if > 0.05, the data is statistically insignificant (Sadiq, 2022).

5. Results and Discussion

According to the results for RQ1, artificial intelligence is the most commonly used digital transformation tool across 14 global supply chain companies analyzed from the Fortune 500 list and the content analysis of their 103 integrated, annual, or sustainability reports from 2020 to 2024 (Figure 3). Digital twin, data analytics, and Internet of Things follow it. These results are similar to the literature analysis that is based on publication data from the databases of Web of Science Core Collection and Scopus.

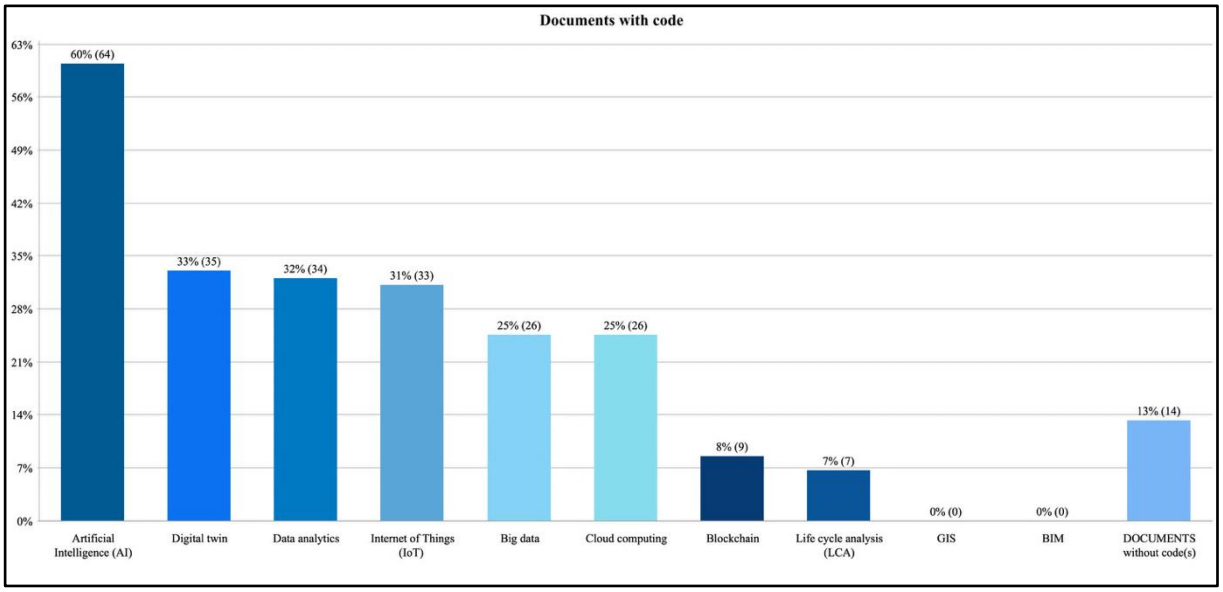


Figure 3. The most commonly mentioned digital technologies within Fortune Global 500 Industrial companies.
Source: authors'

Based on the survey results of 106 participants, the second most common digital transformation tool is also artificial intelligence (Figure 4). Contrary to the Fortune 500 company report analysis, the most common DX tool is data analytics, followed by artificial intelligence, the internet of things, and cloud computing. The difference may be that the company develops reports for external use and is influenced by institutional pressures and a strategic perspective. At the same time, company employees answer the surveys and may provide insights from a more personal perspective.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/j5529249258

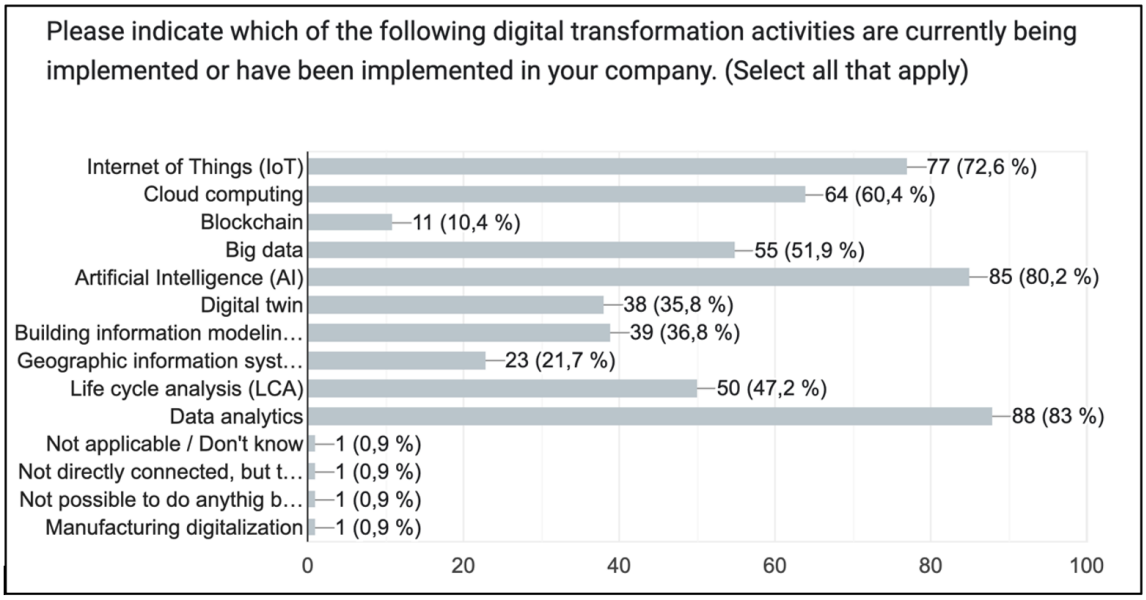


Figure 4. The most commonly used digital transformation tool.
Source: authors

As per RQ2, the greenhouse gas (GHG) emission scope 1 and scope 2 calculations (environmental pillar of three bottom line) are the most common sustainability metrics across 14 global supply chain companies analyzed from the Fortune 500 list and the content analysis of their 103 integrated, annual, or sustainability reports from 2020 to 2024 (Figure 5). It is followed by employee engagement (social pillar), community spending – volunteering (social pillar), and water withdrawal (environmental pillar).

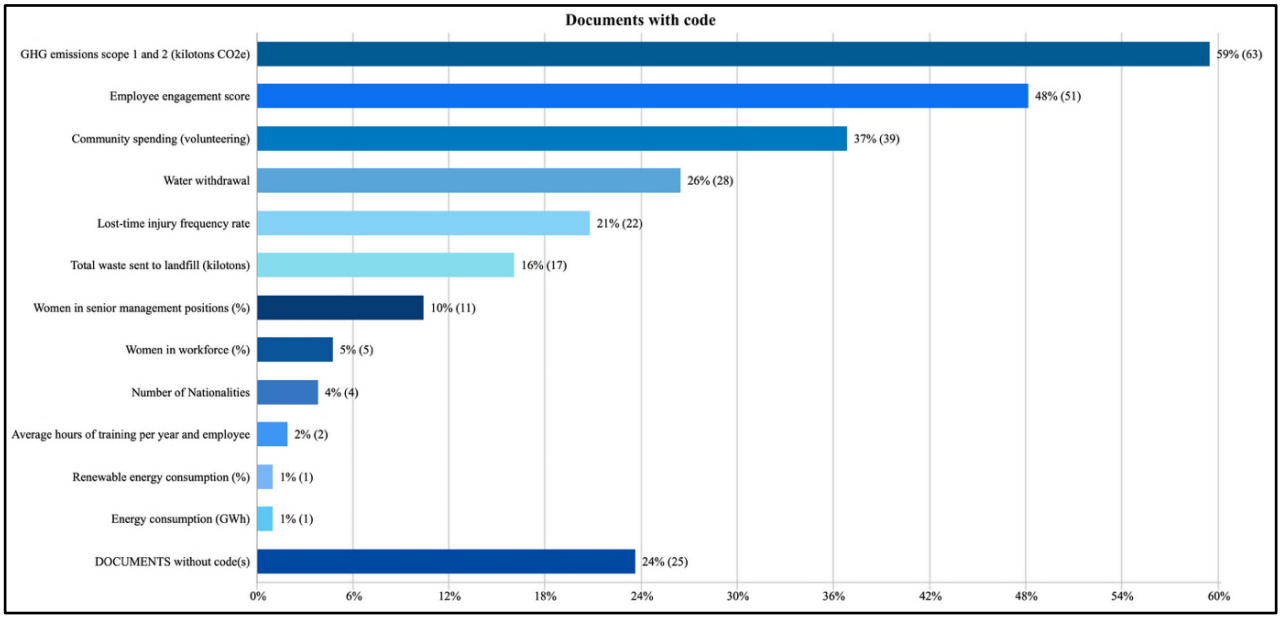


Figure 5. The most commonly mentioned sustainability metrics within Fortune Global 500 Industrial companies.
Source: authors

Based on the survey results of 106 participants, the fifth most common sustainability metric is GHG emissions calculation (Figure 6). Contrary to the Fortune 500 company report analysis, the most common sustainability metric is energy consumption (GWh), followed by the percentage of women in the workforce and employee engagement score.

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2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/j5529249258

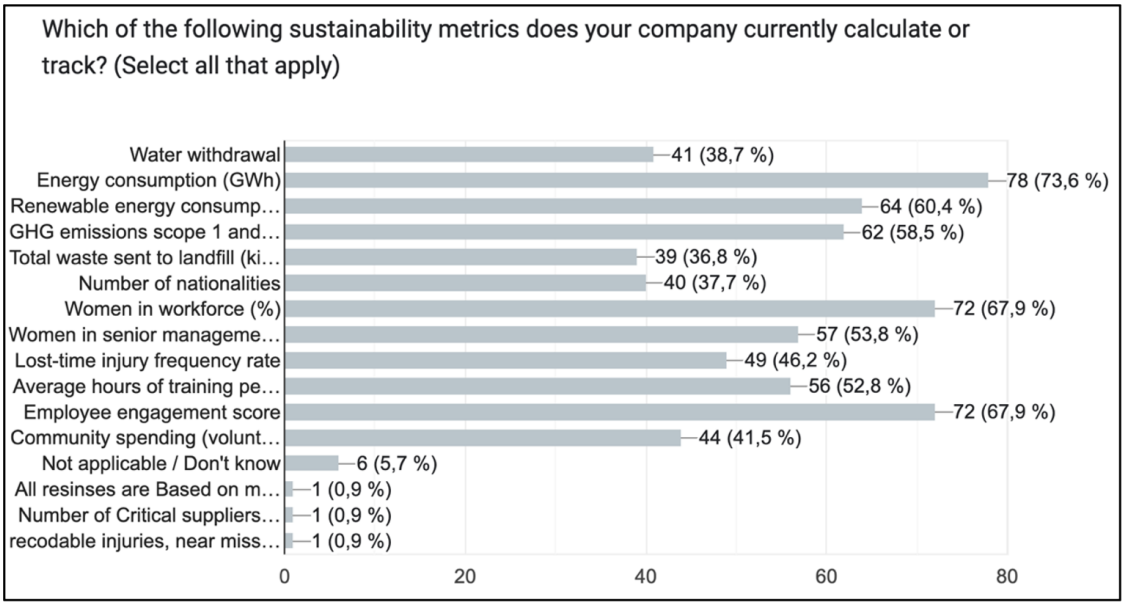


Figure 6. The most commonly used sustainability metrics.
Source: authors

As per RQ3, the survey participants indicate that the environmental pillar is the most common that their company engages in (Figure 7). It may be related to the perception that sustainability is sometimes tied only to environmental issues, while the social and economic pillars may not always be considered as common.

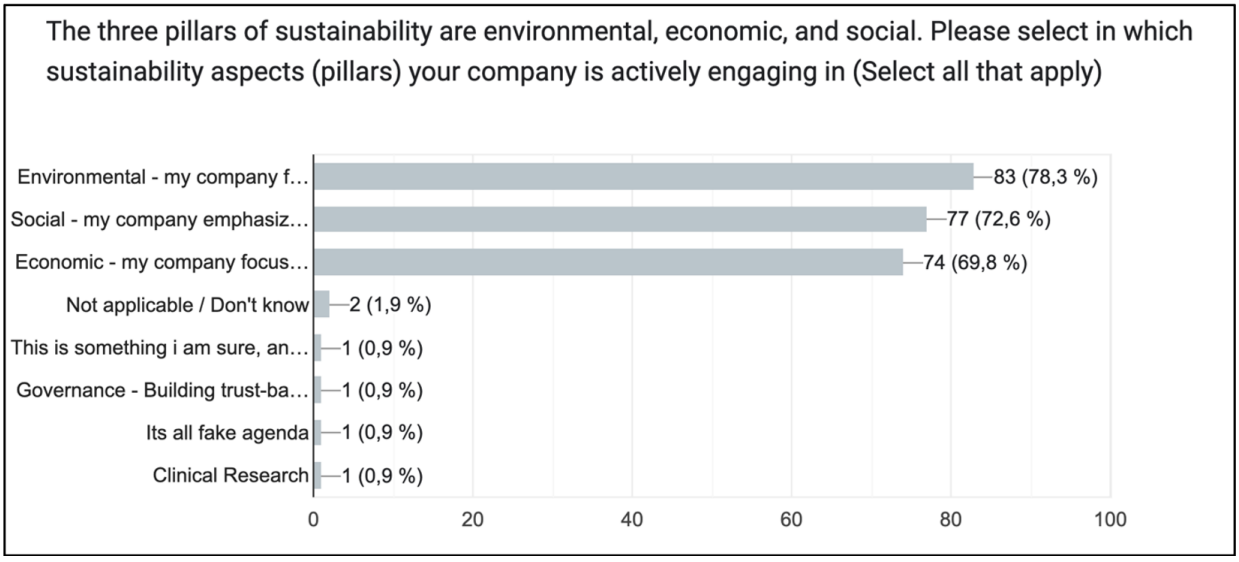


Figure 7. The company's engagement in the sustainability aspects (pillars).
Source: authors

The collected data were loaded into SmartPLM, and the results indicate several relationships among the variables (Figure 8, Table 2). First of all, artificial intelligence (AI) and the sustainability engagement index (SEI) show a positive ($\beta = 0.663$), statistically significant relationship ($p = 0.006$), as the standardized path coefficient is greater than zero and the p-value is less than 0.05. This supports the H2 hypothesis that AI, when implemented within a global supply chain company, positively impacts sustainability engagement by strategically raising awareness of all three pillars. Also, this relates the findings to the Institutional theory and Resource orchestration theory.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/j5529249258

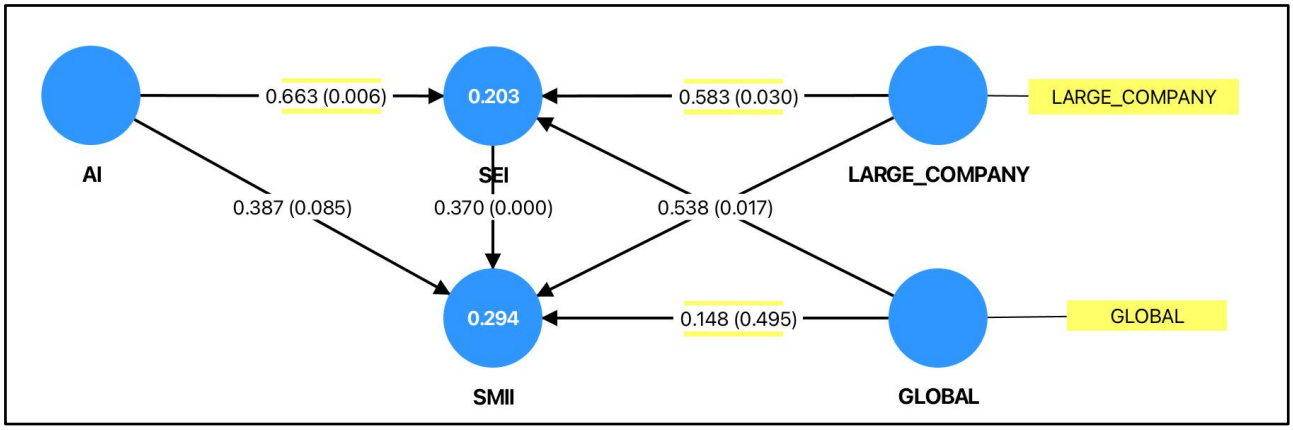


Figure 8. Structural model of the PLS-SEM with calculated results.
Source: authors

Also, there is a positive effect (β = 0.370) and a significant relationship (p = < 0.001) between the sustainability engagement index (SEI) and the sustainability metric index (SMII) in global supply chain companies. Large-sized (>250 employees) companies (LARGE_COMPANY) and the sustainability engagement index (SEI) show a positive effect (β = 0.583) and a significant relationship (p = 0.030). This could be explained by the greater resources in large companies, which also aligns with the Resource orchestration theory. Similarly, large-sized companies (LARGE_COMPANY) and the sustainability metric index (SMII) show a positive effect (β = 0.566) and a significant relationship (p = 0.027). Also, companies operating in more than one continent (GLOBAL) and the sustainability engagement index (SEI) also show a positive effect (β = 0.538) and a significant relationship (p = 0.017), this may also be explained by higher variety and availability of resources.

Table 2. Calculated results of structural path, values, and results interpretation.

Structural path	β -value	t-value	p-value	Results intepretation
AI -> SMII	0.387	1.722	0.085	Positive effect, not significant (H1 not supported)
AI -> SEI	0.663	2.729	0.006	Positive effect, significant (H2 supported)
SEI -> SMII	0.370	3.965	<0.001	Positive effect, significant
LARGE_COMPANY -> SEI	0.583	2.166	0.030	Positive effect, significant
LARGE_COMPANY -> SMII	0.566	2.219	0.027	Positive effect, significant
GLOBAL -> SEI	0.538	2.380	0.017	Positive effect, significant
GLOBAL -> SMII	0.148	0.682	0.495	Positive effect, but not significant

Source: authors

Although there is a positive effect (β = 0.387), the relationship between artificial intelligence (AI) and the sustainability metric index (SMII) is insignificant (p = 0.085) among global supply chain companies. Therefore, H1 is also not supported: AI, if implemented within the company, may not positively impact the use of sustainability metrics at the operational level of the supply chain company, and there is insufficient empirical evidence for the Dynamic Capabilities Theory; therefore, the theory cannot be supported by using this dataset. Moreover, companies operating in more than one continent (GLOBAL) and the sustainability metric index (SMII) show a positive effect (β = 0.148). Still, the relationship is insignificant (p = 0.495); this may be due to differences in regulations across continents, so the operational measurement is not as standardized as general awareness of sustainability.

Therefore, future studies may conduct more in-depth analyses of why implemented artificial intelligence enhances sustainability awareness at the strategic level but does not have a significant impact on sustainability

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
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metric usage at the operational level within large global supply chain companies. This may raise questions for other researchers about strategic-operational differences in the sustainability aspects of AI use in supply chain companies, particularly regarding the implementation gap in sustainability metrics.

Conclusions

As there is no clear consensus on digital transformation and sustainability metrics measurement (operational level) and sustainability awareness (strategic level) within large global supply chain companies, this study aims to analyze the impact of implemented artificial intelligence technology on sustainability metrics and triple bottom line awareness. As two hypotheses are tested and four research questions are answered, the study concludes with the confirmed hypothesis (H2) that implementing AI within a global supply chain company has a positive impact on sustainability engagement in the triple bottom line pillars of environmental, social, and economic aspects.

From a theoretical perspective, this aligns with Institutional theory, given the high external pressures on large and global companies from both stakeholders and competitors. Also, as large international companies tend to have better access to various resources, they can allocate them to topics such as AI implementation and increased sustainability awareness, in line with the Resource Orchestration theory. The main contribution of the study is the empirical identification of strategic and operational differences: AI significantly influences strategic sustainability awareness but shows no statistically significant influence on operational sustainability metrics.
This study can also provide directions for future analysis, as the empirical results suggest that artificial intelligence is the most commonly used digital transformation tool among Fortune 500 global supply chain companies, and these results are consistent with the literature. However, the survey of 106 participants found that it is the second-most-common digital transformation tool, behind data analytics. Future investigators may analyze the differences, as they may provide explanations for the differences between the company-developed reports for external use, which are influenced by institutional pressures and a strategic perspective, and the employees' survey responses, which may offer insights from a more personal perspective.

Also, there are differences between the company's reported sustainability metrics and those of survey participants, which could be further analyzed. As per the company's integrated, annual, and sustainability reports, the greenhouse gas (GHG) emissions calculations (the environmental pillar of the triple bottom line) are the most common metrics. At the same time, the survey results suggest that GHG emissions calculation is only the fifth most common sustainability metric. Contrary to the company report analysis, the most common sustainability metrics are energy consumption, the percentage of women in the workforce, and employee engagement score. This may suggest that the specifics of greenhouse gas calculation are more within the sustainability expert’s responsibility, rather than broader topics such as gender- and employee-related matters or technical and environmental aspects that are more evident within the company, such as energy use in offices or manufacturing facilities.

Moreover, the results of the PLS-SEM analysis indicate that there may be even more opportunities for further research, as a positive effect and significant relationship exist between the sustainability engagement index and the sustainability metric index in global supply chain companies, which could be further explained by other empirical studies focusing solely on the sustainability matters. Large companies and the sustainability engagement index show a positive relationship and a significant association, which may stem from the requirement to disclose sustainability performance under country- or regional-level regulations, as well as from more employees focusing on such topics as their primary function. This could be further explored by analyzing not only from the standpoint of Institutional theory and Resource orchestration theory, but also including other theories. As this study uses PLS-SEM as the primary analysis method, an alternative, such as Bayesian structural equation modeling (BSEM) for complex models and small samples, could be suggested instead (Q. Chen et al., 2024).

From a managerial perspective, the study could provide valuable insights to top management and their decision-making on resource utilization regarding digital technologies, such as AI implementation, and the expectation that it will positively affect their sustainability metrics, which may not be the case. Therefore, managers should

allocate additional resources specifically to sustainability metric calculations rather than expecting sustainability awareness to yield the actual results. Also, the company reports do not always indicate the most commonly used digital transformation technologies, or at least some employees may not be aware of their use, or they may be used only fragmentarily, even though a lot of attention is given to external communication, probably due to external pressures of the stakeholders and by seeking a competitive advantage. Therefore, employees should also be given specific training and information on their management's preferred adoption of novel technologies. This study is subject to several limitations as well. By focusing only on large, global supply chain companies, future studies may include companies of different sizes (micro, startups, small or medium), and more regional companies (focusing only on one operating region instead of global, for instance, Europe), and from other industries (e.g., services or consulting). Also, the survey data collection may be considered limited, as the response rate was 4,4% (103 participants out of 2409 sent requests). This could be solved in future studies by conducting a more widespread study of a broader population, rather than focusing solely on large and global supply chain companies. As this study exclusively focused on AI, as the solely digital transformation technology, other technologies (for instance, data analytics, the internet of things, BIM, GIS, robotics, automation, and virtual and augmented reality), could be researched in relation to sustainability awareness and metrics in the future.

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ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/j5529249258

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Author Contributions: Conceptualization: *G.R.*; methodology: *G.R.*; data analysis: *G.R.*; writing—original draft preparation: *G.R.*; writing; review and editing: *I.M.-K.* visualization: *G.R.* All authors have read and agreed to the published version of the manuscript.

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ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/e7422395924

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DRIVERS OF SELF-REPORTED AND HYPOTHETICAL TAX EVASION BEHAVIOUR: EVIDENCE FROM SLOVAKIA*

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Received 25 February 2026; accepted 26 April 2026; published 30 June 2026

Abstract. The study examines the socio-demographic and experience-related determinants of tax evasion behaviour, distinguishing between self-reported past engagement in tax evasion and hypothetical willingness to engage in tax evasion. Adopting a behaviour perspective, the analysis integrates experience-related factors with socio-demographic characteristics to better understand individual-level tax evasion behaviour beyond purely legal or institutional explanations. Primary data were collected through a questionnaire survey conducted in Slovakia. After data cleaning, responses from 423 respondents were retained for the analysis using a series of binary logistic regression models. The results show that self-reported tax evasion is significantly associated with gender, income level, entrepreneurial experience, and prior exposure to tax audits. In contrast, hypothetical willingness to evade taxes is only weakly related to these factors. When past tax evasion behaviour is included in the scenario-based model, it emerges as a strong predictor of future willingness to engage in tax evasion. This indicates notable differences between the determinants of actual and hypothetical tax evasion behaviour. By distinguishing between past behaviour and scenario-based responses, this study provides evidence that experience-related factors play a role in shaping tax evasion behaviour at the individual level. The findings contribute to the literature on tax compliance by highlighting the importance of behavioural history and by demonstrating that hypothetical measures may not fully reflect real-world tax evasion behaviour.

Keywords: tax evasion; experience; socio-demographic factors; scenario-based tax evasion

Reference to this paper should be made as follows: Kušnírová, D., Malichová, E., Tokarčíková, E., Klinovský, O. 2026. Drivers of self-reported and hypothetical tax evasion behaviour: evidence from Slovakia. *Entrepreneurship and Sustainability Issues*, 13(4), 367-380. http://doi.org/10.9770/e7422395924

JEL Classifications: H26, H24, D91

1. Introduction

Tax evasion remains a long-standing problem of tax systems across countries and continues to attract attention in academic research. Despite improvements in tax administration, enforcement and transparency, non-compliance has not disappeared and often takes forms that are closely linked to individual attitudes, perceptions, experiences, and decision-making processes. According to the Global Tax Evasion Report (2024), tax evasion persists in various forms at the individual level even in settings characterized by enhanced reporting

* *This article was written with the support of the Scientific Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic under project VEGA No. 1/0112/25: SHARECOM – Exploring the potential uses and effects of the sharing economy in businesses.*

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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requirements and formal enforcement mechanisms. This indicates that compliance behaviour cannot be fully explained by legal or institutional factors alone.

Importantly, tax evasion should not be understood solely as a technical or legal violation, but rather as a behavioural outcome shaped by how taxpayers perceive and experience taxation. Individuals' willingness to comply is influenced by attitudes toward tax obligations, perceptions of fairness and complexity, and beliefs about the behaviour of others. Existing research initially emphasized audits, penalties, and detection probabilities as the primary determinants of tax compliance (Joskova, Finardi & Arltova, 2023).

More recent studies, however, incorporate behavioural and psychological perspectives, including the roles of social norms and psychological reactance (Anggraini, Sholihin & Rakhman, 2025).

Experience-related factors, such as familiarity with tax procedures, repeated exposure to filing requirements, and prior interactions with tax authorities, have received relatively limited attention in studies of tax evasion behaviour. Taxpayers differ substantially in the extent to which they understand tax rules, feel confident navigating administrative processes, or perceive tax obligations as predictable and manageable. While experience may reduce uncertainty and unintentional non-compliance, it may also shape strategic behaviour, tolerance toward non-compliance, or resistance to perceived administrative burdens. The behavioural implications of taxpayer experience, therefore, remain ambiguous and insufficiently explored, especially when considered alongside socio-demographic characteristics and psychological mechanisms.

Motivated by these gaps, this study examines tax evasion behaviour from a behavioural perspective that integrates experience-related factors with socio-demographic characteristics and established theoretical frameworks. The study further distinguishes between self-reported past tax evasion and hypothetical willingness to engage in tax evasion, allowing for a comparison between actual and potential non-compliant behaviour. By focusing on how taxpayers' accumulated experience with the tax system influences attitudes, perceptions, and behavioural intentions, the paper seeks to contribute to a more nuanced understanding of tax evasion as a behavioural phenomenon. Rather than addressing tax evasion in terms of fiscal outcomes, the study emphasizes individual-level behaviour and provides insights into how experience shapes compliance-related decisions, with implications for future research on tax behaviour.

To ensure conceptual clarity, the key forms of tax evasion behaviour examined in this study are defined as follows. Self-reported tax evasion behaviour refers to individuals' retrospective declaration of having engaged in tax evasion in the past, typically captured through survey-based measures, which may be subject to reporting biases and measurement limitations (Elffers et al., 1992).

In contrast, hypothetical tax evasion behaviour captures individuals' stated willingness to engage in tax evasion in a scenario-based context, reflecting behavioural intentions rather than actual past conduct. Such measures allow researchers to isolate attitudinal and situational influences on tax compliance and are consistent with behavioural approaches that conceptualise tax evasion as a social dilemma shaped by psychological and social factors (Elffers et al., 1992; Webley et al., 2001).

Prior research suggests that these measurement approaches capture different dimensions of tax evasion, with limited overlap between self-reported and intention-based behaviour (Elffers et al., 1992; Devos & Argan, 2019). Moreover, self-reported data may diverge from actual behaviour due to concealment and institutional factors, including the increasing role of third-party reporting (Gerritsen, 2025).

This multidimensional perspective is further supported by recent research highlighting the role of social norms, enforcement mechanisms, and psychological factors in shaping tax compliance behaviour (Besley et al., 2023; Campos-Vazquez et al., 2023; Løyland et al., 2023; Leisge et al., 2024).

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2. Theoretical background

2.1 Tax evasion behaviour

Tax evasion and tax avoidance have intensified globally in recent years, becoming a pressing concern for tax authorities and policymakers worldwide (Hossain et al., 2024). This phenomenon has attracted considerable public and academic attention, as it poses significant challenges to the effectiveness and fairness of tax systems across countries (Kirchler, 2007; Carvalho & Ávila, 2022). Individuals may reduce their tax liabilities through two fundamentally different approaches. The first is tax avoidance, which involves legally permissible strategies such as income splitting or the deferral of tax payments. The second is tax evasion, which refers to deliberate and illegal actions undertaken to reduce legally owed tax obligations (Alm, 2012; Lee et al., 2015; Rodríguez, 2022). Distinguishing between these two practices is essential, as emphasised by Hasseldine and Morris (2013), who highlight that the determination of the legality of tax avoidance activities is a critical issue in both tax administration and enforcement.

The substantial growth of tax evasion has generated serious concerns about its harmful implications for the integrity and credibility of tax systems (Kumar et al., 2025). As argued by Stiglitz in the Global Tax Evasion Report 2024, tax evasion and tax avoidance more broadly are not an unavoidable phenomenon, but rather a consequence of deliberate policy choices or the absence of effective policy interventions aimed at curbing such practices. Stiglitz further emphasises that when citizens perceive the tax system as unfair, particularly if they believe that not all taxpayers contribute their fair share, their willingness to comply with tax obligations diminishes, potentially leading to a broader rejection of taxation (Stiglitz et al., 2024).

Existing academic research indicates that higher levels of tax complexity are closely linked to increased tax non-compliance. However, the majority of this literature focuses primarily on the behaviour of individual taxpayers, leaving other dimensions of non-compliance relatively underexplored (Taing & Chang 2020; Blaufus et al., 2019; Hassan et al., 2021).

An important theoretical framework for predicting taxpayer compliance is Psychological Reactance Theory (PRT). The theory posits that individuals possess a set of behavioural freedoms, which are recognised as such only when individuals are aware of their existence and believe they are able to exercise them. When these freedoms are restricted or removed, individuals experience psychological reactance. It is a motivational state that prompts efforts to resist the restriction or to restore the threatened freedom. In the context of tax compliance and avoidance, Kirchler (1999) demonstrates that less experienced business owners perceive tax obligations as a greater threat to their freedom than more experienced counterparts, and that this perceived loss of freedom is positively related to intentions to legally avoid or reduce taxes. Such reactance may influence taxpayers to act against tax administration in unethical or illegal ways, such as evading taxes (Falsetta & Spilker 2025). More broadly, tax evasion behaviour can be viewed as one manifestation of taxpayers' resistance to established tax collection mechanisms (Wahyuni et al., 2019). Tax evasion behaviours are shaped by cross-country differences in cultural norms, legal frameworks, and economic conditions, which influence how taxpayers perceive and respond to tax obligations (Saptono et al., 2024; Kanagaretnam, Lee & Lobo, 2024). Tax evasion may take several forms and they include: understatement of income, no submission, overstatement of deductions and failure to pay taxes by the due date (McGee et al., 2022).

Also, tax morale has a significant positive effect on tax compliance behaviour (Prieger, 2023). Tax morale can be defined as the collective attitude of a group or an entire population of taxpayers toward the fulfilment or neglect of their tax obligations (Kirchler, 2007). Kirchgässner (2011) argues that low levels of tax morale are associated with reduced tax compliance.

Recent empirical research further emphasises that tax evasion behaviour is influenced by a combination of social, psychological, and institutional factors. Social norms and enforcement mechanisms play a key role in shaping compliance decisions (Besley et al., 2023), while perceptions of inequality and the behaviour of high-income individuals may significantly affect taxpayers' willingness to comply (Campos-Vazquez et al., 2023). At the same time, experimental and behavioural studies highlight the importance of individual-level psychological traits and the stability of dishonest behaviour across contexts (Leisge et al., 2024). In addition,

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evidence from tax enforcement settings suggests that audits and monitoring mechanisms can lead to significant behavioural adjustments in subsequent tax reporting (Løyland et al., 2023).

2.2 Socio-demographic factors

Socio-demographic characteristics represent an important dimension in explaining differences in tax evasion and tax compliance behaviour. A wide range of studies suggests that individual attributes such as gender, age, education, income, and occupation influence taxpayers' attitudes toward taxation, their moral evaluations, and their willingness to comply. For instance, Devos (2008) provides early empirical evidence that demographic variables are significantly related to taxpayers' attitudes toward tax evasion, indicating that compliance behaviour varies systematically across population groups.

More recent research continues to support the relevance of these factors, particularly through behavioural and psychological perspectives. Falsetta and Spilker (2025) demonstrate that individual characteristics—including age, education, income, and professional experience—shape taxpayers' psychological reactions to tax administration practices, which subsequently affect their intentions to evade taxes. Evidence from developing and transition economies also points to the importance of socio-demographic influences. Muharremi et al. (2022) show that gender, education, employment status, and residential characteristics systematically influence ethical perceptions of tax evasion, with women and more educated individuals generally expressing lower acceptance of tax evasion compared to men and less educated groups.

At the institutional and cross-country level, Carvalho and Ávila (2022) argue that tax evasion cannot be fully understood without considering the underlying socio-economic structure of taxpayer populations, including income levels and occupational composition. Complementing this view, Holkova et al. (2023) find that socio-demographic factors such as gender, age, education, and income source significantly influence tax morale and the tendency toward tax evasion, with women, older individuals, and more educated taxpayers generally exhibiting higher tax ethics.

Finally, large-scale evidence from a meta-analysis by Hofmann et al. (2017) suggests that while the direct effects of age, gender, education, and income on tax compliance are modest, these variables consistently contribute to explaining variation in compliance across countries and regions. As such, socio-demographic characteristics remain an important control in empirical studies of tax compliance and evasion.

2.3 Experience-related factors

Experience-related factors represent a significant yet often overlooked determinant of tax evasion behaviour, as repeated interactions with the tax system shape taxpayers' knowledge, expectations, and behavioural strategies. Through ongoing engagement with tax filing procedures, audits, and administrative requirements, taxpayers accumulate practical experience that shapes their understanding of tax obligations and enforcement mechanisms. This accumulated experience affects not only the technical understanding of tax rules but also broader attitudes toward compliance and evasion.

Evidence from behavioural and ethical perspectives regarding experience influences tax-related attitudes further highlights the learning dimension of tax evasion. McGee et al. (2022) emphasise that attitudes toward tax evasion are shaped not only by economic incentives but also by taxpayers' prior exposure to tax systems, institutional arrangements, and social norms, suggesting that acceptance of evasion may develop through experience over time. Similarly, Devos (2008) argues that taxpayers' previous encounters with taxation contribute to the formation of stable attitudes toward compliance and evasion, reinforcing the role of experience-based learning in tax behaviour.

More recent empirical work links experience directly to psychological mechanisms underlying tax evasion. Falsetta and Spilker (2025) show that work experience and familiarity with tax administration practices influence taxpayers' psychological reactance, which in turn affects intentions to evade taxes. Their results indicate that less experienced individuals respond more strongly to perceived administrative burdens or restrictions, while experienced taxpayers are more likely to adopt calculated and strategic responses based on prior outcomes.

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Insights from the broader literature on experience and decision-making provide additional support for these findings (Putra & Ali, 2022). Mahaputra (2022) argues that experience functions as a form of practical knowledge that guides decision-making in complex and rule-intensive environments, particularly under conditions of uncertainty. Applied to taxation, this perspective implies that taxpayers rely on past experiences, such as audits, penalties, or successful non-detection, when evaluating risks and choosing between compliance and evasion.

Based on the findings of existing research, this study focuses on the influence of socio-demographic factors: gender, age, education, income, and occupation on tax evasion behaviour. In addition, we examine whether these factors also affect scenario-based tax evasion behaviour, that is, both actual and potential behaviour leading to tax evasion. Furthermore, the study investigates whether prior engagement in tax evasion influences future behaviour (Figure 1).

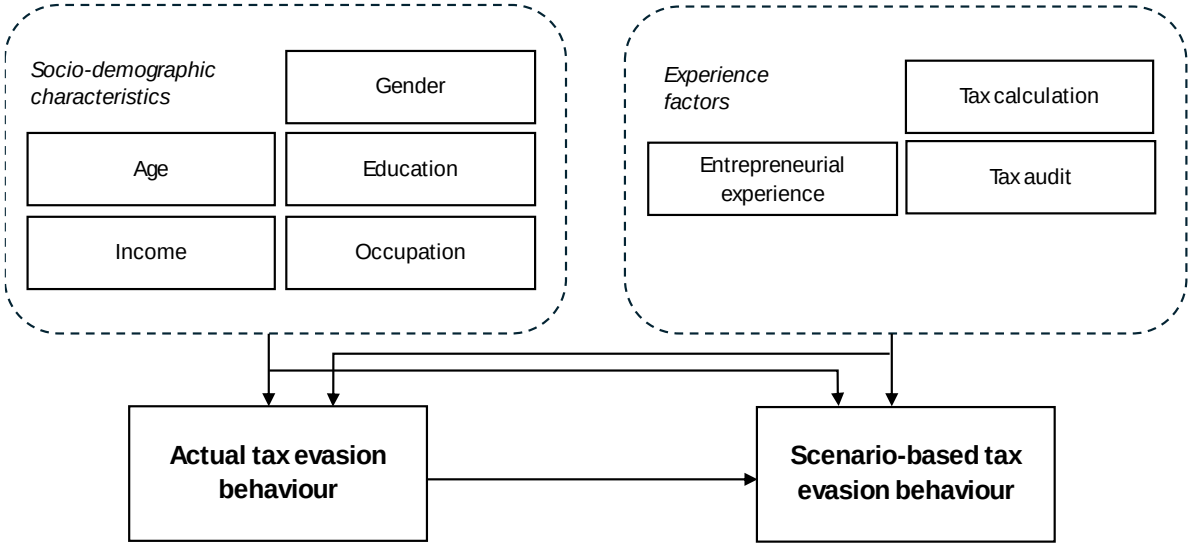


Figure 1. Conceptual diagram of potential determinants of tax evasion behaviour.
Source: own processing

2.4 Hypotheses development

Building on the theoretical and empirical literature, this study formulates a set of hypotheses regarding the relationship between socio-demographic and experience-related factors and tax evasion behaviour. Gender has been consistently associated with differences in risk preferences and tax morale, with prior research suggesting that men exhibit higher tolerance for risk and lower compliance levels compared to women (Holkova et al., 2023; McGee et al., 2022).

Therefore:
H1: Men are more likely to engage in tax evasion than women.
Income is often linked to both opportunity and incentives for tax evasion. Higher-income individuals may have greater opportunities to conceal income or exploit tax system complexity (Alm, 2012). Thus:
H2: Higher income is positively associated with the likelihood of tax evasion.
Entrepreneurial activity is characterised by higher autonomy and discretion in financial reporting, which may increase opportunities for non-compliance. Previous studies suggest that entrepreneurs face more complex tax obligations and may engage in strategic tax behaviour (Devos, 2008). Therefore:
H3: Individuals with entrepreneurial experience are more likely to engage in tax evasion.
Prior interaction with tax authorities, particularly tax audits, may influence subsequent behaviour through learning or adaptation mechanisms. While audits may deter evasion, they may also lead to strategic adjustments based on perceived enforcement effectiveness (Kirchler, 2007). Given the ambiguous theoretical expectation:
H4: Prior experience with tax audits is associated with tax evasion behaviour.

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Finally, behavioural theories suggest that past behaviour is a strong predictor of future behaviour due to habit formation and reduced psychological barriers (Wahyuni et al., 2019). Therefore:
H5: Individuals who have previously engaged in tax evasion are more likely to engage in tax evasion in hypothetical scenarios.

3. Methodology

The aim of this paper is to analyse the socio-demographic and experience-related factors influencing self-reported tax evasion behaviour and to examine whether these factors also predict scenario-based willingness to engage in tax evasion. To achieve this objective, primary data were collected using a structured questionnaire survey conducted in Slovakia. The questionnaire was designed to capture respondents' attitudes towards taxation and their compliance with tax obligations. The survey instrument consisted of four main sections: socio-demographic information, respondents' personal experience of taxation-related situations and their tax-related knowledge, tax morality and perceived tax burden and respondents' willingness to improve their tax compliance behaviour. For the purpose of this analysis, selected items from the questionnaire were used. The questionnaire items, their wording, the response options and the procedures applied to recode and prepare the variables for the analysis are provided in the Appendix. The questionnaire design was informed by prior research on tax compliance and behavioural taxation (Kirchler, 2007; Devos, 2008). Items capturing socio-demographic and experience-related variables follow standard measurement approaches used in empirical tax behaviour studies. The scenario-based question was designed to approximate a common real-world transaction involving informal payments and was conceptually aligned with experimental approaches used in tax compliance research (Alm, 2012).

While the specific scenario has not been directly validated in prior studies, it reflects a widely documented form of informal economic activity and allows for the assessment of behavioural intentions in a controlled context. After data cleaning, responses from 423 respondents were retained for the analysis (questionnaire items used in the research are provided in Annex). Table 1 shows, the sample of respondents was almost gender balanced. Regarding age, the largest share of respondents was aged between 18 and 30 years, followed by those aged 46–60 years. In terms of education, 10.6% of respondents had basic education, 50.6% had secondary education, and 38.8% had tertiary education. With respect to occupation, most respondents were employed (52.5%), followed by students (24.1%), entrepreneurs (11.3%), retirees (8.7%), and unemployed individuals (3.3%) (Table 1).

Table 1. Sample characteristics (N=423)

Characteristics	Frequencies
Gender	49.6% man; 50.4% woman
Age	43.7% 18-30 years; 19.1% 31-45 years; 28.8% 46-60 years; 8.3% 61 and more
Education	10.6% Primary; 50.6% Secondary; 38.8% Tertiary
Occupation	52.5% Employed; 11.3% Entrepreneur; 3.3% Unemployed; 8.7% Retired; 24.1% Student

Source: Own processing

In line with the aim of the study, a series of binary logistic regression models were used to analyse the factors influencing actual tax evasion behaviour and hypothetical willingness to engage in tax evasion. Prior to model estimation, multicollinearity among the explanatory variables was assessed using variance inflation factor (VIF), with no evidence of problematic multicollinearity identified.

4. Results

Based on the responses from the survey, Figure 2 shows the distribution of respondents according to their self-reported tax evasion behaviour and their willingness to engage in tax evasion in a hypothetical scenario. It can be observed that more than 80% of respondents reported that they had never engaged in tax evasion. Only 1.62% of respondents admitted having committed tax evasion once, while 14.81% reported having done so repeatedly.

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However, the results of the scenario-based question show a substantially different outcome. More than 66% of respondents indicated a willingness to engage in tax evasion in the hypothetical situation, of whom over 27% said they would do so without hesitation. These findings suggest that self-reported tax evasion behaviour is considerably lower than scenario-based tax evasion behaviour. This discrepancy may indicate that respondents do not fully perceive the behaviour described in the scenario as tax evasion, or that they apply different standards when evaluating hypothetical situations.

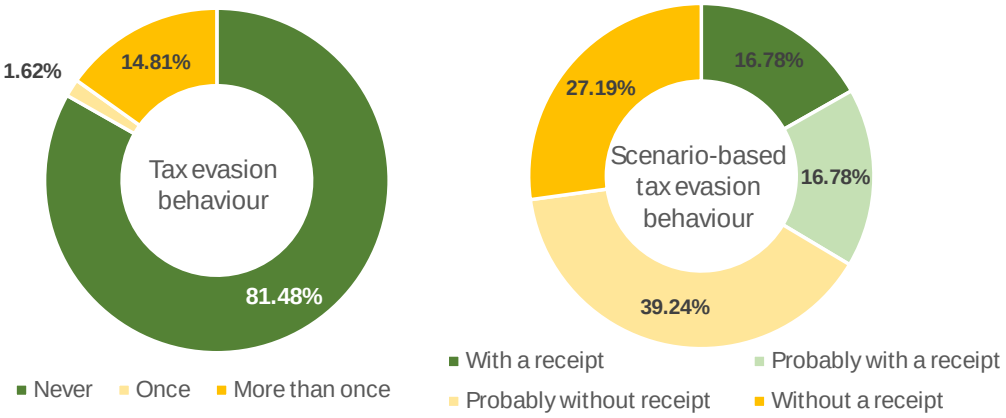


Figure 2. Actual and scenario-based tax evasion behaviour of respondents.
Source: Own processing

4.1 Tax Evasion

To test the proposed hypotheses (H1–H4), a logistic regression model was estimated to identify factors influencing respondents' engagement in tax evasion. The model was statistically significant ($\chi^2(14) = 60.274$, $p < 0.001$) and demonstrated an acceptable fit to the data (–2 Log Likelihood = 313.52; Cox & Snell $R^2 = 0.135$; Nagelkerke $R^2 = 0.228$). Four predictors were identified as statistically significant.

In line with H1, gender was identified as a significant predictor of tax evasion behaviour. The results indicate that men are significantly more likely to have engaged in tax evasion than women (Exp(B) = 2.799, p = 0.001). This finding may suggest that men, on average, exhibit lower tax morale and a higher tolerance for risk, which may increase their propensity to engage in tax evasion compared to women.

Consistent with H2, income was positively associated with the likelihood of tax evasion. To improve interpretability, income was rescaled by dividing its original values by 100. The results show that an increase in income of €100 is associated with a 4.6% increase in the odds of tax evasion (Exp(B) = 1.046, p = 0.013). Although the effect size is relatively small, it suggests that higher income slightly increases the likelihood of engaging in tax evasion.

In line with H3, entrepreneurial experience was identified as a significant predictor of tax evasion behaviour. Individuals who engage in entrepreneurial activity are more prone to tax evasion. The likelihood that entrepreneurs engage in tax evasion is three times higher compared to non-entrepreneurs (Exp(B) = 3.175, p = 0.040), which may be related to the greater discretion and complexity entrepreneurs face in managing their tax obligations. Entrepreneurial activity often involves more flexible income structures, higher autonomy in financial decision-making, and increased exposure to complex tax rules, which may create more opportunities for non-compliant behaviour.

Finally, individuals who have previously been subject to a tax audit exhibit almost three times higher odds of engaging in tax evasion compared to those without such experience (Exp(B) = 2.815, p = 0.007) (Table 2). In line with H4, prior experience with tax audits was associated with tax evasion behaviour. However, this relationship should be interpreted with caution, as it may reflect reverse causality, given that individuals who engage in tax evasion are more likely to be subject to tax audits.

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Table 2. Binary Logistic Regression Results for Tax Evasion (N = 423).

Predictor	B	SE	Wald	Sig.	Exp (B)
Gender (men)	1.027	0.321	10.267	0.001	2.793
Age (18-30) ref. 60+			1.064	.0.786	
Age (31-45) ref. 60+	-.447	0.862	0.269	0.639	3.466
Age (46-60) ref. 60+	-.077	0.854	0.008	0.926	4.939
Education	-.434	0.803	0.292	0.648	3.128
Education (Primary) ref. tertiary			5.957	0.051	
Education (Secondary) ref. tertiary	0.933	0.487	3.665	0.056	2.542
Occupation	-0.179	0.331	0.292	0.589	0.836
Occupation (Employee) ref. student			1.251	0.870	
Occupation (Entrepreneur) ref. student	-0.134	0.532	0.063	0.801	0.875
Occupation (Unemployed) ref. student	-0.494	0.791	0.390	0.532	0.610
Occupation (Retiree) ref. student	-0.209	1.144	0.033	0.855	0.811
Age (18-30) ref. 60+	0.545	0.928	0.346	0.557	1.725
Income (100)	0.045	0.018	6.174	0.013	1.046
Entrepreneurial experience	1.155	0.561	4.233	0.040	3.175
Tax audit	1.035	0.382	7.322	0.007	2.815
Tax calculation	-0.333	0.371	0.804	0.370	0.717
Constant	-2.731	0.984	7.699	0.006	0.065
Chi Square (df) p	60.274 (14) .000				
-2 Log likelihood	313.518				
Cox & Snell R Square	0.135				
Nagelkerke R Square	0.228				

Source: Own processing

4.2 Scenario-Based Tax Evasion

To further examine whether the proposed relationships (H1–H4) hold in a hypothetical context, a second model was estimated to analyse factors predicting whether respondents would accept participating (knowingly or unknowingly) in tax evasion in a hypothetical car repair service scenario. The overall model was statistically significant ($\chi^2(14) = 24.20$, $p = 0.043$), but the model fit was weak (–2LL = 509.88; Cox & Snell $R^2 = .057$; Nagelkerke $R^2 = 0.078$). Among all predictors, only age reached overall significance ($\chi^2(3) = 10.31$, $p = 0.016$), although none of the individual age categories were statistically significant (Table 3). H3 was not supported in this model, as entrepreneurial experience did not significantly predict hypothetical tax evasion behaviour.

Table 3. Binary Logistic Regression Results for Scenario-Based Tax Evasion (N = 423).

Predictor	B	SE	Wald	Sig.	Exp (B)
Gender (men)	0.189	0.227	0.693	0.405	1.208
Age			10.314	0.016	
Age (18-30) ref. 60+	0.362	0.742	0.238	0.625	1.437
Age (31-45) ref. 60+	0.094	0.731	0.017	0.897	1.099
Age (46-60) ref. 60+	-0.619	0.691	0.802	0.371	0.539
Education			1.204	0.548	
Education (Primary) ref. tertiary	0.387	0.423	0.840	0.056	2.542
Education (Secondary) ref. tertiary	-0.052	0.235	0.292	0.589	0.836
Occupation			1.251	0.870	
Occupation (Employee) ref. student	0.555	0.392	2.008	0.156	1.742
Occupation (Entrepreneur) ref. student	0.422	0.634	0.443	0.506	1.525

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Occupation (Unemployed) ref. student	-1.203	0.650	3.423	0.064	0.300
Occupation (Retiree) ref. student	0.829	0.757	1.200	0.273	2.292
Income (100)	0.007	0.015	0.226	0.635	1.007
Entrepreneurial experience	-0.200	0.476	0.176	0.675	0.819
Tax audit	0.350	0.327	1.148	0.284	1.419
Tax calculation	-0.493	0.259	3.616	0.057	0.611
Constant	0.238	0.802	0.088	0.766	1.269
Chi Square (df) p	24.202 (14) .043				
-2 Log likelihood	509.879				
Cox & Snell R Square	0.057				
Nagelkerke R Square	0.078				

Source: Own processing

4.3 Scenario-Based Tax Evasion with Past Behaviour

To test H5 regarding the role of past behaviour in predicting willingness to evade taxes in a hypothetical situation, the variable from the first model was added to the scenario model. The inclusion of this variable substantially improved the model, which became strongly significant ($\chi^2(15) = 44.69$, $p < .001$). Model fit indicators improved considerably: –2LL decreased to 489.39, Cox & Snell R^2 increased to 0.102 and Nagelkerke R^2 to 0.141. This nearly doubles the explained variance compared to the model without prior behaviour. Supporting H5, prior engagement in tax evasion strongly predicts willingness to engage in tax evasion in a hypothetical scenario. Respondents who had engaged in tax evasion in the past had more than five times higher odds of accepting tax evasion in the scenario (Exp(B) = 5.459, $p < 0.001$). No other factors were identified as significant at the 95% confidence level (Table 4).

Table 4. Binary Logistic Regression Results for Scenario-based Tax Evasion with past behaviour (N = 423).

Predictor	**B**	**SE**	**Wald**	**Sig.**	**Exp (B)**
Gender ref. women	0.030	0.234	0.016	0.899	1.030
Age			10.131	0.017	
Age (18-30) ref. 60+	0.536	0.787	0.464	0.496	1.709
Age (31-45) ref. 60+	0.169	0.775	0.048	0.827	1.184
Age (46-60) ref. 60+	-0.506	0.730	0.481	0.488	0.603
Education			0.426	0.808	
Education (Primary) ref. tertiary	0.262	0.435	0.362	0.547	1.299
Education (Secondary) ref. tertiary	-0.006	0.240	0.001	0.981	0.994
Occupation			8.009	0.091	
Occupation (Employee) ref. student	0.646	0.398	2.639	0.104	1.909
Occupation (Entrepreneur) ref. student	0.570	0.663	0.740	0.390	1.768
Occupation (Unemployed) ref. student	-1.234	0.663	3.469	0.063	0.291
Occupation (Retiree) ref. student	0.873	0.797	1.200	0.273	2.393
Income (100)	-0.003	0.015	0.034	0.853	0.997
Entrepreneurial experience	-0.501	0.509	0.970	0.325	0.606
Tax audit	0.140	0.339	0.171	0.680	1.150
Tax calculation	-0.469	0.263	3.176	0.075	0.625
Tax evasion experience	1.697	0.427	15.773	0.000	5.459
Constant	0.077	0.841	0.008	0.927	1.080
Chi Square (df) p	44.687 (15) 0.000				
-2 Log likelihood	489.394				
Cox & Snell R Square	0.102				
Nagelkerke R Square	0.141				

Source: Own processing

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/e7422395924

Results of the models and their comparison show that actual behaviour related to tax evasion can be predicted based on gender, income, entrepreneurial experience, and experience with tax audits. The findings indicate that men, entrepreneurs, individuals with higher incomes, and those who have undergone a tax audit are more prone to engaging in tax evasion (Figure 3).

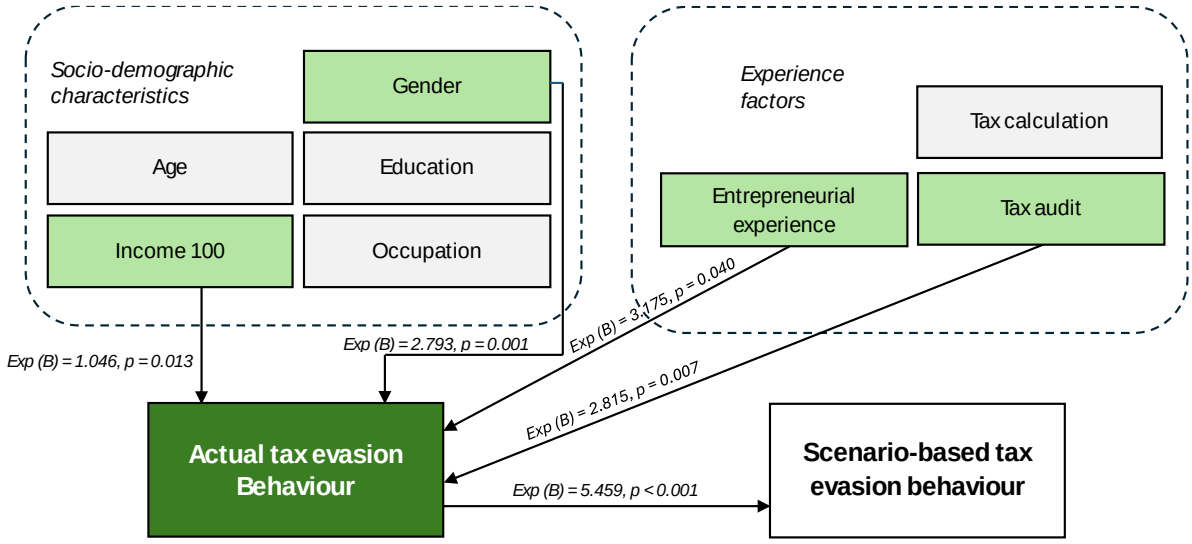


Figure 3. Significant variables derived from the models.
Source: Own processing

However, the results of the second model suggest that neither these nor other factors influence hypothetical behaviour, indicating that respondents apply stronger normative judgement in such scenarios.

In the third model, we added the variable tax evasion experience identified as significant in the first model. This model demonstrates that past engagement in tax evasion is the strongest determinant of willingness to engage in tax evasion in the future. This finding supports behavioural theories suggesting that habits and prior norm violations reduce psychological barriers to repeating the behaviour.

5. Conclusion

The study examined the socio-demographic and experience-related determinants of tax evasion behaviour, distinguishing between self-reported past behaviour and hypothetical willingness to engage in tax evasion. The results show that the drivers of actual tax evasion differ substantially from those influencing scenario-based decisions, highlighting the importance of behavioural context and prior experience.

This study provides several novel contributions to the literature on tax evasion behaviour. First, it explicitly distinguishes between self-reported and hypothetical tax evasion behaviour, allowing for a direct comparison between actual past behaviour and scenario-based behavioural intentions. While prior research has often examined these dimensions separately, this study integrates them within a single empirical framework, thereby offering a more comprehensive understanding of tax evasion behaviour.

Second, the study adopts an original sequence of hypotheses that systematically examines the determinants of self-reported tax evasion behaviour, followed by hypothetical behaviour, and subsequently explores the relationship between these two dimensions. This stepwise analytical approach enables a deeper insight into how past behaviour translates into behavioural intentions under controlled conditions.

Third, the findings contribute to the existing literature by highlighting the role of socio-demographic and experience-related factors in shaping both actual and intended tax evasion behaviour, while also demonstrating

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/e7422395924

that these two dimensions may be influenced differently. This reinforces the view that tax evasion should be understood as a multidimensional phenomenon.

The findings indicate that actual engagement in tax evasion is significantly associated with gender, income, entrepreneurial experience, and prior exposure to tax audits. Men, individuals with higher incomes, entrepreneurs, and respondents who had previously undergone a tax audit were more likely to report having engaged in tax evasion. These results suggest that both socio-demographic characteristics and direct interaction with the tax system shape real-world non-compliant behaviour, particularly in contexts involving greater discretion or complexity.

In contrast, scenario-based tax evasion behaviour was only weakly explained by the examined factors. Although a majority of respondents expressed willingness to evade taxes in a hypothetical situation, most socio-demographic and experience-related variables were not statistically significant. This discrepancy suggests that hypothetical scenarios may not fully capture the mechanisms underlying actual tax evasion behaviour and that respondents may apply different normative standards when evaluating abstract situations.

A key contribution of the study emerges from the inclusion of past tax evasion behaviour in the scenario-based model. Prior engagement in tax evasion proved to be the strongest predictor of future willingness to evade taxes, substantially improving model fit and explanatory power. This finding supports behavioural theories emphasizing learning effects and habit formation, indicating that past norm violations reduce psychological barriers to repeated non-compliance.

Overall, the results underscore the importance of experience and behavioural history in understanding tax evasion. By distinguishing between actual and hypothetical behaviour, this study contributes to a more nuanced view of tax evasion as a dynamic behavioural process shaped by prior experience rather than solely by static individual characteristics.

Despite these contributions, several limitations should be acknowledged. *First*, the empirical specification is based primarily on socio-demographic and experience-related variables and does not include other theoretically relevant determinants of tax compliance, such as risk preferences, perceived detection probability, or tax morale. The omission of these variables may lead to omitted variable bias, and the estimated relationships should therefore be interpreted as correlations rather than causal effects. *Second*, the measurement of tax evasion relies on self-reported data, which may be subject to social desirability bias and underreporting of illegal behaviour, which may lead to measurement error and potential underestimation of true evasion rates. This may lead to an underestimation of the true prevalence of tax evasion and may bias the estimated relationships, attenuating the strength of observed associations. *Third*, the survey question referring to "knowingly committed tax evasion or tax fraud" may be interpreted differently by respondents. Some individuals may not classify minor informal transactions as tax evasion, which may affect comparability across responses. *Finally*, the hypothetical scenario does not explicitly specify enforcement probability, penalties, or legal consequences. As a result, respondents' choices may reflect price sensitivity or social norms rather than a deliberate tax evasion decision under conditions of risk and enforcement.

From a policy perspective, the findings suggest that tax compliance strategies should account for behavioural history and taxpayer experience. Targeted interventions focusing on high-risk groups, such as entrepreneurs and individuals with prior audit exposure, may improve compliance outcomes. Additionally, strengthening taxpayer education and transparency in enforcement procedures may reduce uncertainty and limit strategic non-compliance.

From a broader societal perspective, the results highlight the importance of addressing informal norms and perceptions of fairness within the tax system. Enhancing trust in tax institutions and ensuring consistent enforcement may play a key role in reducing tax evasion behaviour.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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Annex. Questionnaire items used in the research

Question	Response options	Recoding and data cleaning
What is your gender?	male; female; other	Binary variable; responses in the "other" category were excluded from the model due to insufficient sample size (n = 2)
Which age category do you belong to?	18-30 years; 31-45 years; 46-60 years; 61 and more	Categorical variable
Please indicate your highest level of education from the options	Primary; Secondary; Tertiary	Categorical variable
Please indicate your category based on your primary source of income:	Employed; Entrepreneur; Unemployed; Retired; Student	Categorical variable
What is your average monthly income in EUR?	-	Continuous variable; rescaled by dividing all values by 100 to improve interpretability
Are you engaged in business activities?	Yes; No	Binary variable
Have you ever been involved in a tax proceeding or a tax audit?	Yes; No	Binary variable
Have you ever calculated a tax liability for yourself or for another person?	Yes; No	Binary variable
Have you ever knowingly committed tax evasion or tax fraud?	Never; Once; More than once; I prefer not to answer	Recoded into a binary variable (never, at least once); "I prefer not to answer" responses were excluded from the analysis
If a car repair shop offers you a vehicle repair with a receipt for €1,230 or without a receipt for €1,000, how would you decide?	With a receipt for €1,230; Probably with a receipt for €1,230; Probably without a receipt for €1,000; Without a receipt for €1,000; I would look for another car repair shop	Recoded into a binary variable (with a receipt, without a receipt); "I prefer not to answer" responses were excluded from the analysis as they do not indicate a clear choice

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Funding: This article was written with the support of the Scientific Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic under project VEGA No. 1/0112/25: SHARECOM – Exploring the potential uses and effects of the sharing economy in businesses.

Disclosure statement
The authors report there are no competing interests to declare. Generative Artificial Intelligence (AI) tools were used in this study to support language editing, stylistic refinement, and clarity of expression during the preparation and revision of the manuscript. AI-based tools were also used to assist in reformulating selected passages of the text to improve readability and coherence.

Author Contributions: Conceptualization: *Eva Malichová*, *Dana Kušnírová*; methodology: *Eva Malichová*, *Emese Tokarčíková*; data analysis: *Eva Malichová*, *Dana Kušnírová, Oliver Klinovský*, writing—original draft preparation: *Eva Malichová*, *Dana Kušnírová, Oliver Klinovský*, writing; review and editing: *Eva Malichová*, *Dana Kušnírová, Emese Tokarčíková*; visualization: *Eva Malichová*, *Dana Kušnírová*. All authors have read and agreed to the published version of the manuscript.

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/m7649526929

Publisher
http://jssidoi.org/esc/home

THE RELATIONSHIP BETWEEN RISK-TAKING AND FIRM VALUE: DOES EARNINGS MANAGEMENT MATTER? EVIDENCE FROM AN EMERGING CONTEXT

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Received 11 March 2026; accepted 26 April 2026; published 30 June 2026

Abstract. This study examines the effect of risk taking on firm value as well as the effect of risk taking on earnings management in Saudi Arabia. In addition, this study investigates the moderating effect of earnings management on the relationship between risk taking and firm value. We analyzed a sample of nonfinancial firms listed in the Saudi Stock Exchange (Tadawul). The study sample consists of 1008 firm-years observations during the period from 2008 to 2019. The results showed that risk-taking activities are positively valued by market participants and correlated with higher earnings management. In addition, the results indicated that earnings management moderates the positive relationship between risk taking and firm value. These findings are important for business organizations which should be aware that more opaque financial information, higher information asymmetry and lower firm value are likely to be the outcomes when managers engage in risky investment decisions. Governments and regulators should not ignore the negative implications of risk taking that require strengthening firms' oversight and corporate governance mechanisms.

Keywords: business risk; firm value; earnings management; emerging markets; Saudi Arabia

Reference to this paper should be made as follows: El Abd, S. A., Eissa, A. M., Diab, A. 2026. The relationship between risk-taking and firm value: does earnings management matter? Evidence from an emerging context. *Entrepreneurship and Sustainability Issues*, 13(4), 381-394. http://doi.org/10.9770/m7649526929

JEL Classifications: G1, G12, G17

1. Introduction

Firms' risk taking (hereafter, RT) has gained significant attention from researchers worldwide, especially after the global financial crisis of 2008. RT reflects the relationship between risk and returns in the investment decision-making process. RT activities are expected to be associated with higher future returns. Further, RT activities are likely to focus on firm long-term performance and projects with larger payback periods. Such activities can have significant implications for the business environment and management behaviors (Fryt et al., 2022). While managers are bound by a fiduciary duty to act in the best interests of shareholders, their conflicting motivations, coupled with their executive authority and superior knowledge of the firm, often lead them to favor a conservative risk profile (Jensen & Meckling, 1976; Menicucci & Paolucci, 2022). However, favoring conservative investment decisions by management makes it easier for them to divert cash flows to their own advantage and engage in perks-consumption when the firm's earnings are less volatile, thus avoiding the potential for reduced cash flow (Paeleman et al., 2024).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/m7649526929

Additionally, RT activities affect the firm's growth, present and future value, performance, and its survival in the market. Firms with high growth opportunities tend to engage in higher RT to maximize shareholder wealth, which may increase firm value (FV) (Chong et al., 2018; Younas et al., 2019; Oreshile et al., 2025). Therefore, RT is essential for firms to engage in new growth opportunities, which is vital to ensure their long-term survival, prosperity, and continuity (Su et al., 2017). In contrast, although value cannot be created without risk, excessive risk-taking can harm firms and may lead to their collapse. That is, RT activities could also have a high probability of failure. For instance, excessive RT behaviors might increase bankruptcy risks (Cao et al., 2023). Therefore, examining the effect of RT behaviors on firm value has become an important topic to reveal the existing ambiguity regarding the RT-FV relationship, especially in emerging markets such as Saudi Arabia.

Interestingly, firms with higher RT policies may engage in more earnings management (EM) (Alharbi et al., 2021; Mayberry et al., 2021; Cao et al., 2023). This behavior is considered important for these firms to avoid reporting losses or to increase share prices prior to seasoned equity offerings (Roychowdhury 2006). That is, higher firm risk may induce managers to rely on high equity capital and/or leveraged loans, which makes short-term performance more volatile and creates financial obstacles (Kyaw, 2020). Consequently, corporate management is motivated to engage in exploitative behaviors due to anxieties about career advancement, compensation contracts, litigation risks, profit targets, and the pursuit of business empires (Kothari et al., 2009). In other words, financial manipulations and misstatements may be achieved through exploiting circumstances by management to maintain their firm performance. However, more earnings management practices can negatively affect the capital market, resulting, for example, in stock price crashes (Habib & & Hasan, 2017). Therefore, in this study, we are also interested in examining the potential moderating influence of earnings management practices on the relationship between RT and FV.

In doing so, we draw upon the agency theory to understand concerns that may arise when management optimal risk levels differ from those of shareholders. Such risks are closely linked to conflicts between managers (agents) and owners (principals) (Jensen & Meckling, 1976). Consequently, monitoring mechanisms are required as an important governance tool to manage agents' RT behaviors, which is vital to reduce information asymmetry, and, hence, agency problems (Geng et al., 2025; Jin et al., 2025). These concerns are exacerbated when managers engage in opportunistic or earnings management behaviors. These behaviors increase information asymmetry opacity, precluding shareholders' ability to effectively oversight management RT behaviors (Eissa et al., 2025).

Examining Saudi firms in this study is considered important because of the existing business risks in the Saudi business context represented in the economic volatility emerging from oil prices' fluctuations as well as legal and regulatory challenges, such as foreign ownership restrictions and surrounding geopolitical risks. However, recently, with the Saudi Vision 2030 for business growth, there are serious steps being taken by the government towards reducing business risks through following various development policies, the most notable of which is economic diversification. Such policies are considered vital to enhance financial stability and reduce market uncertainty in the business environment. Along with the emerging improvement in the Saudi business setting, it was crucial to enhance financial reporting quality. Recently, the Saudi government has mandated the adoption of the International Financial Reporting Standards (IFRS) by corporations to enhance disclosure, support economic transparency and achieve the business-related goals set in their Vision 2030 (Alruwaili et al., 2025).

By analyzing the data collected from nonfinancial firms listed on the Saudi Stock Exchange (Tadawul) during the period from 2008 to 2019, our results revealed that the positive effect of RT on firm value decreases under information opacity in firms with EM, which can be defined as the deliberate intervention by management in the financial reporting process, using accounting estimates or policy choices to influence reported earnings to achieve specific objectives. This result reflects that EM practices are negatively perceived in the Saudi Stock market. This finding indicates the existence of opportunistic behavior by managers in manipulating accounting numbers rather than reflecting the firm's true economic performance, which may aggravate information asymmetry and increase agency conflicts between management and shareholders. Hence, EM exacerbates management's opportunities to engage in opportunistic practices, such as an involvement in non-value-adding investments, transferring wealth away from shareholders (Eissa et al., 2025). This finding remained robust with using alternative measures of RT and EM. The current finding contributes to literature examining the

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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implications of RT and EM for FV (e.g., Imhof et al., 2014; Shin & Pyo, 2021; Cao et al., 2023). To the best of our knowledge, this is the first study that examines such relationships in emerging markets, such as Saudi Arabia. Further, the originality of the current study stems from its investigation of the moderating role of EM in the RT-FV relationship. At the practical level, our findings highlight to regulators, firms and governmental agencies the importance of considering the expected negative implications that emerge when firms implement RT policies. The current study ensures that more opaque financial information and earnings manipulations are likely to be reported when managers engage in higher risky investments, which can have significant negative implications for the capital market, such as stock price crashes.

The remainder of the paper is organized as follows. Section two reviews literature and develops the study hypotheses. Section three presents research methods. Section four provides results and discusses the study findings. Finally, section five concludes the paper.

2. Literature review and hypotheses development

2.1. The risk taking-firm value relationship

Literature suggests that firm risk can indicate the extent to which management decisions align with shareholder interests. However, literature mostly focuses on the period prior to taking risk decisions in firms. The classical finance theory views the relationship between risk taking and return as positive, meaning that higher risk is associated with higher returns (Van Dinh, 2023). For instance, Bowman (1980) notes that risky investment projects provide higher returns than other projects, but he/she finds a negative correlation between the level of risks in firms and the level of returns in most industries. Since the publication of Bowman (1980), numerous studies have investigated the relationship between risk and return, albeit with reporting mixed findings (e.g., Ghysels et al., 2016). It is noted that the resultant managerial exploitation and information opacity represent potential costs of enterprise risk, which may reduce corporate future value and could be a possible explanation for Bowman's results.

However, some previous studies documented that a firm’s risk taking could benefit its long-term survival and economic growth (Li et al., 2013). Further, Imhof et al. (2014) and Shin and Pyo (2021) explained that excessive risk-taking is not value-destroying, rather it leads to a higher firm value. Consequently, we predict that RT can be positively correlated with firm value by setting our first hypothesis as follows:
H1: There is a positive effect of risk taking on firm value.

2.2. The risk-taking-earnings management relationship

After the financial crisis of 2008, many economic downturns were observed in some countries, with a significant increase in reported failures of high-risk projects. Cao et al. (2023) note that risks undertaken by firms are resource-intensive and depend on capital investment support. That is, the availability of sufficient financial support is a key success factor for high-risk projects. High-risk projects not only require capital investment but also longer payback periods and higher leverage ratios (Djembissi et al., 2011). However, to avoid losses, financial institutions imposed higher interest rates and stricter contractual terms. Consequently, firms with high-risk projects faced greater constraints in using external financing. If these firms violate debt terms, they will face higher debt costs than other firms. Moreover, it is recognized that shareholders prefer to invest in firms pursuing projects with positive net present values, regardless of the associated risks (Faccio et al., 2016).

Therefore, considering such pressures, managers of RT firms have an incentive to manage earnings to avoid term or contract violations. That is, to secure support from financial institutions, managers are incentivized to manipulate earnings to report strong performance and low financial risk. This is consistent with the view that managers working in high-risk establishments are motivated to find ways to achieve their own personal gains (Dechow et al., 1995; Kothari et al. 2005; Hutton et al., 2009). In this regard, some studies have provided evidence that EM can be a useful tool for managers to achieve their personal goals. In this regard, Guidry et al. (1999) find that managers use accrual-based EM to maximize their short-term rewards. Roychowdhury (2006) noted that managers engage in transaction-based real EM to avoid reporting annual losses. Accordingly, managers in high risk-taking firms may engage in earnings manipulation, and selectively hoard firm-specific information in the process of operating risky projects (Cao et al., 2023). Considering the above discussion, we

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/m7649526929

expect that enterprise risk may encourage managers to adopt a more exploitative EM approach. Consequently, the second hypothesis is formulated as follows:
H2: There is a positive effect of RT on EM.

2.3. The moderating influence of earnings management on the RT-FV relationship

Accrual-based EM involves managers who select certain accounting policies from a range of generally accepted policies to achieve profit targets. Managers in firms with higher RT behaviors are expected to focus on improving earnings quality to increase the perceived value of the company depending on the correlation between reported earnings and share price. Recent literature indicates that RT is likely to be associated with EM practices (e.g., Cao et al., 2023). However, although EM activities are informative, they allow managers to display opportunistic behaviors and mislead stakeholders (e.g., Cao et al., 2023). Consequently, we believe that EM might moderate the expected positive relationship between RT and FV. Hence, the third Hypothesis is set as follows:
H3: EM practices moderate the relationship between RT and firm value.

3. Data and methodology

This study employs a quantitative research method based on a deductive methodology. We reviewed literature to develop the study hypotheses. Such hypotheses were empirically tested depending on financial data as shown below in section 3.1. The deductive methodology is considered appropriate for examining the relationships among the earnings management, risk taking and firm value, and for theoretically validating the derived hypotheses.

3.1. Sample selection

This study population consisted of all firms listed on the Saudi Stock Exchange (Tadawul) during the period from 2008 to 2019. Financial data were extracted manually from the annual financial statements, and governance data were extracted from governance reports. Stock prices were collected from "*saudiexchange.sa*", "*argaam.com*", and "*mubasher.info/markets/TDWL*". Sectors with less than 24 observations were excluded to ensure the accuracy of calculating abnormal accruals according to the modified Jones model (1991) used by Dechow et al. (1995). Also, sectors such as financial services, insurance, and banking are excluded, as they are subject to different regulatory procedures. Finally, firms with missing data were excluded. Applying the above criteria, the final sample size was 84 firms with 1008 firm-years observations. Table 1 presents sample distribution across sectors.

Table 1. Sample distribution

Sector		Observations	Percentage
1	Basic materials	384	38.10%
2	Capital goods	108	10.71%
3	Consumer services	48	4.76%
4	Durable goods	48	4.76%
5	Food retail and production	168	16.67%
6	Healthcare	24	2.38%
7	Luxury goods retail	48	4.76%
8	Media and entertainment	24	2.38%
9	Transportation	48	4.76%
10	Telecommunications	36	3.57%
11	Real estate management and development	72	7.14%
Total		1008	100%

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/m7649526929

3.2. Variables' measurements

Firm value is measured depending on Tobin's Q as a ratio of the firm's market value to total assets (Eissa & Eliwa, 2021; Eissa et al., 2025). RT is measured depending on the standard deviation of return on assets and return on equity (Harjoto & Laksmana, 2018; Bhuiyan et al., 2021). EM is measured depending on the modified Jones model (1991) used by Dechow et al. (1995) as follows:

$$ACC_{it}/TA_{it-1} = \alpha + B_1(1/TA_{it-1}) + B_2[(\Delta REV_{it} - \Delta REC_{it})/TA_{it-1})] + B_3(PPE_{it}/TA_{it-1}) + \varepsilon_{it} \quad Model\ (1)$$

In addition, EM is computed according to modified Jones model (1991) used by Kothari et al. (2005), in which return on assets is added, as follows:

$$ACC_{it}/TA_{it-1} = \alpha + B_1(1/TA_{it-1}) + B_2[(\Delta REV_{it} - \Delta REC_{it})/TA_{it-1})] + B_3(PPE_{it}/TA_{it-1}) + B_4\ (ROA_{it-1}/TA_{it-1}) + \varepsilon_{it} \quad Model\ (2)$$

Where: ACC_{it} is total accruals computed as the difference between net profit and operating cash flow, TA_{it-1} is total assets in the beginning of the year, ΔREV_{it} is the change of revenues during the year t, ΔREC_{it} is the change in receivables during the year t. PPE_{it} is the gross Property, Plant, and Equipment. ROA_{it-1} is lagged return on assets for firm i.

3.3 Research models

To test the first hypothesis "there is a positive effect of RT on firm value in Saudi Arabia", the study follows Bhuiyan et al. (2021); in formulating the model as follows:

$$FV_{it} = \alpha + B_1(RT_{it}) + B_2(FirmSize_{it}) + B_3(LEV_{it}) + B_4\ (ROA_{it}) + B_5(FAge_{it}) + B_6(ASize_{it}) + B_7(Industries) + B_8(Years) \quad Model\ (3)$$

To test the second hypothesis "there is a positive effect of RT on EM in Saudi Arabia", the study follows Harjoto and Laksmana (2018); Eissa and Eliwa (2021) in formulating the model as follows:

$$EM_{it} = \alpha + B_1(RT_{it}) + B_2(FirmSize_{it}) + B_3(LEV_{it}) + B_4\ (ROA_{it}) + B_5(FAge_{it}) + B_6(ASize_{it}) + B_7(Industries) + B_8(Years) \quad Model\ (4)$$

To test the third hypothesis "EM moderates the relationship between RT and firm value in Saudi Arabia", the study follows Harjoto and Laksmana (2018); Eissa and Eliwa (2021) in formulating the model as follows:

$$FV_{it} = \alpha + B_1(RT_{it}) + B_2(EM_{it}) + B_3(RT_{it} * EM_{it}) + B_4(FirmSize_{it}) + B_5(LEV_{it}) + B_6\ (ROA_{it}) + B_7(FAge_{it}) + B_8(ASize_{it}) + B_9(Industries) + B_{10}(Years) \quad Model\ (5)$$

Where: $EM_{1\&2it}$ is EM for firm i in the year t, computed according to Models 1 and 2, $RT_{1\&2it}$ is measured depending on standard deviation of return on assets and return on equity for firm i across five years t to t-4. FV_{it} is firm value depending on Tobin's Q as mentioned in section 4-2, $FirmSize_{it}$ is the natural logarithm of total assets for firm i at the end year t. LEV_{it} is the firm leverage computed according to total debt scaled by total assets for firm I in the year t, ROA_{it} is return on assets computed as net profit scaled by total assets for firm i in the year t, $FAge_{it}$ is the natural logarithm for firm age, $ASize_{it}$ is a dummy variable equal one if the firm is audited by big4 and zero otherwise.

4. Empirical results

4.1. Descriptive statistics

Table 2 shows descriptive statistics of our data. The mean value of FV is 1.638 with a standard deviation (SD) of 0.760, and a range from 0.09 to 3.27. The mean value of EM_1 is 0.045 with an SD of 0.038, and a range from 0.00 to 0.14. The mean value of EM_2 is 0.044 with an SD of 0.038, and a range from 0.00 to 0.13. The mean value of RT_1 is 0.073 with an SD of 0.180, and a range from 0.01 to 1.68. The mean value of RT_2 is 0.180 with an SD of 0.384, and a range from 0.02 to 2.92.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/m7649526929

Table 2. Descriptive statistics

		FV	EM1	EM2	RT_1	RT_2	FirmSize	LEV	ROA	FAge	ASize
N	Valid	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008
	Missing	0	0	0	0	0	0	0	0	0	0
Mean		1.638	0.045	0.044	0.073	0.180	14.545	0.375	0.054	3.203	0.584
Std. Error of Mean		.023	0.001	0.001	0.005	0.012	0.047	0.006	0.002	0.0186	0.0155
Median		1.370	0.034	0.032	0.048	0.076	14.487	0.367	0.045	3.332	1.000
Std. Deviation		0.760	0.038	0.038	0.180	0.384	1.496	0.209	0.081	0.591	0.493
Minimum		0.09	0.00	0.00	0.01	0.02	11.05	0.01	-0.13	0.00	0.00
Maximum		3.27	0.14	0.13	1.68	2.92	17.68	0.94	0.24	4.14	1.00

Table 3 presents Pearson correlation matrix. *EM1 and EM2* are positively correlated with FV at the 5% significance level. Notably, the positive relationship between EM and FV in Saudi Arabia can be explained by the fact that Saudi Market is an emerging market that does not differentiate between actual and managed earnings due to market inefficiencies (Asiri & Alzeera, 2013; Alreshidi, 2025; Asiri et al., 2026). Here, corporate managers engage in EM to reduce earnings volatility and project stability, which may be interpreted by investors as a positive signal (De Jong et al., 2014). Furthermore, we noticed that ownership concentration reduces the opportunistic nature of EM and makes it a tool for aligning expectations (Usman & Yero, 2012). Regulatory oversight mitigates the perceived risks associated with this behavior (Jouber & Fakhfakh, 2011). Consequently, EM has a positive impact on firm value in the short term. Further, RT_1 and RT_2 are positively correlated with *FV* at the 1% level. In addition, the correlations between independent variables are below 0.5, and the VIF in all regression is below 4, suggesting that our regressions do not reflect the presence of the multi-collinearity problem.

Table 3. Correlations' matrix

Correlations											
		FV	EM1	EM2	RT_1	RT_2	FirmSize	LEV	ROA	FAge	ASize
FV	Pearson Correlation	1									
	Sig. (2-tailed)										
	N	1008									
EM1	Pearson Correlation	0.065**	1								
	Sig. (2-tailed)	.040									
	N	1008	1008								
EM_2	Pearson Correlation	0.063**	.946***	1							
	Sig. (2-tailed)	.047	.000								
	N	1008	1008	1008							
RT_1	Pearson Correlation	.267***	.160***	.167***	1						
	Sig. (2-tailed)	.000	.000	.000							
	N	1008	1008	1008	1008						
RT_2	Pearson Correlation	.227***	.196***	.190***	.841***	1					
	Sig. (2-tailed)	.000	.000	.000	.000						
	N	1008	1008	1008	1008	1008					
FirmSize	Pearson Correlation	-.292***	-.219***	-.206***	-.294***	-.305***	1				
	Sig. (2-tailed)	.000	.000	.000	.000	.000					
	N	1008	1008	1008	1008	1008	1008				
LEV	Pearson Correlation	-.141***	.117***	.121***	-.143***	.028	.390***	1			
	Sig. (2-tailed)	.000	.000	.000	.000	.376	.000				
	N	1008	1008	1008	1008	1008	1008	1008			
ROA	Pearson Correlation	.244***	-.134***	-.143***	-.082***	-.201***	.115***	-.311***	1		

	Sig. (2-tailed)	.000	.000	.000	.009	.000	.000	.000			
	N	1008	1008	1008	1008	1008	1008	1008	1008		
FAge	Pearson Correlation	.195***	-.078**	-.065**	.013	-.047	-.209***	-.212***	.115***	1	
	Sig. (2-tailed)	.000	.013	.039	.680	.135	.000	.000	.000		
	N	1008	1008	1008	1008	1008	1008	1008	1008	1008	
ASize	Pearson Correlation	.025	-.097***	-.087***	-.184***	-.218***	.439***	.204***	.286***	-.113***	1
	Sig. (2-tailed)	.424	.002	.006	.000	.000	.000	.000	.000	.000	
	N	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008
*, **, ***. Correlation is significant at the 0.10, 0.05 and 0.01 levels respectively (Sig 2-tailed).											

4.2. Testing the RT-FV relationship (H1)

We estimated model 3 depending on the OLS regression method to test our first hypothesis (i.e., the RT-FV relationship). As shown in Panel A of Table 4, the results reveal that RT_1 and RT_2 have significant positive effects on *FV* with β = 1.084, and 0.506 at p< 0.01, respectively. This result indicates that firm value increases during period of increased risk-taking. In addition, we re-estimated model 3 after controlling for lagged Tobin's Q to avoid issues stemming from endogeneity and reverse-causality. Such issues arise from ignoring some variables affecting the consistency of RT and the market value of the firm when formulating the regression model, or from the existence of a reciprocal effect between the market value of the firm and RT. The results presented in Panel B of Table 4 ensure that RT has a positive effect on firm value. These results are consistent with the view that risk-taking, which stems from the selection of investment projects with varying uncertainties about expected future cash flows increases firm value (e.g., Jensen & Meckling, 1976). These results are consistent with literature supporting this prediction (e.g., Imhof et al., 2014), supporting the acceptance of H1.

Table 4. The OLS regression results of model 3 (H1)

Panel A: OLS regression of Model 3						
	Dependent variable is (FV)					
	Independent RT_1			*Independent RT_2*		
	B	t	Sig.	B	t	Sig.
Intercept	3.239***	10.918	0.000	3.457***	11.317	0.000
RT_1	1.084***	9.226	0.000			
RT_2				0.506***	8.586	0.000
FirmSize	-0.178***	-9.167	0.000	-0.174***	-8.903	0.000
LEV	0.211	1.637	0.102	0.072	.556	0.578
ROA	2.710***	8.905	0.000	2.897***	9.410	0.000
FAge	0.099**	2.415	0.016	.097**	2.349	0.019
ASize	0.207***	4.423	0.000	0.221***	4.686	0.000
Industries	Included			Included		
Years	Included			Included		
Adjusted R Square	37.5%			36.8%		
F test	22.55***			21.939***		
Obs.	1008			1008		
Panel B: OLS regression of Model 3 after controlling lagged firm value						
	Dependent variable is (FV)					
	Independent RT_1			*Independent RT_2*		
	B	t	Sig.	B	t	Sig.
Intercept	0.939***	4.866	0.000	0.933***	4.803	0.000
RT_1	0.289***	3.839	0.000			
RT_2				0.126***	3.360	0.001
FirmSize	-0.043***	-3.416	0.001	-0.042***	-3.301	0.001
LEV	0.016	.198	0.843	-0.024	-.305	0.760
ROA	0.737***	3.754	0.000	0.772***	3.879	0.000
FAge	0.020	.737	0.461	0.018	.658	0.511
ASize	0.049*	1.683	0.093	0.052*	1.757	0.079
FV_{t-1}	0.800***	40.807	0.000	0.804***	41.097	0.000

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/m7649526929

Industries	Included	Included
Years	Included	Included
Adjusted R Square	78.9%	78.8%
F test	123.9***	123.310***
Obs.	924	924

4.3. Testing the RT-EM relationship (H2)

We estimated model 4 depending on the OLS regression method to test our second hypothesis (i.e., the RT-EM relationship). As shown in Panel A of Table 5, the results explain that RT_1 has a significant positive effect on EM_1 and EM_2 with $\beta = 0.017$, and 0.018 at $p < 0.05$ and 0.01, respectively. Also, RT_2 has a significant positive effect on EM_1 and EM_2 with $\beta = 0.006$, and 0.007 at $p < 0.05$, respectively. These results ensure that EM rises during the period of increased risk-taking.

In addition, we re-estimated model 4 after controlling for audit committee characteristics (e.g., expertise, meetings frequency, size, independence and ownership interest), to avoid the potential endogeneity stemming from omitted variables that may affect EM practices. In doing so, audit committee expertise (ACE) is measured by the proportion of audit experts on the audit committee. Audit committee meetings (ACM) are measured using the natural logarithm of the number of audit committee meetings in a year. Audit committee size (ACS) is measured by the number of members in the committee. Audit committee independence (ACIND) is measured as the proportion of independent members in the committee. Finally, audit committee ownership (ACO) is measured as the proportion of shares held by audit committee members. The results presented in Panel B of Table 5 confirm the previous results, i.e., RT has a positive effect on EM, supporting H2. Hence, RT can lead firms to conceal the material information regarding risky investments in various accrual accounts. Consequently, RT is associated with EM practices, which decreases transparency financial reporting quality (Mayberry et al., 2021; Cao et al., 2023).

Table 5. OLS regression results of model 4 (H2)

Panel A: OLS regression of Model 4												
	Dependent variable is (EM1)						**Dependent variable is (EM2)**					
	Independent RT_1			*Independent RT_2*			*Independent RT_1*			*Independent RT_2*		
	B	t	Sig.	B	t	Sig.	B	t	Sig.	B	t	Sig.
Intercept	0.131***	7.382	0.000	0.125***	6.857	0.000	0.117***	6.777	0.000	0.110	6.197	.000
RT_1	0.017**	2.370	0.018				0.018***	2.650	0.008			
RT_2				0.006**	1.920	0.045				0.007**	01.984	0.035
FirmSize	-0.005***	-4.678	0.000	-0.005***	-4.684	0.000	-0.004***	-3.956	0.000	-0.005***	-4.020	0.000
LEV	0.030***	3.918	0.000	0.028***	3.661	0.000	0.026***	3.382	0.001	0.023***	3.078	0.002
ROA	-0.004	-0.212	.832	-0.002	-.100	0.920	-0.021	-1.203	0.229	-0.020	-1.099	0.272
FAge	-0.005**	-2.173	0.030	-0.005**	-2.226	0.026	-0.004*	-1.726	0.085	-0.004*	-1.812	0.070
ASize	-0.002	-0.805	0.421	-0.002	-.756	0.450	-0.002	-0.668	0.504	-0.002	-0.632	0.527
Industries	Included			Included			Included			Included		
Years	Included			Included			Included			Included		
Adjusted R Square	14.6%			16.8%			15%			14.7%		
F test	7.164***			7.066***			7.354***			7.189***		
Obs.	1008			1008			1008			1008		
Panel B: OLS regression of Model 4 after controlling audit committee characteristics												
	Dependent variable is (EM1)						**Dependent variable is (EM2)**					
	Independent RT_1			*Independent RT_2*			*Independent RT_1*			*Independent RT_2*		
	B	t	Sig.	B	t	Sig.	B	t	Sig.	B	t	Sig.
Intercept	0.128***	6.155	0.000	0.131***	6.232	0.000	0.118***	5.731	0.000	0.121***	5.854	0.000
RT_1	0.023***	3.115	0.002				0.019***	2.680	0.007			

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/m7649526929

RT_2				0.009**	2.355	0.019				0.006*	1.777	0.076
FirmSize	-0.006***	-4.546	0.000	-0.006***	-4.584	0.000	-0.005***	-3.976	0.000	-0.005***	-4.049	0.000
LEV	0.039***	4.525	0.000	0.036***	4.207	0.000	0.035***	4.162	0.000	0.033***	3.879	0.000
ROA	0.013	.693	0.489	0.017	.859	0.391	-0.002	-0.091	0.928	0.001	0.028	0.977
FAge	-0.004	-1.582	0.114	-0.005	-1.645	0.100	-0.004	-1.546	0.123	-0.004	-1.625	0.105
ASize	-0.003	-1.038	0.299	-0.003	-1.012	0.312	-0.003	-.895	0.371	-0.003	-0.893	0.372
ACE	-0.017*	-1.699	0.090	-0.018*	-1.787	0.074	-0.005	-.536	0.592	-0.007	-0.639	0.523
ACM	0.000	.104	0.917	-1.794E-5	-.029	0.977	0.000	0.434	0.665	0.000	0.318	0.751
ACS	0.002	.797	0.425	0.002	.899	0.369	0.001	0.322	0.748	0.001	0.411	0.681
ACI	-0.023***	-2.743	0.006	-0.023***	-2.732	0.006	-0.019**	-2.303	0.022	-0.019*	-2.278	0.023
ACO	0.000*	-1.766	0.078	0.000*	-1.696	0.090	0.000*	-1.938	0.053	0.000*	-1.877	0.061
Industries	Included			Included			Included			Included		
Years	Included			Included			Included			Included		
Adjusted R Square	14.6%			14.2%			13.8%			13.4%		
F test	5.787***			5.631***			5.465***			5.315***		
Obs.	1008			1008			1008			1008		

4.4. Testing the moderating influence of EM on the RT-FV relationship (H3)

We estimated model 5 depending on the OLS regression method to test our third hypothesis (i.e., the expected moderating influence of EM on the RT-FV relationship). As shown in Panel A of Table 6, Columns 1 to 4, reveal that RT1 and RT2 have a significant positive effect on FV with $\beta = 1.697, 1.698, 0.590$ and 0.568 at $p< 0.01$, respectively. This result ensures that firm value increases during periods of increased risk-taking. However, EM moderates the positive relationship between RT and firm value. The interaction variables RT1*EM1 and RT1*EM2 have a significant negative effect on FV (As shown in Columns 1-2) with $\beta = -6.650$ and -6.575 at $p<0.01$, respectively. Likewise, the interaction variables RT2*EM1 and RT2*EM2 have a significant negative effect on FV (As shown in Columns 3-4) with $\beta = -3.068$ and -3.818 at $p< 0.05$. respectively. These results indicate that market participants react negatively to RT when EM practices increase.

Additionally, we re-estimated model 5 after controlling for lagged Tobin's Q. The results presented in Panel B of Table 5 confirm that EM still moderates the positive relationship between RT and firm value, consistent with our prediction in H3. This finding can be explained within the framework of agency theory (Jensen and Meckling, 1976), as risk-taking is generally viewed as a positive factor reflecting management's pursuit of value-added investment opportunities. However, the increase in EM alongside rising risk levels alter the significance of this behavior. In high-risk environments, management tends to use EM to reduce volatility or conceal true performance, thereby distorting accounting information (Beyer et al., 2019; Eissa et al., 2025). This distortion undermines investor confidence and increases information asymmetry, ultimately raising the cost of capital and reducing the company's market value (Chaney & Lewis, 1995). These results are consistent with literature that highlights the importance of governance tools to manage agents' risk-taking behaviors to mitigate agency problems (Geng et al., 2025; Jin et al., 2025).

Consequently, the RT-FV relationship shifts from positive to negative when risk-taking is interpreted as opportunistic behavior supported by EM, rather than as an efficient investment decision. At this time, EM acts are negatively perceived, transforming risk from a source of value into a source of erosion.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/m7649526929

Table 6. OLS regression results of model 5 (H3)

Panel A: OLS regression of Model 5												
	Dependent variable is (FV)						**Dependent variable is (FV)**					
	Column 1			Column 2			Column 3			Column 4		
	*Independent RT_1*EM_1*			*Independent RT_1*EM_2*			*Independent RT_2*EM_1*			*Independent RT_2*EM_2*		
	B	t	Sig.	B	t	Sig.	B	t	Sig.	B	t	Sig.
Intercept	3.343***	10.439	0.000	3.260***	10.198	0.000	3.339***	10.423	0.000	3.356***	10.504	0.000
RT_1	1.697***	7.050	0.000	1.698***	6.429	0.000						
RT_2							0.590***	5.620	0.000	0.568***	5.298	0.000
EM_1	1.475**	2.575	0.010				1.210**	2.039	0.042			
EM_2				1.425**	2.421	0.016				1.190*	1.955	0.051
RT_1*EM_1	-6.650***	-2.984	0.003									
RT_1*EM_2				-6.575***	-2.661	0.008						
RT_2*EM_1							-3.068**	-2.033	0.030			
RT_2*EM_2										-3.818**	-1.961	0.044
FirmSize	-0.169***	-8.673	0.000	-0.170***	-8.724	0.000	-0.168***	-8.494	0.000	-0.169	-8.549	0.000
LEV	0.197	1.516	0.130	0.195	1.504	0.133	0.040	0.309	0.758	0.041	0.315	0.753
ROA	2.741***	9.046	0.000	2.711***	8.932	0.000	2.920***	9.475	0.000	2.924***	9.497	0.000
FAge	0.104**	2.555	0.011	0.104**	2.548	0.011	0.103**	2.493	0.013	0.102**	2.479	0.013
ASize	0.210***	4.503	0.000	0.211***	4.533	0.000	0.224***	4.763	0.000	0.224***	4.756	0.000
Industries	Included			Included			Included			Included		
Years	Included			Included			Included			Included		
Adjusted R Square	38.1%			37.9%			39.9%			39.9%		
F test	21.636***			21.526***			20.662***			20.643***		
Obs.	1008			1008			1008			1008		
Panel B: OLS regression of Model 5 after controlling lagged firm value												
	Dependent variable is (FV)						**Dependent variable is (FV)**					
	B	t	Sig.	B	t	Sig.	B	t	Sig.	B	t	Sig.
Intercept	0.736***	3.615	0.000	0.929***	4.557	0.000	0.893***	4.455	0.000	0.895***	4.483	0.000
RT_1	0.581***	3.984	0.000	0.558***	3.494	0.000	0.190***	2.997	0.003			
RT_2										0.204***	3.161	0.002
EM_1	0.375	1.035	0.301				0.292	0.781	0.435			
EM_2				0.229	0.622	0.534				0.250	0.659	0.510
RT_1*EM_1	-3.230**	-2.346	0.019									
RT_1*EM_2				-2.896*	-1.908	0.057						
RT_2*EM_1							-2.799**	-2.257	0.020			
RT_2*EM_2										-1.974**	-2.485	0.0138
FirmSize	-0.041***	-3.246	0.001	-0.042***	-3.292	0.001	-0.040***	-3.157	0.002	-0.040***	-3.173	0.002
LEV	0.019	0.231	0.817	0.018	0.227	0.821	-0.031	-0.384	0.701	-0.034	-0.426	0.670
ROA	0.753***	3.840	0.000	0.729***	3.711	0.000	0.785***	3.940	0.000	0.777***	3.901	0.000
FAge	0.021	0.770	0.442	0.020	0.764	0.445	0.018	0.686	0.493	0.019	0.692	0.489
ASize	0.050*	1.727	0.084	0.051*	1.742	0.082	0.053*	1.806	0.071	0.054*	1.822	0.069
FV_{t-1}	0.798***	40.695	0.000	0.799***	40.676	0.000	0.804***	41.026	0.000	0.804***	41.033	0.000
Industries	Included			Included			Included			Included		

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/m7649526929

Years	Included	Included	Included	Included
Adjusted R Square	78.9%	79.6%	78.8%	78.7%
F test	116.281***	115.976***	115.099***	115.189***
Obs.	924	924	924	924

5. Discussion and conclusion

This research contributes to the existing literature by investigating the effect of RT on firm value and the effect of RT on EM. We depend on a sample of nonfinancial firms listed on Saudi Arabia Stock Exchange (Tadawul), during the period 2008 to 2019, where the final sample size includes 1008 firm years observations. The results revealed a positive effect of RT on firm value in Saudi Arabia, consistent with the agency theory that (Jensen & Meckling, 1976), and existing empirical empirical literature (e.g., Imhof et al., 2014). In addition, we find a positive effect of RT on EM in Saudi Arabia, consistent with previous studies indicating that firms with RT use various accrual accounts for concealing the material information regarding risky investments, which ultimately decreases transparency and financial statements' quality (Mayberry et al., 2021; Cao et al., 2023).

Besides, our results revealed that EM moderates the relationship between RT and firm value in Saudi Arabia. This finding is consistent with the agency theory (Jensen & Meckling, 1976), indicating that the prevalence of EM practices along with rising risk behavior alters the market valuation of these risk-taking activities. Managers tend to use EM to reduce volatility or conceal true performance, thereby distorting accounting information during risk-taking periods. Such a distortion undermines investor confidence and increases information asymmetry, ultimately raising the cost of capital and reducing firm value.

This study contributes to literature by presenting unique evidence on the relationship between RT and firm value in emerging markets, such as Saudi Arabia, by investigating the moderating role of EM in the RT-FV relationship. At the practical level, our findings highlight to businesses and investors importance of considering the expected negative implications that emerge when firms implement RT policies. The current study ensures that more opaque financial information and earnings manipulations would be the result when managers engage in higher risky investments, which can have significant negative implications for the capital market, such as stock price crashes. In this context, governments and regulators should ensure the application of effective oversight and corporate governance mechanisms in firms to reduce the negative implications of risk taking.

Finally, our results are not without limitations as we measured RT depending on volatility in ROA and ROE, and EM depending on accruals EM. Future research can re-examine the underlying relationships depending on different proxies for RT and real activity manipulation. Moreover, future research may consider re-examining the existing relationships across longer periods, considering bankruptcy risks when testing the effect of EM on the relationship between RT and firm value. Finally, future studies may consider investigating the effects of macro-economic variables, such as economic policy uncertainty and geopolitical risks, on the relationship between RT and firm value.

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Acknowledgement
The authors extend their appreciation to the Deanship of Postgraduate Studies and Scientific Research at Majmaah University for funding this research work through the project number (R-2026-154).

Author Contributions: Conceptualization: *Aref M. EISSA, Saleh Ali El ABD*; methodology: *Aref M. EISSA, Ahmed DIAB*; data analysis: *Aref M. EISSA, Saleh Ali El ABD*, writing—original draft preparation: *Aref M. EISSA, Saleh Ali El ABD*, writing; review and editing: *Aref M. EISSA, Ahmed DIAB*; visualization: *Saleh Ali El ABD, Ahmed DIAB*. All authors have read and agreed to the published version of the manuscript.

ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/m7649526929

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n9976446883

Publisher
http://jssidoi.org/esc/home

ATHLETES' DROPOUT FROM SLOVAK FOOTBALL – SOCIAL IMPACT OF THE SPORT DETERMINED VIA ITS GEOGRAPHICAL PERSPECTIVE*

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Received 18 February 2026; accepted 29 April 2026; published 30 June 2026

Abstract. The article focuses on athletes' decision to leave organized football in Slovakia. It reveals the impact of this sport on society from a sports geography perspective, understood as the spatial distribution of football participation, accessibility of clubs and infrastructure, and regional disparities affecting athletes' retention, which is still underdeveloped in research. We aim to explore selected aspects to understand the current decrease in the young athletes' participation in the Slovak Football Association's (SFA) competitions. The quantitative methods applied to the data include logistic regression and correlation analysis, with the models being assessed by their accuracy, sensitivity, and specificity. We used an exclusive data set provided directly by the SFA, as well as data extracted from the Sportnet API. This created a unique primary material for our research needs, complemented by official Sport in Figures reports (2015–2021) as secondary data sources. We identified variables significantly influencing the likelihood of athletes staying in organized football (including the age of starting with football, basic line-up, and yellow cards). Based on the results, we defined recommendations for effective athletes' retention strategies so that the sport's social impact, quantified by its geographical dispersion, can be maximized.

Keywords: sports; sports geography; Slovakia; sports management; football

Reference to this paper should be made as follows: Varmus, M., Toman, R., Miciak, M., Sarlak, M., Pancikova, L. 2026. Athletes' dropout from Slovak football – social impact of the sport determined via its geographical perspective. *Entrepreneurship and Sustainability Issues*, 13(4), 395-418. http://doi.org/10.9770/n9976446883

JEL Classifications: J24, R12, Z13

1. Introduction

Sports represent a dynamic area affecting employment and economic activity (Barbu et al., 2020; Chadwick, 2022; Guidotti et al., 2023). Embedded in mainstream business, sports developed links with politics, education, and economy, having a major social and cultural impact in a broad context (Patatt & Sandes, 2025). The growing economic importance of sports created the need for a governance structure (Tomino et al. 2020) provided by sports management (Hammerschmidt et al., 2023). It is the decisions of national sports organizations' managers that form the current situation in a particular sport in the country, affecting society via the sport's spatial coverage (its geographical perspective), which in this study is understood as the territorial accessibility of sport, regional distribution of clubs and infrastructure, concentration of athletes, and differences in opportunities for participation across regions. The more dominant the sport is in the country and the greater area it covers, the

* *This article is the outcome of the project KEGA: 052ŽU-4/2025 The creation of multimedia content for athletes' online dual education in sports management and marketing – career after sports career.*

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n9976446883

greater responsibility is put on the sport's national authority. This is exactly the case of football in Slovakia, being formed by the decisions of managers in SFA.

Sports management must define core knowledge to provide adequate competencies for sports managers and other stakeholders (Liu & Lin, 2012). The basis for its expansion is multidisciplinary sports' research put into broader social context (McCullough et al., 2020). However, this remains a small sub-discipline of managerial and social studies (Masteralexis & Hums, 2023). For its further development, utilization of economics, sociology, psychology, political science, and geography is necessary (Gammelsaeter & Anagnoustoupoulos, 2022). Sports management research expanded beyond traditional approaches, exploring different perspectives (Rich et al., 2021; Bodin et al., 2022; Kim et al., 2024), including sports geography. According to Bale and Dejonghe (2008), the link between these fields' dates to 1879, but such studies usually focus solely on sports. This limits the possibility of harnessing the capacity of research from geography for novel findings with true social impact. The complementarity between geography and sports lies in the geographic components of sport activities (Hall & Lin, 2024). Methods specific to geography are used to ascertain the sports activities' social impact (Koch, 2018; Hall & Lin, 2024), including cartographic approaches (Chirazi, 2019). Their application enables a systemic understanding of phenomena, leading to smoothly working spatial systems (Ilies et al., 2014). Bale (2002) adds that sports geography is understood as examples of systemic mechanisms, exploring the changing landscape characteristics and the symbiosis between the sports environment and its participants to develop new strategies. However, it is not just the direct participants of sports activities. The total impact sports have on society is extended via the sports fans and spectators, youths' meaningful leisure time activities, and the people's healthier and more active lifestyles. All this is built on the sport's popularity as well as its accessibility throughout the country. This is where sports affected by their governance structures meet the geographical aspect in the effort to enhance sports' positive effects on modern societies.

Sports geography needs to be combined with the socio-economic factors in sports management research and practice. Sports became an everyday-life element with corresponding socio-economic risks (Bourg & Gouguet, 2023). Applying this framework explains both basic social and economic motives connected to the participation of society in sports (Ejekwumadu, 2025). However, these factors are difficult to identify because they relate to people's characteristics, often varying within the same community or between groups (Karney, 2021). Moreover, these variables are dynamic by design (Ginevicius et al. 2021; Conger et al, 2021). Including socio-economic factors in research provides a comprehensive picture of sports in a particular region (O'Neil, 2022; Lera-Lopez & Marco, 2022), helping identify areas where interventions are necessary to promote social equity as another part of the sports' impact on society (Prudky, 2022; Dická & Lipták, 2024). Sports' socio-economic and geographical characteristics are studied within geopolitics, socialization as well as housing and migration (Galindo, Vega, 2024; Meneses et al., 2024; Torres, 2024). Still, the research addressing geography of sports connected to sports management for greater social impact is limited (Wise & Kohe, 2020; Kohe & Wise, 2023).

The approached topic gets even more complex with the inclusion of the data available and the ways they can be analyzed. Data analytics are crucial, and its importance grows as technology advances. Strategic emphasis is on the use of data analytics in supporting managerial decision-making with consequent social effects. Szukits and Moricz (2024) motivate towards the building of an analytical decision-making culture. This promotes better use of data at every stage of decision-making. Data analytics is currently revolving around Big Data. This is transforming the decision-making process (Koman et al., 2018; Pittenger et al., 2023), increasing the decisions' quality (Li et al., 2022). Organizations are recommended to popularize Big Data, improving corresponding employees' skills (Staffenova & Kucharcikova, 2023). This is also applicable in sports organizations, leading to better focus on the sports managers' decisions with greater social impact. Data analytics supporting organizational decision-making is an ever-developing area. Pu et al. (2024) focus on Artificial Intelligence (AI) analytics, bringing innovative approaches even to football.

Our study focuses on the analysis of data provided by the SFA exclusively for this research in connection with the geographical aspect determining the sport's broader impact on the whole society. We followed the identified gap, analyzing spatial and managerial factors influencing the dropout of athletes from Slovak organized football with the corresponding social consequences. Our aim is to examine these aspects to better understand their dynamics, leading to the decline in athletes' participation after the age of 15. This research focuses on

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n9976446883

identifying the factors contributing to the problem of young athletes leaving organized football. Thus, it provides a basis for effective strategies to retain young people in organized sport, supporting the corresponding social value of their participation. Leaving organized football is understood as not participating in competitions organized by the SFA.

Our motivation for including sports geography is to address the research gap identified and apply the geographical perspective in the determination of football's impact on society. The study is based on theoretical backgrounds and previous research described in the following chapter. The selected problem has not been sufficiently addressed within Eastern Europe yet. Furthermore, our research responds to the request of the SFA identifying this issue as its key priority. The SFA highlighted the declining participation of youths as a critical challenge and emphasizes the need for a deeper understanding of the underlying factors. This concern is shared by several experts from the Ministry of Tourism and Sports of the Slovak Republic (MTSSR), aware of the long-term consequences of the decline in youths' participation in professional football. Studying the issue is essential not only for the development of football, but also for the wider social and regional dynamics of recreational sports. Our results serve as a guide for targeted strategies to increase youth retention in football. The research also contributes to a more accurate understanding of the factors influencing youths' dropout from football, supporting the national football policy. Previous research in this area has focused mainly on socio-economic factors. We focus on understanding the dropout after the age of 15, combining sports performance, socio-economic background, and regional differences in Slovak football. This is embedded in the broader context of football's social impact, determined via the geographical perspective. We formulated the following research RQ: How can the football association and the clubs influence the dropout of athletes from organized football, considering the context of sports geography and the socio-economic environment?

The article's structure includes theoretical background, methodology, research results, discussion and conclusion. The theoretical background covers the link between football's social impact expressed by the geographical perspective and the decisions sports managers can make to support the youth's participation in this sport. The methodology explains the process of data preparation and analysis to obtain the results interpreted below. The discussion compares our findings with relevant research, and the conclusion summarizes the most significant findings and recommendations drawn from them.

2. Theoretical background

The issue we studied was addressed in the past in several countries, including England or Germany (Bale, 2002). However, there is shortage of knowledge from the perspective of Slovakia's geographical setting. Despite numerous researchers who approached the topic (Bale, 2002), there is still a need for further research on sports geography applied to determine the sport's social impact and its maximization via proper decisions and policies. Such research should focus on the sports environment, athletes' decisions to stay in the sport, and other related characteristics. This need arises in response to socio-economic factors causing the problem that have already been analyzed. The current situation is described within the theoretical background.

2.1 Sports geography perspective in the determination of the sport's social impact

In the context of this study, the geographical perspective of sport is defined as the way sport is distributed and experienced across space, including regional differences in infrastructure, club availability, accessibility for participants, and uneven retention of athletes. This perspective allows the social impact of football to be interpreted not only through participation numbers, but also through its territorial reach and inclusiveness. Although this direction is not currently dominant, it offers scope for studying the causes and consequences of athletes leaving organized football, allowing for the desired interdisciplinarity in research (Rauch, 2022; Menge et al., 2024; Valiyeva et al., 2024). The field studies spatial organization of sports, geographical density of football, and the impact of infrastructure on the retention of athletes in professional and amateur competitions. The analysis of these aspects involves the connection of sociology, economics, and geography (Bale, 2002). Although geographers made significant contributions to sports research, their studies mainly approach political or urban geography. This limits broader interdisciplinary collaboration in the analysis of social factors leading to the termination of athletes' careers in football (Smith et al., 2023).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n9976446883

The economic aspects of sports geography are related to the analysis of professional football markets, investment in clubs, and their regional impact. Additionally, this part of sports geography studies issues funding youth academies and the uneven distribution of resources between elite and amateur football. This contributes to early careers' termination (Hem et al., 2022). Economic inequality among large clubs and smaller regional teams can lead to insufficient support for talented athletes.

The spatial organization of football is influenced by historical, social, and economic factors. Some regions produce more professional athletes due to infrastructure investments, cultural traditions or their training systems. In other areas, athletes have limited opportunities for growth, leading to early careers termination. The concept of sports capes highlights how the availability of stadiums, training centers, and quality youth programs influences athletes' retention in football. Insufficient infrastructure and limited access to training opportunities belong to the key factors forcing athletes to leave organized sport prematurely. This background shows the close interconnections of geographical and social factors, affecting the final sports' position in society. Later in the results, we build on this, depicting the sports' (particularly football's) social impact via the geographical perspective.

2.2 Athletes' dropout affected by the sports managers' decisions

Sports management plays a pivotal role in the process of retaining athletes in organized football. Effective club management, properly set incentives, and quality care can minimize the talents' premature dropout (Zelenkov & Soltsnev, 2023; Hammerschmidt et al., 2024). Social media and marketing impact the creation of strong bonds between athletes, clubs, and fans. This helps keep athletes in football longer (Behrens & Uhrich, 2022). Research studying this focuses on linking sports management with geography, creating space for collaboration among clubs, coaches, and wider community to reduce premature termination of athletes' careers in football (Galindo & Vega, 2024).

Sports managers also need education in geographical aspects to be able to make decisions on the development of athletes' careers. Hall and Lin (2024) point to the need for a better pedagogical understanding of sports geography regarding the sports careers' termination. DeChano-Cook and Hallett (2024) recommend including human and physical geography in teaching to help analyses the factors leading to the athletes' dropout from the organized sports. According to Girginov (2001), it is essential to support teaching with research so that knowledge can be transferred to education and sports management, creating better conditions for longer sports careers.

Athletes' dropout from organized sports is caused by multiple factors. These include the lack of enjoyment, excessive pressure, and negative experiences (Schlesinger et al., 2018; Eliasson & Johansson, 2020; Back et al., 2022a). Psychological stress, burnout, and physical exhaustion contribute significantly to careers' termination in competitive environments (Back et al., 2022a; Soares & Carvalho, 2023). Socio-economic barriers, issues with commuting to training and competitions, changing interests, and injuries are influential here (Espedalen & Seippel, 2022). Parental influence, early specialization, and inadequate support systems increase adolescents' disengagement from sports (van Yperen et al., 2022; Bergin & Lagestad, 2023). Addressing this requires coaching strategies and an inclusive sports environment (Back et al., 2022b). A proper analysis of data is essential to identify the main factors causing the problem in a specific region.

3. Methodology

There is a link between data analysis and managerial decision-making in sports organizations. Individual mobility and human patterns analyzed from multidisciplinary studies are not sufficiently applied within sports geography. Areas of concern include the evaluation of Big Data representing individual behavioral patterns (Rauch, 2022). Focus on further application of data analytics in sports geography is vital. Hoye et al. examined the decision-making role within Canadian national sports organizations. They studied the processes facilitating decision-making. As revealed, sports managers focus on strategy development using data analytics (2023). Decision support in sports organizations in Latin America was addressed by Pérez et al. (2023). They identified gaps in the decision-making process, recommending a decision support model for sports managers ensuring a methodical and operational approach. This is where our study follows, approaching the issue of athletes' dropout

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from organized football in Slovakia, showing applicable results with potential social consequences based on advanced data analytics.

Our research utilizes data mining on a unique primary dataset with further statistical modelling. The dataset used for this procedure was provided exclusively for this research by the national football governing body, the SFA. The arguments that the data from the SFA were not used in any other research and that they were collected in close cooperation with the research team members support their primary nature. Accompanying the primary data, relevant sources of secondary data were used as well, being described later. The problem's specification is the youths' dropout from organized football after the age of 15. The aim is to identify the factors contributing to this phenomenon. The research hypothesis was defined based on previous research in the field as follows, H: The selected variable xi significantly influences athletes' dropout from organized football. Thirteen independent variables (xi, i = 1 – 13) were examined within the hypothesis's verification. These are defined later in the text. The research harnessed multiple software (SW) tools. These were used to calculate the selected statistics, process data sources, and create graphical outputs. MongoDB and MongoDB Compass were applied to process the JSON files from the SFA and the Sportnet API data. Postman was used to send requests to the Sportnet API server. Python was applied for data modification. RStudio was used for modelling. Other data operations were performed in MySQL.

Data Processing – Data sources included mainly the SFA data collection, the Sportnet API, and Sport in Figures ("Šport v číslach") reports (2016a, 2016b, 2018, 2019, 2020, 2021, 2022). Figure 1 illustrates the data processing procedure as a complex approach from the initial data acquisition to the final analysis. The SFA data collection contained the data from the matches covered by the SFA since the 2012/2013 season in object form (JSON – array). The file included data types of number, string, Boolean, or object and array. Another data source was the API (Sportnet API, 2023) with data on players, clubs, and organizations. We used the Sportnet APIs denoted Transfer and User.

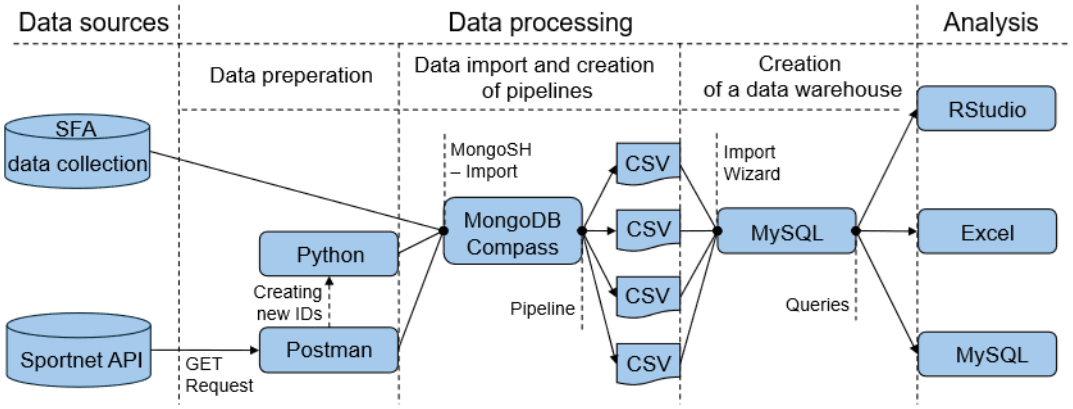


Figure 1. Research data preparation and processing
Source: Own processing

Preparing the Data for Analysis

To get the data from the API, queries were sent to the Sportnet server. Before importing the API data, the Transfer data went through the process of creating a unique ID, as there was an error when trying to import it due to duplicate IDs. This occurred because of the efforts to insert the same ID multiple times. A player ID was used in the transfer record where players can be a part of a transfer multiple times during their careers. To create the composite key, we used Python to cycle through each document, changing the _id to "player_id", adding a new string representing "player_id" + "date_from" (the start date of the transfer). This was assigned as the new _id of the transfer record, solving the problem of duplicate entries. We converted the data from the unstructured to the structured form. We performed the data processing at the NoSQL document level, using the MongoDB tools Compass and mongosh. An example of data processing is the "protocol" object containing an "events" sheet, with a record of each event from the match.

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Creating a Data Warehouse

After creating the data pipelines, the data were exported to CSV files. These were uploaded to MySQL, where each table represented a separate data feed. Before displaying the created ERD model, we defined the basic properties. The unique player identifier was in the "player_id" column. The processed data was viewed in a time horizon with the codebook of the season table. It was convenient to group the data by a numerical identifier of the season (e.g. id – 11; name – 2022/2023). As additional summarization keys and filtering tools, we used "competition_id" (specifying the category and geographical location) and "competitionPart_id" (part of the competition.

Creating the Training and Test Sets

We used MySQL to create the final data set for the training and test sets. Since the tables had tens of thousands of records, the query response did not come in some cases. We solved this via a temporary table with indexes, reducing the computational complexity.

Table 1. Final data cleansing from outliers in MySQL

Season	Number		Discards			Percentage of Discards (%)
	Total	Final	Year	Logic	Goalie	
2	3,245	2,740	9	140	372	4.62
3	3,418	2,887	9	145	391	4.62
4	3,326	2,855	3	126	354	5.21
5	3,405	2,840	6	131	384	5.49
6	3,214	2,770	5	107	341	3.58
7	3,604	3,099	1	119	397	3.36
8	3,350	2,886	1	88	386	2.63
9	3,324	2,800	12	69	350	2.57

Source: Own processing

Table 1 shows the elimination of athletes by season (2 = 2013/2014 to 8 = 2020/2021). The proportion of discarded values is a maximum of 6%. Therefore, the data remained unbiased. Before entering the training and testing data into the RStudio, we filtered out goalkeepers, those whose SFA registration ("old_when_start") was less than 5 and greater than 14 (possible bias), and those whose year of birth was the highest in the season. Goalkeepers were excluded because of the statistics tracked by them.

We removed invalid and inconsistent values. We also excluded data representing a source of potential errors (e.g. incorrectly recorded player registrations). This increased the reliability of the data and the accuracy of output. Additionally, to ensure cross-validation in our research project, we analyzed the data using decision trees, random forests, and the support vector method. These steps corroborated the correctness of our results but were not included within the scope of this study. The total sample for the research consisted of 22,877 athletes in the given age range. The number of athletes in these categories does not change rapidly during the period studied. However, the issue is their continuation in professional sport.

Modelling

The final step of our methodology was modelling itself. We used logistic regression for binary classification to predict which of the two categories the input belongs to. This model applies a logistic function to the training data, mapping the input values to an interval between 0 and 1. The value is interpreted as the probability that the input belongs to the positive class (1), (Hastie et al., 2008).

The logistics function is defined as follows: $p(x) = 1/ (1 + exp(-z))$, where p(x) is the predicted probability of the output, exp is an exponential function, and z is a linear combination of the input features. This is written as: $z = b0 + b1x1 + b2x2 + \ldots + bnxn$, where b0 is the intercept and b1 to bn are the coefficients of the input features.

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Logistic regression was selected as an appropriate tool for the problem approached. It is a method used in the past in similar studies (van Yperen et al., 2022; Espedalen, Seippel, 2022; Chen et al., 2023; Schmid et al., 2024). However, in combination with sports geography and sociology, it is still a less common approach allowing the analysis of relationships between spatial factors and sports performance (Wise, Kohe, 2020; Hall, Lin, 2024).

4. Results

Our research is divided into interconnected parts, providing multiple perspectives on the issue. The first part includes the analysis of secondary data. The remainder presents the results of the primary data analysis (the exclusive SFA dataset). We focus on the participation rate of the population in sports, investigating how many people are actively involved in sports activities. This part addresses regional differences in sports participation, with sports geography enabling a deeper examination of the spatial distribution and the actual impact of sports on society. This part explores inequalities in access to sports activities and the disparity of results from different statistical approaches. We also work with relevant secondary data to describe the socio-economic conditions of Slovakia related to football and the popularity of this sport in the country. These arguments justify the overall focus of the study on football, show the impact of this sport on the country's total sports participation, and depict the socio-economic context necessary for the extrapolation of further analysis's results and their applicability in other regions.

The second part of the results starts with the basic statistical analysis of the SFA data, identifying significant trends and patterns. This is followed by correlation analyses, descriptive statistics, and other methods to identify relationships among the variables studied. At this stage, sports geography perspective is crucial, as spatial analyses bring more precise mapping of behavioral patterns and regional differences. The third part focuses on logistic regression we used to model the likelihood of young athletes' continuous participation in sports activities. Logistic regression helped us identify the factors with the greatest influence.

Population's Participation in Sports

Understanding population's participation in sports is pivotal when examining the dropout from organized football. This parameter allows the identification of target groups of players with the highest risk of leaving and reveals regional and social differences in sports participation. This is essential for the development of effective athletes' retention strategies. According to a study by Malm et al. (2019), healthy lifestyles including active sports participation are a benefit of elite sports events. The findings are consistent with the sports development results from the 1984 Los Angeles Olympic Games. However, sports events can only be used to increase the participation rate of the population in sports if the necessary collaborations among sports organizations, event organizers, and non-sport stakeholders are established via the marketing mix (Chaplin et al., 2016). Denmark is an example of using and maximizing the marketing mix in sports. This country strives to become the most physically active nation in the world. The Sport Concept supports the goal that by 2025, 75% of the population will participate in sports and 50% will be active in sports organizations (European Commission, 2024).

This long-term goal in Denmark is reflected in their current achievements, as according to the results from 2019, Denmark and Sweden achieved the highest levels of population's participation in sports in the EU, at 75.8% and 75.3% respectively (Fig. 2). The EU average was 41.05%. At the other end of the ranking, there are countries such as Romania (6.3%) and Bulgaria (13.6%). Slovakia has a participation rate of 32.6% (18th place) with the need to improve the conditions for sports activities. These significant variations point to regional differences in access to sports and varying levels of support for active lifestyles (Eurostat, 2019).

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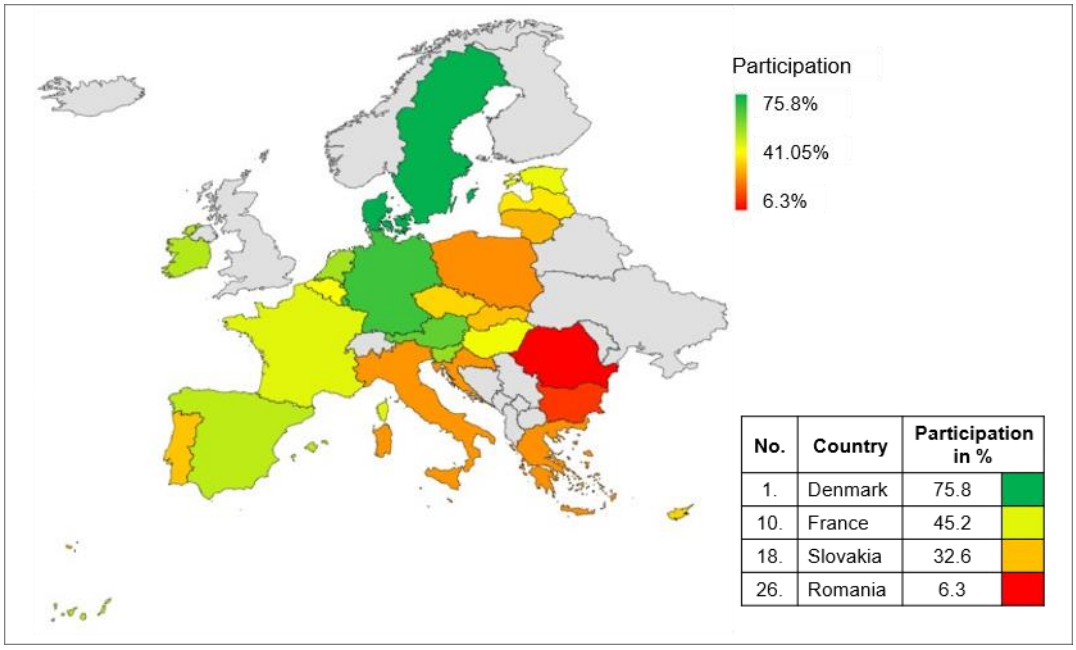


Figure 2. Participation rate of the population in sports
Source: Eurostat, 2019

The results are partially affected by quantitative measurement of physical activity in Eurostat databases (2019). There is another approach (Fig. 3) focusing on combining qualitative and quantitative data collected via interviews to gain insight into people's actual physical activity. The difference is in the percentages of the population participating in sports. According to this approach, Denmark is only in 4th place with 59% and Slovakia has a higher participation rate of 35%. However, this is still low compared to the most-active countries, with Finland reaching the level of 71% (Eurobarometer, 2022).

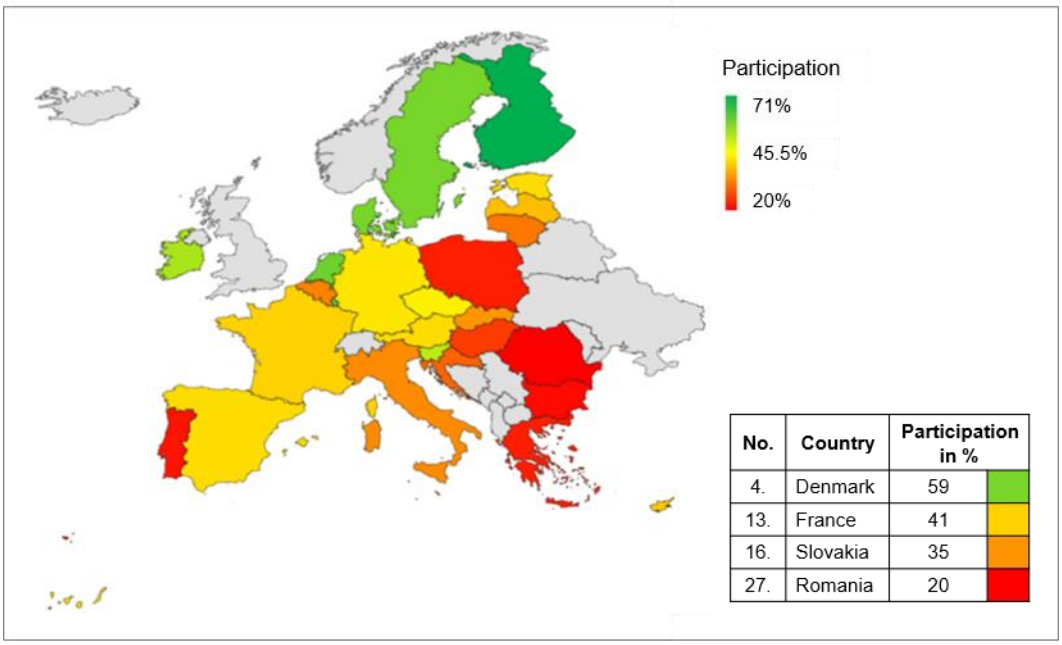


Figure 3. Participation rate of the population in sports
Source: Eurostat, 2022

The different methodological approaches of the European Health Interview Survey and the Eurobarometer (2022) influence the analysis of factors leading to athletes' dropout from organized football. This divergence of surveys shows why data modelling is so important in our study. However, in the case of Slovakia, both approaches show low participation in sports, suggesting that the problem of athletes leaving organized competitions may be related to this.

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Socio-economic Characteristics of Slovakia

UEFA, in collaboration with leading universities, research institutes, and football associations, developed the Social Return on Investment methodology to quantify the impact of football on society. In 2019, this was applied in Slovakia in collaboration with the SFA (2020). The study focused on four main areas: economics, health, social affairs, and sports performance. Each of them was analyzed using specific research tools.

Football contributed €54.1 million to the Slovak economy (€19.5 million in investment in football infrastructure; €34.6 million in expenditure by football players). 14,000 people earn an income from football-related activities. The health benefits of football are estimated at €105 million annually. These include savings in the prevention and treatment of various diseases, reduced mental health costs, and the perceived happiness value football brings. The social aspects of football are reflected in the savings of €18.9 million annually related to crime prevention, education, and the value of volunteer work. Football also contributes to increasing the country's sports performance measured by the UEFA rankings. The growing number of players has a direct impact on the quality of the game and the national team's success. The SFA can secure one new football player for every €120 and get a social return of €1,664, generating high social value. The mechanisms and strategies for the effective utilization of these investments are detailed in the SFA's strategic plans. Football's Popularity in Slovakia and Abroad – The Ministry of Tourism and Sports of the Slovak Republic (2024a) conducts a survey every two years to determine domestic interest in individual sports. This interest is assessed based on methodologies serving as a factor in determining funds for individual sports. Foreign interest is assessed similarly. Football has a domestic interest of 7.30%, putting it in second place after cycling. Its foreign interest is 14.50% (the highest value among the sports included). The ratio of domestic to foreign interest in sports has long shown that this sport is the most popular in Slovakia. Football is the most widespread sport globally with a massive fan base. This is evidenced by the online analysis Topend sports (2025), monitoring 13 selected rankings of the most popular sports worldwide.

Slovak football is organized through more than 1,732 clubs, youth development centers, football academies and 64,606 (MTSSR, 2024a) registered players, with significant regional disparities in infrastructure. Bratislava region, while relatively small in its area, concentrates 99 clubs, 5 youth development centers, and 2 academies, reflecting its professional infrastructure. Trnava and Nitra regions have 214 and 272 clubs respectively, with Trnava operating both 1 youth development center and 2 academies, while Nitra has 4 youth development centers but no academy. The Prešov region stands out with the highest number of clubs (268) and 7 youth development centers, yet only 1 academy, illustrating the imbalance between participation and elite pathways. Similarly, the Košice region has 225 clubs and 3 youth development centers but just 2 academies. Western Slovakia overall concentrates a greater part of the professional infrastructure and academies, whereas Eastern Slovakia shows higher grassroots engagement but limited elite opportunities. These uneven geographical and socio-economic conditions form an essential background for analyzing the athletes' dropout from organized football after the age of 15. The exact values for each Slovak region are listed in Table 2.

Table 2. Regional differences within the organized football in Slovakia

Region	Football clubs	Youth development centres	Football academies
Bratislava	99	5	2
Trnava	214	1	2
Nitra	272	4	0
Trenčín	225	3	1
Žilina	233	3	3
Banská Bystrica	196	3	3
Prešov	268	7	1
Košice	225	3	2

Source: SFZ – Youth development centers, 2025; SFZ – Football academies, 2025; Slovak sports portal, 2025

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For a better understanding of the regional differences within different parts of Slovakia, the data were visualized in Fig. 4.

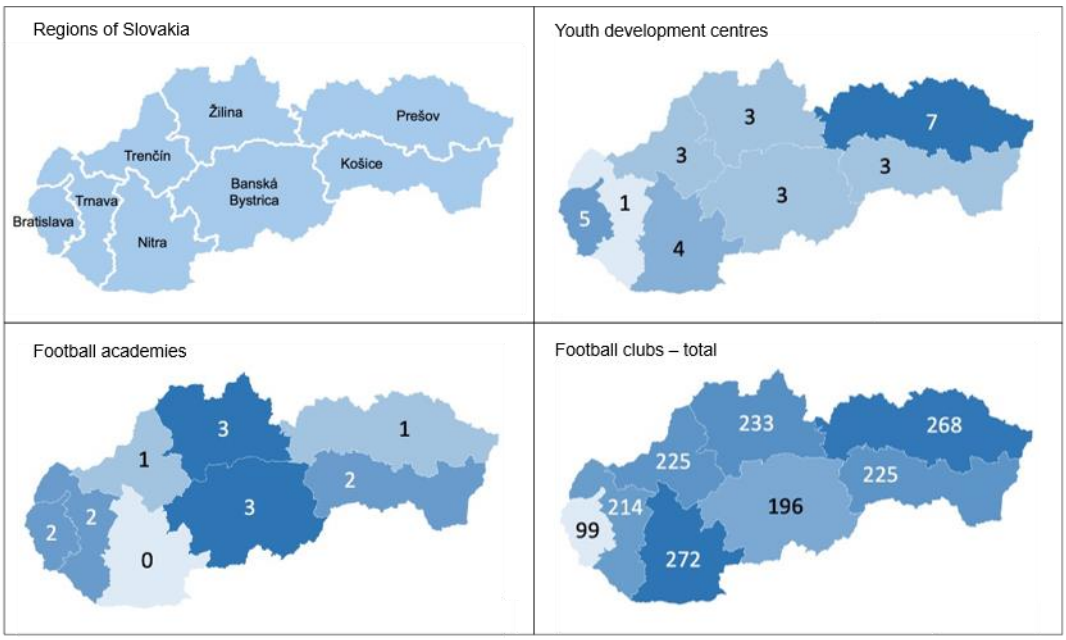


Figure 4. The number of researched elements of Slovak football; created using Bing – Microsoft, OpenStreetMap
Source: SFZ – Youth development centres, 2025; SFZ – Football academies, 2025; Slovak sports portal, 2025

The data on development of the number of registered football players in Slovakia must be analytically processed since 2014. This obligation is in accordance with the Act on Sports. However, it does not concern the entire population of athletes. Only football players registered up to the age of 23 (U23) are included. Analyzing the available development of the number of registered football players (table 3), the decrease between 2016 and 2017 was identified. The number of players decreased from 80,623 to 65,162 (a decrease of 15,461 players, approximately 19%). After 2017, the number increased slightly but did not reach the level of 2016. From 2018 to 2020, it fluctuated around 66,000 to 67,000, while growing only moderately.

Table 3. Decline in the number of athletes in organized football in Slovakia

Year	2015	2016	2017	2018	2019	2020
Number of U23 athletes	75,984	80,623	65,162	66,422	66,746	67,673

Source: NCSR (2015); MTSSR (2024b)

This problem is seen as urgent by the SFA, which led to the request for our study.

Results of Statistical Analysis

Our statistical analysis studied several factors influencing the selected issue in Slovakia. The analyses focus on the number of football players in primary and secondary sports schools by region, the average age of athletes' registration in the SFA, the average number of nominations per match, the average number of matches in the starting line-up, the average number of goals per season, and the differences of other independent variables. A correlation matrix with variables' coding is presented. Coding is important for logistic regression as well.

The analysis shows that the number of pupils attending primary school football classes in Slovakia has decreased by 548 between 2015 and 2021. In 2015, 3,454 pupils were registered in sports classes, while in 2021 this number decreased to 2,906. This downward trend was observed since 2015, but the regular reduction in pupil numbers started in 2018, with an average decrease of approximately 5% per year. The reduction in pupil numbers was influenced by several factors, including the COVID-19 pandemic.

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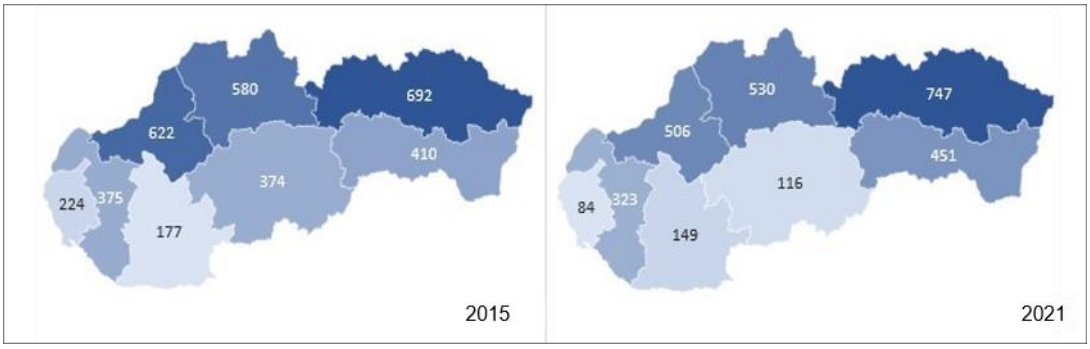


Figure 5. Number of football players in primary sports schools by region – comparison between 2015 and 2021
Source: Sport in Figures reports

Figure 5 shows that Eastern Slovakia was the only region with an increase in the number of pupils in these classes. This growth contrasts with a nationwide downward trend, suggesting regional differences in corresponding factors. A similar downward trend is observed in secondary schools. This can be affected by a change in the methodology of data recording between secondary schools and secondary sports schools. This is confirmed by the data from the counties as well as the distribution of pupils by year group. The number of freshmen in high schools declined each year, which is reflected in the total number of students in high schools with a lag of approximately three years, while maintaining a stable attrition rate between grades.

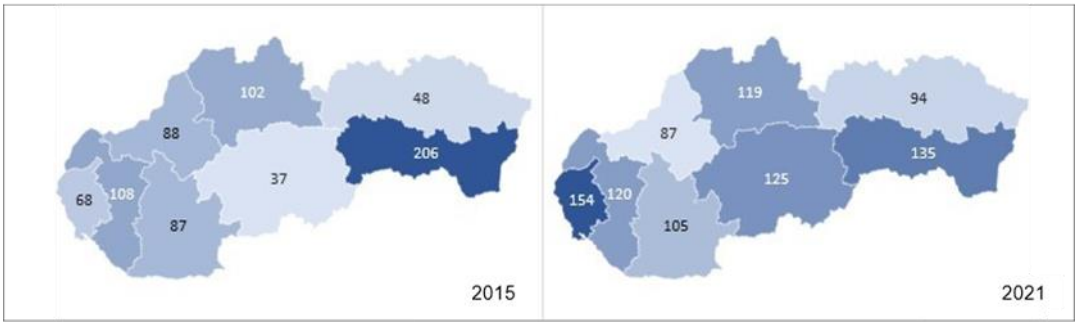


Figure 6. Number of football players in secondary sports schools by region – comparison between 2015 and 2021.
Source: Sport in Figures reports

Figure 6 illustrates the change between 2015 and 2021, where a more even distribution of students between secondary sports schools is evident. There was a general increase in the number of students in such schools over the period studied, with an increase of 115 students in Western Slovakia and 105 students in Central Slovakia. The opposite trend was observed only in Eastern Slovakia, where there was a decrease of 25 students. The data concerning secondary sports schools indicate the opposite trend of students' migration compared to primary schools, again corroborating regional differences.

We also analyzed the athletes' age at registration into organized football. This is crucial in predicting the continuation of a sports career. Fig. 7 (variable x1) shows that the earlier an athlete registers, the higher the probability of continuing with organized football. The decrease in the age of registration may indicate that starting organized football at a younger age is an important factor for further development of athletes and their long-term persistence in the sport. The number of stars an athlete makes in the starting line-up and the number of nominations per match are closely related variables (Fig. 7, x2 and x3). Although these two variables evolve in parallel, the difference between them is stable (in the interval from 4.9 to 6.2), signaling that athletes who start more often in the starting line-up are more likely to continue in the sport. Another significant variable is the number of goals scored (Fig. 7, x5). Prior to the start of the pandemic, the average difference in the number of goals between continuing and non-continuing players was approximately 4.5 goals.

This difference supports the hypothesis that a player's productivity on the pitch can positively influence the chances of continuing with a football career. Other variables (x4 – x7; substitutions, red and yellow cards respectively) have less predictive value. Substitutions show unstable differences between continuing and non-continuing players, suggesting that this variable may not be reliable for predicting further career. Red cards have

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a very low incidence (0.01 per player), suggesting no significant impact on players' career progression. Yellow cards are more frequent (0.25 per player), but their impact is equally indeterminate as the differences between groups of players are negligible and unstable. All the variables examined are explained in Table 4 in the following section.

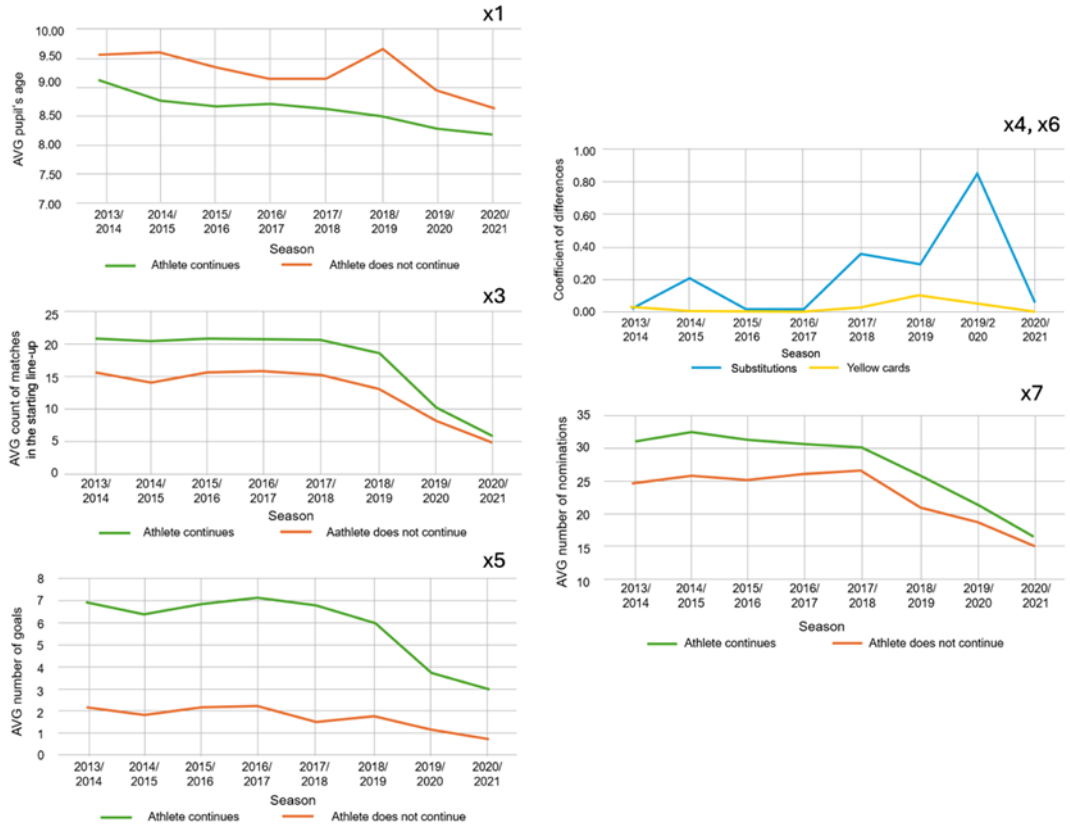


Figure 7. Overview of variables x1, x3, x4, x5, x6, x7 in the period studied
Source: Own elaboration

Logistic Regression – Before the modelling, individual variables were coded. The dependent variable "y" was labelled "Continues," indicating whether the players continue in their sports careers. The independent variables were coded as follows: "x1" represents the age the athletes started playing football ("old_when_start"), "x2" and "x3" indicate the number of nominations and starts in the starting line-up ("app_in_nom" and "app_in_basic"). Variables "x4" to "x6" track statistics such as substitutions ("Substitution"), number of goals ("Goal"), and yellow cards ("YellowCard"). Other variables include the number of red cards ("RedCard" – x7), playing at the position of a defender, midfielder or forward (x8, x9, x10), ability to play at multiple positions ("multiple_positions" – x11), a transfer to another club last season ("transfer_past" – x12), and normalized data on the player's birth ("norm_birth" – x13).

Table 4. Coding of dependent and independent variables.

Variable	Name	Variable	Name
y	Continues	**x7**	RedCard
x1	old_when_start	**x8**	Defender
x2	app_in_nom	**x9**	Midfielder
x3	app_in_basic	**x10**	Forward
x4	Substitution	**x11**	multiple_positions
x5	Goal	**x12**	transfer_past
x6	YellowCard	**x13**	norm_birth

Source: Own elaboration

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The second step was to create a correlation matrix (Fig. 8). The correlation analysis reveals significant relationships between the dependent variable y (career continuation) and the explanatory variables. The variable y shows a negative correlation with the age of starting with organized football (x1: -0.16) and normalized age (x13: -0.27), indicating that a higher age reduces the likelihood of career continuation. Conversely, the positive correlations with nominations (x2: 0.18), starting line-up (x3: 0.24), number of goals (x5: 0.22), and the ability to play at multiple positions (x11: 0.10) indicate that success on the pitch increases the chances of continuing a football career. Among the explanatory variables, the strongest correlation was between the number of nominations and the number of games in the starting line-up (x2 and x3: 0.53), reflecting the logical relationship between nominations and the playing experience. Significant correlations were observed between the number of goals and positions (forward: 0.23, defender: -0.20), indicating players' different roles according to their positions. Furthermore, there was a high correlation between playing at multiple positions and midfielders (x11 and x9: 0.38). Conversely, low or insignificant correlations were found for red cards (x7) or the defender position (x8).

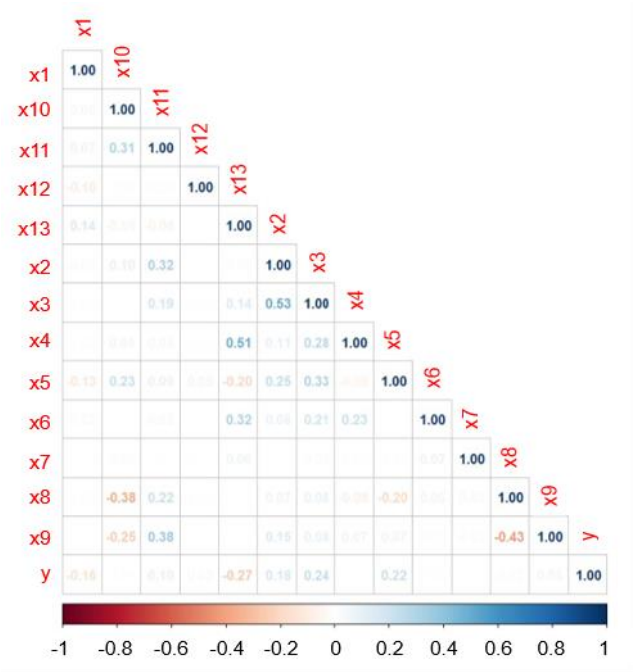


Figure 8. Correlation matrix of the training set
Source: Own elaboration

The last stage was the actual logistic regression. Its results show that the variables x1, x2, x3, x4, x5, x6, x12, and x13 are statistically significant ($p < 0.05$). Variables x1 and x13 have a negative effect on the dependent variable, with x13 showing the strongest negative effect (coefficient = -2.976937, $p < 2e\text{-}16$). The other statistically significant variables (x2, x3, x4, x5, x6, and x12) have a positive effect with varying degrees. In contrast, variables x7, x8, x9, x10, and x11 are not statistically significant ($p > 0.05$). The standard deviation of all coefficients is relatively low, increasing the ultimate estimates' reliability.

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Coefficients:
             Estimate Std. Error z value Pr(>|z|)
(Intercept) -0.207506   0.242842  -0.854   0.3928
x1          -0.157619   0.010977 -14.359  < 2e-16 ***
x2           0.006039   0.002389   2.528   0.0115 *
x3           0.052230   0.002861  18.256  < 2e-16 ***
x4           0.088627   0.007502  11.813  < 2e-16 ***
x5           0.086058   0.005227  16.464  < 2e-16 ***
x6           0.131941   0.027928   4.724 2.31e-06 ***
x7           0.017295   0.195866   0.088   0.9296
x8           0.214440   0.217536   0.986   0.3242
x9           0.097992   0.218453   0.449   0.6537
x10         -0.161535   0.217456  -0.743   0.4576
x11          0.156819   0.228248   0.687   0.4920
x12          0.162432   0.067805   2.396   0.0166 *
x13         -2.976937   0.084542 -35.213  < 2e-16 ***
```

Figure 9. Logistic regression output – coefficients.
Source: Own elaboration

The results (Fig. 9) show that, within the context of the hypothesis set, the x7 – x11 variables do not significantly affect athletes' dropout from organized football. Other variables, x1, x3, x4, x5, x6, and x13 (coefficient statistically significant at the 0.001 level of significance), significantly influence this phenomenon.

The influence of these coefficients can guide sports organizations in identifying critical factors contributing to athletes' retention. The size and direction of these coefficients indicate that the variables have a meaningful impact on the likelihood of an athlete leaving organized football. For instance, since the coefficient for variable x1 is positive, it suggests that higher values of x1 increase the likelihood of attrition, whereas a negative coefficient for x3 suggests that higher values of x3 might lower the probability of the athlete's dropout. This allows practitioners to prioritize interventions with the greatest effect. By focusing on the most influential variables, sports organizations can make data-driven decisions on resource allocation, coaching practices, and player support systems to better retain young athletes.

In the first logistic model including all variables (Table 5), the AIC score was 19,373. This model was used to analyze overall accuracy, sensitivity, and specificity at different thresholds on the training and testing data. At a threshold of 0.4, the model achieved high sensitivity (97.02%) on the training data, meaning that it could correctly identify most positive cases. However, the specificity was low (23.07%), indicating a poor ability to correctly identify negative cases. At higher thresholds, sensitivity decreased but specificity increased, indicating a better balance between identifying positive and negative cases. However, on the test data, overall accuracy and specificity were lower, especially at higher thresholds where the model showed degraded performance (accuracy of 56.29% at a threshold of 0.6).

Table 5. Output of the logistic model – all variables

Quantity – threshold value	Overall accuracy (%)	Sensitivity (%)	Specificity (%)
Train – 0.4	77.02	97.02	23.07
Test – 0.4	74.76	80.25	45.59
Train – 0.5	77.85	93.28	36.24
Test – 0.5	65.14	66.98	55.33
Train – 0.6	76.98	86.47	51.40
Test – 0.6	56.29	54.52	65.76

Source: Own elaboration

The second model (Table 6), including only statistically significant variables, achieved the AIC score of 19,443. Although this model used a simplified set of variables, the results showed a similar trend to the first model. On the training data, it achieved the highest sensitivity (97.06%) at a threshold of 0.4, while specificity remained low (22.69%). As in the first model, sensitivity decreased with increasing threshold, while specificity improved.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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However, on the test data, the model showed lower overall accuracy (56.60% at a threshold of 0.6), suggesting that the model simplification did not lead to a significant improvement in the predictive ability.

Table 6. Output of the logistic model – statistically significant variables.

Quantity – threshold value	Overall accuracy (%)	Sensitivity (%)	Specificity (%)
Train – 0.4	76.95	97.06	22.69
Test – 0.4	74.50	80.00	45.12
Train – 0.5	77.72	93.34	35.58
Test – 0.5	64.43	66.34	54.20
Train – 0.6	76.81	86.42	50.90
Test – 0.6	56.60	54.98	65.31

Source: Own elaboration

The third model (Table 7), based on correlated variables only, achieved the highest AIC score of 19,582, indicating poorer quality compared to the previous models. Although this model contained variables with significant correlation, the overall accuracy, sensitivity, and specificity were very similar to the previous models. High sensitivity (97.54%) was achieved on the training data at a threshold of 0.4, but specificity was even lower (20.67%). On the test data, the overall accuracy was lower, with the best value of 55.50% at a threshold of 0.6. Thus, this model did not yield significant improvement and confirmed minimal differences in metrics between the models.

Table 7. Logistic model output – correlated variables.

Quantity – threshold value	Overall accuracy (%)	Sensitivity (%)	Specificity (%)
Train – 0.4	76.76	97.54	20.67
Test – 0.4	75.36	81.14	44.44
Train – 0.5	77.33	93.41	33.93
Test – 0.5	64.57	66.43	54.65
Train – 0.6	76.85	86.42	51.01
Test – 0.6	55.50	53.63	65.53

Source: Own elaboration

Of the three logistic models, the first model including all variables showed the best performance (the lowest AIC score of 19,373). Although sensitivity was high at lower thresholds, specificity remained low in all models. Simplified models with statistically significant or correlated variables did not yield significant improvement. Including all variables provided the best balance between the model's performance and simplicity.

5. Discussion

The novelty aspect of our study lies primarily in its methodology combining the unique access to exclusive SFA data with advanced modelling. The geographic perspective included helped us detect significant regional disparities affecting the young athletes' dropout from organized football as well as determine the overall social impact of this sport.

Despite our extensive approach, the study still has limitations that must be considered when interpreting the results. These are linked to data quality and availability, methodology, generalizability, and the socio-economic context. Regarding data quality and availability, we used to differentiate, precise data sources. While based on the SFA's databases, our dataset is unique in scope and accessibility, serving as a primary data source for this study. Accuracy is guaranteed by the providers. Nonetheless, some data points may have been incorrectly recorded. The data collection is always subject to random or systematic errors (Wahmed, 2014) possibly distorting the results (Buyse et al., 2017).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n9976446883

Logistic regression assumes linearity between the independent variables and a log odds ratio, the absence of multicollinearity, and proper model specification. Our results are specific to organized football within the SFA, limiting their generalizability to other sports, regions or organizational structures. Our model deliberately excluded socioeconomic, psychological, and cultural factors such as motivational barriers or the influence of family background. Although the combination of sports geography and logistic regression offers an innovative approach, this framework is less developed and may limit the ability to fully understand the spatial context of sports performance and the dropout from organized sports.

The methodology and findings can be applied in research of other sports where similar factors influence athletes' dropout. An example is the decline of young players participating in ice hockey in Canada. There has been a 22% drop in the player base among young athletes in Canada over the past 13 years (Whyno, 2024). The application of methodology and sports geography to research in this regard could help explain the factors why this player dropout from organized ice hockey is occurring. Our research can be done in comparison with other regions, helping identify local specificities in sports. A comparison with the findings of Wilhelmsen (2024) or Hema et al. (2022) is also relevant. Both studies worked with a different methodology but included factors comparable with our results. These highlight that the young athletes' career progression is mainly influenced by sports statistics (number of goals and nominations to the starting line-up). The first study shows that the performance of players in English academies is compromised by the culture shock and high pressure, leading to self-preservation mechanisms. The second study focuses on the burnout of elite female footballers caused by a combination of sport and other responsibilities, with problems related to persistent gender bias. In contrast to our quantitative findings on career progression, both studies identify social and psychological barriers as key factors limiting long-term success in professional football. The juxtaposition of such factors is highly desirable. Our findings on the factors influencing young athletes' participation in organized football are consistent with previous research. These points to a complex network of influences including socio-economic conditions, sports culture, and individual athletes' factors. The research by Schlesinger et al. (2018) confirms that young players' decisions to end their sports careers often stem from a combination of pressure to perform and insufficient support from their clubs. A study by Back et al., (2022b) points out that young athletes face high psychological demands, while the culture shock and unreasonable expectations can lead to their premature retirement from the sport. This factor is demonstrated by the associations we found with the impact of game statistics on athletes. Additionally, research by Eliasson and Johansson (2020) showed that socio-economic conditions have a significant impact on sports participation and that children from disadvantaged backgrounds have limited access to sports. This indicates that to effectively address sports dropout, it is necessary to combine individual, social, and systemic approaches determining the whole sports environment.

Nutakor et al. (2023) shown that socioeconomic status (SES) influences quality of life via social capital. In sports, social capital may be an important factor moderating the effect of SES on athletes' decisions to continue or discontinue their sports careers. Hernandez et al. (2023) showed that although the motivation to obtain a sports scholarship is strong, many families face significant barriers to their children's participation in organized sports. The research revealed that the current culture of youth sports further strengthens these barriers, resulting in limited participation of children from socially disadvantaged families. Macintyre et al. (2018) highlight the impact of social and economic inequality on mental health. According to them, higher levels of income inequality led to a higher prevalence of mental illness. Strandbu et al. (2020) showed that socioeconomic resources influence participation in sports for both boys and girls. Boys from minority backgrounds have even higher participation rates compared to those from majority backgrounds. Girls from minority backgrounds are significantly less likely to participate in sports clubs compared to those from majority backgrounds. Socio-economic resources thus significantly explain the differences in sports participation between minority and majority groups. Cerin and Leslie (2008) suggest that comprehensive, multi-level interventions targeting attitudes and skills related to activity, as well as the social and physical environment, are needed to increase participation in physical activity among more disadvantaged segments. This is supported by Asghar et al. (2024).

Research on the issue can apply different parameters of the socio-economic environment. These strongly influence motivations and barriers to engaging in physical activity, crucial for public health policies. These should address financial constraints via subsidies and discounted access to sports facilities, improve work-life

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n9976446883

balance to address time scarcity, invest in infrastructure in disadvantaged areas, and promote community-based programs (Pedersen et al., 2021). According to Slade et al. (2020), policies aimed at improving physical activity must compete for limited resources with other development investments. These principles could be applied to policies aimed at promoting physical activity, where comprehensive evaluations combining qualitative, quantitative, and mixed methods provide valuable insight. There is a growing emphasis on researchers not limiting themselves to describing and explaining government systems but also engaging in experimentation and intervention activities contributing to improvement. Linking retrospective research focused on scientific validation and prospective research on creative design offers a new approach to integrating traditional methods with innovative approaches. This is useful in the context of policymaking aimed at promoting physical activity (Romme, Meijer, 2019).

Conclusions

Our research identified several factors influencing young athletes' career progression. The most important were the age at which players started playing organized football, the number of nominations to the starting line-up, the number of goals scored, and other game statistics. Conversely, variables such as the number of red cards or the ability to play at multiple positions were not statistically significant. This research provides valuable insights into the SFA in its efforts to understand and address the causes of young players leaving organized football. Thereby, it contributes to the development of effective measures to retain athletes in the competitions' environment.

Comparison with other research shows that while our findings emphasize individual sports performance, socio-economic and cultural influences create significantly broader context. Thus, sports policies and interventions must be multi-level and focus also on social infrastructure and access to sporting opportunities for all. The connection of our results achieved by mathematical modelling with the analysis of secondary data and the other studies' results brought the answer to the research question set. Sports managers should focus on influenceable factors that emerged as statistically significant in our modelling. In their decisions, they must monitor the current socio-economic context related to a specific sport in the region. From this viewpoint, geographical perspective represents an important managerial tool for identifying underserved regions and improving equal access to organized sport.

It is recommended for the state and local governments to invest in sports facilities in disadvantaged areas to increase accessibility of sports. This also contributes to reducing the dropout of young players from organized football. State or club policies should include programs encouraging the identification and development of talented athletes. Specialized training programs and higher number of coaches can help talented players stay in organized sports. We also propose the introduction of specific subsidies and grant programs to cover the costs of sports equipment and participation in competitions for children from lower-income families. This would reduce barriers to entry and retention in organized sports, promoting equality. We encourage closer cooperation among schools and sports clubs, ensuring that young athletes have a balance between sports activities and their education.

Potential errors in the research were related to data collection and processing. The subject of the research is represented by the data collected on organized football within the SFA administration. Therefore, the results may not be directly applicable to other sports or countries. Geographical, cultural, and organizational differences may influence the variability in the factors of athletes' dropout from organized football. Despite these limitations, our research contributes to the knowledge base by its comprehensive analysis, an innovative methodological approach, and practical application. It offers a comprehensive view of the factors influencing athletes' dropout from organized football, providing valuable information for sports managers, coaches, and other stakeholders. The identification of key determinants of athletes' dropout can assist in the development of strategies to retain young talent in organized football, having long-term positive impacts on the sports community and the whole society.

As this study is at the intersection of two research areas, it opens new avenues for making a real impact in public policy research. It involves not only the design and implementation of new policy measures to promote

physical activity, but also the improvement of existing government structures to better respond to complex socio-economic challenges. This integrated approach can lead to policies that are scientifically sound but also practically effective. In the future, it is planned to use the data collected and analyzed to develop new models of youth dropout from organized football and to focus on other popular sports. Future research should also expand the geographical aspect in social research by incorporating spatial data on travel distances, accessibility of training facilities, and regional funding inequalities, to complement the strong performance-based findings of our study.

Extending the research findings to cover similar sports phenomena in other regions and across different sports events represent an important topic as well. An analysis of the international context allows the identification of common and different determinants of athletes' dropout, considering the cultural, socio-economic, and organizational specificities of each region. This way, more effective strategies and policy measures can be designed to promote sports participation and talent development. This approach will strengthen the interdisciplinary nature of this social research and allow for solutions with a global reach.

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Funding: This article is the outcome of the project KEGA: 052ŽU-4/2025 The creation of multimedia content for athletes' online dual education in sports management and marketing – career after sports career.

Data Availability Statement: More information and data can be obtained from the authors on a reasonable request.

Ethical considerations: This study did not require Institutional Review Board (IRB) approval because it does not involve human subjects research as defined by regulatory standards. The data used were provided by the Slovak Football Association (SFA) and consisted exclusively of anonymized, coded datasets on player statistics and competition results. No personal identifying information was accessible to the researchers, and no contact or intervention with individual participants occurred. According to IRB guidelines, studies based on publicly available or coded data, where the investigator cannot ascertain the identities of individuals, do not constitute human subject's research. The present research therefore falls under this exemption category, as data was collected for non-research purposes by the SFA and made available for statistical and managerial analysis only.

Author Contributions: Conceptualization: *Varmus, Adámik, Štaffenová; Šarlák*; methodology: *Varmus, Adámik, Šarlák;* data analysis: *Varmus, Adámik, Štaffenová, Šarlák*; writing—original draft preparation: *Adámik, Štaffenová, Šarlák*; writing; review and editing: *Varmus, Adámik, Štaffenová, Šarlák*; visualization: *Varmus, Adámik, Štaffenová, Šarlák*. All authors have read and agreed to the published version of the manuscript.

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/n9976446883

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/e2627663559

Publisher
http://jssidoi.org/esc/home

HOLISTIC NEUROMARKETING AS A CONCEPTUAL FRAMEWORK FOR STAKEHOLDER BEHAVIOUR AND COMMUNICATION IN ENVIRONMENTAL AND RESOURCE-BASED PROJECTS*

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Received 15 February 2026; accepted 6 May 2026; published 30 June 2026

Abstract. This study addresses the need to understand better stakeholder behaviour and communication processes in environmental and resource-based projects, where social acceptance and securing a social licence to operate are critical to project success. Traditional marketing approaches, although effective in coordinating organisational activities, often fail to capture the cognitive and emotional mechanisms that influence stakeholder decision-making under conditions of uncertainty and perceived risk. This paper aims to develop a conceptual framework of holistic neuromarketing that integrates holistic marketing principles with insights from neuroscience. The study is based on a conceptual research design that uses a systematic literature review, theoretical abstraction, and conceptual modelling. The proposed framework captures the relationships between communication inputs, cognitive-emotional processing, perceived risk, trust formation, and stakeholder behavioural responses. The findings indicate that integrating neuromarketing into holistic marketing enhances the analytical capacity of traditional frameworks by incorporating subconscious and affective dimensions of behaviour. The framework provides a structured basis for improving communication effectiveness, reducing stakeholder resistance, and supporting stakeholder acceptance, while also highlighting ethical considerations. The study contributes to interdisciplinary research and offers a foundation for future empirical investigation.

Keywords: holistic neuromarketing; stakeholder behaviour; stakeholder communication; environmental projects; risk perception

Reference to this paper should be made as follows: Drábik, P., Hanuláková, E., Daňo, F., Dúbravská, K., Mudarri, T. 2026. Holistic neuromarketing as a conceptual framework for stakeholder behaviour and communication in environmental and resource-based projects. *Entrepreneurship and Sustainability Issues*, 13(4), 419-429. http://doi.org/10.9770/e2627663559

JEL Classifications: M31

1. Introduction

Marketing theory and practice have undergone substantial transformation in recent decades, driven by technological advancements, socio-economic and geopolitical shifts, and increasing environmental pressures. In particular, the growing emphasis on sustainability, resource efficiency, and environmental responsibility has fundamentally altered the context in which marketing strategies are developed and implemented. Traditional marketing approaches, grounded in the 4P marketing mix (product, price, place, promotion), have historically

* *This paper was published as an output of the project VEGA 1/0392/23: Changes in the approach to creating distribution management concepts for companies affected by the impacts of social and economic crises caused by the global pandemic and increased security risks, no. V- 23-230-00 of the University of Economics in Bratislava.*

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/e2627663559

focused on transactional interactions between firms and customers. However, the increasing complexity of market systems and the need to address long-term stakeholder relationships necessitate a broader and more integrative perspective (Paramitha, 2024; Msosa et al., 2024; Ambrusevič & Išoraitė, 2025).

In response to these developments, the concept of holistic marketing has emerged as a comprehensive framework that integrates internal, integrated, relationship, and socially responsible marketing dimensions. This approach emphasises the creation of synergistic interactions among multiple stakeholders, including customers, employees, institutions, and communities. From a systems perspective, holistic marketing reflects the principles of holism, where the overall system performance cannot be reduced to the sum of its individual components (Smuts, 1926). Such an approach is particularly relevant in environmental and resource-based projects, where stakeholder perceptions, risk communication, and social acceptance significantly influence project feasibility and long-term sustainability (Iannaccone et al., 2024a). In particular, sectors such as mining, energy infrastructure, and waste management projects are characterised by high levels of environmental sensitivity and stakeholder scrutiny, where communication strategies play a critical role in shaping public perception and influencing project acceptance. Recent studies from the Slovak context further illustrate that stakeholder-oriented sustainability communication is increasingly relevant in projects linked to renewable energy, visitor infrastructure, and post-mining landscape reuse (Iannaccone et al., 2025).

The increasing complexity of stakeholder environments, especially in environmentally sensitive and resource-intensive sectors, has created a need for more advanced analytical and communication tools. In this context, neuromarketing has gained increasing attention as a multidisciplinary field that applies neuroscientific methods to investigate both conscious and subconscious responses to marketing stimuli. Neuroscience provides insights into neural mechanisms underlying decision-making, emotional processing, and perception, thereby offering a robust methodological basis for analysing stakeholder behaviour in complex environments (Camerer et al., 2018). Neuromarketing, originally conceptualised as the application of neuroscientific techniques to marketing problems, enables the identification of cognitive and emotional drivers that traditional research methods often fail to capture (Alsharif et al., 2021).

While traditional marketing has focused on the value and competitive advantage of a product or service, neuromarketing approaches the process holistically, considering the purchasing process itself and the retail environment to create a positive shopping experience. Research in neuroscience and knowledge of the human mind and its subconscious mechanisms in relation to purchasing behaviour and advertising have led to a paradigm shift towards a neuroscientific approach to marketing (Hakin & Levy, 2018; Husić-Mehmedović et al., 2026). Traditional marketing research methods, such as customer surveys, interviews, and questionnaires, have proven to be less reliable sources of research data (Alsharif et al., 2021).

Unlike traditional marketing approaches, which primarily rely on self-reported data, neuromarketing techniques—such as functional magnetic resonance imaging, electroencephalography, and eye-tracking—enable objective measurement of behavioural and emotional responses (Couwenberg et al., 2016; Vukethwele et al., 2025). This shift represents a significant methodological advancement, particularly in contexts where decision-making is influenced by uncertainty, perceived risks, and cognitive biases, as is typical in environmental and resource-based projects (Lim & Weissmann, 2023). In such contexts, stakeholder acceptance is not solely determined by rational evaluation but is strongly influenced by emotional and subconscious factors, which can significantly affect project implementation and the achievement of a social licence to operate (Jijelava & Vanclay, 2018).

Despite the growing body of research on both holistic marketing and neuromarketing, these concepts are predominantly examined independently within the existing literature. Their integration remains underexplored, particularly in environmental and resource-based systems, where complex interactions among stakeholders, institutions, and ecological constraints are critical. This gap highlights the need for a more integrated analytical framework that combines the systemic perspective of holistic marketing with the behavioural and cognitive insights provided by neuromarketing. Addressing this gap is essential to improving communication strategies, enhancing stakeholder engagement, and supporting more effective, sustainable decision-making in complex project environments.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/e2627663559

2. Motivation and objective

The motivation for this study stems from the growing need to effectively manage stakeholder communication and perceptions in complex environmental and resource-based projects. High levels of uncertainty, perceived environmental risks, and conflicting stakeholder interests characterise these projects, and traditional communication and marketing approaches often prove insufficient (Jijelava & Vanclay, 2018). This is also evident in tourism- and landscape-related projects, where the successful development of visitor infrastructure or the adaptive reuse of post-mining areas depends on stakeholders' perceptions of environmental quality, accessibility, safety, and development benefits (Iannaccone et al., 2024b). In such contexts, decision-making processes are not solely driven by rational evaluation but are significantly influenced by cognitive biases, emotional responses, and subconscious perceptions of risk and trust (Wangzhou et al., 2021).

Conventional marketing models, although effective in stable market environments, do not fully capture the complexity of stakeholder behaviour in environments where social acceptance and legitimacy are critical for project implementation. While holistic marketing provides an integrative framework encompassing internal, integrated, relationship, and socially responsible dimensions, its application in environmentally sensitive contexts remains limited, particularly in addressing behavioural and cognitive aspects of stakeholder decision-making. At the same time, neuromarketing has emerged as a multidisciplinary approach that enables a deeper understanding of cognitive and emotional processes underlying human behaviour (Couwenberg et al., 2016). Despite its growing relevance, its integration with holistic marketing remains insufficiently explored, particularly in environmental and resource-based systems, where stakeholder perceptions and acceptance are key determinants of project success (Wiesner & Dargusch, 2022; Chipangamate et al., 2023). This gap highlights the need for a more comprehensive framework that combines systemic marketing approaches with insights from behavioural and neuroscientific research.

The aim of this paper is to explore the relationship between neuromarketing and holistic marketing, with a specific focus on their application in environmental and resource-based projects, particularly to improve stakeholder communication, perception management, and project acceptance. To achieve this aim, the following partial objectives were formulated:
1. To analyse the fundamental paradigms of holistic marketing (internal, integrated, relationship, and socially responsible marketing) in the context of environmental and resource-based project environments.
2. To examine the role of neuromarketing in understanding cognitive and emotional determinants of stakeholder behaviour, particularly in relation to risk perception and decision-making processes.
3. To investigate the integration of neuromarketing techniques into holistic marketing and assess their potential to enhance stakeholder communication, increase transparency, and support project acceptance.

The results of this study contribute to the development of an integrated conceptual framework that extends traditional marketing approaches by incorporating behavioural and cognitive dimensions. This framework provides a basis for more effective communication strategies and supports sustainable decision-making in complex project environments where stakeholder acceptance represents a critical success factor.

3. Methodological Framework and Analytical Approach

To achieve the defined research objectives, this study adopts a conceptual research design grounded in qualitative analysis, theoretical synthesis, and conceptual modelling. The research is based on the assumption that environmental and resource-based projects represent complex socio-technical systems characterised by multi-criteria decision-making, multi-stakeholder interactions, uncertainty, and dynamic processes of risk perception and stakeholder acceptance (Lim & Weissmann, 2023; Chipangamate et al., 2023).

Given the absence of a unified framework integrating neuromarketing and holistic marketing in environmental contexts, the primary aim of this study is not empirical testing, but rather the systematic conceptualisation and integration of existing theoretical knowledge into a coherent analytical framework. In this respect, the paper follows the logic of conceptual research, which seeks to develop new theoretical constructs and relationships by synthesising and extending established bodies of knowledge.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/e2627663559

The analytical process is based on a systematic literature review and theoretical abstraction, drawing on scientific sources indexed in Web of Science, Scopus, and Google Scholar. The literature selection focused on contributions related to holistic marketing, neuromarketing, stakeholder behaviour, risk perception, and communication processes in complex systems. The review enabled the identification of key theoretical constructs and the extraction of relevant variables forming the foundation of the proposed framework (Alsharif et al., 2021; Wangzhou et al., 2021). Recent research also highlights the growing importance of integrating advanced analytical approaches with behavioural and neuroscience-based perspectives in marketing research. In this context, time series modelling and data-driven analytical methods are increasingly used to capture dynamic patterns in consumer and stakeholder behaviour, thereby extending the methodological foundations of neuromarketing and decision-making analysis. These approaches contribute to a deeper understanding of behavioural responses over time and support the development of more robust analytical frameworks in complex systems (Košíková et al., 2025).

Subsequently, comparative analysis and conceptual synthesis were applied to identify relationships among these constructs and to evaluate convergences and divergences across existing theoretical approaches. This process resulted in the development of a structured conceptual model that captures the interactions among communication inputs, cognitive-emotional processing, perceived risk, trust formation, behavioural responses, and stakeholder acceptance. The model reflects a deductively derived structure based on established theoretical assumptions in marketing, behavioural sciences, and environmental project management (Nilashi et al., 2020; Wichmann et al., 2022).

The relationships between variables are further formally structured at a conceptual level to enhance analytical clarity and internal consistency. This formalisation does not constitute an empirical estimate but provides a theoretical basis for future quantitative validation. The proposed framework is therefore designed as a theoretical model that can be subsequently operationalised and tested using quantitative methods such as regression analysis or structural equation modelling.

The use of the R programming language in this study is limited to a supporting role in structuring and visualising conceptual relationships within the model. It is not employed for statistical hypothesis testing or empirical data analysis. Its application serves to ensure logical coherence, transparency, and replicability of the conceptual structure rather than to generate empirical findings.

Overall, the methodological approach of this study is fully consistent with the characteristics of conceptual research, aiming to extend existing theoretical frameworks and provide a structured basis for future empirical investigation. The proposed model of holistic neuromarketing thus represents a theoretical contribution to the understanding of stakeholder behaviour and communication processes in environmental and resource-based systems, where social acceptance and legitimacy are critical determinants of project success.

4. Results

Holistic marketing as a systemic framework in environmental and resource-based projects

The analysis of holistic marketing confirms that this approach is a comprehensive, systems-oriented framework that integrates internal organisational processes, stakeholder relationships, communication strategies, and socially responsible practices. In the context of environmental and resource-based projects, this multidimensional structure is particularly relevant, as project success depends not only on technical feasibility but also on stakeholder perception, trust, and social acceptance.

The four core dimensions of holistic marketing—internal marketing, integrated marketing, relationship marketing, and socially responsible marketing—form an interconnected system that enables organisations to manage complex stakeholder environments. Internal marketing ensures alignment between organisational objectives and employee behaviour, which is essential for projects requiring interdisciplinary coordination and high operational reliability (Cangan, 2019). Integrated marketing provides consistency of communication across multiple channels, which is critical in environments characterised by uncertainty and heightened public sensitivity to environmental risks (Oiku & Adeyeye, 2023). Relationship marketing extends the focus beyond

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/e2627663559

transactional interactions and emphasises long-term engagement with stakeholders, including communities, institutions, and regulatory bodies (Kuncoro et al., 2022). Socially responsible marketing introduces an ethical and environmental dimension, ensuring that project implementation aligns with societal expectations, sustainability principles, and environmental protection requirements. In mining and resource extraction projects, where environmental impacts and community concerns are particularly pronounced, the application of holistic marketing principles provides a structured approach to managing stakeholder communication and mitigating potential conflicts.

Table 1. The holistic marketing concept

Components	**Focus Area**
Internal marketing	Senior management Marketing Department Other departments
Integrated marketing	Communication Products and services Promotion channels
Relationship marketing	Partners Customers Distribution networks
Socially Responsible marketing	Legal Community The environment Ethics

Source: own elaboration

From a systems perspective, these dimensions cannot be analysed independently, as their effectiveness emerges from their mutual interaction. In environmental and resource-based systems, where stakeholder trust and legitimacy are key determinants of project feasibility, holistic marketing provides a structural basis for managing communication, reducing conflicts, and supporting the achievement of a social licence to operate (Jijelava & Vanclay, 2018).

Neuromarketing as a tool for analysing stakeholder behaviour under uncertainty

The analysis further demonstrates that neuromarketing represents a significant methodological extension of traditional marketing approaches, particularly in contexts where stakeholder decision-making is influenced by cognitive biases, emotional responses, and subconscious processes. Unlike conventional research methods based on self-reported data, neuromarketing techniques enable the observation and measurement of underlying cognitive and affective mechanisms that shape stakeholder behaviour (Alsharif et al., 2021).

In environmental and resource-based projects, stakeholder responses to project-related information are often driven by perceived risks, uncertainty, and trust deficits. Neuromarketing provides tools to capture these processes more deeply by analysing physiological and neurological responses to communication stimuli (Couwenberg et al., 2016). Techniques, such as functional magnetic resonance imaging, electroencephalography, eye-tracking, and biometric measurements allow for the identification of attention patterns, emotional activation, and cognitive load associated with specific communication strategies.

The results indicate that neuromarketing contributes to a more precise understanding of how stakeholders process information about environmental risks, project impacts, and organisational intentions. This is particularly important in situations where rational arguments alone are insufficient to influence stakeholder attitudes. By incorporating emotional and subconscious dimensions into the analysis, neuromarketing enhances the ability to design communication strategies that are more effective, targeted, and responsive to stakeholder concerns (Nilashi et al., 2020). In this context, neuromarketing should not be understood as a replacement for traditional marketing approaches, but rather as a complementary analytical tool that increases the explanatory power of stakeholder behaviour models and improves the effectiveness of communication in complex project environments.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/e2627663559

Integration of neuromarketing into holistic marketing: towards a holistic neuromarketing framework
The synthesis of findings reveals that integrating neuromarketing into holistic marketing is not a paradigm shift but an evolutionary development of the existing framework. Holistic marketing provides the structural and strategic foundation, while neuromarketing introduces an additional analytical layer focused on cognitive and emotional processes.

This integration can be observed across all dimensions of holistic marketing. In internal marketing, neuroscientific insights support more effective management of employee behaviour, motivation, and communication, thereby improving organisational performance and coordination (González-Morales et al., 2024). In integrated marketing, neuromarketing enhances the design of communication strategies by identifying which stimuli generate attention and emotional engagement. In relationship marketing, incorporating neuropsychological principles enables a deeper understanding of stakeholder interactions, facilitating more personalised and effective engagement (Shaw, 2017). In socially responsible marketing, the emergence of neuroethical considerations highlights the importance of transparency, data protection, and ethical use of neuroscientific tools in influencing stakeholder behaviour (García et al., 2025). The applicability of this framework is particularly evident in resource-based sectors, where project implementation is frequently conditioned by stakeholder acceptance and the ability to communicate environmental risks and mitigation measures effectively.

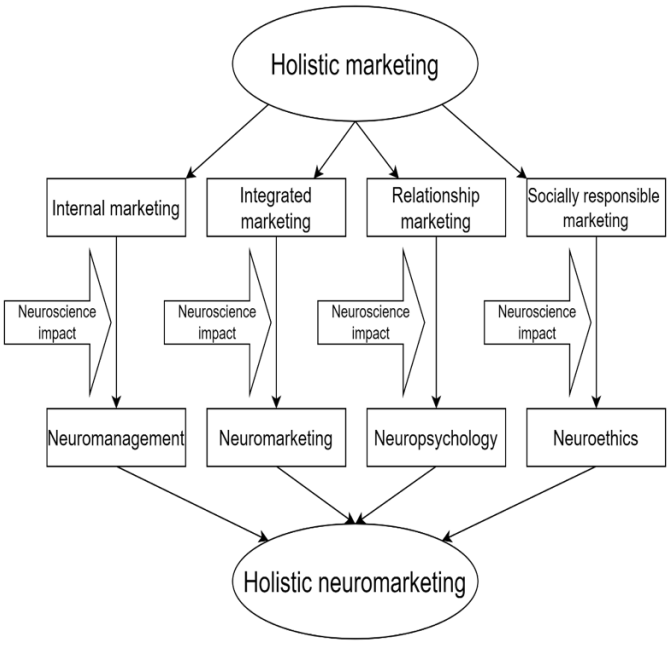


Figure 1. Application of Neuroscience to Holistic Marketing
Source: own elaboration

Figure 1 illustrates the conceptual integration of neuroscience into the four core dimensions of holistic marketing. It demonstrates how neuroscientific insights transform individual marketing components into specialised domains—neuromanagement, neuromarketing, neuropsychology, and neuroethics—which collectively form an extended holistic neuromarketing framework. This integrated model captures the interaction between communication processes, cognitive-emotional responses, and stakeholder behaviour in environmental and resource-based systems.

The interconnection of these elements results in an extended conceptual framework known as holistic neuromarketing. This framework integrates systemic marketing principles with neuroscience insights, enabling a more comprehensive analysis of stakeholder behaviour and communication processes in environmental and resource-based projects. It reflects the need to move beyond purely rational models of decision-making and to incorporate behavioural and cognitive dimensions into the management of complex socio-technical systems.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/e2627663559

The proposed framework provides a structured basis for improving communication effectiveness, reducing stakeholder resistance, and enhancing project acceptance. In environments where social licence to operate is critical, integrating neuromarketing into holistic marketing offers a new perspective on how organisations can manage stakeholder relationships and address the challenges posed by environmental uncertainty and societal expectations (Jijelava and Vanclay, 2018; Wiesner and Dargusch, 2022).

5. Discussion

The findings of this study indicate that the relationship between holistic marketing and neuromarketing should not be interpreted as a paradigm discontinuity, but rather as an evolutionary transformation driven by the integration of neuroscientific insights into established marketing frameworks. Holistic marketing remains conceptually stable in its core dimensions—internal, integrated, relationship, and socially responsible marketing—however, its functional application is significantly extended through the incorporation of cognitive and affective mechanisms that underpin stakeholder behaviour.

From a theoretical perspective, this shift reflects a broader transition within marketing science from predominantly rational and declarative models of decision-making towards behaviourally informed and empirically grounded approaches. Traditional marketing frameworks assume that stakeholder decisions are largely based on conscious evaluation of information, whereas contemporary research demonstrates that a substantial proportion of decision-making processes is driven by subconscious and affective factors (Alsharif et al., 2021). In this context, neuromarketing provides a methodological bridge that enables the systematic analysis and integration of these latent processes into strategic decision-making.

The distinction between holistic marketing and neuromarketing, therefore, lies not in their objectives but in their methodological and epistemological foundations. Holistic marketing operates at a systemic and strategic level, focusing on the coordination of organisational processes and stakeholder relationships. In contrast, neuromarketing operates at the level of individual cognition and perception, utilising advanced neuroscientific techniques such as functional magnetic resonance imaging, electroencephalography, and eye-tracking to capture physiological and neurological responses to marketing stimuli (Couwenberg et al., 2016). These techniques enable the identification of behavioural patterns that are not accessible through conventional research methods, thereby enhancing the explanatory power of marketing models.

In environmental and resource-based projects, this methodological complementarity acquires particular significance. Stakeholder responses in such contexts are often shaped by perceived risks, uncertainty, and trust deficits rather than purely economic considerations. The concept of social licence to operate highlights the importance of stakeholder acceptance as a critical determinant of project viability (Jijelava & Vanclay, 2018). The integration of neuromarketing into holistic marketing therefore provides a more robust analytical framework for understanding how stakeholders perceive environmental risks, process project-related information, and form attitudes towards project implementation. This is especially relevant in mining and resource-intensive industries, where stakeholder opposition has been shown to significantly influence project timelines, operational continuity, and overall project feasibility. In parallel, recent research points to the growing importance of stakeholder-sensitive approaches in the revitalisation of mining landscapes, geospatial interpretation of mining heritage, and the assessment of environmental risks associated with transformed or vulnerable territories (Hvizdák et al., 2023; Zelenakova et al., 2024; Iannaccone et al., 2024b). For example, in mining projects located in environmentally sensitive areas, neuromarketing techniques can be applied to evaluate stakeholder responses to different communication strategies related to environmental impact mitigation, thereby enabling more effective and adaptive stakeholder engagement.

The proposed concept of holistic neuromarketing can thus be interpreted as a higher-order integrative framework that combines systemic coordination with behavioural depth. It extends traditional marketing by embedding cognitive-emotional variables into the analysis of stakeholder interactions, thereby enabling a more nuanced understanding of communication effectiveness and behavioural responses. This is particularly relevant in complex socio-technical systems, where decision-making processes are influenced by multiple interacting

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/e2627663559

factors, including institutional context, environmental uncertainty, and socio-cultural dynamics (Wiesner & Dargusch, 2022; Chipangamate et al., 2023).

Furthermore, the integration of neuroscientific approaches introduces important ethical and governance considerations. The emergence of neuroethics underscores the need to ensure transparency, data protection, and responsible use of behavioural insights in influencing stakeholder decisions (García et al., 2025). In environmental contexts, where public trust is often fragile, the ethical application of neuromarketing techniques is critical to maintaining legitimacy and avoiding manipulation. This highlights the necessity of embedding ethical safeguards within the holistic neuromarketing framework, particularly for projects with significant environmental and societal impacts.

From a practical perspective, the results suggest that organisations operating in environmental and resource-based sectors can benefit from integrating neuromarketing insights into their communication strategies. By aligning systemic marketing principles with empirically grounded behavioural insights, organisations can improve the effectiveness of stakeholder engagement, reduce resistance, and enhance overall project acceptance. This integration enables more adaptive, responsive communication strategies better suited to the complexity of contemporary project environments.

At the same time, it is important to acknowledge the limitations of the proposed framework. As a conceptually driven model, it has not yet been empirically validated, and future research should focus on testing the relationships among communication variables, cognitive-emotional responses, and stakeholder behaviour using quantitative methods such as structural equation modelling. Additionally, further research is needed to explore the scalability of neuromarketing techniques in real-world environmental projects, where resource constraints and ethical considerations may limit their practical implementation.

In summary, integrating neuromarketing into holistic marketing represents a significant advancement in understanding stakeholder behaviour in complex project environments. Rather than replacing existing marketing paradigms, it enhances their analytical capacity by incorporating behavioural and cognitive dimensions. The resulting holistic neuromarketing framework provides a theoretically grounded and practically relevant approach for managing stakeholder relationships, improving communication effectiveness, and supporting sustainable project implementation in environmental and resource-based systems.

6. Conclusions

The present study contributes to advancing interdisciplinary research at the intersection of marketing, behavioural science, and environmental project management by conceptualising the integration of neuromarketing into the framework of holistic marketing. The findings confirm that this integration does not constitute a disruptive paradigm shift, but rather an evolutionary extension that enhances the analytical depth and practical applicability of existing marketing approaches. Holistic marketing remains a robust systemic framework capable of addressing the complexity of stakeholder interactions in environmental and resource-based projects. However, its traditional application has been limited by an insufficient consideration of cognitive and emotional determinants of stakeholder behaviour. By incorporating neuroscientific insights, the proposed concept of holistic neuromarketing extends this framework to include subconscious and affective processes that significantly influence perception, trust formation, and decision-making.

From a theoretical perspective, the study advances current knowledge by formalising the relationship between communication processes, cognitive-emotional responses, perceived risk, and stakeholder acceptance within a unified conceptual model. This integrative approach provides a more comprehensive understanding of how stakeholders interpret and respond to project-related information, particularly in contexts characterised by uncertainty, environmental sensitivity, and conflicting interests.

From a practical standpoint, the findings highlight the potential of neuromarketing techniques to improve communication effectiveness and stakeholder engagement in environmental and resource-based systems. By enabling a more precise identification of behavioural responses and emotional reactions, organisations can

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/e2627663559

design more targeted and adaptive communication strategies, thereby reducing stakeholder resistance and increasing the likelihood of achieving social licence to operate. This is particularly relevant in projects where public perception and trust represent critical success factors. This is particularly important in environmental and resource-based projects, where the success of project implementation is closely linked to the ability to secure and maintain a social licence to operate.

At the same time, the integration of neuroscientific approaches raises important ethical considerations. The application of neuromarketing in stakeholder communication must be guided by principles of transparency, responsibility, and data protection to ensure that behavioural insights are used ethically. The incorporation of neuroethical principles into the holistic neuromarketing framework is therefore essential for maintaining legitimacy and public trust, especially in environmentally sensitive contexts.

Despite its contributions, the study has certain limitations. The proposed framework is conceptual in nature and has not been empirically validated. Future research should focus on testing the model using quantitative methods, such as structural equation modelling, to examine the strength and direction of relationships between key variables. Furthermore, additional research is needed to assess the practical feasibility and scalability of neuromarketing techniques in real-world environmental projects, considering economic, technical, and ethical constraints.

Integrating neuromarketing into holistic marketing offers a promising direction for enhancing stakeholder relationship management in complex socio-technical systems. The concept of holistic neuromarketing provides a theoretically grounded and practically relevant framework that supports more effective communication, improved stakeholder acceptance, and more sustainable project implementation. As environmental and resource-based projects continue to operate in increasingly complex and uncertain environments, such integrative approaches will play a critical role in bridging the gap between technological feasibility and societal acceptance.

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Funding: This paper was published as an output of the project VEGA 1/0392/23: Changes in the approach to creating distribution management concepts for companies affected by the impacts of social and economic crises caused by the global pandemic and increased security risks, no. V- 23-230-00 of the University of Economics in Bratislava.

Data Availability Statement: More primary data can be obtained from the corresponding author on a reasonable request.

Author Contributions: All authors contributed equally. All authors have read and agreed to the published version of the manuscript.

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/w9346523772

Publisher
http://jssidoi.org/esc/home

SUSTAINING LUXURY BRAND PRESENCE ACROSS DIFFERENT GENERATIONS: STRATEGIES TO ENDURING DISTINCTION AND GROWTH

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Received 11 February 2026; accepted 8 May 2026; published 30 June 2026

Abstract. This study aims to analyse how luxury companies can remain timeless and compatible with the ideals of new generations. Additionally, it aims to identify what are the strategies that luxury brands are adopting to attract the new generation (Gen Z). A qualitative study was conducted with brand activation, public relations and advisory professionals who work with the luxury market, who would be able to tell us what strategies are used and what the weight of the distinction between generational cohorts is. The findings reveal that younger generations are more technologically and old approaches such as advertising through magazines or paper press are already not the focus of the marketing budget available. Digital presence through social media profiles, ads and partnerships with influencers has become the focus for keeping brands in touch with their audience. In addition, it is important to provide experiences for the public. For Gen Z, it is important to take a stand on social and environmental issues and to show concern for larger themes. This generation cares about what brands have to offer other than their name, they are looking for authenticity and humanism. The originality of this study lies on analysis of how luxury brands evolve to meet the expectations of Gen Z, a demographic with unique values and purchasing behaviors compared to past generations. While existing research often focuses on digital marketing or generational consumer trends, this study distinguishes itself by analysing the interplay between tradition and innovation. It offers industry perspectives, highlights the shift toward experiential and values-driven marketing, and explores changes in marketing budget allocation. By integrating real-world industry insights with academic analysis, this research adds to the conversation on luxury brand adaptation and provides practical guidance for brand managers navigating the evolving luxury landscape.

Keywords: luxury brands; generation Z; consumer behavior; strategies

Reference to this paper should be made as follows: Fonseca, B., Carrasco-Aguilar, Á., Rua, O. L., Shu, Z. 2026. sustaining luxury brand presence across different generations: strategies to enduring distinction and growth. *Entrepreneurship and Sustainable Issues*, 13(4), 430-444. http://doi.org/10.9770/w9346523772

JEL Classifications: M31, D12, M14, O32

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/w9346523772

1. Introduction

Despite the current geopolitical tensions and the uncertain macroeconomic scenario, the luxury personal goods market set a record in 2022, reaching a market value of €345 billion (Bain & Company, 2023). However, it is not just fluctuations in the economic sector that the luxury market survives. Historically, luxury brands have been associated with exclusivity, tradition, prestige, and superior quality (Vigneron & Johnson, 1999).

Gen Z grew up in a world of cell phones, social media, and rapid access to information (Williams et al., 2010; Hysa et al., 2021). Distinguished by digital nativeness, an entrepreneurial drive, and social awareness, Gen Z differs from Millennials in terms of communication patterns, educational viewpoints, and institutional expectations (Twenge, 2023). As consumers, this generation is worried and aware of social and environmental problems, so when purchasing from luxury brands these individuals look for companies that align with their values such as authenticity, inclusion, and diversity; this cohort wants brands that adopt sustainable and responsible practices (Roberts, 2023). Gen Z, differs by its emphasis on authenticity, sustainability, and innovation, has a distinct set of values and expectations that necessitate novel strategic approaches (Thangavel et al., 2019; Puiu, 2016; Thomas et al., 2022). This circumstance generates a conflict between maintaining brand heritage and the requirement for innovation to attract and keep younger customers (Sjahruddin & Adif, 2024).

Drawing on Piric et al. (2024), there are pronounced generational differences in how social media is used, including variations in user motivations and reactions to brand-related content. Younger audiences tend to be more active on the platforms and are more strongly influenced by Instagram in shaping brand perceptions and purchase intentions. By contrast, older users interact more selectively, showing greater interest in brand and celebrity content rather than peer-driven engagement. These findings highlight the importance for luxury brands to incorporate generationally tailored strategies in their digital marketing efforts to preserve distinctiveness, build emotional resonance, and support long-term growth in a fragmented market landscape.

Similarly, Hua et al. (2025) demonstrate that consumers' willingness to share content, driven by desires for self-presentation, social validation, and identity formation, enhances the perceived conspicuous value of a brand, which in turn fosters loyalty. This study further shows that materialistic values intensify the impact of socially driven motives and reinforce the relationship between perceived value and brand loyalty, underscoring the role of status signaling in online environments. Importantly, these patterns are consistent across Gen Z (and Gen Y), suggesting that despite differences in platform usage, the core psychological drivers related to visibility, recognition, and distinction remain largely stable across generations.

The existing literature on luxury brands provides a thorough examination of the factors that define their essence and the significance of tradition while explaining how this market keeps seeking the attention of older generations (Vigneron and Johnson, 1999). Althought, it was found a lack of articles clarifying how luxury companies can maintain their historical identity while aligning themselves with the growing ideals of Gen Z. This gap motivated this thesis, which seeks to investigate the unique tactics used by luxury companies to reconcile these two factors. In this literature review, we dive deep into characteristics of each generation and how the luxury market survives to these fluctuations. The market's need to adapt and innovate is becoming more urgent (Fredberg & Pregmark, 2016).

Therefore, the following research questions (RQs) are formulated:
RQ1: How can luxury companies remain timeless and compatible with the ideals of Gen Z without losing their essence?
RQ2: What are the strategies that are being adopted by luxury brands to attract the Gen Z?

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/w9346523772

2. Theoretical Background

2.1. Luxury brands and Generation Z

It is now evident that the Internet and social media have played a significant role in making luxury more accessible. Additionally, it can be argued that online interactions and social media activities contribute to socialization processes, influencing the way conspicuous consumption is perceived and experienced (Dobre et al., 2021).

Zhang et al. (2022) targeting four big luxury brands (Louis Vuitton, Ralph Lauren, Gucci, and Burberry) noticed that all these luxury brands focus on enhancing their presence on TikTok by creating brand-generated content, such as showcasing their brand image and fashion shows. They also collaborate with influencers, highlight visually creative and aesthetic elements, and incorporate original songs and hashtags. These strategies not only fulfill consumers' functional and hedonic expectations but also promote engagement by encouraging likes and follows on brand channels.

Shukla and Rosendo-Ríos (2021) state that luxury goods consumption is highly dependent on what others consume within the network and highlighted the significant role of social comparisons and the effects of reference groups regarding luxury consumption basing themselves on network effect theory. These scholars include snob motivation, bandwagon motivation, the Veblen motivation and affirm that when reinforced by the network effects these symbolic motivations will have a direct and positive effect on luxury purchase intentions. Snob motivation reflects a desire for exclusivity and avoidance of widely owned goods, bandwagon motivation reflects a tendency to purchase items because others are buying them, and Veblen motivation reflects a preference for expensive goods as a signal of status and prestige. Within this framework, social media platforms serve as instruments that guarantee widespread public visibility, thereby affording owners of luxury goods the chance to dazzle other owners by showcasing their riches, tastes, expertise, and brand preferences. This may demonstrate how well social media and premium brands work together (Creevey et al., 2021).

With the arrival of the third technological revolution, the digital age has become omnipresent in the lives of Gen Z; With the growth in the use of technology in our daily lives and the growth of social media, various professionals in the virtual field have begun to emerge (Forster-Carneiro et al., 2022). Craig (2019) explains that content creators are all the people who use social media channels such as YouTube, Instagram, Facebook, Twitter, and others to publish entertaining or educational content with an entrepreneurial spirit and desire to generate leads. Therefore, traditional marketing no longer works for this generation. One of the strategies that is working very well with this group is influencer marketing (Roberts, 2023).

Since Gen Z is the first generation to have grown up exclusively in the digital era, its members are extremely tech-savvy and dependent on Internet channels for communication, knowledge, and shopping. As people move across various channels and devices, they anticipate flawless omnichannel purchasing experiences. To guarantee a unified and integrated brand experience is important for brands to maintain consistency across physical stores, internet platforms, and social media (Roberts, 2023). However, despite their great reliance on digital, Gen Z exhibits a desire for interpersonal communication, which contributes to explaining why influence marketing works so well to promote brands (Cho et al., 2021).

The increasing emphasis on sustainability is one of the most noticeable shifts in the trends influencing consumer behaviour (Mohr et al., 2021). Consumers nowadays, especially the younger ones, show a stronger awareness of the environment. This translates into a need for transparent supply chains, sustainable materials, and moral production methods. Consumers seeking to balance their opulent lifestyle with a positive environmental impact are drawn to luxury brands that uphold and promote these ideals.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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Brand loyalty is changing. Some scholars (e.g., Thangavel et al., 2019; Puiu, 2016; Thomas et al., 2022) refer that customers are less likely to form a lifelong commitment to a single luxury brand, particularly younger ones. Loyalty is gained by continuously outstanding experiences, common values, and continued relevance. Luxury brands are responding to this through innovative loyalty programmes, strategic collaborations and exclusive events that seek to keep consumers engaged over time

2.2. Luxury companies' market trends and business strategies

The luxury business, which is continually evolving, confronts substantial problems such as generational attitudes shaping customer preferences where (1) new trends and concerns are brought up by each generation and companies need to keep themselves updated so they can conquer new clients and (2) social, cultural, and technical revolutions have a significant impact on the business tactics used by luxury brands, necessitating ongoing adaptation to remain relevant and attract consumers of various ages (Seo & Buchanan-Oliver, 2015). Unlike previous generations, Millennials and Gen Z favour authentic experiences, ethical principles, and sustainability over the ostentation and status of expensive items; This has changed the focus of luxury companies, which now seek to present authentic stories, emphasize sustainable methods, and demonstrate social responsibility (Vigneron & Johnson, 2004). The purchasing patterns of millennial consumers are identified as socially influenced, brand image affective, and information-intensive behaviours in developed countries (Parment, 2013; Smith, 2011).

Due to consumer demand for information about product origins, manufacturing processes, and the environmental impact of luxury brands, transparency has emerged as a critical component of marketing strategies; businesses that embrace ethical and sustainable practices can stand out in the marketplace and gain the support of customers who care about the environment (Smith, 2011).

Digitalization is essential for communicating with the next generation. Luxury brands are spending money on social media presence, digital marketing tactics, and an online presence. According to Reinikainen et al. (2020), Gen Z is digitally native and highly engaged with content and social media. In order to respond to this new generational trend, companies have been using social networks as a new means of bringing their services/products to their target audience (Hutter et al., 2013; Okonkwo, 2009). Social media marketing has become a must-have for businesses trying to connect with their consumers and reach a larger audience (Quinn, 2016) but not just social media, a full online presence such as websites, online campaigns and social networking is needed (Plowman & Wilson, 2018).

In the digital age, luxury brands have recognized the importance of social media for promoting their goods and services (Kim & Ko, 2010; Okonkwo, 2010). Luxury businesses may interact with consumers, build brand recognition, and raise demand for their products by utilizing social media like Instagram (Kim & Ko, 2010). Luxury brands have leveraged social media to showcase their PR content to reach a younger demographic; This has resulted in a closer relationship between the company and the customer thanks to more relatable, honest, and authentic content (Kim & Ko, 2010). Chanel, Gucci, Burberry, and Louis Vuitton are a few of the companies that actively distribute their content on social media. As an alternative, luxury firms can use digital influencers to target demographics; these influencers build fan networks that draw luxury brands (Vinerean and Oprena, 2019). Luxury buyers' decisions can be influenced by using the viewpoints and experiences of common people who wish to live affluent lives (Seo & Buchanan Oliver, 2019). According to Marwick (2013), influencers can be described as a "state of being famous to a niche group of people" and involves the curation of a persona that feels "authentic to viewers".

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http://doi.org/10.9770/w9346523772

3. Methodology

Methodology approach

A qualitative methodology approach was adopted due its capacity to delve deeply into individuals' experiences, attitudes, and behaviours, providing unique insights into complex phenomena such as luxury brand trends and evolution. This data was collected and analysed using qualitative methods, which included techniques such as interviews, observations, and document analysis. In this study, semi-structured interviews were used to collect data from brand activation, public relations and advisory professionals who have directly dealt with luxury brands. These interviews seek to elicit their viewpoints, experiences, and insights into strategies for sustaining luxury brands over generations (Pandey & Pandey, 2015).

The qualitative methodology was the chosen method to gather data, considering the nuanced nature of luxury brand management. This way the data collection would be more specific, have more contextual understanding and we would be able to analyse deeply the interviewed perspectives. Unlike quantitative methods, which focus on numerical data and statistical analysis, qualitative methodology allows for a deeper exploration of the underlying meanings, motivations, and contexts that shape the strategies employed by luxury brands.

Sample, measures and instrument

Four interviews were conducted with brand activation, public relations and advisory professionals from luxury brands such as Givenchy, Dolce & Gabbana, and Saint Lauren (Table 1). These professionals are from the company Treasurecode Lda., a consultancy and public relations company specialized in the beauty, fashion and lifestyle sectors, whose clients include major national and international brands.

Table 1. Sample

Interviewee	Role in the Company
I_1	Accountant of luxury brand Givenchy Beauty
I_2	Accountant of luxury brand Givenchy Beauty and Leitão Irmão
I_3	Accountant of Dolce & Gabbana and Steve Madden
I_4	Accountant of Elisabetta Franchi and Liu Jo

Source: own work based on the conducted study

The interview was the method used to collect the primary data (Taherdoost, 2021). Interviews are a type of social interaction in which the information obtained comes from a conversation in which the interviewer poses purposeful questions, and the subject of the interview responds with responses that will be utilized to draw a logical conclusion later. These interviews happened during the month of May of 2024. According to Taherdoost (2021), this methodological approach makes it feasible to obtain more detailed information since it involves direct communication. Compared to simply filling out a questionnaire, the interviewee is more likely to be forthcoming while under interrogation, particularly if the interviewer is equipped with the appropriate skills. The interview structure is presented in Table 2.

Table 2. Interview structure

Question(s)	Author(s)
Q1. How important do you think it is to understand and differentiate generations in your daily job?	Adapted from Williams and Page (2009)
Q2. Do you think different generations need different marketing approaches? Justify.	Adapted from Williams and Page (2009); Parment (2013)
Q3. To execute your job in the most effective way possible do you differentiate cohorts when thinking about marketing campaigns?	Adapted from Williams and Page (2009; Grewal et al. (2004); Schade et al. (2016); Wilcox et al. (2009)
Q4. Do you think luxury brands have difficulty in maintaining their essence across generations?	Adapted from Heine (2012); (Kapferer, 2014)

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http://doi.org/10.9770/w9346523772

Q5. How luxury brands have been adapting their communication and strategies throughout generations?	Adapted from Ko et al. (2019); Zhang et al. (2022)
Q6. What changing in trends you perceived in the luxury market throughout your career?	Adapted from Kim & Ko (2010); Bian and Forsythe (2012); Williams and Page (2009)
Q7. Do you think these changing trends were related to the differences between generations?	Adapted from Bian and Forsythe, (2012); Grewal et al. (2004); Schade et al. (2016); Wilcox et al. (2009)
Q8. Do you think Generation Z is an important generation in the luxury market?	Adapted from Roberts (2023)
Q9. How would you define Generation Z as consumers?	Adapted from Roberts (2023)
Q10. What strategies of marketing/channels are being used to attract this cohort?	Adapted from Dobre et al. (2021)

Source: own work based on the conducted study

4. Results

Concerning Q1, the results highlight a strong consensus on the importance of understanding the target audience in brand communication. All interviewees emphasize that effective communication requires aligning brand strategy with generational and audience segmentation. The responses suggest that brand communication is not one-size-fits-all; instead, it must be tailored based on factors such as brand identity, product type, and the intended consumer demographic. This reinforces the idea that a deep understanding of consumer behavior across generations is crucial for sustaining a luxury brand's essence and market relevance. The results are summarised in Table 3.

Table 3. Q1 Results

Interviewee	Key Points	Main Idea
I_1	Understanding generations means understanding the audience; crucial for communication.	Audience understanding is essential for effective communication.
I_2	Brand strategy and target audience must be understood first before executing communication.	Aligning brand strategy with audience targeting is key.
I_3	Communication depends on the product, brand segmentation, and type of message.	Segmentation is necessary at both brand and product levels.
I_4	Different brands have different target audiences and generations, requiring tailored communication.	Communication strategies must adapt to different target audiences.

Source: own work based on the conducted study

Regarding Q2, the results emphasize the necessity of adapting communication strategies based on generational differences in media consumption. All interviewees agree that different age groups engage with distinct platforms, requiring tailored approaches. Younger generations are more active on digital platforms, while older audiences may still rely on traditional media such as print, television, and radio. This highlights the importance of a multi-channel strategy for brands, ensuring that messaging reaches each demographic effectively. The findings reinforce that a one-size-fits-all approach is ineffective in marketing, particularly in the luxury sector, where brand reputation and exclusivity play a crucial role in audience targeting. The results are summarised in Table 4.

Table 4. Q2 Results

Interviewee	Key Points	Main Idea
I_1	Different generations use different platforms; older generations are present on TikTok but may struggle with technology.	Communication should adapt to generational tech preferences.
I_2	Different platforms, approaches, and campaigns are needed for different generations.	Tailoring communication strategies is essential.
I_3	Communication methods should vary by age group; older generations prefer traditional media like print, TV, and radio.	Traditional media is more effective for older audiences.
I_4	Luxury brands target specific audiences using appropriate media; print magazines work for older consumers, but not younger ones.	Media selection should align with generational habits.

Source: own work based on the conducted study

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/w9346523772

Respecting Q3, the results enhance the complexity of audience segmentation beyond just generational differences. While generational targeting is important, several interviewees emphasize the need to consider additional factors such as socioeconomic status, consumer habits, and brand positioning. There is a strong consensus that marketing strategies must be highly differentiated, with tailored campaigns, events, and activations designed for specific audience segments. Particularly in the luxury sector, balancing exclusivity with relevance is a key challenge. These insights reinforce the importance of precision in communication strategies to ensure brand messaging effectively reaches the intended audience. The results are summarised in Table 5.

Table 5. Q3 Results

Interviewee	Key Points	Main Idea
I_1	Beyond generations, targeting within a generation is crucial; factors like wealth and media consumption habits matter.	Effective communication requires both generational and socioeconomic targeting.
I_2	Events and campaigns should be tailored to specific audiences; combining them is not ideal.	Customization of marketing activations is necessary for different targets.
I_3	Differentiation in communication strategies is essential.	A one-size-fits-all approach is ineffective.
I_4	Luxury brands must balance exclusivity with maintaining a modern appeal, especially in different markets.	Luxury brand positioning must align with exclusivity while staying relevant.

Source: own work based on the conducted study

With reference to Q4, the results reveal a nuanced perspective on the challenges of sustaining a luxury brand's essence over time. While some interviewees believe maintaining a luxury brand is easier than establishing one, they all emphasize the need for continuous innovation to remain relevant. A key challenge is striking a balance between reinvention and brand identity, as seen in examples like Tiffany & Co. and Dolce & Gabbana. Successful luxury brands adapt to modern trends and audiences while preserving their core values and exclusivity. Overall, the findings highlight that while adaptation is necessary, it must be strategic to ensure longevity without diluting the brand's prestige. The results are summarised in the Table 6.

Table 6. Q4 Results

Interviewee	Key Points	Main Idea
I_1	Establishing a luxury brand is harder than maintaining it, but innovation is necessary to stay relevant.	Luxury brands must continuously innovate to capture attention.
I_2	Reinvention without losing identity is challenging; successful brands like Tiffany's adapt by collaborating with modern icons.	Balancing tradition with modern appeal is key to longevity.
I_3	Brand evolution can be seamless if identity is preserved, as seen in Dolce & Gabbana's adaptation to trends while maintaining its essence.	Adaptation should enhance, not compromise, brand identity.
I_4	Innovation is a major challenge for luxury brands as they must constantly evolve.	Continuous innovation is essential but difficult.

Source: own work based on the conducted study

As to Q5, the results highlight the evolving nature of luxury brand marketing, emphasizing the shift from traditional exclusivity to more immersive and diverse experiences. Social media has transformed the way luxury brands engage with consumers, allowing for new forms of experiential marketing beyond traditional fashion shows. While exclusivity remains a core pillar, brands now focus on offering unique, money-can't-buy experiences to maintain their prestige. Additionally, a balance between digital and traditional marketing strategies is essential, ensuring broad reach while leveraging influencer partnerships and 360-degree communication strategies. Overall, the findings suggest that adaptability and multi-channel engagement are crucial for sustaining luxury brand appeal in the modern era. The results are summarised in Table 7.

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Table 7. Q5 Results

Interviewee	Key Points	Main Idea
I_1	Luxury brands now offer diverse experiences beyond fashion shows, leveraging social media to engage audiences with exclusive activations.	Experiential marketing is key to modern luxury branding.
I_2	True luxury lies in exclusivity; consumers seek unique, money-can't-buy experiences that enhance a brand's prestige.	Exclusivity through unique experiences sustains luxury appeal.
I_3	While digital marketing is essential, traditional advertising like TV commercials still holds value in reaching a broad audience.	Luxury brands blend traditional and digital strategies for reach.
I_4	360-degree communication strategies, including digital presence and influencer partnerships, are crucial for brand success.	Integrated communication across channels strengthens brand impact.

Source: own work based on the conducted study

Concerning Q6, the results emphasize a significant transformation in luxury brand marketing, driven by the decline of traditional print media and the rise of digital platforms. Younger generations no longer engage with magazines as before, prompting brands to shift their budgets toward digital campaigns, exclusive experiences, and large-scale activations. TikTok has emerged as an unexpected but powerful platform for luxury marketing, demonstrating the industry's need to adapt to new social media trends. Additionally, collaborations with digital influencers and themed collections reflect efforts to remain relevant to younger audiences. Overall, these findings emphasize the necessity for luxury brands to embrace digital innovation while maintaining their core identity. The results are summarised in Table 8.

Table 8. Q6 Results

Interviewee	Key Points	Main Idea
I_1	Luxury brands have shifted budgets from print and TV ads to digital due to declining readership among younger generations.	Print media is losing relevance, leading to increased digital investment.
I_2	Marketing budgets now prioritize digital campaigns, major events, and exclusive experiences instead of traditional fashion magazines.	Luxury brands focus on digital, events, and experiential marketing.
I_3	TikTok has revolutionized luxury marketing; once seen as an unserious platform, it is now a key space for major brands like Gucci.	TikTok's rise has reshaped luxury brand strategies.
I_4	Luxury brands are adapting to younger audiences through digital influencers and themed collections, such as Harry Potter-inspired fashion.	Brands evolve through digital partnerships and generational adaptations.

Source: own work based on the conducted study

Regarding Q7, the results enhance the evolving nature of luxury brand marketing in response to generational shifts and changing digital landscapes. Social media platforms play a crucial role in shaping brand relevance, with TikTok emerging as a key space for engaging younger audiences, while Instagram remains essential for visibility. Younger consumers prioritize experiences over traditional status symbols, using social media to showcase exclusivity and brand engagement. While luxury brands maintain strong identities, they must continuously adapt to avoid losing market relevance. Overall, the findings highlight the necessity of a dynamic, platform-specific approach to effectively connect with different generations while preserving brand prestige. The results are summarised in Table 9.

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Table 9. Q7 Results

Interviewee	Key Points	Main Idea
I_1	Social media platforms evolve, and brands must follow their target audience. Givenchy, aiming for a "cool kid" image, prioritizes TikTok while maintaining presence on Instagram.	Luxury brands must align their platform choices with their brand identity and audience.
I_2	Younger generations value experiences over status and use social media to showcase them. Social media has transformed how luxury is perceived.	Experience-driven marketing is more important than traditional status symbols.
I_3	Luxury brands have strong identities but must still evolve with generational shifts. Adapting to platforms like TikTok is essential for long-term relevance.	Luxury brands must modernize while maintaining their essence.
I_4	Adapting strategies helps brands connect with different generations.	A multi-generational approach is key to luxury brand success.

Source: own work based on the conducted study

Respecting Q8, the results reveal the importance of Gen Z as the future consumer base for luxury brands. While they may not yet have strong purchasing power, they are deeply influenced by social media, influencers, and the aspirational nature of luxury items. Unlike previous generations, who embraced fast fashion and mass consumption, Gen Z is more conscious of sustainability and quality, preferring fewer but higher-value purchases. Luxury brands must cultivate brand desire early, ensuring that when Gen Z enters the workforce, they are loyal consumers. Social media plays a crucial role in shaping their perception of luxury, making digital engagement essential for long-term brand success. The results are summarised in Table 10.

Table 10. Q8 Results

Interviewee	Key Points	Main Idea
I_1	Gen Z does not currently drive luxury brand profits but is crucial for future sales. They desire luxury and will buy more once they enter the workforce.	Gen Z is a future luxury consumer, and brands must build desire early.
I_2	Social media and influencers have made luxury items aspirational for Gen Z. More young people now prioritize owning luxury items.	Social media fuels Gen Z's aspiration for luxury products.
I_3	Gen Z is the next generation of luxury buyers, making them an important target for brands.	Gen Z will eventually become key luxury consumers.
I_4	Gen Z lacks purchasing power but values sustainability and quality over quantity. Social media amplifies their appreciation for luxury, unlike previous generations.	Gen Z's approach to luxury is driven by sustainability, quality, and social media influence.

Source: own work based on the conducted study

With reference to Q9, the results highlight the profound impact of social media on Gen Z's consumption habits, particularly in the luxury sector. Unlike previous generations, their purchasing decisions are heavily influenced by peer validation, online trends, and brand storytelling. Social media platforms, especially TikTok, serve as key spaces where trends emerge, making virality a crucial factor in sales. Additionally, Gen Z places a high value on the experience and meaning behind a product rather than just its function. The rise of "cancel culture" also means brands must align with values that resonate with this generation. Overall, luxury brands must focus on digital engagement, authenticity, and experiential marketing to effectively capture Gen Z's interest and loyalty. The results are summarised in Table 11.

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http://doi.org/10.9770/w9346523772

Table 11. Q9 Results

Interviewee	Key Points	Main Idea
I_1	Gen Z consumers are highly influenced by social media and peer pressure. Viral products sell out quickly because everyone wants to be part of the trend.	Social media and group influence drive Gen Z's purchasing behavior.
I_2	Gen Z cares about a brand's mission, values, and storytelling rather than just the product itself. Cancel culture plays a role in their purchasing decisions.	Gen Z buys based on brand values and storytelling, not just the product.
I_3	This generation values the experience behind a product rather than just the act of buying. They seek deeper meaning in their purchases.	Gen Z prioritizes experiences and emotional connections over simple consumption.
I_4	Social media shapes Gen Z's consumption habits, making it "cool" to showcase branded purchases online. Unboxings and luxury product displays influence buying behavior.	Social media trends and the desire for online validation impact Gen Z's luxury purchases.

Source: own work based on the conducted study

As to Q10, the results emphasize the evolving landscape of luxury brand marketing, emphasizing the dominance of social media, influencer marketing, and experiential activations. TikTok and Instagram emerge as key platforms, with a shift from traditional celebrity endorsements to real, relatable influencers and user-generated content. Additionally, strategic product placement in TV series, music videos, and podcasts proves to be an effective way to position luxury brands in aspirational contexts. Beyond digital, in-person brand activations at festivals and public events create memorable consumer experiences. The insights reinforce the importance of a multi-channel approach, blending digital influence with real-world engagement to maintain luxury brands' desirability among younger generations. The results are summarised in Table 12.

Table 12. Q10 Results

Interviewee	Key Points	Main Idea
I_1	Social media is crucial, but product placement in TV series, music videos, and podcasts is also a powerful marketing strategy.	Luxury brands should use both social media and strategic media placements to enhance brand presence.
I_2	TikTok is the dominant platform, but Instagram remains relevant. Platforms like YouTube and Twitch are important for specific products. Influencer marketing is key in decision-making.	Social media and influencer marketing significantly impact consumer purchasing decisions.
I_3	Social media activations, especially at festivals and public events, create memorable brand experiences. Facebook is no longer relevant.	Interactive brand activations help brands connect with Gen Z beyond digital platforms.
I_4	Luxury brands are shifting from traditional celebrity endorsements to digital influencers and everyday social media users. TikTok plays a key role in brand exposure through organic content like unboxings.	Influencer marketing and user-generated content are shaping luxury brand communication.

Source: own work based on the conducted study

5. Discussion

The results highlight the need for luxury businesses to successfully handle the shifting dynamics of generations (Williams & Page, 2009) The subtleties of consumer behaviour also change when the torch is passed from one generation to the next. It was confirmed that different generations need different marketing approaches as these scholars defended. To stay in line with the zeitgeist, brands must adapt their tactics and be aware of these changing ideals.

Luxury brands are actively adjusting their strategies as they are acutely aware of this reality. The focus on having a strong online presence is a calculated reaction to the inclination towards virtual interaction among digital

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natives. In line with Batat (2019), the results show that in contrast to previous generations, these generations are driving a transformation of the luxury sector, with a focus on experiences, sustainability, digitalisation, and personalisation, in contrast to the traditional model centred on product ownership. Importantly, a key component of luxury firms' strategies is their dedication to providing experiences and being meaningful on their campaigns and missions, always providing feelings and sending a message instead of just showcasing a product.

This study reinforces that the use of storytelling and the linking of emotions to marketing campaigns are essential to the customers' purchasing decision. In this context, it was found that Gen Z values the feelings evoked by campaigns more than the intrinsic characteristics of the products themselves (Bian & Forsythe, 2012). Addicionally, it highligh that Gen Z, unlike other age groups, responds more intensely to narratives that appeal to emotions. Therefore, to attract and retain Gen Z consumers, brands must go beyond simply presenting the qualities of their products. It is essential to create campaigns that tell engaging and exciting stories, establishing a deep and meaningful emotional connection with consumers. This not only differentiates the brand in the competitive market, but also fosters a lasting connection that can positively influence purchasing decisions.

Although the results argue against the ones by Kapferer et al. (2019), mentioning that the essences of luxury brands are not difficult to maintain since their presence in the market is already very strong, results have shown that innovation is fundamental to keeping the brand's name relevant in today's day (Thangavel et al., 2019; Puiu, 2016; Thomas et al., 2022).

Without question, the younger generations (Gen Z in particular) become essential focal areas for premium businesses. These generations have a great deal of influence over market trends because they are seen as the future and, more and more, as the dominant players in the consumer landscape. It is crucial to research and comprehend their preferences as Roberts (2023) defended.

Similar to Mohr et al. (2021), this study also revealed that sustainability causes such as avoiding fast-fashion and consumerism behaviours are in the core of Gen Z, a factor that plays on the side of luxury brands since this generation rather buy less but better-quality items. Like Zhang et al. (2022), it was concluded that for marketing campaigns, influence marketing campaigns are the most effective way to create a connection between brand and customers always through online platforms. TikTok was mentioned has the social media most used by younger generations and how it is important nowadays to communicate with the population.

This study emphasizes how important it is for luxury brands to understand generational trends. A constant state of awareness and adjustment is necessary for the complex dance between changing consumer values and brand initiatives. Luxury companies present themselves not simply as purveyors of grandeur but also as dynamic entities that resonate with the pulse of societal change, all while keeping a close eye on the next generation. Successfully navigating generational gaps emerges as the compass guiding luxury brands towards enduring differentiation and growth in the constantly changing market landscape, as consumer behaviour continues to track new frontiers.

6. Conclusion

Final remarks

This study aims was to analyse how luxury companies can remain timeless and compatible with the ideals of new generations. Additionally, it aims to identify what are the strategies that luxury brands are adopting to attract the new generation (Gen Z).

Through semi-structured interviews with brand activation, public relations and advisory professionals who work with the luxury market, several key themes emerged, highlighting the importance of generational distinctions, the

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evolution of marketing strategies, and the unique characteristics and preferences of younger consumers, particularly Gen Z.

It was concluded that recognizing and addressing the distinct behaviours and preferences of different consumer generations in their daily work is fundamental. Understanding these differences is crucial for developing effective marketing and brand activation strategies. Despite these generational variations, it was concluded that luxury brands do not face significant challenges in maintaining their essence across generations due to their established prestige and reputation. The primary focus is on ensuring that the brand name remains top-of-mind in the luxury market through innovative marketing campaigns and products.

A significant shift in marketing strategies from offline to online channels was noted. Offline marketing is losing its influence over time, with marketing budgets increasingly being allocated to online platforms such as Instagram and TikTok. TikTok was also identified as the leading platform for engaging younger generations, especially Gen Z. However, an interesting perspective was shared, cautioning against the complete abandonment of offline channels. It was argued that offline channels still play a critical role in building credibility and consumer confidence.

It was concluded that different generations require tailored marketing approaches. For older generations, traditional channels like television and magazines are still effective, whereas younger generations gravitate towards online platforms such as Instagram, YouTube, and TikTok. This divergence necessitates a dual-channel strategy to effectively reach and engage a diverse consumer base. Even so Gen Z is still not the main target for luxury brands there was consensus that Gen Z represents the next generation with significant purchasing power, making it imperative for luxury brands to understand and connect with them.

We can conclude that Gen Z values authenticity, realness, public concerns, and experiential engagement. They seek brands that resonate with their values and offer meaningful connections. This generation's demand for authenticity and experiences marks a shift from traditional luxury experiences, such as fashion shows, to more interactive and innovative interactions. However, because of the big presence of social media in their lives, Gen Z is very influential, and trends change fast. Reviews and recommendations are very important in the purchase decision-making of this generation.

In summary, the findings from these interviews reveal that sustaining luxury brands across generations involves a nuanced understanding of generational differences, a strategic shift towards online marketing channels, and a keen focus on the evolving preferences of younger consumers. These insights provide a foundation for developing strategies that ensure the enduring distinction and growth of luxury brands in a dynamic market landscape.

Research limitations

This study encountered several limitations that should be acknowledged. Firstly, the interviewees were professionals operating within the Portuguese market, which may restrict the applicability of the findings to this specific market and culture. Secondly, the inherent complexity of the luxury market presents a significant challenge. Only a small segment of this market was analysed, which may limit the generalizability of the results. In addition, the concept of luxury is highly subjective, making it hard to analyse. It is also important to note that this research focused exclusively on brands offering luxury products, excluding luxury services, which could have influenced the findings.

Future research lines

This study has helped us to understand a little better the complexity of the luxury market and the importance of knowing the different consumers and their characteristics. This study provides a better understanding of

generational shifts and guidance for luxury brands by identifying effective marketing strategies that resonate with the younger generations.

During this research, interesting discoveries were made about the consumer behaviour of Gen Z individuals and the strategies of the luxury market. The reallocation of the available budget from television and press marketing strategies to online channels was one of the most highlighted topics during this research. However, I_3 stressed the importance of never abandoning offline, arguing that this is what brings brands notoriety and credibility. For future research is suggested to dive deep into the co-dependence of online and offline channels in terms of credibility that one brings to another. Studies with future generations may also be interesting to compare and understand the changing trends in the luxury market.

It is also suggested that future research should consider a broader scope, including diverse markets from other countries and both luxury products and services, to enhance the robustness and applicability of the findings. Additionally, it is suggested to conduct a similar study from the consumers' perspective. This study would explore what consumers would like to see more of in the luxury market, what this generation considers relevant in a luxury brand, and the strategies that consumers approve or disapprove of.

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Funding: This work is financed by the author Álvaro Carrasco Aguilar.

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p6895552966

Publisher
http://jssidoi.org/esc/home

ENHANCING EMPLOYEE ENGAGEMENT THROUGH TRANSFORMATIONAL LEADERSHIP AND AI USE: EVIDENCE FROM THE HEALTHCARE SECTOR IN SAUDI ARABIA

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Received 20 February 2026; accepted 15 May 2026; published 30 June 2026

Abstract. The research examines how transformational leadership and AI usage affects healthcare employee engagement in Saudi Arabia. Additionally, it investigates how employee voice moderates the relationship between transformative leadership and employee engagement. The data was collected from 408 healthcare employees who worked at hospitals and healthcare facilities throughout the Kingdom of Saudi Arabia. The researcher utilized Partial Least Squares Structural Equation Modelling (PLS-SEM) to analyze the collected data. The findings showed that the four dimensions of transformational leadership—inspirational motivation, idealized influence, intellectual stimulation, and individualized consideration—significantly influence employee engagement. The findings further show that the usage of AI technologies can lead to more employee engagement. Furthermore, the findings confirm the moderating role of employee voice in enhancing the relationship between transformational leadership and employee engagement. It concludes that employee voice enables transformational leaders to achieve higher employee engagement through settings which support open dialogue and staff involvement. This article contributes to knowledge by combining leadership theory with employee voice concepts and digital transformation elements into a single model which provides healthcare leaders and policymakers with practical methods to boost employee engagement through leadership development and AI-powered workplace technology. Specifically, it underscores the importance of transformational leadership and AI technologies in enhancing employee engagement.

Keywords: transformational leadership; employee engagement; Artificial Intelligence; employee voice; healthcare sector; Saudi Arabia; digital transformation

Reference to this paper should be made as follows: Ramy, H.M.M. 2026. Enhancing employee engagement through transformational leadership and AI use: evidence from the healthcare sector in Saudi Arabia. *Entrepreneurship and Sustainable Issues*, 13(4), 445-460. http://doi.org/10.9770/p6895552966

JEL Classifications: M54

1. Introduction

In the past few years, healthcare organizations have been subjected to high challenges due to the high turbulence and uncertainty in the external environment. Furthermore, there has been many pressures on these organizations due to the high growing expectations from patients, community and relevant stakeholders. These challenges are very relevant to the healthcare sector which needs to balance the high-quality services and operational efficiency provided to patients as well as the happiness and satisfaction of employees and healthcare providers in that sector. Therefore, the importance of leadership has increased as a critical factor for organizational success, as it plays a key role in enhancing employees' attitudes, engagement, and commitment (Ytterstad & Olaisen, 2023). This article focuses on transformational

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p6895552966

leadership, which has an important role in enhancing employee productivity where the literature reports some positive outcomes for it including inspiration, empowerment, individual development and enhancing productivity (Lawrason et al., 2023).

Additionally, there has been a growing interest in the human resources literature in examining the concept of "Employee Engagement", as many studies have reported that engaged employees are more likely to achieve better results at work, where they are characterized by higher energy and they are willing to invest more effort in the workplace (Pincus, 2023). Because of the high workload, emotional demands and time pressure that characterizes the nature of employees' work in the health sector, examining employee engagement is very relevant, where it is considered crucial in enhancing performance, service quality and achieving effectiveness and efficiency in that sector. This study examines how transformational leadership influences employee engagement, where it argues that leadership has a critical role in enhancing employee engagement by motivating employees, providing meaning to work as well as enhancing professional growth of employees of the healthcare sector (Gede & Huluka, 2024). Thus, transformational leadership, with its focus on vision and long-term orientation, intellectual stimulation, and individualized consideration, can be a key determinant of success in that sector. Transformational leadership is important because it inspires employees to strive for excellence in their work and to help the organization achieve its vision and mission. Transformational leaders motivate, engage and commit employees to work optimally within a supportive and empowering work environment. As a result, employees become more motivated and perform better, drive more innovation and ensure long-term organizational success (Bakker et al., 2023; Ytterstad & Olaisen, 2023).

With the growing importance of transformation leadership in enhancing employee engagement, the influence of organizational context and enabling conditions that enhance that relationship has been recently examined in extant literature. For instance, the concept of employee voice has been highlighted recently in the human resources literature. It refers to the capacity of the employee to communicate his ideas and opinions while performing his job to his managers without being fear of any negative consequences (Morrison, 2023). Employee voice is very relevant to the healthcare industry, where front line employees face daily pressures while doing their work. Furthermore, from their daily practices and interactions with other employees and patients, they would have many ideas, suggestions or complaints that can enhance the effectiveness and efficiency of the work. In other words, the article suggests that employees who feel supported and heard tend to exhibit greater engagement. Conversely, limited voice opportunities may reduce the effectiveness of all leadership styles (Zhu et al., 2022; Mohammad et al., 2023).

Recently, the adoption of digital transformation and AI technologies has grown rapidly, where more healthcare organizations are getting used to with the aim of enhancing their service quality, efficiency and effectiveness. These digital solutions are being used in different areas of healthcare services such as scheduling, diagnostics support, patient flow management, data analytics, and administrative automation (Namatovu & Kyambade, 2025). Despite the potential that AI has in enhancing the decision-making process and service quality in the healthcare sector, the success of the implementation depends heavily on employees' ability and willingness to adopt these systems daily. Accordingly, the leadership in that sector might play a crucial role in improving employees' acceptance of digital change as well as their readiness to adopt AI tools in the workplace (Huang et al., 2024).

The connection between transformational leadership and AI usage can be logically explained, where this leadership style is required for encouraging employees to learn, innovate and adapt these innovative systems. They are also needed for creating an environment that supports shared learning and adapting innovative practices (Ahmed et al., 2025). Moreover, the contribution of AI to enhancing employee engagement is noteworthy, where it is expected that it will decrease workload, improve task efficiency and enhance employees' senses of achievement and happiness. Accordingly, AI usage can be an important step that is required for enhancing employee engagement in the health sector workplace.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p6895552966

The current study is conducted within the healthcare sector in the Kingdom of Saudia Arabia, which has seen a massive transformation and improvement under the 2030 vision. For instance, many health care organizations have got advantage of the rapid digital transformation of the country, where they have digitalized almost all their services. Thus, with that expansion of the digital and AI usage in that sector, it has become very important to understand how human factors like transformational leadership and employee voice interact with the AI usage to result in employee engagement. Despite the importance of that topic, the extant literature suffers from the limitations of studies in that context, especially in emerging and developing countries (Li et al., 2023; Namatovu & Kyambade, 2025).

Thus, this article aims to address that gap by investigating the relationship between transformational leadership and employee engagement among healthcare employees in KSA, while incorporating employee voice as a moderating variable. It also contributes by examining the relationship between AI use and employee engagement. The findings of this study are expected to offer both theoretical and practical contributions and implications. For instance, from a theoretical perspective, the study extends leadership and engagement research by incorporating digital work practices into the analysis. From a practical perspective, the findings may provide healthcare managers and policymakers in KSA with a better understanding on how leadership behaviors and organizational conditions can work together with the AI to enhance employee engagement.

The structure of this paper is as follows: First, an overview of the literature on employee engagement, AI use, and transformative leadership is presented. The conceptual framework, research hypotheses, and theoretical background are covered in the section that follows. The data collection and analysis approach are then covered. The results and a discussion of the key findings are then presented. The study's shortcomings, future research directions, and theoretical and managerial implications are all presented in the paper's conclusion.

2. Literature Review and Hypotheses Development

2.1 Transformational Leadership in Healthcare Organizations

With an emphasis on high-stress settings like the healthcare industry, the body of existing literature highlights the critical role that leadership plays in influencing employees' attitudes, actions, and performance results (Alshahrani, 2024). Healthcare organizations depend on a stable supply of skilled employees performing at optimal levels (Curado & Santos, 2022). Employee performance directly impacts the quality of service and safety provided to patients. Leadership is seen as an essential organizational resource that can improve employee engagement and motivation in high-stress settings like the healthcare industry (Gebreheat et al., 2023).

Leadership has been studied using many different theories and models in several contexts. Transactional leaders engage in an exchange with followers that is intended to enhance performance. They use rewards and discipline to motivate followers toward the achievement of desired outcomes (Dianawati et al., 2025). Servant leaders serve followers to help them realize their full potential (Shi & Zhou, 2023). Ethical leaders create work climates that are fair, ethical, with integrity, and model appropriate behavior. Authentic leaders are self-aware, transparent, balanced and consistent in their values and actions. Although all styles of leadership are important for successful organisational management, in this study a particular focus was placed on the theory of transformational leadership. All healthcare organisations are currently undergoing some degree of digital transformation and are operating in a pressurized work environment (Costa et al., 2023). During times of change and instability, such as these organisations are facing, leaders have a 24/7 service to manage, with change and uncertainty going on throughout the organization. This style of management can be particularly effective in garnering employee acceptance of change, shared vision, creative thinking and most importantly making employees feel valued. For these reasons transformational leadership is an appropriate lens through which to view engagement of employees in healthcare organisations facing turbulent times (Piwowar-Sulej et al., 2023).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p6895552966

The most well-established and well-known kind of leadership is transformational leadership. Transformational leadership is centered on motivating, empowering, and promoting change inside the company. Transformational leaders encourage and motivate their employees to work towards realizing shared goals (Alshahrani, 2024). Transformational leadership enhances the performance of employees and encourages them to take on more responsibilities at work by inspiring them to work towards a shared vision (Ytterstad & Olaisen, 2023). The fostering of trust, values, and interest in the work being undertaken enhances the performance of employees and the outcomes of organizations (Gebreheat et al., 2023). In healthcare organizations, managers can encourage employees to exceed their standard role expectations by maintaining high standards of patient care, safety, and quality of service. Therefore, leadership in healthcare organizations is more valuable than leadership in other sectors. The effective implementation of transformational leadership can ensure that healthcare organizations achieve enduring success (Manu, 2022).

The evolving nature of the healthcare industry, the changes happening within the sector, and the challenges relating to staff availability and retention all enhance the relevance of transformational leadership. Workers in the healthcare industry today are expected to perform under high-stress conditions while working with new technologies, new procedures, and new expectations for quality care and service (Tsapnidou et al., 2024). Transformational leaders facilitate this by providing employees with the clarity, support, and sense-making they need to cope with these demands and changes. The positive outcomes of this relationship between leaders and employees have been well documented in the past. It has been demonstrated that transformational leadership promotes higher levels of employee engagement and dedication to the company.

The construct of transformational leadership is viewed conceptually partitioned into its four main dimensions: idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. Each of the four dimensions represents a set of behaviors that leaders exhibit, and together they help to create the leader's overall perception by the follower. Idealized influence is the extent to which employees view their manager as an ethical role model whom they trust and respect. Inspirational motivation involves encouraging employees to work towards attaining noble goals or visions for the organization. The dimension of intellectual stimulation involves fostering creativity and innovation within the organization. Finally, individualized consideration refers to how well the leader understands and caters to individual employees' needs (Khan et al., 2025). An independent examination of each of these dimensions will uncover more about how the practice of transformational leadership enhances employee engagement in healthcare organizations.

2.2 The Concept of Employee Engagement

Employee engagement is the degree to which employees are psychologically, emotionally, and cognitively connected to their work roles. Employee engagement is typically defined as a positive work state that employees experience, characterized by vigor, dedication, and absorption (Gede & Huluka, 2024). Engaged employees exhibit high levels of energy and passion for their work, and they are highly involved in their roles. Employee engagement is seen as more valuable than job satisfaction, as it is an active motivational state that employees experience (Pincus, 2023; Bader et al., 2023). Engaged workers voluntarily devote their own time and energy to improving the organization's performance. Performance, productivity, creativity, and dedication to the company are all thought to be significantly influenced by employee engagement (Ahmed et al., 2025).

Since healthcare personnel must work in a specific environment, employee engagement is especially important in this industry. Healthcare professionals work under conditions of high responsibility, emotional intensity, and time pressure, and their performance directly impacts the safety and well-being of patients (Haddad et al., 2022). The clinical outcomes and efficacy of patient care services are directly improved by engaged staff members in healthcare facilities, who are more focused, resilient, and driven to give their patients high-quality treatment. Engaged employees who work in healthcare facilities are also more likely to demonstrate empathy, teamwork, and proactive solutions to problems encountered in their work, which are all important factors in maintaining patient trust and satisfaction. Employee engagement is important in reducing burnout and turnover among employees, which are two of the most significant

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p6895552966

and persistent challenges faced by healthcare organizations worldwide (Haddad et al., 2022). Employees who feel psychologically connected to their work and who feel supported by their organization are better able to cope with the stresses and demands associated with their work roles. Therefore, employee engagement in healthcare organizations contributes to improving not only the performance of the organization but also to enhancing the well-being of individual employees. Research findings consistently demonstrate that healthcare organizations with high standards of employee engagement achieve superior organizational performance outcomes, improved patient satisfaction rates, and enhanced patient safety outcomes (Scott et al., 2022). Therefore, it should come as no surprise that policymakers and healthcare executives who want to improve the sustainability and effectiveness of healthcare organizations have made employee engagement a top strategic objective (Wang et al., 2023).

2.3 Conceptual Model and Hypotheses Development

Figure 1 shows the conceptual model that was developed based on an extensive literature review. The following sections discuss the proposed hypotheses together with relevant literature. The proposed conceptual model distinguishes transformational leadership as a higher-level leadership construct represented through four dimensions: idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. These dimensions are examined as predictors of employee engagement, while employee voice is modelled as a moderating variable and AI usage is included as an additional direct predictor of employee engagement.

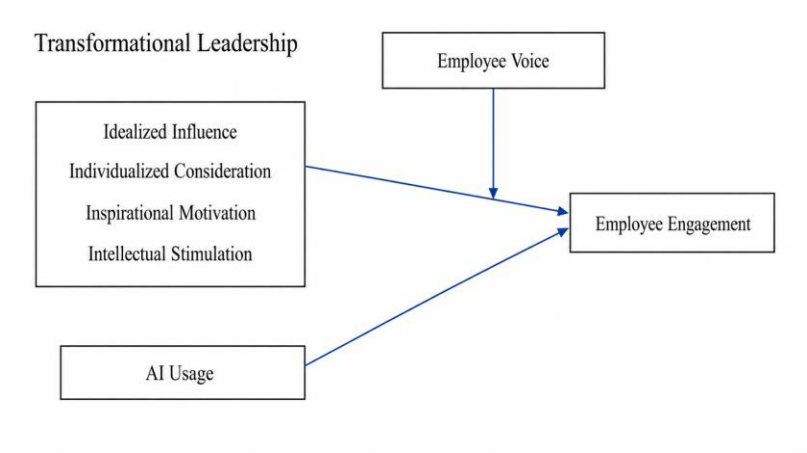


Figure 1. Proposed conceptual model showing transformational leadership and its four dimensions, AI usage, employee voice, and employee engagement
Source: the author

2.3.1 Idealized Influence and Employee Engagement

Idealized influence refers to the degree in which leaders are considered role models who are liked, respected and trusted by their subordinates. Leaders who show high level of idealized influence show high levels of integrity, credibility, fairness and consistency in their actions. For instance, in healthcare organizations, where ethical considerations and professional standards are critical, such leadership behaviors are key in enhancing trust and credibility.

The idealized influence dimension of transformational leadership is key in impacting employee engagement, where it is expected that when employees perceive that their leaders are role models, they tend to feel a sense of pride in their work, and they tend to align with organizational values. Furthermore, they develop a sense of emotional attachment with their leaders and jobs, which in turn enhances their willingness to sacrifice and work harder. By enhancing trust and respect, idealized influence can provide a mechanism for enhancing employee engagement. Thus, employees who trust their leaders are more likely to feel secure, motivated and committed,

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/p6895552966

which has an important role for enhancing employee engagement. Based on these assumptions, the following hypothesis is developed:
H1a: Idealized influence has a positive significant effect on employee engagement.

2.3.2 Inspirational Motivation and Employee Engagement
The inspirational motivation dimension of transformational leadership refers to the managers' ability to set a clear vision for the future and communicate it with high levels of optimism and enthusiasm. These leaders usually encourage employees to perform their jobs by highlighting the significance of work and showing how their roles align with the organizational goals, values and strategies (Khan et al., 2025). For instance, in the context of the healthcare sector, where daily tasks are considered routine or emotionally demanding, inspirational leadership can provide employees with high sense of purpose and direction. In other words, this dimension focuses on the leader's confidence and belief in their employees' abilities, which in turn makes them exert more effort to seek perfection. This is considered a kind of internal motivation which improves the emotional connection of employees with their work. Thus, employees who are inspired by their leaders are likely to exert more enthusiasm, dedication and sacrifices in the workplace. From the previous discussion, we propose the following hypothesis.
H1b: Inspirational motivation has a positive significant effect on employee engagement.

2.3.3 Intellectual Stimulation and Employee Engagement
The practice of intellectual stimulation at work requires organizations to motivate their staff members to develop innovative thinking while they question established beliefs and discover innovative solutions to their work challenges. Leaders who provide intellectual stimulation create learning and innovative environments through their practice of seeking and valuing employee thoughts and viewpoints (Khan et al., 2025). Healthcare organizations require intellectual stimulation because they manage complex problems which need adaptable creative solutions. Staff members who get permission to use their skills and knowledge for creative solutions will probably experience feelings of competence and self-direction. Workers who experience psychological events during their work hours will show increased dedication because they develop mental focus for their work tasks and display passion for their responsibilities which go beyond their regular duties. The combination of intellectual stimulation works to decrease monotony while making work more meaningful which leads to better employee engagement. Accordingly, the following hypothesis is proposed:
H1c: Intellectual stimulation has a positive significant effect on employee engagement.

2.3.4 Individualized Consideration and Employee Engagement
Leaders who practice individualized consideration focus on understanding the personal requirements and abilities and growth potential of each team member. Leaders who demonstrate individualized consideration act as mentors or coaches, providing personalized support and feedback. Healthcare organizations require individualized leadership methods because their personnel members possess distinct experience levels and different skill abilities and professional training (Khan et al., 2025). Leaders who support their employees will build an environment which enables staff members to create strong emotional connections with their work responsibilities and their workplace organization. Organizations which practice individualized consideration enable their staff members to create organizational bonds through trust development which leads to better employee engagement. Leaders who demonstrate authentic interest in employee health and career growth will achieve better employee commitment. Thus, the following hypothesis is suggested:
H1d: Individualized consideration has a positive significant effect on employee engagement.

2.4 The Moderating Role of Employee Voice
The effectiveness of transformational leadership behaviors which should boost employee engagement depends on the specific organizational environment where they get implemented. The way employees understand and react to leadership actions depends on the essential contextual element which is employee voice (Li et al., 2023). The

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/p6895552966

ability of staff members to share their thoughts about work activities and organizational operational methods determines the extent of employee voice. Healthcare organizations need employee voice because their operations depend on staff members who possess specialized knowledge which must be used without making critical mistakes that could lead to dangerous results. Staff members who have the freedom to express their opinions will generate valuable information which enhances operational performance and results. The psychological approach shows that voice practices at work enable staff members to experience autonomy and respect and inclusion which leads to better employee engagement. Employee voice may moderate the relationship between transformational leadership and engagement by amplifying the impact of leadership behaviours. Leaders who demonstrate authentic and supportive transformational leadership in high-voice environments create spaces which motivate employees to participate. Leadership messages which employees experience in low-voice environments lose their meaning because they transform into empty symbols which separate leadership work from employee motivation. Employee voice can help to identify how employees see leaders supporting service delivery. Fostering employee voice can create psychological ownership when employees believe that what they do matters and contribute to the organization's goals. Valuing employees' experience can enhance employees' engagement and commitment to the organization and their work. Employee voice can be particularly relevant in health care as most of the service delivery is conducted by front line staff on a day-to-day basis with patients at the center of their work. As such, employees have unique knowledge and insight which organizations can benefit from when fostering employee voice. When leaders act in a transformational way by giving employees feedback, participation and voices that are heard, an enabling climate of trust and respect can be created. Healthy workplaces enable employees to have a 'voice' at work, feeling supported to express views, ideas and concerns. In this webinar we will explore how voice at work can add value to transformational leadership influence; from being a 'sporous abstraction' to having real impact on employees (Gede & Huluka, 2024). We will look at how employee voice can convert leadership influence into employee motivation, and sustainable employee engagement during periods of rapid organizational change in the healthcare sector. This study argues that employee voice acts as a boundary condition which affects the power of transformational leadership to create employee engagement.

H2: Employee voice moderates the relationship between transformational leadership and employee engagement, such that the relationship is stronger when employee voice is high.

2.5 AI Usage and Employee Engagement

AI technology deployment creates major changes which transform how employees perform their work tasks and their interactions with their work environment. AI systems become effective when deployed correctly because they decrease manual work and enhance operational speed and generate improved choices. The advantages create conditions which help staff members develop their work control abilities and work competence, thus driving their workplace engagement. Healthcare facilities that use AI technology enable their staff to handle complicated work better while they decrease their administrative work which enables them to dedicate more time to patient care. AI tool implementation enables employees to develop better work engagement through systems which create improved work environments that enhance their job meaning. The deployment of AI technology will generate beneficial outcomes which will drive healthcare organizations to achieve higher employee participation.

The implementation of AI systems reconfigures jobs to emphasize less-routine and more complex tasks that involve analysis, customer service, and other engaged behaviors, all of which correlate with increased skill variety, job significance, and task identity, all of which are engagement drivers. AI systems that provide real-time analytics and support decisions, reducing uncertainty, cognitive overload, and fatigue (especially in healthcare), enable workers to focus on high-value tasks like patient care, increasing their psychological empowerment and emotional connection to their work. Finally, the introduction of AI systems is perceived as an indicator of management's commitment to the future of the firm and its employees, which can increase loyalty and encourage positive behaviors. AI systems, when introduced in a training context, are seen as collaborative and intelligent partners who enhance human capital rather than alien objects that generate resistance. The resulting trust and

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positive work attitudes thus reaffirm the proposition that AI usage enhances employee engagement. Based on the previous assumptions, the following hypothesis is proposed:
H3: AI usage has a positive significant effect on employee engagement.

3. Research Methodology

3.1 Research Design

The research design of this study uses quantitative methods to study the impact of transformational leadership dimensions and AI usage on employee engagement in Saudia Arabia health care organizations. It further examines the moderating role of employee voice in enhancing the relationship between transformational leadership and employee engagement.

The study focused on the healthcare industry of the Kingdom of Saudi Arabia which underwent major changes because of healthcare system reforms and digital health programs and rising funding for sophisticated medical systems. Healthcare organizations across KSA now use artificial intelligence systems to improve their operational performance and service delivery and their decision-making abilities. The sector functions as a vital environment which enables researchers to study leadership techniques and employee communication strategies and artificial intelligence deployment and workforce interaction patterns.

The target population of the study consists of healthcare employees working in hospitals and healthcare organisations in KSA. This includes both clinical and administrative staff who are directly or indirectly involved in service delivery and operational processes. The study includes different occupational groups to achieve results which demonstrate leadership and voice and technology adoption from multiple healthcare environments.

A cross-sectional survey approach was employed, as it is suitable for testing hypothesized relationships between multiple constructs within a defined population at a single point in time. The quantitative research method allows scientists to measure perceptions and behaviors through systematic methods which enable them to analyze study variables and their direct and moderate relationships. Data was collected using a structured questionnaire distributed to healthcare employees across various organisations in six cities in KSA.

The researchers used convenience sampling to select participants who were accessible and willing to take part in the study. After 2 months of data collection in November and December 2025, 409 valid responses were collected. The data was analyzed using structural equation modeling techniques with the aid of SmartPLS 4.

The researcher applied all the ethical standards applied at Majmaah University in KSA. Specifically, before distributing the questionnaire, all participants were informed about the study's objectives and were given the right of voluntary withdrawal. Also, the study's data was kept in a secure place and was only used for the purpose of the research. Furthermore, the research didn't ask for any confidential information or personal information to ensure the animosity of the study's' participants.

3.2 Measurement of Variables

All the study's constructs were measured using items borrowed from previously validated scales from the human resources literature, where they were adapted to the health care context. This study used a five-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). For instance, transformational leadership consisted of four dimensions namely: idealized influence, inspirational motivation, intellectual stimulation and individualized consideration. Each dimension was measured using multiple items reflecting employees' perceptions of their immediate supervisors' leadership behaviors. The assessment tools evaluated leaders through their role model actions and their capacity to drive staff motivation and their ability to create innovative solutions and provide personalized care to their team members. Hence, each of the four dimensions was measured using four items

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adapted from Avolio & Bass (2004). This study conceptualizes employee engagement as a positive work-related state which measures employee energy and dedication and their ability to focus on their work activities. The assessment tools measured employee work dedication through their emotional and mental participation and their positive work attitude and their readiness to take on extra work responsibilities. The assessment shows student participation through its increasing numerical values which represent growing student involvement. Employee engagement was measured using five items adopted from Saks (2006). On the other hand, employee voice is conceptualized as employees' perceived ability to express ideas, concerns, and suggestions related to work and organisational processes. The items of the questionnaire are shown in Table 1.

Table 1. Items of the questionnaire

Construct	Manifest Variable	Questionnaire Items
Idealized Influence	II1	My leader acts in ways that build my respect.
	II2	My leader emphasizes the importance of having a shared mission.
	II3	My leader demonstrates high ethical standards.
	II4	My leader behaves in ways that earn my trust.
Inspirational Motivation	IM1	My leader communicates an inspiring vision of the future.
	IM2	My leader expresses confidence that goals will be achieved.
	IM3	My leader motivates others to work toward common objectives.
	IM4	My leader speaks enthusiastically about what needs to be accomplished.
Intellectual Stimulation	IS1	My leader encourages me to think about problems in new ways.
	IS2	My leader challenges me to question traditional assumptions.
	IS3	My leader supports innovative approaches to tasks.
	IS4	My leader seeks different perspectives when solving problems.
Individualized Consideration	IC1	My leader treats me as an individual with unique needs.
	IC2	My leader spends time coaching and developing employees.
	IC3	My leader listens carefully to my concerns.
	IC4	My leader helps me develop my strengths.
Engagement	ENG1	I am fully engaged in my job.
	ENG2	I am enthusiastic about my job.
	ENG3	I feel energetic when performing my work.
	ENG4	I am immersed in my job.
	ENG5	I devote a lot of effort to my job.
Employee Voice	EV1	I formulate and offer suggestions regarding matters that impact my team.
	VOI1	I speak up with ideas for new projects or changes.
	VOI2	I communicate suggestions to improve work procedures.
	VOI3	I encourage others to get involved in issues that affect the group.
	VOI4	I speak up in this group with opinions even if others disagree.
	VOI5	I keep well informed about issues where my opinion might be useful.
AI Usage	AIU	I frequently use AI systems in my job.
	AIU	I regularly rely on AI tools to complete work tasks.
	AIU	I use AI applications as part of my daily work activities.
	AIU	I depend on AI systems to support my decisions.
	AIU	I use AI technologies whenever they are available for my tasks.

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4. Findings

Sample Characteristics

There were 180 female responders (44.0%) and 229 male respondents (56.0%). The majority of respondents (131 respondents, 32.0%) were between the ages of 18 and 34; 114 respondents were between the ages of 34 and 45 (27.9%); 98 respondents were between the ages of 46 and 59 (24.0%); and only 66 respondents were 60 years of age or above (16.1%). According to an examination of the respondents' monthly income, 28.1% of them made less than 10,000 SAR (115 respondents), 41.8% made between 10,001 and 20,000 SAR (171 respondents), and 20.4% made between 20,001 and 40,000 SAR (83 respondents). By contrast, only 40 respondents, or 9.7% of the sample, earned more than 40,000 SAR. In terms of the respondents' educational background, only 14.0% had a postgraduate degree (57 respondents), 60.1% had a college degree (246 respondents), and 25.9% had a secondary school degree (106 respondents).

Measurement model

SmartPLS was used for the statistical study, which was based on a dataset that included 409 healthcare workers. The validity and reliability of the study's constructs must be evaluated before the research hypothesis is tested. Cronbach's alpha and composite reliability (CR) values were computed for each construct in order to assess internal consistency reliability. When these values surpass the suggested threshold of 0.70, satisfactory reliability is attained. Additionally, composite reliability should be investigated before structural model evaluation. The findings showed that Cronbach's alpha values ranged from 0.829 to 0.871 and CR values ranged from 0.887 to 0.912, suggesting good internal consistency and verifying that all constructs exhibit strong dependability.

Additionally, external loadings were examined in order to assess indication reliability. All indicator loadings above the acceptable threshold of 0.70, suggesting strong item reliability. Since each indicator made a sufficient contribution to the corresponding constructs, no items were eliminated from the measurement model.

The Average Variance Extracted (AVE) was used to evaluate convergent validity. AVE values should be greater than 0.50 to show sufficient convergent validity, according to Fornell and Larcker (1981). AVE values ranged from 0.662 to 0.722, according to the results, confirming that each construct accounts for more than half of the variance of its indicators. The comprehensive measurement model results, including outer loadings, composite reliability, Cronbach's alpha, and AVE values, are shown in Table 2.

The Fornell-Larcker criterion was used to evaluate discriminant validity. The findings showed that each concept's square root of AVE was greater than its correlations with every other construct, indicating adequate discriminant validity. These results verify that each construct is empirically distinct from the others and captures a unique concept.

Table 2. Outer loadings, CR values, Cronbach's alpha, and AVE) of the study's constructs

Construct	Cronbach α	CR	AVE
II	0.855	0.902	0.698
IM	0.871	0.912	0.722
IS	0.829	0.887	0.662
IC	0.865	0.907	0.711
EV	0.861	0.907	0.642
AIU	0.848	0.898	0.677
ENG	0.869	0.910	0.699

Assessment of the structural model

The structural model was evaluated using bootstrapping resampling techniques within PLS-SEM to test the suggested hypotheses. To ascertain whether the proposed associations were supported, the analysis concentrated on looking at the standardized path coefficients (β), t-values, and significance levels (p-values).

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The results showed that idealized influence had a favorable and statistically significant impact on employee engagement, supporting H1a ($\beta = 0.222$, $t = 4.247$, $p < 0.001$). Similarly, inspirational motivation showed a substantial beneficial impact on involvement ($\beta = 0.139$, $t = 2.830$, $p = 0.005$), supporting H1b. The findings also supported hypothesis H1c, according to which intellectual stimulation greatly increased worker engagement ($\beta = 0.202$, $t = 4.096$, $p < 0.001$). Individualized consideration also had a favorable and significant effect on involvement, supporting H1d ($\beta = 0.306$, $t = 6.040$, $p < 0.001$).

Additionally, the results supported H3, showing that staff engagement is positively and statistically significantly impacted by AI usage ($\beta = 0.178$, $t = 4.457$, $p < 0.001$). Furthermore, the interaction term between transformational leadership and employee voice demonstrated a significant positive effect on engagement ($\beta = 0.148$, $t = 3.501$, $p = 0.001$), indicating that the positive influence of transformational leadership on engagement becomes stronger when employee voice is high, supporting the moderation hypothesis H2.

The structural model showed significant explanatory power overall. The four transformational leadership qualities, AI usage, and the interaction effect account for 52.5% of the variance in employee engagement, according to the coefficient of determination (R^2) for employee engagement, which was 0.525. This indicates a moderate to large level of prediction accuracy by widely accepted standards.

5. Discussion and Implications

The current study examined how employee engagement in the healthcare industry is impacted by transformational leadership and AI utilization, as well as the function of employee voice as a moderator of these interactions. The results integrate theoretical and practical insights that expand on current leadership, engagement, and digital transformation studies on complex service contexts like healthcare and offer strong support for the proposed conceptual model.

As stated in the study's context section, healthcare organizations function within the pressures of high-stakes environments, great responsibility, and rapidly evolving technological innovations. Therefore, organizing, leadership, and digital competency emerge as key organizational resources.

Therefore, in summary, first, the study found that all four dimensions of transformational leadership significantly increased employee engagement, which supports the multi-dimensionality of the transformational leadership theory. Individual consideration was the strongest among the four dimensions of leadership, followed by idealized influence, intellectual stimulation, and inspirational motivation. Second, the study found that AI utilization positively affected employee engagement, thus supporting the notion that technology can serve as a motivational job resource rather than merely a task-oriented resource. Third, the study identified employee voice as a moderator of the relationships between transformational leadership dimensions and engagement, demonstrating that the beneficial effects of transformational leadership behaviors are strengthened when employees feel they can share their ideas.

In conclusion, these findings align with prior literature regarding the high-stress environment of the healthcare system. Thus, it is not surprising that the present findings suggest that, in such an environment, effective leadership behaviors are centered on the relational aspects of supporting rather than simply performing well. Thus, the current findings support and extend the existing literature on healthcare leaders in that these positive effects of engagement appear to derive from the individualized considerations that healthcare leaders provide to their followers. These findings, therefore, support and extend the prior literature regarding the benefits of these leadership behaviors in complex and high-stress work environments such as healthcare.

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Furthermore, second, the positive effects of technology utilization on employee engagement support the emerging literature on the digital workplace. Thus, this literature suggests that digital technologies can be designed as work-enabling systems to strengthen employees' emotional bonds to their work and the organizations for which they work, thus enhancing their willingness and ability to perform at the high levels of effectiveness required in technologically innovative workplaces like healthcare. Third, the present study's finding that employee voice acts as a mediator between the transformational leadership behaviors and the employee engagement outcomes is new but expected within the context of a complex, technologically innovative, and rapidly changing work environment such as healthcare. Therefore, these findings only support the emerging literature suggesting that healthcare leaders need to consider contextual (organizational climate) factors in their leadership interventions.

In practice, the present findings offer important implications for healthcare managers and health policymakers who wish to enhance the effectiveness of their leaders. Hence, in managing and training healthcare leaders and managers for the future, those responsible for implementing training interventions for those leaders would do well to focus more on improving their supportive communication patterns than on their technical or task-related abilities.

Furthermore, in technologically changing environments like healthcare, enhancing employee engagement is a "critical success factor" for effective organizational performance. Enhancing employee engagement, therefore, requires careful planning to optimize the outcomes for all stakeholders involved, as these stakeholders include employees themselves and the organizations for which they work. The current study's findings thus suggest that such planning requires taking steps to ensure that all available work-related resources can be utilized to promote positive attitudes toward work and foster work-related emotional bonds among employees who work within these technologically changing and rapidly evolving environments. Moreover, managers should also actively work to build a culture of employee voice through the encouragement of employee participation, the development of feedback mechanisms and the promotion of psychological safety. Such factors can further enhance the impact of leadership and boost employee motivation. Finally, at a policy level, initiatives for digital transformation in healthcare should include elements related to manager training and development and the building of a culture of participation, since technology alone is not enough to support improvements in workforce engagement. Hence, the present study provides evidence for the necessity of a dual framework that integrates transformational leadership with technological and cultural factors, in order to support employee engagement in 21st century healthcare organizations.

The findings of the present study may also generalize the relationship between leadership and technological change. Whilst transformational leadership explained little of technological change adoption above and beyond the prediction of structural and psychological factors, its potential to explain employee adoption was nonetheless contingent upon alignment with other organizational characteristics. In organizations with high workload, with emotionally demanding work and with rapid technological change (characteristics of much health care provision), leaders who demonstrated support, trust and individualized consideration were found to be most effective. Transformational leaders help make sense of technological change by providing meaning in the face of organizational digital change. By fostering conditions of intellectual stimulation, leaders may assist employees in becoming psychologically ready to adopt AI and to practice digital work using technology such as clinical AI. The findings of this research have implications for how technology is implemented as an organizational resource. Many organizations are investing heavily in the adoption of AI and other emerging technologies with the objective of enhancing efficiency and employee engagement. However, the findings suggest that in the absence of human-centered leadership, the negative effects of technology on employee attitudes towards work are likely to prevail. Learning-oriented, creative, involved leadership can help employees see technology as an organizational resource rather than a threat to jobs or roles. Leaders can also facilitate employee change that is necessary for effective digital transformation and enhance employee engagement with that change. Our research also explores the role of employee voice in modulating the relationship between employee engagement and leadership. When

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employees perceive that management is open to their ideas and concerns, employees are more likely to feel ownership of organizational goals and be motivated to meet them. Leadership messages about patient-centeredness are more powerful when embedded in an organizational climate that supports participation. In many healthcare organizations it is the frontline staff who have the best understanding of the challenges facing their patients and the organization. We argue that creating a culture that fosters employee voice will ensure that more informed decisions are made that can lead to better patient services.

This study makes theoretical, practical and methodological contributions at the juncture of leadership theories and digital transformation, and links this to employee engagement. While traditional leadership studies have addressed interpersonal influence processes (e.g., Kalshoven et al., 2011), organizations today operate largely in technologically fully mediated environments (e.g., Maier et al., 2015).

The present study looks at the impact of AI usage within the leadership–engagement relationship. Results indicate that leaders can build traditional leadership skills but also exploit technological resources to enable employees to perform more efficiently at their tasks. Thus, both leadership and technology can be seen as organizational resources which complement each other, and which independently of each other have a positive effect on employee engagement. Research shows that employee engagement is critical to the success of healthcare organizations. To create an engaging work environment, organizations must develop transformational leaders, provide enabling technology, and cultivate a healthy communication climate. By integrating these factors, organizations can design workplaces that motivate and engage employees, stimulate innovation, and retain employees.

6. Conclusion

This study integrates theoretical perspectives on transformational leadership, employee engagement and employee voice in the workplace. The study explores the relationship between transformational leadership and employee engagement, using employee voice as a moderator, in the healthcare sector of Saudi Arabia. Findings of the study reveal a positive relationship between transformational leadership and employee engagement. Importantly, the results confirm the moderating role of employee voice on the transformational leadership–employee engagement relationship. Specifically, results reveal that transformational leadership is more effective in enhancing employee engagement when employees feel heard and empowered to share their ideas, views and concerns in the workplace. The study also explores the relationship between employees' use of AI at work and engagement, as employees' technology use at work has become an important work-related factor that can enhance or decrease employee engagement in the workplace. The study used AI in the context of the healthcare sector, where organisations increasingly rely on AI technologies to support their decisions, administrative tasks, to improve work efficiency and enhance services quality. This study extends current research on employee engagement in the digitally enabled healthcare sector by identifying that engagement is predicted by leader behavior and that this relationship is further moderated by the interaction of leader behavior with participative communication climates and technology-enabled work practices.

Our research evidence demonstrates that employee engagement in healthcare organisations can be enhanced by adopting a human-centered approach consisting of human-centric leadership, favorable communication climates and effective digital technologies. Our analysis reveals a positive impact on employee engagement of the four pillars of transformational leadership (and particularly individualized consideration), whereby employees are more engaged when leaders provide personalized attention, support, coaching, trust and recognition of their individual needs. Furthermore, we find that AI usage can act as an enabling work resource supporting employee engagement by facilitating task completion and enhancing focus on higher value-added activities related to quality healthcare services. Moreover, we find a positive moderating effect of employee voice on the leadership–engagement relationship whereby leadership influence is enhanced by a favorable communication climate where

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employees feel safe and supported to speak up and contribute to organisational dialogue. These findings have relevance for Saudi Arabia's rapidly digitalizing healthcare sector and the wider national efforts in business and industry.

7. Limitations and Directions of Future Research

Despite being informative, the study has several limitations that should be considered when interpreting the results. The first limitation is that the study employs a cross-sectional research design, which limits the ability to infer causality between the variables that were found to be related. Although the structural model was supported and its underlying mechanisms were theory-consistent, a longitudinal study would be a better way to assess the evolution of leadership styles, AI usage, and engagement over time. A second limitation is that the study employs self-report data, which may be subject to common method variance and social desirability bias. In a future study, this limitation can be limited by collecting multi-source data, such as ratings from supervisors or organizational behavior, records of AI usage or performance metrics that can be objectively measured. A third limitation is that the findings may not be generalizable to other sectors or locations because the study was based on a convenience sample of healthcare organizations. Future research can limit this limitation by testing the model using probability sampling techniques in a variety of sectors.

Another limitation that can be addressed in future research is that the study only examined employee voice as a moderator; however, other moderators may exist, such as the organizational culture, psychological safety, or technological maturity. Relatedly, a future study can also test whether the use of different types of AI systems (e.g., diagnostic AI, administrative AI, decision-support AI) has different effects on employee engagement. Finally, a comparative cross-national study would be of interest to see whether the relationships found in this study hold constant across different cultures and institutions.

Future studies can explore additional mediating variables and contextual factors which might explain how transformational leadership and the use of technology like AI increases employee engagement. For example, studies can investigate psychological empowerment, job autonomy and perceived organizational support as potential mediating variables through which transformational leaders use the effective usage of technology to increase engagement. Additionally, differences such as digital skills, technological readiness and generational differences (e.g., Gen Y vs. baby boomers) could make a difference in employees' technology-driven workplace perceptions and impact the relationship between transformational leadership and employee engagement. Future research should investigate the relationship between organisational strategies for digital transformation and leadership capability aiming to enhance workforce outcomes. In this study, one technology has been used as an example, but there are many other technologies and applications within digital transformation that can be studied. For example, how data analytics is used, digital infrastructure in healthcare, and the digital innovation culture in healthcare organisations. Future research can also use qualitative approaches, for example, case studies or interviews with employees in healthcare. The study could focus on how leadership practices and AI systems interact with organisational communication processes in everyday work practices. Future research could also investigate longer-term organizational outcomes from employee engagement resulting from employee's experiences of positive transformational working conditions in relation to leadership and AI adoption within healthcare. Potential organizational level outcomes include service quality and patient satisfaction, organizational innovation, employee retention and workplace functioning.

Acknowledgement
The authors extend their appreciation to the Deanship of Postgraduate Studies and Scientific Research at Majmaah University for funding this research work through the project number (R-2026-214).

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ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/f7937756383

Publisher
http://jssidoi.org/esc/home

AI-DRIVEN STUDENT PROFILING: A CROSS-INDUSTRY REVIEW AND FUTURE RESEARCH DIRECTIONS ON MACHINE LEARNING FOR ADMISSIONS AND RETENTION*

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Received 11 January 2026; accepted 19 March 2026; published 30 June 2026

Abstract. Higher education institutions are increasingly facing challenges in student recruitment and retention, necessitating the development of data-driven segmentation and profiling models. Traditional segmentation approaches rely heavily on historical data and often fail to capture shifts in applicant behaviour. In contrast, AI-based techniques enable real-time analysis of interactions, supporting more adaptive and personalised recruitment strategies. Across fields like marketing, finance, and e-commerce, researchers have shown that clustering, supervised learning, and hybrid ML models can meaningfully improve segmentation tasks. This article explores the application of such methodologies in the context of higher education. A systematic literature review (SLR) and a Weighted Sum Model (WSM) were applied to evaluate and rank the relevance and adaptability of segmentation techniques used in the analysed studies. Results indicate that K-Means and Random Forest are widely applied in student segmentation and performance prediction. At the same time, hybrid models, such as K-Means combined with decision trees, offer improved accuracy and interpretability. However, real-time behavioural analytics (e.g., Google Analytics) and natural language processing (NLP) methods remain underexplored. Overall, the findings suggest that AI-driven segmentation models can enhance student engagement, academic success prediction, and strategic enrolment management. Future work will focus on integrating real-time behavioural data, refining segmentation models, and improving predictive analytics for university admissions and retention strategies.

Keywords: student segmentation; student profiling; higher education; machine learning; AI; clustering; predictive analytics

Reference to this paper should be made as follows: Ivashchenko, O., Lelovský, M., Kopp, A., Shmatko, O., Cibák, L. 2026. AI-driven student profiling: a cross-industry review and future research directions on machine learning for admissions and retention. *Entrepreneurship and Sustainability Issues*, 13(4), 461-478. http://doi.org/10.9770/f7937756383

JEL Classifications: I21, I23, C38

Additional disciplines: educology; information and communication; informatics

1. Introduction

Digital transformation is impacting various sectors of the economy and aspects of public life. Educational institutions are increasingly facing challenges not only in understanding and engaging with potential applicants during admissions campaigns, but also in retaining and adapting to the needs of current students. Creating profiles of these individuals, sometimes referred to as "customer identity creation," will improve student enrolment strategies, increase student retention, and create a personalised educational path for students.

* *This research was funded by International grant project of VŠEM No. 1/2024_M – Management of the processes of recovery and sustainable development of public and economic law entities of the EU Member States, in particular Slovakia and Ukraine.*

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/f7937756383

Traditional customer segmentation methods are static, relying on historical data rather than capturing current behaviour. Additionally, they lack predictive capabilities and primarily work with structured data. In contrast, the modern digital era generates vast amounts of unstructured data that are crucial for segmentation, predicting customer behaviour, and retaining customers.

Traditional data analysis methods in education, such as demographic segmentation or survey-based data analysis, do not provide effective results, given the large volumes of data about students and the fact that this data comes from different sources, has a different structure - student applications, academic records, activity on social networks. Machine learning methods address these challenges by integrating data from multiple sources and identifying behavioural patterns that are difficult to detect manually. These models support tasks such as profiling applicants, forecasting academic risks, and estimating the likelihood of student withdrawal. Methods such as clustering, supervised learning, and deep learning models are effective for creating student profiles and uncovering useful insights from the data. Additionally, combining machine learning methods with tools like Google Analytics allows universities to obtain useful statistics on applicants' engagement in real time and to personalise approaches to the recruitment of prospective students.

The purpose of this article is to investigate the application of machine learning methods to create customer profiles in various sectors of the economy, with an emphasis on their relevance and existing solutions for higher education institutions. The review seeks to identify potential gaps in the use of machine learning methods to create applicant and student profiles. These findings will form the basis for further research aimed at developing university applicant and student profiles, which will allow universities to conduct more effective, personalised admission campaigns and possibly increase student retention rates.

2. Literature review

Customer relationship management (CRM) is an integral part of any company's marketing strategy. CRM is a strategic approach to managing customer interactions, which aims to increase customer engagement, satisfaction, and long-term retention. CRM is most often used in business sectors to optimise marketing strategies. Still, in recent years, CRM principles have been increasingly applied by universities to improve the results of admissions campaigns, attract and retain students.

In the higher education sector, the use of CRM enables optimising the admissions process and tracking interactions with students at different stages of the admissions and study process, ultimately improving the performance of the higher education institution. In addition, combining CRM with machine learning and predictive analytics enables universities to identify student groups and personalise interactions with them.

Consider two CRM approaches for better understanding and engaging customers: customer segmentation and customer profiling. Customer segmentation is an analytical method for dividing customers into groups based on common characteristics, widely used in business and marketing. It allows companies to adapt their development strategies and promote products to different segments, thereby increasing efficiency, business profitability and customer engagement (Das et al., 2022).

For universities, segmentation enables you to optimise academic and administrative processes for different student groups. Traditionally, segmentation in higher education can be based on various factors: demographic data (age, nationality, socio-economic background), geographical data, behavioural engagement, academic performance and preferences when choosing disciplines; now, activity in social networks is also added to these data. Segmentation helps universities optimise marketing campaigns for personalised communication with different student groups, taking into account each group's unique needs and interests. Additionally, the use of this tool allows for the development of personalised academic support and individual communication strategies.

Segmentation techniques such as clustering and supervised learning can be effectively applied to student data to identify patterns in enrolment, engagement, and retention, according to research on predictive analytics and customer segmentation tools.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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For universities, it is best to start analysing student data by segmenting students, given that universities attract students from different demographic groups, academic interests, and career goals, as well as behavioural differences, geographical, and socio-economic factors. The conducted student segmentation serves as the basis for student profiling, providing a deeper understanding of individual students within each segment. Student profiling is an approach that segments students by creating detailed profiles based on a combination of data, such as behavioural, demographic, geographic, and social network data. In this context, segmentation divides students into large groups, and profiling allows you to create more detailed student profiles within these groups (Das et al., 2022). Such deeper data analysis enables you to obtain more holistic information about students, for example, enabling early identification of students at risk of expulsion and individual career guidance.

The application of machine learning methods, such as clustering, deep learning, and predictive modelling, provides valuable insights from large datasets. In addition, tools such as Google Analytics help educational institutions analyse student interactions in real time, increasing the effectiveness of recruitment and engagement. The integration of CRM, segmentation, and profiling provides universities with a robust framework for enhancing student engagement and institutional efficiency, which, at the current stage of higher education institutions, especially in Ukraine, is an important factor in ensuring sustainable development and resilience to new challenges. Studies have shown that universities that implement data-driven segmentation and profiling methods have higher student retention rates and improve overall academic performance (Das et al., 2022). The combination of segmentation and student profiling allows universities to apply not universal strategies, but to develop measures and strategies that are tailored to the individual needs of students.

As previously mentioned, segmentation and student profiling are related but serve different purposes in analysing student data. While segmentation provides a macro-level view by grouping students into broader categories, student profiling focuses on micro-level insights by analysing specific characteristics and behaviours of individual students (Hemsley-Brown, 2016). The key differences between segmentation and profiling are summarised as follows in Table 1.

Table 1. The key differences between segmentation and profiling

Aspect	Segmentation	Profiling
Purpose	Group students into broad categories based on common characteristics	Creates detailed, personalised insights for individual students
Scope	Macro-level analysis	Micro-level analysis
Methods Used	Clustering, RFM analysis, demographic segmentation	Predictive modelling, supervised learning, deep learning
Application	Targeted marketing, student recruitment, personalised communication	Personalised learning, academic support, dropout prediction

Source: Own work

According to the study (Das et al., 2022), segmentation should be the first step in the analytical process, providing a structured foundation for student profiling. As a result, by first identifying broad student categories, educational institutions can refine their strategies using detailed profiling methods to ensure services are tailored to individual needs. The integration of CRM, segmentation and profiling approaches into university operations is essential for the effective functioning of educational institutions in an environment of intense competition. CRM is the basis for managing student interactions; segmentation allows you to identify significant groups of students for targeted student engagement and retention; and creating student profiles enables you to implement personalised approaches to student retention and interaction. As segmentation and profiling research continue to evolve, it is important to examine how machine learning (ML) approaches are applied across industries and how these methodologies can be adapted to higher education. This study aims to systematically review the existing literature on machine learning-based segmentation and profiling. To achieve this, a structured methodology for identifying, evaluating, and synthesising relevant scientific articles, previously used in previous studies, was adapted and refined. The following section describes the systematic review process, including database selection, search queries, inclusion and exclusion criteria, and the consensus approach used to ensure robust results.

ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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3. Methodology of review

This study follows a systematic literature review (SLR) approach, with particular attention to accuracy, transparency, and replicability. We build on the structured review process outlined in our earlier work (Cherednichenko et al., 2023) on entity resolution and item matching, adapting it here to examine how AI and ML techniques are applied to segmentation and customer profiling in the education sector. To structure the review, we organised the process into several stages, illustrated in Figure 1.

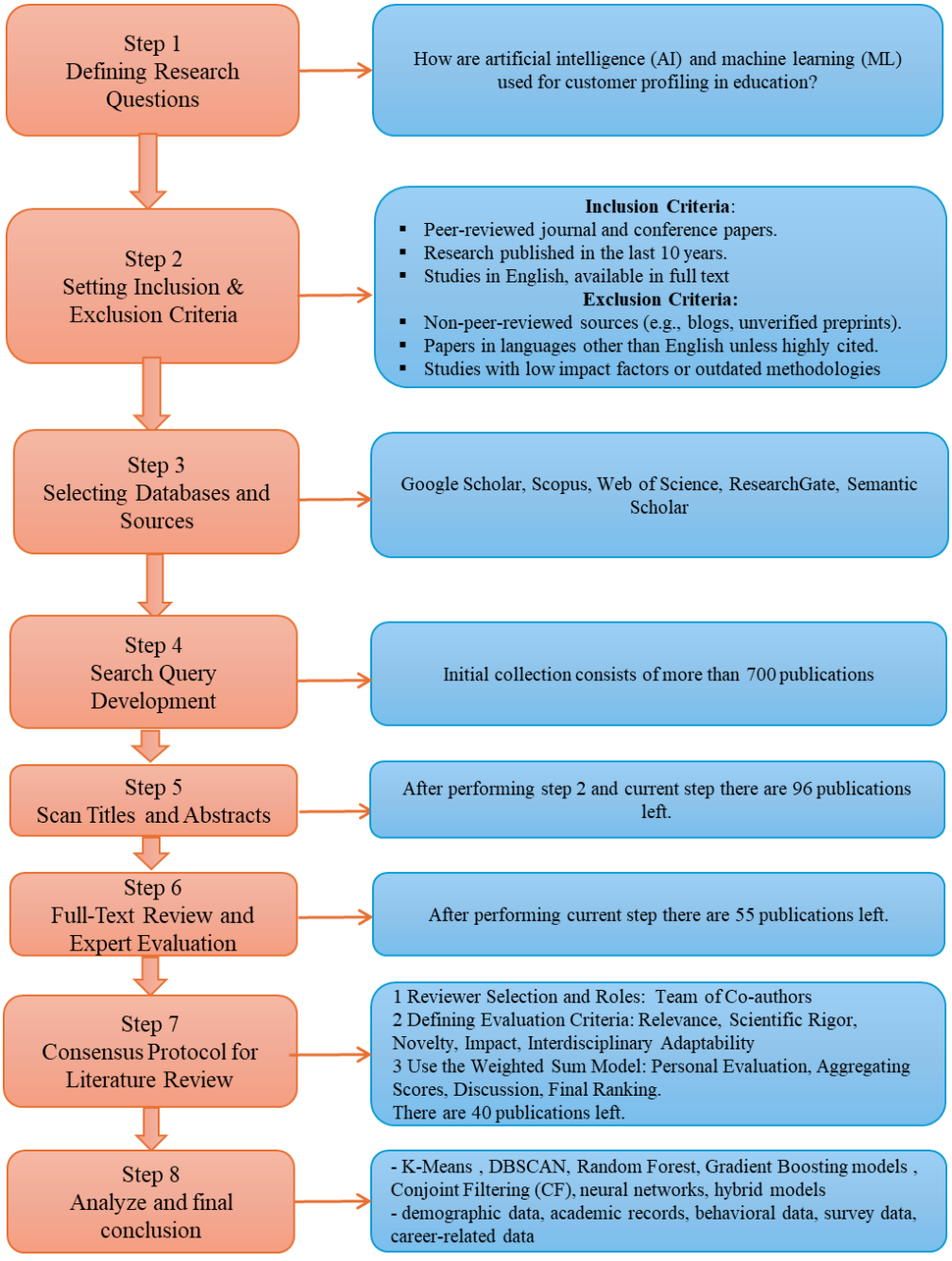


Figure 1. Step by step, the review methodology
Source: Own work

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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1. Defining the research questions. The central research question will be:
"How are artificial intelligence (AI) and machine learning (ML) used for customer profiling in education?".

To explore the main question more fully, we also considered several supporting questions:
"What AI/ML methods are most commonly used for customer profiling?"
"What datasets and features are used for profiling in education?"
"What are the main advantages and limitations of AI-based profiling in this context?"

2. Establishing criteria for including and excluding articles from the review. To ensure the material reviewed is relevant, we applied the following inclusion criteria: peer-reviewed journals and conference publications; studies published primarily within the last five years; publications in English; and publications available to read in full. We also formulated exclusion criteria to filter out studies that did not meet the scope or quality requirements of the review: unverified sources; articles not in English; dissertations; studies with low impact factors or outdated methodologies.

3. Selection of databases and sources. Several bibliometric databases were selected for a comprehensive search of publications, taking into account criteria such as peer-reviewed status, broad coverage, and accessibility: Google Scholar, Scopus, Web of Science, ResearchGate, and Semantic Scholar.
"How are artificial intelligence (AI) and machine learning (ML) used for customer profiling in education?".

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4. Developing a search query. Because segmentation and profiling in higher education is still emerging, we initially adopted a broad search strategy, including information from business, marketing, finance and healthcare. As a result, several search directions were identified, and corresponding queries were developed:

a) General customer profiling using machine learning:
- "machine learning" AND "customer profiling" AND "identity resolution";
- "customer segmentation" AND "predictive analytics" AND "machine learning";
- "data-driven customer profiling" AND "AI";
- "personalisation in customer experience" AND "machine learning";
- "customer behaviour modelling" AND "clustering algorithms";

b) Education-specific profiling (students & university):
- "student profiling" AND "machine learning" AND "university admissions";
- "AI in higher education" AND "student segmentation";
- "predictive analytics" AND "student behaviour" AND "academic performance";
- "university recruitment" AND "AI-driven student profiles";
- "personalised learning" AND "AI" AND "student engagement";
- "student success prediction" AND "data analytics";
- "dropout prediction" AND "machine learning" AND "higher education";

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c) Cross-sector adaptation: finding solutions from other fields for universities:
- "customer insights" AND "AI" AND "higher education";
- "marketing analytics" AND "student enrollment";
- "customer relationship management" AND "education sector";
- "recommendation systems" AND "student retention";
- "customer loyalty prediction" AND "student engagement";
- "AI-driven user profiling" AND "education technology".

After testing multiple query combinations, we selected the formulation that yielded the most relevant results across databases: *("machine learning" OR "AI" OR "artificial intelligence")AND ("customer segmentation" OR "customer profiling" OR "student profiling")AND ("higher education" OR "educational sector" OR "universities") AND ("business" OR "industry" OR "corporate sector")*. Therefore, after the execution of the second and current steps, more than 700 publications were obtained.

5. Title and abstract comparison. Once the search was completed, we screened the retrieved publications against the inclusion and exclusion criteria. After this, the retrieved articles were additionally checked based on:
- exclusion of duplicates, i.e., repeated studies from different databases;
- the relationship between the title and the abstract, with priority given to those studies where machine learning was mentioned.
This step removed duplicates and clearly irrelevant studies. Before proceeding with further evaluation, implementing the above steps reduced the number of publications to 96.

6. Full-text review and peer review. Following the preliminary screening, the co-authors conducted a more detailed assessment of the remaining publications to meet the following criteria:
- citation availability – priority was given to well-cited sources;
- methodological rigour – ensuring the use of sound empirical approaches in research;
- taking into account the presence of segmentation and profiling tasks in the research.
Final decisions were made through discussion and consensus among co-authors. This step reduced the number of publications for further in-depth analysis to 55.

7. Consensus protocol for literature review. The Weighted Sum Model (WSM) was used to evaluate the selected articles. A team of co-authors with expertise in machine learning, educational technology and customer profiling carried out the review process. To ensure consistency, all publications were evaluated according to a structured system of weighted criteria, with weights reflecting the importance of each criterion:
- relevance – alignment with the research area: segmentation and profiling of university students;
- scientific rigour – quality of research methods used;
- novelty – introduction of new concepts or models;
- impact – potential impact on scientific and business communities;
- interdisciplinary adaptability – can the concepts be applied in different fields.

Each co-author assigned a weight to each of the criteria independently. Each publication was evaluated according to these criteria using the following scale: 1 - very low, 2 - low, 3 - moderate, 4 - high, 5 - very high.

After all publications were evaluated for each co-author, a weighted score was calculated for each article using their individual scores and weights. The next step was to calculate the average of the three weighted scores for each article. This approach allows for the individual weighting of each reviewer's criteria to be taken into account.

After the individual evaluation of each publication, a meeting was held between the co-authors to discuss existing discrepancies in scores and weights. This iterative process ensured a balanced and consistent evaluation across all publications. This step allowed us to reduce the number of publications for further in-depth analysis to 40.

The WSM evaluation allowed us to classify the reviewed studies into three relevance tiers, reflecting their methodological quality and their potential applicability to higher-education profiling tasks. Figure 2 presents

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the studies from the first two groups. Studies with the highest rating (4.30+) offer methodologies that are most relevant to our research topic, while studies with lower ratings (3.50) offer AI and clustering methods from other fields that can be adapted to enhance university student segmentation models.

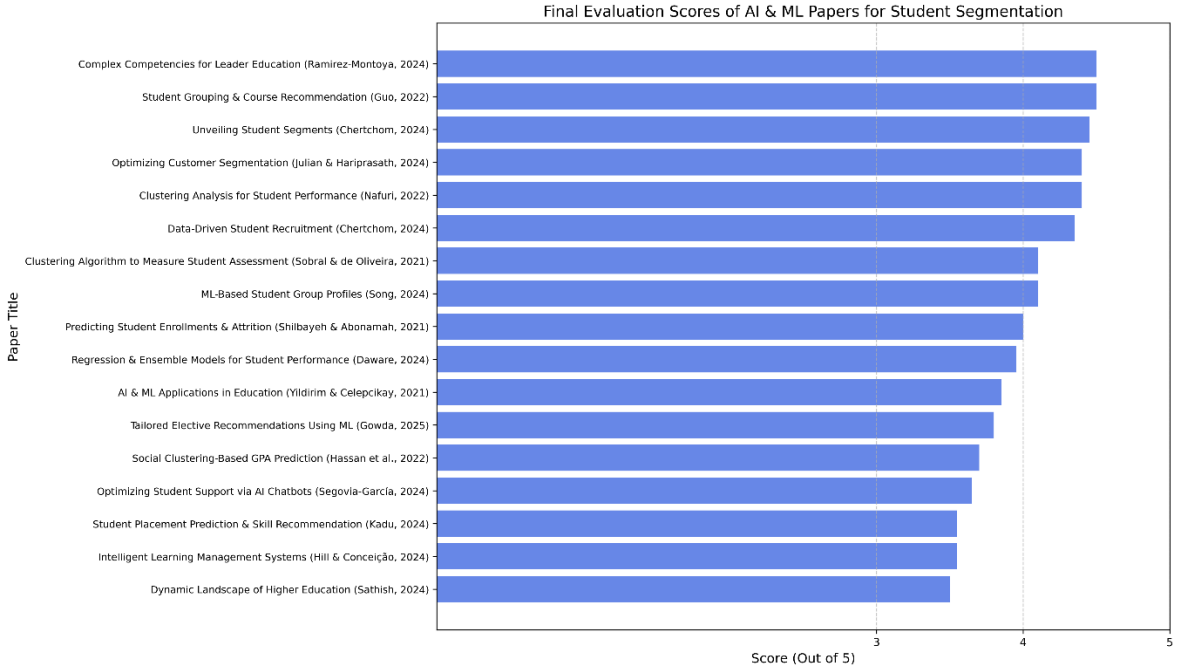


Figure 2. The studies with ranks higher than 3.50
Source: Own work

The articles with the highest rating (4.30+) represent, from the authors' perspective, the most effective methodologies for student segmentation and profiling. These studies directly contribute to the development of AI-driven segmentation and profiling models that can be applied in university marketing and admissions strategies. These studies suggest clustering methods, predictive analytics, and machine learning approaches that can improve admissions personalisation processes and facilitate the development of more effective student engagement and retention strategies.

Studies within the 4.30–3.50 rating range include studies that offer valuable approaches and models that can be adapted for profiling and segmenting students during admissions campaigns. Based on the analysis of student data, these studies offer tools for predicting student success and developing personalised learning strategies.
Articles with a rating below 3.50 focus mainly on customer segmentation and profiling in non-education industries such as banking, retail, and marketing. Despite their industry-specific focus, these studies are valuable because customer segmentation has been extensively applied in these fields for many years with proven, effective implementations. In this regard, they offer artificial intelligence methodologies and clustering infrastructure to improve student profiling models. Their adaptation can facilitate the adoption of innovative techniques and retention strategies by applying business intelligence methods to analyse student data.

The reviewed studies address our research questions and highlight several methodological directions for future work. Less relevant articles, while not directly focused on higher education, offer valuable insights that can help develop models for student segmentation and profiling. In particular, AI-based segmentation techniques obtained from other business areas can be adapted to improve student recruitment strategies, predict enrolment trends, and enhance retention efforts at universities.

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4. Findings and discussion

Artificial intelligence (AI) and machine learning (ML) methods are widely used in higher education, particularly for student profiling, segmentation, predictive analytics, and clustering. We will examine the methods and approaches proposed by the authors in 18 publications that received a score higher than 3.50, and assess their appropriateness for creating student profiles, segmenting students during the admission campaign, and developing personalised learning. In addition, earlier foundational studies are referenced selectively to contextualise the evolution of student profiling approaches; however, these works were not included in the final evaluated set.

In several studies, the authors used ML models to predict student success, retention, and dropout risks. Research on predicting future employment using machine learning methods is highly relevant, given the competition and pressure university graduates face in the modern world. For instance, in (Kadu et al., 2024), the Random Forest machine learning method was used in combination with feature selection to predict employment and provide recommendations on professional skills, based on the following set of data available in the university database: academic performance (CGPA, points), internship experience, completed projects, certificates obtained, aptitude test results, communication skills ratings and extracurricular activities. Another area of application of machine learning methods is to determine the structure of student recruitment and attrition. According to (Shilbayeh & Abonamah, 2021) predictive models such as Random Forest and Decision Trees were applied to identify groups of students that the university should attract to comply with academic standards, and risk groups, i.e. students who are most likely to be expelled. As in previous work, the authors emphasise the importance of properly preparing input data: selecting characteristics, filling in missing data, and removing outliers or incorrectly entered data. The dataset used by the authors for this model included students' demographic data and academic records (e.g., English proficiency, academic performance). In Ramirez-Montoya et al. (2024), the researchers propose using Support Vector Regression (SVR) combined with Recursive Feature Elimination (RFE) to predict student performance. The use of RFE enables the identification of the most relevant predictors for the model, thereby ensuring its interpretability and computational efficiency. Predictive models help identify students who may need additional support and develop targeted interventions. A study (Daware, 2024) explores machine learning methods to analyse key factors influencing student achievement and to develop predictive models. Several algorithms were used, including linear regression, random forest regressor, gradient boosting regressor, support vector regressor (SVR), and K-nearest neighbours regressor, each chosen for its ability to capture different patterns in the data, whether linear or complex. The models were trained using characteristics such as attendance, socio-economic background, parental education, and academic history to determine their impact on student achievement. The best results were achieved with ensemble learning methods, including gradient boosting regressor and support vector regressor (SVR), which effectively captured nonlinear relationships in student achievement data. Using such a model will allow identifying students at risk for academic success and implementing personalised support.

The research (Hassan et al., 2022) integrates clustering (K-Means) with regression (LASSO regression) to predict GPA based on social and academic factors. Students with similar engagement behaviours were grouped, and regression models were applied to each cluster to predict final GPA. Unlike previous works, the authors used not only demographic data but also information on students' social behaviour; this data for their dataset was collected by analysing mobile sensor data and by conducting surveys of students before and after the courses. The findings in (Abyaa et al., 2019) indicate that the characteristics of students, which are used to create a student profile within the framework of the active development of e-learning: a static student profile, knowledge, cognitive abilities, social characteristics and motivation, while these characteristics are used both independently in machine learning models and in combination, as was done in (Hassan et al., 2022). The authors of (Rai et al., 2024) propose the introduction of data analytics into the work of the marketing department and the student recruitment department, for this purpose a survey was developed and conducted among potential applicants, the survey results were used to determine the most potential candidates for enrolment in the university, for this purpose it was proposed to use the following algorithms: Logistic Regression, K-Nearest Neighbor, and Artificial Neural Networks. Artificial Neural Networks demonstrated the highest accuracy.

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http://doi.org/10.9770/f7937756383

Predictive analytics can improve the process of creating a student profile by identifying key characteristics to include. Combining predictive models with clustering can improve approaches to student segmentation.

Another set of studies focuses on clustering techniques, using indicators such as academic results, engagement metrics, and behavioural attributes to form meaningful student segments. For example, in (Mohamed Nafuri et al., 2022), the following clustering methods K-Means, DBSCAN, BIRCH are proposed to identify groups of students based on their performance indicators. In this study, to solve the problem of "large amount of data", which leads to difficulties in data processing and analysis, feature selection methods were applied to find the best attributes for this study. Both supervised (using random forest, extra tree, info gain, and chi-square techniques) and unsupervised (applied variance thresholding (≥0.3) to identify high-variance features and remove redundant ones.) feature selection methods showed the same result, so the following 12 features were selected: place of birth, income groups, high school, university, registration age, entry qualification, field of study, sponsorship, CGPA, number of activities, and employment status. The application of this approach is relevant to university CRM, as it can provide student segmentation for personalised learning. Traditional market analysis methods often fail to handle a large, diverse customer base, a limitation that is also common in higher education institutions due to the volume of student data. The solution to this problem may lie in implementing big data analytics and machine learning, which offer more efficient, automated segmentation methods. Among such approaches, the most popular and effective approach is K-Means clustering (Julian et al., 2024). The researchers (Julian et al., 2024) believe that this technique is particularly useful in retail. Still, from our point of view, it can also be adapted for the higher education sector, thereby improving segmentation and profiling efficiency. In Song et al. (2024), the authors use survey results as data about students. The survey was conducted among 2,492 students, and data were collected on students' demographics, educational status, personal morality, political ideology, interests, and hobbies. To assess the questionnaire's validity and reliability, the Kaiser-Meyer-Olkin (KMO) and Bartlett's tests were used. Based on the clustering results using the K-Means clustering method, the authors built a classification prediction model for university student groups based on the BP neural network. This combination of two machine learning methods helped overcome the limitations of traditional survey result processing, yielding student profiles that support adaptive learning paths and the development of personalised services for students. The K-Means clustering method was used by researchers (Sobral & de Oliveira, 2021) to test whether it is possible to take into account students' self-assessment during the learning process and to assess the correlation between self-assessment and other student characteristics, the data source was the results of a student survey and university academic records. In the study (Chertchom, 2024), clustering-based segmentation using the K-Means algorithm is used to identify patterns of applicant registration to improve student recruitment strategies. The data source was the university's applicant registration system. In this study, the characteristics that determine the choice of applicants were "Province", "Parent Occupation", and "Parent Revenue". The results of this study were used to develop marketing strategies for student recruitment in different regions. The authors' focus (Guo et al., 2022) is on developing an improved K-means clustering algorithm for student segmentation, and they introduce a group-oriented course recommendation model that takes into account both statistical and semantic dimensions. Word2Vec Embeddings was applied for feature extraction to better capture semantic relationships among student characteristics. For further student segmentation was used K-Means Clustering (Improved Version) based on their learning preferences and academic performance. The use of Word2Vec for feature extraction offers an innovative way to analyse unstructured student data, which could be useful in processing text-based academic records, student feedback, and learning preferences.

According to Guan et al. (2020), between 2010 and 2019, the number of studies on student profiling and learning analytics using AI increased significantly, with a focus on learning processes and the application of AI in education. The most common themes in published research focused on learning models, student engagement, and predictive analytics for academic success and dropout prevention. A key feature of this research period was the shift to AI-powered predictive modelling to track student progress, academic performance, and dropout risk. Additionally, learning analytics, big data, the use of AI techniques, and ethical considerations around the use of student data for institutional analytics became key research areas during that period. These ideas are relevant to our research as they highlight how AI-driven segmentation and profiling models can be improved to enhance student support, retention prediction, and personalised academic guidance.

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Artificial intelligence has played a significant role in increasing the integration of personalisation into university learning processes, thereby improving student engagement, academic advising, and real-time learning adaptation (Yildirim & Celepcikay, 2021). AI applications on EdTech platforms play an important role in tracking student behaviour, providing personalised learning experiences, and offering intelligent recommendations. A study by Segovia-García (2024) highlights the role of AI-developed chatbots in student-institution interactions, providing students with instant academic support and guidance. These chatbots generate real-time interaction data that can be used to profile behaviour and clustering patterns to improve student retention strategies. Additionally, Gowda et al. (2025) demonstrate how collaborative filtering and genetic algorithms optimise course recommendations based on choice, ensuring that students receive personalised guidance on their academic trajectory. While these AI-based systems do not directly segment students, they provide important behavioural insights that can improve profiling models for data-driven student support. Modern learning management systems (LMSs) have evolved into sophisticated AI-powered platforms that personalise learning paths. According to Hill and Conceição (2024), intelligent learning management systems (ILMSs) use machine learning algorithms to track student engagement, dynamically adapt course content, and segment students based on real-time interactions. By analysing LMS activity data, institutions can proactively identify students who are struggling, optimise curriculum development, and implement personalised academic interventions. These AI-driven tools create an adaptive education system and also facilitate student segmentation and profiling.

The paper of Sathish et al. (2024) highlights the development of a job recommendation system for students that continuously improves its recommendations based on user feedback (rejection of a job offer or acceptance). This mechanism is similar to adaptive student segmentation models in education, where machine learning algorithms adjust student groupings based on behaviour, activity, and academic performance. In this way, the concept of adaptive learning from recommender systems can be used to improve real-time student segmentation by incorporating dynamic feedback loops, making segmentation models more responsive to students' learning behaviour and performance trends.

The graph (Figure 3) below summarises the frequency of machine learning techniques applied in the reviewed articles. The graph below shows the frequency of use of machine learning methods in the reviewed articles. According to this graph, the following conclusions can be made:

- K-Means clustering is the most widely used technique for student segmentation, often combined with feature selection methods.
- Random Forest and Gradient Boosting models are common for predicting student performance due to their ability to handle multidimensional learning data.
- Conjoint Filtering (CF) and neural networks are gaining popularity for personalised course recommendations and adaptive learning systems.

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http://doi.org/10.9770/f7937756383

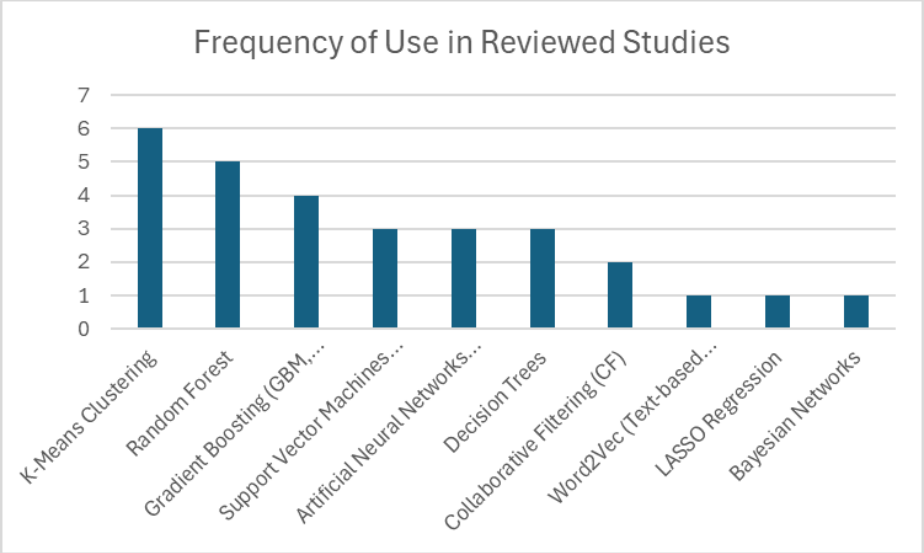


Figure 3. The frequency of machine learning techniques applied in the reviewed articles
Source: Own work

Some interim conclusions can be drawn: first of all: machine learning is widely used for student profiling and retention prediction, using clustering models to segment students based on academic, behavioural, and socio-economic factors; second, course recommendation systems developed using AI methods are becoming a powerful tool to improve learning personalisation; third, hybrid models combining clustering + supervised learning (e.g., K-Means + Decision Trees) are effective in improving segmentation accuracy. It should also be emphasised that although our study did not pay much attention to this issue, ethical issues regarding AI-based analytics remain a key concern, especially in the use of student data for predictive decision-making. Table 2 summarises the primary focus areas, ML techniques used, and potential future applications of these techniques.

Table 2. The primary focus areas, ML techniques used, and potential future applications of these techniques

Focus Area	Key Techniques Identified	Future Applications
Student Profiling & Segmentation	K-Means, DBSCAN, Improved K-Means, BIRCH	Adaptive learning pathways, micro-segmentation
Predicting Student Success & Retention	Random Forest, Decision Trees, SVM, GBM, LASSO Regression	Early intervention, targeted academic support
Personalised Course Recommendation	Collaborative Filtering, Word2Vec, Hybrid AI models	AI-driven academic advising, automated course recommendations
Dropout Prevention & Risk Prediction	Random Forest, Gradient Boosting, Bayesian Networks	AI-powered early warning systems
Learning Analytics & Adaptive LMS	AI-enhanced Learning Management Systems (ILMS), Neural Networks	Dynamic content adaptation, student engagement tracking
University Admissions & Marketing	Logistic Regression, K-Means, Neural Networks	AI-based recruitment strategies, data-driven admissions decision-making
Employment Prediction & Career Matching	Decision Trees, Random Forest, Feature Engineering	AI-powered job placement support, career path recommendations

Source: Own work

In addition to studies on the application of machine learning methods in the higher education sector, studies on the use of various machine learning (ML) methods for customer segmentation and profiling and data set creation strategies in many other sectors (the retail, finance, marketing, and telecommunications sectors of the economy) were selected for analysis, they were rated by authors below 3.50. The aim is to explore how these methods can be adapted and applied in the higher education sector to improve student profiling, admissions strategies, and retention efforts.

ML-driven segmentation methods can be broadly classified into unsupervised, supervised, and hybrid models. These methods are widely used in industries such as finance, marketing, retail, healthcare, and education, and

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provide insights into customer behaviour, preferences, and predictive trends. Our review results are summarised in Tables 3 and 4.

Table 3. Machine learning methods used in various industries to perform segmentation and profiling

Machine Learning Method	Purpose in Customer Segmentation	Relevant Papers & Sources
Unsupervised Learning		
Affinity Propagation	A clustering algorithm that does not require pre-defined cluster numbers.	Mim & Logofătu (2022); Panji (2023)
DBSCAN (Density-Based Spatial Clustering)	Segments high-value customers and filters out noise data.	Hicham & Karim (2022); Kiran et al. (2024)
Fuzzy C-Means Clustering	Used for dynamic segmentation in marketing.	Widianti (2024); Thitiporndharma & Khonthaoagdee (2024)
Hierarchical Clustering	Groups of customers based on purchasing power and product affinity.	Wani (2023); Gupta & Israni (2024)
K-Means Clustering	Groups of customers into similar segments based on pre-defined numerical features.	Mustafa (2023); Wang (2024); Arakh (2024)
	Identifies customer groups based on spending habits, loyalty, and preferences.	Julian & Hariprasath (2024); Saxena (2022); Arakh (2024)
Spectral Clustering	Used in banking to classify credit risk groups	Shaikh & Khedkar (2023)
Principal Component Analysis (PCA)	Reduces data dimensionality to improve segmentation accuracy.	Widianti (2024); Alkhayrat (2020); Wani (2023)
Supervised Learning		
Decision Trees (DT)	Rule-based classification that helps define customer segments.	Mustafa (2023); Thitipomdharma & Khonthaoagdee (2024); Wang (2024)
Random Forest (RF)	Ensemble method that improves accuracy and identifies key features for segmentation.	Mustafa (2023); Cao (2024); Wang (2024)
Support Vector Machines (SVM)	Finds optimal hyperplanes to classify customers into different segments.	Mustafa (2023); Cao (2024); Arakh (2024)
Optimisation Techniques		
Genetic Algorithms	Optimisation technique that enhances clustering accuracy.	Hamidi & Haghi (2024)

Source: Own work

ML-based segmentation has many advantages, but there are still challenges such as data quality, algorithm selection, and interpretation, which can be overcome by hybrid models that combine machine learning with traditional statistical methods, improving both segmentation accuracy and interpretability. These hybrid models often integrate clustering algorithms with dimensionality reduction or ensemble methods, balancing performance and transparency in the segmentation process. For example, using such a combination of K-Means + Decision Trees increases the accuracy of the model and the usefulness of the model in real-world e-commerce scenarios, while universities can use such a hybrid model to group applicants based on academic records and then predict their probability of success.

Table 4. Hybrid models utilised in various industries to perform segmentation and profiling

Hybrid Model Used	Industry	Paper
Gaussian Mixture Model (GMM) + Logistic Regression	Retail / Marketing	John et al. (2023)
PCA + K-Means + Hierarchical Clustering	Finance	Wani (2023)
K-Means + (K-nearest neighbours, Logistic Regression, Decision Tree, Random Forest, Support Vector Machine)		Hoang Dang Tran (2023)
K-Means + Decision Tree	Credit card companies	Thitiporndharma & Khonthaoagdee (2024)
K-Means + PCA + Decision Trees	Retail	Rahmet & Gürkan (2024)
K-Means + Apriori		Phyo et al. (2023)
K-Means + SVM	E-commerce	Arakh (2024)
Hybrid Clustering (K-Means + PCA + Decision Trees)	Various industries	Rahmet & Gürkan (2024)

Source: Own work

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/f7937756383

A major challenge in segmentation is data collection and preprocessing. Industries utilise various dataset creation strategies to build high-quality customer and student profiles (Table 5).

As a result of analysing strategies used in other business sectors, we can distinguish between data fusion and integration and feature development and dimensionality reduction (PCA, LDA). The first approach is effectively used in industries such as telecommunications and retail, combining structured (purchase history) and unstructured data (social media activity) to create a complete customer profile. In higher education, artificial intelligence methods can also be used to combine LMS data, academic records, customer surveys, social media activity to increase segmentation accuracy, and improve the learning experience and admission strategies. The dimensionality reduction approach is actively used in marketing and finance, PCA (principal component analysis) and LDA (linear discriminant analysis) reduce the complexity of the data while preserving the main attributes.

Using this approach in higher education will ensure the selection of the most relevant student attributes for profile development and noise reduction in student data, resulting in a more accurate student profile and improved personalised support system.

Table 5. Dataset creation strategies used in various industries

Paper	Industry	Dataset Used	Key Features
Alkhayrat (2020)	Telecom	Mobile usage data, call detail records	Call frequency, data consumption, billing history
Widianti (2024)		Call detail records, mobile data usage	Call duration, data consumption, network preferences
Shaikh & Khedkar (2023)	Banking	Account activity, credit card transactions	Spending behaviour, credit score, loan history
Wang (2024)	Retail & Finance	Transaction records & customer demographics	Age, income, purchase frequency, payment method
Lewaaelhamd (2023)	Retail & E-commerce	Purchase records, browsing data	Spending frequency, recency, product categories
Mustafa (2023)		Online purchase logs, browsing data	Purchase frequency, spending habits, product categories
Katragadda (2023)	Marketing	Website interactions, ad engagement, online behaviour	Clickstream data, social media engagement, conversion rates
Thitiporndharma & Khonthaoagdee (2024)	Finance	Transaction patterns, credit card usage	Spending clusters, income levels, payment preferences

Source: Own work

Table 6 highlights how ML-based clustering and classification models, leveraging different business areas, can significantly enhance student recruitment strategies by segmenting applicants, identifying outliers, optimising marketing, and improving scholarship distribution.

Table 6. Applications of business model in higher education and their benefits

Business Model	Application in Admissions	Benefits
K-Means Clustering	Groups applicants based on academic performance, location, interests	Helps target marketing efforts and scholarship offers
DBSCAN (Density-Based Clustering)	Identifies outliers (applicants with unique backgrounds)	Ensures diversity and inclusion in recruitment
Hierarchical Clustering	Creates detailed applicant segments based on multiple features	Customises admission messaging for different applicant types
Support Vector Machines (SVM)	Classifies students as high, medium, or low probability enrollees	Optimises recruitment resources by focusing on likely candidates
Neural Networks (Deep Learning)	Predicts which students are most likely to succeed	Improves scholarship and admissions decisions

Source: Own work

To sum up, customer segmentation models from various industries offer valuable methodologies that can be adapted for student profiling and recruitment strategies in higher education. Unsupervised clustering techniques provide dynamic segmentation, supervised models enable academic performance prediction, and hybrid

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
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approaches combine the strengths of both for enhanced student profiling. AI-driven dataset creation techniques, such as data fusion and feature selection, ensure more reliable insights for university decision-making.

Our research aimed to answer the following key question: How are artificial intelligence (AI) and machine learning (ML) used for customer profiling in education? AI and ML are widely used in student segmentation, profiling, predictive analytics, and clustering models; various predictive models are used to predict student performance, dropout probability, and future employability. Learning management systems (LMS), recommender systems, and chatbots powered by AI allow universities to improve student engagement and personalise their learning trajectory. The most common methods used for segmentation are K-Means, DBSCAN, hierarchical clustering, in turn, for predicting student success and dropout rates, such methods as random forest, decision trees, gradient boosting, logistic regression are most often used, various hybrid models are successfully used for both segmentation and prediction, for example, K-means + decision trees, clustering + regression (for example, LASSO regression). In addition to these widely used ML methods, the use of Natural Language Processing (NLP) technique Word2Vec is also being implemented to process student feedback and academic records; joint filtering, neural networks and reinforcement learning are used for personalised recommendations and personalisation of students' learning trajectory. The key issue for the effective and high-quality work of AL/ML models is the selection of student characteristics, the data used in the studied sources can be divided into the following groups:

- demographic data: age, gender, nationality, socio-economic background;
- academic records: GPA, course performance, attendance;
- behavioural data: online engagement, social media activity, LMS interaction;
- survey data: student self-assessment, satisfaction surveys;
- career-related data: internship experience, employment status, skill gaps.

Despite covering many aspects of ML-driven student profiling, some areas remain understudied. First, the integration of Google Analytics to analyse applicant or student behaviour in real time is not actively explored, i.e. most studies use static datasets and do not examine real-time web interactions. Accordingly, future work should investigate how website visitation patterns influence enrolment decisions. Second, there is little use of natural language processing (NLP) methods to process, for example, student feedback, chatbot interactions, and emails, and incorporate this information into student characteristics used in creating profiles. Third, improving hybrid models. Fourth, implementing real-time adaptive segmentation. Current segmentation methods classify students using static datasets, but it is possible, for example, to develop and implement reinforcement learning models that adjust engagement strategies based on real-time student interactions.

Conclusions

This study examined AI and machine learning models and techniques for customer segmentation and profiling in higher education and business, identifying key clustering, predictive analytics, and hybrid models that can be adapted to university admission and retention strategies, and outlining issues that require further research.

Let us outline some future directions for our research on student segmentation and profiling.
Stage 1. Data collection and feature development for student admissions:
1) Collect structured demographic and academic data and unstructured data on applicant behaviour, such as social media activity, university chats, and correspondence;
2) Feature selection methods such as random forest feature importance ranking and principal component analysis (PCA) will be used to optimise data quality;
3) Perform research and application of approaches to combining data from different information sources;
4) Explore the feasibility of using cloud computing solutions such as AWS, Google Cloud or Microsoft Azure for data storage, integration and real-time analytics while complying with GDPR (General Data Protection Regulation) and FERPA (Family Educational Rights and Privacy Act).

Stage 2. Integrating real-time behavioural data and using NLP techniques. As part of Stage 2, future work should focus on integrating real-time tracking of applicant behaviour using web analytics tools such as Google

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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Analytics. In addition, enrichment of the dataset using NLP techniques (e.g., Word2Vec for text analysis of student feedback) will be explored to improve profiling accuracy and segmentation accuracy:
1) Collect and analyse Google Analytics data to track applicant interactions with the university website;
2) Apply NLP techniques to analyse student feedback, chat interactions, and support requests to improve profiling accuracy;
3) Explore the use of reinforcement learning models for adaptive segmentation.

Stage 3. Selecting and testing AI/ML models for student profiling:
1) Conduct experiments on the use of segmentation methods (K-Means, DBSCAN) to cluster students based on admission;
2) Develop predictive models (random forest, gradient boosting, neural networks) to predict student retention and academic achievement;
3) Model evaluation metrics such as F1 score, recall accuracy, and root mean square error (RMSE) will be used to evaluate the effectiveness of different approaches.

This requires considering ethical and data security issues. For AI, machine learning, and data analytics to be fully effective in education, access to student data is essential. However, it should be noted that the rights to educational data should remain with students, and educational institutions should implement robust data protection measures to prevent unauthorised access. Transparency in data collection, storage, and use is essential for building trust in AI-powered educational technologies while protecting students' digital rights, and these requirements need to be considered when collecting data and implementing segmentation and profiling models.

By implementing these three phases of research, we plan to develop data-driven segmentation and profiling models using machine learning and AI techniques to develop marketing strategies to attract and retain students, enabling personalised, effective, and ethical decision-making.

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Funding: This research was funded by International grant project of VŠEM No. 1/2024_M – Management of the processes of recovery and sustainable development of public and economic law entities of the EU Member States, in particular Slovakia and Ukraine.

Author Contributions: Conceptualisation: *Ivashchenko O., Lelovský M., Kopp A.*; methodology: *Ivashchenko O., Kopp A., Shmatko O.*; data analysis: *Ivashchenko O., Shmatko O., Cibák L.*, writing—original draft preparation: *Ivashchenko O., Lelovský M.;* writing; review and editing: *Ivashchenko O., Lelovský M., Cibák L.*; visualisation: *Ivashchenko O., Kopp A.*. All authors have read and agreed to the published version of the manuscript

ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2026 Volume 13 Number 4 (June)
http://doi.org/10.9770/f7937756383

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