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LEADING FACTORS FOR BLOCKCHAIN TECHNOLOGY IMPLEMENTATION IN THE BUSINESS ORGANISATIONS IN THE BULGARIAN CONTEXT*

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Abstract. Blockchain technology is recognised as a digital tool that contributes to increasing the competitiveness of a business organisation, and it is most often applied in the financial sector and supply chains. The technology is widely used in developed countries, but it is also gradually entering developing economies. Attention to technology is provoked under the influence of factors determining innovation development and penetration into the entrepreneurial ecosystem. Some of them are psychological, the others are economical, but in general, they influence the management decision-making to use the technology in the enterprises. The primary purpose of the research is to reveal and group the factors provoking the implementation of blockchain technology in Bulgarian companies. In order to collect the necessary data, an empirical study of the Bulgarian entrepreneurial ecosystem was conducted using a survey method. A factor analysis of the two groups of reasons motivating and limiting the application of blockchain technology was performed with a view to uncovering the hidden factors influencing its implementation in organisations. A regression analysis was then performed to answer the question of which factors most affect the interest in implementing BCT in the business organisation to increase their competitiveness in the supply chain. The research data can be used as a working framework for implementing decentralised software applications in companies that are not informed about the pros and cons of blockchain technology but are looking for a position in the global digitised world.

Keywords: blockchain technology; supply chains; relevant factors for blockchain technology implementation

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1. Introduction

Blockchain technology (BCT) started in 2008 (Nakamoto, 2008) with the explicit aim of changing the traditional financial system, but its diffuse spread penetrates all spheres of economic and social life. The rise of technology significantly impacts supply chains (SC) and financial transactions through the two primary development directions. This technology creates innovative opportunities for identification in various spheres of social and economic activity, including in the administration (Markov, 2022).

Opportunities for the application of innovation in supply chains through BCT (Kshetri, 2018) are associated with the use of smart contracts (Clack et al., 2016; Jankowiak, 2021), transparency of processes (Margo, 2017), reduction of inventories costs (Jiang, 2019), commercial finance (Puschmann, 2017) etc.

The mentioned advantages are part of the motivating factors influencing the decision to use BCT, but some reasons limit the technology implementation. The limiting factors are often recognised as weaknesses and threats associated with the dark side of cryptocurrencies (Lagarde, 2018), loss of digital assets as a result of cyber attacks (Chen & Zeng, 2022), risk of concentration in the mining industry (Schinckus, 2020). Factors leading to the use of the technology are known as motivators and limitations (Saberi et al. 2019), but economic and psychological causes stand out (Gigov & Koprinkova-Noncheva, 2021; Vavrecka et al., 2021).

The main objective of this article is to evaluate the impact of leading factors influencing the adoption of BCT in the field of supply chains. For this purpose, we conduct an empirical study in the Bulgarian entrepreneurial ecosystem using a survey method. The output data will perform a factor analysis which information will form research constructs applicable to regression analysis. Regression analysis will measure the strength of the relationship between the research constructs and the dependent variable. Our findings will help the local and global entrepreneurial ecosystem determine which leading factors will significantly impact managerial decision-making for the adoption of BCT. The research data can be used as a working framework for implementing decentralised software applications in companies that are not informed about the pros and cons of BCT, but are looking for a position in the global digitised world. On the other hand, the academic community could use the methodology to conduct analogical studies.

2. Theoretical background

The reason for conducting the current research is that blockchain technology (BCT) is increasingly recognised as a tool to increase the competitiveness of enterprises' supply chains (SC), providing interoperability of information systems (Dimitrov & Gigov, 2020), flexibility and traceability (Bai, Cordeiro & Sarkis, 2020; Tsolakis et al., 2021). Because Bulgarian companies need to increase their competitiveness, it is relevant to analyse the benefits of implementing BCT through its inherent tools. On the other hand, there are risks from the thoughtless adoption of the technology. The advantages and disadvantages are perceived as "motivators" and "barriers" that greatly influence the decision-making to use the technology within the company. Using the theory of consciousness to evaluate the use of BCT in the field of supply chain management implies an engagement and understanding of the problems it is supposed to solve (Verhoeven et al., 2018). Analysing the appropriateness of a given innovation suggests the study of good practices with an emphasis on the functionality of various BCT applications.

The main research objective is to discover the leading and latent factors influencing the use of BCT in Bulgarian enterprises. For this purpose, it is necessary to conduct a literature review on the problem, to analyse the good practices and the studies carried out so far on the subject. The literature review is an essential part of any study. It has proven to be a well-established practice for the reproducibility, traceability and transparency of reviewer decisions, procedures and conclusions (Bryman, 2012). In this regard, it is foregrounded in the current publication.

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Among the leading studies looking at the impact of implementing the BCT factors is the publication of Kayikci et al. (2022), oriented in the circular economy, presenting a model for identifying critical success factors. The authors also emphasise the need for cooperation and the strengthening of supply chains. The issue of discovering promising BCT implementations enhancing the company's competitiveness to maintain unique competitive advantages is also commented on. These circumstances also support the argument outlined in the present study that insufficient collaboration is a significant obstacle (barrier) to adopting the technology (Kouhizadeh et al., 2021). For this reason, it is necessary to measure the impact of the restriction in question.

Other authors present an analysis that examines the value that could be derived from using BCT within the company (Angelis & Ribeiro da Silva, 2018). The proposed evaluation framework, it is analysed the functionality of the different generations of BCT. Still, the picture is very general, and there is no research on the managers' opinions of the companies. However, joint driving forces are found, such as organisational barriers.

Significant conclusions are found in a publication investigating the sustainability of supply chains through BCT (Saberi et al. 2018), in which researchers separated the limiting factors into external and internal, with the internal to the firm being reduced to intra-organizational, inter-organisational, and system-related. In turn, Dubey et al. (2020) share the opinion of researchers on the topic and, on this basis, conduct an empirical study in the field of humanitarian SC, analysing trust and transparency to achieve resilience in SC in the context of natural disasters. The model of the research in question approaches the one we will propose, the essential difference being that we seek a broader view of the influencing factors and their grouping into separate variables with which to conduct applicable calculations.

In another article focused on analysing the advantages of using BCT in the SC of the fashion industry, Moretto et al. (2022) differentiate the influencing factors of driving forces and barriers, identically dividing them into internal and external to the business organisation. What is special here is the emphasis on external drivers (visibility along the chain, technological reasons, scaling up of good practices, responsibility to end users, use of critical success factors, and commitment to wholesalers). An interesting view in this regard is that of Anguelov and Kenova. They explore factors and sub-factors that affect the timeliness and reliability of deliveries and their importance for the efficiency of the logistic processes (2018). According to the classification of the internal factors of the model, they are fragmented into efficiency-oriented reasons (reducing the cost of delivery and insurance of goods) and effective (automation of processes). Internal motivators include information security and counterfeiting prevention, allocated to transparency and increasing trust in SC (Moretto & Macchion, 2022). On the other hand, the authors of the mentioned research define two groups of limiting factors (technological barriers and financial obstacles). Both factors are associated with the fear of passing implementation costs to the end customer, which marketers avoid. Guaranteeing the origin of the goods through the immutable records in the blockchain infrastructure affects the customer, as it has an impact on a subconscious level, i.e. the company is innovative, and products make customers matter (Moretto & Macchion, 2022). The second group of limitations is also discussed, related to the lack of BCT benchmark in SC with a view to rapid integration, ensuring interoperability (Saberi et al. 2019). The importance of internal factors for the level of enterprise competitiveness is also shared by many other authors (Stoyanova & Angelova, 2018).

In the context of the literature review, the majority of researchers support the statement that as the number of participants in the SC increases, the relevance of the use of BCT is confirmed, i.e. the complexity and globalisation of SC require the use of an information system ensuring traceability, reliability and security of information flows, which by default accompany material flows (Wang, Han & Beynon-Davies, 2019). From here follows the conclusion that the proposed driving forces and limitations are described, and, on their basis, variables can be created to participate in the compilation of an empirical model for calculating the influence of individual motivating and limiting factors. Factor analysis is suitable for constructing variables (Ngai, Cheng & Ho, 2004), as in the context of blockchain technology, similar analysis has been conducted to account for the impact of

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transaction confirmation times on the Ethereum and Bitcoin networks (Zhou, ZhiGang & Yuan, 2022). It has also been taken into consideration that all changes in the enterprise, including those related to logistics, must be carried out, paying attention to the enormous role of the human factor (Anguelov & Angelova, 2017). In this regard, one can consider the conclusions of researchers emphasising the functionalities of BCT, but above all, aimed at achieving competitive advantages in SC (Voss et al., 2002).

In support of what was said, Sahebi et al. (2020) share their method for investigating the influence of different limiting factors. Still, the guild's conclusions conclude that more analyses are needed to prove the applicability of BCT in SC (Böhmecke-Schwafert, Wehinger & Teigland, 2022). Based on those mentioned above, we propose a model of empirical research, which contains several main points: conducting factor analysis, constructing variables, and performing linear and non-linear regression analyses.

3. Research objective and methodology

The research objective and the methodology of the study are based on the toolkit of factor analysis to find the latent but leading factors stimulating and limiting the use of BCT in Bulgarian business organisations operating in the supply chain, locally and globally.

The factors influencing the implementation of Blockchain technology within the business organisation are drivers and limitations (Saberi et al. 2019). A study considering the possible reasons for the perception of BCT, conducted in the Bulgarian entrepreneurial ecosystem reflected the main arguments influencing the use of technology identified as motivators and barriers (Dimitrov & Gigov, 2021). Subsequently, they are structured as psychological-behavioural and economic (Gigov & Koprinkova-Noncheva, 2021), applying the tools inherent in socio-cognitive theories (Bandura, 1986).

The research methodology aims to answer the following research questions:

- How many factors are measured by the research variables from the two sets of reasons?
- Which variables measure which factors?
- Which aspects are represented by which factors?
- Which factor and sub-factor independent variables influence the dependent variable "planning and using of BCT to increase the competitiveness of the supply chains of Bulgarian enterprises".

The questionnaire consists of three blocks, which contain a total of 37 questions. It should be noted that the original model of the questionnaire provided by Saberi et al. (2019), for which we are grateful, contains 64 questions. The statistical tools "Jasp", "R", and "SPSS" are used for the statistical processing of the answers to these questions. The input data was collected through webinar surveys, mainly oriented in the field of Supply Chain Management (SCM). After collecting the data, their descriptive analysis was performed (Dimitrov & Gigov, 2021). To answer the research questions, the research methodology goes through several steps.

The **first step** consists of a preliminary check of the collected data for the adequacy of the sample for factor analysis. This includes checking the internal consistency of the statements in the survey constructs using the Kaiser-Meyer-Olkin, Bartlett and Anti-image correlation matrix tests. According to the Kaiser-Meier-Olkin test, values above 0.5 indicate the presence of at least one latent factor and that all assessed variables are adequate for applying factor analysis. When the values on the diagonal of the anti-image correlation matrix for each statement in the survey construct are greater than 0.6, this is also an indicator of the adequacy of the data sample for factor analysis.

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The **second step** involves factor extraction and analysis of the number of factors revealed. The principal components without the factor rotation method are used for factor extraction. The tools Total variance explained matrix, Scree plot, Communalities and Component matrix are used to analyse the obtained results. After applying the Principal Components Method without factor rotation, an analysis of the total variance of the influencing factors is first performed. The matrix indicates how much of the total variance is explained by the impact of the revealed factors. In the matrix, all variables are considered as factors (components). Each component receives a quality score described by the "eigenvalue" indicator. Only components with high eigenvalues are perceived as main factors. A further analysis of the number of revealed factors is obtained through the scree plot diagram. It visualises the eigenvalues (quality results) determined by the previous method. Components that have eigenvalues above 1 are considered "strong factors". It is assumed that the factors that are located to the point where the line from the steep passes into the bed have the strongest influence. The third analysis of the results involved the calculation of the communality coefficient. It indicates the extent to which the revealed principal factors account for the variance of the input variables used. Values in the range [0 ÷ +1] are considered reliable. The closer the value is to 1, the more reliable the factor is and should be included in the analysis. Values above 0.5 are considered relevant. Component matrix shows the correlation between the variables and the revealed factors – factor loadings. The analysis is applied to obtain more rigorous, objective information about influencing factors. Only those links whose weight is greater than 0.5 are depicted.

In the **third step**, the factors are rotated and constructed. Ideally, each input variable should measure exactly one factor. When a variable has a cross-loading, i.e. it measures several components simultaneously, this complicates the interpretation of the revealed factors. To improve the factor extraction results, the method of principal components with orthogonal rotation using the Varimax (Cureton & Mulaik, 1975) with Kaiser Normalization method is used. The goal is to attempt to redistribute the factor loadings so that each variable has to measure exactly one factor. The results for the weight of each variable according to its association with the corresponding factor are displayed in the Rotated Component Matrix. Each factor reflects the communalities between the variables that measure it. Therefore, the main task when constructing the factors is to carry out a correct interpretation of the general characteristic that the variables measure. Once an interpretable pattern of factor loadings is obtained, factor or component names should be assigned according to the measurement's general leading characteristic. Variables with higher factor loadings should play a more important role in factor naming.

In **the fourth step,** the independent variables are constructed according to latent factors obtained as a result of the factor analysis. Each latent factor assembles the sub-factor variables (motivators and barriers) and transforms them into a separate independent variable. With the obtained constructs, linear and non-linear regression analysis will be applied to determine the influence on the dependent variable "Planning and use of BCT".

After performing the calculations, we proceed to the interpretation of the results.

4. Results and discussion

4.1. Sampling Adequacy Check

The sampling adequacy measure considers how well different statements can form a measurement scale. These scales are considered as latent factors. The evaluation of the initial baseline data using the Kaiser-Meyer-Olkin test of the factors motivating the implementation of BCT is shown in Table 1.

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Table 1. KMO and Bartlett's Test on motivators

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,742
Bartlett's Test of Sphericity	Approx. Chi-Square	278,774
	df	45
	Sig.	,000

The values of the indicator confirm the presence of at least one latent factor, and all other variables are adequate to the model for the application of factor analysis. The evaluation of the initial baseline data for the factors limiting the implementation of BCT (barriers) by the Kaiser-Meier-Olkin test is shown in Table 2. The values of the indicator confirm the presence of at least one significant factor. The detailed analysis found that the other variables have values adequate for their inclusion in the factor analysis.

Table 2. KMO and Bartlett's Test on barriers

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,753
Bartlett's Test of Sphericity	Approx. Chi-Square	282,879
	df	66
	Sig.	,000

The detailed check using the Anti-image correlation matrix tool of the internal consistency of the statements in the survey constructs for the motivating factors (table 3) and limiting factors (table 4) shows that the values on the diagonal of the anti-image correlation matrix for each statement in the survey construct are greater than 0.6, which is also an indicator of the adequacy of the data sample for conducting factor analysis.

Table 3. Anti-image Correlation Matrix on "motivators"

Increasing the transparency, traceability and immutability of information	,759[a]	-,145	-,050	-,226	-,046	-,220	,138	,169	,010	-,027
Digitisation of supply chains	-,145	,766[a]	-,131	-,236	-,352	,124	-,273	-,164	,071	,017
Reduction of intermediaries in trade processes	-,050	-,131	,711[a]	-,304	-,036	,199	-,278	,156	-,211	-,070
The ability to use smart contracts	-,226	-,236	-,304	,727[a]	,203	-,341	,096	-,108	-,049	-,026
Improving the processes of delivery of goods	-,046	-,352	-,036	,203	,762[a]	-,252	-,271	,018	-,148	-,003
Trade contracts risk prevention	-,220	,124	,199	-,341	-,252	,725[a]	-,148	-,256	-,272	,007
Reduce the cost of maintaining inventories	,138	-,273	-,278	,096	-,271	-,148	,735[a]	,133	-,003	,071
low costs of implementing the technology	,169	-,164	,156	-,108	,018	-,256	,133	,675[a]	-,250	,024
Obtaining competitive advantages	,010	,071	-,211	-,049	-,148	-,272	-,003	-,250	,799[a]	-,185
External factors	-,027	,017	-,070	-,026	-,003	,007	,071	,024	-,185	,716[a]
a. Measures of Sampling Adequacy (MSA)										

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Table 4. Anti-image Correlation Matrix on "barriers"

Anti-image Matrices "barriers"											
Financial constraints	,761	-,022	-,345	,041	,068	,074	-,016	-,163	,023	-,078	-,099
Lack of company and organisational strategies	-,022	,686	-,042	-,526	-,121	-,221	,087	-,202	-,166	,024	,138
Lack of expertise in the company	-,345	-,042	,767	-,053	-,173	-,074	-,220	,042	,046	-,296	,099
The organisational culture would not accept the introduction of such a project	,041	-,526	-,053	,675	,037	,099	-,039	-,125	,022	,004	-,026
Lack of interoperability with existing IT-Systems	,068	-,121	-,173	,037	,705	-,248	,137	-,044	,090	-,015	-,359
lack of a BCT benchmark for rapid implementation of the technology	,074	-,221	-,074	,099	-,248	,832	-,079	-,115	-,027	-,176	-,054
Lack of knowledge among clients about BTC	-,016	,087	-,220	-,039	,137	-,079	,759	-,323	-,051	-,011	-,229
Lack of cooperation and coordination between our partners for inclusion in Blockchain smart grid	-,163	-,202	,042	-,125	-,044	-,115	-,323	,818	-,083	-,082	,089
Sensitivity to sharing information in permissioned grids	,023	-,166	,046	,022	,090	-,027	-,051	-,083	,788	-,162	-,230
Limited information infrastructure caused by the requirement for all participants to be "on-board"	-,078	,024	-,296	,004	-,015	-,176	-,011	-,082	-,162	,841	-,169
Insufficient development of the BCT	-,099	,138	,099	-,026	-,359	-,054	-,229	,089	-,230	-,169	,673

4.2. Factor extraction and analysis of the number of factors revealed

Factor extraction was performed using the method of principal components without factor rotation. The analysis of the results of factor extraction is carried out separately for the two groups of reasons - "motivators" and "barriers".

Analysis of the results of the factor analysis of the group of reasons motivating the use of BCT

The analysis of the total variance of the influencing factors for the group of motivators (Table 5) shows that the first four hidden factors have the most pronounced variance, with the cumulative accumulation amounting to 67.39%. For additional certainty, a 5th factor is added, accompanied by its own value of 11%, and the value of the total cumulative variance becomes 78.04%. Thus, the analysis continues with 5 factors, the results of which correlate in 78.04% of cases.

Table 5. Total Variance Explained on "motivators"

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,468	34,684	34,684	3,468	34,684	34,684	2,084	20,841	20,841
2	1,489	14,890	49,574	1,489	14,890	49,574	1,926	19,261	40,103
3	1,096	10,956	60,530	1,096	10,956	60,530	1,400	13,996	54,099
4	,997	9,969	70,499	,997	9,969	70,499	1,329	13,292	67,390
5	,755	7,547	78,045	,755	7,547	78,045	1,066	10,655	78,045
6	,630	6,296	84,341						
7	,497	4,967	89,308						
8	,416	4,165	93,473						
9	,372	3,723	97,196						
10	,280	2,804	100,000						
Extraction Method: Principal Component Analysis.									

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Viewing the results regarding the number of factors using a scree plot shows the contribution of the respective motivating factor to the final score (Fig. 1). Factors located in a position where the line goes from steep to gentle descent have the strongest influence, i.e. the first four. As we noted, we will use in the analysis 5 main factors that explain 78.04% of the total variance.

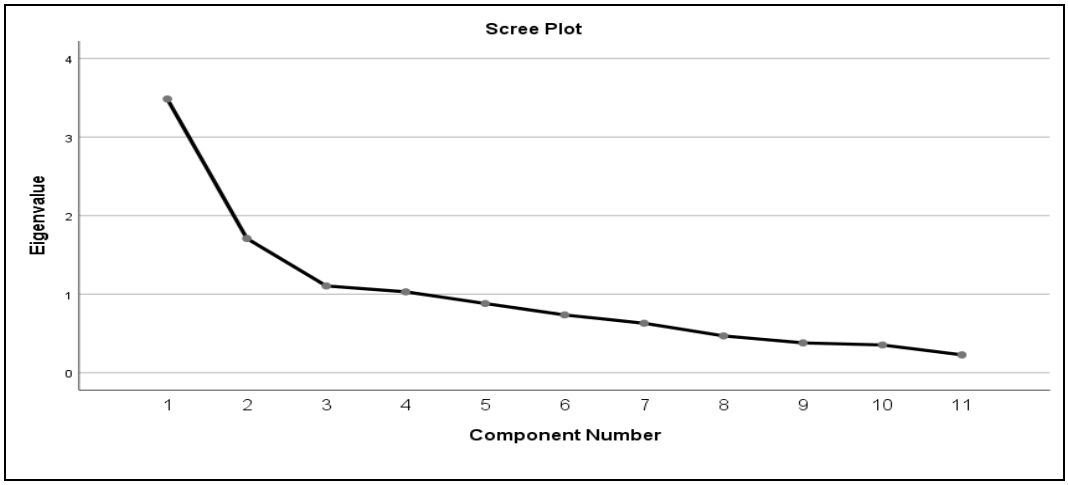

Figure 1. "Scree plot" diagram on "motivators"

The values of the coefficient of communalities as a result of the factor analysis for the group of reasons motivating the use of BCT for five main factors are shown in Table 6.

Table 6. Communalities on "motivators"

Communalities		
	Initial	Extraction
Increasing the transparency, traceability and immutability of information	1,000	,877
Digitisation of supply chains	1,000	,638
Increasing information security through decentralisation storage	1,000	,851
Reduction of intermediaries in trade processes	1,000	,792
The ability to use smart contracts	1,000	,807
Protection of intellectual property	1,000	,739
Improving the processes of delivery of goods	1,000	,738
Trade contracts risk prevention	1,000	,773
Reduce the cost of maintaining inventories	1,000	,659
Low costs of implementing the technology	1,000	,773
Obtaining competitive advantages	1,000	,877
External factors	1,000	,896
Extraction Method: Principal Component Analysis.		

The data visualise high values of the coefficients close to +1, which is considered a positive moment in the current stage of the analysis, i.e. the studied statements are significantly related to the discovered motivating factors. The distribution of motivating reasons to the revealed factors and their factor loading is shown in table 7.

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Table 7. Allocation of variables to relevant motivating factors

	Component				
	1	2	3	4	5
Increasing the transparency, traceability and immutability of information	,502	,520			
Digitisation of supply chains	,703				
Reduction of intermediaries in trade processes	,566				
The ability to use smart contracts	,671	,567			
Improving the processes of delivery of goods	,680				
Trade contracts risk prevention	,711				
Reduce the cost of maintaining inventories	,567	-,540			
Low costs of implementing the technology		,578	,567		
Obtaining competitive advantages	,663				
External factors				,757	,523
Extraction Method: Principal Component Analysis.					
a. 5 components extracted.					

It is important to note that some variables measure more than one factor. Also, a large number of variables correlated only with the first factor. This requires applying the factor rotation method to more clearly redistribute the variables to the revealed factors.

Analysis of the results of the factor analysis of the group of reasons limiting the use of BCT

The analysis of the total variance of the influencing factors for the group of motivators (Table 8) shows that the first three hidden factors have the most pronounced variance, with the cumulative accumulation amounting to 52.08%. For additional security, a 4th factor is added with its value of 13,45%, and the value of the total cumulative variance becomes 65,54%. Thus, the analysis continues with 4 factors that explain the total variance with 65,54%.

Table 8. Total Variance Explained on "barriers"

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,601	32,737	32,737	3,601	32,737	32,737	1,978	17,981	17,981
2	1,464	13,310	46,048	1,464	13,310	46,048	1,971	17,920	35,902
3	1,159	10,536	56,583	1,159	10,536	56,583	1,780	16,186	52,088
4	,985	8,952	65,535	,985	8,952	65,535	1,479	13,447	65,535
5	,782	7,109	72,643						
6	,715	6,497	79,141						
7	,607	5,518	84,658						
8	,518	4,713	89,372						
9	,489	4,447	93,819						
10	,349	3,177	96,996						
11	,330	3,004	100,000						
Extraction Method: Principal Component Analysis.									

Reviewing the results of the factor analysis through the scree plot diagram (Fig. 2) shows that three factors have the strongest influence, located in the position where the line from steep to gentle descent. As noted, we will use in the analysis 4 main factors that explain 65,54% of the total variance.

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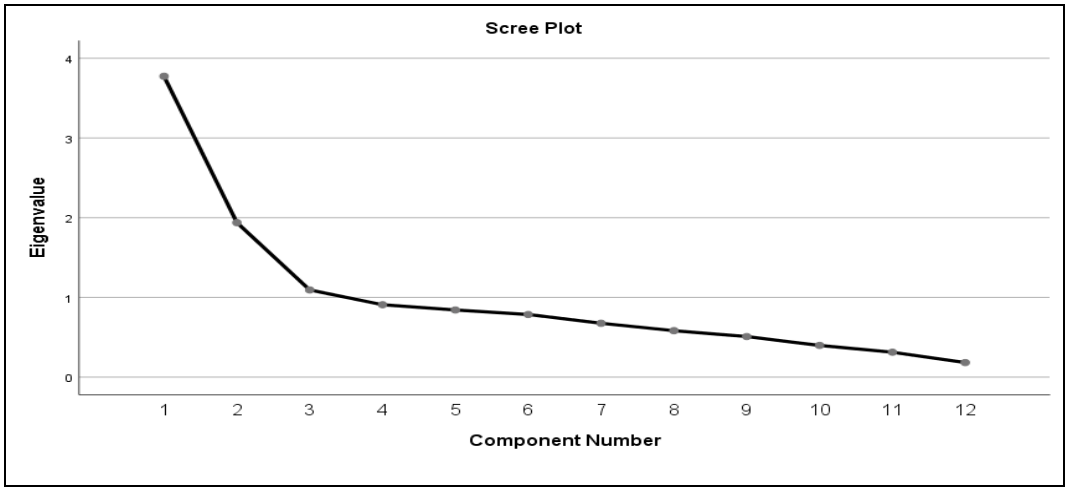

Figure 2. "Scree plot" diagram on "barriers"

The values of the coefficient of communalities as a result of the factor analysis for the group of reasons limiting the use of BCT for four main factors are shown in Table 9.

Table 9. Communalities on "barriers"

Communalities		
	Initial	Extraction
Financial constraints	1,000	,651
Lack of company and organisational strategies	1,000	,790
Lack of expertise in the company	1,000	,695
The organisational culture would not accept the introduction of such a project	1,000	,699
Lack of interoperability with existing IT-Systems	1,000	,771
Lack of a BCT benchmark for rapid implementation of the technology	1,000	,568
Lack of knowledge among clients about BCT	1,000	,546
Lack of cooperation and coordination between our partners for inclusion in Blockchain smart grid	1,000	,584
Sensitivity to sharing information in permissioned grids	1,000	,722
Limited information infrastructure caused by the requirement for all participants to be "on-board"	1,000	,525
Insufficient development of the BCT	1,000	,660
Extraction Method: Principal Component Analysis.		

Inspection of the output data revealed high communality values for the limiting factors (above 0.5), confirming the relevance of the method. The distribution of reasons limiting the use of BCT to the revealed factors and their factor loading is shown in Table 10.

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Table 10. Component matrix "barriers"

	Component			
	1	2	3	4
Financial constraints	,585		-,591	
Lack of company and organisational strategies	,619	,639		
Lack of expertise in the company	,659			
The organisational culture would not accept the introduction of such a project	,502	,692		
Lack of interoperability with existing IT-Systems	,607		,522	
Lack of a BCT benchmark for rapid implementation of the technology	,644			
Lack of knowledge among clients about BTC	,586			
Lack of cooperation and coordination between our partners for inclusion in Blockchain smart grid	,666			
Sensitivity to sharing information in permissioned grids	,517			,680
Limited information infrastructure caused by the requirement for all participants to be "on-board"	,654			
Insufficient development of the BCT	,532	-,515		
Extraction Method: Principal Component Analysis.				
a. 4 components extracted.				

It can be seen from the table that a large number of variables correlated only with the first factor. This requires applying the factor rotation method to more clearly reallocate the variables to the revealed limiting factors.

4.3. Rotation of the factors and construction of the new variables

The rotation further helps distinguish the factors and explores their role in relation to the relevance of the statements in the factor analysis. An orthogonal rotation was performed for analysis purposes. The application of the method of rotating the data for the motivating factors is placed in table 11, and the limiting factors are in table 12. The results show that rotating the motivating factors results in a more even distribution of the variables to the factors and a unique distribution of each variable to the revealed factors.

Table 11. Rotated Component Matrix on "motivators"

	Component				
	1	2	3	4	5
Increasing the transparency, traceability and immutability of information			,922		
Digitisation of supply chains	,659				
Reduction of intermediaries in trade processes				,851	
The ability to use smart contracts				,586	
Improving the processes of delivery of goods	,852				
Trade contracts risk prevention		,675			
Reduce the cost of maintaining inventories	,812				
Low costs of implementing the technology		,578			
Obtaining competitive advantages		,665			
External factors					,940
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.[a]					
a. Rotation converged in 7 iterations.					

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Table 12. Rotated Component Matrix on "barriers"

	Component			
	1	2	3	4
Financial constraints	,806			
Lack of company and organisational strategies		,856		
Lack of expertise in the company	,756			
The organisational culture would not accept the introduction of such a project		,833		
Lack of interoperability with existing IT-Systems			,869	
Lack of a BCT benchmark for rapid implementation of the technology			,646	
Lack of knowledge among clients about BCT	,529			
Lack of cooperation and coordination between our partners for inclusion in Blockchain smart grid		,565		
Sensitivity to sharing information in permissioned grids				,824
Limited information infrastructure caused by the requirement for all participants to be "on-board"				,865
Insufficient development of the BCT				,582
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. [a]				
a. Rotation converged in 6 iterations.				

Based on an analysis of the results of tables 11 and 12 and an interpretation of the general characteristics of the variables allocated to each factor, the following names of the leading motivating and limiting factors were derived (Table 13).

Table 13. Name of the leading motivating and limiting factors

№	Motivators	Barriers
1	Leading to optimise the processes in Supply chain	Technological and subjective limitations
2	Improving company reputation	Constraints caused by organisational policies
3	Factors building trustiness	Communication and financial barriers
4	Web3 factors	Lack of trust and connectivity
5	Unmanageable risks	

4.4. Performing a regression analysis with variables obtained as a result of the factor analysis

Calculations begin by constructing the variables "latent motivators" and "latent barriers". According to social-cognitive theories (Bandura, 1986), "motivators" refer to expectations, while "barriers refer to self-regulation. On this basis, calculations are carried out to answer the question of which variables are influencing to the greatest extent, the interest in implementing BCT in the business organisation to increase the competitiveness of the enterprise in the field of SC. For this purpose, it is appropriate to formulate two hypotheses, namely:

- H1: The "latent motivators" do not influence interest in using blockchain technology to increase the competitiveness of enterprise supply chains;
- H2: The "latent barriers" do not limit the use of blockchain technology as a tool to increase business competitiveness.

In the current case, a linear multifactorial regression analysis is applied with variables constituting the latent motivating and limiting factors, with the first step being a model summary (Table 14).

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Table 14. Model summary of the model with independent constructs inherent to the latent motivating and limiting factors

Model Summary[b]									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	,558[a]	,312	,245	,926	,312	4,684	9	93	,000
a. Predictors: (Constant), Lack of trust and connectivity, Unmanageable risks, Leading to optimise the processes in Supply chain, Factors building trustiness, Technological and subjective limitations, Improving company reputation, Communication and financial barriers, Web3 Factors, Constraints caused by organisational policies									
b. Dependent Variable: Planning and using blockchain technology									

The data support the model's reliability, with the measure of correlation (R) between the dependent and independent variables having an appropriate value (.558). The coefficient of determination also yields an applicable value (.312). On the other hand, information about the significance of the model (Sig F = .000) is relevant to continue the analysis.

The calculations continue by reviewing the independent sub-variables making up the main research constructs and considering the validity of their values to continue the analysis (Table 15).

Table 15. Reliability and Applicability Check of the Independent Variables

Coefficients[a]										
Model	Unstandardised Coefficients		Standardised Coefficients	t	Sig.	95,0% Confidence Interval for B		Correlations	Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Partial	Tolerance	VIF
(Constant)	2,223	,727		3,056	,003	,779	3,668			
Leading to optimise the processes in Supply chain (**LOPSC**)	,001	,030	,004	,036	,971	-,058	,061	,004	,687	1,456
Improving company reputation (**ICR**)	,078	,044	,184	1,761	,082	-,010	,166	,180	,676	1,480
Factors building trustiness (**FBT**)	,027	,070	,037	,387	,700	-,113	,167	,040	,820	1,220
Web3 factor (**W3F**)	,145	,052	,295	2,793	,006	,042	,248	,278	,664	1,507
Unmanageable risks (**UmR**)	,028	,037	,068	,776	,440	-,044	,101	,080	,951	1,051
Technological and subjective limitations (**TSL**)	-,025	,034	-,076	-,735	,464	-,093	,043	-,076	,684	1,463
Constraints caused by organisational policies (**CCOP**)	-,078	,035	-,241	-2,250	,027	-,147	-,009	-,227	,643	1,555
Communication and financial barriers (**CFB**)	-,027	,042	-,066	-,657	,513	-,111	,056	-,068	,745	1,342
Lack of trust and connectivity (**LTC**)	,105	,074	,131	1,407	,163	-,043	,252	,144	,852	1,173

An initial review reported overall high reliability of the constructs, but a closer reading highlighted several key points, namely:

- the assertion certainty indicator (Sig) provided reliable data only for the sub-variables: **LOPSC, ICR, W3F, CCOP**;
- the verification of the confidence interval confirms alternative hypotheses about the influence of the factors: **W3F, CCOP**, i.e.:

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  - web3 factors (**W3F**) are essential for increasing the competitiveness of the business unit's supply chains;
  - the limitations created as a result of organisational policies (**CCOP**) negatively affect the competitiveness of the company, by not adopting new technologies.
- partial correlation is acceptable only for the factors: **W3F, CCOP**;
- the coefficient for independence between the factors (tolerance) marks acceptable values (≥0.5), which supports the conduct of the analysis;
- the "VIF" indicator reports stable values (≤10).

The discovered problems provide an opportunity to calculate the most significant latent factors. Still, before proceeding to this phase, it is appropriate to compile the regression model with the independent variables obtained in the result of the factor analysis. The regression model has the following form:

$$\hat{y} = 2{,}223 + 0{,}001 \cdot \mathbf{LOPSC} + 0{,}078 \cdot \mathbf{ICR} + 0{,}027 \cdot \mathbf{FBT} + 0{,}145 \cdot \mathbf{W3F} + 0{,}028 \cdot \mathbf{UmR} - 0{,}025 \cdot \mathbf{TSL} - - 0{,}078 \cdot \mathbf{CCOP} - 0{,}027 \cdot \mathbf{CFB} - 0{,}105 \cdot \mathbf{LTC}$$

Following the research methodology, a non-linear regression analysis is performed (Table 16).

Table 16. Output data obtained as a result of non-linear regression analysis

Parameter Estimates				
Parameter	Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
a Constant	1,821	,772	,288	3,353
b1 Leading to optimise the processes in Supply chain (**LOPSC**)	,006	,063	-,120	,133
b2 Improving company reputation (**ICR**)	,230	,135	-,039	,499
b3 Factors building trustiness (**FBT**)	,010	,050	-,090	,110
b4 Web3 factor (**W3F**)	,252	,098	,058	,446
b5 Unmanageable risks (**UmR**)	,041	,038	-,034	,115
b6 Technological and subjective limitations (**TSL**)	-,060	,129	-,316	,196
b7 Constraints caused by organisational policies (**CCOP**)	-,157	,068	-,292	-,022
b8 Communication and financial barriers (**CFB**)	-,022	,111	-,242	,199
b9 Lack of trust and connectivity (**LTC**)	,046	,047	-,047	,140

After performing the calculations, the nonlinear regression equation has the following form:

$$\hat{y} = 1{,}821 + 0{,}006 \cdot \mathbf{LOPSC} + 0{,}230 \cdot \mathbf{ICR} + 0{,}010 \cdot \mathbf{FBT} + 0{,}252 \cdot \mathbf{W3F} + 0{,}041 \cdot \mathbf{UmR} - 0{,}060 \cdot \mathbf{TSL} - - 0{,}157 \cdot \mathbf{CCOP} - 0{,}022 \cdot \mathbf{CFB} - 0{,}046 \cdot \mathbf{LTC}$$

The analysis achieves better results, but the confidence interval values again report the desired direction of the regression equation for only two of the latent factors. After analysing the source data, we propose the following regression equation:

$$\hat{y} = 3{,}177 + 0{,}168 \cdot \mathbf{W3F} - 0{,}102 \cdot \mathbf{CCOP}$$

where:
W3F – Web3 factors
CCOP – Constraints caused by organisational policies

The indicated latent factors contain several significant sub-variables. In order to find the most significant influencing sub-variables, we apply a stepwise regression analysis (Table 17).

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Table 17. Output data of the significant sub-variables inherent in the latent factors

Variables Entered/Removed[a]			
Model	Variables Entered	Variables Removed	Method
1	11.5. The ability to use smart contracts	.	Stepwise (Criteria: Probability-of-F-to-enter <= ,050; Probability-of-F-to-remove >= ,100).
2	12.2. Lack of company and organisational strategies	.	Stepwise (Criteria: Probability-of-F-to-enter <= ,050; Probability-of-F-to-remove >= ,100).
a. Dependent Variable: Planning and using blockchain technology			

For more detailed information, we check the main data reliability indicators (Table 18).

Table 18. Data needed to build the regression model

Coefficients[a]											
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.	95,0% Confidence Interval for B		Correlations	Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Partial	Tolerance	VIF
1	(Constant)	2,762	,426		6,479	,000	1,916	3,608			
	11.5. The ability to use smart contracts (**ASCs**)	,331	,081	,360	4,071	,000	,170	,492	,375	,952	1,050
	12.2. Lack of company and organisational strategies (**LCOS**)	-,186	,059	-,277	-3,140	,002	-,303	-,068	-,298	,952	1,050
a. Dependent Variable: Planning and using blockchain technology											

The information from the table provides information in several main directions, namely:

- the direction of the regression model is correct, as the sub-variable forming part of the latent motivating factors "Web3 factor" (usability of smart contracts) follows a positive direction, i.e. increasing the importance of the factor positively affects the dependent variable;
- the sub-variable (lack of company-organisational strategies for technology adoption) inherent in the latent limiting factors follows the correct negative direction, i.e. an increase in the value of the independent variable negatively affects the dependent variable "increasing the competitiveness of supply chains through the use of BCT";
- the reliability indicator reports the required values (Sig ≤ 0.05), supporting the adequacy of the model;
- the confidence interval regarding the influence of the two factors confirms alternative hypotheses identical to those mentioned above;
- the partial correlation for the latent motivating sub-factor was higher than that of the limiting statements;
- the indicator of independence between the factor sub-variables (tolerance) has a value close to +1, verifying the model's reliability.

After reflecting on the conclusions obtained when conducting a stepwise regression, it is appropriate to construct the regression equation with the emitted influencing latent factors.

Hence, the regression model takes the following form:

$\hat{y} = 2{,}762 + 0{,}331 \cdot \mathbf{ASCs} - 0{,}186 \cdot \mathbf{LCOS}$

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For a more adequate interpretation of the data, we present a non-linear regression analysis with the above-mentioned sub-factor variables (Table 19).

Table 19. Values involved in the non-linear regression model

Parameter Estimates				
Parameter	Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
a	2,787	,361	2,072	3,503
b1 the ability to use smart contracts (**ASCs**)	,260	,081	,100	,420
b2 lack of company and organisational strategies (**LCOS**)	-,116	,038	-,190	-,041

The baseline information supports the adequacy of the regression model, both with the direction of the equation and the fact that the absence of "0" at the limits of the confidence interval confirms the alternative hypotheses. The regression equation will take the following form:

$\hat{y}$ = 2,787 + 0,260 . **ASCs** – 0,116 . **LCOS**

The data depict a positive impact on increasing the competitiveness of the supply chains of Bulgarian companies through BCT and, in particular, the use of smart contracts. On the other hand, the lack of organisational policies and strategy for the implementation of BCT reduces the possibility of positioning in the global digitised supply chains, as a result of which the competitiveness of the company is threatened.

Conclusions

Blockchain technology is an innovative tool with many advantages. Still, in developing economies such as Bulgaria, many negative opinions are influenced mainly by the volatility of cryptocurrencies. Despite the negative comments, there are also positive statements backed by scientific facts.

The present study performs an in-depth analysis of the so-called hidden but leading factors influencing the decision to implement Blockchain technology within the business organisation. The calculations depict more motivating than limiting factors, a sign of recognition of technology relevant to business management.

The conducted regression analyses supported the use of BCT to increase the competitiveness of the supply chains of Bulgarian enterprises. Still, the statements and conclusions refer to the globalised digitalised supply chains. The main factors affecting the implementation of blockchain technology in companies are the possibility of using smart contracts and increasing competitiveness. On the other hand, the lack of organisational policies and development strategies limits the diffusion of the technology and decreases the possibility of positioning in the global SC.

The resulting new groups of factors can be used as research constructs in future research in the high information technology applications in supply chains.

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