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MONITORING AND PLANNING OF LOCAL TERRITORIAL DEVELOPMENT AS A MODELABLE BUSINESS PROCESS: THE CASE OF LATVIAN MUNICIPALITIES*

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Abstract. The purpose of this study is to develop a model (using the case of Latvian municipalities), which represents monitoring and planning of local territorial development as a business process. It is hypothetically assumed that business process modeling for monitoring and planning local territorial development is possible and increases the level of this development, but is not widely used in Latvian municipalieties. This hypothesis is tested through a literature analysis, the use of business process modeling tools, action research in Augshdaugava County municipality and statistical analysis of survey data (Latvian municipalities, N = 43, 2024). The evaluation of business process modeling (BPMdl) maturity levels in the context of business process management (BPMng) (in particular, its core elements: strategic alignment, governance, method, information technology, people, culture) is conducted using the Business Process Maturity Model (BPMM). Data were collected through a survey (based on a special 5-score scale of BPMdl maturity levels) of administrative staff responsible for the creation of annual public reports in Latvian municipalities or actively involved in this process. The results of the study indicate a moderate overall level of BPMdl maturity (from 1.91 score for methods to 3.86 score for strategic fit) in Latvian municipalities. Furthermore, BPMdl maturity levels, especially in terms of methods and culture, are statistically significant determinants of local economic development. The results of the discriminant analysis show that, based on BPMdl maturity levels, it is possible to classify Latvian municipalities into groups with a less developed economy and a more developed economy with an accuracy of 95.3%. This study is innovative in the application of BPMdl for local territorial development in Latvia.

Keywords: local territorial development; monitoring; planning; business process; business process modeling (BPMdl); business process management (BPMng); Business Process Maturity Model (BPMM); Latvian municipalities.

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JEL Classifications: R58, H83, O18, C61

1. Introduction

A business process is a series of tasks or activities that are systematically organized and implemented to achieve a specific organizational goal (Weske, 2012). These processes can vary greatly in complexity and scope, ranging from simple procedures like ordering supplies to intricate workflows like product development and supply chain management (van der Aalst & Hee, 2002). Key characteristics of a business process include (van der Aalst, 2016): (1) defined sequence of steps (a clear sequence of activities that need to be performed), but sometimes a business process includes also parallel acitvities, which are not dependent on each others completion and can

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be done parallel (Ng, 2024); (2) objective or goal (a specific outcome or goal that the process aims to achieve); (3) inputs and outputs (resources or information that are processed to produce a final output); (4) participants (individuals, teams or systems involved in executing the process); (5) rules and policies (guidelines that dictate how tasks should be performed).

In different sources, the definition and key elements of a business process may be defined slightly differently, but the essential component of a business process, which distinguishes it from all other processes, is its repeatability (regularity). In turn, all processes occurring at the stage of formation and initial development of an organization are not business processes, since they have a trial, unsettled nature. As for the key elements of a business process displayed in its model, then, with variations in definitions and terminology from different sources, they always include the four key points used in the older, widely spread and still applicable IDEF0 models (IDEF0, 1993): inputs (in the business process diagram it is always to the left of the block depicting one of the sequential steps of business process), outputs (always to the right), mechanisms (always from below) and controls (always from above) (Figure 1).

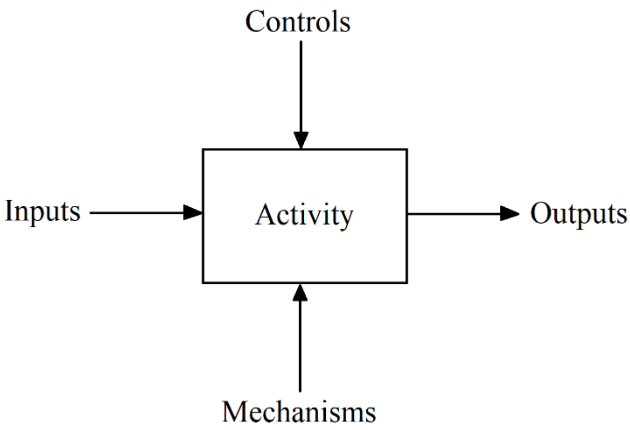

Figure 1. Key functional elements of a business process: the basis of IDEF0 diagram

Note: According to the IDEF0 functional modelling methodology. an input is consumed and transformed by an activity into an output. An activity is triggered when the state of the input and the control allow it, while the mechanism identifies the primary means by which the activity is executed. Thus a control governs when an activity occurs (and is not necessarily consumed) while a mechanism is something that is used (but not consumed) during an activity. In an IDEF0 diagram the boxes represent activities and the connecting arrows represent things (e.g., raw materials, products, documents, and data). It is the location of an arrow relative to the box it connects which determines its role (input, control, output or mechanism). The connecting arrows can split or merge, and a control may also act as an input (i.e., be consumed).

Source: Kalian et al., 2004.

While IDEF0 diagrams are centered around the functional aspects of processes (inputs, outputs, mechanisms, controls), the modern tool for business process modeling, Business Process Model and Notation (BPMN), provides a more dynamic and detailed representation, including (Marlon et al., 2019):

- flow objects – events (something that happens during the process), activities (tasks or work performed in the process), gateways (control the flow of the process, used for splitting and merging paths);
- artifacts – data objects (data required or produced by activities), groups (a visual mechanisms to group related activities), annotations (textual comments to the diagram for clarity);
- connecting objects – sequence flow (the order in which activities are performed), message flow (communication between different process participants), associations (link artifacts and text annotations to flow objects);
- swimlanes – pools (major participants in a process, such as departments or organizations), lanes (sub-divide pools to show roles, responsibilities, or other categorizations).

Thus, IDEF0's focus is on the functional modeling, emphasizing the transformation of inputs into outputs controlled and facilitated by mechanisms and controls, but BPMN's focus is broader, covering not just the transformation of inputs into outputs, but also the sequence and flow of activities, communication between

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participants, and the organizational structure within the process (Garcia-Dominguez et al., 2012). There are also another business process modeling notations such as EPC, YAWL, BPEL as well as analytic tools such as WOPED, WOFLAN, PROM (Weske, 2012), with their own specifics and focus useful for business process modeling.

When applied to the context of local territorial development, a business process encompasses the systematic approach taken to assess, plan and implement strategies for the improvement and growth of a specific geographic area. This involves a series of interrelated activities aimed at diagnosing current conditions and planning future developments (Mickevičius et al., 2022). While commercial organizations apply process management methods, because they accept it as necessity in light of long-term high performance achievements, services of public administration are not yet process managed (Simonova & Sykora, 2011). That is not because public administration organizations would not be interested in application of methods of monitoring and managing quality. The reason is that the services they provide have specific characteristics (for example, legal framework) (Simonova & Sykora, 2011; Maksin, 2014), which determine processes efficiency in the local municipalities (Marks-Bielska & Kurowska, 2017; Marks-Bielska et al., 2020). Our study focuses on possibilities of usage of process modeling for monitoring and planning local territorial development, so that these services in Latvia could be more process managed and monitored.

The paper aims to develop a model representting monitoring and planning of local territorial development as a business process. We are planning to achieve this aim based on the case of Latvian municipalities and technical capacity of available business process modeling notations (widely used BPMN is preferable, but not required). The model itself is primary, but notations are secondary. Our hypothesis is that business process modeling for monitoring and planning local territorial development is possible and increases the level of this development, but is not widely used in Latvian municipalieties. This hypothesis is tested through a literature analysis, the use of business process modeling tools, action research in Augshdaugava County municipality and statistical analysis of survey data (Latvian municipalities, N = 43, 2024).

The next section will provide the review of scientific studies on business process modeling in the context of local territorial development, then I will provide the conceptual framework of my own study and research methodology. The research results and discussion section will present monitoring and planning of local territorial development in Latvian municipalties as a modelable business process, as well as the resulting model. The final section will provide conclusions, study lmitations and recommendations for further research in this area.

2. Literature review

In the context of local territorial development and public administration authorities, the process approach is often declared within various strategic documents that outline the goals, principles and methods for improving public sector efficiency, transparency and service quality. Some of the key strategic documents that typically emphasize the process approach include National e-Government Strategies, Public Administration Reform Plans, Quality Management Systems in Public Administration, Strategic Frameworks for Public Sector Modernization, National Development Plans and other strategic documents (Adeniran et al., 2023). However, in reality the role of process management is often underrated (Bures, 2004; Simonova & Sykora, 2011), and business process modeling in the context of local territorial development is a rather specific and rare issue for scientific research. Although, there are some deep and interesting studies in this area too.

For example, the study "Process Modeling for Regional Territorial Planning" (Simonova & Sykora, 2011) investigates the application of process modeling methods to public administration services, specifically focusing on regional territorial planning. The primary goal of the study is to explore how process modeling can improve the management and monitoring of territorial planning services, which traditionally have not utilized such methods due to the specific characteristics of these services. Key points of the study (Simonova & Sykora, 2011) applicable in our further research are as follows:

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- the study focuses on the creation of territorial analytic data, which are essential inputs for further territorial planning tools like the "Principles of Territorial Development" (act as a cornerstone in regional territorial planning, providing a structured approach to manage, protect and develop the region in a sustainable and coordinated manner. They influence the creation of essential planning documents, support private investments and ensure that all development activities are in harmony with the overall goals of territorial planning). It distinguishes between regular (biannual) and irregular (continuous updates) processes of creating and updating these data;
- a detailed model of the process context for creating territorial analytic data is provided. This includes various actors such as data providers, regional authorities, and the tools and applications used in the process;
- using BPMN tools like Bizagi and Lucidchart the study maps the process flow for both regular and continuous updates of territorial analytic data. It identifies key activities, risks and areas for improvement, particularly focusing on the quality and standardization of input data from various providers;
- to evaluate and improve the process, the study proposes a set of indicators to measure performance. These include format standardization, reception of data, additional communication needs, time required for data model study and conversion of attributes.

Overall, the study "Process Modeling for Regional Territorial Planning" concludes that process and data modeling are effective tools for managing regional territorial planning. It suggests that continuous measurement and refinement of processes based on the proposed indicators can lead to significant improvements in efficiency and quality (Simonova & Sykora, 2011). Thus, the study underscores the potential benefits of applying process management techniques to regional territorial planning, advocating for a more structured and standardized approach to handling spatial data and decision-making processes. This approach aims to enhance the efficiency, transparency and overall quality of public administration services in the context of territorial development.

Within the study "The Impact of the Efficiency of Administration of Territorial Planning Processes on the Development of Territories: Case Study of Pagegiai Municipality, Lithuania" (Mickevičius et al., 2022) the opinion has been expressed that the phasing of the processes of preparation of territorial planning documents, depending on the institution that administers it, hinders the processes of preparation of territorial planning documents by established procedural actions. The object of the research was the complex and special territorial planning documents prepared in the territory of Pagėgiai municipality, which was chosen because the preparation of planning documents in the municipality has slowed down recently. The use of multi-criteria analysis (PROMETHEE software) to evaluate the efficiency of prepared territorial planning documents was a crucial aspect of the study. Criteria included preparation duration, public involvement, ecological and economic considerations, infrastructure development and size of the territory of planning (Mickevičius et al., 2022). The analysis of the processes of the prepared planning documents and the interviews of experts revealed that the planning procedures performed by the administering authorities are inefficient: not all the administering authorities consistently carry out the assigned procedures, delay (in relation to the legal deadline) the planned decisions. According to experts, the reason for the inefficient performance of procedures is the lack of human resources in the administering institutions or their inadequate competence. The inefficiencies in the administrative processes, such as delays and inconsistent execution of assigned procedures, were identified as significant barriers to effective territorial planning and development in Pagegiai municipality (Mickevičius et al., 2022). In our opinion, finding out the reasons for the inefficient performance of procedures using the purely cientific method (expert survey) is a competitive advantage of this tudy, which is applicable in our further research.

In Larvia, the project "Development of Territorial Development Planning Processes and Information System" (*TAPIS* 3rd round, 2017–2020) has been realized by the Central Finance and Contracts Agency with cooperation partners. The project was implemented with the support of the European Regional Development Fund (ERDF) and its total amount of funding was 1,000,000 EUR (Putniņš, 2020). The project ensured the development of the already functioning Territorial Development Planning Information System (Latvian: *Teritorijas attīstības plānošanas informācijas sistēma, TAPIS,* https://tapis.gov.lv). The overarching goal of the project was the development of spatial planning, real estate management and construction data flow and the creation of an integrated data environment (Putniņš, 2020). To achieve this, a subordinate goal was set – to ensure further functional development of *TAPIS* and Regional Development Indicators Module (Latvian: *Reģionālās attīstības indikatoru modulis*, *RAIM*), improvement of public administration efficiency and interoperability in real estate and construction management (Putniņš, 2020).

While the above project is not scientific, but rather applied, the necessity for special structured integrated data for process modeling in the context of territorial development in Latvia is well-supported by scientific studies. For example, the study on smart territorial development in Latvia, particularly focusing on the Zemgale Planning Region (Gemma & Vītoliņa, 2018), underlines the role of data systems in innovation capacity building, regional development monitoring and addressing monocentric development challenges, all of which are core objectives of the TAPIS project. The *RAIM* is highlighted as a crucial tool for monitoring regional development, supporting decision-making and evaluating trends in municipal territories (Gemma & Vītoliņa, 2018). This aligns with *TAPIS'*s goal of creating a structured spatial and textual data environment for better planning and public administration efficiency. One more study (Nipers et al., 2017) highlights several aspects that indicate the importance and relevance of structured integrated data, such as that provided by *TAPIS*, in the context of smart territorial development. The study discusses the importance of data in supporting regional policy and planning, especially in the context of EU funding and regional development strategies. This further emphasizes the need for integrated data systems to inform policy decisions and promote balanced territorial development (Nipers et al., 2017). Thus, Latvian scientific studies support the necessity of special structured integrated data, such as that provided by *TAPIS*, for effective process modeling and smart territorial development in Latvia.

The question arises: are such important integrated data (provided by *TAPIS* project for effective process modeling) used for scientific research and real monitoring and planning of local territorial development? For example, the recently defended Latvian doctoral thesis "Municipal Environmental Governance Development Preconditions" (Lagzdiņa, 2023) does not mention the use of data or results from the *TAPIS* project or the *RAIM*, while emphasizes that successful governance requires an adequate flow of information between science and policy. This includes providing locally specific environmental information that is accessible and usable in decision-making processes. Currently, there is a lack of such information, which hampers effective environmental governance (Lagzdiņa, 2023). At the same time, Latvian municipalities use *TAPIS* and *RAIM* data in their annual public reports – for example, the Public Report 2022 of Augshdaugava County (Latvian: *Augšdaugavas novads*) Municipality uses *TAPIS* and *RAIM* data to assist in the planning and management of real estate projects (including details on infrastructure developments and construction projects that are part of the local government's initiatives), to monitor and evaluate the progress of various environmental and cultural heritage projects, to analyze economic trends and demographic changes in the municipality (including statistics on registered and liquidated businesses, employment rates, and population dynamics), to provide a comprehensive view of the ongoing and planned development projects (Municipal Council of Augshdaugava County (Latvia), 2023a).

There are also some technical scientific studies, the concepts and methods of which can be applied in process modeling for monitoring and planning local territorial development. For example, two key aspects of aggregating business processes and web services (Bruni et al., 2005b): compensations, i.e. ad hoc activities that can undo the effects of a process that fails to complete, and transactional boundaries to delimit the scope of a transactional flow. In our opinion, in the context of local territorial development, compensations can be used to handle unexpected changes or failures in monitoring and planning processes. For example, if these processes encounter delays or fails, compensatory actions can be predefined to mitigate the impact (reallocating funds to other ongoing processes, initiating temporary solutions to address immediate needs, etc.). In turn, transactional boundaries define the scope within which a series of activities are treated as a single unit. Within monitoring and planning of local territorial development, these boundaries can help manage complex processes involving multiple interdependent tasks and stakeholders. For example, each phase of monitoring and planningt can be treated as a transactional boundary. This ensures that all tasks within a phase are completed successfully before moving on to the next phase (for example, data collection, data processing and analysis, writing report can be separated with transactional boundaries). In turn, for the integration of long-term business processes, technical research proposes a paradigm of web services composition (including orchestration of workflows, choreography of exchanged messages, fault handling and transactional integrity with compensation mechanisms) (Bruni et al., 2005a), that also can be applied in process modeling for monitoring and planning local territorial development: to utilize orchestration for centralized management of monitoring and planning workflows and choreography for decentralized interactions among responsible actors, as well as to implement automated systems for monitoring the process itself, detecting faults, and triggering compensatory actions.

Overall, the results of the analysis of scientific research on business process modeling in the context of local territorial development are consistent with the first part of our research hypothesis that business process modeling for monitoring and planning local territorial development is possible and increases the level of this development (indirectly, by increasing the efficiency of its monitoring and planning, or 'institutional efficiency' (Marks-Bielska & Kurowska, 2017). From a practical point of view the only scientific research we found that tried to directly adapt the principles of business process modeling to territorial development within real models (using BPMN) of processes and their context was the study "Process Modeling for Regional Territorial Planning" (Simonova & Sykora, 2011) (see Figure 2 below).

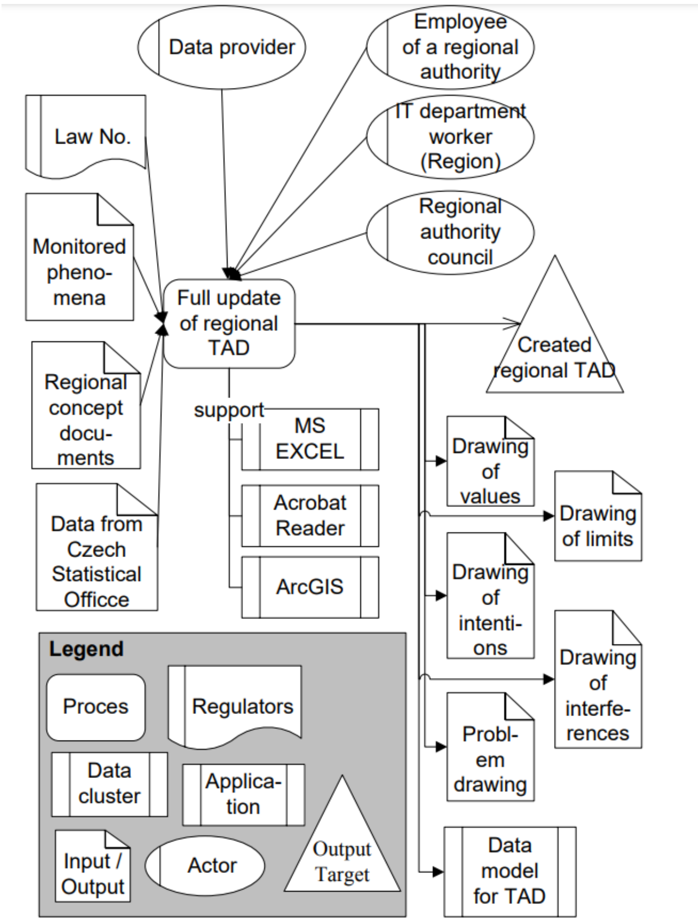

Figure 2. Model of process context (territorial analytical data, TAD)
Source: Simonova & Sykora, 2011.

3. Conceptual framework and research methodology

Within our study (as in almost all analyzed literature on business process modeling), modeling is conceptually understood as a thought abstraction, a reproduction of really existing system (including process) via specially constructed models (Polak et al., 2003). Business process models were designed to help describe, document, communicate and improve organization's business processes (Simonova & Sykora, 2011). One key factor reported for obtaining a high quality business process models is the active participation of all the stakeholders

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that ensures the development of a shared vision of business processes (Monsalve et al., 2011). The graphical tools of business process modeling are for example (Scheer, 1999; van der Aalst & Hee, 2002; Weske, 2012): hierarchical diagram (top-down decomposition of model domain from higher levels to lower ones), diagram of process context (interception of all the significant process contexts) and process map (event-driven process chain diagram; overview of activities induced by events) (Figure 3).

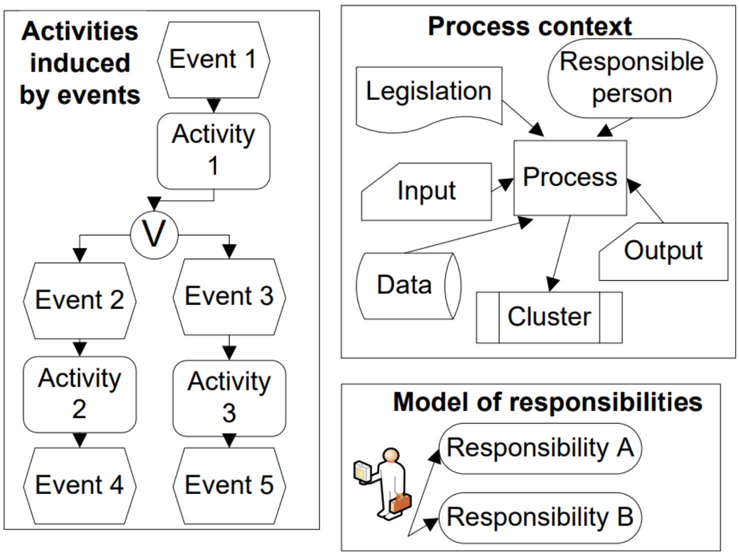

Figure 3. Graphical tools of business process modeling*****
***** We found a bug here: the arrow 'output' should be outgoing the process, not entering.
*Source***:** Simonova & Sykora, 2011.

From a metgodological point of view, we must distinguish business process modeling from the widely used concept of business process management (with the same acronym BPM as business process modeling (in this regard, we will use further the acronym BPMdl for business process modeling and BPMng for business process management)) (Weske, 2012; van der Aalst & Hee, 2002; Rosemann & Brocke, 2010; Marlon et al., 2019), as well as the concepts of process diagnosing (Verbeek et al., 1999), process mining (van der Aalst, 2016) and many others. Business process modeling (BPMdl) is necessary for an enterprise / organization that wants to evaluate, improve, migrate to a different technological platform, automate and / or document its business processes (Bata, 2009; Khlif et al., 2009). In turn, business process management (BPMng) has become a holistic management discipline with suggested six core elements of BPMng: strategic alignment, governance, methods, information technology, people and culture (Rosemann & Brocke, 2010). The book "Process Mining: Data Science in Action" (van der Aalst, 2016) bridged the gap between business process modeling and business intelligence and put process mining within the rapidly growing data science discipline. Another publication, the study "Diagnosing Workflow Processes Using WOFLAN" (Verbeek et al., 1999) refered to process diagnosing as identifying and rectifying errors in workflow process definitions (detailed descriptions of how specific business processes are structured, executed (Weske, 2012)) using the WOFLAN tool – workflow management technology promises a flexible solution for business process support facilitating the easy creation of new business processes and modification of existing processes. In modern computer science terminology, this could be called business process testing (BPT) (ALM Help Center, 2024). Applied literature also mentions such concepts as business process developing, as well as designing, executing, deploying, monitoring (Red Hat Inc., 2024). The question is, what is the conceptual position of business process modeling (BPMdl) among all these activities related to business processes, i.e. what does it mean to 'develop a model of business process' in the context of wider concept – business process management (BPMng)?

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Table 1. Conceptual position and evaluation methodology of business process modeling (BPMdl) in the context of business process management (BPMng)

Process-related activities	Core elements of business process management (BPMng)					
	Strategic alignment*	Gover-nance	Methods	Information technology	People	Culture
Process modekng (developing and designing)**	Maturity level according to Business Process Maturity Model (BPMM): 1 (initiesl),*** 2 (managed), 3 (defined), 4 (quantitatively managed), 5 (optimizing)					
Process diagnosing / testing	Maturity level (1–5)	Maturity level (1–5)	Maturity level (1–5)	Maturity level (1–5)	Maturity level (1–5)	Maturity level (1–5)
Process mining	Maturity level (1–5)	Maturity level (1–5)	Maturity level (1–5)	Maturity level (1–5)	Maturity level (1–5)	Maturity level (1–5)
Process executing and deploying	Maturity level (1–5)	Maturity level (1–5)	Maturity level (1–5)	Maturity level (1–5)	Maturity level (1–5)	Maturity level (1–5)
Process monitoring and improving	Maturity level (1–5)	Maturity level (1–5)	Maturity level (1–5)	Maturity level (1–5)	Maturity level (1–5)	Maturity level (1–5)

* Strategic alignment – ensures processes align with organizational strategy;
Governance – establishes accountability and decision-making structures;
Methods – tools and techniques supporting BPMdl activities;
Information technology – IT solutions supporting process activities;
People – skills and knowledge of individuals managing processes;
Culture – process-related collective values and beliefs.
** Process modeling (developing and designing) – creating detailed and effective process models;
Process diagnosing / testing – identifying and rectifying errors in process definitions;
Process mining – analyzing process data with advanced process mining techniques;
Process executing and deploying – implementing processes efficiently and ensuring they are properly deployed;
Process monitoring and improving – **c**ontinuously observing process performance and making ongoing enhancements based on monitoring data.
*** Maturity levels scale for process-related activities:
1 (initiesl) – processes are unstructured and unpredictable; success depends on individual effort and heroics;
2 (managed) – **p**rocesses are defined and documented but might not be standardized, practices are repeatable;
3 (defined) – processes are standardized, documented and communicated across the organization, there are established standards and guidelines;
4 (quantitatively managed) – processes are measured and controlled, there is a focus on quantitative performance management;
5 (optimizing) – continuous process improvement is enabled by quantitative feedback and innovative ideas.

Source: elaborated based on Verbeek et al., 1999; Lee et al., 2007; Rosemann & Brocke, 2010; Simonova & Sykora, 2011; Weske, 2012; van der Aalst, 2016; Bridges, 2024; Red Hat Inc., 2024.

Business process modeling (BPMdl) is the base for business process management (BPMng) (Simonova & Sykora, 2011). Furthermore, we can interpret business process developing and designing as the synonyms of business process modeling (Table 1). All other activities such as process diagnosing / testing, mining, executing, deploying, monitoring, improving can be considered as subsequent activities following process modeling (developing and designing).

Evaluating business process modeling (developing and designing) in relation to each element of business process management (strategic alignment, governance, methods, information technology, people and culture – Table 1) can be effectively realized using a maturity model framework (Lee et al., 2007). A maturity model helps evaluate the current state and guides the improvement by providing a structured approach to measure various aspects of processes and their management. One of the well-known frameworks for this purpose is the maturity model tailored for business process management, such as the Business Process Maturity Model (BPMM) (Lee et al., 2007; Bridges, 2024). Table 1 outlines a suitable scale and measurement tool for evaluating the process-related activities according to all elements of business process management.

The following Table 2 shows methodology of evaluating business process modeling (developing and designing) in relation to each element of business process management using a maturity model framework.

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Table 2. Methodology of evaluating business process modeling (BPMdl) (developing and designing) in the context of business process management (BPMng)

BPMdl maturity levels	Core elements of business process management (BPMng)					
	Strategic alignment*	Governance	Methods	Information technology	People	Culture
Business process modeling (BPMdl) maturity levels and evaluations						
1 (initiesl)**	No alignment between BPMdl and organization's strategy	No governance structure for BPMdl	Ad hoc methods used for BPMdl	Basic or no IT support for BPMdl	Limited knowledge and skills in BPMdl	No established culture for BPMdl.
2 (managed)	Some processes are aligned with organization's strategy	Informal governance structures in place	Docu-mented but incon-sistent methods	Specific tools are used incon-sistently	Specific roles are assigned but training is inconsistent	Awareness of the importance of BPMdl in certain areas
3 (defined)	BPMdl consistently aligned with strategic goals	Defined roles and responsibi-lities for overseeing BPMdl	Standar-dized methods and tools for BPMdl	Standar-dized IT tools and infrastruc-ture support BPMdl.	Standardized training programs and knowledge-sharing practices	Organization-wide cultural practices supporting BPMdl
4 (quantitative-ly managed)	Quantitative metrics to ensure alignment between processes and strategic objectives	Performance-based governance structures with clear accountabi-lity	Regular evaluation and improve-ment of BPMdl methods	Integrated IT solutions with performan-ce metrics for BPMdl	Quantitative metrics to evaluate the skills and performance of individuals involved in BPMdl	Quantitative cultural assessments to measure engagement and attitudes towards BPMdl
5 (optimizing)	Continuous review and adjustment of processes to maintain strategic alignment	Adaptive governance practices that evolve based on performance feedback	improving methods based on best practices and feedback	Continuous IT innovation to support and enhance BPMdl	Continuous skills improvement and innovation in BPMdl practices	A culture of continuous improvement and innovation in BPMdl

* Strategic alignment – ensures processes align with organizational strategy;
Governance – establishes accountability and decision-making structures;
Methods – tools and techniques supporting BPMdl activities;
Information technology – IT solutions supporting process activities;
People – skills and knowledge of individuals managing processes;
Culture – process-related collective values and beliefs.
** BPMdl maturity levels scale:
1 (initiesl) – processes are unstructured and unpredictable; success depends on individual effort and heroics;
2 (managed) – processes are defined and documented but might not be standardized, practices are repeatable;
3 (defined) – processes are standardized, documented and communicated across the organization, there are established standards and guidelines;
4 (quantitatively managed) – processes are measured and controlled, there is a focus on quantitative performance management;
5 (optimizing) – continuous process improvement is enabled by quantitative feedback and innovative ideas.

Source: elaborated based on Table 1, Lee et al., 2007; Bridges, 2024.

The sequence and methodology of conducting the evaluation of business process modeling (developing and designing) in relation to each element of business process management for some particular organization is the following (based on Lee et al., 2007; Bridges, 2024):

1) survey and interviews: distribution of the evaluation table (in this study – Table 2) to relevant stakeholders and conduct interviews to gather detailed information;
2) document review: review of the existing process documentation, governance structures, training programs and IT tools;
3) data analysis: analysis of the collected data to determine the maturity level of business process modeling (developing and designing) in relation to each element of business process management;

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4) reporting: compilation of the findings highlighting current maturity levels and providing recommendations for improvement.

The object of this study is Latvian municipalities (36 counties and 7 cities of national importance that are not part of the counties (Saeima (Latvia), 2020); such a relatively small sample can be analyzed by statistical methods (Kish, 1965), but requires increased attention to the statistical significance of the results obtained) and their amual public reports (*Latvian: pašvaldību publiskie pārskati*) submited to the Ministry of Smart Administration and Regional Development (Latvian: *Viedās administrācijas un reģionālās attīstības ministrija*) (Ministry of Smart Administration and Regional Development (Latvia), 2024) as regular outputs of a business process of monitoring and planning local territorial development. In turn, the real process of creation of the Public Report 2023 of Augshdaugava County Municipality (Municipal Council of Augshdaugava County (Latvia), 2024) will be the empirical basis for the example of a modelable business process of monitoring and planning local territorial development. A model representting monitoring and planning of local territorial development at Augshdaugava County (i.e., creation of the Public Report 2023 of Augshdaugava County Municipality) as a business process will be developed using IDEF0 and BPMN.

Statistical analysis of the survey data (May–June 2024) from 43 Latvian municipalities used to test the hypothesis that business process modeling for monitoring and planning local territorial development (empirically, business process modeling maturity levels – Table 2) increases the level of this development. Two levels of local territorial (in particular, economic) development of Latvian municipalities (municipalities with a less developed economy and municipalities with a more developed economy) are defined as in the study "Latvian Municipal Budget Expenditures on Transport Infrastructure and Production in the Context of Improving the Local Economy" (Komarova et al., 2024): the economy of a municipality can be empirically interpreted as a less developed if it has the average annual income tax per capita below the mean, and as a more developed if it has the average annual income tax per capita above the mean. These two groups of municipalities are target groups (variables) in statistical analysis, but BPMdl maturity level in relation to each element of BPMng (strategic alignment, governance, methods, information technology, people and culture – Table 2) served as potential determinants. The methods of statistical analysis include comparison of means, correlation and regression analysis, and discriminant analysis to identify statistically significant aspects of business process modeling that influence local economic development.

The study of the real process of creation of the Public Report 2023 of Augshdaugava County Municipality conducted on May–June 2024 at Augshdaugava County Municipality (Latvia) within internship project "Algorithm of Data-Driven Machine Diagnostics and Planning of Local Territorial Development: The Case of Latvian Municipalities" (supervisors: Professor Frangioni from the University of Pisa, Executive Director Dzalbe from Augshdaugava County Municipality) of the one of co-auhors. The empirical research followed an action research methodology (Baskerville & Myers, 2004), with active participation of the above fellow in business process of creating the annual public report of Augshdaugava County Municipality. The action research methodology aims at acquiring new knowledge but providing, at the same time, value to the participant organization (in this case – Augshdaugava County Municipality). This approach has been extensively used for information systems research (Baskerville & Myers, 2004; Davison et al., 2004).

4. Research results and discussion

The analyzed empirical outputs of monitoring and planning local territorial development in Latvian municipalities are their annual public reports. Annual public reports of Latvian municipalities are comprehensive documents that provide detailed information about the municipality's activities, financial status, strategic developments and community engagement over the past year. These reports are essential for ensuring transparency, accountability and informing the society about the municipality's performance and future plans (Cabinet of Ministers (Latvia), 2010). According to the Regulations No. 413 "On annual public reports" issued by the Cabinet of Ministers (Latvia) in 2010, the general structure of these reports must include:

(1) Introduction: overview of the municipality's mission, vision, and strategic goals;
(2) Financial Summary: detailed financial statements including revenue, expenditures and budget allocations;

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(3) Key Achievements: highlights of major projects, initiatives, and accomplishments over the past year;
(4) Performance Metrics: analysis of key performance indicators and metrics that measure the municipality's effectiveness and efficiency;
(5) Public Participation: information on public involvement in municipal decision-making processes;
(6) Future Plans: strategic plans and objectives for the upcoming year;
(7) Compliance and Governance: details on compliance with regulations, governance practices and internal controls;
(8) Additional Sections: any other relevant sections specific to the municipality's unique activities or challenges.

The following Figure 4 shows the generally modeled business process of the creation of annual public reports in Latvian municipalities.

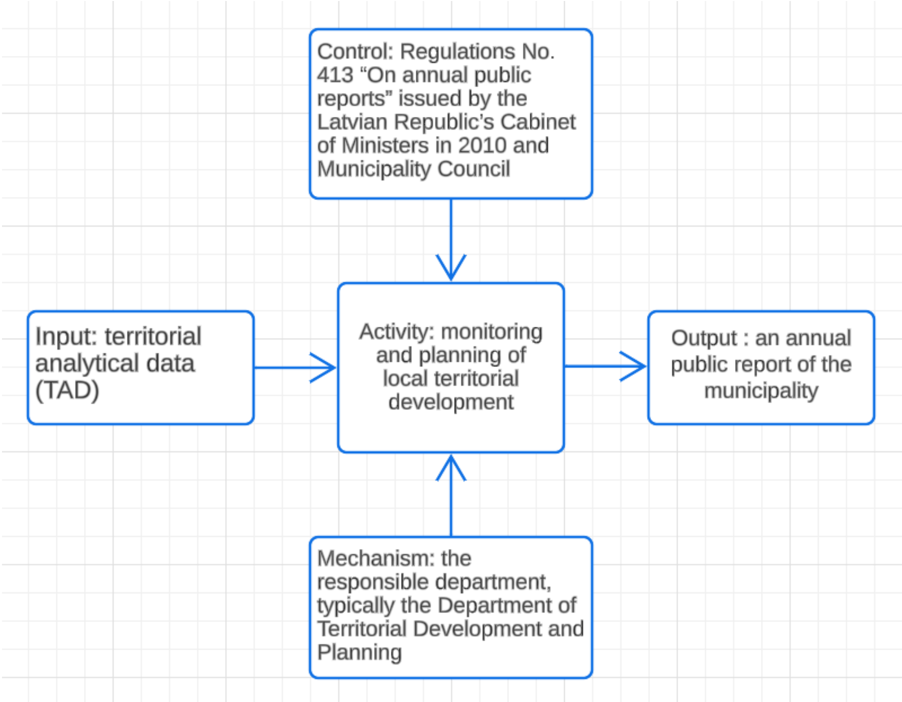

Figure 4. Common IDEF0 diagram of the creation of annual public reports in Latvian municipalities

Note:

- Activity: the main activity is "Monitoring and planning of local territorial development";
- Control: the activity is governed by Regulations No. 413 "On annual public reports" issued by the Cabinet of Ministers (Latvia) in 2010 and Municipal Council;
- Mechanism: the activity is carried out by the responsible department, typically the Department of Territorial Development and Planning;
- Input: the process uses territorial analytical data (TAD) as input;
- Output: the result of the process is an annual public report of the municipality.

Source: elaborated using IDEF0 software.

As for Augshdaugava County Municipality, its Municipal Council (15 members) is managed by the Chairman, 1st Deputy Chairman, Deputy Chairmen (2 persons). The activity of the Municipal Council is ensured by five standing committees: (1) Finance Committee (9 members); (2) Committee on Social and Health Issues (7 members); (3) Economic Committee (7 members); (4) Committee on Education, Culture and Sports (9 members); (5) Development Committee (coordinates the creation of annual public reports) (9 members). In turn, administration of Augshdaugava County Municipality consists of the Executive Director, his 1st Deputy (she signs the annual public reports – Municipal Council of Augshdaugava County (Latvia), 2023a, 2024) and Technical Director (Municipal Council of Augshdaugava County (Latvia), 2023b). There is no documented hierarchy of this structure. However, there is a documented territorial structure of Augshdaugava County, which

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consists of 10 sub-counties, including 2 towns and 25 rural comunes (Municipal Council of Augshdaugava County (Latvia), 2023b).

In reality, the process of the creation of annual public reports in Augshdaugava County Municipality is not formally modeled, described and documented neither within "By-laws of Augshdaugava County Municipality" (Municipal Council of Augshdaugava County (Latvia), 2023b), nor by the Work Regulations of Augshdaugava County Municipality (Municipal Council of Augshdaugava County (Latvia), 2023c). However, this process is organized annually, resulting in the adoption of an annual public report (29 May in 2023 (Municipal Council h Augshdaugava County (Latvia), 2023a) and 27 June in 2024 (Municipal Council of Augshdaugava County (Latvia), 2024)) and its submission to the Ministry of Smart Administration and Regional Development. This process is managed by the 1st Deputy Executive Director and coordinated by the Development Committee, but all other committees provide data on their areas of competence. Sometimes this process is delayed due to unsubmitted data, and then the extremely intense work of the Development Committee remains in the last days before the adoption and submission of the annual public report. Thus, modeling the process of the creation of annual public reports in Augshdaugava County Municipality (as in many other Latvian municipalities) is necessary for more efficient monitoring and planning of local territorial development.

When modeling the process of creation of annual public reports in Augshdaugava County Municipality, there is a large gap between the situation 'as ir' and the situation 'to be' (Weske, 2012), which can be reduced by introducing the principles of BPMdl into the actual working practice of the municipality. The following Table 3 provides a description of the successive stages of the process (with a schedule starting after March 31 – the deadline of submitting budget reports of Latvian municipalities to the State Treasure) of the creation of annual public reports in Augshdaugava County Municipality, considering the functional aspects of the business process covered by IDEF0 diagram (Figures 1 and 4): activity, inputs, mechanisms, controls, outputs (and according to IDEF0 logic, the output of the previous subprocess is the input to the next one). The process of the creation of the annual public report in Augshdaugava County Municipality begins with an analysis of the public report for the previous uear (Table 3), and each subsequent report shows some evolution. For example, the Public Report 2022 of Augshdaugava County Municipality had no table of contents and ended with an unfounded emotional verdict: "The municipality expresses the hope that a lot of children will be born in Augshdaugava County, strong families will be created, and the older people will live long and beautiful lives" (Municipal Council of Augshdaugava County (Latvia), 2023a). In turn, the Public Report 2023 of Augshdaugava County Municipality is better structured (at least has clear table of contents) and more analytical, without unreasonable hopes (Municipal Council of Augshdaugava County (Latvia), 2024).

Table 3. The process of the creation of annual public report of Augshdaugava County Municipality based on IDEF0 diagram

Activity	Input	Mechanism	Control	Output
Analyzing the public report for the previous year (the first week of April)	The text of public report for previous year	Members of the Development Committee	Municial Council, including all its Committees	Guidelines for collecting data from various external and internal sources and worjing out sub-reports
Collecting and visualizing data (the further April)	Guidelines for collecting data from various external and internal sources and worjing out sub-reports	Personnel of the structural unit managed by Development Committee	Article 13 of the Regulations No. 413 "On annual public reports" (Cabinet of Ministers (Latvia) 2010): The information to be included in the report is prepared on the basis of measurable, reliable (verified) and analyzable indicators. Indicators are included in the text of the report and are used to substantiate statements that describe the scope, result, effectiveness or impact of the work done (Cabinet of Ministers (Latvia), 2010). * Article 12: The report of the municipality provides information on the activities of the relevant municipality in the reporting year, as well as the results of the implementation of	The set of collected and visualized data

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			indicators of investment projects included in the planning documents of the municipality. The municipal report contains the following information...	
Presenting collected and visualized data (the last days of April)	The set of collected and visualized data	Members of the Development Committee	Municial Council, including all its Committees	The accepted set of data ready for further analysis
Analyzing and describing data (the first part of MAy)	The accepted set of data ready for further analysis	Personnel of the structrial units managed by all Committees of the Municipal Council	Article 12 of the Regulations No. 413 "On annual public reports" (Cabinet of Ministers (Latvia) 2010): The report of the municipality provides information on the activities of the relevant municipality in the reporting year, as well as the results of the implementation of indicators of investment projects included in the planning documents of the municipality. The municipal report contains the following information...	Created five sub-reports about competence areas of Committees
Working out the draft final version of annual public report (the second part of May)	Created five sub-reports about competence areas of Committees	Personnel of the structural unit managed by the Development Committee	Municial Council, including all its Committees	The draft final version of annual public report with comments from the Municipal Council
Working out the final version of annual public report (the first part of June)	The draft final version of annual public report with comments from the Municipal Council	Personnel of the structural unit managed by the Development Committee	1st Deputy Executive Director of Augshdaugava County Municipality	The final version of the annual public report
Presenting the annual public report (mid-June)	The final version of the annual public report	Members of the Development Committee	Municial Council, including all its Committees	The accepted annual public report ready for submission to the Ministry of Smart Administration and Regional Development

Source: elaborated based on Figures 1 and 4 and results of the action research.

The following Figure 5 shows part of the business process model of the creation of the the annual public report in Augshdaugava County Municipality (in particular, the parallel activity – collecting and visulizing data).

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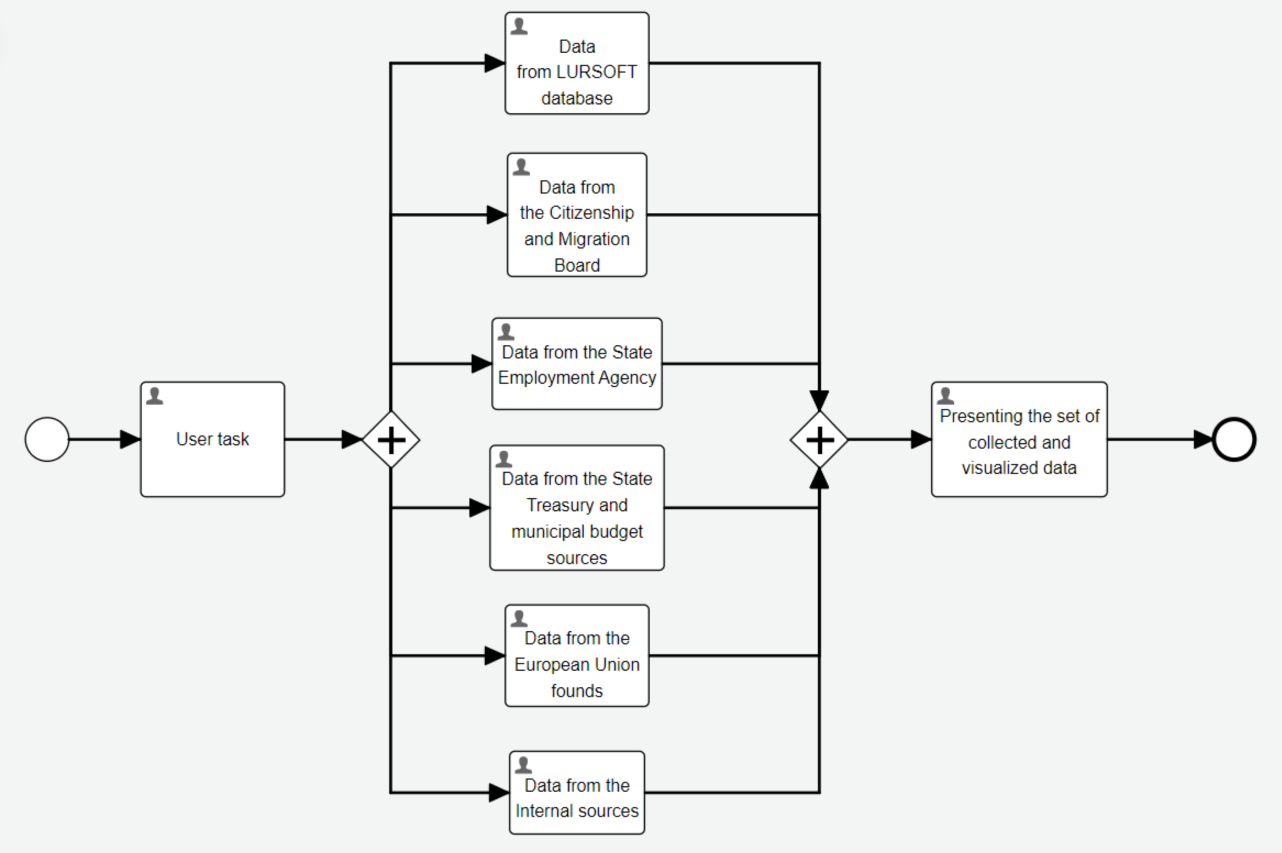

Figure 5. The subprocess of the creation of the annual public report in Augshdaugava County Municipality: BPMN diagram

Note:

Terrtorial analytical data (TAD) is collected and visualized by the Development Committee from the following sources:

- LURSOFT database (information about companies and their operations);
- Citizenship and Migration Board (demographic data such as pation anopuld age);
- State Employment Agency (employment and unemployment level statistics);
- State Treasury and municipal budget sources (financial data);
- European Union funds (income from various projects);
- Internal sources (internal data from all structural units of Augshdaugava County Municipality)

Collected and visualized data set is presented by the Development Committee to all other committees of the Municipal Council.

Source: elaborated using Flowable Work BPMN software.

As already mentioned, in fact there is a large gap between the situation ‘as is’ and the situation ‘to be’, and the process of the creation of the annual public report in Augshdaugava County Municipality is not modeled, but is implemented in accordance with more or less intuitive practice, and success is often depends on individual, sometimes almost heroic, efforts rather than on systematic processes. The situation with business process modeling in all Latvian municipalities (considering their division into two groups: with a less developed economy (including Augshdaugava County) and with a more developed economy (Komarova et al., 2024)) was investigated using statistical analysis of survey data presented in Annex 1.

Survey data collection from the entire set of Latvian municipalities (N = 43), conducted on May–June 2024, is based on the methodology of evaluating business process modeling (BPMdl) (developing and designing) in the context of business process management (BPMng) (Table 2). The maturity levels scale with a description was sent to the administrative staff responsible for the creation of annual public reports in Latvian municipalities or actively involved in this process and was further explained by us during interviews with them. They then subjectively (based on a review of the existing process documentation, governance structures, training programs and IT tools (Lee et al., 2007)) evaluated the maturity level of BPMdl in their municipalities in relation to each of the core elements of BPMng (strategic alignment, governance, methods, information technology, people and culture) on a maturity levels scale from 1 (initial) to 5 (optimizing) (Table 2).

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To obtain more stable results, statistical analysis of the survey data (Annex 1) was implemented using four methods of quantitative data analysis: comparison of means (to test the statistical significance of the difference in BPMdl maturity levels between two groups of Latvian municipalities), correlation and regression analysis (to identify the relationships between BPMdl maturity levels and the level of local economic development in Latvian municipalities), discriminant analysis (to find those 'discriminating' BPMdl factors and their 'discriminant power' that determine the level of local economic development in Latvian municipalities).

The means of BPMdl maturity levels in relation to the core elements of BPMng and the results of its comparison between groups of Latvian municipalities with different levels of local economic development are presented in the following table.

Table 4. Means of buainwaa peocess modeling (BPMdl) maturity levels in relation to the core elements of business process management (BPMng) in Latvian municipalities, scale from 1 to 5,* 2024

BPMdl maturity levels in relation to the core elements of BPMng**	The entire set of Latvian municipalities, N = 43***	Latvian municipalities with a less developed economy, n = 26****	Latvian municipalities with a more developed economy, n = 17	Statistical significance of difference, p*****
Strategic alignment	3.86	3.77	4.00	0.289 (statistically insignificant difference)
Governance	3.05	2.85	3.35	0.041 (statistically significant difference)
Methods	1.91	1.42	2.65	<0.001 (statistically significant difference)
Information technology	3.33	3.23	3.47	0.207 (statistically insignificant difference)
People	2.23	1.69	3.06	<0.001 (statistically significant difference)
Culture	2.07	1.35	3.18	<0.001 (statistically significant difference))

* BPMdl maturity levels scale:
1 (initiesl) – processes are unstructured and unpredictable; success depends on individual effort and heroics;
2 (managed) – **p**rocesses are defined and documented but might not be standardized, practices are repeatable;
3 (defined) – processes are standardized, documented and communicated across the organization, there are established standards and guidelines;
4 (quantitatively managed) – processes are measured and controlled, there is a focus on quantitative performance management;
5 (optimizing) – continuous process improvement is enabled by quantitative feedback and innovative ideas.
** Strategic alignment – ensures processes align with organizational strategy;
Governance – establishes accountability and decision-making structures;
Methods – tools and techniques supporting BPMdl activities;
Information technology – IT solutions supporting process activities;
People – skills and knowledge of individuals managing processes;
Culture – process-related collective values and beliefs.
*** The estimates were provided by the administrative staff responsible for creating the annual public reports of Latvian municipalities or actively involved in this process.
******** The municipality with a less developed economy has the average annual income tax per capita below the mean; the municipality with a more developed economy has the average annual income tax per capita above the mean (Komarova et al. 2024).
***** To identify the statistical significance of difference in BPMdl maturity levels in relation to the core elements of BPMng, independent sample means were compared with a t-criterion for means equity (2-tailed significance).
Source: calculated using IBM SPSS Statistics software and survey data from Annex 1.

The means of BPMdl maturity levels in relation to the core elements of BPMng presented in Table 4 demonstrate a moderate overall level of BPMdl maturity (from 1.91 score for methods to 3.86 score for strategic alihnment) in Latvian municipalities. However, municipalities with a more developed economy have significantly higher BPMdl scores in relation to the four elements of BPMng: governance, methods, people and culture. In turn, processes' alignment with organizational strategy (strategic alignment) and IT solutions supporting process activities (information technology), respectively, have quantitatively managed and defined maturity levels (3–4 score) in both groups of Latvian municipalities. It means that declaratively in strategies and in terms of IT infrastructure, BPMdl is equally developed in Latvian municipalities with different levels of local economic development, but BPMdl governance, methods supporting BPMdl activities, skills and knowledge of people, as well as process-related culture have statistically significant differences between municipaliies with a less developed economy and municipalities with a more developed economy.

Table 5. Correlation between business process modeling (BPMdl) maturity levels and the level of local economic development in Latvian municipalities, N = 43, Kendall coefficient,* 2024

BPMdl maturity levels in relation to the core elements of BPMng**	Level of local economic development, 1 or 2***	Statistical significance of difference, p
Strategic alignment, 1–5***	0.158	0.283 (statistically insignificant correlation)
Governance, 1–5	0.319 (correlation is significant with 95% probability)	0.028 (statistically significant correlation)
Methods, 1–5	0.670 (correlation is significant with 99% probability)	<0.001 (statistically significant correlation)
Information technology, 1–5	0.152	0.307 (statistically insignificant correlation)
People, 1–5	0.560 (correlation is significant with 99% probability)	<0.001 (statistically significant correlation)
Culture, 1–5	0.793 (correlation is significant with 99% probability)	<0.001 (statistically significant correlation)

* The Kendall coefficient for calculating the correlation was chosen due to the dichotomous variable of the level of local economic development (Sweet, Grace-Martin 2012) .
** Strategic alignment – ensures processes align with organizational strategy;
Governance – establishes accountability and decision-making structures;
Methods – tools and techniques supporting BPMdl activities;
Information technology – IT solutions supporting process activities;
People – skills and knowledge of individuals managing processes;
Culture – process-related collective values and beliefs.
******* 1 – less developed municipality (has the average annual income tax per capita below the mean); 2 – more developed municipality (has the average annual income tax per capita above the mean.
**** BPMdl maturity levels scale:
1 (initiesl) – processes are unstructured and unpredictable; success depends on individual effort and heroics;
2 (managed) – **p**rocesses are defined and documented but might not be standardized, practices are repeatable;
3 (defined) – processes are standardized, documented and communicated across the organization, there are established standards and guidelines;
4 (quantitatively managed) – processes are measured and controlled, there is a focus on quantitative performance management;
5 (optimizing) – continuous process improvement is enabled by quantitative feedback and innovative ideas.

Source: calculated using IBM SPSS Statistics software and survey data from Annex 1.

The results of the correlation analysis presented in Tanle 5 show that there are some statistically significant and strong relationships between business process modeling (BPMdl) maturity levels and the level of local economic development in Latvian municipalities. For example, the strongest correlations are observed between process-related culture and the level of local economic development ($r = 0.793$, $p < 0.001$) and between methods supporting BPMdl activities and the level of local economic development ($r = 0.670$, $p < 0.001$). However, correlation analysis does not allow us to identify the direction of these connections, i.e. whether BPMdl maturity levels are driving local economic development and not vice versa. To find out, we conducted a regression analysis in which the resulting variable was a quantified measure of local economic development, average annual income tax per capita, and the factor variables were BPMdl maturity levels in relation to the six core elements of BPMng. Using the stepwise method of inclusion of variables, the following linear regression equation was obtained:

$$y = 316.52 + 113{,}63x_2 + 112.64x_6, \qquad (1)$$

where:

y – the average annual income tax percapita, eur;
x_2 – BPMdl maturity level in relation to governance (establishes accountability and decision-making structures), 1–5;
x_6 – BPMdl maturity level in relation to culture (process-related collective values and beliefs), 1–5.
Excluded variables:
x_1 – BPMdl maturity level in relation to strategic alignment (ensures processes align with organizational strategy), 1–5;
x_3 – BPMdl maturity level in relation to methods (tools and techniques supporting BPMdl activities), 1–5;
x_4 – BPMdl maturity level in relation to information technology (IT solutions supporting process activities), 1–5;
x_5 – BPMdl maturity level in relation to people (skills and knowledge of individuals managing processes)), 1–5.
Source: calculated using IBM SPSS Statistics software and survey data from Annex 1.

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The results of the regression analysis show that BPMdl maturity levels (in particular in relation to its methods and culture) is a driving force for local economic development in Latvian municipalities. Specifically, each additional score of process-related methods increases the average annual income tax per capita by 113.63 euros, and the additional score of process-related culture – by 112.64 euros. All other correlating factors of BPMdl (governance and people – Table 5) are not the driving force of local economic development in Latvian municipalities, but rather are themselves driven by it.

To obtain even more stable results of the empirical study of business process modeling (BPMdl) in the context of business process management (BPMng), discriminant analysis was carried out in order to find among the BPMdl factors those 'discriminating' variables, which determine statistically significantly those group, into which a particular municipality will included – the group with a less developed economy or the group with a more developed economy.

The first two results of discriminant analysis presented in Tables 6 and 7 are test results and indicate the possibility of carrying out discriminant analysis as such on this particular sample, consisting of 43 municipalities. Table 6 presents the coefficients of the discriminant function.

Table 6. Test result of discriminant analysis: eigenvalues, Latvian municipalities, N = 43, 2024

Function	Eigenvalue	% of variance	Cumulative %	Canonical correlation
1	5.326	100.0	100.0	0.918

Source: calculated using IBM SPSS Statistics software and survey data from Annex 1.

The correlation coefficient between the calculated values of the discriminant function and actual group membership, equal to 0.918 (Table 6), is satisfactory (Sweet & Grace-Martin, 2012).

Table 7. Test result of discriminant analysis: Wilks' Lambda, Latvian municipalities, N = 43, 2024

Test of function(s)	Wilks' Lambda	Chi-square	df	Statistical significance, p
1	0.158	70.095	6	,<0.001

Source: calculated using IBM SPSS Statistics software and survey data from Annex 1.

The test conducted using the Wilks' Lambda criteria for whether the mean values of the discriminant function differ significantly among themselves in both groups of municipalities – with a less developed economy and with a more developed economy, shows a very significant result (p < 0.001) (Table 7).

The main result of the discriminant analysis is a classification table showing the accuracy of the predictions hit (Table 8), as well as test results indicating the statistical significance (i.e., real 'discriminant power') of all potentially 'discriminating' variables included in the analysis (Table 9).

Table 8. Classification results of discriminant analysis, Latvian municipalities, N = 43, 2024

<table>
<tr><th rowspan="2">Period of measurement</th><th rowspan="2">Units</th><th rowspan="2">Groups of municipalities</th><th colspan="2">Predicted group membership</th><th rowspan="2">Total</th></tr>
<tr><th>Municipalities with a less developed economy</th><th>Municipalities with a more developed economy</th></tr>
<tr><td rowspan="4">Origina</td><td rowspan="2">Count</td><td>Municipalities with a less developed economy</td><td>25</td><td>1</td><td>26</td></tr>
<tr><td>Municipalities with a more developed economy</td><td>1</td><td>16</td><td>17</td></tr>
<tr><td rowspan="2">%</td><td>Municipalities with a less developed economy</td><td>96.2</td><td>3.8</td><td>100.0</td></tr>
<tr><td>Municipalities with a more developed economy</td><td>5.9</td><td>94.1</td><td>100.0</td></tr>
</table>

Note: 95.3% of original grouped observations classified correctly.
Source: calculated using IBM SPSS Statistics software and survey data from Annex 1.

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The classification results obtained in the course of discriminant analysis and presented in Table 8 indicate that out of 26 cases of municipalities with a less developed economy, using discriminant analysis model, 25 municipalities were correctly predicted to fall precisely into this group, i.e. in 96.2% of cases. One case out of 26 (3.8%) was mistakenly attributed to the group of municipalities with a more developed economy. In turn, in the group of municipalities with a more developed economy, 1 case (5.9%) was erroneously assigned to the 'wrong' group, but it was correctly predicted that they would fall into the group with of municipalities with a more developed economy for 16 cases, i.e., for 94.1% of municipalities.

The main result of applying discriminant analysis is the average level of correctness of predictions of cases falling into the corresponding group of municipalities: with a less developed economy and with a more developed economy. In our analysis, 25 + 16 = 41 cases correctly predicted to fall into the corresponding group, which is 95.3% (Table 8). This is a very high indicator of correctness of predictions (Sweet & Grace-Martin, 2012), showing that in 95% of cases it is possible to know what level of local economic development in a municipality is, looking only at BPMdl maturity levels in this municipality.

The answer to the question of which of the six analyzed variables (BPMdl maturity levels in relation to the core elements of BPMng) have to be looked at in order to immediately say (with an 95% of correctness) which of the two groups a particular munivipality will fall into can be found in the following table. Data of Table 9 shows the statistical significance (i.e. real 'discriminant power') of the potentially 'discriminating' BPMdl factors participated in the discriminant analysis.

Table 9. Statistical significance of the potentially 'discriminating' BPMdl factors participated in the discriminant analysis, Latvian municipalities, N = 43, 2024

BPMdl maturity levels in relation to the core elements of BPMng*	Wilks' Lambda	F	Statistical significance, p
Strategic alignment, 1–5**	0.971	1.206	0.279
Governance, 1–5	0.898	4.652	0.037
Methods, 1–5	0.480	44.374	< 0.001
Information technology, 1–5	0.966	1.438	0.237
People, 1–5	0.614	25.820	< 0.001
Culture, 1–5	0.264	114.272	< 0.001

* Strategic alignment – ensures processes align with organizational strategy;
Governance – establishes accountability and decision-making structures;
Methods – tools and techniques supporting BPMdl activities;
Information technology – IT solutions supporting process activities;
People – skills and knowledge of individuals managing processes;
Culture – process-related collective values and beliefs.
** BPMdl maturity levels scale:
1 (initiesl) – processes are unstructured and unpredictable; success depends on individual effort and heroics;
2 (managed) – **p**rocesses are defined and documented but might not be standardized, practices are repeatable;
3 (defined) – processes are standardized, documented and communicated across the organization, there are established standards and guidelines;
4 (quantitatively managed) – processes are measured and controlled, there is a focus on quantitative performance management;
5 (optimizing) – continuous process improvement is enabled by quantitative feedback and innovative ideas.
Note: the grouping variable is the level of local economic development in Latvian municipalities.

Source: calculated using IBM SPSS Statistics software and survey data from Annex 1.

The data presented in Table 9 indicates that, as in the comparison of means and in correlation and regression analysis, BPMdl maturity levels in relation to the two core elements of BPMng (strategic alignment and information technology) are not statistically significant also for predicting the level of local wconomic development in a particular municipality. In turn, BPMdl maturity levels in relation to its [BPMdl] governance (p = 0.037), and especially methods, people and culture (p < 0.001) are those 'discriminating' variables that determine the level of local economic development in Latvian municipalities.

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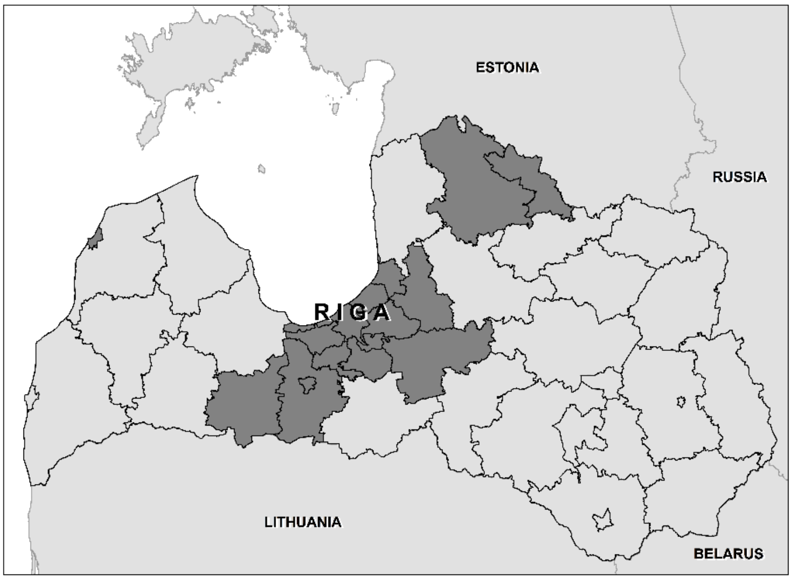

Figure 6. Geographical concentration of the group of Latvian municipalities with a more developed economy, n = 17, 2024
Source: compiled using ArcGIS software and the data from Annex 1.

Geographically, the group of Latvian municipalities with a more developed economy and a more mature BPMdl is concentrated around the capital of Latvia, as well as near the border with Estonia (Estonia is the most economically developed country among Latvia's neighboring countries – Kochetkov & Masharskiy, 2023) (Figure 6).

5. Conclusions

The study investigated the application of business process modeling (BPMdl) to the monitoring and planning of local territorial development in Latvian municipalities. The key findings and conclusions are as follows:

(1) the research confirmed that BPMdl could be effectively applied in municipalities. This approach enables systematic data collection, detailed analysis, strategic planning, effective implementation and continuous monitoring, leading to more informed decision-making and optimized development outcomes. By adopting a structured approach to BPMdl, municipalities can significantly enhance their efficiency and effectiveness in monitoring and planning of local territorial development;

(2) statistical analysis (comparison of means, correlation and regression analysis, discriminant analysis) of survey data from all 43 Latvian municipalities revealed significant differences in BPMdl maturity levels between municipalities with a less developed economy and municipalities with a more developed economy. Latvian municipalities with a less developed economy exhibited statistically lower BPMdl maturity levels in relation to such core elements of business process management (BPMng) as governance, methods, people and culture;

(3) a significant barrier identified was the lack of specialists in BPMdl. In Latvian municipalities, business processes are intuitive, unstructured and unpredictable, and success often depends on individual efforts rather than systematic processes. To improve BPMdl practices, municipalities should invest in training and developing BPMdl specialists, standardize and document processes, and utilize integrated IT solutions to support BPMdl activities. Continuous improvement should be encouraged through feedback and innovative practices;

(4) the research hypothesis that BPMdl for monitoring and planning local territorial development is possible and increases the level of this development, but is not widely used in Latvian municipalities, was confirmed by a review of scientific research on business process modeling applied to local territorial development, statistical analysis of survey data from all Latvian municipalities and the action

research in Augshdaugava County Municipality (a Latvian municipality with a less developed economy);

(5) for the first time in Latvia, the study tried to model the business process of the creation of annual public reports in Latvian municipalities using BPMdl tools such as IDEF0 and BPMN. This modeling proved that monitoring and planning of local territorial development is a modelable business process. For the further research is recommended to explore the long-term impacts of BPMdl implementation on local territorial development and to refine the models and methodologies used in this study.

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Annex 1. Survey data on the maturity level of business process modeling (NPMdl) **(developing and designing)** in relation to each element of business process management (BPMng), Latvian municipalities, N = 43,* 2024

Latvian municipalities	Core elements of Business Process Management (BPMng)						Average annual income tax per capita, eur	Level of economic development
	Strategic Align-ment**	Governan-ce	Methods	Infor-mation Tech-nology	People	Cul-ture		
Adazhi County	4	2	3	4	3	3	1248,18	2
Aizkraukle County	4	3	2	3	2	1	707,41	1
Aluksne County	3	3	1	3	1	2	594,00	1
Augshdaugava County	4	2	1	4	2	2	457,23	1
Balvi County	4	3	1	3	1	1	526,55	1
Bauska County	4	3	2	3	1	1	704,75	1
Cesis County	3	2	2	4	1	1	758,44	1
Daugavpils City	5	4	1	4	2	2	575,53	1
Dienvidkur-zeme County	3	3	1	3	2	1	633,14	1
Dobele County	3	2	2	4	4	3	794,48	2
Gulbene County	4	3	1	3	2	3	651,75	1
Kekava County	3	3	3	3	1	4	1161,31	2
Kraslava County	4	2	2	4	3	1	426,00	1
Kuldiga County	4	3	2	4	3	1	632,19	1
Liepaya City	5	3	1	4	2	1	724,85	1
Limbazhi County	4	5	1	3	1	2	677,47	1
Livani County	4	2	1	3	1	1	547,19	1
Ludza County	3	3	1	4	2	2	478,84	1
Madona County	4	3	2	3	1	1	629,77	1
Marupe County	4	4	2	4	1	3	1384,93	2
Ogre County	5	3	3	3	3	3	940,14	2
Olaine County	4	3	3	3	4	3	923,84	2
Preili County	4	2	1	4	4	1	516,07	1
Rezekne City	5	4	2	4	2	2	636,60	1
Rezekne County	3	3	2	3	1	1	451,93	1
Ropazhi County	4	4	3	3	3	4	1167,05	2
Riga City	5	5	4	4	3	4	1159,68	2
Salaspils County	4	4	3	4	4	3	962,38	2
Saldus County	3	2	2	2	1	1	693,59	1
Saulkrasti County	3	3	2	3	3	3	986,02	2
Sigulda County	4	3	3	3	3	3	973,87	2
Smiltene County	3	2	1	2	2	1	676,77	1

Talsi County	4	3	2	4	1	2	636,25	1
Tukums County	4	3	1	3	2	1	719,24	1
Valka County	4	3	1	4	4	3	818,88	2
Valmiera County	4	3	3	4	2	2	822,96	2
Varaklani County	3	3	1	2	1	1	489,52	1
Ventspils City	3	4	3	4	3	4	907,74	2
Ventspils County	3	3	2	2	2	1	674,94	1
Yekabpils County	4	2	1	3	1	1	615,12	1
Yelgava City	5	4	2	3	4	3	870,13	2
Yelgava County	4	3	2	3	3	3	797,35	2
Yurmala City	5	4	3	3	4	3	1198,65	2

* The estimates were provided by the administrative staff responsible for cre3ating the annual public reports of Latvian municipalities or actively involved in this process.
** Strategic Alignment – ensures processes align with organizational strategy;
Governance – establishes accountability and decision-making structures;
Methods – tools and techniques supporting BPMdl activities;
Information Technology – IT solutions supporting process activities;
People – skills and knowledge of individuals managing processes;
Culture – process-related collective values and beliefs.
*** Maturity levels scale:
1 (initiesl) – processes are unstructured and unpredictable; success depends on individual effort and heroics;
2 (managed) – **p**rocesses are defined and documented but might not be standardized, practices are repeatable;
3 (defined) – processes are standardized, documented and communicated across the organization, there are established standards and guidelines;
4 (quantitatively managed) – processes are measured and controlled, there is a focus on quantitative performance management;
5 (optimizing) – continuous process improvement is enabled by quantitative feedback and innovative ideas.
******** 1 – less developed municipality (has the average annual income tax per capita below the mean); 2 – more developed municipality (has the average annual income tax per capita above the mean.

Source: own collected data (May–June 2024), calculated based on the methodology from Komarova et al. 2024 and data from State Treasury (Latvia) 2024; the research methodology for evaluating the maturity level of business process modeling (BPMdl) is presented in Table 2.

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