
BPMN Diagrams as an Essential Tool for Enhancing Business Process Management and Team Collaboration

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Abstract:

Purpose: The goal of the research is to critically analyze how BPMN diagrams can optimize operations and contribute to the improvement of team dynamics, focusing on theoretical concepts and practical outcomes within a specific industry context and as strategic tools for enhancing business process management and team collaboration, particularly in the context of an IT company based in Ukraine.

Design/Methodology/Approach: The research methodology is based on an expert method, that gives authors the opportunity to examine the expert opinions, including top management and project managers in an IT company, which indicates strong support for BPMN diagrams.

Findings: The findings suggest that using of BPMN diagrams significantly enhance project clarity and operational alignment. The structured use of BPMN has been shown to foster a shared understanding among different project teams, which is crucial for the synchronized execution of complex IT projects.

Practical Implications: The research results demonstrate the significant potential of BPMN diagrams for improving business process management and team collaboration in the IT sector, particularly within Ukrainian companies. The application of BPMN diagrams can enhance process transparency, increase the efficiency of interdepartmental communication, and optimize resource utilization. The findings can be utilized by organizations to develop digital transformation strategies, automate business processes, manage risks, and boost competitiveness. This enables companies to make informed decisions, adapt to dynamic market changes, and create innovative solutions that align with the demands of Industry 5.0 and sustainable development.

Originality/Value: The study demonstrates that BPMN diagrams significantly enhance project clarity, operational alignment, and interdepartmental collaboration in a Ukrainian IT company. By providing a standardized method for visualizing workflows, BPMN reduces communication barriers and improves team coordination. BPMN diagrams have been

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proven to be crucial for the effective management of complex IT projects, positioning them as both practical tools and key innovations in optimizing business processes.

Keywords: *Business processes, BPMN diagrams, project management, team efficiency, business analysis, team management tool.*

JEL Codes: *M15, O33, C88, L86, D23.*

Paper Type: *Research article.*

1. Introduction

In today's rapidly evolving economic world, organizations are compelled to continuously improve their business operations to maintain competitiveness and adapt to new market realities. This need encompasses both emerging enterprises and well-established industry players, pushing them to innovate and reassess their business processes constantly. Such transformations are largely driven by escalating pressure from external environmental factors, including the integration of advanced technologies, changes in consumer expectations, and market dynamics. However, internal initiatives led by proactive organizational leadership also play a key role in driving these changes.

Despite advancements in tools and methodologies designed to improve the design, analysis, evaluation, and maintenance of business process descriptions, many organizations still struggle with the effective implementation of comprehensive business process models. The main issue lies in the lack of an all-encompassing framework that covers all organizational activities and the intricacies of its processes. This is especially relevant for IT companies in Ukraine, where there is a high emphasis on intellectualization and digitization of business processes as well as their flexibility and precision in conditions of high risks and uncertainty of business environment,

The research explores how BPMN diagrams facilitate a thorough analysis of organizational operations, ensuring optimal interaction between different business processes. Through the lens of a Ukrainian IT company, the study examines how BPMN diagrams drive innovation by improving process management and adapting to the industry's evolving demands. The article discusses the strategic integration of BPMN diagrams in reimagining process management structures, aligning them with the principles of a knowledge-driven economy characterized by digital transformation and the imperatives of Industry 4.0 and 5.0.

The relevance of BPMN diagrams extends beyond operational efficiency to their potential impact on sustainable development. By optimizing resource utilization, reducing operational redundancies, and fostering transparent decision-making,

BPMN diagrams enable organizations to align with environmental, social, and governance (ESG) principles. In the current global economy, characterized by heightened ecological and social challenges, the integration of tools like BPMN is critical. Their application supports businesses in adopting practices that reduce environmental impacts, promote social equity, and ensure long-term economic resilience. This focus underscores the importance of BPMN as a strategic asset for businesses aiming to contribute to global sustainability goals while maintaining competitive advantage.

This research analysis is based on expert interviews and a comprehensive literature review, focusing on the intersection of innovation, technology adoption, and organizational development. It aims to address key questions regarding the effectiveness of BPMN diagrams in fostering an innovative organizational culture and enhancing operational efficiency. By providing a detailed account of implementation within a specific organizational context - an IT company in Ukraine - this study contributes to a nuanced understanding of how BPMN diagrams catalyze sustainable organizational innovation and growth.

2. Literature Review

Processes of intellectualization, digitalization, and globalization of socio-economic processes at the end of the 20th – and beginning of the 21st century became an important source of increasing the productive potential and competitiveness of economic entities and accelerating the pace of economic growth in general. At the same time, during this period, the business environment became more and more dynamic, competitive and unpredictable, which objectively actualized the attention of researchers to the issues of effective management of business processes in general and team management in particular.

Accordingly, the enhancement of business process management efficiency within teams through the application of modern information technologies (Martin, 1995), technological innovations in the business environment (Moore, 1991), oriented business modelling (Laguna and Marklund, 2018), optimization methods (Pardalos, Žilinskas, and Žilinskas, 2017) has been a topic of interest of many modern researchers in the context of increasing operational efficiency, innovativeness, productivity and competitiveness of the enterprise.

For this reason, improving the efficiency of business process management through modern information technologies is increasingly recognized as critical to organizational success. In particular, it is substantiated in the work of the famous scientist Davenport (2007) in "Competing on Analytics: The New Science of Winning," in which he proved the importance of information technologies in enhancing organizational effectiveness and provided a foundational understanding of their impact on business processes.

In the difficult economic conditions of the functioning of Ukrainian business structures, the issue of optimizing the management of business processes using modern information and communication technologies and appropriate software is also the subject of research by many Ukrainian scientists.

In particular, the use of appropriate software for optimizing business processes is investigated by Chernikova (2021), for assessing the production potential of business structures by Dyachenko (2022), for the functional structure of an innovation-oriented business model by Bagley (2018), for improving the quality of business planning by Mykhailenko, Godun, and Yukhimenko, (2021), for the management of human resources by Bazaliyska (2022), as well as for the implementation of a comprehensive strategy of digital transformation of business structures (Zhossan and Kirichenko, 2022; Zub and Kalach, 2021).

At the same time, in their studies, Ukrainian researchers focus on business modeling of the strategic development of an enterprise to increase its competitive potential (Khoma and Lopatovska, 2022), implementation of agile approach in anti-crisis management (Reshetnik, Shulpina, and Reshetnik, 2020).

An important aspect in the modelling of business processes is comprehensibility and accessibility for various users-interested persons, as well as the possibility of transparent design and regulation of business processes with the possibility of their further automation according to the existing needs. In the work "Reengineering the Corporation", Hammer and Champy (1993) created a methodology that utilizes IT to radically redesign business processes to significantly improve productivity and efficiency.

Their concept of "business process reengineering" highlights the transformational potential of BPMN diagrams in optimizing business processes. At the same time, Moore's technology adoption lifecycle theory (1991) helps to understand how BPMN diagrams are applied across industries and their impact on organizational processes in practice.

Stephen Alter's work in "The Work System Method: Connecting People, Processes, and IT for Business Results" (2006) provides a foundation for understanding how BPMN diagrams integrate with other organizational systems to enhance overall effectiveness. Alter's work emphasizes the systemic nature of innovations through BPMN, impacting processes, roles, and IT usage.

In this connection, the contribution of Harmon P. in "Business process change: a manager's guide to improving, redesigning, and automating processes" (2007), is significant for the recognition of practical methods for enhancing and automating business processes using BPMN diagrams and provide general understanding how they operate in real-world business process settings.

Authors such as Ross Dawson in "Enterprise 2.0: How Technology, E-Commerce, and Web 2.0 Are Transforming Business" (2009) explore how BPMN can facilitate organizations' transition to digital environments, and the joint research by Beverly Sparks and van der Aalst in "BPMN and Modeling: A White Paper" (2013) explores the integration of BPMN diagrams with modeling technologies. Their findings point to opportunities for future research in testing and optimizing processes modeled with BPMN before full-scale implementation, which could significantly enhance predictive analytics and decision-making capabilities.

Empirical evidence supporting the effectiveness of BPMN diagrams was illustrated by Wil van der Aalst's in his work "Process Mining: Data Science in Action" (2016), where he analyzed process intelligence and business process management. His research emphasizes the analysis of event logs to improve business process design, highlighting the complementary nature of BPMN diagrams and process mining methods in refining business operations.

Johann Pakowski's work "Successful Business Process Management: What You Need to Know to Get Results" (2014) provides practical examples and applications of BPMN in various corporate settings. His work offers a hands-on approach to implementing BPMN diagrams, highlighting their role in achieving operational excellence.

Susan Page proposed the important role of BPMN diagrams as methods for simplifying complex processes in "The Power of Business Process Improvement" (2015). Her approach helps organizations reduce waste and enhance efficiency directly linking the theoretical applications of BPMN and tangible business outcomes.

The best practical solutions in modelling business processes using BPMN diagrams, in particular their newer version - BPMN 2.0. was presented in the work of Allweyer (2016). As Allweyer highlighted, an important step in the notation of BPMN 2.0 is the fixation of responsibility between the participants of the process, as well as the possibility of modeling the process taking into account its hierarchy and the interconnection of all processes in the company.

In the conditions of modern challenges, including economic crises, pandemics, wars, and technological developments, it is very important for business structures to be adaptable to changes, to flexible business management and process modelling. In this connection, BPMN diagrams are an important tool for enhancing communication among team members as well as the formation of a collaboration network by which enterprises actually work (Kourbarakis and Paradakis, 2022).

At the same time, as Metin and Tokdemir (2017) proved, it is also very important that business system changes must be understandable to business analysts and IT professionals to implement these processes as a software system. This also applies to

BPMN diagrams, particularly their certain defects, which can be detected and eliminated to improve business processes.

It should be noted, that current research-aimed at using BPMN diagrams to increase the effectiveness of business process management in practice, in particular Prado-Prado, García-Arca, Fernández-González, and Mosteiro-Añón (2020) developed a participatory methodology that facilitates lean management implementation in healthcare by involving staff in the project (personnel pillar), detecting and analysing “waste” in value chain processes (processes pillar) and establishing control and measurement mechanisms in line with objectives.

Also, scientists propose to improve business processes and corporate communications on the basis of the BPMN diagrams advancement. In particular, Polančič and Orban (2023) conducted an experimental study in which they tested two modeling notations – standardized BPMN conversation diagrams and a BPMN extension with corporate communications-specific concepts. The results of the study confirmed the effectiveness of standard BPMN diagrams, as well as the positive aspects of extended diagrams.

Integrating theoretical foundations from the works of scientists with empirical research results provides a solid basis for understanding the significance of BPMN diagrams in contemporary business practice. At the same time, it is also very important to investigate the practical experience of using the BPMN diagrams in the real business environment, in particular in the most dynamic technological IT sector, as well as in conditions of an unstable external environment and external shocks, using the example of a Ukrainian IT company.

This will provide an opportunity to investigate the effectiveness of using these diagrams in optimizing process management, particularly in managing the company's human resources, which is the main intellectual capital, a resource of dynamic changes and progressive development.

The implementation of BPMN diagrams not only enhances operational efficiency and team collaboration but also contributes to the broader goals of sustainable development. By optimizing resource allocation, reducing redundancies, and improving decision-making processes, BPMN supports organizations in adopting practices that minimize environmental impact and promote social responsibility.

This alignment with sustainable development principles is particularly relevant in today's economy, where businesses are encouraged to balance profitability with ecological and social considerations. Such capabilities of BPMN diagrams are not always taken into account, although the so-called "green patterns" already exist (Schoorman, Behrens, and Knackstedt, 2017), but it is obvious that their use depends on the specifics of the business environment and the company's field of activity.

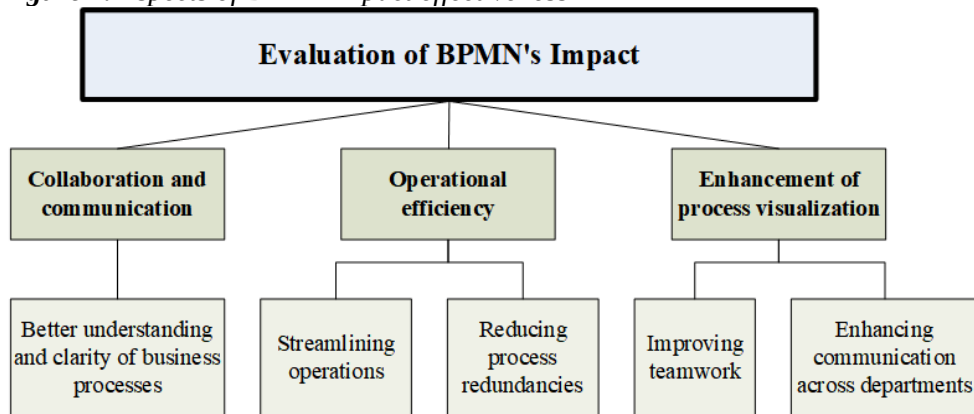
Overall, the ability of BPMN to facilitate digital transformation and support Industry 5.0 principles ensures that companies remain adaptable and resilient, contributing to sustainable economic growth in a knowledge-driven economy.

3. Research Methodology

The purpose of this research is to evaluate the effectiveness of BPMN diagrams in improving business process management and team collaboration within a specific technological industry, using an IT company based in Ukraine as an example. At the same time, paying the main attention to operational efficiency and teamwork, the authors want to draw attention to the much wider potential of BPMN diagrams and their social usefulness, in particular in the context of the requirements of sustainable development, which at the present stage is the global paradigm of societal development.

The research methodology is based on the method of expert assessments and involved 15 IT industry experts, each with extensive experience in implementing BPMN diagrams in organizations of various sizes (with more than 20 employees). These experts were selected to provide a broad perspective on the diverse applications and impacts of BPMN diagrams. The evaluation focused on three main aspects of BPMN impact, as illustrated in Figure 1.

Figure 1. *Aspects of BPMN impact effectiveness*



Source: *Authors' own elaboration.*

Figure 1 highlights the essential dimensions of BPMN diagrams' influence on business processes, including improved collaboration, enhanced operational performance, and clear process visualization. These components contribute to sustainability by promoting resource-efficient workflows, minimizing unnecessary activities, and fostering inclusive teamwork. By facilitating better communication and process alignment, BPMN supports both organizational goals and sustainable development initiatives.

To conduct the research, fifteen experts from the IT industry in Ukraine, who have significant experience in the application and implementation of BPMN diagrams in people and capital management processes (teams of more than 20 people), helped to create a checklist of questions to determine the effectiveness of BPMN diagrams and the main aspects of their impact on the IT industry (Table 1).

Table 1. Extended checklist of questions for evaluating the effectiveness of BPMN diagrams

№	Section	Scope of Activity	Questions
1	Implementation and Adoption of BPMN Diagrams	Implementation Methodology	– What was the methodology for implementing BPMN diagrams in your company? – How was it aligned with existing business processes?
		Needs Analysis	– How was the business needs analysis conducted to identify areas where BPMN diagrams could be most effective?
		Process Changes	– Which processes experienced the most significant changes during the transition to BPMN? – How did these changes impact the overall company strategy?
		Stakeholder Engagement	– How were different stakeholders (management, managers, team members) involved in the BPMN diagram implementation process? – Were there any conflicts of interest, and how were they resolved?
		Integration with Other Systems	– How are BPMN diagrams integrated with other tools (ERP, CRM, DevOps) to ensure continuity of business processes?
2	Assessment of Management Effectiveness through BPMN Diagrams	KPIs and Metrics	– What key performance indicators (KPIs) are used to assess the impact of BPMN diagrams on team management? – How have these indicators changed after the implementation of BPMN?
		Impact on Scalability	– How do BPMN diagrams affect the company's ability to scale its operations and projects? – How do they assist in managing large teams (over 20 people)?
		Change Management	– How do BPMN diagrams assist in the change management process? – Do they enable more effective coordination of changes across different departments?
		Systematic Processes	– How do BPMN diagrams contribute to creating a systematic approach to project management and ensuring process transparency?
		Time and Resource Optimization	– To what extent does the use of BPMN diagrams reduce the time required to develop and implementing new projects? – How does this impact the effectiveness of resource utilization?
3	Risk Identification		– How do BPMN diagrams assist in the early

№	Section	Scope of Activity	Questions
			detection of potential risks and vulnerabilities in processes? – What risk analysis methods are used based on BPMN?
		Financial Flow Management	– How do BPMN diagrams assist in the early detection of potential risks and vulnerabilities in processes? – What risk analysis methods are used based on BPMN?
		Forecasting and Analytics	– How do BPMN diagrams support forecasting financial costs and project ROI? – What analytics tools are integrated with BPMN for these purposes?
		Automation of Routine Processes	– How are BPMN diagrams used to automate routine business processes? – Which of these processes have provided the greatest economic impact?
		Impact on Long-Term Planning	– How has the use of BPMN diagrams impacted the company's long-term financial and strategic planning?
4	Impact on the IT Industry and Competitive Advantage	Competitive Advantages	– How have BPMN diagrams helped your company gain or maintain a competitive advantage? – Have you observed any changes in market positioning?
		Innovation and Development	– What innovative practices or innovations have been introduced due to using BPMN diagrams? – How has this affected the company's adaptability to market changes?
		Industry Trends	– Do you track trends in the use of BPMN diagrams within your industry? – Which of these trends have had the greatest impact on your business?
		Collaboration with Partners	– How does the use of BPMN diagrams affect interactions with partners and suppliers? – Have they improved the coordination of joint projects?
		Process Standardization	– How have BPMN diagrams contributed to the standardization of processes within your company? – Has there been an observed improvement in the quality of services or products as a result?
5	Training, Preparation, and Staff Adaptation	Training Strategy	– What strategies and methodologies were implemented to train staff to work with BPMN diagrams? – How is the effectiveness of these training programs evaluated?
		Transformation of Work Skills	– How have BPMN diagrams influenced the changes in the required competencies and skills of employees? – Have there been any changes in roles and responsibilities within the team?
		Optimization of Training	– What BPMN tools are used to optimize internal training and employee development?
		Employee Perception	– How do employees react to the implementation of BPMN diagrams? – Have you observed any changes in motivation and job satisfaction among employees?

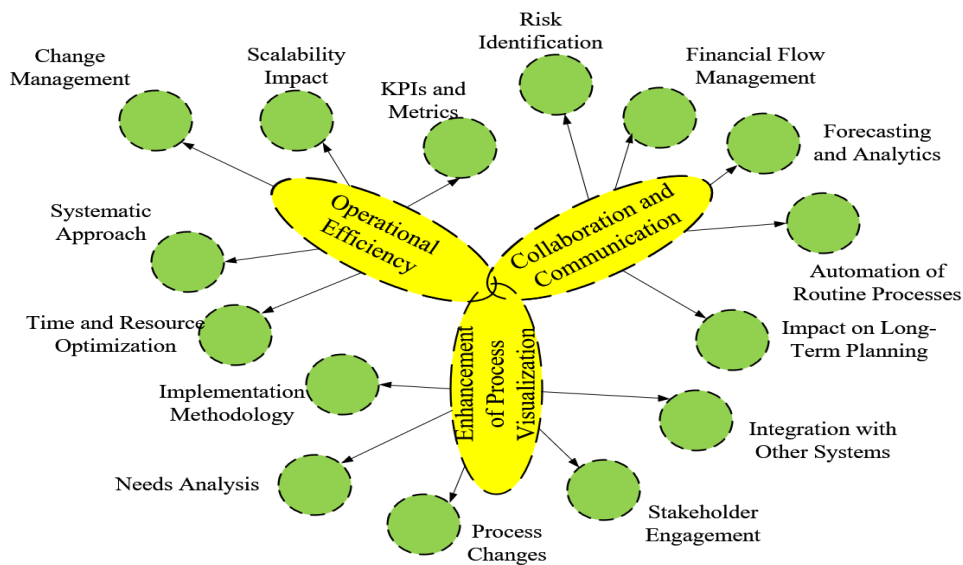
№	Section	Scope of Activity	Questions
		Performance Evaluation	– How are BPMN diagrams used to assess employee performance? – Have these performance indicators improved after the implementation of BPMN?

Source: Authors' own elaboration.

Data were gathered using structured interviews, conducted online to accommodate the participants' geographical dispersion. Each interview session lasted around 60 minutes, providing sufficient time for comprehensive discussions on each of the three categories. The interviews were recorded and subsequently transcribed to ensure precise data analysis.

The responses were analyzed using descriptive statistics to compute each category's mean and standard deviation, providing a quantitative overview of the data (Figure 2).

Figure 2. Distribution of checklist questions by category



Source: Authors' own elaboration.

Figure 2 organizes the checklist questions into categories such as risk management, scalability, and efficiency improvements. This structure reflects BPMN's capacity to address key organizational challenges while supporting sustainable practices. By focusing on these categories, BPMN diagrams help businesses manage risks, optimize resources, and adapt effectively to changing conditions, aligning with the principles of responsible and sustainable growth.

This quantitative analysis was further enhanced by a qualitative content analysis of the interview transcripts, which aimed to identify recurring themes and expert perspectives on the practical advantages and limitations of BPMN diagrams.

To systematically assess these aspects, a five-point Likert scale was used (1 – very low effectiveness, 5 – very high effectiveness). Experts were asked to rate the importance of BPMN diagrams in each of the three categories based on their personal experience and observed results in their organizations.

Based on the response results, the average ratings for each category were determined:

$$\bar{X} = \frac{\sum X}{N} \quad (1)$$

where $\bar{X}$ is — the average rating, X_i — is each value of the score, and N — is the number of assessments (experts).

The standard deviation of the scores for each category was calculated using the formula:

$$\delta = \sqrt{\frac{\sum (X_i - \bar{X})^2}{N - 1}} \quad (2)$$

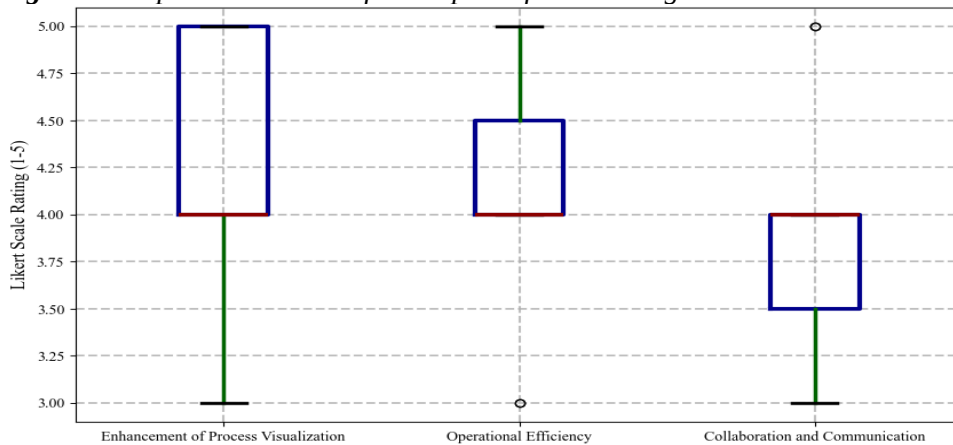
де δ — standard deviation, $\bar{X}$ — average value of ratings, X_i — each value of the score, N — number of assessments (experts).

Table 2. *Assessment of the impact of BPMN by expert opinion*

Category	Description of the impact	Average score (1-5)	Standard deviation
Improved process visualization	A detailed assessment of how BPMN diagrams help to visualize complex processes clearly and efficiently.	4.5	0.74
Operational efficiency	Evaluate the extent to which BPMN diagrams optimize workflows and help save money and time.	4.13	0.64
Cooperation and communication	Analyze BPMN diagrams to facilitate better interdepartmental communication and collaborative efforts.	3.87	0.64

Source: *Authors' own elaboration.*

A graphical representation of the expert assessment of the impact of BPMN diagrams on the Likert scale is shown in Figure 3.

Figure 3. Expert assessment of the impact of BPMN diagrams on the Likert scale

Source: Authors' own elaboration.

Figure 3 presents the distribution of expert ratings on the impact of BPMN diagrams across three categories: process visualization improvement, operational efficiency, and collaboration and communication. Each category is assessed using a Likert scale (from 1 to 5), which allows for visualizing variability and central tendencies in the experts' responses. The structured approach to data collection and analysis provides a comprehensive understanding of BPMN diagrams' effectiveness in various organizational contexts.

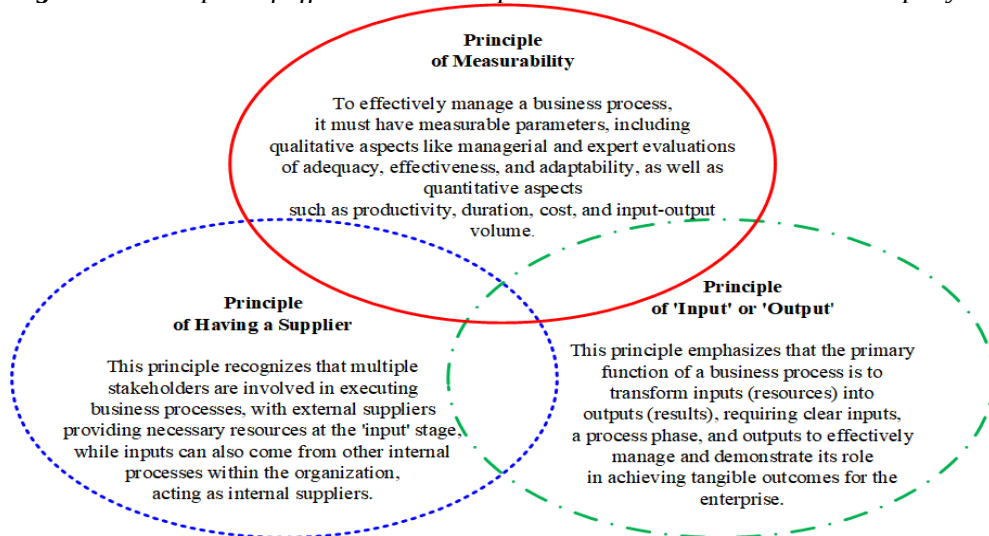
This methodology not only offers empirical insights into BPMN's practical application but also contributes to theoretical discussions on business process management in contemporary settings. The consistently high scores illustrate BPMN's potential to enhance organizational processes while contributing to sustainable development. By improving clarity, reducing resource waste, and supporting cohesive teamwork, BPMN helps organizations achieve both immediate operational objectives and long-term sustainability targets.

4. Research Results

Experts identified several key principles for effectively creating a business process network within a company: the "input" or "output" principle, the supplier presence principle, and the measurability principle (Figure 4).

Figure 4 depicts the foundational principles for developing robust business process networks, such as clear input-output mechanisms, measurable outcomes, and effective integration with suppliers. These principles enable businesses to streamline operations, optimize resource use, and ensure transparent decision-making. By adhering to these principles, organizations can align operational efficiency with sustainability goals, fostering economic, environmental, and social balance.

Figure 4. Principles of effective business process network creation in a company

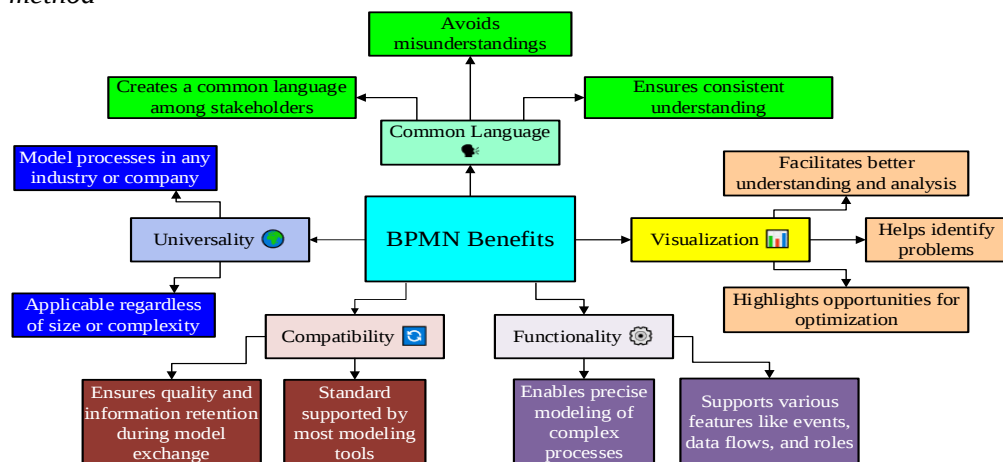


Source: Authors' own elaboration.

With these principles in mind, the next step is to explore the tools available for modelling and describing business processes. A wide range of tools are available, each with its own strengths and weaknesses. This article will focus on the BPMN modeling language.

BPMN is a business process modelling language that has become a synthesis of modelling best practices and a new standard in the development of business processes and network services. BPMN was released in 2004. BPMN stands out as one of the best methods for modelling and describing business processes for several reasons, which are presented in Figure 5.

Figure 5. Features of modelling and describing business processes using the BPMN method



Source: Authors' own elaboration.

Figure 5 presents the main characteristics of BPMN as a tool for modeling business processes, emphasizing its versatility, compatibility, and functionality. By providing a standardized visual representation of work processes, BPMN ensures a consistent understanding among stakeholders, allowing organizations to avoid misunderstandings and optimize work. These functions support sustainable development by promoting resource efficiency, reducing process redundancy, and facilitating transparent decision-making across industries.

Thus, using BPMN can increase the efficiency of business processes and facilitate better collaboration and communication between all participants, while also supporting key aspects of sustainable development. By streamlining workflows and reducing redundancies, BPMN not only saves time and costs but also minimizes resource waste, contributing to environmental sustainability.

The implementation of BPMN diagrams in business processes contributes to achieving sustainable development goals by optimizing resource utilization, reducing operational costs, and promoting energy efficiency. This ensures more effective resource management and minimizes negative environmental impacts, particularly in the highly demanding technological environment of the IT industry. By adopting BPMN diagrams, organizations can significantly reduce their ecological footprint.

Implementing optimized workflows can decrease energy consumption by automating routine processes and minimizing manual interventions. Studies show that such automation can lead to a reduction in carbon emissions by up to 20%, particularly in IT-intensive operations. BPMN's ability to streamline communication reduces the need for excessive documentation, which in turn contributes to a decrease in paper waste. Additionally, BPMN supports the social dimensions of sustainable development by fostering inclusivity and engaging employees at all levels in process optimization.

This dual focus enables companies to maintain competitiveness while addressing contemporary environmental and social challenges, particularly aligning with ESG (Environmental, Social, and Governance) objectives. BPMN's impact can be seen in its application within a Ukrainian IT company, where the adoption of BPMN diagrams resulted in a 15% reduction in project implementation time and a 10% decrease in resource allocation costs. Such improvements not only optimize operational efficiency but also contribute to long-term sustainability by ensuring balanced resource utilization and reduced operational waste.

The clarity provided by BPMN fosters greater social equity within organizations by enabling employees from diverse roles, including HR and customer success, to participate in process optimization without requiring technical expertise. For instance, BPMN enables the optimization of software development lifecycles by

minimizing unnecessary resource allocation and promoting agile practices that inherently support sustainability through waste reduction and enhanced efficiency.

Also, it addresses the social dimensions of sustainability by fostering transparency and collaboration, enhances inclusivity in decision-making processes, and empowers teams to contribute to sustainability goals. Organizations can leverage BPMN to design workflows that prioritize ethical considerations, such as fair labor practices in supply chains or inclusive hiring policies, ensuring alignment with broader ESG (Environmental, Social, and Governance) principles.

Looking ahead, integrating BPMN with artificial intelligence (AI) and machine learning tools introduces new opportunities for advancing sustainable development. Predictive analytics powered by these technologies enables organizations to utilize BPMN diagrams for forecasting resource requirements, optimizing energy consumption, and identifying potential risks.

AI-driven BPMN solutions dynamically uncover inefficiencies in workflows and provide real-time recommendations for improvement, significantly enhancing operational efficiency and decision-making. Such innovations not only strengthen organizational adaptability but also deepen the commitment to ESG principles, ensuring resilience and sustainability in dynamic market environments.

This empowerment aligns with sustainable development principles by promoting fair access to innovation and ensuring that all stakeholders have a role in driving organizational efficiency and sustainability.

Compared to other process modeling tools, such as UML or EPC, BPMN demonstrates superior adaptability to sustainability goals. Unlike UML, which primarily focuses on system design, BPMN offers a comprehensive view of business workflows, incorporating both operational and strategic elements. Similarly, while EPC diagrams excel in documenting complex processes, they often lack the flexibility to adapt to dynamic business environments. BPMN's balance of simplicity and functionality makes it a more effective tool for addressing the environmental and social challenges faced by modern organizations.

Regardless of how valuable a tool can be, it's even more important to know exactly when to use it. Below are some scenarios in which BPMN can be used effectively (Table 3).

Table 3. *Scenarios for effective use of BPMN (authors' own elaboration)*

№	Script	Description of the script
1.	Formal business process modeling	This is useful for simplifying the description and understanding of the process for others, whether they are other specialists in the same organization or any external analyst. The person responsible for the business process knows all the steps and

№	Script	Description of the script
		people involved. However, communicating this information to others can be difficult. BPMN helps to structure this information and present it in a diagram, making it easier to understand and follow.
2.	Process execution	A key feature of the BPMN standard is its ability to execute processes. The BPMN structure allows you to take a model and execute it without the need for coding, greatly simplifying the implementation of business processes.
3.	Sharing, identifying, and improving business processes	Once you have documented how a process works, it is possible to share and discuss this information with other team members. An important functionality of many tools is easily sharing the diagram. While business models can indeed be abstract, this abstraction is ultimately necessary to discuss and improve business processes.
4.	BPMN diagram as a tool (Fig. 6)	A BPMN diagram is a graphical representation that allows business users to model and automate their business processes using various artifacts. While some artifacts are extremely easy to use, others can be more sophisticated and complex. The latter may require extensive training and understanding of its nuances and capabilities to use them more effectively.

Source: Authors' own elaboration.

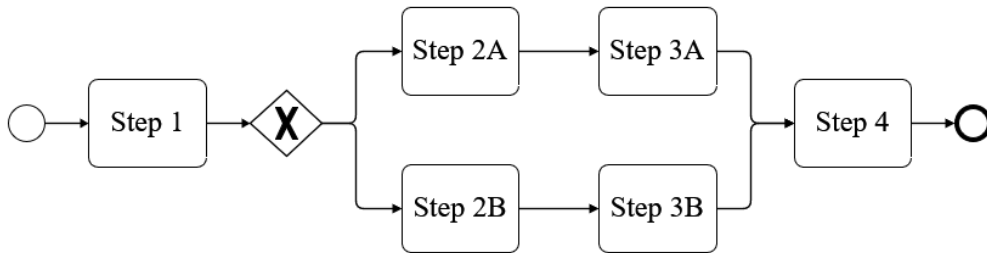
The results of this study highlight that the use of BPMN diagrams contributes significantly to the implementation of sustainable business practices. By improving transparency and streamlining workflows, BPMN facilitates more efficient use of resources, reduces operational waste, and supports better energy management. These benefits are particularly critical for aligning business processes with the goals of environmental sustainability.

Additionally, enhanced collaboration and communication, as fostered by BPMN, create a foundation for socially responsible management, promoting inclusivity and employee engagement. Such outcomes not only boost organizational efficiency but also align with the principles of sustainable development, ensuring that businesses can adapt to modern challenges while supporting long-term ecological and societal balance.

The practical significance of BPMN diagrams becomes evident when visualizing complex workflows, as they allow for a detailed representation of each process step and its interactions.

Such visualization not only enhances clarity and efficiency but also bridges theoretical insights with their real-world applications. Figure 6 illustrates a general business process model, demonstrating the structured approach BPMN offers for optimizing and automating workflows in diverse organizational settings.

Figure 6. General Diagram of a Business Process Model



Source: Authors' own elaboration.

Figure 6 illustrates a general BPMN business process model, starting with an initiating event and progressing through decision points, parallel tasks, and final convergence. The diagram begins with *Step 1 - Initiation*, which serves as the starting point of the process where a specific event triggers the entire workflow. This step typically involves receiving an input necessary to begin the process, such as a request form or a system-generated alert. Following this, there is a *Decision Point (Gateway)*, depicted by a diamond shape, which determines the direction of the workflow based on certain conditions or criteria. This gateway splits the process into two parallel paths, which could be based on a yes/no or other binary decision.

The model then proceeds to Step 2A and Step 2B, representing parallel processing activities. Step 2A might involve a specific task or set of tasks that occur concurrently with Step 2B, potentially addressing one aspect of the process, such as processing a part of a request or performing a specific operation. Simultaneously, Step 2B could entail different actions or focus on another element of the request, such as validating information or preparing necessary resources.

Subsequently, the process continues with Step 3A and Step 3B, representing a continuation of parallel processing. Step 3A follows Step 2A and may represent the progression of tasks initiated in Step 2A, advancing the process toward completion. Similarly, Step 3B follows Step 2B and generally continues the tasks or operations started in Step 2B.

Upon completing the parallel steps, the outcomes converge into a single path leading to Step 4 - Convergence and Finalization. This step marks the final stage of the process, where all parallel processes are integrated, and any remaining actions required to finalize the overall process are carried out. These actions may include consolidating results, making final decisions, or preparing outputs. Finally, the process reaches its End, typically resulting in an output or decision that signifies the completion of the business process.

The BPMN language is structured around flowcharts and graphic symbols, which are divided into four main categories within diagrams (Figure 7). The first category, Flow Objects, includes elements such as events, tasks, and gateways that define the

process flow. Processes typically start with an initial event, move through a series of tasks or actions and decision points, and end with a final event.

More complex workflows may involve sub-processes, intermediate events, and different types of gateways to direct the process flow. For example, an exclusive gateway restricts the path to a single option, whereas an inclusive gateway provides multiple paths based on certain conditions.

The second category, Connecting Objects, links flow objects using symbols like message flows, sequence flows, and associations, represented by dashed, solid, or dotted lines to show the connections between different elements in the process.

The third category, Swimlanes, uses pools and lanes to separate different activities, indicating distinct participants or roles within the process. Pools represent major stakeholders, such as an organization, department, or customer, while lanes within a pool illustrate the workflow for specific roles or participants, defining their responsibilities throughout the process.

Lastly, Artifacts provide additional context to the workflow, including data objects, groups, and annotations. Data objects represent the data required for specific actions, groups categorize related actions logically, and annotations explain for specific parts of the diagram.

Artifacts help detail the inputs, outputs, data objects, and data stores essential for executing a business process, thereby enhancing the comprehensiveness and clarity of the BPMN diagram. BPMN diagrams can range from simple to complex and are capable of displaying the nuances associated with one or both internal and external processes. They are usually divided into three categories (Figure 8).

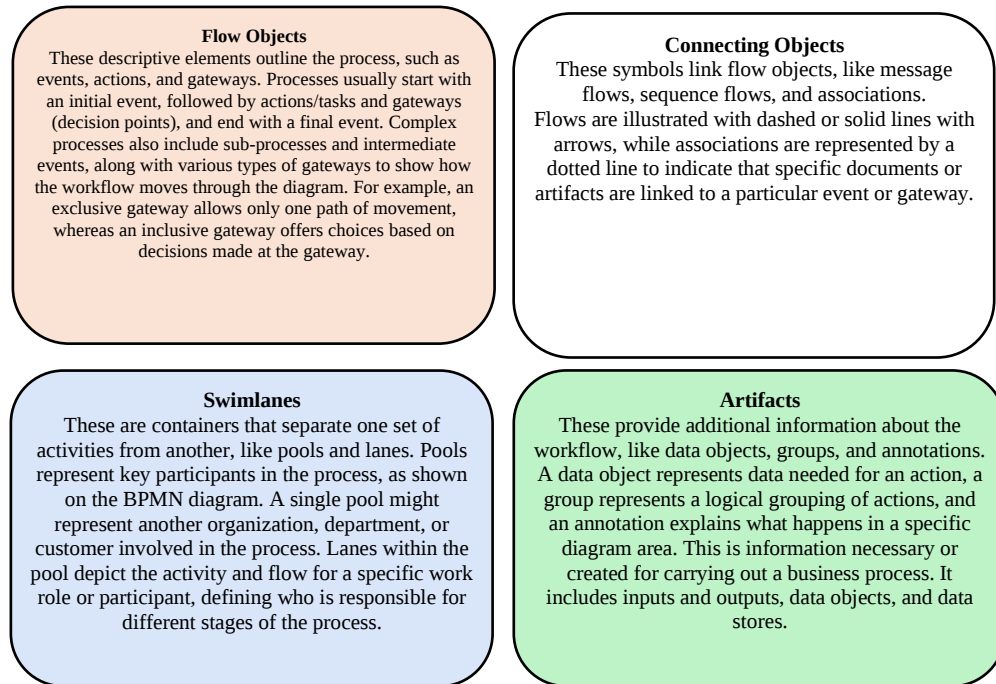
Figure 8 outlines various types of BPMN diagrams, including collaboration, conversation, and choreography diagrams. These diagrams demonstrate BPMN's flexibility in representing both internal and external business processes. By enabling precise modelling of complex workflows and interorganizational interactions, BPMN supports sustainable practices through improved resource coordination and reduced process redundancies.

Besides this formal means of classifying BPMN diagrams, other forms of classification are more user-friendly for business users. In this form, BPMN diagrams are categorized into two types (Table 4).

Figure 9 depicts a simple BPMN diagram that highlights the basic sequence of actions, from initiation to completion. This straightforward visualization aids in understanding processes, even for non-technical stakeholders, promoting inclusivity and effective communication. By simplifying process management, BPMN

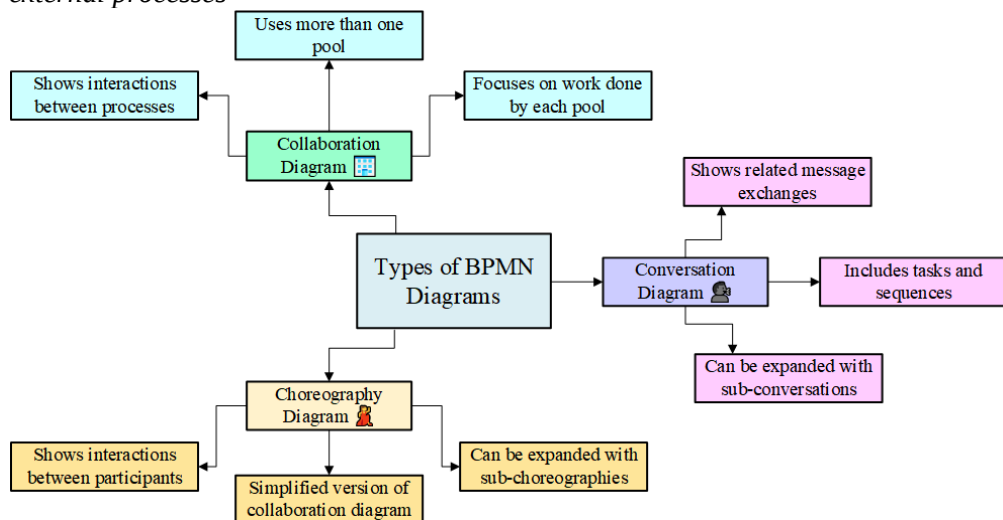
facilitates sustainable resource use and decision-making, supporting both organizational efficiency and environmental goals.

Figure 7. Object categories for BPMN diagrams



Source: Authors' own elaboration.

Figure 8. Types of diagrams that are associated with one or both internal and external processes



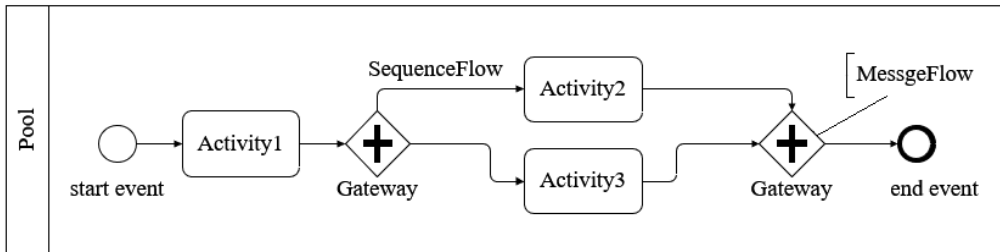
Source: Authors' own elaboration.

Table 4. *Category of diagrams*

№	Diagram view	Description	Graphical representation
1	Simple Diagrams	These diagrams are generally easy to understand as they use a basic set of artifacts. These artifacts include user tasks, gateways, and timers used for setting due dates or scheduled events, etc. With simple diagrams, even if the created process model is a large diagram, it still tends to be easy to understand.	Figure 9
2	Complex Diagrams	On the other hand, complex diagrams utilize the full set of artifacts provided by the BPMN standard. The advantage of using these comprehensive BPMN standard artifacts is that they allow users to describe virtually every business situation. They can represent almost any business process of a company or organization, but this is often at the expense of easy understandability. In such cases, to comprehend the defined business process, the user needs to have extensive knowledge about how all the artifacts work and interact with each other.	Figure 10

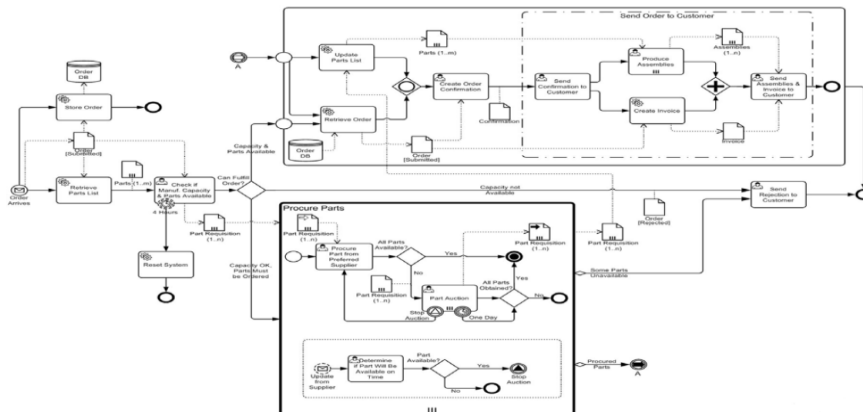
Source: Authors' own elaboration.

Figure 9. *Sample of Simple BPMN Diagram*



Source: Authors' own elaboration.

Figure 10. *Sample of Complex BPMN Diagram (authors' own elaboration)*



Source: Authors' own elaboration.

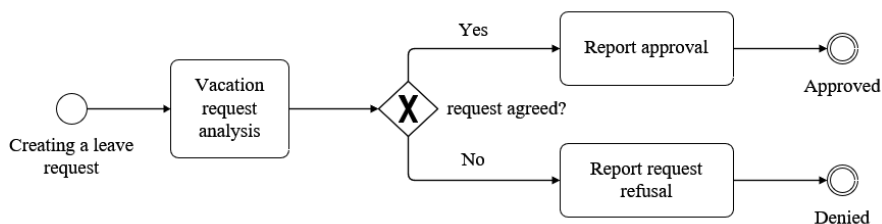
BPMN has become integral to nearly every industry and specialization due to its versatility and efficiency. Key sectors that have prioritized BPMN for their process management include human resources, healthcare, education, and finance. Let's examine some business processes in human resources management that can benefit from BPMN (Table 5).

Table 5. Examples of business processes in human resources management (authors' own elaboration)

№	Business process	Process description
1	Optimizing Leave and Absence Processes in Companies	The leave request process is a staple in HR departments worldwide. Its ubiquity makes it more critical and straightforward to manage. In fact, a lack of automation in this area can lead to excessive time and resource expenditure on unnecessary steps. By automating this process with BPMN, organizations can better manage absences. It provides employees with an easy tool for submitting, tracking, and understanding the status of their leave requests while allowing the process to be tailored to the company's specific needs. An example of effectively optimizing a company's leave approval process using BPMN is illustrated in Figure 11.
2	Request for Travel Expense Reimbursement	The process for requesting travel advances or per diems is another common procedure in organizations. Automating this process could significantly reduce paperwork across various departments, freeing up time for more urgent and complex tasks, and essentially putting this process on autopilot. (Figure 12).

Source: Authors' own elaboration.

Figure 11. General Overview of BPMN Diagram for Leave Request Process

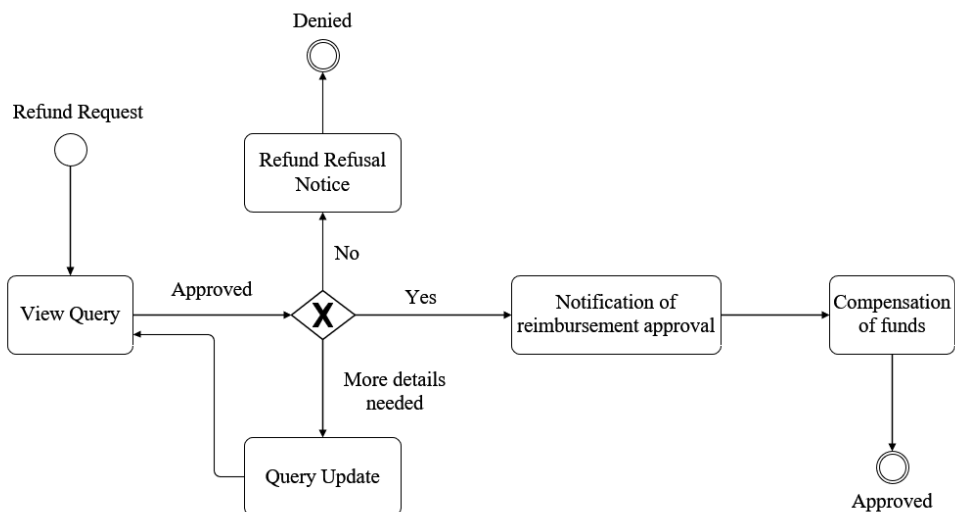


Source: Authors' own elaboration.

4.1 BPMN Diagram Using Case Examples

To analyze the processes, we decided to focus on a Ukrainian IT company that specializes in the development of mobile and web applications. All business processes in the company are documented in writing, a common practice in the industry. The main business processes involve client interactions at various stages of their projects, with involvement from departments like sales, analytics, development, testing, and occasionally marketing.

Figure 12. General Overview of BPMN Diagram for Expense Reimbursement Request (authors' own elaboration)



Source: Authors' own elaboration.

However, among all company processes, a specific one stands out - the "client request processing" process. This involves several key roles: The Sales Manager handles the pre-sale process and client needs; the Business Analyst is responsible for analyzing the client's idea and finding optimal solutions; the Project Manager manages project reception and team-client communication; and the Legal and Financial Department deals with contract signing and payment processing.

At this stage, we consider the process for approving and handling client requests, noting that each role has its specific actions. The process begins with a Sales Manager responding to a client inquiry, leading to an online meeting. Depending on the information gathered, the Sales Manager may involve a Business Analyst, who has detailed actions further outlined in BPMN diagrams.

After analysis and need identification, the client is referred back to the Sales Manager, who then coordinates with the Legal and Financial Department for contract signing. Once the contract is signed and payment is made, the client is handed over to the Project Manager.

Having analyzed and described the "client request processing" business process, we can now create a BPMN diagram using the online application BPMN.IO. This application allows real-time diagram creation with a wide range of available shapes. The first step in creating the diagram involves setting up pools and lanes for the subsequent diagram elements. As a result of all these actions, we have a detailed business process for "Client Request Processing" visualized through a BPMN diagram (Figure13).

Figure 13 block 6 shows a branching that occurs after the project's completion. This leads to the Business Analyst working on project improvements and proposing new solutions, potentially resulting in the project's continuation. Alternatively, the project may conclude, with the Legal Department issuing a completion certificate (Figure 13 block 7).

Following project completion, the final stage involves a semi-automatic step where the Sales Manager sends a thank-you letter to the client. After a certain period, a follow-up letter is sent, offering new services and inquiring about the project's outcome (Figure 13 block 8).

The BPMN diagram in Figure 13 provides a comprehensive overview of the "Client Request Processing" business process within an IT company specializing in mobile and web app development. The process involves multiple departments, including Sales, Analytics, Development, Testing, and occasionally Marketing, all documented in writing.

The diagram begins with the Sales Manager responding to a client inquiry, which leads to an initial online meeting. The Sales Manager gathers information and, if necessary, involves a Business Analyst to analyze the client's needs and propose optimal solutions. After the analysis, the client returns to the Sales Manager, who coordinates with the Legal and Financial Department to finalize the contract and process payments. Upon completion of these steps, the client is handed over to a Project Manager for the development phase.

The BPMN diagram is structured into two main pools, 'Client' and 'Client Delegation Process,' with the latter divided into four lanes: Sales Manager, Business Analyst, Project Manager, and Finance and Law Department. Each lane represents specific roles and actions within the business process, from initial client engagement to the conclusion of the project and follow-up activities.

The diagram illustrates the decision points, parallel processes, and subsequent actions based on client responses and project outcomes. It highlights the workflow's flexibility and adaptability, accommodating various scenarios, such as project continuation or conclusion, and ensures a systematic approach to client management and project delivery. The final stages include sending thank-you and follow-up letters to maintain client relationships and explore future collaboration opportunities. This complete view illustrates the entire process flow, capturing every critical step from initial client contact to project completion and subsequent follow-up actions.

The use of BPMN diagrams in managing business processes in an IT company demonstrates significant potential for improving the efficiency of economic processes. In particular, BPMN diagrams provide a standardized and visual representation of business processes, which promotes better understanding and collaboration between different departments.

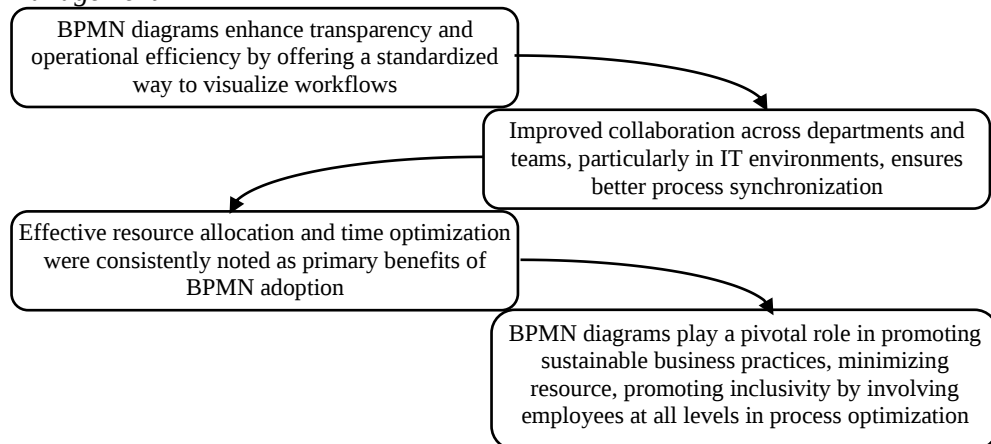
This avoids misunderstandings, increases the transparency of operations, and facilitates informed decision-making. As a result, companies can optimize their processes, reduce errors, and cut operational costs.

The effectiveness of BPMN diagrams in economic processes is especially noticeable in terms of the ability to adapt to rapid market changes and technological innovations. In the context of digital transformation and the development of industries 4.0 and 5.0, BPMN is becoming an important tool for increasing the flexibility and resilience of organizations. It allows IT companies to respond quickly to changes in demand, quickly implement new technologies and improve process management ultimately increasing their market competitiveness

5. Discussion

The research findings highlight the significant advantages of BPMN diagrams in improving business process management and team collaboration, particularly in the fast-paced and ever-evolving IT sector. Ukrainian IT companies, which operate in challenging and dynamic environments, stand to gain considerably from the structured application of BPMN diagrams. These tools offer critical enhancements in three main areas: workflow clarity, operational efficiency, and interdepartmental collaboration, while also contributing meaningfully to sustainability goals (Figure 14).

Figure 14. *Contribution of BPMN diagrams to improving business process management*



Source: *Authors' own elaboration.*

Workflow clarity: BPMN diagrams are highly effective in providing clear and standardized visual representations of complex workflows. By breaking down intricate processes into intuitive elements, BPMN ensures that everyone involved – whether technical or non-technical – has a shared understanding of roles, tasks, and

responsibilities. This clarity is particularly vital in IT environments, where multiple teams work on interdependent tasks and quick adaptations to project requirements.

An important functional specificity of BPMN diagrams is their ability to cater to varying levels of expertise within an organization. Business analysts, project managers, and technical teams can all use BPMN diagrams to communicate effectively, bridging knowledge gaps and aligning operational goals. In Ukrainian IT companies, where cross-functional collaboration is a key of success, the clarity offered by BPMN has proven indispensable in managing projects with tight deadlines and complex deliverables.

Operational efficiency: The introduction of BPMN diagrams has delivered measurable improvements in operational efficiency and reductions in project delays. By visualizing workflows and pinpointing inefficiencies, BPMN allows companies to streamline their processes and focus on what truly drives results. Also, with clearly defined workflows, teams can prioritize high-impact tasks, ensuring that human and financial resources are utilized optimally.

This capability is especially valuable in IT projects, where resource constraints and shifting priorities are common challenges. Furthermore, BPMN's adaptability allows organizations to revise workflows on the fly, maintaining agility and competitiveness in an ever-changing market.

Collaboration and communication: The benefits extend beyond internal operations. BPMN diagrams enhance external collaboration by making project workflows and timelines more transparent to clients and partners. This transparency not only builds trust but also streamlines decision-making, reducing costly delays and rework. Ukrainian IT companies have noted that BPMN's ability to foster open communication has led to stronger client relationships and more cohesive project execution.

BPMN diagrams have played a pivotal role in bridging communication gaps between diverse stakeholders. By providing a standardized framework for process descriptions, BPMN ensures that technical and non-technical team members can communicate effectively. In addition to improving internal communication, BPMN diagrams facilitate external collaboration with clients and partners.

For instance, clients can better understand project workflows and timelines through BPMN diagrams, enabling them to provide more informed feedback and make timely decisions. This alignment not only enhances client satisfaction but also reduces the likelihood of costly misunderstandings or rework.

Within Ukrainian IT companies, such improvements in communication have fostered a more collaborative organizational culture, where diverse teams work together toward common goals with greater efficiency.

Contributions to sustainability: Beyond operational improvements, BPMN diagrams play a pivotal role in promoting sustainable business practices. By streamlining workflows, BPMN minimizes resource wastage and optimizes energy usage, especially in IT systems where inefficiencies can lead to significant environmental impacts.

On the social side, BPMN promotes inclusivity by involving employees at all levels in process optimization. This ensures that diverse perspectives are considered, fostering a sense of ownership and accountability among team members. These practices align with Environmental, Social, and Governance (ESG) goals, such as equitable resource distribution and ethical labor practices.

BPMN diagrams are helping organizations not only meet immediate operational needs but also integrate sustainability into their long-term strategies. This dual focus ensures that businesses remain competitive in today's market while contributing to broader environmental and social goals.

6. Limitations of the Study

Several limitations should be acknowledged to provide a balanced view of the research.

The first is a narrow participant pool. By relying on input primarily from top management and project managers, the research captures a strategic perspective but may overlook the practical experiences of other stakeholders, such as team members or clients. Their perspectives could add valuable insights into the day-to-day usability and impact of BPMN diagrams.

The second limitation is potential implementation challenges. The research primarily focuses on the benefits of BPMN diagrams and does not address potential obstacles in their implementation. Issues like resistance to change, the need for training, or integration with existing systems could significantly influence their effectiveness but were not explored in details.

The third one is rapidly changing industry. The IT sector is dynamic, with technologies and methodologies evolving at a fast pace. This study does not focus on how BPMN diagrams might need to adapt to future trends or challenges, such as the integration of AI or other emerging technologies.

Another limitation of this research lies in the exploration of sustainable development aspects. While the study demonstrates the efficiency of BPMN diagrams in optimizing processes and resource utilization, it does not fully quantify their environmental or social impact.

Future studies could expand on this by measuring specific sustainability metrics, such as energy savings, reduction in carbon emissions, or improvements in workforce well-being, to provide a more holistic understanding of BPMN's contribution to sustainable development goals.

All these aspects should be taken into account when conducting further research into the possibilities of improving the BPMN diagrams in business process management at enterprises in various sectors of the economy.

7. Conclusions

Modeling business processes is crucial in many managements and information system projects, but it's is a challenge for many companies and organizations. Analyzing the major problems and challenges of business modeling from different perspectives, including those of researchers and practitioners, helps us better understand the principles of how research and business process practice interact.

Using information technology elements in modeling, typical for complex digital economy systems, can increase the maturity of business process modeling in organizations. This, in turn, may lead to a growing need for research into new approaches and the development of tools and methods that better meet market needs as it becomes more digital.

BPMN is a standard for modeling business processes using graphical notation to describe actions and their interconnections. BPMN is an effective tool for modeling business processes because it provides a standardized way to visualize processes and identify potential problems and improvements.

Research has shown that implementing BPMN diagrams in companies can help improve the efficiency of business processes and reduce costs. The main benefits of using BPMN diagrams include easier communication between different departments, the ability to monitor and analyze business processes, improved task execution quality, reduced errors, and increased employee productivity.

The findings of this research underline the broader relevance of BPMN diagrams beyond their operational benefits. By fostering efficient resource use, minimizing redundancies, and supporting effective communication, BPMN diagrams align with key principles of sustainable development. Their integration into business processes enables organizations to not only achieve economic efficiency but also address environmental and social responsibilities, paving the way for a more sustainable and resilient operational framework.

Furthermore, the ability of BPMN diagrams to foster transparency and inclusivity ensures that all stakeholders, from employees to management, can engage in collaborative decision-making aligned with sustainability goals. This alignment is

particularly significant for addressing Environmental, Social, and Governance (ESG) objectives, including ethical labor practices, reduced environmental impact, and long-term organizational resilience. These insights highlight the need for further exploration of BPMN applications in driving organizational contributions to global sustainability objectives.

Future academic research should also address the balance between the complexity and usability of BPMN diagrams. While these diagrams offer detailed mapping of business processes, their complexity can hinder broader adoption, particularly among stakeholders lacking technical expertise. Investigating methods to simplify BPMN tools without losing their informational richness could be a valuable area of study.

Additionally, there is a need for empirical research that quantitatively assesses the impact of BPMN on organizational performance, especially within the IT sector. Given the rapidly evolving technological landscape and organizational changes in the IT industry, particularly in a developing economy like Ukraine, further research is required to determine how BPMN diagrams can be effectively adapted to respond to swift changes in technology and business practices.

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