



**Business Process Management:  
Current Applications  
and the Challenges of Adoption**

**Edited by**

**Renata Gabryelczyk  
Tomislav Hernaus**

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# Table of Contents

<b>From the Editors</b>	7
Renata Gabryelczyk, Tomislav Hernaus	
<b>A data control framework for SAF-T reporting: A process-based approach</b>	13
Jerzy Auksztol, Magdalena Chomuszko	
<b>Mastering digital transformation through business process management: Investigating alignments, goals, orchestration, and roles</b>	41
Ana-Marija Stjepić, Lucija Ivančić, Dalia Suša Vugec	
<b>Implementing a decision support system in the transport process management of a small Slovak transport company</b>	75
Miroslava Nyulásziová, Dana Pařová	
<b>Knowledge-oriented business process management as a catalyst to the existence of network organizations</b>	107
Olga Sobolewska	
<b>Dissimilarities between applied methods of project management impacting regression in business processes and technical architecture</b>	133
Hubert Bogumił	
<b>The relationship between Business Process Management and Knowledge Management - selected aspects from a study of companies in Poland</b>	169
Agnieszka Bitkowska	



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## From the Editors

Business Process Management (BPM) has been evolving for over 25 years in information systems research, management science, and organizational practice (Vom Brocke & Mendling, 2018). The earliest characteristics of BPM concentrated around process analysis, improvement and control, in a less strict manner that required reengineering (Elzinga, Horak, Lee, & Bruner, 1995). More mature approaches, observed since the year 2000, have been promoting the so-called *process thinking*, i.e. managing an organization from a process-based point of view. These approaches emphasize that process and team work oriented organizational structures should be aligned with other management systems. Process management should be holistic by its nature so as to cover an entire organization.

Although BPM researchers stressed the need for system thinking at that time, published literature distinguished two perspectives of looking at BPM: the *organizational perspective* and the *technological perspective* of BPM. From the *organizational perspective*, authors focused on a number of key factors, i.e., process governance, a process-based organizational structure concept, customer orientation of internal and external processes, managing an organization based on process outputs, building process relations, and improving process maturity throughout the customer value chain, as well as through strategically aligning process initiatives to organizational objectives. From the *technological perspective*, the key factors of interest to authors, referred to as *BPMS* (Business Process Management System), include IT methods, techniques and tools that support the designing, implementation, modeling and simulation of business processes and are considered to be an extension of classical workflow systems or an environment for designing management support IT systems, e.g. ERP class systems.

An integrated and interdisciplinary approach was proposed in the framework of six core BPM elements required for the holistic and sustainable use of process management (Rosemann & Vom Brocke, 2010). These include strategic alignment, governance, methods, information technology, people and culture. In this sense, technology is only one of six closely interrelated elements.



Currently, there are two distinct directions in the evolution of BPM: traditional BPM and digital BPM. The former encompasses methods, techniques and systems that traditionally lead to increased organizational efficiency and to improved process effectiveness and flexibility. Although studies on BPM have been continuously evolving, some research gaps still remain open. The traditional understanding of process management seems particularly vital to organizations in developing economies, which sometimes follow practices and models that were designed and tested in highly developed countries, but should also be committed to drawing on their own experience and understanding of their local business environment (Gabryelczyk & Roztocki, 2018). Research on BPM in this traditional focus is still needed to better document, implement and improve idiosyncratic business processes in the context of an organization, environment, culture, and country. This is also confirmed by research conducted under the JEMI Special Issue on Business Process Management.

Besides the traditionally shaped approach to BPM, organizations increasingly treat BPM as a driver of organizational innovation and as an essential part of the digital transformation (Vom Brocke & Schmiedel, 2015). New digital technologies such as social media, digital platforms, big data and advanced data analytics, blockchains, robotics, etc., enable development and growth in a constantly changing environment. To take advantage of these opportunities in the digital world, organizations require new BPM competences and capabilities. However, digital disruption creates quite a challenge for the BPM research community. How can BPM capabilities be developed in order to achieve adaptability, growth, flexibility, and agility? How can BPM foster innovations within and throughout organizations? These are just some of the issues for future BPM-related research. Threads associated with employing BPM for digital transformation have been included in a proposed Special Issue on BPM.

This Special Issue on BPM consists of six articles including contributions from invited authors from three transition economies: Croatia, Slovakia, and Poland. All of the papers focus on applications of the process approach to management or directly to the adoption of Business Process Management. The majority of articles relate to the traditional BPM thread, although the indicated BPM alliances with other concepts such as *Knowledge Management*, *Change Management*, and *Project Management* are worthy of note. Only one article addresses the topic of BPM in the context of digital transformation. The nature and structure of these articles may be indicative of the current motivational factors and process maturity levels of organizations adopting ordinary and/or advanced BPM practices. When analyzing the content of individual articles, we pay attention to the factors underlying BPM adoption.

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We understand the primary motivation to be the expected benefits from BPM. Therefore, we can assume this Special Issue to be a contribution to BPM development in the form of the indicating motivation and triggers for BPM adoption.

The first paper, by Jerzy Auksztol and Magdalena Chomuszko, proposes a process-based approach to construct a Data Control Framework for Standard Audit File for Tax (SAF-T). The process approach is used to redesign the internal financial control processes and procedures of an organization to meet the new requirements of a fiscal audit. The process approach, combined with risk management and quality management, is, therefore, a tool supporting entrepreneurs adapting to new regulations imposed on them by their external environment, particularly those of tax authorities. Therefore, in this case, the main motivation for adopting elements of BPM was the impact of external environment factors.

The paper by Ana-Marija Stjepić, Lucija Ivančić, and Dalia Suša Vugec focuses on the link between Business Process Management and digital transformation. The authors have developed a theoretical framework for the emerging role of BPM in digitalization and as a guide for researchers and practitioners conducting digital transformation initiatives in organizations. The results obtained in the article prove that the set goals and expected benefits of digital transformation can be achieved by a rethink and improvement of the processes, with a particular focus on end-to-end customer processes through supply chain management. Based on this article, we can conclude that one of the main motivational factors for BPM adoption is a desire to obtain the benefits of digital transformation.

The article written by Miroslava Nyulásziová and Dana Pařová takes up the issues of using and linking the process approach and BPM lifecycle with the designing of decision support systems. The authors of this paper have developed an innovative system for decision support by implementing modeling, analysis, and improvement methods to the transportation process in the studied organization. The forwarding company's case study presented in the paper also shows how BPM adoption began with a single main process that has been streamlined and automated. Therefore, the motivations for BPM adoption were not only operational, relating to the optimization of the cost of the process, but also managerial, oriented on improving the decision-making process. The use of information technology allowed the full exploitation of the potential for process improvements.

The next paper by Olga Sobolewska is about incorporating the issues of BPM into the contemporary challenges of network organizations. The author claims that the organization's orientation towards both business processes and knowledge management is a strong success factor for network cooperation.

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The author argues that modern organizations should focus on managing knowledge-oriented processes to become attractive to cooperation partners for network organizations. In this article, BPM adoption is of a strategic nature for the purposes of undertaking new forms of cooperation.

The paper by Hubert Bogumił has an interdisciplinary character and, in a unique way, shows the connections between the concepts of process management, organizational change management, and IT project management. The author undertook the challenge of examining how problems for organizations managing IT projects facilitate in different ways the use of distinctive approaches to improve business processes. The author emphasizes that the main difficulty is the fact that modern organizations most often use a hybrid approach, with elements of both traditional project management and agile. The need to create a work environment that takes into account the risk of unexpected system and business regression, as well as a diagnosis of the causes and methods of its mitigation, is the initial research result in this paper. This article contributes to the development of BPM governance and integration of IT governance. The motivational factors for BPM are multi-faceted, as is the scope of the article. However, their managerial and cultural character (related to methods of communication and rules of cooperation in teams) should be emphasized.

The article by Agnieszka Bitkowska concerns the integration of the concept of Knowledge Management and BPM. The author restates in her article that the identification, acquisition, presentation and documentation of knowledge are not independent tasks, but are implemented within business processes. In this paper, the correlations between BPM and Knowledge Management have been examined and the benefits and practical implications resulting from the integrated implementation of both concepts are emphasized. In the case of this article, BPM adoption can be a success factor for the implementation of Knowledge Management and the achievement of associated benefits.

Studying Business Process Management from the different angles presented in this Special Issue should enrich our understanding of current BPM practices and better realize future challenges, especially those related to BPM development in the context of digital transformation and the integration of BPM with other management-related concepts. In addition, the contribution made by the authors of this Special Issue allowed us to see various motivations and triggers for BPM adoption, from operational, to managerial, strategic, cultural and technological ones, and those driven by the external environment.

We would like to thank the authors for their contribution to this Special Issue. We would also like to thank all the reviewers for their valuable comments, which helped the authors improve their articles significantly.

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We are firmly convinced that the BPM research results presented in this Special Issue will help strengthen the existing body of BPM knowledge. We recommend reading the related issue of the JEMI journal to the wider community of BPM researchers, practitioners, and enthusiasts.

## Guest Editors

Renata Gabryelczyk<sup>1</sup> , Tomislav Hernaus<sup>2</sup> 

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# A data control framework for SAF-T reporting: A process-based approach

Jerzy Auksztol<sup>1</sup> , Magdalena Chomuszko<sup>2</sup> 

## Abstract

*We present an innovative process-based approach aimed at helping entrepreneurs to adapt to the new circumstances arising from the introduction of the Standard Audit File for Tax (SAF-T), which is changing the paradigm of tax authorities<sup>3</sup> in dealing with tax non-compliance. The responsibility to protect against evaders has shifted significantly from tax administration towards entrepreneurs, increasing the risk of financial penalties and torts. Simultaneously, it has enabled the introduction of innovative management concepts in the field of financial inspection, auditing, and tax compliance. A process-based approach has been proposed to cope with the complex challenges the entrepreneurs and accountants are now facing in this subject. It is used as a framework for combining key management concepts, like due diligence and quality management, which are typically applied separately. We have achieved our goal by constructing a Data Control Framework (DCF) for SAF-T that addresses the need for the redesign of internal financial control procedures to meet the new requirements of a fiscal audit. Two research methods have been used in this paper: (1) a survey to assess the effects of the implementation of the SAF-T standard in the enterprise and (2) design science research (DSR) for building the proposed framework.*

**Keywords:** Value Added Tax (VAT), VAT gap, VAT carousel, process-based approach, business process management, financial control, risk management, quality management, due diligence, Standard Audit File for Tax (SAF-T), dataset for accounting research, enterprise information systems, eXtensible Markup Language (XML)

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3 In this paper, the following terms are used interchangeably: tax authorities, tax administration, and revenue body.

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## INTRODUCTION

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The Standard Audit File for Tax (SAF-T) is an open standard format based on eXtensible Markup Language (XML), which enables the storing and transferring of data for tax audit purposes. It was first published by the Organization for Economic Co-operation and Development (OECD) in 2005, with major amendments and extensions in 2010 (OECD, 2017b, p. 65). Revenue bodies in many countries have adopted this standard with great success, inter alia in Austria, France, Luxembourg, Lithuania, Norway, Poland, and Portugal. The relatively simple idea of sending financial records directly to the tax authorities has changed significantly the approach to audits on tax compliance. Its characteristics can be grouped in a four-fold way: (1) the reduction of burden by automation, (2) moving from collecting aggregates to individual records, (3) tax compliance process redesign, (4) increasing the taxpayer's responsibility for evaders' misconduct.

- 1) *The reduction of burden by automation.* It reflects the postulate to reduce tax compliance cost to a minimum (Braithwaite, 2013a, p. 1). SAF-T can optimize efficiently the mutual communication between taxpayers and revenue bodies. On the taxpayers' side, it is achieved by changing the features of the enterprise information system (EIS)<sup>4</sup>, where the functionality of exporting financial data to SAF-T has been built in by EIS developers. Therefore, this software can generate the required records and file them with the tax authorities via the Internet. The taxpayer's manual data feed is not needed anymore. On the opposite end, the tax administration automatically receives financial records from taxpayers and loads them into the administrative databases for further control, analysis and audit, eliminating manual or semi-manual, time-consuming work.
- 2) *Moving from collecting aggregates to individual records.* SAF-T extends significantly the information scope available to revenue bodies without unnecessary delay. It helps build administrative registers consisting of individual records taken from different databases kept by taxpayers. For example, SAF-T for VAT collects data for each transaction carried out by VAT payers, which can be matched with corresponding records from their contractors. In consequence, the revenue body receives powerful tools to build a pool of cases earmarked for more precise and accurate fiscal auditing.
- 3) *Tax compliance process redesign.* Built by revenue bodies over the years, the system of tax audit based on collecting aggregates has changed significantly, mainly due to the possibility of direct access to the individual records of the whole population of taxpayers. Choosing individuals for

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<sup>4</sup> We assume that the enterprise information system consists, for example, of a financial accounting application.

tax audit has become much more precise since the introduction of SAFT. Big Data technologies (Vasarhelyi, Kogan, & Tuttle, 2015) and Business Intelligence analytics (Wu, Ou, Lin, Chand, & Yen, 2012; OECD, 2017a, p. 38) which have been adopted by tax administration are also helpful in this field. This also opens the perspective for mitigating the negative effects of tax audit where a subjective interpretation may cause tension between an honest taxpayer and an inflexible tax inspector (Kirchler, Hoelzl, & Wahl, 2008, p. 214-215).

- 4) *Increasing the taxpayer's responsibility for evaders' misconduct.* It mainly results from the very nature of value added tax (VAT), where (Ebrill, Keen, & Bodin, 2001, p. 2) *the tax is charged and collected throughout the production process, with provision for tax payable to be reduced by the tax paid in respect of purchases.* It means that the tax paid by the final consumer is collected at each stage of the production and distribution chain. Taxpayers can reduce their tax by the amount paid earlier. This encourages sophisticated VAT frauds, which can involve honest taxpayers. It happens through the reduction of tax payable by the amount of tax shown in the documentation of the purchasing process, but in reality not paid by tax evaders and fraudsters. One of the methods of VAT fraud is called missing trader or carousel, discussed extensively in specialist literature (Ainsworth, 2006; Keen & Smith, 2006). Another well-known mechanism is connected with the carbon allowance (Frunza, Guegan, & Tchiebaut, 2010, p. 4), which can be traded on an electronic exchange market, thus increasing the fraud speed and volume. Tax authorities, in response to these kinds of frauds, have introduced changes to legislation that impose the tax liability on all participants involved in a transaction, even when some of them are unaware of the tax evasion. Collecting individual transaction records through SAF-T increases the compliance due to more accurate detection of all participants in fraudulent transactions.

This paper has two main objectives. The first one is to examine the accountants' attitude to changes caused by the introduction of the breakthrough SAF-T reporting. Accountants bear overall responsibility for tax compliance and build their own internal, accounting-focused procedures for fulfilling this task. Now, the changed circumstances have triggered a need to spread the responsibility for tax compliance to key employees performing processes involving vendors and purchasers. The accountants' attitude in this matter can be a motivation for research in the management field.

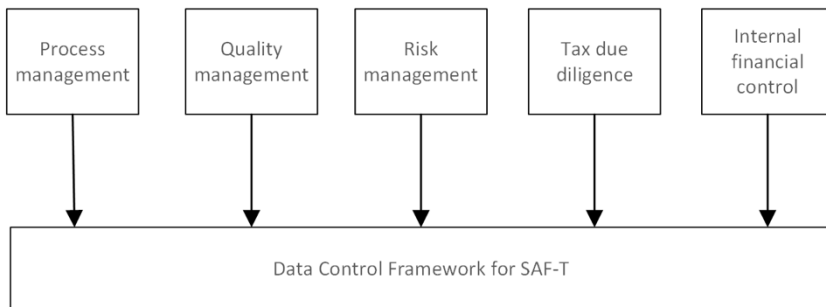
The second aim of this paper is to explore a Data Control Framework (DCF) for SAF-T, which helps entrepreneurs to build a resilient organization which responds in an agile way to the new circumstances arising from the introduction of SAF-T. Thus, we raise a discussion about the impact of SAF-T on decision processes executed at all levels of the economy: micro, mezzo, and macro.



The main body of our study is divided into seven parts. Following the introduction, we identify the problem to be solved and set up the overall goal of DCF in the context of changing the relationship between entrepreneurs and tax authorities. In the third section, we present the theoretical background for constructing DCF, drawn from the process-based approach which integrates many useful management concepts investigated separately. We discuss business process management as an integration foundation, quality and risk management, together with tax due diligence and financial control. In the fourth section, we expound on the method used to achieve our goal. The building process of DCF is based on the widely recognized Design Science Research method. In the fifth section, we examine the research results consisting of (1) the survey analysis of the accountants’ attitude to SAF-T, mostly responsible for tax compliance, and (2) the design of DCF. The sixth section demonstrates the usefulness and evaluates the suitability of the constructed DCF. The discussion and conclusion (sections seven and eight) summarize our study.

**THEORETICAL BACKGROUND**

In the theoretical investigation, we build the background for constructing our framework integrating many useful management concepts (Figure 6), which are explored separately elsewhere. The term framework we use after Shapira (2000, p. 1314) where: (...) it (1) provides a structure to organize observations, and (2) describes the structure in a clear and precise manner. At the beginning of this section, we explore the process-based approach as an integration foundation. Subsequently, we outline other concepts, i.e. quality management, risk management, tax due diligence, and internal financial control.



**Figure 6.** Components of the Data Control Framework for SAF-T

## Process management

Since the introduction of the business process reengineering concept outlined by Hammer (1990), Davenport (1993), and Hammer and Champy (1993), the idea of modeling the organization by means of processes has spread throughout academia and practice, building a foundation for a business process management discipline. Over almost three decades, it has matured, becoming a strategic means for constructing a competitive and resilient enterprise. However, the starting point of this idea can be found much earlier in Williams' (1967) paper where the author presented the concept of improving the production process efficiency by shortening its timespan and increasing the volume of production<sup>5</sup>. The debate about modeling the organizations by processes was saturated in response to the publications by Davenport (1993), Hammer (1990) and Champy (1993). The hype generated by the promising results of business process reformulating convinced many practitioners to implement it. Studies concentrating on critical success factors caused by the radical change in the organizations reported some difficulties in determining the real outcome as a success or failure (Larsen & Myers, 1997). In the beginning, the financial indicators of the analyzed case displayed meaningful improvement, but later the implications were much more difficult. Rosemann (2014) explained this effect as a lack of a sufficient amount of methods supporting radical re-design and innovation in the organizational processes. The following decade showed a significant advancement in the theory and practice enriching the set of available process notations (e.g., Business Process Management Notation or Extension in Unified Modeling Language), process assessment tools (e.g., Six Sigma) and enterprise systems implementation (Sheer, 2000). Becker, Rosemann, and Uthmann (2002) presented some other fields where the process approach proved its value: lean management, activity-based costing, total quality management, process innovation, workflow management, and supply chain management. We would also like to extend this list with the capability maturity model (Van Looy, De Backer, & Poels, 2011) business continuity management, and enterprise information systems' implementation.

In the literature, we can find a variety of definitions presenting many different directions of approaches to business process management. Swenson and von Rosing (2015) published a review of approximately 100 papers and put forward their proposal (p. 87) incorporating key thoughts found in the literature:

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<sup>5</sup> Williams' (1967) contribution explains to some extent the use of the term *engineering* in the organizational and social context, e.g. business process reengineering, although the Oxford Dictionary (2018b) defines it as *the branch of science and technology concerned with the design, building, and use of engines, machines, and structures*, which means that it is a pure technical, not an organizational matter. It confuses many scholars especially in the management field.

*Business process management (BPM) is a discipline involving any combination of modeling, automation, execution, control, measurement, and optimization of business activity flows in applicable combination to support enterprise goals, spanning organizational and system boundaries and involving employees, customers, and partners within and beyond the enterprise boundaries*

This definition reflects the contribution of various scientists and development of the idea where the organization is analyzed by processes performed both internally and in relationships with external stakeholders. The problem stated in the second section of this paper may be solved in the process designed according to the discipline defined above.

The term process itself is defined in the literature in many ways. We take the classic proposal introduced by Davenport (1993, p. 5): *A process is thus a specific ordering of work activities across time and place, with a beginning, an end, and clearly identified inputs and outputs: a structure for action.*

We see our contribution here in using a process-based approach as the foundation for combining the many management concepts required to solve the increasingly complex challenges found in the changing social, organizational, legal, and technical environment that entrepreneurs are facing today.

## **Quality management**

In defining the term data quality, we will follow the work presented in the paper by Wang and Strong (1996). They introduced a framework for capturing data quality (DQ) consisting of four dimensions (p. 6): (i) *intrinsic DQ* grasping the essence of data content, (ii) *contextual DQ* considering the task in which data are used, (iii) *representational DQ* related to the form of presenting and using data and (iv) *accessibility DQ* examining the way the data are approached. Subsequently, we will explore the first two dimensions for the purpose of constructing DCF. Two dimensions drawn in a hierarchical way examine *intrinsic DQ*: accuracy and objectivity. Following the ISO (1994) standard, we can extend the term accuracy to the following sentence: it is a measure of closeness of the financial records stored in the enterprise information system to the real economic events. The objectivity dimension, on the other hand, is strictly connected with the objectivity principle defined in accounting as a requirement that financial records are based on solid evidence. In our framework, it will also illustrate the solid evidence for tax purposes. The second discussed dimension is *contextual DQ*, which in our framework determines the use of each financial record for fiscal audit.

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We can now define the anticipated quality of financial records stored in enterprise information systems. It is the measure of accuracy, objectivity and context of data used in the process of a permanent fiscal audit using SAF-T data. In this context, SAF-T will be treated as the end product for quality assessment. To achieve an acceptable quality of financial records, we will use recommendations included in the concepts of quality and process management.

Introduced by Deming, Drucker, and Shewhart, the concept of quality management is broadly presented in the literature. Therefore, we assume the classic approach is grounded in theory and business practice. One of its main rules states that the end product's quality is determined by all the activities performed in the processes serving the construction of this product. This concept is derived from E. Deming's principle *Improve process. Improve constantly and forever every process for planning, production, and service* (Kanji, 1990). We can conclude from this rule that in quality management theoretical and practical movement, special attention was paid to the process management concept.

### **Risk management**

The risk management approach is widely discussed in the literature on management, finance, working conditions, as well as natural disaster protection and safety (Lalonde & Boiral, 2012). In our study, we use the normative perspective of risk management summarized in ISO 31000 (ISO 2009). It is connected with the previously set goal of achieving relevance and adjustment to the dynamic circumstances. The normative view is generally built on theory and practice in order to help practitioners structure their effort at unifying activities performed by many independent agents. ISO 31000 is divided into three main parts: principles, framework, and process. In the principles part, we can find sentences important from the DCF point of view, i.e.: (i) *risk management is an integral part of all organizational processes* and (ii) *risk management is part of decision making*. It means that at all stages of the activities performed in the context of specific processes, employers at all decision and operational levels use the risk management approach to identify, analyze, evaluate and treat non-compliance risks in a uniform way. The result of this approach is feeding the enterprise information system with correct, high-quality financial data that can be sent to the tax authorities.

### **Tax due diligence**

Due diligence is a concept helpful in the provision of tax compliance. It was introduced by revenue authorities in the fiscal audit procedure in response to evaders exploiting legal loopholes. An additional factor raising the significance

of this concept is the action taken by legislators. It extended the responsibility for the tax obligation to all participants involved in a transaction, where the VAT is not paid in the proper amount. The answer to this situation was to make entrepreneurs liable for the thorough investigation of each contractor. But at the same time, we can point out the legal restriction binding on entrepreneurs in fully performing such activities. Due diligence can help to mitigate the risks that result from establishing business relationships with unreliable contractors. The definition of due diligence can be found in online sources. According to the Oxford Dictionary (2018a), due diligence is *reasonable steps taken by a person to avoid committing a tort or offense* and we will use it as a background for ensuring tax compliance and call it tax due diligence.

### **Internal financial control**

Internal financial control is the central part of DCF. Its goal is to fulfill the obligation to guarantee quality of data being entered into the enterprise information system. In defining this term, we follow the normative approach similar to the one presented in the case of risk management. After ICAEW<sup>6</sup> (1994, p. 1), we define it as:

*The internal control established in order to provide reasonable assurance of (a) the safeguarding of assets against unauthorized use or disposition; and (b) the maintenance of proper accounting records and the reliability of financial information used within the business or for publication.*

This definition serves accurately the purpose of DCF because it focuses on proper accounting records. However, the introduction of SAF-T entailed the extension of the group of employees responsible for proper accounting data. From that moment, not only accountants but also employees involved in the purchase and sale processes are obliged to perform permanent financial control to ensure tax compliance.

## **METHODOLOGY**

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### **Problem statement and research motivation**

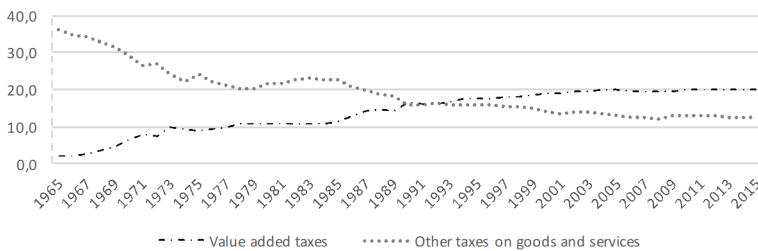
As has been stated above, the introduction of SAF-T changed the relationships between revenue bodies and taxpayers significantly, strengthening the authorities' power but also opening the opportunities for improvements. The former manifests in the direct and automatic access to the individual records collected by taxpayers resulting in the more accurate detection of tax avoidance,

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<sup>6</sup> Institute of Chartered Accountants in England and Wales.

evasion, and fraud. The implementation of SAF-T in the whole economy is not a one-step project. It is divided into many phases resulting in the future tight interface between the revenues' and taxpayers' information systems. The case of Poland (OECD 2017b, p. 66) shows that the approach exercised by tax offices is efficiency-oriented. In the beginning, it focused on VAT revenue because of: (1) increasing receipts from VAT in government income, (2) its susceptibility to fraud as well as (3) achievable semantic consistency.

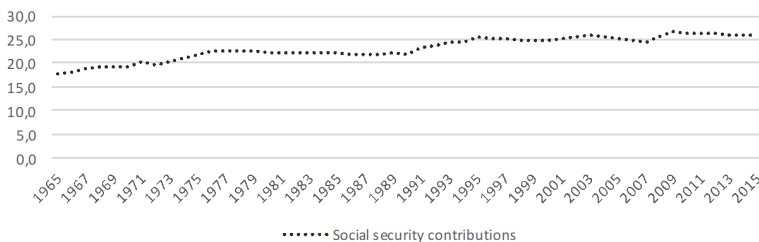
The first decisive factor causing the focus on VAT in introducing SAF-T is *increasing receipts from VAT in government income*. This claim can be confirmed by analyzing statistical data published by the OECD (2017a) concerning the VAT share in the total tax revenue of OECD countries (Figure 1).



**Figure 1.** Trends in the consumption tax structure (1965-2015, as % of total tax revenue)

Source: OECD (2017a, p. 24).

It can be noticed that VAT takes over the dominant position in consumption taxes, although the importance of other taxes, such as excise, remains substantial. Another trend highlighting the significance of VAT, seemingly not connected with consumption taxes, is the increasing share of social security contributions in total tax revenue (Figure 2).



**Figure 2.** Social security contribution share in OECD countries (% of total tax revenue)

Source: OECD (2017a, p. 24).

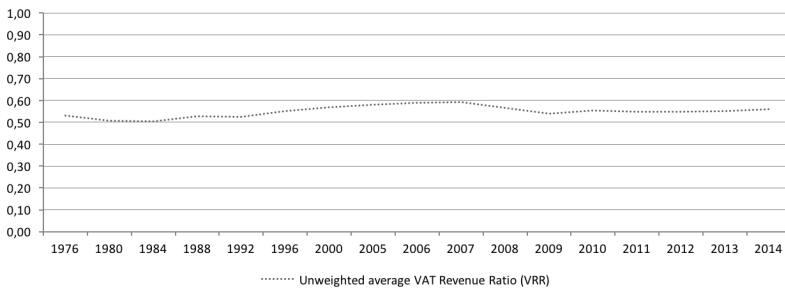
Many developed countries are facing demographic problems, which will likely lead to the debate on shifting social contribution to consumption taxes (Thomas & Picos-Sánchez, 2012; Pestel & Sommer, 2013).

The second discussed factor is VAT’s *susceptibility to fraud*. Its roots can be found in the design of VAT, where the taxpayers can reduce their tax payable by the amount paid earlier in the purchasing process<sup>7</sup>. The scope and intensity of this phenomenon are challenging to measure, but economists built some indicators to estimate it using aggregates delivered by the national account statistics. One of them is called VAT gap presented by Poniatowski, Bonch-Osmolovskiy, and Belkindas (2016, p. 15) in their acknowledged report. Another interesting material, discussing the VAT Revenue Ratio (VRR), was published by the OECD (2016b), where the analyses covered a long period. Further on, we will focus on the latter.

VRR is defined as the indicator calculated according to Formula 1.

$$[VAT\ Revenue\ Ratio] = \frac{[VAT\ Revenue]}{([Consumption] - [VAT\ revenue]) * [standard\ VAT\ rate]} \tag{1}$$

The interpretation of this indicator focuses on the deviation from value 1 which represents a desirable solution. It reflects the VAT revenue sourced from all consumption taxed at VAT standard rate. The values below 1 reflect exemptions, reduced VAT rates<sup>8</sup> and, first and foremost, tax non-compliance resulting from calculation errors, avoidance, evasion, and fraud. The values above 1 inform that cascading VAT cannot be claimed for some products. Figure 3 presents the unweighted average of VRR for OECD countries over almost four decades from 1976 to 2014.



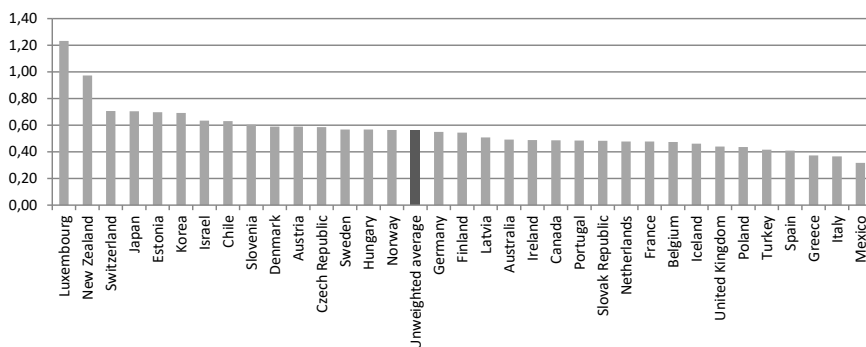
**Figure 3.** Unweighted average VAT Revenue Ratio for OECD countries

Source: OECD (2016, p. 118).

<sup>7</sup> See Introduction section.

<sup>8</sup> Application of reduced VAT rates has its ground in efficiency and social equity gains projected by government (Ebrill, Keen, & Bodin, 2001, 68-82).

Despite a stable trend in tax efficiency on a broader range, a deviation from the average will be subjected to further investigation. Figure 4 shows the VRR for selected OECD countries in 2014.



**Figure 4.** VAT Revenue Ratio for OECD countries in 2014

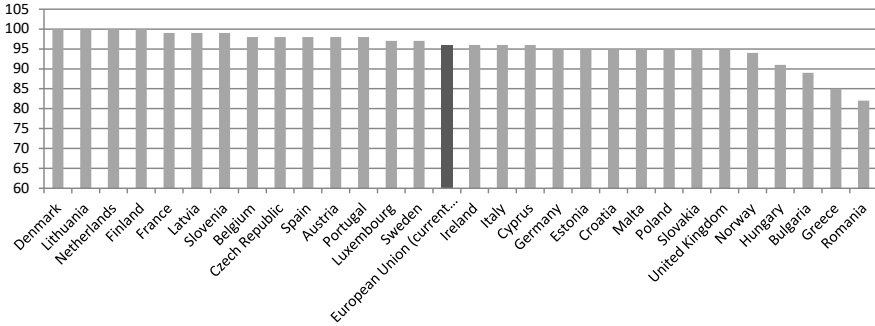
Source: OECD (2016, p. 118).

Luxembourg is the only country to record the results of VRR above value 1. Moreover, it achieved a spectacular increase of 0.64 percentage points from the year 1976, not observed elsewhere. Other countries like New Zealand, Switzerland, Japan, Estonia, and South Korea are also successful in building an efficient system for VAT. The sources and causes of this approach were discussed by the OCED (2016).

The third factor which determined the choice of VAT for SAF-T reporting in the first place is *achievable semantic consistency*. Revenue authorities always strove to gather detailed information about each transaction performed in the economy, but the burden associated with manual collecting was overwhelming. However, the technological developments laid the grounds for the introduction of new ideas, viz. SAF-T, addressing the need to collect more precise records. One of these technological developments is the Internet's global spread. The vast majority of enterprises in the European Union (98%) use fixed or mobile broadband Internet access (Figure 5).

Despite slight variations across countries (Lithuania – 100%, France – 99%, Austria – 98%, Portugal – 98%, Luxembourg – 97%, Poland – 95 %, Norway – 94%), their tax authorities were able to introduce SAF-T with great success, because Internet access supported the whole process.





**Figure 5.** Proportion of enterprises using broadband access to the Internet (fixed or mobile) in the EU and Norway in 2017 (%)

Source: Eurostat (2018).

Another determinant of the smooth implementation of SAF-T, originally built by the OECD and associated organizations<sup>9</sup>, was its compatibility with the widespread XML open standard for data storage and communication. It allowed for the agile implementation of additional requirements regarding enterprise information systems to work with SAF-T. The crucial factor in such projects, where data collected from the whole population of enterprises are stored in one place, is the demand for semantic consistency. In the case of VAT, the use of unique identification of an enterprise through the National Business Registry Number can help meet the requirements for automatic matching and checking taxed turnover between contracting entities. Other sections of SAF-T, like balance sheet or profit and loss reports, require additional adjustment for automatic analysis. Each enterprise builds its own policy of registering economic events in accounting ledgers, causing the needs for individual, case-by-case analysis in tax audit control. Therefore, the tax administration in Poland introduced legislation that requires all enterprises, micro, small, medium and large to send periodically SAF-T generated returns from their VAT registers. On the other hand, the additional SAF-T sections, like inventory, bank operations, sales, and general ledger, are filed only on demand, probably in order to investigate each case separately, because an automatic search for patterns is limited due to the semantic inconsistency, for example, the same account number can be used for various purposes in different entities. Sophisticated tax avoidance methods are another barrier that can only be traced through individual fiscal audits. The development of artificial intelligence (AI) technology and the semantic standardization

9 i.e. Business Application Software Development Association and accounting bodies.

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of SAF-T returns obtained from different enterprises are ways to overcome these barriers in the future.

Concluding, we can claim that SAF-T has significantly changed the way tax authorities execute their power in monitoring tax compliance through the collection of financial records in one central place. It helps restrict the impact of avoidance, evasion, and fraud on VAT receipts. It also reduces the burden associated with filling in unnecessary declarations with aggregates, which can now be generated from individual financial records, stored in the submitted SAF-T data. Another benefit is the prospect of shorter tax refund times. It also fosters tracing transactions with unrecognized evaders and fraudsters.

At first glance, the introduction of SAF-T seems to be only a technical and organizational issue, but to a large degree, it is a fundamental breakthrough in the relationship between the revenue body and taxpayer, where the former gains more power through extended knowledge and the latter can expect fair treatment from objective auditing. It is also expected that at a macroeconomic level, fraud reduction will be perceptible. At an enterprise level, it generates the need for redesigning internal financial inspections to reduce the risks of providing the tax administration with incorrect SAF-T data or unwittingly establishing cooperation with tax evaders and fraudsters.

## **Research method**

The first objective of our study presented in the *Introduction* section is accomplished through a survey that provides opinions on SAF-T implementation as expressed by an internet-based accounting discussion group. It is essential to assess these opinions in order to address and adjust the DCF design to the implied expectation. We are aware that these kinds of groups connect people who are mostly involved in tax compliance. The responses have been collected in a non-probability sampling survey where the results are not representative of the whole population. This can be used only for an approximation of the issue. For implementation of the second objective, namely constructing DCF, we employ the Design Science Research (DSR) widely discussed in research literature (Gregor & Jones, 2007; Gregor & Hevner, 2013). It guides us through the process of constructing the scientific artifact for entrepreneurs looking for the organizational concepts to improve the effectiveness and efficiency of a formal organization in the changing circumstance discussed above. In this context, we follow the procedure set up by Peffers, Tuunanen, Rothenberger, and Chatterjee (2007).

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## RESEARCH RESULTS AND DISCUSSION

### Effects imposed by SAF-T implementation

The aim of the study was to acquire knowledge about the accountants' subjective assessment of the effects imposed by SAF-T implementation in the enterprise. We hypothesize that they assess it mainly as additional cost-generating work due to the obligation of adapting the company to the requirements of SAF-T reporting, overlooking the opportunity to adjust their business processes to new circumstances. The survey was intended for the participants of the aforementioned discussion group and was carried out in March and April 2018. Forty-nine questionnaires were collected.

In the first question (Table 1), the respondents were asked to indicate the selected statement (seven multiple choices plus one open-ended question) related to SAF-T reporting.

As many as 69.4% indicated the first option, i.e. the increase in the amount of work related to the preparation of tax settlements. The second-ranked answer results from the first one, as it implied incurring additional costs (item 2 with 40.8%). The third answer, which referred to the benefits for the company from *raising practical competences (using computer programs)*, was marked by 32.6% of the respondents. Only 6.1% pointed to the *improvement of business management*, which does not give ground for rejecting our hypothesis.

**Table 1.** The SAF-T implementation

Reporting via SAF-T entail the following results	Response structure (%)
1. Increased workload related to the preparation of tax settlements	69.4
2. Incurring additional costs resulting from adapting the company to the requirements of SAF-T reporting	40.8
3. Raising practical competences (using computer programs)	32.6
4. Raising substantive competences (knowledge)	24.5
5. Computerization of the enterprise	14.3
6. SAF-T reporting did not cause any changes in the enterprise	10.2
7. Improvement of business management	6.1
8. Others	2.0

The analysis of the next question (Table 2) shows that the survey participants positively assessed the introduction of SAF-T reporting. 53.1%

of respondents considered it a good idea and 10.2% a very good idea. 30.6%, however, had a negative attitude toward this concept (item 3 and 4), which requires further investigation.

**Table 2.** Subjective assessment of the SAF-T implementation concept

How do you assess the idea of reporting via SAF-T?	Response structure (%)	
1. Very good idea	10.2	
2. Good idea	53.1	63.3
3. Bad idea	18.4	
4. Very bad idea	12.2	30.6
5. I have no opinion	6.1	6.1
	<b>100.0</b>	<b>100.0</b>

Such responses, on the one hand, disclose a great awareness of the need for changes in tax settlements and, on the other, apprehension about costs and burden, without any benefits to the company. When asked: *How do you assess the preparation of your company to the requirements of SAF-T?*, 75.5% of the respondents gave it the top marks (38.8% - very good, 36.7% - good). Few (4.1%) assessed the preparation of their company as insufficient (Table 3).

**Table 3.** Assessment of preparation to the SAF-T requirements

How do you assess the preparation of your company to the requirements of SAF-T?	Response structure (%)	
1. Very good	38.8	
2. Good	36.7	75.5
3. Enough	20.4	20.4
4. Insufficient	4.1	4.1
5. I have no opinion	0.0	0.0
	<b>100.0</b>	<b>100.0</b>

The last question (Table 4) in the survey concerns the concept of due diligence in respect to taxation (three multiple choices). Most respondents pointed to the following answer: *tax due in SAT-F reporting means good practice that guarantees the correctness of data in the information systems and SAF-T* (49%). Second, 30.6% of the respondents stated that this is only *a statutory requirement without practical significance*. The smallest group of 20.4% responded that tax due diligence is a way to avoid liability in the event of entering into relationships with a dishonest contractor.

**Table 4.** Perception of tax due diligence in SAF-T reporting

Due diligence is:	Response structure (%)
1. Good practice that guarantees the correctness of data in the information systems and SAF-T	50.0
2. A statutory requirement without practical significance	31.3
3. The legal requirements that exempt from liability in the event of entering into relationships with a dishonest contractor	20.8

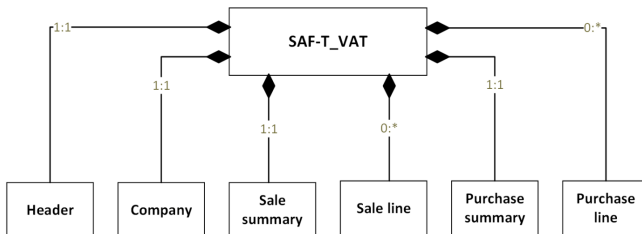
The above survey shows that a significant group of respondents focuses on a narrow area of issues related to SAF-T reporting or launching business controls, and some do not combine them with a wider business context.

**Data control framework design**

In this section, we follow the procedure of constructing an artifact called Data Control Framework (DCF) for SAF-T. It consists of five components: quality management, process management, risk management, tax due diligence, and financial control (Figure 6). They are used as a foundation for building a specific solution in a particular enterprise.

At a glance, fulfilling the legal obligation of sending SAF-T to the tax authorities requires solving the technical issue connected with adding functionality to the existing enterprise information systems. However, the previous discourse proved that it is not enough. The key point lies in the quality of data entered into the enterprise information systems, which generate the required SAF-T data and sending them to the appropriate authorities automatically. This latter action of the whole process must not be accomplished manually.

The documentation of SAF-T is the starting point towards the implementation of checkpoints for financial control (Figure 7).



**Figure 7.** General schema of SAF-T\_VAT

Source: own elaboration based on documentation of Ministry of Finance in Poland.

The analysis of the graph indicates that the processes can be distributed under the following items:

- the selling process;
- the purchasing process;
- the process of managing basic data.

From this overall view of the process management approach, we can propose the points for performing financial control, e.g. inspection, and checking for tax compliance (Table 5).

**Table 5.** Data internal control workflow for SAF-T reporting – general view

Process	Data	Inspection	EIS module	SAF-T section
purchase	goods/stock/costs	supplier/ transaction	purchase	-
inventory management	receipts/release/ transfer	goods/ transaction	inventory	inventory section of the SAF-T
sale	income	customer/ transaction	sale	sales section of the SAF-T
payment	receipts/ remittances	payments	banking	bank operations section of the SAF-T
<b>financial &amp; accounting</b>	<b>data from all modules of the enterprise information system</b>	<b>data quality</b>	<b>financial &amp; accounting</b>	<b>account books section of the SAF-T VAT settlement section of the SAF-T</b>

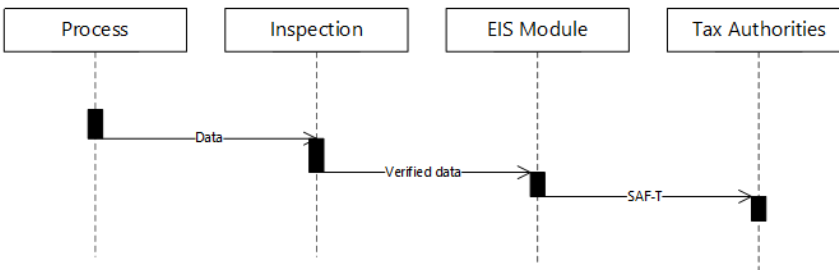
In the proposed DCF, data quality control is treated as an integral part of all processes identified in the enterprise corresponding to the product purchase, inventory management, sale and payment (Table 5). Analyzing purchases, data control should be added to the list of activities defined in the process called *order materials and services* (APQC 2018). One of the activities in this process is called *record receipt of good* and followed by *research/resolve exceptions* (APQC 2018). These activities should verify conformity of the received goods with the invoice, documenting the delivery before entering data into the enterprise information systems. In terms of sales, the key processes *manage sales orders* (APQC 2018) and *operate outbound transportation* (APQC 2018) are the subjects for verifying the contractor's integrity, especially concerning export, where the VAT is zero-rated. In this case, all additional documents confirming delivery to the recipient, e.g. incurrence, waybill or delivery-note, are crucial to mitigate the risk.

Process mapping introduced in process-oriented management also helps to point out related processes which are important to identify additional

risk of tax non-compliance, for example, *manage customers and accounts* (APQC 2018). In DCF, this process is responsible for identifying the risk of establishing a relationship with unreliable contractors. The above list does not cover all possible situations that may arise in the future. It should be verified in accordance with principles and foundation of risk analysis. According to the accounting rules, the financial control guarantees the data accuracy and objectivity from the perspective of data quality discussed in the subsection dedicated to quality management.

### Integration of the building blocks

The course of action presented in the previous subsection leads us to the conclusion that each management concept contributes to the efficacy of DCF. It is mostly discoursed separately losing the whole picture of processes performed in the enterprise. Having in mind the need to solve real-life challenges, we proposed an integrated approach that combines key management methods in one unified foundation. This direction traces the path according to which the taxpayer guarantees reliable data in the enterprise information system (EIS), and thus in SAF-T. Figure 8 presents this path according to DCF.



**Figure 8.** Workflow for SAF-T Reporting

Explaining the sequence of the presented actions, it is possible to identify their individual stages combined with the concept taken from DCF:

- 1) Identification of business processes (process management).
- 2) Design of procedures that implement processes for collecting data (process management).
- 3) Assessing the risk of non-compliance (risk management and due diligence).
- 4) Data control (quality management and financial control).

- 5) Data recording in the enterprise information system (IT subject).
- 6) Transferring data from enterprise information system to SAF-T (IT subject).
- 7) Sending SAF-T to tax authorities (IT subject).

The identification of processes is mainly based on the documentation of SAF-T sections (Figure 7). They are comprehensible and can be used not only as a clue to identify processes but also as a support for designing procedures from the point of view of data needs for enterprise information system. This paper only discusses the sections of SAF-T\_VAT, which is an example that can be used as a support to develop other processes related to SAF-T. The key action is data inspection understood as an assessment of the data quality from the perspective of accuracy, objectivity and its context. This step includes verification procedures for the indicated data documented by the taxpayer in case of inquiries from tax authorities.

DCF, in the last step, presents the supply of SAF-T sections with data obtained from the enterprise information system modules. However, from the taxpayer's point of view, this is a repetitive and generally automated activity, because its task is to take correct and compliant data from the enterprise information system. SAF-T is fed with the help of specific functionality of computer programs and the user does not perform these operations manually. If the goal of obtaining reliable data in the enterprise information system is achieved, then SAF-T will also be correct.

### **Demonstration, evaluation, and communication**

The last step in constructing the artifact according to the Design Science Research rules is the demonstration of usefulness, evaluation of suitability, and presentation of communication. To accomplish this task, we discuss the case of public consultation which took place at the Parliament in Poland regarding the work performed by the Finance Ministry (Ministry) on the development of the taxpayers' approach to deal with non-compliance risk in relationships with contractors, after spreading the responsibility for unpaid tax to all parties, even the ones unwittingly involved in fraudulent transactions. We present DCF relevance by pointing out the correspondence between rules set up by the Ministry and DCF components.

The debate was initiated by Kulesza (2017) who submitted the following parliamentary questions:

- Is the Ministry planning a draft amendment to the Value Added Tax Act in which the definition of due diligence will be introduced?



- Is the Ministry planning to issue clear and precise guidelines for entrepreneurs, specifying what actions they must take to exercise due diligence?
- What are the sources of information about the actions which entrepreneurs must take to exercise due diligence?
- Is investigative due diligence a sufficient method of appraising a business?
- What is the percentage distribution of the statement of due diligence or its lack in conducted tax inspection, which assessed this issue?

In response to the interpellation, the Deputy Minister of Finance pointed out that special care should be taken in case of any doubts when establishing relationships with a contractor. Further on, he provided examples of circumstances that may indicate a high risk of tax fraud. The Deputy Minister also mentioned that the Ministry is working on a list of due diligence criteria. These measures, however, face serious obstacles. Building a closed set of rules in the form of a standard or legal act is limited. It results from the significant diversification of economic relations that necessitate taking into account a different approach to due diligence.

The next step in creating a list of reasons for due diligence in the context of taxation was the announcement of tax consultations<sup>10</sup>. They resulted in 69 opinions received from taxpayers. On the basis of this material, the Ministry announced the preparation of a list that will serve taxpayers as a guideline for checking data to be entered into information systems. This would act e.g. as an instrument that will have a protective value for honest taxpayers.

Analyzing the material that was sent during the consultations, it is possible to claim that it contains valuable information and solutions that can be used not only for the purposes of VAT settlement. The most frequently repeated inspection activities that should be performed by the taxpayer in order to verify the data before entering them into enterprise information systems are:

- obtaining information about the taxpayer's legal status;
- verification of the entity in VAT administrative registers (e.g., VAT Information and Exchange System – VIES);
- verification of data reliability in relation to entries in other administrative business registers;
- checking the possession of required licenses and permits;
- checking the contractor's solvency, i.e. checking whether the contractors pay security contributions, taxes and whether they are registered in debt records;

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<sup>10</sup> Notification on the beginning of tax consultations of 30 June 2017.

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- verification of conformity of the received goods with the invoice documenting the delivery;
  - verification of a bank account, whether it belongs to a given entity.

The above list presents an extended range of activities assigned to the following processes: (i) *manage customers and accounts*, (ii) *order materials and services*, and (iii) *manage sales orders* discussed in subsection *Process management*. The concept of risk management and tax due diligence helped to adjust process activities to the primary goal of mitigating the risk of establishing a relationship with an unreliable contractor.

As a result of this work, The Ministry of Finance in Poland (2108) published the document titled *Methodology for the assessment of due diligence by purchasers of goods in domestic transactions*. This document is hierarchically divided into three parts summarizing signals of risk grouped by the nature of activities performed by taxpayer in relationship with contractors.

- 1) Risk assessment at the start of cooperation.
- 2) Due diligence assessment during cooperation.
- 3) Due diligence assessment in a split payment transaction.

In Table 6, we give the list of signals for risk identification in the relationship with contractors in domestic transactions. It has a linear form because of its overlapping characteristics. The second column contains components of the *Methodology...* In the third column, we present the process compatible with DCF in which the identification of risk and further action of risk management should take place. It is also connected with the tax due diligence activities.

Some doubts visible in Table 6 need to be clarified. We have detected a contradiction to the theory of risk management in point 6. According to this theory, the entrepreneurs are encouraged to mitigate risk encountered in their business but the recommendation of the Ministry says that no risk in business relationships can be accompanied by high risk of involvement in an evader's transaction. This contradiction needs further investigation especially in the field of entrepreneur's perception of superficial transaction circumstances built by evaders and speculators. In point 17 we can encounter the method of split payment not clarified earlier. It has been introduced by tax authorities and is applied in many countries. It is based on the principle that taxpayers split their payment into two parts – one, consisting of payment for goods or services, is transferred to the contractor and the other, being the amount of VAT, is transferred to the tax authorities which govern the correct tax settlement of transaction.

**Table 6.** Recommendation for assessment of due diligence by purchasers of goods in domestic transactions

<b>Signals of risk pointed out by Ministry of Finance in Poland</b>	<b>Category of signal</b>	<b>Place for recognition in process map by APQC v.7.20</b>
1. Lack of contractor registration in administrative registers, e.g. VAT Information and Exchange System – VIES or National Official Business Register.	1. Risk assessment at the start of cooperation.	3.5.2 Manage customers and accounts.
2. Contractor is not registered as a VAT payer.	1. Risk assessment at the start of cooperation.	3.5.2 Manage customers and accounts.
3. During the cooperation, the contractor was deleted from the national VAT register.	2. Due diligence assessment during cooperation.	3.5.4. Manage sales orders. 4.2.4. Appraise and develop suppliers.
4. The contractor does not have, or - despite the taxpayer's request - did not submit the required concessions and permits for goods being the subject of planned transactions.	1. Risk assessment at the start of cooperation.	3.5.2 Manage customers and accounts.
5. Persons executing transactions do not have authorization to act on behalf of a contractor.	1. Risk assessment at the start of cooperation. 2. Due diligence assessment during cooperation.	3.5.2 Manage customers and accounts. 3.5.4. Manage sales orders. 4.2.4. Appraise and develop suppliers.
6. The transaction was carried out without any economic risk.	2. Due diligence assessment during cooperation.	3.5.4. Manage sales orders.
7. The taxpayer made a payment in cash or benefited from a price reduction in the case of cash payments exceeding the limits specified in the statutes.	2. Due diligence assessment during cooperation.	8.6.1. Process accounts payable.
8. The taxpayer paid for the goods by transfer to two separate bank accounts for goods and VAT, a third-party bank account or a foreign bank account in the case of domestic delivery.	2. Due diligence assessment during cooperation.	8.6.1. Process accounts payable.
9. The price of goods offered to the taxpayer by the contractor deviates significantly from the market price with no economic justification.	2. Due diligence assessment during cooperation.	4.2.4. Appraise and develop suppliers.
10. The taxpayer purchased goods classified to a different sector than that in which the seller operates, when there is no economic reason for the change of the seller's business profile.	2. Due diligence assessment during cooperation.	4.2.4. Appraise and develop suppliers.

<b>Signals of risk pointed out by Ministry of Finance in Poland</b>	<b>Category of signal</b>	<b>Place for recognition in process map by APQC v.7.20</b>
11. The contractor has a registered office or place of business at the address where there were no signs of doing business.	1. Risk assessment at the start of cooperation.	3.5.2 Manage customers and accounts.
12. The transaction was executed on conditions significantly different from those which were considered in the sector as ensuring the safety of trading.	2. Due diligence assessment during cooperation.	3.5.4. Manage sales orders. 4.2.4. Appraise and develop suppliers.
13. The contractor delivered goods that do not meet the quality requirements specified in the generally applicable provisions of law.	2. Due diligence assessment during cooperation.	4.2.4. Appraise and develop suppliers.
14. The transaction between the taxpayer and the contractor was not documented by a contract, order or other confirmation of the terms of the transaction.	2. Due diligence assessment during cooperation.	3.5.4. Manage sales orders. 4.2.4. Appraise and develop suppliers.
15. The contractor being a capital company had at its disposal share capital disproportionately low in relation to the transaction circumstances or did not have organizational and technical facilities adequate to the type and scale of business operations.	1. Risk assessment at the start of cooperation.	3.5.2 Manage customers and accounts.
16. The contractor does not have a website or is not present in social media with information relevant to the scale of the business, although it is customary in the sector in which the contractor operates.	1. Risk assessment at the start of cooperation.	Manage customers and accounts.
17. Transaction executed with split payment method, where the invoice: (a) was issued by non-existing entity, (b) acknowledges activities not performed, (c) contains amounts inconsistent with reality, (d) confirms actions to circumvent the legal act.	3. Due diligence assessment in split payment transaction.	3.5.2 Manage customers and accounts. 3.5.4. Manage sales orders. 4.2.4. Appraise and develop suppliers. 8.2.2. Invoice customer. 8.2.3. Process accounts receivable. 8.6.1. Process accounts payable.

**Source:** own elaboration based on Ministry of Finance in Poland (2018) and APQC (2018).

This method increases the level of security but does not eliminate the risk of evaders' involvement, so point 17 recommends some actions. It should also be stated that split payment may have an adverse effect on liquidity by extending tax refund dates, which can be eliminated by smooth introduction of automatic processing of SAF-T executed by tax authorities.

## CONCLUSION

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In this paper, we have proposed a framework built on the response to the need for a redesign of internal financial control procedures requiring adjustment to new conditions established after the introduction of the Standard Audit File for Tax (SAF-T) in dealing with external stakeholders like contractors and tax authorities. These conditions cover: (i) burden reduction in taxing by automation, (ii) moving from collecting aggregates to individual records, (iii) tax compliance process redesign and, (iv) increasing the taxpayer's responsibility for evaders' misconduct. The integrated approach included scientifically and practically grounded concepts, like tax due diligence, processes, and quality and risk management, together with financial control. It shaped the solution, demonstrated in the evaluation process, which can be effectively introduced by enterprises.

Data Control Framework (DCF) takes the complex, multidimensional challenges of the smooth introduction of SAF-T carried out in many countries. This solution combines many separate management concepts in one integrated approach based on the process-based foundation addressing the breakthrough made by SAF-T, not recognized by entrepreneurs, as our survey showed.

We constructed the framework by focusing on the relationships with the external stakeholders such as contractors and tax authorities. Another research area in this field is a revision, which SAF-T can induce in financial controls and audit processes implemented in the internal structure of an enterprise composed of one or more legal entities. The use of open standards like XML enforced by legal obligation on producers of the enterprise information systems opened the unrestricted use of SAF-T. Financial data collected at the level of a single enterprise, corporate group, or tax administration, becomes *ipso facto* a new dataset, open for new management research.

The integrated approach used in DCF is a key concern in its structure. There are many management concepts focused only on one issue, missing the whole picture of mutually intertwined activities performed by an individual employee. We proposed to bridge this gap by applying the integrated approach based on the process-based foundation responding to the complex challenges and threats of current and future reality. Further on, DCF can be used as a framework for research on relationships between entrepreneurs and audit authorities including the tax administration.

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### Abstrakt

*W artykule prezentujemy innowacyjne podejście o charakterze procesowym mające na celu wsparcie przedsiębiorców w dostosowaniu się do nowych okoliczności powstałych po wprowadzeniu raportowania przy użyciu Jednolitego Pliku Kontrolnego (JPK), powodującego istotną zmianę stanowiska urzędów skarbowych w postępowaniach o unikaniu opodatkowania. Ciężar przeciwdziałania temu procederowi przeniesiono z administracji podatkowej na przedsiębiorców, zwiększając tym samym ryzyko kar finansowych i odpowiedzialności deliktowej. Jednak w tym samym momencie otworzyły się nowe możliwości wprowadzenia innowacyjnych koncepcji zarządzania w zakresie kontroli finansowej, audytu i zgodności podatkowej. Aby sprostać tym wyzwaniom wykorzystywano podejście procesowe jako platformę integrującą kluczowe koncepcje zarządzania ryzykiem i jakością oraz należytej staranności, które powszechnie analizowane były rozłącznie. Cel nasz osiągnęliśmy opracowując Szablon Postępowania przy Kontroli Danych dla JPK, który zaspokaja potrzebę wprowadzenia procedur wewnętrznej kontroli finansowej odpowiadającej nowym wymaganiom kontroli skarbowej. W pracy wykorzystano dwie metody badawcze: (1) badanie ankietowe oceniające efekty wdrożenia standardu JPK w przedsiębiorstwie oraz (2) podejście projektowe umożliwiające opracowanie rzeczowego szablonu postępowania.*

**Słowa kluczowe:** Podatek od Wartości Dodanej (Value Added Tax - VAT), luka VAT, karuzela VAT, podejście procesowe, zarządzanie procesami biznesowymi, kontrola finansowa, zarządzanie ryzykiem, zarządzanie jakością, należyta staranność, Jednolity Plik Kontrolny (JPK), systemy zarządzania przedsiębiorstwem, Rozszerzony Język Znaczników (eXtended Markup Language - XML)

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# Mastering digital transformation through business process management: Investigating alignments, goals, orchestration, and roles

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## Abstract

Both business process management and digital transformation are areas that have been a topic of interest for both academia and practice. Since digital transformation is the creation of new, innovative business models and/or change and improvement of the existing business model with the help of digital technologies, one could raise a question regarding the role which business process management plays in digital transformation. With the purpose of shedding some light on that, this paper presents a theoretical framework for observing the link between business process management and digital transformation. Moreover, the results of an extensive literature review and analysis with regards to the presented framework has been given. The results confirm the important role of business process management in digital transformation. However, the results also indicate the need for further research and a greater understanding of practice.

**Keywords:** digital transformation, business process management, digital economy, digital technology, digitalization, digitization, literature review

## INTRODUCTION

Rapid development of technology, as well as many changes in the global market today, has led to the emergence of a new trend – digital transformation. As

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stated in Tapscott (1997), digital economy opportunities can facilitate the creation of new business models. Besides, he also highlights the usage of digital technology for restructuring existing business processes and models (Tapscott, 1997). Similarly, Terrar (2015) indicates that a successful digital transformation process leads to the creation of new business models, as also pointed out in the digital transformation definition debate in the work of Henriette, Feki, and Boughzala, (2015). According to Pejić Bach, Spremić, and Suša Vugec (2018), digital transformation refers to the change of existing business models as well as to the creation of new ones by implementing and using digital technologies in the process. There are many drivers for digital transformations, such as advancement in technology, the appearance of new business models, changes in expectations of the customers, etc. (Valdez-de-Leon, 2016).

On the other hand, business process management is a well-established discipline, which has been studied by many researchers and implemented in practice all over the world (e.g., Škrinjar, Bosilj Vukšić, & Indihar-Štemberger, 2008; Hernaus, Pejić Bach, & Bosilj Vukšić, 2012; Buh, 2016). Business processes are the core of every organization, and therefore, their management is of great importance in practice. However, changes that are happening on the global market also influence changes within the organizations that have to adapt to new conditions as quickly as possible in order to prosper in the market. One of the ways they are able to follow the global trends is to make changes to their business processes. Therefore, the role of business process management in digital transformation should be investigated (Van Looy, 2018).

Considering all of the above, the main goal of this study is twofold. The first goal of the study is to present an overview of the available literature regarding the link between digital transformation and business process management. The second goal of this study is to set a theoretical framework regarding the role of business process management in digital transformation that could serve as a guideline for future research, as well as a guideline for practice when conducting digital transformation initiatives.

In order to achieve the stated goals of the paper, its structure is as follows. After the introduction, a literature review is given, presenting the main ideas behind business process management and digital transformation, as well as the background for investigating the link between two named scientific areas. Next, the research methods are described in terms of the search methods for the presented literature review and the research framework. The third part of the paper refers to the presentation and analysis of the results, while in the fourth part of the paper a short discussion is given. The paper ends with a conclusion, limitations of the study, and directions for future research.

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## LITERATURE REVIEW

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### Business process management

Business process management is a field of research that has been the focus of researchers for numerous years, which does not come as a surprise given that business processes play a pivotal role within every organization. According to Reijers (2006), the basis of each organization is primarily business processes, not products or services, which is in line with the definition of business processes provided by Scheer and Nüttgens (2000, p. 376), who define it as “a procedure relevant for adding value to an organization.” Having in mind the definitions of business processes, it is very important for the organization to monitor and manage their processes in an effective way. In addition, tools and techniques for managing business processes, as well as process models, are considered to be one of the most valuable organizational assets (Turetken & Demirors, 2011; Alotaibi, 2016).

During the course of time, some authors have described business process management as a technical discipline focused on information technology (IT) with the purpose of process automation, analysis, and improvement (Zairi, 1997; Harmon, 2003). On the other side, other authors (e.g., DeToro & McCabe, 1997; Harmon, 2007) presented business process management as a managerial discipline. However, in the last decade, the understanding of business process management has shifted from focusing on an IT or managerial aspect towards a multidisciplinary and holistic view of the discipline (Rosemann & de Bruin, 2005; Grau & Moorman, 2014; vom Brocke et al., 2014; Müller, Schmiedel, Gorbacheva, & vom Brocke, 2014; Van Looy, 2017). According to Schmiedel, vom Brocke, and Recker (2013, p. 293), business process management is “a holistic management approach focused on organizational processes as opposed to organizational functions.” Hammer (2015, p. 3) views it as “a comprehensive system for managing and transforming organizational operations.” The holistic nature of business process management includes the measurement and improvement of business processes, as well as alignment with organizational strategy and goals (Bosilj Vukšić, Suša Vugec, & Lovrić, 2017). If that alignment is successful, organizations can achieve better business results (Van Looy, 2017; Harmon, 2018).

Even though business process management has existed as a discipline over a long period of time, the interest of the practice for implementation and adoption of business process management is not decreasing. On the contrary, the latest research shows that the market for business process management is expected to grow between 2017 and 2023 at 14% of

compound annual growth rate (Market Research Future, 2018), which confirms its relevance for organizations.

## Digital transformation

In the process of the ongoing digital transformation efforts in organizations, the need for systematically defining the underlying management and organizational activities emerges. Hence, different authors provide different views on digital transformation. However, a common conceptual agreement is still missing, as also pointed out in the literature reviews by numerous authors (Bosilj Vukšić, Ivančić, & Suša Vugec, 2018; Henriette et al., 2015; Reis, Amorim, Melão, & Matos, 2018).

It is important to differentiate between the terms “digitization” and “digitalization.” While “digitization” refers to changing from analog to digital (Gartner Inc, 2018a), “digitalization” refers to improving existing business models, creating new revenue, as well as value-adding opportunities with the help of digital technologies (Gartner Inc, 2018b). According to Bosilj Vukšić, Ivančić, and Suša Vugec (2018), this definitions ambiguity is commonly seen in digital transformation literature, indicating unfilled research space for systematically outlining digital transformation and its related concepts. According to Pejić Bach et al. (2018), digital technologies imply the usage of digital resources such as digital tools, algorithms, applications, and various technologies, and can be considered as the most important factor in the digital economy. Spremić (2017a) argues that digital technologies enable the efficient use of digital goods within a digital environment, aiming to create disruptive innovations that can be considered as “game changers” in the market. Digital technologies can bring many benefits to organizations in every industry, which is the main reason that more and more initiatives are being conducted, aiming to explore and exploit digital technologies (Matt, Hess, & Benlian, 2015). Hence, the term “digitalization” is more suitable for explaining the impact of digital technologies on organizations in the process of digitally transforming, while the term “digitization” should be diminished from the digital transformation debate unless being properly used. For instance, “digitization” in digital transformation initiatives can be used in medical informatics research or interdisciplinary engineering fields, as it has been used properly ever since the beginnings of computerization (see for instance the adequate use in (Akos & Tsui, 1996; Steinhubl & Topol, 2015).

Similarly to the dissolution between the terms “digitization” and “digitalization” that was stated before, the necessity for a clear differentiation between “digitalization” and “digital transformation” needs to be repeated, since a misidentification of these terms is evident, as pointed out by Bosilj

Vukšić et al. (2018). While “digitalization” has already been defined in the previous paragraph as the employment of new, digital technologies in organizations, such as cloud; augmented reality; robotics; and Big Data (Spremić, 2017a), “digital transformation” is a holistic concept that includes digital and other technologies, as well as organizational and strategic changes. Despite the occasional misidentification, a holistic definition of digital transformation is often stressed by numerous authors (e.g., Kane, Palmer, Philips, Kiron, & Buckley, 2015; 2016). For instance, Reis et al. (2018) define digital transformation as “the use of new digital technologies that enables major business improvements and influences all aspects of customers’ life.” Henriette et al. (2015) refer to it in terms of “more than just a technological shift,” but transformations having “an impact on the business models, the operational processes and the end-user experience.” Digital transformation, according to the definition provided by Terrar (2015), is the process that an organization is going through when it makes a shift “from a legacy approach to new ways of working and thinking using digital, social, mobile, and emerging technologies.” Conducting a digital transformation within an organization does not imply only the transformation of key business operations and processes, but changes in organizational structures, as well as in management concepts, ways of thinking and leading (Matt et al., 2015; Terrar, 2015). Francis (2018) summarizes five areas that are included in digital transformation, being: (i) a shift in thinking, (ii) changes in leadership, (iii) technology embracement, (iv) digitization of resources, and (v) innovation embracement. In order to lead their organizations towards successful digital transformation processes, management should encourage innovative thinking and digitization, leading to the creation of new business models (Terrar, 2015).

Moreover, Matt et al. (2015) present a framework for successful digital transformation consisting of four dimensions: (i) changes in value creation, (ii) structural changes, (iii) use of technologies and (iv) financial aspect, emphasizing the importance of the close alignment of the mentioned dimensions. On the other hand, Kontić and Vidicki (2018) argue that the main management focus should be on competitiveness, products and services, as well as on marketing, rather than on financing. Nevertheless, for conducting a successful digital transformation it is of great importance to develop a good and clear digital strategy. It is important to understand that digital strategy is not equal to IT strategy. As stated in McDonald (2012), IT strategy is mostly based on isolated technologies, while digital strategy includes the simultaneous use of several digital technologies, combines digital and physical resources, and is concentrated on specific business outcomes (McDonald, 2012; Spremić, 2017a). However, it is crucial to achieve and

maintain alignment between IT strategy, digital transformation strategy, and all other organizational strategies (Matt et al., 2015).

### **The link between business process management and digital transformation**

As has already been mentioned, digital transformation can be performed by either changing the existing business model with the help of digital technologies or by creating a new, innovative one (Pejić Bach et al., 2018). Hence, if the organization chooses to conduct a digital transformation following the direction of changing the existent business model, it implies changing the existent business processes of the organization. Additionally, the latest study on the state of business process management, conducted on 184 respondents, reveals that the majority of organizations put their focus on incremental changes and the improvement of existing business processes, in combination with adopting new technologies (Harmon, 2018). Although Tapscott (1997) recognizes that the new digital economy can lead to the creation of new business models, he also underlines the possibility of using digital technology tools in order to change and restructure existing business processes.

Consequently and as already pointed out, it seems that parts of digital transformation endeavors can be correlated with business process management in organizations. Heberle, Lowe, Gustafsson, and Vorrei (2017) argue that for successful digital transformation, it is essential to automate existing business processes within an organization by digitization, integration, and analysis of data, as well as the establishment of new business models by digitalization. In accordance, vom Brocke et al. (2017) stress the significant role that structured data along with stable, reliable, and integrated processes play in digital transformation. Moreover, de Bruin (2007) discovered that business process management initiatives are experiencing an evolution from “process improvement to business transformation.” Collaboration between digital transformation and business process management can bring new opportunities for business process management, since, according to Rosemann (2014), business process management currently lacks a proactive, opportunity, and innovation-seeking initiative.

Indeed, in the recent period, numerous members of both academia and practice have recognized the importance of business process management for digital transformation. For example, Araujo (2017), Francis (2018), and Sandle (2018), as well as Kirchmer, Franz, and Gusain (2018) view the role of business process management within a digital transformation as a central one. Moreover, Sandle (2018) explains how business process management can help in the process of digital transformation by pointing out five ways,

being: (i) the use of process engines, (ii) effective use of business analytics, (iii) effective use of content management, (iv) the use of collaboration tools, and (v) using automation to become an agile organization.

Having in mind all previously stated facts, and to the best of authors' knowledge, there is still no clear theoretical framework that combines digital transformation and business process management. Moreover, some authors indicate the need for further investigation of the role of business process management in digital transformation (e.g., Van Looy, 2018). Hence, this paper aims to shed some light on the role that business process management plays in the digital transformation process.

## RESEARCH METHODS

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### Search strategy for the literature review

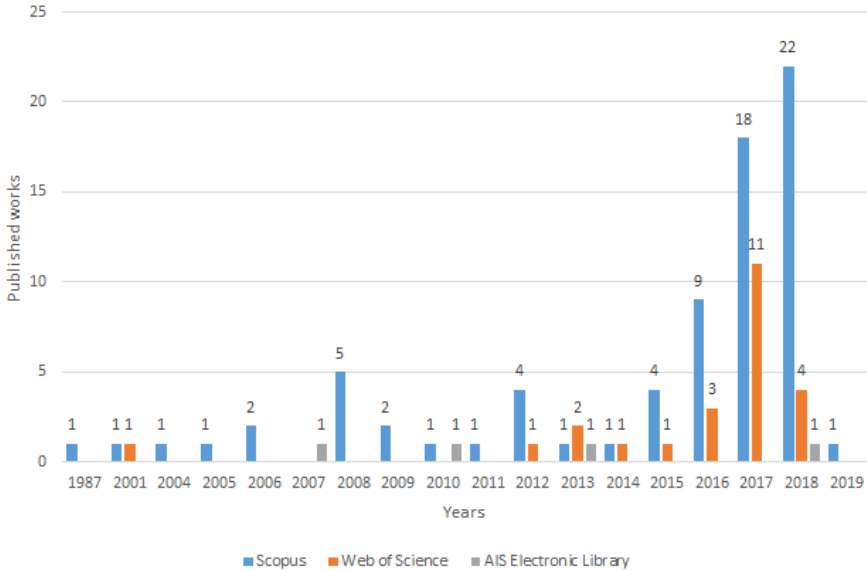
One of the goals of this paper is to review the body of literature on a given topic. In order to accomplish this goal, a literature review was conducted and carried out in October 2018.

During the literature search process, it has been essential to gather relevant papers that would support the chosen topic of this study. For this purpose, the authors have reviewed the literature on the following databases of scientific articles: Web of Science and Scopus. In addition, aiming for more precise research results, as well as a deeper coverage of the body of literature and a better understanding, the AIS Electronic Library has also been included in the search process. Taking into consideration the fact that Information Science is an interdisciplinary field, as well as the fact that there is a wide research spectrum of business process management concepts and digital transformation concepts, no restrictions for research fields have been set during the search process. Therefore, all research fields and indexes that are covered in the chosen scientific papers databases have been included in the search process. Bearing in mind that the relationship between these two concepts has only recently attracted attention from authors within scientific circles, the process of research has not been limited to a certain period of time.

Consequently, all papers written throughout the years have been taken into account in the search process. Figure 1 presents the number of published papers found in all searched databases (Web of Science, Scopus, and AIS Electronic Library). As is visible from Figure 1, it shows that only in the last couple of years has an increased interest been seen within the scientific circles for a topic related to the relationship between business process management and digital transformation concepts. Since conference



papers are key sources for the literature review process in the Information Science field (Danneels, 2016), proceedings papers, journal articles, and book chapters have been included in this literature review research. No language restrictions have been set in the literature search process.



**Figure 1.** Number of works published in the Web of Science, Scopus and AIS Electronic Library in the period 1987-2019

### The selection process of articles for analysis

The first step in this literature review has been the definition of search keywords. The focus on selecting adequate keywords has been on terms related to the concepts of business process management and digital transformation. Given that the main goal of this literature review is to identify the links between the named two concepts, the combinations of keywords that have been chosen and used in the literature search are presented in Table 1.

Considering that the terms digitization, digitalization, and digital transformation are being used interchangeably, as outlined in more detail in the Digital transformation section, a broad range of keyword combinations have been included in the search. Table 2 presents the results that have been acquired according to the above-mentioned combination of keywords for each database.

**Table 1.** Keywords combinations by searched databases

Database	Keyword combination
Web of Science	TOPIC: (“digital transformation” OR “digital business” OR “digitization” OR “digitalization”) AND TOPIC: (“business process* management” OR “business process management OR “process* management”)
Scopus	TITLE-ABS-KEY (“digital transformation” OR “digital business” OR “digitization” OR “digitalization”) AND TITLE-ABS-KEY (“business process* management” OR “BUSINESS PROCESS MANAGEMENT” OR “process* management”)
AIS Electronic Library	subject: (“digital transformation” OR “digital business” OR “digitization” OR “digitalization”) AND subject: (“business process* management” OR “business process management” OR “process* management”)

**Table 2.** Keyword combinations by searched databases

Database	Total hits	Journal articles	Conference papers	Other forms of works	Languages (number of papers)	Time period of publishing
Web of Science	24	9	15	0	English (22), German (2)	2001-2018
Scopus	75	11	53	1 article in press, 1 book, 2 book chapters, 53 conference papers 7 conference reviews	English (70), Chinese (1), German (3), Portuguese (1)	2010-2019
AIS Electronic Library	4	2	2	0	English (4)	2007-2018

A total of 103 studies have been found using the defined keywords, which could potentially be included in the analysis.

Figure 2 shows the diversity of research areas in which articles and conference proceedings papers have been published within the Web of Science database. The results presented in Figure 2 show that the majority of papers published within the Web of Science database belongs to the area of computer science (11), followed by the area of engineering (8). On the other side, a minority of the articles found, belong to the areas of cardiovascular system and cardiology, ophthalmology, library science and social sciences, and other topics (1 article in each area).



**Figure 2.** Number of published papers by research area within the Web of Science database

In the second step of the literature review, the search results have been refined. Papers that had access restrictions have been eliminated first, after which 100 papers remained for further analysis. Alongside the excluded papers with access restrictions, papers that have been found in more than one searched database have also been removed from further analysis, leaving 78 papers in the analysis. Next, due to the language barrier, papers that have not been written in English have also been removed from further analysis. Consequently, 73 papers remained for analysis. Furthermore, within the Scopus database, a total of 8 works have been excluded, 7 conference proceedings and 1 book, due to the fact that they only referred to business process management and digital transformation in their titles or introduction editorial text, and not in the content itself. Accordingly, 65 papers were taken onto the next step of the literature review process.

In the third step of the literature review, all of the papers have been read and analyzed according to their topic. Papers were considered relevant if they referred to the phenomenon of business process management and digital transformation. In each paper, the accuracy of the search keywords, as well as the topic matching of each article with the chosen topic of the research, was sought. For instance, the abbreviation BPM has been used in several articles for the expression “Beam Position Monitor,” which is not

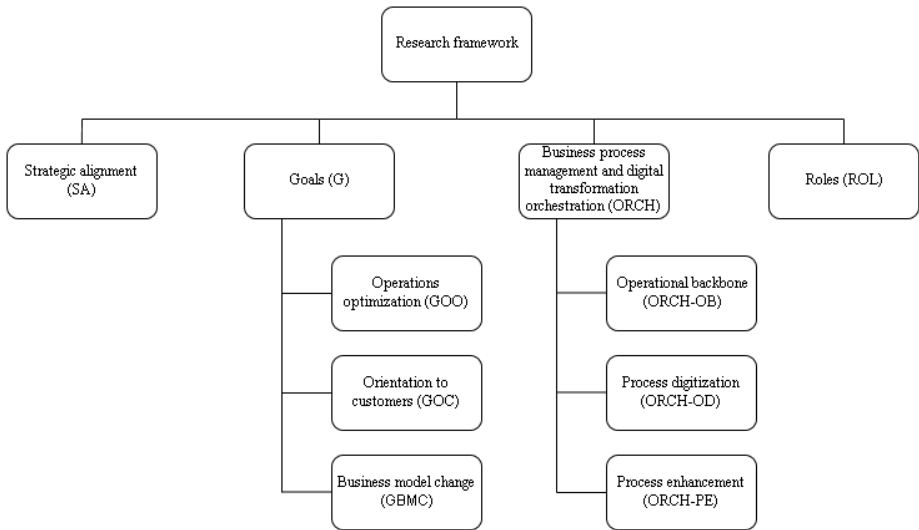
in accordance with the use of BPM as “Business Process Management.” Therefore, those papers were excluded from the analysis in this step. Papers that have also been excluded in the further analysis were dealing with the topic of business process management or digital transformation focusing on the philosophical standpoint of programming, boundary management, or describing new business modeling frameworks. Consequently, in the remaining 40 papers, including journal articles, proceedings papers, and book chapters, an analysis of linkages between business process management and digital transformation has been made.

### **Content analysis model**

Since diverse definitions of the digital transformation concept exist, this study opted for the holistic view on digital transformation represented in the works of Valdez-de-Leon (2016) and MIT Sloan researchers (e.g., Kane, Palmer, Philips, Kiron, & Buckley, 2015; 2016). For the purpose of this study, digital transformation is viewed as a phenomenon affecting all areas of an organization, induced by, but not limited to, technological changes. Moreover, business process management is observed through the lens of digital transformation in order to shed some light on the intersections and opportunities that business process management is facing in the digital transformation era.

Based on the preliminary literature review, a conceptual framework used for paper analysis has been constructed in order to systematically identify the intersections of digital transformation and business process management. A presented framework is following the works of Valdez-de-Leon (2016), Sebastian et al. (2017), and Reis et al. (2018). According to Reis et al. (2018), digital transformation comprehension can be classified into three main views: (i) technological, (ii) organizational, and (iii) social. The technological view adopts new digital technologies implementation; the organizational view focuses on business process changes, new business model introductions and consequently other management related practices; while the social view considers social factors, including the impact of digital transformation on customers (Reis et al., 2018). Sebastian et al. (2017) define three essential components for successful digital transformation: (i) a digital strategy, (ii) an operational backbone, and (iii) a digital services platform. The last two components are related to technology and are considered as capabilities for the successful implementation of digital goals set up in the strategy (Sebastian et al., 2017). Consequently, a strategic view has been added to the framework of this research.

On the other hand, Valdez-de-Leon (2016) finds that organizations address, besides strategy and technology, several other components in the process of digital transformation that form the following dimensions: (i) organization, (ii) customer, (iii) ecosystem, (iv) operations and (v) innovation. For the purpose of this review, the identified components of digital transformation in the literature overview have been merged in agreement with the holistic definition of digital transformation. This article is following, reorganized and adapted to match the research context of digital transformation and business process management intersections. Hence, a framework is organized into four main dimensions representing four views on digital transformation: (i) strategic alignment (strategic view), (ii) goals (organizational view), (iii) business process management and digital transformation orchestration (technological view), and (iv) roles (social view). Some dimensions have been divided into sub-dimensions, which are more closely connected to the business process domain, as presented in Figure 3.



**Figure 3.** Theoretical framework for investigating intersections of business process management and digital transformation

The strategic alignment (strategic view) dimension comprises organizations’ attitudes towards digital transformation and is a basis for conducting all other activities and changes in the process of digitally transforming the organization. Organizations that have a clear digital vision and a will to pursue the advantages that a transformation can bring will

actively encourage digital initiatives and devote financial investments to the development of digital projects (Matt et al., 2015; Valdez-de-Leon, 2016). To accomplish this level, an enactment of digital strategy is inevitable. In order to keep up with recent changes in the environment, but also in the organization, digital strategy is constantly evolving and being revised until at some point, reach the status where it is an organizational decision driver (Chaniyas & Hess, 2016; Valdez-de-Leon, 2016). Nevertheless, as noticed by Andriole (2017), not every organization needs to conduct a (radical) digital transformation. In their study investigation, Hess, Matt, Benlian, and Wiesböck (2016) found that organizational strategies differ in focus and scope. According to Sebastian et al. (2017), there are two main directions that one digital strategy can embrace: (i) focus on customers, and (ii) focus on digitized solutions. In both directions, business processes are likely to be altered in terms of optimization to adapt to customers' need, or they are completely digitized using new and innovative solutions. Therefore, it is possible that the processes and systems behind them are working efficiently and that there is no need to change them (Andriole, 2017), i.e. an alignment with the state of process architecture needs to be considered. Hence, a digital strategy is a "business strategy that incorporates the opportunities that the digital economy presents" (Sebastian et al., 2017, p. 198) and being such, it focuses on the "transformation of products, processes and organizational aspects owing to new technologies" (Matt et al., 2015, p. 339).

The goals dimension (organizational view) gathers activities and initiatives under digital transformation, which can be classified into three sub-dimensions according to their outcome. Those are (i) operations optimization, (ii) orientation to customers, and (iii) business model change. Some digital transformation initiatives strive to achieve greater efficiency of operations by using technologies and methods elaborated in the technological view concept (Valdez-de-Leon, 2016; Chen, Li, Wu, & Luo, 2017). Operations optimization can be joined with the means for reaching higher customer satisfaction and inclusion, often through the notions of customer experience, customer engagement, or designing a customer journey (Westerman, Calmédjane, Bonnet, Ferraris, & McAfee, 2011; Sebastian et al., 2017). Informed decisions about new digital solutions and services are brought about based on customer needs (Valdez-de-Leon, 2016). In their study, Piccinini, Gregory, and Kolbe (2015, p. 1645) conclude that digital transformation customers have "a more active role in co-production, co-creation, and problem-solving". Strong orientation to customers is also at the center of the business process management related concept of process orientation (Kohlbacher & Gruenwald, 2011). On the other hand, if digital transformation results in a change to a business model, it is a more radical change in organizations'

processes and value-chain that “generates a new revenue stream” (Schallmo, Williams, & Boardman, 2017). Some of the companies will be enforced to change their business models completely due to digital disruption in their industry. However, some can take more time and adapt through incremental changes in customer-related processes and operations (Westerman, Tannou, Bonnet, Ferraris, & McAfee, 2012).

The business process management and digital transformation orchestration dimension encompasses a technological view on digital transformation and is divided into three sub-dimensions: (i) process digitization, (ii) operational backbone, and (iii) process enhancement. Reis et al. (2018) suggested that when considering the technological aspect, new digital technologies are the root of digital transformation. So-called “primary” and “secondary” digital technologies (Spremić, 2017b, p. 215) or “SMACIT” technologies (Sebastian et al., 2017, p. 197) are utilized in organizations, including social, mobile, cloud, Internet of Things, big data technology and related methods, robotics and other. Although not every organization can digitize its products, every industry has the possibility to digitize its processes for raising the quality of services or gaining real-time decision-making data (Kohli & Johnson, 2011). Digital technologies are hence implemented for process digitization, integrated through a digital services platform, and provide agility and flexibility (Valdez-de-Leon, 2016; Sebastian et al., 2017).

Nevertheless, achieving this flexibility and speed can be daunting, since existing IT systems and business process models are often inoperable with new digital solutions or do not provide the required information (Andriole, 2017; Erjavec et al., 2018). Therefore, in order to be able to provide an adequate information flow and reliability for digitization changes, an efficient operational system in the background is required. This operational backbone includes technologies well known in information systems literature such as integral Enterprise Resource Planning systems, customer relationship management systems or business process modeling and simulation software (Andriole, 2017; Sebastian et al., 2017). Although, according to Reis et al. (2018), process change is a part of the organizational view, this paper categorized process enhancement into the technological view following the other two base-works (Sebastian et al., 2017; Valdez-de-Leon, 2016). The activities of business process management are placed under the technology dimension of Valdez-de-Leon (2016). In more detail, an alignment of the processes with digital IT architecture and the optimization of end-to-end processes are considered (Valdez-de-Leon, 2016, p. 30). Sebastian et al. (2017) point out that alongside systems integration, standardization of processes is taking place. Hence, in order to make a clear distinction between the process changes occurring in the first two sub-concepts, respectively

process digitization and operational backbone, a process enhancement sub-dimension is introduced in this view. Process enhancement indicates that process changes don't necessarily need to be driven by technology, but can be small and innovative process improvements using other available resources, as also noticed by Kane et al. (2016).

The roles dimension (social view) refers to new, digital roles being introduced in organizations and their interoperability with existing positions. In most literature, higher managing roles are investigated, i.e. CxOs alongside the introduction of the CDO (Chief Digital Officer) role (Matt et al., 2015; Singh & Hess, 2017). Similar to the prior research on business-IT alignment, where the impact and importance of the CIO (Chief Information Officer) role and other IT executives was stressed (Queiroz, 2017), the CIO-CEO (Chief Executive Officer) relationship is still discussed, but now in the context of digital transformation (Westerman et al., 2012). Although CIOs can still be found having a subordinate position, for instance in relation to the COO (Chief Operating Officer), digital transformation teams are comprised of IT, process and other business sector employees (Erjavec et al., 2018) owing to the "cross-functional characteristics" of digital transformation (Matt et al., 2015).

## RESULTS ANALYSIS AND DISCUSSION

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Within this section, the results obtained from the conducted analysis of the selected 40 papers gained through the process of the literature search are presented and discussed.

For the purposes of this paper, and the conduction of the literature review, the authors rely on a content analysis model, established through the previous research by Valdez-de-Leon (2016), Sebastian et al. (2017) and Reis et al. (2018). The model is made up of four dimensions that represent a potential link between the two concepts, business process management, and digital transformation. As previously explained, the first dimension is related to the strategic importance of business process management in digital transformation and vice versa, while the second dimension of the model considers the goals that are to be achieved in the observed company, simultaneously observing them through the sub-dimensions of business operations optimization, business orientation to customers or business model change. The third dimension of the content analysis model refers to the orchestration of business process management and digital transformation concepts, relying on the following three sub-dimensions: operational backbone, process digitization, and process enhancement. The last, fourth dimension refers to organizational roles that connect the concepts

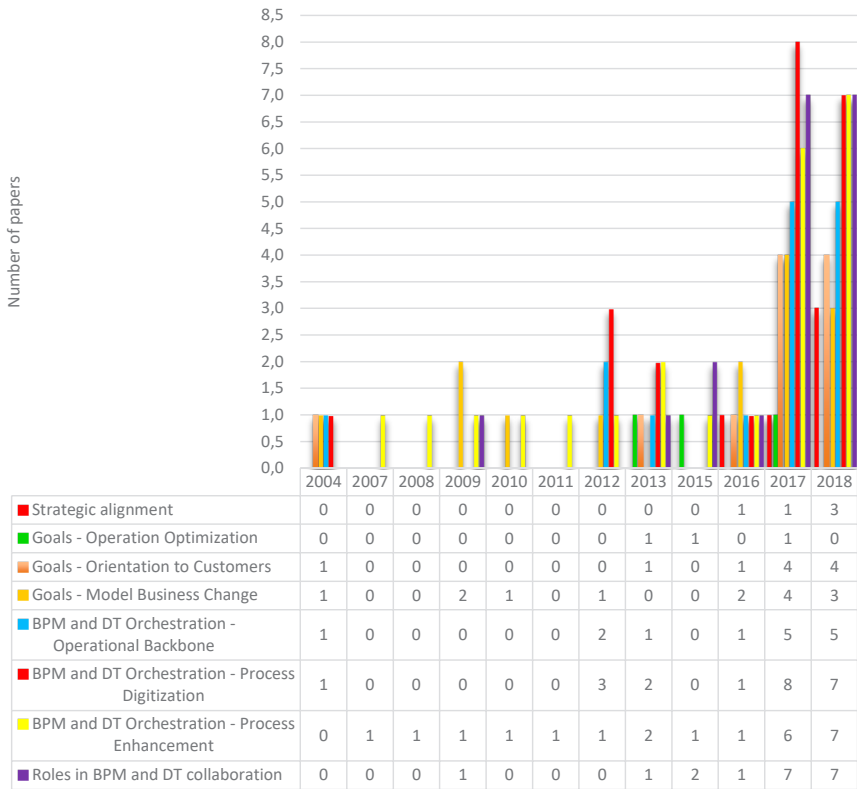


of business process management and digital transformation in a particular business segment. Therefore, all 40 papers have been analyzed according to the four categories of the selected content analysis model, and the results of the analysis are shown in Table 3.

As mentioned before, the interest of researchers in the relationship between business process management and digital transformation concepts has been growing in recent years. Therefore, for the purpose of this paper, it has been decided to examine the parts of the content analysis model through the publishing years of the analyzed papers and to show which connecting dimensions, between the business process management and digital transformation concepts, have been in the focus of researchers for each year. The results are shown in Figure 4.

As is notable from Figure 4, initially the interest in linking business process management and digital transformation has been more focused on the observation and analysis of the potential linkage among organizational goals, process digitization or creating new products, and providing new services. It is evident from Figure 4 that in 2009 the interest of researchers in the area of linking the business process management and digital transformation concepts was mostly focused on the goals of changing the business model, while the biggest focus in 2012 was directed on process digitization within business process management and digital transformation orchestration. In 2013, articles were equally focused on the links between the business process management concept and digital transformation concept in terms of improving the process within the organization and their digitization. In 2015, a leading place of interest took on the dimension of the organizational roles which appear within the organization as a result of a collaboration between digital transformation and business process management. It is evident that the biggest number of papers that are related to the topic of the relationship between business process management and digital transformation, in the context of all categories within the chosen model, have been published in the last two years. The three most often contained categories of the content analysis model within the analyzed papers are: (i) business process management and digital transformation orchestration – process enhancement, (ii) business process management and digital transformation orchestration – process digitization, and (iii) roles in business process management and digital transformation collaboration.

### Analyzed model's components vs publishing years of papers (n=40)



**Figure 4.** Frequency of appearance of the components of the model within the analyzed articles by publication year

Each paper has been read in detail, observed and, according to the content, assigned to one or more dimensions based on the content analysis model. Consequently, Table 3 has been prepared, showing the dimensions of content analysis model and the papers assigned to each dimension according to its content. Table 3 contains all papers listed by the authors of the paper. In addition, each component of chosen content analysis model has been coded, as shown in Figure 3.

**Table 3.** Matrix of analyzed papers (in alphabetical order)

Paper	SA	GOO	GOC	GBMC	ORCH-OB	ORCH-PD	ORCH-PE	ROL-BPMDT
Cocca, Marciano, Rossi, and Alberti (2018)		+	+		+	+	+	+
Dallasega, Rauch, and Frosolini (2018)		+					+	+
Denner, Puschel, and Roglinger (2018)								+
Faria and Nóvoa (2017)						+	+	
Feibert, Hansen, and Jacobsen (2018)		+	+		+		+	
Fleig and Maedche (2017)							+	+
Flores, Vera, and Tucci (2009)				+				+
Glykas (2004)			+	+	+	+		
Grabis and Kampars (2018)					+	+	+	
Heberle, Löwe, Gustafsson, and Vorrei (2017)		+	+	+	+	+	+	
Heliades, Halkiopoulos, and Arvanitis (2017)						+		
Herzberg and Kunze (2015)		+					+	+
Hildebrandt, Debois, Slaats, and Marquard (2017)						+		
Imgrund, Fischer, Janiesch, and Winkelmann (2018)					+	+		+
Joubert, and Roodt (2010)				+			+	
Karla, Friedrichsn, and Braun (2011)							+	
Kirchmer (2015)								+
Kirchmer, Franz, and Gusain (2018)	+					+	+	+
Kirkham, Wood, Winfield, Coolin, and Smallwood (2009)				+			+	
Komarov, Konovalov, and Kazantsev (2016)				+				
Lederer, Betz, and Schmidt (2018)	+	+		+	+	+	+	+
Lederer, Betz, Kurz and, Schmidt (2017)				+	+	+		+
Lederer, Knapp, and Schott (2017)			+		+	+	+	+
Leyh, Bley, and Seek (2017)	+							+
Manferdini (2012)						+		
Manfreda (2017)			+	+	+	+		+
Mathrani, Mathrani, and Viehland (2013)		+	+		+	+	+	+

Paper	SA	GOO	GOC	GBMC	ORCH-OB	ORCH-PD	ORCH-PE	ROL-BPMDT
Neubauer and Krenn (2017)					+	+		
Oberhauser, Pogolski, and Matic (2018)						+		
Paschek, Luminosu, and Draghici (2017)							+	+
Rohner (2013)						+	+	
Roszkowska (2017)				+			+	
Seidel, Adams, ter Hofstede, and Rosemann (2007)							+	
Sienou, Lamine, Karduck, and Pingaud (2008)							+	
Sun, Chang, and Wan (2012)					+	+	+	
Van Looy (2017)			+					+
Van Looy (2018)	+		+					+
Vom Brocke et al. (2016)	+		+	+	+	+	+	+
Wang and Zhang (2012)				+	+	+		
Warnecke, Gevorkjan, and Teuteberg (2018)						+	+	

As can be seen from Table 3, when it comes to strategic alignment between business process management and digital transformation concepts, a total of 5 papers deals with business process management strategic implications within digital transformation and vice versa. For example, Kirchmer et al. (2018) argue that business process management is a source of significant value for organizations, in terms of transforming strategy into execution based on people and technology, and therefore plays a central role in the process of digital transformation by enabling digitalization and constant strategy execution. On the other hand, Van Looy (2018) indicates that service delivery to customers and stakeholders, operational excellence, and expansion are the shared strategic reasons between business process management and digital transformation.

In the case of highlighting organizational goals as a linkage between the business process management and the digital transformation concepts, out of 40 selected works, 20 of them are relying on one or more of the three sub-dimensions that fall under the dimension of goals. Out of those 20 papers, in 7 of them, business optimization goal is mentioned. Furthermore, in 10 works, authors mention business orientation towards customers as a goal, while most of the papers (12 of them) mention the goal of business model change as the link between the business process management and the digital transformation concepts. Based on the obtained results, it is interesting to

notice that the most common combination of business goals, contained in the selected papers, is the combination of business orientation towards customers and changes in the business model. Cocca et al. (2018) conducted research in a manufacturing company striving to become a “smart factory.” According to them, the transformation was provoked by the high volatility of external business factors in the environment, as well as the change in customers’ expectations (Cocca et al., 2018). Customers are becoming more demanding in their requirements, as also noticed by Feibert et al. (2017), expecting high-quality and tailor-made services, even if core business is product-based (Cocca et al., 2018; Glykas, 2004). At the same time, they strongly anticipate those new digital services offering to be free of charge (vom Brocke et al., 2016). In such a customer-oriented atmosphere, operations optimization through the analysis of supply chain management can establish end-to-end business process integration in order to create added-value for customers (Feibert et al., 2017), which is consistent with (re)designing customers’ journeys.

Regarding innovation potential, Van Looy (2017) investigated the BPM and digital innovation relationship in organizations and found them to be complementary, however, the direction of the influence is still not clear. Innovations and improvements in the performance of operations are often linked with an external knowledge source. Digital enterprises reach out to the academic community to solicit ideas and gain professional knowledge on implementation and evaluation methods (vom Brocke et al., 2016). Moreover, according to Roszkowska (2017, p. 53), “most organizations need digital transformation to effectively access external knowledge.” When it comes to more significant changes in influencing business models, some companies are radically changing their ways of work by deploying numerous information and communication technologies. An example of this kind is the disruptive pressures in the publishing and printing industry (Glykas, 2004). Discussion on the level and source of innovations, and resultant changes, can be stressed in relation to incentives for an ambidextrous organization and exploitative and explorative BPM capabilities (van Looy, 2017; 2018; Roszkowska, 2017). Besides the more momentous change to the underlying business model intertwined with the incremental optimization of business processes that ambidexterity is offering, a third concept regarding the organizational business model is noticeable. Use of technologies and exploitation of data that is now being both collected and analyzed enables the existence and creation of various business models within one organization, specifically arranged for different users (Kirkham et al., 2009). Kirchner (2013, p. 131) notices that “static business models are no longer able to keep pace with such dynamic change.” Lederer et al. (2017, p. 4) refer to this phenomenon as “case-driven BPM,” which is in line with other authors

arguing that business processes are becoming more dynamic and require flexibility (Heikkinen & Hilgarth, 2016).

The orchestration of business process management and digital transformation concepts, in one or more of its dimensions, is contained within 34 of the 40 selected and analyzed papers. When talking about the orchestration of business process management and digital transformation concepts in terms of “Operational Backbone” and, therefore, about the application of standard systems such as Enterprise Resource Planning systems or generally so-called core IT in business, according to the results, it is noticeable that 15 papers in some way touched upon this kind of linkage between these two concepts. Information and communications technology have great importance as a backbone in the process of digitalization (Feibert et al., 2017). According to Cocca et al. (2018), an Enterprise Information Planning system is considered as the backbone of digital transformation and a key trigger in supporting the implementation processes of this concept within an organization. In the case of shipping companies within the maritime transport industry, information and communications technology as an operating platform brings many business advantages, such as supporting supply chain management, increasing the quality and efficiency of services provided to customers, lessening business costs, etc. (Feibert et al., 2017). According to Kirchmer et al. (2018), various digital technologies and tools greatly support the digitalization of processes within organizations. Therefore, process digitization, as the second dimension of a goal dimension, as it has been defined within the model, has been observed through the use of two different digital technologies in business. According to Spremić (2017b), primary digital technologies include the appliance of mobile technologies, social networks, cloud computing, big data, sensors, and the Internet of Things. The use of primary digital technologies such as cloud-based services opens the path for a possible change from existing internal processes into a connected intelligent business process sequence, which creates new values in the digital transformation environment (Lederer et al., 2017). The application of secondary digital technologies is oriented towards technologies such as additive manufacturing (3D printers), drones, wearable technologies, holograms, virtual and augmented reality, cognitive technologies (artificial intelligence), deep learning algorithms, facial and speech recognition, etc. (Spremić, 2017b). When observing the digitalization process within the management of processes in the organization, digital tools such as processes automation supported by robot technology, process modeling tools, data mining tools, technologies that are appropriate for analytical processes, etc. are being emphasized (Kirchmer et al., 2018). Also, digital technologies such as drones, robotics, mobile technology, Internet of

Things devices, wearables, virtual and augmented reality, etc., contribute to business processes digitalization and, consequently, to the quality of business performance within the organization (Heberle et al., 2017). According to the results, a total of 22 papers contained one of the technologies mentioned above that supported digitization of the process in a particular business segment. The dimension within the model's component pertaining to the orchestration of business process management and digital transformation concepts and which concerned process improvement was mentioned in a total of 23 articles out of the total number of analyzed articles. According to research results conducted by Mathrani et al. (2017) within three different companies, the process enhancement that was supported by the application of digital technology and digital business strategy was visible through reduced number of errors in the process of price structuring, improved manufacturing, and supply processes, increased organizational competitiveness, automated marketing processes, improvement of production planning and delivery services, better customer service, etc.

When discussing the organizational roles that emerge from the collaboration between business process management and digital transformation concepts, it can be seen from the results that 19 articles recognized the importance of this dimension by mentioning one of the organizational roles through managing the digital transformation process in the organization, participation in the digital transformation of business processes or in another collaborative form that links digital transformation and business process management. Such a high number of papers dealing with this topic confirms its importance. According to many authors, the organizational roles involved in the collaboration between digital transformation and business process management can appear as process owner program manager, participation of internal and external stakeholders, participation of customers, project manager, CIO, Chief Technology Officers (CTO), CEO, CDO, IT process managers, etc. (e.g., Van Looy, 2018, Imgrund et al., 2018, Dallasega et al., 2018, Paschek et al., 2018)

## CONCLUSION

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This study presents the results of the literature review on the link between digital transformation and business process management. First, the strategy for the literature search was set. Then, the literature search was conducted, performing searches within the Web of Science, Scopus, and AIS Electronic Library databases, resulting in overall 40 different papers that have been further analyzed in this paper. Next, following the works of Valdez-de-Leon

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(2016), Sebastian et al. (2017), and Reis et al. (2018), a theoretical framework has been developed. The presented framework consists of four dimensions and several sub-dimensions, as explained previously in the paper, which has served as a basis for the content analysis of the results gained by the literature search.

The results of the content analysis indicate that only a small number of authors understand the importance of strategic alignment, which is an indicator that further research is needed in order to deepen the understanding of the topic. Moreover, according to the results, the dimension of business process management and digital transformation orchestration, which consist of three sub-dimensions: operational backbone, process digitization, and process enhancement; occupied the greatest interest of authors in the analyzed papers. In addition, improving processes within the organization was the most common sub-dimension linking the concepts of digital transformation and business process management.

The results regarding digital transformation efforts and goals indicate a greater orientation to customers, who demand a high quality of offered services, tailored according to their needs, even in the case of the primary physical industries. These outcomes can be achieved by rethinking end-to-end customer processes through supply chain management. Hence, organizations employ diverse technologies and optimize their operations taking into consideration specifics and requirements of a business. Consequently, digital transformation does not need to drastically change ways of work to the extent that it involves changes in the underlying business model. Nevertheless, the need for greater process flexibility, induced by a customer-centric business and the dynamics of the environment, leads to the novelty of occurrence of multiple business models in one organization. This is consistent with the possibilities that an ambidextrous organizational design is offering. Moreover, a dynamic business model setup where the models' architecture is adapted to suit goals of a certain consumer can be correlated with case-driven BPM, which imposes new opportunities for business process management development and research investigation. Finally, the results regarding the role dimension of the model indicate the importance of understanding the organizational roles in the collaboration between business process management and digital transformation.

In the end, the research framework or content analysis model that has been presented in this paper, which is based on the literature overview and supported by the analyzed literature review papers, is proposed as a theoretical framework for further investigation on business process management in the digital era, especially in relation to digital transformation initiatives and projects in organizations.



Although this study extends the body of knowledge, there are certain limitations that need to be recognized. One of the limitations refers to the limited access to databases and papers which the researchers had during this study. Another one is the language barrier because of which some of the hits from the literature search had to be dismissed. As for future research plans, one of the possible directions for future research could be to expand the literature search to other databases, besides the three searched for the purpose of this paper.

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### **Abstrakt**

*Zarówno zarządzanie procesami biznesowymi, jak i transformacja cyfrowa to obszary, które były przedmiotem zainteresowania zarówno środowiska akademickiego, jak i praktyki. Ponieważ cyfrowa transformacja to tworzenie nowych, innowacyjnych modeli biznesu i/lub zmiana i doskonalenie istniejącego modelu biznesu za pomocą technologii cyfrowych, można postawić pytanie dotyczące roli zarządzania procesami biznesowymi w transformacji cyfrowej. Aby rzucić na to nieco światła, niniejszy artykuł przedstawia teoretyczne ramy dla obserwacji związku między zarządzaniem procesami biznesowymi a transformacją cyfrową. Ponadto, podano wyniki obszernego przeglądu literatury i analizy w odniesieniu do przedstawionych ram. Wyniki potwierdzają ważną rolę zarządzania procesami biznesowymi w transformacji cyfrowej. Jednak wyniki wskazują również na potrzebę dalszych badań i lepszego zrozumienia praktyki.*

**Słowa kluczowe:** transformacja cyfrowa, zarządzanie procesami biznesowymi, gospodarka cyfrowa, technologia cyfrowa, digitalizacja, digitalizacja, przegląd literatury.

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# Implementing a decision support system in the transport process management of a small Slovak transport company

Miroslava Nyulásziová<sup>1</sup> , Dana Paľová<sup>2</sup> 

## Abstract

*It is indisputable that the continuous development of digital technologies influences the business environment. Using information technologies means easier access to a huge amount of business information, which is hard to include in day-to-day decision-making. Traditional data processing methods in business management become inadequate. So, business process management approaches and business data analysis are the tools that could be utilized to optimize processes in a company and to harvest valuable information that can provide a variety of decision-making material for company management. This article deals with the analysis, modeling, and optimization of the transport process, as well as the design of a system for decision support in this process within a small transport company. The research is focused on the development of an innovative decision support system based on a company's data analysis in order to improve the management of the transport service process.*

**Keywords:** *decision support, transport service process, data analysis, enterprise management*

## INTRODUCTION

Gartner (2018) defines Business Process Management (BPM) as “a discipline that uses various methods to discover, model, analyze, measure, improve, and optimize business processes.” The aim of BPM is to support the core objectives of the company. Davenport and Short (1990), define processes as a set of logical tasks or activities, which aim to achieve defined business goals.

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Implementing BPM principles into business management helps to analyze the current state of the company in total, or each department individually, and identifies areas for improvement within a company. Implementation of BPM is not a simple matter and it is as strongly influenced by the internal situation in a company as it is by the external factors (Gabryelczyk & Roztocki, 2018). The positive impact of introducing BPM technology is visible in improved productivity, cost savings, and flow-time reduction. The implementation of workflow management and straight-through processing methods results in automation throughout the core business processes of the company (Aalst, 2013). The new digital technologies enable and support growth and innovation in the new business environment (Vom Brocke & Mendling, 2018). At present, technologies influence the business strategy of the company itself and present a key to aligning IT investments with the business strategy. The objective of employing IT solutions into the business environment is to support work organization and the conjunction of the tasks needed to be done with the available company resources. To optimize the business process and its management, it is not enough to provide tasks and employees with smart tools, as it is important to analyze the connection amongst process activities within the process workflow, employees involved in the process, and data produced during the process lifecycle.

A rapid increase in digitalized data creates space for systematic business processes data collection. The extraction of these is a challenge because business informatics covers different kinds of information systems (ERP, CMS, SCM, etc.) with a huge amount of different data. One of them, with considerable potential, is logistics and its processes. Thanks to the significant development of information technologies (IT), optimized logistics presents a key factor in supporting the competitiveness of companies in the market. Logistics is the process-oriented activity of a company and presents a complicated system containing the number of goods and information flows, the amount of which grows at the management level (Chow, Choy, & Lee, 2007).

The main problem of logistics processes (including its transport service sub-process) in a company is the appropriate analysis of a huge amount of data (weather forecast, vehicle data, driver data, data about goods transported, etc.) created and collected from the different sources used during the process itself (Khabbazi, Hasan, & Sulaiman, 2013; Chung & Gray, 1999; Bardi, Raghunathan, & Bagchi, 1994; Lee & Park, 2008; Khabbazi, Ismail, Ismail, Mousavi, & Mirsanes, 2011). The main aim of the research presented in this paper is the introduction of the appropriate analytical methods that make it possible to improve the sub-process of drivers' assignments on particular routes, in the case of a small Slovakian transport company. It presents one of sub-processes of the main process in the mentioned

company. In addition, we describe the development of an automated system, which is able to download available data from the company's vehicles and, using data mining models, provide up-to-date and accurate information for company management. Finally, we present the results obtained from the implementation of this system into the company's environment. From a BPM point of view, the designed system allows one to get a more complex overview of the transportation process, especially about utilizing its resources (drivers, vehicles, fuel, etc.), which leads to a growth in the competitiveness of the company and more effective company management.

## LITERATURE REVIEW AND RESEARCH BACKGROUND

At present, logistics, and particularly transportation services, are considered as an integral part of modern society. With logistics, it is important to consider the processes of planning, organizing and managing material flow, stockpiling, and the provision of services and related information from the place of origin to the point of consumption (Aalst, Adriansyah, Medeiros, & Arcieri, 2011; Ma, Xie, Huang, & Xiong, 2015). It should be stated that logistics is generally process-oriented. Analyzing and improving every process in a company could lead to a better performance of the company. Based on Dumas, Rosa, Mendling, and Reijers (2013) and Rosemann and Brocke (2015), Business Process Management (BPM) consists of six phases:

- 1) Design – associated with the identification of current business processes. The result is a new or updated design process. In addition, at this stage, the tasks and responsibilities of the team members are defined, and the purpose of the process and the expected results are determined.
- 2) Modeling – represents the possibilities of running processes in different scenarios. This is a what-if analysis. The aim is not only the processing of the modeling techniques but also the processing of the analytical methods.
- 3) Implementation – related to the transformation of the models into executable processes. It includes two aspects - organizational change management and process automation. Model implementation includes, amongst other things, the creation of the process streams, data mapping, user interface creation, resource integration, and company systems usage, user, and role settings.
- 4) Execution – this phase involves testing by users and, in the case of a functional process, deploying the process in companies. It also includes employee training or organizational changes related to the new processes.

- 5) Monitoring – once the process has started, relevant data are collected and analyzed, process efficiency is measured, and progress is identified. The goal is to determine whether the process is successful in relation to the set goals.
- 6) Optimization – a phase that includes methods to facilitate process development and enhancement. At this stage, mistakes or deviations and any changes needed to be implemented to make the process more efficient are recorded. However, the process is continuously improved according to the six mentioned phases.

Process analysis is a relatively young area that does not include only process of modeling, but it combines multiple disciplines (BPM, visualization, optimization, machine learning, data analysis, etc.) (Aalst et al., 2011). Combining multiple disciplines, it overcomes the limitations of the abstract processes. In addition, using process analysis is it possible to use new data to generate useful information within the business environment and to generate predictive and optimization models that may result in an improvement of business processes. From that point of view, process analysis combines the idea of modeling processes with data analysis methods, and the involvement of data mining methods means the deployment of information technology into business processes. Data mining itself is used only in those steps of the business processes where decisions are needed to be made (Chung & Gray, 1999).

At present, data analysis has increasing importance. Data analysis was mentioned for the first time at the beginning of the 1990s, together with the concept of data mining in databases. The first data analysis experiments began with data from databases filled with customer, product, and transaction information (Fayyad, 1996). From this viewpoint, we can understand data analysis as a process of selecting, exploring, modeling, and visualizing a large amount of data with the aim of discovering patterns or relationships that are not yet known. This way it is possible to get clear and more obvious results and use them to improve the process of analysis. The new technologies and data mining tools provide organizations with new insights from previously unused data sources (Terek, 2010).

Another article (Giraldo, Jiménez, & Tarabes, 2015) concluded that data mining, when applied to business data that supports processes, can improve business management as well as the achievement of enterprise objectives. The results of the case study mentioned in the article suggest that the integration of process management and data mining is a good choice for business (Giraldo et al., 2015). The authors of another article (Vukšić, Bach, & Popovič, 2013), pointed out the importance of linking BPM with enterprise information systems that result in better business performance. Aalst et al.

(2011) were focused on extracting, processing, and analyzing data stored in BPM systems. The authors presented a methodology usable for extracting events, especially related to logistics company processes. Based on the data obtained and analyzed by data mining techniques, they showed that by using these methods, the shortcomings in the purchase order process could be identified. And finally, by analyzing and reconstructing partial processes, the logistics business process could be optimized, and the rules, overall knowledge, and the knowledge gained from data mining methods could be used by other business processes or for business management support, especially for decision-making. The author in the article (Feelders, Daniels, & Holsheimer, 2000) discussed the use of data mining in business processes, focusing on integrating models into the existing application systems of the enterprise. Because of this research, the author argued that it is important to use data mining methods to manage business processes.

Data mining technologies can help businesses collect and analyze various logistics management information in a timely and accurate manner. Data mining and related technologies can significantly help to improve the logistics decision-making process, to improve the quality of data analysis, to improve the quality of the service provided, to increase reliability, and so on (Daoping & Xiaojing, 2010). From previous facts it follows that data analysis and logistics are closely related. Logistics companies generate huge amounts of data that has the potential for new, further analyzes on a daily basis. The placement of various sensors on vehicles, inventory management, tracking of shipments, etc. - all these procedures allow one to generate a large amount of data (Berglund, Laarhoven, & Sharman, 2006). For logistics companies, it is difficult to extract valuable information from such a large amount of data to make timely and accurate decisions that are used to manage the business process and logistics itself; therefore, it is difficult to reduce logistics costs and increase enterprise revenues (Daoping & Xiaojing, 2010). Data itself and data analysis represent a source of inspiration for the logistics service providers to develop new business models, based on the analysis of the correlations between, for example, weather conditions, influenza epidemics and consumer internet purchases. This analysis can help to discover, for example, that bad weather leads to a higher realization of internet purchases, which means a higher number of packages sent (Paul & Saravanan, 2011). Such kinds of models can help to optimize processes and can result in an increase in customer satisfaction (Asef-Vaziri, Laporte, & Ortiz, 2007). At present, the optimization of logistics processes is the greatest opportunity to achieve cost savings, to improve decision-making, and to optimize inventory and mode of transport selection.

Recently, various research studies have highlighted the benefits of using data in the logistics process. Finding a good solution to the problem of vehicle



and driver planning is extremely challenging due to complexity and different constraints (Peng, Li, & Yuanyuan, 2009). It is difficult to find the optimal solution leading to cost minimization (Golden, Raghavan, & Wasil, 2008; Boonprasurt & Nanthavanij, 2012). Goel and Irnich (2016) and Chen (2013) dealt with the problem of crew planning and their results demonstrated that effective crew planning could significantly reduce the operating costs of a company. The research of Laurent and Hao (2007) dealt with the problem of crew and vehicle planning in a limousine rental company. The objective was to find a way to maximize driver employment and optimize some of the economic objectives of the company in real-time and company resources management (e.g., scheduled drives could be canceled or modified at the last minute according to customer requirements). The main objective of the research done by Portugal, Lourenço, Paixão (2009) was to introduce new mathematical models explaining the complexity of crew planning and to present the easiness of the implementation of these models into real situations. The researchers introduced a generalized crew planning problem, where the user requirements are considered. Development of these models was based on the wide cooperation amongst different Portuguese bus transportation companies. The authors followed the operational research methodology steps (problem identification, system understanding, mathematical model formulation, model validation, best alternative selection, results presentation, implementation, and evaluation). The main goal was to find a model that can be integrated into the decision-making information system used for crew planning. The shortcoming of this research is that the authors do not consider drivers' working time, EC Regulation No. 561/2006, and the problem of minimizing cost. Huisman and Wagelmans (2006) researched the problem of crew and vehicle planning using a dynamic solution based on the optimalization problem sequence. The authors in their research consider restrictions such as maximum working time, minimum break time, and so on. The suggested approach was tested on a small data set in one company and in a one-week planning horizon. The shortcoming of the described approach is the calculation time – it is too long to apply in practice and will not be easy to test in a practical environment, and for multiple warehouses, the dynamic approach does not work well.

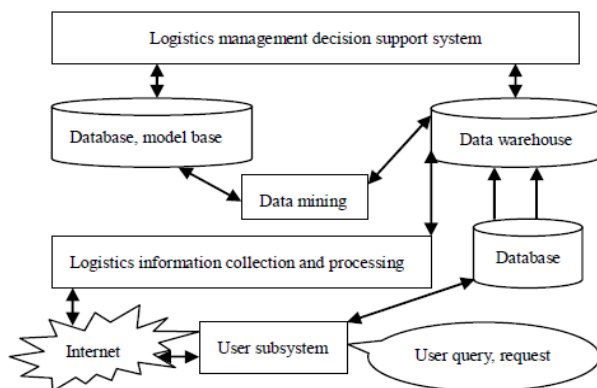
The growing amount of data and its processing has become an important part of decision-making in logistics management. Data mining technologies are becoming more and more effective in modern logistics (Zhang & Zhang, 2015). Decision support models based on data acquisition overcome difficulties in analyzing business decisions. Modern logistics management depends on access to accurate and timely information (Langley, 1985). The structure of a modern logistics management system based on data mining is

illustrated in the following Figure 1. The modern logistics management system consists of two main parts (Cogna & Huifeng, 2009; Liu & Guangsheng, 2008):

- data warehouse technology that allows one to store more historical data obtained from logistics activities as a database. It provides features to use historical data to predict and analyze trends and market sales. At the same time, data warehouse technology can describe and organize a vast array of diverse logistical management data that helps all members of the supply chain share logistics information;
- overall system design – because the knowledge base has been designed and implemented, decision-makers can easily select and use knowledge through a visual interface without a deeper understanding of the decision-making system, data warehouse, data mining, and other related activities.

Based on (Cogna & Huifeng, 2009), (Liu & Guangsheng, 2008), as shown in Figure 1, parts of the system and their features could be described by the following:

- logistics management decision support system – this system can provide logistics companies' managers with the latest and most important knowledge that helps them to make the right and valid decisions (e.g., unified distribution of freight, driver load, vehicle load, motivation, and driver remuneration) (Strömberg & Karlsson, 2013);
- data mining module – according to the purpose of the logistics management decision (Lai, 2015) the algorithms for data mining (artificial neural networks, decision-making storms) (Laxhammar & Gascón-Vallbona, 2015), Naive Bayes classifier (Ferreira, Almeida, & Silvia, 2015; Muchová, Paralič, & Nemčík, 2017), clustering (Vogetseder, 2008)) are chosen and applied to the data in the database. This step extracts and cleanses useful information that is translated into a simplified form of the data.
- database and data warehouse – all business-related data are collected in databases and further organized, aggregated for on-line analysis into a data warehouse. Depending on the data mining characteristics and missions, the data needed for further analysis is selected (Huai, Shah, & Miller, 2005), (Ferreira et al., 2015);
- data collection and processing – the huge amount of data that is derived from logistics activities is collected, processed, transmitted and stored in the database in the format of the platform;
- user's subsystem – users can access the system's web interface through a corresponding protocol and send queries and requests to the system.



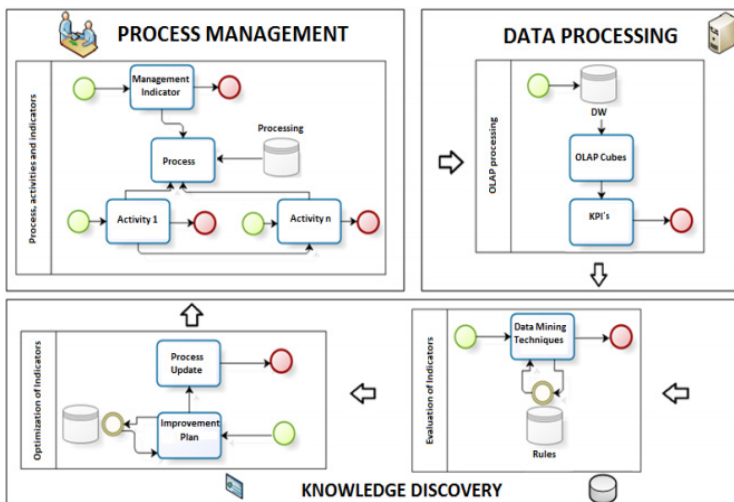
**Figure 1.** The structure of a modern logistics management information system

Source: Cogna & Huifeng (2009).

A decision support system (DSS) is an information system that supports business or organizational decision-making. It is a system that can analyze business data and present it in a form that makes it easier to make business decisions (Sauter, 2011; Moreno, Camacho, & Barrero, 2010). A properly designed decision support system is an interactive software system with goals like to identify and solve problems and make decisions. The decision support system has its substantiation even in logistics and its sub-processes. Moynihan, Raj, Sterling, and Nichols (1995) describe the design and development of a decision support system that uses heuristic simulation techniques to plan logistics and distribution activities and measure their impact on corporate profits. The proposed system was tested by industry experts. However, the system is not sufficient to quantify the costs and is insufficient to properly assess the impact of changes in the marketing and distribution environment. Hu and Sheng (2014) are concerned with the design of the decision support system for managing and optimizing public logistics information services for drivers, logistics customers, and relevant logistics and management service providers with the goal to minimize emissions. The basis of the proposed DSS is to provide real-time dynamic information with an aim to minimize logistics costs, energy, and pollution. The authors propose DSS as part of the management and optimization of logistics information services in China. Fanti (2015) deals with the design and development of a decision support system that can manage the flow of goods and business transactions between individual ports. DSS architecture is designed using simulation and optimization modules. The companies which want to use the proposed system must take tactical and operational decisions

in logical systems. Simulation results show that the application of modern ICT-based solutions has enormous potential for efficient real-time traffic management, reducing delivery times in ports. The simulations also pointed out the possibility of reorganizing the workflow to exploit human resources more appropriately. DSS was also developed by Sperger and Mönch (2014), where the kernel of the system was based on a distributed hierarchical algorithm using company data stored in ERP. The system was used in the field of cooperative transportation planning. This system was also used to offer graphical user interfaces to interact with the users.

The integration of data mining into business processes is not a trivial task, even though BPMs provide flexible support for design, deployment, and business process management (Wegener & Rűping, 2010). Research, however, is still pointing to the limitations of literature on the effective use of BPM knowledge and data mining (Vukšić, Bach, & Popović, 2013; Kang, Kim, & Kang, 2012). The integration of data mining into BPM is illustrated in the following Figure 2. It consists of three main components. One of them is process management. In this step, process management activities are defined. Another component, data processing, consists of collecting data from a data warehouse (for example using OLAP cubes). OLAP cubes are a multidimensional way to show the relationship between data. In the next step is it possible to apply data mining techniques through knowledge discovery. The obtained knowledge is used to update company business processes.



**Figure 2.** Integrating BPM and data mining

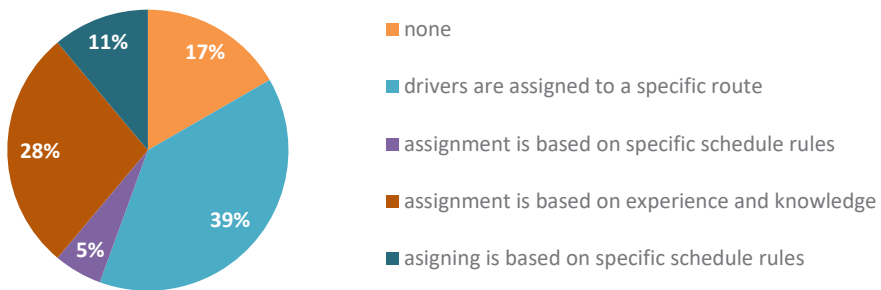
## METHODOLOGY

### Research motivation

In order to map the level of the automation transport processes amongst small Slovakian transport companies, a questionnaire survey was conducted in September 2016. Based on a predefined set of questions focused on fields like driving style analysis, use of information technology and way drivers are assigned to a planned delivery route, transport companies were asked to answer the questions and provide data that was later analyzed and interpreted.

By analyzing the responses from all the respondents, an attempt was made to verify whether the research proposed in this study would be interesting in practice as well. More than 300 logistics and transport companies were contacted.

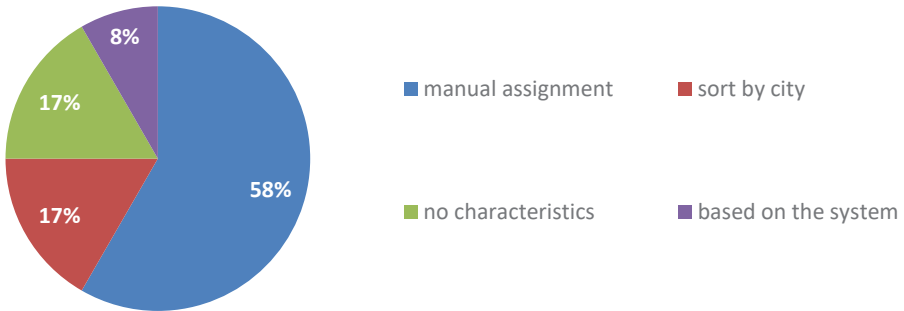
One of the questions was focused on the practical usage of the system for proposing or deciding the assignment of drivers to routes by particular respondents. From the responses, about 10% of the respondents stated that they could not imagine using this system, 40% of the respondents would probably not use this system, while the other 50% would like to use such a system in their companies. In practice, drivers are assigned to specific routes by applying different principles. Figure 3 represents the distribution of the particular principles among respondents' companies.



**Figure 3.** Answers to the question obtained through the questionnaire survey

Another question was related to the way drivers are assigned to the planned delivery route, whether such assignment is based on using an automated system or if the assignment is manually based on some characteristics or features. According to the graphical summary of the responses in Figure 4, it can be seen that more than half of the companies assign their drivers to the delivery route manually, mostly according to the

senders, recipients, weight, and size of the goods, size and load capacity of the vehicle. Companies also take into account the number of routes and, finally, compliance with transport legislation (adherence to rules for rest days). 17% of the companies surveyed stated that they do not assign drivers to a route according to any characteristics or preferences, and the same percentage of companies assign drivers to a route according to a predetermined location.



**Figure 4.** Answers to the question obtained through the questionnaire survey

From the results obtained in the questionnaire survey and the above-mentioned published studies results, the intention to design and create a decision support system for the process of assigning drivers to a route, as well as for analyzing other aspects of drivers' routes, is more than justified. The results prove that logistic company managers do not have a comprehensive tool to facilitate their decision-making.

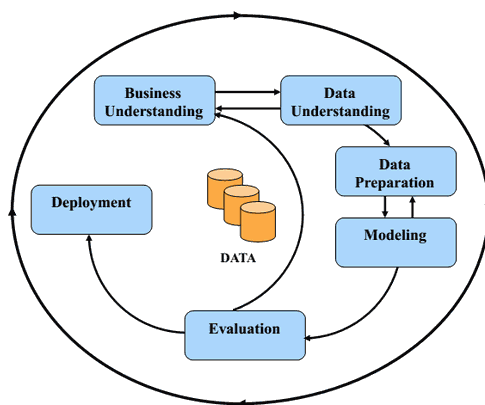
### Case study: A transport logistics company

The whole research process was organized and implemented according to the typical model of research process used in the field of information systems (Oates, 2006). While solving the practical task in a small Slovak transport company, we have used several research methods and strategies at various phases of the research process. At the beginning of our research, a survey of published studies was realized to confirm the justness and practical usability of our research.

In order to evaluate the research done using data acquisition methods, we used a questionnaire and an observation of the current state of the company during the analysis phase and data analysis experiments. We also did an interview with a company manager responsible for the supported transport sub-process, to obtain answers about the initial situation in the transport

company as well as about the user requirements for the decision support system that has been created. During the implementation of the methods mentioned above, we realized that the main objective of the research is to modify the transport sub-process in a way that provides an analysis of company data and recommendations for the company manager on the process of driver assignment to a particular route. At the same time, it is important to provide the results of the analysis in a suitable visual representation for faster and easier decision-making and company management.

The basis of the decision support system is the analysis of the relevant data. All available data analysis was performed using the CRISP-DM methodology. CRISP-DM is a methodology developed within the framework of the European Research Project. It represents the six life cycle stages of a data analysis project, which constitutes a universal methodology applicable in different areas (Pour, Maryška, & Novotný, 2012). There are close relationships between the different stages of the life cycle of the project to help organizations understand the data mining process. The following Figure 5 shows the process model CRISP-DM (Paralič, 2003).



**Figure 5.** Phases of the CRISP-DM reference model

Source: Paralič (2003).

Figure 5 shows a data analysis cycle based on CRISP-DM and, as mentioned, consists of six phases (Fayyad, 2015):

- 1) Business understanding – the first phase is about defining business goals and requirements from a managerial perspective as well as defining data mining goals and a preliminary project plan.
- 2) Data understanding – the phase starts with the initial data collection, which aims to get the necessary and relevant data from existing databases, load and integrate them. Initial data collection also includes

- a description of the methods used to retrieve data. The analyst's task is to identify potential problems and find solutions.
- 3) Data preparation – after getting acquainted with the data, the next step is to prepare the data. The data preparation phase covers all the activities associated with creating the final set of data to be used for modeling. Tasks associated with data preparation can be performed multiple times in any order. These are tasks such as data collection, data cleaning, data construction, data integration, and data formatting.
  - 4) Modeling – this is the process of applying data mining methods with setting parameters to optimal values. Modeling consists of four tasks: selecting modeling techniques, testing the proposal, building a model, and evaluating the resulting models. The first step in modeling is the choice of the modeling technique to be used. It can be, for example, decision trees, association rules, neural networks, and so on.
  - 5) Evaluation – the previous steps of the review addressed factors such as the accuracy and the generality of the model. At this stage, an assessment is made of the extent to which the model meets business objectives and whether there is any business reason why this model is inadequate. Another option, if time and budget constraints allow, is to test the models. The review process is trying to find out if there is a task that has been overlooked in some way, or if something has not got lost. It's about controlling the whole process. This check also includes questions about quality assurance, such as whether the model has been created correctly, whether the correct attributes have been used, and so on. Depending on the results of the process evaluation, the reviewers decide how to proceed further. This will determine whether to complete the project and go to the next stage – deploy or initiate further iteration or create a new data mining project.
  - 6) Deployment – the deployment phase takes into account the results of the evaluation and determines the deployment strategy. An important role at this stage is the monitoring and maintenance of the plan if the project and the results themselves form part of everyday business. A carefully prepared monitoring and maintenance plan helps prevent misuse of the data acquisition and the results of the analysis using created models. The detailed monitoring plan takes into account the specific type of deployment. At the end of the project, the project team will evaluate the positives, the negatives, determine what needs to be improved, and prepare the final report. Depending on the deployment plan, this report may only be a project summary, or it may be a final version, including a comprehensive presentation of the results.

After the development of DSS and its implementation in a transport company environment, experiments using data analysis with the real company data were done. The results achieved by the performed experiments were evaluated taking into account the CRISP-DM methodology, and quantitative

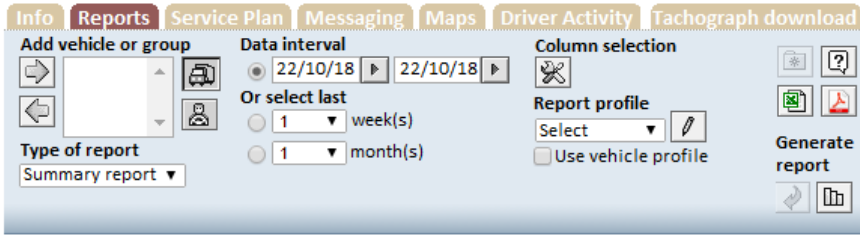


analysis methods were used to evaluate the obtained data (Kurgan & Musilek, 2006; Waller & Fawcett, 2013). In order to evaluate the data obtained from the interview with the transport company manager, qualitative data analysis was used (Šuc & Bratko, 2001; Šuc & Bratko, 2003).

### **The problem definition and the solution design**

Within the business understanding phase, we focused on modifying an existing process and information analysis appropriate to the transport company manager in order to help him obtain the necessary and valuable information from the company systems. Thanks to such information, the user can monitor not only vehicle, driver, or fleet consumption but can also monitor other factors that influence fuel consumption and make timely and accurate decisions. The analyzed company operates a road freight transport business, shipping goods to the final consumer or other businesses. The Dynafleet Online system – Volvo Truck Corporation – is used to manage the transport processes. The company also uses a second system to communicate with vehicles. The communication between the system and the vehicles is via the mobile telephone network. The vehicles are set to regularly export data to the system, or the dispatcher can manually download data. Information downloaded from the vehicles is stored in the database. Subsequently, it is possible to export the data to an Excel file for further analysis. Prior to implementing the innovative decision tool, the only data provided by the system was about the vehicle's location and event data for the vehicle or group of vehicles over a certain period of time (event time, driver's name, distance traveled, fuel, fuel status, location, weight, etc.) and the data that provided information about the driving style of the driver (average speed, top gear, economy, cruise control, idling, etc.).

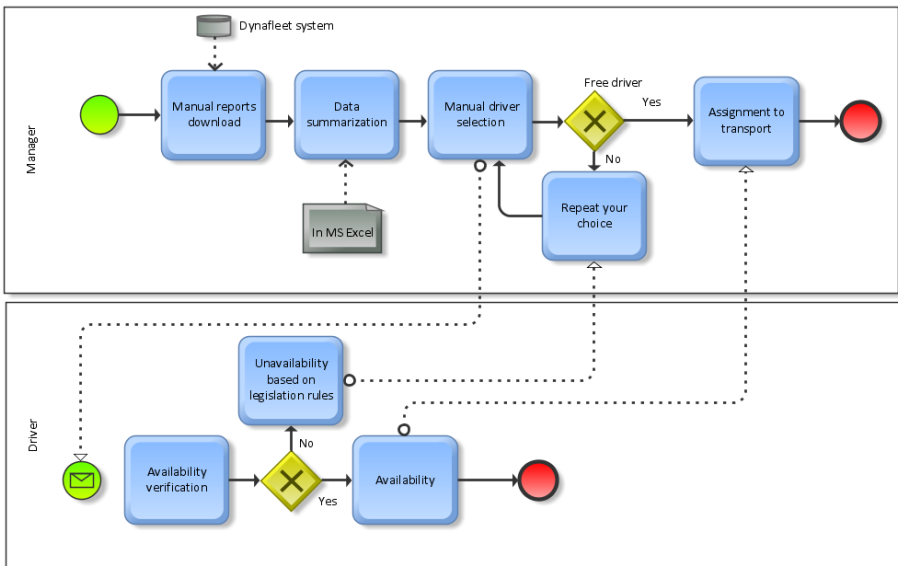
After comparing the interview results and the current system functions analysis, it can be stated that the current system used by the transport company is inadequate. It is possible to choose different reports for analysis (e.g., Overview report, Summary report, Exception report, Fuel and adBlue report, Mileage report, Time report for the vehicles and drivers), but there is no possibility to choose more interesting attributes for the manager. In the tool used currently, it is not possible to create customized reports and charts and compare consumption and other various attributes (e.g. above economy time, top gear, engine load, overspeed, cruise control, etc.), facts that would interest company management. Based on the requirements defined by the company manager, Dynafleet Online – Volvo Truck Corporation software cannot combine attributes and results can only be viewed according to predefined attributes tools (Figure 6).



**Figure 6.** The current data representation system

Source: Dynafleet Online – Volvo Truck Corporation.

In addition, the data collected and stored in this system’s database is automatically deleted after a certain time, so it is not possible to work with historical data. Figure 7 represents the analyzed process without the proposed decision support system, while Figure 8 shows the same process but with DSS implemented. In the case of Figure 7, the manager manually downloads data generated and collected by the Dynafleet tool and decides which driver to assign to a route based on the obtained reports. This process is quite time consuming because the manager must manually collect the data needed for the decision.

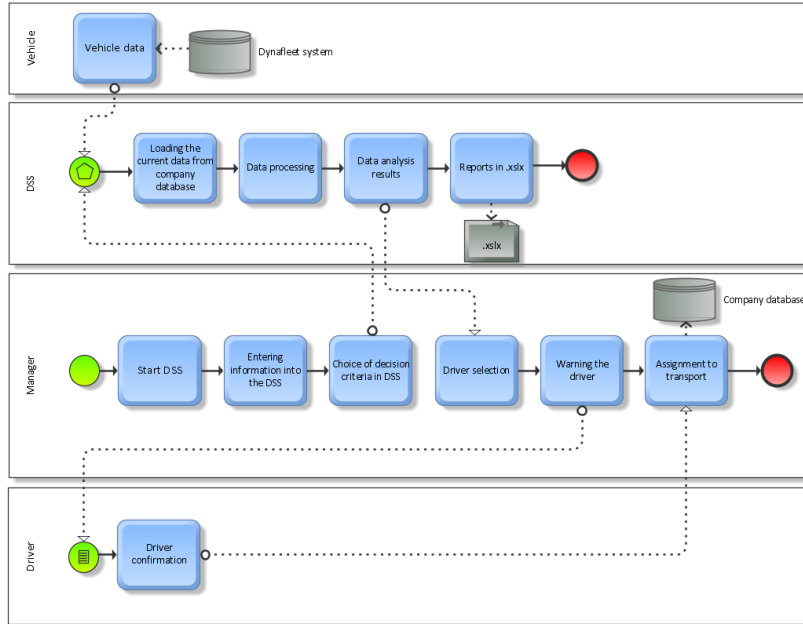


**Figure 7.** Processes before the introduction of the DSS system

Source: own processing – ARIS Express.

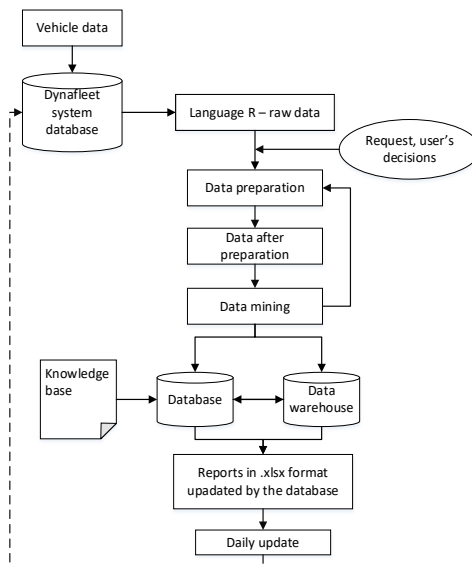
In the next picture, the automated process of assigning drivers to a route using the proposed system is presented. The system works on a common database that allows more comfortable querying and statistical analysis. The success of the proposed system is that it saves time, creates flexibility, and improves decision-making based on up-to-date data. The objective of the system set by the management is to increase the company's profits through more efficient driver assignments, as well as increased fleet management and driver analysis. As stated in Igbaria, Sprague, Basnet, and Foulds (1996), DSS does not replace the decision-maker, but it supports the decisions where the part of the analysis can be systematized by the computer so that the decision-maker's insight and judgment are improved. The system proposes decision-making advice, which is more comfortable for the company manager. Based on the process and data collected by company analysis, it was found that not all the data stored in the database were needed for business management and transport management processes. In order to optimize the transport management process, it was necessary to pre-process the data. The preparation of the data consisted of the selection of suitable attributes and the removal of irrelevant attributes. We removed the attributes that contained the same amount of value from the data that provided the fuel consumption information. Further, we removed from the driving style information the data attributes that were not needed for analysis. We removed other attributes due to redundant information in the system. Finally, the innovated system uses information from the existing enterprise database and implements a unified analytical approach in order to make the relationships between data and used algorithms more visible.

The analysis of the current situation and functions provided by the Dynafleet Online system led us to design an innovative support system based on data analysis and visualization. The main idea of the system is covered by the integration of the data mining methods into BPM (as is shown in Figure 2). The main objective of the designed transport system based on user requirements is to analyze the driving style of individual drivers and the vehicles of the transport company. It has to be a software system, which makes it possible to update the vehicle data daily and provide it in a suitable visual presentation. Based on the models of Congna and Huifeng (2009) and according to Liu and Guangsheng (2008), we propose our own model of the innovated transport DSS, which supports the process of the transport realized by company (see Figure 9). Unlike this mentioned system (described in Figure 1), our DSS's main structure does not cover the modern logistic management information system as a whole, but only the concerns on transport services carried out by the analyzed company.



**Figure 8.** Processes after the introduction of the DSS system

Source: own processing – ARIS Express.



**Figure 9.** Structure of the proposed logistics DSS

Parts of the designed DSS can be briefly described as following:

- vehicle data – presents each vehicle’s data collected by a built-in mobile unit about the traffic and status of the vehicle in the current situation;
- dynafleet database – means a data repository, where data is automatically stored in the database via a vehicle mobile unit;
- language R – raw data using R language, data from the Dynafleet database is automatically downloaded for the following data processing;
- data pre-processing – includes basic pre-processing tasks such as data clearing (deleting or filling in missing values, removing inconsistent values), removing redundant and duplicated data, transforming, data reduction (attribute selection). Additionally, data pre-processing includes the generation of the new attributes, the integration (merging) of two data files;
- data after preparation – contains already pre-processed data set ready for further data modeling;
- data mining tools – applying Machine Learning Algorithms (such as Naive Bayes Classifier, and Decision Tree; Fayyad, 1996; Kantardzic, 2003; Perrey, Spillecke, & Umblijs, 2010);
- database – all the data is stored in the database, along with an understanding of the knowledge base. The data is later organized and aggregated for on-line analysis into a data warehouse;
- data warehouse – the historical data is stored here and, according to the purpose of the decision-making, it is available to users to create different analyzes and charts;
- knowledge base – provides information about working hours, rest days and days off. The data is kept up to date;
- reports are created in MS Excel, in .xlsx format – OLAP analytics information is aggregated into an Excel spreadsheet, where the data analysis tools for creating a contingent table provide the user with various reports, whether in the form of spreadsheets or graphs.

Compared to the existing transport management systems described in Congna and Huifeng (2009) and Dejun and Huifeng (2008), the proposed system is, in addition, complemented by a daily data update, when every day (“fresh”) data from the system database is reloaded into the R program pre-processed to the data mining models required form. The data mining models are re-trained every day after new data is imported. By deploying a system that improves the driver assignment process to the route, we expect a 10% reduction (as was presented in the study by Ferreira et al., 2015) in daily fuel consumption, resulting in a reduction in diesel costs of more than 20 € per vehicle per day. It means savings of more than 6000 € per vehicle per year for the company.

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## RESULTS

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### Practical implementation of DSS and acquired results

The proposed system and its practical applicability were tested in the environment of a Slovak transport company. However, before the implementation itself of the newly-developed decision system, the company's processes and technologies were analyzed in order to secure the customization of the proposed system according to the needs of the analyzed company.

According to Oates (2006), designing and creating an IT artifact focuses especially on creating new IT products. In our case, it is a new decision support system. The proposed system provides the transport company manager with a better understanding of activity and data processing, which supports decision-making on driver and vehicle assignment to routes. The system design was executed using Microsoft SQL Server 2016, Visual Studio, and MS Excel with the Data Analysis tool. An important task was to divide the data into a table of facts and dimension tables on the basis of already prepared data. The database data model was created in MS SQL Server 2016, where 9-dimension tables and one table of facts were created.

The created analysis, implemented in the tracing application, is simple and easy to interpret and understand. Through various filters, users can see and search/analyze data from different angles without any limitations. Reports can help to track fuel consumption of individual vehicles or drivers, as well as find reasons for higher fuel consumption. Compared to the possibilities of the currently used analytics, the obtained results are something new, as the existing solutions do not use Business Intelligence approaches to visualize data.

The system was designed for a transport company manager to better understand and process the data, in order to support decisions when assigning drivers and vehicles to a route. Through the graphical interface, the user can update the data from the previous day, and the data can be evaluated statistically and graphically. In addition, the system always offers an up-to-date overview of the factors affecting fuel consumption and overall rating. The system can also recommend a driver for the planned route based on the specified parameters. After updating the data and saving it to the database, the company manager can download data in the form of a pivot table and generate the required reports.

For easier operation of the proposed system, the graphical interface of DSS is divided as follows:

- data update – data retrieval, data preparation, data updating and sending data to MS Excel with the possibility of visualization;

- statistics – includes descriptive characteristics of the final, daily updated file, including graphs and correlations;
- impact on average fuel consumption – machine learning algorithms run in the background of the application. The objective is to analyze the impact of the attributes on average fuel consumption;
- impact on the overall rating – in this case, the machine learning algorithms run in the background to analyze the impact of attributes on the overall rating;
- decision tree – the results of decision tree analysis can provide support for transport decisions;
- recommendation – driver recommendation for the planned delivery route. This is also a fully automated and updated functionality.

Figure 10 shows a part of the user interface of the system, the menu for selecting the parameters, based on which the system calculates the probabilities of the individual drivers. The user chooses the driver's starting position along with the route's destination. Next, it chooses the distance between these two locations. Likewise, the user chooses the weight of the load. The month is included in the model as the results of the analysis have shown that the month influences average fuel consumption and affects the driving style of the drivers. As a decision attribute, we chose average fuel consumption divided by three intervals. In the background of the application, the models for all drivers are triggered, the inputs to the test set are user-defined parameters, and the output is the probability of the average fuel consumption (or overall rating) of the individual drivers.

Figure 11 shows the output of the specified parameters and shows the probability of achieving fuel consumption in three classes for individual drivers. After the user has defined the route, the program displays the probability of reaching a certain fuel consumption class on the route. These probabilities are calculated using the Naive Bayes classifier. In machine learning, the Naive Bayes classifier is a simple probabilistic classifier. It is based on probability models, and their role is to predict whether the example belongs to a certain class, based on the Bayesian condition of probability (Rish, 2001).

The table will help the manager decide which driver to assign to a route, in order to achieve the lowest possible fuel consumption. For a better understanding of the practical situation: The manager could choose Driver\_B because, with a probability of 57%, he is likely to consume less than 26.5 l / 100 km. Driver\_D on the same route, with a probability of 98%, will likely consume more than 31.63 l / 100 km.

### Driver recommendation

Choose parameters

**Country (from)**

**City (from)**

**Country (to)**

**City (to)**

**Choose distance (km)**

**Choose weight (kg)**

**Choose month**

**Choose the decision attribute**

**Figure 10.** Selecting the parameters for a driver recommendation

	6.24-26.5	26.49-31.6	31.63-54.1	Last drive date	Days of driving	Number of days the driver did not drive
Driver_A	0.07	0.21	0.71	2018-03-21	-	0
Driver_B	0.57	0.34	0.09	2018-03-17	19	4
Driver_C	0.09	0.38	0.53	2018-03-08	-	13
Driver_D	0.01	0.01	0.98	2018-03-21	7	0
Driver_E	0.57	0.34	0.09	2018-02-02	-	47
Driver_F	0.44	0.40	0.16	2017-06-29	-	265
Driver_G	0.32	0.49	0.19	2018-03-21	15	0
Driver_H	0.10	0.40	0.50	2017-03-04	-	382
Driver_I	0.57	0.34	0.09	2018-03-21	6	0
Driver_J	0.44	0.40	0.16	2017-07-20	-	244
Driver_K	0.05	0.04	0.91	2018-02-13	21	36
Driver_L	0.54	0.36	0.10	2018-03-21	33	0

**Figure 11.** Probability of fuel consumption at three intervals



Because our transport management proposal also consists of the knowledge base, the rules stored in the system based on the logistics management structure are used in this part of the application. The last three columns of the table, shown in Figure 11, provide data about the time spent driving by each driver. The data in these columns are linked to March 21, 2018, when the proposed application was tested in the transport company. Information and data are updated from the previous day, which is in our case is March 20, 2018. The column “Last driving date” indicates the date when the driver last drove. Since the company has six vehicles, the number of driving days is calculated from the date in the last row of the individual vehicles, with the condition of the attribute – driver’s name being tested. This information is entered into a table for the particular driver. The number of days the driver missed uses the current date function and counts from the last driving date. The number of driving days will help the manager of the company decide whether the driver is already entitled to a rest day. The information on the number of days the driver missed gives information about the driver’s free time.

The results of the experiments showed that choosing a driver and correctly applying driving style recommendations could have a significant impact on the reduction of fuel consumption. The acquired knowledge from the models should, therefore, be useful for managers who are in charge of assigning a driver to a route. Based on all the information about the company and our system structure, we expect that, after proper implementation of the project, the average fuel consumption per vehicle could reduce by 10% per day. It means a 20 € reduction in diesel per day per vehicle and a yearly saving in the level of 6000 € per vehicle.

The pilot test of the system within the transport company environment took place on March 21, 2018, and the system is currently still in a prototype testing phase. However, the company manager can look and compare the first results, as fuel consumption is available before deployment of the system into the test operation. In Table 1, we can see the average fuel consumption and the average rating of the driver’s driving style before deployment of the system and the results during system testing. The average consumption of all the drivers before deployment was 31.109 l/100 km. This consumption is from 2 June 2015 to 21 March 2018. During the test, when the company manager used the functions of the system and assigned the driver to the planned delivery route as recommended by the system, the average fuel consumption decreased by 1.9 l/100 km. System test data were collected for March-October 2018. In the table, we can see the fuel consumption of individual drivers. We see a significant improvement has been achieved by the Driver\_A, when average fuel consumption fell by 3.69 l/100 km.

**Table 1.** Comparing results

	Before deploying the system		System in testing	
	Average fuel consumption (l/100km)	Average rating (%)	Average fuel consumption (l/100km)	Average rating (%)
Driver A	32.95	74.98	29.26	77.65
Driver B	30.93	76.86	28.20	77.35
Driver C	30.81	73.63	28.57	78.26
Driver D	31.93	76.86	29.44	78.45
Driver E	29.96	77	28.98	77.56
Driver F	31.86	77.2	29.19	78.61
Driver G	32.30	74.85	32.17	76.12
Driver H	30.89	77.38	29.18	78.23
Driver I	29.96	76.99	30.40	75.12
Driver J	30.94	75.5	28.64	79.26
Driver K	31.91	75.51	29.15	77.23
Driver L	30.87	76.58	29.16	77.87

Further improvement was achieved by the B, C, D, F, J, and K drivers, where average fuel consumption decreased by more than 2 l/100 km. Conversely, Driver\_I got worse and Driver\_G achieved approximately the same fuel consumption. Total average fuel consumption declined by 6.12%. Despite the short period of testing of the system, we can say that if the manager applies the system to real-life operations, it can save both fuel and finance. In addition to the average consumption, we can see an improvement in the overall rating in the table. The overall rating is the driver's driving style, which is affected by a number of other attributes such as cruise control, average speed, overall distance, braking, economy driving, and more. This gives the manager a quick overview of how the driver was driving the route. Based on the results in the table, we can say that drivers' rating has improved by about 4%.

## DISCUSSION AND FUTURE RESEARCH

The system the company is currently using makes it possible to create only simple analyzes and preview the results based on predefined attributes. Compared to the original system, the newly developed decision supporting system provides managers with data about fuel consumption and factors influencing this consumption. Besides this basic information, it also provides functionality for monitoring individual drivers (driving style and consumption,

vehicle types, number of journeys, etc.) and saving real data to a database already containing all historical data. In addition, although it was not the purpose of our research, it is possible to monitor the vehicle occupancy as well as the overall distance driven by individual drivers. Data analysis results are visualized in the form of reports and charts. In this way, they are helpful to the company manager who can use them for motivating and evaluating employees, whilst providing drivers with recommendations on how to reduce fuel consumption. Besides everything mentioned, the developed system helps to support the decision-making process of the selected business processes of the transport company.

The effort to maintain the competitiveness of the company is a driving force behind the introduction and constant innovation of business informatics. Effective management, based on the data provided by the company's different information systems, is a necessity at present. And, as was presented in the paper and in other research papers (Bardi et al., 1994; Rish, 2001; Pighin, 2016), data analysis and process management are vital in the modern logistics environment. The main objective of the paper was to present the design of the decision support system. The system is based on the principle of the implementation of data mining to support the decision process of driver assignment/selection within a small transport company. The research of studies focused on the same problem had shown that a good level of system automation within small companies results in employing ERP (Enterprise Resource Planning) systems that are focused on integrating various business processes. The shortage is that these systems are not developed to support all the specialties of the logistic process itself. The proposed system is based on transport management's sub-process analysis. The developed system links the data mining area to the decision-making process in the mentioned process. The capability to upgrade the data has shifted the system to a higher level because the system is capable of training application-based models, and the company manager can be provided with up-to-date information. We can state that after testing the system in a logistics company for about 8 months, the company has reduced its fuel consumption by 6.12% and its managers have used the data in different areas of decision-making, and rewarding and motivating employees. Such a proposed system can be implemented in all logistics companies using Volvo vehicles and the Dynafleet Online system. For other companies, it would be necessary to adjust the system settings so that they track the specific attributes set by their information systems.

It is possible to extend the scope of the presented decision support system by introducing other attributes to the data analysis models (e.g., weather-enhanced data model, current traffic situation, etc.).

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## CONCLUSION

As stated by Swenson and Rosing (2015), it is important to realize that BPM is not just about the automation of business processes, but about improving them and also its improvement cannot be secured by the implementation of the new information system or application. But as is stated above “Business process management (BPM) is a discipline involving any combination of modeling, automation, execution, control, measurement, and optimization of the business activity flows in applicable combination to support enterprise goals, spanning organizational and system boundaries, and involving employees, customers, and partners within and beyond the enterprise boundaries.” From that follows, that automation of the process is an important part of BPM. Applying a BPM approach depends on the needs and the possibilities of every particular business. The research concerned one of the processes of a small transport company, the transport services and the possibility to implement a decision support system to its environment. The transport company identified the transport process as its core process and the management of the company was interested in the analysis of this process. Besides the presented questionnaire results, the interest of the company’s management was the reason and motivation as to why we were not concerned about implementing the BPM approach to all processes but, instead, started by analyzing and automating this company’s sub-process. It presents the first approach to business processes improvement, including a more precise analysis of the company as a whole.

The use of data mining methods and techniques in business processes is increasing, but the corresponding level of utilization has still not been achieved. The reviewed literature demonstrates that data mining in business process management is mainly used to support decision-making. However, it should be noted that there is not much research going on in the implementation of data mining in business processes and thus creates a place for further research and the practical implementation of developed automated systems in business management.

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## Other sources

Vehicle communication system Dynafleet Online – Volvo Truck Corporation  
Integrating Business Process Management and Data mining for organizational decision-making

### Abstrakt

Bezsporne jest, że ciągły rozwój technologii cyfrowych wpływa na otoczenie biznesowe. Korzystanie z technologii informatycznych oznacza łatwiejszy dostęp do ogromnej ilości informacji biznesowych, co trudno jest uwzględnić w codziennym podejmowaniu decyzji. Tradycyjne metody przetwarzania danych w zarządzaniu przedsiębiorstwem stają się nieodpowiednie. Podejście do zarządzania procesami biznesowymi i analiza danych biznesowych to narzędzia, które można wykorzystać do optymalizacji procesów w firmie i do zebrania cennych informacji, które mogą dostarczyć różnorodnych materiałów decyzyjnych do zarządzania firmą. Artykuł dotyczy analizy, modelowania i optymalizacji procesu transportu, a także projektowania systemu wspomagania decyzji w tym procesie w małej firmie transportowej. Badania koncentrują się na opracowaniu innowacyjnego systemu wspomagania decyzji opartego na analizie danych firmy w celu usprawnienia zarządzania procesem transportu.

**Słowa kluczowe:** *wsparcie decyzyjne, proces obsługi transportu, analiza danych, zarządzanie przedsiębiorstwem*

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# Knowledge-oriented business process management as a catalyst to the existence of network organizations

Olga Sobolewska<sup>1</sup> 

## Abstract

*Nowadays, more and more often, we are dealing with the emergence of network organizations. These are organizations set up to accomplish specific tasks and are created by unrelated organizations. Choosing such a partner cannot be and is not accidental. It is a process in which knowledge about a possible partner and its resources as well as opportunities are used. The author puts forward the thesis that the organization's orientation both on business processes and knowledge management is a strong determinant for undertaking network cooperation. In order to verify such a formulated question, a questionnaire was carried out. Questions about factors influencing the decision about undertaking cooperation in the network structure were directed to a non-random group. The organizations that participated in the study have experience in running projects within the network structure. The study is of a contributing nature, but it can be a starting point for further considerations and for an attempt to build a model of a general nature.*

**Keywords:** *network organization, business process management, knowledge-oriented business process management, cooperation determinants, process of knowledge management, flexible organization*

## INTRODUCTION

The modern market requires organizations to be flexible. This flexibility is understood as the ability to quickly adapt to new market requirements in various areas of operation, such as the company's systems (including IT), structure, and even organizational culture. These challenges are usually encountered by network organizations, whose operation is often conditioned by the existence of a specific project or order. The article aims to show the

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interdependencies between organizations with a network structure and process-managed organizations that are associated with the traditional orientation and relatively low flexibility. A question arises as to whether it is possible to combine these two, seemingly contradictory, entities. A hypothesis is put forward that this is not only possible but also common in management practice. Furthermore, it is argued that network organizations constitute the future of management, given that process efficiency, and in particular, the efficiency of knowledge-oriented processes makes the organization attractive and is a strong asset when it comes to seeking project partners.

The research hypothesis put forward in the article says that the business process management efficiency of the organization being a member of a network organization has a positive impact on the effectiveness of the whole project. To define this relationship, questionnaire surveys were carried out with the participation of business, scientific, and public-benefit organizations. The article presents the concept of business process management and its evolution. A contemporary tendency in business process management has been shown, which from the classic engineering, optimization approach, turns towards knowledge management as one of the key resources of the modern organization. Organizations with a network structure were also presented as an example of structures built for the full use of partners' knowledge and resources. It also indicates the factors determining the establishment of a cooperative relationship between unassociated entities. One of the most important arguments justifying such cooperation is the process excellence of the partners. It is a way to use inaccessible resources and the opportunity to develop knowledge resources, so important for modern organizations.

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## LITERATURE BACKGROUND

### **Knowledge-oriented business process management as a concept – evolution of meaning**

Business process management understood as the orientation and improvement of processes implemented within the organization is an approach that goes hand in hand with management sciences. Traditional management in an organization used to rely on the assumption that it is necessary to develop operating systems that are as transparent as possible to their contractors. Due to the fact that organizations used to employ or work with low-qualified employees, the relationships between organization members were very simple, whereas learning roles merely required long-term repetition of the same activities. The division of responsibilities was

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strictly defined, too, with the educated and decision-making superior at one end, and the order-executing employee at the other (Grajewski, 2012).

The precursor of business process orientation is Porter (1985), who, along with the concept of the value chain, pointed to the need to integrate it and its interoperability. This concept was continued by Deming, who showed in a flow diagram the links between organizations from the customer to the supplier as a process that can be measured and improved, as is the case in production processes where an even better solution is sought (Deming, 1986; McCormack & Johnson, 2001). Business process orientation allows organizations to think together as one unit to increase efficiency in meeting customer needs (Nadarajah & Kadir, 2016).

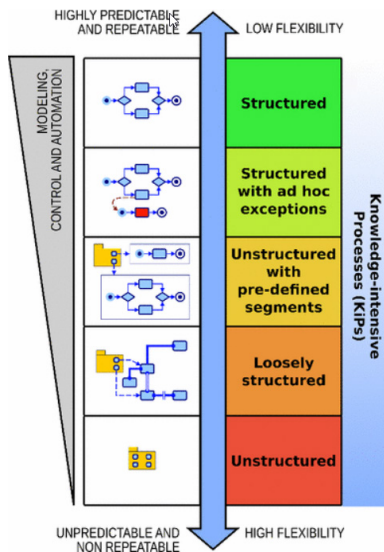
The process is a sequence of events related to each other in a cause-and-effect manner, which are stages, phases, stages of development (Hofman & Skrzypek, 2010). The goal of the process is, as Hammer and Champy write (1996), to provide the customer with a specific service or product. A similar approach focused on satisfying market needs (dictated by the organization's environment), can be found by Rummler and Brache (2000). More and more often, along with the development of management sciences, it is evident to indicate an equally important source for process improvement, which is strengthening and improving the customer relationship not only with external customers but also internal ones (Hofman & Skrzypek, 2010; Szczepańska & Bugdol, 2016; Nadarajah & Kadir, 2016).

The constantly changing requirements and expectations of the market towards the organization, the declining life cycles of the products or the permissive volatility of both international clients and the world-wide crowded competition, force companies to look again at the processes of the company. As a result, business process management (BPM) is one of the most important tasks for management. It is not limited to production processes, but its range begins to cover the whole spectrum of organization management, becoming a holistic management philosophy (Choong, 2013, Ravesteyn & Batenburg, 2010).

The performance and effectiveness of the operation of a business process-managed organization is a direct derivation of the efficiency of the processes carried out in them (Bitkowska, 2018; Gabryelczyk & Roztock, 2018). A condition conducive to such improvement and enhancement of the organization's functions is the existence of static processes, i.e. those that provide a detailed description of said functions in the form of an algorithm of action. Today, however, increasingly fewer processes taking place in organizations are static. Research indicates that, depending on the industry, only 20–40% of all processes are static, with this value having shown a downward trend over time (Szelągowski, 2018, p. 48). Static processes are undoubtedly those regulated by

law, patents, licenses and concessions, and as such, they are strictly subject to objective restrictions (laws of physics or chemical reactions).

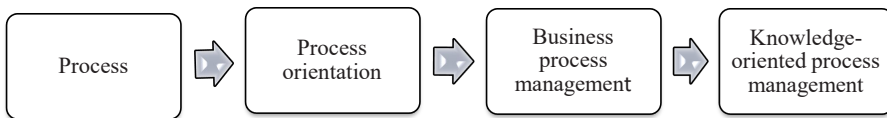
The ongoing changeability of the environment, increasing customer expectations, and competitive pressure, require the organization’s readiness for flexible operation. At the highest level, flexibility should be understood, above all, as the ability of the organization to adapt its own functioning to changes occurring in the environment, which have not been previously foreseen. This means that the organization should be able to learn, adapt to the environment, and quickly redefine internal tasks, systems, and structures. It is becoming increasingly more common for processes taking place in the organization to be volatile. Organizations participating in the market constantly exchange with the environment, and as a result, they have to agree to adapt to its constantly changing external conditions (Gabryelczyk & Roztocki, 2018). This also affects the processes occurring within these organizations, which also need to be subject to more or less profound changes, which applies in particular to those activities that are associated with the creation and provision of value, products or services to the customer. Increasingly often, organizations need to personalize their product or service to meet market needs, which by default prompts them to introduce certain changes to their previous activities. In this way, processes taking place in organizations are becoming less and less static (Figure 1).



**Figure 1.** The spectrum of process management

Source: Di Ciccio, Marella & Russo (2015, p. 6).

Under such conditions, a natural consequence is the modification of the view of business process management, which evolved from the traditional approach typical of industrial engineering and assumptions about the invariability of the process. In classical terms, process modifications consisted of eliminating redundant activities and a gradual but slow improvement in line with the Deming Cycle. Today, this model is being replaced by the adaptation of processes that take place in organizations to customer requirements, as well by approaching business processes and knowledge as two inherently linked elements (Bitkowska, 2018; Szelągowski, 2018) (Figure 2).



**Figure 2.** The evolution of business process management

Source: Bitkowska (2018, p. 21).

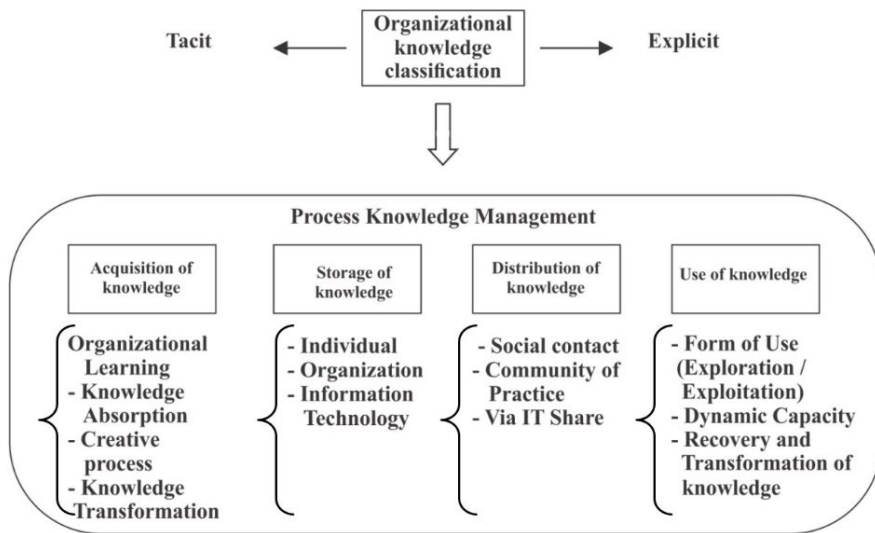
Knowledge-oriented process management should integrate two parallel approaches – managing the processes taking place in the organization in order to improve and optimize those processes, as well as the approach resulting from the management of non-material resources of the organization. The processes taking place in the organization should not only focus on the excellence in the production of services or products, but also on the fact that the natural product that arises as a result of the process is knowledge. The fact of creating an intangible asset as a result of business process management should be taken into account at each level of the production process implementation, and the knowledge management processes themselves become “a fundamental task and the challenges of our time” (Claver-Cortés, Zaragoza-Sáez, & Pertusa-Ortega, 2007).

Knowledge is a resource that should be dynamically managed by any organization that hopes to achieve a competitive advantage (Birkinshaw & Sheehan, 2002; Chen, Huang, & Hsiao, 2010; Hamel, 2007; Mills & Smith, 2011; Kisielnicki & Sobolewska, 2018). Knowledge management is a conscious strategy of acquiring the right knowledge for the right people and delivering it to them at the right time. But it is not everything. The full process of knowledge management also takes into account the sharing of knowledge, as well as the “release of knowledge” so that the use of knowledge will improve the efficiency of business processes and ultimately improve the organization (O’Dell & Grayson, 1998). Constant changeability, which is an opportunity and, at the same time, the fear of modern organizations, means



that knowledge management and the integration of these processes with manufacturing practices contribute to increasing innovation. “Organizations are interested in their customers and increasing their productivity” (Nguyen & Mohamed, 2011, p. 206).

The process of knowledge management introduced by Davenport and Prusak (1998) included three basic activities: knowledge acquisition, codification, and distribution. As part of the process of acquiring knowledge, the organization should actively seek sources of information and knowledge, classify the information obtained (selection and its evaluation), acquire new knowledge and take care of its continuous creation as a result of the processes taking place in the organization. Codification and transfer of knowledge consist of preparing knowledge for a form in which it can be used. It can be done by entering data into databases or preparing appropriate data repositories that are useful, convenient and available almost “on-demand” for members of the organization. The significance of the fact of using knowledge for the needs of the organization’s activity was shown in the process, which is shown in Figure 3.



**Figure 3.** The Knowledge Management Process

Source: Kakabadse and Kakabadse & Kouzmin (2003).

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The knowledge must be used as a basis for the development of new knowledge through integration, innovation, creation, and extension of the existing knowledge base, and should continue to be used as a basis for decision-making. Knowledge management enables organizations to make decisions and, at the same time, knowledge is an element that forms the basis for creating new knowledge through innovation (Nooteboom, van Haverbeke, Duysters, Gilsing, & van der Oord, 2007; Ganzaroli, de Noni, Orsi, & Belussi, 2016). The new knowledge is build based on already existing knowledge. An interesting, and at the same time, a very important approach can be seen in Walsh and Ungson (1991), who wrote about the use of knowledge on two levels: automatic and controlled. Automatic use of knowledge is a routine activity that is developed in an organization through procedures, structure, or organizational culture. However, as the complexity of activities increases, or as changes take place, non-routine activity is required, and it is necessary to look for unconventional knowledge, often located in different repositories, or the need to create it. This requires an organization of flexibility, which Teece, Pisano, and Shuen (1997) defines as “[...] the ability of the firm to integrate, build, and reconfigure their internal powers in order to quickly respond to the environmental changes.”

Examples of such dynamic capabilities of an organization may be research and development activities, alliances and acquisitions, technology transfers, and procedures (Zollo & Winter, 2002). Such activities are part of the knowledge management process in the organization and are directly derived from the learning process while being a gradual and systematic (if they are regularly undertaken) method of modifying the organization’s routine and its routine, automatic knowledge management process. These mechanisms constitute a cycle of knowledge evolution. This cycle implements research and exploitation in order to seek solutions to the hidden needs of the environment and transform these solutions into procedures.

The form of acquiring and developing knowledge resources does not have to be taking over another organization or technology transfer, but it can also be undertaking cooperation activities. Nowadays, more and more often, this cooperation takes the form of an organization with a network structure, which is a derivative of the development of an IT network. Modern organizations, as part of their goals, are not limited to their resources, but increasingly use the possibility of establishing cooperation with other entities, unrelated to the capital of the organization.

## Network organizations

The digital revolution, of which we are both witnesses and active contributors, covered the sphere of management to a large extent (Brynjolfsson & McAfee, 2015). This impact is visible both in the take-over of broader areas of organizations' management through IT systems (e.g., the already extremely common automation of production and the increasingly progressive automation of other areas of the organization), as well as changes in the organizations themselves and their organizational structures. Contemporary organizations are less and less reminiscent of those from a decade ago. Classical organizations, organized in a hierarchical manner, undergo a peculiar path of evolution. In the 60s of the last century, one could observe the transformation of classical linear organizational connections into matrix structures, aimed at improving management and facilitating project management. Today, we are increasingly observing the flexibility of these structures towards network and self-management organizations (Robertson, 2015). The creation of this type of organization, to a large extent, is conditioned by the development of networks and information technologies (ICT). Networking of the organization does not only mean the way of formal organization of the structure but, to a much greater extent, indicates their way of functioning. Network organizations are currently created to strengthen and better use knowledge resources, which directly affects the improvement of the efficiency of business process management in the organization.

All organizational activity intended to achieve predefined goals requires the commitment of resources. As the scope of activities undertaken is broadening and the complexity of tasks carried out is growing, these resources have to be more and more differentiated, and increasingly numerous. Initiating new measures requires the organization to make decisions concerning its relations with an environment. The ability to create competitive advantages is the factor which to a great extent determines future actions of the organization and influences its attractiveness for other market players. The aforementioned competitive advantages are built on the basis of resources owned or used by the enterprise. Traditionally, enterprise resources are divided into two categories: tangible and intangible. Tangible resources include fixed assets, real estates, machines, raw materials, and financial resources. Intangible resources consist of various procedures, operational models, know-how, owned patents, and the human factor – employees and their experience, knowledge, skills. The classical definition of a resource states that it must be valuable, rare as well as difficult to copy and substitute. Dollinger (2002) enumerates 6 types of strategic resources

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of the undertaking (PROFIT formula): physical, reputational, organizational, financial, intellectual, human, and technological.

One may notice more and more discussions about global competitive advantages, which are the result of efficient links between national circumstances and the company's strategy (Porter, 1985). Even the operational excellence of an enterprise resulting in achieving leadership cannot guarantee success in a new market. Available resources constitute one of the pillars of the strategy, the second one being the surrounding of the organization. In the case of business organizations, we usually talk about a competitive (market) environment where a customer is able to choose a supplier. In such a situation, the position can be expanded to new markets and new segments, and the actual market power can be strengthened through the strategy of finding a business partner. The current competitor can turn into a kind of partner (coopetition).

Coopetition is the relation of cooperation where at least two entities share selected resources with the aim of achieving common objectives. Characteristic features of coopetitive relations, which are emphasized in numerous publications and which are reflected in definitions of this notion, are as follows (Pronshikh & Sobolewska, 2018):

- the duality of relations – the co-existence of competition and cooperation, which is possible due to the division of areas devoted to specific actions as well as to the effective coordination of activities performed by cooperating organizations in these distributed operational zones;
- interdependence – which is demonstrated by the mutual dependence of parties involved and also by sharing resources submitted to the coopetitive relation in any form (as an item, a qualification or a skill);
- long-term character of the relation – the longer perspectives of cooperation, the more eager the partners are to start collaboration; the duration of cooperation also affects the amount and the variety of contracts signed within the framework of coopetition as well as the internal structure of this interaction;
- openness – the cooperation must exist between two or more organizations; yet, there is no limit on the number of parties involved; the openness also concerns markets which take part in this coopetition, because collaborating parties do not have to be exclusively direct competitors; cooperation can take any form or scope – the will of the parties and the capability of jointly identified goals are the only decisive factors in this case.

Network organizations are the result of the transformation of traditional structures, organized in a hierarchical manner, into modern forms functioning due to the use of information technologies. These are structures that they do not relate to, as much as in the case of classical organizations, functional and geographical limitations. The motive power for them is the ICT network, thanks to which they can, without major obstacles, exceed geographical and institutional boundaries. M. Castells even talks about a new type of economy (information economy), which replaces the old type of industrial approach (Castells, 2007). While in the previous type of economy a competitive advantage was generated due to economies of scale, now the new economy is guided by the economics of the network, which consists of increasing the coverage of the network, and the network can significantly increase its value by connecting to other networks. The creation and functioning of network organizations in the conditions of a new approach to management is caused by the desire to search for modern and non-standard solutions, knowledge development, and supporting innovation.

Network organizations are organizations that arise as a result of a combination of different, often independent, units. This connection can be of a temporary nature, often limited to the implementation of a defined, specific task. Collaborative relations between organizations may be of a different nature, they may concern both material and intangible resources of the organization (Zott & Amit, 2010). The basic goal that guides the creation of such structures is to achieve a synergy effect, faster or more effective implementation, thanks to the combination of resources and objectives. Hence, in network structures, particular attention can be paid to information connections.

Stańczyk-Hugiet, as the basic motive for the creation and functioning of network structures, indicates “the benefit obtained from running a business,” which he describes as an economic pension (Niemczyk, Stańczyk-Hugiet, & Jasiński, 2012). As a factor determining the existence of network organizations, Mikuła (2006) indicates a reduction in transaction and transport costs, which are often accentuated as the next effect of the digital revolution. He also emphasizes the fact that the creation of a new type of organization, so separate from the existing organizational forms, requires its members to develop new styles and management models. This need, resulting from the need to strengthen cooperation between self-governed teams of experts and to facilitate their fast and effective communication in order to achieve the objectives adopted by the network organization, is also emphasized in the works of Kirkpatrick (2011) and Hamel (2007). It is also a way of limiting the risk and uncertainty associated with running a business, especially in emergency situations, because the network makes it possible

to transfer some of the threats to its participants. Niemczyk even writes about a specific “bypass system” (Niemczyk et al., 2013) in the context of risk management for network organizations that “gives a sense of greater security in a market competition situation, means greater resource flexibility, fewer capital needs” (Łobejko, 2012).

Brilman (2002) lists four types of network organizations: integrated networks, federated networks, contractual networks, direct relations networks. In the business context, three main types of network organization are mentioned (Snow, Miles, & Coleman, 1992):

- inner, where, in the framework within a large organization, there are separate units acting as profit centers;
- stable, where the company (the parent company) is in the center of the organization ordering work for other related organizations. These are long-term connections;
- dynamic, these are temporary alliances, taking the form of agreements with other organizations that provide key (both tangible and intangible) resources for the agreement.

Organizations undertaking cooperation within a network organization choose various forms of connections: strategic alliances, clusters, or co-op relations. The main goal of each of these organizational forms is to achieve goals that would be unachievable for an alone organization. However, this is not a typical activity only for business organizations. It is more and more often, a form of reception by territorial administration units (Bartkowiak & Koszel, 2015; Matthews & Schulman, 2005) or health services (Baretta, 2008). It is also an extremely popular form of operation in the functioning of scientific organizational units (laboratories, research institutes, universities). Among the benefits that result from joint action, the most frequently mentioned are: gaining access to valuable, from the point of view of the organization’s goals, resources, increase in innovation, reduction of operating costs, as well as expenditure on research and development. All these factors translate into strengthening the competitive position of the organization, and may also be one of the methods of eliminating operational risk.

Cooperative action in the form of a network offers organizations the opportunity to use not only their own knowledge, skills, and competences but also those of their partners. For an organization, it is a chance to build or strengthen its market position. An important role in network arrangements is played by ICT systems that support the development of new models of work, communication, and collaboration. In consequence, more and more various organizational networks are being established as “extended organizations.”

(Tubielewicz, 2013). These are structures that are strongly focused on sharing, exchanging and generating knowledge, skills, and competences, thereby often being the place for innovative solutions. A network is a model or metaphor that describes a system of relationships among a specified number of units. While this number can be very large in social relationships (the case of social networks), it is usually clearly defined in economic relationships. These relationships include (Kisielnicki & Sobolewska, 2018):

- links and interactions among units within the network, where links are long-term and interactions are short-term relationships;
- structure and position understood as the interdependence of the elements that make up the network and, as a result, the way in which they form interrelationships;
- process understood as a change of ties among companies as an effect of jointly implemented tasks.

For enterprises, it is becoming necessary to cooperate in the development of new products or in a wide range of activities called innovation development. This is determined by the high cost of research and development activities that can represent an impassable barrier for an individual company (Merrifield, 2007). Such constraints are encountered not only by small and medium-sized enterprises, which have limited resources because of their structure. It turns out that also “giants” are more and more frequently seizing the opportunity for cooperation. Particularly spectacular cooperation is present in automotive markets where manufacturers have been working together for years to build modern cars and engines, or where, as announced by Toyota, Nissan, and Honda in early 2015, they are declaring cooperation on the development of hydrogen stations for modern FCVs (Fuel Cell Vehicles). It should be noted that it is neither the first nor the last such cooperative relationship established in the automotive market.

Similar collaborative relationships are perceptible in virtually all sectors of today’s economy. The need to develop cooperative relationships ensues from two groups of factors: internal, resulting from the specificity of the organization itself, the way of management, goals, and strategies, and the organizational culture in place (Cygler, 2009). The second group of factors influencing the willingness to collaborate includes sectoral factors (Table 1) that differ considerably in the case of business and scientific entities. Regardless of the sector and the specificity of the organization itself, the development path (and the pace of market changes), however, requires organizations to be prepared for a variety of actions including cooperation.

Depending on its scope, such cooperation will vary in nature. It can be pursued within a single organization when collaborative relationships are established by independent branches and departments. It may be very broad when representatives of organizations outside the sector where the initiator is active are invited to cooperate.

**Table 1.** Impact of sectoral factors on the cooperation of enterprises and universities

Sector parameter	Impact on business cooperation			Impact on university cooperation		
	low	middle	high	low	middle	high
Technological advancement			+			+
Susceptibility to globalization			+	not applicable		
Intensification of competition			+		+	
Concentration of the sector's structure and intensity		+				+
Profitability and growth rate of the sector		+			+	
Entry barriers		+		+		
Confidence in supply		+		+		
The threat of substitutes	+				+	
Sector's age	+			not applicable		

Source: Sobolewska (2016).

Such a relationship occurs in the case of clusters, where the cluster consists of representatives of business, science, and administration, and sometimes even representatives of the third sector, which is non-profit organization.

Nonetheless, regardless of the scope of collaboration and the number of partners in the relationship, the optimal form of its implementation is the network structure. It is a consequence of going beyond a rigid organizational structure and related connections. Successful transfer of knowledge and technology between participants in a network organization requires mutual relationships to be built up. Such relationships will occur in the following areas: scientific partnership, research services, academic entrepreneurship, human capital mobility, commercialization of intellectual property rights, and scientific and popular science publications. Knowledge and technology are most often transferred between these entities through the appointment of a researcher/researchers acting for the university and representatives of the company. Such cooperation is governed by contracts, draws on the experience gained during the implementation of other projects, and is easier thanks to the previously developed network of contacts.



The need to cooperate, within network structures, that is, those that extend beyond the boundaries of the organization has become the everyday life of modern companies. In the introduction of the article, the assumption underlying the study is marked. It is an assumption that modern organizations are increasingly undertaking cooperation activities. They do it for the implementation of various types of projects. One of the important factors that determine the selection of a partner for the implementation of the project is the opinion on its efficiency in business process management, including knowledge processes. Network organizations are structures that carry out complex projects, often going beyond the boundaries of one industry. Therefore, they are aware of the need to dynamically acquire knowledge by creating alliances and networks of cooperation. The hypothesis put forward in the article says that high-quality business process management influences the effectiveness of the network organizations.

## RESEARCH METHODS

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The research hypothesis adopted in the study says that the process efficiency of an organization being a member of a network organization has a positive and significant impact on the effectiveness of project implementation.

For its verification, the main hypothesis was decomposed into two partial hypotheses:

- H1: Organization with high-quality management of its internal processes is an attractive partner in the process of creating a network organization;
- H2: These processes are becoming a key resource in the implementation of network organization tasks.

On the basis of the literature review and factors that influence the decision to start cooperation, a research questionnaire was prepared, which consisted of 9 questions. In each of the questions asked, the respondents were asked to indicate the answer using a five-point Likert scale, from 1 (least meaning) to 5 (the most important factor). The questionnaire was sent by e-mail in April 2019 to each organization with a request for a reply. The survey was addressed to people holding managerial functions in organizations and carrying out their tasks in a networked manner. These were people who participated in the decision-making process to undertake cooperation activities in a network manner or had access to information about the conditions and criteria for such cooperation. Therefore, the research sample (Table 2) was limited to persons who perform managerial functions or are responsible for managing the part of the organization's activities (project managers or task managers).

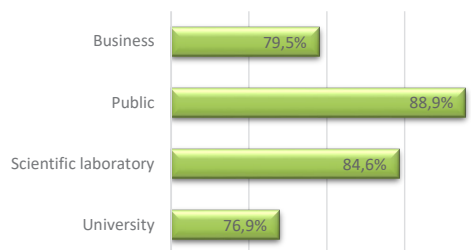
**Table 2.** Organizations participating in the survey – breakdown

Sample characteristics (affiliation)	N	%
University	26	29.89
Scientific laboratory	13	14.94
Public	9	10.34
Business	39	44.83
Total	87	100

The survey, after rejecting answers given as incomplete (8 questionnaires), was completed by 87 people. The questionnaire interview was not random, because the survey invited individuals who, over the last 5 years, undertook networking activities. Organizations representing both business and the public sector and science participated in the study.

## STUDY RESULTS

The study formulated two partial hypotheses. The first one concerns the factors influencing the decision to start cooperation in the network structure. In particular, it focuses on the importance of quality in process management as determinants for undertaking such a form of cooperation. The organizations that participated in the survey indicated in the vast majority that they have a constant network of partners developed as a result of subsequent projects. This is especially visible in the case of scientific institutions, which, as is evident from the statements of the respondents, strive to build a network of connections. It is visible in Figure 4, which shows the answer to the question about whether the organizations have permanent networks of partners with which they continue cooperation after previous, positive project experiences.



**Figure 4.** Weighted averages for answers to the question about the existence of a network of collaborators for respondents representing various market sectors

The question posed in the survey concerned the motives (reasons) for cooperation in network structures (Cygler, 2009; Sobolewska, 2016). These are internal factors resulting from the specificity of the company, the model of management, objectives and strategy, as well as the relevant organizational culture. The factors included:

- complementarity of resources understood as the opportunity to supplement own, often insufficient, resources (both tangible and intangible) by means of access to those available to a partner in a network organization. That is the factor most often emphasized as being decisive in the responses given by scientific entities, but it is also increasingly often<sup>1</sup> viewed as significant for the operation of business units. Access to resources through networking is often a strategy to meet market needs in the fastest possible way. This is often a necessary condition for the emergence of innovation and its subsequent effective implementation;
- opinion regarding quality of resources. Organizations deciding to cooperate do this in a non-random way. This factor is closely related to the previous one, as the partner's resources for cooperation are expected to be not only complementary, in relation to those available to the organization, but they also have to meet the quality criterion. It should be noted that this requirement does not always related to the highest quality, as organizations are not always able to estimate it, or they simply do not have enough bargaining power. Quality, in this case, means meeting the organization's requirements. The definition contained in the ISO 9001 standard can also be recalled, where quality is understood as "(...) the degree to which a set of inherent features meets requirements" (ISO, 9001: 2000). In this case, the concept fully reflects the viewpoint of the survey participants;
- reputation enjoyed by the organization;
- ability to interact/experience, which stems from earlier cooperation activities undertaken by the organization. This is strongly related to the reputation of the organization as a partner for cooperation;
- system of connections with other organizations understood as a network of available collaborators, a network of internal contacts that have an impact on the organization's knowledge resources;
- convergence of organizational cultures;
- adjustment of organizational structures of the organizations cooperating with each other;
- organization size symmetry;
- convergence of goals and strategies.

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<sup>1</sup> Reference to previous research which analyzed factors influencing decisions of cooperation for business organizations and scientific entities (Sobolewska, 2016).

Answers pointing to the significance of individual factors in the decision to undertake network cooperation are illustrated in the graph in Figure 5. Participants of the study provided answers using a 5-point Likert scale, where 1 meant a completely insignificant factor and 5 a factor of the highest importance. In Figure 5, the results are shown using the weighted average of all 87 responses.

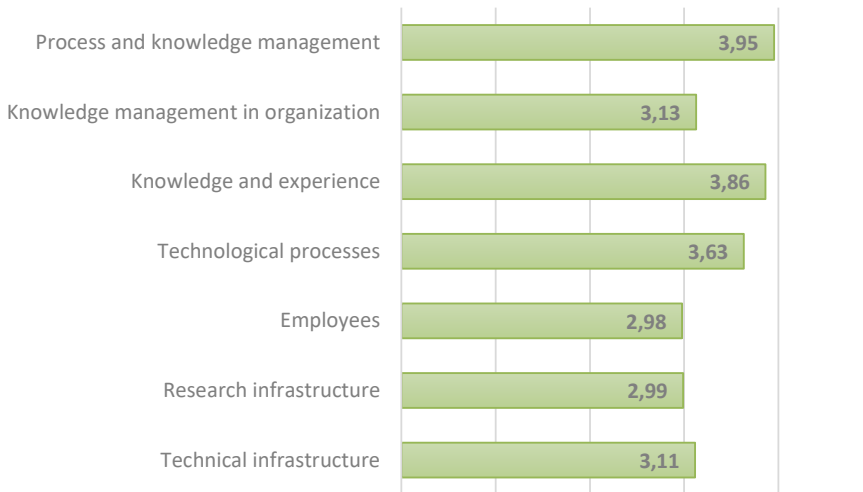


**Figure 5.** Weighted averages for the answer to the question about the factors deciding about cooperation in the network structure

The factors that were identified as the most important for building network relations can be divided into two basic groups: those related to resources (complementarity of resources, opinion on the quality of these resources), and those associated with the good reputation of the organization itself (experience in establishing cooperation relations, good credit or a system of connections with other organizations). This indicates that the cooperation partner is very often selected based on detailed interviews and analysis of the context. This choice is not accidental, and good reputation evaluation – both of the willingness to cooperate and resources – is an important, if not crucial, factor. The organization's resources can take various forms assessed by the following inquiry. Organizations were asked to indicate, using the same five-point Likert scale, elements constituting the resources that have the strongest influence on their willingness to cooperate. The following were mentioned:

- technical infrastructure understood as equipment and facilities available to organizations;
- research infrastructure, i.e. laboratories or particularly efficient R&D teams;

- employees or specific personnel working in the organization (knowledge workers).
- knowledge and experience of the organization, manifested in executed projects, held licenses, patents or certificates;
- technological processes taking place in the organization, their efficiency, and effectiveness;
- opinion of the high quality of knowledge management in the organization;
- opinion of the high quality of knowledge and business process management in the organization, management of knowledge-oriented processes;

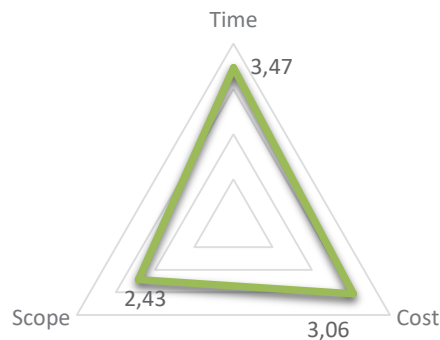


**Figure 6.** Weighted averages for the response to the question about how resource factors are decisive for cooperation in a network structure

Figure 6 shows the weighted averages of the obtained answers results. The organization’s orientation towards the efficiency of knowledge management and processes; that is, the implementation of knowledge-oriented process management requirements is particularly evident. Purely process orientation, the aim of which is to develop the most optimal procedures in the organization, both basic and auxiliary processes, is still an attractive factor, but insufficient in the opinion of modern organizations. Considering the answers obtained as a result of the surveys, it can be assumed that the first hypothesis regarding the significance of the opinion on the quality of business process management and the impact of this assessment on the attractiveness of cooperation partners has been positively verified.

The second hypothesis says that these processes become a key resource in the implementation of network organization tasks. The aim of the study is to verify whether efficiency in business process management translates into the effectiveness of the entire project implementation, which in turn determines the degree of implementation of the network organization goals. As a result, it can be assumed that this will positively affect the opinion of the partner and this opinion will be reflected in subsequent decisions regarding the creation of a group of colleagues.

Further questions addressed to the respondents focused on whether the good quality of processes that are implemented by one or several cooperation partners positively influenced the three classic dimensions of the project, its scope, time and costs (Figure 7).



**Figure 7.** The impact of high-quality processes on the elements of the project triangle

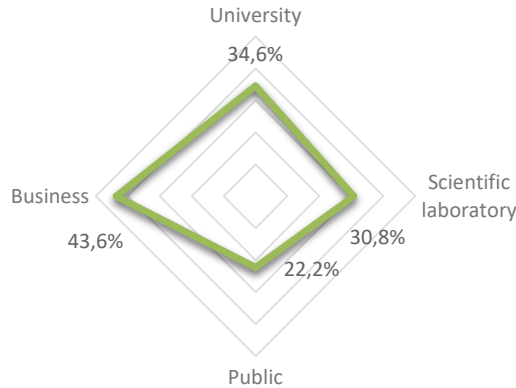
As can be seen in Figure 7, the respondents did not notice the significant impact of process integrity of partners on the project implementation, which does not mean, however, that it does not matter. This question was twofold, it asked for an indication of the impact on a five-point scale, but it also contained an open question. It turns out that the respondents, at the stage of project planning and implementation, took into account the high quality of processes, which in effect was a priori taken into account when planning project activities

When asked about what stage of the project, and to what extent the process efficiency is particularly important, the respondents were in agreement. Already at the level of initiating cooperation, the factor that influences the selection of a partner was the resource in the form of its procedural efficiency. 87.4% of the surveys pointed to this fact. The ability to rely on an efficiently executed business process is also very important

in the process of project planning, as indicated by 82% of respondents. In the opinion of the respondents, the implementation of the project is only the implementation of the agreed action plans. In this way, the second hypothesis was verified positively. It can be concluded that while the high quality of the processes taking place in the organization is not a factor that significantly affects the project already during its implementation, it is a very important condition for the initiation of cooperation, which also confirms the answers given by the respondents under questions about the determinants of network cooperation.

All of the organizations surveyed admitted that they were managed in a procedural way. Each of them has clearly identified processes, and the manner and effectiveness of their implementation is a constant object of interest and monitoring by the organization.

As to the question of whether the project has been modified as a result of the project currently implemented within the organization, then business organizations had the highest proportion of modification of processes, and the smallest extent of modifications occurred in the case of units from the public zone (Figure 8). The latter can be explained by the fact that these units operate under conditions strictly limited by the applicable legal regulations. These modifications were temporary (limited by the time of network collaboration), but the experiences resulting from the implementation of the project in the network structure were, as acknowledged by the respondents, recorded and are to be used in the further functioning of the organization.



**Figure 8.** Impact of cooperation on the course of ongoing processes

In each organization, according to the responses of the respondents, there is knowledge management resulting from the project implementation.

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The lessons learned experience, even when this methodology is not required by the project organization, is recorded in the organization databases and information systems. In the case of units representing science (universities and research laboratories), a particular way to use the acquired knowledge and experience is to publish them as reports and post-project articles.

## CONCLUSION

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Perfection is very important in the area of processes. The processes that the organization implements in an efficient way are invariably a factor creating a good opinion about that organization. It turns out, however, that they do not exhaust the list of factors. Cooperation with an organization managed in a model business process-oriented way is attractive, although companies are increasingly paying attention to their operation's long-term perspective. That can be observed in the recent emergence of knowledge orientation, where it is knowledge and management of business processes that are the most valued factors when making decisions about cooperation. Organizations respond to changing market demands and high volatility in markets. No market sector is foreign to the necessity to constantly adapt products and services in order to tailor them to the requirements of the modern customer. That, in turn, forces organizations to adapt and modify their processes. Hence, the processes, even the most perfect ones, lose the status of immutability, and the very fact of developing a given process is no longer a guarantor of market success.

This does not imply, however, that business process management is losing its importance. On the contrary, it is an approach that drives the organization to closely reflect on its internal phenomena and activities. As such, business process management prompts organizations to learn not only about the process itself but everything related to its conditions, inputs, and outputs. All of that translates into a huge knowledge base that must be utilized by the organization. Therefore, modern process-oriented enterprises – almost intuitively, on the basis of evolution – lean towards a process and knowledge orientation, with a view to becoming attractive cooperation partners for network organizations.

In the introduction to the article, a research question was posed, which states that business process orientation in an organization is one of the most important factors influencing the creation of a network organization. This is evident in the described research. An undoubted limitation of the research presented in the article is its scope. The second is the inhomogeneity of the trial. It was chosen in a targeted manner, among organizations which, according to the author's knowledge, undertook cooperation activities in the form of a network organization. A lack of randomness turns out to be an advantage in



this case (because it limits the number of surveys in which the obtained answer will exclude the participant from participation in the research, for example, through the lack of experience in cooperation outside the organization's structures). On the other hand, it is a limitation, because these organizations have, in the vast majority, good experience in the field of cooperation.

Results suggest that in the network structures under scrutiny, resources, and abilities to cooperate play a more important role for partnership than the organizational or cultural similarities of the institutions involved. In addition, we found that knowledge management and organizational experience is perceived by participants as more critical for successful cooperation than the quality of personnel.

A flexible and efficient structure, such as a network organization, has to seek "perfect" partners. However, those partners cannot simply recognize the need to adjust their processes; they must also effectively implement them. Management of knowledge-oriented business processes is a means to meet these requirements.

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### **Abstrakt**

*Współcześnie coraz częściej mamy do czynienia z powstawaniem organizacji o charakterze sieciowym. Są to organizacje zakładane w celu realizacji konkretnych zadań i są tworzone przez niepowiązane organizacje. Wybór kooperanta nie może być i nie jest przypadkowy. Jest to proces, w którym wykorzystywana jest wiedza o ewentualnym partnerze i jego zasobach, a także możliwościach. Autorka stawia tezę, iż orientacja organizacji na procesy, a także na zarządzanie wiedzą jest silną determinantą dla podejmowania współpracy sieciowej. W celu weryfikacji tak sformułowanego pytania, została przeprowadzona ankieta. Pytania o czynniki wpływające na decyzję o podjęciu działania współpracy w ramach struktury sieciowej, zostały skierowane do grupy nielosowej. Organizacje, które uczestniczyły w badaniu, mają doświadczenie w prowadzeniu projektów w ramach struktury sieciowej. Badanie ma charakter przy czynkowy, może być jednak punktem wyjścia dla dalszych rozważań oraz do próby budowy modelu o charakterze ogólnym.*

**Słowa kluczowe:** organizacja sieciowa, zarządzanie procesowe, zarządzanie procesowe zorientowane na wiedzę, determinanty współpracy, proces zarządzania wiedzą, organizacja elastyczna

## **Biographical note**

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# Dissimilarities between applied methods of project management impacting regression in business processes and technical architecture

Hubert Bogumił<sup>1</sup> 

## Abstract

*The aim of this paper is to explore the drivers of keeping the consistency within business processes that are highly supported by system configuration, while the system architecture is impacted by a technical change in the organization that uses both traditional and agile methods of change management. Two research questions were raised related to the most frequent road blocks in managing system and business non-regression in hybrid management of change and the respective methods used to limit the system and business regression in the conflicting approaches of business operation models. In the research, a tailored method of multiple case study was used based on primary and secondary data from accessible documentation of projects, experience from tests and production cut-overs performed in the mix-method of project management, and change management circumstances. Overall findings wrap up the conclusion which is, that in order to keep control using the rules of BPM in transforming an organization, it is an indispensable necessity to use open cooperation that addresses cross-organization business objectives and overall business sensitivity for threads related to an agnostic approach of change realization chained by methodological rules. The advantages of collected knowledge may lead to formed ways of securing business objectives from unexpected regression driven by internal and independent organizational enforcements.*

**Keywords:** *business hybrid organization, business and technical change, business regression, IT system regression*

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## INTRODUCTION

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Organizational change is one constant value, driving life and business objectives and, hence, shaping the conditions of business processes, that were raised by numerous authors, e.g. Harmon (2007, p. 33). While unexpected occurrences influence business process governance on a daily basis and are perceived as natural inconveniences that require better planning and prediction for the future, the improper and independent implementation of intended change brings confusion on the legitimacy of adapted orderliness and aligned business processes that can be caused by natural deficiencies to manage the risks, as identified by Moran (2014, p. 36-37).

Business organizations, usually being well aware of the related risks and challenges, make efforts to consider, predict and identify any occurrence of change and try comprehensively to estimate its impact. Hillson (2017, p. 3) also underlines the role of increasing expectations related to this aspect. Some organizations, especially those that perform their business activities in highly regulated environments, are equipping their business processes with risk management tools that mitigate any deficiencies that may appear by materializing risks.

Nowadays, each organization is more and more aware of its subjectivity to different types of risks and increasingly this trend is strengthened by information technologies (IT). Information systems are demanded by every aspect of business architecture, constituting a constantly undying need and an inseparable compulsion that accompanies any business idea and its consequent change (Avila & Garcés, 2017). Business Process Management, as a highly IT-soaked area, also influences IT changes that are strictly connected to innovative notions. This paper exemplifies the inter-dependencies between the ways changes are implemented and the possible aftermaths that can emerge.

In order to get clarity and comprehension of the used terms and definitions, it is important to explain the overall relations between them. *Business Architecture* is defined by The Open Group Architecture Framework (TOGAF) as the overall business organization, strategy, governance, which was adequately expressed in Harrison's position (2011, p. 18). We believe it is valuable to supplement this definition with processes orderliness, which allows one to constitute business governance and entrepreneurial organism toward realizing set business goals and targets. To support business architecture, and also business initiatives, an organization uses *Technical Architecture*, which is defined as an embodied information system structure, adopted and implemented in a particular business organization to support business architecture and business initiatives; known also as technology architecture with its technical (software and hardware including middleware,

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networks, communications, processing, and standards) capabilities, as also stated according to TOGAF by Harrison (2011, p. 18).

Consequently, there is a need to define *Business Change* as a change in business process functioning in an organization, driven by people, which has been underlined by Stumpf (2015, p. 6). Business change in this paper is recognized as a single source for launching a chain of events through the obvious impact of technical architecture, and inducing related risks to bring regression in technical order and, subsequently, potentially impairing business architecture neighborhoods. On the other hand, it is necessary to underline that any other kind of business change that does not engender technical change is not a subject of this analysis. To picture this aspect, we may call two such examples as product parametrization, new plan of tariffs, etc.

As a usual successor to business change, in a highly technologized business organization, a *Technical Change* can be observed. It can be defined as a change in the technical architecture supporting business processes, requiring adequate analysis and technology, as also stated by Paton and McCalman (2008, p. 22). In this elaboration technical change is inducted by business change and strictly related to the change of version in configuration item (system, application, etc.). Consequently, any changes that do not directly entail a change in configuration item version are not a part of this analysis, for example, changes in parameter tables of database to bring new services or change existing ones.

To efficiently manage both business and technical changes it is important to introduce *Change Management*, which is a process embracing all the necessary activities to coordinate business and technical changes in an organization. Also called a “key skill” or even a “key survival skill,” as defined by Paton and McCalman (2008, p. XVI), the change management process is very often connected to a business readiness point of state that is a consequence of the implemented change; as such it may also refer to other dimensions as qualitative communication management, procedural readiness, staffing, etc. The change management process is well equipped with a portfolio of methods used to run it, for example, ITIL.

Further, Change Management is by best practices decomposed to other managerial sub-processes, with one of them being *Project Management*, named by Kerzner (2017, p. 2) as a coordinated set of tasks and activities aimed at realizing a project’s objectives. Project management is usually widely perceived as a large group of activities embracing: time management, risk management, schedule management, people management, scope management, test management, development and integration management, etc. The general approach presented in this paper, to all advanced terms and definitions on project management, is to express it as solely the management



of unrepeatable work centered on achieving clearly specified aims. Project management is willingly taken as a subject of many methods and methodologies, both traditional, for example, PRINCE2, or agile, for example, AgilePM. At the same time, there is a clearly visible lack of a methodological approach to the use of mixed project management methods such as cascade and agile. This substantial gap is quite onerous, especially for those organizations that are in the middle of a transformation, or under pressure to use both of them at the same time.

The paper also analyzes *Hybrid Organization*, which we define as an organization where project management and superior change management processes are realized in both: traditional, cascade routine and a new, agile method creating teams and sub-organizations to proceed with a specific way of conduct, for example, DevOps, to support agile performance.

*DevOps* is identified as a business structure in an organization focused on realizing a particular set of business processes or value streams, usually highly independent within an organization and being equipped with technical support and adequately resourced, in order to realize business processes and related changes in an efficient and agile way, that was also intended by Kaiser (2018, pp. 2-4).

As the subject of the study is *System Regression*, it is important to provide a clear understanding of this term and define this as an unplanned change, resulting in an impairment of the business process and technical architecture that impacts the connected configuration or service. Such an approach is also provided by Kaiser (2018, p. 222). It is worth underlining that the risk of regression is one of the key aspects of the realization of the technical change within a system landscape, which results in the necessity to use advanced mitigation methods as non-regression tests; the occurrence of regression may result in unpredictable consequences and lead to a substantial impairment in the system and business architecture; in the hybrid organization, regression management is one of the key challenges that impacts the stakeholders of change implementation.

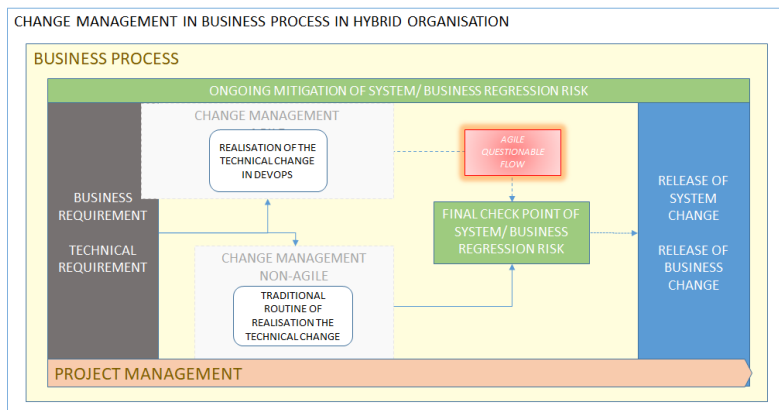
Nowadays, business organizations commonly use processes that are fully supported by information technology, as they are also connected to external dependencies such as regulatory reporting, external payment systems, intermediary vendors, outsourcers, etc. In the common perception, a well-performing business organization is very often bounded by the established rules and governance of Business Process Management.

Nevertheless, the market and the general surrounding business environments of a particular industry promote everlasting competition, which enforces mature business organizations to use more and more modern solutions. Many stakeholders within a particular business organization,

and outside of it, perceive technological racing, and thus innovations and improvements, as key factors to keep up with market expectations. This endless searching is simultaneously full of side effects, risks, threats, and even dangers that may lead to disaster. In accordance with Teniente and Weidlich (2018, p. 614), in highly technologically-embraced business processes that are subject to BPM, there is a more frequently noticeable phenomenon of clear addiction which, even when a single business operation encounters severe issues, may be caused by one, and sometimes a non-pecuniary, technical change in information systems.

As a technical change process is an integral part of a change management process, there can be stated a homogeneous definition that technical change qualifies only changes in a system (software) component version, as also identified by Muller and Rumpel (2015). It is important to distinguish a technical change from a parameter change within an information system or application as long as parametrization does not impact the change in a technical component version. According to the currently used standards, many technical changes are realized in a prompt and agile approach, and keeping a close focus on configuration management and the appropriate version appliance has become an indispensable necessity and enormous challenge. The challenge increases in geometric progress to the scale of the technical changes and the number of their releases.

It is important to realize that every single attempt of change implementation may cause regression in the overall organizational order. Figure 1 displays the above-mentioned area, presenting the questionable flow that is a subject of the research.



**Figure 1.** Change Management in the business process of a Hybrid Organization - logic diagram

Bearing in mind that agility in a business organization influences every possible aspect of business governance and organism (Unhelkar (2013, p. 452), it also clearly impacts existing practices and methods of business change. As introduced by multiple IT service management approaches, for example, ITIL<sup>2</sup> (Kaiser, 2018, p. 2), each component (configuration item: CI) has its own features and is versioned by the unique value, being a service asset. Kaiser (2018, p. 137) has endorsed such an approach, referring to the unique nature of each separate CI. All CIs configure a system landscape that is technical support for business processes. Many CIs do not function as independent elements but are in relation with other CIs. As mentioned by Avila and Garces (2017), this clearly and certainly leads to the conclusion that any technical change within the single CI (its version) may influence other related CIs and disclose unexpected consequences, which respectively may elicit the system regression in an overall system landscape. As Parsons (2014) identifies, following the occurrence of regression in a system landscape, it is obvious to notice the next step of the impairment of other business processes. The occurrence and matter of technical and, thus, business regression is very well known and is usually mitigated by multiple non-regression tests that can significantly decrease the project and system risk, as also described by Kaiser (2018, p. 288). In the hybrid change management performing organizations that face operational challenges related to independence and transparent governance, there are frequently repeating concerns of how to efficiently manage business processes that are impacted by business changes and, as Paton and McCalman (2008, p. 77) notice, it is connected to technical changes in order to keep business processes unimpaired.

The aim of the following research is to attempt to fill the gap in the methods and currently known practices allowing the smooth use of BPM, as was also identified by Teniente and Weidlich (2018, p. 614).

To display the universality of the regression problem caused by a technical change, we have chosen three organizations that represent in general: differential industries, maturity of IT adoption and openness for agility in the realization of business change. The research as such embraces reasons, challenges and answers of technical, and hence business, regression caused by diverse and incompatible practices related to project management and change management approaches. During the study, we attempted to interview key people who have a direct impact on all stages of creating a change and, at the same time, safeguard the risk of the negative consequences that changes may cause. All these elements have been described in the part of the paper related to Research Methods.

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2 ITIL – IT Infrastructure Library.

For strengthening the research business case, it is worth underlining that some fragmented researches have already identified issues of gapping areas between traditional methods and DevOps-oriented practices being a source of severe issues, which can be referred as well to Kaiser (2018, p. 73). Considering that either Project Management methodologies<sup>3</sup> or ITIL do not provide answers and rules or help driving business practices for hybrid ways to manage the change, it is crucial to raise the following research question:

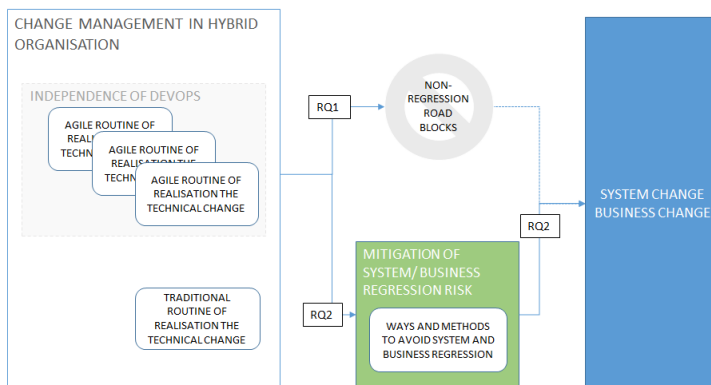
RQ1: What are the most frequent road blocks in managing system and business non-regression in a hybrid management of change?

And to supplement the analysis, it is crucial to refer to the consequent step that can be expressed by the following question:

RQ2: What methods are used by organizations to limit system and business regression in the conflicting approaches of business operation models such as traditional and agile?

The above questions try to address the shaping of the approaches and best practices that may be followed by defining reference models supporting those organizations, which wish to look for benefits and filling the gaps resulting from the use of such a hybrid style of change management. The following Figure 2 expresses the relations between the research questions.

SYSTEM LANDSCAPE CONSISTENCY IN HYBRID ORGANISATION



**Figure 2.** Research questions – logic diagram

<sup>3</sup> Both types of Project Management methodologies as waterfall, e.g. Prince2 or agile, e.g. AgilePM.

The emerging answers to the research questions will articulate the subject matter synthesis of the overall issues and ways of how to resolve them.

Nevertheless, the refined conclusions may also deliver honorable points to restart the discussion on how a business organization needs to perform to avoid easily predictable traps, as identified by Yazici (2009).

To present a comprehensive approach it is important to refer to the structure of the analysis and, hence, the paper as is. Thus, the elaboration has been compounded in the paragraphs stated below.

Firstly, there is a literature background of the raised theme, which also allows a better understanding of the root cause of the identified issues and subject matters of change in business processes powered by technology. The following paragraphs provide a description of the adopted research methods and their justification in the specific circumstances that were faced by the author. Next, there are the results and analysis obtained in the course of the research, which allow one to comprehensively understand how the raised issues and concerns may be addressed. The article concludes with further discussion and conclusive statements that summarize the matter of research, further discussion, consideration and, in consequence, future research options.

## LITERATURE BACKGROUND

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The business architecture of an organization is shaped and structured by business processes. A well-performing set of business processes is always the subject of careful establishment and has been named as Business Process Engineering – BPE. Elzinga, Gullledge and Lee (1999) approach BPE as assessing ways in which companies' productivity, product quality, and operations can be improved. A further step is another theory related to business process improvements that can be introduced, and that is specified as Business Process Reengineering – BPR. As noticed by Simon (1994, p. 29), it may embrace, among others, such criteria as the rearrangement of organizational structures, processes and tasks. According to Hammer (2001, p. 35), BPR is *“the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed.”* Thus, the necessity to look for improvements in business processes is natural from the perspective of innovations that are driven by technology, and also from the perspective of desiring to get higher business value that can be considerably supported by technology as well. It is also good to notice the overall place of a business model as a consequent set of processes efficiently or even effectively working.

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While a business model can be related to an optimal state that such a set of business processes fell into, Białek-Jaworska and Gabryelczyk (2016) noticed that a business model can be extensively described by its components. Going further, they perceive a business model through its definition regarding the way a company delivers customer value. Another factor is the way the company makes customers pay for such value. However, the key point here seems to be refining the way a company transforms these payments into profits.

Changes in the business model usually enforce further reengineering of business processes. As business processes are highly equipped by information technologies, such changes can be perceived as sensitive for the overall business and technical architecture in the business organization. Simon (1994, pp. 59-61) describes IT as being disruptive for traditional processes that were mostly operated by humans, and indeed IT has been refining revolutionary changes that act at a highly speedy rate.

Nevertheless, it seems that the most unpredictable and thus devastating is the unplanned and unexpected failures in running business processes caused by the technology that supports it in a usual code of conduct. Ślędziewska, Gabryelczyk, and Włoch (2017) link the Resource-Based Theory, which helps to understand competencies within organization, to the necessity to define digital competencies, which refer to the strategies for managing related assets and thus to the further development of specific skills within an organization. A lack of such digital competencies may drive unexpected occurrences in technical architecture. Dwivedi, Wade, and Schneberger (2012, p. 415) connect this phenomenon to the difference between working routines or systems and the information systems that are there to support, but in some circumstances may overwhelm, users. Moreover, it can even be worsened when intra-organization communication is not properly handled, as it is well noticed by Dwivedi et al. (2012, p. 100), who refers to this as the information distribution approach. It brings attention to the substantial role of intra-organizational communication in an Organizational Learning model, as pointed out by Dwivedi et al. (2012, p. 97).

Crashes that appear in the daily use of technology or its amortization can be somewhat considered and understood as natural occurrences. However, failures that are induced by changing technology can bring enormous and unbudgeted repercussions. In the following paragraphs, we will focus on the disruptions that are caused by regressive technologies during the implementation of technical changes, by change management processes running in traditional, cascade routines, and agile ones.

## **An impairment of the business process caused by a technical change**

Although the definition of business impairment and the consequent impairment within BPM, which is caused by system regression and its management, is not a new appearance, as currently a basic emergence is observed of correlative problems triggered by a persistent approach to establish and use new, innovative tools and methods of agile managed organizations, as noticed by Mihalache (2017). This is very often applied to those organizations that are in the transformation from traditional operating models, as underlined by Unhelkar (2013, p. 146).

Pisano (2006) ascertains that *“strategies adopted by firms that have successfully profited from their innovative activities cast into new light old questions about the impact of intellectual property protection on the rate and direction of innovation.”* At the same time, it is necessary to underline that more and more accepted innovations in a limited time scale may create considerable issues connected to their efficient administration and management, and can result in the emergence of unexpected breaks in business processes.

McManus, Seville, Vargo, and Brunsdon (2008) notice that building and keeping more resilient organizations are considered to be able to create an adequate response to the crisis or emergency management issue that occurred. In consequence, resilience for organizations is found to have three principal attributes. McManus et al. (2008) list situation awareness, management of keystone vulnerabilities, and adaptive capacity. Also, it is indispensable to equip the organization with a facilitated process that can assist in enhancing its performance according to these attributes. This is directly touching such aspects as impairment of business processes and the ways organizations can manage them. By its nature, an impairment may have numerous different root causes related to differences in how the business is conducted and how the changes in technical and business architecture are performed. According to Kakar’s (2017) considerations, most of the enterprises which mainly use agile methods perform their operations within independent sub-organizations, named DevOps. Such an approach can efficiently realize business objectives, serving prompt change management routines to support them (Kakar, 2017).

## **Independence traps for business agility**

In agile-oriented organizations, the independence of DevOps groups also shapes the new governance of system configuration by a clear division and separation of assigning a particular system CI (i.e., application) to the sub-

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org independent management, noticed also by Kaiser (2018, p. 122). Such a tight relation equally helps DevOps to realize changes in business processes and independent decision-making on the direction of change and future evolution, which was exposed by Mishra, Garbajosa, Wang, Bosch, and Abrahamson (2017).

Although an independent approach can substantially raise the efficiently prompt realization of business objectives for particular DevOps, it may also lead to an unpredicted impairment in the general system landscape of a horizontal organization and further cascade business impacts (Wells, 2012). Even more complicated and dispersed problems can be observed in hybrid organizations, where there are two approaches to realize business targets and cross-organization governance, as significantly gapped by independently functioning DevOps (Kakar, 2017).

In the large portfolio of unexpectedly emerging problems, they can be grouped and listed as the following: delays or stoppages of the business process and operations (Boehm & Turner, 2005), discontinuity of business performance (Pralhad, 1998), substantially impacting business reputation (Resnick, 2004), regulatory incompliance and litigation. Each of them can determine inconceivable effects for the further functioning of business organizations.

### **Mitigation challenges for technical change-related risks impacting business processes**

The core ways on how to mitigate and manage the risk of business and BPM regression, impacted by system regression, in both an agile and hybrid organization is the subject of this analysis. Although the matter exists in many organizations, it is unexpectedly rare that business organizations raise it sufficiently to establish durable mechanisms to mitigate it. Although some research proposes patterns of algorithms on how to efficiently propagate changes to align business change with IT change, as elaborated by Avila & Garces (2017), they nevertheless seem to remain still in the exploration phase or, even more, only in theoretical considerations. Despite certain omits in this area, business organizations raise overall awareness and start to work out practices that may mitigate the risks of regression. The subject was raised by Kaiser (2018, p. 122), who dedicated conclusive findings to such mitigating practices.

To bring more comprehensiveness to regression in business processes impacted by regressive technology, it is natural to segment its dimensions and try to understand them from such perspectives as the right notice of regression, its severity and business impact, and exploring its root causes, as endorsed by Paton and McCalman (2008, p. 248).



## RESEARCH METHODS AND APPROACH

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The aim of selecting the right research method for this subject was to make the research widely based on people's experience and findings. As the baseline items being examined were relatively new for other checked researches, the key acting stakeholding parties must have obviously been people. In this elaboration, a method of a multiple case study analysis focused on real-life organizations has been used, which was previously refined by Yin (2017, p. 91), and the issues they faced for the limitation of system regression. The research is established on an exploratory qualitative study with the goal to develop a methodological road map to manage such occurrences in similar organizations. Three medium-size organizations were selected: a mid-size commercial bank, a trading company, and a software house. All of them had an understanding and use of BPM from independent industries and were in the transformation process to adapt an agile approached operational model, similar to Mihalache's (2017) research. The refined choice of them was driven by general criteria based on two dimensions. The first of them is the observed extensive leadership to transform an organization from a traditional cascade-change driven one to an agile one. The second dimension is related to the variety of industries they represent, so as to get many general conclusions that can be relatively universal from a business perspective.

Based on the regulatory circumstances and legal environment, the above organizations work in, the transformation has a different rhythm and differs from one to the others. It makes the research much more interesting as the outcomes supplement each other and create a well-designed landscape of findings.

The case study focuses on the author's own observations taken from daily work in close touch to the project environment and interviews with the CIO, business representatives or project managers, and the COO of each company. The supplemental material has been collected, based on particular change projects' documentation, as business requirements, functional and technical specifications, risk registers, test scenarios, Configuration Management Database (CMDB) reporting, status dashboards, and others. These methods of gathering empirical data from primary and secondary sources are in line with the proposal for the case study research offered by Yin (2017, p. 91), who underlines the advantages of using multiple cases as more compelling and giving the effect of research as more robust. Such points in organizational change naturally allow one to explore the hybrid approach and, hence, the overall struggling and trade-off between time, delivery quality and the purity of used methods, as also underlined by Harrison and Lock (2017, p. 50). In order to collect so much comprehensive data, the research process was established in the following steps:

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**Step 1.** Identification of issues related to the occurrence of business regression impacted by regressive technology and review the subject matter literature; the variety of identified issues determined the need to group them aggregated by similar features;

**Step 2.** Understanding the gaps in current research and the definition of research queries; the review of accessible literature helped to diagnose the research gaps and locate them in the two groups of used methods – agile and cascade; selection of the research method as the multiple case study analysis focused on real-life organizations as described by Yin (2017, p. 91);

**Step 3.** Observations and documentation studies; self-observations from realized projects supplemented by documented material were an additional input strengthening the interviews performed with key stakeholders;

**Step 4.** Interviews with selected stakeholders and driving for conclusions; interviews constituted the core valuable driver of research; in addition, it is good to underline that all the interviews were completed in a project environment; thus the openness and honesty of the collected information is very much aligned with its accuracy. There were also supplemental studies of additional material appointed by stakeholders.

The analysis is also based on the author's own broader observations during the realization of system-related projects and additionally supported by secondary data – a review of project documentation. This approach has also been used and presented in Yazici's (2009) elaboration. The raised questions have been adequately addressed and additionally supported by a broader explanation of the business and technical dimensions of occurred regression from the perspective of the notice of regression, its severity, and business impact, and conclusive exploration of its root causes, that was similarly exposed by Paton and McCalman (2008, p. 248).

## **OBTAINED RESULTS**

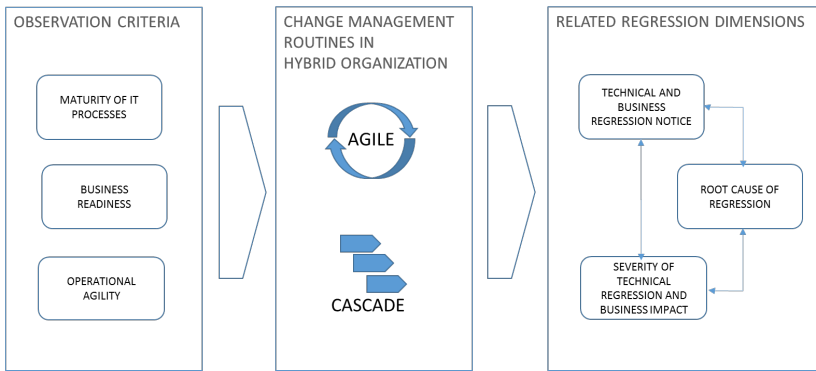
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### **Case studies**

The basis for the analysis was established around three organizations: a mid-size commercial bank, a trading company and a software house; and the most important factor driving this choice was to observe the determined leadership required to promptly transform an organization into an agile one.

All stakeholders clearly underlined that organizational readiness for an agile operating model was one of their targets and even as defined objectives obtained from supervisors. During the interviews, each stakeholder tried to point out several main features of agile-related business readiness. However, the platform and main goal were always targeted at efficient communication and cooperation between the business and IT toward delivering the expected change in business processes in prompt timeframes. Figure 3 displays the relations between grouped observation criteria and related system regression dimensions that were raised by the author’s respondents.

OBSERVATIONS CRITERIA AND CONCLUSIVE FINDINGS CHAIN RELATED TO SYSTEM AND BUSINESS REGRESSION PHENOMENON



**Figure 3.** Observations criteria and regression dimensions

Figure 3 illustrates the following paragraphs, which summarize the current stage and review each one from the perspective of transformation advance. The description of the current situation has been divided by observation categories that attempt to display the selected wider picture of progressing to organization agility in a particular company. The refined categories were captured based on the Strategic Alignment Maturity model (SAM). The model touches descriptive and prescriptive aspects of alignment to attain higher levels of IT maturity and, consequently, effectiveness. This directly guides business organizations on how to improve business performance, as mentioned by Luftman, Tal, Dwivedi, and Rigoni (2010). As SAM relates to six business architecture dimensions to express its maturity: Communications, Value Measurements, IT Governance, Partnership, IT Scope, and Skills, we have exposed the following ones to visualize the paper’s targets: Maturity of IT processes, Business readiness, and have added Operational agility as a key performing factor. The chosen observation criteria reflect the logical transformation aspects that were raised many times during discussions and

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interviews with selected stakeholders. Almost everyone underlined that the starting point of a successful agile transformation needs to be a well-functioning IT organization. When an IT organization performs to expected levels and with matured processes and practices, the next success factor seems to be openness for change from the business functions and, thus, its readiness to get a new operating, agile model. Such declarations from business divisions could also be supported by the current agile practices used that can be valuable for resilient transformation. That is why operational agility is one of the core points that can be another important grip for handling agile transformation.

### **Maturity of IT processes**

Business organizations utilize numerous tools that support business management and, respectively, also support IT governance. As IT-related problems extensively impact business processes, it is apparent to the leaders that it is indispensable to have a deeper view on IT-related aspects. Rogers (2009, p. 255) relates such needs to their embracement within the Capability Maturity Model (CMM). As per Rogers (2009, p. 255), many variations of the original model and, thus, frameworks, connect to the capability maturity model and other maturity models that are not part of any formal frameworks. The analysis embraced in Table 1 summarizes the overall view captured from the researched companies.

The above stated as-is quick facts on the maturity of IT processes consequently influence business readiness for applying new, agile-related ways of conduct.

### **Business readiness**

Business readiness or substitutable, organizational readiness is quite a wide-ranging sense of terms. Among many of them, the most suitable for this paper is the one as presented by Weiner (2009) and constituting organizational readiness as a “shared psychological state in which organizational members feel committed to implementing an organizational change and are confident in their collective abilities to do so.” From the perspective of an overall approach and adaptive behaviors to accept organizational change and perform in a new atmosphere of agility, such a definition is comprehensive. Thus, respective observations have been collected and presented in Table 2. This adequately fits into the frame of the research.

**Table 1.** Maturity of IT processes

Organization	Maturity of IT processes
Commercial Bank	<p>Business processes are fully covered by IT system support; any manual set of activities chased against possibility of automation. Well performing horizontal IT service management model is strongly supported by ITIL and related system tools.</p> <p>Change management process is centrally managed with minor exceptions. Constant aspirations to refine DEVOPS model of change management performance were observed.</p> <p>There is a well adopted and used CMDB<sup>4</sup>. Any exceptions from using CMDB are persistently registered and audited.</p>
Trading Company	<p>Business processes are in the majority covered by IT system support. Nevertheless, there are gaps in coverage of processes by systems that are strongly defended by related staff.</p> <p>IT service management processes are under construction and partly working. There are gaps in understanding the necessity for IT services and ways of their contracting and clearing.</p> <p>Change management practices differ from department to department. The company is working on unification of change processes. For now, CM processes are not formalized nor described. Ways of performance based on best practices and verbal transmission are commonly used.</p> <p>CMDB has been partly adopted for selected critical configuration items. The process of Configuration Management is based on an expert method. There is no routine to keep CMDB records actual. Any updates are executed usually only by clear requests from the CIO.</p>
Software House	<p>Business processes are fully covered by an IT system support. There are no manual activities, nor home-based solutions used for business processes. The office applications are only used for supporting the work of humans;</p> <p>IT service management is efficiently repeatable and adopted in a particular company's division. There is full coverage of the system's development life cycle and maintenance by ITIL processes and best practices. Persistently seeking ways of improvement is adopted in the company's culture.</p> <p>Change management process is featured for each division and is independent. There is a full rollout to DevOps teams with a strong sense of efficient communication between teams as necessary.</p> <p>CMS<sup>5</sup> is widely dispersed among divisions and is locally adopted and managed. There is well-constructed communication on changes and the relationship between configuration items located in different DevOps teams.</p>

4 CMDB – Configuration Management Database.

5 CMS – Configuration Management System.

**Table 2.** Business readiness

Organization	Business readiness
Commercial Bank	<p>There is raised focus on business value and prompt response to market change. Favorable accents are put on profitability and refined business chase on any emerging business change.</p> <p>There is a high willingness to close cooperation with IT and agile working methods. A culture of advanced understanding and importance of IT systems has been refined, and the way of their performance to very low level of granularity (e.g., Business very often possesses knowledge of tables in data base layer of system).</p> <p>There is well-driven sense of reporting on business value. Reporting and status update seem natural and indispensable factor of peoples' activities.</p>
Trading Company	<p>Business targets are quite steady and shaped within strict regulatory frames. Although the business innovation stream is well exposed to communication with the staff. New ideas are trying to get some daylight, however possible improvements and new ways of business performance are rather based on the routine to follow what competition does.</p> <p>Clear separation from IT influence and gaps of understanding IT-driven business processes and getting additional value from closer cooperation. IT department is perceived as a focused magic center. The company staff receive IT solutions and partly are understood as business miracles with no clear understanding of their need and level of importance and moreover the ways they work.</p> <p>Business value is unfocused for business departments. Profitability and business case are being built and reviewed at Management Board level. Lower levels of supervision are typical decision takers with low willingness to look for value or initiate further related ideas.</p>
Software House	<p>Business and IT are treated as one correlated mechanism with a high level of mutual understanding. Business lines are assigned to people who are very well oriented in IT capabilities and are involved in any discussion on IT aspects in an easy and unfettered way.</p> <p>Business value is very well defined and focused on by all staff. There is currently an existing program of additional benefits and net fee revenue calculation for individuals that contribute their active involvement in achieving real value – e.g. new contracts or cost saving. The staff is highly committed and aware of the business and competitive edge of the company's strategy and tactics.</p> <p>Business value and profitability are frequently reported. The staff is very well aware of reporting routines and its importance for the overall functioning of business directions within the company.</p>

The analysis of business readiness has clearly delivered an overall view of organizational preparation to introduce a transformation process toward an agile model of performance. The next-step researching point was to check

the current status of those parts of the organization that declared agility as the currently used approach and code of operational conduct.

### Operational agility

As with the definition of business readiness, there have been numerous attempts to describe operational agility. One of the most eligible, which sticks to the spirit of this research, is presented by Sajdak (2015), who defined it as the *“ability to adapt a company’s business processes so that it can quickly, accurately, and effectively exploit market-driven innovation.”* Additionally, it is worth including such a designation of operational agility as to *“reconfigure existing processes quickly and create new ones to take advantage of dynamically changing market conditions”* (Sajdak, 2015).

Operational agility determines the level of performance of business processes and thus the overall functioning and efficiency of BPM. Table 3 embraces the observations and declarations from respondents on this matter.

**Table 3.** Operational agility

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Organization	Operational agility
Commercial Bank	Pilot DevOps Teams are performing in each business department. Several careful ways of adopting agile methods have emerged, although there is strong board commitment to respective transformation and constant enhancement of connected initiatives. As per the nature of business, adjusting operations to agile routines is critically dependent on a non-influential rule for client’s activities and functionality. From another perspective, agile practices are carefully adopted based on the review and potential appraisal of external supervisory bodies.
Trading Company	Selected IT change projects are practiced with the use of agile methodologies. Nevertheless, such practices are more related to new interest and desire for new experiments than a real need to delivering business and technical change quicker and more efficiently. Business and technical stakeholders declare openness for agile methods. There are related risks or threats unnoticeable as per business nature.
Software House	DevOps are efficiently working and organized for the entire company with a high independence and internal sense of competition. Nevertheless, there is a high sense of independence that causes an overall inkling of many small business organizations within one huge organizational body. Therefore, there is an existing overall question of keeping the consistency in business strategy applied to the entire enterprise as one running business organization.

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Operational agility has indeed got a much broader sense and, again, can be expressed in multi-dimensional criteria. However, the paper has limited them to the above presented statements to target its research aims.

### **Conclusive findings**

Toward getting a tolerably consistent and transparent overall view, there is an attempt to summarize conclusions on the as-is situation in a particular company. Clear observations can be refined, noticeable after the analysis of the current stage of agile transformation for the above-stated organizations. Software House is the most advanced company in getting to full agility. There are good awareness and understanding of the indispensability of mutual functioning, the axis of business-IT as performing machinery toward creating business value and a competitive market edge, and at the same time allowing people to develop their skills, competency, and interests in the innovative business organization.

Bank is fully aware of what steps to take toward getting to agility and is persistently realizing them. Nevertheless, due to keeping critical processes and business operations to high-standards and well-controlled, the transformation to agile reality is featured with evolutionary and careful steps. It is necessary to avoid any influence on the client's wellness or comfort and thus, the bank's impaired reputation. Another important point is to avoid the risk of exposing the bank to its regulatory bodies as a consequence of unexpected business impairment.

Trading company is in the stage of testing agile methods and the possibility of their further adoption, with no clear planned path to transform the operations into an agile formula. Nowadays, there are several initiatives launched to experiment and to collect a sort of experience toward preparing for any further planning of agility adoption. The company has got clear gaps related to staff awareness and overall understanding of why agility needs to be adopted and what benefits it may create for the company.

Despite the differences in the advance of a transformation to an agile functioning organization and understanding of its purpose, all three companies face high-level issues related to technical and further business regression that frequently occur during the realization of change projects, as was also noticed by Costantino, Di Gravio and Nonino (2015). Unexpectedly, a lower level of technical regression has been declared and observed in the trading company and the higher ones in the software house. The first impression of such a state is coming from the level of advanced technical support of business processes and the respective awareness by staff. Another explanation might



be connected with the different technical regression tolerance in a particular industry and thus different exposure to risk occurrence and threats.

### **The roots, however, are diametrically different**

With respect to the banking organization, although the phenomenon of technical and business regression is well managed and smartly limited, the business impact is the highest one in comparison to the other companies. This results from two general principles that put the bank out on more sensitive exposure than the remaining business organizations. These principles are:

- reputation of bank as an institution of public trust and the connected client's loyalty and security;
- strictly regulated banking industry and strong requirements of the code of business conducts defined by external regulatory bodies.

Going further, it is necessary to summarize the risks and potential influence from the technical regression caused by technical change on the business organization and the level of business and value impairment they may result. The following paragraphs present the observed regression dimension and root-cause. They are based on considerably repetitive notifications from respondents that can be grouped into such categories as *technical and business regression notice*, *severity of technical regression and business impact*, *root cause of regression* and *mitigation methods used or to be used*. They comprehensively embrace those observations that are qualitatively connected to the subject of the research.

### **Technical and business regression notice**

Our respondents underlined the importance of the moment when regression occurrence is noticeable. Although regressive tests are usually adopted for any technical change-related projects, it is rather unlikely to commit that all potential regression is to be mitigated. In conclusion to this fact, it is indispensable to emerge the ability to capture first symptoms of regression and promptly addressing potential business impact. As highlighted by the respondents and grouped in Table 4, such capabilities can be constructed and based on two engines: technical and cultural. Per the technical engine, it can be expressed as a set of tools, based on the statistical monitoring of technical and business processes. While technical regression predictive engines are providing early warning signals, the cultural engine can mobilize all human vitality to support it

in parallel. It is achieved by the consequent building of people's awareness and sensitivity for disquieting signals in daily work activities.

**Table 4.** Technical and Business regression notice

Organization	Technical and Business regression notice
Commercial Bank	There is carefully monitored and predicted potential influence of technical change of business processes thus there are quickly observed and identified gaps in particular business functions. Technical regression is most often assumed and observed for quick fix changes and unplanned releases. Thus, such regressive changes are accepted and, consequently, well managed by an emergency change management process or even business continuity planning. Within agile teams, the regression occurs more frequently than for the rest of the organization and sometimes is alarmingly ignored as non-material for particular DevOps.
Trading Company	There are mid-term identified gaps in business process functions. Surprisingly, there are no quick, adaptive processes run or the need to react promptly and efficiently. Technical regression is observed for newly implemented systems independently, a method that has been used for change management. There is a high tolerance of regression occurrence and hence fixing resulted dysfunctionalities are deferred in time.
Software House	There are immediate alerts of non-working elements in business or technical processes. High sensitivity level is displayed by staff as well as there is full awareness of the potential impairment to the business organization. Technical regression is constantly monitored for horizontal processes bulked by BPM and respective systems. Almost every release of a single technical change in such systems in one DevOps results in technical regression in other DevOps. Well-kept communication channels are working and there are established additional communication enhancements in crisis occurrence – i.e. frequent and multi-status meetings during the day or launching war-rooms, where the resolution is worked out until success.

Early regression notice may considerably increase further mitigation by the use of adequate counteraction. It is always accompanied by an appropriate qualification of the severity related to the occurred regression and circumscription of the potential impact on business processes.

## Severity of technical regression and business impact

This dimension was evaluated as the biggest repercussion driver that requires promptness on analysis and consequent response. Our respondents endorsed such a sequence of steps as the critical chain on keeping the business process in a healthy condition with minimal impairment. As presented in Table 5, some respondents mentioned that a quick reaction may even retain the continuity of business processes, which is a key factor for business organization survival.

**Table 5.** Severity of technical regression and business impact

Organization	Severity of technical regression and business impact
Commercial Bank	System regression may have a high impact on business functions. It usually engages additional resources and war-room activities. In some cases, it even resulted in the launching of BCM <sup>6</sup> and back-out plans. The most severe one resulted in inaccessible front-end services for the bank's customers.
Trading Company	There is a medium impact on business functions, especially due to the fact that technical and business architecture by its nature are not in direct relations. The highest risk can be caused by those configuration items that have an influence on metric and billing systems.
Software House	The severity of system regression is perceived as medium. It occurs frequently and hence best practices on how to manage with such situations have been worked out. Quick fix teams and post production cut-off incident management emerged. The most nagging issue is related to external delivery slippage and possible litigation.

As both regression notice and the identified severity are critical entry points to properly manage the occurrence of regression, it is important to attempt at concluding on the root cause that identifies the sources of the regression phenomenon.

## Root cause of regression

As per business best practices, it is always valuable to conclude any issues or winning points after they have occurred or have been achieved. As listed in Table 6, our respondents in referring to such lessons learned, were focusing on the fundamental reasons that generate unexpected system regression and thus overall threads for the functioning of business processes.

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<sup>6</sup> BCM – Business Continuity Management.

**Table 6.** Root cause of regression

Organization	Root cause of regression
Commercial Bank	<p>Quick fix changes are realized in the simplified procedures that omit some non-regression mitigation rules. For quick fix changes, the most important is the time to fix and sometimes it influences the necessary acceptance of a potential end, and even known regression upshots that may appear. The appetite for such acceptance is always contrary to comprehensive risk management rules.</p> <p>Agile methods skip some configuration management practices and alarmingly also adopted rules in order to promptly address the project's aims. Thus, the risk of non-regression is neglected especially for insular systems.</p>
Trading Company	<p>There is most often the lack of formal configuration management and extensive use of expert methods for possible regression identification. This approach causes the snowballing of technical regression. However, the risk of the existence of such regression is not connected to enormous business effects and is usually connected to the off-lining of one or two systems that in fact may well be around in such a size of enterprise and in this particular industry.</p> <p>For cascade method-run projects, frequent delays are observed that influence on approaching with simplifications in the very end stages. In consequence, they generate unexpected technical and business regression.</p> <p>Agile teams usually do not use any configuration management practices that seem only cumbersome as declared many times by agile teams.</p>
Software House	<p>A highly independent approach is used for frequent releases and individual styles and practices to implement changes within DevOps. There are still gaps in efficiency of the communication methods used between DevOps on realized changes in horizontal systems. Although lessons learned are discussed after each release.</p> <p>Additionally, a persistent eagerness is observed to get improvements in communication ways. The reason for this is a frequently raised and maintained awareness and clearly exposed factor, that gaps and inefficiency in communication is one of the major roadblocks in managing non-regression and overall system configuration aspects. Increasing numbers of releases that constitute KPI in overall competition between DevOps. This aspect is also supporting numbers of regressive issues. There is an observed and underlined challenge of realizing releases with no support from professional technology tools dedicated to change management in agile-performed software houses.</p>

In conclusion of the noticed root causes, there were naturally raised ideas on how to exclude such reasons or at least try to shape any ways to make them calmer. Our respondents willingly proposed different mitigation ideas connected to the system regression reasons.

## Mitigation methods used or to be used

Among the different ideas to mitigate system regression, there was a reasonable possibility to group them into the following bulks that are displayed in Table 7. Such groups can be a good starting point to create a flavor of the indispensable steps toward getting agreement between the supporters of traditional, cascade methods of the change management process and those who are persistent followers of agile-related methods and tools.

**Table 7.** Mitigation methods used or to be used

Organization	Mitigation methods used or to be used
Commercial Bank	<p>There is an adopted ongoing learning curve that assures continuous awareness within the change team. Lessons learned workshops are used after each mid-size occurrence of system regression.</p> <p>Despite using agile techniques, there is an indispensable need for respecting the configuration management guidelines, also for dedicated and seemingly isolated systems. The process of configuration management keeps relatively high standards and any omissions or apostasy from constituted rules are carefully reviewed and even, if necessary, audited.</p>
Trading Company	<p>Non-regression activities declaration is stated in the project’s documentation and status meetings. Nevertheless, all mitigation seems to remain rather as a declaration of necessary activities than a real plan that is to be realized.</p> <p>The project managers treat all tasks to avoid non-regression as a necessity in fulfillment methodologies and expected rules and as a kind of side-effect of their work.</p> <p>Financial discipline, incurring staff’s discretionary compensation, has been adopted – i.e. yearly bonus. Thus, most disciplinary and motivation factors are potentially impacting people’s wages. The impact, however, is connected to additional benefits and not as a KPI on some ‘at risk’ parts of wages.</p>
Software House	<p>Introduction of one dispersed CMS and rules of use that clearly support all configuration management related needs and consequently to distinctly mitigate the risks of regression. Dispersed configuration management tools quickly and flexibly support all necessary activities to prevent any occurrence of potential regression, however specifically within a particular, single DevOps.</p> <p>There is a need to flatten the independence and thus to lead the improvement of communication between DevOps for changes in horizontal systems. Still, there is a need for enormous efforts to be taken to handle the security of non-regression for horizontal projects and the need to enhance and refine communication channels.</p> <p>Another idea is connected to the introduction of new KPIs – e.g.: percentage of occurred regression points counted in simple cases of impaired configuration items by changes called during project realization.</p>

In the three examined companies, a huge bulk of differences has been observed among the overall approaches to handle non-regression related tasks and activities. Therefore, the interviews brought also deep

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and distinguished differences of attitudes among individuals regarding the overall perception of root-causes related to the above dimensions and their interesting behavioral expressions.

In discussions with people who are still strongly rooted in traditional cascade methods, a delicate skepticism and diplomatic curiosity were observed with respect to agile codes of conduct and reluctant reconciliation with upcoming changes. It is the usual behavior also observed in other researches that expose behavioral performance and the attitudes of people representing cascade-traditional approaches to project management. Supporters of traditional, cascade methods, being well aware of the level of regression launched by DevOps teams and issues related to this, were strongly underlining the need for an efficient and centrally controlled configuration and the management of non-regression, which was also endorsed by Pries and Quigley (2009, p. 179). Another very important factor that was usually re-called during discussion was the need for clear communication and, going one step forward, the necessity for giving the status of communication performance between DevOps and traditional teams.

Polar different attitudes were presented by people that have been using agile methods for at least several months. They excluded any need for central control of their practices and a somewhat hostile attitude to cascade and traditional methods of change management. Most often, DevOps teams perceive BPM as a driver of a particular value stream and do not connect it to its horizontal use across an entire organization. Nevertheless, they understand the phenomenon of system regression and thus, business regression caused by changes in systems when they are uncontrolled by central functions. Nevertheless, they displayed diametrically different approaches on the roots and possible resolution that is quite natural as observed by the others, as Mishra's et al. (2017) considerations. At the same time, agile supporters also seemed to become supporters of keeping shortages or even the limitation of communication across business organization. They perceive the need for openness as a kind of danger that may incur their independence as an integral sub-organization within a large business organism. Another obstacle listed was the fact that open and frequent communication may be a challenging point to getting a competitive position and may impair their overall results and ranking of scores achieved among all DevOps.

The outcomes of the performed study have addressed the Research Questions in the following conclusions:

RQ1 – the perspective of the most frequent road blocks in managing system and business non-regression in agile and hybrid organizations is shaped by the following root-causes:

- 1) **Feeling of independence** and limited or no need to inform about planned changes within an organization. The first impression is a very egocentric code of performance and putting all possible accents on the value and wellness of DevOps as a highly independent sub-organization. DevOps perceive agility as a principal (and very often as the only one) objective of change, and any occurrence of system and business regression connected to the change is rather occasional and usually insignificant or even found as part of the usual business code of conduct. This perception might be correct within the operations and also BPM rules, however solely limited to particular and single DevOps sub-organization. As naturally resulted, traditionalists notice hermetic barriers avoiding the controlling of configuration and change management inside DevOps. Feeling of independence also creates a crashing zone that impacts overall communication. This intractable aspect was most often raised by traditionalists and is the subject to the next paragraph.
- 2) **Poor communication** and a highly competitive approach to the realization of changes in a business process among DevOps. While traditionalists are separated from getting a satisfactory awareness of activities and performance inside DevOps, there is another related regularity that isolates a single DevOps team from another by using strong, but natural, communication fire-walls. DevOps teams expound it as a strong factor influencing their competitiveness in relation to other DevOps teams. This comes from an even more general approach that is the result of agility and emphasizes the enhanced need for competition between DevOps. Traditionalists also noticed this rule and there were ongoing suggestions on the modification or even cancellation of any competitive KPIs that really hinder overall cooperation and efficiency. Traditionalists also raised the phenomenon of calamitous impact for functioning processes across the company, including indeed Business Process Management rules and practices.
- 3) **Use of different approaches and tools** to manage the system configuration and regression. This is a key aspect when a business organization uses different project management and change management methods. While a particular DevOps is well aware of the practices, methods, and tools used toward performing an efficient agile change management process, there is a very limited or no exchange of information about changes in configuration among DevOps or other non-DevOps teams. This phenomenon has also been mentioned by other researchers, however, more from a pure business perspective, as also exposed by Mishra et al. (2017). The root cause of this, despite the above stated poor communication, is the persistent use of different approaches and tools for release management. The most aggravating driver of such a position is an effort to collate releases set in sprints to horizontal and periodic release plans in the overall business organization. Usually, such

attempts run out, resulting in an even deeper dislike and assertiveness between traditionalists and supporters of agility. Nevertheless, both sides expressed that the use of different tools determines one key failure factor preventing the successful and non-regressive technical and, in consequence, business change. It is quite clear, and a certain fact, to observe that agile supporters do not wish any changes in such an approach making it hermetic and proof from outside inference.

As the substantial root-cause of appearance and subsistence of road blocks for successful and non-regressive change were expressed and commonly shared, the proposed solutions and mitigation drivers are often in opposition between supporters of traditional and agile methods.

Consequently, as per the discussion with representatives of DevOps teams, there is an increasing issue-phenomenon to perceive BPM as a local implementation only, with no need for reference to horizontal use within the entire enterprise organism. A similar notice is presented by Teniente and Weidlich (2018, p. 614).

In reference to literature, it is necessary to underline that agile enthusiasts perceive rather as roadblocks for agile methods such aspects as, for example, security, that was clearly underlined by Kaiser (2018, p. 97), than their impact on the overall consistency of change delivery. They tend rather look for getting the highest level of agility by using new methods, being faster and more efficient, as also noticed by Komai, Nakanishi, and Saidi (2017). Moreover, the cure to eliminate inconsistency is most often postulated to automate the release management process in the sole competence of DevOps, which has been considered also by Kaiser (2018, p. 286), which may increase DevOps results, strengthening further independence, but consequently increasing the risk level of regression occurrence in an overall hybrid organization. A similar approach has been presented in another elaboration where another common and important business aspect as enhanced business communication is recognized as one of the roadblocks of agility (Smite, Moe, & Agerfalk, 2010, p. 311).

RQ2 – the proposed and/or used methods by organizations to limit the system and business non-regression in the conflicting approaches of business operation models as traditional and agile are as following:

- 1) **Use of unified configuration management tools and information source.** This solution, naturally consistent and non-collusive, however, became a bone of contention between supporters of traditional, cascade methods of project management and change management, and those



who support agile reality. While traditionalists are opting for one, even central configuration management system and configuration planning, that is also noticed by Pries and Quigley (2009, p. 256), the agile supporters feel handcuffed by CMDDB as external to a DevOps imposed tool that may incur their competitiveness and efficiency. Interestingly, agile supporters understand the traditional need to use such tools to keep overall awareness they nevertheless present an individual assertiveness in their particular cases. While targeting and, moreover, achieving the golden mean is extremely difficult, there is a necessity to underline that the use of one configuration management tool seems to be indispensable to keep overall consistency awareness and is one of the key mitigation methods for the risk of system regression and overall risk level within a managed project. It is worthy to consider if such a tool can have dispersed nature and technology that can still keep the sense of independence of a particular DevOps team.

- 2) **Overall notification on planned technical change**, while business change may still remain uncovered out of the sub-org. The agile supporters perceive it as an unnecessary and time-consuming effort that encumbers their change management process and even influences efficient operations. They rather resist introducing such a hampering point to their well-performing processes even if it may significantly decrease the level of regression risk, on which Moran (2014, p. 28) raised the discussion. Nevertheless, agile supporters were keen to continue the discussion on how the planned change could be notified. Some respondents emphasized that the way of notification can be a key point of using or abandoning it, in the course of change management. Traditionalists are convinced that sharing information on system change is an important bridge in a hybrid functioning organization and is open to the method of its propagation. It shapes a very interesting conclusion that is based on the general rule to keep things as simple as possible in operations practices. The correctly shaped information structure, transparent and with short and comprehensive content and then a sharing flow, can be a key success factor in adopting it in hybrid methods of change management.
- 3) **Planning and realizing cross-organization non-regression activities (non-regression tests) whenever needed with horizontal coordination of a regression avoidance process.** Such a proposed solution would display the wide picture of potential risks of non-regression and would be another natural denouement within intractable cooperation between traditionalists and agile supporters. However, this and the last conclusion again elicited polar attitudes. Although agile supporters generally understand such occurrences as horizontal releases, they connect them to regulatory conversions that may impact cross-organizational changes and still focus more on the need for the protection of their independence in operational activities. As such, they do not feel it addresses such

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subjectively wide initiatives, and the eventual changes necessary for them can still be performed in the agile regime and practices adopted in particular DevOps. This conclusion touches on a new phenomenon that can constitute a substance of hybrid performance – to embrace business horizontal needs in a traditional program that controls changes realized in DevOps using their own methods and tools. This may be really connected to the multi-level health condition of Business Process Management and, consequently, may critically impact it. What is surprisingly valuable is that both sides were keen to accept such a proposition. Moreover, the DevOps teams were open to support additional initiatives as cross-organization non-regression tests. Despite displaying a high awareness and understanding of the potential impacts on BPM, and thus on the governance of an entire business organization, there are extended stipulations that all required steps to be taken using practices and rules of particular DevOps.

Similarly, as in the roadblock section, agile enthusiasts rather perceive the above-proposed methods as more ceremonial, but somewhat valuable, and that require adequate sizing, which was also underlined by Moran (2014, pp. 77-78). There is an all-existing question, on how to efficiently locate the function of BPM across hybrid business organizations. Agile supporters most often raise the same sort of questions, which are more similar to questioning what value is provided by BPM as horizontal governance and how it can be beneficial to a particular and single DevOps team.

## DISCUSSION

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The above-stated findings indeed require further analysis, extended communication, and dialogue between traditionalists and agile supporters. As communication seems a very sensitive and gapped area, we truly believe that in particular situations, it requires to be remodeled and based on best practices that follow master models or theories, as stated by Dwivedi et al. (2012, p. 100). It seems critically significant to achieve the right level of mutual awareness as the first step and mutual understanding as to the second step. What is of key importance is the final step to get agreement on planned methods and ways of performance that can be compact, easy in use and, moreover, will not impair the sense of independence for a particular DevOps team, as Kakar (2017) noticed as well.

The dialogue and agreement require a transparent and open form with a clear intention of the aim as well as the use of consequent practices in change management, which is finding the mitigation methods and tools to

prevent or decrease the occurrence of system and, thus, business regression in an organization, which was also raised by Galavan, Murray and Markides (2008, p. 119).

The general obstacles on the way of getting value from such a discussion have been stated in the preceding analysis. However, there is an additional point underlined by agile supporters – why consume time and efforts on getting agreement if on the horizon there is a clear aim – to get agile and DevOps oriented for an entire business organization. It brings a clear answer – as long as a business organization consists of more than just one DevOps team, getting horizontal agreement and cooperation is a kind of indispensable factor to keep a consistent and efficient operationalization governed by Business Process Management practices and thus defined business targets.

As presented above, there are numerous differences expressed by both sides, and objections or even open disagreement on the approach to managing the change. Nevertheless, we do hope, that based on open and continuous discussion, more efficient ways and tools will be established that can be accepted by both supporters. This is necessary to achieve the correct conditions for realizing technical change and thus achieving business targets and keeping the organization robust.

To comprehensively support the outcomes of the above-stated considerations, it would be beneficial to continue with the respective research and work in detail with the impacted parties. As such, we would underline the need to undertake exploratory work on the following aspects:

- evolving BPM toward meeting the challenges of business process performance in a Hybrid organization during transformation to an agile operating model and a Hybrid Organization holding both operating models; such research would target the question of how to efficiently govern business processes in DevOps and outside DevOps, in the same business organization; another question that could be raised is how to handle the transformation process to an agile operating model, effectively manage business processes, and mitigate risks of their impairment;
- enhancing communication methods, tools and practices between DevOps and the remaining parts of the organization; the exploratory works would target developing communication channels and practices to improve or even create the appropriate communication; it would need to take a leveraged survey approach that could then be supplemented by additional interviews;
- automation of non-regression activities to simplify and empower mitigating the risk of business and system regression; based on the use of automatic tests and the currently known best practices for

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using RPA<sup>7</sup>, it could be valuable to work on refining the guidelines on how to automate and better address methods to prevent regression in a business organization; an extended review of the literature and the efficient organization of dedicated brainstorming sessions with subject matter experts would strengthen such efforts.

All attempts and openness toward getting a better functioning enterprise that efficiently manages its business processes and mitigates the risk of regression will outcome with mid-term and long-term results that strengthen the value of the whole organization.

## CONCLUSION

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The overall conclusion leads to the argument that a Hybrid Organization faces far-reaching challenges connected to the unexpected and sudden appearance of system and business regression that inclusively connects to traditional Business Process Management. Among numerous reasons, it is important to refine and group those that are natural regression drivers, mainly for Hybrid Organizations. Concluding the above-reviewed aspects, it emerged that subjective dimensions are the root-cause limbs for regressive occurrences and inaction of processes as such. All hitherto analyzed reasons, additionally attempted by refining mitigation methods, are focused and summarized in Table 8.

The above-stated reasons and mitigation propositions can also be concentrated and propagated as a general solution to keeping an inter-team attitude of open dialogue and persistently seeking improved cooperation. This can work out methods and practices such as the use of unified configuration management processes and tools, keeping communication on planned changes, and the willingness to participate in horizontal initiatives when called for and necessary as a multi-level verification of non-regression.

Such verification is another aspect of good cooperation, which is a 'must criteria' for the successful management of change. Usually, it takes the shape of non-regression and multi-platform tests that need enhanced cooperation between different teams. Such a need for the non-regression testing approach was exposed also by Parsons (2014) and seems to be the natural mitigation practice that may help in any doubtful situation.

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<sup>7</sup> RPA – Robotics Process Automation.

**Table 8.** Dimensions of inaction in Change Management causing regression. Mitigation steps

Dimensions of inaction	Root-cause and mitigation
Lack or poor communication	Lack or poor communication between DevOps teams and traditionally running teams and parts of business organizations, highly impact underperformance or inaction of the change management process. This phenomenon is well known in almost all business organizations and, moreover, requires taking constant and persistent efforts to work on improvements and new communication channel solutions. Among many used expedients, it seems indispensable to keep open status communication supported by regular change management inter-departmental meetings. Another, more sensitive solution may be the emergence of human resources scoring against proper communication.
Internal independence	Oversized feelings of internal independence or even extended needs for keeping competitive and exceptional self-picture in the internal business racing landscape may be ruining appropriate change management and maintaining a non-regressive approach for change adoption. It is one of the most difficult factors as from a logical perspective it seems natural for DevOps organization and exceptive to the attempts of wider organizational dependency. This is a general issue for hybrid organizations and a specific trap of keeping dual routines of project and change management. Nevertheless, it seems intransigent to adopt acceptable breakthroughs toward ensuring proper communication and cooperation between single DevOps and the other parts of the business organization. Similarly to the approach that can be used in case of improving communication, it requires regular status meetings and a scoring approach.
Use of different technological stacks	Use of different technological stacks may cause significant impairment to the system and business architecture and processes controlled by BPM as well as finally business targets. This is particularly connected to the configuration management tools that are being used in parallel or supplementing each other, which lead to informational disorder and an increased direct risk of regression. The first and key solution seems to be unification and the use of one or integrated CMDB that can be a single referential point supporting project management and non-regressive approach of implementing a change.
Exertion of manual routines	Enhanced use of manual practices of performing configuration checks and change process. As adapted a long time ago, manual work will not hold up the increasing demands of release management in highly supported IT processes. Automation on change management and non-regression activities would reinforce the resilience of change implementation and mitigation of business and system risk regression.

Getting a mutual understanding and agreement on ways of proceeding can bring additional values and strengthen internal business routines and confidence.

It also supports the overall conclusion of the necessity to enhance the cross-organizational spirit of getting mutual value through open and honest internal cooperation. This creates such ensuing benefits as operational consistency, external competitiveness within industry, and many other business imperatives. These conclusions can also be observed in the group of findings among other researchers (Daniel & Daniel, 2018).

## Acknowledgments

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### **Abstrakt**

*Celem tego artykułu jest zbadanie czynników zachowania spójności procesów biznesowych, silnie wspieranych przez technologie IT, podczas pojawiania się zmian w architekturze technicznej organizacji, która stosuje zarówno tradycyjne, jak i zwinne metody zarządzania zmianami. Postawiono dwa pytania badawcze dotyczące najczęstszych przeszkód w zarządzaniu regresją systemową i biznesową przy użyciu hybrydowych sposobów realizacji zmian oraz odpowiednich metod stosowanych w celu ograniczenia regresji systemowej i biznesowej w konfliktujących się podejściach reprezentowanych przez różne modele operacyjne. W badaniach zastosowano sprofilowaną metodę wielokrotnego studium przypadku w oparciu o dane pierwotne i wtórne pochodzące z dokumentacji projektowej, doświadczeń z testów i uruchomień produkcyjnych systemów, przeprowadzanych zróżnicowanymi metodami zarządzania projektami i zmianami. Ogólne wnioski koncentrują się na tym, że aby zachować kontrolę przy stosowaniu zasad BPM w przekształcaniu organizacji, niezbędna jest otwarta współpraca, która pozwoli osiągać cele biznesowe w ramach organizacji i zachować wrażliwość biznesową przy agnostycznym podejściu do realizacji zmian w myśl stosowanych metodyk. Zalety zgromadzonej wiedzy mogą prowadzić do zarysowania sposobów zabezpieczenia celów biznesowych przed nieoczekiwaną regresją wynikającą z wewnętrznych i niezależnych mechanizmów realizacji zmian organizacyjnych.*

**Słowa kluczowe:** *hybrydowa organizacja biznesowa, zmiany biznesowe i techniczne, regresja biznesowa, regresja systemowa*

### **Biographical note**

**Hubert Bogumił** graduated from the Faculty of Economic Sciences, University of Warsaw, in 1996. Since then, he has followed a professional career acting for large global corporations, the majority in the banking sector. Hubert is a Program and Project Manager with long experience in the delivery of IT-related projects. Hubert has participated in numerous initiatives, such as: establishing new banks, transformation of banking organizations, IT implementation projects, optimization of IT processes and decommissioning of banks. Hubert has been actively contributing to the project management and IT process management methods being adopted in organizations that he supported. Hubert is currently following Ph.D. studies at the University of Warsaw, focusing his exploratory work on the methodological aspects of IT change management in the hybrid, cascade, and agile-driven, environments.

# The relationship between Business Process Management and Knowledge Management - selected aspects from a study of companies in Poland

Agnieszka Bitkowska<sup>1</sup> 

## Abstract

*The integration of the concepts of Business Process Management (BPM) and Knowledge Management (KM) is a challenging research issue today, and should be analyzed jointly in contemporary enterprises. The challenge for modern process organizations is the constant accumulation of knowledge and its skillful use in order to gain a competitive advantage and ensure a stable position in the market. Despite the growing interest among researchers and practitioners there is a lack of articles in this area. The main objective of this paper is to identify the relation between Business Process Management and Knowledge Management. The article presents the results of empirical research conducted by the author in contemporary enterprises in Poland in 2019, and some solutions, as well as benefits, related to the correlation of these two concepts. Business Process Management has a positive influence over Knowledge Management processes. The identification, acquisition, presentation and documentation of knowledge are not independent tasks, but are implemented within processes. The implementation of Knowledge Management stimulates employee creativity and supports internal communication. Building a process organization using best practices and guidelines minimizes the risk of failure of projects to improve the organization and implement Knowledge Management. In order to test the correlations between them, Yule's, Pearson's, and Bykowski's coefficients have been used.*

**Keywords:** *business process management, knowledge management, knowledge management process*

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## INTRODUCTION

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Under the circumstances surrounding the highly volatile economy of the 21st century, the business environment is unpredictable. In order to preserve a competitive market position, it is necessary to continuously improve an organization. Dynamically changing environmental conditions – the development of information technologies and processes of digitization, knowledge economy, globalization and challenges resulting from the fourth technological revolution – create new opportunities for the development of enterprises, and at the same time the need to create appropriate adaptation mechanisms.

In a knowledge-based economy, traditional resources, such as labor or capital, play a smaller role. Knowledge is a valuable asset of contemporary organizations that underlies the organization's activity in all its aspects and dimensions (Gierszewska, 2011; Zięba, 2017). Today's organizations are more aware than ever of the dependence of their competitiveness on their intellectual resources and key competences. Knowledge - one of the most important determinants of competitiveness - has a direct impact on the success of any organization (Gierszewska, 2018).

One of the concepts here is Business Process Management (BPM) (Burlton, 2001; Harmon, 2007; Jeston & Nelis, 2014; Pyzdek & Keller, 2009; Smith & Fingar, 2003). It has become the inspiration and foundation of many researchers as well as application initiatives over more than a dozen recent years. As far as the theory of management is concerned, one of the trends in organizational management is process approach which comprehensively and horizontally attends to the structure of an organization (Rummler & Brache, 1995). Business Process Management in an organization should take into account the knowledge resources that the organization possesses in order to ensure that employees have access to knowledge regarding specific tasks which are part of particular business processes (Maier & Remus, 2002; Ho, Hsieh, & Hung, 2014; Jung, Choi, & Song, 2007). Therefore, the processes occurring in an organization should be increased, based on individual, team, and organizational knowledge and, consequently, they become more and more flexible as well as adjusted to the changing environmental conditions (Richter-von Hagen, Ratz, & Povalej, 2005; Gabryelczyk & Roztock, 2018).

The main objective of this paper is to identify the relation between Business Process Management and Knowledge Management (KM) through the Knowledge Management process in contemporary enterprises. Although the idea of Knowledge Management implementation and its influence on innovation performance of organizations have been proposed (Alavi & Leidner, 2001; Andreeva & Kianto, 2012; Chong, Ooi, Lin, & Teh,

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2010; Lundvall & Nielsen, 2007; Pastuszak & Chadam, 2013; Yin-Kuan, Ng, Voon-Hsien, Lee, Alex, & Pei-Lee Gan, 2012), the approaches that focus on Knowledge Management within the business process level are limited (Wiig, 1995; Papavassiliou & Mentzas, 2003). Currently, to the best of one's knowledge, such an overview and such an analysis of BPM standards have not so far been undertaken. Ultimately, the adoption of the process of Knowledge Management contributes to an increase in the level of innovation in organizations that are managed on the basis of processes. The main research question was formulated as:

RQ: What is the relationship between Business Process Management and Knowledge Management?

Prior to conducting analysis, the main hypothesis was put forward as:

H: Business Process Management has a positive influence on Knowledge Management.

From an empirical aspect, the implementation of the objectives of the article included the analysis of Business Process Management, or elements of this concept, in organizations operating in Poland. The following research techniques and methods were used: literature analysis, questionnaire. In the first stage of the work, the author made an analysis and evaluation of the Business Process Management of contemporary enterprises by conducting a methodological foundation. The next stage was the analysis of Business Process Management in contemporary organizations operating in Poland through the implementation of their own empirical research in 2019.

## **THEORETICAL BACKGROUND**

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The modern market requires organizations to be flexible. A company's ability to achieve its aims calls for successful adaptation to the changes occurring in its environment as well as for the creation of its own solutions. The ever-growing number of enterprises adapting to the conditions of their environment take advantage of a process approach, understood as orienting the company towards processes occurring within it (Antonucci & Goeke, 2011). The process approach is a basis for introducing Business Process Management, which over the past dozen years has become an inspiration and a foundation for numerous initiatives of various types of application. The concept of Business Process Management has begun to incite greater interest

among both theoreticians and researchers. Business Process Management (BPM) has emerged as a holistic management discipline covering process-centered technologies, modeling and analysis methods, as well as such things as strategic alignment, governance, people and culture (Rosemann & vom Brocke, 2010). The increase in the literature related to Business Process Management, the appearance of specialist magazines (e.g., Business Process Management Journal) and conferences (e.g., BPM-Conference) as well as relevant university courses, has indicated the fact that BPM is an evolutionary trend in management studies (Ko, Lee, & Lee, 2009). The main challenge that contemporary enterprises seem to face in the light of constant changes in the market is the complex and structuralized implementation of Business Process Management, which will enable them to reach their intended goals (Malinova & Mendling, 2018). Definitions presented in the subject literature point to: a comprehensive approach to an organization, realized by means of management functions appropriate to the processes; connecting this approach with an organization's strategy; and undertaking actions aimed at raising efficiency while engaging human resources and information technologies. They also point to optimization, elimination of all shortcomings and inefficiencies in an organization, and a focus on creating value. Business Process Management means the systematic application of proper concepts, methods and instruments that influence the processes at their various stages – defining, modelling, implementing, controlling and enhancing – conducted in accordance with a company's strategy and encompassing the whole company with regard to its organizational, social, financial, IT and knowledge-related aspects (Bitkowska, 2013). It is essential to constantly improve processes and reformulate their concepts. The aim of it all is to create a process-based organization.

Business Process Management enables a company to adapt to the challenges posed by its environment and create new possibilities of gaining an advantage over the competition. Properly defining processes, and then modelling, implementing, controlling and enhancing them, considerably improves both a company's profitability and customer satisfaction, and consequently boosts the company's competitive potential. Using a formalized approach makes it easier for an organization's managers to carry out projects, ensuring risk reduction and enhancing the probability of achieving the intended aims. Diagnoses of needs and challenges that companies face (Antonucci & Goeke, 2011) indicate the popularity of, and a growing demand for, process-based methods and instruments for improving an organization's effectiveness.

The development of Business Process Management is a response to the growing turbulence of the environment and the interior of the enterprise, increased complexity of internal and external processes, individualization of

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customer needs and expectations, short product-life cycles and an increase in the importance of intangible assets in creating a competitive advantage. The process stream is located in the sphere of contemporary management trends that promote decentralization, customer orientation, reorientation of the organizational structure from vertical to horizontal, which contribute to the growth of the organization's effectiveness in changing conditions (Trocki, 2016).

The main goal of Business Process Management is to improve the efficiency of operations in the enterprise by structuring activities in terms of creating added value, paying particular attention to customer preferences and needs, and the proper description and configuration of processes in the enterprise in accordance with the criteria of time and space. In many cases, meeting these requirements is not always possible due to the lack of a design approach or the need to use knowledge. The main advantage is to ensure ongoing control over the connections between individual processes in the whole system.

Contemporary organizations use Business Process Management in order to improve competitiveness, efficiency, flexibility, financial results or the quality of customer service, and the internal structure of processes. Focusing on Business Process Management, organizations improve the effectiveness of existing systems, processes and products, using the available philosophies, principles, tools and management methods. Organizations use star-standard solutions in the form of good practices, reference models, industry models, and use models of maturity which indicate further directions of development in the field of Business Process Management. Moreover, organizations use a multi-dimensional approach that includes IT, social or organizational dimensions (Hislop, 2013; Spanyi, 2005; Harmon, 2007; Smith & Fingar, 2003). The digital transformation of business processes will require an increasing level of automation and robotization. The Business Process Management systems (BPMS) are supplemented by RPA (Robotic Process Automation), whose main task is to correct, develop and support internal processes in order to achieve maximum efficiency, but they do not replace the work done by employees (Mejssner, 2018). Opportunities in the areas of the fourth technological revolution, intensifying digitization and globalization determine changes in process-oriented enterprises. The concept of integrated Business Process Management may be responsible, taking into account anticipated projects as well as knowledge (Bitkowska, 2019a).

Knowledge Management is part of organizational management and encompasses all the processes related to the localization, acquisition, creation, transfer, application, and retention of knowledge, which serve the purposes of an organization, including analyses, planning, operational activity, and control (Donate & Sánchez de Pablo, 2015; Tiago, Couto, Tiago, & Vieira, 2007; Wen, 2009; Bitkowska, 2017). A process model is based on practical

experiences and solutions that large consulting firms make use of. A large contribution to the development of the process model has been provided by Davenport and Prusak from IBM Consulting Group (1997) and Probst, Raub and Romhardt (2000). They have made a synthesis of the existing practical experiences. In line with the process model, Knowledge Management is all the processes allowing one to create, disseminate, and use knowledge in order to fulfill the purposes of an organization. There are three main phases of Knowledge Management: acquisition (creation) of knowledge, sharing knowledge, and transforming knowledge into decisions (Bitkowska, 2017). The process model used mainly by large organizations is based on methods proven in practice. There is also the so-called Japanese model (Nonaka & Takeuchi, 1995). Knowledge Management based on the principle of a spiral is a repeating cycle of four processes of knowledge conversion: internalization, socialization, externalization, combination (Bitkowska, 2017).

Ho, Hsieh, and Hung (2014), presented an interesting integrated model which considers how knowledge enablers, (KCP - knowledge circulation processes), and individual job performances direct firms' effective application of Knowledge Management. KCP has further application by individuals to improve job performance (Lin, 2007; Liao & Wu, 2010; Lundvall & Nielsen, 2007; Rehman, Asghar, & Ahmad, 2015). Gavrilova, Alsufiev and Pleshkova (2017) indicated that Knowledge Management practices are considered the key element for enhanced innovative performance.

According to Handzic (2017) the knowledge process component of the model covers various processes through which knowledge is moved (e.g., transfer person-to-person, person-to-document) and modified (e.g., creative idea generation, mining of hidden patterns in capturing data). Handzic is underlining that the better the processes of knowledge generation, sharing, capture and discovery, the greater the likelihood that the knowledge needed will be available leading to more effective and innovative organizational performance (Hanadzic, 2017; Bitkowska, 2017).

The improvement in client satisfaction and the effectiveness of services and decision making must also be highlighted. Knowledge is the inseparable resource processed as part of the processes. Knowledge is generated when organizational processes take place, such as: distribution, marketing, designing, and preparation of production. As far as knowledge created in the course of the processes of designing and preparation of production is concerned, it is technical in character. Knowledge is put to use by both the performers of processes – process team members – as well as the owners of processes (Bitkowska, 2017). Any information related to processes, such as: process models, indicators, measures, and aims, should be collected and formalized in order to contribute to the improvement and, consequently, the

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development of the whole organization (Bitkowska, 2017). An approach of a model-based design of knowledge-oriented processes proposes a reference model for Knowledge Management (see Warnecke, Gissler, & Stammwitz, 1998). The reference model consists of an object model with system elements and activities, a process model and an implementation model.

Business process modeling – an approach to depict the way organizations conduct current or future business processes – is a fundamental prerequisite for organizations wishing to engage in business process improvement or Business Process Management initiatives (Indulska, Recker, Rosemann, Green, & Peter, 2009; Madison, 2005). In their most basic form, process models describe, typically in a graphical way, the activities, events and control flow logic that constitutes a business process (Bosilj-Vukšić, 2006; Recker, Rosemann, Indulska, & Green, 2009). Additional information, such as goals, risks and performance metrics for example, can also be included. Accordingly, process models are considered a key instrument for the analysis and design of process-aware Information Systems (Dumas, van der Aalst, & Hofstede, 2005), organizational documentation and re-engineering (Davenport & Short, 1990; Davenport, 1992), and the design of service-oriented architectures (Rabhi, Yu, Dabous, & Wu, 2007).

Process modeling is concerned with the transformation of knowledge about the functioning of a selected (business) area in an organization, and the processes that take place within it, into the corresponding models. Lately, the market has been flooded with numerous IT solutions supporting the designing and monitoring of business. Such software aids the process of identification of tasks undertaken by individual organizational units, and allows one to create a graphic representation of a business process and simulate the course of a business process. Usually, such software ensures the possibility to prepare user interfaces in the client-server architecture, which enables control of the work of individual participants in the process. As far as a definition of a graphic representation of a business process is concerned, many various notations that support business process modelling may be used, e.g., BPMN (Business Process Modelling Notation) and BPEL (Business Process Execution Language) (Ho, Hsieh, & Hung, 2014; Silver, 2011). One of the most popular standards of process modeling is the Business Process Modelling Notation (BPMN) (Silver, 2011; Spanyi, 2005). The currently applicable standard BPMN 2.0 was published by the Business Process Management Initiative (BPMI) in 2011. The main objective of the creation of the BPMN was the preparation of notation to describe processes, which would be easy to understand by all parties taking part in modeling, especially business analysts and software developers responsible for the implementation of solutions supporting processes, or people who possess content-related knowledge but no broad understanding

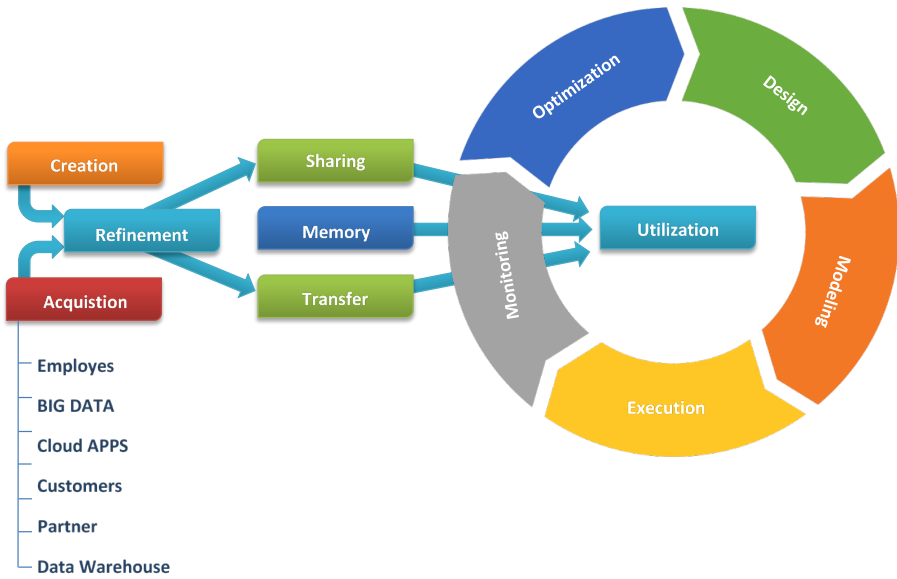


of modeling. Some authors indicated other popular standards in modeling: UML, DMN and the models and the diagrams provided by these notations (Kluza, Wiśniewski, Jobczyk, Ligeza, & Suchenia, 2017). Żytniewski (2016) in some research presented the integration of software agents (an element that performs and automates business processes) within business processes and the processes of knowledge. The main aim of the proposed architecture of a software solution was designed to support the modelling of business processes and improve these processes (Żytniewski, 2016, 2017).

Zhu (2015) underlines that Knowledge Management as a meta-process in relation to BPM if KM is placed on top of BPM. In this perspective, Knowledge Management is used at the strategic level as a generator, amplifier and accelerator of value creation (Steve, 2019). This means KM improves BPM performance as a process, riding on top of business process improving and accelerating the creation of value (Zhu, 2015). In this case, knowledge is the critical component in the business process. Linderman, Schroeder, and Sanders (2010) indicated the link between process management systems and knowledge creation, and Martínez-Martínez, Luis, Suárez, Montero, and del Arco (2018) underlined that Knowledge Management is a tool for improving business processes.

With digitalization, more and more data and information will be generated in a shorter time, which should be collected and processed into internal knowledge in order to be competitive (Paschek, Ivascu, & Draghici, 2018). Through the variety of data and information, a well-grounded knowledge database can be developed and used for the adoption and optimization of Business Processes. It is recognized that KM plays an essential role as a background for the better management, adjustment and implementation of processes (Paschek, Ivascu, & Draghici, 2018) (Figure 1).

Business Process Management has emerged as a well-respected variable in the design of high-performance organizations (Franz, Kirchmer, & Roseman, 2012). Managerial variables such as products and services, customers and employees, and physical or digital assets (e.g., data and information), the conceptualization and management of business processes still face some fundamental challenges (Franz, Kirchmer, & Roseman, 2012). One of these is the link between BPM activities and their contribution to corporate value (efficiency, compliance, integration, quality, agility, networking) (Figure 2, Table 1).



**Figure 1.** KM - BPM Process Model

Source: Paschek, Ivascu, & Draghici (2018).



**Figure 2.** Value-driven Business Process Management (VBPM)

Source: based on Franz, Kirchmer, & Rosemann (2012).

**Table 1.** Characteristics the values of BPM - Transparency

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Type	Characteristics
A process model repository	That is scalable, supports user and user group management, covers current process modeling standards, but can be customized, and allows publishing models via various channels (for example, over an intranet)
The design of process models	That is intuitive to relevant stakeholders in terms of their graphical design. This will typically require extensions and improved visualizations to make the dominant process modelling techniques such as business process modeling notation (BPMN) and event driven process chain (EPC) easier to understand.
Widely disseminated models	That is easy to access (e.g., on the corporate intranet) without compromising information security.
The design of process models	Capture relevant information for specific purposes, for example risk annotations for risk management, or job descriptions for HR management.
Role-based process models	That only allow stakeholders to see those models that are relevant to them.

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**Source:** based on Franz, Kirchmer, & Rosemann (2012).

Knowledge Management should be based on three fundamental pillars: people, technology, and processes (Table 2). A major role in Knowledge Management is played by information technologies, management systems, attitudes of the staff, and organizational cultures that arouses enthusiasm and eagerness in staff members, which contribute to knowledge sharing and the creation of so-called ‘project teams’ (Alavi & Leidner, 2001; Andreeva & Kianto, 2012; Barnes & Milton, 2014; Bartol & Srivastava, 2002). The strategy pursued by an organization, its employees, technology, and organizational culture underlie the process of Knowledge Management, in particular: creation, codification, and transfer of knowledge.

Business Process Management in an organization should take into consideration the knowledge resources that it possesses in order to ensure that employees have access to knowledge about specific tasks performed as part of a particular business process (Maier & Remus, 2002).

**Table 2.** Characteristics of business processes

Type of business process	Characteristics
Knowledge-intensive	The processes are often considered complex in general, with many, but conceptually simple, (usually) document-centred activities; at the heart of these processes are a few central decision steps which require personal judgment based on experience, a comprehensive knowledge about the given as well as about older, similar cases, access to much specific information manifold legal regulation and standard operating procedures.
Weakly-structured	The processes under consideration normally consist of many steps performed by many people in different roles; often several departments are involved, sometimes in different locations, etc. Though legal regulations prescribe the departments and/or roles to be involved, the specific sequence of processing steps may vary for specific instances due to particular exceptions, or complications. Even if the business process is determined completely, complex, not formally modelled decision processes may be embedded in black boxes, or the process may change during its enactment.

Source: Papavassiliou & Mentzas (2003).

The key factors causing all processes in an organization to run smoothly are learning and cooperation. Therefore, the processes occurring in an organization should be increased based on individual, team, and organizational knowledge and, consequently, they become more and more flexible as well as adjusting to the changing environmental conditions. Each organization should collect knowledge on the processes that take place within it.

Moreover, employees should play an active role in shaping the course of processes and the implementation of changes in an enterprise (Long, Jung, Choi, & Song, 2007; Tiago, Couto, Tiago, & Vieira, 2007). A new motivation system which is designed for teamwork should be developed, which would stimulate the striving for increased efficiency as well as the transfer of knowledge among team members (Choi, Poon, & Davis, 2008; Donate & de Pablo, 2015). Knowledge as the main resource of an organization may not be put to good use if employees compete with one another while hiding information and not sharing their skills. Teamwork helps to improve qualifications. The main advantage arising from the adoption of the model of Knowledge Management is that it allows users to avoid an excess of

information, increase the usefulness of knowledge, and concentrate on the information that is of key importance for the value chain (Jung, Choi, & Song, 2007). Due to the information-related significance of process models, advanced support tools should also have the feature of publishing the contents for the purposes of an organization. This may take the form of a simple export of the graphic representations of process diagrams into files, however, it is often possible to present the whole models as process portals. They are kept in intranet networks and allow the authorized members of an organization to look through the selected images of the process map and access their attributes.

To use the synergies of Knowledge Management and Business Process Management, it is necessary to enable the use of knowledge not only during the design and the analysis stages of the processes performed, but above all during their implementation. According to U. Remus, knowledge-oriented Knowledge Management is necessary, while at the same time consciously shaping of business processes, so that they use and support Knowledge Management (Maier & Remus, 2002).

If appropriate organizational conditions are created, and in addition the awareness of the management and the staff is awoken, it allows the diffusion of knowledge which contributes to the development of innovative ideas and solutions (Chen & Huang, 2009; Darroch, 2005; Du Plessis, 2007; Hislop, 2013; Hsu & Shen, 2005). The successful promotion of new ideas, effective acquisition and sharing of good practices, and integration of various areas of specialist knowledge, altogether, they create conditions for the development and growth of a company (Tiago, Couto, Tiago, & Vieira, 2007; Wen, 2009).

The primary benefit of using process-oriented Knowledge Management is that it helps users avoid information overload, increases knowledge usability, and focuses on information that is essential to the value chain (Jung, Choi, & Song, 2007). The benefits of implementing a Knowledge Management process include, among others, providing knowledge resources to the right people at the right place and time, facilitating the search for and applying specialized knowledge and know-how, supporting cooperation, communication, knowledge sharing, continuous learning and the improvement of both individual employees as well as the entire organization (Bitkowska, 2019b).

It is assumed that business processes are used to achieve the goals of the organization, and that knowledge and data are developed in accordance with these goals, and are also their output. Thanks to the learning process of the organization, based on the continuous selection, collection and analysis of knowledge resources obtained during the implementation of business processes, there is both knowledge development and process improvement.

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In practice, the so-called industry reference models serve as guidelines in introducing Business Process Management in enterprises. Reference models represent knowledge that can be used depending on the application of the model, and can create a structured and methodological framework (Process Classification Framework – PCF).

## RESEARCH METHODOLOGY AND RESULTS

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Empirical research has been carried out on a sample of 122 companies operating in Poland in 2019. A selection of companies in the study was performed by the method of target screening, taking into account only organizations that have implemented and adopted Business Process Management. The main criterion was whether an organization adopts BPM, however, the number of employees and economic situation were also taken into consideration. Poland is one of the developing countries in Eastern Europe and is, at the same time, a member of the European Union. So far there has been no research on the modeling of the process of Knowledge Management in process organizations.

An important criterion for the division of the companies under examination was the number of employees. The companies under analysis were classified into the following groups: small enterprises – 10-49 people (24.60%), medium-sized enterprises – 50-249 people (24.60%), and large ones – 250 or more people (50.80%). The survey questionnaire was filled in by management staff, executives, owners, process managers, experts in BPM, representatives of quality management, members of process offices, business analysts, and project managers.

The reasons given for the implementation of Business Process Management (Table 3) seem important. The most common reasons provided by the respondents were: improving the effectiveness of achieving strategic and operational goals, coordination of BPM, cost rationalization, faster reaction to client needs and expectations of improvement in their competitive position, an increase in innovation, and a rise in revenues and profits.

In those organizations that use BPM, respondents pointed to various reasons for its implementation. The most frequently reported reasons included: improvement in their competitive position (51.00%), implementation of ISO standards (49.00%), faster response to the needs and expectations of clients (44.10%), implementation of an IT system (36.30%) and increased flexibility of the organization's operation (36.30%). Also important were: the ability to react quickly to changes in the market environment (34.3%), cost

reduction (31.40%), and an increase in revenues and profits (31.40%). The least attention was paid to the development of employees (17.60%).

For comparison, global research has shown that enterprises implement BPM in a comprehensive and orderly manner. The main premises associated with its use included primarily cost reduction and improved process efficiency (53% in 2017, 53% in 2015 and 35% in 2013), coordination of management processes (36% in 2017, 30% in 2015 and 35% in 2013), improving existing products or creating new ones (28% in 2017, 33% in 2015 and 34% in 2013), as well as improving IT resource management (26% in 2017 and 15% in 2015). Other factors related to supervision and control (21% in 2017, 17% in 2015 and 15% in 2013) and changes in organizational culture (15% in 2017 and 17% in 2015) (Harmon, 2018).

**Table 3.** Reasons for the implementation of Business Process Management (in %)

Response	Total	The number of employed people 10–49	The number of employed people 50–249	The number in % of employed people above 249
Improving the effectiveness of achieving strategic and operational goals	42.62	20.20	32.60	47.20
Coordination of BPM	42.62	20.10	34.90	45.00
Rationalization/cost reduction	40.98	19.50	22.30	58.20
Faster response to customer needs and expectations/increased flexibility	36.89	15.10	27.10	58.80
Ability to quickly respond to changes in the market environment	29.51	18.20	18.90	62.90
Supervision and control, risk management. Creation of unambiguous management principles and control mechanisms and division of responsibilities	27.87	12.20	31.60	56.20
Improving existing products, creating new products or introducing new business lines	26.23	20.10	30.90	49.00
Implementation of an IT system	25.41	17.50	23.30	59.20
Implementation of ISO standards	20.49	13.10	32.10	55.80

**Source:** own work, based on empirical research carried out in 2019.

The introduction of Business Process Management into organizations results from the requirements imposed by the changing environmental conditions and is, first and foremost, intended to develop organizations and

help them face the competition. The percentage of such organizations is large and very similar in each case under discussion. An inseparable element of the functioning of Business Process Management is the use of dedicated IT tools. The results of the analysis of the research concerning the Business Process Management lifecycle are presented in Table 4. Process optimization was declared by 65.57% of the surveyed enterprises, identification of processes 54.92%, controlling of processes was stated by 52.46% of the surveyed organizations, while process modelling was identified by 41.80%.

**Table 4.** The lifecycle of Business Process Management (in %)

Response	Total	The number of employed people 10–49	The number in % of employed people 50–249	The number of employed people above 249
Optimization/improvement of processes	65.57	12.20	31.60	56.20
Identification of processes	54.92	10.10	44.90	45.00
Process controlling	52.46	15.50	26.30	58.20
Process modelling	41.80	10.10	26.10	64.80
Process simulation	23.77	61.90	19.90	18.20

Source: own work, based on empirical research carried out in 2019.

The Knowledge Management process was implemented by 22.13% of the surveyed organizations. The most common subprocesses are: use of knowledge (59.84%), sharing knowledge (56.56%) and creating knowledge (55.74%). The less common occurrences of Knowledge Management are its localization (31.97%), dissemination of knowledge (30.33%), and storage of knowledge (28.69%) (Table 5).

It should be stressed that BPM has exerted a considerable influence over the improvement of the quality of work both inside and outside an organization. An appropriate organizational climate and a willingness to develop the organization, generate the Knowledge Management process. In a process-based organization, it is necessary to create proper relations driven by cooperation and joint action, which has a positive influence on the modelling of Knowledge Management processes.



**Table 5.** The subprocesses of the model of the process of Knowledge Management (in %)

Response	Total	The number of employed people 10–49	The number of employed people 50–249	The number of employed people above 249
The use of knowledge	59.84	23.20	32.60	44.20
Sharing knowledge	56.56	20.10	34.90	45.00
Developing/creating knowledge	55.74	18.50	23.30	58.20
Acquiring knowledge	44.26	16.10	26.10	58.80
Locating knowledge	31.97	18.20	18.90	62.90
Dissemination of knowledge	30.33	12.20	31.60	56.20
Storage of knowledge	28.69	20.10	30.90	49.00

Source: Own work, based on empirical research carried out in 2019.

Companies have noticed that implementing the Knowledge Management process brings some benefits. First and foremost, it was possible to use collected knowledge more extensively as well as assess, document, and gathered it; moreover, knowledge was shared among employees who learned and developed their competencies (Table 6).

The challenge for modern process organizations is the constant accumulation of knowledge and its skillful use in order to gain a competitive advantage and ensure a stable position in the market. Knowledge Management in an organization is closely related to Business Process Management. The use of this concept makes it possible to improve the competitiveness of enterprises, and continuously improve and develop. Medium and small process organizations present a greater involvement in Knowledge Management than microorganisms. The identification, acquisition, presentation and documentation of knowledge are not independent tasks, but are implemented within economic processes. Team cooperation helps in improving qualifications. The implementation of Knowledge Management stimulates employee creativity and supports internal communication. Building a process organization using best practices and guidelines minimizes the risk of failure of projects to improve the organization and implement Knowledge Management. Business Process Management in organizations should take into account their knowledge resources which provide employees with knowledge about specific tasks within the implementation of individual business processes.

**Table 6.** The benefits arising from implementing the process of Knowledge Management (in %)

Response	Total	The number of employed people 10–49	The number of employed people 50–249	The number of employed people above 249
Sharing knowledge/ process experience	46.72	20.20	32.60	47.20
Collection/use of knowledge about the processes/trial experience	36.07	19.10	35.90	45.00
Cooperation between process managers	43.44	17.50	22.30	60.20
Motivating process owners/process team members to share knowledge	22.13	13.10	29.10	58.80
Appropriate communication and information flow in the process team	45.90	18.20	22.90	58.90
A database of specialists and process/project experts	23.77	11.20	32.60	56.20
The ability to train employees/ managers in the field of analyzing, redesigning and improving processes	28.69	20.10	30.90	49.00
Building awareness related to the use of knowledge in processes	23.77	19.50	21.30	59.20
Employees can make changes to processes according to customer requirements	22.13	10.10	32.10	58.80

Source: own work, based on empirical research carried out in 2019.

In order to test the correlations between Business Process Management and the Knowledge Management process Yule's, Pearson's, and Bykowski's coefficients have been used. Inferences concerning the main hypothesis, point to the fact that Business Process Management has a positive influence

over Knowledge Management (Yule's coefficient 0.95, Pearson's coefficient 0.81 and Bykowski's coefficient 0.79) (Bitkowska, 2019b).

Analysis of all the correlations under examination shows that Yule's coefficient indicates a high convergence of each studied attribute and the use of the Knowledge Management process. The reason for this is that all the phenomena are heavily dependent on one another; they are closely related. The indication testifies to a strong correlation among the attributes. Inferences concerning the main hypothesis, point to the fact that Business Process Management has a moderate, positive influence over the Knowledge Management process.

## CONCLUSIONS

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Business Process Management is treated as an up-to-date approach to an organization's operation, while process structures offer a sense of order. It is easier for organizations using Business Process Management to model Knowledge Management processes; knowledge is collected in databases of processes in repositories (Bitkowska, 2019b). There are knowledge resources and they are used, modified, shaped, and perpetuated. There are also relations based on knowledge sharing, which are part of the informal organizational culture. The preparation of the Knowledge Management process is intended to systematize these informal rules and relations that exist in process-based organizations and make them objective. The aim is to acquire, process, store, and distribute knowledge. The most significant actions in this context should be oriented at the adoption of IT systems supporting the modelling of the process of Knowledge Management. IT tools are supposed to ensure that the Knowledge Management process is run effectively. by being introduced into knowledge process management (i.e., planning, coordinating, monitoring, and accounting for) and the organizational culture (Bitkowska, 2017; Bitkowska, 2019b). In turn, this fosters training and builds cooperation among staff members. Coping with this sphere, and its operationalization by means of specific strategic, structural, technological, and personal solutions, constitutes a challenge for each and every process-based organization.

The adoption of this concept allows for improvement in the competitiveness of enterprises and ensures continual advancement and development. Modelling of the Knowledge Management process aids companies in determining and deciding on priorities as well as the objectives of remedial projects, and offers incentives to identify the necessary actions that need to be taken in order to develop innovativeness (Bitkowska, 2017). If a process-

based organization is built on the best practices and guidelines, the risk of failure of projects intended to improve the organization and implement the model of Knowledge Management is minimized. The social factor needs to be taken into consideration as well as the technological one, by way of using IT tools from the perspective of the strategy that is being followed. The analysis that has been performed and the resultant conclusions may be applicable in other European countries or other organizations which intend to implement the process of Knowledge Management. The findings also indicate that ICT practices improve financial performance only when they are coupled with HRM practices (Bitkowska, 2017).

The findings of this study have several important implications for project managers who wish to initiate successful KM practices within their projects. The present study was concerned with organizations operating in Poland, which have introduced Business Process Management. To a smaller extent, the deliberations will also be applicable to microenterprises, to companies that are only just beginning to operate, and to the ones that do not adopt modern management concepts and advanced IT tools (Bitkowska, 2017). There is a need to undertake further research action regarding, e.g., a comparative analysis of European countries. Fast development of software supporting BPM indicates that it is reasonable to study this issue in the context of Knowledge Management. Certainly, knowledge-related implementations must be based both on the right tools and take into account the social factor as well as the strategy that an organization follows. A synergistic effect is to be expected within the system of Knowledge Management. This is a practical implication for managers. The deliberations presented in this paper lead to a conclusion that there is a need to conduct further and a more in-depth literature study as well as empirical research regarding the issues in question, taking into account specific sectors of operation of process-based companies, or continue research with respect to other European countries.

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### **Abstrakt**

*Integracja koncepcji zarządzania procesowego (BPM) i zarządzania wiedzą (KM) stanowi aktualny problem badawczy, który należy przeanalizować w przedsiębiorstwach. Wyzwaniem dla współczesnych organizacji procesowych jest ciągłe gromadzenie wiedzy i umiejętne jej wykorzystywanie w celu uzyskania przewagi konkurencyjnej i zapewnienia stabilnej pozycji na rynku. Pomimo rosnącego zainteresowania badaczy i praktyków brakuje artykułów dotyczących omawianej problematyki. Głównym celem artykułu jest identyfikacja związku między zarządzaniem procesowym a zarządzaniem wiedzą. W artykule przedstawiono wyniki badań empirycznych przeprowadzonych przez we współczesnych przedsiębiorstwach w 2019 r. w Polsce, a także korzyści związane z korelacją tych dwóch pojęć. Zarządzanie procesowe ma pozytywny wpływ na zarządzanie wiedzą, a w szczególności procesy zarządzania wiedzą. Identyfikacja, pozyskiwanie, prezentacja i dokumentacja wiedzy nie są niezależnymi zadaniami, ale są realizowane w ramach procesów. Wdrożenie zarządzania wiedzą stymuluje kreatywność pracowników i wspiera komunikację wewnętrzną. Budowanie organizacji procesowej przy użyciu najlepszych praktyk i wytycznych minimalizuje ryzyko niepowodzenia projektów w celu poprawy organizacji i wdrożenia zarządzania wiedzą. Do przetestowania korelacji między koncepcją zarządzania procesowego i zarządzania wiedzą wykorzystano współczynniki Yule'a, Pearsona i Bykowskiego.*

**Słowa kluczowe:** zarządzanie procesowe, zarządzanie wiedzą, proces zarządzania wiedzą

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## Table of Contents

<b>From the Editors</b>	7
Renata Gabryelczyk, Tomislav Hernaus	
<b>A data control framework for SAF-T reporting: A process-based approach</b>	13
Jerzy Auksztol, Magdalena Chomuszko	
<b>Mastering digital transformation through business process management: Investigating alignments, goals, orchestration, and roles</b>	41
Ana-Marija Stjepić, Lucija Ivančić, Dalia Suša Vugec	
<b>Implementing a decision support system in the transport process management of a small Slovak transport company</b>	75
Miroslava Nyulásziová, Dana Pařová	
<b>Knowledge-oriented business process management as a catalyst to the existence of network organizations</b>	107
Olga Sobolewska	
<b>Dissimilarities between applied methods of project management impacting regression in business processes and technical architecture</b>	133
Hubert Bogumiř	
<b>The relationship between Business Process Management and Knowledge Management - selected aspects from a study of companies in Poland</b>	169
Agnieszka Bitkowska	

