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Foreword

"Journal of Business Management" continues the topic of previous journal editions on IT opportunities and application results including risks across industries. In addition to the issues mentioned above, the reader may also be interested in the experience of different countries in this area.

Several articles in the publication are related to the financial sphere. Its digital transformation is leading to major structural changes in the financial sphere as well.

As the socio-economic system accelerates, strategic foresight plays an increasingly important role in both companies and public administration. Strategic foresight connections with management innovations discussed in one of the edition conceptual papers too.

All the papers were double-blind peer reviewed. Following the necessary corrections and additions resulting from the review process, six accepted papers were included in the issue.

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Vulfs Kozlinskis, Prof. Emeritus, Dr. habil. oec.
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Strategic foresight capability as an enabler of management innovation

ABSTRACT

**Purpose.** To investigate strategic foresight capability and its role in enabling the process of management innovation.

**Approach.** The research follows a narrative literature review, divided into three phases, during which the key topics – strategic foresight, management innovation and managerial cognition – are researched for their potential interaction.

**Findings.** Each individual has an innate capability for foresight. In organisations, strategic foresight capability is developed and sustained by both managers and employees. Managerial cognition is the basis for developing strategic foresight capability; therefore, it is vital for it to be addressed prior to reviewing the application of strategic foresight. Well-developed strategic foresight capability acts as an enabler for management innovation, which, in turn, ensures an organisation’s sustainability. The research identified a connection between strategic foresight capability and management innovation.

**Value.** This conceptual paper investigates strategic foresight capability and its role in the process of delivering management innovation. The study has set a basis for further research towards defining strategic foresight capability in the context of managerial dynamic capability. In particular, this is true for organisations that have a long history and are thus exposed to the challenges of upcoming business environment changes.

**Keywords:** strategic foresight capability, management innovation, managerial cognition, dynamic managerial capabilities
INTRODUCTION

Innovation is often regarded as a tool ensuring the long-term sustainability of an organisation. This is true for various types of innovation, including management innovation. Therefore, it is important to discuss the factors which impact the development of capability to deliver innovation. In order to successfully utilise innovative intentions, it is important to understand their roots.

Innovative intention is a product of cognitions involving normative assessments, attitudes and belief-based analysis of past experience leading to reasoned action (Miniard and Cohen, 1983; Fishbein and Ajzen, 1975). Some researchers argue that innovative attitudes and intentions are often influenced by the situation rather than by an organization’s cultural values (Camelo-Ordaz et al., 2011; Rokeach and Kliejunas, 1972).

A significant amount of literature discusses the relationship between management cognition and the ability to deliver innovation (Ajzen, 2002; Zlatanović and Mulej, 2015; Alabduljader, 2019); nevertheless, it often omits intermediary factors like organizational, team and individual capability to ensure innovation. These factors are closely linked to management practices throughout the organisation. The executed management practices reflect the existing managerial capabilities. Managerial capabilities are vital for business performance and sustainability, fostering an environment for innovation to thrive. One such managerial capability is related to strategic foresight.

Strategic foresight is a rather new discipline that evolved in the late 1950s and gained popularity in recent decades. According to Rohrbeck, the strategic foresight concept is rather complex and has not been clearly defined – it is viewed as a process, a tool, and a capability and is weakly linked (Rohrbeck et al., 2015) to the current business environment.

The field for research of strategic foresight is vast and as indicated in the systematic literature review by Iden et al. (2017), the focus is on strategic foresight’s application methods rather than the added value and motivation for its application. Manral (2011) emphasises that despite the previous research, better understanding of the management of the micro-processes by which innovations unfold is still called for.

In this conceptual paper, for the purpose of better understanding the role of strategic foresight in delivering innovation, it is viewed from a managerial capability perspective. A certain skill set and mindset is required to master strategic foresight. This presents a crucial need to understand the cognitive capabilities of managers and the potential correlations among managerial cognition, strategic foresight and management innovation.

Ettlie et al. (2014) explain that from an organisational perspective, cognition is approached by two separate domains: entrepreneurial and managerial. In this article, the managerial
domain is discussed, thus offering interdisciplinary insights for discussing strategic foresight, as the authors have addressed the disciplines of psychology and business with the aim to define the potential relationship.

The authors put forward an assumption stating that strategic foresight cognitive managerial capabilities have a direct impact on the application of strategic foresight in an organization, thus ensuring management innovation. The higher the strategic foresight cognitive managerial capabilities, the higher the added value from management innovation delivered to the stakeholders.

To investigate this assumption, the authors address the following research question: Does managerial cognition capacity have an impact on the application of strategic foresight?

As previously mentioned, this conceptual paper strives to be interdisciplinary in nature; therefore, as a research method, the authors have selected a narrative literature approach. The study is based on the research of leading authors and thinkers in the areas corresponding to the research question. Nevertheless, in order to limit any biases and reflect on the scientific discussion, the authors have looked at other related research.

The narrative literature review as a research method was conducted in three phases. During the first phase, the authors scanned such databases as Scopus, Emerald Insight, and Web of Science in order to determine leading research items and scholars. The search was executed by using keywords matching the topics of this conceptual paper: strategic foresight, management innovation and managerial cognition. During the second phase of the literature review, the authors added additional keywords to the search – management innovation and cognition – since the results of the first phase indicated the need to broaden the scope of the literature review. The third phase focused on identifying correlations in the literature among the three key topics – strategic foresight, managerial cognition and management innovation – with a focus on identifying how strategic foresight enables management innovation.

**MANAGEMENT INNOVATION**

Management innovation (Hamel, 2006; Birkinshaw *et al.*, 2008; Mol and Birkinshaw, 2014; Walker *et al.*, 2010) or managerial innovation (Favoreu *et al.*, 2018; Damanpour, 2014) is defined as the adoption of management methods, organisational and operating practices and behaviours that are new to the organisation and aim to improve organisational performance (Walker, 2006; Mol and Birkinshaw, 2014; Damanpour and Schneider, 2008). To put all of the above in simple terms – it is about changing how managers do what they do (Hamel, 2006).
The concept of management innovation is becoming increasingly popular in the literature (Alabduljader, 2019), as the current, rapidly changing environment demands nonstop execution (Rosario et al., 2013) in order to ensure business sustainability. However, Alabduljader (2019) argues that nonstop management innovation is required instead. Management innovation comprises a novelty introduced in an established organisation, causing organisational changes and thus bringing benefits to the stakeholders in the short or long term.

Attainment of business goals in the context of an uncertain environment requires innovation in management principles and processes to establish a long-lasting advantage and enhance an organisation’s competitive advantage. But not everything might be as simple as it seems. Alabduljader (2019) argues that the novelty or the newness of something gives rise to a discussion, as it is unclear against what referential frameworks it is being measured.

The opinion leaders – Birkinshaw and Hamel in their research (Hamel, 2006; Mol and Birkinshaw, 2014; Birkinshaw et al., 2008) – often refer to management innovation as being the “state of the art” within the organisational context. However, the question whether it is enough to look at managerial innovation through the lens of the organisation or rather the external environment remains open for further research.

Despite the ongoing discussion, scholars have strived to identify the characteristics of management innovation as follows (Hamel, 2006; Walker, 2006):

- A bewitching problem that demands fresh thinking, a challenge for management orthodoxy;
- Novel principles or paradigms that have the power to illuminate new approaches;
- A careful deconstruction of the conventions and dogma that constrain creative thinking;
- Examples and analogies that help redefine what is possible;
- Changes in internal operating methods and social interactions, representing a part of an ongoing programme, executed systematically.

Hamel (2006) emphasises that the only way to change how managers work is to reinvent the process that is governing the work, e.g. such management processes as strategic planning, hiring and promotion, internal communication, project management, etc. Even though management innovation has allowed companies to cross new performance thresholds, few companies have a well-boned process to proceed with management innovation. A number of companies have formal methodologies when it comes to product innovations. Currently, it is very popular to execute various improvements in existing business processes or to create new ones in order to increase efficiency and reduce costs. However, innovation capability is required to proceed with any type of innovation within an organisation.
Alabduljader (2019), following an extensive literature review, extracts drivers which can influence the degree of innovation in the organisation, the most important of which are referred to as talents and skills. Zlatanović and Mulej (2015), apart from this, also emphasise that the internal culture of the organisation, accompanied with the understanding of the external environment, are among the main enablers of management innovation. According to Alabduljader (2019), innovation can enable an organisation to outdo its competitors. He also notes the importance of the work environment in fostering innovation and innovative intention. Innovative intention is a form of the broader construct of behavioural intention represented by an individual’s likelihood to perform a particular behaviour or class of behaviours (Ajzen, 2002).

Innovative intention is characterized as the degree of readiness to engage in various forms of behaviour targeted at individual, group, and organizational levels for effecting improvement, goal attainment, and change; and ranging from behaviours associated with the early phase of idea generation to eventual implementation and learning (Tidd et al., 2001; Shalley et al., 2004; Woodman et al., 1993). As noted by Anderson et al. (2014), the topic of how innovation and creativity should be enabled in the organisation in a systematic and sustainable manner – innovation behaviour – has not been sufficiently addressed.

In the context of innovation behaviour, the dynamic capabilities framework is considered to be rather limited as it does not present a sufficient linkage between development capabilities and organisational strategies (Ambrosini and Bowman, 2009; Helfat and Peteraf, 2009).

Ekvall (1997) states that those organisations striving to be recognised as innovative face the continuous challenge of replacing repetitive business process routines within increasingly uncertain actions and environments, thus leading to innovation. This is, however, not an easy task as managers often fall back on their habitual routines rather than change them towards the process of innovation (Cavagnou, 2011). Damanpour and Schneider (2006) generalise innovation as a process consisting of four phases: awareness, adoption, implementation and institutionalisation / routinisation.

Further research on innovation and dynamic capabilities reveals that innovation capability is characterised as one of the critical components of dynamic capability (Wang and Ahmed, 2007). Furthermore, innovation capability is even referred to as a form of dynamic capability (Anderson et al., 2014). Recent studies identify several managerial micro-foundations, such as leadership characteristics. However, research regarding managerial cognitive and personality characteristics influencing the development of a firm's dynamic capabilities remains limited (Helfat and Peteraf, 2015; Hodgkinson and Healey, 2011).

Anticipatory activities influence the cognitive capabilities of the organization to sense and make sense of changes, risks, opportunities and the need for strategic shifts (Rhisiart et al.,
Strategic foresight capability as an enabler of management innovation (2015). Foresight activities, when properly deployed in a day-to-day activity and as a capability embedded in an organization’s culture and structure, can help to identify signals that cannot be detected using the habitual and dominant search logic of businesses (Schoemaker and Day, 2009). The role of foresight in enhancing dynamic capabilities has been explored for innovation in firms (Rohrbeck and Gemünden, 2010).

Separate concepts have been identified: ‘foresight attitude’ – the learning cultivated by individual managers – and the programmed ‘foresight activity’ within the organizational setting (Bootz, 2010). Deployment of strategic foresight activities has an important role in the overall innovation processes – in visioning (Sarpong and Maclean, 2012) and in guiding strategic innovation (Rohrbeck and Gemünden, 2011). Nevertheless, as research has identified, management innovation can only be enabled on the Mature and World-class maturity levels as only on those levels have executives, and the organisation as a whole, mastered strategic foresight capability.

Based on the previous discussions, it turns out that strategic foresight and management innovation have strong relationships. From the authors’ point of view, strategic foresight can be considered as an enabler or a tool of management innovation in the organizational context.

**FORESIGHT AND STRATEGIC FORESIGHT**

Foresight insists on the necessity to live creatively (Klakurka, 2016) and is referred to as the core knowledge-based competence within the organisation (Major et al., 2001) which is mainly applied to improve the perception of opportunities (Bezold, 2010). In order to enhance perception capabilities, Klakurka (2016) suggests engaging in processes that would allow individual expression and collective awareness of creative possibilities. These processes, once created, should be included in the long-term strategic planning activities. Moreover, these processes should be predictive and creative (Tevis, 2010).

On many occasions, foresight is executed as a process of recreating historical events (Burrows and Gnad, 2018). Such an approach is backed by the assumptions that the future is created based on past events, which leads to the belief that the future is predicted rather than foreseen, thus highlighting the disorganisation of the academic environment (Rohrbeck, 2015) and perception that foresight has evolved in isolation from the research body of business strategy (Major et al., 2001). This opposes other scientific discussions in which foresight considers the future to be an open space that is yet to be built (Djuricic and Bootz, 2019) based on the sensing of market transformations (Klakurka, 2016) or future markets (Micic, 2010) and perceiving them as the reality of the future. Miller (2011) goes even further, stating that the main challenge is not to find ways to “know” the future but rather embracing the novelty of not knowing the future. This strongly correlates with
cognitive biases, which, in the organisational context, comprise managerial cognition, leading to the anticipated application of strategic foresight.

It has already been highlighted that the existing body of literature does not reflect the consensus on the definition of strategic foresight. Therefore, the authors propose understanding strategic foresight as a complex concept to create and maintain a forward view (Rohrbeck et al., 2015; Slaughter, 1999), sense opportunities and improvements (Saarikko et al., 2014) and assist decision makers in forming the organisation’s future course of action (Vecchiato, 2012; Slaughter, 1999).

One of the roles of strategic foresight is to challenge the mental models and existing assumptions (Heger and Rohrbeck, 2012) of managers. However, strategic foresight as a capability for future value creation and sustainability is often resisted by managers; the same is true for the existing body of literature (Vecchiato and Roveda, 2010). Instead, they tend to rely on tools and methods as the magic recipe to prepare them for the challenges of the future. Such behaviour is linked to the epistemological challenge strategic foresight is associated with (Miller, 2011) as well as personality types and their capabilities (Morrow, 2003).

**DYNAMIC MANAGERIAL CAPABILITY FOR STRATEGIC FORESIGHT**

Based on the research by Morrow (2003), it can be assumed that strategic foresight capability has to be dynamic in nature, but it does not necessarily have to possess dynamic capability characteristics. Dynamic capabilities refer to the organisation’s ability to enhance competitive advantage and, thus, sustainability for the future.

Teece et al. (1997) define dynamic capabilities as the ability of an organisation to develop and reconfigure both internal and external competences to address the rapidly changing environment. Three key characteristics have been outlined for dynamic capabilities: sensing, seizing and transforming. Both strategic foresight and managerial cognition have roots within dynamic capabilities (Eisenhardt and Martin, 2000; Wilkens et al., 2016). Dynamic capabilities enable companies to shape the environment they are operating within (Teece et al., 1997). Thus, managerial cognition is a key enabler of capabilities within the organisation, fostering the capability for strategic foresight, which is viewed as the dynamic managerial capability. From the authors’ point of view, application of strategic foresight requires the presence of managerial dynamic capability to sense and seize the opportunities for transforming the organization to create the desired future.
Dynamic managerial capabilities help managers to cope with unpredictable changes and present managers with an ability to create, expand, or change the resource base of an organisation (Helfat et al., 2007).

It is often argued that strategic foresight should be integrated into the dynamic capabilities framework as it helps to operationalise it. The practical application of the dynamic capabilities framework leads to enhanced performance and thus the sustainability of an organisation (Eisenhardt and Martin, 2000; Pulsiri and Vatananan-thesenvitz, 2018). Nevertheless, recent literature on the topic reveals two directions: one follows the assumption that strategic foresight is a dynamic capability itself; the other is more specific and relates it to a dynamic managerial capability.

Strategic foresight as a dynamic managerial capability enhances the decision-making processes in organisations (Helfat and Adner, 2003; Helfat and Martin, 2014; Vecchiato, 2012), leading to management innovations. In addition, dynamic capabilities lead to ensuring sustainability in uncertain environments (Rohrbeck, 2012). However, it should be emphasised that management innovation is possible only at a certain strategic foresight managerial capability maturity level.

Nevertheless, the authors emphasise that despite strategic foresight possessing similar characteristics as dynamic capabilities, it should not necessarily be considered as a dynamic capability itself. Strategic foresight capability has to be dynamic by nature as there are several strategic foresight levels requiring development of strategic foresight capability. Therefore, the authors have reflected on the framework of dynamic capabilities to illustrate the similarities and benefits for organisations. As previously mentioned, in the current body of literature there is no common approach to the phenomenon of strategic foresight; therefore, the authors conceptualise the view on strategic foresight.

Slaughter (1996) developed a model reflecting the foresight implementation levels within a social context. Years later, a similar model was developed by Grimm (2009), explaining foresight maturity levels. This conceptual paper follows Grimm’s foresight maturity levels since Grimm’s approach is more organisation-oriented in comparison to the social approach described by Slaughter. The authors assume that there is a correlation between the strategic foresight and management innovation – this correlation is illustrated in Figure 1. It is also clear, based on the strategic foresight’s literature review, that a certain mindset is required to master strategic foresight. The authors have integrated the cognition levels (Bloom et al., 1995) into the Figure 1 to illustrate the connection to strategic foresight levels introduced by Grimm (2009).
As discussed previously, strategic foresight has characteristics of dynamic managerial capability, which can be present on an individual, group or organisational level. Every manager has an innate ability for foresight, but it has to be enhanced for it to become a managerial capability, which is dynamic by nature. Therefore, it is crucial to understand where this capability originates from and what the main drivers are as well as under which conditions it leads to management innovation. Thus, cognition, particularly managerial cognition, has to be investigated.

The mind is an information processing system (Haugeland, 1981); thus, cognition, in a broad sense, can be characterised as the possession of the conscious and unconscious mental processing of knowledge (Brymer et al., 2011) or, in a more simplified way, how people work with information to solve problems (Ericsson, 2003). From the authors’ point of view, cognition is broader than knowledge; it has to be related to understanding and raising awareness about the particular phenomena and tools available for delivering solutions to a problem.

Cognitions have evolved together with interactions with the world; this process includes both shaping the surrounding world and being shaped (Weick, 1995). These interactions are based on domain-specific cognitive skills (e.g. divergent thinking, sensemaking, sense giving) as outlined by Mumford et al. (2015). This fosters the opinion that there are different levels of knowledge and awareness required for managerial cognition to be able to utilise the sensing, seizing and transforming stages of dynamic capabilities.

Gioia and Chittipeddi (1991) argue that sensemaking and sense giving skills are of particular importance for successful leadership as they represent an integration of several
Strategic foresight capability as an enabler of management innovation

mental models. Both skills are required for application of strategic foresight, particularly in sense breaking events (Pratt, 2000). Mumford et al. (2015) rightly note that within the literature of leadership, leaders are described as those who do not need to think; rather, they must act.

Managerial cognition highlights such managerial capabilities or mental capacities as sensing opportunities, seizing activities for mobilising resources and reconfiguring resources.

The ability to sense new opportunities depends on how sharp a manager’s early perception of the weak signals of the environment is as well as attention to the related opportunities – sensemaking (Helfat and Peteraf, 2015).

Sensemaking is required for enforcing new business developments which are recognised but not yet implemented in day-to-day practice as existing key performance indicators delay the introduction of new practices (Wilkens et al., 2016). Furthermore, researchers note that an open-minded attitude, as a pre-requisite for sensing opportunities, is not always present in new business development. However, mental models need to be challenged in light of the changing environment (Rhisiart et al., 2015). Signals might get missed as organisations tend to have their own interpretation of the world according to their own ‘cognitive categories’ (Tsoukas and Shepherd, 2004).

![Figure 2. Interaction among managerial cognition, strategic foresight and management innovation](image)

The existing scientific literature on managerial cognition has largely focused on understanding the subjective interpretation of an organisation’s external environment by senior executives (Manral, 2011). Manral (2011) further explains that most of the research on the impact of cognition on an organization’s internal environment in which innovation is fostered remains within the domain of psychology. Thus, one can conclude that the drivers or other aspects of innovation have not been uncovered fully.
The changing environment constantly forces managers to face complex problems requiring significant cognitive efforts (Uotila, 2015) and swift decision-making skills. Cognition provides new categorisations and interpretative frameworks for everyday situations (Uotila, 2015). Neisser (1976) recognises cognitions as mental templates that individuals use to form meaning in the context of the information environment. He explains that during this process individuals strive to connect three contexts: the past, the present and the future. During the cognition process, one can either enable an alternative view to the world or create path dependencies (Vergne and Durand, 2011), influencing the decision-making process in the whole organisation. Managerial cognitions are recognised as a specific field of analysis derived from the micro-foundations of dynamic capabilities (Wilkens et al., 2016).

**CONCLUSION**

This conceptual paper strived to address the interrelations among management innovation, strategic foresight and managerial cognition.

1. As previously discussed, strategic foresight capability is fostered by cognitive processes which, in turn, have roots in micro-foundations of dynamic capabilities, referred to as processes and routines based on capabilities (Teece, 2007). Nevertheless, it is worth noting that for strategic foresight to become a dynamic capability, managers have to master the ability to sense opportunities and to seize and transform the organisation and its resources to adapt to the expected changes. The literature review reflected on the RQ regarding the impact of managerial cognition on application of strategic foresight. The conceptual paper addressed the potential interrelations among strategic foresight, managerial cognition and management innovation. This study has created the basis for further research to identify the exact linkage between two complex concepts – strategic foresight and management innovation – as well as to identify the role of managerial cognition in the process of innovation. Nevertheless, investigating strategic foresight from the perspective of dynamic capabilities provided valuable clues towards identifying the relationship between two concepts: managerial cognition and strategic foresight. Further research is still required; nevertheless, based on the similarities among the levels of managerial cognition and strategic foresight, it can be concluded that the former has a significant impact on the implementation and application of the latter throughout an organisation. This is because there are certain sets of understanding, attitudes and skills required for managers to master strategic foresight.

2. Looking through the prism of dynamic capabilities, managers require not only the sensing capability; they must also possess the skills required to seize opportunities and effectively transform the organisation. Thus, it can be concluded that the higher the level of managerial cognition, the higher the level of strategic foresight application that can be
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achieved. The higher the management’s awareness of challenges and opportunities, the higher the probability that the organisation will foster an innovative environment. Thus, management innovation can only be enabled on certain strategic foresight maturity levels – Mature and World-class – as on these levels, managerial cognition abilities have the highest capacity.

This paper shall serve as an introduction for broader research to address the influence of managerial cognition on strategic foresight.

REFERENCES:


Determinants and impacts of computer system validation on firm-level performance

MARIUS SCHONBERGER
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ABSTRACT

Purpose. Amendments to regulatory directives in the medical device industry are forcing manufacturers to constantly review and adapt their business processes. In this context, the current focus is on computer system validation (CSV). The aim of this research is to identify determinants and impacts of CSV on firm performance and to determine the associated challenges, especially for small and medium-sized enterprises (SMEs).

Design/methodology/approach. A structured literature review was carried out which analyses published studies, evaluates contributions, and summarises knowledge. For this purpose, a previously developed research model served as the basis for data collection.

Findings. A total of 233 research papers were examined and divided into different categories and classified according to different criteria. Most of the research papers are grounded on a resource-based approach and predominantly investigate the impact of IT resources or capabilities on firm performance. Moreover, the review reveals that no research could be identified that justified changes in firm performance due to the implementation of CSV.

Research limitations/implications. The results of this paper can only be generalized to the specific population of scientific publications within the selected literature databases. Implications for future research are suggested.

Originality/value. The findings are derived from an exhaustive literature review of quantitative and qualitative studies. Thus, this research serves as a theoretical foundation for the investigation of change in firm performance as a result of IT resources and the mediator role of CSV and provides a path for future research for this field of study.

Keywords: Literature review, Computer system validation, Firm performance, Resource-based theory (RBT), SME, Medical device industry.
INTRODUCTION

The importance of information and communication technology (ICT) in healthcare continues to grow, driven by various disruptive changes, such as an ageing population, advances in the biology of disease and the practice of medicine, and the spread of connectivity and mobile technology (Fiaidhi et al., 2016; Schonberger and Vasiljeva, 2018). ICTs offer vast opportunities to support healthcare industries and improve their effectiveness and efficiency (Gomes and Romão, 2018). The aim of ICT for healthcare in Europe is to improve the quality, access and efficacy of health products and services for all citizens (Ammenwerth et al., 2004). Therefore, more and more medical device manufacturers are relying heavily on software to develop devices that help patients lead better lives. Thus, software has become a significant economic factor and occupies an important role in the critical functions of medical devices (Schonberger and Vasiljeva, 2018). However, with the benefits of software comes the risk of defects and errors.

According to Fu (2011), software-based medical devices led to over 537 recalls between 2002 and 2010, affecting more than 1.5 million devices. During this period, 11.3% of all recalls were due to software errors (Fu, 2011). A study by the Commonwealth Fund (2005) showed that in the U.S. approximately 35% of all respondents reported a medical mistake, medication error, or lab error (Schoen et al., 2005). In comparison, only 23% of respondents in Germany and 22% in the U.K. reported medical errors. The study was based on a survey of 700 patients in Australia, Canada and New Zealand and 1,500 adults in the U.S., the U.K. and Germany (Schoen et al., 2005). According to an AAMI study from 2016, medical errors caused more than 250,000 deaths each year in the U.S. and accounted for almost one in ten deaths. As Appendix 1 shows, a total of 271 recalls for medical devices, resulting from software errors, were reported to the U.S. Food and Drug Administration (FDA) in 2018 alone (FDA, 2019). This corresponds to an increase of 76 recalls (around 39%) compared to 2017. In addition, it is evident that most recalls are due to failures in software design. Other software-related recalls are due to missing or inadequate software design controls and testing procedures as well as the increasing complexity of the medical device usage environment (see Appendix 1). In summary, medical devices are often exposed to a high number of failures with potentially catastrophic effects on patients (Alemzadeh et al., 2013).

Against this background, regulations require specific documentation on product safety, efficacy, strength, quality and purity (Yogesh et al., 2015) in order to be able to identify the source of the defect retrospectively in the event of damage. Consequently, regulations and laws within the medical technology industry influence the manufacture, ordering and delivery of medical products; handling in warehouses; distribution; and a variety of other activities in the areas of manufacturing, quality assurance, marketing and research and development (Bendale et al., 2011). In summary, legal regulations control many aspects of how a company in the medical device industry must be operated. For this purpose, it is
essential that all computer and software systems involved in the aforementioned processes are validated and supported as well as controlled by procedures and documentation that ensure their conformity (Bendale et al., 2011). However, the implementation of computer system validation (CSV) is not only necessary due to legal regulations, but also in terms of economic, social and technological aspects (Schonberger and Vasiljeva, 2018). The problem for many medical technology companies is that the regulations only stipulate that CSV must be applied and which ICT must be considered in the company (e.g. FDA, 2002; ISO, 2016); the exact scope or a structured approach are not specified (Schonberger and Vasiljeva, 2018; Von Culin, 2011). To ensure that regulatory requirements are met, the challenge for manufacturers is to determine which ICT needs to be validated and how much validation is appropriate (Schonberger and Vasiljeva, 2018; McDowall, 2005).

This research is part of an already started research project and deals with the analysis of the subject of CSV in small and medium-sized enterprises (SMEs) in the medical technology industry. The aim of this research project lies in developing a risk-based management model for CSV in SMEs within the medical device industry. Based on a previous study (Schonberger and Vasiljeva, 2018), a structured and comprehensive literature review will be conducted to identify and evaluate determinants and impacts of CSV on firm performance. With regard to the aforementioned key problem, the following research questions are to be answered within the scope of this research:

1. To what extent has the relationship between CSV and firm performance been investigated in the literature so far?
2. Which theories and concepts have been used so far in the literature to investigate the relationship between CSV and firm performance?
3. What are the implications and challenges for future research in the area of CSV?

This research is structured as follows: First, the necessary terminological basics are explained in section 2. In section 3, the underlying research methodology is described. In section 4, the results of the structured literature review will be explained and analysed. A critical discussion of the results of the literature review follows in section 5. In this context, the results are compared and evaluated with regard to the research questions. Finally, the contribution concludes with the limitations of this research and recommendations on further research activities in section 6.

**BASIC TERMINOLOGY**

The medical technology industry in Europe

Medical technology is defined as “any technology used to save lives or transform the health of individuals suffering from a wide range of conditions” (MedTech, 2018:5). The
medical technology sector is the most important part of the healthcare sector (Maresova et al., 2015). According to a current study by MedTech (2018), around 7.2% of the total expenditure in healthcare was spent on medical technology in 2018. Furthermore, 95% of the 27,000 medical technology companies in Europe are SMEs employing more than 675,000 people (MedTech, 2018). With approx. 30% of the worldwide expenditure on medical devices, Europe holds one of the biggest markets for medical technology (Klein, 2016). In addition, the medical technology sector is one of the most innovative industries in Europe (Klein, 2016). According to the European Patent Office (EPO, 2018), more patent applications were filed for medical technology in 2017 (13,090 applications) than for any other field of technology, including digital communication (11,694), computer technology (11,174), and biotechnology (6,278).

As already explained in the introduction, the market for medical technology and devices is one of the sectors that is actively regulated by directives (Foe Owono, 2015). Two leading regulatory authorities are responsible for defining, updating and verifying compliance of medical devices in Europe: The Medical Device Regulation (MDR) regulates almost all areas of medical devices, e.g. developing, manufacturing, or placing on the European market (Wagner and Schanze, 2018), while the FDA uses the 21 CFR 820 Quality Systems Regulation in stipulating to medical device manufacturers how to establish and maintain a quality assurance system (Francum, 2014). Although the FDA is primarily responsible for the U.S. market, many European medical device manufacturers follow FDA regulations, even if they do not sell their medical devices in the U.S. (Schonberger and Vasiljeva, 2018).

**The role of ICT in the medical technology industry**

ICTs are an important economic factor for the health sector and make a significant contribution to the improvement of products and services provided to patients (Schonberger and Cirjevskis, 2017). The main objective of ICT in healthcare is to manage information from all health-related activities, including planning, monitoring, coordination and decision-making (Gomes and Romão, 2018). Thus, ICT in healthcare has been identified as a key instrument to facilitate communication (Häyrinen et al., 2008). It is widely recognized that the use of ICT offers enormous opportunities to support healthcare professionals and increase the efficiency, effectiveness and appropriateness of care (Gomes and Romão, 2018). However, from a regulatory and business perspective, the benefits of using ICT can only be reaped if it is ensured that each system does what it claims to do, reliably and repeatably (Yogesh et al., 2015). The introduction and application of CSV is mandatory for medical device manufacturers to ensure this state of their computer and software systems in use (see section 4).
RESEARCH METHODOLOGY

As described in the introduction, the medical device industry faces major challenges in implementing and applying suitable CSV approaches (see section 1). To investigate this complex problem, a systematic literature review was carried out, which analyses published studies, evaluates contributions, and summarises knowledge. For this purpose, a previously developed research model served as the basis for data collection (Schönberger and Vasiljeva, 2018; see Appendix 2). As the conceptual model in Appendix 2 shows, firm performance, IT capability, risk management capability, and CSV are the focus of the literature review. The aim of this review is to identify determinants and impacts of CSV on firm performance and to determine the associated challenges, especially for SMEs. The structure of the literature review, which is based on the methods of Schönberger et al. (2014), Mikelsone and Liela (2015) and Schönberger (2018), is described below.

Problem formulation

In general, the literature review described within this research is intended to give an overview of the content and thematic orientation of the literature. The primary aim of the review is to obtain a comprehensive overview of the current status of the literature. As a result, the review should identify literature that can explain the relationships between the variables in the conceptual model (see Appendix 2). Thus, within the scope of the review, the following main question should be answered: “How does IT capability and risk management capability (RMC) impact firm performance due to the implementation of CSV in SMEs from the medical device industry?” (Schönberger and Vasiljeva, 2018). This question is connected to the first research question stated in this paper (see section 1). In order to investigate this problem, the underlying literature review process is described and explained below.

Literature review process

The publications identified by the systematic literature review should refer as comprehensively as possible to the problem statement already described before. For this purpose, various literature databases were selected at the beginning of the review and an extensive keyword search was carried out. Therefore, based on the variables of the conceptual model, the following main keywords were used: IT Capability, Risk Management, Computer System Validation, and Firm Performance. In addition, while most of the research papers within the information system literature are grounded on a resource-based or dynamic capability approach (Schönberger and Vasiljeva, 2018), the existing keywords were supplemented as follows: Resource-based Theory and Dynamic Capability. The following literature databases were searched for literature: Google Scholar, Scopus, EBSCO Academic Search, ScienceDirect, Emerald Insight and Sage Journals.
The search was carried out in several steps. First, a full overall search was performed. Here, the previously mentioned keywords were combined in an appropriate way: Each main keyword was AND-linked to the corresponding thesaurus terms, while these were OR-linked. For example: “Computer System Validation” AND “Computer Validation” OR “Software Validation” OR “CSV”. Afterwards, each search string was inserted into the search of the respective literature databases. The search was then restricted to article titles, abstracts and keywords. The findings of the first overall search are listed in Table 1.

<table>
<thead>
<tr>
<th>Databases</th>
<th>RBT</th>
<th>DC</th>
<th>IT cap.</th>
<th>CSV</th>
<th>FP</th>
<th>RM</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBSCO</td>
<td>206</td>
<td>176</td>
<td>135</td>
<td>96</td>
<td>1419</td>
<td>52221</td>
</tr>
<tr>
<td>Emerald Insight</td>
<td>927</td>
<td>874</td>
<td>246</td>
<td>1</td>
<td>8803</td>
<td>12630</td>
</tr>
<tr>
<td>Google Scholar</td>
<td>23100</td>
<td>19100</td>
<td>12200</td>
<td>680</td>
<td>449000</td>
<td>1020000</td>
</tr>
<tr>
<td>Sage Journals</td>
<td>451</td>
<td>323</td>
<td>81</td>
<td>26</td>
<td>4369</td>
<td>13206</td>
</tr>
<tr>
<td>ScienceDirect</td>
<td>1291</td>
<td>1290</td>
<td>757338</td>
<td>86</td>
<td>15377</td>
<td>61647</td>
</tr>
<tr>
<td>Scopus</td>
<td>866</td>
<td>2998</td>
<td>923</td>
<td>69</td>
<td>10626</td>
<td>99371</td>
</tr>
<tr>
<td>Total:</td>
<td>26841</td>
<td>24761</td>
<td>770923</td>
<td>958</td>
<td>489594</td>
<td>1259075</td>
</tr>
</tbody>
</table>

(Legend: RBT = Resource-based theory, DC = Dynamic capability, IT cap. = IT capability, CSV = Computer system validation, FP = Firm performance, RM = Risk management)

In the second step, the first results were restricted to fully accessible publications only. While all databases have the possibility to narrow down the results by several search criteria, in the case of Google Scholar it was not possible to filter the results by only fully accessible publications. Therefore, after each search term the specification “filetype:pdf” had to be added, meaning that only results in PDF format were listed in Google Scholar. The findings of the second search are listed in Table 2.

<table>
<thead>
<tr>
<th>Databases</th>
<th>RBT</th>
<th>DC</th>
<th>IT cap.</th>
<th>CSV</th>
<th>FP</th>
<th>RM</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBSCO</td>
<td>53</td>
<td>49</td>
<td>57</td>
<td>49</td>
<td>364</td>
<td>13258</td>
</tr>
<tr>
<td>Emerald Insight</td>
<td>13</td>
<td>18</td>
<td>3</td>
<td>0</td>
<td>165</td>
<td>148</td>
</tr>
<tr>
<td>Google Scholar</td>
<td>10300</td>
<td>6710</td>
<td>2760</td>
<td>132</td>
<td>26800</td>
<td>121000</td>
</tr>
<tr>
<td>Sage Journals</td>
<td>38</td>
<td>33</td>
<td>8</td>
<td>4</td>
<td>283</td>
<td>1423</td>
</tr>
<tr>
<td>ScienceDirect</td>
<td>155</td>
<td>153</td>
<td>62921</td>
<td>2</td>
<td>1442</td>
<td>6390</td>
</tr>
<tr>
<td>Scopus</td>
<td>3</td>
<td>47</td>
<td>7</td>
<td>0</td>
<td>84</td>
<td>1891</td>
</tr>
<tr>
<td>Total:</td>
<td>10562</td>
<td>7010</td>
<td>62996</td>
<td>187</td>
<td>29138</td>
<td>144110</td>
</tr>
</tbody>
</table>

In the next step, the duplicates within the findings were eliminated and linguistic restrictions were performed afterwards. For reasons of better comparability, only English-language literature is taken into account for this study. Due to considerable differences between the definition of SMEs in the U.S. and the proposal of the European Commission (SBA, 2017), literature sources referring to the definition of SMEs in the U.S. are excluded, as this makes it difficult to compare the English-language literature.

Following the linguistic restrictions, content limitations were also defined. First, the results of the literature review were reduced to ranked journals and proceedings according to the ABDC and ABS quality lists. These scales were selected because they are currently widely used in academic research (Rowlinson et al., 2015). In addition, articles published in scientific journals are considered to be certified knowledge, as these articles must undergo a consistent review process (Koseoglu, 2016; Ramos-Rodrigues and Ruiz-Navarro, 2004). Furthermore, although it is acknowledged that books or dissertations also influence scientific thinking, academic journals and conferences are generally regarded as the dominant communication platform for researchers (Schönberger et al., 2018). Second, according to the research background, European SMEs from the medical device industry are the focus of the literature review. Therefore, the publications were examined again with the help of a keyword analysis. The following keywords were selected: small and medium enterprises, small and medium-sized enterprises, SME, medical device industry, and medical device manufacture. This ensured that only publications related to the introductory problem were selected (see section 1).

Finally, at the end of the literature review, the results were analysed by reading the abstracts and references of the remaining research papers. Again, publications were eliminated that were not focused on the problem formulation. However, other relevant literature was also included which was listed in the references of the publications. Figure 1 shows the entire literature research process.
In order to achieve the best possible and most adequate results through the literature review, research papers, conference papers, proceedings, monographs, books, dissertations and postdoctoral theses are examined and evaluated. As the focus on SMEs implies the identification of only a few literature sources, there is no limitation regarding the time of the publication. A time limitation could thus possibly prevent the consideration of older relevant sources of literature. This also applies to the term “Computer System Validation”, which has already been identified in previous studies (Schönberger and Vasiljeva, 2018; Schönberger, 2018). Nevertheless, a consideration of current literature is aspired to. Furthermore, for better comparability of the literature, the term “SME” is used universally without any specific industry reference.

**Literature analysis**

In order to be able to analyse the identified publications more precisely, they were stored in an Excel spreadsheet. This made it possible to create a comprehensive literature database on the one hand and to use the Excel functions for statistical evaluation of the results on the other. For the construction of the literature database, the names of the
authors, the title of the publication, the year, the publication type or the name of the journal, the volume of the journal, the page numbers as well as the keywords of the authors specified in the publication were inserted into the Excel spreadsheet for each publication. The transfer of articles from the literature databases was done by exporting the data into a text file and importing this file into Excel with one exception: The transfer of articles from Google Scholar was done manually.

Since data retrieved from bibliographic sources usually contain errors (Cobo et al., 2011), e.g. spelling mistakes in the name of the author, in the journal title or in the reference list, a content analysis could not be carried out directly and manual data processing of the retrieved data was necessary. In order to improve the quality of the data and thus achieve better results in content analysis, the data was therefore manually checked and cleaned up by adding information to incomplete or incorrect original records, e.g. if the author’s name was incomplete or keywords had to be split if they were stated in a string and not separately. Finally, the abstracts and references of the 215 publications were read and further relevant literature referenced in the publications was also stored in the Excel spreadsheet. Furthermore, irrelevant literature was excluded. Thus, publications were also included in this study which do not correspond to the limitation of ranked journals or proceedings (see Figure 1).

RESEARCH FINDINGS

Structure of the literature base

Based on the literature review, a total of 233 publications were identified, of which most are journals (n=159), followed by conference proceedings (n=20) and books (n=18; see Appendix 3). The top cited journals are the MIS Quarterly Journal (n=16), followed by the Strategic Management Journal (n=11) and the Information and Management Journal (n=8). According to the ABDC quality list from 2016, nearly 20 percent of the findings are ranked in A*-Journals, and 22 percent are ranked in A-Journals. The quality of the journals according to the ABS quality list from 2018 is a little bit different: here only seven percent are classified as a 4*-Journal, and four percent as a 4-Journal. However, although non-ranked publications were eliminated, there are several non-ranked publications within the literature database (see Appendix 4). This can be explained by the fact that in the analysis of the references of the publications from the first results (Step 7), publications were also included in the literature database that do not belong to the defined limitations and restrictions from the literature review process (see Figure 1). The top cited proceedings are from the European Conference on Information Systems (ECIS, n=6), followed by the International Business Information Management Conference (IBIMA, n=2) and the International Conference on Information Systems (ICIS, n=2). The conference proceedings
are, according to the ERA database from 2010, mainly classified as A-Conferences (50 percent, see Appendix 5).

The analysis of the keywords contained in the literature database shows, not surprisingly, that the initially used main keywords are among the top ten. The most frequently mentioned keyword was Resource-based theory (n=24), followed by IT capability (n=23) and Dynamic capability (n=21). More interesting is the fact that related keywords that were not selected at the beginning of the review were mentioned more often than some main keywords. For example, the keywords Competitive advantage (n=16) or Information Technology (n = 13) were mentioned more frequently than the keyword Computer System Validation (n=8). Another interesting fact is that although SMEs are the focus of this research, the keyword SME was not included in the initial keyword analysis but is now in the top ten keywords (n=11).

![Figure 2. Historical trends of main keywords used for the literature review](image-url)

Figure 2 gives an overview of the historical trends of the main keywords. It is obvious that most keywords appeared after the year 2003. In addition, it can be observed that keywords such as Resource-based theory or Firm performance occur almost every year. An exception is the keyword Computer System Validation, which was first mentioned in the year 2015. The reasons for the lack of literature between 1997 and 2003 could be explained by Kondratiev waves, an economic theory that describes economic fluctuations over a period of 40-60 years (Goransson and Soderberg, 2005). The last wave corresponding to this theory began to rise in the early 1970s to mid-1990s and describes economic effects based on the use and diffusion of information technology (IT) (Goransson and Soderberg, 2005). With the beginning of this wave, scholars were increasingly researching the impact of IT on the economy. The usual delay in publishing research results may have led to a lack of scientific literature between 1997 and 2003.
In the following, the historical trends of the individual main keywords are examined in detail (see Figure 3). It can be seen that in terms of the keywords Resource-based theory and Firm performance, research activities have declined slightly over the last few years, while activities in terms of the keywords Dynamic capability and IT capability have increased significantly. Literature on the keyword Risk Management is more or less stable and increasing slightly. However, no statements can be made about trends regarding the keyword Computer System Validation, as there is a major gap in the literature.

In summary, an answer can already be given to the first research question. The literature review carried out in this paper has shown that the subject of CSV is still largely unexplored in current ICT literature (see Table 1 and Figure 3). Furthermore, most of the research papers are grounded on a resource-based approach and predominantly investigate the impact of IT resources or capabilities on firm performance. Moreover, the review reveals that no research could be identified that justified changes in firm performance due to the implementation of CSV.

Results of the literature review

In the following, the results of the literature review are explained, whereby the focus here is more on the contents of the identified publications. The following paragraphs concentrate on the analysis of the main keywords (see section 3) and thus on the evaluation of the previously established conceptual model (see Appendix 2).

Resource-based theory and IT resources

The understanding of the relationship between IT-related capabilities and firm performance has been the subject of numerous studies in recent years and has commonly
been investigated by resource-based theory (RBT) (e.g. Bharadwaj, 2000; Chen and Tsou, 2012). To understand how organizations achieve a sustainable competitive advantage, RBT analyses and interprets organizations’ resources (Madhani, 2009; Ray et al., 2005; Wade and Hulland, 2004). The concept behind RBT focuses on the unique combination of resources of a firm that are economically valuable, rare, and difficult to imitate (Barney, 1991) and considers them as sources of superior performance and competitive advantage (Grant, 1991; Wade and Hulland, 2004). An overview of various definitions of the term “RBT” is provided in Table 3.

Table 3

**Selection of definitions related to the term “Resource-based theory”**

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maijoor and Van Witteloostuijn (1996:549)</td>
<td>“The resource-based view of the firm is a recent management theory that seeks to identify the resources that may provide firms with a sustainable competitive advantage.”</td>
</tr>
<tr>
<td>Bharadwaj (2000:170)</td>
<td>“The resource-based view […] focuses on costly-to-copy attributes of a firm which are seen as the fundamental drivers of performance.”</td>
</tr>
<tr>
<td>Galbreath (2005:979)</td>
<td>“RBT […] is built upon the theory that a firm’s success is largely determined by the resources it owns and controls.”</td>
</tr>
<tr>
<td>Madhani (2009:3)</td>
<td>“The […] resource-based view analyzes and interprets internal resources of the organizations and emphasizes resources and capabilities in formulating strategy to achieve sustainable competitive advantages.”</td>
</tr>
</tbody>
</table>

However, although RBT provides a useful theoretical perspective to assess the heterogeneity of firm performance, the existing IT literature lacks clarity in the definition and conceptualization of IT resources (Wade and Hulland, 2004; Aral and Weill, 2007). This is evident from the fact that in recent years researchers in the field of RBT have subsumed a multiplicity of different terminologies under the heading “resource”, including competencies (e.g. Prahalad and Hamel, 1990), skills (e.g. Grant, 1991), strategic assets (Amit and Schoemaker, 1993), assets (Ross et al., 1996), assets and capabilities (e.g. Wade and Hulland, 2004), and stocks (Capron and Hulland, 1999). In summary, firm resources are broadly defined to include assets, organizational processes, firm attributes, information, information technologies, or knowledge, which can be used to implement value-creating
business strategies (e.g. Galbreath, 2005; Mata et al., 1995; Barney, 1991; Wernerfelt, 1984).

As this research project, as described before (see section 1), focuses on computer systems and ICT in SMEs of the medical technology industry, IT-related resources are therefore the focus of the analysis of RBT. According to Wade and Hulland (2004), RBT started to emerge in ICT research in the middle of the 1990s (which confirms the theory of Kondratiev waves; see section 4.1). Ross et al. (1996) separated IT-related resources into three IT assets which, together with IT processes, would contribute to business value. These three IT resources were defined as human assets (e.g. technical capabilities, business understanding), technology assets (e.g. physical IT assets, IT infrastructure) and relationship assets (e.g. partnerships with other departments). This categorization was later redefined by Bharadwaj (2000) to include IT infrastructure, personnel IT resources and IT-capable intangible assets. An overview of further various classifications according to the term “IT resource” is provided in Table 4.

Table 4

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>IT-related resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mata et al. (1995)</td>
<td>Access to capital, proprietary technology, technical IT skills, managerial IT skills</td>
</tr>
<tr>
<td>Ross et al. (1996)</td>
<td>Reusable technology base, IT-business partnering relationship, IT human resources</td>
</tr>
<tr>
<td>Feeney and Willcocks (1998)</td>
<td>Design of IT infrastructure, business and IT vision, delivery of IS services</td>
</tr>
<tr>
<td>Bharadwaj et al. (1999)</td>
<td>IT infrastructure, business process integration, internal IT partnerships, external IT partnerships, IT management, strategic vision of IT</td>
</tr>
<tr>
<td>Bharadwaj (2000)</td>
<td>IT infrastructure, human IT resources, IT-enabled intangibles</td>
</tr>
<tr>
<td>Sambamurthy et al. (2003)</td>
<td>IT investment scale, IT capabilities</td>
</tr>
<tr>
<td>Aral and Weill (2007)</td>
<td>IT (technical) assets, IT (human) capabilities</td>
</tr>
</tbody>
</table>

As can be seen from Table 4, over the years different IT-related resources have been examined. However, there are often overlaps, for example IT capabilities (e.g. Mata et al., 1995; Sambamurthy et al., 2003; Aral and Weill, 2007), IT infrastructure (e.g. Feeney and Willcocks, 1998; Bharadwaj et al., 1999; Bharadwaj, 2000), or Human IT resources (e.g. Ross et al., 1996; Bharadwaj, 2000; Aral and Weill, 2007). In this context, ICT is an important factor in making organisational resources accessible and divisable so that firms can respond more flexibly to changing market needs (Bharadwaj, 2000).
Dynamic capability and IT capabilities

As markets are dynamic, the resources of a firm also need to change over a period of time to become relevant to changing market conditions (Lin and Wu, 2014; Madhani, 2009). The dynamic capabilities (DC) approach is based on this perspective, extending RBT to include environmental and technological change (Daniel et al., 2014; Madhani, 2009; Aral and Weil, 2007). DC refers to a firm’s ability to integrate, build, and reconfigure internal and external competencies (Cirjevskis, 2016; Liu et al., 2013; Teece et al., 1997). Thus, the DC perspective is a widely applied paradigm to explain variance in performance across competing firms (Cirjevskis, 2016; Liu et al., 2013; Barreto, 2010; Zott, 2003; Teece et al., 1997). An overview of various definitions of the term “DC” is provided in Table 5.

Table 5

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teece et al. (1997:516)</td>
<td>“[…] the firm’s ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments.”</td>
</tr>
<tr>
<td>Eisenhardt and Martin (2000:1107)</td>
<td>“The firm’s processes that use resources – specifically the processes to integrate, reconfigure, gain and release resources – to match and even create market change. Dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die.”</td>
</tr>
<tr>
<td>Zott (2003:98)</td>
<td>“[…] the ability to generate alternative resource configurations by way of imitation and experimentation.”</td>
</tr>
<tr>
<td>Wade and Hulland (2004:131)</td>
<td>“[…] by acting as a buffer between core resources and the changing business environment, dynamic resources help a firm adjust its resource mix and thereby maintain the sustainability of the firm’s competitive advantage […].”</td>
</tr>
<tr>
<td>Cepeda and Vera (2007:427)</td>
<td>“[…] the processes to reconfigure a firm’s resources and operational routines in the manner envisioned and deemed appropriate by its principal decision makers.”</td>
</tr>
<tr>
<td>Lin and Wu (2014:408)</td>
<td>“[…] the capabilities of a firm to integrate, learn and reconfigure internal and external resources.”</td>
</tr>
</tbody>
</table>

Since the DC perspective was first introduced by Teece et al. (1997), numerous definitions for DCs have emerged. Some scholars define DCs as routines (e.g. Pavlou and El Sawy, 2011; Helfat and Peteraf, 2009; Zollo and Winter, 2002), while others describe them as processes (e.g. Cepeda and Vera, 2007; Eisenhardt and Martin, 2000). In addition, various researchers define DCs as high-level capabilities to adapt operational processes and
routines to develop new value-creating strategies (Daniel et al., 2014; Liu et al., 2013; Cepeda and Vera, 2007; Helfat and Peteraf, 2003; Eisenhardt and Martin, 2000).

Table 6

Selection of definitions related to the term “IT capability”

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bhadrawaj (2000:171)</td>
<td>“A firm’s IT capability is defined […] as its ability to mobilize and deploy IT-based resources in combination or co-present with other resources and capabilities.”</td>
</tr>
<tr>
<td>Marchand et al. (2000:73)</td>
<td>“A company’s capability to effectively manage information-technology (IT) applications and infrastructure to support operations, business processes, innovation and managerial decision making.”</td>
</tr>
<tr>
<td>Aral and Weill (2007:765)</td>
<td>“IT resources are combinations of investment allocations and a mutually reinforcing system of competencies and practices that together represent organizational IT capabilities.”</td>
</tr>
<tr>
<td>Stoel and Muhanna (2009:182)</td>
<td>[…] IT capabilities are defined “as complex bundles of IT-related resources, skills and knowledge, exercised through business processes, that enable firms to coordinate activities and make use of the IT assets to provide desired results.”</td>
</tr>
<tr>
<td>Parida et al. (2009:537)</td>
<td>[…] “ICT capability is defined as a firm’s ability to use strategically ICT functions or applications for their business purposes and competitive advantage.”</td>
</tr>
</tbody>
</table>

Within the ICT domain, scholars have shaped the term IT-enabled capabilities to measure a firm’s performance in exploiting its IT resources, competencies and capabilities (Van de Wetering et al., 2017). In this context, IT capabilities in current IT business value research are considered as lower-order capabilities that enable the development of higher-order capabilities, such as agility (e.g. Sambamurthy et al., 2003), knowledge management (e.g. Tanriverdi, 2005), or operational capabilities (e.g. Pavlou and El Sawy, 2011). Rai et al. (2006:227) also define IT capability as “a lower-order capability that can be leveraged to develop a higher-order process capability, which is a source of significant and sustained performance gains for the firm.” An overview of further various classifications according to the term “IT capability” is provided in Table 6.

Previous research focusing on IT capabilities is mainly rooted in RBT (Pavlou and El Sawy, 2011). Thus, there are similarities between the various characterizations of IT resources and the different definitions of IT capability (see Table 6). In the vast majority of empirical studies, IT capabilities are conceived merely as an aggregation of IT resources and other IT-related resources or competencies (Van de Wetering et al., 2017; Wade and
Hulland, 2004). In summary, IT capability has been seen as a sophisticated, multidimensional construct, and the literature has recommended several distinct IT-related resources that aggregate into IT capability (Pavlou and El Sawy, 2011).

Computer System Validation and Risk Management

The term “validation” is used in the current ICT literature with very different meanings (Schonberger, 2018). Rooted in the software engineering and software developing literature, Sommerville (2011:41) defines validation as follows: “Software validation […] is intended to show that a system both conforms to its specification and that it meets the expectations of the system customer.” A similar definition is provided by the DIN ISO 9000:2015 norm, which describes validation as a “confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled” (ISO, 2015). The definitions demonstrate that in the software development industry, validation usually relates to testing software against its specifications and requirements.

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>FDA (2002:6)</td>
<td>“[…] confirmation by examination and provision of objective evidence that software specifications conform to user needs and intended uses, and that the particular requirements implemented through software can be consistently fulfilled.”</td>
</tr>
<tr>
<td>Veverka (2002:52)</td>
<td>“Computer systems validation ensures that systems perform according to their defined specifications.”</td>
</tr>
<tr>
<td>Hrgarek (2008:2)</td>
<td>“Validation is a process of obtaining evidence and determining that a final software system meets the user’s needs and expectations.”</td>
</tr>
<tr>
<td>Bendale et al. (2011:27)</td>
<td>“[…] the process by which all aspects of a process (including computer systems) are shown to meet all quality requirements, and comply with applicable rules and regulations regarding product quality, safety and traceability.”</td>
</tr>
<tr>
<td>Yogesh et al. (2015:445)</td>
<td>“Computer System Validation provides documented proof that the system (e.g. hardware, software, peripherals and network) will repeatedly and reliably do what it is designed to do […].”</td>
</tr>
</tbody>
</table>

However, the understanding of validation in this research is addressed to manufacturers of medical devices who need to verify that their processes provide consistent product quality. In this context, CSV is a requirement on the quality system of each manufacturer (Schonberger, 2018; Bendale et al., 2011; Hrgarek, 2008; FDA, 2002) and must therefore
prove that the computer systems operate according to their specifications and that this declaration is confirmed by formal documentary evidence (Yogesh et al., 2015; Bendale et al., 2011; Tracy and Nash, 2002). Following this understanding, a computer system in the healthcare domain includes not only software and hardware, but also devices and instruments associated with the computer system as well as trained personnel operating the system and/or devices using standard operating procedures and manuals (Yogesh et al., 2015; Bendale et al., 2011; Yin, 2010; Hrgarek, 2008). The primary objective of CSV is to achieve and maintain regulatory compliance (see section 1) while ensuring the peak performance and functionality of these systems (Bendale et al., 2011; Veverka, 2002). An overview of various definitions of the term “CSV” is provided in Table 7.

In summary, the main task of CSV is to prove that each computer system fulfils its intended purpose within the production and quality processes of a medical device manufacturer. In doing so, the validation of computer systems exceeds the activities of pure software testing by far (Bendale et al., 2011). The aim is to avoid software problems that could have serious consequences for the patient, the user or third parties. To eliminate these problems, researchers have developed various risk-based approaches to CSV implementation over the last few years or pointed out that risks should be identified and assessed during CSV (e.g. Charan and Vishal Gupta, 2016; von Culin, 2011; Hrgarek, 2008; Tracy and Nash, 2002). This stream was also fostered by the fact that in 2003 the FDA proposed the introduction and implementation of risk-based validation (Charan and Vishal Gupta, 2016; McCaffery et al., 2012; Yin, 2010; McDowall, 2005). However, according to von Culin (2011:32), the medical device industry “seems to be facing several challenges implementing a risk-based approach with computer system validation.”

The reasons for this include the fact that it is unclear when a computer system is risky and when it is not (von Culin, 2011; McDowall, 2005). The FDA regulations do not necessarily facilitate the situation: “For lower risk devices, only baseline validation activities may be conducted. As the risk increases additional validation activities should be added to cover the additional risk.” (2002:12). Another reason is the lack of essential decision-making tools, which can lead to “over-validation” for some computer systems and “under-validation” for others (Veverka, 2002). Nevertheless, the current CSV literature contains several risk analysis approaches that can be used for CSV (e.g. Charan and Vishal Gupta, 2016; von Culin, 2011; McDowall, 2005). However, one of the main conclusions is that one risk approach does not fit all validation situations; thus, the person in charge of risk assessment should select the best methodology for the problem (McDowall, 2009). This in turn poses the problem that each company has to decide for itself which ICTs need to be validated, what risk they bear and how much validation is appropriate to ensure compliance with regulatory requirements (Schonberger and Vasiljeva, 2018; McDowall, 2005).

In conclusion, CSV within the medical device industry is highly dependent upon an established quality management and quality assurance system (Yogesh et al., 2015;
Determinants and impacts of computer system validation on firm-level performance

Bendale et al., 2011). Even though difficulties in interpreting regulations and applying CSV techniques have overshadowed their intended purpose, implementing systematic CSV helps prevent software problems from entering the production environment (Bendale et al., 2011; Veverka, 2002). Although the FDA’s regulations mainly apply in the FDA-regulated environment, the suggestions and recommendations to implement and apply a risk-based approach to CSV have also been implemented within the non-FDA-regulated environment, e.g. in many European companies.

### Firm performance

Firm performance is a relevant construct in current ICT-related research and frequently used as a dependent variable (e.g. Liu et al., 2013; Stoel and Muhanna, 2009; Aral and Weill, 2007; Bharadwaj, 2000). Within the strategic management literature, stakeholder theory is often used as the basis for determining firm performance (e.g. Harrison and Wicks, 2013; Santos and Brito, 2012; Richard et al., 2009). Stakeholder theory allows one to solve the question of the distinction between performance requirements and performance outcomes, enabling performance measurements to evaluate the satisfaction of at least one group of stakeholders (Santos and Brito, 2012). As Carneiro et al. (2007) observed, this conceptualization of firm performance can be applied across different companies. This insight has also been confirmed by the use of RBT. According to Ray et al. (2005), RBT explains differences in performance in terms of the types of resources and capabilities that different companies control, regardless of whether these are at the firm or process level. Furthermore, empirical studies of firm performance using RBT have identified differences not only between companies in the same industry, but also in groups within industries (Wade and Hulland, 2004). However, Ray et al. (2004) warn against the difficulties of testing RBT using aggregated measures of performance and suggest the use of indicators directly connected to the resources under analysis. Therefore, the application of stakeholder theory is more appropriate, as each stakeholder can distinguish between high and low performers (Carneiro et al., 2007).

<table>
<thead>
<tr>
<th>Performance constructs</th>
<th>Sample indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profitability</td>
<td>Return on assets, EBTIDA Margin, Return on investment, Net income/Revenues, Return on equity, Economic value added</td>
</tr>
<tr>
<td>Market value</td>
<td>Earnings per share, Stock price improvement, Dividend yield, Stock price volatility, Market value added (market value/equity), Tobin’s q (market value/replacement value of assets)</td>
</tr>
</tbody>
</table>

(Santos and Brito, 2012:103)
The definition of firm performance and its measurement continues to challenge scholars due to its complexity (Santos and Brito, 2012). Combs et al. (2005) developed an approach to managing this complexity by analyzing published articles in the Strategic Management Journal between 1980 and 2004 about the application of different measurement scales to the study of firm performance. The findings of their research were based on 238 empirical studies in which 56 different indicators were used. In the majority of cases, financial performance was used (82 percent), with profitability measures being the most common choice (52 percent). Comparable studies had similar results analyzing different databases in other time periods (e.g. Santos and Brito, 2012; Richard et al., 2009; Carton and Hofer, 2006). Over the last few years, various indicators have been established within the literature that are either unidimensional or multidimensional (Santos and Brito, 2012).

Since unidimensionality would mean that all stakeholders have similar requirements and needs, based on stakeholder theory, this would be a simplified representation of such a complex construct and thus unlikely (Santos and Brito, 2012; Combs et al., 2005). This makes multidimensional constructs more suitable for measuring firm performance, as multidimensionality proposes that each dimension symbolizes an aspect of the firm’s overall performance and is represented by a distinct set of indicators (Santos and Brito, 2012). In this context, Santos and Brito (2012) provide an overview of sample indicators for firm performance based on seven performance constructs (growth, profitability, market value, customer and employee satisfaction, and social and environmental performance) as shown in Table 8.

In research on ICT-enabled firm performance, recent literature questions the direct effects of IT capabilities on firm performance by contending that the effects are mediated by other
Determinants and impacts of computer system validation on firm-level performance capabilities (Liu et al., 2013; Mithas et al., 2011; Pavlou and El Sawy, 2011; Ray et al., 2005). Wade and Hulland (2004) state that information systems exert their influence on the company through complementary relationships with other company-related assets and capabilities. Other researchers assume that knowledge management and agility represent important mediators that help to establish the nomological network for the impact of IT capabilities on firm performance (Sambamurthy et al., 2003). Mithas et al. (2011) argue that IT capabilities affect firm performance by enabling higher-order business capabilities. Thus, the impacts of IT capabilities, as lower-order capabilities, on firm performance are mediated by dynamic and operational capabilities, as higher-order capabilities (Liu et al., 2013; Pavlou and El Sawy, 2011; Rai et al., 2006; Sambamurthy et al., 2003; Kohli and Grover, 2008; Mithas et al., 2011). Ong and Chen (2014) identified that the impact of IT capabilities on firm value is greater than on firm performance. In this context, they defined firm performance as backward-looking measures and short-term influences and firm value as forward-looking performance and long-term influences (Ong and Chen, 2014). Overall, scholars examining ICT-enabled firm performance have usually used financial-based or accounting-based indicators to measure the impact of ICT on firms (e.g. Liu et al., 2013; Mithas et al., 2011; Aral and Weill, 2007; Bharadwaj, 2000).

DISCUSSION, CRITICAL REVIEW AND CONCLUSION

In this section, the results of the literature review are critically discussed, leading to a revision of the initial conceptual model for the underlying research project (see Appendix 2). Furthermore, answers to the research questions posed in the introduction of this paper (see section 1) are provided.

According to the results of the literature review, and to answer the second research question, the most important theories underlying the investigation of ICT on firm performance are RBT, DC and stakeholder theory. However, according to Bharadwaj (2000), only a limited number of studies have explored RBT of IT. Similarly, Wade and Hulland (2004) state that only a few discussions on RBT have been conducted in the field of information systems. In view of the findings of the above literature review, these statements appear to have been disproved. It is shown that since the work of Bharadwaj (2000) and Wade and Hulland (2004) numerous studies have been done to examine the effects of RBT on ICT (e.g. Parida et al., 2009; Stoel and Muhanna, 2009; Aral and Weill, 2007; Ray et al., 2005).

Although Bharadwaj (2000) states that RBT provides a framework for the conceptual analysis of the impact of IT on firm performance, scholars argue that investments in IT systems per se do not offer sustainable benefits as these investments can easily be duplicated by competitors (e.g. Ray et al., 2004; Bharadwaj, 2000; Mata et al., 1995). Such a simplified view, however, assesses the value of IT systems exclusively on the basis of
their individual components, assumes that IT assets can be separated, and neglects the synergies of the integrated system (Bharadwaj, 2000). According to RBT, physical, human and organizational resources and capabilities can serve as a source of competitive advantage for a company; however, these assets must outperform equivalent resources and capabilities of the competitors (Barney, 1991). In this context, researchers have analysed numerous IT resources for their impact on the competitive advantage of enterprises (see Table 4), where parallel to the taxonomy proposed by Barney (1991) (physical, human, organizational resources and capabilities), the flexibility of IT infrastructure, the competence of IT personnel and the ability of IT management are the primary dimensions of IT capabilities (e.g. Rockmann et al., 2015; Chen and Tsou, 2012; Kim et al., 2011; Wade and Hulland, 2004; Chung et al., 2003; Byrd and Turner, 2001).

Synthesizing from the above, RBT argues that competitive advantages arise from unique combinations of resources that are economically valuable, scarce and difficult to imitate (Barney, 1991). DCs are an appropriate framework to explain how companies can differentiate and compete in a turbulent environment, acknowledging that they need to evolve and reconfigure their ICT operations co-evolutionarily in order to remain competitive (Van de Wetering et al., 2017). Based on RBT, firms have learned to combine their IT resources in order to achieve a competitive advantage by developing complicated-to-acquire and difficult-to-imitate IT resources, thus creating an overall IT capability (Bharadwaj, 2000). In light of this, for the current research, the term “IT resource” is defined according to Aral and Weill (2007) as the overall term that explains IT assets of the company on the one hand and IT capabilities in connection with employees working in the company on the other. IT assets represent IT investments intended for specific strategic purposes, e.g. the flexible IT infrastructure or business applications within an enterprise, while IT capabilities comprise interlocking systems of practices and competencies that complement IT, e.g. human IT resources or the quality of IT management (Aral and Weill, 2007).

One of the main findings of the literature review is that CSV has not often been at the forefront of either current or past research. This is somewhat surprising as, on the one hand, the different regulatory directives force manufacturers of medical devices to implement and document CSV and, on the other hand, there are no suitable approaches for implementing CSV for companies, especially for SMEs (Schonberger, 2018). Moreover, it is apparent that within the literature the wording for CSV varies, e.g. system validation (von Culin, 2011), validation of software and computer systems (Huber, 2005), software validation (FDA, 2002; Hrgarek, 2008), validation of computerized systems (Esch et al., 2007), computer validation (Bhusnure et al., 2015), or computer software validation (Bendale et al., 2011). In developing a risk-based approach to CSV in SMEs of the medical device industry, uncertainty about the term “CSV” in particular will lead to difficulties both in the implementation of validation tasks and in the development of a long-term validation concept (Schonberger and Vasiljeva, 2018).
Although the literature analysis focused on risk management approaches with the intention to transfer these approaches to the application of a risk-based CSV approach, it has been shown that the approaches identified are not suitable for application within the scope of CSV. For this reason, risk-based approaches have developed in the CSV literature to date which contain risk management concepts. However, these concepts are mostly based on subjective scales for risk assessment. The exceptions are the studies by McDowall (2005) and Charan and Vishal Gupta (2016). McDowall (2005) bases his risk-based approach on risk assessment according to the Boston grid of system use and nature of the software as well as on the GAMP 5 guide to classification of computer systems. The approach of Charan and Vishal Gupta (2016) is also based on the GAMP 5 guideline, but the risk-based approach according to DIN ISO 14971 is proposed for the assessment of risk. However, this again poses the problem that SMEs in particular will have problems with the implementation of such large frameworks, in addition to the increased financial and personnel expenditure required for the implementation (Schonberger, 2018).

Another problem with the implementation of CSV in SMEs is the documentation required to be compliant with the regulations (Bendale et al., 2011; von Culin, 2011). The basis for proper documentation of CSV is the validation master plan (VMP), which describes the acceptance criteria, necessary validation activities with assigned responsibilities, and priorities and schedules for the execution of the validation activities (McDowall, 2009; Hrgarek, 2008). Moreover, the core of the VMP is the list-inventory of the computer systems to be validated (McDowall, 2009). As generally no one involved in the CSV process has all the necessary capabilities to identify all necessary computer systems and assess their specific systemic risks (Veverka, 2002), the development of a VMP is often problematic, especially for SMEs. In addition, there is the danger that inadequate analysis of the IT systems will not identify faulty systems, which on the one hand complicates risk assessment within the CSV process and on the other can result in hazards for patients, users or third parties.
The critical analysis of the findings of the literature review led to far-reaching changes in the initial conceptual model (see Figure 4). Based on RBT and on the new understanding of IT resources, the variable “IT capability” was extended to “IT assets”, enabling a differentiated view of physical resources (flexible IT infrastructure, business applications), human resources (human IT resources) and organizational capabilities (IT management capability). The last two dimensions are combined to form the variable “IT capability”. Finally, the variables “IT capability” and “IT assets” were integrated into a higher-level construct, “IT resources”. The variable “Risk management capability” was removed from the resource level and integrated into the variable “Computer System Validation” at the process level (Risk assessment). The dependent variable of “Firm performance” has remained unchanged. The changes, however, preserve the original statement of the model: The dependent variable of “Firm performance of SMEs” is influenced by the independent variables of “IT assets” and “IT capabilities” (IT resources) of the SME, while the mediating variable “Computer System Validation” helps to explain how these IT resources bring about firm performance. Finally, the results of the literature review can be summarized in the following hypotheses of the conceptual model:

- **H1**: Enterprises’ degree of IT assets is positively associated with better CSV.
- **H2**: Enterprises’ degree of IT capability is positively associated with better CSV.
- **H3**: The relationship between IT assets and CSV is positively mediated by IT-enabled DCs.
- **H4**: The relationship between IT capability and CSV is positively mediated by IT-enabled DCs.
• H5: Enterprises’ degree of CSV is positively associated with better firm performance.
• H6: Enterprises’ degree of IT assets is positively associated with better firm performance.
• H7: Enterprises’ degree of IT capability is positively associated with better firm performance.

In conclusion, the results of this literature review provide significant contributions to ICT research, RBT, the DC perspective, and general management and organization literature in several ways and represent the first published attempt to explore the effects of CSV on the firm performance of SME medical device manufacturers. Moreover, the findings of this study contribute to theoretical development in the field of CSV. Finally, since CSV is a practice-centred field, the findings may also help CEOs and managers in formulating and implementing strategies in their enterprises. Thus, ICT researchers as well as practitioners from the medical device industry can benefit from the results of this research paper.

LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

Although the authors of this paper have endeavoured to achieve a high degree of objectivity, accuracy and validity, this research has several limitations. RBT has emerged as a leading theory within strategy research, providing a framework for identifying and analysing the sources of competitive advantage (e.g. Madhani, 2009; Galbreath, 2005); however, the theory assumes that resources are always used in their best way, saying little about how this actually occurs (Melville et al., 2004). In addition, the theory ignores the place of long-term competitive advantage in dynamic markets as well as changing business conditions (Van de Wetering et al., 2017). Therefore, extending RBT by DC seems to be useful in understanding long-term competitive advantages in dynamic markets characterized by rapid change (Melville et al., 2004).

As described in section 3, the selection of articles for literature review was carried out according to a well-defined procedure (see Figure 1) in order to achieve complete objectivity and comprehensiveness. However, the selection process may have been affected implicitly by existing biases. Furthermore, the procedure for identifying full accessible papers in Google Scholar using the “filetype:pdf” search suffix led to papers being output in PDF format, while papers in other formats, e.g. DOC or DOCX format, were excluded. Thus, the results of this research would gain further quality through the inclusion of other document formats.

In particular, research into the implementation of a risk-based approach to CSV and the identification of all necessary computer systems for validation still reveals major gaps.
While larger companies often have sufficient resources to outsource CSV to external service providers, the question arises as to how SMEs in particular, which often have limited resources (Nguyen, 2009; Razak et al., 2009; Buschfeld et al., 2011), can fulfil this task. Moreover, this situation eventually has a negative impact on the performance and competitiveness of SMEs, which are threatened by the lack of information on the hazards and risks that can arise in the development of medical devices (Schonberger and Vasiljeva, 2018).

After evaluating the available information and scientific content on CSV, it becomes clear that the importance and relevance of the subject is increasing in both practical and academic terms. However, the main question still to be answered is whether CSV contributes to the long-term firm performance of medical device manufacturers and, if so, to what extent its contribution is measured. This type of assessment can only be done retrospectively, but there is a limitation due to the scarcity of data so far, and this will not change if clear, standardised indicators are not established and if they are not measured regularly over a longer period of time. For this purpose, and to answer the third research question, this work provides several connecting factors for further research work in line with the overall research project. Thus, the next step is to identify how SMEs in the medical device industry have already implemented CSV approaches within their company. In this context, a questionnaire will be developed to help gather the necessary information on the use of CSV in European companies in the medical device industry. Once it is clear what role CSV plays in the development and production of medical devices, the challenge will be to provide manufacturers with an appropriate CSV approach, which is particularly important for SMEs in the medical device industry.

In addition, as the literature review shows, further research will also be necessary beyond the scope of the overall research project. Thus, a recommendation for further research consists of identifying suitable risk processes for CSV. In particular, it is necessary to examine which risk approaches are appropriate for CSV and how much risk assessment is sufficient to comply with the regulatory requirements. A further recommendation is analysis of the legal regulations mentioned in the context of this research, in particular closer examination of their necessity or correctness as well as their applicability to SMEs in the medical technology industry. Finally, another recommendation is research of SME medical device manufacturers in Europe, more precisely analysis of their existing resources and capabilities (not only IT resources or capabilities) and thus identification of further indicators to evaluate business performance in the respective industry.

REFERENCES

Determinants and impacts of computer system validation on firm-level performance


Determinants and impacts of computer system validation on firm-level performance


Appendix 1. Total medical device recalls resulting from software errors in 2018. Authors’ own elaboration using the FDA Medical Device Recall Database. Recall date from 01/01/2018 to 31/12/2018. (FDA, 2019)

Appendix 2. Conceptual model from the research by Schonberger and Vasiljeva (2018), which served as a basis for the literature review of this study
Appendix 3. **Overview of the literature database**

<table>
<thead>
<tr>
<th>Publication type</th>
<th>Amount of publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journal</td>
<td>159</td>
</tr>
<tr>
<td>Proceedings</td>
<td>20</td>
</tr>
<tr>
<td>Book</td>
<td>18</td>
</tr>
<tr>
<td>Report</td>
<td>10</td>
</tr>
<tr>
<td>Online</td>
<td>9</td>
</tr>
<tr>
<td>Guidance Document</td>
<td>8</td>
</tr>
<tr>
<td>Dissertation</td>
<td>5</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>233</strong></td>
</tr>
</tbody>
</table>

Appendix 4. **Quality of the journals according to the ABDC (2016) and ABS (2018) quality lists**
### Appendix 5. Amount and quality of conference proceedings according to the ERA (2010) quality list

<table>
<thead>
<tr>
<th>Conference Proceedings</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proceedings of the European Conference on Information Systems</td>
<td>6</td>
</tr>
<tr>
<td>Proceedings of the International Business Information Management Conference</td>
<td>2</td>
</tr>
<tr>
<td>Proceedings of the International Conference on Information Systems</td>
<td>2</td>
</tr>
<tr>
<td>Proceedings of the International Conference on Systems Engineering</td>
<td>2</td>
</tr>
<tr>
<td>Proceedings of the Americas Conference on Information Systems</td>
<td>1</td>
</tr>
<tr>
<td>Proceedings of the Annual Hawaii International Conference on Systems Sciences</td>
<td>1</td>
</tr>
<tr>
<td>Proceedings of the Central European Conference on Information &amp; Intelligent Systems</td>
<td>1</td>
</tr>
<tr>
<td>Proceedings of the International Conference on Advanced Management Science</td>
<td>1</td>
</tr>
<tr>
<td>Proceedings of the International Product-focused Software Process Improvement Conference</td>
<td>1</td>
</tr>
<tr>
<td>Proceedings of the International Workshop on Software Quality</td>
<td>1</td>
</tr>
</tbody>
</table>
The Problematics of Digital Driver Classification and Measurement Standards in the Russian Advertising Market

GALINA DERYABINA
NINA TRUBNIKOVA

ABSTRACT

Purpose. The purpose of this study is to analyse one of the most rapidly growing segments of the media industry – the digital market and the drivers of its growth – as well as to identify the best ways of managing it. The authors use the example of Russia: a country with a dynamically growing advertising market.

Design/methodology/approach. Analysis of the relevant content-based Internet advertising classifications constitutes the methodological importance of this work. The study includes a survey conducted by the authors.

Findings. The authors identify how the recent transformations intensify the development of Internet communications by spanning all the traditional segments of the communications industry: television, radio, print press and outdoor communications. The study includes an analysis of relations among the key market players (advertisers, media companies, communication agencies and research companies), accompanying these changes as evidence of their transforming impact.

Practical implications. The absence of clear control systems in Internet communications might lead to the loss of interest in Internet advertising among key advertisers. Only coordinated actions of all the interested market participants will allow for achieving transparency of new communication formats. Thus, consensus becomes an important task for modern Russian communications management.

Originality/value. This study is important in terms of the transforming impact of digital drivers under the influence of social and economic factors. Efficient digital communication requires complex managerial action.

Paper type. Research paper.

Keywords: marketing communications, digital technologies, media, advertising market, content JEL Code M37.
INTRODUCTION

The advertising industry is one of the intensively expanding segments of the global as well as Russian economy. Therefore, an accurate forecast of its development determines several important directions: the advertisers’ communication strategies and the general state of advertising management as well as the functioning of various media, which, to a considerable degree, bases its activity on advertising business models.

The structure of the digital market

“Digital marketing consists of different sub-categories such as social networking, online communities, viral marketing, wikis, and blogs, as well as mobile marketing” (Harvard Business School, 2010; Wymbs, 2011). Weinberg and Pehlivan (2011), refer to “social networks, online communities, wikis, blogs and micro-blog as social media”.

In order to comprehend the situation on the digital advertising market, we should consider the fact that globally and in Russia, the Internet industry represents four markets (Runet Economics, 2016):

- the digital communications market (advertising and marketing)
- infrastructure (software, hosting and domains)
- the electronic content market (games, music, books, mass media and video)
- the e-commerce market (retail, e-payments and travel)

The digital drivers changing the media landscape and the structure of communications in the media-advertising market have the systems character proving the relevance of the study. On the one hand, digital drivers intensify the development of the market of Internet communications as part of the media-advertising industry. On the other hand, it is important to understand that digital drivers generate a competitive environment and affect classical media by contributing to their infiltration into the Internet and engaging the digital inventory. In many ways, these are the same media, but already in the digital medium (Chaffey et al., 2010). This results in the redistribution of the media investments outflowing from the traditional mass media into the Internet by causing the stagnation and slowing down of some segments along with a boost in others. This flow promotes certain communication strategies regarding the choice of media. In order to compete with the Internet, traditional players have to introduce new technologies that are transparent and attractive for advertisers.
General characteristics of the modern state of the digital advertising market

Digital communications are becoming the paramount factor of the entire communications market growth. The Global Digital Report 2018 of WeAreSocial and Hootsuite reveals there are more than 4 billion people around the world using the Internet (Digital in 2018).

In its report on global advertising market trends, released in December 2018, Magna, the centralized IPG Mediabrands resource, reveals that global advertising revenue grew by a record 7.2% in 2018, reaching $552 billion in the 70 countries analysed by Magna. This is the strongest growth rate since 2010, when the ad market recovered after the two years’ recession, and the second strongest since 2004, thanks to the combination of the strong demand and the cyclical drivers.

The macroeconomic situation in a country, mainly on the level of consumers (solvent demand, changed consumption structure, etc.), remains the key factor affecting the state of the advertising market (Stolyarova, 2017). However, after the crisis of 2015, the advertising market in Russia recovered much more quickly than the rest of the country's economy.

Internet advertising continues to grow dynamically as its formats rapidly evolve. In the conditions of uncertainty caused by the economic and political situation in Russia in 2014-2015 and the drop in most commodity markets, Internet segment growth slowed down considerably by 18% and 15% respectively (Figure 1).

![Internet advertising market growth in 2013-2017, Russia](http://www.akarussia.ru/download/rre18.pdf)

In 2018, the Russian advertising market grew by 12%, reaching 469 billion roubles. The share of marketing services amounted to 115 billion roubles (Figure 2). The highest growth (22%) was observed in the Internet channel, while print press dropped by 12%. The TV
channel experienced 9% growth, where the niche TV channels contributed by 38% growth.

Taking into consideration the creative and production budgets as well as advertising agencies’ fees, the market amounted to 810-830 billion roubles (12-13 billion USD).

![Figure 2. The size of marketing communications in 2018 (billion RUB), Russia](image)

Source: based on Russian Association of Communications Agencies, http://www.akarussia.ru/knowledge/market_size/id8690

The significant size of the Internet in the Russian advertising pie is largely explained by a relatively low entrance threshold for small and medium-sized businesses (Radkevich, 2016), the possibility of distanced ad placement given the wide geographical extent of the country, and the presence of major domestic players in search engines, mail and social media.

**THEORETICAL BACKGROUND AND METHODOLOGY**

The study of the impact of digital drivers in the communication industry is one of the new fields in the global science of economics, marketing and marketing communications, coming from the emerging phenomenon itself. The field has expanded from Internet marketing to the exploration of communication patterns of the digital medium, which is certainly a wider object of study. One of the important aspects of this study is the analysis of the points of influence of digital intensifiers on the basic sectors of the media-advertising market and its key subjects, including the sphere of the methodological management of these processes.
The aspiration of the manufacturer to get the potential buyer interested in the purchasing of goods and services determines the advertising expenses. Therefore, it is logical to suppose that advertising activity, including in the digital medium, correlates in a certain way with the general situation in the economy, which ultimately determines the activity of the market subjects. The authors base their study on consistent patterns characterizing the dependence of advertising industry development on the overall economic situation. In this regard, one has to mention the works of authors (e.g., Picard, 2011; Doyle, 2013; Tellis, G. and Tellis, K., 2009; Sinclair, 2012; Chang and Chan-Olmsted, 2005,) who explored the media economy advertising bonds and the correlation between the overall state of the economy and the activity on the advertising market.

During the economic crisis, company managers demonstrated a more lenient attitude towards digital instruments than the classical media, where in the conditions of the austere economy, the target audience expressed a reaction more clearly and the expenses of communicating were more justified. In this connection, the authors deemed it necessary to study the materials covering the communication activity in the period of recession, when the drop in advertising activity was a universal tendency (Veselov, 2009).

Therefore, the authors take into consideration the results of research on the Russian advertising market, where the structural shift towards digital communication became the legitimate outcome in the period of the economy's after-crisis recovery. This phenomenon has been analysed in depth by numerous authors (Veselov, 2009, 2010; Kolomiez, 2009; Kovylov, 2016), whose works have significantly contributed to the study of the formation of the digital medium in Russia. These researchers have formed the understanding of the fact that the crisis in communication was largely caused by the social-economic consequences of the technical revolution of the late 20th / early 21st centuries and structural reforms of the media-advertising sphere. According to multiple specialists, these tendencies acquire much richer contents when analysed on the level of particular markets in terms of media advertising comparisons. The authors derived significant informational support from the annually issued Advertising Almanac prepared by the Association of Communications Agencies of Russia (AKAR). Respective electronic versions of this important source are accessible on their site and allow for tracing over a decade of history of advertising in Russia. A number of authors, such as Nazarov and Kovalev (2008), apply the territorial approach and study the factors of the country context affecting the connection between economic developments and advertising activity in the digital medium, which leads to qualitative changes in advertising management. The development of industry in different countries is disparate and determined by such factors as demographics, consumption structure, local or global content preference and business models.

The approach applied in this study includes prognostic analysis of the market subjects’ behaviour under the influence of digital drivers. Generally, in the global professional discourse there is almost zero opportunity for a single scientist to conduct his own field
research – both on the macro level and at the level of a single company. The factor of trade secrets and the high-tech requirements regarding the research tools explain such a limited access to the object of study. Therefore, in order to understand the processes taking place in the digital advertising market, one has to conduct a comparative analysis of the reports and research materials of global companies and authoritative Russian research organizations and apply one’s own experience of work at such companies and organizations. The empirical base for the research is comprised of data from the industrial monitoring of advertising on the Russian market (the company Mediascope, formerly TNS Russia). Moreover, the authors use data from a prognostic analytical study of the international companies ZenithOptimedia and GroupM, materials from the analytical centre Vi (now merged with Gasprommedia, together forming the National Advertising Alliance), their own experience and some field studies.

Nevertheless, analysis of introducing digital technologies on the level of a single corporation can also help in understanding the processes as they really are. *This study uses the results of a survey, conducted by the authors, among Russian companies’ representatives, whose professional activity centres on Internet promotion and digital marketing, regarding the effectiveness of investments in various digital segments.*

The questionnaires consisted of several open and closed questions and were sent by e-mail. The processing of questionnaires was conducted from April to June 2019. Advertisers responsible for digital promotion, mostly employees of communication departments of both big and small companies, were invited to participate in the survey.

The respondent base was formed based on companies collaborating with the Peoples' Friendship University of Russia in organizing practical experience for students studying Advertising and Public Relations. In general, the respondents demonstrated openness and willingness to participate in the survey in regard to the topics concerning modern trends in interactive promotion.

The survey had an exploratory nature, with the main goal of verifying the influence of drivers, identified by the authors on the basis of analysis of information from open sources, of the digital segment of the communication industry. In total, 42 company representatives were interviewed, which can be considered a representative sample based on the expert status of the respondents and given the aim of the authors to clarify the boundaries of the research field.

*The proposition of this study is as follows: the means of purely technological factors cannot solve the problem of transparency in the digital medium and on the Internet.* The solution is rooted in the intersection of the organizational and managerial efforts of the entities in charge. The digital drivers intensifying the development of the advertising market and marketing communications have a technological form but social and economic content; their impact sets off complex changes in the life of society. The digital drivers of
the market not only affect the market but also change the quality of the entire advertising sphere, drastically affecting all the segments of the media-advertising market. We observe the proof of this impact in the changed managerial behaviour of the key market players: advertisers, agencies, and even consumers.

The technological factors in the digital environment set the conditions for the action of managerial factors. However, these factors per se cannot solve the communication problems, as they act in both positive and negative ways. Thus, the solution may be aggregating the technological, organizational and managerial efforts of the authorized high-status organizations managing Internet advertising, providing expert evaluation of its volume, and acting on the macroeconomic level and in the legal field.

DISCUSSIONS AND FINDINGS

Development of hypotheses

Flexibility in regard to the possibility to adapt to a particular client's media targets seems to be a recipe for success on the rapidly growing market, allowing for working out a unique, non-trivially structured strategy based on the application of individualized instruments. Meanwhile, digital communications, primarily on the Internet, have numerous opportunities for monitoring efficiency in terms of awareness of goods as well as sales, used to generate a system of advertisers' operative control over their advertising budgets.

The digital component ensures creating ads in formats adapted to the user, context and environment. In the perspective of management, the digital medium shows a variety of approaches to the content amplifying the technical means of its delivery. It turns out, however, that the rate of technological development has become so high that it limits the prediction validity period. The precision level already drops on the horizon of the next 10-15 years.

Today, technologies used to make digital communications attractive for management even in periods of crisis work in the reverse direction. The main problem of the Internet for a modern advertiser is the loss of transparency, which helped digital communications to win an important victory over the traditional media and attract the attention of key advertisers in the initial period. In other media, experts can precisely assess advertising budgets, brands, advertising campaigns, particular advertising platforms (TV channels, radio stations, press), categories of goods and services, etc., while the Internet is devoid of adequate tools allowing one to evaluate the budgets of particular market subjects (Nazarov, 2010).
The main problem of the Internet is the lack of transparency of advertising budget volume assessment that occurs due to the deficiency of adequate measurement standards or a universal system, the results of which might be trusted.

Although the media measuring of the Russian Internet is conducted by such serious companies as Mediascope (Web Index project), Gemius (Gemius Audience project) and Comscore (comScoreMMX and Video Metrix projects), the problem is not yet solved. According to some evaluations, platforms showing advertisements to users receive less than 20% of the budget allocated by the advertiser, covering the commission of the media-buying agency which is responsible for the development and realization of advertising strategy for the client, including buying the advertisement, and a long chain of subcontractors and technological mediators managing its placement. Apart from that, even the funds that reach the platform do not serve the advertiser in full.

There is a problem of fraud around the globe as well as in Russia, for example, the placing of a paid advertising announcement out of the user's sight but counting it as shown, or "clicking off" the budget, winding up traffic with the help of various program tricks, etc. The advertiser loses his capital and cannot make an appropriate complaint due to the lack of adequate measurements.

Research companies have enough competences and methodologies but lack the data, technologies, coordination of market participants and resources to get the necessary products on the market. Advertising management must solve the problem of media measurements on the Internet; otherwise, this sphere will ultimately lose financing from influential and authoritative advertisers.

The paramount terminological question today is what to consider as Internet advertising. The classification of the advertising market and Internet advertising should be created based on the type of context presented to the consumer, and not according to the means of transmitting the advertising information. These days, the consumer of digital multimedia information barely notices how the content gets into his field of vision. There is a narrow interpretation of Internet advertising where the advertising is generated by the Internet per se, so-called Internet medium-nurtured content: social networks, search engines, blogs, etc. (Veselov, 2017).

There is a broader concept of Internet advertising which, apart from the specific Internet content, also includes multimedia content, which can exist in different environments and media. One such environment is the Internet medium, used only for delivery and distribution. Thus, the Internet infrastructure successfully delivers the publisher’s content (magazines, newspapers, brochures, books, leaflets and catalogues), video content (including television content), and radio content. It is the content type in its essential aspect that determines the approaches to its promotion.
Classification of Internet advertising is a methodical question important for the evaluating of size and dynamics of the Internet advertising market. Today, there are many different criteria for distinguishing segments in Internet advertising: type of advertising message (text, "window", banner, textual-graphic image, video clip, branding, special project, etc.); delivery device (computer, mobile gadget, smart TV); pricing/payment method (per click, per visiting, per action, etc.); user information source for advertising targeting (search query, personal data, offline sources, etc.). The habitual division of Internet advertising into "media" and "context" has ceased to reflect reality: this approach did not allow for the defining of numerous borderline cases. The criteria for attributing different formats to a certain sub-segment have not been completely formulated. When the market learns to measure all the accessible screens of content consumption (desktop, mobile gadgets, smart TV, television) and to combine their results, advertising will make a qualitative leap. Therefore, working out the criteria is vital.

Returning to the problem of transparency and evaluation of the Internet advertising market in Russia, questions of classification have become the most important issue for the market players and their clients in the last two years. The advertising industry, represented by AKAR (Association of Communications Agencies of Russia) and IAB Russia (the Russian division of the non-profit partnership for helping the development of Internet advertising – Interactive Advertising Bureau), apply serious effort to accurately evaluating the true situation in the segment of Internet advertising. However, the two highly respected associations adhere to different classification systems.

This gave rise to the question of coordinating the system of evaluation of Internet advertising market volume, which became one of the most significant events. Working out the classification standards is extremely important, as in this case, the classification is not purely scientifically theoretical, but primarily of a practical character, helping the digital communications segment, constituting an efficient method of promotion to win the competition for advertisers' budgets. In order to achieve this, Internet advertising should have evaluation parameters comparable to other media segments (television, radio, press, outdoor advertising, etc.), and its classification should be universal to allow for comparison with other countries' budget numbers. The classification used by AKAR meets these standards. The "category search" is advertising found in the results based on users' queries, while the "display" is any advertising shown to the user on sites, except "search" and "classified" (small paid ads). The division of Internet advertising into "display", "search" and "classified" reflects the international practice of singling out Internet segments by transnational advertising groups and most Internet associations (Table 1; Table 2).
Table 1

Size and dynamics of Internet advertising by segment in 2017

<table>
<thead>
<tr>
<th>Segments of Internet ad</th>
<th>Size, in bn. RUB</th>
<th>Dynamics, %</th>
<th>Share, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search</td>
<td>73.1</td>
<td>25%</td>
<td>44%</td>
</tr>
<tr>
<td>Display</td>
<td>93.2</td>
<td>21%</td>
<td>56%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>166.3</td>
<td>22%</td>
<td>100%</td>
</tr>
</tbody>
</table>


Table 2

Size and dynamics of Internet advertising by classification of IAB in 2017

<table>
<thead>
<tr>
<th>Segments of Internet ad</th>
<th>Sub-segments</th>
<th>Size, in bn. RUB</th>
<th>Dynamics, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance</td>
<td>Search</td>
<td>73.1</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td>CPX</td>
<td>58.9</td>
<td>19%</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>132.0</td>
<td>22%</td>
</tr>
<tr>
<td>Branding</td>
<td>CPM</td>
<td>26.0</td>
<td>23%</td>
</tr>
<tr>
<td></td>
<td>Video</td>
<td>8.3</td>
<td>26%</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>34.3</td>
<td>24%</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>166.3</td>
<td>22%</td>
</tr>
</tbody>
</table>


IAB experts suggest classifying the size of Internet advertising in accordance with pricing types, so-called performance branding. According to IAB Russia: "Performance marketing is the concept of building marketing on the side of the advertiser, advertising agency or platform, where the entire set of applied instruments and technologies is aimed to influence a concrete user performing the targeted action. This action might be a visit to the site, call, quality target address, sending of an email address, installing an application, etc."

Dividing advertising into branding and performance in the classification of IAB virtually clarifies the previously existing sub-segments of "media" and "context" Internet advertising. In case the target is branding, then the instruments solving the image tasks are implied where the payment is made for showing the advertising message (CPM). Meanwhile, if the final goal is a result, then the payment is made for clicks (CPC) or for "leads" (CPL) – for the user's registration on the advertiser's site, leaving personal data, calling, downloading an app, etc. Such an approach implies a result in the form of targeted actions of the user after contact with the ad.

In other words, IAB classify all payment-for-action sales as belonging to the segment of performance marketing. There are three suggested pricing models: CPC (cost per click), CPL (cost per lead) – the cost for a targeted action, e.g. messaging or calling – and CPA (cost per action): the cost for a target action immediately on the advertiser's site, e.g. an order. The segment of performance marketing falls into two sub-segments: search...
and CPX. The former includes search advertising; the latter encompasses all the rest, including, for instance, social networks. It is not quite clear, though, why such an important and relatively easily evaluated instance as social networks is not classified as a separate sub-segment.

In overviewing the modern principles of Internet advertising classification, one ought to look at how digital drivers transform existing communication practices.

The following characteristics are traditionally regarded as the key advantages of digital media: advanced interactivity, wide possibilities of obtaining various marketing information, individualization or "effective addressing" of marketing content messages to consumers, opportunities for integrating goods and service promotion campaigns, and transnational marketing (Chaffey et al., 2009).

This study includes the following drivers of market growth:

- New conditions and formats of communication dictated by the use of mobile gadgets;
- Communication efficiency control systems accessible in digital media;
- Increased consumer activity and the incipience of a significant C2C (consumer-to-consumer) communication segment;
- The system of digital content and its optimization, including the development of cloud storage technologies and visualization of content that expands the formats for delivering information to the target audience;
- The transformation of social networks from communication platforms to content generators, acquiring new monetization possibilities; the impact of digital technologies on non-digital tools and media.

Let us examine the impact of these drivers in more detail.

THE IMPACT OF DIGITAL DRIVERS: NEW CHALLENGES

Formation of mobile media

The development of mobile technologies has generated a situation where one consumer has several gadgets (smartphone, laptop, etc.).

According to Mediascope data for 2018, the audience of the mobile Internet in Russia reached 75 million people, corresponding to more than 60% of the Russian population, surpassing desktop users, and continues to grow steadily (Mediascope, 2019).
Due to saturation, the segment’s growth rate will gradually slow down, but this effect is quite natural for a mature market. Today, accretion occurs primarily not among youth but among the middle aged, 40+ population; thus, the audience is “maturing” and “aging.” Today, all the generations, each distinguished by its own activity and intensity of using this channel, exploit the mobile Internet. This is becoming the main viewing channel for the young and active audience; however, other audiences still require other screens: television and desktop. Perhaps the next step will be cross-platform integration of the mobile and desktop platforms, allowing for combining advertising formats regardless of the gadget used at a particular moment.

Today, we can diagnose the change in the model of consuming advertising information brought to mobile gadgets. *Mobile marketing is rightly considered as a market of new possibilities and the main point of Internet advertising growth.* The infiltration of mobile gadgets into daily life is changing the structure of advertising message delivery in specific ways. New formats of ad placement are emerging in the mobile medium, displacing traditional media Internet advertising. The last two years present a trend of converting mobile ads into the standard instrument of interactive advertising.

*Mobile advertising is finally becoming the standard tool within the media mix.* The trend of mobile advertising transformation from a new and experimental direction into one of the standard interactive advertising tools has continued for the last two years (IAB Barometer, 2018).

The players of the Russian market confirm the willingness of their clients to invest in mobile advertising, along with deeper cross-media digital analytics, which will allow for understanding the structure of spending and forecasting efficiency. The growth of media advertising on mobile platforms is explained by the multiple opportunities of interactive communication with the user, and, therefore, the growing interest on the part of the advertisers. Carrying a personalized message to a concrete user via mobile gadgets is growing in value. The reasons are the increased involvement in consumption, a higher level of trust for the information on the mobile gadget screen, and the possibility of adapting advertising to the users' queries.

Today, *mobile video is reaching the peak of popularity and remains the main trend and simultaneously the growth driver for the entire mobile segment.* Compact, creative video clips go viral, promoting not only sales, but also global recognition of the brand. The possibilities of mobile advertising have attracted companies which did not employ digital communications for promotion before. A good example of traditional advertisers switching to digital are the communicational offers of the telecommunications company Maximatelekom, the operator of Wi-Fi in the Moscow metro, launching the format of a branded page where the user watches a video and advertising banners while waiting for the web connection. The operator's data shows that the top 30 advertisers in Russia place their ads online "underground" (according to TNS (Mediascope)). This allows them to reach
over 1.5 million passengers daily that pass an extra hour on the Internet. Beforehand, the audience of the Moscow metro was reachable only via indoor advertising media.

**Technologies for expanding analytical possibilities**

The advertising management of companies and professional market players expect the most changes with the introduction of the reinforced analytical component, with maximally narrow targeting via expanding technological possibilities of platforms, which is one of the digital drivers today.

The quality of measuring and monitoring the efficiency of digital communications is changing under the influence of the new instruments. High-quality marketing data about target audiences can satisfy advertisers’ requirements for expense control and efficient budget management. Today, information about consumers’ specific media use and goods and service consumption consists of traditional sociological data. Data on users’ reactions to specific marketing belongs to the service providers. The key feature of the digital medium is the application of new metrics characterizing audience behaviour: consumers’ actions registered in real time, allowing for the precise measurement of the real yield from particular marketing activities, leading to increased conversions due to more precise target instruments. Targeting tools that have gained popularity among Russian marketers are currently multiplying and include geolocation, time, and network behaviour-based data along with social-demographic characteristics. Overall, the way of the digital future is user network database targeting: networks are embracing a greater audience and contain the user characteristics important for the advertiser.

Today, work with big data is the key trend being realised in the media segment. Massive database targeting helps to economise the advertiser’s budget, minimising the amount of non-targeted shows.

The possibility to accumulate and analyse big data allows for rendering advertising more precisely. This is the type of analytics advertisers have an interest in as they aspire to attract the attention of the audience.

*Mergers and partnerships of companies which have access to big data are an important trend in today's market.* Retailers, banks, and telecom operators store such data. Access to a vast audience allows for obtaining valuable information about users and making targeted offers which take into consideration the particularities of their online and offline behaviour, movement routes, purchases, etc.

However, there are a number of other efficient instruments. GetResponse researchers noted in 2017 that *marketers called email and social media the top two digital channels with a high return on investment (ROI).* The research was based on a survey of 2,520 digital marketers from around the globe working in B2C and B2B: 18% of the respondents from all branches noted that email marketing produced the best ROI; social media came in
second with 17%; SEO (search engine optimization) took third place (14%); and context network advertising was fourth (12%). The respondents employed in marketing and advertising agencies rated email marketing, SMM (social media marketing), and search optimization as the top three high ROI channels.

Companies are taking decisive steps towards the development of digital formats or marketing communications based on a high evaluation of their efficiency. The respondents in Russia employed in digital promotion, including FMCG companies and retail and business service representatives, also demonstrated their partiality to email marketing (22%) at a higher rate than in the global survey. SEO optimization proved less popular, in connection with its technical requirements for certain qualifications (15%). Meanwhile, only 40-50% of respondents in Russia (75% in Moscow) provide an electronic address vs. a mobile telephone number, which demonstrates the still low use of this channel by consumers.

Social networks are popular among Russian advertisers. According to the survey, 24% rate them as the most efficient tool in terms of ROI. Perhaps social networks in Russia have not yet become as habitual and trivial an instrument as they are perceived in developed countries, where they have a longer history. The limitation of the survey is the impossibility of determining the respondents’ qualifications and experience in applying digital instruments. In Russian companies, there is a lack of qualified specialists to execute digital promotions. Most marketers are simultaneously responsible for classical methods of promotion, so they are unable to focus on this specific and intensively changing professional field.

Today, the number of digital instruments used by companies has grown from 5-7 to 7-9. More than 25% use more than 10 digital instruments (IAB Barometer, 2018).

The survey conducted by the authors among the key advertisers in 2019 highlighted the main changes in the market of interactive advertising during the last year. Among the prominent ones are the growth of mobile content consumption, the development of video formats and social networks, and attention to the quality of content.

To evaluate the involvement of selected advertisers in digital communications, the authors posed the question of the share of the advertising budget spent on digital communications in the company. At the same time, the question of the total budget was not raised due to obvious commercial reasons, and it was not possible to relate the amount of spending on digital communications to the size of the company in this study.

However, it became clear that most advertisers spend around 30 percent of their budgets on digital communications, and the proportion of those who spend more or less is relatively small. The answer “difficult to evaluate”, which was given by 8 percent of advertisers, is not related to low awareness but to the inability to differentiate the costs of direct advertising and PR promotion due to the hybrid nature of many formats (see Figure 3).
Upon discovering the fact that companies have rather significant budgets for promotion in the digital environment, the authors looked at the factors advertisers consider the most advantageous for the development of digital communications. The most popular answer among the respondents was the possibility of targeting, reaching the right target audiences, then the scale of the impact and factors associated with the quality of the impact, meaning such characteristics of content as interactivity, multimedia, and nativeness (several factors could be chosen by the same respondent). Additionally, the respondents noted the problematic state of classical offline media, the effectiveness of which demonstrates a steady decline (see Figure 4).

Meanwhile, there may be numerous other reasons for companies to interact with their target audience through social media. These include brand awareness (Michaelidou et al., 2011), thought leadership, human resource and employer branding (Sivertzen et al., 2013), public relations (Doyle and Lee, 2016) and corporate social responsibility (Reilly and Hynan, 2014).
The research also helped to identify the most popular digital communication tools, which is especially important for analysis of digital drivers of the advertising market, giving an idea of the modern “menu” of advertisers, the structure of their preferences, and allows for drawing conclusions about the development prospects of a particular tool. Respondents were asked to choose, based on their experience, the most effective and promising communications, developing thanks to the new opportunities offered by the digital drivers of the advertising market (see Figure 5).

Figure 4. The factors of interest for advertisers in digital communications, Russia

Figure 5. Digital formats popular among advertisers, Russia
Targeted advertising in social networks was, as expected, the winner, being an increasingly flexible and successfully customizable tool. Search engine optimization, coming in second, has undergone significant technological changes, providing greater process control to companies. The choice of native advertising, sponsorship, and gamification reveals the humanization of digital technologies, accounting for the "human" requests for games and interactivity.

The choice of effective tools by advertisers confirms the authors' hypothesis on the technological nature of the flagship areas of digital communications, which have a decisive influence on strategies and behaviour of the main players of the media market. At the same time, the active position of companies, their competencies and balanced choice of digital innovations, indicates the importance of strategic management of this segment of communications.

To summarize, the lack of media measurements is becoming a restraining factor in the development of the new segments in classical media as well as the Internet. Measurements help advertisers to identify new marketing priorities and effectively manage their budgets. Advertising in Russia will make an evolutionary leap when Russian marketers learn to measure all the accessible content consumption screens (e.g. desktops, mobile gadgets, smart TVs, televisions) and to combine their results (Radkevich, 2017).

**Intensive development of the niche, narrow professional and visual social networks**

This driver allows advertisers to concentrate more specifically on their chosen target audiences. In the new digital conditions, individuals’ trajectories in the sphere of the media “landscape” have become so diversified that applying traditional advertising schemes is becoming impossible. The opposition of the centralized mass media and personalized media environments manifests itself in the acceleration of social media development. *Among the main trends of the SMM segment, it is necessary to note the improvement in the quality of SMM thanks to the increased professionalism of the market participants.* This was especially important in Russia, lacking a professional infrastructure for training of digital communications specialists. Today the situation has changed for the better thanks to emerging university and college educational programmes as well as a developed system of conferences and industrial events. Apart from this, Russian advertisers are wary of actively promoting their brands in social networks due to unpredictable effects and non-targeted contents that marketers have not yet learned to control (Tulik, 2017).

Indeed, with modern means of delivering advertising material, the industry is gradually losing control over the “meeting point” of a certain advertising message and a consumer as well as the context in which this encounter occurs. Specialists are discussing the necessity of developing native advertising, employing a personalized approach when advertising carries a certain value for the user. In Russia, the segment of social networks follows
global trends but also has its own specifics. Thus, Russia is one of the few countries where global players like Facebook and Twitter do not occupy the dominant position. According to Mediascope, the Russian social network VKontakte leads in Russia.

Proximity marketing refers to location-based attributes (Latham, 2017). Location-based marketing focuses on the physical location of potential clients. It adapts to the particular “personal traits of customers by making assumptions about their habits and preferences, based on their location at a particular moment” (Latham, 2017).

Targeted advertising in social networks became the most requested format (according to more than 80% of interviewed advertisers) with the highest growth: 48% of respondents expected its share in the advertising budgets of companies to grow in 2019 (IAB Barometer, 2018).

**Mediatisation of trade partners and consumers**

Proactive consumer behaviour (when the consumer finds it useful to initiate contact with an advertiser) calls for complex approaches to SMM promotion and other types of digital communications. The changing media environment modifies media consumption and generates the optimal conditions for innovation and individual experimentation in this field.

The technological innovations in the sphere of communications are so radical that they can cause the restructuring of the bases of the entire industry. The main trend of these institutional shifts is driven by the transformation of the consumer into the active subject of communication (Zborovskaya, 2015). The process of media consumption is no longer limited by a certain place and time of action. The transformation of electronic media into a natural habitat, a process that specialists call “mediatisation”, is highly ambiguous in terms of its social, cultural, and economic consequences (Kolomiec, 2009). It is equally ambiguous for advertising, as the forms of relations in all social institutions – state, family, education, etc. – undergo changes. Digitalization allows users to create communicational messages that are impossible to generate in traditional technology, at a relatively low cost. For instance, making a newsletter is considerably cheaper in an electronic format than on paper.

This technology is gaining special importance among companies with limited consumer reach via traditional media, e.g. pharmaceutical companies. Companies rent or purchase electronic databases to promote their brands via e-mailing or text messaging, combining such messages with promotion methods (discounts, gifts, etc.).

However, digitalization represents certain barriers for effective communication. Owing to digital technologies, people are gradually slipping away from the control and the constant pressure of centralized media, which ceases to carry any meaningful information, and are creating their own, individualized media environments (Kolomiec, 2009, 14). In these
conditions, advertising has to employ entertaining online formats to channel marketing information, and gamification has already become one of the most important activity fields for marketers (Zichermann and Linder, 2013). A decade ago, researchers began to argue that the best and most effective form of advertising is interactive, aspiring to engage the consumer in the process of transmitting and widely distributing advertising messages. The digital reality has changed the perception of creativity considerably. Today, professional and amateur cultural productions are not that far from each other. Represented by the new media, the communication environment turns the individual himself into the main advertising platform, thus forming a C2C channel along with the B2B and B2C channels. It is the consumer, endowed with various possibilities to share his opinion on goods and services with many others, who becomes the main distributor of marketing communications (Karyakina, 2010). This tendency has no particular distinguishing traits in Russia, where it completely corresponds to the universal key trends of the development of an information society.

Meanwhile, we are also starting to see the emerging trend of a digital B2B2C channel, especially among international corporations in Russia, where the producing companies involve their trade partners in digital communication with themselves and consumers. They use this channel to appoint tasks, control the execution and measure the trade results, including retail advocacy programmes for consumers.

We are talking here about an emerging trend, as the Internet network, smartphone coverage and retailers’ digital skills in Russia are far from ideal and require rather high investments and development. While the final goal of such digitalization is to get closer contact with the consumer, control of sales as well as increased efficiency (replacement of manual fieldwork, i.e. merchandising) is gradually advancing.

**Content: personalization and visualization**

Content in all its manifestations is one of the most important means by which companies attract users. Today, in the era of informational abundance, we observe the growing importance of quality content, active monetization of content in the digital medium, and the search for new distribution channels. Communicational media depend on content generators as well as consumers. In many ways, advertising (along with music) has shaped the video-clip culture of modern audio-visual creativity. This means that media content is blended into 30-second advertising messages that harmoniously alternate with equally brief informational or entertaining clips (Karyakina, 2010).

AKAR replaced market assessments based on the type of advertising with a measurement based on the type of content. The digital segment has been divided into video, audio and print content.
Table 3. Advertising Market Volume by Type of Content in 2018

<table>
<thead>
<tr>
<th>Segments</th>
<th>2018 Bn. RUB</th>
<th>Dynamics %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Video Content</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incl. traditional TV</td>
<td>187.0</td>
<td>9%</td>
</tr>
<tr>
<td>Cinema (&quot;screen ads&quot;)</td>
<td>1.0</td>
<td>7%</td>
</tr>
<tr>
<td>Online video (stream+VOD)</td>
<td>10.0</td>
<td>21%</td>
</tr>
<tr>
<td><strong>Audio Content</strong></td>
<td>17.3</td>
<td>1%</td>
</tr>
<tr>
<td>Incl. air (FM/AM)</td>
<td>16.9</td>
<td>0%</td>
</tr>
<tr>
<td>Digital-audio</td>
<td>0.4</td>
<td>3 times</td>
</tr>
<tr>
<td><strong>Print Houses Content</strong></td>
<td>32.0</td>
<td>-3%</td>
</tr>
<tr>
<td>Print</td>
<td>18.0</td>
<td>-12%</td>
</tr>
<tr>
<td>Digital</td>
<td>14.0</td>
<td>13%</td>
</tr>
<tr>
<td><strong>Out of Home</strong></td>
<td>42.8</td>
<td>2%</td>
</tr>
<tr>
<td><strong>Internet Services</strong></td>
<td>178.6</td>
<td>22%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>468.7</td>
<td>12%</td>
</tr>
</tbody>
</table>


Publishing content

The digital part of publishing content includes hybrid media (publishing houses owning both print and Internet media) as well as pure digital Internet resources (without print versions).

AKAR and IAB Russia analyse the sub-segment of online video based on a measurement of in-stream advertising. This sub-segment includes the budgets of video advertising of online cinema and websites of TV companies, video hosting, and licensed players in social media. Video advertising is a quickly growing instrument of interactive advertising. More than 75% of surveyed companies use different types of interactive video (traditional and mobile). Among the companies using digital video, 42% allocate separate budgets, while 22% do not divide the budget between interactive video and TV (IAB Barometer, 2018).

Audio content

The market of audio advertising demonstrates the high dynamics of growth driven by the new technologies and formats appearing on the market as well as the new market players. To form a full picture of the audio advertising industry, IAB Russia renewed the audio ad segment map in 2019.

According to IAB study, the audio advertising market volume amounted to 465.3 bn. RUB in 2018, 3 times more than in 2017 thanks to the new players, and was divided into groups: Agencies, Communication Groups, Audio Ad Network, Data, Online Audio Sellers, Tech Solutions, Research, Publishers.
In the second year, the network systems delivering the inventory for audio ads are included in the advertising volume calculation (IAB Russia, 2018).

**Video content**

The new tendencies are connected with the rapid growth of various technological tools for delivering content to consumers. Never before have advertisers enjoyed such a wide range of targeted commercial information delivery instruments, enabling a 360-degree strategy that employs various platforms for distributing content. One of the major drivers in the sphere of digital advertising is online video advertising. In Russia, Mediascope, the recognized media measurer, monitors Internet advertising. Initially, the company presented information regarding banners’ advertising placement and later regarding special Internet projects, out-stream video and native ads.

Today, video ad sales on the Internet demonstrate steady growth rates. The volume of video viewing from mobile gadgets is increasing and will soon exceed computer content viewing. However, with such a variety of advertising media, it has become difficult to get through to the consumer: the multiplication of delivery channels has led to a drop in their efficiency as informational resources (Zborovskaya, 2013) in a diversified, competitive media environment; virtually any content should be advertising by attracting consumers’ attention. Creating advertising content is turning into media art or the art of media, the art of presenting goods and services (Kazaryan, 2017).

To replace direct advertising, marketers have developed engaging branded content that is “woven” into everyday life and leans on what people themselves think. Advertisers’ digital departments must ensure quick and easy access to this content for the consumer in any environment and on any platform.

Meanwhile, “the big challenge for advertisers, apart from reading the content” has become “finding enough individuals to make comments or feedback to posts” (Michaelidou et al., 2011; Simula et al., 2015). Therefore, it is “crucial to understand if the type of content sharing has any impact on the individuals’ willingness to interact with the company through commenting on social media” (Michaelidou et al., 2011; Simula et al., 2015).

Native advertising, which is not identified as a direct pressure to buy, has become a global trend in the last 2-3 years. Russian advertisers, too, have appreciated the advantages of the format, which fits organically into the content. The market players consider the expanded possibilities of visual content provided by the technologies of virtual reality (VR) and augmented reality (AR) to be the determining trend until 2020.
Installing digital technologies in classical media

Digital drivers greatly affect other segments of the advertising pie. If one regards the Internet as a technological platform, then all media are represented today in digital formats in a certain percentage, which is why there is a tangible need for a joint-effort reconsideration by the advertising community of the existing classification of media segments.

In regard to television, with the ongoing growth of paid television and online TV advertising, these segments might slowly ascend to dominance. In developing markets, including Russia, they are notably leaning towards digitization and an outflow of viewers because of smartphones and tablets. In televiewing, Russia is taking its own course. The main feature is that high-quality over-the-air television is free, which is why the per-day number of traditional media-consuming hours has not decreased; on the contrary, it has increased with the additional content viewing online. The choice of content today depends on the viewer’s wishes rather than the broadcast schedule. This is happening thanks to so-called non-linear viewing set-ups, including various on-demand video-providing services. Content is also accessible via search engines.

As a technological medium, the Internet has considerably expanded the possibilities of content delivery, including television content. Online video viewing has become a regular practice for Russian megapolis dwellers. According to Mediascope, half of the residents of Russian cities with a population above 700 thousand people watch videos online. The advertising industry is looking for ways to consolidate television advertising space with online video as well as to apply the Internet technologies to TV advertising. The interaction can occur in the form of television advertising, with the broadcaster receiving feedback from the audience, or with the audience acting by means of a device to access the Internet, e.g. proceeding to the advertiser’s site on their smartphone. In the coming years, television companies (TV channels and other generators of television content) and their partners in Russia will become increasingly active in the digital medium. Existing platforms for distributing television content online will be improved, and new ones will be created.

Similar to other industries, traditional radio has to react to the challenges presented by the development of digital technologies. Currently the main threat to radio stations is posed by advanced streaming services. There are several major players in Russia: YandexMusic, Google Play, Apple Music and SoundCloud, along with VKontakte music listening. For a listener, streaming might have a range of attractive functions: the possibility of playlist and music control, high personalization, etc. Nevertheless, radio has been winning so far thanks to the professional approach to music shows, higher accessibility, absence of payment, and listeners' loyalty. Streaming services are continuously evolving in order to eliminate the drawbacks which cause many people to
prefer radio. Unfortunately, it seems unlikely for Russian holdings to enter the streaming market: so far, the business has been unprofitable and required huge investments.

Meanwhile, Russian holdings are taking their own route to business transformation, actively developing the sites of their stations and online portals, working on new formats and experimenting with new technologies: audio advertising, online targeting, implementing new analytics instruments, creating new online and offline formats.

The data received can be used to launch advertising campaigns on the Internet where users’ interest is piqued in several minutes after viewing a video. Even traditional outdoor advertising employs digital technologies to adapt to different users, contexts, and environments (Mutom, 2017). Digital OOH (out-of-home) media is the key component for the growth of outdoor advertising, while the market of traditional media in this segment remains stable. This branch is currently in the stage of actively transferring to digital formats.

In Moscow, for instance, a process of inventory accumulation is underway. A network of digital 15x5 supersites has been created, and digital billboards, essentially digitized 6x3m screens, are gaining popularity. Brands’ interest in digital OOH media is very high; the demand exceeds the supply. Recommendations on how to increase ROI while combining digital and traditional OOH media are being worked out by different groups of advertisers. However, developing such technologies in Russia requires practitioner competence as well as market stability.

Digital formats have become the major drivers of growth. In this situation of high demand, the research company Mediascope began monitoring digital outdoor media in 2018. This monitoring allows for fixing the entire ad placement information, including the exact time and place of the broadcast, spot duration and other data. Mediascope has developed a special method of independent data collection from players at billboards by also analysing the work of digital constructions. Today, they monitor 300 digital constructions of Gallery Company, which launched sales of digital ads last year. Such data has become a convenient instrument of advertising campaign control.

We should not overlook the digital changes in print press and the move of numerous publishers to an online format. As noted, advertising investments in the press are the most susceptible to reductions during periods of economic instability. Television and radio are proving to be somewhat more resilient in times of structural transformations compared to printed media (Zhigunova, 2017), although there are serious reasons to believe this is due to the format of the media rather than the overall market trend.
CONCLUSIONS AND RECOMMENDATIONS

Our conclusions concern the various aspects of the impact of digital drivers on the communication market and its main segments.

1. The study demonstrates the modern state of the communication industry in Russia and its digital market after the crisis caused by the economic instability of 2014-2015 as well as the difficulties brought by the economic sanctions. The market manifested rapid and stable growth of client activity and the development of its infrastructure.

Meanwhile, the relations between advertisers and communications agencies require new management approaches. Medium-sized and large companies, as locomotives of these changes, entered into digital interaction with partners and began to implement digital solutions to increase the efficiency of business.

2. Digital drivers represent the most sought-after and rapidly multiplying points of contact between consumers and brands. Brand communicators must re-evaluate their traditional relations with customers, allowing the latter to choose the format of communication by themselves. This implies an even deeper integration of all the technologies employed in branding in order to better understand and serve the audience.

However, digital instruments have to include strategic integrated approaches in branding and promotion, the ability to see the picture in its entirety, applying the “scanner” of analytics to all activities and, as a result, working out a complex development strategy.

3. Today, new technologies can be used both in favour of advertisers and against them, concealing the true paid advertising coverage and discrediting digital communications. In order to ensure the stable development of the advertising industry in the absence of clear control systems, advertising management should conduct a policy of openness towards clients and improve evaluation instruments, which will allow for controlling the targeted application of clients' budgets.

Our recommendations concern the optimization of tactics and strategies of the main market participants in consideration of the impact of digital drivers. These participants, communication industry professionals and companies specializing in the field of digital marketing, are compelled to think about their future in the context of informational changes; for them, digital marketing serves as a means of gaining loyal consumers and a way to preserve their position in a highly competitive market.

The Internet ensures consumer engagement without the abrupt injections of the regular advertising campaigns that were the basis of the media-advertising world in the twentieth
The Problematics of Digital Driver Classification and Measurement Standards in the Russian Advertising Market

century. However, advertisers must understand that Internet communication, once economical and technically uncomplicated, has changed drastically. In the near future, the main social networks will focus on paid content as never before. Without a solid marketing budget, brands will find it increasingly difficult to get access to new viewers on large platforms. Nevertheless, even paid participation does not automatically solve the problem of severe competition: *advertisers should pay attention to the quality of their content and its individualization* while employing new platforms to expand their presence, searching for a target segment among niche audiences and launching innovative products.

Tactical solutions, which are relatively standardized in classical media communications, are becoming paramount in the digital medium. Advertisers and their supporting agencies should remember it is not enough to simply determine and segment the target audience with subsequent budget injections in various promotion channels. It is necessary to understand the client’s readiness to purchase a product: how much, at what rate, with the help of which channel, for what purpose, and in which conditions. As shown in this study, the state of digital content is the key driver of communication market development. The study proves that, today, consumers themselves have become active generators of content. In their informational field, they want to see authentic and relevant content. This means that in order to deliver that content, *brands will have to forego editing and censure.* Communication should not look staged; it should occur in real time, in formats such as live programmes, streaming, comments, etc., that do not allow the long discussions habitual to brand managers. Certainly, live content production risks damaging brand image; however, this is the only way to reinforce the loyalty of younger audiences.

The advent of younger generations whose ways of obtaining and using information are different from those of the past is changing the surface of the market. Resources based on knowledge and skills, including competences in the field of marketing, have been among the main sources of competitive advantage in the market during the last decades. This calls for analysis of the changes in training standards for marketing service specialists in the era of digital communications. Many of them are not quite prepared for the current changes, nor do they have the necessary competences to face the new challenges.

*One of the main tasks for the future, therefore, is preparation of managers and marketers so that they will be ready to interact with better-informed and technically equipped consumers,* using technologies that are more complex and continuously raising their competence, primarily in the field of technology.

Due to the continuous and intensive generation of new knowledge in this sphere, the systematized training of specialists in institutions of professional education is complicated. This is an especially serious problem for Russia, as the Russian education system has just started integrating into the global educational market. Therefore, Russian managers are advised to invest in the professional development of their digital marketers in various new
forms (conferences, online courses, training abroad, etc.). These and other systematized efforts will allow Russia to take a worthy place on the global digital map.

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Do Financial Intermediaries Promote Availability of Financial Instruments for Micro-Enterprises?

ILONA BEIZITERE

ABSTRACT

The aim of the study is to investigate the role of financial intermediaries in promoting the availability of financial instruments for micro-enterprises in Latvia. The EU financial assistance policy for supporting business activity is accomplished on a national scale through tailor-made financial instruments implemented by financial institutions. Thus, the latter have been entrusted to act as intermediaries that offer government support to companies that have hitherto had difficulty in obtaining the necessary funding. Such aid schemes significantly facilitate access to finance for companies, especially micro-entities that have faced financial constraints in recent years.

Design/methodology/approach. The study examines the model of corporate financing established for accessing financial instruments in Latvia and scrutinizes the functions of government institutions involved in the model. Some of the practical aspects of financial mediation have been uncovered through individual interviews with financial experts. A survey of Latvian enterprises, covering 1879 micro-enterprises, provides an overview of the remaining limitations on obtaining external financing, including state aid. It highlights the attitudes and perceptions of micro-enterprises on the likelihood of obtaining financial instruments.

Originality/value. The role of financial intermediaries in ensuring the availability of financial instruments in Latvia has not been studied before and has mainly been made visible through everyday practice. Although the JSC Development Finance Institution Altum, as the principal intermediary, has been actively involved in implementing new forms of support, the study has revealed areas for potential improvement in providing better access to financial instruments for micro-enterprises.

Keywords: financial availability, financial intermediaries, financial instruments, micro-enterprises

JEL code: D83, G29, L29, Research paper
INTRODUCTION

The European Union (hereinafter – EU) has developed state aid instruments to provide funding for companies that experience difficulties in accessing external sources of funding. Tailor-made financial instruments (hereinafter – FIs) are EU financial support measures for addressing specific Union policy objectives (European Commission, 2018c). The Regulations of the European Commission allow for some flexibility in implementing priority support strategies, which, in turn, enables Member States to develop their own programmes and choose the most appropriate FIs, appoint intermediaries and identify the eligible target groups (European Commission, 2013a). An important condition for the introduction of FIs is that they should not compete with the financial products of the regular financial market operators, for example, offers from banks or leasing companies. Typically, FIs are developed for companies that are not targeted by traditional lenders because of the considerable risk involved (OECD, 2015).

This study examines the availability of FIs to both established micro-enterprises and emerging or start-up companies. For the purposes of the study, a micro-enterprise is solely seen as a micro or small-sized business performer, or a start-up that meets the definition of the European Commission (2003) for micro-enterprise (hereinafter – ME). By enterprise size, MEs are the most common type of businesses in Europe, since they represent about 93% of all European companies (European Commission, 2018a). Moreover, 99% of all the newly established enterprises in the European Union are micro-enterprises or small business performers (Kraemer-Eis et al., 2016). At the end of 2016 and 2017, companies of 9 or fewer employees in Latvia accounted for about 94% of the total number of economically active enterprises (Central Statistical Bureau, 2018).

In accordance with the Partnership Agreement (Cabinet of Ministers, 2014), the EU has allocated 5.6 billion euros of financing to Latvia in the plan for 2014-2020. The total investment in the Latvian economy, with government co-financing included, will reach 6.9 billion euros over the said period (European Commission, 2018b). In accordance with EU regulation (European Commission, 2013b), each European fund is subject to the same rules of planning, management and monitoring as the Cohesion Fund, the European Regional Development Fund, the European Social Fund and other funds; therefore, this study looks at support for MEs regardless of the diverse funds from which it is sourced.

Although Latvia has been awarded substantial support from EU funds, there are still practical considerations that call into question the availability of EU support in the form of FIs for a sufficiently broad range of MEs.
BACKGROUND STUDIES

The phenomenon of financial support through state aid is influenced by various factors, and intermediaries need to take into account certain key aspects of their activities.

Aid in the form of FIs is an advantage granted by the state to selective undertakings through intermediary bodies with a certain amount of resources. As regards state support to companies in their early stages of development, the position taken by Vivarelli (2013) is that it should be limited to such cases of market failure that prevent growth of potentially powerful companies, for example, companies with outstanding human capital or innovative ideas. The author warns against automatic support for all seekers, requiring prior analysis of the factors predicting their survival prospects. The observation made is that selective support policies have a greater impact, for example, on employment growth, than support doled out to all companies that seek it. Direct financial support should be prudent and focused and support businesses promoting progress.

At the same time, the OECD (2015) finds that although alternative support from untraditional sources is particularly important for start-ups, high growth and innovative SMEs, it may also be required for a wider range of SMEs. There is also a capital loophole for those companies that wish to modify their business.

As regards MEs, Masiak et al. (2017a) acknowledge that the financial needs of MEs are different compared to the needs of companies in other size classes. In the EU, financing models, including schemes with intermediaries that are particularly well-suited for providing external financing for MEs, are not sufficiently developed (OECD, 2015). European MEs are more likely to use internal financing and are slower in their uptake of state support through FIs. Masiak et al. (2017b) show the reasons limiting MEs’ access to government funding, including lack of awareness among entrepreneurs about public funding programmes, failure of the programmes to meet the needs of MEs, and the administrative burden involved.

The OECD (2018) points out that the availability of alternative sources of funding should be viewed from the aspects of both demand and supply. On the demand side, there are many entrepreneurs who lack financial knowledge, strategic vision, and in some cases may not even have the willingness or understanding to raise any other kind of financing apart from a traditional loan successfully. On the supply side, the interest of potential investors in providing private capital co-financing may be hampered by the general lack of transparency and the regulatory barriers in the financial markets of SMEs. As a result, FIs for SMEs often operate in markets with a small number of participants and low liquidity where there is less demand for them.
on the part of the SMEs, which, in turn, dissuades potential finance providers. Such a market can hardly be seen as attractive for potential financiers.

The OECD (2015) shows that competition on the supply side has encouraged financial institutions to develop innovative solutions. For example, Attuel-Mendes (2016) examines models of crowdfunding along with microfinance as an instrument against financial exclusion. Crowd-to-business platforms function as intermediaries between microfinance institutions and investors. Microfinance institutions with non-traditional lending patterns initially emerged as financial market operators to overcome the ME financing gap. The author notes that the emergence of new financing models has been driven by the growing competition between the private and the public sector as well as restrictions in the banking sector with the enhancement of Basel III precautionary principles and the development of new information and communication technologies. Political and regulatory support for the introduction of new financing models has also proven important.

Allen and Santomero (1997) look at the financial intermediation phenomenon and its role over time in the context of the changing financial system. In the past, the role of financial intermediaries was mostly linked to transaction costs and the need to decrease the amount of asymmetric information (between the financier and borrower). The role of intermediaries as risk transfer facilitators, operating in an increasingly complex financial market, has been growing. The OECD (2015) suggests that innovative financial products in the private sector, coupled with a measured amount of state aid, has enabled the financial system to overcome the information and agency challenges typical for financing SMEs. However, in the process of loan intermediation, it is important to maintain a balance between the risks and the expected amount of compensation. In view of this aspect, finance providers have to weigh which company is worthy of support in order to avoid inefficient allocation of capital while serving as an intermediary. This situation of intermediaries is facilitated by the fact that they may be beneficiaries of state aid if the costs of implementing a financial instrument or service exceeds the market standard (European Commission, 2017b).

The availability of funding for MEs depends not only on the accessibility of state aid, but also on the overall support policies. Isenberg (2010), who mentions policies and finances among other components of the business ecosystem, indicates that each ecosystem is unique due to the manifold causal relationships between its components. This view is supported by the OECD (2015), emphasizing that the starting point for changes in the funding policy for SMEs should be to ensure balance in the wider business environment, and drawing attention to the interconnectivity between the macroeconomic environment and the financial sector.
Without overcoming the barriers within the external environment, it will not be possible to ensure demand for funding on the part of companies.

The authors Wishlade et al. (2017) indicate that public and private investment placements have slowed down in recent years as the investment supply side is rather complex. The role of national promotion banks as financial intermediaries in the financing of the economy is growing, although the picture varies from country to country. Through carefully crafted FIs, these banks provide support to SMEs if market failures lead to underinvestment. Although the regulatory framework for FIs has improved, implementation of FIs remains a challenge for some managing authorities. The plethora of European and local initiatives could make the offer of FIs to their beneficiaries difficult to understand. The authors point out that funding intermediaries lack timely issued guidelines and more stable rules that EU fund managers should prepare. In these circumstances, policymakers face the challenge of streamlining public interventions and adapting FIs to the relevant economic and institutional context.

When assessing business policies, the OECD (2018) indicates that only in a few countries do they focus on SMEs in particular. In some cases, measures to promote accessibility of funding have not yielded the desired results, because entrepreneurs are not prepared to absorb investment due to lack of expert knowledge. The findings of the OECD have also been confirmed by Beizitère’s study (2018), which concludes that one of the factors that decrease the availability of FIs for Latvian MEs is a lack of knowledge and skills for fundraising through FIs. In the study, 73% of the respondents from MEs did not know what the FIs offered by EU funds were, while 5% of the respondents had no wish whatsoever to obtain external financial resources.

The experience of the UK (Calabrese et al., 2017) in supporting SMEs that wished to access bank loans has provided evidence to the effect that SMEs demonstrating awareness of government initiatives and knowledge of how loan schemes are financed were less likely to be banned from obtaining financial support. Likewise, loan requests from those SMEs that understood how support funds and bans operate were less likely to be turned down.

As he assessed Latvia's experience in implementing the business start-up programme of 2009-2015, Cebulis (2015) noted its importance for promoting access to finance for newly established companies in particular. The programme was popular in Latvia because it offered comprehensive support, involving advice and training apart from financing. The joint stock company Development Finance Institution Altum (hereinafter – Altum) implemented support worth EUR 24.2 million. The counselling offered by Altum related to the development of a business plan.
Training, in turn, was implemented by contracted training companies. The programme included 1612 participants that were trained and another 4560 participants that benefited from consultations, with 1302 loans issued. This placement of investments showed an acceptable level of risk as the rate of non-performing loans in the focused programme was 9.2%.

The experience gathered by the European Association of Development Agencies (hereinafter – EURADA) shows that the most effective measures to promote FIs’ availability were those that focused not only on capital market imperfections but also on information market gaps (Saublens, 2013b). In their view, basic business consulting could be the only cost-effective form of support for micro businesses.

**RESEARCH OBJECTIVES AND METHODOLOGY**

The aim of the study is to find out about the role of financial intermediaries in ensuring that MEs are able to access FIs for government support in Latvia. Research was conducted with the purpose to answer, from a practical point of view, the following questions:

1. What is the financing model for delivering state support to companies through EU fund-based FIs in Latvia?
2. What kinds of FIs specifically targeted at MEs are offered by financial intermediaries?
3. Does the existing model allow for some flexibility of financial intermediaries when helping MEs to adapt to the changing situation, within the framework of the policies adopted by EU funds and local programmes?

To improve the understanding of the financing model for state aid intended for business support and the role of financial intermediaries, individual interviews with financial experts and representatives of the entities involved in the financing model were conducted. A personal interview was agreed upon by representatives from Altum, the Central Finance and Contracting Agency of the Republic of Latvia (hereinafter – CFCA), the Ministry of Economics of the Republic of Latvia (hereinafter – EM), the financial company Capitalia SE, the management consulting company Civitta Latvija and by a business expert with financial expertise.

A company survey, also covering MEs, was developed to find out their needs for external financing and explore the financial constraints that hamper the access of businesses to finance. The aim of the survey, carried out with the assistance of the Marketing and Public Opinion Research Centre SKDS, was to find out if companies
had experienced a need for financing from different financial sources, including state aid, over the last three years. The survey not only identified the difficulties faced by companies, and especially MEs, in obtaining external funding, but also clarified the grounds for rejection of their requests.

The target population of the survey consisted of companies across the territory of Latvia, operating in strategically important industries, defined as such by the government. The selected population comprised all the active companies registered in the Latvian Company Register with the NACE codes of the 11 selected sectors, totalling 32308 companies.

A structured questionnaire was developed for conducting the survey in the Internet environment, and in January 2018 it was sent out to companies with accessible e-mail addresses of all the selected sectors. The questionnaire contained 18 questions regarding the financing of the company and was addressed to the official primarily responsible for the company’s finances. Valid responses were received from 2511 companies, of which 1879 were MEs.

**FINDINGS**

For the purposes of financing entrepreneurial activity from EU funds, finances are distributed among financial intermediaries (banks, leasing companies, guarantee funds and other financiers), which in turn provide them to entrepreneurs (European Commission, 2018c). The finance institution Altum and venture capital funds have been entrusted to act as financial intermediaries in Latvia (Fig.1).

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**Figure 1. Functioning of financial instruments in Latvia**  
Source: created by the author based on information from Altum, CFCA, EM
The Ministry of Finance of the Republic of Latvia, as the managing authority, is responsible for the overall implementation of the EU fund programme approved by the Cabinet of Ministers. In turn, the CFCA is an institution of direct administration under the Ministry of Finance. Its mission is to monitor the implementation of EU funds and financial projects important for the development of Latvia. In turn, development and monitoring of specific national support programmes is the realm of the relevant ministry or other appropriate body. The authority responsible for supporting business is the Ministry of Economics, whereas Altum (established as a 100% state-owned JSC) acts as the financial intermediary for implementing FI programmes for companies (Saeima, 2014). Altum offers access to EU funds through direct FIs, such as loans, credit and export credit guarantees, and indirect investments in partnership with venture capital funds, which include private equity. This funding scheme for FIs could be described as rather centralized, as public support from EU funds is entrusted to one principal intermediary. It differs from other countries' schemes. For comparison, it should be noted that Lithuania had four financial intermediaries, whereas Estonia had three bodies offering EU FIs to entrepreneurs at the end of 2016 (European Commission, 2017a).

As stated by the interviewed business expert, there are different models of financial intermediation in Europe. An example of this is EURADA, offering experience-based financing solutions and schemes that include different collaborative partners, in line with the business development cycle and needs of the company. EURADA has found that the features of an efficient funding scheme are a diversified supply of financial sources, sufficient demand for financing among entrepreneurs, and coherence between supply and demand for funding. Such a funding scheme ensures that FIs not only complement each other, but also include all forms of external capital (including bank loans), private equity (family and friends, business angels) as well as formal venture capital and subordinated funding. In addition, entrepreneurs should be aware of each funding type’s adequacy in the business life cycle (Saulens, 2013a).

EU support is designed so that FIs are available to a company throughout its development (Kraemer-Eis et al., 2018). From the point of view of the business cycle, the FIs offered to companies in Latvia are available at every development stage of the company (Fig. 2).
Figure 2. **Availability of financial instruments depending on the company’s development stage in Latvia.** Source: created by the author based on an interview with representatives from Altum.

Data at the disposal of Altum generally point to good availability of funding for MEs (Fig. 3). The growth rate of Altum’s portfolio for the ME segment was generally higher than the growth rate of its portfolios for companies of other size classes. In 2018, internal interim data show that 68% of a 121.7 million euro loan portfolio was made up of loans for MEs. Accordingly, in 2017, ME loans were 65% of the portfolio. The annual report notes that the structure of loan and guarantee financial instrument portfolios reflects the priorities of the Latvian government in the implementation of state aid (Altum, 2018a). However, Altum’s loan portfolio for MEs, which constituted 118 million euros towards the end of 2017, was only 0.1% of the total ME loan portfolio of commercial banks (Beizitere, 2018).
Altum has also been focusing on support for start-ups. Within the framework of the start-up programme, by mid-2018, a total of 47.1 million euros was granted to 2457 new business projects (Altum, 2018b). Considering that Company Register data indicate that about 10-11 thousand companies are annually registered in Latvia (Lursoft Ltd, 2018), the share of start-up companies that have received support is negligible.

Altum’s credit guarantees are popular with Latvian companies. In accordance with Altum’s data, the guarantees it issued to MEs covered a total of 5.7 million euros in 2017, enabling companies to take out bank loans in the amount of 8.6 million euros. However, popularity with MEs remained lower than with the larger-sized companies. The loan amounts made available to MEs through Altum’s credit guarantees reached around 8% of the total corporate loans of commercial banks only in one single quarter of 2017 (Beizitere, 2018).

The high risk FI programme implemented in Latvia via Altum is not very popular within the ME segment. This is evidenced by Altum’s internal information that although Altum's total investments in venture capital funds amounted to 57.0 million euros in 2017, there were only 192 projects that received funding from venture capital funds. Early stage financing came from one seed capital fund, supporting a total of 91 projects for 5.0 million euros. The rest of the financing was provided to companies in their growth and development stages and came from 4 venture capital funds and 4 expansion capital funds. In 2017, Altum, together with the Latvian Business Angels’ Network, launched a pilot project for supporting microcompanies and small businesses with co-financing for innovative ideas. However, within those locally based funding initiatives, with the risk split between Altum and private investors, the amount allocated by Altum was only 450 thousand euros to 8 new
companies. Unfortunately, as the pilot project with the Latvian Business Angels’ funding did not gain popularity, it is no longer offered.

In 2018, three acceleration funds started operating in cooperation with Altum to support businesses at the seed and start-up stages, focusing on support for innovative ideas or products, especially within projects with emphasis on technology and industry. Notably, this is a new initiative with national public funding and private co-financing from acceleration funds. Over the next three years, accelerated investment is expected to receive approximately 120 outlook ideas. Total public funding in these funds will amount to 15 million euro together with the Altum investment. In addition to the abovementioned funds, three venture capital funds, respectively seed, start-up and growth capital funds, started operations in the second half of 2018. Total public funding from Altum investments in venture capital funds is expected to amount to EUR 75 million (Altum, 2018a).

According to an interview with Altum’s representatives, Altum is also actively providing access to finance for an ever broader range of entrepreneurs. In the framework of a recent initiative relating to Altum’s loan conditions, there have been a number of improvements for business start-ups, including extension of the loan repayment term. The new Altum portfolio guarantees will help SMEs to obtain financing from credit institutions (current assets, credit lines, investment loans and finance leases) at a lower interest rate. They will also provide for faster loans and fewer documents required, since the decision will be a one-stop decision taken by the credit institution itself. Previously, the decision was first taken by the credit institution, and then Altum decided on whether a guarantee was applicable.

A financial expert, working as a project manager at the company Civitta Latvija, stated in an interview that a range of financing options for businesses was presently available in Latvia. Money is available from various sources, as long as the business has a clearly identified goal and a strategy to be investment-ready.

A company survey yielded some unexpected results in terms of funding sources. In response to the question "What are the types of financing your company uses or has used during 2015-2017?", the 1869 MEs surveyed pointed out the following sources: Altum – 4%, EU funds – 6%, venture capital and business angels – 1%, Altum guaranteed bank loans – 3%. 64% of the companies relied solely on internal financing. By contrast, 26% of MEs chose more traditional sources and financial products such as a bank loan, credit line, overdraft, leasing, or factoring. Meanwhile, 49% of the MEs surveyed acknowledged that they had needed new or additional funding over the last 3 years. Only 15% (or 141) of the MEs, however, had turned to Altum to seek it. Altum had rejected the funding requests of 55 MEs, while only 34 MEs had obtained the full amount they had been seeking. Also, 26 of the MEs had
declined to accept the offer. The reasons most commonly stated were that the process was too complicated to handle, required a large amount of documents, the required collateral was too high, and the money offered was too pricey.

When questioned about the reasons for not seeking financing from Altum, 53% of the MEs that responded stated that "they lacked knowledge about the financing opportunities offered by Altum". In turn, 19% of the MEs responded that they "felt that Altum would not provide them with the required funding".

As Adamsone (2017) points out, policymakers should better understand what our businesses need. There are cases when companies cannot find anything appropriate for their needs because the objectives of EU policy are not in line with the wishes of entrepreneurs. Often entrepreneurs deliberately choose not to use EU funds for business development. The author mentions some reasons similar to those of the company survey: lack of knowledge of EU fund financing, no suitable support programme, the entrepreneur is not satisfied with the programme requirements, the requirement of project documentation seems too complicated.

A study conducted by Altum has stated that there is an estimated need of about 7 billion euros for business development in Latvia to cover the next three years (Firmas.lv and LETA, 2018). As acknowledged by Altum, it currently finances 40% of the amount that potentially deserves support, since the majority of entrepreneurs are not even applying for it. Should Altum receive the requests of all the companies that seek financing and have been rejected by the banks, it could issue double the amount of loans. However, entrepreneurs should engage in fundraising more actively, since apparently a large part of new and small companies do not look for financing at all.

As the manager of Capitalia SE said in an interview, his financial company does not compete with Altum, nor with banks, although they offer similar financial products to FIs. He emphasized that financing from Capitalia SE can serve for micro and small businesses as a simple addition or alternative to borrowing from banks. Various financing in the form of loans and investments up to EUR 1 million are offered to businesses. The practice of this private financial company since 2007 successfully demonstrates its ability to offset the financial market failure to MEs in Latvia as an alternative finance provider. Notably in 2019, Capitalia SE plans to further develop the promotion of existing financial products, including venture capital investments. As the company has an agreement with the European Investment Fund for a total amount of EUR 10 million, this will enable it to operate more actively in microfinance with loans in the amount of up to EUR 25 000 (Capitalia, 2018).
CONCLUSIONS AND RECOMMENDATIONS

There are many aspects to ensuring that MEs can access finance via FIs. Accessibility is affected not only by the support offered by the intermediaries and their activities, but also by the willingness, approach and readiness of the entrepreneurs themselves, especially in the ME segment.

A nationally functioning financial support model and interaction and support of the involved government bodies have an essential role to play. In the case of Latvia, the model developed is operationally sound.

Rapid changes in the external environment trigger new initiatives in the financial market for companies striving to overcome financial limitations. They do not always fit in with the provisions on how the funds offered by the EU should be distributed. Although the regulatory framework is restrictive in setting down the priorities for support and specific provisions for the deployment of funds, on a national level Latvian intermediaries are implementing important initiatives aimed at supporting a broad range of MEs. With the backing of the Latvian government, Altum is expanding the model of EU fund-based financial support for companies by collaborating with private venture capital investors and funds to develop joint focused offers for MEs. This demonstrates the ability of the Latvian government and financing bodies to apply EU-developed FIs for local needs.

At the same time, the potential of the principal intermediary Altum in supporting business activity and, especially, MEs, has not been fully exploited. From the point of view of the business ecosystem, Altum has only a limited ability to influence and satisfy the demands of businesses. Also, the actual amount of funding required by MEs in Latvia has not been fully assessed: many MEs refrain from turning to Altum or solid financial institutions.

In order to improve the availability of FIs to Latvian MEs, business support policymakers should:

1. Extend the FI programme offering to include counselling and training for entrepreneurs; apart from promoting awareness among entrepreneurs about raising investment, different sources for financing and types of state aid, training could also provide specific knowledge about FIs.
2. Allow for some flexibility in the conditions for applying for FIs. Intermediaries should be able to modify the terms of the programmes entrusted to them up to an admissible risk level and in line with the needs of MEs identified in practice, so that the conditions appear feasible and the bureaucratic burden is reduced.
3. Back up entrepreneurs through other government activities not only for promoting availability of financial support, but also for organizing in-depth financial education, especially for new entrepreneurs, with a view to enhancing their ability to raise investment for the development of their companies.

4. Improve Altum’s role as a state aid intermediary by extending its financial function through cooperation with various partners and complementing its offer of FIs with other services, both financial and non-financial, that meet micro-entities’ needs.

Finally, to improve future availability of financing for MEs, it is crucial not to ignore new initiatives in the financial market that could be both competitive with and complementary to the existing FI offer.

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Do Financial Intermediaries Promote Availability of Financial Instruments for Micro-Enterprises?


Do Financial Intermediaries Promote Availability of Financial Instruments for Micro-Enterprises?


Financial sector changes and technologies: a look at fintech in Latvia

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ABSTRACT

Purpose. To research drivers and technological issues in the financial sector with regards to fintech companies in Latvia.

Methodology. Interviews with leading fintech industry experts in Latvia. The research team conducted nine expert interviews out of thirty potential expert interviews within the research: six C-level expert interviews, two expert interviews with heads of IT and two expert interviews with heads of HR.

Findings. Increasing competitiveness among incumbent market players has forced traditional business model modification; investor demand for continuous cost decreases has led to the dismissal of highly skilled and paid employees with the result that evolving and accessible technology has magnified entrepreneurial behaviour. Fintech companies are primarily focusing on customer-centric automatized processes that are designed based on descriptive and predictive analytics models developed by business analysts and data science teams. Fintech companies are not only changing the financial sector by offering more choices to their customers but also providing technology companies with new niches and possibilities to expand their business.

Originality/value. We empirically researched what kind of changes have arisen in the financial sector; what the main drivers are for those changes; what kind of technologies or platforms are used by fintech companies; and what kind of technologies or platforms are considered as prospective for the financial sector in Latvia. The answers to these questions could offer guidance for financial sector representatives, which could be helpful for development, taking into account that technology’s correlation with social acceptance has driven digital transformation changes.

Paper type: Research paper.

Keywords: Digital Transformation, Competency, Financial Sector, Technologies, Fintech, Latvia, Platforms.
INTRODUCTION

Metaphorically, financial sector change is compared by academic researchers with challenges faced by US manufacturing companies in the 1980s, and financial sector technology evolvement is most observable in the taxi and hotel industries, where technology has transformed traditional services into decentralized online platforms just recently. It is mentioned in some literature sources that, since the financial sector is challenged by new start-up companies that combine finance and technology, thereby creating customer-centric disruptive innovations, the incumbent banking industry is experiencing a shift in its business model and processes (Li et al., 2017; Schulte and Liu, 2017; Gomber et al., 2018).

Alt and Puschmann (2012) argue that the financial sector started to experience steady changes after the financial crisis in 2009 due to tightened financial regulation and the innovative downstream of technological solutions, which caused major changes in customer behaviour. Anagnostopoulos (2017) agrees with Alt and Puschmann (2012) that changes in financial regulation together with rapid technological development in the finance domain cause financial sector structural change, transforming financial sector business models and process outputs.

Digital transformation is penetrating the financial sector. The financial sector is challenged by new start-up companies that combine finance and technology, thereby creating disruptive innovations.

Bons et al. (2012) reveal in their research that, historically, the banking industry can be considered as technology adaption pioneers with extensive investments in technology to support their business diversifications. Scott et al. (2017) continue to research the impact of investments in technology implementation on financial sector development from a historical perspective. The authors discuss observations of the 1980s and 1990s, when academic researchers were extremely concerned about the impact of technology adoption on macro and micro-level economic outputs. According to the authors, evidence collected by academic researchers over the last two decades has shown that technologies have yielded notable economic returns. Scott et al. (2017) discuss how innovative companies can gain a market share over their competitors by introducing new operational processes, new products and services or, in other words, overriding pre-existing market conditions with technological advances. The authors’ research demonstrates that companies with intensively applied technology capital experience faster productivity growth.

The authors of this paper elaborate a concept of the impact of technology expansion on financial sector development, stating that technology promotes new product development and process improvements, and in fact, both aspects foster each other under continuous
technology development conditions (see Figure 1).

Figure 1. Impact of technology expansion on financial sector development
Source: Created by the authors based on Scott et al. (2017)

The authors perform a study of information technology’s impact on the financial sector of Latvia to research changes and technologies currently used and considered as prospective in the financial sector. The authors carry out interviews with leading fintech industry experts.

THEORETICAL ASPECTS OF DIGITAL TRANSFORMATION AND FINANCIAL SECTOR STRUCTURAL CHANGE

Digital transformation

During the last decade, digital transformation has been penetrating the social, governmental, industrial and entrepreneurial domains. Academic researchers in the information technology, business and economic fields frequently explain digital transformation based on the following two main elements: new business model creation and process enhancement. There is no generally acknowledged definition of digital transformation due to its relatively short history and interdisciplinary nature.

Gray and Rumpe (2017) attempt to investigate the definitions of digital transformation by distinguishing between the concepts of “digital” and “transformation” for an extended understanding of the term. According to Gray and Rumpe (2017), “‘Transformation’ describes a general process that starts with some initial situation that moves toward a changed, and supposedly better situation”. The authors point out that underlying transformation within the scope of digital transformation is rather a continuous evolution of new business models and processes or continuous changes of targeted domains and most probably may never meet a stable end. Gray and Rumpe (2017) suggest that “digital” entails changes driven by information technology allowing one to process large amounts of data in real time to provide stakeholders with profound insights about their business
processes. Kotarba (2018) specifies that digital is the “formation of new entities and relationships driven by application of information technology”. Ebert and Duarte (2018) support the concepts discussed by Gray and Rumpe (2017) and describe digital transformation as a technology-driven continuous change process to increase productivity. The authors declare that digital transformation helps incumbent market leaders address customers’ future needs by adapting processes to the necessary digital changes in order to be ahead of the competition among other incumbents, but the incumbent market leaders are rather passive in disrupting or cannibalizing their core incumbent products; therefore, there is still an opportunity for new technology-based startup companies to explore and occupy gaps existing in the market (Ebert and Duarte, 2018).

The present authors agree that rapid technology development has enhanced multiple processes to evolve at the incumbent company level directly and indirectly. Increasing competitiveness among incumbent market players has forced traditional business model modification; investor demands for continuous cost decreases have led to the dismissal of highly skilled and paid employees with the result that evolving and accessible technology has magnified entrepreneurial behaviour. Figure 2 shows that, apart from completely new company and business model creation, it is possible that within start-up companies digital transformation is driving the replacement of the existing business model with a completely new one. The authors maintain that new business models can be run together with existing business models and recent trends also represent new business model acquisition and integration in addition to the existing business model. Moreover, the authors argue that the focus of start-up companies on sustainable business plans is related to their relatively short life cycle. Digital transformation entrepreneurs are creating new business models with the purpose of developing their business to the level where it is possible to seek acquisition deals from incumbent enterprise solution companies. After their business is sold, entrepreneurs look for a new start-up and new business model as technology evolves.

Figure 2. Business model modification types based on digital transformation
Source: Created by the authors based on Geissdoerfer et al. (2018)
Based on the above, the creation of new business models within digital transformation as an indicator of changes is widely discussed by many academic research authors, but there is a lack of in-depth research on new business model creation associated with digital transformation. Kotarba (2018) has conducted extensive research on the new business model created by digital transformation.

**Financial sector structural change**

The authors of this paper argue that changes in the regulatory environment of the financial sector, increasing financial service costs through fees and commissions, customer lock-in business models and technology development for inside process-oriented improvements have forced entrepreneurs to fill in the gap of business opportunities. New finance and technology-based companies offer financial products to underserved customer segments and decrease the time, speed and costs for financial products using technology advancement in an era where social acceptance of technology has been achieved. There are significantly less customer lock-in business models for technology-based financial companies and processes developed by companies that are oriented primarily towards customer process improvements.

Companies that combine finance and technology are abbreviated as fintech in academic literature sources. Although fintech is a broadly used term to denote finance and technology companies, its definition is still ambiguous among academic researchers. Zavolokina et al. (2016) claim that “fintech is a living body with a flexible and changing nature rather than a stable notion that is transparent and clearly understood”. Alt et al. (2018) specify that fintech differs from the terms “digital finance” or “e-finance” used in earlier periods due to the following two key forces that are attributable exclusively to fintech: process disruption and service transformation together with technology innovation. The authors argue that there are three level differences between the fintech phase and the digital banking phase. Contrary to incumbent banks, fintech companies adopt core internal processes at the organizational level to be customer-centric and shift internal central competencies to data analytics and online channel management. Customer service and transaction handling competencies are secondary for fintech due to in-house automatized processes based on API connections. The authors reveal that fintech companies at the business network level are extensively networked with specialized external partners, who complement core in-house technology platforms and related processes. Competition among fintech companies tends to be high, and fintech customer retention is relatively low due to reduced switching service costs. In comparison to incumbent banks, the regulatory level of equity to be maintained by fintech companies at the external organizational level is lower and there is less supervision at the international level (Alt et al., 2018). For fintech differentiators from digital financial and e-commerce companies, see Figure 3.
The authors argue that the main differences existing between the incumbent bank and fintech business models are firstly related to the internal level. Fintech companies are primarily focusing on customer-centric automatized processes that are designed on the basis of descriptive and predictive analytics models developed by business analysts and data science teams using advanced data analytics tools like PostgreSQL, Phyton or R. At the same time, incumbent bank technology improvement processes are related mostly to internal operational process improvements, analytical capacities are still developing as most banks face the issue that only 20% of customer personal and behavioural data are in electronic format (Schulte and Liu, 2017), and most incumbent banks are still managing offline channels with face-to-face recognition for customer onboarding and servicing due to business processes established a long time ago and in conformity with regulatory requirements.

Alt and Puschmann (2012) discuss how financial sector change is caused by changing customer behaviour. The authors point out that “digitally native” customers are seeking electronic channels and demanding more transparency and more technology-based and customer-focused financial service solutions, which typically are not established in the banking industry. The authors argue that this is changing the whole concept of customer service processes in the financial sector. The authors of this paper maintain that the statement of Alt and Puschmann (2012) is in line with the previously discussed observation that digital transformation has been driven by the social acceptance of overall technology development.

Also, Anagnostopoulos (2017) considers demographics to be one of the driving factors of financial sector changes. The authors accept the concept that “digitally native” customers have completely changed the perception of how customer processes will be designed for highly technically proficient digital clients and that fintech companies are created to meet the needs of people who have opted for financial services provided completely online, where speed, assistance on the spot and great reach are key factors, thereby no longer visiting offline branches. The present authors maintain that new financial sector players
who are delivering new concepts of how to serve customers’ financial needs using technology are stimulating change throughout the sector.

**RESEARCH METHODOLOGY**

**Type of research and design of the research instrument**

The process of qualitative research was designed as face-to-face expert interviews and the definition of central interview questions for the research based on the literature review and related questions.

The expert interview study was constructed by asking a few open-ended interview questions, and the authors sought to collect detailed views and opinions from the interview participants.

The interviews were conducted on the premises of the company whose representatives were interviewed, and potential competition clauses were discussed and agreed on before the interviews were started to avoid collecting any harmful information.

Three central questions were defined to explore the central concept of the study performed by the authors: (1) What kind of changes have arisen in the financial sector? (2) What are the main drivers for those changes? (3) What kind of technologies or platforms are used by fintech companies and what kind of technologies or platforms are considered as prospective for the financial sector in Latvia?

The interviews took place from 17 December 2017 to 5 January 2018; one interview was carried out in English and all other interviews were carried out in Latvian. The expert interviews were conducted over a short period of time and the authors made sure that the questions were not reformulated so that the interview results were comparable.

**Profiles of experts**

The authors conducted nine fintech expert interviews out of thirty potential expert interviews within the research: six C-level expert interviews, two expert interviews with heads of IT and two expert interviews with heads of HR. The experts represent Mogo, Cream Finance and Sun Finance, which are all fast-growing, technology-driven, international lending companies, as well as Twino (P2P investment/lending platform company), Monea (instant payments company) and Nordigen (customer screening services company).

The authors of the research analyzed the profiles of the experts based on information provided on their websites and in LinkedIn profiles.
C-level expert profiles:

1. a bachelor of science in business and economics and worked for a leading online lending company, from 2009 to 2016.
2. an MBA degree and experience in the banking sector.
3. an MBA degree and has been employed only by Monea.
4. a bachelor’s degree in business and economics and has broad work experience in marketing and project management.
5. a bachelor’s degree in computer science and an MBA. The expert has ten years’ experience in the customer service field.
6. an executive MBA degree and has been employed only by the fintech company he founded.

IT experts:

1. CIO who has various licenses and certifications from Microsoft and six years’ work experience in the management of software development in the online gambling industry.
2. CIO who has a computer science background and technical work experience with Exigen Services.

HR experts:

1. a master’s degree in business management and nine years’ work experience.
2. a head of HR who has HR education and experience in a fintech company from 2013 to 2017 preceded by five years’ HR experience with a production company.

Profiles of fintech companies

By illustrating one parameter turnover per employee, it appears that fintech companies representing different business models have different business growth trends. See Figures 4 and 5.

![Figure 4](image1)

![Figure 5](image2)
At the same time, the analysis of these and other financial data should be carefully addressed because of the very short term that describes them. If individual credit companies have started their business at the end of the first decade of this century, in the wake of the global financial crisis, then the so-called platform companies started around 2014-2015. It is quite obvious that by analysing fintech in the financial intermediation services sector, the fintech credit industry and fintech platform industry can be distributed as separate sectors in the fintech segment.

The authors of this paper have chosen situational analysis and expert interviews as the most relevant research tool, enabling them to track processes in these industries and the financial intermediation services sector in general and to understand what is happening in the fintech segment.

RESEARCH RESULTS

CEO interviews

RQ1: What kind of changes have you noticed in the financial sector (banks, fintech) and do you consider those changes to be fundamental?

C-level experts of fintech companies agree that financial sector changes are fundamental for various reasons. The Sun Finance expert mentioned that regulatory changes have reached a point of extreme burden with regard to the regulation of non-resident services and AML. The expert highlighted that regulatory requirements will be even tighter, or the regulator will start the deregulation process. The Mogo and Monea experts also stated that regulation drives structural changes in the financial sector. The Cream Finance expert pointed out that today everything is happening much faster. According to the expert, most banks in Latvia have no ambition to develop, and the expert does not consider banks to be competition. The Monea expert shares the opinion of the Cream Finance expert that banks have little ambition to expand business beyond their current business model. According to the Cream Finance expert, banks cannot be regarded as competitors of fintech as they serve completely different client segments and have never positioned themselves as technology companies. The Sun Finance expert argued that the fintech industry is definitely competing and will continue to compete with banks as fintech credit companies are able to serve customer segments better by offering attractive finance products to bank customers through technology and data analytics development. The Twino expert pointed out that previously banks created products for customers and forced them to use those products, but
fintech companies are developing products based on customer needs. According to this expert, there is always an addressed customer need behind products of fintech companies. The Mogo expert argued that financial services are available from both banks and fintech, but the biggest difference is the ambition of fintech companies to run a business. The Monea expert mentioned that there are two types of fintech solutions: ambitious fintech companies that want to achieve something and fintech companies seeking to become digital banks or be part of established big banks.

The Nordigen expert noted that 4Finance and Ferratum offering online lending was the biggest milestone for the financial sector in Europe. The expert argued that their business changed the finance industry, since the market saw that online lending, digitalization and automatization can actually work, and pointed out that now everyone is moving toward digitalization and automatization. The expert maintained that only very prosperous banks will be able to keep offline branches. The expert referred to discussions with large investors who have invested in projects like Facebook and Dropbox and indicated that they see open banking as the financial sector’s future and everything that can be built on top of open banking will be the future of fintech. The expert stressed that Nordigen has proved that bank account transaction data have real power, as much as credit bureaus.

**RQ1-1: What are the main drivers for those changes?**

The Twino expert pointed out that competition is the main driver for financial sector change and stressed the importance of UX (user experience), which determines how a customer feels when using the product and whether the customer will return. This expert argued that technology is definitely not the primary driver for financial sector change and the winner among the competition will be the one who provides the best UX and service to customers. The Monea expert stated that the transparent structure of fintech service fees in comparison to the hidden banking fee approach is the driver of the change. The Cream Finance expert noted that the driver for financial sector change is that many fintech company products are designed like a game, which is attractive for millennials. The Mogo expert argued that financial sector change is driven by the ambition of young people to learn technologies and earn money. The Sun Finance expert pointed out that financial sector change drivers are regulation controlled by the EU and the US and technology development and mentioned instant payments as an important milestone for changes observed in the financial sector.

The authors of this research summarize that, according to the opinion of fintech CEOs, regulation, technology development, ambitions and competition are the main drivers of financial sector change.

**RQ2: What kind of technologies or platforms are currently being used by your company and what kind of technologies or platforms do you consider as prospective?**
The Cream Finance expert shared their challenging experience when the company launched a business using a generic lending system bought from a Lithuanian company, which seemed to be a relevant approach for the quick launch of the business and subsequent rapid growth, but it soon became clear that the platform did not accommodate their need for growth. The expert explained that the company outsourced an IT team in Poland to develop a new lending system, which unfortunately turned out to be an unsuccessful project, and, in order to maintain business growth and sustainability, the company made a strategic decision to insource a technology team and develop an in-house lending system. The insourced technology team is located in Austria.

The Sun Finance expert said that they are constantly following new tendencies in the technology market and implementing innovative solutions in addition to the current technology solution. The expert pointed out that the system has to be sustainable and prematurely launched technology solutions can result in a business developing much faster than the prematurely launched technology. According to the expert, there are two main success factors for a fintech business to be able to grow and develop sustainably: technology and credit risk management.

The Twino expert argued that there are few requirements for a product launch from the technology perspective and pointed out that the main thing is to go into the market with the working product having only a front page, while running the back end of the business can be done in Excel. The expert noted that the back end of the product can be built after all necessary product modifications and that it is important that each product and process is built or modified based on credit risk and data analysis. The expert noted that the product-data-people concept is obsolete, and the new concept is people-data-productivity.

The Mogo and Monea experts maintained that the current technology platform fully supports the company’s needs in running a business.

The Nordigen expert pointed out that Nordigen would not have been possible 15 years ago and highlighted that the non-banking sector is helping to develop and start cooperation with banks. The expert pointed out that Nordigen uses cloud services and noted that AWS is very comfortable to use and it has been recognized as a safe environment for technologies. The expert pointed out that the future driver for Nordigen is open banking development and emphasized that real open banking does not work anywhere in the world. The expert mentioned that big banks are trying to implement open banking and pointed out that in ten years open banking will be everywhere. The expert indicated that Nordigen’s vision is to be an alternative solution to the credit bureau as there is not enough information about clients in the credit bureau to make creditworthiness decisions.

**CIO expert interview**
RQ1: What kind of changes have you noticed in the financial sector (banks, fintech) and do you consider those changes to be fundamental?

The Sun Finance expert shared the observation that fintech companies are moving away from the use of a single programming language like, traditionally, Java or PHP and are building a multilanguage approach system, which consists of many different modules. The expert argued that in fintech each module can be written in a different programming language and the ability to work with extensive API-based network systems and manage connections between modules is becoming the main skill. According to the expert, the DevOps approach with a development team and infrastructure merged into one team makes it possible for fintech companies to scale their business, build a more effective business process and do more with less. The expert noted that the concept involving separate developer and infrastructure teams is obsolete because the technology team will run what has been built; the whole team will be aligned to be capable of delivering sustainable systems and products. The Mogo expert agrees with the Sun Finance expert that AWS, Microsoft Azur or Oracle cloud services give fintech companies necessary scalability and transparency through the “infrastructure-as-a-code” approach. The Sun Finance expert pointed out that fintech companies are looking for opportunities to use API-driven innovative technologies rather than the one-enterprise solution. The expert mentioned that the ability to measure process quality, code and technical team performance applying the OKR system forces the whole industry to think smarter and pointed out that, due to a rapidly changing technology environment, there will be a team assigned to constantly monitor market changes, and the technical team will be ready to replace the solution they are using today with a potentially better solution. The expert noted that process quality is becoming the core driver for customers and, accordingly, the ability to monitor and measure process performance and improve quality is the key driver for competitiveness. The Mogo expert expressed his view that there is no need for extensive programming language knowledge in the financial sector as there are many existing open-source solutions and only the ability to use those resources is needed to develop new products.

RQ1-1: What are the main drivers for those changes?

The Sun Finance expert noted that the DevOps approach is the main change because it has grown for the last six years, and not only in the work of such giants as Google and Amazon. The expert pointed out that unseparated development and infrastructure is becoming pretty common and argued that the main drivers are about scaling, being efficient, doing more with less time. The expert stressed that developers are expensive and Google’s SRE program is definitely the main driver in the engineering world.

The Sun Finance expert emphasized that it is very important which code you use, which infrastructure, tribes and guilds, to move everybody as one if you build it to run it and stressed the importance of developing with the operational mindset and product life cycle
management. The expert indicated that the company is moving toward more sustainable product development and mentioned as an example that to turn down quality of video to make the system more reliable is a major indicator and concluded that reliability is more important for customers than quality of video.

The Mogo expert pointed out that the driver is that there is no need to develop anything from the beginning and mentioned that systems are working on AWS; there is no need to worry when hardware memory is full. The expert emphasized that there are many ready services available, with no need to develop anything from scratch, and pointed out that infrastructure-as-a-code is a key element for today. The expert emphasized that everything is transparent and measurable and argued that this is very important. The expert concluded that desktop-as-a-service is available and pointed out that knowledge of how to use it is very important.

**RQ2: What kind of technologies or platforms are currently being used by your company and what kind of technologies or platforms do you consider as prospective?**

The Sun Finance expert explained that the company uses cloud platforms and pointed out that open-source technology is absolutely a future for Sun Finance. The Mogo expert said that current technologies are sufficient for today and the future needs of the company.

**Head of HR expert interview**

**RQ1: What kind of changes have you noticed in the financial sector (banks, fintech) and do you consider those changes to be fundamental?**

The Sun Finance expert shared the opinion that when credit fintech companies just started to operate, there was high negativity around the sector, which was mainly caused by banks, as fintech companies were able to adopt technology quickly and to address client needs. The expert pointed out that today new specialists in the financial sector want quick growth, and career growth is often much more important for candidates than remuneration.

The Mogo expert mentioned that, as far as they have noticed, fintech companies disrupt bank processes and observed that it is hard for banks to change. The expert argued that the banking industry needs to change its competencies, skills and fixed mindset.

**RQ1-1: What are the main drivers for those changes?**

The Sun Finance expert noted that technology is definitely the main driver for finance industry change and mentioned as an example that today everything can be done over the phone or through the internet. The expert pointed out that technology also changes personalities and requirements for the work environment and emphasized that convenience and speed drive the development of technology and the company.
The Mogo expert noted that the financial sector is changing and adopting processes where speed, flexibility, dynamics, non-bureaucratic processes and flat organizational structures are core. The expert emphasized that entrepreneurship culture is changing the whole financial sector.

**RQ2: What kind of technologies or platforms are currently being used by your company and what kind of technologies or platforms do you consider as prospective?**

The Sun Finance expert explained that the company is using the latest technologies available on the market and pointed out that an opportunity to learn and apply knowledge in practice is very attractive for employees. The expert pointed out that for the future the company is moving toward a full self-service system and, as an example, mentioned self-service culture where each employee will be able to manage relationships with HR in an online system. The expert indicated that big data analysis and artificial intelligence are the future of HR, and HR data analysts will be in high demand.

The Mogo expert explained that currently HR is being managed using Excel and admitted that it is hard to convince management that there is a necessity for an advanced HR system and that those who have not used HR management through an advanced system cannot understand its value. The expert shared the experience that it is difficult to carry out HR data management if there is no HR system in place and pointed out the importance of analyzing HR data. The expert pointed out that data analytics and artificial intelligence are the future for HR decision-making during the hiring process.

**Analysis of responses**

**Financial sector change.** All the experts have noticed that the financial sector is changing. Same-level experts have a similar opinion on financial sector structural change, but there are differences in opinion among different-level experts. The C-level experts consider that financial sector changes are driven by regulation, technology development, digitalization, automatization and the ambition to grow. The technical experts argue that the ability to scale business using technology is the key driver and point out that open-source services, multilanguage programming, DevOps and the ability to measure system performance drive financial sector change. The HR experts maintain that digitalization, speed of services and employees’ ambition to grow quickly trigger technology sector changes.

The authors agree with the experts that the financial sector is experiencing structural change. The authors maintain that technology sector development started decades ago. Social acceptance of technology is an important milestone that accelerates technology development. The authors also maintain that technologies enhance processes, improve customer experience and scale the business owing to data available in electronic form, which facilitates the ability to analyze and process large amounts of data in real time. This
drive has increased analytical competency demand from companies that see the future value of the power of analytics.

**Main drivers of financial sector change.** The experts mention various drivers for financial sector change. C-level experts argue that technology is not the main driver of the change. The experts mention extensive venture capital availability, ambition and competitiveness as the main drivers of financial sector change. The technology experts and HR experts believe that technology is the main driver of change.

The authors agree with the C-level experts that technology is not the main driver of the change. The authors maintain that social acceptance drives technology development. This results in increasing competitiveness driven by the ambition of company leaders.

**Technologies currently used and considered as prospective.** The C-level experts agree that business will be run using an in-house system. The C-level experts expressed different opinions on the readiness of technology to be launched in the market. The platform fintech company experts strongly believe in the minimum viable solution, while the credit fintech company experts are against prematurely launched systems. Both platform and credit technology experts point out the importance of open-source technology and opportunities to use cloud services. The HR-level experts believe that technology is important for HR process management and point out that the current HR management practice using Excel sheets is obsolete.

The authors concluded that companies are undergoing continuous technology development. The authors argue that there cannot be a situation under rapidly developing technology conditions where a company is completely ready for the market system. The researchers maintain that the fintech industry has only existed since 2015 and, for this reason, not enough experience has been collected to be in a position to evaluate sustainability aspects.

**CONCLUSIONS**

Digital transformation entrepreneurs are creating new business models with the purpose of developing their business to the level where it is possible to seek acquisition deals from incumbent one-enterprise-solution companies. Fintech companies are primarily focusing on customer-centric automatized processes that are designed on the basis of descriptive and predictive analytics models developed by business analysts and data science teams.

Digital transformation helps incumbent market leaders address future customers’ needs by adapting processes to necessary digital changes in order to be ahead of competition among other incumbents. The paper points out that the incumbent market leaders are rather passive in disrupting or cannibalizing their core incumbent products; therefore, there is still
an opportunity for new technology-based startup companies to explore and occupy gaps existing in the market. The research emphasizes that digital transformation has triggered different factors that have magnified entrepreneurial behaviour. The authors conclude that fintech companies are not only offering financial products to underserved customer segments but also providing financial services to the entire pyramid of customers and point out that fintech companies are decreasing the time, speed and costs for financial products using technology. The paper argues that digital transformation contributes to financial sector structural change because there are significantly less customer lock-in business models and processes developed by fintech companies that are oriented primarily towards customer process improvements.

Financial sector structural change can be considered as fundamental. The main factors leading the change are social technology acceptance and entrepreneurs’ ambition to establish fintech companies.

The creation of new business models within digital transformation as an indicator of changes is widely discussed by many researchers, but there is a lack of in-depth research on new business model creation associated with digital transformation. Increasing competitiveness among incumbent market players has forced traditional business model modification.

REFERENCES


The role of mortgage payment insurance in reducing the mortgage default risk level in Latvia

ANDRIS FOMINS
AIVARS SPILBERGS
MARIS KRASTINS

ABSTRACT

Purpose. The use mortgage payment insurance as an instrument to reduce the credit risk of mortgage loans in Latvia is significantly lower than in EU and other developed countries. The authors aim to investigate the role of mortgage payment insurance in reducing the credit risk of mortgage loans and assess its potential impact on the housing market in Latvia.

Design. The authors created the following research structure:

Information on the level of use and coverage of home loan payment insurance in Latvian commercial banks has been collected and analysed.

The authors carried out calculations of a person's risk statistics in Latvia and modelling of the potential impact of a borrower’s insurance on the household’s losses.

Findings. Mortgage loans are one of the key resources for improving the welfare of families in developed countries. On the other hand, during the recent crisis 16% of borrowers faced problems with housing loan repayment, while 10% of borrowers were forced to look for new housing because the property was taken over as a result of default (FCMC, 2019). This problem is not systematically addressed at the moment in commercial banks in Latvia.

Originality. No studies have been carried out in Latvia that assess losses in case of temporary incapacity, permanent incapacity for work or forced unemployment in credit institutions and households in Latvia in the context of mortgage lending.

Keywords: mortgage payment insurance, mortgage default risk and unemployment.

Paper classification: research paper
INTRODUCTION

The Latvian financial services market can be characterized as relatively simple and fragmented in terms of use of financial services. This is especially true for financial services related to risk-taking, namely loans. Voluntary transfer of risk to third parties is not popular and borrowers do not appreciate its role in personal finance management. Instead, borrowers fully assume all the risks associated with adverse developments in their personal finances. As a result, even short-term financial problems, such as job loss, can cause significant losses to the borrower and increase the level of risk in credit institutions.

Often, the reason for such household financial behaviour is the cost of the service and low likelihood of risk. In this situation it would also be possible to talk about the low level of financial literacy of Latvian society. However, consumers of financial services in Latvia in this situation lose out because they do not get full protection against the risks that they cannot fully control.

Latvian commercial banks use mortgage guaranty insurance as a credit risk mitigation tool, but the use of mortgage payment protection insurance by borrowers is rather insignificant.

This makes the mortgage lending system in Latvia more vulnerable to external risks, and the financial services received by borrowers are less favourable than they would be in a fully and comprehensively developed market situation. The low utilization rate of mortgage payment insurance and insufficient risk allocation prevent insurers from offering the consumer a more affordable price for this financial service.

THEORETICAL FRAMEWORK OF THE RESEARCH

Risk has come increasingly to characterize homeownership, and the provision of risk mitigation has become more important, particularly in terms of ensuring that borrowers can maintain their stream of mortgage payments (Ford, 2012).

Mortgage insurance is a contract that can indemnify the loss of the mortgage bank while the borrower default and the auction income of the collateral (or the house) does not cover the loan balance (Wu et al., 2017). Mortgage insurance is offered in different forms. Primary mortgage insurance is the insurance of a single mortgage credit. Mortgage portfolio insurance covers whole pools of loans (Chen, 2000) by providing varying combinations of accident, sickness and unemployment insurance and is used to protect the mortgage payments of policyholders in the event of a fall in income (Ashton and Hudson, 2017).
Mortgage guaranty insurance (MGI) and mortgage payment insurance (MPI) play a major role in credit risk mitigation in developed countries. Before the financial crisis in 2008, fewer default events occurred and the hazard rate was low (Wu et al., 2017). Lenders and borrowers have experienced significant losses due to defaults of households in an economic crisis situation. For mortgage financers, mortgage insurance opens up the possibility of leaving behind the limits of a fixed loan to value ratio (LTV) in favour of a flexible combination of individual LTV and mortgage insurance. By using private mortgage insurance, mortgage financers can expand their lending business to higher LTV ratios without incurring the related risks (Kofner, 2007). Consumers in underdeveloped markets lose out in this situation as they are forced to receive less advantageous mortgage services. There may be some support in this area in the form of public housing loan guarantees, but the range of beneficiaries is usually relatively limited. MGI and MPI can provide borrowers with equivalent benefits, but on market terms.

MGI can help lenders and borrowers to cope with the default risk of mortgage credits. MGI is taken out by the debtor of a mortgage in favour of the lender. The insurance covers the loss risk of the creditor in case of a borrower’s default (Park, 2016). While MGI does not directly prevent defaults, it protects lenders and the economy from their often harmful consequences (Park, 2016). MPI is a mortgage insurance product that can protect both the borrower and the lender after a mortgage transaction is made, by guaranteeing the regular payments that ensure repayment (Kofner, 2007). Regular repayment of the loan is the main goal of a lender. Smart lenders do not rely solely on LTV in problematic situations.

During an economic downturn and especially in times of crisis, lenders and borrowers experience significant losses due to defaults of households. Mortgage payment protection insurance is an ‘add-on’ service providing varying combinations of accident, sickness and unemployment insurance and is used to protect the mortgage payments of policyholders in the event of a reduction in income (Ashton and Hudson, 2017). Mortgage insurance is not intended to prevent loan defaults, only to compensate investors if they occur. While not all “underwater” borrowers default, distressed borrowers with home equity can in theory always refinance or sell the property to avoid default. Mortgage insurance is typically associated with high LTV ratios, but according to this theory the presence of mortgage insurance should have little impact on the default rates for loans with similar levels of home equity (Park, 2016).

Lenders often have greater knowledge of a borrower’s credit risk than captured in traditional underwriting standards available to mortgage insurers. Bank lenders may have detailed knowledge of the financial situation of a customer from years of providing banking and financial services. This asymmetric information allows lenders the option to profitably self-insure when lending to lower risk borrowers (Park, 2016).

Even if a country’s market and regulatory environment is conducive to high-volume low-risk mortgage financing, the mortgage insurer must avert ‘adverse selection of risk’, i.e., it
must overcome the mortgage lender’s natural inclination to choose – loan by loan – which cases to submit for insurance and which cases to ‘self-insure’. After all, who more than the lender is likely to know which credits and which properties present significant incremental risks most in need of insurance against default-induced losses. (Blood, 2001)

There are important differences between MPI and MGI:

- MGI pays out to the lender whereas MPI protects the borrower;
- MGI provides all-risk coverage. Default-related losses of the lender are insured absolutely independent of the reasons for defaulting;
- MPI covers the risk of a temporary loss of earned income with respect to mortgage repayments;
- MPI provides preventive coverage. It helps to prevent defaults by replacing missing income to the borrower;
- With MGI, the insured event is the mortgagor's default;
- MPI is subject to moral hazard, whereas the moral hazard problem is non-existent with MGI, at least in the lender-borrower relationship (because it pays out to the lender). Regarding the coverage range (omitting important causes of default) and the types of risks insured by MPI, the moral hazard risk should be limited (Kofner, 2007).

MGI and MPI are important elements of a fully developed national system of real estate finance. Without MGI and MPI, borrowers are unable to make a sensible down payment and are either excluded from access to mortgage credit or suffer from unfair lending practices. Mortgage insurers help lenders to improve their risk management (Kofner, 2007).

Given the systematic risk, which is due to macro-economic factors like interest and unemployment rates, worldwide risk dispersion across different economic cycles would make a lot of sense. The more countries are covered by mortgage insurance, the better international risk dispersion will work. (Kofner, 2007)

There are two alternative views of home mortgage default behaviour (Jackson and Kasserman, 1980):

- The equity theory of default holds that borrowers base their default decisions on a rational comparison of financial costs and returns involved in continuing or terminating mortgage payments.
- The alternative is the ability-to-pay theory of default. According to this approach, mortgagors refrain from loan default as long as income flows are sufficient to meet the periodic payment without undue financial burden.

Under the equity theory, the current loan to value ratio (CLTV), which measures the equity position of the borrower (i.e. the market value of the mortgaged property divided by the
outstanding mortgage loan at each point in time), is considered to be the most important factor in default decisions. By contrast, under the ability-to-pay model, the current debt servicing ratio (CDSR), defined as the monthly repayment obligations as a percentage of current monthly income, which captures the repayment capability of the borrower, plays a critical role in accounting for defaults. (Kofner, 2007)

The insurance covers a mortgager's monthly mortgage repayments (interest payments and amortization) if he or she is unable to work because of unemployment, accident, or sickness. Usually all three risks are insured, but it is possible to insure against a subset, particularly where other insurance is already in place (Whitehead and Holmans, 1999). MPPI pays out to the borrower and its payouts are independent of a household’s financial resources (Song, 2005).

From a housing policy perspective, the idea of private mortgage insurance is convincing because of its potential to shorten the savings phase ahead of homeownership. It could bring young families into their first home many years earlier. Mortgage insurance allows for higher LTV lending and can be regarded as a substitute for equity capital. It surely has the potential to raise the homeownership rate by considerably reducing the average entry age of homeownership (Kofner, 2007).

Private mortgage insurance enables lenders to share the risks of mortgage lending to riskier target groups. It is offered in different forms for the primary and the secondary mortgage credit markets and faces competition on both markets (Kofner, 2007). In addition to the unemployment risks faced by mortgage borrowers, an important determinant of the risk of arrears and repossession is the non-financial resources at the mortgagor’s disposal relative to his/her essential outgoings and mortgage payments. For example, a single person with a small mortgage and sizeable savings is more likely to be able to survive a short bout of unemployment than someone with many dependants, a large mortgage and meagre savings. One would, therefore, anticipate higher levels of insurance take-up amongst households that have diminutive savings relative to family outgoings (Pryce and Keoghan, 2002).

**MORTGAGE LOANS AND INSURANCE MARKET DEVELOPMENT IN LATVIA**

Mortgage loans play an important role in ensuring the well-being and long-term stability of society. According to an EU-SILC survey, the overcrowding rate in Latvia (40.5%) in 2017 was 2.4 times higher than the EU average, while only 10% of owner-occupied dwellings in Latvia were encumbered with mortgage. The EU average level of encumbrance was 2.8 times higher than in Latvia, while the level of more developed EU countries ranges from 40-60%.
The active development phase of housing lending in Latvia started approximately fifteen years ago (see Figure 2). It developed rapidly between 2002 and 2006, and mortgage loans made up a significant share of commercial banks’ income in this time period. However, the rapid growth of mortgage lending, reaching an average increase of 90% per annum, slowed considerably starting from mid-2007, following the adoption of an anti-inflation plan by the Cabinet of Ministers of Latvia. For almost five years after the crisis, housing lending stagnated because:

- Banks reviewed their credit policies, as they suffered significant losses on loans issued before the financial crisis;
- Households were cautious, as the decline in unemployment and growth in income started only 4-5 years after the crisis, e.g. from 2013. In addition, the inability of a substantial share of borrowers to repay commitments previously assumed gave rise to excessive vigilance against new credit claims;
- Global political and economic uncertainty from 2014-2016 did not provide sufficient assurance about long-term stability.
The role of mortgage payment insurance in reducing the mortgage default risk level in Latvia

Figure 2. Latvian credit institutions’ loan portfolio development
Source: FCMC, 2019

Even now, despite a resurgence of household lending, including mortgage lending, a further downward trend in the loan portfolio can be observed, which, in the authors’ view, is another consequence of the 2008 financial crisis and is linked to the repayment of active “old” liabilities. Banks and consumers are still cautious about the issue of new commitments and the amount of new loans issued is not able to compensate for the reduction in the loan portfolio caused by the repayment of current active liabilities. Overall, such a market development scenario cannot be welcomed, and there is an objective need to build credit market growth on a more stable basis in the future.

Property insurance products are closely related to household lending. They include a variety of insurance coverage that protects against risks such as fire, theft and some types of weather damage but exclude any risk related to the solvency of the borrower. Property insurance product growth has a strong correlation with a country’s economic development and the development of financial markets. Latvia has experienced such a situation: on May 1st, 2004, Latvia joined the EU (European Union, 2019), and that was a crucial signal for different industries that the country is safe, that it is developing and has a strong future. Rapid growth of financial markets, especially the banking sector and leasing companies, took place. Scandinavian financial groups (e.g. Hansa Leasing, SEB banka, Hansabanka) provided the Latvian financial market with cheap long-term money. Latvian households had the possibility to get a loan for the purchase of a new car or real estate. This caused a property bubble and the development of a property insurance bubble (Figure 3). One of the
factors that influenced the growth of the insurance market is the mandatory character of property insurance.

![Gross direct premiums written on the domestic market: property insurance in Latvia (millions, EUR) and Insurance Europe member states (billions, EUR)](chart)

Figure 3. **Gross direct premiums written on the domestic market: property insurance in Latvia (millions, EUR) and Insurance Europe member states (billions, EUR)**

Source: (Insurance Europe, 2019)

In 2017, property premiums in EU grew 3.6%, while, at the same time, the Latvian property insurance market grew more than 3 times faster (+13.8) (Insurance Europe, 2019). Insurance density identifies how much money an inhabitant spends on insurance. Latvia had a very low insurance density base before joining EU and it still remains almost 10 times lower than in Europe on average.

<table>
<thead>
<tr>
<th>Density: property insurance in Latvia and the EU average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (total premiums EUR per inhabitant): property insurance in Latvia and the EU (average)</td>
</tr>
<tr>
<td><strong>Country</strong></td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>LV</td>
</tr>
<tr>
<td>Insurance  Europe member states</td>
</tr>
</tbody>
</table>

Source: (Insurance Europe, 2019)
From another point of view, the property insurance premium growth tendency is positive, and further development of this market segment is expected. This will be influenced by the growth in mortgage lending, rising property prices and the mandatory character of property insurance for borrowers.

**MORTGAGE LOAN LOSS RATES AND MORTGAGE PAYMENT INSURANCE IN LATVIA**

In order to minimise the credit risk, Latvian commercial banks in cooperation with Latvian insurance companies offer different types of mortgage payment insurance (MPI) (see Table 2).

<table>
<thead>
<tr>
<th>Option</th>
<th>MPI type</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandatory or up to the borrower</td>
<td>Temporary disablement</td>
<td>Monthly payments</td>
</tr>
<tr>
<td></td>
<td>Permanently lost capacity for work</td>
<td>Full housing loan balance</td>
</tr>
<tr>
<td></td>
<td>Loss of life</td>
<td>Full housing loan balance</td>
</tr>
<tr>
<td>Up to the borrower</td>
<td>Involuntary unemployment</td>
<td>Monthly payments</td>
</tr>
</tbody>
</table>

Source: Swedbank and SEB banka (2019)

As seen in Table 2, MPI in Latvia largely covers external risks of the borrower, leaving behavioural risks to the lender.

The low level of use of MPI can be largely explained by the low level of development of the insurance market in Latvia in general. As seen in Table 3, insurance density and penetration levels are way below EU average levels.

| Density and penetration: the domestic insurance market in Latvia and the EU (average) |
|---------------------------------------------------------------|---------------------------------|-------------------------------|
| Density (total premiums per inhabitant): domestic market in Latvia and the EU (average) | Country                        | 2013  | 2014  | 2015  | 2016  | 2017  |
| LV                                                           | 96.0                           | 101.0 | 112.0 | 103.0 | 123.0 |
| Insurance Europe member states                               | 2.464                          | 2.585 | 1.847 | 1.854 | 1.855 |
| Penetration (total premiums to GDP): domestic market in Latvia and the EU (average) | Country                        | 2013  | 2014  | 2015  | 2016  | 2017  |
| LV                                                           | 0.8%                           | 0.9%  | 0.9%  | 0.8%  | 0.9%  |
| Insurance Europe member states                               | 5.6%                           | 5.7%  | 4.9%  | 4.9%  | 5.2%  |

Source: (Insurance Europe, 2019)
The inability of borrowers to meet their commitments, as well as the limited possibilities of refinancing due to sharply falling housing prices in Latvia from 2008 to 2010, led to a rapid increase in non-performing loans (NPLs). In analysing the causes of the NPL increase (see Figure 4), the authors concluded that the most relevant factors were “external circumstances”, such as:

- unemployment (a correlation rate of 0.8018 over the period of 2001-2018 highlights a strong positive association) and occupational disability (temporary or permanent);
- real wages growth (-0.7827 highlights a pretty strong negative association);
- GDP growth (-0.667 indicates a pretty strong negative association);
- the behaviour of the households themselves, such as:
  - excessive commitment (the correlation coefficient 0.5618 indicates a medium strong positive association) and insufficient savings;
  - mismanagement of personal incomes and costs of living;
  - competitiveness in the labour market (qualifications and experience);
  - other aspects.
The role of mortgage payment insurance in reducing the mortgage default risk level in Latvia

A survey performed by the authors of leading Latvian commercial banks representing 56% of the housing loan portfolio showed that less than one third, ca. 30% of borrowers, were using MPI at the end of 2018. In comparison, in Estonia and Lithuania the share of mortgage payment insurance users among mortgage lenders is more than twice as high. At the same time, comparing the statistics as of 30.09.2018 from EBA (see Figure 5), it can be concluded that in countries where the majority of mortgage loans are covered by mortgage payment insurance, the level of credit losses was approximately twice as low as it is currently in Latvia.

THE IMPACT OF UNEMPLOYMENT ON MORTGAGE DEFAULT AND LOSS RATES IN LATVIA

The authors used primary data from The State Social Insurance Agency of Latvia (SSIA) for the period of 2013 to 2018. The unemployment statistics were grouped by age groups that are traditionally used by banks to group their credit clients and are also more frequently mentioned in studies such as Bell and Blanchflower, 2011: 25-34; 35-44; 45-54 and 55-64.

Age groups up to 25 and over 64 years were not included in the study since their proportion in the housing loans portfolio is not significant.

The authors assessed the likelihood of unemployment using the following formula:
\[ LoU_{i,t} = \frac{Uc_{i,t}}{E_{i,t}} \]  

where \( LoU_{i,t} \) - likelihood of unemployment within age group \( i \), during year \( t \); 
\( Uc_{i,t} \) - unemployment cases within age group \( i \), during year \( t \); 
\( E_{i,t} \) - employed within age group \( i \), in year \( t \).

Figure 6 shows the trends for the likelihood of unemployment by age groups for the period of 2013 to 2018.

The following hypothesis testing was performed to assess the statistical stability of the unemployment likelihood ratios calculated:

- \( H_0 \): Likelihood of unemployment is not dependent on age group and year;
- \( H_A \): Likelihood of unemployment is dependent on age group and year.

For the hypothesis testing, the authors used two-factor ANOVA, and the results are shown in Table 4 and Table 5:
The role of mortgage payment insurance in reducing the mortgage default risk level in Latvia

Table 4

Average unemployment rates and variances by ages and years

<table>
<thead>
<tr>
<th>SUMMARY</th>
<th>Count</th>
<th>Sum</th>
<th>Average</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-34</td>
<td>6</td>
<td>0.526631</td>
<td>0.087772</td>
<td>0.000052</td>
</tr>
<tr>
<td>35-44</td>
<td>6</td>
<td>0.390104</td>
<td>0.065017</td>
<td>0.000026</td>
</tr>
<tr>
<td>45-54</td>
<td>6</td>
<td>0.362597</td>
<td>0.060433</td>
<td>0.000058</td>
</tr>
<tr>
<td>55-64</td>
<td>6</td>
<td>0.406148</td>
<td>0.067691</td>
<td>0.000047</td>
</tr>
<tr>
<td>2013</td>
<td>4</td>
<td>0.288033</td>
<td>0.072008</td>
<td>0.000138</td>
</tr>
<tr>
<td>2014</td>
<td>4</td>
<td>0.272557</td>
<td>0.068139</td>
<td>0.000172</td>
</tr>
<tr>
<td>2015</td>
<td>4</td>
<td>0.307832</td>
<td>0.076958</td>
<td>0.000140</td>
</tr>
<tr>
<td>2016</td>
<td>4</td>
<td>0.309730</td>
<td>0.077433</td>
<td>0.000167</td>
</tr>
<tr>
<td>2017</td>
<td>4</td>
<td>0.262178</td>
<td>0.065545</td>
<td>0.000161</td>
</tr>
<tr>
<td>2018</td>
<td>4</td>
<td>0.245149</td>
<td>0.061287</td>
<td>0.000126</td>
</tr>
</tbody>
</table>

Source: Calculated by the authors, based on SSIA data

Table 5

Two-factor ANOVA test summary statistics on unemployment rates

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
<th>F crit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rows</td>
<td>0.002624</td>
<td>3</td>
<td>0.000875</td>
<td>151.597</td>
<td>0.00000000002</td>
<td>3.287</td>
</tr>
<tr>
<td>Columns</td>
<td>0.000826</td>
<td>5</td>
<td>0.000165</td>
<td>28.647</td>
<td>0.000000036137</td>
<td>2.901</td>
</tr>
<tr>
<td>Error</td>
<td>0.000087</td>
<td>15</td>
<td>0.000006</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>0.003537</td>
<td>23</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Calculated by the authors, based on SSIA data

Conclusion: the authors reject $H_0$ because $F_i > F_{crit}$, $F_i > F_{crit}$ and the p-values for both are very low. We have statistically significant evidence at $a < 0.000001$ that likelihood of unemployment is dependent on age group and year.

In this study, the authors assessed the indemnity rate using the following formula:

$$I_{i,t} = LoU_{i,t} \times AvgUp_{i,t}$$

(2)

where $I_{i,t}$ - indemnity rate for age group $i$, during year $t$;

$AvgUp_{i,t}$ - average unemployment duration within age group $i$, during year $t$;

Figure 7 shows the trends for the indemnity rate by age groups for the period of 2013-2018.
Figure 7. **Indemnity rates in case of unemployment in Latvia 2013-2018**

Source: Calculated by the authors, based on SSIA data

The following hypothesis testing was performed to assess the statistical stability of the indemnity rates calculated:

- **$H_0$:** Indemnity rates in case of unemployment are not dependent on age group and year;
- **$H_A$:** Indemnity rates in case of unemployment are dependent on age group and year.

For the hypothesis testing we used two-Factor ANOVA, and the results are shown in Table 6 and Table 7.

### Table 6

<table>
<thead>
<tr>
<th>SUMMARY</th>
<th>Count</th>
<th>Sum</th>
<th>Average</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-34</td>
<td>6</td>
<td>0.259331</td>
<td>0.034222</td>
<td>0.000330</td>
</tr>
<tr>
<td>35-44</td>
<td>6</td>
<td>0.187202</td>
<td>0.031200</td>
<td>0.000063</td>
</tr>
<tr>
<td>45-54</td>
<td>6</td>
<td>0.195425</td>
<td>0.032571</td>
<td>0.000057</td>
</tr>
<tr>
<td>55-64</td>
<td>6</td>
<td>0.226028</td>
<td>0.037671</td>
<td>0.000186</td>
</tr>
</tbody>
</table>

| 2013    | 4     | 0.147895  | 0.036974 | 0.000029  |
| 2014    | 4     | 0.137252  | 0.034313 | 0.000021  |
| 2015    | 4     | 0.186253  | 0.046563 | 0.000114  |
| 2016    | 4     | 0.191745  | 0.047936 | 0.000349  |
| 2017    | 4     | 0.123106  | 0.030777 | 0.000016  |
| 2018    | 4     | 0.081736  | 0.020434 | 0.000008  |

Source: Calculated by the authors, based on SSIA data
The role of mortgage payment insurance in reducing the mortgage default risk level in Latvia

Two-Factor ANOVA test summary statistics on indemnity rates

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
<th>F crit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rows</td>
<td>0.000538</td>
<td>3</td>
<td>0.000179</td>
<td>2.509</td>
<td>0.09831</td>
<td>3.287</td>
</tr>
<tr>
<td>Columns</td>
<td>0.002109</td>
<td>5</td>
<td>0.000442</td>
<td>5.903</td>
<td>0.00328</td>
<td>2.901</td>
</tr>
<tr>
<td>Total</td>
<td>0.003719</td>
<td>23</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Calculated by the authors, based on SSIA data

Conclusion: the authors cannot reject $H_0$ because $F_i < F_{crit}$ and $p_i$-value $> 5\%$. However, $F_t > F_{crit}$ and $p_t$-value $< 5\%$. There is no statistically significant evidence at $a = 0.05$ that indemnity rates in case of unemployment are dependent on age group.

To evaluate the effect of MPI on the default rate, a regression model was developed that describes the relationship between the unemployment rate and the default. Based on EBA data (EBA, 2019) on default statistics in Latvia and Eurostat unemployment data (Eurostat, 2019), four linear and non-linear regression models were calibrated, of which the best fit ($p$-value $< 0.01$) was as follows:

$$y = 9.3506 \times x^2 - 1.2778 \times x + 0.0496$$

(3)

where $y$ - default rate,

$x$ - unemployment rate.

The best fit regression model (3) coefficient of determination of 0.763 shows that 76.3\% of default rate variations can be explained by changes in the unemployment rate and related factors, e.g. wage changes, etc. The shape of a second-order polynomial regression model (3) also determines that the default rates rises rapidly with unemployment exceeding 9-9.5\%. This conclusion can also be easily explained from an economic point of view – it is relatively easier to find a new job at an unemployment level of up to 7-8\% in a shorter period after the loss of previous work, while unemployment benefits only slightly reduce income levels and some expenses can be covered by savings.

Using the regression model obtained, the effect of MPI on the default rate under several unemployment scenarios was estimated; see Figure 8.
Figure 8. **Relationships between the default rates and the coverage of MPI at different levels of unemployment.** Source: Calculated by the authors, based on the best fit regression model

According to the calculations performed, it can be concluded that an MPI coverage increase from the existing level to 60% (current Estonian and Lithuanian) offers a possibility to reduce the default rate 2.1-2.3 times depending on the unemployment level. If the coverage ratio increases to 100%, the effect is even larger: 3.5-4.3 times; see Table 8.

**Table 8**

<table>
<thead>
<tr>
<th>Unemployment rate</th>
<th>MPI coverage 60%</th>
<th>MPI coverage 100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>12%</td>
<td>2.32</td>
<td>4.30</td>
</tr>
<tr>
<td>10%</td>
<td>2.25</td>
<td>4.10</td>
</tr>
<tr>
<td>8%</td>
<td>2.15</td>
<td>3.77</td>
</tr>
<tr>
<td>6%</td>
<td>2.07</td>
<td>3.54</td>
</tr>
</tbody>
</table>

It is no surprise that a higher effect is expected at a higher unemployment rate, reaching 2.3 (4.3) times, respectively. This means a significant reduction of credit risk in Latvian financial institutions that perform mortgage-lending activities.
CONCLUSIONS

The active development phase of housing lending in Latvia started approximately in 2002. It developed rapidly up to the year 2006 and mortgage loans made up a significant share of commercial banks’ income in this time period. However, the rapid growth of mortgage lending, reaching an average increase of 90% per annum, slowed considerably starting from mid-2007, following the adoption of an anti-inflation plan by the Cabinet of Ministers of Latvia.

The financial crisis of 2009-2010 showed the shortcomings of mortgage lending practices:

- The liberal banking credit policy, the reliance on collateral appreciation, and the failure to assess the risks of borrowers’ income adequacy and stability led to significant credit losses in the Latvian banking sector;
- Borrowers’ overconfidence in the constant rise in income and housing prices led to excessive commitments and the subsequent inability to repay them.

The most relevant factors for the NPL increase in Latvia during the financial crisis were “external circumstances” such as unemployment and occupational disability (temporary or permanent), real wages and the decrease in GDP.

The behaviour of households themselves has influenced the quality of loan portfolios in Latvian commercial banks. The most influential factors are excessive commitment and insufficient savings, mismanagement of personal income, increase in costs of living and personal competitiveness in the labour market (qualifications and experience).

At the beginning of 2019, less than one third of Latvia's commercial banks' housing loans were covered by mortgage payment protection insurance, whereas in Estonia and Lithuania coverage rates were ca. twice as high. In contrast, the loss rates in Latvia were ca. twice as high, and this proves that the problem is not being addressed at the moment accordingly.

The survey conducted by the authors in the context of this study showed that the main reason why mortgage payments are not insured is risk underestimation, particularly unemployment, against which less than a fifth of borrowers are insured.

As part of this study:

- The likelihood of unemployment was analysed per age group based on Latvian SSIA data from 2013-2018. As a result of the two-factor ANOVA test, we found statistically significant evidence ($a < 0.000001$), that likelihood of unemployment is dependent on age group and year;
Indemnity rates were analysed per age group. As a result of the two-factor ANOVA test, we concluded that there is no statistically significant evidence at $a = 0.05$ that indemnity rates in case of unemployment are dependent on age group.

The research conducted by the authors shows that MPI offers a possibility to reduce the mortgage loan default rate in Latvia approximately 3 to 5 times depending on the risk profile of borrowers of mortgage loans, including occupation, qualification, age, etc.

The research shows that 76.3% of default rate variations can be explained by changes in the unemployment rate and related factors, e.g. wage changes, etc. The default rates rise rapidly with unemployment exceeding 9-9.5%. It is relatively easier to find a new job at an unemployment level of up to 7-8% in a shorter period after the loss of previous work, while unemployment benefits only slightly reduce income levels and some expenses can be covered by savings.

In order to achieve a significant improvement in the context of mortgage payment insurance and at least achieve the Estonian and Lithuanian level in the coming years, the following is necessary:

- The FCMC should initiate the process of educating borrowers about the effectiveness of mortgage payment insurance – the ability to protect families from material losses in the event of a failure to pay mortgage according schedule;
- Reinforcing cooperation between commercial banks and insurance companies to more actively promote the benefits of mortgage payment insurance products for borrowers;
- Latvian credit institutions should improve their mortgage pricing methodologies by including a corresponding reduction in the underlying price of a loan (interest rate), taking into account the objective reduction of the borrower’s individual credit risk level.

REFERENCES

The role of mortgage payment insurance in reducing the mortgage default risk level in Latvia


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