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Graduate School of Management

Master in Management

DIGITAL TRANSFORMATION MATURITY: STUDY FOR RUSSIAN MARKET

Master's Thesis by the 2nd year student

Concentration — Marketing

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АННОТАЦИЯ

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Название ВКР	Зрелость цифровой трансформации: исследование российского рынка
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Научный руководитель	Кандидат физико-математических наук Э.В.Страхович
Описание цели, задач и основных результатов	Целью данной диссертации является разработка рабочего инструмента на основе анализа литературы для определения уровня цифровой трансформации компаний различных размеров, а также апробация полученной методологии путем анализа малых, средних и крупных российских предприятий, которые уже начали свой путь цифровой трансформации за последние 2 года. Для достижения поставленной цели, в первую очередь был проведен системный обзор литературы, благодаря которому, была осуществлена дифференциация существующих определений цифровой трансформации и моделей цифровой зрелости. Затем, на основе проведенного анализа были определены параметры измерений для модели, которые наиболее подходят для исследования уровня цифровой зрелости компаний разного размера. Следующим шагом стала разработка инструмента в виде опроса для проведения тестирования полученной модели. Далее, с помощью опроса было определено распределение российских компаний по уровням цифровой зрелости на основе используемой модели, а также были описаны следующие параметры рынка: как компаниям удалось реализовать ключевые задачи трансформации, текущую цифровую стратегию, планы по модернизации рабочих мест и инвестиционные цели, а также, какие барьеры и пути их преодоления компании встретили или планируют встретить на своем пути к цифровой трансформации.
Ключевые слова	Цифровая трансформация, модель цифровой зрелости, область цифровой зрелости, абдуктивный исследовательский подход.

ABSTRACT

Master Student's Name	Yurovsikh Kristina Andreevna
Master Thesis Title	Digital Transformation Maturity: Study for Russian Market
Educational Program	BM.5669.2018
Main field of study	Marketing
Year	2020
Academic Advisor's Name	Candidate of Physics and Mathematics E.V.Strakhovich
Description of the goal, tasks and main results	The main goal of this thesis is to develop a working tool based on literature analysis to determine the level of digital transformation of companies of various sizes, as well as to test the resulting methodology by analyzing small, medium and large Russian enterprises that have already started their digital transformation path over the past 2 years. To achieve this goal, first of all, a systematic review of the literature was conducted, thanks to which the existing definitions of digital transformation and models of digital maturity were differentiated. Then, based on the analysis, were determined the measurement parameters for the model that are most suitable for studying the level of digital maturity of companies of different sizes. The next step was to develop a tool in the form of a survey for testing the resulting model. Further, the survey determined the distribution of Russian companies by digital maturity levels based on the model used, and described the following market parameters: how companies managed to implement key transformation tasks, current digital strategy, plans to modernize jobs and investment goals, as well as what barriers and ways to overcome them companies have met or plan to meet on their way to digital transformation.
Keywords	Digital transformation, digital maturity model, digital maturity area, abductive research approach.

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1. Introduction

1.1. Relevance of the study

Digital transformation (DT) is becoming a major topic for companies around the world. It is assumed that companies that are unable to adapt to the digital world will undoubtedly fall victim to «digital Darwinism», when actors may disappear, and only the fittest enterprises that respond to technological trends will survive to remain on the competitive transformation (Schwartz 2001).

In order to start the transition to digital transformation, it is necessary to assess the level at which the enterprise is currently located. Assessment of the readiness of production enterprises for digital transformation consists in evaluating and analyzing not only the production infrastructure, but also the analysis of the strategy and business processes of all divisions of the enterprise.

Today, several approaches to assessing a company's digital maturity are presented in the world practice. All models are based on the analysis of data obtained by survey and observation methods. A certain level of digital maturity is assigned to a company after collecting quantitative weighted assessments through a special questionnaire with various sets of aspects that identify the existing level of use of digital technologies or the potential for their implementation.

The term «digital transformation» as a reflection of the use of digital technologies in all areas of society in the management literature has appeared relatively recently, and different researchers and their groups interpret it differently. At the same time, everyone considers them one of the main challenges to modern business and management, as digital technologies are widely used in various industries — medicine, education, mass media, urban economy, entertainment, travel and leisure, manufacturing, finance, transport, etc., changing their appearance, structure and competition.

Plenty of academics and practitioners have found several definitions of the term «digital transformation»: for Forester, it is the achievement of operational efficiency and flexibility using digital technologies; for Gartner, it is a business model that allows you to create value and generate revenue; for Deloitte, it is an exponential growth of connections; and for the altimeter group, it is attracting customers at any point of contact with them.

An important criterion for the quality of the DT process in business is the level of «digital maturity», and its improvement is the business strategy. Digital maturity (DM) is the level of systematic understanding of all processes, key aspects, and competencies related to DT and the use of digitalization in the development of strategies, business models, systems of interaction with partners, and so on. Analyzing this maturity and «digital readiness» of different companies, experts

note in many cases the obvious lag of organizational culture, organizational behavior, and training from operational processes and technologies.

Anyway, while new technologies are changing the face of our world, are Russian companies ready for this? What prospects and difficulties may arise for Russian companies along this path? Will they be able to transform fast enough?

This study is based on a systematic review of the literature on existing theoretical approaches to developing general digital maturity model for different sizes of enterprises. Unsurprisingly, the results of the SLR will show, that current models of digital maturity are often not suitable for SMEs or large companies either, and the current research strategy suffers from some limitations. In this thesis there is framework offered and validated to measure a level of a digital maturity

In recent years, Russia has just started implementing various government programs for digital transformation of the economy and its market is not yet well-studied. According to 2018 data, Russian middle and large companies are on average at the level of digital maturity that is typical for all countries with developed economies. However, in recent years, the growth rate of digitalization, according to other indicators, has increased significantly. Thus, taking into account the context, it will be relevant to find out what are the current positions of different Russian companies in the context of the inevitable trend of global digital transformation.

1.2. Research questions and aims of the study

The purpose of this thesis is to develop a working tool based on literature analysis for analyzing the level of digital transformation for companies of various sizes, as well as testing the resulting methodology by analyzing the Russian market for the development and scaling of small, medium and large Russian enterprises that have already started their digital transformation path over the past 2 years.

Given all of the above, the research questions could be formulated as follows:
1) How to determine the differentiation of associated terms with digital transformation and the maturity model for determining the organizational degree of digital transformation?
2) Which measurements for the possible model are suitable for investigating the level of digital maturity, according to the limitations of the planned study?
3) How companies have managed to implement the key transformation tasks, current digital strategy, plans to modernize workplaces and investment goals, as well as to determine what barriers and ways to overcome them companies have met or plan to meet on their way to digital transformation.

2. Literature review

2.1 Digital Transformation

With the advent of new digital technologies, for example, social networks, mobile devices, big data, etc. firms in almost all industries are conducting numerous initiatives to study and use their advantages (Fitzgerald 2013).

This often involves transforming key business operations and effects of products and processes, as well as organizational structures, as companies need to create management practices to manage these complex transformations (Matt 2015)

Thus, society as a whole is facing rapid and radical changes due to the maturation of digital technologies and their widespread penetration into all markets (Ebert 2016).

In addition to the increased demand from customers, companies face increasingly tough competition due to globalization (G. C. Westerman 2011) and are pressured to switch to digital technologies earlier than others in order to survive and gain competitive advantages (Bharadwaj 2000).

Therefore, in recent years, "born digital " pioneers (such as Amazon, Facebook, and Google) have become powerful behemoths, while companies that have long dominated their industries have found their traditional value proposition under threat (Sebastian 2017).

However, despite many technological innovations and recipes for their implementation, whether in business, public administration or private life, the real Digital transformation takes much longer and faces greater difficulties than expected (Zinder 2016).

Unfortunately, there are many recent examples of organizations that have failed to keep up with the new digital reality: examples include the bankruptcy of Blockbuster movie distribution companies, largely caused by the inability of these firms to quickly develop and implement new digital business models (Hess 2016).

Successful digital transformation requires an organization to develop a wide range of capabilities, the importance of which will vary depending on the business context and the specific needs of the organization. Digital technologies must take a Central place in the way businesses operate, and organizations must effectively rethink and possibly reinvent their business models to remain competitive (Carcary 2016).

Several concepts have been put forward to refer to digital transformation (for example, digitization, digitization), and although they are often used indiscriminately in the literature, researchers are constantly trying to define their boundaries to avoid duplication.

Henrietta et al. (Henriette 2015) conducted a similar systematic review of the literature but used a different database (Scopus). Their work also focuses on the vulnerabilities and opportunities of digital transformation, but various contributions arise from focusing on the impact of digital opportunities on digital transformation and explaining how digitalization transforms business models, operational processes, and user experience.

Thus, based on the literature review, this paragraph offers a definition of digital transformation, provides an overview of the literature. To this end, the next section provides a brief description of the methodological approach, followed by a review of the literature.

This section follows the method of systematic literature review, which is closely related to a set of scientific methods aimed at limiting systematic error (bias), mainly by identifying, evaluating, and synthesizing all relevant research (Petticrew 2006). To reduce potential bias, there were adopted two different approaches: a qualitative approach based on bibliometric analysis, and a qualitative approach focused on content analysis of literature (Coombes 2013).

Table 1 summarizes the research methodology. Both approaches should be considered as "complementary" in recognizing the structure of the study area (Acedo 2005). Other researchers have also conducted identical literature reviews, for example (Coombes 2013).

Table 1 Research methodology. Source: compiled by the author.

Approach	Description	Content
Quantitative approach	A quantitative characterization of the selected publications	— Publications distribution — Distribution per author and journal — Major research approaches — Keyword frequency
Qualitative approach	Content analysis of the selected articles	— Digital Transformation definitions — Themes and categories

It was decided to start with the inclusion criteria, using the term "digital transformation" in the topic (title, abstract, and keywords). While various keywords can be considered a viable alternative, "Digital transformation" is a phenomenon we want to explore.

Table 2 Systematic literature review process. Source: compiled by the author

Criteria	Filters	Documents
Keyword	«Digital Transformation»	
Restriction	Topic (title, abstract, authors keywords)	260
Document type	Articles and conference proceedings	235
Language	English	206

Adding such terms to the study may lead researchers to a biased understanding, since not all terms have the same meaning (for example, digitization, digitization). The search for articles was conducted regardless of time limits, but the coverage to journal articles and conference materials also was reduced. To avoid misinterpretation, the selected documents should have been written in English (table 2). A total of 206 scientific articles were obtained as a result of the exclusion process from the database.

2.1.1 Quantitative analysis

Despite the fact that the number of works on digital transformation has grown over time, only after 2014, their number has increased significantly. In 2016, 45% of the total number of articles are journal articles and 55% are conference materials, which highlights the high value of conference materials.

The United States of America, Germany, and the people's Republic of China contributed the most to these publications, with 21%, 19%, and 5%, respectively. The reason for such quantitative indicators in these countries may be related to the introduction of new technologies in all major sectors of activity.

According to the estimation of the distribution of citations (Table 3) the most cited articles focus on the problems that innovative technologies bring to firms ' business (Karimi 2015).

Table 3 Article distribution per author. Source: compiled by the author.

Top 10 authors	Jouranl	Year	Citations
Karimi and Walter (Karimi 2015)	Jouranal of Management Information Systems	2015	133
Nagy and Koles (Nagy 2014)	Convergence – The International Journal of Research into New Media Technology	2014	120
Trantopoulos et al. (Trantopoulos 2017)	MIS Quarterly	2017	115
Alos-Simo et al. (Alos-Simo 2017)	Industrial Management & Data Systems	2017	109
Sherer et al. (Sherer 2016)	Information & Management	2016	106
Ranganathan et al.	International Journal of Information Management	2011	101
Agarwal et al.	Information Systems Research	2010	95
Benlian and Haffke	Journal of Strategic Information Management	2016	94
Chen et al.	Internet Research	2016	84
Schmidt et al.	Practice of Enterprise Modeling	2015	82

Therefore, they do not study the determinants of digital transformation that arose after its adoption in order to understand its consequences. In addition, some other relevant articles are emerging, while government efforts are expanding to digitize health systems as a means to make them safer, more accessible, and more affordable (Agarwal 2010).

In addition, the distribution of journals and the quality of these publications was also studied by conducting a study on Incites Journal Citation Reports that measures the impact, influence, or prestige of the journal (Table 4).

Table 4 Article distribution per journal. Source: compiled by the author.

Top 5 publication journals	Count	Quartile	% of 206
MIS Quarterly Executive	10	Q2	4,854%
Communications in Computer and Information Science	6	-	2,913%
Lecture Notes in Business Information Processing	5	--	2,427%
Digital Transformation and Global Society	4	-	1,942%
Lecture Notes in Computer Science	4	Q4	1,942%

The journal that had the most publications in the field of digital transformation was Mis Quarterly Executive, which is a journal with a focus on practical research, which is a strong indication that this topic is largely driven by practitioners.

Literature reviews have just counted four cases; however, the preponderance of conceptual and illustrative case studies is clear evidence of the lack of maturity of this phenomenon, hence future research should focus more on establishing the theoretical foundations of this field based on existing theories or developing new ones.

Also, there was conducted a similar search with the term «digitalization», in the subject and with the same filters, and found 2,200 documents. This search led to an increase in the number of articles and conference materials, as well as to the appearance of literature reviews. It will be useful for scientists to pay more attention to digital transformation, since there have been few articles and literature reviews compared to other similar terms, and to try to understand why there is such a large discrepancy between the terms. In order to understand the most important research topics, there were also collected the most frequently cited keywords (Table 5).

Table 5 Keyword frequency (more than 6 occurences). Source: compiled by the author.

Keyword	Record count
Digital transformation	60
Digitalization	25
Management	18
Internet of Things	13
Internet	10
Strategy	9
Government	9
Industry 4.0	8
Innovation	8
Technology	7
Enterprise Architecture	7
Competitive Advantage	6
Information-Technology	6
Systems	6
Educational Technology	6
Digital Business	6

The columns show that the most common keywords are: Digital transformation, digitalization, and management in this order. Keyword analysis can provide the key to discovering ideas for future research, as well as understanding which terms are closest to a digital topic. It is almost self-evident that the main terms are closely related. This analysis shows that digital transformation and digitalization are similar terms that are applied to services, processes, and organizational structures in all it / is and web tools; therefore, communication with management is just as vital as the need for companies to create management practices to manage these complex transformations (Matt 2015).

2.1.2 Qualitative analysis

Like Kokkinakis et al. (Kokkinakos 2016) argues that modern technologies such as social software, data analysis, etc. revolutionize the daily activities of modern organizations at all possible levels and in all possible ways, and thus digital transformation is expected to be one of the most common terms on the World Wide Web; because of its importance, many authors are trying to define and discuss the exact concept of digital transformation.

This argument confirms the importance of defining digital transformation, since there is no formal categorization in the scientific literature and its boundaries are often blurred. The task of defining the concept of digital transformation can be solved after these definitions are reduced to their main elements. Table 6 illustrates typical definitions taken from the literature.

Table 6 Digital Transformation Definitions. Source: compiled by the author.

Author(s)	Definition(s)
Fitzgerald et al. (Fitzgerald 2013); McDonald and Rowsell-Jones (McDonald 2012)	Use of new digital technologies, such as social media, mobile, analytics or embedded devices, in order to enable major business improvements like enhancing customer experience, streamlining operations or creating new business models (Fitzgerald 2013). As such, the Digital Transformation goes beyond merely digitizing resources and results in value and revenues being created from digital assets (McDonald 2012)
Solis et al. (Solis 2014)	The realignment of, or new investment in, technology and business models to more effectively engage digital customers at every touch point in the customer experience lifecycle
Collin et al. (Collin 2015); Gimpel and Röglinger (Gimpel 2015); Kane et al. (G. P. Kane 2015)	While digitization commonly describes the mere conversion of analogue into digital information, the terms Digital Transformation and digitalization are used interchangeably and refer to a broad concept affecting politics, business, and social issues
Martin (Martin 2008)	Digital Transformation is now commonly interpreted as such usage of Information and Communication Technology, when not trivial automation is performed, but fundamentally new capabilities are created in business, public government, and in people's and society life

Westerman et al. (G. C. Westerman 2011)	Digital Transformation is defined as the use of technology to radically improve performance or reach of enterprises
Stolterman and Fors (Stolterman 2004)	Digital Transformation is the changes that digital technology causes or influences in all aspects of human life

The various definitions of digital transformation (DT) can be divided into three separate elements:

1) Technological - DT is based on the use of new digital technologies, such as social media, mobile devices, Analytics, or embedded devices;

2) Organizational – DT requires changing organizational processes or creating new business models;

3) Social – DT is a phenomenon that affects all aspects of human life, for example, by improving the customer experience.

Almost all of these topics are used by researchers in defining digital transformation (Table 6). Therefore, in this paper digital transformation is defined as the use of new digital technologies that can significantly improve the business and affect all aspects of customers ' lives. There was also an analysis of at the most relevant categories by intersecting the most frequently used research areas and keywords (Table 7)

Table 7 Qualitative Analysis. Source: compiled by the author.

% of 206	Research area	Cited keywords	Categories
34%	Information systems	Industry 4.0	IT/IS integration
22%	Business economic	Digital business enterprise architecture	Development of new business models
8%	Education	Educational technology	Training/Education to add new skills
4%	Management science	Management	Process and operations management
1%	Governmen	Public sector transformation	Ramification to other sectors

Digital transformation has always been closely linked to industry and is currently undergoing huge changes again, as industry 4.0 represents the upcoming fourth industrial revolution. It focuses on end-to-end digitization of all physical assets and integration into digital ecosystems with value chain partners (Lee 2017).

Another important task is to integrate "digital" technologies into the DNA of business models. This is especially important for the success of any company, and it becomes a critical management issue (Horlacher 2016). As with any it changes, it is not enough to simply implement it in an organization (R. L. Benjamin 1993); the success of digital transformation depends on changes in the management of processes and operations (Dremel 2017). To implement such management, people must be trained in the process of change, which takes into account the unique problems associated with it (R. L. Benjamin 1993).

The digital revolution is positively developing a digital and standardized work environment (Lei 2016). Some workplaces are virtualized or remotely managed, which requires new communication skills and knowledge about virtual worlds (Richert 2016). In social terms, clients also acquire new competencies to be able to interact with digital organizations to exist in the digital age (Zinder 2016).

The digital age not only encourages innovation in the business sector, but also seems to influence developments in the public sector (Kokkinakos 2016). State digitalization is one of the promising topics, and it will have more prospects for development in the future. In addition, there is growing interest in the health sector (Kohli 2011), as there has been a significant increase in research on health digitalization in recent years (Agarwal 2010).

While we recognize the existence of maturity models in this area developed primarily by practitioners (such as the IDC maturity model), the academic community has not yet chosen a consensus maturity model for digital transformation that can be applied to all sectors of activity. Therefore, in this paper it is proposed an in-depth study on the differentiation of associated terms with digital transformation and a maturity model for determining the organizational degree of digital transformation. Although Digital Transformation is popular among practitioners, this term tends to be neglected in the scholarly literature.

The aforementioned argument is well evidenced if we conduct a search using both terms "Digital Transformation" and "Digitalization".

The conclusion is presented from two different perspectives. First, from the cynic viewpoint, Digital Transformation may be considered as a management fashion (Abrahamson 1996) or as the reincarnation of past IT-enabled change initiatives with new outfits. IT-enabled change resurfaced a few years ago through the business process management movement. As business process management seems to be losing interest, a new buzzword to capture a renewed interest from managers, consultants and software companies. On the other hand, enthusiasts may argue that Digital Transformation includes novel elements that deserve due attention and pose interesting challenges for future research.

In particular, the results support that managers should adapt their business strategy to the digital reality, by integrating new technologies in their business models, which raises the importance of processes and operations management topic. Scholars, at the other side, are required to conduct further research to address DT opportunities and challenges.

This review has some limitations. As this literature review is limited to a single term, it is possible that some relevant articles are missing. A truly comprehensive approach to produce a systematic literature review also requires the use of more than one digital repository; therefore, by analyzing other repositories besides GSOM, the results obtained might be different; however, given that our priority is transparency and easy reproduction of results this choice may be acceptable when comparing the pros and cons. It is also believed that the methodology used in this article can be reproduced with other terms.

2.2 Digital Transformation Maturity

The purpose of this paragraph is to present modern developments in the field of digital maturity models. After conducting a systematic review of the literature, 24 relevant studies were eventually identified, including 23 different models, and various characteristics of various digital maturity models were extracted.

The main focus was on the measurements used to measure digital maturity in various model approaches. Particular light was shed on organizational culture and the extent to which it is represented in models. Among other things, the results indicate that the dimensions used in different models can be very different and that only some models include transformational capabilities in addition to digital ones.

In particular, organizational culture as a special dimension of digital maturity is already represented in several models, which indicates the growing importance of culture as a factor contributing to digital transformation efforts.

In addition to a comprehensive overview of the most widely used dimensions that measure digital maturity, this sector also presents a synthesis of the most commonly considered cultural attributes. This review ultimately shows that most existing models provide an incomplete picture of digital maturity, that cultural attributes that reflect digital culture are not systematically integrated, and that digital maturity models specific to the service sector are clearly underrepresented. It also clearly shows that research into the maturity of digital transformation as a holistic concept is insufficient and requires more attention from researchers in the future.

Digital transformation itself simultaneously affects several areas of the organization's activities. Several stakeholders should be involved in defining the transformation strategy. All

these groups need a common and consistent understanding of the relevant areas to be considered and prioritization of digital transformation activities (Berghaus 2016).

Therefore, managers must understand the current state of their organization's digital transformation and "must identify action points for their transformation roadmap, prioritize different activities, and develop a strategic vision for the digital age " (Berghaus, Stages in Digital Business Transformation: Results of an Empirical Maturity Study. 2016).

Consequently, the need to systematically assess the overall state of digital transformation and determine an effective path to the desired future state of digital maturity in organizations is growing significantly. Digital maturity is important for companies because there is evidence that firms with higher levels of digital maturity are outperforming industry competitors in various dimensions of financial performance (G. M.-A. Westerman 2012).

The digital maturity model can help management and employees in developing a clear road map for transformational activities with the aim of increasing the level of digital maturity.

In recent years, an unclear number of different maturity models have been developed to conceptualize and evaluate digital maturity in organizations in order to effectively manage and guide digital transformation. Although previous reviews of digital maturity models have already been conducted (Canetta 2018), there is still a lack of understanding of what the most common maturity measurements used in existing models are.

Chanias and Hess (Chanias 2016) also stated that there is a content-related (for example, core dimensions) heterogeneity of different models of digital maturity. In addition, there are indications that many models are too universal in nature to be applied to any particular industry and as such they are not intended to provide specific recommendations (Valdez-de-Leon 2016). Moreover, none of the previous reviews considered the aspect of corporate culture as a measure

of digital maturity, although there is evidence that culture is the number one obstacle to digital transformation (Buvat 2017).

In light of this, a systematic review of the literature is conducted with the following questions guiding the review:

1. Who is driving the development of digital maturity models - a practitioner or an academic?
2. What are the different areas (industrial contexts) considered by digital maturity models?
3. What are the most common maturity measurements used in digital maturity models?
4. The extent to which the organizational culture and what cultural attributes are considered in the models of digital maturity.

2.2.1 Digital maturity

The term "maturity" refers to a state of completion, perfection, or readiness (Lahrmann 2011) and is the result of progress in the development of the system. Maturing systems (such as organizations) improve their capabilities over time to achieve some desirable future state. Sometimes digital transformation and digital maturity are used interchangeably without regard for differences (Leipzig 2017), but digital maturity can be seen more as a systematic way to transform an organization into a digital form (G. P. Kane 2017).

Therefore, the term "digital maturity" specifically reflects the state of a company's digital transformation (Chanias 2016). It describes what the company has already achieved in terms of its transformation efforts and how the company is systematically preparing to adapt to an increasingly digital environment in order to remain competitive. Digital maturity goes beyond a purely technological interpretation that simply reflects the degree to which a company performs tasks and processes information flows, but also reflects a managerial interpretation that describes what the company has already achieved in terms of performing digital transformation efforts, including changes in products, services, processes, skills, culture, and abilities in relation to mastering change processes (Chanias 2016).

Thus, digital maturity includes technological and managerial aspects and can therefore be considered as a holistic concept. Organizations reach the highest level of maturity when they have both a strong digital Foundation and a good understanding of how to use this Foundation for strategic business advantage (Shahiduzzaman 2017).

Moreover, digital maturity is not a static concept, because the digital landscape is constantly changing. Thus, the organization will have to evaluate maturity overtime (Shahiduzzaman 2017). In this systematic review of the literature (SLR), the term «digital transformation maturity» is used to reflect the relationship between the concepts of «digital transformation» and «digital maturity» and to emphasize that digital maturity is a holistic concept that reflects the technological and managerial aspects.

2.2.2 Digital Maturity Model

The maturity model provides some guidance on how organizations approach their transformation and displays typical ways in which organizations go about their transformation (Berghaus 2016). Maturity models can be considered as a tool that mainly allows you to assess the state (Becker 2009) and indicates a potential, expected or typical path of development to the desired target state (Poppelbuss 2011). The digital maturity model to help companies to assess their ability to confront the digital transformation in accordance with pre-defined dimensions. Especially in the case of transformational travel, they can help in understanding the current state and capabilities of an organization to effectively manage and guide digital transformation efforts in a systematic manner. Digital maturity models consist of measurements and criteria that describe areas of action and measures at various levels that indicate the path of evolution to maturity (Berghaus, Stages in Digital Business Transformation: Results of an Empirical Maturity Study. 2016). Measurement is a specific, measurable, and independent component that reflects an important, fundamental, and separate aspect of digital maturity and describes the scope (De Bruin 2005).

The definition of the term «maturity level» may be related to the potential maturity model. In this context, the maturity level consists of appropriate specific and common practices for a pre-defined set of maturity indicators that can improve the overall maturity of the organization. The level of maturity of an organization makes it possible to characterize its effectiveness and can be defined as an evolutionary plateau for increasing organizational maturity. The terms «maturity stage» and «maturity level» can be used interchangeably.

At this point, the 24 studies present 23 different digital maturity models. Special attention was paid to the model approach and design parameters of the included models in order to better categorize and compare different approaches (Table 8). To get an idea of who led the research on digital maturity over time, all the research was grouped into studies published by practitioners or academics.

Table 8   Used characteristics for data extraction. Source: compiled by the author.

Study	Model design	Model approach	Culture
Author Year of publication Journal Publisher	Dimensions and specific attributes (content) Number of maturity levels/stages Number of assessment items	Focus of model (domain, general) Application purpose (descriptive, prescriptive) Maturing approach (linear, non-linear) Application method (self-/3rd party assessment)	Culture reflected in the model (yes/no)

In order to take into account, the context and challenges of various industries, the included digital maturity models were further classified into two model approaches:

i.   Models that relate to a specific industrial area, such as manufacturing;
ii. Models that are not developed for a specific industrial context, which can therefore be considered General models.

This classification provides a better understanding of what different areas are being considered by modern models, and whether different modeling approaches differ with respect to the maturity measurements used.

All 23 included digital maturity models include 130 maturity sizes, of which 41 are the same in all models and 84 have completely different and unique ratings, making comparability impossible. To better understand the meaning of maturity measurements, all identified attributes were extracted that describe the measurement in more detail. This allowed the development of a nomenclature that reflects the most common areas of maturity and made it easier to map each of the 125 original dimensions. It was calculated how often the overall maturity area can be compared to the original dimensions of the included models, and hence the frequency for each overall maturity area was obtained. Similarly, 25 different attributes related to culture in all models were identified and calculated based on their occurrence in all models. All 25 defined attributes were grouped into the main categories of cultural attributes (Table. 8) to better analyze and compare them with other cultural models. In the next step, all identified attributes were mapped to the main categories. Thus, it would be possible to estimate the frequency of cultural categories.

2.2.3 Descriptive results of the studies

Results of the first hit for applied search keywords that address the concept of «digital maturity» is significantly lower (1,925 first hits) than the first hit results for «digital transformation» (25,400 first hits). This generally indicates that there is little scientific literature in the field of digital maturity compared to the field of digital transformation. With the specific keywords «digital transformation maturity», only 38 primary studies were found, and during the screening process, the number of eligible studies remaining for synthesis was reduced to 3 studies. This suggests that less attention has been paid to this area in the past, and therefore academic research seems completely immature in that field. Additional sources were identified by screening reference lists of 11 included studies (Canetta 2018). Thus, 13 additional studies describing models and concepts of digital maturity were identified and included in the final set of studies.

All models of digital maturity (n = 23) included in the final set of studies were classified by specific characteristics (Table 9). Most of the studies were published in the last 5 years, while almost 40% of the included studies were published in 2016.

The first studies on digital maturity were published in 2011 and 2012. Both studies were developed by a medical practitioner (G. C. Westerman 2011). The first study focused on measuring industry digitization in 15 different industry sectors and various business process dimensions.

Table 9 Digital maturity models. Source: compiled by the author.

Study	Model character (number of dimensions/ maturity levels)	Model approach (focus of model, maturing approach, application method)	Domain	Culture
Strategy&/Booz (2012)	4 / «Digitiz. Index»	General, linear, 3rd party assisted	Industry sectors	No
MIT / Capgemini (2012)	6 / 4 archetypes	General, non-linear, self-assessment		No
Lichtblau et al. (2015)	6 /6 stages	Domain-specific, linear, 3rd party assisted	Manufacturing	
McKinsey (2015)	4 / «Dig. Quotient»	General, non-linear, 3rd party assisted		Yes
Roland Berger (2015)	4 / «Digital Gap»	General, linear, 3rd party assisted	Industry sectors	
Neuland (2015)	8 / 5 stages	General, linear, 3rd party assisted		Yes
Dell & Intel (2015)	5/ «Digital Transfromation Index»	General, linear, self-assesment	Industry sectors; regions	No
PWC (2016) – Industry 4.0	7 / 4 stages	Domain-specific, linear, 3rd party assisted	Manufacturing	Yes

Valdez-de-Leon (2016)	7 / 6 stages	Domain-specific, linear, self-assessment	Telecom Services	Yes
Schuhmacher et al. (2016)	9 / 5 stages	Domain-specific, non-linear, self-assessment	Manufacturing	Yes
Forrester (2016)	4 / 4 archetypes	General, linear, self-assessment		Yes
KPMG (2016)	7 / 4 archetypes	General, non-linear, self-assessment		Yes
Leyh et al. (2016)	4 / 5 stages	Domain specific, linear, 3rd party assisted		No
Berghaus, Back (2016)	9 / 5 stages	General, linear, self-assessment		Yes
Uhl, Gollenia (2016)	6 / 4 stages	General, linear, self-assessment		No
MIT / Deloitte (2017)	4 / 3 archetypes	General, n/a, n/a		Yes
Remane et al. (2017)	2 / 5 clusters	General, non-linear, self-assessment		No
PWC (2017)	9 / 4 archetypes	General, non-linear, self-assessment		Yes
A de Carolis et al. (2017)	4 / 5 stages	Domain-specific, linear, self-assessment	Manufacturing	Yes
Leino et al. (2017), VTT	6 / 4 stages	General, non-linear, self-assessment		Yes
Acatech (2017)	4 / 6 stages	Domain-specific, linear, 3rd party assisted	Manufacturing	Yes
Canetta et al. (2018)	5 / n/a.	Domain-specific, non-linear, self-assessment	Manufacturing	No
Colli et al. (2018)	5 / 6 stages	Domain-specific, non-linear, self-assessment	Manufacturing	No

The MIT/Capgemini study described a digital transformation maturity model that distinguishes between "digital intensity "and "digital transformation intensity" and identified 4 archetypes that reflect different levels of digital maturity. This research has shown that in addition to its capabilities, transformational capabilities are also needed for successful digital transformation.

Up until 2015, practitioners were the driving force behind the development of digital maturity models. Only one of the included studies was published by scientists (Lichtblau 2015). Since 2016, scientists have begun to draw attention to this area of research, and since then, almost 70% of the included research has been done by scientists. Overall, the included set of studies shows that since 2011, academics have developed several more models of digital maturity (12 models) than practitioners (10 models).

The domain-specific approach is reflected in 41% of all included models, while 78% (7 models) of all domain-specific models of digital maturity are developed by scientists, which

underscores the growing attention of scientists to research on digital maturity since 2015, driven by Industry 4.0 and the need for more specific and complex models. This also explains why the most represented domain is «production» (89% of all domain-specific digital maturity models) (Table 10).

Table 10 Models clustered by originator and model approach (n = 23). Source: compiled by the author.

	General approach	Domain-specific approach
Academics	5 models (23%)	7 models (32%)
Practitioners	10 models (36%)	2 models (9%)

There is only one included study on the maturity of digital transformation, which is «telecommunications services». It is clear that this indicates a lack of attention to the service sector – neither from practitioners nor from scientists.

Almost all of the included digital maturity models are descriptive in nature and therefore limit their scope to assessing the level of digital maturity only it provides no guidance or clear road map on how to reach a higher level of maturity (prescriptive). 13 models (59%) follow a linear approach to maturity, which means that they suggest a linear evolutionary path for organizations engaged in digital transformation efforts. The rest reflect a non-linear approach to maturity. The majority (78%, 7 models) of nonlinear digital maturity models represent a general model approach. The level of digital maturity is assessed using self-assessment in 59% of models. Models developed by practitioners - mostly consultants - tend to use third-party auxiliary evaluation, since their purpose is to identify gaps in maturity and offer consulting services to address these gaps.

All included studies proposed a digital model of maturity in different sizes, maturity stages and elements of the assessment. Some models distinguish between two main areas that cover digital assets (e.g., digital capabilities, investment, digital infrastructure) and factors that contribute to transformation (e.g., vision, culture, leadership, management, innovation, or flexibility), combining dimensions in these two areas (Shahiduzzaman 2017). This highlights the importance of the managerial and "soft" aspect of digital transformation efforts.

The number of dimensions describing digital maturity varies between models and lies between 4 and 9, the number of stages of digital maturity lies between 4 and 6. Most of the models considered (55%) use certain stages to describe maturity. Some models (23%) offer archetypes describing digital maturity that, combined with two main dimensions, depict a company's digital

maturity in a 2×2 matrix. A Small fraction of model that mostly created by consultants use a kind of digital index to describe digital maturity (Oltmanns 2015).

To understand and compare the extent to which digital maturity areas are considered, all the initial measurements from existing maturity models that were analyzed were grouped into the suggested «most common maturity areas» (Table 11).

Table 11 Most common digital maturity areas identified in included studies (n = 23). Source: compiled by the author.

Maturity area	Attributes & characteristics
Digital Culture	Attributes that enhance digital transformation efforts: risk-taking, testing and training, a no-blame culture, customer focus, openness to change, flexibility, and employee autonomy.
Technology	ICT and IT architecture/systems and new IT systems based on digitalization, flexibility of supporting systems, digital data processing.
Operations & Processes	Process digitization and automation, flexibility/agility of processes, bringing processes to an industrialized standard, operations excellence.
Digital Strategy	Development/execution of a strategy using digital technology to do business in fundamentally new ways, bold long-term orientation, linked to business strategy, I4.0 roadmap.
Organization	Management structure/practices supporting digital business, cross-functional collaboration, digital skills embedded throughout the organization, roles/tasks related to digitalization defined, adequate resource allocation, cross-functional teams to implement digital business priorities, flexible communities, agile management.
Digital Skills	Digital skills, expertise, experience and interest; personnel dedicated to I4.0, ICT competencies of employees, data empowered decision making, openness to new technologies, employees have access to digital skills/expertise as needed.
Innovation	Opportunities to work more flexibly, develop breakthrough business models, use agile methods, involve the client in the innovation process, funding innovations, regularly conducted innovations.
Customer Insight & Experience	Customer benefit from digitization; personalization of products/services; utilizing digital services to engage customers; focus on customer value; digitization of customer touchpoints; creating value out of data, customer participation and empowerment.
Governance	Ensuring comprehensive/reliable execution of digital strategy; everyone has a mandate to think creatively and innovate, systematic approaches are taken to innovation/change management, engagement on different hierarchical levels, standards and regulations, adequate resource allocation.
Vision	Organization has defined an initial digital vision; digital technology realizes the vision of the organization; all staff work in sync with the digital vision.
Digital Ecosystem	The organization operates as part of a digital ecosystem; digitization / integration of vertical / horizontal value chains, digital connection to the business network (for example, via the API), interoperable technology platforms allow you to create new / highly customizable solutions that can be customized by end users.
Leadership	Leadership team learning new technologies, leaders have a compelling long-term vision, leaders actively identify and realize new opportunities, foster

	collaboration, existence of central coordination for I4.0 or digital transformation.
Compliance & Security	IT security, digital security, IT compliance within organization and towards stakeholders, assessing risk factors, risk management, IP, optimizing value-chain network for compliance; avoid unauthorized access.
Products & Services	Smart products/services, digitization of product/service offerings, data analytics deployed for individualization, data-based services, digital features.
Business Model	Developing new and breakthrough business models, integrated customer solutions across the supply chain, digital product/service portfolio with SW, network (M2M) and data as a key differentiator, digital initiatives generate value, business models expand.

In the next step, all the initial measurements were compared with the most common areas of maturity. Multiple mappings were possible for each dimension, since dimensions and included attributes sometimes refer to multiple maturity areas. The frequency of initial measurements compared with General areas of maturity in domain-specific and General digital maturity models was estimated.

The analysis shows that in domain-specific models of digital maturity, «technology» is the most targeted area of maturity, followed by «digital skills» and «operations and processes». Due to the lack of available digital maturity models for other industries, this ranking mainly reflects the manufacturing sector driven by Industry 4.0 and its strong focus on technology. This is causally related to the importance of digital skills and experience needed to cope with technological complexity. The importance of automation and flexibility of processes is evidenced by a strong representation of the «operations and processes» maturity area. This area of maturity similar to domain models which is also actively considered in General approaches to maturity models.

A strong difference can be found in the «products and services» maturity area, which is much more strongly considered in subject-specific models than in models with a General approach. This reflects the fact that data-driven smart products and services play a crucial role in Industry 4.0. It is also emphasized that the «products and services» aspect clearly does not have the same meaning in General models, since they apply to any industry. At the same time, «innovation» gets much more attention in the overall model of digital maturity, which emphasizes that the organization's ability to develop new products and services is much stronger there.

«Understanding customers & experience» is also represented more strongly overall than in domain-specific digital maturity models, which may indicate that the ability to understand customers and create a great customer experience is not considered important in domain-specific models. Much more weight is given to the topic of «compliance and security» in specific subject

areas than in General models. This is due to a strong focus on «technology» that brings with it compliance and IT/ digital security.

All areas of maturity relevant to the organization's transformational capabilities (such as vision, leadership, digital culture, innovation, management, and so on) that use digital technologies play a more important role in General models of digital maturity than in specific domains. Both digital and transformational capabilities are necessary for the success of digital transformation efforts in every organization. This analysis provides some evidence that transformational capabilities are not sufficiently represented in the subject models of digital maturity.

This systematic review of the literature summarizes research and current developments in the field of digital maturity. The results show that since 2016 there has been an increase in the number of academic research in the field of digital maturity: mainly due to Industry 4.0. The number of identified models of digital maturity corresponds to previously published works (Chanias 2016). This systematic review of the literature identified and included 23 acceptable models of digital maturity. The analysis performed in this paper goes beyond the work presented in the previously published papers mentioned above, as particular attention was paid to the type of measurements used in various digital maturity models.

The research results of this review strongly suggest that all the identified models use different approaches to describing digital maturity. There is no consistent definition of digital maturity, since all the different models of maturity and the underlying definition of digital maturity demonstrate heterogeneity of content and methodology. Even the models of digital maturity considered in this paper for specific areas, mainly reflecting the manufacturing sector, show significant differences at maturity, the applicable dimensions, nomenclature, levels, and characteristics.

Comparison of areas of maturity that are discussed in various models yields interesting results. First, the «product and services» dimension plays a clearly secondary role in General models compared to subject-specific models. Second, the cultural dimension plays a much more important role in General models of digital maturity than in domain models.

Other «soft» dimensions that are more related to transformational capabilities, such as leadership, vision, and innovation culture, are also considered more in General models of digital maturity than in domain models. Third, it becomes clear that the «business model» maturity area is not considered in all the models considered in this review. It seems that the digitalization of the business model is ignored in most approaches to digital maturity. Only a few models address this aspect. This can be interpreted to mean that most companies focus more on exploiting digital technologies than on researching digital innovations and developing new digital products and business models to generate new digital revenue. Fourth «customer understanding and experience»

as a characteristic of digital maturity plays a secondary role in subject-specific models. Thus, it can be argued that General models of digital maturity are more concerned with transformational capabilities, and domain models are more concerned with digital technological capabilities when evaluating a company's digital maturity.

In addition, General models tend to show a greater external orientation and therefore take customer experience into account as criteria for digital maturity much more strongly than models focused on specific areas. A comparison of all the maturity indicators presented in different models shows that most models give an incomplete picture of digital maturity. Either transformational management capabilities (such as vision, culture, leadership, management, innovation, flexibility, etc.) or the digital foundation of an organization (such as technology, digital skills, organization, strategy, customer experience, etc.) are not considered sufficiently and systematically.

In this context, particular light has been shed on the dimension of «culture», as organizational culture is increasingly seen as the number one obstacle to digital transformation (Buvat 2017) and as the most significant barrier to digital efficiency (Goran 2016).

What sets digital leaders apart from the rest is a clear digital strategy combined with a culture and leadership aimed at driving transformation. Employees in digital Mature organizations describe their culture as more collaborative and innovative compared to other organizations, and they claim that leadership has sufficient digital skills (G. P. Kane 2015). Digital Mature companies also have cultures that embrace an expanded appetite for risk-taking, rapid experimentation, large investments in talent and recruitment, and leaders who excel in soft skills (G. P. Kane 2017).
More than half of the digital maturity models reviewed include «culture» as a separate dimension. Within these models, attributes such as «collaboration», «agility and flexibility», «organizational learning», «ability to change», and «customer focus» are among the most common cultural attributes in all models.

Innovation is indirectly addressed by attributes such as «failure tolerance», «risk tolerance», and «development of new digital methods of work». When comparing the identified cultural attributes with the attributes proposed by mass culture models such as Buvat et al. 2017, it becomes obvious that there is a correspondence to some extent.

Other proposed attributes describing digital culture (Buvat 2017) like «digital thinking», «data-based decision-making», and «open culture», are clearly underrepresented in the models of digital maturity under consideration. Thus, there is an obvious need to consistently identify the attributes of digital culture that contribute to digital transformation and systematically incorporate these cultural attributes into models of digital maturity. In addition, the findings of this review indicate a lack of digital maturity models that reflect areas other than manufacturing, considering the context and challenges of other industries.

Driven by Industry 4.0, most existing models turn to the field of manufacturing. More specific and detailed modeling approaches that provide additional levels of detail are needed to reflect industry capabilities and characteristics and give companies effective guidance on achieving digital maturity in various industrial and functional contexts. Especially the service sector needs more attention in the future, as more and more manufacturing companies recognize the services of secondary market is the driving force of revenue, and digital technologies open new opportunities, especially in the service (G. L. Benjamin 2019).

As for the design of models, in all the models considered, there are could be found a discrepancy between the levels and characteristics that characterize digital maturity. There is no standard approach to describing levels of digital maturity, even in an area like manufacturing. In most cases, the description of digital maturity levels and therefore the classification of companies is too vague. Thus, the assessment does not provide clear guidelines for new digital initiatives and does not provide a clear map of potential actions for management. Thus, more detailed assessment approaches with specific characteristics for each specific maturity level will be required.

3. Empirical Study

3.1 A framework building process

The next section will describe the analytical approach of systematic literature review (SLR). To date, various analytical strategies have been developed and implemented to analyze existing literature (Glaser & Strauss, 1967; Silver & Lewins, 2014). It was decided that the best method to adopt was a mixture of the grounded theory of Glaser and Strauss (1967) combined with the mirror reflection procedure of Wieringa (2014). The SLR is considered a clear and transparent procedure for a well-thought-out literature review that will help in the validity of future research. The initial measurements of the digital maturity model came from SLR results (Table 11), which must be further developed using primary data sources from various digital maturity reserches. To better understand the conclusions of the SLR, it is important to briefly outline the approach used to develop the theory, which is outlined in the table (Table 12).

Table 12 Theory development

Reasoning	Description
Inductive	Bottom-up; ignore existing theories, qualitative (Glaser & Strauss, 1967; Eisenhardt, 1989)
Deductive	Top-down; existing theories considered, quantitative
Abductive	Top-down & bottom-up; mixture of existing theories and original data, mixed methods

This paper recognizes the importance of existing research on the maturity model, but also points to the need to use primary data sources to facilitate the revision and development of initial measurements of the maturity model. It is recommended to use the abductive method because it takes into account previous theories of maturity models and the importance of using primary sources in developing the theory. The structure of the abductive approach is shown in following Figure (Fig. 1).
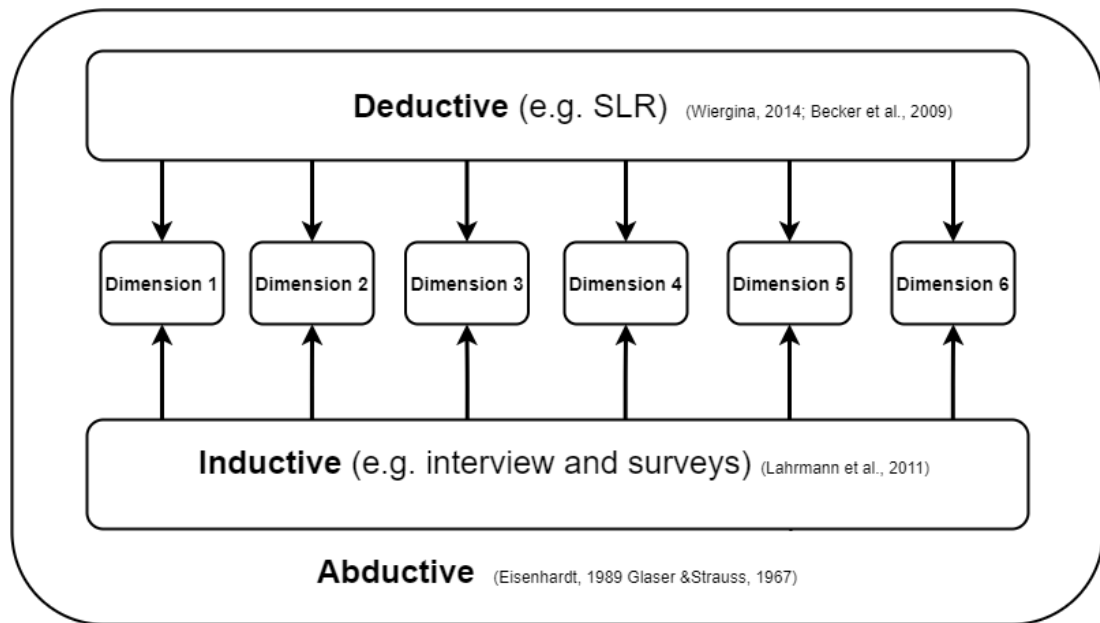
Figure 1 Overview of abductive research approach

The difficulty of defining a digital maturity model arose during the SLR. To ensure that all possible digital maturity models are covered, SLR has uncovered 23 maturity models that could be considered digital.

As discussed earlier, this work aims to develop and validate a multi-enterprise digital maturity model; therefore, it suggests using Becker et al.'s (2009) and Lahrmann (2011) procedures models to develop a maturity model. A mixed approach is recommended, since these two procedural models emphasize top-down and bottom-up approaches to developing a maturity model. In addition, the combination of a top-down approach and a bottom-up approach is appropriate for abductive reasoning.

Researchers interested in maturity models should not only operationalize this concept, but also point out its direction (Tarkhan et al., 2016) and the scope (De Bruin, Freeze, Kaulkarni, & Rosemann, 2005) of maturity models. The focus of the maturity model is a key aspect for further advancement in the field of the maturity model. Confirmed by SLR, maturity models can be classified as follows (Table 13).

Table 13 Maturity Model Development Type (Tarhan et al., 2016).

Type of Focus	Description
Metalevel	Metalevel analyses are defined as broad surveys conducted in numerous companies and the reported results are used to create a meta maturity model
Development	Development provides a detailed description of a specific maturity model based on theories which can be derived by a top down approach (Becker et al., 2009), bottom up approach (Lahrmann et al., 2011), industry standards (e.g. CMM, SPICE, PLM, etc.) or predetermined organizational silos
Application	Models are implemented and evaluated within real business contexts
Validation	Validation of maturity models determines how accurate the description or explanation of the research findings are (Eriksson & Kovalainen, 2008)

One of the reasons why the scope of maturity models should be outlined is to distinguish the model from other existing models, as well as to create unique digital models of transformation opportunities for companies of different sizes (De Bruit et al., 2005). Table 9 shows all maturity models evaluated at the SLR stage.

Based on the proposed research strategy, this study recognizes the importance of existing studies of the maturity model, but also understands the need for raw data to help revise and shape new dimensions of the maturity model. One of the reasons that made it difficult to create a mirror system was the lack of standardized terminology for classifying digital maturity levels. To date, there is no generally accepted terminology for opportunities in the digital maturity model. This paper argues that the taxonomy of opportunities is important in order to draw conclusions among SMEs and cross-examine cases.

Since the subject of research in this work is the Russian market including small, medium, and large businesses, it is necessary to use a model of digital transformation maturity that will work for companies of different spectrum. As a result of the review of existing models, it has become clear that all the majority are either in a specific business area or are aimed only at large companies or SMEs separately.

A total of 23 maturity model studies were initially collected, and among them 6 SME-oriented maturity models were selected from this initial collection for further analysis. Detailed results of SLR 23 maturity models can be found in the literature review.

For this study, different maturity models from different industries and goals were selected to better assess what General digital maturity models should look like. Figure 2 shows the current limitations of research in the field of maturity models based on a systematic literature review.
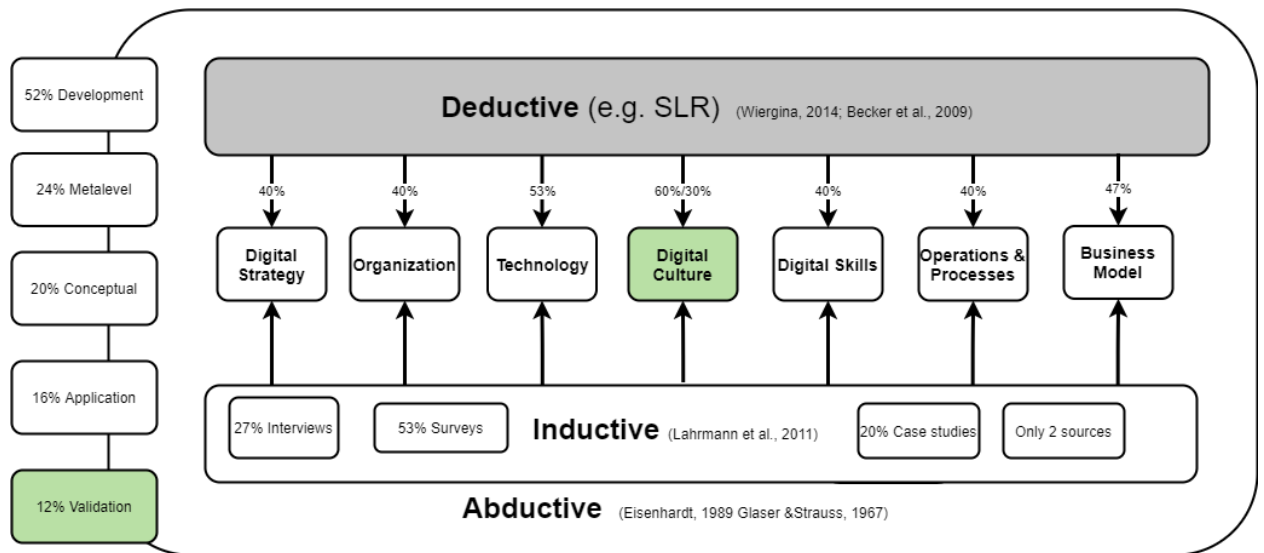
Figure 2 Literature review findings

As shown in figure 2, the most significant aspect of the SME digital maturity model is the measurement of Digital Culture. It is also obvious that very few maturity models have actually been tested. These results are supported by previous studies that have shown that there is still no validation of the maturity model in this area (Mittal et al, 2018; Lasrado, Kihn & Ihantola, 2015; Tarhan et al., 2016; Correia et al., 2017; Tapia, Daneva, & van Eck, 2007; van Hillegersberg, 2019).

For example, Tarkhan et al. (2016) analyzed the literature on business process maturity models for the period from 1990 to 2014. The authors systematically examined 61 studies out of 2,899 initially sought maturity models. The authors identified four categories of maturity model concepts: 1) development, 2) Application, 3) validation, and 4) meta-analysis. The authors found that only 9% of the articles were devoted to validation of maturity models. Commenting on the issue of validation of the maturity model, Tapia et al. (2007) argued that «validation is the biggest challenge in our study, because, with very few exceptions, the existing literature provides almost no advice on how to empirically test the maturity model».

One of the biggest challenges in studying the maturity model is providing evidence that the model reliably and accurately measures what it should do (Blondiau, Mettler, & Winter, 2013). The proposed framework extends the "Digital Transformation Index II" methodology (Dell Technologies 2016) to adaptation for the SME's either. This methodology is explained in a few lines below. On the other hand, experimental testing of the preliminary structure helped to correct it and build it final framework.

Overall, the proposed framework aims to ensure that guide for small, medium-sized, and large enterprises to identify their digital maturity level and future steps to implement in their digital transformation strategy, so there remains unchanged competitiveness in turbulent conditions.

As mentioned earlier, this framework has been developed to extend the successful "Digital Transformation Index II" (DTI II) methodology by Dell Technologies where the specifics of small and medium-sized companies are not taken into account.

In 2016, Dell Technologies, in collaboration with Intel and Vanson Bourne, compiled the Digital Transformation Index. For the research 4,600 business leaders from more than forty countries were surveyed to analyze companies' transformation initiatives. The DT Index study, conducted jointly with Intel Corporation, examined the situation with digital transformation in medium-sized and large companies, and also identified the corresponding expectations and fears of their managers.

The following table (Table 14) shows how the survey sections (1-4) reveal the main areas of digital maturity that were highlighted as a result of the literature review (Table 11).

Table 14 Compliance of the Dell methodology with common areas for measuring the level of Digital Maturity (DM)

Survey section	Common DM area to estimate	Other soft DM sub-dimensions to cover
Section 1	Digital Strategy	Technology; Operations & Processes; Organization; Digital Ecosystem; Compliance & Security; Business Model
Section 2	Organization	Digital Culture; Technology; Digital Strategy; Digital Skills; Governance; Vision; Leadership; Compliance & Security; Business Model; Products & Services.
Section 3	Digital Culture	Operations & Processes; Innovation; Customer Insight & Experience; Digital Skills
Section 4	Technology	Compliance & Security; Products & Services; Digital Ecosystem

In short, DTI II consists of the following stages (based on a structured self-assessment tools):

1) Determination of the extent to which companies successfully performing different actions to support digital transformation.

2) Determination of the current digital initiatives

3) Determination of the extent to which companies addressing each of the factors to stay competitive and succeed in the digital future.

4) Determination of new emerging technologies, in which organization is planning to invest in over the next 1-3 years to lay the groundwork for digital future.

The structure developed for both SMEs and large companies should take into account the lower degree of formalization of strategies, processes and organization compared to larger firms (North and Varvakis, 2016). Therefore, current and desired levels of digital maturity should be described

in terms of practice and in terms that are easy to understand. Approaches developed for large companies, such as digital quotient (McKinsey, 2015), assume a formalized organization with sufficient resources. In addition, many of these assessments are not provided for free. That is why the framework aimed at developing a simple, free tool with a solid theoretical base.

This study consists of a survey that includes 7 sections that contain two types of questions: multiple choice, as well as rating using the Likert scale. Each question encloses all the main parameters of measuring the degree of digital transformation in a separate organization. Only 1-4 sections are used for determination of digital maturity (Application 1).

According to this methodology, all companies can be divided into 5 benchmark groups, according to their level of digital maturity (Table 15).

Table 15 Digital Transformation Index Bemchmark Groups

Benchmark group	Characteristic
Digital leaders	Digital ingrained in DNA
Digital adopters	Mature digital plans, investments and innovations in place
Digital evaluators	Gradual digital transformation and planning
Digital followers	Very few investments; tentative plans
Digital laggards	No digital plans; limited initiatives and investments

Using this approach in this study, we can not only determine the distribution among the levels of digital maturity among Russian companies, but also find out what barriers to successful digitalization they face at the moment. In addition, there is will be received an answer to the question: what steps companies are going to take to overcome the barriers that have arisen on the path of digital transformation.

In addition, it was decided to divide all tested companies by size, business area and employee's position in order to determine:

1) Whether these factors are significant for determining the level of digital transformation;
2) What conclusions can be drawn based on the analysis of these parameters.

Considering all the above, this study is quantitative in nature. Based on the research questions and chosen methodological approach, current research was conducted in the following order:

1) Conduct a survey;
2) Preparation of the raw data;
3) Analysis of the obtained data and presentation of conclusions in the form of a report.

3.2 Data collection and research plan

Based on data from a several similar study using digital maturity frameworks for the Russian market a reliable sample size will be 100 managers of Russian businesses.
The data used for quantitatively validating the model was collected from the beginning of February to mid of April 2020. During this period n=100, working for firms in various industries in Russia completed the survey.

In a first step of data analysis, descriptive statistics were generated to receive a first overview of the results as well as of possible structural differences or relations in the sample. Additionally, diverse statistical significance tests were conducted to see whether the overall maturity results, as well as the results in each dimension. No considerable structural characteristics could be identified in the sample, what leads to the conclusion that companies that participated in the survey are more or less on the same maturity level, independent of factors such as industry or location, especially since personal attributes of the participants, such as age, position or working experience, do not seem to influence their subjective assessment of organization's digital maturity in the present case.

In addition, in order to ensure homogeneity of the sample, it is necessary to limit the selection of companies to those who are already making certain steps in terms of digital transformation within last 2 years.

In order to collect this data, it was decided to use the client base of implemented projects of the company, which is engaged in business automation and digitalization, as its professional commercial activity. None of the surveyed companies, as well as the donor company of the database, gave official permission to disclose confidential data, so all data in this work will be provided anonymously.

Therefore, data collection consisted of the following steps:

1) Creating a sample of companies participating in the survey. Among the main selection criteria:
— The company must not apply for any services for automation and digitalization of its business earlier than in 2018.
— The digital transformation project has already been completed and is currently under maintenance.

— Individuals who were surveyed are representatives of top management of the companies, or business owners - decision makers who are familiar with all levels of the organization.

2) Sending out a questionnaire in the context of conducting an audit as part of customer support after the project is completed. The main difficulty is that the survey is written in English, and managers and responsible persons do not speak English so well. Therefore, the format of the survey in this case is transformed into the format of a personal interview with closed questions.

3) After collecting the necessary data, the next step is to start processing. To do this, it was necessary to first correlate the responses for each question with the points that are given for each answer. The following table shows the order in which each response is evaluated individually (Table 16).

Table 16 The distribution of points for answers of the questionnaire. Source: compiled by the author.

Section	Response	Point
1	I don't know	0
	Not done and no plans to do	1
	Planned to do	2
	In process of doing – early stages	3
	In process of doing - mature stages	4
	Fully completed for now - successfully	5
2	Integrating digital goals (into all departmental/staff objectives)	1
	Developing mature on-demand models	1
	Using agile software development to accelerate new product/services development	1
	Using always connected, sensor enabled and location aware technologies	1
	Building security and privacy into all devices, applications and algorithms	1
	Sharing knowledge across business functions equipping IT leaders with business skills and business leaders with IT skills	1
	Using widespread automated decision-making (artificial intelligence)	1
	Acting on intelligence in real-time	1
	Investing in digital skills/talent (i.e. teach all employees how to code)	1
	Developing an open innovation model/accelerator program	1
	None of these	1
	I don't know	0
3	I don't know	0
	No plans	1
	Research/planning stage	2
	Not doing well, in pockets of the organization	3
	Not doing well, organization-wide	4
	Doing well, in pockets of the organization	5
	Doing well, organization-wide	6
4	Cybersecurity	1
	Internet of Things technology (turning everyday objects into network connected sensors so they can send and receive data)	1
	Multi-cloud environment where each application is deployed in the most appropriate cloud (private or public)	1
	Artificial intelligence (i.e. visual perception, speech recognition, decision-making, and translation between languages – performed by computers rather than humans)	1
	Compute-centric approach to data center design and workload enablement/optimization	1
	Flash technology to reduce latency, allow for greater storage density and performance increase	1
	Applying Augmented or Virtual Reality	1
	Cognitive systems technologies that use natural language processing and machine learning to enable more efficient interaction between people and machines	1
	Distributed ledger technology (i.e. blockchain)	1
	Commercial UAVs (drones)	1
	Quantum computing	1
	Neuromorphic hardware that can imitate the brain more efficiently	1

		1
	None of these	1
	I don't know	0

4) The next step is to define a score range for each level of digital transformation in the model. Since this part of the methodology is not publicly available, this paper defines this ranges by method of sorting using self-testing tool that Dell offers on its website using the same methodology. The table below shows the final distribution (Table 17).

Table 17 Score range distribution for DTI approach. Source: compiled by the author.

	Section 1	Section 2	Section 3	Section 4	Total score range
Digital Leader	33-35	9-10	35-36	11-12	86-93
Digital Adopter	30-32	7-8	33-34	9-10	77-85
Digital Evaluator	26-29	5-6	31-32	7-8	67-76
Digital Follower	20-25	3-4	24-30	4-6	51-66
Digital Laggard	0-19	0-2	0-23	0-3	0-50

This evaluation system offers to evaluate the level of digital transformation separately for each section, after which the results are added up and it becomes possible to give a final assessment of the company as a whole.

4. Findings

As part of the study, 100 representatives of enterprises from the main sectors of the Russian economy were surveyed.

The sample of respondents was based on managers of various levels: 34 of them hold the positions of Director or Vice-President, 60 - Deputy Director, head of the Department (Fig.3).
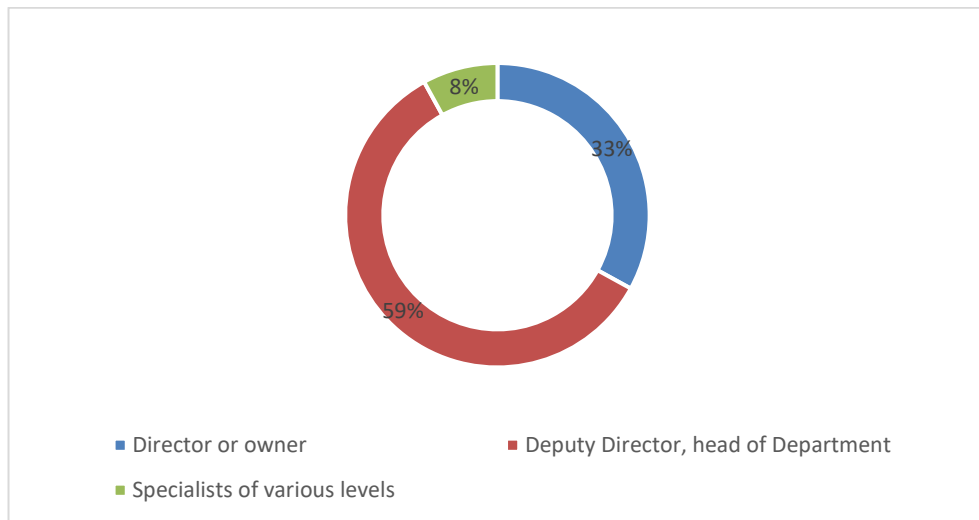

Figure 3 Distribution of respondents by position

As it turned out, digital transformation is particularly relevant for large companies and those operating in a highly competitive market. Large structures with more than 500 employees showed the greatest interest in the study (Fig. 4).
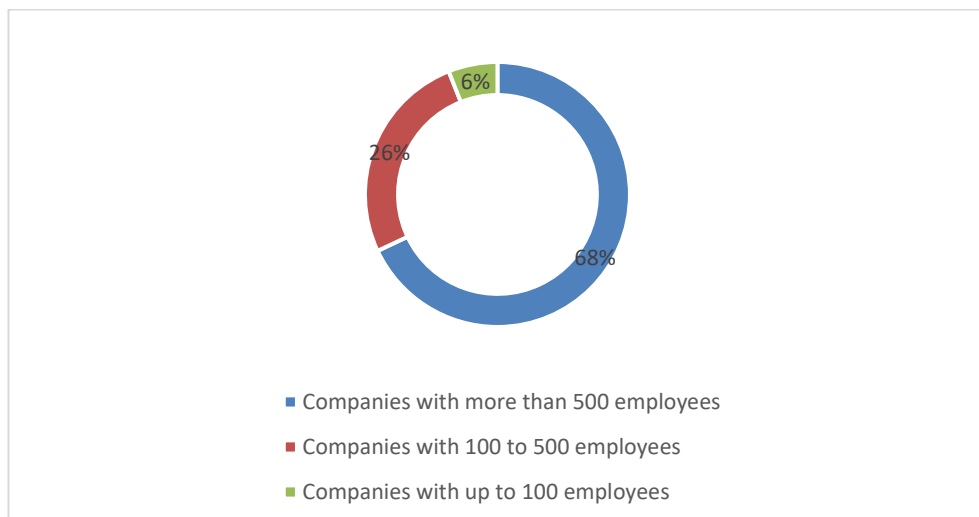
Figure 4 Distribution of respondents by the size of the companies they work for

Among the areas of activity, the topic was the most relevant for representatives of the financial sector (Fig. 5).
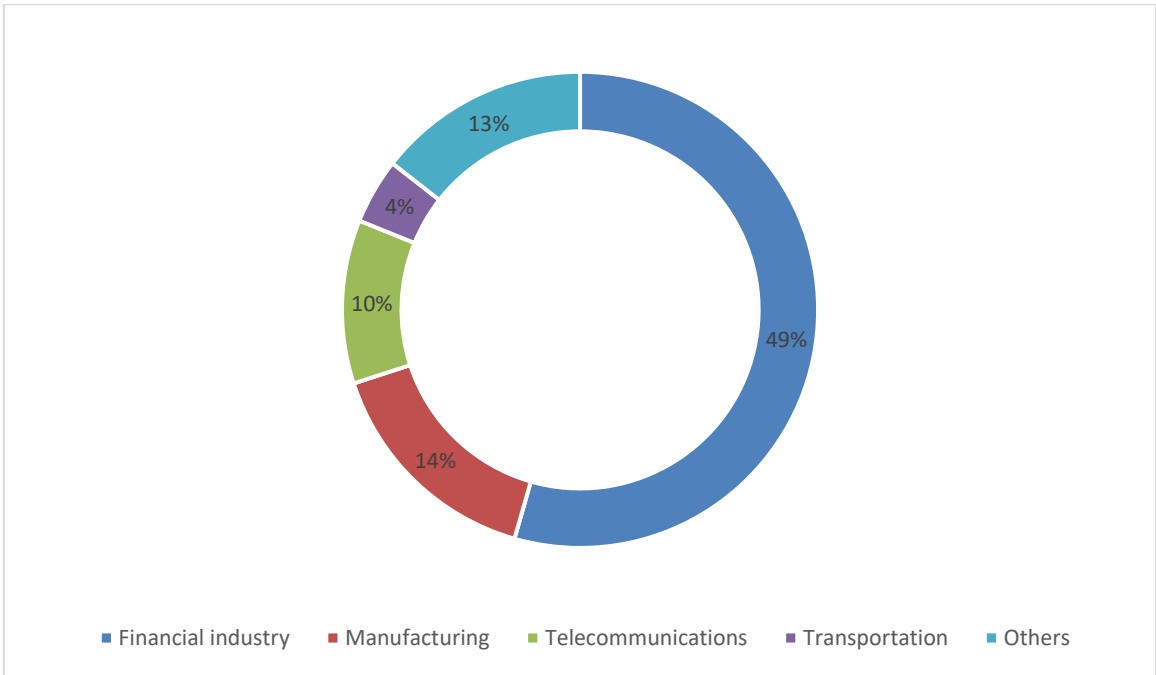
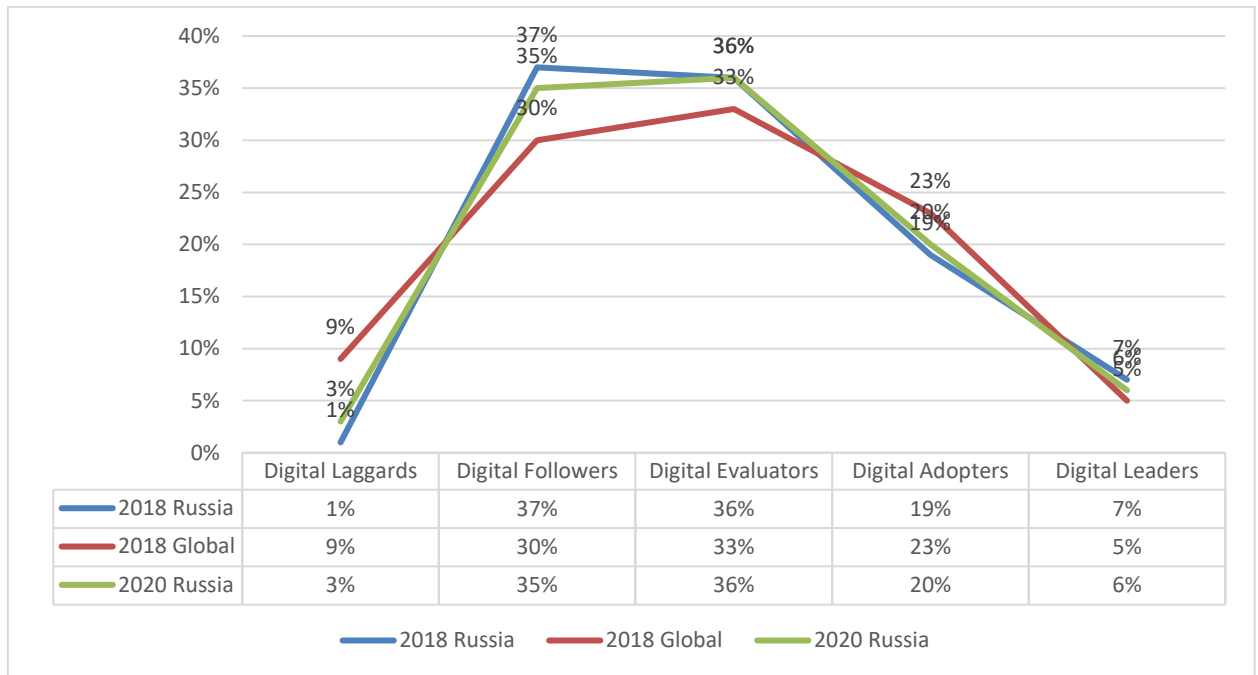Figure 5 Distribution of respondents by industry or activity

The result of data processing showed the following distribution by category of the level of digital transformation among Russian companies (Table 18).

Table 18 The distribution of digital transformation maturity in Russia, 2020 (out of 100 respondents). Source: compiled by the author.

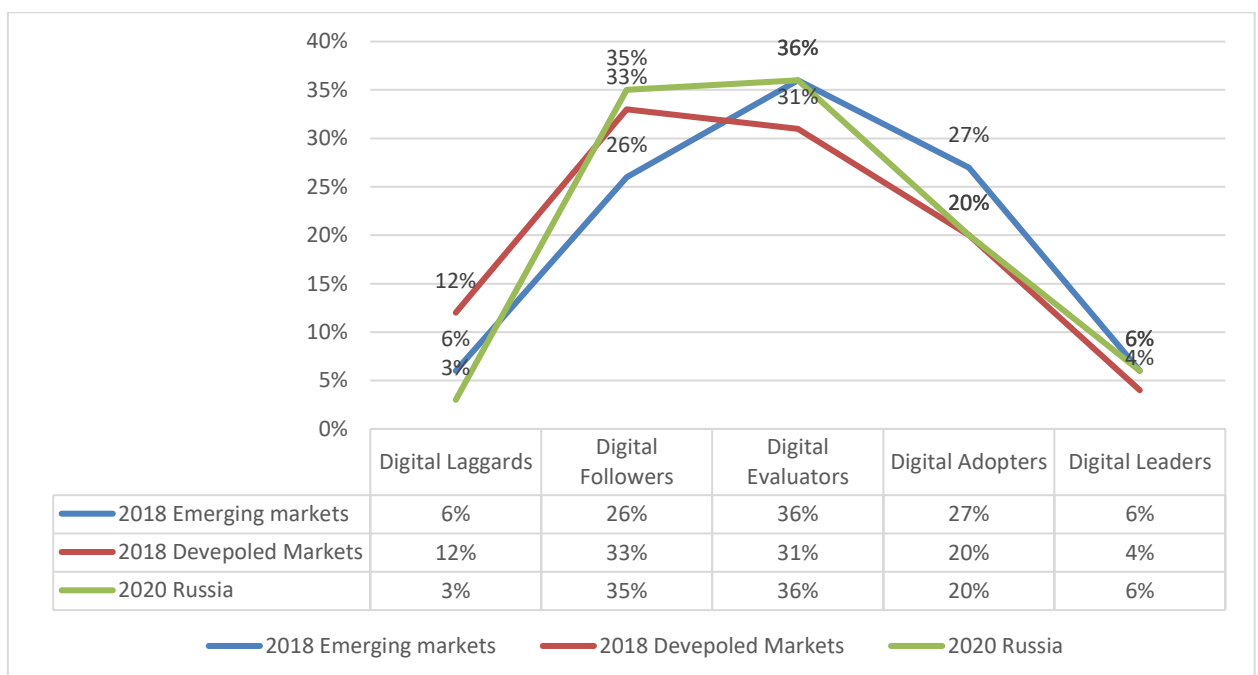| Benchmark Group	Description	% of respondents
Digital Leaders	Digital transformation is visible throughout the entire structure of the enterprise in one form or another	6%
Digital Adopters	Have a ready-made digital transformation plan, investments in the active phase	20%
Digital Evaluators	They are gradually and carefully implementing the digital transformation and are planning further steps, including further investments	36%
Digital Followers	A modest investment in digital transformation plans are in the discussion stage	35%
Digital Laggards	Do not have a digital transformation plan, initiatives and investments are limited	3%

Only 6% of Russian companies belong to the category of «Digital Leaders». If considered separately by industry, among the Digital Leaders that are in the process of implementing the digital transformation strategy are companies related to the banking sector, financial services, IT and software development, as well as industrial production. On the other hand, the industries where digitalization is developing the worst are business services (maintenance and support), entertainment, and construction.

Figure 5 Digital Transformation Index: 2018 to 2020 Source: compiled by the author.

	Digital Laggards	Digital Followers	Digital Evaluators	Digital Adopters	Digital Leaders
2018 Russia	1%	37%	36%	19%	7%
2018 Global	9%	30%	33%	23%	5%
2020 Russia	3%	35%	36%	20%	6%

According to the data, in 2020 Russia is closer to the global indicators, but the percentage of Leaders and Laggards has worsened. However, the overall trend has shifted slightly to the right, which may be a sign that Russia is moving away from the indicators of developed markets towards more emerging ones. (Figure 6).

Figure 6 Transformation in Emerging & Developed Markets. Source: compiled by the author.

|	Digital Laggards	Digital Followers	Digital Evaluators	Digital Adopters	Digital Leaders
2018 Emerging markets	6%	26%	36%	27%	6%
2018 Devepoled Markets	12%	33%	31%	20%	4%
2020 Russia	3%	35%	36%	20%	6%

In addition, today 20% of companies are classified as Digital Adopters. These are companies that have a digital transformation plan and are actively investing in this direction.

Also, according to the study, 38% of companies collectively occupy the bottom two categories. This means that they are either performing the digital transformation very slowly, or do not have a corresponding plan at all.

The next point of the survey allows to find out how Russian companies see their future in 5 years (Fig. 7).

Figure 7 Five Year Outlook For Their Organization. Source: compiled by the author.
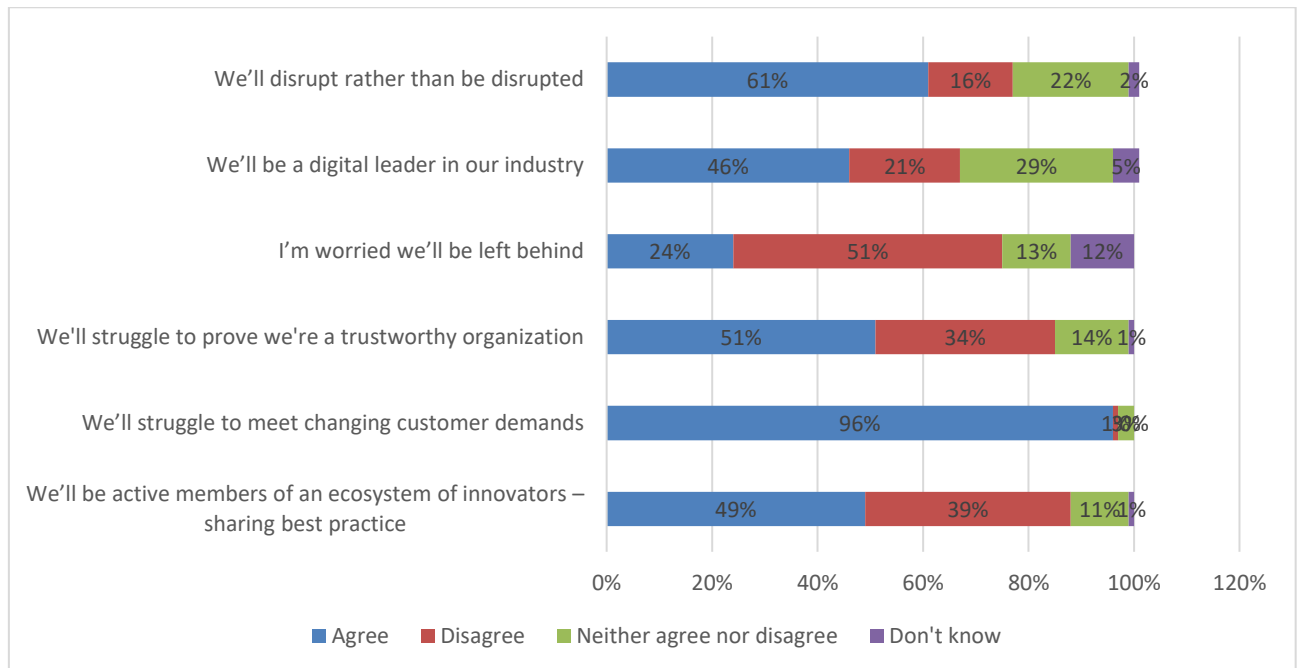
According to the data obtained, 96% of respondents in Russia believe that in the next 5 years their companies will face difficulties in meeting the changing needs of customers, while 24% worry that they may lose the market altogether.

The next section of the survey revealed what obstacles to digital transformation have become relevant at this time (Fig.8).

Figure 8 Barriers To Digital Progress. Source: compiled by the author.
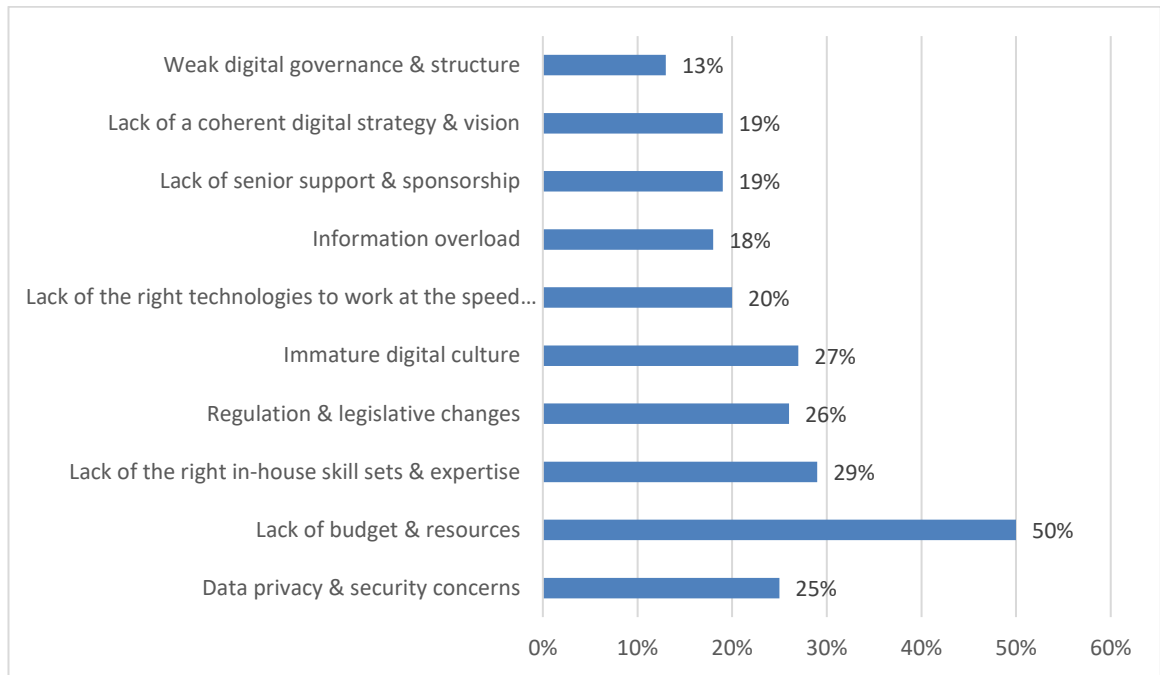
Today, 88% of Russian companies surveyed face difficult obstacles to digital transformation. Here are the 5 main obstacles:

1. Lack of necessary resources and budget (50%)
2. Lack of necessary knowledge and skills of the staff (29%)
3. Immature digital culture (27%)
4. Regulatory or legislative changes (26%)
5. Unresolved data security and privacy issues (25%)

These factors make it difficult to fully implement the digital transformation. For example, the managers of 91% of Russian enterprises surveyed believe that digital transformation should cover the structure of the enterprise to a greater extent (Table 24). At the same time, 61% are convinced that in the next 5 years they will be the initiators of changes rather than adapt to external changes (Fig. 9).

Figure 9 Response to Digital Transformation Today. Source: compiled by the author.
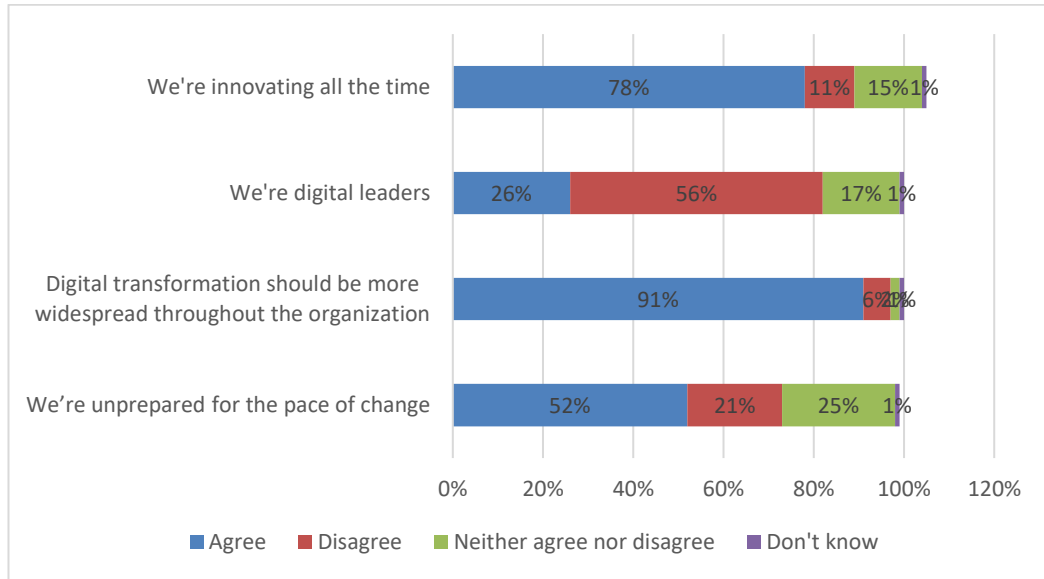

The next conclusion that can be drawn from the study concerns overcoming the above-mentioned obstacles.

The research shows that companies are taking steps to overcome the obstacles to digital transformation and are trying to find ways to beat their competitors. This is indicated by the following figures (Fig.10).

:

— 55% of Russian companies use digital technologies to accelerate the creation of new products and services;

— 68% of companies integrate security and privacy into all devices, applications, and algorithms;

— 42% of companies strive to train their staff in the necessary skills, such as programming, and pass them the necessary knowledge;

— 56% of companies share knowledge between departments, training it managers in business skills, and business managers in information technology skills.

Figure 10 How Organizations Are Transforming Today. Source: compiled by the author.
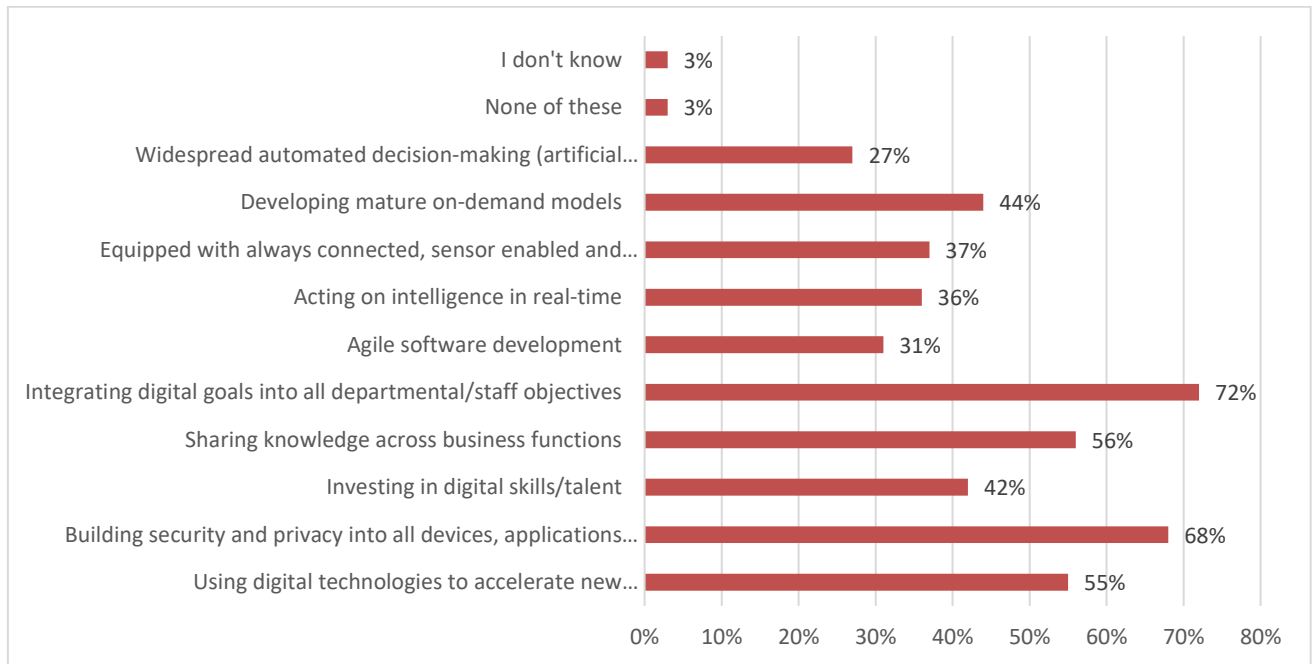

Innovative technologies and cybersecurity, which market players are also turning to, help in the transformation and guarantee its success.

In the next 1 year or three Russian companies plan to invest in the following areas:

— 67% - in cybersecurity;
— 56% - in a server-centric approach to building a data center, supporting and optimizing workloads;
— 46% - in flash memory;
— 39% - in multi-cloud environments;
— 34% - in artificial intelligence.

A significant proportion of companies plan to experiment with innovative technologies: 30% plan to invest in blockchain, 12% - in quantum computing, and 24% - in virtual and augmented reality (Fig.11).

Figure 11 Technology Investment Plans Over the Next 1-3 Years. Source: compiled by the author.
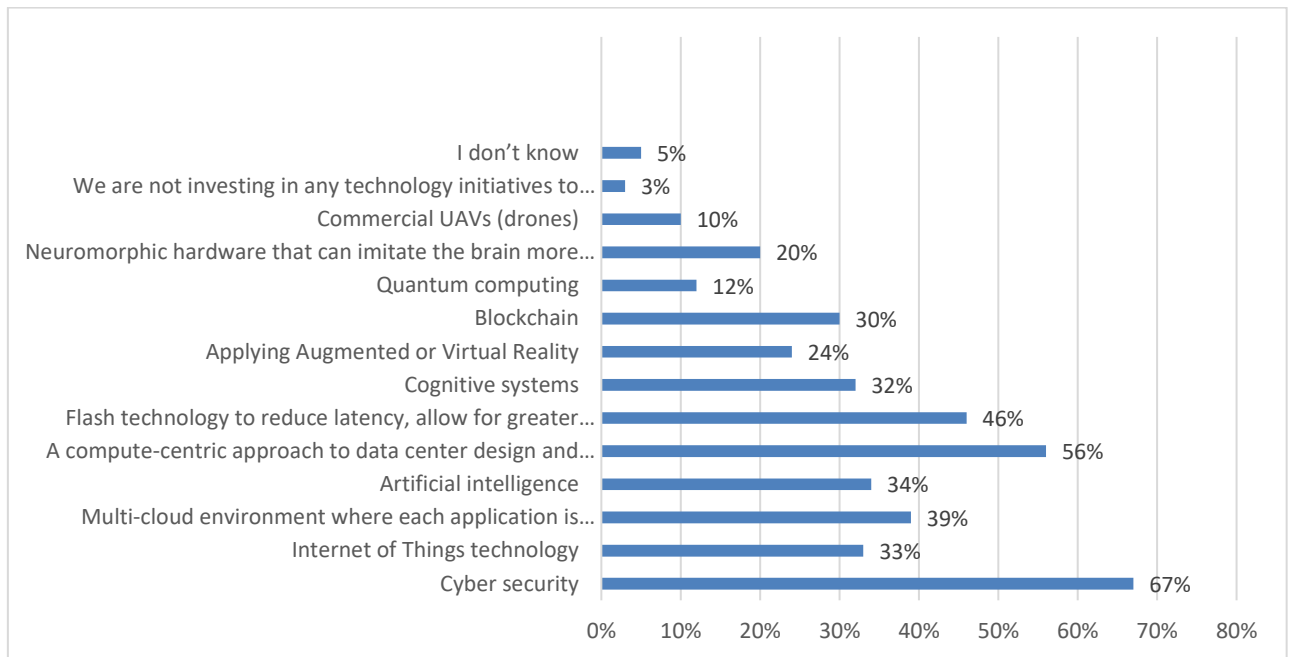
4.1 Responses from representatives of large samples

Among the respondents who took part in the study, two large groups can be distinguished: by size (enterprises with more than 500 employees) and by field of activity (financial structures). Their responses differed from those of other organizations, although not significantly.

Thus, large companies have predictably moved further along the path of digital transformation: almost 60% of them already integrated digital goals into all departmental/staff objectives (against 48% in the entire sample), while there are slightly fewer optimists, who said they will be Digital Leaders in their industry in the next 5 years. When developing transformation strategies, the management of these organizations tends to be more centralized.

In addition, their top managers are three times lower than the average (16%), assess the lack of necessary resources and budget.

There are more optimists in financial organizations (91%), and a larger share of those who consider that they will be active members of an ecosystem of innovators - sharing best practice (56%).

Almost 70% of respondents mentioned the importance of changing the approach to working with clients, because of the struggle to meet changing customer demands. These

companies complain less about the struggle to prove they are a trustworthy organization, the lack of senior support & sponsorship, and, consequently, problems with the budget. At the same time, respondents from this industry estimate their five year outlook as they «will disrupt rather than be disrupted».

Nevertheless, all respondents agree on two main points of perception of digital transformation. The percentage of respondents who were considered as "Digital Evaluators" and "Digital Adopters" and is approximately the same for different types of companies (Fig. 12).
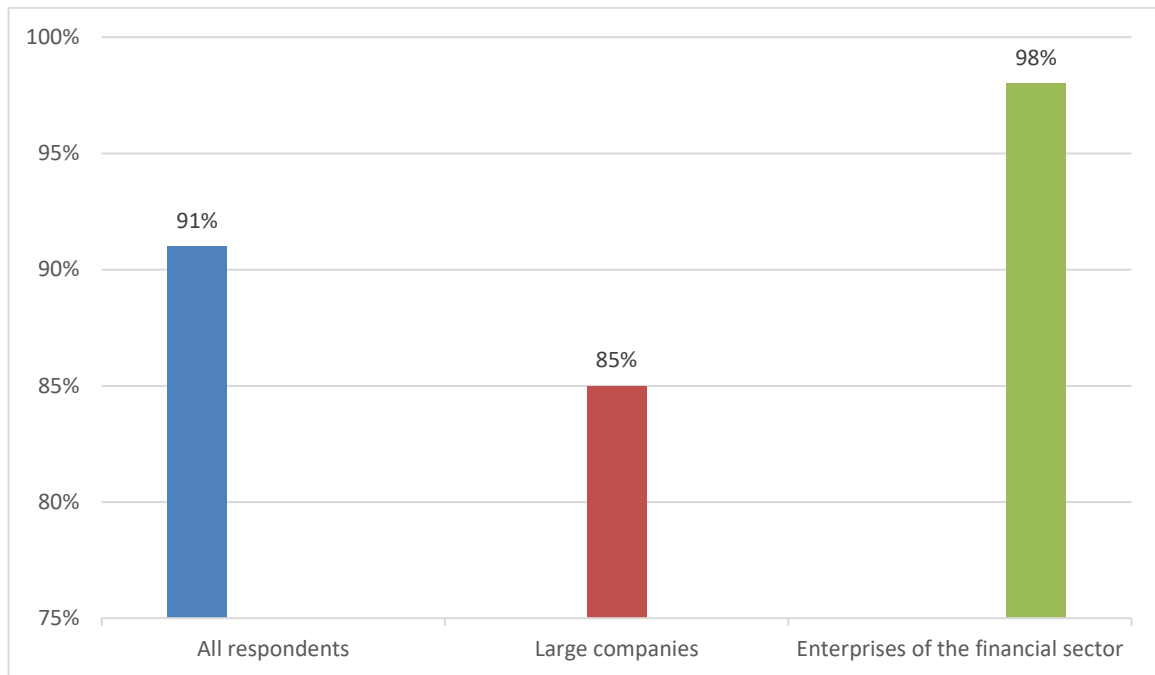

Figure 12 Percentage of companies at different digital maturity levels

Similar are the shares of those who believe that their company will struggle from Data privacy & Security concerns as well as from Regulation & Legislative changes. (Fig. 13).
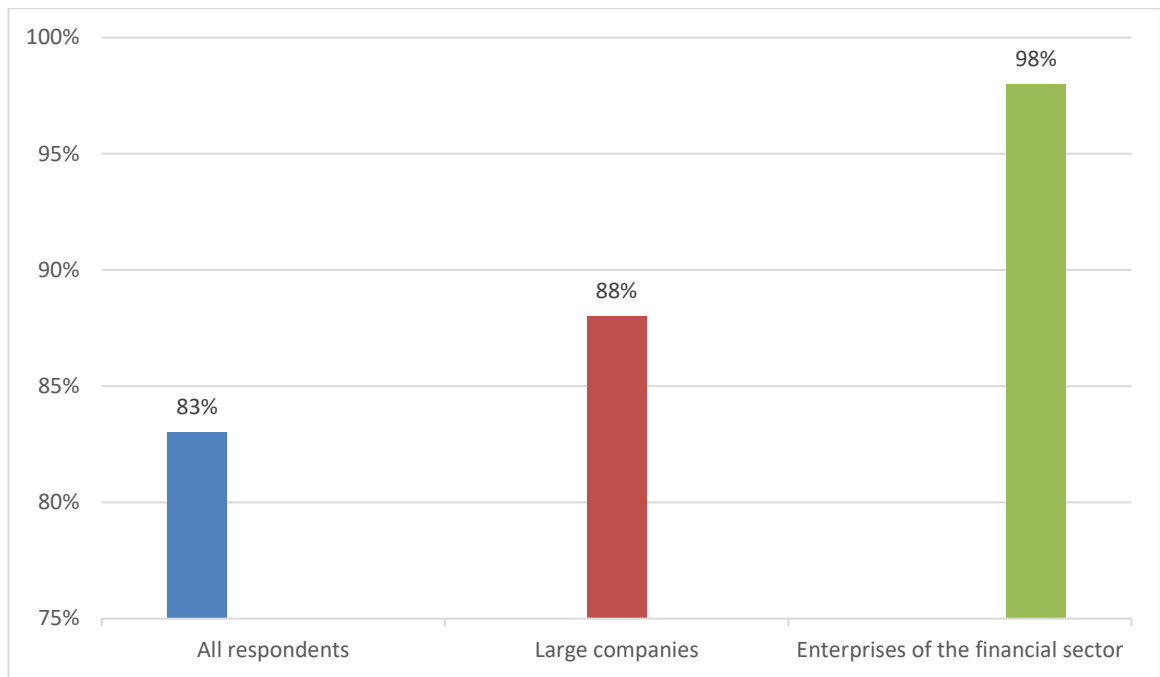
Figure 13 Percentage of respondents who believe that their company will struggle from Data privacy & Security concerns as well as from Regulation & Legislative changes.

4.2 Managerial implications

According to the results of the research, among the factors hindering digital transformation in the Russian Federation, the following can be indicated: lack of a built strategy, lack of qualified personnel, low level of competence and knowledge among employees of enterprises, lack of integration of new and existing technologies and data, inflexible or slow processes, outdated technologies, lack of close links between IT and business, lack of readiness for change, insufficient funding, management position, possible risks. In modern conditions of digitization of the industrial enterprises have to carry out a reorganization of its activities, including in connection with the implementation of information systems. This is associated with serious risks, since the implementation of ready-made or custom-designed projects often ends in failure.

Due to the fact that the writing of this part of the work coincided with the peak of the COVID-19 epidemic in the world, as well as the global financial crisis, it is impossible not to take this context into account when writing practical recommendations.

In any case, the impact of these two events simultaneously on the entire world economy in all its manifestations will still be studied in detail by future researchers. However, it so happened that the forced isolation mode in its essence served as a huge impetus to accelerate the process of business automation everywhere. Thus, if the world was already moving fast before the advent of coronavirus, now companies that once developed a digital strategy for one to three years now have

to scale their initiatives within a few days or weeks, along the way radically reducing costs and optimizing all business processes, in order to stay in the market.

According to recent European survey[1], about 70 percent of executives from Austria, Germany and Switzerland said the pandemic is likely to accelerate the pace of their digital transformation. This recovery is already evident in various sectors and geographical regions. We can also take into account the experience of Asian banks, and how quickly they have moved physical channels to the Internet (McKinsey&Company 2020). As healthcare providers quickly moved to telemedicine, insurers moved to self-service claims assessment, and retailers moved to contactless shopping and delivery.

The current crisis seems to be the start of new era, in which digital technology has become the centerpiece of any interaction, forcing both organizations and individuals to move up the adoption curve almost overnight. In this new world digital channels are becoming the main (and in some cases the only) model for customer interaction, and automated processes are the main driver of productivity and the basis of flexible, transparent and stable supply chains. In this world agile ways of working are a prerequisite for meeting seemingly daily changes in customer behavior.

Now is the time to rethink digital initiatives—those that provide short-term assistance to employees, customers and a wide range of stakeholders to whom businesses are increasingly responsible, as well as those that position themselves in the post-crisis world.

Therefore, the following recommendations would not only be relevant for Russian business, which in recent years has rather gone into a period of stagnation, as we have seen from the results of the study. The spread of the crisis globally has only increased the need for a competent digital transformation. In addition, thanks to this, we can actively use the experience and current research that is currently being conducted for various business areas around the world, in order to understand what digital strategy will be relevant in the new realities.

1. The situation requires more risk-taking and learning.

Every company knows how to pilot new digital initiatives in «normal» times, but very few do so at the scale and speed suddenly required by the COVID-19 crisis. This is because in normal times, customer and market penalties for widespread «testing and training» may seem too high, and organizational hurdles may seem too steep. Shareholders of public companies demand immediate returns. Finance departments have a strong grip on the funds needed to move new initiatives forward quickly. Clients are often slow to adapt to new ways of doing business, and

[1] M. Malev 03/04/2020 «Is the coronavirus pandemic an engine for the digital transformation?» Retrieved from: https://dmexco.com/stories/is-the-coronavirus-pandemic-an-engine-for-the-digital-transformation/

traditional acceptance curves reflect this innate inertia. And the organizational culture, with its deep fluted silos, hinders flexibility and collaboration. As a result, companies often experiment at a pace that doesn't match the speed of change around them, slowing down their ability to learn fast enough to keep up. In addition, they rarely take the bold steps necessary to move quickly from piloted initiatives to scale successful ones, although McKinsey research shows that bold steps to introduce digital technologies at an early stage and at scale, combined with intensive resource allocation to digital initiatives and mergers and acquisitions, are highly correlated with value creation (McKinsey Quarterly 2017).

2. New offerings

By now, companies have already created the minimum viable nerve center needed to coordinate the crisis response (Usher 2020). This nerve center provides a natural collection point for critical strategic information, helping companies stay close to the rapidly changing needs of key customer segments and the ways that competitors and markets move to meet them. Of course, mapping these changes helps eliminate the immediate risks, but it also allows you to look ahead over time and consider more serious problems and opportunities—those that could lead to significant disruption during the ongoing crisis. Just as digital platforms have disrupted value pools and value chains in the past (McKinsey Quarterly 2017), the COVID-19 crisis will cause similar changes at the ecosystem level-not only changes in the economy, but also new ways to serve customers and work with suppliers across traditional industry boundaries (Venkat Atluri 2017).
For example, in the near term, most organizations are looking for a virtual replacement for their previous physical offerings, or at least new ways to make them available with minimal physical contact.

New offers that lead to this can often include new partnerships or the need to access new platforms and digital markets that the company has not yet participated in. As you interact with new partners and platforms, you need to look for opportunities to go beyond the comfort zones of the organization, as well as get access to places where you can confidently invest valuable time, people, and funds to achieve the best effect.

Design thinki*ng*, which involves using systems thinking and intuition to solve complex problems and explore ideal future States, will be crucial. The design-oriented approach focuses primarily on end users or customers (McKinsey Digital 2016). But it also helps to understand in real time how suppliers, channel partners, and competitors respond to the crisis, and how the ecosystem that includes them all develops for the next normal process that occurs after the immediate crisis disappears.

3. Rethink business model at its core.

Going beyond the comfort zones will require management to fully understand the business and operating models. Even though resources are necessarily limited, the experience of leading companies suggests that focusing on areas that affect most of the core of business will give you a better chance of success, both in the near and longer term, than minor improvements in other areas (McKinsey Digital 2017).

Organizations that make minor changes to the boundaries of their business model almost always fail to achieve their goals. Manipulation leads to returns on investment below the cost of capital and to changes (and learning) that are too small to match the external rate of destruction. In particular, organizations that quickly implement artificial intelligence tools and algorithms, as well as Design thinking, and use them to rethink their business at scale have outperformed their peers. This will be increasingly true as companies deal with large amounts of data in a rapidly changing landscape and seek to quickly and accurately adjust the course compared to their peers. While the results will vary significantly from industry to industry, several common themes are emerging across sectors that suggest «next normal» changes in cost structure and operating models in the future.

3.1 Transparency and flexibility of the supply chain.

Almost daily news stories tell how retailers around the world are running out of stock during a crisis, such as a shortage of toilet paper in the United States. It is also clear that retailers with full transparency of the supply chain before the crisis—as well as algorithms for detecting changes in the purchasing structure - did a better job of navigating during the crisis. Other sectors, many of which experience their own supply chain difficulties during a crisis, can learn from their retail counterparts to create the transparency and flexibility needed to prevent (or at least mitigate) supply chain disruptions in the future.

3.2 Data security

Security was also in the news, whether it was the security of people themselves or the security of goods and data. Zoom managed to successfully navigate the rapid scaling of its usage volume, but it also faced security gaps that needed to be addressed immediately. Many organizations are experiencing similar painful lessons during this crisis period.

3.3 Remote workforce and automation.

Another common theme emerging recently is the widespread desire to develop the flexibility and diversity brought by distance work. Learning how to maintain productivity — even as companies will return to office buildings after the lockdown ends, and even as companies continue to automate their operations—will be crucial to getting the most value out of this real experiment that is happening. In retail, for example, robots are widely used in the store to take on

more transactional tasks, such as checking inventory in store aisles and executing orders remotely. These investments will not be canceled after the crisis, and those who have done so will find themselves in a winning cost structure during the recovery.

4. Daring the development of the business portfolio

No company can accelerate the implementation of all its strategic imperatives without resorting to mergers and acquisitions (M&A) to accelerate their implementation. This is especially true for digital strategy, where mergers and acquisitions can help companies acquire talent and create opportunities, even if they offer access to new products, services, and solutions, as well as new market segments and customers.

More broadly, we know from studies of economic downturns (McKinsey Quarterly 2019) that companies that invest when valuations are low outperform those that don't. These companies got rid of inefficient businesses 10% faster than their counterparts at the beginning of the crisis (or sometimes in anticipation of the crisis), and then switched to mergers and acquisitions at the first sign of recovery.

In more conventional times, one of the main challenges that companies face in their digital transformation is the need to acquire digital talent and capabilities by acquiring technology companies that are usually priced in multiples that capital markets may view as diluting for the buyer. The current downturn may remove this critical hurdle, especially if companies are temporarily freed from the tyranny of quarterly earnings expectations. As valuations decline, the crisis and its immediate consequences may be a good time to acquire assets that were previously unavailable. We can already see that many private investment companies are actively seeking to use large amounts of capital.

5. Speeding up the learning process

However, bold movement does not mean mindless movement. Bold actions and the ability to learn are closely linked. The ability to learn in real time during a crisis is actually the only ingredient that can speed up management ability to scale quickly.

In situations of extreme uncertainty, management teams need to quickly understand what works, what doesn't, and why. This requires identifying and studying unknown elements as quickly as they appear. Before the crisis, leading companies were already increasing the pace of their training in the framework of accelerated organizational metabolism[2]. Companies can look at their example as they work to adapt more quickly to changes during a crisis—and beyond.

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[2] McKinsey Quarterly, June 27 2019: The drumbeat of digital: How winning teams play. Retrieved from: https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/the-drumbeat-of-digital-how-winning-teams-play

6. Speed up data viewing

Start with an assessment of the frequency with which you browse the available data. You should view multiple data sources weekly (or more often) to assess the changing needs of your customers and business partners, as well as your own performance. Look at your crisis nerve center as the only source of truth for getting new data about employees, customers, channel partners, supply chains, and the ecosystems in which company participates in. Then turn to secure file sharing technologies like Box and Zoom to remotely share and discuss ideas from this faster data analysis.

7. Focus on technology

The rapid transition to virtual operations and interactions, both inside and outside organization, also makes it possible to speed up the process of learning and implementing technologies that organization may have just started experimenting with. As the experiment scales, so does the training. A quick transition to digital technology can also identify potential problem areas in organization's current technology stack, allowing manager to quickly assess how well technology will perform in the future. Here are some factors that managers should pay attention to as they learn about new technologies faster and adopt them:

7.1 Data security.

7.2 Scalability.

Where do crashes and crashes occur when 100 percent of your interactions with customers, employees, and business partners become virtual?

7.3 Usability.

Right now, customers and business partners often have no choice but to access products or services through new digital offerings. Their capabilities will expand as companies emerge from the crisis. How well will new offers hold up? If current usability level is low, experiment to improve it now while you still have a captive audience with which you can collaborate and learn.

8. Testing and training

In normal times, experimentation can sometimes seem like a risky game. Changing the work patterns that employees, customers, or business partners are used to may seem to risk alienating them, even if these experiments are aimed at long-term benefits for all stakeholders. The COVID-19 crisis, however, made experimentation both a necessity and an expectation.

Start with customer-focused initiatives that, while more complex, offer a greater positive impact. Use automation and predictive Analytics to quickly and effectively isolate difficulties. Look for opportunities to standardize what you are learning to support scaling digital solutions across core business processes. Standardization can help speed up project implementation by reducing confusion and creating common tools that can be used by broad groups of people.

9. Learning to scale

As companies increase the speed of their metabolic learning, they need to quickly translate what they are learning into large-scale responses. The scale of what you will learn is always the obstacle to digital transformation.

While companies often pilot new digital initiatives with the intention of learning from them before they are deployed widely, these experiments and pilot projects usually test only one dimension at a time, such as the conversion/engagement/satisfaction of individual customers, the unit Economics of a single transaction, or the user experience of a given digital solution. Whether they like it or not, companies in crisis mode find themselves in a different type of pilot: one of the digital programs on a massive scale.

The rapid transition to full-scale operation in many types of digital operations and interfaces has brought with it many challenges (for example, creating and delivering laptops in less than two weeks to all employees so that 100 percent of them can work remotely compared to 10 percent who were previously remote). But it also brings opportunities. At the broadest level, they include the ability to learn in real time about where value is happening in your markets and industry, the ability to quickly learn and respond to what works in your operations and agile organizational approach, and the ability to find out where you are more or less able to move quickly—which can help inform where you might need to buy a business rather than build it.

10. Observation of interaction effects

Because scaling quickly requires changing multiple parts of the business model or the client's journey simultaneously, now is the most valuable time to observe the effects of interaction between multiple variables. For example, healthcare professionals face increased demand for services (including mental health and other non-COVID-19 presentations) at the same time as their traditional channels are restricted, all in the context of strict privacy laws. This has led many providers to quickly test and adopt telemedicine protocols that were often not available in many medical offices before, and to focus on privacy as well as patient susceptibility to participate in these new channels. Providers are exploring what types of diseases and patient segments they can treat remotely, while they are widely implementing new apps (such as Yale Medicine's MyChart) to speed up their patients ' digital medical treatment.

Similarly, when a retailer releases a new app for delivery across the country on the same day over the course of a week, it tests much more variability at a time, such as consumer perception of this new channel. Because of the scale, it can learn about differences in acceptance and profitability by region and store format. It can test whether its technology partners can scale in 1,000 stores. It can check whether its vendor database can adapt the distribution to work with the new model. However, shifting multiple variables at the same time also increases the degree of

difficulty in interpreting results—because you no longer isolate one variable at a time. Companies that have already invested in artificial intelligence capabilities will benefit significantly. By making further investments now—even if you haven't started working yet—you will continue to pay out in the post-crisis period.

11. Simplifying and focusing

Given the degree of complexity created by large-scale experiments, organizations need to find ways to simplify and focus their efforts to avoid congestion. This is partly for them, since the crisis closes many physical distribution channels and makes it impossible to access others. But further rationalization is needed, depending on what works, what doesn't, and why. This is perhaps the first global crisis in which companies have the ability to collect and evaluate real-time data about their customers and what they are doing (or trying to do) during this time of forced virtualization. Pruning events and offers that are no longer viable, while aggressively addressing issues that arise with your offers, will help increase the likelihood of retaining a higher proportion of customers in your cheaper digital channels after the crisis passes.

12. Don't go through this alone

Research shows that people and organizations learn faster as a result of network effects. In other words, the more people or organizations you add to the overall solution space, the faster learning happens—and the faster productivity increases. Some argue that these network effects occur in the so-called collaboration curve.

During a crisis, changing needs lead to rapid changes in the way employees think and behave, which are manifested in a greater willingness to try something new. Think about how you can best support the way your talented employees learn. One option is to create or use platform-based talent markets that help organizations quickly reallocate their workforce when changing priorities and directions—and help talented employees improve their training levels. Be sure that you are looking not only within your own company, but also through businesses to include your channel partners, your suppliers, and your suppliers. They are likely to be more willing than ever to collaborate and share data and knowledge to better ensure everyone's collective survival.

In conclusion, it is often the case in business that the greatest lessons are learned from the most destructive times of crisis. We believe that companies that can simultaneously care about and rise above the critical and day-to-day demands of their crisis response can get unique information that will inform their response and help ensure that their digital future is more robust by exiting COVID-19 than it was before.

5. Conclusion

This thesis contributes to the existing literature by providing a detailed systematic review of the literature on twenty-three models of digital maturity. In addition, this dissertation proposes a research design concept for further development of the field of maturity model. Based on these findings, seven universal aspects of the maturity model for companies of any size were found: 1) strategy, 2) products/services, 3) technology, 4) People and culture, 5) management and 6) processes 7) business model. In addition, developed framework was tested as part of a study of Russian companies and proved its reliability and reproducibility. Based on the research, a number of digital strategies were proposed that are applicable not only in the Russian market, since they take into account the rapidly changing global context of the global financial crisis and the coronavirus pandemic.

As for the content of the results, there have been once again seen that although digital transformation is no longer something new for Russian companies, they are very critical of their success: less than a quarter (21%) of respondents believe that they have the necessary resources and competencies to implement their plans for digitalization. Among the investment areas for 2019-2021, cybersecurity, multi-cloud environments, flash storage technologies and the Internet of things are most often mentioned.

The indicators of the Russian market are closer to global standards, in other words, they have deteriorated. The digital maturity curve shows that the picture in the Russian market has become more similar to the picture for countries with emerging economies, rather than developed ones, as it was before.

Finally, there is the conclusion could be drawn, that the research goals were successfully completed, the methodology used in the study has shown its reliability, and the results are useful and can be used in future studies.

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APPLICATION 1 – Digital Transformation Survey.

1. In terms of your organization's existing IT strategy, to what extent are you successfully doing any of the following to support your digital business transformation? 0 = I don't know; 1 = Not done and no plans to do; 2 = Planned to do; 3 = In process of doing – early stages; 4 = In process of doing - mature stages; 5 = Fully completed for now - successfully
1.1 Investing in/developing modern application architectures
1.2 Investing in a multi-cloud deployment
1.3 Investing in data center modernization
1.4 Investing in/shifting to software-defined technologies
1.5 Investing in building a converged infrastructure
1.6 Investing in/increasing storage (to accommodate predictive analytics, Al, IOT, etc)
1.7 Investing in/embedding cybersecurity measures
2. Thinking about what the digital future of your organization looks like, which of the following is your organization doing? Please select all that apply.
Integrating digital goals (into all departmental/staff objectives)
Developing mature on-demand models
Using agile software development to accelerate new product/services development
Using always connected, sensor enabled and location aware technologies
Building security and privacy into all devices, applications and algorithms
Sharing knowledge across business functions equipping IT leaders with business skills and business leaders with IT skills
Using widespread automated decision-making (artificial intelligence)
Acting on intelligence in real-time
Investing in digital skills/talent (i.e. teach all employees how to code)
Developing an open innovation model/accelerator program
None of these
I don't know
3. How is your organization addressing each of the below now to stay competitive and succeed in the digital future? 0 = I don't know; 1 = No plans; 2 = Research/planning stage; 3 = Not doing well, in pockets of the organization; 4 = Not doing well, organization-wide ; 5 = Doing well, in pockets of the organization; 6 = Doing well, organization-wide
3.1 Predictively spot new opportunities
3.2 Innovate in an agile way
3.3 Demonstrate transparency and trust
3.4 Deliver a unique and personalized experience
3.5 Deliver always-on operations in real time
3.6 Provide digital skills and training
4. What new emerging technologies will your organization investing in over the next 1-3 years to lay the groundwork for your digital future? Please select all that apply.
Cybersecurity

	Internet of Things technology (turning everyday objects into network connected sensors so they can send and receive data)
	Multi-cloud environment where each application is deployed in the most appropriate cloud (private or public)
	Artificial intelligence (i.e. visual perception, speech recognition, decision-making, and translation between languages – performed by computers rather than humans)
	Compute-centric approach to data center design and workload enablement/optimization
	Flash technology to reduce latency, allow for greater storage density and performance increase
	Applying Augmented or Virtual Reality
	Cognitive systems technologies that use natural language processing and machine learning to enable more efficient interaction between people and machines
	Distributed ledger technology (i.e. blockchain)
	Commercial UAVs (drones)
	Quantum computing
	Neuromorphic hardware that can imitate the brain more efficiently
	None of these
	I don't know

5. Looking to the next 5 years, to what extent do you agree with the following statements about your organization? Agree/disagree/neither agree nor disagree/don't know

	We'll be active members of an ecosystem of innovators – sharing best practice
	We'll struggle to meet changing customer demands
	We'll struggle to prove we're a trustworthy organization
	I'm worried we'll be left behind
	We'll be a digital leader in our industry
	We'll disrupt rather than be disrupted

6. What are the main barriers to achieving digital transformation within your organization? Please select all that apply.

	Data privacy & security concerns
	Lack of budget & resources
	Lack of the right in-house skill sets & expertise
	Regulation & legislative changes
	Immature digital culture
	Lack of the right technologies to work at the speed of business
	Information overload
	Lack of senior support & sponsorship
	Lack of a coherent digital strategy & vision
	Weak digital governance & structure

7. To what extent do the following statements reflect your organization's response to the pace of digital disruption? Agree/disagree/neither agree nor disagree/don't know

	We're unprepared for the pace of change
	Digital transformation should be more widespread throughout the organization
	We're digital leaders
	We're innovating all the time