St. Petersburg University
Graduate School of Management

Master in Management Program

THE COUNTRY-SPECIFIC INFLUENCES ON SUPPLY CHAIN DIGITALISATION IN RUSSIA

Master's Thesis by the 2nd year student Concentration — HEC Paris Double Degree, Gabriel Gretener

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ЗАЯВЛЕНИЕ О САМОСТОЯТЕЛЬНОМ ХАРАКТЕРЕ

ВЫПОЛНЕНИ ВЫПУСКНОЙ КВАЛИФИКАЦИОННОЙ РАБОТЫ

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АННОТАЦИЯ

Автор	Гретенер Габриэль Сидней
Название магистерской диссертации	Страновые факторы, влияющие на диджитализацию цепей поставок в России
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Направление подготовки	Менеджмент
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Научный руководитель	Константин Викторович Кротов
Описание цели, задач и основных результатов	Широкая научная и управленческая дискуссия посвящена теме дигитализации цепочки поставок. Дигитализация процессов цепочек поставок - это очень быстро развивающаяся область как в практике, так и в исследованиях. Внешние условия, которые могут повлиять на процесс и результаты цифровой обработки, с самого начала были частью дискуссии. Прошлые исследования показали, что цепочки поставок и их дигитализация зависят от множества влияющих факторов, которые связаны с географией, экономикой и обществом. Однако до сих пор не было проведено целостной оценки характера и влияния этих факторов в России. Эта статья направлена на обеспечение целостной оценки обеими идентифицирующими особенностями сфокусированных на дигитализации цепочек поставок в России и объяснения выявленных особенностей в фокусе. Для этих целей применяется смешанный метод, который включает как количественные, так и качественные элементы. Идентификация особенностей в фокусе основана на обширном опросе в сочетании с бенчмаркингом. Затем выявленные расхождения расследуются, рассматривая две соответствующие компании и их поведение и мотивацию в области дигитализации. Результаты показывают, что макроэкономические условия в России препятствуют реализации крупномасштабных проектов автоматизации процессов, в то время как более простые и масштабируемые решения, например: облака или онлайн-платформы пользуются большим спросом.
Ключевые слова	Дигитализация цепочки поставок, Автоматизация

ABSTRACT

Master Student's Name	Gabriel Sidney Gretener
Master Thesis Title	The Country-Specific Influences on Supply Chain Digitalisation in Russia
Faculty	Graduate School of Management
Main field of study	Management
Year	2018
Academic Advisor's Name	Konstantin V. Krotov
Description of the goal, tasks and main results	A broad scientific and managerial discourse deals with the topic of supply chain digitalization. The digitalization of supply chain processes is a very fast evolving area in both practice and research. External conditions that might influence this digitalization process and outcomes have been part of the discourse from the very beginning on. Past research has shown that supply chains and the digitalization thereof are influenced by a myriad of influence factors that stem from geography, economy and society. So far, however, no holistic assessment of the nature and impact of these influence factors in Russia has been made. This paper aims at providing such a holistic assessment by both identifying peculiarities in the focus of supply chain digitalization in Russia and explaining the identified peculiarities in focus. For this purposes, a mixed method approach is followed that comprises both quantitative and qualitative elements. The identification of peculiarities in focus is based on an extensive survey combined with a benchmarking. The identified divergences are then further investigated by looking at two relevant companies and their digitalization behavior and motivation. Results show that the macroeconomic conditions in Russia hamper the implementation of large-scale process automation projects, while more simple and scalable solutions like e.g. clouds or online platforms are in high demand.
Keywords	Supply Chain Digitalization, Automation

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BI	Business Intelligence
e.g.	exempli gratia (for example)
et al.	et alii, et aliae
etc.	et cetera
i.e.	id est
IoT	Internet of Things
MNC	Multi-national company
OEM	Original Equipment Manufacturer
p.	page
pp.	pages
RFID	Radio frequency Identification
ROI	Return on investment
RQ	Research questions
SaaS	Software as a service
vs.	versus

1. Introduction

Over the last few decades, it has become general understanding that firms are not all encompassing, isolated constructs. Rather, they are organizations embedded in a broad ecosystem of partners and stakeholders that rely on mutual collaboration. Firms need suppliers that help them to generate the value proposition demanded by the market, as well as partners that help them bring this value proposition actually to clients. Today, firms are connected to more partners than ever. Trends like globalization and outsourcing drive modern companies into collaboration with partners in every aspect. In most industries, vertical integration is a thing of the past. Reliance on external service providers and suppliers is common in all corners of a company, ranging from physical manufacturing processes to the servicing of the company-own cafeteria.

A contemporary key driver of this development is digitalization. Recent innovations and the rapid development of solutions for a myriad of purposes make it easier than ever to collaborate with partners across geographical distance, function and jurisdiction. The variety of new possibilities based on digital solutions seems to be unlimited. Digitalization disrupts every function within a company; production, sales, marketing, research & development – digitalization changes the way how processes within and between these departments as well as between entire companies function. The overall result of this digital revolution is a modern, digitalized supply chain that can be distinguished from traditional supply chains in manifold aspects. Digitalized supply chains are significantly different in terms of shape, multidimensional network structures are replacing rather simple linear structures (Hearnshaw & Wilson, 2013; Stevens, 2016). They offer entirely new levels of visibility and flexibility (Chengalur-Smith, Duchessi, & Gil-Garcia, 2012; Delen, Hardgrave, & Sharda, 2007) and increasingly rely on automated processes and activities (Wu, Yue, Jin, & Yen, 2016; Alicke, Rexhausen, & Seyfert, 2016).

All these developments obviously don not occur under sterile conditions and in empty space. Companies as well as the supply chain ecosystem they are part of are reacting to a broad variety of influences. This makes them to a certain degree dependent on external conditions, and it is reasonable to assume that these external conditions in turn shape the supply chain ecosystems to a certain extent. Influences from the social sphere, technological developments, the macroeconomic environment as well as the geographical situation significantly impact supply chains (Barry, 2004; Luo, Van Hoek, & Roos, 2001).

All these external influences that might shape a supply chain and were mentioned in previous literature have in some way interesting peculiarities in Russia. The geography, society

and economy of Russia is expected to have manifold impacts on supply chains. As a result, historically, supply chains in Russia tend to be «highly fragmented and notoriously difficult to manage» (Roberts, 2005, p. 53). Thus, the dependency on the general environment seems to be particularly interesting and impactful in the case of Russia. Geography, regulatory framework, economy as well as culture provide an environment that appears to be significantly different from most other economies. All these peculiarities obviously might influence the impact of specific technologies in the context of supply chain digitalization. Some technologies might offer advantages that are particularly significant under the conditions that can be found in Russia, while other technologies might be of little use or face insurmountable barriers. No other nation has such vast land resources, with its population and domestic economic activity dispersed over two continents. Russia features with Moscow one of the world's largest cities, and at the same time it has some of the least densely populated areas in the world. Both the challenges and the opportunities resulting to business are enormous. Managing a supply chain under these circumstances is a genuine key activity in basically any physical business, requiring a vast amount of attention in planning and implementation. The impact on the economic activity inside the country is evident. Companies that are active nationwide are, apart from certain specific industries, rather sparse. The result is a largely dispersed marked in most industries, with rather well-established and dominant local players that often fail to grow beyond their traditional key markets (Lorentz & Lounela, 2011). These challenges resulting from the mere geographical size of the market are meeting additional challenges based on demographics and culture. Especially the income situation of households is marked by large differences across the country with corresponding consequences for the purchasing power of certain regions. In most recent history, this general inequality was additionally hit by a rather strong economic crisis, coming along with high inflation rates and negative GDP growth.

Many industries, such as for example retail, feature in addition to the already difficult geographical situation a legal environment that makes efficient operations even more difficult. The sanctions enacted by the European Union and the countersanctions imposed by Russia limit the potential markets for sourcing products, thus limiting the availability of suppliers. Also in the domestic market, a myriad of rules and laws apply that require licensing and accurate quality control mechanisms in many industries.

Overall, it is undisputable that Russia is a very promising but difficult market to serve and place to operate. A broad variety of challenges and barriers stemming from the general environment and surroundings of supply chains seem to complicate strategic as well as operational business. Building and maintaining a solid supply chain under such conditions is not easy and requires adaptation. This paper sheds light on this need for adaptation in the context of

supply chain digitalization and investigates the particular influence factors that can be observed in Russia. Through the identification of categorical differences in terms of progress and focus of supply chain digitalization between Russia and other industrial nations, the basis for a more profound insight on the reasons of divergence and differences is created. The paper thereby draws on both primary and secondary resources and uses quantitative as well as qualitative methods. The results come along with managerial implications that have high practical relevance and indicate some ideal practices for successful supply chain digitalization in Russia.

1.1. Aim of Analysis & Research Objectives

Although supply chain digitalization is subject to a wide and vivid discourse at the moment, and the impact of external conditions on (digital) supply chains is increasingly investigated, previous literature deals primarily with either non-aggregated, isolated or with highly generalized, context-less aspects of the topic. A comprehensive investigation of how external factors work in an aggregated, holistic perspective in a specific country so far is lacking. Although Russia is clearly an interesting case, the amount of research that has so far been conducted on external influence factors in Russia is extremely sparse.

The key question that is raised in this paper is how the digitalization of Russian supply chains is possibly different from the digitalization of supply chains elsewhere. This implies two key research objectives. First, differences in terms of focus have to be identified. This implies that the popularity and relevance of different technologies in Russian supply chains is measured and benchmarked against the same data from another country; in this paper Switzerland as a proxy for an ideal western European country is selected.

Second, these identified discrepancies have to be investigated further in order to describe the magnitude, direction as well as the reasons for the discrepancies. This implies that the discrepancies are investigated in-depth in a qualitative manner in order to explain how and why these differences occur.

It is obvious that these two research objectives are strongly related to each other; the second objective is in a relationship of dependency with the first objective. In combination, they aim at providing a holistic and comprehensive picture of the discrepancies of supply chain digitalization between Russia and a western European country.

As a proxy for a western European country, Switzerland is chosen. This choice is based on a variety of factors, the main one being the availability of recent, reliable and comprehensive data. Previous collaboration with the authors of the «Logistikmarktstudie Schweiz 2017» (original German title: «Logistics Market Study Switzerland 2017») ensures a strong expertise

and accurate knowledge about the status quo and current developments in Swiss supply chains. The study was conducted in 2017; more than 500 companies from various industries participated in the study and gave a detailed picture of their current supply chain digitalization status, activities and plans. The study is conducted annually, 2017 was the tenth edition of the study. Another key factor for the choice of Switzerland as benchmark is the fact that Switzerland is offering an environment for supply chain digitalization that is pretty much the opposite of the environment that can be found in Russia. A more detailed elaboration on this relationship as well as a detailed description of data sources can be found in the chapter concerning methodology.

From the two interrelated research objectives, the concise research questions can be deducted. From the first research objective, two more concise research questions can be deducted:

RQ1.1: Which technologies are, compared to Switzerland, more popular and developed in Russia?
RQ1.2: Which technologies are, compared to Switzerland, less popular and developed in Russia?

The term «popularity» can thereby further be concretized. It refers to the current degree of implementation as well as the intention and commitment to further investments in the future. The answers to those two initial research questions ideally provide an accurate picture of the discrepancies of supply chain digitalization in Russia compared to supply chain digitalization in Switzerland.

The second research objective is a bit more general and clearly requires further definition by means of concise research questions. The explanation and detailed description of the discrepancies require a more in-depth analysis. The impact from different spheres of influence has to be assessed in order to come to holistic and comprehensive conclusions that reflect reality. Based on previous literature, a selection of four key spheres of influence is made: Society, geography, technology and economy. Further details and complete reasoning regarding this selection can be found in the literature review section. Since, according to previous literature, the impact of technology is the most general one and most developments have a global impact, little country-specificity can be expected. That's why the impact of technology is discussed in a broader, general way in order to establish a general knowledge base, and is only for verification purposes investigated in expert interviews and cases. Thus, based on the idea of three country specific key spheres of influence, the following research questions can be defined:

RQ 2.1: How do cultural & social peculiarities influence supply chain digitalization in Russia?

RQ 2.2: How do geographical & demographical peculiarities influence supply chain digitalization in Russia?

RQ 2.3: How do economic & political peculiarities influence supply chain digitalization in Russia?

These three research questions shed light on the most relevant influencing factors and thus potential sources of discrepancies. Answering these questions should result in a clear picture of differences as well as reasons for these differences in supply chain digitalization between Russia and Switzerland.

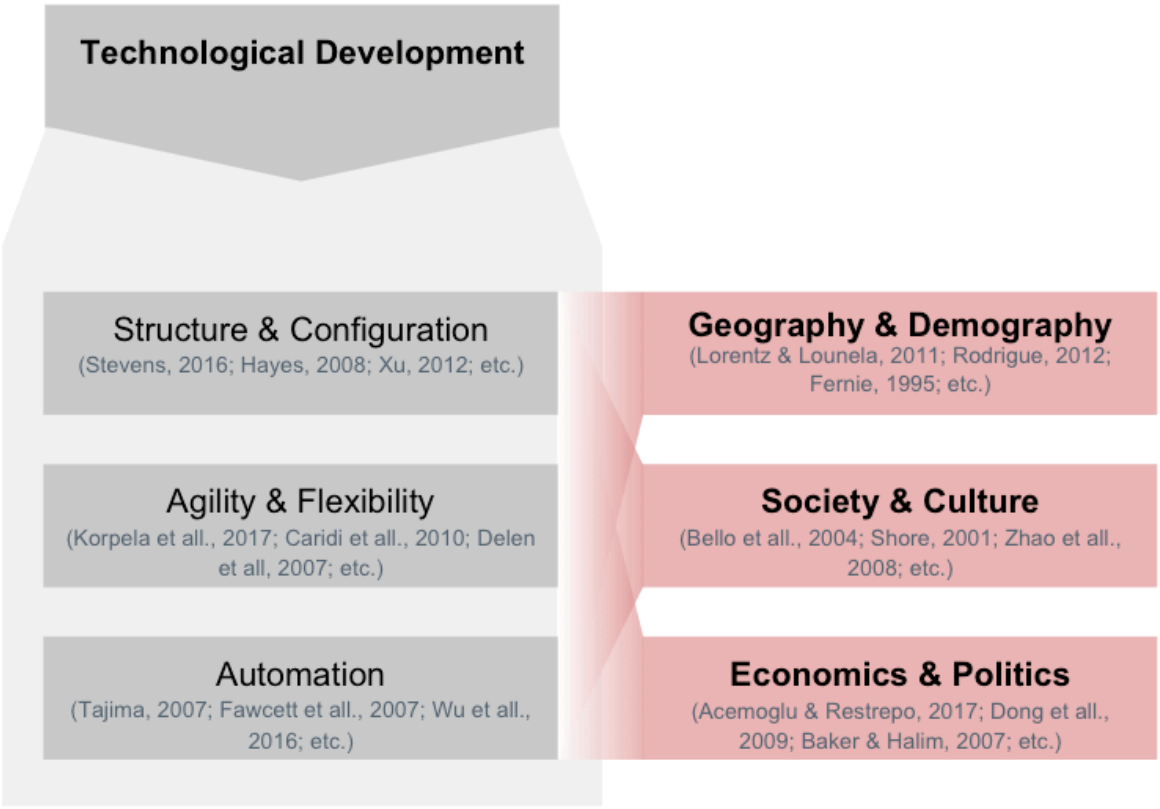

Figure 1: Conceptual overview of general impact areas of supply chain digitalization and environmental spheres from which external influence factors might stem from.

The selected spheres of influence are, obviously, not completely independent from each other. The illustration above visualizes the three country-specific influence spheres that are in focus in the research questions as well as the general impact areas resulting from technological developments that will be exposed to influences stemming from the three external spheres. Each sphere of influence should be considered as not only influencing supply chains and the

technological development thereof, but also the other spheres of influence. Economic and political developments, for example, can be seen as being closely intertwined with culture and society (R&D). These interdependencies are elaborated in more detail in the literature review. The key point is that in the final discussion, the answers to each research question has to be synthesized into a coherent picture that does not neglect potential reciprocities between factors.

2. Literature Review

In order to put the research into context, a look at the status quo of literature on the topic is essential. For the study, two distinct areas of research are relevant. First of all, the general status of supply chain digitalization has to be established thoroughly. Second, the current knowledge regarding potential factors of influence on the status of supply chain digitalization is relevant. Thus, in order to set the necessary foundation for the study and the final discussion, both of these spheres are covered in-depth. In addition to that, it is necessary to define some of the key terms that are used throughout the study. Clear definitions help to establish a common understanding of the key terminology and thus support and sharpen the general understanding of the research and study. This is especially relevant since the investigated area of research is dealing with current, vivid and fast-changing developments and features general terms that are not indisputably defined and thus require distinction and clarification.

2.1. Classification and Topical Boundaries

In order to avoid confusion, misunderstandings or any form of ambiguity, the overall topic and thus scope of this paper with respect to terminology has to be clarified. Particular relevance has the classification of supply chain and the demarcation against aspects belonging to the overarching discipline of supply chain management that are not in focus in this paper. The term supply chain management is very widely used in practice as well as in research. Often, the discourse is marked by buzzwords and fuzziness with respect to the boundaries and used terms. This wide and broad nature of the topic results often in a vagueness and sometimes even ambiguity of existing definitions and approaches, failing to explicitly describing the philosophy and contents of supply chain management (Tan, 2001). The term supply chain management itself came up in the 1980s as a combination of different philosophies, including various internal business process like e.g. manufacturing, distribution or purchasing (Harland, 1996).

One of the most widely used definitions is the following, provided by the Global Supply Chain Forum and related to the idea of an integrated view of various internal business processes:

> *«Supply Chain Management is the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders.»* (Lambert & Cooper, 2000, p. 66)

This definition as well as most other common definitions underline the aspect of actual management and the corresponding processes. This cognitive component distinguishes between the transcendent discipline of supply chain management and a mere physical flow of goods; supply chain management is in strong contrast to the simple movement of goods and can be described as a «a set of management processes» (Mentzer, et al., 2001, p. 10). However, for this paper the focus does not lie primarily on management processes, but more on the underlying physical flow of goods, the actual supply chain and aspects that are immediately related to it. The definition of the term supply chain itself generally is in harmony with the definition of supply chain management but focuses on particular aspects of the overarching discipline. One of the key aspects in focus is the common network characteristic of supply chains which is often emphasized in widely used definitions, like e.g. in the one of Christopher (2011):

> *« |...] the supply chain is the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer.»* (Christopher, 2011, p. 13)

To be more concise, it can be specified that a supply chain network consists of several distinct units which are characterized and directed to demand, transformation and supply (Davis, 1993). Thus, it is apparent that the key focus of the supply chains lies on the actual structure of a network and the physical flow that passes through different companies and undergoes various transformations and is finally directed towards the market. Building on and rooting in this foundation of the actual supply chain, more transcendent and comprehensive management process that are part of the overarching discipline of supply chain management can be conceptualized. Although certain aspects of digitalization that are treated in this paper have strong ties to processes that can be seen part of the transcendent discipline of supply chain management, the overall focus lies on the fundamental term supply chain and the actual flow of goods.

2.2 Previous Research on Supply Chain Digitalization

In recent years, a broad variety of scholars have investigated the impact and potential of digitalization on supply chains. They found a variety of implications, many of which unlock new potential and come along with advantages and benefits for the companies participating in digitalized supply chains. At the same time, however, also a variety of challenges stemming

from supply chain digitalization has been identified and investigated. In the following, the key findings of previous research are briefly explained.

2.2.1 Supply chain structure

In the recent past, it became apparent that digitalization of supply chains has opened the horizon to new configurations and structures of supply chains. Historically, a supply chain usually followed a rather linear, sequential order; materials flow forward, from raw material to finished product, and information flows backwards, starting with the final customer's purchase (Beamon, 1998). This sequential order as well as the information flows have significantly changed due to digitalization – new technologies enable the configuration of a supply chain that takes different shapes and operation modes.

In the more recent past, a thorough shift from competition on company level towards competition on a supply chain level could be observed; the determining factor is the output of the entire supply chain, and not the output of a single company (Stadtler, 2015). In this context, obviously, the configuration and functioning of the supply chain is a key driver of success. The optimization and integration of the supply chain can unlock large potential for synergies and efficiency improvements and thus drives competition between distinct supply chains (Koh, Demirbag, Bayraktar, Tatoglu, & Zaim, 2007). Supply chains evolve increasingly away from linear supply chains towards multilayered, complex, flexible and agile value networks that are highly adaptive and fully digital (Sherer, 2005).

The digitalization of supply chains has the potential to change the way how supply chains are configured in a broad variety of ways. Digitalization can help firms to cope with information flows and provides deeper insights by means of advanced analytics, and that is of crucial importance in the context of supply chain structure. A broad number of impacts, rooted in and driven by digitalization, changes the way how supply chains are structured and function.
One key influence of digitalization consists of the massively increased possibilities of supply chain integration. Supply chain integration is a necessary mean to succeed in competition between entire supply chains; it allows for optimization by strategic, tactical and operative management of a large number of nodes and actors in the supply chain (Stevens, 1989). Today, it is clear that simple, linear supply chains are in many contexts not viable anymore. The ideal modern, efficient supply chains can be generally characterized as scale-free, with short path lengths and a high clustering coefficient, implying that ideally, the supply chain is a network clustered around hub firms that steer and dynamically manage the supply chain (Hearnshaw & Wilson, 2013). For that to be possible, obviously, effective means of data collection, processing

and exchange are crucial. Digitalization comes along with a broad variety of innovations and technologies that enable fast, reliable and efficient ways to share and handle information and thus paves the way for more complex and comprising supply chain integration (Lotfi, Mukhtar, Sahran, & Zadeh, 2013). New technologies that came to market over the past two decades allow for fast and easy data sharing and thus fostered more comprising and comprehensively integrated supply chains in the form of networks and clusters (Stevens, 2016). The environment for this digitalization-induced change can be found in a paradigm change; while IT historically was rather regarded as a simple function, it nowadays often emerges as deeply rooted, underlying core resource with key significance for a company and all of its departments and activities (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013).

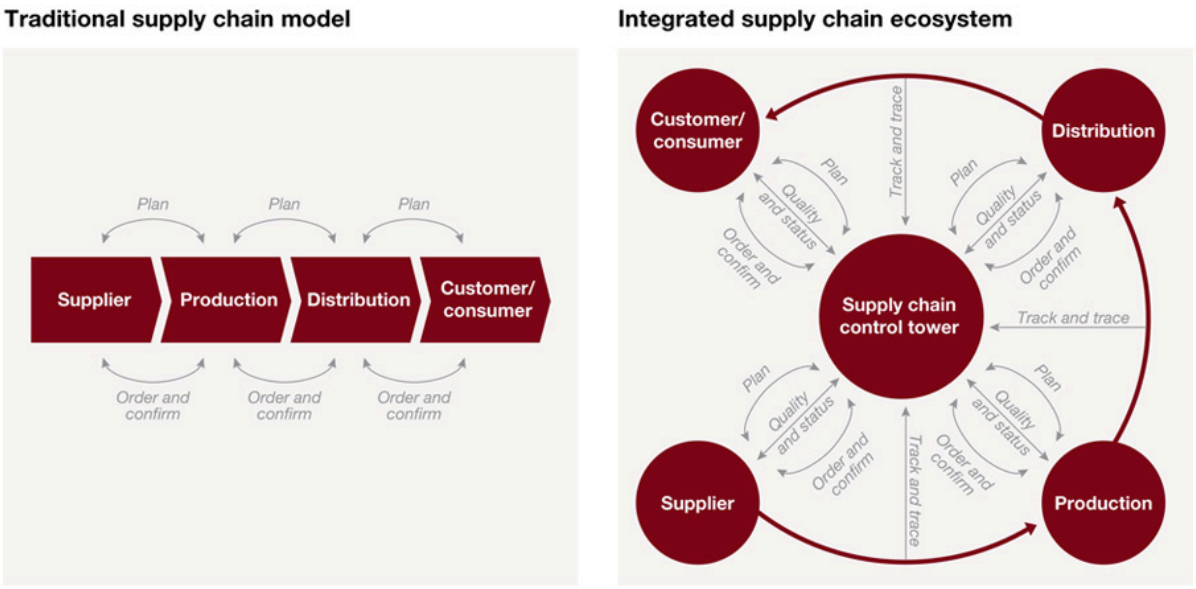

Figure 2: Traditional supply chain model vs. contemporary integrated supply chain ecosystem structured as a network around a central agent. (Strategy&, 2017)

A very direct impact on the structure of supply chains results from new information technologies that enable new connections between different actors in the supply chain. Cloud computing allows for fast, easy and cost-efficient sharing of vast computing resources across scattered locations, thereby overcoming geographical factors (Hayes, 2008). In a supply chain context, the cloud can serve as a central pool of information, with which the supply chain activities can be coordinated (Leukel, Kirn, & Schlegel, 2011). By providing a central platform for coordination and collaboration through information exchange, clouds significantly contribute to the flexibility of supply chains and variety of possible configurations (Cegielski, Jones-Farmer, Wu, & Hazen, 2012). New configurations can also result from the new possibilities with respect to automation based on cloud computing (Gimenez & Lourenco, 2008). It is clear that

the potential of cloud computing goes way beyond the simple purpose of data exchange and sharing, and has the potential to immediately integrate all functions and processes in a supply chain. By centrally managing and integrating dispersed resources such as for example production facilities directly into the cloud system, cloud manufacturing becomes possible (Xu, 2012). Cloud manufacturing can be characterized by one single link, the cloud, that connects users, such as for example the design team of an OEM, with physical resource providers, such as for example a factory operator (Wu, Greer, Rosen, & Schaefer, 2013).

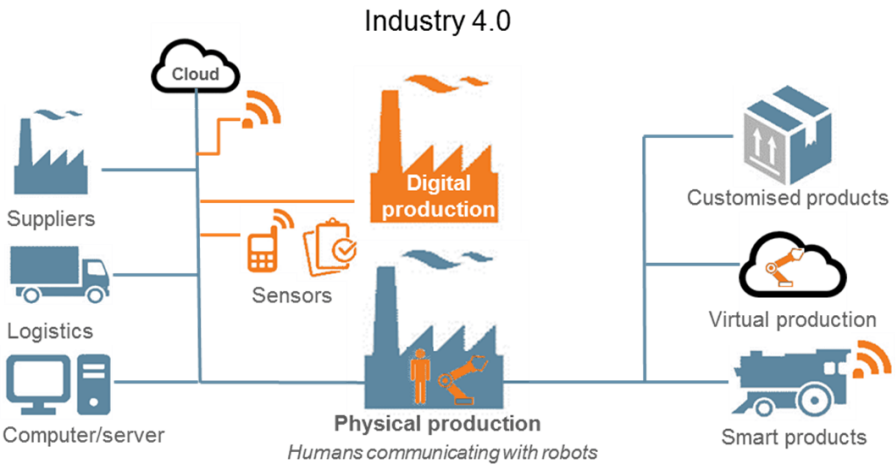

Figure 3: Illustration of the functioning of cloud manufacturing (Lasinkas, 2017)

The move towards cloud computing in supply chains is driven by a variety of advantages that the technology offers. Cloud solutions offer very strong scalability; they are therefore perfectly apt in an environment of growing complexity and rapid growth (Wu, Cegielski, Hazen, & Hall, 2013). The scalability and flexibility also has a direct impact on the costs of IT infrastructure; cloud services are usually charged rather on a variable than on a fixed basis and therefore expenses are more proportionate to demand, what increases flexibility especially in highly competitive industries (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013).

Another, also very immediate impact is stemming from new, digital manufacturing technologies like 3d-printing or cloud manufacturing. By using such direct digital manufacturing technologies, the supply chain changes radically since the production is moved to the client, thereby disruptively impacting logistics and inventory (Swanson, 2017). By producing even complex goods that used to require several independent and extensive manufacturing steps in a flexible, local facility, wide parts of previously required infrastructure is not needed anymore, and distribution as well as manufacturing follows fundamentally different paths. Based on the flexibility that direct digital manufacturing allows, manufacturers can enjoy significant economies of scope, and the resulting tendency toward a high level of integration likely leads to profound reconfigurations of supply chains (Sasson & Johnson, 2016). The exact matching of

production to demand in terms of time, quantity and characteristics massively reduces the required transportation needs and thus reduces the need for energy as well as waste to an absolute minimum (Chen, Heyer, Ibbotson, Solonitis, Steingrimsson, & Thiede, 2015).

In Russia, the trend towards modern configurations of supply chains clearly has arrived, but faces some difficulties. Outsourcing and decentralization are strategies that are rather new to Russian firms. In the Soviet Union, the vast majority of firms were vertically integrated to a very large extent, thus supply chains were comparably short and comprised only a very limited number of agents (Bateman, 1998). The supply chain was controlled by the state planning institutions, and it was designed to replace the coordination and steering processes that a marketplace usually fulfills (Davis-Sramek, Fugate, Miller, Germain, Izyumov, & Krotov, 2017). Today, the legacy of the soviet era and the then dominant paradigm of vertical integration are still visible. Unless Russian firms are not forced to outsource due to strong competition, especially older firms with Soviet heritage still tend to refrain from outsourcing and further reaching collaboration with partners (Davis-Sramek et all., 2017). Nevertheless, there are also signs of change and development even in companies with Soviet heritage, major government stakeholders and long-existing structures. A good example is formed by the recent activities and objectives of the Russian Railways RZD. In recent years, RZD is following a very contemporary strategy that aims at collaboration and cooperation with external partners in order to innovate and improve basically every aspect of business and become a modern, vastly digitalized and technologically advanced company that operates in a competitive manner (Thurner & Gershman, 2014). This also is reflected in actions towards a different role in supply chains. Russian Railways is aiming at becoming a provider of a whole array of services and positions itself increasingly as a holistic partner in modern supply chain ecosystems; one action towards this diversification and move towards a holistic service provider was the acquisition of the French logistics and distribution company GEFCO in 2012 (Russian Railways RZD Holding, 2018). Thus, there are efforts of companies with all kinds of heritage to reshape the supply chains they are part of. Examples like the one of RZD show that it is possible to reconfigure and reposition oneself and shape new integrated supply chain ecosystems despite a challenging and possibly hindering legacy in terms of culture, history and structure.

2.2.2 Visibility & agility

Digitalization does not only have an impact on how the supply chain is configured and structured. It also changes the way how it is perceived and viewed, and how it can be adapted to changing conditions.

One of the key characteristics of a digitalized supply chain is visibility. In general, visibility has been a defining characteristic for supply chains; the boundaries of visibility for any focal agent in a supply chain generally constitute the boundaries of the supply chain in the perception of that particular focal agent, and these boundaries become fuzzier with increasing distance from the focal agent (Carter, Rogers, & Choi, 2015). By means of digitalization, this horizon becomes more comprehensive and clear. The key driver of supply chain visibility is data sharing, since it fosters a holistic, current and common understanding of processes and activities in the supply chain (Chengalur-Smith, Duchessi, & Gil-Garcia, 2012). New, sophisticated technologies such as for example block chain technology enable a standardized, time-stamped and secure end-to-end delivery of confidential information and thus reduce technological and trust issues previously related to information sharing (Korpela, Hallikas, & Dahlberg, 2017). Digitally supported high levels of visibility are particularly favorable in supply chains that can be characterized by a high degree of virtuality (i.e. dispersed manufacturing and high intermediation) and complexity (related to number of nodes and tiers), since visibility can be seen as a counterbalance to complexity and virtuality (Caridi, Crippa, Perego, Sianesi, & Tumino, 2010). New technologies have also opened a broad variety of new possibilities related to traceability. One of the key technologies in this area is radio-frequency identification technology (RFID): It enables full traceability of physical goods and thus can provide the necessary data to ensure full visibility of material flows in a supply chain (Delen, Hardgrave, & Sharda, 2007). This traceability and real-time visibility can be the foundation for a broad variety of operational and strategic optimizations; it can help to increase speed, accuracy and efficiency of supply chains, and can be used for strategic change such as reconfigurations or reorganizations (Sarac, Absi, & Dauzère-Pérès, 2010).

A high degree of visibility in a supply chain can be used for various purposes. Some of the most common artifacts are real-time reports, dashboards and other structured data outputs which help companies to optimize and effectively manage the supply chain as well as their processes within the supply chain (Parviainen, Kääriäinen, Tihinen, & Teppola, 2017).
Since the shared information that is required to increase visibility obviously has a certain value, firms in a supply chain might have some forms of reservations against sharing of internal information. In order to motivate companies in a supply chain to participate in continuous and extensive information sharing, mutual trust, mutual benefits, shared investments and collaborative, firm-transcending decision-making are key factors (Chengalur-Smith, Duchessi, & Gil-Garcia, 2012). Visibility and comprehensive information can, in some industries or in relation with certain value propositions, also be very crucial for other purposes such as risk management, public relations or investor relations. With increased visibility and data processing

capabilities, companies that are active in often criticized, infamous and unsustainable industries such as the apparel or chemical industry can ensure their credibility and mitigate risks stemming from public relations (Busse, Meinlschmidt, & Foerstl, 2017).

A very crucial challenge in the implementation and exploitation of higher supply chain visibility and agility stems from data processing needs. The amount of data that is gathered, e.g. by means of RFID tracking, is tremendous and by magnitudes larger than traditional data flows, and the required transmission, storage and processing of these vast masses of raw, often unstructured data requires strong capabilities and extensive infrastructure (Delen, Hardgrave, & Sharda, 2007). Related to this challenge are also some of the main barriers of adoption for visibility-enhancing IoT technologies such as RFID. The most cited reasons are a lack of ROI due to large investment needs and hidden costs, technical risks due to system and technology complexity and privacy concerns due to a lack of security (Tajima, 2007).

A second defining characteristic of digitalized supply chains is a pronounced agility. Generally, agility is a very desirable characteristic; the term is often used interchangeably with the terms flexibility, adaptability and responsiveness (Li, Chung, Goldsby, & Holsapple, 2008). Adaptability and visibility are closely related; holistic visibility of the supply chain is a key part and often precondition for agility (Agarwal, Shankar, & Tiwari, 2007). Today, agility is a necessary characteristic of supply chains in order to deliver superior value, manage risks and avoid disruptions (Braunscheidel & Suresh, 2009).

Just as visibility, also agility is highly dependent on IT resources; an agile supply chain generally requires strong data processing capabilities (Liu, Ke, Wei, & Hua, 2013). This dependency also makes sense if the strong relation between agility and visibility, which is also strongly dependent on digitalized solutions, is considered. As in the case of visibility, it can be assumed that a lack of IT infrastructure is one of the key barriers to agility.

Supply chain agility can also be seen in a strong interrelationship with other areas of supply chain digitalization. Basically every major implication of supply chain digitalization supports agility. Automation as one of the key developments of industry 4.0 can be seen as a crucial driver for supply chain agility; automated processes and equipment tend to increase flexibility, adaptability and responsiveness of the supply chain (Bechtsis, Tsolakis, Vlachos, & Iakovou, 2017). Similarly, direct digital manufacturing significantly increases the flexibility and agility of a supply chain, since it allows for quick adaptation to market conditions, changes in product portfolios as well as for switching service providers and suppliers (Rogers, Baricz, & Pawar, 2016). Also cloud computing and specifically cloud manufacturing increase the agility of supply chains significantly; by enabling fast and thorough adaptions to the manufacturing processes and network structure, clouds make supply chains extremely dynamically adjustable to

changes in the marketplace and the manufacturing environment (Wu, Greer, Rosen, & Schaefer, 2013). Overall, it is clear that agility shouldn't be considered in an isolated manner. It is highly interrelated with other developments driven by digitalization, and can be seen more as an overall result that can be achieved if the digitalization of a supply chain is thoroughly orchestrated and exploited.

In Russia, visibility and agility are topics that are clearly relevant; challenges stemming from distance, regulatory environment, safety and political situation and many other areas make it desirable for supply chains to be as visible and agile as possible. Especially the recent years of crisis and the resulting increase in competitive pressure and sourcing difficulties made many companies reconsider their supply chain activities and realize initiatives to make their supply chains more visible, flexible, agile and overall faster in order to provide a competitive value proposition to customers (Van Riet, 2017). One example are the efforts of the French DIY retailer Leroy Merlin. In 2014, a completely new and digital supply chain and inventory management solution was introduced, increasing visibility, flexibility and responsiveness to improve availability, service and efficiency for the end customer (Vujanic & Videnina, 2014). However, there are various challenges that make full visibility and agility a difficult achievement in Russia. For example, most available and common software solutions to support supply chain visibility are not available in Russian; in fact, Russian is the least supported widely spoken language (Veldhuijzen & van Doesburg, 2012). Another important challenge can be found in the aspect of power distribution between supply chain partners. While in European markets usually retailers and large brands have power and control over wide parts of their supply chains, suppliers of such companies enjoy a more powerful position in Russia due to stronger significance of the raw materials market, giving them often the last word in negotiations (Belaya & Hanf, 2011). Suppliers often can dictate shelf space and are not pressured to rush deliveries, what is bearing large potential for conflict if a European retailer like French Auchan enters the market (Roberts, 2005). Such lack of collaboration, reliability and willingness to become part of an integrated supply chain is clearly a massive challenge for implementing visibility and agility solutions; without stable collaboration or at least reliable lead times, it is extremely difficult to implement fast changes or overarching control and transparency.

2.2.3 Automation

A very widely and promising development that is driven by digitalization is automation. In recent years, various applications and processes of all kind have been automated and thereby triggered a discourse that goes far beyond the technological dimension. Due to its potentially

profound impact on society, it is widely discussed in public often in an emotional and political manner. From a supply chain perspective, the profoundness of the impact of automation is apparent too. The topic is very multifaceted and the discourse in research over the past few years is vivid and growing.

Automation usually requires a highly digitalized environment with a broad variety of supporting technologies. Many automated solutions, especially ones that are related to logistics and inventory, require identification technologies such as RFID in order to find orientation and avoid mistakes (Tajima, 2007). The key issue in highly automated supply chains is the availability of information; processes are fully data-driven and thus require real-time information and extensive connectivity between objects, human beings and other system dynamics (Majeed & Rupasinghe, 2017). It is of utter importance that the entire supply chain follows a single standard and has similar digital capabilities, otherwise system incompatibilities act as insurmountable barriers that set strict limits to automation in a supply chain (Fawcett, Osterhaus, Magnan, Brau, & McCarter, 2007).

Obviously, not only physical processes can become a target of automation. Also more complex management processes bear a huge potential for more efficient, automated applications. This has implications for example on the first aspect mentioned in this chapter, the reconfiguration and structuring of the supply chain network. With the help of smart IT solutions, this process of adaptation becomes dynamical and automated and enables for example the automated search for digital manufacturing services (Ameri & Patil, 2012). Especially in relation with ecommerce, automated solutions for transaction processes were very popular from the beginning on and contribute to the viability of many digital business models (Eng, 2004). Automation comes along with many benefits for companies. One of the key benefits resulting from the automation of physical and planning processes is a usually significant gain in efficiency mainly based on optimized resource utilization, higher speed and less waste (Alicke, Rexhausen, & Seyfert, 2016). Benefits stemming from process automation are usually two dimensional, with one dimension generally being cost efficiency and the second dimension usually being related to functional benefits, e.g. higher reliability (Wu, Yue, Jin, & Yen, 2016).

It is obvious that automation and all the other above mentioned areas of supply chain digitalization are interacting, and many of them are even in a relationship of dependency. Clearly, the potential of all these technologies and developments is maximized when they are integrated with each other (Wu, Yue, Jin, & Yen, 2016).

2.3 Previous Research on External Influences on Supply Chains

A supply chain is a construct that is exposed to its environment, and this environment obviously contributes to the shape and characteristics of the supply chain. A broad variety of crucial and defining external influences have been identified and discussed in previous literature. According to Barry (2004), the supply chain is exposed to factors such as labor supply, energy supply, technological development and the political as well as the economic environment, with those factors also being the main source of the most severe risks to supply chains. The relevance and practice of certain key activities in a supply chain are dependent on external factors. Luo, Van Hoek and Roos (2001) conclude that the role and practice of logistics is dependent on culture, infrastructure and the economic system.

Also the natural environment should be considered as a crucial factor of influence. On one hand, the natural environment has become a key source of stakeholder claims and stakeholder influence (Lamming & Hampson, 1996). On the other hand, the natural environment influences supply chains directly and indirectly through conditions such as weather or events such as natural disasters (Christopher & Peck, 2004). Although a supply chain usually is believed to be based on economically reasoned decisions, social aspects play a significant role. A supply chain's social environment and relationship setting can thus have a significant impact on performance and success (Loch & Wu, 2008). According to Russell and Hoag (2004), such social influences can be especially significant in relation with the adoption of new technologies in supply chains. Thus, the social environment is particularly relevant in the discussion about external influences on supply chain digitalization.

2.3.1 Social and cultural influences

There is a broad variety of particular influences on supply chains and supply chain digitalization that could stem from the social sphere. Due to the broadness of the topic, the number of different streams of discourse is enormous. One of the most established frameworks for classifying and characterizing society and social environment in general in a management context is Hofstede's theory of cultural dimensions. Hofstede (1983) came to the original conclusion that cultural peculiarities can be classified by the use of four dimensions: Power distance, uncertainty avoidance, individualism and masculinity. Additional dimensions were added later, however, the focus remained on the initial four cultural dimensions (Hofstede, 1991). The relevance of the theory with respect to the context of supply chains as well as digitalization has been elaborated in recent research. The cultural dimensions appear to have a particularly severe impact in supply chains that spread across different cultural environments,

and in situations of novelties, e.g. the introduction of an innovation to the supply chain (Bello, Lohtia, & Sangtani, 2004). Thus, cultural characteristics might be particularly relevant with respect to supply chain digitalization and all the changes and innovations that are comprised in it. For example, a strong degree of collectivism (i.e. a weak pronunciation of individualism) comes along with a strong identification with the values and norms of an organization, driving a strive for congruence in terms of values and norms with partners and thus supports strong, profound and long-lasting supply chain relationships (Zhao, Huo, Flynn, & Yeung, 2008). The dimension of individualism has also been found to have a significant impact on information sharing and data exchange; an organization in a setting of strong collectivism is generally more likely to engage in extensive sharing of sensitive information (Shore & Venkatachalam, 2003). Thus, digitalization driven supply chain integration should be more effective and easier to realize in the environment of a culture that exhibits strong collectivism. The willingness and ability to share data is also strongly influenced by the cultural dimension of power distance. Differences with respect to power distance, e.g. between a supplier in a high power distance environment dealing with a focal firm in a low power distance environment, and the resulting differences in the management style make extensive information sharing programs difficult (Shore, 2001). However, at the same time power distance can also have a more holistic impact, supporting data sharing and the quality of supply chain partnerships in general. In an environment of high power distance, management has strong and widely unquestioned reward power, which can be helpful in building strong and trustful relationships with supply chain partners through the reciprocal exchange of favors (Zhao, Huo, Flynn, & Yeung, 2008).

With regard to supply chain agility and visibility, the cultural dimension of uncertainty avoidance is particularly relevant. According to Griffith and Myers (2005), agility and flexibility in supply chain operations are particularly appreciated if a culture of low uncertainty avoidance is predominant. A low uncertainty avoidance comes along with short-term orientation, and agility can be seen as contributing to success under short-term orientation. However, the same effect holds also in the opposite directions. A strong tendency towards uncertainty avoidance can be seen as a hindrance and threat to reliability in a supply chain network that requires agility and flexibility, and will most likely lead to frequent late deliveries and similar supply chain failures (Durach & Wiengarten, 2017).

From a cultural perspective, several interesting peculiarities should be mentioned about the situation in Russia. In terms of the cultural dimensions, Russia shows a very interesting profile that is in many aspects contrary to the profile that characterizes most Western European or North American countries. The profile of cultural dimensions in Russia is unique and rooted in the political and economic history of the country (Naumov & Puffer, 2000). The differences

become clearly visible when the scores are contrasted with the ones of a Western European country like Switzerland.

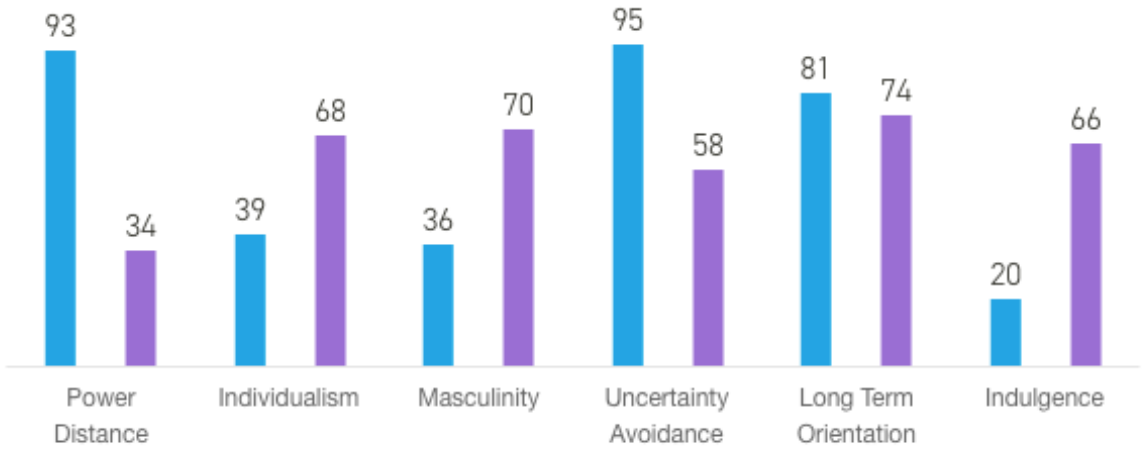

Figure 4: Cultural dimension scores for Switzerland (pink) and Russia (blue); 1 implies very low characteristics, 100 implies maximum characteristics. (Hofstede, 1991)

On first sight, it is apparent that Russia has a remarkably high score in the dimension of power distance. This implies that Russian people generally accept inequality in power distribution and rather do not question authority (Hofstede & Minkov, 2011). Based on the above elaborated findings of Zhao et all. (2008), this could have a positive impact on the strength of relationships between supply chain agents and thus serve as an enabler for data sharing. At the same time, however, data sharing might be more difficult with business partners e.g. from Western Europe according to Shore (2001).

Russia exhibits a comparably low score for individualism. Thus, the coherence of society and the association to groups is quite strong in Russia, and emphasis lies on the collective rather than the individual (Hofstede & Minkov, 2011). According to Shore and Venkatachalam (2003), this high degree of collectivism should be an enabler for extensive data sharing.

The score for uncertainty avoidance in Russia is among the highest worldwide, reflecting a general intolerance for ambiguity in society (Hofstede & Minkov, 2011). This strong intolerance for uncertainty might hamper the development and exploitation of agility, as Griffith and Myers (2005) established. Therefore, although the preconditions as well as incentives for agility might be fully given, firms might not appreciate the potential benefits.

In addition to the unique profile in terms of Hofstede's cultural dimensions, Russian society features additional social peculiarities rooted in the historic background of the country. The disruptive transition to a market economy in the early 1990s made many managers rely primarily on personal contacts, since this seemed to be an appropriate way to deal with the high degree of uncertainty in relationships with suppliers and other business partners (Puffer, 1994).

Thus, it is apparent that in the 1990s and well beyond that, business relationships were mostly congruent with personal relationships.

2.3.2 Geographical influences

It is quite obvious that the geographical environment a supply chain is embedded in can influence various aspects of operations and strategy. A supply chain in an environment as it can be found e.g. in Siberia will most likely be exposed to completely different challenges as well as advantages than a supply chain that is rooted e.g. in an area with tropical climate. Since geography generally is an extremely wide area of research and comprises many different topics, ranging from geopolitics over geology all the way to demographics, the variety of potential influences is naturally also very broad.

Today, many supply chains spread across the globe, and strategies such as outsourcing lead to a geographically highly dispersed value creation. The geographical dichotomy between production and consumption usually is the basis for several additional agents and nodes in a supply chain, dealing mainly with logistics and distribution but also supporting functions such as finance (Rodrigue, 2012).

Urbanization has a strong effect on how supply chains are structured and how processes are laid out. Geographical conditions in terms of urbanization have a direct impact on costs of logistics; since urbanization generally comes along with high property prices, storage and logistics facilities often have a completely different shape than in less densely populated, rather rural areas (Fernie, 1995). The costs generated by high wages and property prices in urban areas can easily outweigh the benefits of proximity to the consumer, what can drive a decentralization of supply chains (Bogataj, Grubbström, & Bogataj, 2011). This is perfectly in line with the general trend towards global supply chains mentioned above. In an effort to decrease costs, operations are outsourced and decentralized. Globalization and decentralization thus make supply chains generally more vulnerable to disruptions due to an increased number of potential exposure points and an increase in distance that generally comes along with a decrease in control (Stecke & Kumar, 2009).

The geographical environment of a supply chain can have a strong impact on the reliability of a supply chain. Most supply chains are extremely vulnerable to external shocks that can stem from events such as earthquakes, flooding, storms and other natural disasters, and such events often have a very long-lasting impact on the performance of the affected supply chain (Tang, 2006). The tendency towards broad, highly interconnected supply chain networks as a result of supply chain digitalization has thereby two different effects opposing each other. While

contemporary, interconnected configurations of digital supply chains make it easier to react to an external shock by redistributing and circumventing the issue, the often broader spread of the network and the geographical dislocation makes it at the same time more likely that a part of the network is exposed to a natural disaster or something similar at any given time (Todo, Nakajima, & Matous, 2015).

The performance of a supply chain is obviously also sensitive to the regulatory framework in which the supply chain operates. A generally rather negative attitude of a country's regulatory bodies towards global trade often complicates transactions and logistics within a supply chain, and failures due to late deliveries or similar failures are frequent (Durach & Wiengarten, 2017).

In Russia, the vastness of the country naturally creates some challenges for supply chains. While in western Russia well developed urban areas exist, the largest parts of the country are rather sparsely populated and urban areas are located very far from each other. This obviously has an impact on companies that operate in Russia. Lorentz and Lounela (2011), for example, suggest that the extremely long distances in Russia require companies to focus on logistics what might restrain them in other activities such as marketing. For some companies, however, the challenge is so big that they simply restrict themselves to a small part of the country. The massive challenge of logistics is for example the core restraint that makes fast food chains such as McDonald's hesitate to expand further east into Siberia (Marson, 2017). The difficulties caused by the geographic conditions in Russia are reflected also in many other industries. The vast majority of retailers do not maintain a supply chain that reaches out to the entire country, what makes Russia an extremely fragmented retail market with large disparities between urban and rural areas (Lorentz & Lounela, 2011). Thus, the geographical distance that is an omnipresent issue in Russia has a profound impact on businesses and their supply chains, and thus naturally also on the digitalization thereof.

2.3.3 Economic factors

There are various macroeconomic factors that can have a direct or indirect effect on supply chains and their digitalization. These effects mostly relate to the developments at the labor and capital market.

Labor supply is obviously a crucial factor for any supply chain. Depending on the design of a supply chain, more or less manual labor is required. Thereby, labor costs are usually in a strong relationship with the physical capital employed in a supply chain; if labor costs are high, it is sensible to employ large amounts of physical capital in order to increase labor productivity,

while in the case of low labor costs, it is often cheaper to rely on simple manual labor (Fernie, 1995). Thus, in a low-wage environment, it is rather unlikely that manual labor is heavily supported or even replaced by physical capital like e.g. robots. However, beyond the point where manual labor and robots become equally competitive in terms of productivity and cost, robots tend to substitute manual labor quite consequently (Acemoglu & Restrepo, 2017). The competitiveness of technology, reflected in the break-even point of the required investment, thus depends mostly on the wage rates; however, the break-even point is also immediately related to other conditions such as e.g. economies of scale, cost of capital as well as competition and the relationship of supply and demand (Dijkhuizen, Huirne, Harsh, & Gardner, 1997). The same break-even considerations also seem to hold true for more general and basic physical capital that supports the productivity of manual labor (Dong, Goodrum, Haas, & Caldas, 2009).

Another factor that is rooted in the macroeconomic environment are capital costs. Supply chain digitalization and supply chain reconfigurations in general often require significant investments that lead to a significant one-time cash outflow or less significant recurring cash outflows over a long period of time, depending on the chosen form of financing. In any case, the cost of the funds that are used for the investment have to be considered. When it comes to IT-related investments that are often required for the digitalization of a supply chain, like e.g. networking or cloud computing solutions, the resulting capital costs are a significant fraction of the total investment cost (Greenberg, Hamilton, Maltz, & Patel, 2008). The need for funds usually is even much higher in automation projects due to the fact that usually more physical capital needs to be purchased or leased; thus, capital costs are a major concern and common barrier for automation projects (Baker & Halim, 2007). Overall, it can be deduced that expensive large-scale supply chain digitalization projects generally would benefit from a low-interest rate and low-risk environment, resulting in rather low capital costs.

Another factor that can be considered as a macroeconomic influence are taxes. Taxes can have a multitude of effects on the profitability of a company and on investment pay-off. Depending on the formulation of tax laws, different incentives and disincentives for various behaviors can result. A very immediate effect on supply chain digitalization could stem from payroll taxes. Such taxes, if imposed on employers, increase the actual cost of labor as perceived by a company directly. Such payroll taxes drop out with automation; without a corresponding tax on physical capital, payroll taxes thus make manual labor less competitive and incentivize automation (Autor, 2015). It also incentivizes to maximize the productivity of remaining workers with the help of additional physical capital in basically any case (Tyers & Zhou, 2017). Therefore, it can be concluded that significant payroll taxes that are to be borne by the employer incentivize companies to replace workers fully or at least minimize the number of workers with

the help of automation and digitalization. Apart from payroll taxes, also the manifestation of other forms of taxation are likely to have an impact on the digitalization behavior in supply chains. For example, relating to the above mentioned significance of capital costs, deductibility of interest expenses for corporate income tax purposes might influence the volume and financing of large investments. In recent years, many governments also granted income tax credits for companies that invested locally in advanced, digital large-scale manufacturing plants, serving as incentive to expand, replace or update old plants and digitalize operations (Graetz & Doud, 2013).

Also, trade-related taxes like tariffs might accelerate the digitally enabled decentralization and localization of production and supply chain activities. The geographical configuration of supply chains might further be influenced by corporate income tax regulation; digitalization and the usually resulting increase in income from intellectual capital give companies more freedom to optimize their taxes by shifting intellectual property income to low-tax jurisdictions (Graetz & Doud, 2013).

Additionally, general macroeconomic stability often influences the investment and digitalization behavior of companies. Macroeconomic shocks like e.g. a significant devaluation of currency often lead into periods with strongly reduced investments or even divestiture and thus hamper progress and competitiveness (Chisari & Ferro, 2005). Thus, the necessary funds for large investments in new technologies are often lacking after macroeconomic shocks. The general productivity-enhancing and cost-reducing effect of digitalization is counterbalancing this tendency to neglect investments; especially in widely analogue emerging economies, digitalization of production and supply chain activities appears to be a sensible measure to cope with increased shock-induced competitive pressure on global markets (Tadeu & Silva, 2017). Thus, macroeconomic stability, or rather the lack of it, on one hand usually hampers investments but at the same time works as an incentive to digitalize and update production in order to stay competitive in a crisis.

Little research has so far been done on potential influences of the regulatory environment on supply chain digitalization in Russia. However, previous literature reveals certain aspects that hint at relevant developments. Inkinen, Tapaninen and Pulli (2009) analyzed information exchange in Finnish logistics chains, and came to the conclusion that cross-border logistics still heavily rely on manual paper mainly due to the way how governmental and customs processes are conceived and operated.

3. Methodology

The research design of this study is based on a generally applied and promoted structure, which includes a research strategy, core concepts which are laid out in the literature review and detailed information on the methodology used in the collection and analysis of the data (Punch, 2014).

In order to deliver a truly profound and comprehensive insight, the study is based on different types of primary research and at the same time draws from relevant high-quality secondary sources. Thanks to a symbiosis of quantitative and qualitative research, solid and representative answers to the initial research questions shall be elaborated. Therefore, as this paper is trying to come to empirical conclusions by looking at quantitative and qualitative data, a paradigm-driven approach is followed (Punch, 2014). The focus on a particular country and market environment gives the research a certain descriptive character. However, due to the way how the collected data and insights are put into context, a comparative dimension is realized. There are various approaches toward the research process and research design. Many of them serve distinct purposes, while others are quite generally applicable. Probably the most simple and streamlined research process is the one that is predominant in marketing research. The classical marketing research process follows five stages (Malhotra & Birks, 2003):

1. Problem Definition
2. Research Design Development
3. Data Collection
4. Data Analysis
5. Report Presentation

This suggested process offers flexibility and is very widely applicable in both academic and business research. It thus is the ideal underlying process structure not only for marketing research, but basically for any kind of research (Stuart, McCutcheon, Handfield, McLachlin, & Samson, 2002).

As established above, the paper aims at going beyond mere descriptive research. By answering two overarching sequential research questions, the differences in supply chain digitalization between Russia and Switzerland shall be explained. These two overarching research questions are split down further into a total of six subquestions:

RQ 1.1: Which technologies are, compared to Switzerland, more popular in Russia?

RQ 1.2: Which technologies are, compared to Switzerland, less popular in Russia?

RQ 2.1: How do social peculiarities influence supply chain digitalization in Russia?

RQ 2.2: How do geographical peculiarities influence supply chain digitalization in Russia?

RQ 2.3: How do economic peculiarities influence supply chain digitalization in Russia?

These five subquestions set a horizon for the research that is clear and distinct and at the same time wide enough to not ignore relevant factors and potential insights. All research questions are closely interrelated with each other, and the two overarching parts are in sequential order. In order to answer the initial questions about the country-specific state of progress regarding supply chain digitalization, a pre-determined questionnaire is used in order to derive results that are widely comparable. The results are compared and analyzed with the help of statistical means. Based on this process, the work classifies as quantitative research (Creswell, 2014). Based on the lack of coherent theory and previous research as well as the existing need to describe possible phenomena, quantitative research is also the generally recommended form of analysis (Morse, 1991). Thus, a so-called mixed methods approach is followed in order to answer the research questions as thorough and insightful as possible. Creswell, Clark, Gutmann and Hanson (2003) came up with a precise definition of mixed method research that characterizes the process and other characteristics clearly:

> *«A mixed methods study involves the collection or analysis of both quantitative and/or qualitative data in a single study in which the data are collected concurrently or sequentially, are given a priority, and involve the integration of the data at one or more stages in the process of research.»* (Creswell, Plano Clark, Gutmann, & Hanson, 2003, p. 165)

In a first stage, the popularity of different technologies and the progress of different areas of development is investigated with the help of quantitative analysis. In a second stage, the identified points of interest that resulted from the quantitative study are investigated deeper in a qualitative manner.

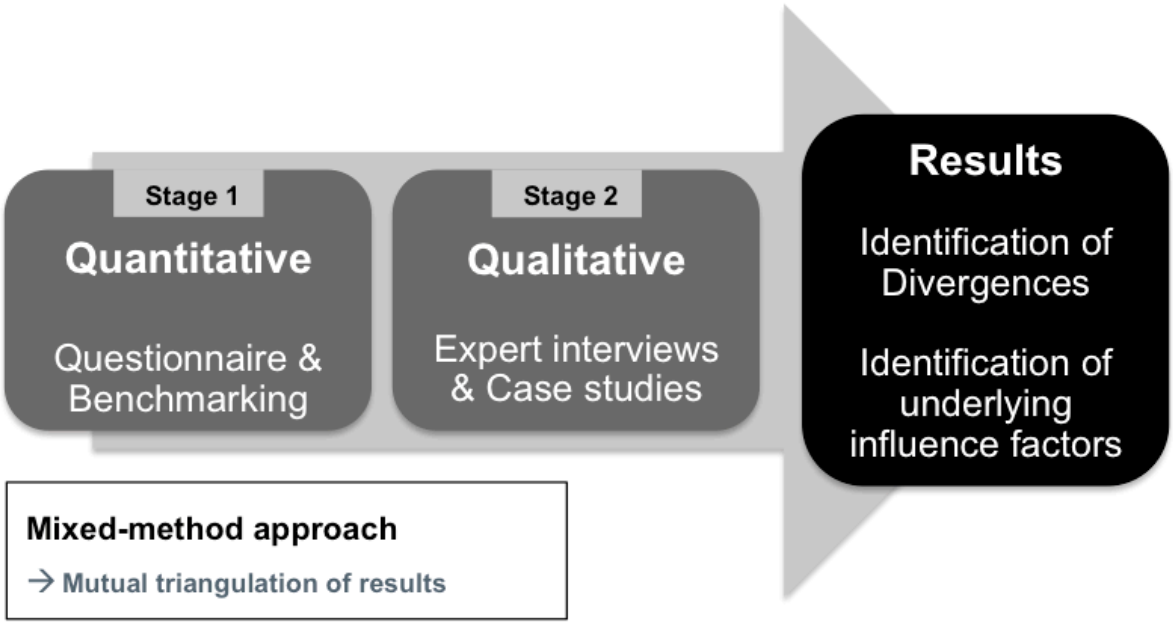

Figure 5: Overview of the mixed method approach used in the study, illustrating the two sequentil stages and the desired outcomes.

The result of the first stage is the identification of potential divergences, while the second stage should result in explanations for these divergences in the form of underlying influence factors. The two stages are in sequential orders, since the results of the first stage are the basis for a part of the interview questions and case studies of the second part. The two stages also allow for a mutual triangulation of results; the quantitative findings of the first stage should be verifiable at least partially in the second stage.

3.1 Quantitative Stage

In the initial stage, companies with significant supply chain operations on the territory of the Russian Federation are asked to participate in a survey about their current state of supply chain digitalization. Subject to the survey are companies of all kind of size, industry background, age or heritage. The only criterion is that the participating companies maintain physical supply chain processes in Russia.

The survey is also of particular relevance in the case of companies that participate in expert interviews in the second, qualitative stage. Before the interviews are conducted, participants are asked to answer a comprehensive questionnaire about their supply chain digitalization activities. This questionnaire serves as basis for a benchmarking. By analyzing the given answers and putting them into context by comparing them with a relevant benchmark, an initial profound insight into the general focus and progress of digitalization at the participating

company can be gained. By considering these initial insights, a more precise and targeted approach can be followed in the interview stage.

The survey is conducted with the help of a questionnaire that is mainly available as Google form, in both Russian and English language. Alternatively, for example for employees who are not allowed to use any Google Drive applications at their workplace, an Excel-version of the questionnaire is provided. A short introductory text gives all necessary information for the participants to fill out the questionnaire properly. After that, each candidate is asked to answer a total of 12 questions. These questions are structured into four parts, of which each part has a distinct purpose:

1. **Questions concerning the current status of development and implementation (5 questions):** Those questions are the actual core of the analysis, since the answers indicate the actual status quo. They are entirely based on the previous study that was conducted in Switzerland and thus have been fully verified in previous research.
2. **Questions concerning planned investments (2 questions):** These questions indicate the direction and speed of further development and gives a clear insight into which topics and issues are treated and digitalized with priority. They are entirely based on the previous study that was conducted in Switzerland and thus have been fully verified in previous research.
3. **Questions concerning beliefs of the participant (2 questions):** In these questions, the participants are asked about their general beliefs, e.g. about the implications of digitalization on performance or general obstacles for digitalization. The purpose of these questions is to gain a better understanding of motivation and hindrances for companies to digitalize their supply chains. Some of the questions are based on the previous Swiss study and therefore have been fully verified in previous research. Other questions were designed specifically for this paper and aim at investigating the specific situation in Russia.
4. **Questions concerning the participants' company (3 questions):** These questions aim at providing for a basis for the categorization of the participants based on their company characteristics and thus also contributes to the overall characterization of the sample.

In order to avoid any conditions of framing, the questions regarding the participant's company are placed at the end. The questions regarding current status of implementation and planned investments are in a mixed order, so that current status and planned investments in particular are explored subsequently without distracting interruptions.

3.1.1 Benchmark country

Clearly, key challenges in a country as vast as Russia stem from logistics. The shipping of goods is a core function in a supply chain and vital for successful operations. Bridging distance between local markets, between suppliers and retailers or between different manufacturing steps is a crucial process that is exposed to risks and challenges that increase with geographical distance. Thus, the performance of logistics is a good indicator for the functionality and quality of supply chain operations.

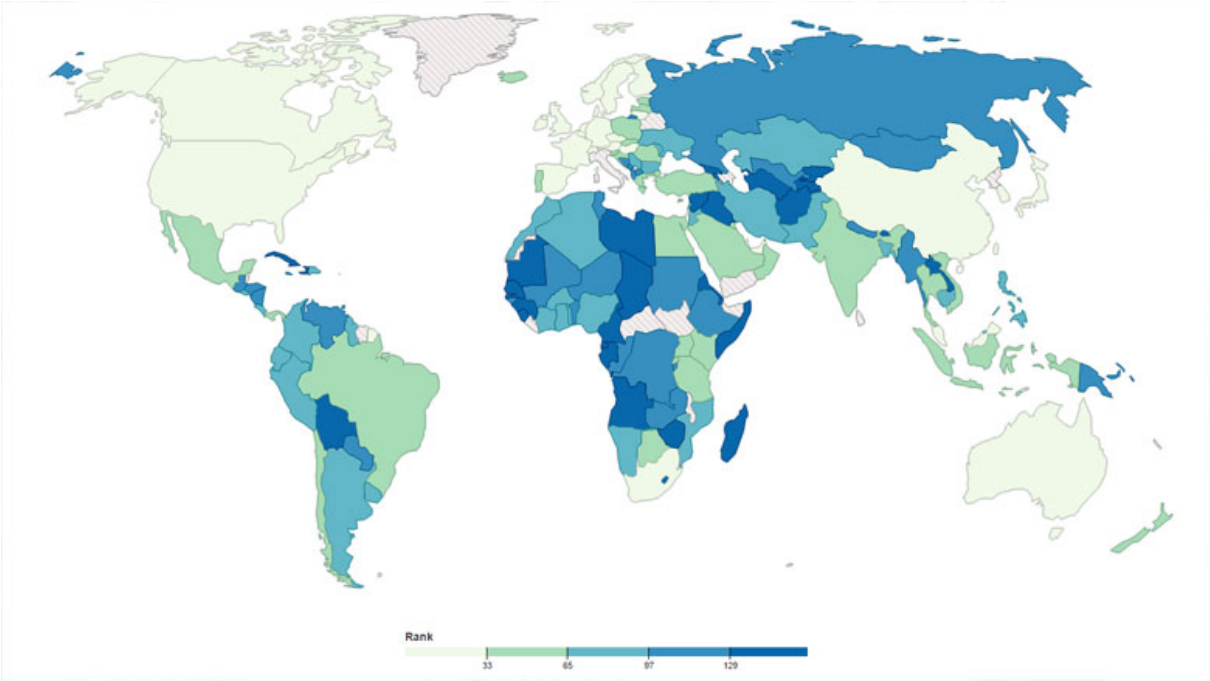

Figure 6: Logistics performance index results illustrated by country; dark colors imply poor performance, light colors imply high performance. (World Bank, 2018)

The World Bank issues annually an index that allows for the comparison of logistics performance in all countries around the globe. The index is based on an extensive survey of operators in the logistics industry, and comprised a total of 160 countries in the latest edition of 2016 (World Bank, 2017). A look at the graphical representation of the ranks in figure 1 reveals immediately a strong discrepancy between Russia and most leading industrial nations. In the 2016 edition, the Russian Federation occupied the 99th rank and thus is in a similar area of the ranking as many African nations (World Bank, 2017). According to the ranking, Russia is far off from the leaders. One of the highest ranked countries, Switzerland, serves as benchmark for the quantitative analysis in this paper.

Figure 7: Logistics performance split into different dimensions of performance; 1 implies poorest possible performance, 5 implies best possible performance. (World Bank, 2018)

A detailed look at the scorecards of Russia and Switzerland, the country that serves as benchmark in this paper, gives a clear overview. While Switzerland, which ranked 11th in the overall ranking, has strong performance in almost every aspect with only slight deficits in international shipments, Russia's scorecard exhibits the exact opposite picture. Especially customs seem to be a particularly weak spot. A more profound look at the criteria that resulted in the mediocre rank of Russia confirms the impression given in the scorecard: logistics operators in Russia face challenges in basically all areas.

	Russian Federation	Switzerland
Shipments meeting quality criteria	54.55%	97%
Import land (LT/distance)	14 days / 2646 km	5 days / 750 km
Export land (LT/distance)	5 days / 1012 km	5 days / 750 km
Import air or sea (LT/distance)	7 days / 668 km	2 days / 75 km
Export air or sea (LT/distance)	5 days / 617 km	1 day / 75 km
# documents import	5	2
# documents export	4	2

Table 1: Concise metrics of logistics performance, comparison between Russia and chosen benchmark country Switzerland. (World Bank, 2018)

A direct comparison of some performance indicators reveal striking differences between the two countries. While in Switzerland, quick access to a nearby airport or port is available in basically any case, Russian logistics providers have to cover distances of more than 600 km on average from or to an airport or seaport. A similar situation is prevalent with logistics on land; due to the vastness of the country, distances can spread over several thousand kilometers. Also, bureaucracy is much more of an issue in Russia than in Switzerland; more than twice as many

documents are needed in logistics in Russia. Overall, the percentage of shipments that meet the expected quality criteria is with less than 55% devastatingly low in Russia.

3.1.2 Previous study «Logistikmarktstudie Schweiz»

To create a context for the findings of the questionnaire and establish a comparative relationship, results from a previous survey from the year 2016 conducted among Swiss companies are taken into consideration. The data from this survey serves as a best practice benchmark for the responses obtained in Russia. This benchmarking adds a quantitative aspect to the analysis and underlines the comparative dimension to the study. It helps to contextualize the results and makes the identification of divergences possible. Also, the comparative benchmarking results can be considered as a solid basis for managerial recommendations with a profound rooting in reality and practice. Also, the previously conducted Swiss survey serves as demonstration of the economic validity of the questions that are used in the questionnaire here in Russia. The questions that are adapted from the survey already underwent several critical reviews and tests for the original study and thus can be considered as sensible, concise and connected to practice.

The original survey was conducted as foundation for the comprehensive report «Logistikmarktstudie Schweiz 2018» (translated as «Logistics Market Study Switzerland 2018»), written by Stölzle, Hofmann and Oettmeier (2017). The study is written and published every year, whereby each annual edition has a different additional focus topic. The edition of 2017 aimed at capturing the status quo of supply chain digitalization in Switzerland with a focus on logistics functions, both at specialized logistics providers as well as companies that use the services of such companies. This means that apart from logistics companies, also other companies mainly from the industries retail, manufacturing and consumer goods were in focus; in total, 170 companies participated in the study (Stölzle, Hofmann, & Oettmeier, 2017). This large number of participants combined with the outstanding relevance of participants and quality of the data make it one of the most detailed and comprehensive study about the topic that was conducted in recent years. It is therefore the ideal foundation of a benchmark that reflects the current situation in an advanced Western European country.

The underlying data from the original survey, however, was treated and analyzed in a different manner for the purposes of this paper. In the original paper, the responses were weighed with the revenue of a company in order to give a representative overview of the situation in the economy in terms of output. For this study, the absolute count, i.e. the situation in every single company, is relevant and thus such a weighting is not conducted; neither with the

benchmark data nor with the newly generated data from the survey in Russia. In order to nevertheless account for potential differences and patterns that might be due to the company size, statistical analysis is used in order to control for potential correlation or causation impacts of the company size, both in terms of revenue and number of employees. This method also allows for the elimination of potentially deterring effects based on currency exchange rates, the number of participants or the sample size and consistency in general.

3.2 Qualitative Stage

In the qualitative assessment of the identified gaps and the profound reasoning of differences, two selected cases are analyzed in a detailed manner. The situation at both companies which exhibit representative behavior and status regarding supply chain digitalization is investigated by considering the companies' background, strategy, resources as well as beliefs. The method used for that purpose is a general and simple case study approach. The case study is a very widely used method in research that finds application in a broad variety of areas. Its versatility makes it the ideal tool for research in business; the method is focused on understanding the current dynamics of the investigated area and usually aims at deducing theoretical concepts from reality (Stuart, McCutcheon, Handfield, McLachlin, & Samson, 2002). Other purposes of case study research apart from theory generation include providing description and testing existing theory (Eisenhardt, 1989). In the research design of this paper, the case studies fulfill both the purpose of providing description and generating theory: On one hand, observations and descriptions from the quantitative part are verified and enhanced with the help of the case studies. On the other hand, qualitative investigation regarding the reasons and background of the status quo allows for theorizing and deriving generalized relationships between the status quo and external factors prevalent in Russia.

Case studies can be conducted in a broad variety of configurations in terms of form and number. It can be distinguished between the multiple case study method, where several cases are used for theory generalization, and the single case study method. Very often a multiple case study method facilitates reliable theory generalization. However, through means of strategic case selection and contextualization, a single case study method is as effective for theory generalization as a multiple case study approach (Flyvbjerg, 2006). The case study approach chosen in this paper has various traits; it can be characterized as explanatory as well as instrumental, and for the purpose of triangulation of survey results even descriptive. It is of explanatory nature since it aims at establishing causal links between external factors and the real-

life activities and behavior of a company (Yin, 2003). The instrumental approach stems from the fact that the cases aren't primarily used to understand the particular situation of the cases, but rather the external factors in general that were prevalent in the cases (Baxter & Jack, 2008). Thereby, the typicality and representativeness of the cases is not of utmost necessity; contextualization and focus on external variables allow for theorization independently of the nature of the cases (Stake, 1995).

Interviews serve as the key source for both case studies. The interviews are conducted in a semi-structured manner, i.e. the interview followed a predefined set of questions, but for a variety of purposes like e.g. clarification, elaboration or specification of answers, additional and spontaneous questions can be added (Voss, Tsikriktsis, & Frohlich, 2002). Therefore, guiding interventions and interruptions were possible and aim at supporting the overall understanding as well as the level of detail. In a fully structured interview, such spontaneous inquiries and deviations from the predefined interview guide would not be possible (Cassell, 2009). A complete version of the prepared interview guide with all questions that were used can be found in the appendix. As interview participants, exclusively people who are highly familiar with all activities and strategic initiatives in their respective companies are selected. Interviews were conducted personally and on site. Since several questions are quite detailed and thus might require the interviewee to consider previous actions as well as future plans and possibly even require the interviewee to do research or at least remember his questionnaire responses, the full interview guide is provided to interview participants in advance.
The predefined interview questions are split into three parts that can be distinguished by their degree of specificity and topical focus:

1st part: General and company related questions
2nd part: Influence-factor related questions
3rd part: Influence-factor related questions based on survey responses

The order follows a funnel-approach; the initial questions are rather general and related to the company's activities and strategy in broad terms, while the last questions are genuinely specific and ask for concise information concerning a close topical focus. Using the analyzed company's questionnaire response as an additional source and starting point for further research in the case study facilitates triangulation of evidence and thereby strengthens the grounding of conclusions and derived generalizations (Eisenhardt, 1989). Furthermore, referring to the survey results allows for triangulation of the situation indicated in the answers.

4. Description & Discussion of Results

4.1 Overview of Survey Results & Identification of Divergences

The survey was distributed both through personal networks, mostly in and around St. Petersburg, and through general requests for participation to relevant companies all over Russia. The result was a total of 28 responses, of which 27 were fully completed and useable. The vast majority of the responses was in Russian, only three of the responses were completed on the English version of questionnaire. The resulting sample is quite diverse in terms of company backgrounds. Among the respondents were nine international companies that have their headquarters outside Russia; most of them have European heritage. The size of the companies who participated ranged from 11 employees up to 4500 employees; this large spread in terms of company size is also reflected in the revenue of the participating companies. Most companies among the participants, however, can be categorized as medium-sized companies with 100 to 500 employees.

The results give a good overview of differences and commonalities in the digitalization behavior of Russian companies and Western European companies. Overall, it is apparent that there is no genuine backlog of companies here in Russia compared to the benchmark of companies in Switzerland. It is remarkable that all technologies, even the most advanced IoT applications, find use in Russia just as they do in Europe. Basically all companies that participated in the survey claimed to be interested in the topic, and the vast majority of companies is developing and implementing digitalization solutions of some sort. A look at the relevance and exploitation of existing data shows that Russian companies are currently working on performance measurement, process improvement and forecast improvement, just as companies in Switzerland do as well. However, when it comes to more transcendent and strategic use of data, either related to the new development or the improvement of business models, Russian companies seem to be lagging behind; less companies use data for the improvement of their

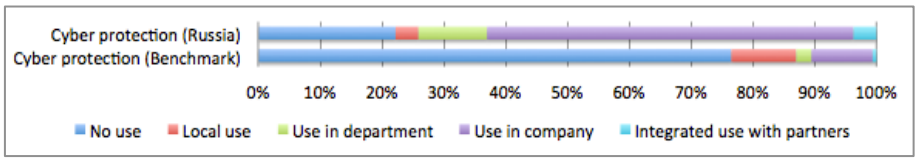

Figure 8: Scope of use of cyber protection technologies in the Russian sample compared to the scope of use in the Swiss benchmark sample.

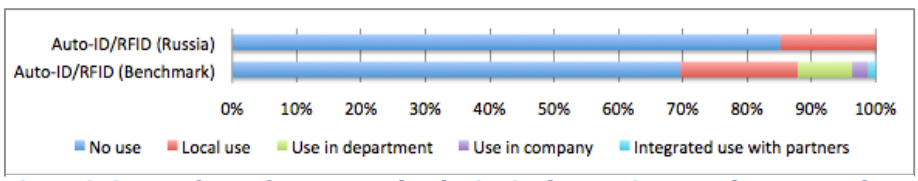

Figure 9: Scope of use of Auto-ID technologies in the Russian sample compared to the scope of use in the Swiss benchmark sample.

current business model and more than two thirds of the participants don't exploit data for the development of new business models.

More interesting and revealing is a look at the technologies that are used and the future investments into these technologies that are planned. Here, the survey distinguishes between general digital technologies which can be seen as basic underlying technologies that form the foundation for applications, and more advanced and comprehensive IoT applications like e.g. autonomous vehicles or additive manufacturing. In both of these categories, the benchmark comparison reveals a very mixed picture; some technologies vary significantly in terms of popularity between Russia and the Swiss benchmark. The most significant divergence concerns cyber protection technologies. In the Swiss benchmark sample, only ten percent of the participating companies claim to have comprehensive cyber protection technologies companywide. In Russia, the situation is the exact opposite, with most companies having implemented company wide solutions or even integrated solutions with their partner firms. Other technologies that are clearly more popular among the Russian sample compared to the Swiss sample are cloud computing, location determination and mobile radio technology. These technologies are very widely used, with the vast majority of Russian companies using them at least on a local basis, e.g. for a particular function. Less popular, in contrast, are technologies that are directly related to automation. Although almost half of the companies from the Russian sample claim to be using actuators, almost all of them only do so on a local basis. Companies from the Swiss sample, however, are using actuators on a department- or companywide basis. When it comes to Auto-ID technologies like RFID, the picture is even clearer; in the Russian sample, the technology is used by 15% of the participants, but exclusively on a local basis. Thus, there are no comprehensive Auto-ID solutions that were implemented yet in the participating Russian companies. The share of companies using Auto-ID technologies among the Swiss participating firms, however, is twice as large and more than 10% of the participants use the technology on a department- or companywide basis.

With IoT applications, the situation looks similar; some technologies are more popular in Russia, others less. IoT applications that are particularly popular and used more widely among Russian companies compared to the benchmark include telematics, big data analytics and advanced planning systems. All these technologies are used much more widely on all levels, i.e. on local basis, department and companywide as well as in integrated solutions together with

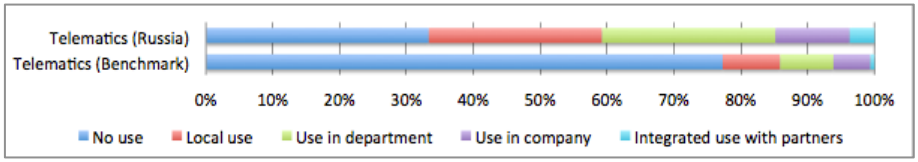

Figure 10: Scope of use of telematics applications among companies in the Russian sample compared to the use of telematics applications in the Swiss sample.

supply chain partners. They also generally reflect the patterns that are elaborated above, since some of the general digital technologies serve as basis for advanced IoT applications. For example, telematics applications usually rely on location determination and mobile radio technology. Thus, a strong usage of those technologies is needed in order to put comprehensive telematics solutions in place. However, also here technologies that are related to automation are clearly less popular among participants of the Russian sample compared to participants of the Swiss sample. Technologies such as smart buildings, additive manufacturing or intelligent loading vehicles are used less widely and usually only on a local and strictly limited basis.

An analysis of the sample data set reveals some further interesting insights. The sample shows that rather small companies, both in terms of the number of employees and the annual revenue, tend to be less advanced in supply chain digitalization than larger companies in Russia. This is particularly interesting when the situation is compared with the benchmarking data set from Switzerland. Linear regressions with the degree of digitalization (e.g. in terms of the overall interest in the topic, development of previous solutions, implementation of particular technologies) as dependent variables and the company size (in terms of number of employees as well as revenue) as independent variable do not yield any statistically significant results, and the explanatory power of the already insignificant models is generally very low. The size of the data set (N = 159 – 171, depending on the dependent variable) would clearly be large enough and thus can be excluded as reason for the insignificance of the regression results. Thus, it can be concluded that in the data set there is actually no significant relationship between company size and degree of supply chain digitalization. This lack of correlation also makes the initial dataset from the study conducted in Switzerland perfectly suitable for benchmarking, since deterring factors based on the sample composition are unlikely. Although the Russian sample is too small to derive statistically relevant regression results, a look at the data clearly reveals a correlation between company size and degree of supply chain digitalization. Smaller companies, especially the ones with less than 100 employees, barely use digital technologies and usually don't have any planned investments in digitalization or IoT technologies.

Another strong divergence in the sample exists between companies which have their roots in Russia and companies that are originally foreign, i.e. have their headquarters outside of Russia. Without any exception, all the most advanced and most digitalized companies that participated in the survey had their headquarters outside Russia. This divergence can also be observed irrespective of the company size; throughout all industries and sizes international companies appear to be clearly more advanced in terms of supply chain digitalization. However, due to the limited sample size, no statistically relevant regression analysis is possible.

4.2 Case «International Logistics Company A»

The initial case study builds on insights gained at the international logistics company A (for reasons of confidentiality, the actual name of the company as well as the name of the interviewed person are anonymized), an international logistics company that also offers a broad variety of value adding services such as consulting. The international logistics company A is European-based, the headquarter is located in Belgium. Activities spread all over the globe with a certain focus on Eastern Europe, Russia and CIS as well as South East Asia, China and India. The international logistics company A has a long history of operations in Russia, with activities dating back even into the Soviet Era. A presence with comprehensive own facilities in St. Petersburg has been existing for the last 16 years (Manager Logistics Company A, 2018). Today, logistics company A maintains five offices in Russia, located in St. Petersburg, Moscow, Novorossiysk, and Siberia. Tobacco, chemicals, Oil & Gas and consumer goods are the key industries that are served in Russia. In addition to the strong presence in Russia, company A has various offices in neighboring countries like the Baltic states, Ukraine and Kazakhstan that are highly relevant for cross-border logistics.

The value proposition that company A provides to its customers goes far beyond simple logistics. The company aims at providing complete and sophisticated supply chain solutions that provide clients with all the necessary services that are needed to be present in the Russian market. In order to develop the most suitable supply chain solutions, an increasing amount of additional non-physical services is provided. Digitalization thereby plays a crucial role. Logistics company A has developed an array of data-based competencies that support the development of more advanced, secure and efficient supply chain solutions for clients. Logistics-related data analytics are a key part of the company's value proposition today.

Also in operations, company A overhauled many areas and processes and digitalized them. Today, the company builds on technologies such as cloud computing to improve information flows and information storage. Furthermore, the gathered data is exploited for various purposes, ranging from simple performance measurement to complex business model innovation projects. Although the company generally has a very digitalization-oriented mindset and already implemented or has planned the digitalization of many activities, the company doesn't follow a strictly defined digitalization strategy; neither on the level of local offices nor on the group level (Manager Logistics Company A, 2018). Instead, local offices are free to develop and implement digitalization projects that correspond to their own and their clients' needs. In Russia, this freedom is used to follow a very pragmatic approach and develop digital solutions only where they actually generate value. Thus, digitalization at the international

logistics company A is very need-driven and either the response to a problem or the solution to exploit a clearly identifiable potential.

Overall, the survey results convey the impression that A is truly up to date and following the most recent technological developments without any delay. The company is highly interested in supply chain digitalization, and has already realized a broad variety of digitalization projects in almost all parts of the company in Russia. Furthermore, the company is continuously investing in new projects and is proactively developing new solutions. The current focus of attention at the logistics company A correspondingly varies with respect to the area of digitalization; while some technologies are already fully implemented within the entire company, several other technologies are still in local use or even test mode and await comprehensive exploitation throughout the company. For example, company A is currently working on the companywide implementation of a solution to mobilize operations, e.g. with the help of mobile devices, and on automation. For the digitalization of measurements and control through sensors as well as for self-controlling applications, however, the focus lies only on some particular areas. In general, this focus is rather contradicting common intuition. The areas of digitalization usually follow a chronological order; companies start by switching from analogue or manual data gathering and movement to digital data collection and actuators. This switch from analogue to digital builds the foundation for further, more complex digitalization projects which are dealing with mobilization or the company-overarching integration. The most advanced fields of digitalization, automation and self-controlling/self-steering applications, are for most companies still out of reach and require strong know-how and infrastructure. This pattern of focus is partially reflected in the average focus of Swiss logistics companies; they mainly focus on the first three stages of digitalization. Logistics company A, in comparison, pays comparably low attention to the switch from analogue to digital and is mainly focused on more advanced areas of application, like the integration of partners and automation.

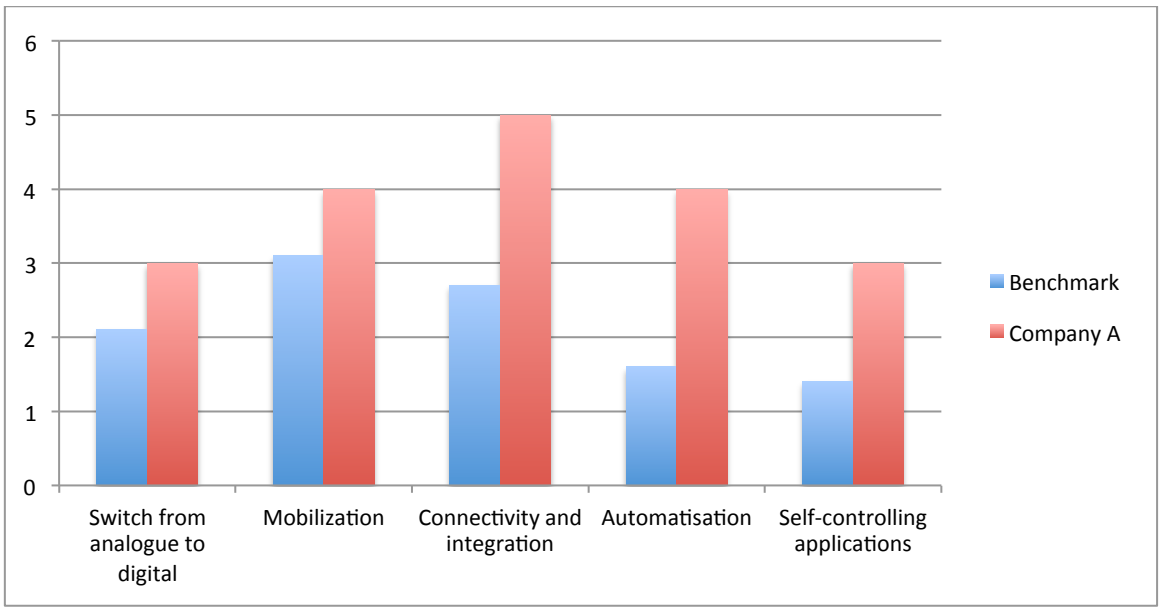

Figure 11: Focus of categorical digitalization activities at company A compared to the benchmark average (1=no focus, 2=local focus, 3=departmentwide focus, 4=companywide focus, 5=integrated focus together with partner companies).

The way how data is used also varies with respect to the broadness of the application area. Mostly, data is currently used on a department-wide basis; i.e. existing data is used to improve the performance, forecasts or business model innovation within particular departments. On a company-wide basis, data is only used for general process improvement.

The survey responses of logistics company A give a holistic first impression about the supply chain digitalization activities of the company in Russia. On first sight, it appears like A is using an array of very advanced digitally-enabled technologies in order to create value for their clients. This first impression is confirmed when the responses of A are benchmarked against the responses of comparable Swiss logistics companies. The visualization of the current status quo in terms of technology application as well as the planned investments in figure 11, however, clearly show some differences in focus between the average Swiss logistics company and company A. If both the current status as well as the planned investments are considered together, it is apparent that, with some exceptions, these differences are not simply the result of a time lag or difference in timing in general. They are actual differences in terms of focus, which differentiate the approach of Swiss logistics companies from the approach to supply chain digitalization chosen by company A.

A look at the use of digital technologies at logistics company A reveals a substantial difference in the focus on cyber security compared to the benchmark sample. While it is on average the second least important technology from the selection for Swiss logistics companies, it has full priority and is company-wide implemented at company A. Other technologies that are significantly used more widely at company A are cloud computing technologies, technologies

for location determination and mobile radio technology. These technologies are used company-wide at A, while most Swiss companies use them only on a department-basis. The only technologies where Swiss logistics companies seem to have an edge over A are auto-ID technologies and sensor technologies. Both of these technologies seem to have rather low priority for A, since A is currently not using these technologies at all or only to a very limited extent. This situation won't change in the near future; no investments in auto-ID technologies are planned, and the time horizon for planned investments in sensor technologies is over three years. This lack of focus on these technologies, which according to existing literature show an enormous potential (Delen, Hardgrave, & Sharda, 2007; Sarac, Absi, & Dauzère-Pérès, 2010), appears on first sight as a surprise.

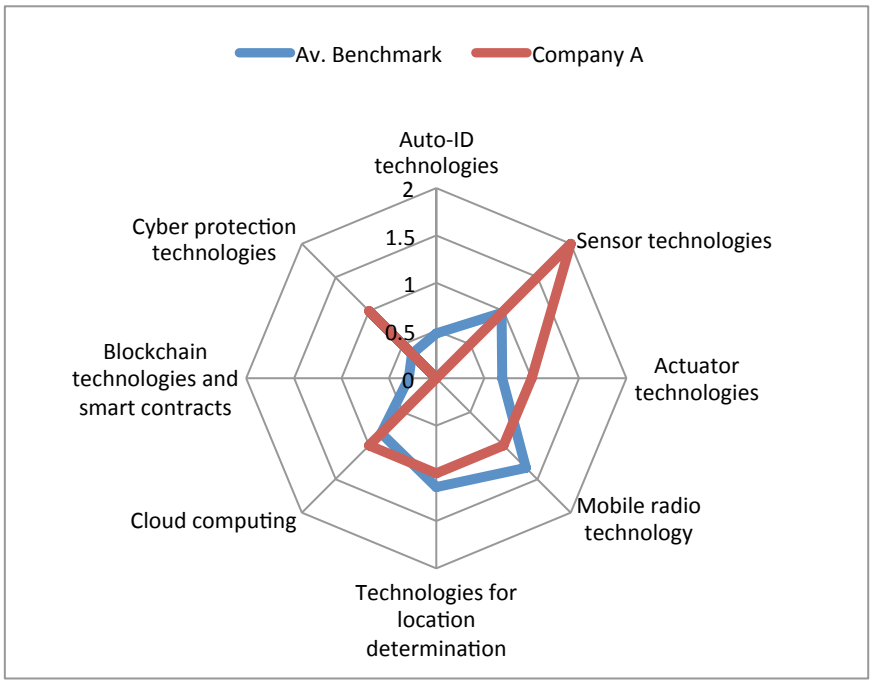

Figure 12: Use of general digital technologies at company A (0=no use, 1=local use, 2=departmentwide use, 3=companywide use, 4= integrated use with partners).

The situation regarding the use of industry 4.0 applications shows an even more diverse picture. Two technologies, telematics and smart buildings, seem to be not interesting at all for logistics company A. The technologies are neither in use today, nor are any investments in the future planned. Swiss

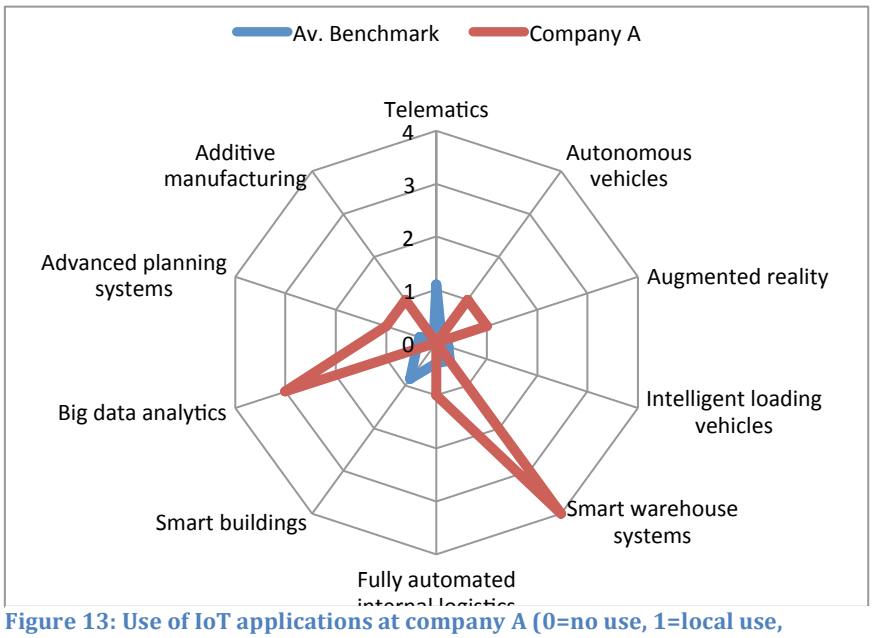

Figure 13: Use of IoT applications at company A (0=no use, 1=local use, 2=departmentwide use, 3=companywide use, 4=integrated use with partners).

logistics companies, in contrast, already use both technologies often on local or department-wide basis, and plan to make further investments in the short-term. With other technologies, it seems like logistics company A has similar interests as Swiss logistics companies, however, investments are timed differently. For example, A is already using autonomous vehicles locally, while the use of such vehicles is today almost inexistent in Swiss logistics companies. Logistics company A also intends to further invest in autonomous vehicles and thus use them more widely. Similarly do Swiss companies, on average they are planning to make investments in the near future, within the next three years. Logistics company A planned investments in autonomous vehicles, however, have a long-term horizon and are planned beyond the next three years. Therefore, the current advantage at A compared to most Swiss logistics companies in terms of use of autonomous vehicles will likely be compensated in the near future by investments in this area at Swiss companies.

There are some significant differences between company A's expectations about the impact of digitalization and the expectations of the average Swiss logistics provider. With the exception of only two areas, cost and stability, A is clearly more optimistic than Swiss companies. However, the general direction of the expectations is with the exception of flexibility broadly compatible. With respect to cost and stability, the two areas where A is most pessimistic, also the optimism of Swiss companies was quite limited. The most striking differences can be found in the areas related to stability and flexibility. While most companies in Switzerland are either neutral or expect a slight improvement of stability and resilience through means of digitalization, logistics company A is expecting with a slight deterioration rather the opposite effect. Swiss companies expect on average a negative impact of digitalization only with respect to flexibility and agility. Here, however, logistics company A is contradicting most significantly; the company expects in Russia a strong improvement of the situation thanks to digitalization.

4.3 Case «International Logistics Company B»

As a second case study, the situation at another large international logistics company in Russia is analyzed. The company is one of the world's largest logistics service providers. It's headquarter is located in Western Europe, and a still widely present founder clearly left his marks in the corporate culture of the still mostly family-owned company. The international logistics company B has its Russian headquarter in Moscow and operates three local branches in the western part of Russia and in the far eastern part of the country. Additionally, three local representative offices support the availability and presence of the company in the Russian market. The industry focus of the company's clients depends strongly on the part of the country.

While logistics company B serves clients form a broad variety of industries in the western part of the country, activities in Siberia and the far east are basically fully dedicated to the oil and gas industry. Although the company is very widely represented in Russia and is well established in the market, the company doesn't serve any Russian clients at the moment (Manager Logistics Company B, 2018). Internationally, customers usually enter long-term contracts with logistics company B. Also in Russia, the company has usually strong contractual bonds with its clients; however, long-term contracts with a duration of more than five years are rather rare here.

The company acts as a full-service logistics provider, and thus offers a broad variety of services to its clients. Services range from traditional land, sea or air transport to advanced full-service supply chain solutions including services such as warehousing, insurance or customs. For several years now, the company has been implementing digitalization solutions throughout all operations, departments and locations. Thereby, project initiatives are both driven by the company itself as well as by the clients. Very often, large-scale projects are initiated together with key customers. The terms and scope of the required investments are clearly predefined in the contract, usually with a medium-term duration. As an example, the local manager mentioned a current project where a comprehensive RFID solution is implemented throughout company B's facilities and fully integrated with the other, external parts of the supply chain (Manager Logistics Company B, 2018). Also very common, especially with more basic and less company-specific parts of the business, is a country-wide or even global rollout of general and scalable solutions to a large number of clients. An example for such a general digital supply chain solution are the business intelligence and tracking solutions that the company currently is rolling out and offering to an increasing number of clients. Compared to other countries, logistics company B is rather cautious and hesitant with large-scale investments in Russia. While in other countries, the company itself invests in large-scale solutions like e.g. automated warehouses, in Russia significant investments are only made in collaboration with clients and tied to a fixed contract with a widely secured ROI.

Compared to international logistics company A, the degree of autonomy and managerial freedom is more restricted at international logistics company B. Although every country subsidiary generally has far-reaching freedom to serve customers in the way that fits the local conditions best, there is a broad variety of directives and overall strategic norms from the headquarters that have to be followed. Recently, digitalization has also become a key priority in the overall corporate strategy. Aiming at standardization and unification of the degree of digitalization as well as the applications and measures implemented, the strategy helps to harmonize digitalization efforts in all local subsidiaries and increase efficiency and scalability. For the Russian branch, digitalization has been a relevant topic since the beginning of operations.

However, especially in the last two years a large number of initiatives have been realized. Thereby, the focus of digitalization efforts has been shifting; initially, the local digitalization strategy focused on digital and IoT solutions for warehousing, while in the most recent history transportation has become a key focus of digitalization initiatives. Overall, the Russian subsidiary of the company can be considered to be on the company average in terms of supply chain digitalization (Manager Logistics Company B, 2018). Several efforts have been made, especially in the last two years, and in many initiatives like e.g. dash boarding or the implementation of the BI solution Tableau Russia had a lead and pilot role.

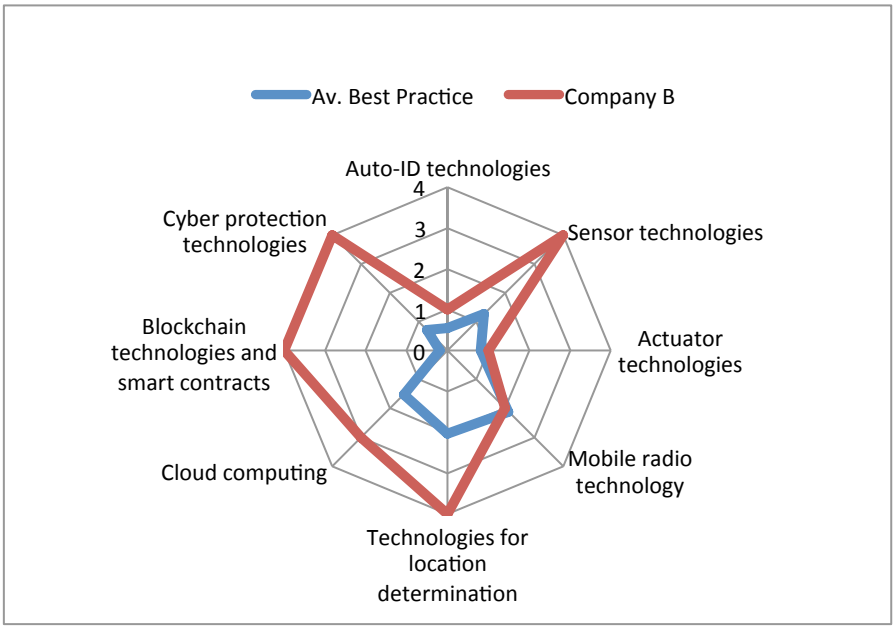

Figure 14: Use of general digital supply chain technologies at company B (0=no use, 1=local use, 2=departmentwide use, 3=companywide use, 4=integrated use with partners).

A look at the digital supply chain technologies that are used at company B and the planned investments related thereto reveal some striking deviations from the benchmark and also some clear differences to technology use at international logistics company A. There is a very significant difference in the intensity of use between general, underlying digital technologies like e.g. cloud computing, and advanced IoT applications like e.g. augmented reality. While general digital technologies are used in an absolute best-practice manner throughout the company, advanced IoT applications are niche solutions that are barely used with some exceptions. Of the general digital technologies, all are used and most of them even on a company level or even in an integrated manner with partner companies. Thus, logistics company B uses all technologies more intensively and wider than the average participant of the Swiss benchmark study. The divergence from the benchmark is particularly strong with young and highly advanced technologies. For example, blockchain technology is barely used on an experimental level in Swiss companies, while logistics company B is currently implementing a very comprehensive blockchain-based electronic documentation and invoicing solution. The already wide use of general digital supply

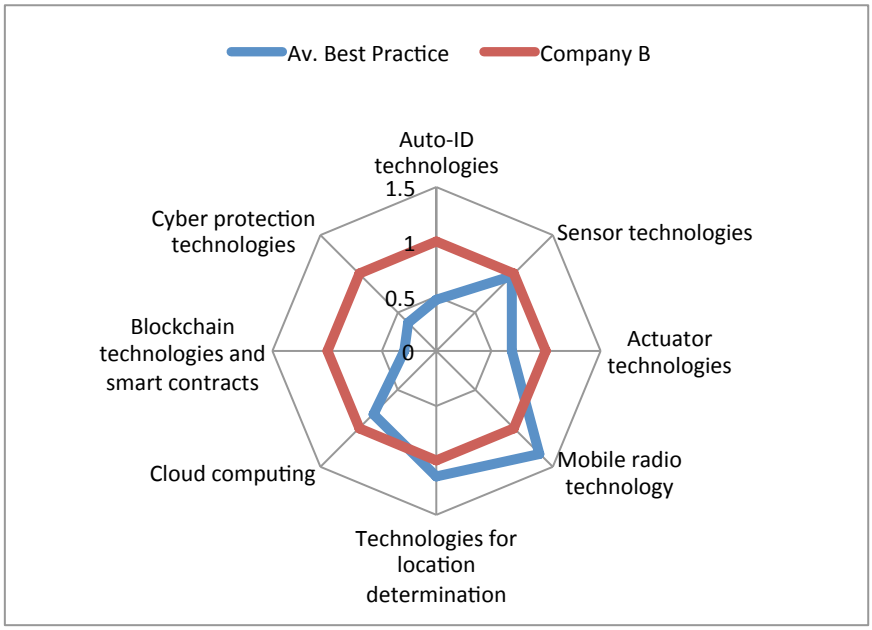

Figure 15: Planned investments in general digital supply chain technologies at company B (0=no planned investment, 1=planned in less than one year, 2=planned in 1-3 years, 3=planned in more than three years)

chain technologies is constantly expanded as the planned investments of company B show; for all investigated technologies, investments are in the pipeline and will be realized within less than a year. This strong pace of investment and holistic approach to digitalization clearly reflects the strategic focus the company's headquarters has been implementing in the most recent past.

More advanced IoT applications, in contrast, are not in focus for company B at the moment, with the exception of telematics and big data analytics. Both of these technologies are related to a stronger focus on scalable BI solutions that is currently implemented at company B. Other applications are currently not realistically feasible, and client's interests are not strong enough yet to make actual large-scale investments sensible; unlike at other locations, company B hesitates to commit itself to own significant investments without the clear commitment of a client (Manager Logistics Company B, 2018). This is also reflected in the planning horizon and the focus of planned investments; investments in big data, smart buildings, autonomous vehicles and telematics are planned in the immediate future, while there are no plans whatsoever for other technologies.

Comparison of cases

	International Logistics Company A	International Logistics Company A
Entrance in Russian market	1993	1992
Local market served	Russia + Central Asia	Eastern Europe + Russia
Strategy	No HQ strategy, full autonomy of local branches with duty to inform	HQ strategy with goal of harmonization of local digitalization efforts, before full autonomy of local branches
Clients	Both international and Russian clients	Only international clients
Investment behavior	Short- to medium-term horizon, strongly pragmatic approach with clear prospects for success and for larger projects client commitment; experimental projects for R&D and marketing purposes	Short term horizon, investments either based on contractual commitment of client or clear scalability and wide applicability of solutions
Use of digital technologies	Wide use, also integrated with clients, of a broad variety of technologies; no or limited use of blockchain, auto-ID and sensor technology	Many integration projects with clients, very wide usage of all technologies except for auto-ID and actuator technologies
Use of IoT applications	Use of a broad variety of technologies, but mostly on a local or department basis; no use of smart loading vehicles, telematics and smart buildings	Selective use, but technologies that are used (telematics and big data analytics) are implemented thoroughly and widely
Geographical focus	Entire country, majority of operations in western part of the country	Entire country, majority of operations in western part of the country
Interfaces	Partly automated digital (EDI), partly manual/via correspondence	Only automated digital interfaces for data exchange (EDI)

Table 2: Tabellaric comparison between international logistics company A and international logistics company B with respect to digitalization behavior.

4.4 Influence Factors and Explanations

In the case interviews as well as selected survey questions, the impact of external influence factors on supply chain digitalization in Russia was in focus. The actual situation and the explanations of companies in Russia gave valuable insights into potential reasons for differences in the digitalization status and behavior of companies in Russia.

The geography as well as demography of Russia is a source for many difficulties that also impact supply chain digitalization. Thereby, the geography-induced difficulties are both the source of problems and the basis for strong potential for digitalization. The vastness of the country and the strong differences between the urban areas of St. Petersburg or Moscow and the

rest of the country force companies to collaborate with local partners. According to the experience of logistics company A, there are for example no road transportation companies that are active nationwide and can offer the same quality and lead times throughout the country; thus, reliance on local partners for transportation is absolutely necessary (Manager Logistics Company A, 2018). This experience of a logistics company seems to be very common also for other industries. As Lorentz and Lounela (2011) concluded, the Russian retail market is extremely fragmented and thus requires e.g. large consumer goods companies to collaborate mostly with local retail and distribution partners instead of relying on a few large nationwide active chains. This collaboration with mostly small or medium-sized local partners makes it difficult to develop and implement comprehensive digitalization and automation between companies, since often know-how, economies of scale and infrastructure is lacking (Manager Logistics Company A, 2018).

The large geographical distance between different offices in the country naturally implies that different locations in the same country are operating in different time zones. According to the experience of company A as well as company B, this makes management and coordination much more difficult since the timeslots for communication are limited. Digital communication tools as well as digital surveillance and quality control technologies help to keep control and manage activities in local offices despite the large distances and time differences. Digital supply chain technologies also help to improve visibility and traceability of actions and thereby create value through increased security and control. A concise and remarkable example for this added value is the tracing and alarm system that was developed and applied at logistics company A. The system was developed as a solution to make long-distance truck transports safer; the long distances between cities were especially for the transportation of high-value goods like tobacco always a risk (De Meulemeester, 2017). The developed solution does not only trace the movements of the truck, it also secures the truck door and responds to any unauthorized opening of the door with an immediate emergency call to the nearest possible intervention team of police or guards. This application of sensor and tracking technology illustrates the strong potential for digital solutions as a response to long distances, sparsely populated areas and a general lack of security infrastructure.

Throughout the interviews, it was made very clear that supply chain digitalization faces a rough macroeconomic environment in Russia that is not very favorable. The suggested findings of Fernie (1995), saying that labor costs do have an impact on decisions with respect to productivity-enhancing physical capital and automation, are definitely reflected in the behavior of companies in Russia. Many companies refrain from automating and digitalizing their operations because it's simply too expensive compared to manual labor. Thereby, the experience

of the European logistics company A shows that the low cost of manual labor stand in an immediate relationship with other macroeconomic factors like exchange rates and the cost of capital; the recent developments regarding the Ruble can be seen as standing in relationship with the degree of digitalization (Manager Logistics Company A, 2018). Since most companies rely for digitalization projects on western technology, the investment is in most cases either in Euro or US-Dollar. Manual labor, in comparison, is remunerated in the domestic currency, i.e. Rubles. Also revenues will for most companies be in Rubles, since only few manufactured products are exported from Russia. This implies that the company has the choice between making an investment in EUR or USD or further rely on manual labor paid in the same currency as the revenues. The devaluation of the Ruble over the past few years fundamentally changed the dynamics of this set of options in a way that today many digitalization projects disappoint in terms of return on investment, and new projects require investments that are so high that the breakeven point and the payback period exceed reasonable horizons. Many companies prefer to stick to manual labor that is connected with potentially lower returns but clearly less risk.

Another macroeconomic impact stems from high interest rates in combination with uncertainty about the future, respectively macroeconomic stability in general. Many investors, especially young Russian companies, search for payback periods that are as short as one year and generally try to keep risks as low as possible; this clearly speaks against digitalization since most large digitalization projects require an initial investment which often only pays off in a medium- or long-term period (Manager Logistics Company A, 2018). Thus, many companies will favor recurring expenses for the remuneration of workers over tying up expensive capital in a project that requires a medium- or even long-term commitment. The above-mentioned fact that the Ruble exchange rate makes most digitalization projects even more capital intensive further amplifies this effect.

Overall, these macroeconomic effects leave a clear imprint in the focus of digitalization and an even more visible imprint on the investment plans of companies. As the results of the survey show, most companies have a very short investment horizon, and thus investments are usually planned in the immediate future or not at all. In terms of focus of digitalization, clearly small-scale solutions or large-scale solutions with very easy scalability are preferred over extensive, fully integrated and thus expensive solutions. As both companies from the case studies confirmed, the macroeconomic environment requires companies to apply a strong pragmatism and focus on ROI in digitalization projects (Manager Logistics Company A, 2018; Manager Logistics Company B, 2018). The current situation thus benefits and drives supply chain digitalization by providing strong incentives for easy-to-implement solutions with low capital intensity on one side and high impact and return prospects on the other side. As a

consequence, technologies like cloud computing, business intelligence solutions or also many tracking and tracing solutions, which all can be implemented at reasonable cost but fix crucial problems and/or increase efficiency significantly, are particularly popular and widely used in Russia. In contrast, expensive large-scale projects that often also require a full integration with other supply chain partners, like e.g. RFID technology or fully automated warehouses, often don't have good prospects in Russia. Such large IoT projects are often only implemented at multinational corporate firms that have global standards and long-term planning horizons (Manager Logistics Company B, 2018). Some IoT technologies are still out of reach for full commercial exploitation and everyday use, but are nevertheless interesting for research and development purposes. Although such experimental use of IoT applications is according to the sample data subject to the above mentioned pragmatism and thus to a certain extent less common than in Western Europe especially on a department- or company-wide level, some companies still find ways to exploit them. The international logistics company A is a good example for such experimental use; driven by entrepreneurial curiosity and strong convincement of technology, very advanced IoT technologies for additive manufacturing as well as augmented reality have been locally used, e.g. for marketing purposes, and will be further developed in the future (Manager Logistics Company A, 2018).

The impact of the macroeconomic influence goes beyond concise investment plans and project implementations. It also directly and indirectly affects the underlying beliefs and expectations that are generally associated with supply chain digitalization. Russian companies see supply chain digitalization basically in every aspect, e.g. safety, reliability, flexibility etc. more enthusiastic and expect a more positive impact on performance than Western European companies do, with the exception of cost. When it comes to cost, European companies clearly expect savings and improvements based on digitalization. Russian companies, in contrast, see cost as the only dimension of supply chain performance that will most likely be negatively affected by digitalization. This fully reflects the elaborated differences in the macroeconomic environment and the fundamentally different dynamics due to labor and capital costs.

Another aspect that was mentioned as key obstacle for digitalization in Russia is the legal and political environment that supply chains face. It was mentioned by the vast majority of survey participants as a significant obstacle to digitalization, and the interviews fully confirmed this negative and incapacitating influence stemming from legislation and policy. According to the situation at logistics company A, the constant need for written documentation, the overwhelming number of detailed regulations and the necessity for clearly defined contractual relationships make it difficult to implement simplifying digital solutions (Manager Logistics Company A, 2018). At some points, legislation stands in the way of digital documentation in an

immediate manner. Until very recently, electronic invoicing and purely digital documentation of certain financial documents was restricted; thus, very modern technologies like e.g. blockchain documentation solutions did not have a lot of purpose and legitimization due to requirement of physical exchange and storage (Manager Logistics Company B, 2018). Also the Russian requirements and regulations concerning data storage and processing can be a significant additional obstacle. The very vast majority of software-as-a-service (SaaS) providers which offer common and scalable software solutions for various aspects of supply chain digitalization are not Russian and have their servers located in Europe or the USA. In order to use such solutions in Russia, local data storage has to be implemented what complicates the process of implementation and often increases cost for both set-up and maintenance (Manager Logistics Company A, 2018).

4.4.1 Overview of identified influence factors

Scope of digitalization	Sphere of influence	Factor described in previous literature	Factor described in practice by case companies	Implication for digitalization at case companies
Structure & configuration	Geographical	Fragmented market with a large number of local players (Lorentz & Lounela, 2011)	Highly dispersed market and lack of nationwide partners require companies to collaborate with a large number of local firms	Reliance on a large number of mid-size local partners make comprehensive digital supply chain integration very difficult; favors transitional solutions with high scalability like e.g. clouds or online platforms
		Distance & geographical challenges require companies to develop core capabilities in supply chain areas (Lorentz & Lounela, 2011)	Increased focus of activities and capabilities on basic, traditional supply chain and operations functions in Russia	Lack of higher strategic goals and resources make comprehensive, company-wide digitalization initiatives and strategies scarce; pragmatism-driven local digitalization measures with clear focus on ROI are favored
	Economic & political	Government-related activities such as e.g. customs are still mostly analogue (Inkinen, Tapaninen, & Pulli, 2009)	Legally correct documentation in Russia is an arduous process that is highly regulated and formalized, consumes resources and complicates activities	Digitalization of documentation is difficult due to formal requirement and established processes
				There is large potential for blockchain or other digital technologies that facilitate easy legally conform documentation
		Different power distributions between companies and their suppliers lead to a lack of incentive and difficulties in collaboration (Belaya & Hanf, 2011; Roberts, 2005)	Most large companies and corporate groups have priorities that are not related to long-term digitalization efforts and a focus on short-term operational and internal affairs	Integrated digital solutions and data sharing with large suppliers or clients, especially of Russian heritage, are not popular and face several organizational and structural barriers
	Social & cultural	Soviet legacy of integrated production remains as obstacle for collaboration with external partners and outsourcing (Davis-Sramek, Fugate, Miller, Germain, Izyumov, & Krotov, 2017)	General attitude of distrust and requirement for highly regulated contractual relationships make horizontal collaboration very difficult	Modern, digitally enabled supply chain configurations like e.g. a fully integrated supply chain ecosystem or cloud manufacturing are difficult to implement

Visibility & agility	Geographical	The value and positive impact of high degrees of supply chain visibility are particularly pronounced in an environment that requires flexibility and is marked by complexity through a large number of nodes (Caridi, Crippa, Perego, Sianesi, & Tumino, 2010)	The high degree of dispersion of the Russian market combined with a lack of nationwide partners require companies to collaborate with a large number of local firms, what significantly complicates operations	Track & trace solutions as well as business intelligence solutions that aggregate data from a large number of partners and feed them in real time to management add significant value and become a key part of supply chain value propositions
		Large geographical distance and dispersion of a supply chain negatively impacts control and increases the number of potential exposure points and environmental risks (Stecke & Kumar, 2009)	Large distances between destinations in Russia in combination with environmental conditions like e.g. weather lead to a large variance of delivery times, which in turn requires higher safety margins in planning	Advanced planning systems in combination with BI and telematics-solutions make a significant reduction of required safety margins possible and thus contribute to efficiency and efficacy of operations
		Higher levels of supply chain agility improves performance and competitiveness in macroeconomically volatile countries (Tadeu & Silva, 2017)	Flexible responses to client's needs and demands and added value through shorter lead times were particularly important during the most recent currency and economic crisis	BI and advanced planning systems are particularly popular since they help companies in dealing with strong levels of uncertainty
	Economic & political	Russian society exhibits very high levels of uncertainty avoidance and power distance, what makes it difficult to implement and exploit agility in a supply chain (Hofstede & Minkov, 2011; Griffith & Myers, 2005)	Hierarchical order and the clear assignment of responsibilities as well as a strong commitment to comply with rules complicate quick and appropriate responses to incidents	Digitalization as well as automation very often require standardization and structuring; occasional flaws or deviations from that standard trigger often far-reaching problems and disruptions; the impaired ability to deal with such deviations efficiently negatively impact the exploitation of digitalization-based benefits
	Social & cultural	Russian society exhibits high levels of power distance, what implies that power is adhered to and inequality generally is accepted (Hofstede & Minkov, 2011)	Management decisions are rarely questioned and ordered actions are executed; it is rather easy to push through even controversial initiatives and decisions	Digitalization-related projects can be implemented and executed even if they have controversial consequences, e.g. related to control or responsibility of employees

		High levels of power distance complicate data sharing processes if the negotiating parties are not on equal hierarchical rank or position (Shore, 2001)	High power distance and clear competency regulations make it very difficult to enter data sharing arrangements by negotiating with employees; possibility of arranging data sharing agreements with C-level management or owners	The integration of external parties in digitalization projects is generally difficult, digitalization and automation projects across company borders are rather rare
Automation	Economic & political	Low labor cost make automation and the use of robots expensive and not competitive in relative terms (Fernie, 1995)	Especially short-term focused companies refrain from committing themselves to investments in automation and robots and benefit from cheap labor in Russia instead	Automated solutions are less widely used and especially in short-term oriented and volatile industries not popular
		The often high capital intensity and investment need of automation projects generate significant capital costs for companies (Baker & Halim, 2007)	High capital costs in Russia significantly impair break even point and payback period of digitalization projects in general; with automation projects, these high capital costs often make automation non-competitive compared to manual labor expenses	Automated solutions are less widely used and especially in short-term oriented and volatile industries not popular; only strong MNCs can afford the long payback times and the thus long-term investment horizon needed for large-scale automation projects
		Equal standards and similar levels of know-how and infrastructure are necessary in order to enable the automation of interfaces between companies or implement integrated supply chain solutions (Fawcett, Osterhaus, Magnan, Brau, & McCarter, 2007)	The degree of know-how varies to a large extent between different companies; in many companies, very basic know-how and infrastructure is lacking	Automated interfaces and integrated supply chain solutions between several firms are rare; often, company borders are also the borders of automation
		Automation requires a strong technical understanding from the people involved and compatibility of machine and human (Majeed & Rupasinghe, 2017)	Strong generation gap in Russia persists; there's a large amount of highly qualified young professionals in IT and natural sciences which is highly familiar with the matter, while currently still a lot of older managers and executive lack competency and know-how related to the topic	Successful implementation of highly advanced automation solutions would be possible based on strong intellectual capital and human resources, especially in rather young companies with limited heritage and legacy

Table 3: Concluding table with all clearly identifiable influence factors, both based on literature as well as the investigated cases, and connected to the identified divergences from the survey

5. Managerial Implications & Recommendations

Having detailed knowledge about the environment and potential influence factors that can stem from it is definitely helpful for any manager. From the identified influence factors, several recommendations for managers in Russian supply chains can be derived.

As both companies from the investigated cases showed, it is of utmost importance that the profitability of investments is as secure as possible, and payback times as short as possible. The macroeconomic instability that is reflected in strong interest rate and exchange rate volatility as well as inflation threats and demand shocks make it basically impossible to plan on a long-term basis and invest correspondingly – the degree of uncertainty is simply too high. The investigated cases show that managers can deal in two ways to counteract this challenging macroeconomic environment. The first way is to be cautious with investments and search for a maximum of scalability and a minimum of resource consumption. Both companies from the cases were able to successfully implement various projects despite limited resources and a very strong focus on pragmatism. The second way to deal with macroeconomic uncertainty is to aim at reducing it by distributing and sharing the risk in a broader way. Both investigated companies require clear contractual commitments from clients in order to make larger investments with a longer payback time. Medium-term contracts, e.g. with a duration of 3 or even 5 years, to secure the utilization and revenue of a particular investment give security in planning and can significantly reduce the risks connected to investment. According to the managers of company A and company B, especially European companies in Russia are willing to enter medium-term contracts in exchange for high standards in quality, reliability and compliance (Manager Logistics Company B, 2018; Manager Logistics Company A, 2018).

The unique geographical vastness of Russia is the source for various challenges and influences the digitalization behavior at both investigated companies significantly. Supply chain digitalization provides simple solutions in this area. By investing in supply chain visibility and agility enhancing digitalization projects, managers can realize significant gains in efficiency for their companies. Since very often, companies are forced to partner up with small, local firms that are spread across enormous geographical distances, supply chain integration projects often look different in Russia than in Western Europe. Managers should understand the differences in know-how, level of digitalization and infrastructure between different partners and aim for the minimum viable product that is understood and accepted by all partners. A strong focus on pragmatism can also help avoiding negative consequences of path dependencies and dominant legacies. Path dependency is often the result of over-commitment and large investments that were not in line with actual needs and demand. By clearly identifying and calculating the

potential before the implementation and investment, negative surprises and post-rationalization are less frequently necessary.

A variety of challenges are derived from the social and cultural environment in Russia. These challenges often require strong leadership and an array of soft skills from a manager. Full awareness of hierarchical orders and assigned competencies and responsibilities are necessary for a multitude of situations. Internally, these structures and competencies should be designed in a way that despite a culture of power distance and collectivism proactive behavior is fostered. Especially among younger employees, such a proactivity-fostering culture and environment can be established through consistent reinforcement and corresponding demonstrative leadership (Manager Logistics Company B, 2018). Externally, a deep understanding of hierarchies and organizational structures is necessary to direct proposals and claims to the right people. It is usually much easier and faster to arrange e.g. data sharing agreements with senior managers than with junior managers. Managers should also be aware that a more authoritarian management style is in most cases fully acceptable. They can use this fact by creating clear directives and goals, e.g. to push digitalization projects quickly through implementation.

Overall it can be concluded that familiarity with the environment is key to success for managers, not only in Russia. A good manager should deliberately screen the macroeconomic, geographic and social environment of the department or company he steers and identify potential pitfalls but also potential sources for competitive advantage. Familiarity with the general influence factors that are elaborated and explained in this paper serve as a good starting point for such a screening, since it sheds light on commonly sensitive or risky aspects of business.

6. Limitations & Suggestions for Further Research

The conducted study is obviously subject to certain limitations with respect to various factors, including the data that was generated and analyzed, the context of the study as well as the general status of research focusing on supply chain digitalization.

One of the key limitations is the amount of quantitative data that was generated and used for the analysis. Although the questionnaire was sent out to a large number of potentially interested participants, the final number of responses was rather small. The overall sample size was too small to derive statistically relevant results. It was also too small to create representative subsets of the sample, thus e.g. a representative structuring according to industry or company size was not possible. Therefore, although the data was representative enough to derive overall trends and tendencies by means of descriptive statistics, a larger sample size with more diverse responses would allow for more detailed results, e.g. based on industry-specific or company size-specific analysis.

With respect to the qualitative data that was collected, a certain selection bias persists. Both companies that were analyzed and interviewed were international companies with their headquarters in Europe. They were in many ways very advanced with respect to digitalization, partly beyond doubt due to their foreign background and their headquarters' strategy and resources. The quantitative survey results have shown some substantial differences between companies with their headquarters in Russia and foreign-controlled companies. Thus, it would be very interesting to further investigate whether Russian-based companies are simply more exposed to the identified external factors, or if they face additional influence factors. This would be especially interesting due to the fact that cultural heritage and company roots dating back to Soviet Union times seem to be a significant hindrance to digitalization.

7. Final Conclusion

As previous research already has demonstrated in a myriad of vastly different and independent, diverse projects, both supply chain and digitalization activities are widely dependent on the external environment they are embedded in. Due to the vast size, unique location and peculiar economic history and culture, Russia provides a very distinct environment for supply chain operations. This environment is, as widely acknowledged in literature and confirmed by the corporate representatives that interviewed, challenging and thus can be seen as demanding and promising at the same time.

This challenging environment can have a positive effect as well as a negative effect on supply chain digitalization, as the results of this study show. Some technologies help companies to overcome the challenges they face in Russia and thus are widely spread and developed in Russian supply chains. To this category of technologies that benefit from the peculiar environment in Russia belong mostly technologies and applications that have an immediate positive impact, are fully scalable and often don't require significant upfront investments. A very popular example are telematics-based track and trace solutions; they were used in some form by the majority of survey participants, and both companies that were investigated in the cases exploit the technology widely and successfully. Basic track and trace solutions, e.g. to locate trucks in real time, don't require large investments but create a significant positive impact on efficiency by helping companies to become more reliable, punctual and as a result reduce safety margins and downtime. Such technologies are so beneficial that it makes sense even for smaller companies to make this step towards better visibility and higher agility.

Other technologies which are implemented and exploited successfully in Western Europe have become victims of the challenging environment found in Russia. External influence factors either delay or even make a large-scale breakthrough of these technologies impossible. Most of these technologies are concerning advanced IoT technologies, most of them related to automation. These applications that are less popular in Russia compared to the benchmark of Switzerland can be generally characterized by their large need for upfront investments and the resulting requirement of medium or even long-term commitment and economic stability. The study shows that only in very selected cases, companies commit themselves to such large automation and digitalization projects. Most companies favor the flexibility and low capital intensity of manual labor instead.

The survey showed that there are substantial differences between companies of different sizes and different heritage; these differences were also strongly confirmed in the expert

interviews. For many international companies that are active in Russia, supply chain digitalization is a topic with a high priority that is enforced, incentivized and often steered by the company's headquarters. As the expert interviews showed, subsidiaries in a MNC often stand in (constructive) internal competition with each other; proactive and progressive behavior is fostered and rewarded. Also, many MNC subsidiaries can draw on resources and solutions that were already developed and tested at a different subsidiary or office location. Russian companies, in contrast, do not only have no access to such resources, but they also have to cope with their company culture that often is still marked by Soviet legacy.

Overall, it can be concluded that supply chain digitalization is definitely a development that has arrived in Russia and generates value for firms in this country on a daily basis. In the sample that was investigated, only in a very limited number of aspects a backlog compared to the Swiss benchmark was recognizable. In contrast, especially general digital supply chain technologies are used even wider here in Russia. Companies in Russia are enthusiastic about the topic and believe in the benefits of supply chain digitalization. The fast paced technological development will sooner or later make also technologies that are so far not very popular in Russia more widely accessible.

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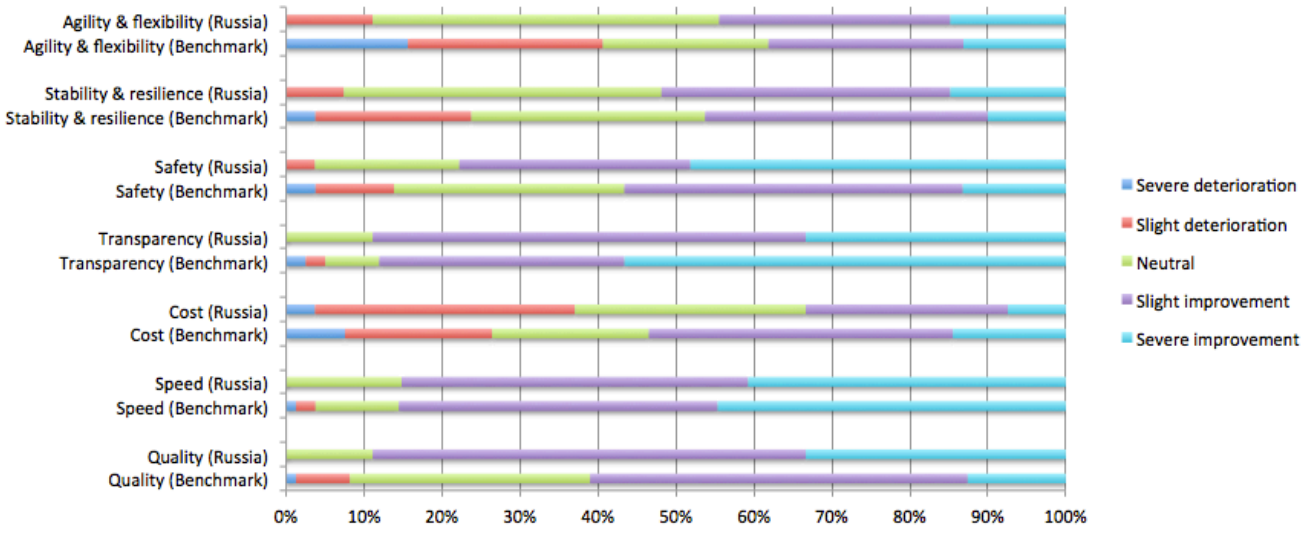
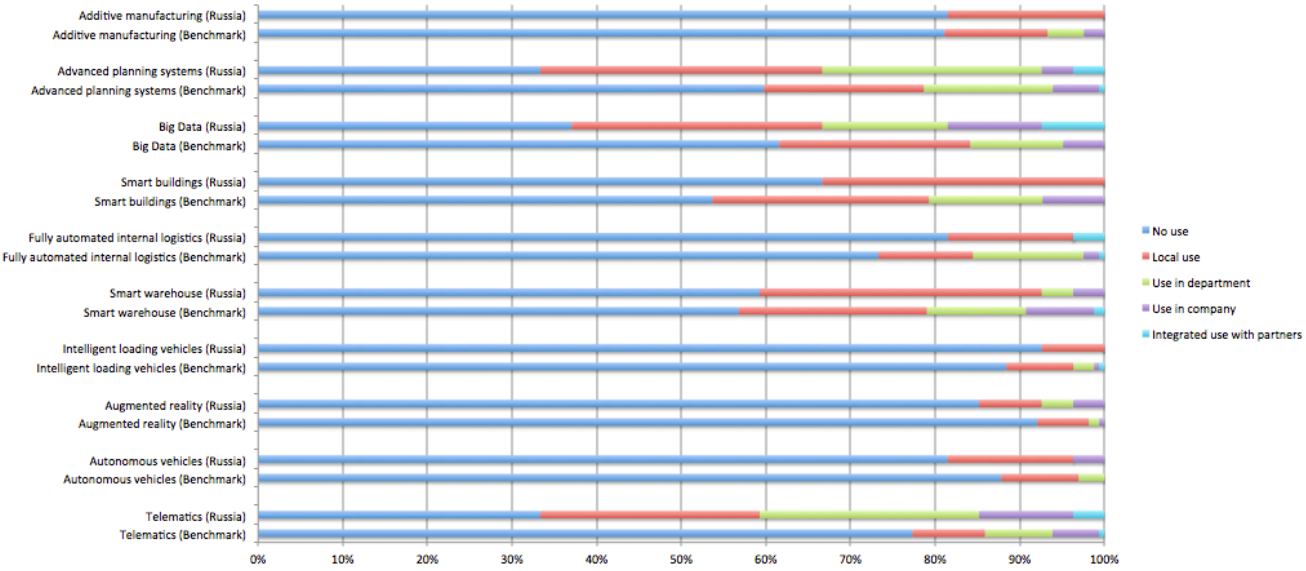
Appendix

Survey Results & Benchmarking

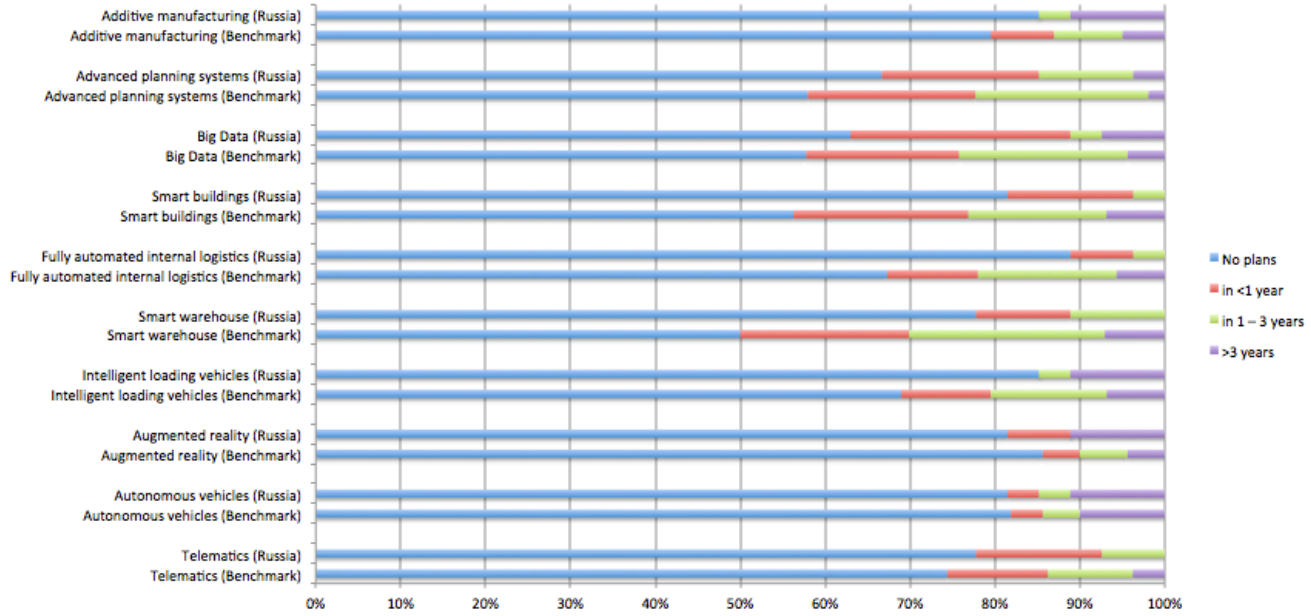
Expected impact of supply chain digitalization on various dimensions of performance (percentage of sample, N Russia = 27, N Benchmark = 159)



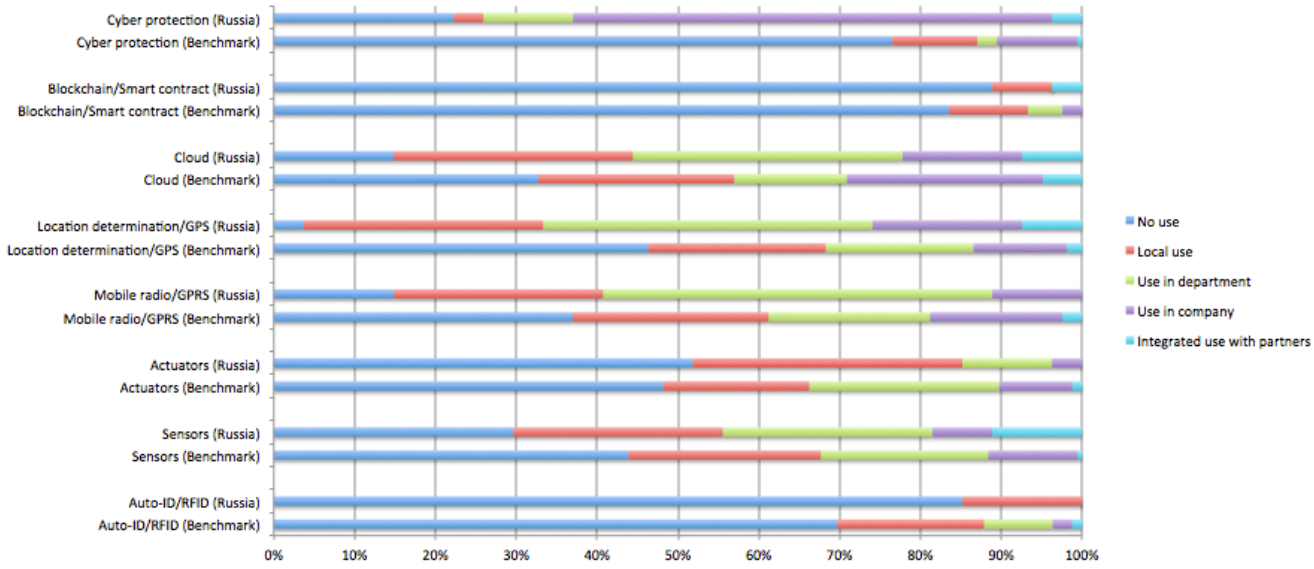
Use of IoT technologies in supply chains (percentage of sample, N Russia = 27, N Benchmark = 163)



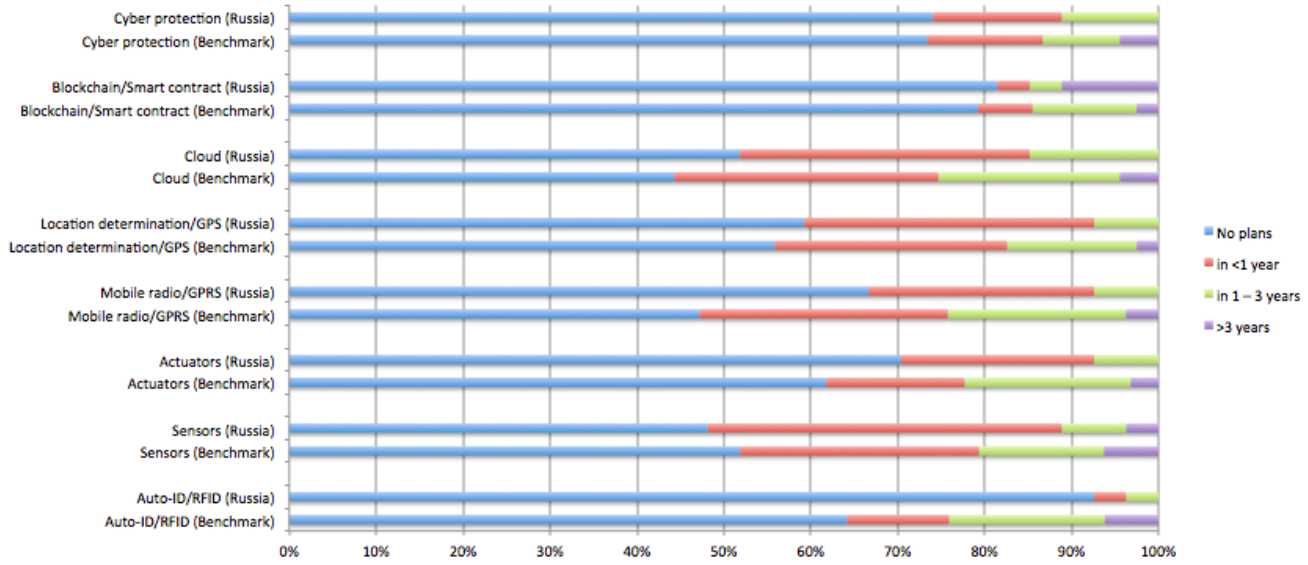
Planned investments in IoT technologies
(percentage of sample, N Russia = 27, N Benchmark = 160)



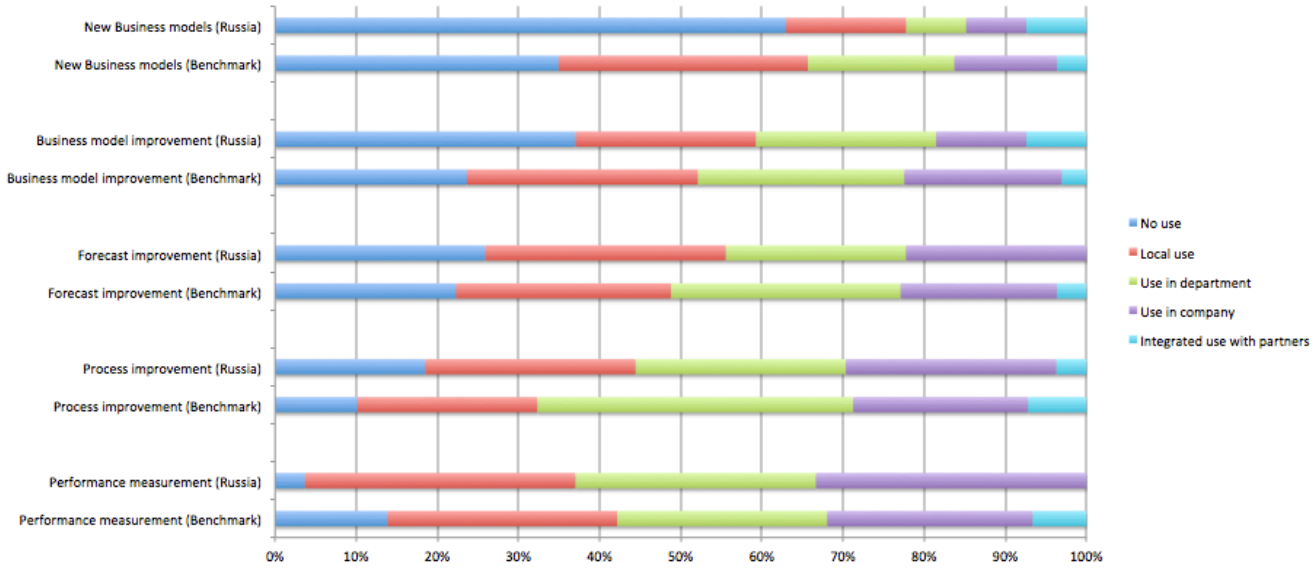
Use of digital technologies in supply chains
(percentage of sample, N Russia = 27, N Benchmark = 162)



Planned investments in digital technologies
(percentage of sample, N Russia = 27, N Benchmark = 158)

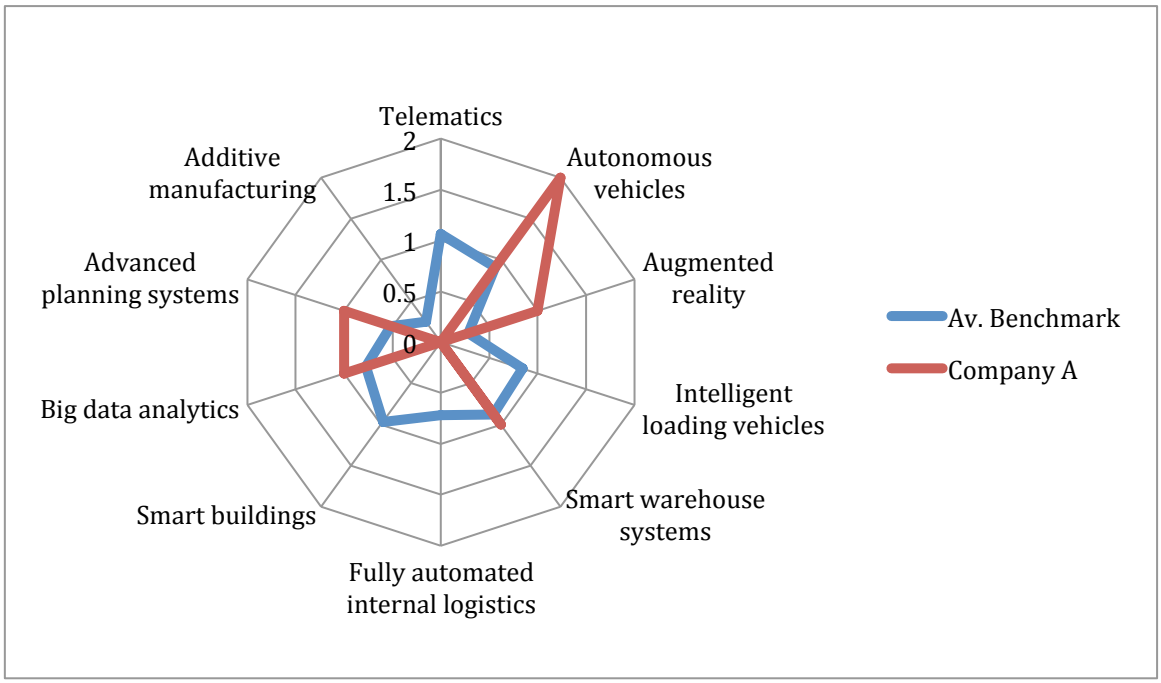


Use and exploitation of available data
(percentage of sample, N Russia = 27, N Benchmark = 165)

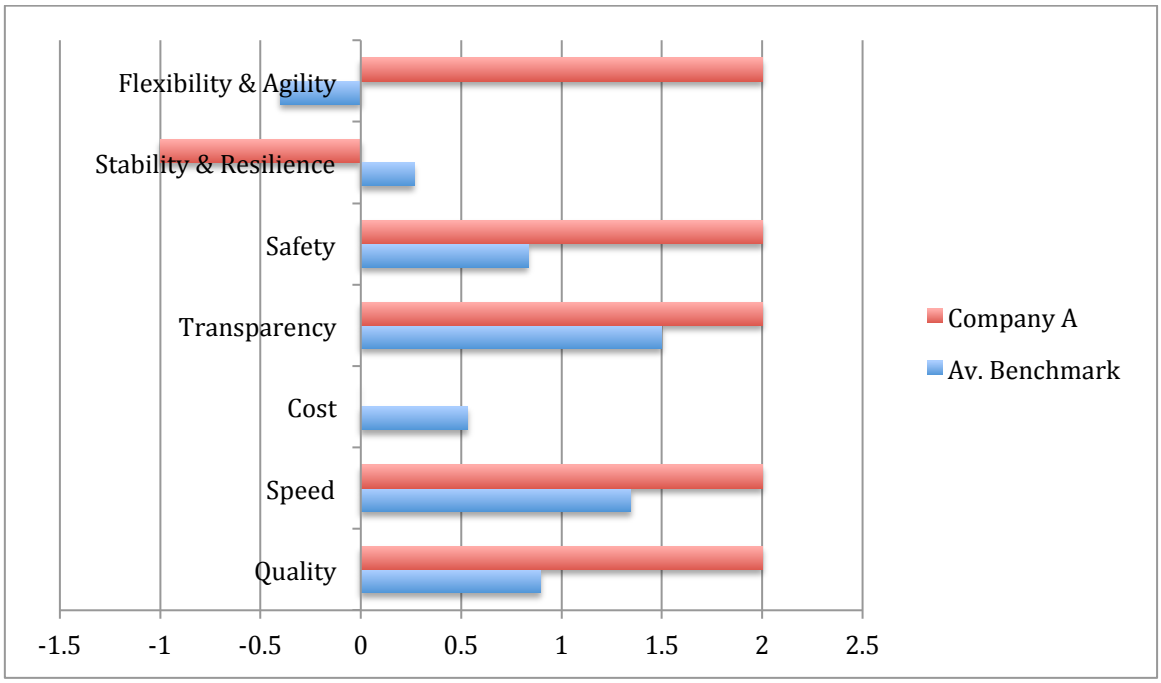


Additional survey results – International logistics company A

Planned investments in IoT technologies (0 = no investments planned, 1 = planned in <1 year, 2 = planned in 1 – 3 years, 3 = planned in >3 years)

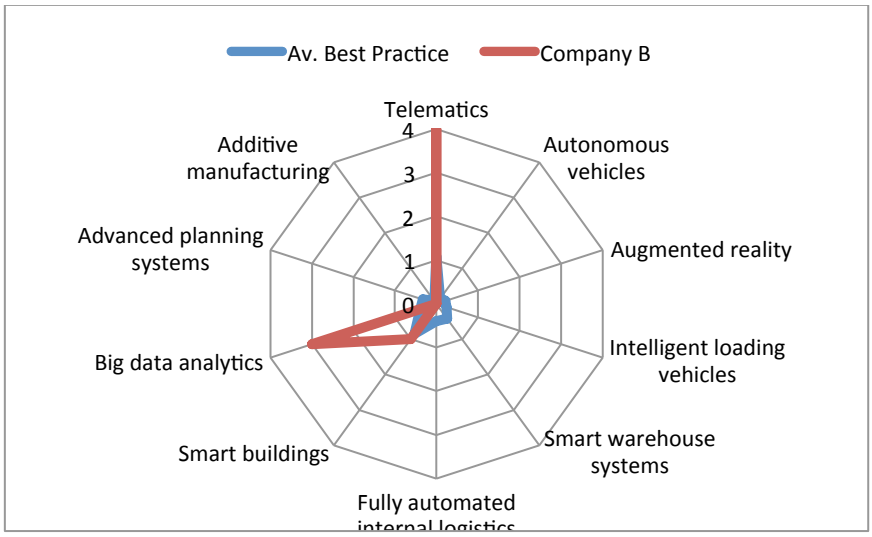


Expected impact of IoT and supply chain digitalization on different dimensions of performance (-2 = severe deterioration, -1 = slight deterioration, 0 = neutral, 1 = slight improvement, 2 = significant improvement)

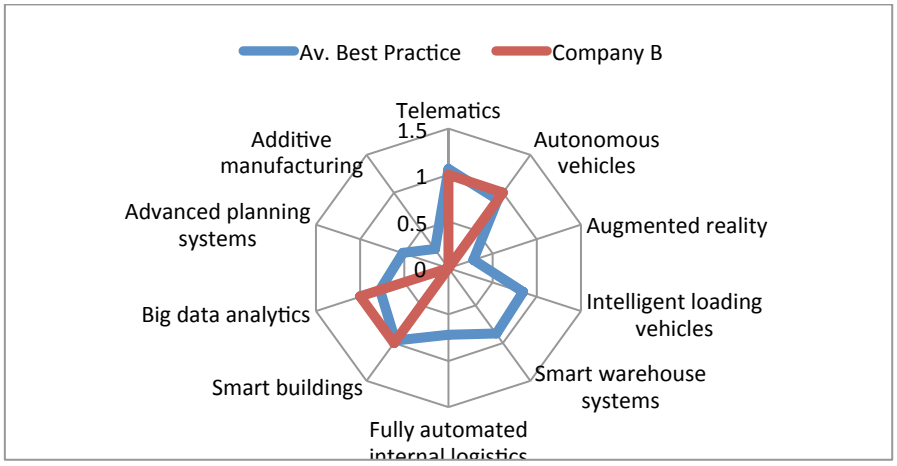


Additional survey results – International logistics company B

Use of IoT technologies (0 = no use, 1 = local use, 2 = departmentwide use, 3 = companywide use, 4 = integrated use with partners)



Planned investments in IoT technologies (0 = no investments planned, 1 = planned in <1 year, 2 = planned in 1 – 3 years, 3 = planned in >3 years)



Interview Transcripts

Interview transcript – International logistics company A

General and company-related questions:

1. **Would you describe the supply chains you are part of as digitalized?**
   I would, but not always. Also here, as I told during the tour, if you have a contract for only one year, companies are reluctant to digitalize. However, bigger European companies you see that they are more digitalized, with them we digitalize more. We get orders via EDI-message, so there is no typing anymore. We also send them feedback via EDI. In the future, such things will hopefully be in a blockchain solution. We give them interfaces, access to information on online platform. We both integrate with their system, we make information available on any device and we also analyze information. Also this analyzed information is shared with our clients. Not all logistics companies use analytics today. It's all online, updated automatically. So the information is always up to date, compared to previous powerpoint presentations or Excel sheets. In the online platform, you see information like claims made, the evolvement of volumes and other KPIs. This way, we can see how we can make workflows more lean; e.g. by optimizing the arrival times of trucks. We also see how much manual work is provided and how many value-adding activities are performed. Often, we open the eyes of our clients with the data we prepare and show them. Another example is the B2B onlineshop we made for a client which is fully integrated with our warehouse system. We are still taking steps every day. Blockchain is the future, today it is only used very limited. We are not there yet. – Do you see any differences in the relevance of blockchain with respect to industries? – Of course. High value goods might be particularly interesting, or some areas where a huge amount of data today is needed to make transactions. So it varies case by case if it is really interesting to use blockchain or not. Overall, it is not a revolution, but an evolution. A lot of things are happening at the same time, technology got much more efficient and advanced. (Reference to book "Thank you for being late"): A lot of things happened since 2007, that year was crucial. Many companies and products were launched that year. All of these things are now melting together. And a lot will still happen.
2. **Since when is digitalization a relevant topic for you?**
   Today we call it digitalization. But it started long ago. Today we still use EDI messages which were first described in the 1960s by the UN. What does blockchain add? That it is for sure not changed. For me it's an evolution more than a revolution. You try to be quicker and more efficient every day by applying technology. But you're not using technology as such, just to use technology for its own sake. It is a way to get somewhere. Now, it's also much more about performance. I remember than years ago in my previous job, we started more visionary projects, but technology was not ready. The ideas were there, but the computers were not strong enough to realize it efficiently enough. Today, you put it in the cloud and you have all the computing power you need. It's definitely an evolution, but today it goes much faster. If you compare 2007 and today, it's a huge difference in terms of possibilities.
3. **Does your company have a formal digitalization strategy?**
   We have a path we are following. We put IT as a very important item on the management agenda. But we don't know where we will be in 5 years. I think anybody who claims that he knows is probably lying. We are deciding intuity-based and opportunity-based. We are also playing with a lot of things; we try things sometimes for a period as long as 6 months and then decide to not further follow it for some reason. – So you would say that the fact that you don't have a formal digitalization strategy also gives you a lot of freedom and flexibility? – Yes. We are not fixed to an agenda. We are trying out things, which sometimes end up being very nice and sometimes we have to admit that the time is

not ready for some things. This year, we tried bots. We still don't know if we want to go further with that or not. Bots are a different approach to get to the same result, but more efficient. – Does your company as a group have a formal digitalization strategy? – We are regionally organized. We decide ourself what to do for CIS. But of course we align with headquarter. We discuss best practices with them and try to help eachother. But it is not everything central in our case. Which has advantages and disadvantages. You get a certain level of competition; we want to perform better than European colleagues. But, you could say that sometimes you waste money on doing the same thing twice. But we will not be forced to implement decisions of the headquarter against our will. This doesn't happen here. For example, at another global logistics company, a new system was developed from scratch, and it failed. In the end every location had to live with it and cover the costs. Here something like this would never happen. It is motivating to have the freedom to develop things on our own things. I try to also give this freedom to my people, and this works. We get nice results. Also our customers give us very good feedback. E.g. they really appreciate the transparency that we created with our data sharing platform.

I have an IT strategy, but I wouldn't call it a digital strategy. It says that IT supports business activities in a changing environment. In the end, we want to create value for our customers and our company. I don't know what will happen in the future, and priorities today can be overruled by other priorities tomorrow. We have a few things we say we really want to do, e.g. things that are in progress now today, but that can change tomorrow. We have a slogan: Systemize, analyze, optimize, which you could see as a vision. If something isn't in a system, it is very hard to analyze, so very difficult to optimize. There are some rules of the game as well, we want things to be scalable. That means e.g. that we want to have as much as possible in the cloud in the future. It should be secure, what also speaks in favor of the cloud. We are professional in storing goods, other companies like Google or Amazon are professional in storing data. It is very nice that digitalization and industry 4.0 really puts IT on top of the agenda at many companies. IT used to be seen as a supporting function, a cost factor. It's now much more seen as a crucial element in the business. And that is something that changed in the last 15 years. But it also got much more complexer, nobody can know all applications and have a complete overview over security. There are legal issues, in Europe the GDPR rules make clouds a sensitive topic. There are a lot of nuances in the topic where we are still looking for the answer. I would say that we are very pragmatic. We are looking at real problems and try to solve them. They can be problems of our people, problems of our customers, and we try to formulate a digital answer to that. Some companies, like many large silicon valley companies like Tesla or Uber, have the possibility to burn cash. We don't have this possibility, so we have to be pragmatic. We have to make sure that if we do something, it won't ruin our company. But we are very busy with digitalization. We are also thinking about how we can digitalize our sales process. Today, this is still a people business. We are thinking about how we could make that a real digital business.

4. **How are the digitalization efforts of your company different in Russia compared to other locations?**

I don't like to say that we are better or worse, because I don't know always the exact situation of other locations. We are maybe sometimes more following. Somebody else started something and implemented it, and then we pick it up. Sometimes, because we wait, we are better because we have more background and experience we can refer to. We don't do the technology because we want the technology. We always use technology to solve a problem. It doesn't make sense to say that we want to do something with big data, if there's no problem to solve with it. First, we always identify the problem and then search for the technology that could solve it. That's the pragmatism we have here. We are thinking about a communication platform. That's a very vague term. So first, we think

about what such a platform should do. For about a year, I see that we have the need for such a platform, but I don't see the answer today. I don't see a system today that can help us with it. Then suddenly, you see it and then you implement it. But that sometimes takes time. Another approach would be to simply develop our own solution. That would cost a lot of money. I'm in favor of out-of-the-box solution that is already somehow available. I don't think that we are so crazy original that nobody else already thought about it before. If there is a solution ready, I prefer to use it and maybe modify it a bit. If you start building everything on your own, then your cost will not be in balance with the benefits you get. Microsoft, e.g., has a lot of solution which are bad at first, but then usually evolve very fast and become great solutions to start with. Slack was a threat for Microsoft, and they started to develop Teams with a lot of resources, and today it is good. Another example is Power BI which was Microsoft's answer to Tableau. Our headquarter worked with Tableau, we work with Power BI. Our results are very impressive at a minimum of cost.

5. **How would you describe the overall degree of digitalization in Russia compared to other locations?**
   I think we are a little bit behind. We are doing very nice things. But in general, I think we are a bit behind. I see several reasons for that. One thing is the pragmatism we apply. We are always questioning if it's really worth it or not. It's also about focus. You can't do everything. And it's also about bureaucratism. There are rules of the game in Russia which are harder than in Europe. You have more rules, and more rules means you have more difficulties in digitalization. And I think overall in Russia digitalization in B2B is lower. In other aspects, there are also great things; as a consumer in B2C, digitalization is much quicker. Uber was quicker here, online banking etc. was sooner available here. The reason for that is probably that you had in Europe huge investments in infrastructure like e.g. in landline networks, and they had to be paid off. So investments in new technologies were delayed. Here, there was no infrastructure, so you immediately put the latest technology. That makes connectivity also much cheaper here in Russia. Similar developments are happening today in Africa. Also, as a company we are already quite long here in Russia. That means that we have legacy, we have old systems and structures. – So you would think if you would start today from scratch you would be more digital? – Yes, you would probably do it different. I suggested that for the next business we start, we should really do it like a new company. To be able to start with a clean sheet is worth a lot. – Did you use this opportunity when you started in other locations like Novosibirsk or Chelyabinsk? – No. We did it the same way. Because you have the system, you want to level that. But it's actually a very good question, I never thought of that. As an experiment, the idea to do it in another location would be interesting. For companies with a long heritage it's difficult to deal with their past when they digitalize. A friend of mine works for a large Dutch bank which said that they want to become 100% digital. However, a lot of the IT infrastructure dates back even to the 1980s. If you're a new company, you don't have to deal with such things.
6. **How digitalized are your clients' supply chains?**
   It depends on the customer. It's very hard to generalize. But of course, European companies are generally more digitalized. But also there, in large corporate environments it is sometimes very hard to digitalize. If you look at their priorities list, there are always a thousand other things above supply chain digitalization. We see that as an opportunity, we offer them to outsource digitalization. We help them to digitalize. Sometimes with success, sometimes we open their eyes but still don't implement it. An example is our digital app to make audits. Normally, that's done on paper, you had to take a picture and write a report. We have an app with a checklist to do that and add pictures. If we show that to our customers, they really like that and sometimes ask us to take over the audits. With things like this, we help them. Another example is the guarding; we implemented a

digital visitor pass system. This saved us three guards. We optimized that a lot. There are only benefits, and our clients see that.

7. **Is your company the driving force behind supply chain digitalization, or do your clients make the first step?**
   It's a combination. Sometimes it's our client, sometimes it's us. But we try to identify opportunities to give digital answers to our clients. For example, we have our digital track system which helped us to become a relevant player on the cigarette market. We saw that there was a lack of solution on the market, we developed a track and trace system that could fill this gap. So we saw an opportunity and filled the gap. It wasn't the customer that asked us.
8. **How difficult is it to realize digitalization-related projects together with your clients? Do your clients appreciate digital integration?**
   Data sharing is very difficult. We are still in an old culture where data is private and company-owned. With corporate clients, if you ask them to share data, an NDA and review by the headquarters and a lot of other things are necessary to go through. There are in general still a lot of things to do. Horizontal collaboration, e.g. several shippers working together to get an optimal loading of trucks, is still very nice in words but very hard to realize. There's too much resistance to data sharing and a lack of willingness to collaborate. The mental process of sharing data of your employer's company with other people is dominated by the threat that you might get fired for giving out information. I also don't know if that will change with the next generation; maybe they are used to share information and will question the existing system. Again, a new company could have the culture and strategy to share everything. So sharing of information is very hard, also in Europe. The question is always who will in the end run away with profits, and what about my job if something goes wrong. We also do analytic projects for customers, they also start with an NDA and that works. But in collaboration, it's always very hard to understand each other perfectly. What is the end goal of the supply chain? A happy customer. But the question is who the end customer is, who has to be taken care of. Openness is clearly the key to huge efficiency improvements, but today we are not ready for that. We have an example where we did it with combined data from two customers which we had to help them, but that was data which we had. They didn't share that data with us, we generated that ourselves.
9. **How open are your clients for information and data sharing?**
   See above.
10. **Logistics supply chains perform rather poor in a global comparison according to the annual World Bank ranking. Do you see that reflected in your activities in Russia?**
    It is much more difficult in every aspect. It starts with transport. In Europe, you send an email and you get it. In Russia, you need a 20-page contract. – That's because there's a lack of competition? – No, there is competition. That's just a legal requirement. You need so many documents. It's again a legal thing. The government built in so many control mechanisms that you just have to fulfill. Sure, it's not as efficient as it could be. – Do you see any differences in efficiency between you and Russian logistics providers? – Depends. Some are more efficient, but not that clean as we are. Some are less efficient, because they lack the focus on efficiency. A lot of things are really legally based, you just have to fulfill much more requirements and provide more documentation. The infrastructure is also problematic. The road from here to Moscow is basically a simple road in Europe, not a highway. Again, that's linked to the government. Another thing is culture. Mistakes are not accepted in Russia, the first question which is asked is always asked is who's guilty. As an answer, a control mechanism is built in. It will still go wrong, so another control mechanism will be implemented, and before you realize it you have more people controlling things than actually doing things. I do, however, think that people actually want efficiency and things are really changing fast. Also infrastructure is

developing very fast, in the last five years already a lot of things happened. There are huge things being taken. It is improving.

11. **How would you describe progress in the digitalization of Russian supply chains? Is the development keeping pace with e.g. Western Europe?**
    It is everywhere changing really fast, sometimes even too fast. Many people can't follow anymore, and that keeps things down. I think it is at the same speed here in Russia, sometimes even faster, but not in all fields. There are great programmers here in Russia. But not all companies use that. The history of a company and the mentality of the owner really have a strong impact on that. It's not black or white. There are some companies who still don't have any know-how. They have no idea what EDI is, they don't know how to export data into Excel sheets. They are very far away from best practice.

Influence-factor related questions:

12. **Do the rather high costs of capital in Russia influence your decisions concerning digitalization-related investments?**
    I think the capital cost plays a role but it's not crucial. The question is the impact on return on investment. And if you consider digitalization, you also talk about replacement of people. And if people are cheap, this impact is not large enough. Also, your investments are probably in EUR or USD, because technology comes from Europe or the US, so the investments needed in RUB actually increased due to exchange rate changes. The salary of a warehouse employee is 30000 RUB, that's today almost half as it was five years ago. The same investment will due to that have a much longer payback period today. Especially with large projects that have a long payback period, this development is very significant. Generally, especially Russian investors search for a payback period that is as short as possible.
13. **Labor costs in Russia are quite low, what has an immediate impact on the potential return on investment for supply chain digitalization. However, at the same time unemployment is in many regions quite low, in some industries even a labor shortage is apparent. How do you consider these counteracting influences in your supply chain digitalization (and particularly automation) efforts?**
    It is counterbalancing for sure, if you don't find the people you need to automate. But personally, I question the impact of low unemployment. Productivity is extremely low, and a lot of people have jobs that are actually not needed. By activating these people and increasing productivity with very simple measures, unemployment effects can change. Also, a real crisis due to low unemployment and lack of new employees would drive salaries up. That didn't happen to a large extent over the past years, salaries didn't rise excessively. Manual labor is therefore still affordable. The market would correct itself. – So for you it's not difficult to find employees? – It's always difficult to find good employees. But it's not impossible to find people. We don't see salaries doubling every year, in case of real shortage you would see that. Also migration from Tajikistan, Belarus, Ukraine and other CIS countries balances the market. The difference in salaries is still large enough to attract people.
14. **Your company is active throughout the country, in different regions of Russia. Has that any influence on the number of partners required for your operations?**
    We are sometimes really sourcing locally. We search for local real estate owners. For other things, we search for national partners, like equipment or IT. If it's about transportation, there it's really local. We work with medium-sized companies, and they are only working locally. There we do have more partners than probably in Western Europe. Even transportation companies that say they are active in the entire country usually focus very strongly on SPB and Moscow, and the rest they can't offer it with high quality or on short notice. – So that means if you want to integrate partners you have more companies you would have to collaborate with? – Yes. Also, for big suppliers it

makes sense to really integrate them and develop interfaces and solutions. For smaller partners, this isn't lucrative. We just ask them to go to our website and enter data there. They benefit from our portal, but not to the same extent as large digitalized partners.

15. **How would you describe the influence of geographical distance on your activities in Russia? How does it impact visibility and control in your supply chain?**
    It makes it more difficult to manage a supply chain. Already the time difference between here and Novosibirsk makes things more difficult. You have to handle your business before noon with Novosibirsk. With visibility, there is still the human factor. People increasingly want to understand what's happening in real time, any moment. Information helps to control and bridge this large distance. E.g. we found out that one of our warehouse in Siberia was shut down every day hours before the official closing time, without digital solutions it would be almost impossible to reveal such a thing. Also with trains and trucks, we know what's happening today and where our goods are.
16. **What potential do you see in digitally enabled decentralized supply chains (e.g. through means of additive manufacturing or cloud manufacturing) in Russia?**
    I think things will really change. Today, a lot of goods are moving around, while tomorrow things will be produced where they are actually needed. But that's not happening today. People are still trying to get a hold of it. We change goods last minute and customize things on site, but those are very basic and limited things. The real manufacturing is still centralized. We see changes in the flows from China, the Silk Road is developing and will changes flows in the near future.
17. **Would you consider the general legal and administrative environment in Russia to be rather driving or hampering supply chain digitalization?**
    Even within our company, the legal and accounting department is seen as very important, with a veto right on most things. In Europe that's more a supportive department, here it's all about control. That's really hampering the business, the development. Whatever you want to do, you need a contract. A contract is already a sing of mistrust, you're already thinking about how to break up. It's a sign of distrust. And it reduces flexibility. You can't act spontaneously. In Europe, you do a lot more with oral agreements.
18. **Russian society generally seems to be extremely reluctant to uncertainty, tolerant to power distance and quite collectivist. Do you see any of those characteristics reflected in your daily business? If yes, do you see any influence in favor or against digitalization?**
    I'm not sure about uncertainty. Everybody prefers stability, and here in Russia people actually can handle uncertainty quite well, there's no panic. There's a huge difference between generations. The older generation expects everything to come from above and doesn't act proactively, it's all about execution and collectivism. The new generation is not signing that anymore, they want progress and question management decisions. The power distance which is still dominant today is actually in favor of digitalization, because you can push through decisions. You can take and implement decisions here that would never be accepted in Europe. They accept power and believe in power, and implement and execute decisions. That also could be abused, you can really push through things.
19. **How would you describe the general role of logistics in a supply chain in Russia? Is it any different from the role of logistics e.g. in Western European supply chains?**
    It is clearly more challenging here. You have to invest a lot more time and resources due to he complexity of the Russian market, geography, safety, bureaucracy etc. But, there's a lack of strategy in a lot of cases. In European supply chains, there is a more strategic approach and as a logistics provider, you can adapt to that. Here, we hear little about strategy. It's more about execution and transportation. That ties up resources which are clearly missing at other places. In Europe we also didn't have marketing 40 years ago, it's basically an evolution companies and supply chains go through. I think that it's today still about getting the basics right. You need your factory and transportation properly

working before you can take the next step. Operations and solving problems is in focus, strategy and development is secondary.

Survey-based questions:

20. **You selected low labor costs and high implementation costs as the main obstacles for supply chain digitalization in Russia. Usually, companies struggle with a lack of know-how and available solutions. How did you manage to deal with those very common obstacles?**
    I think we have the luck to have a lot of know-how inhouse, we have a lot of smart IT guys. We also collaborate with schools, we want to get inputs from students. In general, the know-how is available. Education is more available in Russia than in Europe, especially with respect to science, maths and IT. It's much harder to find a good programmer in Europe. About solutions, I think there were never more solutions ready and available than today. You just have to find them. And sometimes that takes time. Sometimes you implement a solution and then realize it was not the right solution. For me it's strange that companies believe that available solutions are an issue. It's also about combining solutions. Know-how you can build if you want, available solutions you can find. But you need to look around, maybe you need to talk to competitors, maybe you need to collaborate. You have to make an effort to find them.
21. **You seem to use your available data for basically all possible purposes, from performance measurement to business model innovation. Where have you been most and least successful in the exploitation of data?**
    I think the most successful is the easiest one, visualization of data and supporting the understanding with it. The least successful one is business model development. To develop data-based business models is very difficult. We use it as well for performance measurements and improvement, that works fine. But business model innovation is difficult. It's difficult to find actual revenue streams. There are a lot of idea, but the way from idea to realization is very hard. To have an idea and check it with statistics is easy, but to realize takes a lot of effort and energy. There are a lot of stakeholders involved and everybody needs to support it.
22. **You seem to have no interest in Auto-ID technologies like e.g. RFID, and also sensor technologies seem to be out of focus at your company. Could you please elaborate on the reasons for that focus.**
    Auto-ID solutions, I just don't see it. That's pragmatism; I simply don't see the advantage of a tag vs. a scan. It's also about choices, RFID is still not cheap, and changing our setup would be a big investment. The barcodes work very good, and I don't expect that RFID would bring a large improvement. I didn't make all the calculations, so it's more a gut feeling. But sensors are generally in focus, we will invest a lot there. We have today track & trace sensors, and we revise all of that. That's the way to go for us.
23. **You are (locally) using very advanced industry 4.0 technologies such as additive manufacturing or augmented reality. How are these technologies performing so far in your company?**
    Boys like toys… Not only. But you have these dreams where you're not sure about realization. And I really see in the near-term future the use of virtual reality in combination with robots. People could operate from a room several robots at one time, saving the time when the robots are moving between locations. That combination of augmented reality and robotic would have a huge potential in my eyes. With that, you would solve the issue of differences in the weight or substance of transported goods. A human doing that with the help of a cyborg would solve that problem immediately. It's

an idea. Augmented reality is really the future. A lot of people don't believe that yet, but I'm sure there will be a lot of augmented reality applications in a few year. Virtual screens have a huge potential. Hololenses are still extremely expensive today, but those prices will come down soon. The combination of the advantages of a human and a robot solves almost all problems that are still existing with automation can be solved.
We have a lot of spareparts in our warehouses. With 3d printers you can throw that out. That will change everything. Customization in the end before it goes to the customer is already implemented in many cases, e.g. paint. 3d printing for us is also about marketing, it's an interesting technology for the long term.

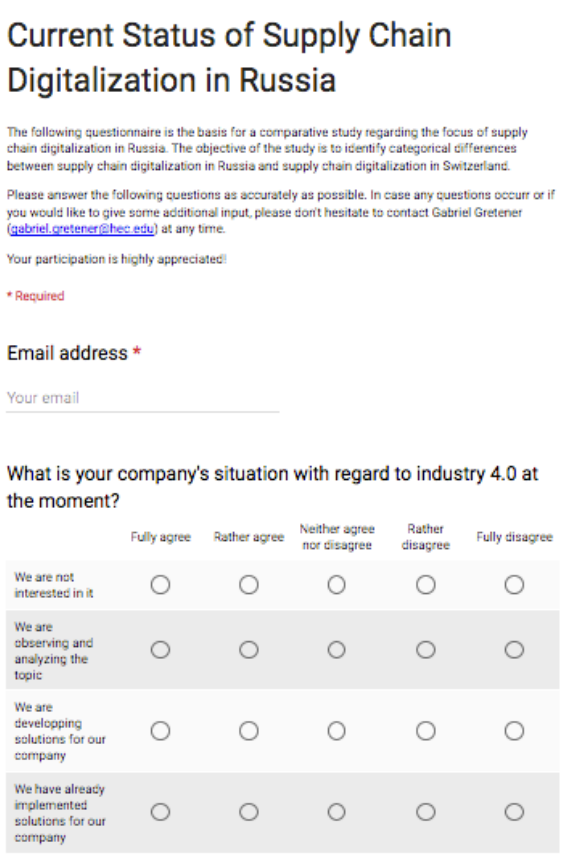
24. **Unlike many other companies you seem to be skeptical about potential cost advantages through digitalization. You even predict a mild deterioration of stability and resilience as a result of supply chain digitalization. Why so?**
If you automate how most companies automate today, you have to standardize. And if something goes wrong, this standard which you created gets interrupted. A simple example; a customer sends every week 70 Excel-files, and we have to combine them to one single Excel sheet. We develop a macro that does all that instead of adding them together manually. It's even sent to the customer automatically. Then, suddenly, without any talk, the customer asks to change something in the file and the whole thing doesn't work anymore. So you really need somebody who understands everything and can intervene quickly to make it work again. In a lot of cases, people don't consider this maintenance. The cost of the infrastructure, the total cost of IT is based on that much higher than many expect. You need a lot of resources that are in the end more expensive than manual labor. If you don't consider that, you risk getting a big surprise. Again, there's our pragmatism. I'm sure digitalization is great for quality and everything, but if something goes wrong, what then? Pen and paper works always but not efficient. A cyberatack can stop your whole company. But I'm maybe a bit pessimistic here, things will get cheaper in the future. In the future, there will be easier solutions for software and coding. AI

Interview transcript – European logistics company B

On request of the interviewed manager at company B, the exact transcript of the interview is not published due to confidentiality reasons. On request, excerpts are available.

Online-Questionnaire

The online-questionnaire, developed as a Google form, was created originally in English language. A full and accurate translation in Russia was then created based on the original English version. For reasons of simplicity, only the original English version is depicted on the following pages.



Current Status of Supply Chain Digitalization in Russia

The following questionnaire is the basis for a comparative study regarding the focus of supply chain digitalization in Russia. The objective of the study is to identify categorical differences between supply chain digitalization in Russia and supply chain digitalization in Switzerland.

Please answer the following questions as accurately as possible. In case any questions occurr or if you would like to give some additional input, please don't hesitate to contact Gabriel Gretener (gabriel.gretener@hec.edu) at any time.

Your participation is highly appreciated!

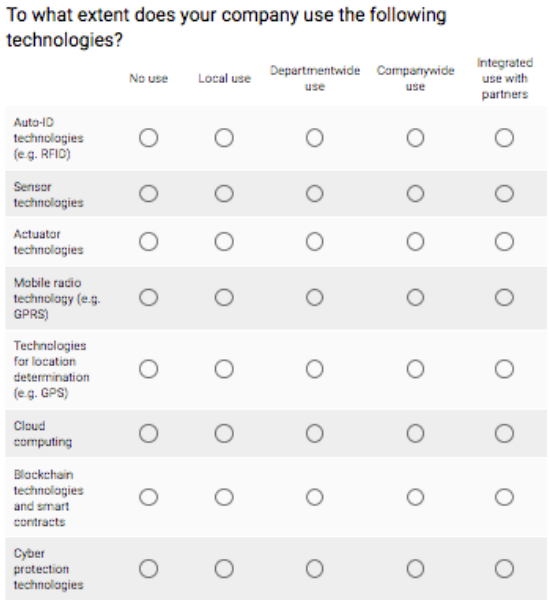
* Required

Email address *

Your email

What is your company's situation with regard to industry 4.0 at the moment?

	Fully agree	Rather agree	Neither agree nor disagree	Rather disagree	Fully disagree
We are not interested in it	○	○	○	○	○
We are observing and analyzing the topic	○	○	○	○	○
We are developping solutions for our company	○	○	○	○	○
We have already implemented solutions for our company	○	○	○	○	○

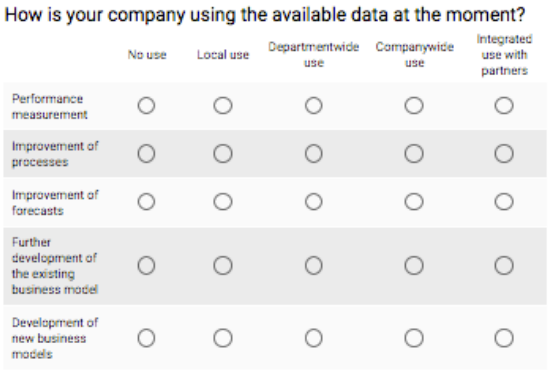


To what extent does your company use the following technologies?

	No use	Local use	Departmentwide use	Companywide use	Integrated use with partners
Auto-ID technologies (e.g. RFID)	○	○	○	○	○
Sensor technologies	○	○	○	○	○
Actuator technologies	○	○	○	○	○
Mobile radio technology (e.g. GPRS)	○	○	○	○	○
Technologies for location determination (e.g. GPS)	○	○	○	○	○
Cloud computing	○	○	○	○	○
Blockchain technologies and smart contracts	○	○	○	○	○
Cyber protection technologies	○	○	○	○	○

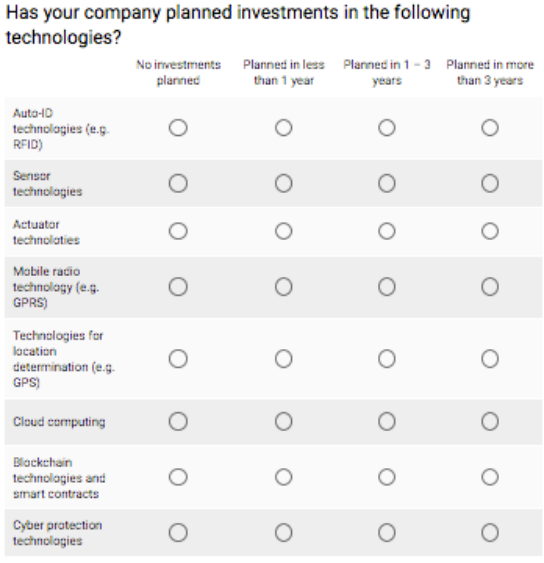
With what areas of industry 4.0 are you dealing right now?

	No use	Local use	Departmentwide use	Companywide use	Integrated use with partners
Switch from analogue to digital (install sensors and actors)	○	○	○	○	○
Mobilization (use of mobile devices and radio technology)	○	○	○	○	○
Connectivity and integration (e.g. with suppliers or partners)	○	○	○	○	○
Automatisation	○	○	○	○	○
Self-controlling applications	○	○	○	○	○



How is your company using the available data at the moment?

	No use	Local use	Departmentwide use	Companywide use	Integrated use with partners
Performance measurement	○	○	○	○	○
Improvement of processes	○	○	○	○	○
Improvement of forecasts	○	○	○	○	○
Further development of the existing business model	○	○	○	○	○
Development of new business models	○	○	○	○	○



Has your company planned investments in the following technologies?

	No investments planned	Planned in less than 1 year	Planned in 1 – 3 years	Planned in more than 3 years
Auto-ID technologies (e.g. RFID)	○	○	○	○
Sensor technologies	○	○	○	○
Actuator technologies	○	○	○	○
Mobile radio technology (e.g. GPRS)	○	○	○	○
Technologies for location determination (e.g. GPS)	○	○	○	○
Cloud computing	○	○	○	○
Blockchain technologies and smart contracts	○	○	○	○
Cyber protection technologies	○	○	○	○

To what extent does your company use the following industry 4.0 technologies?

	No use	Local use	Departmentwide use	Companywide use	Integrated use with partners
Telematics with realtime communication between vehicles	○	○	○	○	○
Autonomous vehicles	○	○	○	○	○
Augmented reality applications	○	○	○	○	○
Intelligent loading vehicles	○	○	○	○	○
Smart warehouse systems	○	○	○	○	○
Fully automated internal logistic solutions	○	○	○	○	○
Smart buildings	○	○	○	○	○
Big Data analytics	○	○	○	○	○
Advanced planning systems	○	○	○	○	○
Additive manufacturing solutions (3D-printing)	○	○	○	○	○

Has your company planned investments in the following industry 4.0 technologies?

	No investments planned	Planned in less than 1 year	Planned in 1 – 3 years	Planned in more than 3 years
Telematics with realtime communication between vehicles	○	○	○	○
Autonomous vehicles	○	○	○	○
Augmented reality applications	○	○	○	○
Intellient loading vehicles	○	○	○	○
Smart warehouse systems	○	○	○	○
Fully automated internal logistic solutions	○	○	○	○
Smart buildings	○	○	○	○
Big Data analytics	○	○	○	○
Advanced planning systems	○	○	○	○
Additive manufacturing solutions (3D-printing)	○	○	○	○

How will industry 4.0 change the following aspects of supply chain performance in your opinion?

	Severe deterioration	Mild deterioration	No impact	Mild improvement	Strong improvement
Quality	○	○	○	○	○
Speed	○	○	○	○	○
Cost	○	○	○	○	○
Transparency	○	○	○	○	○
Safety	○	○	○	○	○
Stability and resilience	○	○	○	○	○
Flexibility and agility	○	○	○	○	○

What are the main obstacles for supply chain digitalization in Russia in your opinion?

- ☐ Regulation & legal situation
- ☐ Cost
- ☐ Availability of solutions
- ☐ Lack of digitalization at suppliers and distributors
- ☐ Other: _____

Is your company's headquarter in Russia?

Choose

How many employees does your company have at the moment?

Your answer

What was your company's revenue last year?

Choose

SUBMIT

Page 1 of 1

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