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BARRIERS AND STRATEGIES FOR THE DIGITAL TRANSFORMATION OF SME SUPPLY CHAINS

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ABSTRACT

The article is devoted to the study of barriers to the digitalization of supply chains and mechanisms for overcoming them in small and medium-sized businesses.

Purpose. The aim of the work is to identify, systematize and compare the barriers preventing the introduction of digital technologies in small and medium-sized enterprises and large companies based on bibliometric and systematic analysis of scientific literature.

Methodology. The study is based on the application of a bibliometric and systematic review of scientific literature aimed at identifying and analyzing barriers to the digitalization of supply chains, as well as strategies for overcoming them in small and medium-sized enterprises and large companies. The selection of publications was carried out in the Scopus database according to predefined inclusion and exclusion criteria. The final sample included 76 peer-reviewed scientific papers, the results of which were subjected to comparative analysis.

Originality / value. The originality of the research lies in the development of an integrative model of digital transformation of supply chains based on the generalization of the results of the analysis of scientific sources. The proposed model takes into account the impact of enterprise size on digitalization processes and fills the existing gap in the literature associated with insufficient knowledge of the differences between small and medium-sized enterprises and large companies. The practical value of the research is to identify the features of digital technology implementation strategies and mechanisms for overcoming barriers to digitalization in organizations of various scales.

Findings. Found that small and medium-sized manufacturing enterprises face more pronounced barriers to the digitalization of supply chains compared to large corporations. Six categories of barriers have been identified: financial, technological, organizational, strategic, regulatory, and human capital-related, the intensity of which varies significantly depending on the scale of the enterprise. It is shown that the geographical location and the level of development of the institutional environment are significant contextual factors determining the results of transformation.

Keywords: digital supply chain, SMEs, Industry 4.0, barriers, strategies, digital transformation.

INTRODUCTION

The introduction of Industry 4.0 technologies has led to significant changes in the dynamics of competition in global manufacturing, which has necessitated the digital transformation of supply chains as a requirement rather than an opportunity for manufacturing companies. The use of advanced technologies, including IoT, artificial intelligence, blockchain, cloud computing, and analytics, is becoming more widespread in supply chains, providing greater transparency, predictability, and reliability [1; 2]. Given the instability of global value chains, the digitalization of supply chain processes has been recognized as one of the most important factors determining the competitiveness of production.

Small and medium-sized businesses (SMEs) occupy a structurally significant position in the transformation process. Comprising the vast majority of manufacturing companies worldwide and making a significant contri-

bution to job creation and GDP growth in both developed and emerging markets, SMEs act as the backbone of global supply chain systems [3; 4]. Since small and medium-sized enterprises are suppliers, subcontractors and manufacturers of components for large companies, the digitalization of small and medium-sized businesses is more than an organizational task, but rather a requirement to ensure the efficient operation of the supply chain. Despite the aforementioned importance, small and medium-sized enterprises are significantly lagging behind multinational corporations in terms of implementing industry 4.0 solutions [3]; this is because the problems they face are more widespread and inherently complex than those faced by resource-rich organizations.

SMEs overcome obstacles using strategies, including external collaboration with industry associations, technology providers, and universities [5], implement affordable hardware and software [6], using cloud systems that reduce investment, and implementing extensive education and professional development initiatives [7]. The role of senior management in the quest for digitalization is becoming a key success factor [8], while external support for the digital transition is considered a crucial first step [9]. Despite the continuing shortage of resources, SMEs have additional advantages, including a high level of flexibility and mobility [4], which allows them to respond more quickly to changes in the market environment. Some examples of positive outcomes of digitalization include increased operational efficiency, lower costs, increased transparency, and increased supply chain resilience [2]. Geographical location significantly affects these processes, as developing countries face more serious obstacles related to lack of infrastructure and regulatory issues [10] than developed countries, which have more reliable institutions [11].

SMEs face great difficulties when it comes to the transition to a digital supply chain due to the limited resources they have access to compare to larger companies. Despite the large constraints, small enterprises are succeeding in transforming their digital supply chain by applying unique business strategies compared to large multinational companies, which leads to a noticeable difference in the timing of breakthrough innovations in industry 4.0 [3]. In particular, the key obstacles are economic factors such as significant investment costs and limited access to finance [7], technical issues such as low infrastructure development and cybersecurity issues [12], as well as organizational issues including skills shortages, resistance to change, and insufficient involvement of senior managers [4]. These barriers are especially heavy for SMEs due to limited resources [13], due to the rigor of budgeting [7], and the need to coordinate both business processes and digital transformation activities without the participation of specialized units [14]. Large companies carry out structural transformations through the implementation of one large project, and SMEs usually use step-by-step approaches, starting with the introduction of small solutions that correspond to their current infrastructure [15].

Scientists have considered this issue from different perspectives within the existing literature. On the one hand, there is a significant amount of research on the barriers associated with the digital transformation process in SMEs, albeit in general [15; 7]. On the other hand, extensive research has been conducted on the implementation of a digital supply chain without considering firm size as a limiting variable [16; 17]. However, very few studies have focused on the differences between small and large firms regarding the barriers to digital transformation of the supply chain, as well as the methods used to overcome them.

The analysis addresses the following research question: how do SMEs recognize and overcome the obstacles associated with the digitalization of their supply chains compared to large multinational organizations? The main focus is on identifying the factors influencing the processes of digital transformation, as well as identifying differences in approaches to the introduction of digital technologies in organizations of various scales.

Materials and methods

As part of a systematic review of the scientific literature on the Scopus database, the keywords “barriers” and “digital supply chain” were used to select sources, which made it possible to cover research on the problems of digital transformation of supply chains.

There are some limitations associated with the analysis presented in the above-mentioned literature:

- The search process was limited to two main keywords and the Scopus database. Although the database covers a wide range of scientific articles, searching additional databases such as Web of Science, EBSCO, and Google Scholar may lead to additional relevant research and thus create a risk of bias in the selection process;

- data extraction in the current literature review was performed using a large language model (LLM) with-

out independent verification by a second reviewer and an assessment of the coefficient of mutual agreement. Although detailed instructions on data extraction are available, this method carries the risk of systematic errors that cannot be quantified using the existing analysis methodology;

- There is a significant geographical disparity in the selected studies, as the majorities (more than 50%) are represented in emerging economies in Asia and Latin America, including about 15 articles from India. This may pose a problem when summarizing the results in the context of other regions, such as sub-Saharan Africa or Central Asia;

- since only those studies that have shown positive results regarding digital transformation in small and medium-sized enterprises are published, there is a risk of publication bias. This means that there may be overly optimistic estimates of the possibility of such transformations and their benefits in the modern literature;

- The time frame limited to the period 2020-2026 makes the review less comprehensive in terms of research on digital transformation conducted before the pandemic.

The selection took place in several successive stages of screening and filtration. The selection process is shown in Figure 1.

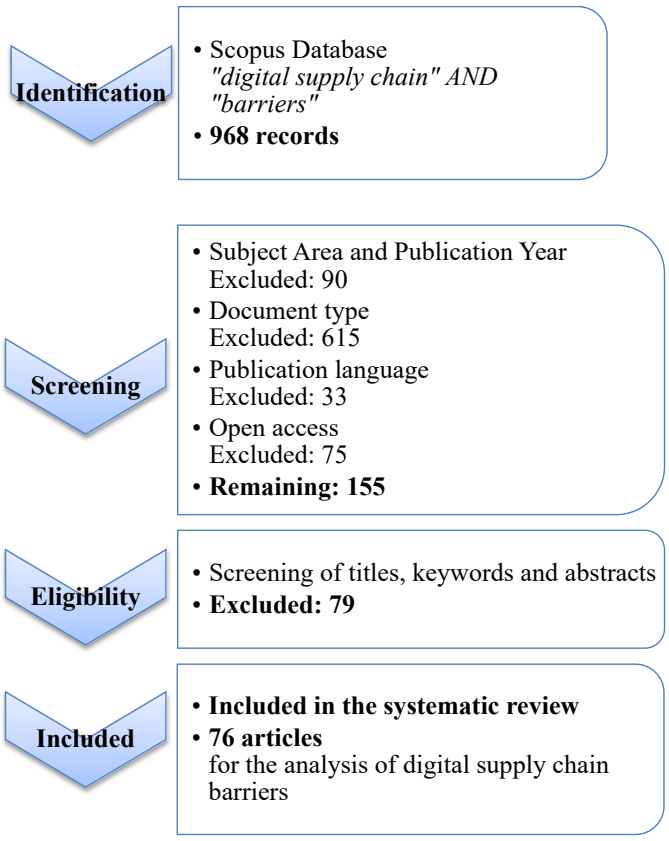


Figure 1 – The process of selecting literature on the PRISMA methodology
Note: Developed by the authors based on the literature review.

At the first stage, filters were applied by subject area (Business, Management and Accounting; Social Sciences; Economics, Econometrics and Finance) and time range (2020-2026), which excluded 90 publications from other subject areas. There are 878 records left.

At the second stage, a filter was applied by document type: only articles were selected, excluding reviews, conference materials, and books (n = 615). There are 263 entries left.

At the third stage, a filter was applied by the language of publication – English and Russian, which excluded 33 publications in other languages. There are 230 entries left.

At the fourth stage, only Open Access publications were selected, which excluded 75 articles. There are 155 entries left.

At the fifth stage, headings, keywords and annotations were analyzed for compliance with the manufacturing sector. 79 publications on non-productive sectors (services, agriculture, healthcare, etc.) were excluded.

Thus, 76 articles were included in the final systematic review, of which 25 are directly devoted to the manufacturing sector, and 51 cover related topics with partial relevance to production.

According to previous research, there is an obvious difference between small and large companies when it comes to their experience of digital transformation. Small firms are significantly lagging behind large companies in terms of taking advantage of disruptive technologies in industry 4.0, and continue to face difficulties at the decision-making stage for implementation [3].

For example, while large corporations have successfully implemented the principles of Industry 4.0 and received tangible benefits, small and medium-sized enterprises still face difficulties in implementing this concept due to the many challenges they face. There are differences when it comes to how companies allocate resources, as the former have dedicated resources dedicated to implementing new technologies, which the latter do not [15].

However, despite this difference, SMEs have several strengths of their own, such as flexibility, which means that SMEs can effectively use new technologies due to their flexible structure, although they have difficulty obtaining resources [4]. However, the flexibility and responsiveness shown by SMEs may mitigate some of these disadvantages [14]. On the other hand, large firms use technology more often than small and medium-sized enterprises due to their ability to experiment without running out of resources. This situation forces small and medium-sized businesses to rely on outside help and wait until the benefits of using such technology by larger companies become apparent.

Result and discussion

Based on the analysis of selected academic sources, barriers to the digital transformation of supply chains have been identified. Below is a comparative table that allows you to systematize and compare the key barriers to digitalization in small and medium-sized enterprises and large companies.

Table 1 – comparative analysis of DSC transformation barriers

Barrier category	Barrier factors	SMEs	Large enterprises
Financial	High capital expenditures (CapEx) for IT infrastructure [18]; long payback periods [19]; shortage of working capital for R&D activities [20].	High	Medium
Technological	Cybersecurity vulnerabilities [16]; complexity of legacy system integration [21]; low level of technological maturity [22].	High	High
Organizational	Resistance to change and fear of job losses [23]; data fragmentation (“data silos”) [24]; lack of a digital culture [25].	High	Medium
Strategic	Weak top management support [19]; absence of a digital roadmap [26]; misalignment between IT and business objectives [18].	Medium	Medium
Regulatory	Lack of industry standards [18]; uncertainty regarding intellectual property rights [27]; weak institutional frameworks [28].	Medium	Low
Human Capital	Skills shortages at the intersection of Supply Chain Management (SCM) and Data Science [18]; insufficient training resources [6]; low employee engagement [29].	High	Medium
Note: Compiled by the authors based on literature review			

An analysis of the frequency of mentions confirms that technological and financial barriers are universally dominant factors, but their nature differs: for SMEs, the financial barrier is a «threshold» (cutting off access to technology), while for large companies it is associated with the efficiency of allocating huge budgets [18; 20]. The intensity of organizational and personnel barriers is significantly higher in the SME segment (76% and 71%, respectively), due to the lack of resources for internal retraining and high dependence on the personal position of the business owner [6; 25]. At the same time, large corporations are more likely to face strategic mismatches due to the complexity of their layered networks [21; 26]. The ISM (interpretive structural

modeling) method is recognized in these sources as the most effective method for determining hierarchy, as it allows us to determine that «leadership support» and «strategy availability» are the main drivers that influence overcoming all other groups [19; 7].

The results of the analysis of academic literature on digital supply chain transformation are not only a process of introducing innovative tools, but also a radical restructuring of business models and operational processes [18]. The study showed that the barriers to achieving digital perfection are multidimensional, and that enterprise size acts as a critical moderating variable that determines the intensity and specificity of the manifestation of certain obstacles. Table 2 below shows the main demonstration of the most common barriers and recommended strategies to reduce and overcome them in the context of digitalization of the SME supply chain.

Table 2 – Key demonstrations of barriers and strategies for overcoming digital transformation of supply chains in SMEs

Barrier	**Key manifestations**	**Main mitigation strategies**
Financial	High capital investment requirements for digital infrastructure, limited access to financing, and uncertainty regarding return on investment (ROI) [18; 19]	Adoption of Software-as-a-Service (SaaS) models, government subsidies, strategic partnerships, and alternative financing mechanisms [29; 7]
Organizational	Resistance to change, silo mentality, lack of digital culture, and insufficient inter-organizational trust [23; 21]	Agile approaches, employee training programs, and cross-functional transformation teams [30; [26]
Strategic	Absence of a digital strategy, lack of key performance indicators (KPIs), and insufficient managerial support [26; 8]	Development of a digital roadmap and integration of digital objectives into corporate strategy [25; 26]
Technological	System incompatibility, cybersecurity threats, inadequate infrastructure, and lack of interoperability standards [16; 22]	Adoption of cloud technologies, open-source solutions, and blockchain platforms [29; 22]
Human Capital	Shortage of digital competencies, insufficient training opportunities, and low levels of digital literacy [18; 6]	Partnerships with universities, workforce upskilling programs, and knowledge management systems [25]; 31]
Regulatory	Lack of unified standards, legal uncertainty, and weak government support [18; 23]	Participation in government initiatives, industry associations, and standard-setting activities [20; 22]
Note: Compiled by the authors based on literature review		

The systematization of the data shows that the limitations identified form a complex hierarchical structure in which strategic and organizational factors are often the main causes, while financial and technological difficulties are the causes of their secondary consequences.

Analysis of financial barriers confirms their status as the main determinant of limiting the possibility of starting transformational projects. For SMEs, this factor is expressed in the form of a “survival threshold”, where an acute liquidity deficit and high initial capital costs for IT infrastructure bother the launch of even small-scale pilot programs [7]. Unlike SMEs, large manufacturing companies do not face an absolute shortage of capital, but rather face the problem of effective distribution within a multi-level supply chain and uncertainty regarding return on investment (ROI), which often leads to the so-called “productivity paradox” [26; 19].

The organizational barrier in academic discourse is recognized as the fundamental “driving force” that determines the vector of digital development. In the segment of SMEs, the transformation process is highly dependent on the personal views and digital literacy of the business owner, which creates significant internal inertia in the absence of a culture of formal change [32; 4].

In the context of strategic barriers, large corporations are increasingly characterized by the problem of digital fragmentation, when different units implement isolated technological solutions that are not synchronized with the goals of the entire supply chain [24; 21]. The lack of a clear digital roadmap and support from top management is the main cause of subsequent failures, as it is the strategic uncertainty that leads to chaotic investments that do not bring the real value of the business [8; 25].

Technological constraints demonstrate a high degree of correlation with barriers to human capital. Large manufacturing firms, in turn, spend huge resources on solving interaction problems and integrating Industry

4.0 solutions with massively unmodern systems, which significantly slows down the pace of transition to digital technology [33; 16].

As part of the human capital barrier, a systematic shortage of specialists with competencies in the interface of supply chain management and Data Analysis directly limits the ability of companies to effectively use complex cyberphysical systems [18; 6]. In this sense, SMEs are the most sensitive due to the high risk of brain leakage after initial employee training and are forced to depend technologically on external suppliers.

Regulatory factors create an additional layer of complexity, especially in the context of emerging economies. Legal uncertainty about data ownership and the lack of uniform standards for information exchange create an atmosphere of uncertainty among supply chain partners [22; 23]. SMEs often suffer passively from a lack of targeted state support and a weak institutional environment, and large transnational players are forced to maneuver in the face of strict international requirements and cross-border restrictions [34; 28].

Summing up the results obtained, we can conclude about the divergent nature of barriers, if for SMEs transformation is a matter of survival in conditions of resource scarcity, then for large businesses it is aimed at managing organizational complexity. Thus, financial constraints and lack of qualifications are the most important for small enterprises, and for large companies, the problems of strategic alignment and system integration are very important. Successful digital transformation of the supply chain cannot be achieved by solving isolated problems, it requires a comprehensive management approach that simultaneously minimizes financial risks, develops human capital, and forms a flexible digital culture within a clearly defined strategic development pathway.

The contextual conditions of developed and developing countries are very different from each other. Developing countries face inadequate technological infrastructure [35], inadequate regulation [36], and slower adoption rates [37]. Emerging economies such as India, Brazil, Pakistan, and Indonesia pose unique challenges in infrastructure, regulation, and resources [12]. While developed countries are achieving positive results in digitalization, less developed countries are facing digital [38]. There are significant differences in the regulatory framework, as developing countries generally lack industry standards for industry 4.0 [10].

Various empirical studies have identified various advantages associated with successful transformation into a digital business model. Strategically, companies gain a competitive advantage and sustainability [12]. From an operational perspective, enterprises benefit from shorter production and scheduling times, optimizing the use of raw materials and equipment, increasing productivity, and minimizing waste and energy use [39]. The advantages of supply chain management are high reliability, efficient use of resources, cost minimization, and faster delivery times [40]. In addition, firms are gaining visibility, decision-making capabilities are improving, and operational efficiency and traceability are improving [2]. Examples of quantitative results include savings of up to 28% when using third-party logistics, an 18% reduction in storage costs [42], an increase in OEE of up to 60% [39], and improved profitability indicators such as return on investment and sales growth [40].

The most important lessons related to SMEs include the need to understand and model barriers before making changes [7], adapting solutions to suit the size of the company, and implementing people-centered strategies. Flexibility and agility enable small and medium-sized enterprises to cope with the challenges posed by change [41]. Strong managerial leadership, sufficient technological capacity, and collaboration are fundamental for effective integration [14]. Operational implementation along with staff training and strategic budgeting [17] improves results. The focus is on removing major obstacles such as Internet accessibility and organizational issues [43] before more complex implementations can begin.

The role of contextual differences in explaining such heterogeneity is evident from the observation that data from economically developed European countries [11] demonstrate a relatively higher degree of opportunity for transformation due to favorable regulatory frameworks and advanced technological infrastructure compared to data from developing countries [10]. In developing countries, India is becoming a widely studied example [12], where financial and infrastructural difficulties remain significant obstacles.

Moreover, the size of the company is the most important factor in the studied group of SMEs. The difference between MSEs and Mes [41] is that although MSES do not have resources, they benefit from their flexibility, while Mes has more resources, but they face a complex organizational structure and therefore find the transformation process more difficult. The industry context plays a crucial role in mitigating the effects of

transformation. In the automotive industry [8], the need for transformation is explained by the need for equipment manufacturers to create integrated supply chains. In the case of the food industry [39], traceability and sustainability are becoming central themes, while in the textile and clothing industry [44], supply chain fragmentation and labor intensity are emerging.

The interconnection of barriers explains the diversity of transformation outcomes. Financial constraints are related to technological constraints due to the inability to invest in infrastructure development [12]. Consequently, the limitation of organizational capabilities due to technological limitations perpetuates a vicious circle of disadvantages of small firms. However, this cycle can be interrupted by applying certain mechanisms. External intervention contributes to the transformation process by providing the necessary sources and skills that are not available in the organizations themselves [9]. Establishing partnerships opens up opportunities for capacity building [4], which will eliminate internal weaknesses. Applying step-by-step approaches [15] reduces both risks and resource requirements at each stage, making transformation possible within existing constraints. Low-cost open source technologies [6] indicate that financial barriers can be circumvented rather than eliminated. Cloud technologies [7] turn the concept of capital investment into operational expenses, which better reflects the financial situation of small and medium-sized businesses.

An analysis of the research literature reveals the following pattern characteristic of successful digital transformation of the supply chain among SMEs:

External incentives: Transformation begins with external incentives, whether its government projects, industrial organizations, collaboration with universities, or the influence of large customers on the supply chain [9].

Strategic coherence: leadership's commitment to transformation and the formulation of strategic orientation provide an organization's vision [8].

Capacity building activities: Training, skill acquisition, and organizational change create the opportunities needed for transformation [7].

Iteration and implementation: Starting transformations with pilot projects incorporating technologies compatible with existing systems and gradually scaling up [42].

Adaptive management: Using systems such as PDCA helps with continuous learning and adaptation [14].

Unlike the above-mentioned model, enterprise solutions usually involve large-scale architectural implementation [15] with significant use of the company's own resources [11]. In other words, this approach focuses on flexibility and adaptability [4], allowing similar results to be achieved without complete transformation.

However, research shows that overcoming barriers to the transformation of small and medium-sized businesses is less important than choosing the right ways to overcome obstacles. Instead of facing fewer barriers, successful SMEs can develop appropriate solutions, including collaboration with external partners, phased implementation, and strategic use of appropriate technologies, allowing progress to be made despite ongoing challenges.

There are some barriers that can only be eliminated through a collaborative approach. For example, regulatory uncertainty [45] and the lack of a coordinated national policy [10] require government actions that go beyond the activities of individual firms. The shortage of qualified personnel in the labor market [6] is an obstacle for all local SMEs, regardless of their strategy. Therefore, collective efforts are required to solve these problems.

The relative weakness of SMEs compared to large companies remains unchanged throughout the transformation process [3]; however, this problem can be solved, at least in some areas. The flexibility of SMEs [4] ensures a faster response to changes in the market environment. In addition, strategic actions aimed at implementing high-performance technologies [46] can be more efficient and cost-effective. It seems that although there will always be differences in the scale of transformation between small and large enterprises, the former can achieve digitalization in this area.

In this regard, the model we have developed representing the process of digital transformation in SME supply chains is shown in Figure 1 based on the results analyzed above and is intended to be interpreted from left to right, taking into account the presence of two-way feedback between non-adjacent stages in recognition of the iterative nature of the process.

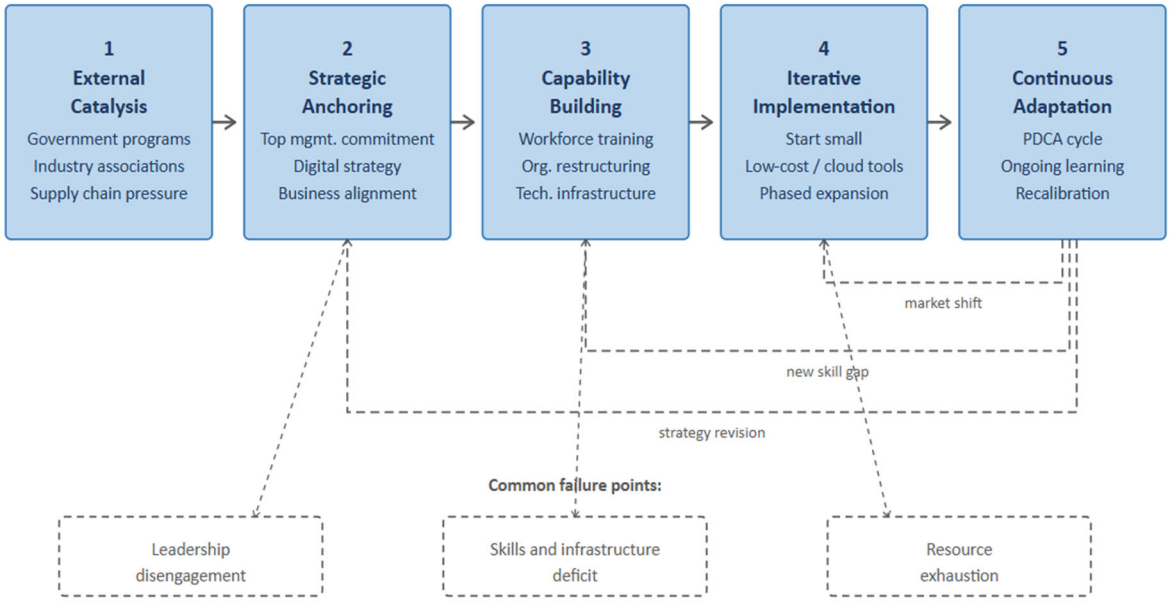


Figure 2 – Integrative model of digital transformation of SME supply chains
Note: Developed by the authors based on the literature review.

The first step in the digital transformation process is external catalysis (Stage 1). Digital transformation is usually driven by external rather than internal factors; it is either driven by supply chain partners, government digital transformation initiatives, industry organizations, and researchers [9]. The transition to the next stage occurs when the organization reaches a level of awareness sufficient to attract the attention of managers. Strategic consolidation (stage 2) involves attracting the attention of senior managers and developing a digital strategy consistent with the overall goals of the company [8]. Failure to complete this stage due to insufficient involvement of senior managers or lack of economic justification embarrasses subsequent implementation.

Capacity building (stage 3) includes staff training, organizational restructuring, and the creation of the hardware and software necessary to carry out digital transformation. In the iterative implementation phase (stage 4), companies are gradually introducing technologies compatible with their existing infrastructure through an iterative process that starts with simple, low-cost, or cloud-based tools and moves on to more advanced ones [15; 42]. In turn, continuous adaptation (stage 5) relies on systematic feedback processes such as the PDCA cycle, which provides training and correction [14].

CONCLUSION

The systematic review carried out provides a detailed answer to the central research question: SMEs and large companies not only face different barriers in the digitization of supply chains – they work on a fundamentally different transformation logic. Large corporations are implementing large – scale architectural changes based on internal resources and long-term strategic planning, while SMEs are moving in a repetitive manner-from small to large, from external impulse to internal training, from available cloud tools to more complex technologies [15]. The fundamental conclusion is that the success of the digital transformation of SMEs is determined not by the scale of resources, but by the quality of the chosen approach to overcoming barriers.

Of the six identified categories of barriers, technological and financial are universal, but their nature varies depending on the size of the enterprise. For SMEs, the financial barrier is marginal-it blocks access to the technology itself, and for large companies, the same problem becomes the problem of effective distribution of existing budgets. Organizational and personnel barriers place disproportionate pressure on SMEs because they do not have specialized change management units. At the same time, barriers do not exist in isolation: the

weakness of strategic leadership causes a chain reaction, while increasing financial, technological, and personnel constraints [18].

The proposed integrative five-stage transformation model fills an existing gap in the literature by offering a structural way from the external catalysis to the stage of continuous adaption. The existing transformation models were developed primarily for large organizations and do not take into account the specifics of the resource constraints of SMEs. The proposed model fills this gap by describing the path that small businesses are really moving along – non-linearly, with returns and iterations, relying on external partnerships as a substitute for internal expertise.

A comparative analysis revealed a paradox: exactly what makes SMEs vulnerable – small size, flat structure, lack of bureaucracy – is at the same time their main competitive advantage in the transformation process. Flexibility and the ability to adapt quickly allow SMEs to implement changes where and when large corporations are bogged down in the coordination and coordination of multi-level networks. The gap between SMEs and large businesses in terms of digitalization is likely to remain, but it does not mean that transformation is impossible for small businesses.

In this regard, practical research solutions are relevant for the following three groups:

- SME managers should start their transformation with cloud and open-source solutions, converting unaffordable capital costs into manageable operating costs, and build partnerships with universities and industry associations as an alternative to expensive in-house experts;

- within the framework of state regulators, it is necessary to develop industry-specific standards for data exchange and subsidize digital acceleration programs.

- large companies should rethink the role of SME suppliers: their digital maturity directly determines the transparency and sustainability of the entire supply chain, which means that investments in the technological development of partners are investments in their own competitiveness [4].

Thus, the proposed model in the context of Kazakhstan's manufacturing SMEs, where infrastructural and regulatory barriers have pronounced regional specifics, takes into account the impact of enterprise size on digitalization processes and the implementation of mechanisms to overcome barriers to digitalization in SMEs. The digital transformation of SMEs is not just an organizational task for individual enterprises, but a systemic condition for the sustainability of global supply chains in the era of Industry 4.0. Thus, the further development of digital technologies and the creation of favorable conditions for their implementation in the SME sector are the most important prerequisites for sustainable economic growth and increasing the competitiveness of the economy in the context of accelerating digitalization.

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ШАҒЫН ЖӘНЕ ОРТА БИЗНЕСТІҢ ЖЕТКІЗУ ТІЗБЕКТЕРІН ЦИФРЛЫҚ ТРАНСФОРМАЦИЯЛАУДЫҢ КЕДЕРГІЛЕРІ МЕН СТРАТЕГИЯЛАРЫ

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АҢДАТПА

Мақала жеткізу тізбегін цифрландырудағы кедергілерді және оларды шағын және орта бизнесте еңсеру тетіктерін зерттеуге арналған.

Зерттеу мақсаты. Жұмыстың мақсаты-ғылыми әдебиеттерді библиометриялық және жүйелі талдау негізінде шағын және орта бизнес пен ірі компанияларда цифрлық технологияларды енгізуге кедергі келтіретін кедергілерді анықтау, жүйелеу және салыстыру.

Әдіснамасы. Зерттеу жеткізілім тізбегін цифрландырудағы кедергілерді анықтауға және талдауға бағытталған ғылыми әдебиеттерге библиометриялық және жүйелі шолуды, сондай-ақ оларды шағын және орта кәсіпорындар мен ірі компанияларда еңсеру стратегияларын қолдануға негізделген. Жарияланымдарды іріктеу Scopus дерекқорында алдын ала белгіленген қосу және алып тастау критерийлеріне сәйкес жүргізілді. Қорытынды үлгіге рецензияланған 76 ғылыми жұмыс енгізілді, олардың нәтижелері салыстырмалы талдаудан өтті.

Зерттеудің бірегейлігі / құндылығы. Зерттеудің өзіндік ерекшелігі ғылыми дереккөздерді талдау нәтижелерін жалпылау негізінде жеткізу тізбегін цифрлық түрлендірудің интегративті моделін жасауда жатыр. Ұсынылған модель кәсіпорын көлемінің цифрландыру процестеріне әсерін ескереді және шағын және орта кәсіпорындар мен ірі компаниялар арасындағы айырмашылықтар туралы жеткіліксіз біліммен байланысты әдебиеттердегі олқылықтың орнын толтырады. Зерттеудің практикалық құндылығы әртүрлі масштабтағы ұйымдарда цифрландырудағы кедергілерді еңсеру үшін цифрлық технологияларды енгізу стратегиялары мен тетіктерінің ерекшеліктерін анықтауда жатыр.

Зерттеу нәтижелері. Шағын және орта өндіріс кәсіпорындары ірі корпорациялармен салыстырғанда жеткізу тізбегін цифрландыруда айқын кедергілерге тап болатыны анықталды. Кедергілердің алты категориясы анықталды: қаржылық, технологиялық, ұйымдастырушылық, стратегиялық, реттеуші және адами капиталға байланысты, олардың қарқындылығы кәсіпорынның ауқымына байланысты айтарлықтай өзгереді. Географиялық орналасуы мен институционалдық ортаның даму деңгейі трансформация нәтижелерін анықтайтын маңызды контекстік факторлар болып табылатындығы көрсетілген.

Түйін сөздер: цифрлық жеткізу тізбегі, Шоб, Индустрия 4.0, кедергілер, стратегиялар, цифрлық трансформация.

БАРЬЕРЫ И СТРАТЕГИИ ЦИФРОВОЙ ТРАНСФОРМАЦИИ ЦЕПОЧЕК ПОСТАВОК МАЛОГО И СРЕДНЕГО БИЗНЕСА

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АННОТАЦИЯ

Статья посвящена исследованию барьеров на пути цифровизации цепочек поставок и механизмов их преодоления в малом и среднем бизнесе.

Цель исследования. Целью работы является выявление, систематизация и сравнение барьеров, препятствующих внедрению цифровых технологий в малом и среднем бизнесе и крупных компаниях, на основе библиометрического и систематического анализа научной литературы.

Методология. Исследование основано на применении библиометрического и систематического обзора научной литературы, направленного на выявление и анализ барьеров на пути цифровизации цепочек поставок, а также стратегий их преодоления на малых и средних предприятиях и в крупных компаниях. Отбор публикаций проводился в базе данных Scopus в соответствии с заранее определенными критериями включения и исключения. В итоговую выборку вошли 76 рецензируемых научных работ, результаты которых были подвергнуты сравнительному анализу.

Оригинальность / ценность исследования. Оригинальность исследования заключается в разработке интегративной модели цифровой трансформации цепочек поставок, основанной на обобщении результатов анализа научных источников. Предлагаемая модель учитывает влияние размера предприятия на процессы цифровизации и восполняет существующий пробел в литературе, связанный с недостаточным знанием различий между малыми и средними предприятиями и крупными компаниями. Практическая ценность исследования заключается в выявлении специфики стратегий внедрения цифровых технологий и механизмов преодоления барьеров на пути цифровизации в организациях различного масштаба.

Результаты исследования. Было установлено, что малые и средние производственные предприятия сталкиваются с более выраженными барьерами на пути цифровизации цепочек поставок по сравнению с крупными корпорациями. Было выделено шесть категорий барьеров: финансовые, технологические, организационные, стратегические, нормативные и связанные с человеческим капиталом, интенсивность которых существенно варьируется в зависимости от масштаба предприятия. Показано, что географическое положение и уровень развития институциональной среды являются значимыми контекстуальными факторами, определяющими результаты трансформации.

Ключевые слова: цифровая цепочка поставок, МСБ, Индустрия 4.0, барьеры, стратегии, цифровая трансформация.

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