Supply Chain Digital Transformation

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Abstract

In the context of the 4.0 revolution and the 2-years of pandemic, many companies are reassessing their supply chains, in order to ensure their survival and increase their agility and flexibility. For this purpose, the digital supply chain is a key concept, to which managers are giving more and more importance. A digital supply chain can add more resilience to the logistic activities, as it offers more instruments for visibility, control and forecasting. The purpose of this paper is to identify the new technologies applied in the management of the supply chain, highlight their importance and research about the extent to which Romanian companies have planned/implemented a SC digital transformation. Our study is based on both theoretical and empirical research that investigates the degree of digitization of SC (supply chain) in the case of Romanian companies. A survey was sent to employees and managers working in companies operating on the Romanian market and we had 31 valid responses. While the sample is not considered representative for the Romanian economy, we can draw some conclusions about the degree of use of new technologies in supply chain management activities. The results show that most companies from Romania that were included in the study are in early stages of SC digitization. This research is addressed to both academics and practitioners in the field of SCM (supply chain management), as it can be useful for a better understanding of how the implementation of new technologies in SC activities can lead to an increase of business performance, as many previous studies suggest.

Keywords

Digital supply chain, digital transformation, blockchain technology, logistics 4.0, Romanian market

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Introduction

In a turbulent global business environment, characterized by economic, financial, environmental and social risks, the digitization of the supply chain is a tool designed to contribute to an efficient risk management at the level of the SC (Ivanov and Dolgui, 2019).

The effects of the pandemic have revealed several vulnerabilities in many supply chains across the globe and put pressure on companies to find solutions to increase the resilience of their logistic networks while trying to boost their competitiveness (Harvard Business Review, 2021).

New technologies enable the configuration of innovative logistics solutions, with a direct impact on costs, transparency and the resilience of the global logistics chain. Improving the management of information flow at the supply chain level is a condition of success (Christopher, 2016). The process of digitization causes changes in the business model and many companies invest in the digital transformation of the supply chain.

It is important for the actors involved in supply chain management (suppliers, exporters, importers and other auxiliary services providers in international trade, etc.) to be aware of the advantages that come with

the implementation of new technologies in current operations like international contracting, logistics and international payments (Belu et al., 2021).

One of the objectives of our research is to highlight the benefits of implementing modern technologies in supply chain management.

1. Review of the scientific literature

Digital supply chain, also known as Supply Chain 4.0., appeared thanks to Industry 4.0 designed for intelligent production units (factories), that was developed and implemented based on big data technologies and the Internet of Things (Paksoy, Koçhan and Samar, 2021). RFID, sensors, GPS, electronic data interchange (EDI) and information detection equipment are technologies that allow easy tracking of supply chain activities. For the supply chain management, important requirements are such as: the right quality at the right time and the right goods in the right quantity and the right quality and the right price. The new phrase that will underlie the reconfiguration of the supply chain will be „just in case".

Switching from Traditional Supply Chain to Digital Supply Chain (DSC)

The importance of digitization is emphasized in many papers published in the scientific literature and industry reports, highlighting the advantages of new technologies underlying the digitization process: blockchain, Big Data, Internet of Things, artificial intelligence, augmented reality, autonomous vehicles, 3D printing, cloud computing, and so on.

The phrase „logistics 4.0" involves the use of new technologies in the management of the supply chain in order to improve its performance. This new term refers to the close link between logistics and digitization, resulting in the transformation of processes specific to the supply chain. Logistics 4.0 ensures the creation of a fully interconnected supply chain, which provides transparency and visibility to the participants involved in the logistics activities.

The traditional supply chain is a complex system in which raw materials - factors of production - are manufactured into finished products and then distributed to end users (individual consumers or companies). It includes suppliers, processing centers, warehouses, distribution centers and retail outlets (Popa and Belu, 2018).

Figure no. 1. Traditional supply chain vs digital supply chain
Source: De Souza et al., 2021, p.4

There are several definitions for the notion of "digital supply chain (DSC)" and we will present the most relevant. Büyüközkan and Göçer (2018) define digital supply chain as "an intelligent best-fit technological system that is based on the capability of massive data disposal and excellent cooperation and communication for digital hardware, software, and networks to support and synchronize interaction between organizations by making services more valuable, accessible and affordable with consistent, agile and effective outcomes". Kinnet (2015) defines DSC as a smart, value-based network that uses new technologies to create new business models.

Bhargava, Ranchal and Ben Othmane (2013) state that DSC is based on systems (e.g. software, hardware, communication networks) that support interactions between globally distributed organizations and orchestrates the activities of the partners in supply chains. These activities include buying, making, storing, moving and selling a product.

Digital supply chain has a number of features such as: speed, flexibility, global connectivity, real-time management, transparency, scalability, innovative, proactive, environmentally friendly. Speed: refers to the speed with which goods are delivered, which is important for all DSC participants.

Implementation of new technologies in the supply chain

The implementation of technologies like Internet of Things, Artificial Intelligence or blockchain has made it possible to set up intelligent logistics operations that have reduced inventory costs, with investments being redirected to faster and more reliable deliveries.

1. Blockchain Technology in Supply Chain Management

Distributed ledger technology, which is the basis of blockchain, is a database maintained and updated in-dependently by each participant (or node) in a network, and the records are built independently and main-tained by each node. The entire chain of records is supervised by mathematical algorithms, ensuring data integrity and security (Berneis, Bartsch and Winkler, 2021). This ensures a complete record of all opera-tions included in the database.

The application of blockchain technology in logistics activities has a number of advantages (Hackius and Petersen, 2017): transparency- the transport of products is easily tracked and all processes are visible; (b) efficient management of commercial, delivery, transport and customs documents; (c) optimizing supply chain activities; security of information, which is unalterable and immutable.

Smart contracts, based on blockchain technology, allow the negotiation and conclusion of contracts without the involvement of intermediaries. These contracts are self-executing when certain conditions are met. Smart contracts are identified as a source of benefits for SCM (Berneis, Bartsch and Winkler, 2021)

2. IA in Supply Chain Management

Artificial intelligence is the ability of a machine to imitate human functions, such as "reasoning, learning, planning and creativity". A supply chain generates a large amount of data, which can be analyzed, patterns can be identified and information can be generated about each SC link. Thus, companies can achieve cost reductions, but also a reduction of delivery time (Fosso Wamba et al., 2020).

AI-based innovations can contribute to real-time coordination and collaboration of activities, leading to better transparency at SC level (Bock, Wolter and Ferrell, 2020).

Machine learning can help companies discover dysfunctional supply chain patterns using algorithms meant to identify the factors that influence the success or failure in a SC. These patterns can refer to inventory management, supplier quality, demand forecasting, production planning, transportation management. IA contributes to SC resilience.

3. IoT in Supply Chain Management

The Internet of Things (IoT) enables the interconnection via internet of smart devices that share specific information and data with each other and with other remote digital platforms to support real-time decision-making processes by users or smart devices using machine communication. IoT sensors will be able to provide important information to customers, reducing the risks of non-compliant deliveries (Belu, 2019).

IoT could lead to significant changes that enable the transformation of the supply chain into a demand chain. Thanks to technology, the request can be tracked with product-based sensors, which help to detect how the product is used and the environmental demand. In practice, this means expanding the IoT ecosys-tem beyond traditional logistics visions to include end-user interactions, enabling companies to better align purchase orders with actual demand curves (Bonderud, 2021).

Current challenges in the process of supply chain digital transformation

1. Main trends at international level

Several studies have researched the trends in digital transformation of the supply chain at international level. The Council of Supply Chain Management Professionals together with the company ToolsGroup (global leader in dedicated supply chain software) conducted a study in 2021, with 200 respondents - pro-fessionals from different countries, involved in production, retail, logistics or consulting firms (CSCMP, 2021).

Trying to find out if companies have a strategy for SC digital transformation and if it has already been implemented, researchers synthetized the answers and found that only 12% are already enjoying the benefits of this process, while 39% are in execution phases, 39% are still exploring and 10% don't have any plans in this regard.

According to this study, the key factors that drive a digitization of the supply chain are: the desire of companies to evolve in line with customer expectations, the need for more efficiency of personnel activities and focus on higher level tasks by automation of recurrent work and overall improvement of business performance (over 40% of respondents have chosen these three objectives). Other important drivers of change are referring to the improvement of customer services, better reactions in case of SC disruptions and more resilience of SC (over 30% of respondents) – more information is detailed in Figure no. 2.
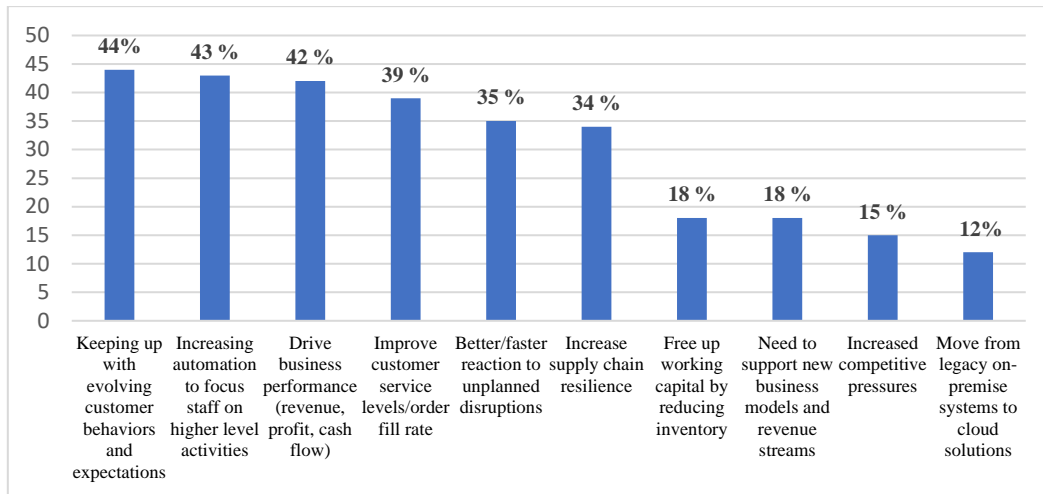
Figures add to more than 100% due to multiple responses

Figure no. 2. Key factors that drive a digitization of the supply chain
Source: Toolsgroup and CSMP, 2021

One of the issues discussed in this study was the influence of Covid-19 pandemic on the process of digital transformation of SC and 42% of respondents were of the opinion that the pandemic accelerated the process of digitization of SC, 17% of respondents felt that the pandemic shifted their organization's digitization priorities, 15% of respondents stated that the pandemic delayed the process of digitization of SC, 26% of respondents were of the opinion that the pandemic did not affect the digitization strategy of SC (Figure 3).
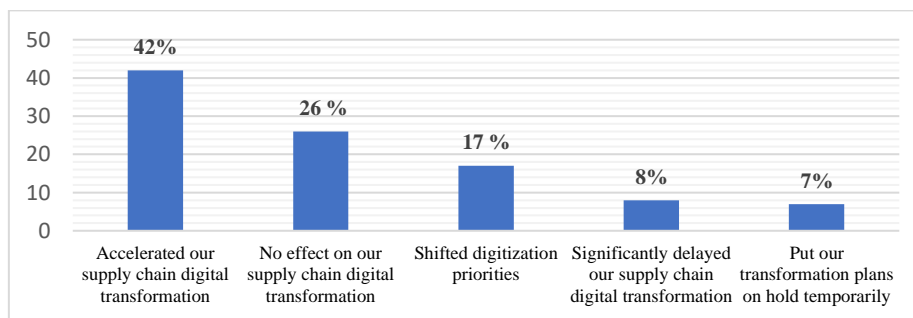

Figure no. 3. Influence of Covid-19 pandemic on the process of digital transformation of SC
Source: Toolsgroup and CSMP, 2021

The main obstacles in implementing SC digital transformation strategies were identified in this study. Among these, the most important are related to human resources: lack of specific skills (41% of respondents) and fear of change (28%). Other obstacles are related to the quality of data (34%), rigidity of existing technology (28%) and uncertainty of economic environment related to the pandemic (28%). A similar study conducted in 2019 identified fear of change, data quality/lack of data and risk aversion as top three obstacles that respondents consider important setbacks to their company's SC digital transformation. Of course, depending of the advancement of the digital transformation strategy implementation in a company, the obstacles vary in different stages.

2. Supply chain trends on the Romanian market

A study on „Trends and strategies in logistics and supply chain management - opportunities for digital transformation" was conducted in 2021 by ARILOG and MEDNET Marketing Research Center (Arilog, 2021).

The survey targeted 354 people, general managers and departmental directors of companies with the following fields of activity: logistics and transport service providers, manufacturers (FMCG, automotive, fashion, packaging), construction, pharma, retail. 118 responses were validated.

The responses showed a low degree of digitization and a slow reaction to market changes, but Romanian companies have taken important steps towards this purpose in the past year. The main goals set up by Romanian companies for the next period are: innovation, automation and process optimization.

The main challenges identified by companies for the next 3 years are: digitization of processes, increasing demand for faster delivery, cost optimization and process transformation.

The most important obstacles standing in the way of digitization process appear to be the resistance to change, a characteristic of developing economies with rather low levels of education (Figure 4).
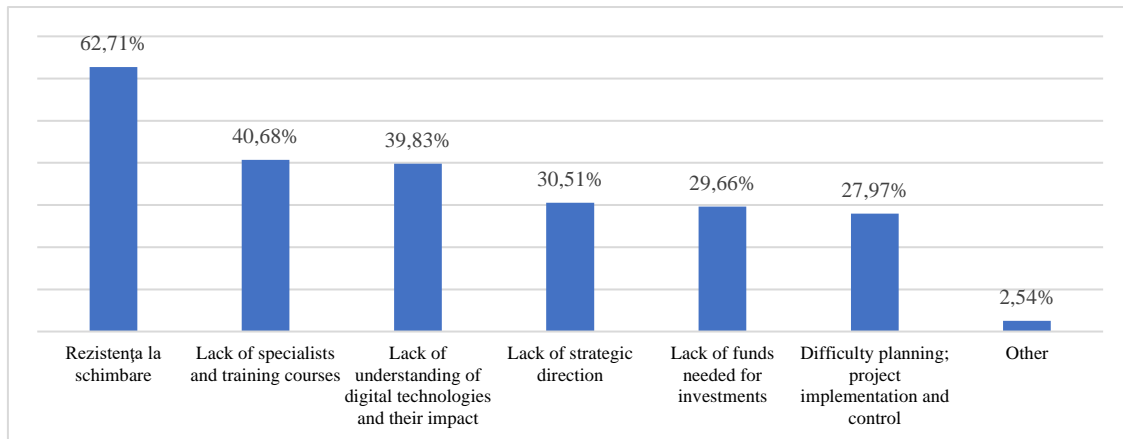

Figure no. 4. Barriers to the digitization process
Source: Toolsgroup and CSMP, 2021

For the next three years, the main directions for technologic development of companies include implementing reporting and analysis systems (almost 40% of respondents) and automating warehouse processes, such as RFIP, RPA, Pick by Voice (around 10-20% of respondents). Complex automation is on a more far away horizon, as the local market is considered not mature enough. Other directions for future development that are targeted by Romanian companies are visible in Figure 5.
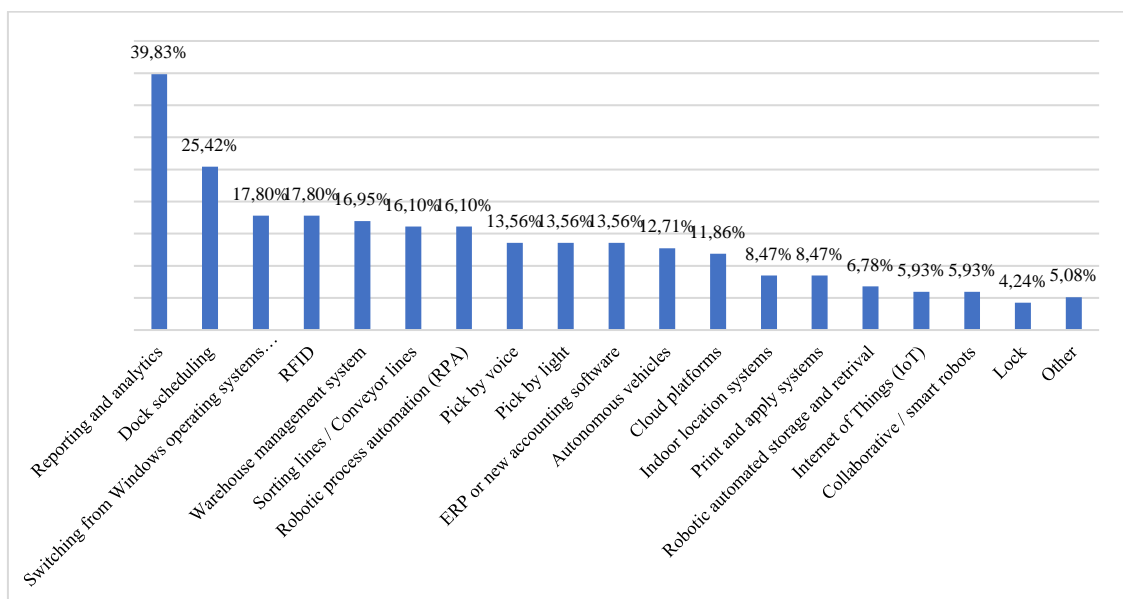

Figure no. 5. Technologies to be implemented in the next 3 years
Source: Toolsgroup and CSMP, 2021

A view into the future of Romanian logistics market is described by the answers of survey participants. By 2025, over 70% consider that automation is the main trend that will dominate the logistics market and over 60% bet on the multi-functional development of warehouse facilities.

According to respondents, digital transformation comes with new opportunities within the company and the main focus should be on the digitization of business processes and increasing transparency in the supply chain.

2. Research methodology

The first part of our research was focused on reviewing the main contributions in the field of digital transformation of the supply chain and identifying the most relevant empirical studies, at local and international level. The most important results of these studies are synthetized and presented in the literature review section of our paper.

For the empirical part of our research we used a questionnaire, consisting of two parts: the first one includes 5 questions regarding the main characteristics of the company and the second one has 7 questions focused on the main aspects regarding the status of planning and/or implementation of a digital strategy for the supply chain.

The survey targeted 50 respondents and 31 answers were validated. We analyzed the results using statistical methods. The conclusions were formulated by comparing our results to findings of similar studies, conducted on Romania or at international level. We included graphical representation of our results, and we mention that figures add to more than 100% due to multiple responses for each variant.

The sample is not considered representative for the Romanian market. The main characteristics of companies included in our sample are:

• Their main activity is in sectors like: international logistics, constructions, oil & gas, agriculture, tires production, real estate industrial logistics, banking, air conditioning sales and installation, pharmaceuticals delivery, energy, freight forwarding, supply chain, IT Fintech, audit and taxes.

• 60% of the companies are based in Romania, 20% have their headquarters in EU countries and 20% in non-EU countries

• 76,7% have only local operations and 23,3% have also international activities

• According to the number of employees over 50% are big companies (over 250 employees), 30% are medium-size enterprises (between 50-249 employees), 20% are small enterprises (between 10-49 employees) and 10% are micro-enterprises (under 9 employees)

• Approx. 32% of companies have an annual revenue in Romania of over 50 mil euro, approx. 35% between 10-50 mil euro, approx. 18% between 2-10 mil euro and over 14% have less than 2 mil euro.

3. Results and discussion

The first three questions of the second part of our questionnaire were aimed at contouring the perspective of our respondents on the digital transformation of the supply chain: main perceived benefits, key factors that drive an organization to pursue this strategy and the main obstacles identified so far.

Our results show that the main three perceived benefits of implementing a strategy for digital transformation of the supply chain are: increase automation of tasks (77,4%), increase business performance (64,5%) and reduce work with printed documents (61,3%). More benefits selected by respondents can be seen in Figure 6.
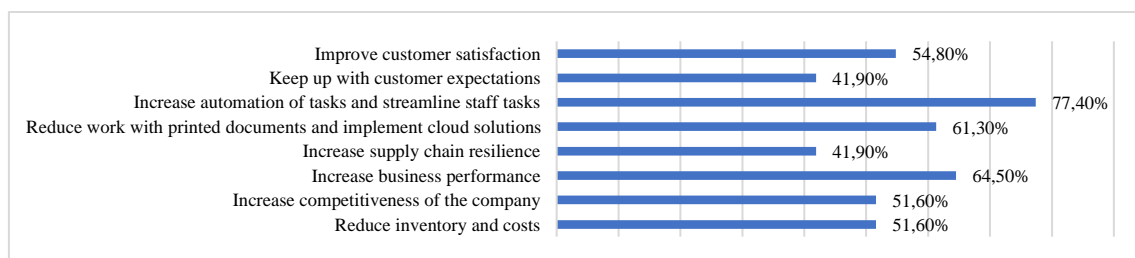

Figure no. 6. Benefits of implementing a strategy for SC digital transformation
Source: own processing according to the results of our survey

Identifying the key factors driving managers to pursue a digital transformation of the supply chain is fundamental if we want to understand future trends in this area. The answers given by our respondents are

synthetized in Figure 7. The main motivation expressed by 80% of respondents is to increase the overall business performance, followed by the desire to develop a more agile response in case of crisis (over 50%).
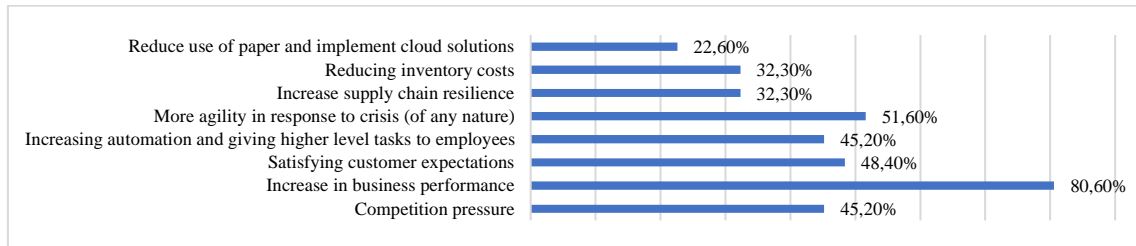

Figure no. 7. Key factors driving SC digital transformation
Source: own processing according to the results of our survey

The main obstacles that stand in the way of implementing the digital transformation are: the difficulty to implement changes in the current technologies, the uncertainty of economic and political environment and the lack of specific skills of employees. More obstacles are presented in Figure 8. The fact that Romania is included in the category of modest innovators (along with Bulgaria), while 13 EU-countries are considered moderate innovators, 7 EU-countries are strong innovators and 5 EU-countries are innovation leaders (according to European Innovation Scoreboard 2020 cited in Sarbu et al. (2020), shows that the Romanian technological environment is less developed in our country.
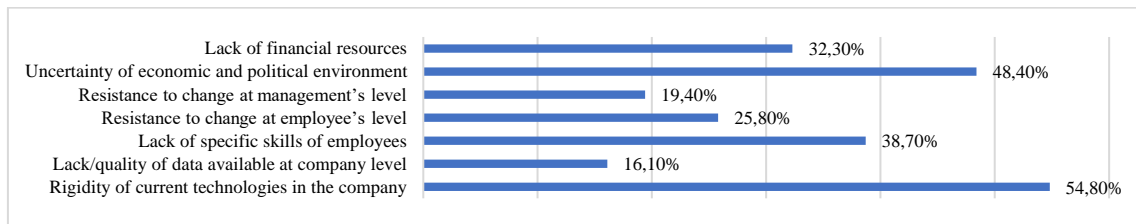

Figure no. 8. Main obstacles for SC digital transformation
Source: own processing according to the results of our survey

We also discussed the impact of the COVID-19 pandemic on companies from the Romanian market and our results show that the vulnerabilities of the supply chain were exposed, there was a greater supplier instability and these conditions actually created more incentive for accelerating the digitization process.

According to our respondents, 29% of companies are already enjoying the benefits of a digital supply chain, while over 35% are at an initial phase or have not yet taken any steps in this direction. Most companies are in middle stages: approximately 16% are planning a strategy and over 19% are already in implementation phase.

As for the future plans of Romanian companies, we identified several areas of interest in which new technologies will be implemented in the next three years: reporting and analytics (54,8%), robotic process automation, artificial intelligence and machine learning, cloud platform (35,5%). Other areas of interest with over 20% of respondent's options are: demand forecasting, planning of production and sales, warehouse management systems, ERP software, internet of things, smart robots.

Conclusions

Digitization will revolutionize the logistics industry. However, digital transformation requires new digital business models for companies that want to remain profitable and maintain their current position in the market. Large investments are required for digital transformation of the supply chain, but in the long run they will bring a reduction in costs and greater customer satisfaction. Digital transformation comes with new opportunities within the company and the main focus should be on the digitization of business processes and increasing transparency in the supply chain.

The pandemic context, but also the 4.0 revolution determined more and more companies to reconfigure supply chains based on new technologies. In fact, according to logistics specialists, the supply chain of the future is smarter, less volatile and easier to navigate.

Romanian companies face a number of barriers in the digitalization process, such as: resistance to change, considered to be the biggest barrier and low levels of digital education. Still, more and more companies are considering the digital transformation of the supply chain as a necessary process in order to optimize costs

and human resources use, keep up with competition and with customer demands. Most of them are at initial stages of preparation, but almost a third of our respondents consider the benefits of implementing a digital transformation strategy are already visible in their activity.

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