

APPROACHES RELATED-TO THE FUNCTIONING AND DIGITAL TRANSFORMATION WITHIN SUPPLY CHAIN MANAGEMENT

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ABSTRACT

The leaps and transformations manifested over the recent decades have led to the development of new concepts such as "Society 5.0", "Industry 5.0" and "Supply Chain Management 5.0". These are especially important now and they will continue to be important in the future too because they generate social and economic evolution that will make room for technological models and innovations with beneficial impact socially and economically. The determination of new threats and the global pandemic challenges require changes in the functioning of the existing supply chain management, which will be built and will operate under new challenging conditions, considering the latest technological and economic developments as well as the requirements and demands of individual and organizational buyers. In this article, we highlight a few functional aspects of digital SCM related to automated platforms and traceability as well as the relational elements of the continuous digitized of the supply chain management for the benefit of the companies integrated into the system, of the buyers, and of the general socio-economic climate.

KEYWORDS: *digital operations, digital supply chain management transformation, digitalization of supply-chain management, digitalized components, supply chain management (SCM).*

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1. INTRODUCTION

Developments during the early decade of the 21st century, marked by pandemic turbulence, highlight the need for a technological leap by implementing innovations specific to the concepts of "Society 5.0", "Industry 5.0" and "Supply Chain Management 5.0". In this sense, the economic development corresponding to the new consumption requirements will depend on the design, establishment, operation, and viability of supply chains 5.0 (Guilherme, 2020). The key areas of modern supply chain management, considered advanced business-technical systems, must fully meet the new challenges both functionally and in terms of flexibility, adaptability, and agility, hence the need to achieve the projected economic performance, regardless of the threats and shortages manifested in the socio-economic sphere (national, continental, global).

Due to the COVID-19 outbreak many states have implemented social-distancing policies that abruptly adapt to the digital world (Park et.al. 2022, 579) Being seen as a gate for all the decision-making processes, sustainable development aims at protecting the working environment by giving it

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a sustainable competitive advantage. Great innovation potential is needed to implement knowledge management assets that are decisive for the global market.

Researchers are trying to identify the most probable strategies for managing the risk impact in the supply chain and for improving social sustainability during this outbreak situation. SCM strategies may become unpredictable when a strong emphasis is placed on a consistent demand and supply volatility strategy (Taqi et.al., 2020). The decisional ranking comes in hand for addressing the competitive capabilities to reduce those risks. High levels of visibility and collaboration between the top management and policymakers should be fostered in the name of systemic awareness.

Global economic demands, determined by the challenges and the continuous turbulences in achieving the necessary balance between supply and demand, call for the digital SCM to turn to both high-performance technical systems and to advanced practices, allowing for the synergy of all companies within this affairs mechanism to continuously adapt to the dynamic markets through innovative techniques meant to ensure the satisfaction, the attraction, and the loyalty of individuals and of organizational buyers (customers) (Oracle, 2017. 2-3).

The digital technology used in the supply chains combines many types of technologies that enable automation of production lines as well as the data exchange between those digital technologies and manufacturing processes, generating valuable opportunities for supply development (Costa et.al., 2022, 462). Changes in the logistic and supply chain value created by digital technologies improve the vertical and horizontal adjustments of the supply chain networks.

The determinations of "Society 5.0" and "Industry 5.0" on "SCM 5.0" are meant to develop the performance of the business environment by continuous competition, by transforming and adapting the supply chains to the demands of the reference markets (zonal, national, European, global). In this manner, the risks are associated with the normal and efficient component operation of each supply chain within the competing and constantly changing economies and markets (European Commission Directorate-General for Research and Innovation Directorate F-Prosperity Unit F.5, 2021, 7-9).

Considering the modern and efficient operation of digital SCM, which integrates digital logistics management (planning, transport, handling, warehousing, storage, order fulfilment, specific information flows, etc.) appropriate to the respective economic system (up to 70% of the total SCM), both managers and marketers of integrated and partner companies must focus on those relational functions that allow for an efficient and competitive operation and evolution of the business in full agreement with the requirements of current and potential customers.

The challenges faced by today's society compel the developed countries of the world to take a series of preventive economic measures to keep their economies functional and to help them to develop. Thus, in December 2021, the President of the United States signed an order on "America's Supply Chains", which highlighted the need for increasing resilience and functional performance for each of these economic business systems in a turbulent market environment, an act also determined by China's exacerbated competitive claims. The actions of the At-Large Working Group (established by the above-mentioned order) aim, amongst other things, to focus the US government's strategy on maintaining the development and modernization of the country's supply chains for critical and strategically important national products, so that they become safer in the future, more resilient and effective in the face of economic, climate, pandemic, military risks, vulnerabilities, and other threats (Sullivan, 2021, 6-18).

In this material we present information and data on digital supply chain management (SCM), first through an effective operational approach (in sections 2 and 3), given the modern mechanism of business integration through automated platforms and traceability within the specific components (of SCM). Next (in section 4) we reveal a personal point of view on the digital transformation focused on increasing SCM performance and, obviously, specific resilience.

In the successive phases of the paper elaboration, we used some methods suitable for specialized scientific research, respectively: observation, comparative analysis, evaluation, interpretation, induction and deduction. By applying these methods, following the study of specific literature and as current as possible, we identified the notions and terms treated, formulating opinions and suggestions necessary for digital transformation for the efficient operation of digital supply chain management, even in terms of threats and vulnerabilities. specific to the current period, but also in the future. Therefore, in our opinion, the continuation of the digitization process within the supply chain will obviously determine the efficiency of all internal operations, determining new dimensions of its agility, resilience and robustness.

2. CORRELATIVE APPROACHES TO THE EFFICIENT DIGITAL OPERATIONS WITHIN SUPPLY CHAIN MANAGEMENT

To understand the full functioning of the digital SCM, we believe that we must start from the integration of the efficient functioning of this complex business mechanism in automated platforms (such as ERP and EDI) in order to correlate and achieve the full fluency of specific digital operations. In this context, strategic factors become effective when the organization's purpose, mission, and values are reflected in modern performance strategies that access new products and markets, and methods to redefine productivity in the case of SCM or build new collaborative supply chains (Porter, 2011, 62-77). Choices for optimizing performance in an organization will dictate the impact of internal work processes. The relationship between performance and internal supply processes is perceived through initiatives to promote sustainable SCM (Seuring et.al., 2008, 1545-1551), which inspires sustainability and ergonomic work design.

To meet the requirements of the market and to counteract the manifold functional risks (determined by internal and external factors), at present, companies integrated into supply chains make extensive use of technological innovations and IT applications, including ERP systems, EDI, and RFID; e-commerce, support systems for decision making, etc. All these have determined companies to change their business strategies and processes, alongside the renewal of technologies, to increase flexibility and competitiveness in partnership and competitive relations (Garg and Goel, 2021). In Figure 1 we can notice the importance, the place, and the role of the supply chain as part of the Enterprise Resource Planning concept implemented by utilizing the specific platform.

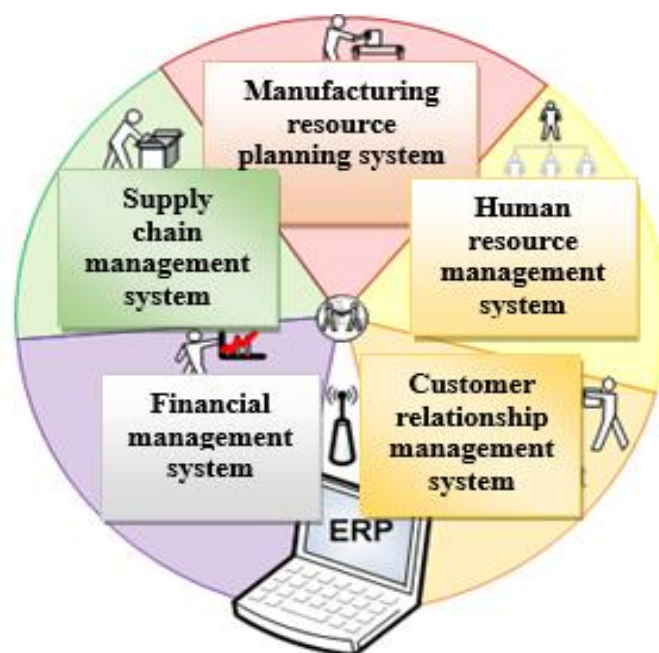


Figure 1. The Supply Chain as part of the Enterprise Resource Planning platform

Source: authors (2022)

At present, as well as in the future, companies will have to act to identify and apply business models that can permanently reflect functional, organizational, and inter-organizational modernity as part of the supply chain systems. This major objective reveals the necessity of bringing efficacy to company management by using highly developed platforms destined for resource planning, as part of the SCM, such as the Enterprise Resource Planning-ERP. At the same time, the analysis, evaluation, and concrete implementation of efficient business processes, as part of the supply chain system, require the continuous implementation of efficient and evolved solutions, which should determine significant reductions in logistic costs, a fact that must be reflected in the prices of goods destined to meet the needs (requirements) of consumers (users), which are undergoing a continual process of change (World Economic Forum, 2021, 6-15).

In the context of a constantly changing business environment, a transition call from the traditional systems and methods used within the supply chain to more advanced systems and digital software is required to be able to respond effectively to the new challenges of the ongoing pandemic. The efficient SCM ensures that customer requirements are met by implementing a standardized and digitalized mechanism, which essentially involves a holistic approach: marketing (classic and digital, through the specialized structure), which acts proactively, analysing customer demand and anticipating sales in the following period; production acts (based on the information and data provided by marketing) by ordering the necessary quantities of raw materials, materials, components, spare parts in order to carry out the conversion process necessary to fulfil the realization of the finished product, as well as by being involved in the management of relations with the suppliers; distribution (through the structure of sales and logistics, being dependent on marketing and production)-ensures the process of delivering the requested product through logistics channels, making it available to individual and/or organizational customers, being involved in customer relationship management. Therefore, within this mechanism, for the design and efficient

conduct of operations specific to each partner company, the capabilities of digital technology that can be utilized in a digital supply chain are Cloud Computing; Big Analysis; Internet of Things; social media; User Media; User Interface; Robotics; 3D Printing; Nanotech (Schrauf and Bertram, 2017, 5). Figure 2 shows a holistic model, adequate to digitalize the SCM.

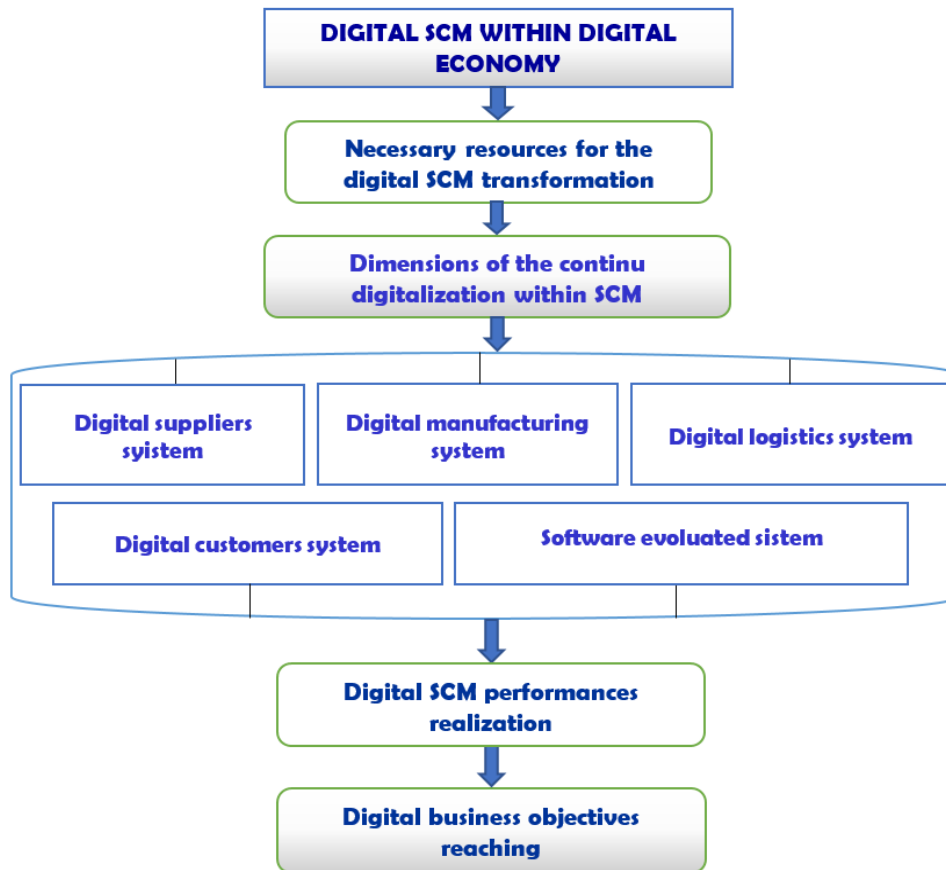


Figure 2. A holistic picture of the SCM digitization

Source: authors (2022)

The digital functioning of a supply chain management is based on the use of all new technological systems that facilitate the implementation of automated processes, predictive analyses, operations connected to artificial intelligence, and the extended use of the Internet, to enable electronic connections necessary for the creation and the carrying out of all fluxes (materials, finances, information) using networks integrating partner companies and final clients (consumers and users). For example, the “Electronic Data Interchange (EDI)” system has allowed and will continue to allow partner companies that are part of the supply chain to use the end-to-end electronic transaction mechanism along the entire cycle of business, the benefits of this being important savings in terms of time and of the resources used. In this case, the mechanism mentioned before as part of the supply chain mainly facilitates:

- *inter-organizational interaction anytime, by eliminating waiting times;*
- *the continuous flow of data and/or documents between the supply chain partners;*
- *users' acquisition (in real-time) of the necessary information regarding the existence of products;*
- *levels of stocks, the evolution of sales, and the quantum of expenses, to streamline business processes;*

- *reduction (in terms of complexity) of functional attributes correlated with eliminating errors in the processing, elaboration, and transmission of data and/or documents to business partners* (Pacific commerce, 2021).

The adequate functioning of EDI within a digital supply chain requires the projection and implementation of a standardized process that allows for rapid international flows and circuits so that the products that form the object of the clients' requests may be manufactured and shipped (Just in Time) on the date and to the location specified by them. For increased functional performance, EDI systems can be interconnected with ERP ones or integrated into them (Debicki and Kolinski, 2018, 688-690). Furthermore, based on the EDI system and the "e-Procurement" platform (both can be integrated into the ERP platform) in the supply chain, the concept of "beneficiary's stock controlled by the supplier" is materialized. In Figure 3 we present a simplified functional sequence of the EDI system.

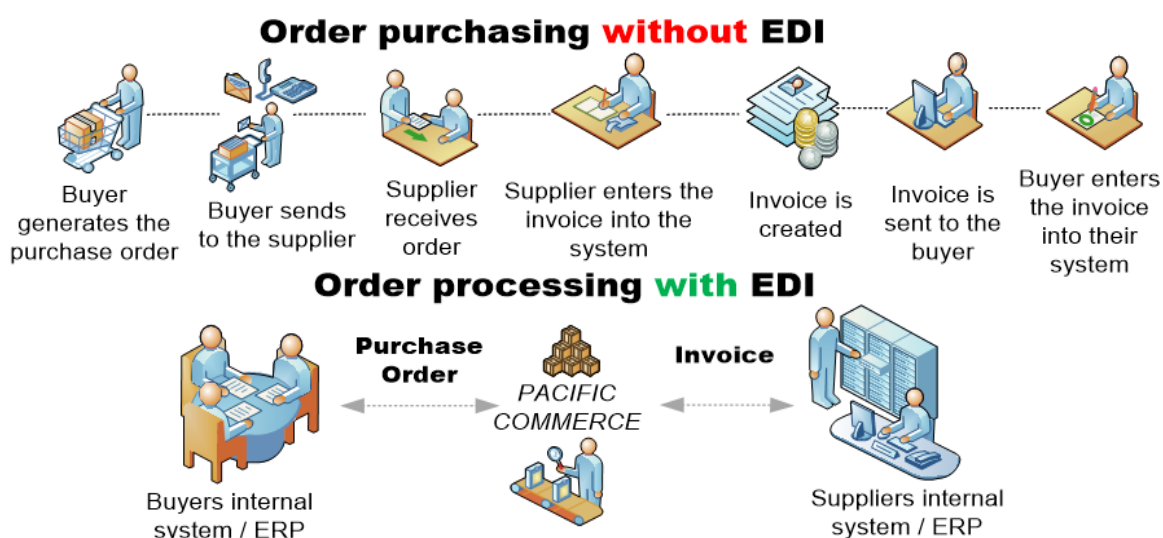


Figure 3. Facilities of EDI practice

Source: adapted from Pacific commerce (2021)

As far as the above-mentioned aspects are concerned, the proper functioning of an efficient supply chain in the digital system is directly dependent on the transactional patterns of e-commerce (B2B; B2C; B2G). For example, B2B and B2C methods are particularly interesting, both in terms of the general mechanism of digitization and especially in terms of the involvement of the digital and physical supply chain (fully or partially) in the process of transitioning the product from supplier to recipient.

Under these circumstances, even under the current manifestation of disruptive factors, the more intensified the demand for products and/or services becomes, the more complex the operations within a supply chain become and the higher the need for an efficient operation of the above is, demonstrating thus that digitalization is the optimal solution.

3. ASPECTS OF THE TRACEABILITY OF GOODS DESTINED FOR THE MARKET WITHIN THE DIGITAL SCM

The open mindset in the field of supply chain management can be adopted by IIT (intellectual information technology) as a crucial option to growth and competitiveness in previously inaccessible fields. Equally combining artificial intelligence and network technology under the

actual fourth industrial revolution means closing the gap in product or service automation that can transform any manufacturing industry. Therefore, as far as the acceptance of technology in the supply chain is regarded, we must mention the great concern regarding the resistance to technological changes and its interoperability between different work sectors (Ravichandran and Gayathri, 2020, 88).

In the modern SCM, there is an adequate mechanism of traceability, which is based on a procedural, methodological, and experimental mindset. Within this framework, each company that is part of a supply chain has its system of traceability because of increasing functional organizational visibility. Simultaneously, as we are dealing with continuous economic interaction between partners as part of the supply chain, which moves upstream as well as downstream, this process is achieved through data and information sharing between the functionally integrated companies that are part of the system with regards to the product that must be manufactured and traded to satisfy the demands of the individual (buyers) and final organizational clients (GS1 - Global Traceability Standard, 2017, 21-23).

From a conceptual point of view, traceability determines the location of a material (raw material), or that of a semi-fabricated item, of a spare part, or of a final product during the specific operations as part of a supply chain, such as order; delivery; movement through transport; handling; temporary storage; fabrication/manufacturing; distribution by the producing company or by storage centres, wholesale dealers, retailers, small shops) until the final customers (Supply Chain Management Terms and Glossary, 2008).

On a global level, there exists also the “GS1 Global Traceability Standard (GST)” system the objective of which is to aid companies (but not only) in actions related to projections and implementations of standards for beneficial functioning, but also to be efficiently integrated into modern supply-delivery chains. According to this specification, traceability has the role of allowing and facilitating the tracing of history, usage, or location of an object - according to ISO 9001 from 2015. The scope of the GS1 (GST) system is to facilitate the implementation of traceability, through adequate standards, taking into account the monitoring of the production of and the capitalization on a product as part of a digital supply chain, facilitating the process of obtaining details regarding the nature of raw materials, of materials, of spare parts, their origin; the history of information and data regarding conversion or manufacturing; the actions of distribution and localization of the product following the delivery process. Moreover, partner companies may use a common language (employing the system) when it comes to the collection and standardized identification of real and complete data and information by using bar codes and/or EPC/RFID labels (GS1 – Global Traceability Standard, 2017, 6-8). In Figure 4 we present a simplified model of the traceability process that is used in the digital supply chain management.



Figure 4. Traceability within digital Supply Chain Management
 Source: adapted from GS1 - Global Traceability Standard (2017, 21-23)

Thus, according to our point of view, there are two key components of traceability through digital means:

a) *upstream*, targeting the monitoring of the supply of raw materials and materials suited to conversion requirements and the tracing of the creation of the final product in the fabrication process.

b) *downstream*, regarding the monitoring of the identification and the localization by digital means of the product requested by consumers (users) in every segment (point) of the supply chain, according to adequate criteria, with the purpose of bringing, removing, or re-introducing the product on the market (in points of sale or to the final customers) according to the requirements of consumption and usage. What follows is the tracing of the product's acceptance along the consumption process or along with the usage by its final beneficiaries. Within this framework, functional internet sensors are of particular importance since they allow the continuous monitoring of goods in transit because of their movement through specific logistic channels towards the destination.

Based on these aspects, according to expert evaluation, we can conclude that a performing supply chain requires digital traceability meant to facilitate the partner companies' achievement of functional sustainability and the accomplishment of business objectives under conditions of projected efficiency and resilience. Apart from operational progress, traceability allows the aforementioned companies (partners within the supply chain) to minimize the impact and reduce the effect of certain external disturbing factors and processes, determining evaluations, analyses, experiments, and the creation of products that are competitive and viable for customers; it allows for the tracing of products and their movement along the supply chain; obtaining real information regarding entries and exits of goods; respecting the requirements and the obligations assumed by suppliers; for the adequate conduct of the conversion and distribution processes (Toma, 2019).

All of these will be used by the managers in the aforementioned cases (components of the supply chain) to act efficiently, to make adequate predictions; to carry out scenarios followed by the dynamic optimization of specific operations; by the prompt identification of the useless consumption of resources; they will also have the possibility to immediately respond to fluctuating demand; fulfil orders more efficiently; to diminish costs and increase income; to increase their market share; to achieve a better return of investment (Farahani, 2015, 2-9).

In Figure 5 we present a complex of facilities associated with digital traceability with a major impact on the performance obtained within the digital SCM.

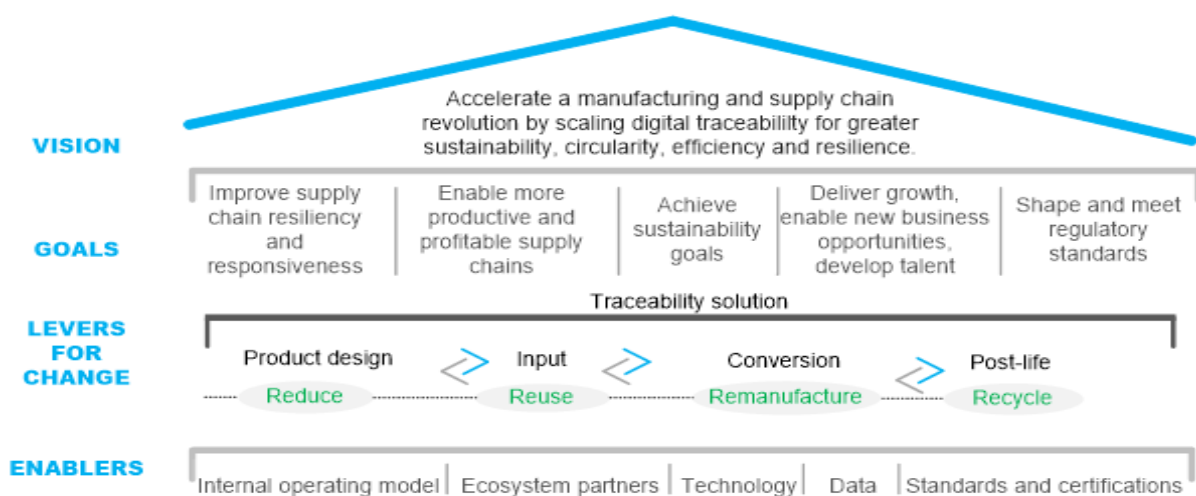


Figure 5. Benefits of traceability in the digital Supply Chain Management
 Source: adapted from World Economic Forum (2021, 6-15)

If the core of advanced technologies is automation, the user's experience is becoming an increasingly important decision criterion for the beneficiaries of modern goods. Green procurement is a must in the integrated supply chain activities that include recycling, reusing, or remanufacturing operations of both products and packages, which remains a clear focus of the management in a sustainable supply chain (Proença et al., 2022, 459). Consequently, decision-makers can improve the convenience of standardization use to encourage new technologies or to boost extended learning, not only for the increase in familiarity and digital expertise, but also because of their increasing trust in social digital networking.

4. PERFORMANT DIGITAL TRANSFORMATION CONSIDERATIONS WITHIN DIGITAL SUPPLY CHAIN MANAGEMENT

The digitalization era involves the dynamic integration of digital technologies in all areas of activity, which leads to continuous and effective changes in the conduct of individuals and organizations. Under these conditions, the digitalization of the supply chain is achieved and is dependent on the specific management, which is focused on the modernization by means of the digitalization of its operations concerning acquisition, production, logistics system, and by its mechanism of information technology. Of course, this goal involves standardization, efficiency, and business flows that are continually tailored to the requirements of customers who are increasingly dependent on the Internet, e-commerce, and digital marketing. Therefore, the modern operation of supply chain management is also dependent on the ease of connecting individuals and organizations in the digital environment to obtain the right products, at the right prices, in the required locations (Agrawal and Narain, 2018, 13-14).

Ingenious quality management systems indicate long-term results when the traditional focus shifts to quality through technical control, not only for the product but for the process too (Litvaj et.al., 2022, 572). Dealing with a complex supply chain challenges the management to innovate methods and tools to achieve the desired effect. There are several effective tools that can be successfully used in the case of such a system, and they are like the interactive large-scale communication methods, such as LGM methods, democratic debates for generating new ideas, and implementing comprehensive decisions and strategies by openly discussing what already works within that organization. Following our analysis, Figure 6 shows the determinants of increasing business performance within functional mechanism of digital SCM.

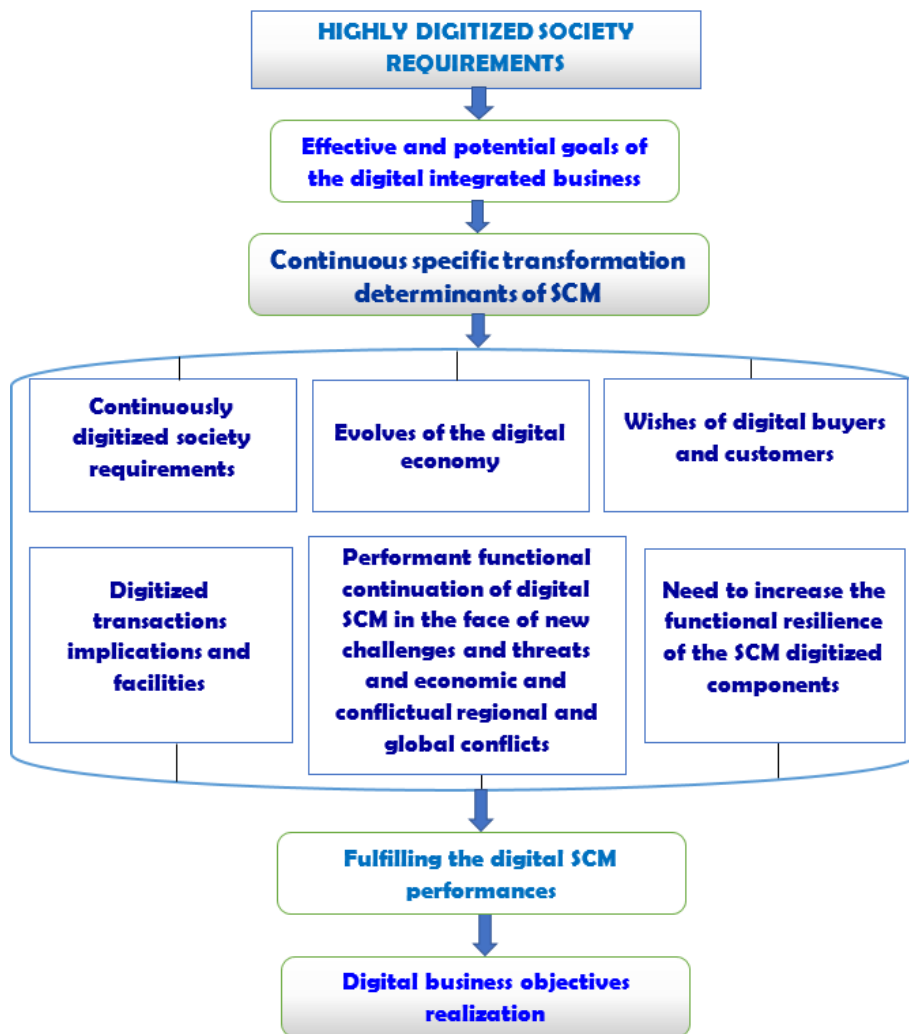


Figure 6. Elements of the dynamic digital supply chain management transformation

Source: authors (2022)

At present, due to economic turmoil, the fierce competition between the supply chains determines an intensification of the use of modern technological systems within their functional mechanisms. Thus, digitalization is a major objective for each company because it requires their functional integration within a supply chain through highly automated systems and platforms that achieve the performance parameters set by advanced business strategies. Other studies demonstrate the redesign of business models where the relationship supplier-procurer is more service-focused than product-focused (Agrawal and Narain, 2018, 4-5). Therefore, through the continuous digitalization of the SCM, the necessary visibility and transparency are achieved in a business network that is permanently resilient and continuously receptive to the changes in the market environment (Robotics Automation, 2020).

The desire for sustainability comes to light to overcome critical managerial moments. Long-term thinking attracts an exchange of values that involves the supply chain. The integration of sustainability will influence the supply chain management, both regarding the primary activities (inbound logistics, production, outbound logistics, marketing and sales, services) and to the secondary activities (company infrastructure, human resources management, information and communication technology, procurement) (Litvaj et.al., 2022, 572). In Figure 7 we present some determinants of continued digitization within the SCM.

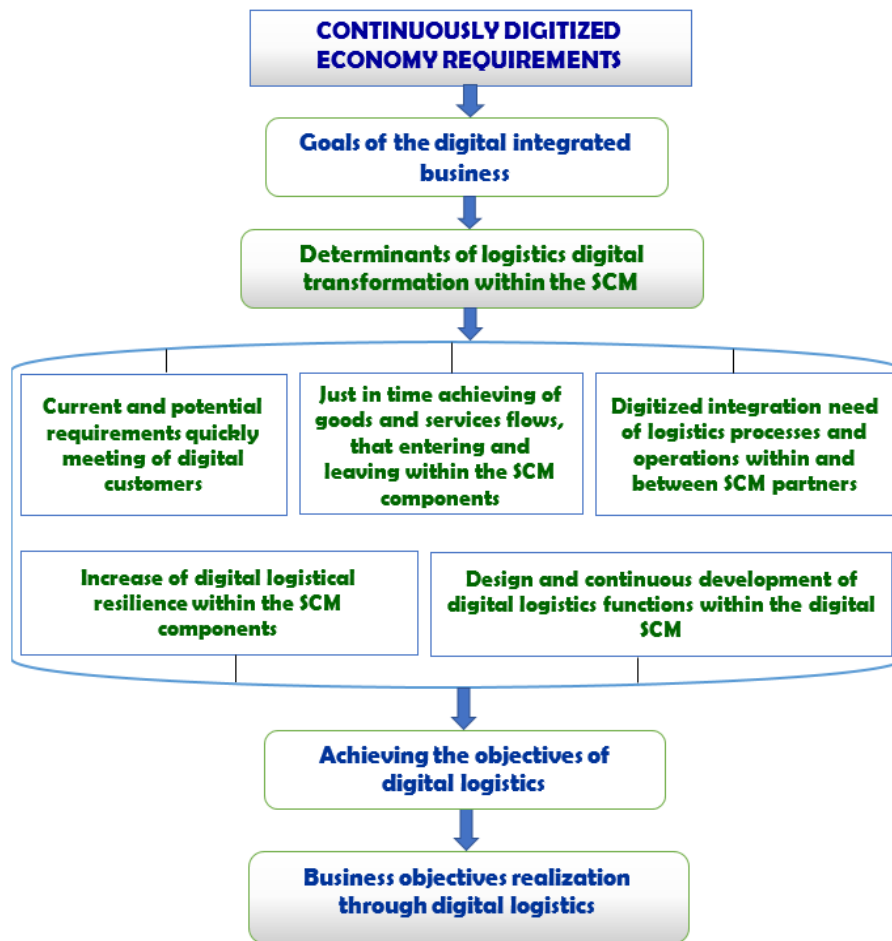


Figure 7. Logistics elements of continuu digitization within SCM

Source: authors (2022)

Creating new types of databases, effective methods of characterizing products, or developing an analytic instrument for processing diagnose enhance the data collection in real-time. One example would be that supply chain management can easily respond to extensive demands by acquiring multiple human-like sensor functionalities, big data, Internet of Things (IoT), and cloud technology. Opportunity is here created by the challenge of new technologies through modern technological strategies (Park et al., 2022, 579).

According to expert predictions, the management of the digital supply chain brings into discussion the following aspects:

- *implementing the appropriate skill set necessary for the efficient marketing of the components of the supply chain;*
- *strategic planning for all the essential operations (supply, manufacturing, distribution);*
- *using state-of-the-art technologies in carrying out operations that are specific to each component of the supply chain to ensure efficient functioning within the digital system.*
- *evincing and implementing strong operations management skills and flows specific to the supply chain profile;*
- *achieving total visibility, according to “end-to-end” requirements, adequate for the electronic relationship between the partners and the operations within the supply chain;*
- *monitoring the real-time development of all specific suppliers, producers, distributors, and carriers to increase labour productivity by optimally achieving products and by rapidly*

capitalizing on these on the market, thus obtaining turnovers and profit with less effort. This also helps managers to gain experience about meeting the exact requirements and needs of current and potential consumers or users (Martson, 2019).

We may conclude that the increased visibility along a supply chain 5.0 will be determined by the efficient functionality of the "Industry 5.0" components, based on innovation, advanced technological systems, adequate criteria of performance, as well as on appropriate analyses and evaluations of the degree to which these criteria are being met under concrete conditions of certainty, risk, or uncertainty. The frequency of market changes expedites any technological innovation, and the pressure falls on decision-makers who are the ones responsible for guaranteeing sustainable development. One can notice here the ability to quantify the economic, business, social, and environmental matrix at different time horizons. A proper link between the strategist's knowledge and the organizational results reflects the trade-offs between alternative possibilities.

According to Gartner, based on an opinion poll undertaken in 2019, we may conclude that digitalization represents a strategic objective for all the companies that are part of a supply chain, a source of competitive advantage over one's competitors. The same organism evinces important investments that companies will need to make as part of the supply chains (around 50%), until the year 2024, in "applications which support artificial intelligence and advanced capacities of analysis" (Hippold, 2021).

5. CONCLUSIONS

As a result of the technological progress, the traditional supply chain management has gradually evolved towards modernity becoming able to respond to business strategies and plans as efficiently as possible. For example, introducing sensors and automation has determined obvious progress in achieving real-time communication, in taking adequate decisions, as well as in the efficient carrying out of specific operations within the partner companies of the supply chain, thereby allowing for the integration of all the components, from suppliers to customers. All of these have led to lower costs, which within the competitive process represents a major objective as it leads to an increase in the functional efficiency of the supply chain in competition with another or various other supply chains of the same type.

One can notice that the role and the importance of the supply chain have increased within the framework. One also must take into consideration the type of industry it is profiled in, the high quality of the products that must be delivered, the urgency of distribution determined by demand, the delivery methods (push, pull and mixed) characteristic to the distributors and logistic channels to satisfy consumption and usage requests in time and under superior conditions.

Nowadays we can notice how the nationally, continentally, and globally spread product crisis is caused by the inefficient functioning of supply chains management, due to various factors, such as the decrease of consumer demand; the increase in the inflation rate, and, consequently, higher prices for raw materials; the disruptions manifested at level of the manufacturing companies as a result of the decrease in fabrication processes, both as a result of the manifestation of the aforementioned factors and especially because of the diminishing of the highly qualified workforce.

In the future, various actors will be integrated into the modern supply chain, each evincing its functional complexity. The next system constituted for achieving the projected performance needs adequate monitoring of all the phases that are part of the product capitalization according to the interests of each stakeholder or to the demands of each customer.

All these considered, we are of the opinion that a reshaping of the supply chain management is necessary to achieve the level required by modernity and this implies the integration of evolved

digital systems endowed with user-friendly applications that cater for the increasing requirements of business monitoring imposed by customers and market competition.

At the same time, new digital means may facilitate the emergence of new business models by evincing income fluxes and providing necessary data for companies that are part of the supply chain management. Efficient manufacturing and selling should immediately meet the requirements of present and potential customers. A safe interaction in the supply-demand relationship can be achieved with the help of innovative technological elements. The professional experience in the development of technical systems and in the integration of emerging technologies contributes to promoting organizational sustainability.

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