Proceedings of the International Conference on Industrial Engineering and Operations Management

Publisher: IEOM Society International, USA DOI: 10.46254/GC02.20240113
Published: December 01, 2024

The Impact of Logistics Digitalization on the Performance of the Companies

Rim Sghiouri
Laboratory of Engineering Sciences
National School of Applied Sciences
Ibn Tofail University
Kenitra, Morocco
rim.sghiouri@uit.ac.ma

Chouaib Elhammouchi
Laboratory of Engineering Sciences
National School of Applied Sciences
Ibn Tofail University
Kenitra, Morocco
chouaib.elhammouchi@uit.ac.ma

Abstract

Digital transformation has become paramount for any company seeking to improve its performance in terms of cost, delivery time, and service quality. Today, we have entered a digital age characterized by new needs for responsiveness, obliging companies to adapt to this continuously evolving context. Numerous researchers consider digitalization as the best solution to the challenges faced by companies in this new economic environment. This revolution presents several opportunities for companies across the supply chain, from the first supplier to the last customer. It enables process optimization, cost reduction, improved customer satisfaction, on-time delivery, and helps organizations become more efficient. Technological advancements have allowed companies to optimize their delivery processes, reduce costs, and enhance the customer experience. In this article, we will explore the impact of logistics digitalization on business performance and its benefits.

Keywords

Digitalization, performance, supply chain, impact of logistics digitalization.

1. Introduction

In today's rapidly evolving business landscape, companies must adapt to stay competitive. Customers are increasingly demanding due to the abundance of choices available, making it challenging to balance customer satisfaction with cost reduction. Moreover, advancements in information and communication technologies have revolutionized the way businesses operate. Companies are growing larger, expanding their operations globally, and becoming increasingly interconnected. This new reality has presented significant challenges, including the need to adapt to globalization and digitalization while capitalizing on their benefits.

Over the past decade, the concept of digitalizing business processes and supply chains has gained prominence. It is now an imperative for large-scale organizations. Traditional supply chain management is no longer sufficient to meet the demands of today's market, with its new competitors and evolving customer expectations. To thrive in this dynamic environment, companies must embrace digital transformation, which entails:

- Significantly increased responsiveness
- Substantial cost reductions
- Marked improvements in quality and customer service
- Enhanced overall performance

2. Definitions

2.1 What is Industry4.0?

Industry 4.0 represents the vision of an increasingly digitized production. This concept describes how the "Internet of Things, data, and services" will transform production processes, the supply chain, and working methods (Acatech 2014). Industry experts often refer to this as the fourth industrial revolution. They describe it as a new level in the organization and management of the entire value chain, closer to the individual wishes of customers.

In this perspective, the value chain encompasses the entire product life cycle: from the idea, through ordering, development and manufacturing, delivery of the product to the end customer, to product recycling, with all associated services.

The growing advance of digital technology catapults us into the "second machine age" (Brynjolfsson/McAfee 2014a). Thus, data is the raw material of this fourth industrial revolution (see Figure. 1.)

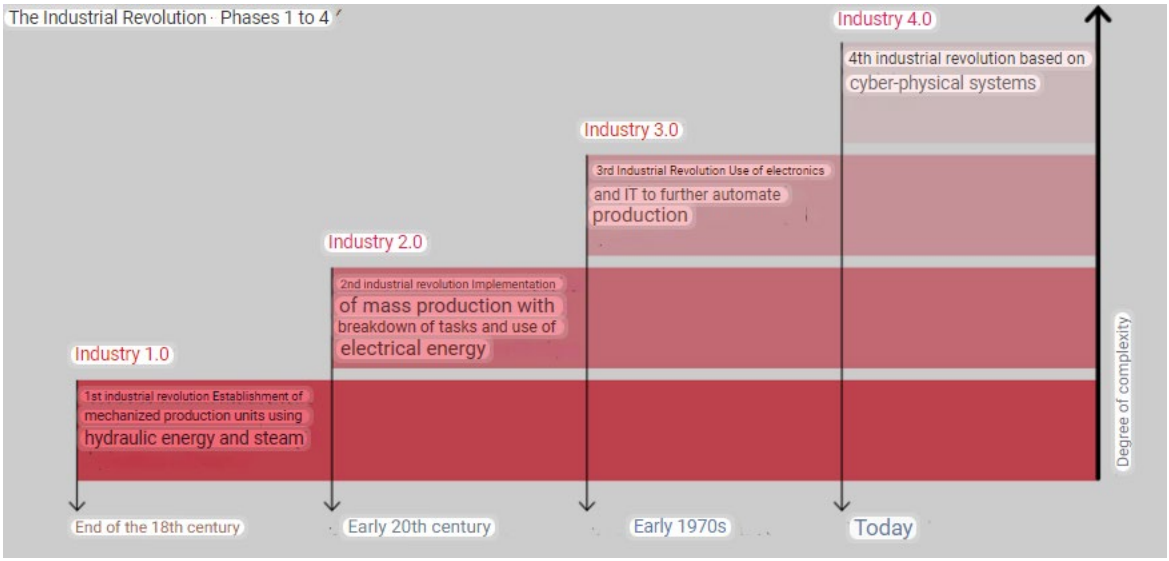

Figure 1. The Industrial Revolution

In the future, they will be accessible anytime, anywhere. For those who can exploit this inexhaustible mine of data, fantastic perspectives will open up, particularly in terms of flexibility and efficiency. Industry 4.0 could be a result of this digital progression, constituting a network between all the instances involved in value creation, within which all relevant information would be exchanged autonomously and directly.

The association of humans, objects, and systems gives birth to dynamic value creation networks, optimized in real-time, capable of self-organizing above the company level and can be optimized according to various criteria - such as costs, availability, and resource consumption.

The vision therefore represents pure efficiency, thanks to the highest level of flexibility and the perfect fluidity of value creation. According to this vision, objects could in the future communicate directly with each other autonomously (see Figure. 2.)

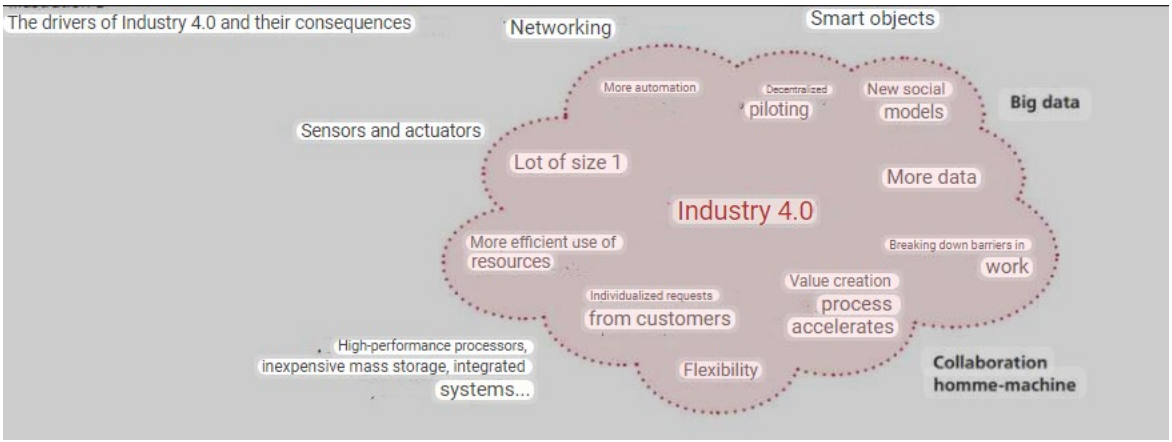

Figure 2. The drivers of Industry 4.0 and their consequences

2.2 What is Logistics?

The concept of logistics originated in antiquity, especially for the military, and has evolved over time. Some even trace it back to the time of Alexander the Great.

In the 1960s, logistics was associated with transportation, handling, and storage, in order to maintain a good level of efficiency, which created a conflict with the production function.

In the 1970s, people began to talk about managing flows in order to increase responsiveness and flexibility, giving rise to the notion of the logistics function.

In the 1980s, the anticipatory dimension was discussed; Strategic planning and forecasting, dimensions including inventory management and control, which created a support for financial management seeking to reduce inventory costs. The 1990s saw the emergence of flow management, namely Supply Chain Management (SCM), which allowed for the opening up to other functions such as sales, project management.

Since the 2000s to the present day, we have been talking about sustainable logistics and responsible SC, virtual chains and Supply Chain Management GSCM, which has also opened the door to the emergence of Human Resources Management and Customer Service Management; Customer Relationship Management, namely CRM (Table 1).

Table 1. History of logistics in the companies

Years	Logistics Function	Tools and Models (examples)	Organization
1960	Transport, Handling, Storage	Wilson (1934); Forester (1985); Use of operations research	Arbitrary and disjoint optimization of different company functions
1970	Flow Management	Use of operations research MRP	Search for dyadic logistical compromises between functions linked by the same flow
1980	Importance of information systems. Emergence of the notion of outsourcing	MRP2, DRP, Distribution logistics bases, Kanban, JAT	Dual dimension of organizational and operational logistics
1990	Supply Chain Management (SCM)	ERP, Cross docking, GPA, EDI, ECR, CPFR	"Strategic management options overdetermine the firm's organizational choices" (Colin, 2005). Inter-organizational dimension with SCM
2000-2016	Supply Chain Management (GSCM)	Sharing; "logistics factories" of e-commerce	Extended social responsibility to the supply chain; hyper-competition between supply chains

While "supply chain management" can be considered a synonym for "logistics," logistics encompasses more than just managing flows. It also requires the design of physical systems that will create and move these flows, both internally within a single production site and externally between multiple production sites within a group or network of companies.

In an unstable economic environment, under the pressure of increasing competition, shorter product cycles, and increasingly complex IT, legal, and financial systems, companies must improve their performance by optimizing their resources and reducing costs. Providing the product or service desired by the customer as quickly as possible, more cheaply and more efficiently than its competitors on the market is the major concern of every company.

Regardless of the field of activity (health, industry, transport, etc.), the performance of the company has an influence on customer satisfaction and loyalty, as well as on the company's results.
With digitalization becoming a reality, professionals predict that in the future, if it hasn't already started, competition will no longer be between companies but between supply chains.

2.2 What is the Supply Chain?

The supply chain encompasses all the operations carried out for the manufacture of a product or service, from the extraction of raw materials to delivery to the end customer, including the stages of transformation, storage, and distribution.

Today, more and more, the supply chain is viewed as a network that brings together several of the activities mentioned, due to the complexity of current organizations and their international dimension.

In addition to material flows, the supply chain includes information flows and financial flows. Each stage of transformation or distribution can involve new actors, either new suppliers or new intermediate customers, with new information flows as well.

There are countless definitions of the supply chain in the literature.
Tayur et al (Tayur et al. 1999) define the supply chain as "a system of subcontractors, producers, distributors, retailers, and customers between whom material flows are exchanged in the direction of suppliers to customers, and information flows in both directions."

Lambert et al (Lambert et al. 1998) propose a simple definition: "A supply chain is the entire set of firms that bring products or services to the market," which is a very general definition. Lee and Bellington (Lee et al. 1993) give a more operational vision: "a network of facilities that ensures the functions of raw material supply, transformation of these raw materials into components and then into finished products, and distribution of the finished product to the customer."Govil and Proth (Govil and Proth 2002) give the following definition: "the supply chain is a global network of organizations that cooperate to improve the flow of materials and information between suppliers and customers at the lowest cost and the greatest speed.

The objective of the supply chain is customer satisfaction." This definition suggests that the supply chain encompasses independent partners but viewed as a single entity or a single strategy.

In one of the most important books on supply chains, Chopra and Meindil (Chopra and Meindil 2007) give the following definition: "a supply chain consists of all the steps involved directly or indirectly in fulfilling a customer's request.
The supply chain includes not only the manufacturer and its suppliers, but also transporters, warehouses, retailers, and customers themselves."

Beyond a given company, Rota et al (Rota et al. 2001) define the supply chain of a given product (or family of products) as "the set of companies involved in the manufacturing, distribution, and sales processes of the product, from the first supplier to the ultimate customer." This leads us to see the different types of organization of supply chains.

Functions of the Supply Chain

-Procurement

It is the most upstream function of the supply chain. The materials and components supplied constitute 60% to 70% of the costs of manufactured products (Ouzizi 2005) in a majority of companies. Reducing procurement costs contributes to reducing the costs of finished products, and thus to having more financial margins.

The delivery times of suppliers and the reliability of distribution influence more than production time on the stock level and the quality of service of each manufacturer (Harmon 1992). The general trend of customer/supplier relationships is towards more cooperation through faster information sharing using new information systems based on information and communication technologies that have revolutionized past practices where we were rather in a face-to-face configuration rather than a beneficial collaboration for all participants.

-Production

The production function is at the heart of the supply chain, it is the skills that the company holds to manufacture, develop or transform raw materials into products or services. It gives the capacity of the supply chain to produce and thus gives an indication of its responsiveness to fluctuating market demands.

If the factories have been built with a large production capacity, sometimes excessive, then one can be reactive to demand in the presence of additional quantities to be made, this environment has the advantage of being available for customers in case of urgent requests, but on the other hand a part of the production capacity may remain inactive which generates additional costs and expenses.

On the other hand, if the production capacity is limited, the supply chain struggles to be very reactive and can therefore lose market share because it is not able to respond favorably to certain demands. It is therefore necessary to find a balance between responsiveness and costs.

-Storage

Storage includes all quantities stored throughout the process, starting with the stock of raw materials, the stock of components, the stock of work in progress, and finally the stock of finished products. Stocks are therefore shared between the different actors: suppliers, producers, and distributors. Here too, the question arises of finding a balance between better responsiveness and cost reduction. It is obvious that the more stocks we have, the more reactive the supply chain is to fluctuations in market demand. However, having stocks generates costs and risks, especially in the case of perishable products or products whose speed of innovation is such that a new range of the same product put on the market by a competitor can make obsolete the quantities of this product in stock and thus a significant loss. Inventory management is one of the keys to success and optimization of an entire supply chain.

Better management of this function can generate significant savings, DELL's experience in this area is a well-known example. Moreover, with the advent of "just-in-time" management techniques, many companies tend towards having zero stock, or just what it takes to produce and satisfy orders.
But this is obviously not without risks.

-Distribution and transportation

The transport function intervenes throughout the chain, the transport of raw materials, the transport of components between factories, the transport of components to warehouses or distribution centers, as well as the delivery of finished products to customers. The relationship between the responsiveness of the chain and its efficiency can also be seen through the choice of mode of transport. The fastest modes of transport, such as airplanes, are very expensive, but allow you to react very quickly and thus satisfy unpredictable demands.

Rail or truck transport modes are more efficient in terms of costs incurred but less fast. All partners can choose to combine these modes of transport and adapt them to certain situations according to the importance of the demand and the total gain generated. The problems related to distribution and transport can be seen from several angles. We can try to find the best possible routes to visit the collection and/or distribution points (Vehicle routing problems, vehicle tour problems), or, as mentioned above, look for the best modes of transport, or the quantities of products that must be transported to customers while minimizing the overall cost of transport and stocks.
Indeed, according to studies (Hugos 2003), transport and distribution costs constitute one-third of the overall operational costs of a supply chain, making their optimization a major challenge for companies.

-Sales
The sales function is the ultimate function in a supply chain, its effectiveness depends on the performance of upstream functions. If we have optimized during the previous steps, then we facilitate the task of the sales staff, because they will be able to offer more competitive prices than the competition, otherwise the margins will be very narrow and the profits not very important, or even generate losses.

2.3 What is Logistics 4.0?
The digitization of the supply chain is one of the key elements in the effective implementation of the 4.0 industrial concept. It integrates the latest communication and information technologies.

Intelligent and digital network systems connect people, machines, equipment, logistics, and products to allow them to communicate directly. The optimization of production can be favored by the rapid integration of logistics into the supply chain.

Logistics 4.0 is a digital management based on computer connectivity, information digitization, and the use of software. Information processing is more complex than "2.0" and "3.0" logistics, which depend more on mechanization and process standardization and are essential to the expansion of international trade.2

This concept was born from the emergence of industry 4.0, which consists of connecting all data systems together in order to digitize all processes. This industry 4.0 is made possible thanks to technological advances in the field of digital, robotics, etc.

Connecting everything allows the automation of a good number of processes and indirectly an increase in productivity, yields, as well as a decrease in production costs and better tracking of goods. This industry coupled with a new logistics makes it possible to meet the competitiveness challenges of the sector.

Logistics 4.0, also called supply chain 4.0, will therefore consist of organizing, in a different way, the processes of reception, storage, and shipping in order to integrate the hyper-connectivity of customers, whether they are distributors or industrialists.

This digitization will notably allow companies to benefit from increased surveillance and control of their activity. These elements combined will make it possible to maintain the good quality of the products and to make real-time decisions in order, for example, to anticipate unforeseen events in the supply chain.

3. What are the advantages and the challenges of Supply chain digitalization?
Digital transformation is now one of the priorities of supply chain managers, regardless of the industry concerned. Decision-makers also plan to increase their investments in supply chain digitalization in the coming years.

It's a matter of flexibility, responsiveness, and therefore long-term competitiveness. In today's uncertain and volatile world, this is essential. However, companies must face certain key challenges in this area.

3.1 What The advantages of Supply chain digitalization
According to the latest study co-conducted by the Council of Supply Chain Management Professionals and Tools Group, a global specialist in supply chain planning and optimization software, 93% of companies say they are actively engaged in the process of digitizing their supply chain. If the digitization of the supply chain is becoming so widespread within companies, it is because it offers a significant competitive advantage for their business.

-Reduce costs
The digitization and automation of the supply chain make it possible to gain in efficiency, accelerate processes, and limit manual errors, which contributes to reducing total acquisition costs. Logistics teams are thus relieved of low value-added tasks (such as filling out delivery slips, for example) to focus on managing more strategic missions.

-Gain in productivity

As highlighted previously, logistics teams no longer have to fill out administrative documents, (re)enter data, or search for information.
The digitization of the supply chain substantially increases the productivity of the company.

-Improve decision-making
The use of new disruptive technologies (Big Data, Internet of Things, Artificial Intelligence, etc.) facilitates and accelerates decision-making.
By relying on reliable, relevant, and real-time data flows, companies can notably optimize the management of their stocks and supplies, while gaining in agility and responsiveness.

-Improve collaboration between the different actors
This digitization also allows companies to streamline exchanges (via EDI messaging, web portal...) with their network of suppliers and commercial partners, improving the quality and reliability of supplies. In the long term, this translates above all into better service to the end customer, by avoiding potential stock shortages and other inconveniences.

-Contribute to the CSR strategy
The digitization of the supply chain also contributes to the Corporate Social Responsibility strategy.
First of all, organizations are able to reduce their impact on the environment.
With adapted digital tools, it is possible to optimize loading in order to reduce the number of trucks on the roads and the associated greenhouse gas emissions. More broadly, companies can finally manage their CSR approach using adapted digital solutions.
By digitizing their supply chain, organizations win on all fronts. Ultimately, they boost their operational, economic, and environmental performance.

3.2 The major challenges of Supply Chain digitalization

To succeed in the digital transformation of its supply chain, many challenges arise. If the nature of these challenges varies according to the maturity of each company, there remain three essential challenges related to technical tools and human factors.

-The information system and data
Today, the main challenge of supply chain digitalization remains technical.
It is particularly crystallized around the current information system of companies, but also around the availability and quality of data.
It is imperative to put in place a solid technical foundation, based on clear processes and governance, to initiate this digital shift.

-Training of teams
The lack of qualified collaborators is also one of the main obstacles to the digitization of the supply chain. In this regard, a recent survey entitled "PwC's 2023 Digital Trends in Supply Chain Survey" highlights that two-thirds of decision-makers expect the digitization of their supply chain to require a certain improvement in the skills of employees.
Indeed, organizations need specific skills (data analysis, statistical modeling, etc.) to advance on such strategic projects. However, the supply chain sector suffers from a shortage of talent.
It is therefore essential for companies to adapt their recruitment and continuing education strategy.

-Accompanying change
As in any transformation project, the appropriation of teams and the adaptation of corporate culture are key.
Companies must focus on a real change management and adopt effective communication to accompany teams in this digital shift.

This is the sine qua non condition for obtaining their adhesion and guaranteeing the success of such a project.
A subject of even greater importance since, according to the CSCMP and Tools Group, more than a third of decision-makers believe that the fear of change that exists within their structure is one of the main obstacles to the implementation of digital transformation plans of their supply chain.
Successive crises have highlighted the strategic dimension of the supply chain with, as key words: agility, traceability, and security.

In such a context, the automation and digitalization of the supply chain, as well as the digitalization of purchases, represent a new lever for value creation. If a large majority of companies have initiated this digital shift, they still need to adapt to this new reality to reap all the benefits.

4. The Impact of logistics digitalization on company performance

Industry 4.0 technologies such as big data, cyber-physical systems, and the Internet of Things have a significant positive impact on improving company performance (Teng et al. 2022). Theoretical and empirical research by (Peng and Tao 2022), (Chouaibi et al. 2022), and (Wang et al.2022) on the impact of transformation on organizational performance has shown that digital transformation has a significant effect on company performance. Similarly, (Li 2022) has empirically confirmed that digital transformation significantly influences a company's economic and environmental performance.
In this concept of surplus, and based on an empirical study conducted on a sample of Chinese companies between 2009 and 2019, (Zhai et al. 2022) confirmed the hypothesis that digital transformation improves company performance.

Likewise, the results of a study by (Teng et al. 2022) show that digital transformation can improve company performance through processes.Therefore, the digitalization of logistics offers numerous advantages for companies, directly impacting their performance. Primarily, we can mention:

-Improved visibility and traceability:
Thanks to technologies such as QR codes and RFID chips, it is possible to track products throughout the supply chain.
This allows companies to know the location and status of their goods in real-time, facilitating inventory management and reducing the risk of loss or theft.

-Cost reduction:
Digitalization allows for the automation of many manual tasks, reducing errors and associated costs.
For example, the use of inventory management software optimizes stock levels, avoiding overstocks or stockouts.
Additionally, digitalization streamlines processes, reducing delivery times and logistics costs.

-Improved responsiveness:
Thanks to digitalization, companies can react more quickly to changes in demand or market conditions.
For example, if a product experiences high demand, it is possible to quickly adjust stock levels to meet that demand.
Moreover, thanks to real-time shipment tracking systems, it is possible to quickly detect delays or delivery problems and take the necessary measures.

-Better collaboration:
Digitalization allows for better collaboration among the various actors in the supply chain, such as suppliers, transporters, and customers.
Thanks to e-commerce platforms, it is possible to share information in real-time, facilitating coordination and decision-making.
The digitalization of logistics has a significant impact on the performance and efficiency of companies.
By optimizing processes, improving visibility, and fostering collaboration, digitalization allows companies to optimize their operations and respond more effectively to customer needs. It can provide numerous benefits such as:

-Improved customer satisfaction:
Thanks to better visibility and increased responsiveness, companies can respond more effectively to customer needs.
For example, by optimizing delivery times or offering the ability to track the status of a delivery in real-time, companies can improve the customer experience and strengthen loyalty.

-Reduction of errors and returns:
Digitalization allows for the automation of many manual tasks, reducing the risk of errors.
For example, the use of inventory management systems minimizes errors in counting or tracking products.
This reduces the risk of incorrect delivery or defective products, resulting in fewer returns and associated costs.

-Optimization of resources:
Digitalization allows for the optimization of resource utilization, such as warehouses and delivery vehicles.

Thanks to warehouse management software, it is possible to plan and organize storage space efficiently, optimizing storage capacity and reducing associated costs. Similarly, thanks to vehicle tracking systems, it is possible to optimize delivery routes, reducing travel times and fuel costs.

-Adaptation to new trends:
Digitalization allows companies to adapt more easily to new market trends, such as e-commerce or online sales.
Thanks to e-commerce platforms, companies can expand their online presence and reach a wider audience.
This can lead to increased sales and business expansion.

5. Conclusion

The digital transformation of the supply chain is a major challenge for companies. It is a strategic lever for value creation, which makes it possible to gain in efficiency, productivity, and responsiveness. However, this digital shift requires a certain adaptation of the information system, the acquisition of new skills, and a real change management.

References

Brynjolfsson, Erik; McAfee, Andrew; Spence, Michael: New World Order: Labor, Capital, and Ideas in the Power Law Economy, in: *Foreign Affairs 93 (4), S. 44–53,* 2014b.

Chopra and Meindil, 2007 : S. Chopra, P. Meindil, Gestion de la chaîne d'approvisionnement. Stratégie, planification et fonctionnement, *Prentice Hall 2007*

Chouaibi, S., Festa, G., Quaglia, R., & Rossi, M. , The risky impact of digital transformation on organizational performance – evidence from Tunisia. *Technological Forecasting and Social Change, 178, 121571. https://doi.org/10.1016/j.techfore.2022.121571*

Daniel Buhr, « Une politique d'innovation sociale pour l'industrie 4.0 » *FRIEDRICH-EBERT-STIFTUNG.* 2015

Govil and Proth, 2002 : S.Govil, J. Proth, De la logistique au supply chain management : une revue de la littérature published in *Revue française de gestion en 2002*

Hugos,: B. Hugos, La chaîne logistique *, revue Journal of Business Logistics,* 2003

Jeschke S. , Quo Vadis Logistik 4.0,2016 available at: *www.ima-zlw-ifu.rwth-aachen.de/fileadmin/user_upload/INSTITUTSCLUSTER/Publikation_Medien/Vortraege /download//Quo_vadis_Logistik4.0_17March2016.pdf (accessed 18 February 2017).*

Li, L., Digital transformation and sustainable performance : The moderating role of market turbulence. *Industrial Marketing Management, 104, 28-37.*2022. *https://doi.org/10.1016/j.indmarman.2022.04.007*

Peng, Y., & Tao, C., Can digital transformation promote enterprise performance ? —From the perspective of public policy and innovation. *Journal of Innovation & Knowledge, 7(3), 100198,* 2022. *https://doi.org/10.1016/j.jik.2022.100198*

Rota et al, K.Rota, La maîtrise des flux (coordonateur : J.P. Campagne) : Chapitre 5 "Gestion des flux dans les chaînes logistiques (Supply Chain Management)", *Ouvrage Hermès : Traité Systèmes pour l'ingénieur, Ed. Hermès.2003*

Tayur et al, S. Tayur, Quantitative models for supply chain management. *Kluwer Academic Publishers. 1999.*

Teng, X., Wu, Z., & Yang, F. , Impact of the Digital Transformation of Smalland Medium-Sized Listed Companies on Performance : Based on a Cost-Benefit Analysis Framework. *Journal of Mathematics, 2022. Scopus. https://doi.org/10.1155/2022/1504499*

Wang, H., Cao, W., & Wang, F., Digital Transformation and Manufacturing Firm Performance : Evidence from China. Sustainability (Switzerland), *14(16).*2022. *Scopus. https://doi.org/10.3390/su141610212*

Zhai, H., Yang, M., & Chan, K. C., Does digital transformation enhance a firm's performance ? Evidence from China. *Technology in Society, 68, 101841*, 2021. *https://doi.org/10.1016/j.techsoc.2021.101841*

Biographies

Rim Sghiouri is a Doctor of Industrial and Logistics Engineering in Laboratory of Engineering sciences in ENSA University Ibn Tofail Kenitra, Morocco. She have also a Master on E-logistics from ESITH Casablanca, She worked in a different companies of automotive Industry in Morocco like Lear Automotive, Sumitomo Electric Wiring System, Intertronic,

Chouaib Elhammouchi is a Doctor of Industrial and Logistics Engineering in Laboratory of Engineering sciences in ENSA University Ibn Tofail Kenitra, Morocco. He is also an Engineer of International Logistics from ESITH Casablanca, He worked in a different company of automotive Industry in Morocco like Sumito Electric Wiring System, Faurecia, Hirschmann automotive, Polydesign.