

Digitalization and industry 4.0 within the supply chain: a review of contributions and barriers

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Abstract: The purpose of this paper is to identify and analyze the contributions and barriers of digitalization and industry 4.0 within supply chain (SC). The paper performs a systematic literature review through the management research data bases published between the period of 2012 and January 2021. The paper shows that digitalization and Industry 4.0 improve firm information system, enhance management processes and insure competitiveness. However, it also found that the stigmas left by previous technologies, the lack of industry specific guidelines, lack of digital skills and talents, or lack of top management commitment prevent the adoption of these technologies in the SC. The choice made by limiting analysis on the HCERES journals restricts the scope and future analysis should enlarge the area.

Keywords : Digitization ; Industry 4.0 ; Supply chain ; Barriers ; Contribution

Digitalisation et industrie 4.0 au sein de la supply chain: contributions et freins

Résumé : L'objectif de cet article est d'identifier et d'analyser les contributions et les obstacles de la digitalisation et de l'industrie 4.0 au sein de la supply chain (SC). L'article effectue une revue systématique de la littérature à travers les bases de données de recherche en gestion publiées entre la période de 2012 et janvier 2021. L'article montre que la digitalisation et l'industrie 4.0 améliorent le système d'information des entreprises, améliorent les processus de gestion et assurent la compétitivité. Cependant, il a également constaté que les stigmates laissés par les technologies précédentes, le manque de directives spécifiques à l'industrie, le manque de compétences et de talents numériques ou le manque d'engagement de la direction empêchent l'adoption de ces technologies dans la SC. Le choix fait de limiter l'analyse aux revues du HCERES enrestreint le périmètre et les analyses futures devraient élargir le champ.

Mots clés : Numérisation, Digitalisation ; Industrie 4.0 ; Supply chain ; Obstacles ; Contribution

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1. INTRODUCTION

The Fourth Industrial Revolution, i.e. digitalization (Parviainen et al., 2017) strengthened the firm's organizational capacities by improving their information systems. This new challenge reorganizes entire production methods and also affects supply chain activities (Wu et al., 2016, Vetois and Raimbault, 2017). According to Gartner's glossary, digitalization is the use of digital technologies to change a business model and provide new revenue and value producing opportunities. It is the process of moving to a digital business (Bloomberg, 2018). It is distinct from digitization which is considered as the conversion of analogue data into digital form (Parviainen et al., 2017). While digitalization is more about business operations, digital transformation (DT) initiatives, will typically include several digitalization projects and social interactions or business models. But the present research treats digitalization and digital transformation indifferently, as did Parviainen et al. (2017). These authors admitted that digital transformation affects organisations in four levels: process, organization, business domain, society. The study does not analyse the society level.

Digitalization is found to be a prerequisite for Industry 4.0. For Couzineau-Zegwaard (2020), the introduction of Industry 4.0 within the manufacturing has several impacts on the entire Supply chain (SC). Before this author, Fel et al. (2019), already highlighted this through their study among a panel of SC practitioners. They found that, three quarters of the experts investigated, in their study predicted that the firm's SC will be radically transformed as a result of the hybridization between industry and services induced by 4.0 technologies. Hence, even maintenance, specification or update services will have to fit into the same chain. For Parviainen et al. (2017), with digitalization, costs can be cut by up to 90 percent and turnaround times improved by several orders of magnitude. Going paperless also improves data collection and helps manage performance or shed light to cost and risk drivers.

There are numerous objectives for digital transformation (Kraus et al., 2022). The primary aim is to solve challenges concerning efficiency and effectiveness (Heavin and Power, 2018). Hess et al. (2016) state therefore that companies that do not rapidly develop and implement DT strategies are unlikely to keep pace and compete in the new digital reality. Digitalization transformed the entire industry sector, from small to wide range enterprise. If this is clear for large scale enterprises, it remains less obvious for SMEs even if many authors prove the evidence of their importance. Analyzing how digital technologies facilitate business model innovations in the creative industries, Li (2020b) found that its have facilitated pervasive changes in business models. Kirtley and O'Mahony (2020) found that digitalization helps improve SMEs' performance. While Müller et al. (2021) found that digital transformation is changing SMEs' traditional business model and customers' value creation process, Skare et al. (2023) highlighted that digital transformation strengthens SMEs' ability and flexibility to address main business issues. Previously, Khin and Ho (2019) highlighted that, SMEs use digital technologies to produce new digital products and services, expand the consumer base, and improve business performance. They also take the opportunities of easy access of network to connect with suppliers that meet their requirements in rapidly changing markets and supply chains (Kergroach, 2021).

The objective of this paper is to analyze, through a systematic review of the literature, the contributions and reluctance of digitalization in supply chains. It aims globally to define what Industry 4.0 is, but also analyses different technologies it abounds. Moreover, it analyses the industrial fields in which they are deployed, their contributions for the improvement of industrial and SC practices. Therefore, a systematic review is realized on the main databases in management science.

The next section presents the methodology of the literature review. Then, a state of art on digitalization within industries is presented in section three, as well as the contributions of digitalization to SC. This section also presents the

barriers to the Industry 4.0 implementation within the SC. The section four suggests some implications. The final section concludes the paper.

2. METHODOLOGY

This paper is built up on a systematic literature review from 2012 and 2021. It follows methods use by several authors in management science and suitable for our objectives because it is based on two stages: a systematic literature review followed by a bibliometric analysis. This approach is called "Systematic Literature Network Analysis (SLNA)" by Ben-Daya et al. (2019) or Colicchia and Strozzi (2012). The authors found that this method is more objective and suitable for studying emerging fields and their trends.

The first stage searched for publication titles and abstracts for the initial downloading of published research literature between 2012 and 2021. This was made around keywords such as "supply chain digitization", "Supply chain digitalization" "Industry 4.0", "Block Chain", "Internet of Things", "Cloud computing", "Big data", "Cyberphysical system", "IT in business" in english and french. The initial query provided 1704 research papers. In the second step, we restricted the selection to articles published in the area of business and management as done Kraus et al. (2022). Then, we selected 778 research papers. We screened the titles, keywords, and abstracts of the remaining papers to exclude those that were not relevant for achieving the aim of the paper in step three. This step focuses only on papers around digitalization within SC by associating terms such as "SC performance", "firm results", "SC practices", "firm efficiency". Table 1 present overall database analyzed in this paper.

Table 1: number of articles extracted per database

| Data base | Nombre of articles extracted |
|-------------------------|------------------------------|
| Emerald | 95 |
| Science Direct | 140 |
| Francis & Taylor online | 133 |
| Scopus | 304 |
| Others | 11 |

All database share 80,42% of their papers with Scopus database. After removing duplicates, it remained 378 papers.

In the fourth step, the authors restricted the search to HCERES papers ranking published both in English and French. The final set is covered 207 articles that appeared appropriate for structuring the research on digitalization in the fields of business and management. The mayor criterion was to be a paper that treats the impact of digitalization or the former technologies on the SC.

The papers considered are those published between 2012 and January 2021 as presented in the table 2. As the digitalization of industrial practices is not a new phenomenon, several publications date from before 2010. In this review, the publications prior to this date were ignored because the concept of Industry 4.0 came into being in 2011 (Lasi et al., 2014).

Table 2 : papers per year

| Year | Nombre of articles |
|------|--------------------|
| 2012 | 2 |
| 2013 | 0 |
| 2014 | 1 |
| 2015 | 9 |
| 2016 | 2 |
| 2017 | 9 |
| 2018 | 14 |
| 2019 | 58 |
| 2020 | 103 |
| 2021 | 9 |

The number of published papers around Industry 4.0 increases year after year. 2020 has the largest number of publications. This can be explained by the growing interest of researchers to the subject. For the year 2021, only the published papers of January were included.

Most of journals considered have significant impact factor (from 4,8 to 28,8 see table 3 below). After identifying the articles, we profiling them by using database index.

Web of Science and Scopus data bases generate files that contain all information necessary to automatically conduct the research profiling by simply inserting these files into the software. As the other bases do not provide such information, we performed that task manually (de Oliveira et al., 2018).

Authors then analyzed the abstracts and implications of selected papers. Then the entire paper. Likewise, if the main subject, the objectives, the methodology but not the main results were not clearly identified, a rigorous analysis of the whole document should be carried out.

According to table 3, Production Planning & Control is the most representative journal of our review (50 papers) and its impact factor is high (11,1). It is followed by International Journal of

production Research (23) that's one of the most cited (92%) journal in management with an impact factor of 14,6. The Supply chain Management journal is on the third place with 12 papers. Even if its impact factor (13,4) is high than that of the most represented journal in this study. More than 66% of papers are published in the journals that impact factor is equal or high than 10.

The resulting analysis allow the following review.

Table 3 :impact factor

| Review | SiteScore | Citation 2018-21 | % Cited | Number of Papers |
|--|-----------|------------------|---------|------------------|
| International Journal of Information Management | 28,8 | 18463 | 94 | 5 |
| Journal of Cleaner Production | 15,8 | 284941 | 90 | 5 |
| Journal of anufacturing systems | 15 | 8211 | 86 | 3 |
| International Journal of production Research | 14,6 | 22896 | 92 | 23 |
| International Journal of Production Economics | 14,3 | 17448 | 87 | 3 |
| Technological Forecasting and Social Change | 13,7 | 25242 | 85 | 8 |
| Supply chain Management | 13,4 | 2342 | 85 | 12 |
| Journal of Manufacturing and Technology Management | 12,2 | 3386 | 89 | 7 |
| International Journal of Physical Distribution &Logistics Management | 11,4 | 1973 | 87 | 5 |
| Journal of Business Research | 11,2 | 30303 | 85 | 7 |
| International Journal of Operations & Production Management | 11,1 | 3442 | 88 | 4 |
| Production Planning & Control | 11,1 | 3856 | 91 | 50 |
| Journal of Purchasing and Supply Management | 10,4 | 1441 | 94 | 2 |
| The International Journal of Logistics Management | 10,1 | 1989 | 88 | 4 |
| Journal of Enterprise Information Management | 8,2 | 1954 | 91 | 9 |
| Management Decision | 7,9 | 4740 | 88 | 2 |
| International Journal of Logistics Research and Applications | 7,7 | 986 | 91 | 2 |
| Industrial Management & Data Systems | 7,2 | 3018 | 84 | 9 |
| Total Quality Management & Business Excellence | 7,2 | 2796 | 89 | 3 |
| Business Process Management Journal | 6,2 | 2138 | 83 | 7 |
| Technology Analysis & Strategic Management | 5,1 | 2064 | 82 | 2 |
| Economics of Innovation and New Technology | 4,8 | 812 | 84 | 2 |
| Logistique& Management | NA | NA | NA | 5 |
| Supply Chain Forum: An International Journal | 4,3 | 1142 | NA | 8 |
| Others (only one paper identified/journal) | NA | NA | NA | 20 |

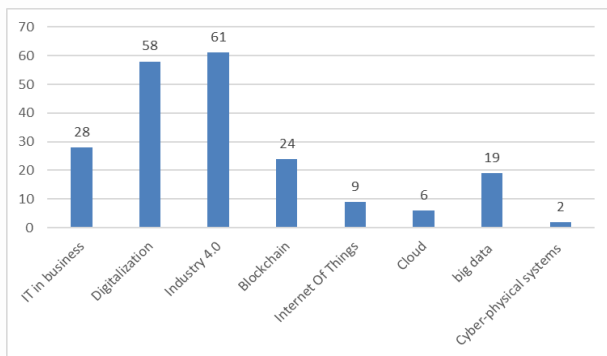
3. SYSTEMATIC LITERATURE REVIEW

This section will present the context of research, the research area, barriers for the digital

transformation and different methods used by authors within digitalization research.

3.1 Research context

There are numerous objectives for digital transformation within firms (Kraus et al., 2022). Digital transformation affects organisations in four levels: process, organization, business domain, society (Parviainen et al., 2017). For these authors, with digitalization, costs can be reduced. The introduction of Industry 4.0 within the manufacturing has several impacts on the entire Supply chain (Couzineau-Zegwaard, 2020). Digital transformation facilitates business model innovations in industries (Li, 2020b). With its set of technologies available, digitalization improves collaboration between supply chain members. The most relevant technologies within the selected



papers are presented in the figure 1.

Figure 1 : technologies available

Papers on Industry 4.0 are the most representative in a set of papers analyzed. Its followed by digitalization. Big data, Blockchain and IoT appear as important technologies within SC. It is however difficult to realize a clear split between the above technologies. Individually, the concepts of digitalization and Industry 4.0 are the most developed. If we consider that Industry 4.0 brings together Blockchain technologies, the Internet of Things (IoT), Cloud, Big Data and Cyber-Physical System (CPS), we will have a much higher number of published papers on the technology. Their number would be higher than that of publications related to IT (digitization) and digitalization which are prerequisites for the implementation of Industry 4.0. With these available technologies within the industry, it found remain difficult to easily identifying their real contributions. The next section would help to clarify this issue.

3.2 The area of digitalization

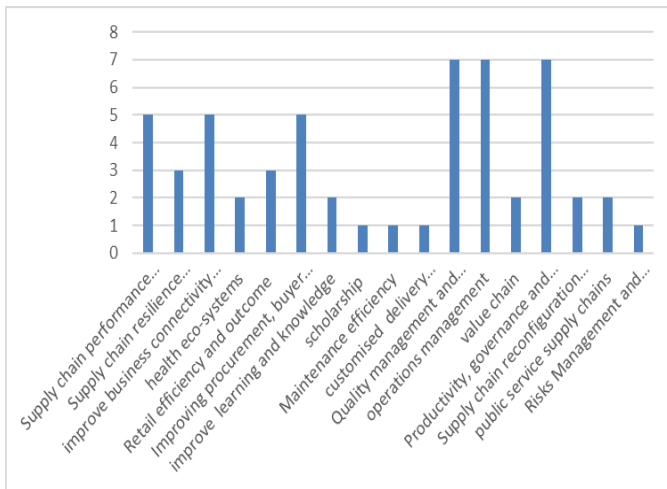
Digitalization tools are important for managing the SCs and enhancing their performance in this dynamic environment (Jabbour et al., 2020; Gupa et al., 2020). The digitalization of SC aims to facilitate exchanges between stakeholders. The review identified 59 articles addressed that (see figure 2 for illustration).

The researches presented in the figure show that digitalization aims to increase productivity, enhance the operations management, increase the resilience of the SC, facilitate exchanges but also lighten the management of relationships between customers and suppliers. It participates in the improvement of quality management practices and sustainable SC. This observation is also that of Ben-Daya et al. (2019) who find that the areas covered by digitalization include visibility of production units, production planning, production scheduling, quality inside and beyond the manufacturer unit, maintenance and connectivity of supply chains. It is thus implemented in industries as well as in the agriculture, in the health sectors or in the public administrations. According to Verhoef et al. (2021), digital transformation follows three distinct phases: digitization, digitalization, and digital transformation.

For Daxböck et al. (2019), organizations have already started adopting digitalization tools for revolutionizing their SCs. For these authors, in near future, organizations will not be able to function without digital tools. The available applications can achieve the strategic objectives decided by the managers, and then, based on real-time information from several Internet sources, can propose a solution to a problem that may arise (Swanson, 2017).

Couzineau-Zegwaard (2020) found that digital solutions cover a fairly broad spectrum of solutions that improve the company's capabilities. This in different ways: predict demand, model and simulate its various processes, collaborate within the company, but also with service providers, suppliers, partners and customers, more, automate industrial and logistical processing as well as

processing related to the transmission of



administrative or operational information.

Figure 2 : themes addressed within digitalization researches

The study conducted by Forrester Research (2008) on the implementation of digitalization concludes that American industries are reaping the benefits of digitalization, in particular through the reduction of cycle time, timely delivery of products to the customers, achieving higher efficiency and improvement in SC agility (Hennelly et al., 2020, Gupa et al., 2020). With adoption of digitalization and IT in supply chain management (SCM), firms can improve their performance by developing and storing data regarding customers, suppliers and others stakeholders in the organization (Gupa et al., 2020). By virtue of their use potential, digitalization tools shorten the distances between business partners and strengthen the links between the firms and its customers.

However, this reality still seems misunderstood by many companies. This is the case of SMEs, for example. Taiminen and Karjaluoto (2015) question the understanding of the digitalization challenges within SMEs. They wonder if SMEs have understood the fundamental change in the nature of communication brought about by digitalization. Because according to them, SMEs do not seem to use the full potential of new digital tools and therefore do not yet take advantage of their opportunities. However, these technologies

provide SMEs the opportunity to reach interesting marketplaces while expanding their customer portfolio (Benzidia, 2012). Thus, digital transformation of SMEs can improve business results and increase the productivity and output of the workforce (Hai, 2021).

The line between digitalization and Industry 4.0 is very thin, but the difference between the two concepts lies in the fact that digitalization, which itself preceded by digitization, is a prerequisite for the adoption of Industry 4.0. Therefore, what will be the contribution of Industry 4.0. to supply chain?

Papers published on Industry 4.0 mainly present the performance resulting from its implementation. Authors demonstrate the ease of operations within the supply chain bringing out by the technology. They also present some success models within the supply chain. The researchers also identifying the expectations of managers vis-à-vis this revolution. The fields of investigation are as varied as the number of topics covered. Industry, health, defence, SMEs, retails, energy or even services, agriculture.

It emerges from the literature that Industry 4.0 is defined through several concepts such as Industrial Internet, Smart Manufacturing, Smart factory, Factory of the future/Factories of the future, Advanced Manufacturing, Intelligent Manufacturing, Industry of the future / High value manufacturing, Smart Industry/SmartIndustry, Manufacturing 4.0, Integrated industry, Digital Factory, Manufacturing Renaissance, Make in India (Kagermann et al., 2013; Falet et al. , 2019).

According to Blanchet (2016), Industry 4.0 is not a fad per se. It is a concept that represents the adoption by industry of techniques and processes enabled by digitalization, cloud computing, the Internet of Things and big data to gain competitive advantages in national and worldwide markets (Reinhardt et al., 2020). Each of these technologies has numerous advantages which the potential is gradually revealed in the literature.

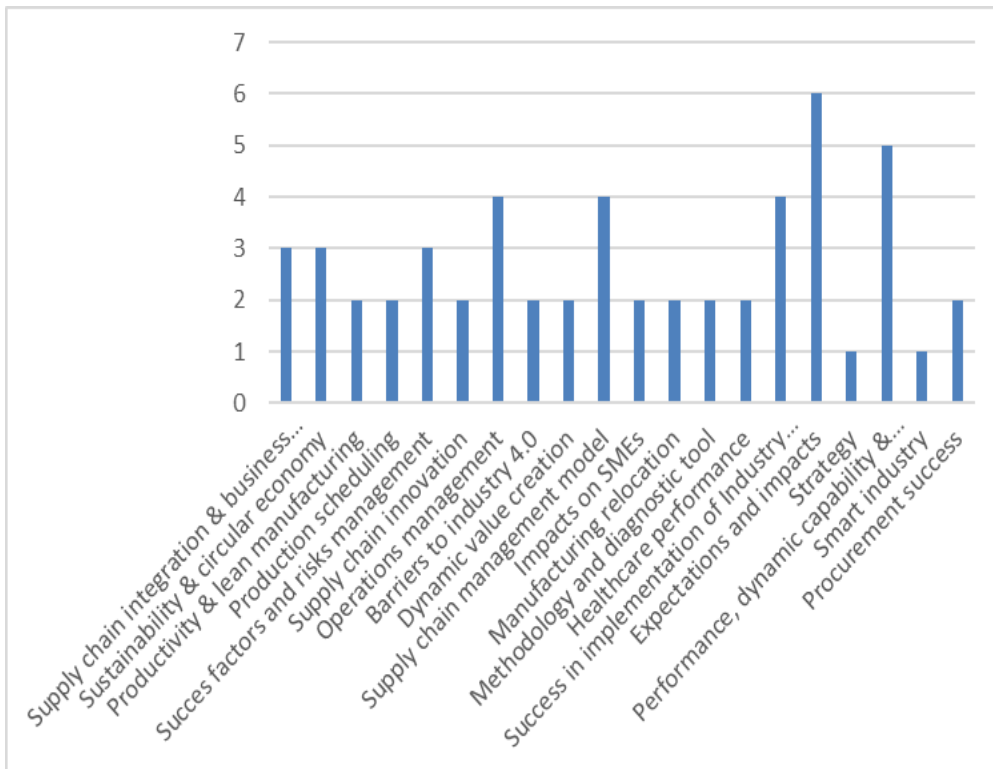


Figure 3 : topics developed within Industry 4.0 papers

The Internet of Things is one of the major enablers of SC cohesion. Ben-Daya et al. (2017) defined it as a network of physical objects that are digitally connected to sense, monitor and interact within a company and between the company and its supply chain enabling agility, visibility, tracking and information sharing to facilitate timely planning, control and coordination of the supply chain processes. Some authors like Tu (2018) argues for the transparency that IoT brings to SCM due to the global network of physical objects. Mainly devoted to the SC delivery processes, transformation or even food SCs, IoT could help manage SC remotely, provide more precise information and ensure better coordination between different entities for effective decisions taken.

IoT improve previous technologies in SC. As showed Tu et al., its outperforms current barcode-based system regarding labor cost, efficiency, and operational adaptiveness. Their potential favour exchanges between SC members. Thus, Haddud et al. (2017) confirm the significance impact of IoT potential benefits to individual organizations and their entire supply chains. Its contribute to build critical success factors for successful SCM. Cui et al. (2022) provide most important measures of the IoT

in improving SC. i.e. improving information transparency, strengthening the integration of management information systems and improving large data processing abilities.

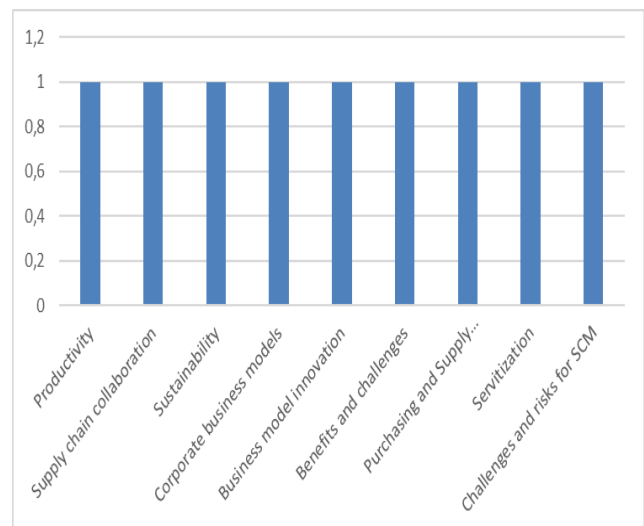


Figure 4 : topics developed in IoT papers

The nine articles selected on IoT develop different topics: productivity, SC sustainability and innovation or servitization. But, by considering that some technologies like RFID or more widely IT in business, are initial stage of IoT, 27 others papers

must be considered. The figure 4 provides details for IoT specific papers.

Analysing the impact of IoT in retail sector, De Vass et al. (2021) reveal that multiple IoT forms provide additional capabilities in data auto-capture, visibility, intelligence, and information sharing for greater integration of retail supply chains. That, in turn, enhances supply chain performance in cost, quality, delivery, and flexibility dimensions to improve firm financial, social, and environmental sustainability. From purchasing side, IoT help to work with dynamic and complex markets. Its also supports the development of a more capable and efficient Purchasing and Supply Management organisation (Legenvre et al., 2021).

Internet of Things takes supply chain communications to another level: the possibility of human to things communication and autonomous coordination among ‘things’ while being stored in a facility or being transported between different supply chain entities (Ben-Daya et al., 2017). This technology will allow the reduction in the time between data capture and decision-making that enables supply chains to react to changes in real time allowing levels of agility and responsiveness never experienced before (Ben-Daya et al., 2017, Ellis et al., 2015). With these possibilities, IoT provides more capabilities to react when risks arise.

Prim et al. (2021), present the IoT and Big Data as tools for real-time monitoring of supply chain processes, supporting proactive decision-making, reducing operational costs and improving product quality. They also claim that a collaborative partnership would reduce the learning curve and barriers to adoption, and increase the likelihood of successful implementation. Blockchain bring more security to the above collaborative partnership.

Blockchain is considered as a distributed database of common public/private records or ledgers of all digital transactions that have been executed and shared between agents participating in the chain (Benhayoun et Saikouk, 2022 ;Saber et al., 2019). Though Blockchain Technology (BT)–SCM integration is still in its infancy (Queiroz et al., 2020), from Swan (2015) perspective, its enables

timely and more efficient business relationships. It mitigates risks and reduces transaction costs. It overcomes currency fluctuations and speculation between shipper and importers as well as other stakeholders. It verifies the origin of a product by providing information on time, place and manufacturers, and offers information on its journey from suppliers to consumers (Lesueur-Cazé et al., 2022; Benhayoun et Saikouk, 2022). Decentralization bringing out by Blockchains promotes security as it makes less likely to crash, be corrupted or hacked (Benhayoun and Saikouk, 2022; Tian, 2016). The double spending and double-booking problems can also be easily solved by the blockchain as there will only be one transaction related to the previous and ongoing block in the chain that can be approved.

There are other technologies such as Direct Digital Manufacturing (DDM), Cloud, Big Data or Cyber-physical systems and they contribute to improve products or improve their ability to meet customer demand. For example, in food industry, Ali et al. (2021) noted that the main drivers for the adoption of Industry 4.0 technologies are cost optimization, food safety concern, facilitation of regulatory compliance and the ability to better match supply and demand.

The above figure 5 present topics addressed by Blockchain technology.

Most of papers deal with BT adoption, its importance in SC efficiency or SC sustainability in developed and emerging economies. Economies in which there are differences in the variables that determine the BTs as well as their stage of diffusion (Wamba and Queiroz, 2022).

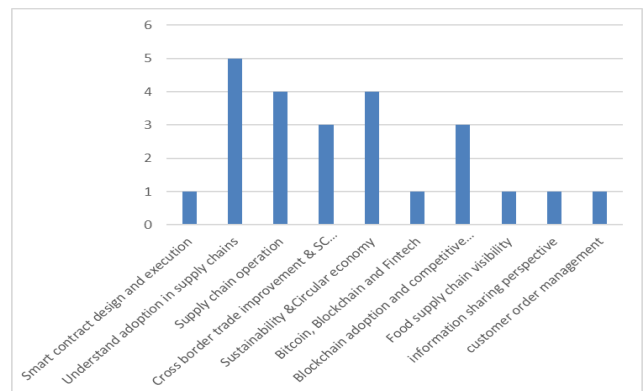


Figure 5 : topics developed in blockchain papers

Foremost, while Queiroz et al. (2021) pointed out that, the most critical constructs that directly affect BT adoption in emerging economy are facilitating conditions, trust, social influence, and effort expectancy, Kamble et al. (2019) found that the technology readiness index constructs-Insecurity and discomfort have an insignificant effect on the perceived ease of use and usefulness. For these authors, perceived usefulness, attitude, and perceived behavioural control affect the behavioural intention. They found that, subjective norm has a negligible impact on behavioural intention. Finally, Wong et al. (2020) revealed that facilitating condition, technology readiness and technology affinity have a positive influence on intention to use BT in SC and regulatory support moderates the effect of Facilitating Condition.

While most of papers on BT seek to understand its importance in SC, others provide insight for its implementation within SC operations as well as in SC sustainability. For Wang et al. (2019), the value of such technologies for supply chain management lies in four areas: extended visibility and traceability, supply chain digitalization and disintermediation, improved data security and smart contracts.

Widely, blockchain could transform practice, including enhancing product safety and security, improving quality management, reducing illegal counterfeiting, improving sustainable supply chain management, advancing inventory management and replenishment, reducing the need for intermediaries, impacting new product design and development, and reducing the cost of supply chain transactions (Cole et al., 2019). The above efforts are more-oriented toward improving operational-level capabilities (information sharing and coordination capabilities) than strategic-level capabilities (integration and collaboration capabilities) within SC (Nandi et al., 2020).

According to the first group of authors, implementing Blockchain helps to fulfilling SC goals of performance. Therefore, dealing with inefficiency within SC operations Xue et al. (2021) find that blockchain is a helpful tool to realize the goal of SC management to reduce cost, improve

quality and enhance the overall efficiency of the system. Blockchain improves the efficiency of the process: it reduces the number of operations, reduces the average time of orders in the system, reduces workload, shows traceability of orders and improves visibility to various supply chain participants (Rogerson et Parry, 2020; Martinez et al., 2019, Wang et al., 2019). Blockchain technology (BT) increases the operational transparency of the Supply Chain and the trust that is built between members of the Supply Chain, which improves coordination (Dubey et al., 2020). BT largely contributes to the improvement of demand forecasting in SCs (Benhayoun et Saikouk, 2022).

For Azzi et al. (2019), the BT is introduced to achieve the supply chain's objectives, by reducing the risk emerging from the tracking system and data management. More, competitive performance is directly improved through blockchain adoption and also indirectly through blockchain-enabled process and relational innovation (Fosso Wamba and Guthrie, 2020). Kayikci et al. (2022) admitted that BT resolving major challenges, such as traceability, trust, and accountability in the food industry.

The second group is focus on circular economy. Though BT adoption to boost circular economy has been mostly at the demonstration and piloting stage (Kouhizadeh et al., 2020; Wang et al., 2019), Nandi et al. (2021) show significant patterns on adoption levels of the BT-enabled circular economy system (BCES) and localization, agility and digitization (L-A-D) capability development. For these authors, the greater the BCES adoption capabilities, the greater the L-A-D capabilities.

For example, even Blockchain promotes cooperation between the main players in the aviation industry and the air traffic controllers to reduce fragmentation, inefficiency, and uncoordinated operations, or allows information and data sharing, Di Vaio and Varriale (2020) show that Blockchain it is still not possible to observe a high level of sustainable performance.

Authors use different methods to address the impact of digitalization on SC as presented in the section below.

3.3 Methods developed in papers on digitization

These researches are developed within several sectors. The most representative is manufacturing industry (fashion, agribusiness, automotive, energy, ...), service industry (transport, logistic, tourism retailing, ...), Healthcare...

Quantitative methods are the most representative in research on digitalization over the period studied (36,36%) followed by Qualitative methods (35,40%). Conceptual researches represent about 24%. This result may explain the maturation path followed by research on digitalization. The table below provides details of methods used by authors in this review.

Table 4 : Methods developed

| Methods | Method details | Number |
|----------------------|---|------------|
| Conceptual | Review/conceptual framework | 50 |
| Qualitative methods | Case study | 34 |
| | Delphi | 8 |
| | Semi structured interview | 32 |
| Quantitative methods | SEM Methods | 23 |
| | Mathematical/simulation | 29 |
| | Others (Multivariate analysis, regression, ...) | 24 |
| Mixed methods | Interview-survey | 9 |
| Total | | 209 |

Even if the importance of technology is highlighted in the SC, the remain many reasons that prevent managers to adopt it. Section 3.4 presents some of them.

3.4 Barriers to the implementation of digitalization

There are numerous barriers on the adoption of digitalization and Industry 4.0. This can overall be attributed to the stigmas left by previous technologies (ERP for example), ignorance or fear of the unknown among some managers and their perceived adoption costs (Papathanasiou et al., 2020).

Lack of transparency in information is one of most important barrier. As pointed out Derrouiche (2022), information integrity, transparency, and security are necessary requirements for Supply

Chain 4.0 applications, especially when there are several stakeholders sharing and processing sensitive data. Lesueur-Cazé et al. (2022) pointed out the governance issues as the mayor difficulty in Blockchain adoption within SC.

For some authors, the non-adoption of Industry 4.0 isofar attributed to the reluctance of some stakeholders, or due to the lack of standard architecture, to Internet access difficulties, contractual problems, confidentiality and security issues and the underdevelopment issue (Chauhan et al., 2021; Kamble et al., 2019). For example, in the electronic marketplace, Benzidia (2014) found that, the mayor challenge remains the security and technological reliability issue for succeed in reverse auction. But there is also the matter of organizational culture, process re-engineering and staff resistance to change that can hinder the implementation of technology (Derrouiche, 2022). More, it can be the matter of organizational inertia, financial constraints or lack of resources sharing within the food supply chain (Ali et al., 2021).

For others, factors such as : "no sense of urgency", lack of industry specific guidelines, lack of digital skills and talents (Nguyen et al., 2015), lack of an overall digitalization strategy and competing priorities (Kane et al., 2015), lack of understanding and lack of top management commitment; lack of support and absence of government policies; and poor level of research and development, high implementation and running costs; fear of failure; compatibility issues are the main obstacles to the adoption of Industry 4.0 (Agrawal et al., 2019; Majumdar et al., 2020). In the SMEs sector, Stentoft et al. (2020) found that it is the lack of managers perception of Industry 4.0, and not their perception of the high barriers of Industry 4.0, that hinders the SME development readiness for technology. Finally, for Haddud et al. (2017), IoT challenges are still perceived as major obstacles to their adoption.

From the above developments, many implications can be drawn. Section 4 highlights some.

4. IMPLICATIONS

According to Papathanasiou et al. (2020), ERP transformations have left organisations fatigued and disinclined towards further systems development and resistant to subsequent change. Yet they are well aware of the positive contributions of technologies such as blockchain on business practices. This therefore implies for managers to first and foremost carry out a check-up of the company's current technology state before embarking on a new one that would overlap the existing without, however, providing any real perceived value.

For Chauhan et al. (2021), intrinsic barriers (vs extrinsic) are more important and relevant for the adoption of Industry 4.0. This assumes that if we fail in specifying the objectives of digitalization and in the clarifying process of its potential benefits and costs, it will be difficult to remove reluctances and take advantage of its prowess. Like these authors, and with the accordance of the resource-based view theory, we urge managers to take into account the availability of both material and human resources. They will better do this by preparing the different stakeholders both through training and communication.

In addition, industries in developing economies are still struggling to embrace Industry 4.0. The actors are specifically interested in technologies that allow them to strengthen their productivity in order to ensure their economies of scale and therefore reduce costs to offer a price matching the customers income. While, the implementation of technologies such as blockchain or IoT would stimulate trust between partners and speed up the innovation process, which are another source of competitiveness.

Although represented in the papers analyzed, the implementation of Industry 4.0 in retail chains does not interest researchers as much as the upstream part of the chain or the firm internal process management. Yet Piroth et al. (2020) find that logistics issues and technological infrastructure are viewed as key drivers of online grocery retailing. Retail chains should therefore take greater

ownership of these technologies to improve their services.

5. CONCLUSION

This research aimed to analyze the papers dealing with the impacts of digitalization and mainly of Industry 4.0, Blockchain and IoT on the supply chain. It emerges that it is a new subject which is arousing more and more the researchers' interest in observing the ever-increasing number of publications. The impacts observed are numerous and cover a wide spectrum of themes specific to various types of industries and environments. Some barriers are presented, but also some implications aimed at drawing attention both to vigilance in choice of technology, but also to the unavoidable nature of this new industrial revolution for the supply chain.

The attempt to splitting the themes or technologies analyzed, which is certainly interesting for understanding the research directions, remains poorly realistic. For example, it is difficult to be able to clearly distinguish between articles dealing with digitalization from those dealing with Industry 4.0. Future researches must consider this. The choice made on the HCERES journals repository restricts the scope of the literature review analysis initiated. We plan to expand this field in our future research.

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