Impacts of Digital Technologies on Supply Chains: First Results from a Systematic Literature Review

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Abstract: In the current competitive era supply chains (SCs) need to access real-time data and information to be more flexible and integrated. In such a way a higher customer service level and an increased market share has to be achieved to guarantee competitivity. The advent of digital technologies of Industry 4.0 can assist SC members to connect and make it possible to share critical data quickly and safely. To this end, it is required to deeply investigate how digital technologies can impact the different SC areas. Therefore, the present work discusses the first results of a comprehensive Systematic Literature Review (SLR) aiming at understanding how digital technologies change SC behaviour. Cloud Computing, Big Data Analytics, and Blockchain are here selected since they are among those technologies that are potentially most able to make connectivity throughout the SC. The paper presents and discusses multiple classifications of the available literature for each technology in various relevant Supply Chain Management (SCM) aspects. The outcomes of this taxonomy pave the way for academicians to assess the benefits and limitations of the selected digital technologies and illustrate gaps for using them in SCM. Also, for practitioners, the present work assists SC's decision-makers in formulating the appropriate investment strategies in the selected digital technologies. Future research will be devoted to complete the SLR by exploring other relevant technologies.

Keywords: digital technologies, supply chain management, supply chain behavior, Systematic Literature Review..

1. Introduction

The advent of the Internet and technological innovations, by wide-spreading in all the aspects of human life, has changed customer requirements (Ghadge *et al.*, 2020). In this modern world, customers' expectations from high service levels are not just related to provide products. They need reliable and timely delivery and, in case of certain products, such as for instance food or luxury ones, also to know about the origin of the related materials. In this regard, the supply chain (SC) as a core part for providing products and the associated services to end customers must change to be more flexible, integrated, and responsive. SC members need to have real-time information about customer preferences and the other critical information like rate of customer demand, inventory levels in different echelons, and lead times. The present paper focuses on Cloud Computing (CC), Blockchain (BC), and Big Data Analytics (BDA) as they have been considered as prominent digital technologies to support information sharing between different SC echelons, and thus make SCs more connected and integrated (Neaga *et al.*, 2015; Wang, Liu and Zheng, 2018). Moreover, as depicted in Figure 1, among the digital technologies most able to support SC echelon connection, namely CC, BDA, BC, and Internet of Things (IoT), the trend lines indicate a growing number of published scientific research related to SCM applications of CC, BDA, BC compared to the IoT ones. This witnesses the great attention posed to such technologies in recent years. CC can assist SC echelons to access real-time information that brings about their integration (Novais, Maqueira and Ortiz-Bas, 2019). Similarly, BC as a new disruptive technology, by providing tamper-proof information, leads to improve trust (Gurtu and Johny, 2019), which enhances collaboration between SC echelons (Wan, Huang and Holtskog, 2020). Finally, BDA, aiming to identify uncertainties in customer demand to better respond to customer needs, reduces costs and risk in SCs (Mishra *et al.*, 2018). All of these aspects allow enhancing visibility throughout the SC.

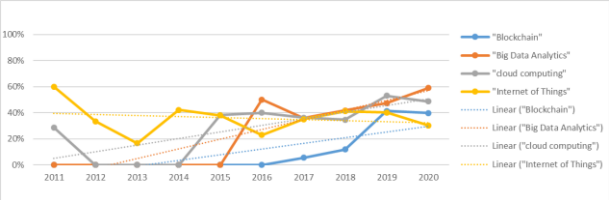

Figure 1: Trends of published research on SCM applications of selected digital technologies

Also, benefits stemming from applying these technologies can increase the competitive advantage of SCs (Sheel and Nath, 2019).Therefore, studying the impact of such digital technologies on the SC behaviour should be investigated. To this end, it deserves to identify the importance and applicability of the technologies at issue for different SC processes. Likewise, it could be beneficial to explore their usefulness to improve different associated issues in SCM. Moreover, the possible concurrent application of these technologies should be considered to help real-world implementation of them. To this end, Systematic Literature Reviews (SLRs) could be one of the useful approaches to study the effects of digital technologies on the behaviour of SC echelons by extracting knowledge and gaps from studying present works from different perspectives. However, previous SLRs did not consider a comprehensive set of aspects to investigate the literature based on a well-organized framework. Gülçin Büyüközkan and Göçer, (2018) and Queiroz, Telles and Bonilla (2019) investigated different methodologies for applying digital

technologies in SCM for their SLR. By focusing on recent contributions, Winkelhaus and Grosse (2020) showed the effect of digital technologies on some logistics and SCM processes. Kummer et al. (2020) as well as Paliwal, Chandra and Sharma (2020) illustrated the advantage of different theories, namely: agency theory, information theory, institutional theory, the resource-based view for using BC in SCM. Also, Novais, Maqueira and Ortiz-Bas (2019) performed SLR for CC in SC by considering both aspects related to methodologies and some processes. Similarly, Jede and Teuteberg (2015) investigate the significance of CC in SC from methodology and theory perspective. To the best of our knowledge, this is the first paper which studies the effect of CC, BDA, and BC on the behaviour of SC members by conducting a multi-perspective SLR based on a comprehensive and well-structured framework to extract gaps. In our SLR different aspects and main characteristics of SCM are included, namely SC processes, SC associated issues, SC applied methodologies, SC applied theories, and the combination of different digital technologies in SC. The main aim of this research is to answer the following research questions: What is the state of the art in applying the addressed digital technologies to SCs? What are the topics of these technologies in SCs most debated by the current literature? What are the relevant future directions and potential gaps to be explored by the researchers? The rest of the paper is organized as follow: in Section 2 the research background is presented. Section 3 explains the methodology adopted to carry out the SLR, the related inclusion and exclusion criteria, and briefly introduction about the structure of conceptual framework of present SLR. In Section 4 the related research trends are investigated for each aspect. Section 5 discusses the main points and research gaps emerging from the SLR in different aspect for each technology. Finally, Section 6 concludes the paper by interpreting main points for each of the investigated aspects of the framework, and reveals the limitations and some points for the future development of the present research.

2. Research background

Büyüközkan and Göçer (2018) asserted that there is no enough comprehensive research on how digital technologies affect entire SCs. On the other hand, many pieces of research highlighted the necessity of investigating the effects of digitalization on each single SC process and activity (Jede and Teuteberg, 2015). As a result, the present work intends to investigate both the perspectives by conducting a SLR to have a big picture of the current gaps. Among different digital technologies of Industry 4.0, Moufaddal, Benghabrit and Bouhaddou (2019) introduced CC and BDA as the most attractive ones to use in the Digital Supply Chain (DSC) because they are not limited to the specific processes or situation, like Additive Manufacturing or Augmented Reality. Furthermore, the implementation of BDA in the SC leads to an increased use of CC as a solution for storing a large quantity of heterogeneous data (Addo-Tenkorang and Helo, 2016). Moreover, BC as a disruptive technology has significant potential to be combined with the other digital technologies like BDA (Wamba and Queiroz, 2020). Also, applying BC has been reported to have a positive effect on SC performance by increasing trust, transparency, and traceability (Mahyuni *et al.*, 2020). Additionally, digital technologies can have a great impact on SC sustainability. Similarly, Mahyuni *et al.* (2020) indicated the effect of using BC on the SC performance by improving sustainable efforts. Besides, Bag *et al.* (2020) showed that manufacturing sustainability and evolving in circular economy efforts can be achieved by applying BDA to SCs. Novais, Maqueira and Ortiz-Bas (2019) suggested the importance of studying combinations of different digital technologies to reveal the full power of Industry 4.0 and its effects on the DSC. However, there are some SLRs focused on just one single technology out of the ones selected for the present work. Novais, Maqueira and Ortiz-Bas (2019) investigated through a SLR the positive effects of using CC to stimulate SC integration by providing real-time data. Kummer *et al.* (2020) performed an SLR on the applied theories about BC in SC. They addressed six organizational theories: agency theory, information theory, institutional theory, network theory, the resource-based view, and transaction cost analysis. Finally, Chiappetta Jabbour *et al.* (2020) studied the effects and gaps of applying BDA to increase SC sustainability by again performing an SLR. However, based on the present literature, our work is one of the first attempts to study the effects of digital communication technologies on the behaviour of SC echelons by performing an SLR focused on different investigation aspects regarding SC structure and problems, methodology to investigate them, as well as the combination of multiple technologies.

3. Research methodology

SLR is a scientific reproducible procedure to explore, evaluate, and extract gaps from published papers in a research field and identifying the boundary of knowledge (Barbosa *et al.*, 2018). This procedure minimizes the bias in the selection of the considered papers (Pournader *et al.*, 2020), which leads to having a complete extraction of knowledge. Compared to a SLR, in a narrative literature review, it is hard to repeat the results of literature analysis due to the fact that the papers are selected based on the authors' experience (Liao *et al.*, 2017). However, in systematic literature studies, one can take a look at all the possible results without having pre-judgment about the selected papers. Also, as another procedure for conducting a literature review, text analytics is easy to reproduce but the results cannot provide a deep knowledge extraction (Aryal *et al.*, 2018). The present SLR has been performed based on the procedure proposed by Tranfield, Denyer and Smart (2003) in three steps: 1. planning the review process, 2. searching and conducting the review, 3. reporting results and recommendations. This procedure was used in many previous works for performing SLRs in SC like (Barbosa *et al.*, 2018; Queiroz, Telles and Bonilla, 2019; Pournader *et al.*, 2020). Sections 3.1, 3.2. and 3.3 are dedicated to explain the first step. Section 4 is related to the second step. Finally, Section 5 discusses the results according to step 3 of the mentioned procedure.

3.1 Search engine and keyword selection

For conducting this research, Scopus has been considered to search papers because, in comparison with the other search engines like Web of Science, it includes a larger number of papers, a more complete range of disciplines (Mishra *et al.*, 2018), and various types of resources (Bag *et al.*, 2020). In the present SLR the authors have considered two levels of keywords which are combined with AND as conjuncture. In the first level the keywords "Cloud Computing", "Blockchain", "Block chain", and "Big Data Analytics" are searched separately. As the second level, a combination between each of the first level keywords and the keyword "Supply Chain" was used to delimit the context of the search.

3.2 Inclusion and exclusion criteria

It is prerequisite in conducting SLR to set proper inclusion and exclusion criteria to decide about the obtained results. This step is important to have a rigor structure for selecting the most relevant papers to extract knowledge and make clear recommendations (Chang and Chen, 2020). Here the authors set two types of exclusion criteria as following. First level exclusion criteria (for filtering the results by searching in Scopus): limiting the language to English papers and just considering journal papers. Excluding other sources like book chapters, conference papers, and editorials leads to just addressing high quality papers (Arunachalam, Kumar and Kawalek, 2018). No limitations were defined at this step on the other fields, like year of publication or subject area, in order not to miss relevant papers. Second level exclusion criteria (by investigating title, abstract, and keywords in first round of reading, or when studying full papers in the second round for qualification): a) Papers that do not refer to the scope of the research about manufacturing SCM. b) Papers that do not mention considerable contributions about digital technologies in SCM. c) Papers that are more related to computer science because they are focused on the technical aspects of digital technologies and give minor contribution to the aim of the present work. d) Duplicate papers. e) Papers that have been published before 2010 with zero citations. Due to the fact that the notion of Industry 4.0 and the trend of research on its main technologies have been born after 2010. Therefore, if a paper has been published before 2010, and got zero citations, it implies that it could not be identified as a seminal work in this area. Totally 228 papers were qualified for evaluating in final SLR and subsequent classification in different aspects of conceptual framework of SLR.

3.3 Conceptual framework for SLR and knowledge extraction

The way of organizing papers to extract gaps and knowledge could be one the important parts of each SLR. In fact, clear and well organized classification can bring more useful insights from the literature to extract the gaps for future research. In the following, each of the five perspectives of the conceptual framework adopted by the present work will be introduced to illustrate the significance of investigating them.

Supply chain processes: As Jede and Teuteberg (2015) discussed, many studies address digitalization in the overall SC. Hence, there is a lack of research investigating the impact of different digital technologies on each specific SC process. In fact, having such a perspective in the DSC could bring about deepening knowledge of academicians and practitioners regarding the advantages and potential applicability of digital technologies in each SC process and encourage real implementations of them. Moreover, it can assist to develop a DSC roadmap (Büyüközkan and Göçer, 2018) based on the maturity of each digital technology in different processes. Figure 2 shows all the processes that have been considered for investigation in the present work.

Supply chain associated issues: The main SC issues in the contex of digital technologies have been scarcely addressed in DSC. Based on the author's knowledge and review of the analyzed literature, the main SC issues are here defined as Figure 3. Each of these areas plays a prominent role in achieving a smoother and integrated SC.

Supply chain applied methodologies: The present study pays special attention to the different methodologies that are applied in the considered works. This investigation could shape a perspective to guide researchers to figure out the most appropriate methods to approach digital technologies as well as the related applications. Therefore, based on the works by Büyüközkan & Göçer (2018), Novais et al. (2019) and Schmidt & Wagner (2019) principal research methodologies have been identified and indicated in Figure 4.

Supply chain applied theories: In the field of DSC, by considering the infant stage of the research, having an overview of the used theories in the context of different technologies can open new directions for future research. Also, investigating this perspective leads to identify potential applications of digital technologies by evidence-based theories (Kummer *et al.*, 2020). Moreover, as Jede and Teuteberg (2015) mentioned, using different theories help to grow up the emerging fields like Industry 4.0 technologies from infant stage to higher maturity levels . No predefined and complete set of theories was identified in the literature, so the SC theories analysed in the present work have been defined based on those applied by the investigated papers (Figure 5).

Combination of digital technologies in SC: The combination of different technologies may result in increasing efficiency and making a higher level of SC integration (Novais et al., 2019). Oliveira and Handfield (2019) encouraged researchers to figure out the potential of combining different digital technologies in SC decision making. Existing DSC literature reviews overlooked to carefully investigate this dimension among the most promising ones (Winkelhaus & Grosse, 2020) to pave the way for further research in the field. Moreover, it could help practitioner to better assess the development of multiple digital technologies in their SCs. The integration among the three communication digital technologies at issue and the Industry 4.0 technologies in Table 1 has been analysed.

4. Classification and research trends

In this section the effects of digital technologies on SCM are investigated from different aspects of conceptual framework for SLR. It is worth mentioning that the assignment of papers to the classes is not mutually exclusive. Each aspect is discussed in the following subsections.

4.1 Supply chain processes

Figure 1 shows the distribution of the number of papers addressing each process for each technology. Based on Figure 2 most of the papers (179 paper out of 228) considered the impact of communication digital technologies on the whole SC without study their effects on each individual process. Also, Figure 2 implied Procurement (5 paper), Warehousing (0 paper), Inventory management (2 paper), Customer relationship (6 paper) as the least investigated processes.

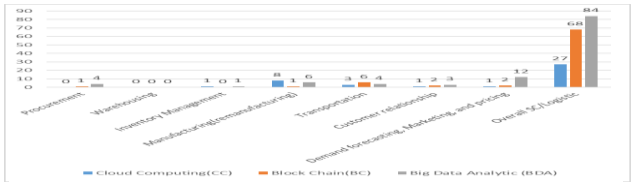

Figure 2: Distribution of SC process classification

4.2 Supply chain associated issues

Figure 3 indicates the distribution of the considered SC issues in the analysed papers for each technology. As Figure 3 depicts, most of the papers are related to information sharing as the main issue for DSC (139 out of 228 paper). Moreover, Financial issues (2 paper), Scheduling (3 paper), and Business models (8 paper) are less debated and need further attention in DSC.

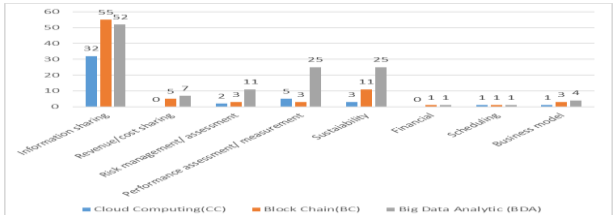

Figure 3: Distribution of SC associated issues classification

4.3 Supply chain applied methodologies

Figure 4 depicts the distribution of applied methodologies for each technology in the selected papers. Totally, as it can be concluded from figure 4, in DSC it is prevalent to use survey/ case study to assess the impacts of communication digital technologies on SCM (95 paper).

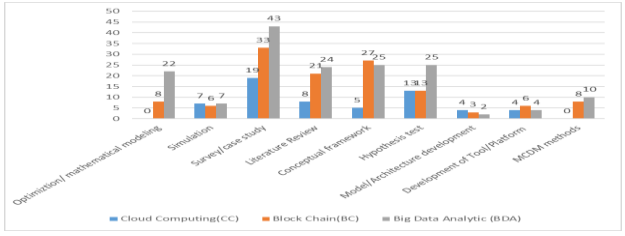

Figure 4: Distribution of SC applied methodologies

4.4 Supply chain applied theories

To assign the papers to this aspect, the selected papers have proposed more than 40 theories for investigating CC, BC, and BDA in SCM. Therefore, just those that have been used more than once have been considered in reporting the results. Figure 5 shows the distribution of high frequent applied theories in the papers for each technology. Based on the results of Figure 5, a high number of papers did not develop any theoretical foundation for DSC. However, Game Theory (16 paper), Resource Based View (19 paper), and Dynamic Capability (13 paper) are the most applied theories.

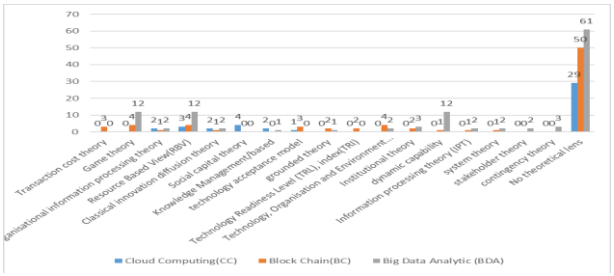

Figure 5: Distribution of SC applied theories

4.5 Combination of digital technologies in SC

Table 1 indicates the distribution of papers about combinations of each of the addressed technologies with the other Industry 4.0 ones. Here, aside from the previously mentioned technologies, the comparison includes Augmented Reality (AR), Robotics (R), Sensor Technology (ST), Self-driving Vehicles (SDV), Drone, Artificial Intelligence (AI), and Cyber Physical Systems (CPS). As a result, CC can be identified as the most integrated communication technology with all the other Industry 4.0 ones. Also, IoT is the most suitable Industry 4.0 technology to be combined with CC, BC, BDA.

Technologies	CC	BC	BDA	AR	R	ST	IoT	SDV	Drone	AM	AI	CPS
CC		1	13	2	2	0	14	0	0	5	1	1
BC	1		2	0	0	0	9	0	0	1	3	0
BDA	13	2		1	1	1	6	0	0	1	2	0

Table 1: Digital technologies combination: n. of papers

5. Analysis of results and gap identification

In this section, for each of the selected technologies, the results from the previous classification will be discussed and gaps will be consequently addressed.

5.1 Cloud Computing outcomes

As it can be concluded from Figure 2, the majority of research on CC have investigated the SC as a whole. There is few research on specific SC processes assisted by CC. This result is also confirmed by the previous research (Jede and Teuteberg, 2015). As an interesting point, it can be observed that the manufacturing process is the one with the highest number of associated papers. The reason could be explained by the main characteristic of CC in connecting different parts of the SC and make it possible to solve the operational problems of manufacturing processes by utilising real time data in dispersed production systems. However, there is a lack of CC applications to the procurement and warehousing

processes as the previous work by Novais, Maqueira and Ortiz-Bas (2019) has suggested.

Figure 3 illustrates that information sharing is the most studied issue when investigating CC in SCs to provide real time data, thanks to the fact that CC changes the IT structure of the SC (Addo-Tenkorang and Helo, 2016). On the other hand, the effect of using CC is neglected in financial issues. The latest issue could stem from the confidentiality of data related to financial transactions. Therefore, SC members are reluctant to share this type of information by CC. This weakness could be overcome by combining CC with BC to share data in a safe way. Additionally, as it can be concluded from Figure 3, due to the lack of research in studying revenue/ cost sharing in CC, it is valuable to investigate the subsequent effects of applying CC and possible revenue/cost sharing between SC members. Indeed, applying CC to SCs could bring about reducing the Bullwhip Effect by fostering collaboration in demand forecasting, which may lead to share the associated costs and benefits according to a revenue/cost sharing framework. Also, there is some room for more research on the other considered SC issues because the current number of papers in each of them is scarce and more attention is needed.

By focusing on the applied methodologies, according to Figure 4 many pieces of research use surveys and case studies in combination with hypothesis testing for analysing CC. However, there is no work relying on optimization approaches. This could be interpreted by the main characteristic of CC as a storage for a huge amount of data able to make timely connections in SCs, which is not an analytic tool for supporting decisions (Addo-Tenkorang and Helo, 2016). On the other hand, simulation could be considered as one of the appropriate approaches for studying the impact of CC on SCs. In particular, academicians need to pay more attention to investigate the effect of applying digital technologies to help practitioners in their implementations. For instance, there is just one work (Ghadge *et al.*, 2020) on applying System Dynamics to simulate the effects of CC on the behaviour of SCs' members.The majority of works on CC in SCs did not consider any theoretical lens (Figure 5). It could be as a result of the novelty of CC in such a field and its consequent still limited implementation. Based on Figure 5, Resource-Based Theory and Social Capital theory are identified as two prevalent theories in studying CC in SCs. In fact, in these theories CC could be considered as a resource and the aim is to figure out the effect of the constructed relationship by CC on the competitive advantage of SCs (Shee *et al.*, 2018).

5.2 Blockchain outcomes

According to the process classification, most of the works about BC considered SC as whole and did not address the effects of this technology on single SC processes. Therefore, in line with previous research outcomes , it is concluded from Figure 2 that future works should address the possible impacts of BC on each process, like inventory management, procurement, and customer relationship management (Queiroz, Telles and Bonilla, 2019). As a matter of fact, using BC in inventory management may increase trust and transparency by protecting inventory level data and other relevant data in different SC echelons. Also, in customer relationship management BC helps to provide transparency of originality of products, which can lead to gain a competitive advantage. In procurement, BC, by improving trust between SC members, can assist in the supplier evaluation process. Moreover, due to the novelty of BC in SCs its application to warehousing is still unclear and needs further studies. Analysing the BC from the perspective of the SC issues previously defined results in identifying information sharing as the most addressed topic. Also Figure 3 implies that, sustainability is the second most debated issue in BC. In fact, although this technology is in its infant stage, there is a good effort in investigating its applicability in various areas of SCM especially to increase sustainability (Kouhizadeh, Saberi and Sarkis, 2021). Future works in this field need to pay more attention to investigate BC effects on revenue sharing/cost sharing by improving the construction of trust relationships between different SC echelons and members. Also, BC can have a great effect on transparency, which leads to more effective risk-management in the entire SC. Moreover, transparency and trust stemming from using BC can result in better performance assessment in different SC echelons to make it as one of the potential directions for future research.

According to the classification of applied methodologies shown in Figure 4, most of the papers analysing BC applies surveys and case studies, conceptual frameworks, and literature reviews. It is worth noting that there is a relevant number of papers using optimization as the addressed methodology. However, few works study the impacts of BC by applying simulation. Figure 5 depicts the applied theories in addressing BC in SCs. In comparison with CC and BDA, there are various types of theories applied. As an interesting point, there are some works that make use of Game Theory. The reason could be explained by the pivotal role of BC in coordinating the secure interactions among SC actors. Nevertheless, like CC and BDA, most of the papers do not apply any theoretical lens in their works.

5.3 Big Data outcomes

As it can be concluded from Figure 2, like CC and BC most of the research do not address, each single SC process. Moreover, due to the nature of BDA, many researches apply it to demand forecasting and customer relationship management. However, there is significant potential in applying BDA to other SC processes, such as procurement, warehousing, inventory management, and transportation (Aryal *et al.*, 2018). Surprisingly, there is no work related to warehousing, although this technology can have significant advantages in improving internal and external logistics flows (Yudhistyra *et al.*, 2020) by assisting dynamic and real time decision making.

According to Figure 3, there are few papers considering the application of BDA to scheduling and financial issues. Nonetheless, BDA capabilities may result in better assigning of operational tasks and scheduling in manufacturing. Also, the analytics power of BDA can have a better prediction on patterns of financial issues in

SCM. From the applied methodologies point of view, as Figure 4 depicts, the prevailing methodologies are surveys and case studies, conceptual frameworks, hypothesis testing, and literature reviews (Arunachalam, Kumar and Kawalek, 2018). Moreover, there is a significant number of papers applying optimization as the main methodology to investigate BDA. The main reason could be that, compared to CC and BC, the key feature of BDA is its analytic characteristic to support decision making. However, from the simulation point of view, by considering the novelty and high cost of real implementation of BDA in SCs, simulation methods like System Dynamics could be beneficial to study the influence of BDA in the long term. Investigating the theories applied to study BDA (Figure 5) reveals that the existing papers are more focused on Game Theory, Resource Based View, and Dynamic Capability as theoretical lens. However, the majority of the selected papers about BDA still did not consider any theoretical foundation. Moreover, the considerable number of papers about Game Theory could be relevant to use it for analysing the price or marketing strategies in BDA (Xiang and Xu, 2020).

6. Discussion and conclusion

This research aims to provide a big picture of the current literature in the field of DSC and figures out how relevant Industry 4.0 technologies can impact the behaviour of SC members by transforming the ways of connecting the different SC echelons. In this regard, a comprehensive SRL was conducted in the field of manufacturing SCM and CC, BC, BDA were considered as the most effective communication technologies to connect SC echelons. In DSC literature currently available, there is a lack of multi-perspective literature review frameworks to extract the gaps in a systematic and classified way in order to cover a wide range of possible relevant SC issues and characteristics. The present work aims to fill this gap by developing a conceptual framework to extract related knowledge in this field by conducting a SLR. Also, it is a first attempt to concurrently study through a SLR the state of the art of CC, BC, and BDA in SCM as emerging digital communication technologies. This combination brings about a better perception of the future opportunities in the development of DSCs. As it is evident from Table 1, there is appropriate relevance for integrating BDA and CC. Moreover, from the SLR it could be perceived that IoT is one of the potential technologies to combine with CC, BC, And BDA (Moufaddal, Benghabrit and Bouhaddou, 2019). Additionally, Additive Manufacturing (AM) as an another emerging technology is in its early stage. However, it attracts researchers to improve DSC by combining it with the other Industry 4.0 technologies especially with CC. Based on what was discussed, future research should pay special attention to figure out the impacts of using CC, BC, and BDA in improving the internal and external connections between each single SC process(Büyüközkan and Göçer, 2018). Moreover, there is a gap in using the mentioned digital technologies in scheduling and financial issues in the realm of SC, which could be closed by achieving more integration among BC, CC, and BDA. Furthermore, still there are few works in the other SC issues, like risk assessment/ management, revenue/cost sharing, and business models. About applied methodologies, the majority of the previous papers rely on surveys and case studies combined with hypothesis testing, conceptual frameworks, and literature reviews. In fact, thanks to the novelty of digital technologies in SCM, the previous works aim to clear their effects by empirical and conceptual methods. Hence, future works should focus on methodologies such as optimization and simulation to study CC, BC, and BDA for going ahead to the maturity stage of applying these technologies to SCs. Also, many pieces of research in the selected papers for this SLR did not apply any theoretical lens. However, according to Figure 5, there is a huge diversity in using theories in studying digital technologies. It implies that there is no prominent theory in DSC, although Resource Based View, Dynamic Capability, and Game Theory could be identified as the most relevant ones with a high using frequency in previous works, especially those about BDA.

Finally, the present work can assist academicians to have a big picture and illustrate the gaps for each communication digital technology, as well as highlight the gaps extracted from the combined used of these technologies in different SC aspects. The present work indicates to practitioners the potential capability of using communication digital technologies to improve the SC behaviour and helps to construct a road map for implementing them in different processes, also in combination with each other. However, there are some limitations in the present research. First, just three digital technologies were considered to foster SC communication and integration. Second, the search results were obtained by a limited number of keywords, which may lead to some relevant papers not included in the SLR. Third, snowballing was not discussed in this paper because just started at the time the authors wrote it. Therefore, the future work will complete the snowballing process to be sure not to miss any significant paper. Then, this study will be enlarged to other digital communication technologies like IoT. Moreover, as a further research direction, it is suggested to use additional various keywords for searching in Scopus.

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