Internet of Things 12 (2020) 100318

Contents lists available at ScienceDirect

Internet of Things

journal homepage: www.elsevier.com/locate/iot

Review article

Internet of Things research in supply chain management and logistics: A bibliometric analysis

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ARTICLE INFO

Article history:
Received 9 September 2020
Revised 26 October 2020
Accepted 27 October 2020
Available online 2 November 2020

Keywords:
Internet of Things
Supply chain management
Literature review
Bibliometrics

ABSTRACT

This study reviews Internet of Things (IoT) research in supply chain management (SCM) and logistics. A thorough review and bibliometric analysis were conducted to analytically and objectively unearth the knowledge development in IoT research within the context of SCM and logistics. The analysis started with the selection of 807 journal articles published over a two-decade period. Then, the articles were analyzed according to bibliometric parameters such as year of publication, sources, authors, and institutions. A keyword co-occurrence network was used to cluster the pertinent literature. Results of the review and bibliometric analysis reveal that IoT research has attracted significant attention from the SCM and logistics community. Three leading journals published widely on IoT and the fifteen most productive authors are identified. Based on the keyword co-occurrence clustering, the IoT literature in SCM and logistics is focalized on RFID technology, Industry 4.0 technologies, reverse logistics, and additionally covers various industries, such as the food, retailing, construction, and the pharmaceutical sector. The study provides researchers with a better understanding of IoT research in SCM and logistics and existing knowledge gaps for further research. Practitioners may benefit from the review to keep abreast of the current discussions and applications of IoT in diverse industrial sectors. To the best of the authors' knowledge, the current review is one of the few attempts to investigate IoT research in SCM and logistics using a comprehensive set of articles published during the past two decades.

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https://doi.org/10.1016/j.iot.2020.100318

1. Introduction

In recent years, supply chain management (SCM) and logistics have witnessed tremendous paradigm shifts [123]. The increasing interest in SCM and logistics has been driven by competitive pressure and has led to its eventual elevation to turn into a critical part of company operations and strategy [147]. The role of these organizational functions has, understandably, become more pronounced, and companies need to efficiently manage their supply chain and logistics activities to sustain their competitive position in an increasingly dynamic business environment [138,144,146]. Organizations have to continuously upgrade their SCM and logistics systems in order to deliver the right product to the right customer at the right time [146]. Traditionally, logistics has been considered an expensive but necessary cost driver for businesses rather than a strategic source for competitive advantage [103]. However, with the emergence of new technologies, organizations have been able to seize novel opportunities and achieve competitive advantages [24]. The integration of new technologies has the potential to improve the exchange of information and to facilitate the monitoring of physical goods throughout the supply chain [127,149,151].

Developments in information technology (IT) have played a key role in enhancing the planning, implementing, and control of the flows and storage of goods, services, and information from the point of origin to the point of consumption for the purpose of increasing customer satisfaction [41]. The pace of change brought by new technologies has transformed the way in which businesses create and deliver value for consumers. For example, the advent of Industry 4.0 has proven a critical success factor for providing several business benefits including the optimization of business operations and value chain activities [142]. In this context, Industry 4.0 is a term coined by the German economic development agency (GTAI) that refers to the emergence, advancement and convergence of various technologies that ensure an almost real-time connection between the physical and digital world [121]. Accordingly, technology has been, and continues to be, an essential enabler for effective SCM. It plays a critical role in coordinating the players through improving communication, acquiring and transmitting data, thereby enabling effective decision-making and enhancing supply chain performance [119,133]. Internet of Things (IoT) is one of the latest IT developments in SCM that can provide more accurate information for more effective decision-making.

As supply chains have become smarter, more technology-driven, and intertwined, research on IoT has rapidly grown with a surge of studies addressing innovative applications in SCM and logistics. Some researchers have begun using bibliometric techniques to study IoT. For example, Nobre and Tavares [118] have recently conducted a bibliometric review to investigate the literature on big data and IoT applications in the context of the circular economy. Although their review was based on 30,557 and 32,550 documents related to the circular economy and big data/IoT, respectively, their study was generally beyond the scope of SCM and logistics. Sakhnini et al. [135] carried out a bibliometric survey to explore security aspects of IoT-aided smart grids. Bouzembrak et al. [33] conducted a review and bibliometric analysis to investigate the use of IoT in food safety. They found that IoT represents a relatively new approach to ensure food safety, and that the technology is used mainly to monitor temperature, humidity, and location. Even though the authors employed some bibliometric techniques, their study was purely focused on the food industry.

More recently, Kamran et al. [82] conducted a bibliometric analysis of articles in the blockchain and IoT domain, including papers from leading journals and conference proceedings. However, a focus on IoT in the context of SCM and logistics is missing in their study. To reduce this knowledge gap, the present study aims to contribute to the ongoing debate on IoT. As research activity in general has a cyclical nature [50], scholars often take a step back and analyze existing research to get new insights. The motivation of our study draws on the study of Portugal Ferreira [130], who notes that when research fields become increasingly intricate and mature, scholars should try to occasionally generate insights from the knowledge obtained in order to make new contributions, analyze current trends and research traditions, and identify potential research gaps for further investigation. By examining the knowledge structure of IoT research in SCM and logistics, we thus fill an important research gap in the literature and help to extend the academic debate on the evolutionary pattern of this technology. We believe that by investigating IoT research, we provide an in-depth understanding of its future potential and accelerate the conceptual development of this unceasingly evolving research area. More specifically, our work builds on prior literature and uses bibliometric methods to answer the following research questions:

- How has IoT literature within SCM and logistics grown since its emergence?
- What are the main countries contributing to academic IoT literature in SCM and logistics?
- Which researchers and articles are most influential in IoT literature in SCM and logistics?
- What are the current trends of IoT literature in the SCM and logistics field?
- What are hot research topics and discussions in the reviewed literature?

The organization of the study is as follows. Section 2 presents the literature review on the role of IoT in SCM and is followed by the research methodology in Section 3. Section 4 provides the results of the analysis. Section 5 discusses the findings of the study, the research implications and concludes the paper with a summary of the study contributions and its limitations.

2. The role of IoT in SCM

There are many definitions of IoT available in the literature. According to Mehl [111], IoT is a technological concept in which multiple devices are connected that have the possibility of switching on and off the web in order to use software and automation processes for smart applications. Communication can be established, for example, with RFID tags that are connected to a network to transmit identification information [164]. In the context of SCM, IoT has been defined as a network of physical objects that are digitally connected to sense, monitor and interact within a company and between a company and its supply chain enabling agility, visibility, tracking and information sharing to facilitate timely planning, control and coordination of supply chain processes [22]. As a pathway to operational excellence, IoT has assumed a critical role in several aspects of SCM [47]. IoT is conceptualized as a worldwide network wherein objects and sensors are interconnected, controlled, and optimized through wired links, wireless channels, or hybrid systems [18,65]. The concept of IoT can be classified into three essential components: internet-oriented (middleware), things-oriented (devices, sensors), and semantic-oriented (knowledge) [18]. The internet-oriented part comprises the technologies and protocols necessary to ensure the ad-hoc networking of physical objects and their reachability on the internet [18]. The things-oriented part includes devices and smart objects (e.g., sensors, actuators, radio frequency identification (RFID) that can be connected to the internet [136]) and the semantic-oriented part deals with issues of data management, which arise due to the massive information shared by smart objects, and the connection of resources which are accessible through a web interface [3]. Since the advent of wireless technology, IoT has gained increased popularity [10] and attracted the attention of the SCM community [22,37,81,132]. IoT has significantly contributed to industrial automation and allowed the integration and fusing of industrial sensor networks, RFID network for logistics management, and networks for plant control and enterprise information management [42].

Moreover, IoT has provided means for firms to improve their operational efficiencies, ensure convenience of their activities, and sustain their competitive advantage [28,126]. Through the use of IoT, firms have the potential to streamline information flows [156], offer substantial efficiency gains across all the stages of the supply chain [56], and facilitate inter- and intra-organizational communication and integration [105,166]. For example, based on IoT, the global fashion retailer Zara has succeeded in maintaining high planning flexibility, robust replenishment solutions, shorter lead times, and fewer product variations [131]. The importance of IoT within the industrial environment has become more pronounced, as a recent report from Markets and Markets has forecasted that the industrial IoT market will increase from USD 77.3 billion in 2020 to USD 110.6 billion by 2025, at a CAGR of 7.4% during the forecast period [109]. Likewise, the report 'State of the IoT & Short Term Outlook 2018' by IoT Analytics outlines that there will be 9.9 billion IoT devices in 2020 and 21.5 billion by 2025. In terms of value, the world IoT market is projected to reach USD 1567 billion by 2025 (IoT [77]).

There are several reasons for firms to consider applying IoT in their business and supply chain models. In this regard, the extant literature has established that IoT can be useful in product tracking [3,53,108] in order to locate products, materials, and assets, and to know their current status and environmental conditions [104]. For example, several scholars have investigated the potentials of RFID for supply chain traceability, stating that RFID provides increased visibility, tracking and enhanced communication throughout the supply chain [2,16,54,73,78,98,115,125]. In the food industry, increasing the traceability capability of the firm is crucial for successfully responding to consumer demands for quality and safe food products [108]. Beyond reducing operational costs, IoT can also lead to more customized, responsive, agile, and innovative customer service [14]. As such, the use of IoT in information sharing helps firms to better understand the needs of their customers and to collaborate with them for better demand planning and customer service [156]. IoT helps to close the information gap in modern supply chains by capturing fine-grained information among organizational entities, processes, and people in real-time [80]. It has the potential to improve the cost and time efficiency as well as the effectiveness of several functions in SCM and logistics, ranging from inbound logistics to outbound operations [129]. However, the integration of IoT in SCM and logistics is not without challenges. According to previous studies, the adoption of IoT in the supply chain is still in its nascent stage [80,113], and it has been plagued by multiple and complex issues as various as security concerns [10,37,154], privacy issues [25], and organizational reluctance towards investing in IoT [20,39,137].

3. Research methodology

As the primary goal of this study is to evaluate the current knowledge structure of IoT research in SCM and logistics, we employed a bibliometric analysis. This type of analysis constitutes a systematic analytical technique that helps to determine the most influential scholars, their affiliations, the keywords they choose, and, even more important, how academic works are related to one another [158]. The bibliometric approach is appropriate when evaluating the current status of a particular discipline using different indicators such as highly cited publications, scholars, journals, academic institutions, and countries. With the use of bibliometrics, researchers are also able to assess research collaboration among scholars, institutions, and countries. This approach offers a transparent, static, and systematic representation of research [13]. Similarly, bibliometric analysis is a well-established form of meta-analytical research [60] and a statistical method that identifies the qualitative and quantitative changes in a specific research topic [11]. This research method has been widely used in the prior literature to analyze vast amounts of publications in fields and domains as diverse as sustainability [48,110], green SCM [55], and supply chain risk management [88]. Therefore, this study draws on bibliometric analysis as the ideal method to examine the current knowledge base on which IoT is founded in SCM and logistics.

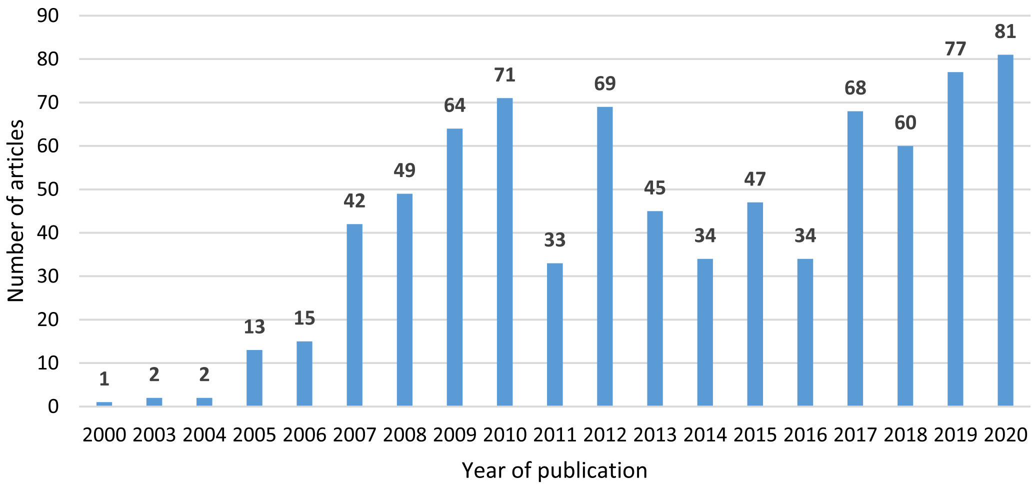

Fig. 1. Year-wise distribution of IoT research in the field of SCM and logistics.

3.1. Data collection

For our bibliometric analysis, data from the Scopus database was extracted. Scopus is a world-leading scientific database widely known for its extensive, reliable content, and the large number of publications it contains, including journals published by international publishers like Elsevier, Springer, Taylor and Francis, EmeraldInsight, and IEEE ([61;107]). The search string used was the following: *("internet of things" OR IoT OR RFID OR WSN OR "wireless sensor network*" OR GPS OR actuator* OR sensor*) AND ("supply chain*" OR logistic*).* The search was performed in the title, abstract and keywords fields. To ensure the high quality and academic nature of the literature, only peer-reviewed journal articles in English were considered. The subject area was limited to business and management. Initially, the search query returned 986 documents. The authors screened the titles and abstracts of these articles for relevance, filtering out publications with missing bibliometric data (e.g., abstract, keywords). This resulted in 807 documents that were extracted in CSV format for the final analysis using the bibliometric tool VOSviewer. This is an open-source computer program that was developed for generating, visualizing, and analyzing term maps as well as to generate a keyword co-occurrence network [52].

4. Results of the descriptive analysis and discussion

In the upcoming sections, we will present and discuss the main results from the bibliometric analysis.

4.1. Descriptive statistics

To answer the first research question pertaining to the growth of IoT literature in SCM and logistics, we traced the evolution of IoT research in the field of SCM and logistics. Fig. 1 depicts the annual distribution of journal articles, showing an inconsistently growing trend since 2000. About two decades ago, the topic of IoT exhibited a gradual increase. In the first decade (2000–2010), the number of articles increased markedly, with the number of articles peaking in 2010 with 71 papers, illustrating the fresh and developing status of IoT research in SCM and logistics. However, in the second decade (2010–2020), the number of publications followed an unstable trend, with ups and downs, but with an apparent increase in the last three years. As of the time of writing (August 2020), the number of publications was the highest, and there are strong indications that the scholarly production will roughly double by the end of 2020. This indicates the resurgence of interest in IoT applications in SCM and logistics. The revival of interest in IoT research is comparable to that of cloud computing, where Ardito et al. [12], argue that this technology has been rising due to the emergence of modern high-speed networks, which allows rapid access to remote data.

Table 1 illustrates the top 15 journals publishing articles on IoT. In total, these journals published 342 articles, representing 42% of the 807 articles that were contained in our sample. The *International Journal of RF Technologies: Research and Applications* tops the list with 56 published papers. Following closely, the *International Journal of Production Research* published 53 articles, the *International Journal of Production Economics* 50 articles, and *Industrial Management and Data Systems* 26 articles. The journal distribution of the scientific output suggests that IoT research was published in top journals that have previously enriched the field with foundational concepts, knowledge, theories, techniques, and tools. The scope of these journals spans several areas and topics in SCM and logistics, including technology applications, production and manufacturing, operations management, and sustainability. Therefore, articles published in these journals reflect the richness, diversity, and interdisciplinarity of IoT research in SCM and logistics.

Table 1
Top 15 most relevant journals.

Journal	Number of articles
International Journal of RF Technologies: Research and Applications	56
International Journal of Production Research	53
International Journal of Production Economics	50
Industrial Management and Data Systems	26
Journal of Cleaner Production	21
International Journal of Supply Chain Management	19
Journal of Theoretical and Applied Electronic Commerce Research	15
Production and Operations Management	14
Supply Chain Management	13
Decision Support Systems	13
Business Process Management Journal	13
Production Planning and Control	13
Logistics Journal	13
International Journal of Manufacturing Technology and Management	12
International Journal of Logistics Systems and Management	11

Table 2
Top 15 most productive scholars.

Authors	Number of articles
Bottani E.	14
Choy K.L.	14
Volpi A.	13
Piramuthu S.	13
Rizzi A.	10
Huang G.Q.	10
Reyes P.M.	10
Thiesse F.	10
Wang X.	10
Bertolini M.	10
Angeles R.	10
Zhou W.	9
Ngai E.W.T.	8
Kumar S.	8
Gunasekaran A.	8

Table 3
Institutions with more than 10 publications on IoT research in SCM and logistics.

Institution	No. of publications
Hong Kong Polytechnic University	35
University of Parma	21
University of Hong Kong	17
University of Florida	16
RMIT University	11
California State University	10
University of St. Gallen	10
University of Bremen	10
University of New Brunswick Fredericton	10

4.2. Statistics of the influential authors, institutions, and countries

Table 2 shows the 15 most productive scholars in IoT and SCM research as found in the Scopus database and ranked according to their output in top journals.

Table 3 presents the top 10 academic institutions contributing the most to IoT research in the context of SCM and logistics. The affiliation with the highest number of published papers is Hong Kong Polytechnic University with 35 publications, followed by the University of Parma with 21 publications and the University of Hong Kong with 17 publications. Overall, the list of the top ten productive institutions does not include institutions in developing countries. Even though the research activity on IoT and SCM and logistics disperses globally, the low productivity of academic institutions situated in developing countries may partially be explained by the weak collaboration between countries, particularly between authors of developing and developed countries. The deficiency of IoT infrastructure and lack of connectivity may be another reason for the digital divide between these countries.

Table 4
Top 15 contributing countries.

Countries	Number of articles	Percentage (%)
USA	238	29%
China	85	10%
Germany	72	9%
UK	60	7%
Italy	56	7%
Hong Kong	55	7%
India	55	7%
Canada	42	5%
Australia	39	5%
Taiwan	30	4%
France	24	3%
South Korea	22	3%
Sweden	21	3%
Switzerland	18	2%
Finland	18	2%
Top 15 countries	835	100%

Table 5
Top 20 frequent keywords in the IoT research.

Keyword	Occurrence
RFID	427
SCM	252
IoT	133
logistics	44
industry 4.0	34
simulation	26
IT	20
big data	19
tracking	19
EPC	18
innovation	18
case study	17
identification	17
technology	17
blockchain	16
RL	16
information systems	14
inventory management	14
retailing	14
traceability	14

Table 4 depicts the respective countries' scientific output as published in Scopus. As can be seen, highest number of papers (238) originated in the USA, followed by China (85), Germany (72), the UK (60), and Italy (56). Summarizing, IoT research within the field of SCM and logistics has been conducted worldwide, albeit there is a high concentration of academic research output in developed countries. North America and Europe made more contributions than Asia, while African nations are not included in the list. While this may call for the strengthening of scientific collaboration, it should be noted that only publications in English language were considered for this study.

4.3. Statistics of keywords and citations

Table 5 presents the 20 most frequent keywords. It shows that "RFID" is the keyword that is used most often, highlighting the importance of this technology for IoT in SCM and logistics. According to several scholars, RFID is considered a breakthrough in SCM, and its integration in SCM and logistics can improve internal efficiencies, process visibility, and automation [5,16,71,81,83,92,99]. The second and third most frequently used keywords are "SCM" and "IoT", respectively. In recent years, supply chains have witnessed tremendous change, shifting from being a purely operational function to an independent SCM function [17]. As they have become smarter [36] and more complex to manage [59], organizations tend to use a variety of technologies, of which IoT is just an example, to respond quickly to changes, support logistics activities, operate more effectively and efficiently [22,162]. The keywords "Industry 4.0″, "simulation", "big data", and "blockchain" also appear frequently in the researched literature, revealing that IoT is the backbone of industry 4.0, a strategic initiative recently developed by Germany to support manufacturing industries with high cutting edge and competitive manufacturing technologies [79]. The concept of IoT is closely related to simulation since the real-time visibility enabled by IoT can advance simulation applications, assist in identifying trends and devising proactive measures for numerous SCM and logistics

Table 6
Top 15 most globally cited articles.

Articles	Global citations
[100]	1434
[161]	1346
[84]	661
[160]	650
[99]	581
[163]	564
[145]	509
[87]	456
[76]	442
[49]	431
[38]	422
[176]	421
[51]	383
[32]	377
[6]	144

activities [7]. Moreover, big data can be used to collect and process data generated from IoT devices in the supply chain, enabling firms to locate process flaws and to mitigate costly manufacturing mistakes [4]. Furthermore, IoT can be combined with blockchain technology [132] to improve retailing communication and transparency [156], ensure granular tracking of product characteristics [89], and achieve end-to-end supply chain visibility [171]. Therefore, all these keywords indicate the far-reaching potentials of IoT for SCM and logistics.

The top fifteen articles based on the number of citations are shown in Table 6. Based on Google Scholar citations, Lee and Lee [100] receive the highest citation number among all papers (1434), followed by the article from Weber [161] with 1346 citations. These two studies are seminal as they diffused quickly among the SCM and logistics community, setting the theoretical foundation and explanation for IoT research in this field. Another key observation from our analysis is that these studies received many citations and broad dissemination among scholars due to the renewed interest in IoT. The third rank is held by Kärkkäinen [84], with 661 total citations in Google Scholar. This study revolves around the potential of RFID in a supply chain with short life-cycle products. The article by Wang et al. [160] received 650 citations and the one from Lee and Özer [99] 581. A closer look at these papers as well as the remaining ones on the list reveals that a primary focus of previous research was on RFID applications in SCM and logistics.

5. Results of network analysis and discussion

5.1. Analysis of keyword co-occurrence network

Keyword co-occurrences constitute a relational bibliometric indicator that is related to scientific knowledge itself [139,172]. This scientometric tool helps to generate clusters that enable a broader view of divergent research foci in a specific scientific field [29]. To analyze the network, we started with the extraction of all keywords from each paper. Then we preprocessed and refined the keywords to ensure consistency. For example, keywords written in full length (e.g., internet of things, radio frequency identification, supply chain management) were replaced with acronyms. Two keywords tend to be close if they appear in the same papers more frequently. The analysis of the keyword co-occurrence network allows researchers to reveal the core content of the literature and to describe the structure of a field. Therefore, to generate the network, the data were inputted in VOSviewer, and the density-based spatial clustering using full counting method was employed [91]. As the appropriate number of keywords in the network should range between 200 and 500 [58], the frequency of keywords appearing in the map was set to be 3. As a result, six clusters with different colors were obtained, as shown in Fig. 2. A node represents a keyword, and the size of the node is proportional to the co-occurrence frequency of the keyword. The distance between two nodes in the figure is determined by density, and the larger this density, the closer is the distance between two nodes.

To enhance the analysis, we considered the ten most frequent keywords in each cluster (see Table 7). Each cluster was labeled on the basis its most salient characteristics and the themes emerging from its keywords.

5.2. Discussion of research foci

5.2.1. RFID for better SCM and logistics

Table 7 reveals that cluster 1 is centered on the applications of RFID and its value in SCM and logistics, and thus we labeled it as RFID for better SCM and logistics. The most relevant keywords in this cluster are "RFID", "SCM", "simulation" and "tracking". RFID is a system that can automatically identify and capture data, allowing an electronic device (reader) to use radio waves to identify a tagged object [54]. As an improvement to barcoding, an RFID system consists of small tags storing electronic product code (EPC) data [95]. RFID is a key component of IoT [171], and it paves the way for several innovative

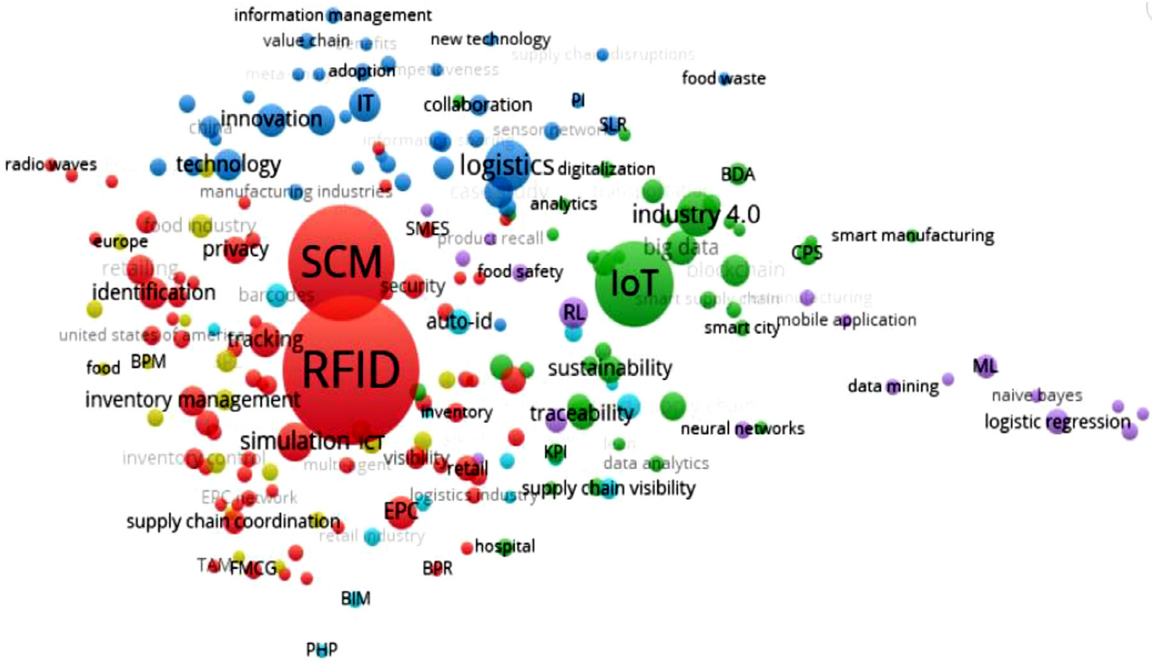

Fig. 2. Keyword co-occurrence network.

Table 7
Top ten keywords based on keyword co-occurrence clustering.

No.	Cluster 1 (RFID for better SCM and logistics)	Cluster 2 (IoT and Industry 4.0 technologies)	Cluster 3 (IoT support for innovation and collaboration in SCM and logistics)	Cluster 4 (IoT for the food supply chain)	Cluster 5 (IoT for reverse logistics)	Cluster 6 (IoT for retail and other industrial sectors)
1	RFID	IoT	Logistics	Food industry	RL	Auto-ID
2	SCM	Industry 4.0	IT	3PL	Logistic regression	Sensors
3	Simulation	Big data	Innovation	ICT	CLSC	Barcodes
4	Tracking	Blockchain	Case study	DSS	ML	Supply chain visibility
5	EPC	Traceability	Technology	Warehouse management	Decision tree	GPS
6	Identification	Food supply chain	Information systems	Framework	Food safety	Retail industry
7	Inventory management	Sustainability	China	AHP	Neural networks	BIM
8	Retailing	Healthcare	Implementation	CBR	Data mining	Cold chain
9	Privacy	WSN	Collaboration	Operations management	Production planning	Pharmaceutical supply chain
10	Technology adoption	Cloud computing	Benchmarking	Performance measurement	Remanufacturing	Retail supply chain

applications in SCM and logistics [86]. For instance, organizations can use RFID to improve performance [2], operational efficiencies, inventory management [27,85,93,96], and traceability [16]. For material handling and physical distribution design, the value of RFID is evident because firms can use the technology to increase automation and significantly reduce manual tasks and errors [97]. The advantages of RFID have been commonly recognized by several industries including retail [115]. manufacturing, healthcare, agriculture [16], transportation [120], apparel [69], minerals and mining [94], and construction [170]. Data acquired from RFID systems can serve as the basis for successful simulation modeling because the sensing capabilities of the technology provide ample amounts of data that are useful to build accurate simulation models for monitoring throughput and process efficiencies [7]. However, the benefits of RFID do not come without challenges. Several studies note that the adoption of the technology might be hindered by cost, privacy and security problems, and other technical issues [5,97,140]. While the literature on the potentials and challenges of RFID in SCM and logistics is abundant, there is still a need to understand the strategic value that RFID can provide for all supply chain actors. The investigation of the long-term impact of RFID systems in closed-loop supply chains and reverse logistics [155] is another interesting avenue for future research. As a core IoT element, researchers should draw upon the field's wealth of existing knowledge to clarify how RFID can be an enabler for green and environmentally responsive supply chains.

5.2.2. IoT and industry 4.0 technologies

Cluster 2 includes the technologies that drive digital transformation and facilitate the successful transition toward Industry 4.0. To make this a reality, all supply chain and logistics processes need to be digitized and automated [148]. Keywords such as "IoT", "Industry 4.0″, "big data", and "blockchain" are therefore included in this cluster. The implementation of IoT has generated big data streams that firms can use for analytical purposes, thereby ensuring high data accuracy and clarity, actionable insights, and evidence-based decisions across the supply chain [14]. The literature also reinforces the argument that the combination of IoT and blockchain is highly promising for SCM and logistics [132]. The use of these technologies enables supply chain partners to exchange information more reliably and to improve the traceability of their shipments [112]. In this regard, blockchain has great potential to increase supply chain visibility [17], trust and collaboration [57], operational efficiencies [21], and sustainability [47,[134]. The integration of blockchain and IoT can consolidate SCM and logistics activities, enabling organizations to achieve competitive advantages. Furthermore, blockchain is a key enabling technology in several sectors such as the food and healthcare industries. The technology can overcome the inability of organizations to make effective use of data captured by IoT systems [30].

It is surprising to notice that, in this cluster, the term “cloud computing” is only ranked in the tenth position. This can potentially be explained by the fact that IoT research is more inclined toward blockchain for the storage of IoT data, rather than cloud servers. From the discussions of this cluster, it emerged that there is still ample room for examining the value of IoT when merged with Industry 4.0 technologies. To date, for example, few business cases exist to showcase the application of IoT for big data analytics initiatives in the logistics industry [74]. The lack of practical cases blurs the vision of organizations and makes them unable to make well-informed decisions regarding IoT adoption in SCM and logistics. A contribution opportunity from future studies would be to explain how IoT and big data converge, improve the integration of supply chain processes, and drive logistics innovations and new business opportunities. In spite of the growing importance of blockchain technology, there is a paucity of studies that identify and characterize the contextual settings that are relevant for tailoring the right blockchain configuration [150]. Therefore, the investigation of the business context and situational factors that influence the combined usage of blockchain and IoT is another promising research direction. As such, the understanding of the organizational goals, processes, and environment can aid practitioners in determining the appropriate business context in which IoT and other Industry 4.0 technologies can be applied together. Further discussion is also needed on whether blockchain will replace cloud-based data storage and outperform cloud computing technology in terms of security, compatibility with current organizational practices, and compliance with core business values, goals, and needs.

5.2.3. IoT support for innovation and collaboration in SCM and logistics

Another research topic is related to the technology’s potential for innovation and collaboration, which constitutes cluster 3, labeled as IoT support for innovation and collaboration in SCM and logistics. Big data generated and recorded through IoT networks can encourage organizations to explore innovation opportunities and devise data-driven solutions and strategies to enhance their competitiveness [102]. In order to sustain their market position, logistics companies can use the knowledge obtained from IoT to become advanced innovation-based logistics service providers [152]. For example, Öztayşi et al. [122] argue that customer data collected through RFID systems can be used for service innovation, supporting brand differentiation, competitiveness, and loyalty. IoT technologies enable higher levels of real-time visibility and coordination between marketing and manufacturing activities and thus contribute to the growth of innovation capabilities of the organization [23]. Moreover, organizations can use IoT to improve their supply chain processes, satisfy customer demands, and pursue innovation [66].

With more stakeholders involved in increasingly complex value networks, IoT facilitates the development of more intelligent supply chains and stronger collaborations among exchange partners [128]. The complexity of the business environment often causes operational waste throughout the supply chain [175]. Moreover, IoT can also be used as a means of operational excellence to improve collaboration and collaborative processes. In their recent study, Cui et al. [47] find that IoT can enhance information transparency, strengthen the integration of management information systems, and increase the data processing capabilities of an organization, all of which are all necessary to improve supply chain collaboration. The importance of an empirical approach is evident in this cluster, as researchers have favored the use of case studies to gain real practical insights into the effectiveness of IoT in SCM and logistics [26,96,117,153]. As recommended by Yin [167], case studies are valuable in the first stages of theory development, especially when they are aimed at examining phenomena with little or theoretical background. However, the rapid growth in IoT also implies that scholars apply more empirical methods such as surveys, interviews, and experiments to investigate how IoT is perceived and can help organizations to establish successful collaborative relationships in the supply chain. More studies on the role of IoT to drive business model innovation, promote change, and accelerate product development are therefore needed. This is crucial as managers may apply the technology to develop dynamic capabilities, inculcate creativity within their organizations, and foster innovation in SCM and logistics.

5.2.4. IoT for the food supply chain

Cluster 4 revolves around the applications of IoT in the food industry. Several complexities and intricacies characterize food supply chains, such as fragmentation, perishability, as well as quality and safety issues [1]. Food organizations also encounter other challenges, including supply interruptions, food waste, and non-sustainable practices [114]. As a result, food supply chains constitute an integral component of every economy, and there is a compelling need for organizations to consider the adoption of IoT to reduce food waste, increase food safety, and optimize operational efficiencies throughout the entire food chain [22]. The digitalization process by means of IoT solutions can assist in the management of food supply chains, embed more efficient practices, and help to monitor product history and origin tracking [46]. Similarly, the use of IoT sensors facilitates the implementation of policies for the management of fresh products (e.g., First-In First-Out (FIFO)), thus helping organizations to generate substantial cost savings [23]. For example, Bottani et al. [31] posit that the integration of RFID in the food organization can provide a quantitative assessment of critical issues of perishable food management, including on-shelf availability, stockouts, shelf management, and product freshness. Feng et al. [57] suggest that the capabilities of IoT-based food traceability systems can be empowered by the use of blockchain because the technology can secure ambient data (e.g., temperature, humidity, O_2, CO_2), which is collected and automatically transmitted by IoT sensors.

Through the use of IoT, food suppliers can rely on the sensing capacities of the technology to effectively and efficiently manage their procedures pertaining to food safety thereby increasing consumer trust in food products [19]. In this cluster, studies have also advocated the use of decision support systems (DSS) to develop smart logistics systems for controlling industrial food processes, ensuring real-time product traceability [169], and maintaining accurate prediction of shelf life [70]. Additionally, case-based reasoning (CBR) has been applied along with IoT tools to handle the global concerns facing the management of food supply chains [96,168]. Using CBR, Tsang et al. [153] contend that effective storage of environmentally sensitive products, such as food, can be established, thereby supporting third-party (3P) logistics entities to maintain good cargo monitoring in the cold chain context. Besides CBR, the analytical hierarchy process (AHP) is another artificial intelligence technique that has been leveraged as a decision-making tool to support the selection of the best 3P logistics service providers in IoT-based agriculture supply chains [165]. The findings of this cluster suggest that researchers should explore how IoT can be used to synchronize information sharing among organizations and to develop a systematic and holistic approach to tackle food quality and safety issues in the food industry. Empirical studies on the selection of capable IoT sensors in the food supply chain are required to provide practitioners with insights into the specific technical features of IoT devices necessary for the improvement of the overall performance of the food chain.

5.2.5. IoT for reverse logistics

Cluster 5 focuses on IoT and its relationship with reverse logistics (RL). Broadly, reverse logistics denotes the collection of returned products in collecting points and their flow from downstream to upstream within the supply chain [15]. The main goal of reverse logistics is to foster sustainability in the supply chain by reducing negative environmental impacts [155]. To effectively handle returned or damaged products in the supply chain, the use of RFID and IoT sensors have the potential to improve reverse logistics processes and the total recovered value of used products for manufacturing companies [44]. Likewise, IoT can streamline reverse logistics [[8,116]], optimize efficiencies [[15],[75]], and improve the management of reusable assets for the recycling of products [143]. IoT can also provide accurate and timely information regarding returned products, thus laying the foundation for the successful management of reverse logistics [68]. Access to real-time information enables organizations to have more control over the distribution channels of their returned products. In this sense, Gu and Liu [68] argue that the integration of IoT in the reverse logistics system is conducive to a complete closed-loop logistics system (CLSC) that ensures the effective operation of the whole system. Kongar et al. [90] note that the use of RFID, as a prominent IoT component, represents an effective solution to some longstanding problems that hamper the development of reverse logistics, including the tracking of returned products as well as the assessment of the value of the remaining usable content and the overall cost. Another finding from this cluster is that numerous studies use logistics regression and neural networks to develop predictive models for equipment failure risks [43,173], RFID adoption decisions [9], and for creating flexible and intelligent transportation systems [35].

Artificial intelligence techniques such as machine learning (ML) have been used with IoT, specifically RFID, to assist organizations in optimizing their remanufacturing processes, gain insightful knowledge relating to the market, and to establish adequate manufacturing strategies [174]. Data mining can also be used in IoT-based reverse logistics systems to uncover hidden patterns in IoT data and generate more accurate predictions about backflow data, thereby boosting reverse logistics initiatives [68]. The inclusion of "food safety" in this cluster indicates that reverse logistics can benefit from IoT to enhance the forecasting precision and inventory management of food products due to transparency and reduced uncertainties related to customer returns and recalls [155]. However, the literature discussing this topic is relatively scant, which illustrates the need to elucidate the potentials of IoT for food reverse logistics in more detail. In general, scholars should scrutinize the possibilities of IoT in various reverse logistics activities like recycling, waste disposal, and redistribution of products. The drivers and barriers of IoT adoption in the context of reverse logistics need to be examined so that managers can formulate effective policies and strategies for the smooth implementation of IoT in their reverse logistics designs and operations.

5.2.6. IoT for retail and other industrial sectors

The last cluster is labeled as IoT for the retail supply chain and other industrial sectors. It details how IoT functions as a catalyst involving different technologies for empowering the retail industry, as well as other industrial sectors such as construction and the pharmaceutical industry. The retail sector is at the forefront of picking up IoT to mitigate the issues posed by its current business practices [157]. The literature highlighting the enablers of IoT in this industry is well-established. For example, Shin and Eksioglu [141] and Shin and Eksioglu [140] claim that two main implications of RFID technology in the retail industry are operational efficiency and cost savings. Gawankar et al. [64] assert that IoT is one of the major drivers of developing retail 4.0 supply chains, which are data-driven and have the ability to provide superior products and enhance the consumer shopping experience. For instance, the incorporation of RFID technology increases operational performance and flexibility in retailing activities because RFID tags offer higher data storage capacity, resiliency, and durability than barcodes in a harsh retail environment [63]. Moreover, the additional benefits of IoT adoption in retail supply chains include visibility, adaption, and reduced operational risks and costs [81]. Retail businesses can further be enriched with GPS devices to support the modern concept of IoT [22] and optimize intra- and inter-organizational processes [62].

Apart from retailing, IoT benefits the construction industry in that it enables the tracking of materials and equipment and reduce construction waste [53]. In this context, Li et al. [101] suggest IoT-enabled multidimensional building information modeling (BIM) using RFID to leverage timely captured data from smart construction objects to make well-informed decisions. Wang et al. [159] argue that IoT-based real-time shop floor material management can be useful for solving issues encountered during the development of panelized construction such as data inconsistency, information delays, and lack of accurate process waste measurements, thus helping to advance the smart construction management approach. For the pharmaceutical industry, IoT can be used to avoid loss of high-value shipments [72], spot counterfeit items [8], increase the visibility of drug flows [34,106], and ensure the proper handling of drugs [45],[67],[124]. Although several studies have already been devoted to investigating the role of IoT in these industries, there is still a lack of research on the specific opportunities in the service industry. Empirical evidence of the impact of IoT on customer satisfaction in the service industry is urgently required in light of the increasing servitization of world economies [40]. Turning attention back to the retail industry, researchers should demonstrate how advances in IoT can influence the familiarity and expertise of retailers and consumers during the technology adoption process. In the context of inter- and intra-organizational adoption of IoT, clarifying this impact is crucial in order for organizations to reap operational gains and increase customer satisfaction. The structural changes induced by IoT implementations in firm-supplier relationships should therefore be examined as IoT helps firms to create in-house capabilities, thus reducing their dependence on suppliers. By analogy, some of these research directions apply equally well to the other industries, notably, pharmaceuticals and construction.

6. Conclusions, research implications, limitations

6.1. Summary of findings

The main goal of this paper is to provide a holistic view and structured review of IoT research in the field of SCM and logistics. To attain our aim, we carried out a bibliometric analysis of IoT-related publications retrieved from the Scopus database. A total of 807 journal articles were selected for the final review. The findings from the analysis can be helpful to scholars engaged in this research field and willing to start new projects on IoT applications in SCM and logistics. Although the recent literature has led to some relevant insights by analyzing the possibilities of IoT in the supply chain context, there is still a lack of thorough and objective bibliometric reviews that uncover the knowledge structure of this field as well as its progress for SCM and logistics.

Several key insights can be drawn from this study. First, the number of publications has rapidly increased during the first decade of the 2000s. In the second decade, publication has experienced inconsistent growth, yet the upward trend is likely to be continued in the near future. The journal-wise distribution of the selected articles yielded that most papers have been published in the *International Journal of RF Technologies: Research and Applications*, the *International Journal of Production Research,* and the *International Journal of Production Economics*. This illustrates the role of these leading outlets to significantly advance IoT research and make it a strong tradition in the literature of SCM and logistics. In terms of productivity Bottani E., Choy K.L., Volpi A. and Piramuthu S. were the most productive ones. In terms of institutional contributions, the Hong Kong Polytechnic University is the most productive institution. All highly productive academic institutions are located in developed countries. These findings indicate that language barriers prevent researchers from non-English-speaking nations from publishing in leading anglophone journals. In terms of national contributions, we noticed a high concentration of publications from developed Western countries, such as the USA, Germany, and the UK, where research is advanced by established and reputable universities. Meanwhile, Asian countries are represented by China and India. Finally, our analysis of the core content uncovers six major research clusters for IoT in the context of SCM and logistics.

6.2. Research implications

For researchers seeking to gain a better understanding of IoT within SCM and logistics, the core content of IoT literature was identified using the approach of keyword frequency. The main findings as gained from applying the bibliometric method are the in-depth analysis of RFID technology, its potentials, and challenges in SCM and logistics. More recently, however, researchers turn their attention to Industry 4.0, big data, and blockchain technology. The merge of these technologies with IoT is expected to create more value for organizations and improve their operational processes, such as tracking, product identification, and traceability. To grasp a better understanding of IoT research in SCM and logistics, researchers can refer to the most influential papers in the pertinent literature, which are listed in this paper. Being conscious of the seminal articles and their authors will help initiate further developments, encourage co-authorship collaborations, and enhance the overall quality of future research work. In addition, the analysis of the keyword co-occurrence network helps to reveal the structure of topics and themes discussed in IoT research within SCM and logistics. Similarly, it helps to unearth the core content of

IoT research and identify several research gaps. The research focuses are primarily centered on three main themes: (1) the application of RFID in SCM and logistics, (2) the convergence of IoT with Industry 4.0 technologies, and (3) IoT support for logistics collaboration and innovation. The applications of IoT benefit various industrial sectors; nevertheless, in the reviewed literature, a significant focus is on the food, retail, construction, and pharmaceutical industries. The findings from the keyword co-occurrence network analysis indicate that IoT can facilitate real-time data capture, optimize organizational processes, and foster supply chain sustainability. The positive impact of the technology on SCM and logistics can be become increasingly ascertained if IoT is used in conjunction with blockchain, big data, and artificial intelligence techniques, such as machine learning, neural networks, and data mining. However, the benefits of the IoT do not come without technical, security and privacy, organizational, and regulatory challenges. In this respect, researchers and practitioners should closely work together to improve the technical aspects of IoT devices, devise policies and strategies for implementing IoT, and carefully plan their investments in IoT technologies to develop more robust data-driven supply chains and smart logistics. In short, the current study uses a rigorous, objective, and meaningful method to systematize related research topics and identify several avenues for future research. To the best of our knowledge, this is the first attempt to analyze the knowledge structure of IoT in SCM and logistics using a large sample of journal articles published over two decades. Our findings will be helpful for SCM and logistics scholars and practitioners to gain a broader view of the current status of IoT research, and our recommendations for future research will inform them on the topics that need more attention.

6.3. Limitations and future research directions

The analysis of IoT research in SCM and logistics reveals many novel insights and makes an important contribution to the literature, outlining the evolution of scholarly production, the key journals, productive authors, major institutions, and contributing nations. Nevertheless, several shortcomings are noteworthy in this research. While our sample from the Scopus database is inclusive, it is not exhaustive, and the sample might be biased by the choice of the selection criteria. As is usually done in academic literature reviews, our focus was on academic journal articles that were published in English language, which excludes potentially interesting and groundbreaking research being published in other outlets or languages. Furthermore, it is important to note that our research covers academic findings and the categorization by affiliation or region does not allow to draw conclusions regarding the current state of IoT applications in the industry or the development status of a particular country.

Building on the results of this review, future studies should extend the context of this study and enhance its findings by gathering more data from other renowned scientific databases such as Web of Science and EBSCOhost. Future bibliometric reviews may consider other equally vital sources of knowledge such as conference papers, books, and book chapters to generate further insights. The clustering of research themes based on bibliographic coupling or article co-citation can be another useful approach in future bibliometric studies. Future studies should also explore non-English IoT research and underline its contribution to this research domain. We argue that there are more critical and emerging research topics to look at, which are also closely connected to the IoT research field. However, the outcomes of our bibliometric analysis shed light on this increasingly vibrant and compelling research area. Even though academics and practitioners have already devoted huge attention to IoT in recent years, the integration of IoT in the supply chain is still in its infancy. Therefore, we hope this paper motivates academics to encourage the SCM and logistics community to devote more effort to this evolving area of interest and to keep abreast of this trendsetting field of IoT research.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] R. Accorsi, S. Cholette, R. Manzini, A. Tufano, A hierarchical data architecture for sustainable food supply chain management and planning, J. Clean. Prod. 203 (2018) 1039–1054.
[2] S.P. Afsharian, A. Alizadeh, M. Chehrehpak, Effects of applying radio frequency identification in supply chain management: an empirical study of manufacturing enterprises, Int. J. Bus. Inf. Syst. 23 (1) (2016) 97–115.
[3] C.C. Aggarwal, N. Ashish, A. Sheth, The Internet of Things: a survey from the data-centric perspective, in: C.C. Aggarwal (Ed.), Managing and Mining Sensor Data, Springer US, Boston, MA, 2013, pp. 383–428.
[4] Aho, A.-.M. (2015), "Product Data Analytics Service Model for Manufacturing Company", Lecture Notes in Business Information Processing, Vol. 224, pp. 282–296.
[5] I. Al Kattan, T. Al Khudairi, Simulation of inventory control system in a supply chain using RFID, Int. J. Inf. Syst. Supply Chain Manag. 3 (1) (2010) 68–86.
[6] A. Ali, M. Haseeb, Radio frequency identification (RFID) technology as a strategic tool towards higher performance of supply chain operations in textile and apparel industry of Malaysia, Uncertain Supply Chain Manag. 7 (2) (2019) 215–226.
[7] M. Amini, R.F. Otondo, B.D. Janz, M.G. Pitts, Simulation modeling and analysis: a collateral application and exposition of RFID technology, Prod. Oper. Manag. 16 (5) (2007) 586–598.
[8] R. Angeles, RFID adoption in the supply chain: the rational expectations hypothesis alternative view, Int. J. Integr. Supply Manag. 4 (3–4) (2008) 257–277.
[9] R. Angeles, Theoretical views on the potential shopper response to RFID item tagging, Int. J. Bus. Inf. Syst. 4 (1) (2009) 63–84.
[10] A. Anirudh, V.K. Pandey, J.S. Sodhi, T. Bagga, Next generation Indian campuses going SMART, Int. J. Appl. Bus. Econ. Res. 15 (21) (2017) 385–398.
[11] I.D. Apriliyanti, I. Alon, Bibliometric analysis of absorptive capacity, Int. Bus. Rev. 26 (5) (2017) 896–907.

[12] L. Ardito, A.M. Petruzzelli, U. Panniello, A.C. Garavelli, Towards industry 4.0: mapping digital technologies for supply chain management-marketing integration, Bus. Process Manag. J. 25 (2) (2019) 323–346.
[13] M. Aria, C. Cuccurullo, Bibliometrix: an R-tool for comprehensive science mapping analysis, J. Informetr. 11 (4) (2017) 959–975.
[14] A. Aryal, Y. Liao, P. Nattuthurai, B. Li, The emerging big data analytics and IoT in supply chain management: a systematic review, in: Supply Chain Management, 25, Emerald Group Publishing Ltd, 2018, pp. 141–156.
[15] R. Asif, Reverse logistics: RFID the key to optimality, J. Ind. Eng. Manag. 4 (2) (2011) 281–300.
[16] M. Attaran, RFID: an enabler of supply chain operations, Supply Chain Manag.: Int. J. 12 (4) (2007) 249–257.
[17] M. Attaran, Digital technology enablers and their implications for supply chain management, Supply Chain Forum, Taylor and Francis Ltd., 2020 available at, doi:10.1080/16258312.2020.1751568.
[18] L. Atzori, A. Iera, G. Morabito, The internet of things: a survey, Comput. Netw. 54 (15) (2010) 2787–2805.
[19] S. Balamurugan, A. Ayyasamy, K.S. Joseph, Iot based supply chain traceability using enhanced naive bayes approach for scheming the food safety issues, Int. J. Sci. Technol. Res. 9 (3) (2020) 1184–1192.
[20] C. Bardaki, P. Kourouthanassis, K. Pramatari, Exploring the deployment and adoption of RFID-enabled retail promotions management, Int. J. RF Technol.: Res. Appl. 2 (2) (2010) 91–115.
[21] G. Bavassano, C. Ferrari, A. Tei, Blockchain: how shipping industry is dealing with the ultimate technological leap, Research in Transportation Business and Management, Elsevier Ltd, 2020 available at, doi:10.1016/j.rtbm.2020.100428.
[22] M. Ben-Daya, E. Hassini, Z. Bahroun, Internet of things and supply chain management: a literature review, Int. J. Prod. Res. 57 (15–16) (2019) 4719–4742.
[23] M. Bertolini, G. Ferretti, G. Vignali, A. Volpi, Reducing out of stock, shrinkage and overstock through RFID in the fresh food supply chain: evidence from an Italian retail pilot, Int. J. RF Technol.: Res. Appl. 4 (2) (2013) 107–125.
[24] R. Bhandari, Impact of technology on logistics and supply chain management, IOSR J. Bus. Manag. 2 (2014) 17.
[25] H.S. Birkel, E. Hartmann, Impact of IoT challenges and risks for SCM, in: Supply Chain Management, 24, Emerald Group Publishing Ltd, 2019, pp. 39–61.
[26] H.S. Birkel, E. Hartmann, Internet of Things – the future of managing supply chain risks, in: Supply Chain Management, 25, Emerald Group Publishing Ltd, 2020, pp. 535–548.
[27] A.K. Biswal, M. Jenamani, S.K. Kumar, Warehouse efficiency improvement using RFID in a humanitarian supply chain: implications for Indian food security system, Transp. Res. Part E: Logist. Transp. Rev. 109 (2018) 205–224.
[28] E. Borgiaa, The Internet of Things vision: key features, applications and open issues, Comput. Commun. 54 (2014) 1–31.
[29] K. Börner, C. Chaomei, K.W. Boyack, Visualizing knowledge domains, Annu Rev Inform Sci 37 (1) (2000) 179–255.
[30] I. Bose, C.W. Lam, Facing the challenges of RFID data management, Int. J. Inf. Syst. Supply Chain Manag. 1 (4) (2008) 19.
[31] E. Bottani, M. Bertolini, A. Rizzi, G. Romagnoli, Monitoring on-shelf availability, out-of-stock and product freshness through RFID in the fresh food supply chain, Int. J. RF Technol.: Res. Appl. 8 (1–2) (2017) 33–55.
[32] E. Bottani, A. Rizzi, Economical assessment of the impact of RFID technology and EPC system on the fast-moving consumer goods supply chain, Int. J. Prod. Econ. 112 (2) (2008) 548–569.
[33] Y. Bouzembrak, M. Klüche, A. Gavai, H.J.P. Marvin, Internet of Things in food safety: literature review and a bibliometric analysis, Trends Food Sci. Technol. 94 (2019) 54–64.
[34] R.V. Bradley, T.L. Esper, J. In, K.B. Lee, B.C. Bichescu, T.A. Byrd, The joint use of RFID and EDI: implications for hospital performance, in: Production and Operations Management, 27, Wiley-Blackwell, 2018, pp. 2071–2090.
[35] A. Brzozowska, D. Bubel, A. Kalinichenko, Analysis of the road traffic management system in the neural network development perspective, Eastern-Eur. J. Enterp. Technol. 2 (3–98) (2019) 16–24.
[36] K. Butner, The smarter supply chain of the future, Strategy Leadersh. 38 (1) (2010) 22–31.
[37] F. Caro, R. Sadr, The Internet of Things (IoT) in retail: bridging supply and demand, Bus. Horiz. 62 (1) (2019) 47–54.
[38] C.-.C. Chao, J.-.M. Yang, W.-.Y. Jen, Determining technology trends and forecasts of RFID by a historical review and bibliometric analysis from 1991 to 2005, Technovation 27 (5) (2007) 268–279.
[39] H. Chen, A. Papazafeiropoulou, An empirical study for radio frequency identification (RFID) adoption by SMEs in the Taiwanese information technology (IT) industry, Asian Acad. Manag. J.l 17 (2) (2012) 39–58.
[40] D.W. Cho, Y.H. Lee, S.H. Ahn, M.K. Hwang, A framework for measuring the performance of service supply chain management, Comput. Ind. Eng. 62 (3) (2012) 801–818.
[41] K.H. Chow, K.L. Choy, W.B. Lee, On the design of a real-time knowledge-based system for managing logistics operations, Intell. Syst. Account. Financ. Manag. 14 (1–2) (2006) 3–25.
[42] C. Christauskas, R. Miseviciene, A. O'Driscoll, J. Daugelaite, R.D. Sleator, T. Heupel, S. Schmitz, et al., Overview of business innovations and research opportunities in blockchain and introduction to the special issue, Int. J. Prod. Econ. 2 (1) (2016) 28.
[43] X. Chu, Y. Li, Y. Xie, D. Tian, W. Mu, Regional difference analyzing and prediction model building for Chinese wine consumers' sensory preference, Br. Food J. 122 (8) (2019) 2587–2602.
[44] C. Condea, F. Thiesse, E. Fleisch, Assessing the impact of RFID and sensor technologies on the returns management of time-sensitive products, Bus. Process Manag. J. 16 (6) (2010) 954–971.
[45] C. Condea, F. Thiesse, E. Fleisch, RFID-enabled shelf replenishment with backroom monitoring in retail stores, Decis. Support Syst. 52 (4) (2012) 839–849.
[46] A.E. Coronado Mondragon, C.E. Coronado Mondragon, E.S. Coronado, Managing the food supply chain in the age of digitalisation: a conceptual approach in the fisheries sector, Production Planning and Control, Taylor and Francis Ltd., 2020 available at, doi:10.1080/09537287.2020.1733123.
[47] L. Cui, M. Gao, J. Dai, J. Mou, Improving supply chain collaboration through operational excellence approaches: an IoT perspective, Industrial Management and Data Systems, Emerald Group Publishing Ltd, 2020 available at, doi:10.1108/IMDS-01-2020-0016.
[48] J.G. Cullen, Educating business students about sustainability: a bibliometric review of current trends and research needs, J. Bus. Ethics 145 (2) (2017) 429–439.
[49] J. Curtin, R.J. Kauffman, F.J. Riggins, Making the 'MOST' out of RFID technology: a research agenda for the study of the adoption, usage and impact of RFID, Inf. Technol. Manag. 8 (2) (2007) 87–110.
[50] J.D. Daniels, Relevance in International business research: a need for more linkages, J. Int. Bus. Stud. 22 (2) (1991) 177–186.
[51] D. Delen, B.C. Hardgrave, R. Sharda, RFID for better supply-chain management through enhanced information visibility, Prod. Oper. Manag. 16 (5) (2007) 613–624.
[52] N. van Eck, L. Waltman, Software survey: vOSviewer, a computer program for bibliometric mapping, Scientometrics 84 (2) (2009) 523–538.
[53] R. Edirisinghe, Digital skin of the construction site: smart sensor technologies towards the future smart construction site, Eng. Constr. Archit. Manag. 26 (2) (2019) 184–223.
[54] V. Elia, M.G. Gnoni, Pervasiveness of RFID technology: a survey based on case studies analysis, Int. J. RF Technol.: Res. Appl. 5 (1–2) (2013) 41–61.
[55] B. Fahimnia, J. Sarkis, H. Davarzani, Green supply chain management: a review and bibliometric analysis, Int. J. Prod. Econ. 162 (2015) 101–114.
[56] T. Fan, F. Tao, S. Deng, S. Li, Impact of RFID technology on supply chain decisions with inventory inaccuracies, Int. J. Prod. Econ. 159 (2015) 117–125.
[57] H. Feng, X. Wang, Y. Duan, J. Zhang, X. Zhang, Applying blockchain technology to improve agri-food traceability: a review of development methods, benefits and challenges, J. Clean. Prod. 260 (2020) available at, doi:10.1016/j.jclepro.2020.121031.
[58] M. Fernandez-Alles, A. Ramos-Rodríguez, Intellectual structure of human resources management research: a bibliometric analysis of the journal Human Resource Management, 1985–2005, J. Am. Soc. Inf. Sci. Technol. 60 (1) (2009) 161–175.

[59] J. Fernie, L. Sparks, A.C. McKinnon, Retail logistics in the UK: past, present and future, Int. J. Retail Distrib. Manag. 38 (11) (2010) 894–914.
[60] M. Fetscherin, D. Heinrich, Consumer brand relationships research: a bibliometric citation meta-analysis, J. Bus. Res. 68 (2) (2015) 380–390.
[61] A. Foncubierta-Rodríguez, H. Müller, A. Depeursinge, Retrieval of high-dimensional visual data: current state, trends and challenges ahead, Multimed. Tools Appl. 69 (2) (2014) 539–567.
[62] S. Fosso Wamba, Achieving supply chain integration using RFID technology: the case of emerging intelligent B-to-B e-commerce processes in a living laboratory, Bus. Process Manag. J. 18 (1) (2012) 58–81.
[63] B. Gao, Q. Zhou, S. Li, X. Liu, A real time stare in market strategy for supply chain financing pledge risk management, in: Proceedings of IEEE International Conference on Industrial Engineering and Engineering Management, 2019-December, IEEE Computer Society, 2019, pp. 1116–1119.
[64] S.A. Gawankar, A. Gunasekaran, S. Kamble, A study on investments in the big data-driven supply chain, performance measures and organisational performance in Indian retail 4.0 context, Int. J. Prod. Res. 58 (5) (2020) 1574–1593.
[65] D. Giusto, A. Iera, G. Morabito, L. Atzori, The Internet of Things: 20th Tyrrhenian Workshop On Digital Communications, Springer Science & Business Media, 2010.
[66] V. Gružauskas, S. Baskutis, V. Navickas, Minimizing the trade-off between sustainability and cost effective performance by using autonomous vehicles, J. Clean. Prod. 184 (2018) 709–717.
[67] V.C. Gu, K. Black, Integration of TTF and network externalities for RFID adoption in healthcare industry, Int. J. Prod. Perform. Manag. (2020) available at, doi:10.1108/IJPPM-11-2018-0418.
[68] Y. Gu, Q. Liu, Research on the application of the internet of things in reverse logistics information management, J. Ind. Eng. Manag. 6 (4) (2013) 963–973.
[69] Z.X. Guo, E.W.T. Ngai, C. Yang, X. Liang, An RFID-based intelligent decision support system architecture for production monitoring and scheduling in a distributed manufacturing environment, Int. J. Prod. Econ. 159 (2015) 16–28.
[70] T. Haflidason, G. Ólafsdóttir, S. Bogason, G. Stefánsson, Criteria for temperature alerts in cod supply chains, Int. J. Phys. Distrib. Logist. Manag. 42 (4) (2012) 355–371.
[71] B.C. Hardgrave, Charles Vögele: reaping the benefits of source-to-store RFID, in: Apparel, 50, Edgell Communications Inc., 2009, pp. 17–20.
[72] G. Hendrik Haan, J. van Hillegersberg, E. de Jong, K. Sikkel, Adoption of wireless sensors in supply chains: a process view analysis of a pharmaceutical cold chain, J. Theor. Appl. Electron. Commerce Res. 8 (2) (2013) 138–154.
[73] R. van Hoek, Exploring blockchain implementation in the supply chain: learning from pioneers and RFID research, Int. J. Oper. Prod. Manag. 39 (2019) 829–859.
[74] J. Hopkins, P. Hawking, Big Data Analytics and IoT in logistics: a case study, Int. J. Logist. Manag. 29 (2) (2018) 575–591.
[75] J.-L. Hou, C.-H. Huang, Quantitative performance evaluation of RFID applications in the supply chain of the printing industry, Ind. Manag. Data Syst. 106 (1) (2006) 96–120.
[76] C.-W. Hsu, A.H. Hu, Applying hazardous substance management to supplier selection using analytic network process, J. Clean. Prod. 17 (2) (2009) 255–264.
[77] IoT Analytics. (2018), "State of the IoT & Short Term Outlook 2018″, available at: https://iot-analytics.com/product/state-of-the-iot-2018/ (accessed 16 August 2020).
[78] Z. Irani, A. Gunasekaran, Y.K. Dwivedi, Radio frequency identification (RFID): research trends and framework, Int. J. Prod. Res. 48 (9) (2010) 2485–2511.
[79] H. Kagermann, J. Helbig, A. Hellinger, W. Wahlster, Recommendations for Implementing the Strategic Initiative INDUSTRIE 4.0: Securing the Future of German Manufacturing Industry, National Academy of Science and Engineering, 2013 Final Report of the Industrie 4.0 Working Group, Forschungsunion.
[80] S.S. Kamble, A. Gunasekaran, S.A. Gawankar, Achieving sustainable performance in a data-driven agriculture supply chain: a review for research and applications, Int. J. Prod. Econ. 219 (2019) 179–194.
[81] S.S. Kamble, A. Gunasekaran, H. Parekh, S. Joshi, Modeling the Internet of Things adoption barriers in food retail supply chains, J. Retail. Consum. Serv. 48 (2019) 154–168.
[82] M. Kamran, H.U. Khan, W. Nisar, M. Farooq, S.-U. Rehman, Blockchain and Internet of Things: a bibliometric study, Comput. Electr. Eng. 81 (2020) available at, doi:10.1016/j.compeleceng.2019.106525.
[83] A. Karagiannaki, G. Doukidis, K. Pramatari, A framework for mapping the RFID-enabled process redesign in a simulation model, J. Oper. Res. Soc. 65 (11) (2014) 1700–1710.
[84] M. Kärkkäinen, Increasing efficiency in the supply chain for short shelf life goods using RFID tagging, Int. J. Retail Distrib. Manag. 31 (10) (2003) 529–536.
[85] N. Kasiri, More insights into RFID-enabled changes in retail: a simulation model, Int. J. RF Technol.: Res. Appl. 7 (4) (2016) 229–248.
[86] Y.A. Kathawala, B. Tueck, The use of RFID for traffic management, Int. J. Technol. Policy Manag. 8 (2) (2008) 111–125.
[87] T. Kelepouris, K. Pramatari, G. Doukidis, RFID-enabled traceability in the food supply chain, Ind. Manag. Data Syst. 107 (2) (2007) 183–200.
[88] I. Kilubi, Investigating current paradigms in supply chain risk management – a bibliometric study, Bus. Process Manag. J. 22 (4) (2016) 662–692.
[89] H.M. Kim, M. Laskowski, Toward an ontology-driven blockchain design for supply-chain provenance, Intell. Syst. Account. Financ. Manag. 25 (1) (2018) 18–27.
[90] E. Kongar, E. Haznedaroglu, O. Abdelghany, M.O. Bahtiyar, A novel IT infrastructure for reverse logistics operations of end-of-life pharmaceutical products, in: Information Technology and Management, 16, Springer New York LLC, 2015, pp. 51–65.
[91] H.-P. Kriegel, P. Kröger, J. Sander, A. Zimek, Density-based clustering, WIREs Data Min. Knowl. Discov. 1 (3) (2011) 231–240.
[92] V. Krotov, I. Junglas, RFID as a disruptive innovation, J. Theor. Appl. Electron. Commerce Res. 3 (2) (2008) 44–59.
[93] A. Kumar, S. Rahman, RFID-enabled process reengineering of closed-loop supply chains in the healthcare industry of Singapore, J. Clean. Prod. 85 (2014) 382–394.
[94] B. Kvarnström, E. Vanhatalo, Using RFID to improve traceability in process industry: experiments in a distribution chain for iron ore pellets, J. Manuf. Technol. Manag. 21 (1) (2010) 139–154.
[95] F. Lai, J. Hutchinson, G. Zhang, Radio frequency identification (RFID) in China: opportunities and challenges, Int. J. Retail Distrib. Manag. 33 (12) (2005) 905–916.
[96] S.I. Lao, K.L. Choy, G.T.S. Ho, R.C.M. Yam, An RFRS that combines RFID and CBR technologies, Ind. Manag. Data Syst. 112 (3) (2012) 385–404.
[97] K.H. Lau, T. Sirichoti, A study on RFID adoption in the grocery retailing industry of Thailand, Int. J. Inf. Syst. Supply Chain Manag. 5 (3) (2012) 58–77.
[98] D. Lee, J. Park, RFID-based traceability in the supply chain, Ind. Manag. Data Syst. 108 (6) (2008) 713–725.
[99] H. Lee, Ö Özer, Unlocking the value of RFID, in: Production and Operations Management, 16, Florida International University, 2007, pp. 40–64.
[100] I. Lee, K. Lee, The Internet of Things (IoT): applications, investments, and challenges for enterprises, Bus. Horiz. 58 (4) (2015) 431–440.
[101] C.Z. Li, R.Y. Zhong, F. Xue, G. Xu, K. Chen, G.G. Huang, G.Q. Shen, Integrating RFID and BIM technologies for mitigating risks and improving schedule performance of prefabricated house construction, J. Clean. Prod. 165 (2017) 1048–1062.
[102] D. Li, X. Wang, Dynamic supply chain decisions based on networked sensor data: an application in the chilled food retail chain, Int. J. Prod. Res. 55 (17) (2017) 5127–5141.
[103] B. Lin, J. Collins, R.K. Su, Supply chain costing: an activity-based perspective, Int. J. Phys. Distrib. Logist. Mana. 31 (10) (2001) 702–713.
[104] A.M. López De La Cruz, H.P.M. Veeke, G. Lodewijks, Intelligent supply chain by using prognostic logistics, Int. J. Serv. Oper. Inform. 2 (2) (2007) 152–163.
[105] P. Lou, Q. Liu, Z. Zhou, H. Wang, Agile supply chain management over the Internet of Things, in: *Proceedings of the 2011 International Conference on Management and Service Science*, presented at the 2011 International Conference on Management and Service Science, Wuhan, China, IEEE, 2011, pp. 1–4.

[106] M. Maffia, L. Mainetti, L. Patrono, E. Urso, Evaluation of potential effects of RFID-based item-level tracing systems on the integrity of biological pharmaceutical products, Int. J. RF Technol.: Res. Appl. 3 (2) (2012) 101–118.
[107] N. Maflahi, M. Thelwall, When are readership counts as useful as citation counts? Scopus versus Mendeley for LIS journals, J. Assoc. Inf. Sci. Technol. 67 (1) (2016) 191–199.
[108] M. Maksimović, V. Vujović, E. Omanović-Mikličanin, Application of internet of things in food packaging and transportation, Int. J. Sustain. Agric. Manag. Inform. 1 (4) (2015) 333–350.
[109] Markets and Markets. (2020), "Industrial IoT (IIoT) Market by Device & Technology (Sensor, RFID, Industrial Robotics, DCS, Condition Monitoring, Networking Technology), Connectivity (Wired, Wireless, Field Technology), Software (PLM, MES, SCADA), Vertical, Region - Global Forecast to 2025", available at: https://www.marketsandmarkets.com/Market-Reports/industrial-internet-of-things-market-129733727.html?gclid=CjwKCAiA1rPyBRAREiwA1UIy8HeVQ_mbRZH2eOFTcuZok4BdBR_57FIIK72wJX4Wg1Y1hQIuAs-cUBoCnzcQAvD_BwE (accessed 16 August 2020).
[110] A. Marvuglia, L. Havinga, O. Heidrich, J. Fonseca, N. Gaitani, D. Reckien, Advances and challenges in assessing urban sustainability: an advanced bibliometric review, Renew. Sustain. Energy Rev. 124 (2020) 109788.
[111] B. Mehl, What is IoT? Here are the definitions from industry experts, Access Control Experts (2018) available at https://www.getkisi.com/blog/what-is-iot .
[112] Z. Merkaš, D. Perkov, V. Bonin, The significance of blockchain technology in digital transformation of logistics and transportation, Int. J. E-Serv. Mob. Appl. 12 (1) (2020) 1–20.
[113] M. Mital, V. Chang, P. Choudhary, A. Papa, A.K. Pani, Adoption of Internet of Things in India: a test of competing models using a structured equation modeling approach, in: Technological Forecasting and Social Change, 136, Elsevier Inc, 2018, pp. 339–346.
[114] S. Mithun Ali, M.A. Moktadir, G. Kabir, J. Chakma, M.J.U. Rumi, M.T. Islam, Framework for evaluating risks in food supply chain: implications in food wastage reduction, J. Clean. Prod. 228 (2019) 786–800.
[115] A. Musa, A.-A.A. Dabo, A review of RFID in supply chain management: 2000–2015, Global J. Flex. Syst. Manag. 17 (2) (2016) 189–228.
[116] J.J. Nativi, S. Lee, Impact of RFID information-sharing strategies on a decentralized supply chain with reverse logistics operations, Int. J. Prod. Econ. 136 (2) (2012) 366–377.
[117] E.W.T. Ngai, F.F.C. Suk, S.Y.Y. Lo, Development of an RFID-based sushi management system: the case of a conveyor-belt sushi restaurant, Int. J. Prod. Econ. 112 (2) (2008) 630–645.
[118] G.C. Nobre, E. Tavares, Scientific literature analysis on big data and internet of things applications on circular economy: a bibliometric study, in: Scientometrics, 111, Springer, 2017, pp. 463–492. Akadémiai Kiadó.
[119] N. O'Connor, P.B. Lowry, H. Treiblmaier, Interorganizational cooperation and supplier performance in high-technology supply chains, Heliyon 6 (3) (2020) e03434 1- 16.
[120] C.M. de Oliveira, P.J.S.R. Soares, G. Morales, J. Arica, I.O. Matias, RFID and its applications on supply chain in Brazil: A structured literature review (2006 - 2016), Rev. Espac. 38 (31) (2017) available at https://www.scopus.com/inward/record.uri?eid=2-s2.0-85021922345&partnerID=40&md5=f062191611541391ded4cdb73eea55cb .
[121] T.L. Olsen, B. Tomlin, Industry 4.0: opportunities and challenges for operations management, Manuf. Serv. Oper. Manag., INFORMS 22 (1) (2019) 113–122.
[122] B. Öztayşi, S. Baysan, F. Akpinar, Radio frequency identification (RFID) in hospitality, Technovation 29 (9) (2009) 618–624.
[123] S. Pan, E. Ballot, G.Q. Huang, B. Montreuil, Physical Internet and interconnected logistics services: research and applications, Int. J. Prod. Res. 55 (9) (2017) 2603–2609.
[124] M. Papert, P. Rimpler, A. Pflaum, Enhancing supply chain visibility in a pharmaceutical supply chain: solutions based on automatic identification technology, Int. J. Phys. Distrib. Logist. Manag. 46 (9) (2016) 859–884.
[125] K.S. Park, C.E. Koh, K. Nam, Perceptions of RFID technology: a cross-national study, Ind. Manag. Data Syst. 110 (5) (2010) 682–700.
[126] G.C. Parry, S.A. Brax, R.S. Maull, I.C.L. Ng, Operationalising IoT for reverse supply: the development of use-visibility measures, Supply Chain Manag.: Int. J. 21 (2) (2016) 228–244.
[127] J.B. Perussi, F. Gressler, R. Seleme, Supply chain 4.0: autonomous vehicles and equipment to meet demand, Int. J. Supply Chain Manag. 8 (4) (2019) 33–41.
[128] S. Piramuthu, A. Rizzi, G. Vignali, A. Volpi, Benchmarking of RFID devices for apparel applications: an experimental approach, Int. J. RF Technol.: Res. Appl. 6 (2–3) (2015) 151–169.
[129] M. Pishdar, F. Ghasemzadeh, J. Antucheviciene, J. Saparauskas, Internet of things and its challenges in supply chain management: a rough strength-relation analysis method [Internet věcí a jeho výzvy pro supply chain management: metoda analýzy hrubé síly], in: E a M: Ekonomie a Management, 21, Technical University of Liberec, 2018, pp. 208–222.
[130] M. Portugal Ferreira, A bibliometric study on Ghoshal's managing across borders, in: Multinational Business Review, 19, Emerald Group Publishing Limited, 2011, pp. 357–375.
[131] S. Qrunfleh, M. Tarafdar, Supply chain information systems strategy: impacts on supply chain performance and firm performance, Int. J. Prod. Econ. 147 (2014) 340–350.
[132] A. Rejeb, J.G. Keogh, H. Treiblmaier, Leveraging the Internet of Things and blockchain technology in supply chain management, Futur Internet 11 (7) (2019) 161.
[133] D.F. Ross, Introduction to Supply Chain Management Technologies, St Lucie Press, Boca Raton, FL, 2016.
[134] S. Saberi, M. Kouhizadeh, J. Sarkis, L. Shen, Blockchain technology and its relationships to sustainable supply chain management, Int. J. Prod. Res. 57 (7) (2019) 2117–2135.
[135] J. Sakhnini, H. Karimipour, A. Dehghantanha, R.M. Parizi, G. Srivastava, Security aspects of Internet of Things aided smart grids: a bibliometric survey, Internet Things (2019) 100111. https://www.sciencedirect.com/science/article/pii/S2542660519302148?casa_token=vq8P09tD7hIAAAAA:wW_FzNDCDwHOk_isjgUQdZfGMNpyNXMTsGFMydeCJBi5aJ7EBtBdmpIZSWYsc4U4foQ7nvpiEw.
[136] Y. Saleem, N. Crespi, M.H. Rehmani, R. Copeland, D. Hussein, E. Bertin, Exploitation of social IoT for recommendation services, in: *Proceedings of the 2016 IEEE 3rd World Forum on Internet of Things (WF-IoT)*, presented at the 2016 IEEE 3rd World Forum on Internet of Things (WF-IoT), 2016, pp. 359–364.
[137] A. Sharma, P. Khanna, Relevance of adopting emerging technologies in outbound supply chain: new paradigm for cement industry, in: Operations and Supply Chain Management, 13, Operations and Supply Chain Management Forum, 2020, pp. 210–221.
[138] S.M. Shavarani, M. Golabi, G. Izbirak, A capacitated biobjective location problem with uniformly distributed demands in the UAV-supported delivery operation, Int. Trans. Oper. Res. n/a (n/a) (2019) available at, doi:10.1111/itor.12735.
[139] N. Shibata, Y. Kajikawa, K. Matsushima, Topological analysis of citation networks to discover the future core articles, J. Am. Soc. Inf. Sci. Technol. 58 (6) (2007) 872–882.
[140] S. Shin, B. Eksioglu, Effects of RFID technology on efficiency and profitability in retail supply Chains, J. Appl. Bus. Res. 30 (3) (2014) 633–645.
[141] S. Shin, B. Eksioglu, An empirical study of RFID productivity in the U.S. retail supply chain, Int. J. Prod. Econ. 163 (2015) 89–96.
[142] R. Strange, A. Zucchella, Industry 4.0, global value chains and international business, in: Multinational Business Review, 25, Emerald Publishing Limited, 2017, pp. 174–184.
[143] L. Suhong, J.K. Visich, Radio frequency identification: supply chain impact and implementation challenges, Int. J. Integr. Supply Manag. 2 (4) (2006) 407–424.
[144] C. Sum, C. Teo, K. Ng, Strategic logistics management in Singapore, Int. J. Oper. Prod. Manag. 21 (9) (2001) 1239–1260.
[145] M. Tajima, Strategic value of RFID in supply chain management, J. Purch. Supply Manag. 13 (4) (2007) 261–273.
[146] C.S. Tang, L.P. Veelenturf, The strategic role of logistics in the industry 4.0 era, Transp. Res. Part E: Logist. Transp. Rev. 129 (2019) 1–11.

[147] P.H. Tatham, K.M. Spens, D. Taylor, Development of the academic contribution to humanitarian logistics and supply chain management, Management Research News, 32, Emerald Group Publishing Limited, 2009 available at, doi:10.1108/mrn.2009.02132kaa.001.
[148] B. Tjahjono, C. Esplugues, E. Ares, G. Pelaez, What does industry 4.0 mean to supply chain?, in: Procedia Manuf., 13, 2017, pp. 1175–1182.
[149] H. Treiblmaier, The impact of the blockchain on the supply chain: a theory-based research framework, Supply Chain Manag.: Int. J. 23 (6) (2018) 545–559.
[150] H. Treiblmaier, Toward more rigorous blockchain research: recommendations for writing blockchain case studies, Front. Blockchain 2 (Article 3) (2019) 1–15.
[151] H. Treiblmaier, K. Mirkovski, P.B. Lowry, Z.G. Zacharia, The physical internet as a new supply chain paradigm: a systematic literature review and a comprehensive framework, Int. J. Logist. Manag. 31 (2) (2020) 239–287.
[152] W.-.C. Tsai, L.-.L. Tang, A model of the adoption of radio frequency identification technology: the case of logistics service firms, J. Eng. Technol. Manag. 29 (1) (2012) 131–151.
[153] Y.P. Tsang, K.L. Choy, C.H. Wu, G.T.S. Ho, H.Y. Lam, P.S. Koo, An IoT-based cargo monitoring system for enhancing operational effectiveness under a cold chain environment, Int. J. Eng. Bus. Manag. 9 (2017) available at, doi:10.1177/1847979017749063.
[154] L. Urquhart, D. McAuley, Avoiding the internet of insecure industrial things, Comput. Law Secur. Rev. 34 (3) (2018) 450–466.
[155] M. Usama, A. Ramish, Towards a sustainable reverse logistics framework / typologies based on radio frequency identification (RFID), in: Operations and Supply Chain Management, 13, Operations and Supply Chain Management Forum, 2020, pp. 222–232.
[156] T. de Vass, H. Shee, S. Miah, The effect of 'Internet of Things' on supply chain integration and performance: an organisational capability perspective, Australas. J. Inf. Syst. 22 (2018) available at, doi:10.3127/ajis.v22i0.1734.
[157] T. de Vass, H. Shee, S.J. Miah, Iot in supply chain management: a narrative on retail sector sustainability, Int. J. Logist. Res. Appl. (2020) available at, doi:10.1080/13675567.2020.1787970.
[158] H. Wahyuni, I. Vanany, U. Ciptomulyono, Food safety and halal food in the supply chain: review and bibliometric analysis, J. Ind. Eng. Manag. 12 (2) (2019) 373–391.
[159] M. Wang, M.S. Altaf, M. Al-Hussein, Y. Ma, Framework for an IoT-based shop floor material management system for panelized homebuilding, Int. J. Constr. Manag. 20 (2) (2020) 130–145.
[160] Y.-.M. Wang, Y.-.S. Wang, Y.-.F. Yang, Understanding the determinants of RFID adoption in the manufacturing industry, Technol. Forecast. Soc. Change 77 (5) (2010) 803–815.
[161] R.H. Weber, Internet of Things–new security and privacy challenges, Comput. Law Secur. Rev. 26 (1) (2010) 23–30.
[162] S. Winkelhaus, E.H. Grosse, Logistics 4.0: a systematic review towards a new logistics system, Int. J. Prod. Res. 58 (1) (2020) 18–43.
[163] N.C. Wu, M.A. Nystrom, T.R. Lin, H.C. Yu, Challenges to global RFID adoption, Technovation 26 (12) (2006) 1317–1323.
[164] L.D. Xu, W. He, S. Li, Internet of Things in industries: a survey, IEEE Trans. Ind. Inf. 10 (4) (2014) 2233–2243.
[165] S. Yadav, D. Garg, S. Luthra, Selection of third-party logistics services for internet of things-based agriculture supply chain management, Int. J. Logist. Syst. Manag. 35 (2) (2020) 204–230.
[166] J. Yan, S. Xin, Q. Liu, W. Xu, L. Yang, L. Fan, B. Chen, et al., Intelligent supply chain integration and management based on cloud of things, Int. J. Distrib. Sens. Netw. 10 (3) (2014) 624839.
[167] R.K. Yin, Case Study Research and Applications: Design and Methods, SAGE Publications, 2017.
[168] J.S.M. Yuen, K.L. Choy, H.Y. Lam, Y.P. Tsang, An intelligent-internet of things (IoT) outbound logistics knowledge management system for handling temperature sensitive products, Int. J. Knowl. Syst. Sci. 9 (1) (2018) 23–40.
[169] R. Yusianto, Suprihatin Marimin, H. Hardjomidjojo, Smart logistics system in food horticulture industrial products: a systematic review and future research agenda, Int. J. Supply Chain Manag. 9 (2) (2020) 943–956.
[170] S. Zailani, Y. Fernando, H. Zakaria, Determinants of RFID adoption among logistics service providers in Malaysia: a discriminant analysis, Int. J. Logist. Syst. Manag. 7 (3) (2010) 345–367.
[171] P.J. Zelbst, K.W. Green, V.E. Sower, P.L. Bond, The impact of RFID, IIoT, and blockchain technologies on supply chain transparency, J. Manuf. Technol. Manag. 31 (3) (2019) 441–457.
[172] J. Zhang, J. Xie, W. Hou, X. Tu, J. Xu, F. Song, Z. Wang, et al., Mapping the knowledge structure of research on patient adherence: knowledge domain visualization based co-word analysis and social network analysis, PLoS One 7 (4) (2012) e34497.
[173] Z. Zhang, P. Zhang, Seeing around the corner: an analytic approach for predictive maintenance using sensor data, J. Manag. Anal. 2 (4) (2015) 333–350.
[174] W. Zhou, S. Piramuthu, Remanufacturing with RFID item-level information: optimization, waste reduction and quality improvement, Int. J. Prod. Econ. 145 (2) (2013) 647–657.
[175] W. Zhou, S. Piramuthu, IoT security perspective of a flexible healthcare supply chain, in: Information Technology and Management, 19, Springer New York LLC, 2018, pp. 141–153.
[176] X. Zhu, S.K. Mukhopadhyay, H. Kurata, A review of RFID technology and its managerial applications in different industries, J. Eng. Technol. Manag. 29 (1) (2012) 152–167.