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A data-driven, comparative review of the academic literature and news media on blockchain-enabled supply chain management: Trends, gaps, and research needs

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ABSTRACT

The application of blockchain technology in supply chain management has become a popular area of discussion in research and practice. This paper develops a computational, data-driven synthesis of the scholarly literature versus news media on BT-enabled supply chain management (BT-SCM) to uncover major trends, understand how academic research is aligned with business practice, and find out existing gaps. Through text mining and topic modeling of 1148 full-text research papers and 5130 news articles, major themes within each domain, their patterns of evolution over time, and the depth and breadth of their associations were identified. Mapping analyses were also conducted based on the supply chain operations reference (SCOR) model and the main SCM research streams to further explore existing knowledge gaps. The findings revealed that BT-enabled supply chain asset management, BT-enabled reverse logistics and closed-loop supply chain, and actual versus anticipated performance outcomes of BT-SCM are among important pathways for future research. The findings also highlighted where there is more need to enhance the practical relevance of BT-SCM research considering advances in business adoption. The paper provides a comprehensive, unbiased assessment of the BT-SCM knowledge landscape and a taxonomy of the research questions related to the technical and managerial aspects of BT-SCM that are particularly useful for the community of researchers in the field. It offers a practical framework that can be applied to assess the academic literature on other emerging technologies in SCM where state-of-the-practice is key to guiding research efforts.

1. Introduction

Over recent years, blockchain technology (BT) has been attracting much attention from both scholars and practitioners in the supply chain management (SCM) domain. Researchers from different managerial and technical disciplines have been exploring various aspects of BT-enabled supply chain management (BT-SCM) and how the potentials and benefits of BT in support of supply chain operations can be realized effectively. The industry has also been experiencing a rapidly increasing adoption rate of the technology such that the BT supply chain market is anticipated to grow at a rate even higher than that of the whole BT market (Research and Markets, 2019). This interest stems from the unique features of BT that make it a viable solution to many of the challenges pertaining to supply chain integration and coordination (Wang et al., 2020).

The idea of BT has been originally developed to create cryptocurrencies (Nakamoto, 2008). BT is a digital ledger that stores records of a transaction in a decentralized manner, usually with no central authority. It is organized in an append-only, sequential chain of blocks using cryptographic links and is designed to be tamper-resistant and tamper-evident (Yaga et al., 2018; ISO, 2020). The technical characteristics of BT enhance the security of transactions while allowing to create a system of shared trust and eliminating the problem of single point of failure (Bodkhe et al., 2020). Tian (2016) is one of the first studies that has articulated the advantages of using BT for enhanced traceability in the agri-food supply chain. BT provides a real-time, immutable ledger of informational, financial, and physical transactions between supply chain partners and helps to integrate functions across organizational boundaries. It enables a more coordinated, efficient network of supply chain partners by ensuring a single version of truth across the network. This reduces data reconciliation, in turn improving accuracy of demand forecasts, and helps manage supply

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chain resources more effectively (Perboli et al., 2018; Helo and Hao, 2019; Kamble et al., 2019; Wong et al., 2020). BT enables faster supply chain processes and makes them more reliable, transparent, traceable, and cost-effective (Azzi et al., 2019; Kamble et al., 2020; Tönnissen and Teuteberg, 2020). It further helps address the inevitable issues of trust in supply chain transactions and network-wide collaborations (Rejeb et al., 2021).

Despite the ongoing, intense endeavors in both academia and industry, the current body of knowledge on BT-SCM is still far from maturity. It exhibits an ever-expanding, but fragmented scope of topics pertaining to the development, adoption, and impacts of BT solutions in support of different supply chain operations as well as the necessary supply chain transformations in a wide range of use cases. This calls for a comprehensive assessment of the current state of domain knowledge with a coherent synthesis and classification of the key themes, which in turn allows to systematically identify where the knowledge gaps are.

In an attempt to address this need, a number of review papers have been published, mostly based on a systematic literature review (SLR) or other qualitative approaches, that examine the state of research on BT in the supply chain (e.g., Queiroz et al., 2019; Chang and Chen, 2020) and related subject matters such as BT-enabled supply chain monitoring (Júnior et al., 2022) and sustainable SCM (Paliwal et al., 2020). However, these studies suffer from limitations. First, while SLRs reduce bias and have other advantages such as improved transparency and reliability compared to narrative reviews, they are still influenced by self-reporting bias and subjectivity that make the obtained results less reproducible (O'Brien and Mc Guckin, 2016; Khorram Niaki and Nonino, 2017; Kar and Navin, 2021). Second, systematic reviews require considerable manual effort and, consequently, previous studies have been restricted to a relatively narrow sample of papers that inhibit them from developing a holistic manifestation of the available knowledge. Third, and most importantly, the published reviews in this domain rely upon academic research as the only source of information. However, a large portion of the accumulated knowledge is represented in grey literature including news articles, blogs, and white papers. This is particularly the case with emerging technologies such as BT where applied research and development (R&D) activities have mainly taken place outside academia. Today, relevant BT-SCM topics are discussed in leading business technology outlets as well as specialized news and analysis websites featuring cryptocurrency and BT or supply chain, logistics, and procurement matters. Much original, timely information can be extracted from BT-SCM trends and developments, opinions of experts and practitioners, commercial BT-SCM solutions and use-cases, and industry experiences reported in news media that cannot be found in academic research content.

In general, technology is moving rapidly and news media can react to it much faster than the academic literature (Jones, 2018). More importantly, the content in news media comes from the practitioner standpoint and reflects on expertise and experience in business and industrial settings (Garousi et al., 2019). These characteristics make news content a rich and informative source for academic research, particularly within the technology domain (Canito et al., 2018; Lim and Maglio, 2018). The news media takes a more application-oriented perspective in discussing trendy topics. Such a perspective is particularly important for scholarly research in information system (IS) and SCM, where practical relevance is always a key concern (Te'eni et al., 2017; Svanberg, 2020). In this way, discussions in news media can inform academic research by pointing out emerging problems and directions in practical landscape that need scholarly attention. In light of these considerations, this paper aims to address the following research questions:

RQ1:. What are data-driven classifications of the academic literature and news articles on BT-SCM, major constituting trends, and their evolution over time?

RQ2:. How are topics in the academic literature aligned with BT-SCM trends in business practice?

RQ3:. What are existing gaps in the BT-SCM literature?

A topic modeling approach is adopted to scrutinize collections of full-text research papers and news articles identified from Web of Science (WoS) and Google News, respectively. Such an approach enables an exploration of vast amounts of available textual information to discover trends and thematic structure of the domain knowledge and conduct comparative analysis in an objective, unbiased manner. The paper also maps major BT-SCM trends concerning the SCM landscape and research streams to create a more holistic understanding of the current body of knowledge and uncover existing gaps and directions for future investigations. The main contributions of this paper are two-fold. First, it presents an automated, text mining-based review and synthesis of the current state of knowledge on BT-SCM. It identifies major topics and patterns of discussion in each of the academic and news domains and the evolution of topics over time. Second, the paper provides a computational assessment of the practical relevance of the academic literature on BT-SCM by identifying how existing research is aligned with the current state of business practice and how it corresponds to the trends in business landscape. Such an assessment of the literature is beneficial to different parties in the BT-SCM research community by helping to guide their future efforts and create synergy between academic and practical knowledge. This paper is the first that provides a data-driven, comparative analysis of large collections of scholarly and news corpora discussing BT in the SCM domain.

The remainder of the paper is organized as follows. Section 2 describes the research methodology, including details of identification and preparation of the corpora as well as the analysis procedure. The results are presented in Section 3. Section 4 discusses the topic models as well as the findings from comparative and mapping analyses to highlight existing knowledge gaps and bring forward recommendations for future research. The paper ends with conclusions in Section 5.

2. Methodology

2.1. Topic modeling for knowledge extraction

Delen and Crossland (2008) have proposed the application of text mining as a viable approach to knowledge discovery from a large volume of literature, enabling researchers to overcome shortcomings with manual literature reviews. In particular, topic modeling has been applied as a powerful unsupervised text analytics technique to explore large collections of scholarly publications and analyze research developments in many fields, including IS (e.g., Jeyaraj and Zadeh, 2020; Sharma et al., 2021). It has also been applied extensively to extract knowledge and highlight trends of academic research on different emerging technologies such as business intelligence (BI) (Moro et al., 2015) and artificial intelligence (AI) (Mustak et al., 2021). Asmussen and Møller (2020) and Zhou et al. (2021) have applied topic modeling to analyze research literature about enterprise information systems and Industry 4.0 in SCM. Kim et al. (2020) have presented a yearly-based topic modeling analysis of the abstracts of 231 journal papers to examine trends and characteristics of BT research.

Similarly, topic modeling has been recognized as an effective tool to extract and classify knowledge from huge amounts of unstructured textual data in digital media. This includes the content available through news aggregators such as LexisNexis (Ardia et al., 2019) and social media platforms such as Reddit (Jeong et al., 2019). Alagheband et al. (2020) have conducted a time-based gap analysis of cybersecurity-related content in news media compared to academia by using topic modeling. Lim and Maglio (2018) have applied topic modeling to news articles along with literature data to create a data-driven understanding of smart service systems.

2.2. Identification and preparation of corpora

The relevant papers and news articles were identified from the Web of Science (WoS) Core Collection and Google News databases, respectively. The WoS is a well-established tool for conducting literature review studies due to its credibility, reliability, broad coverage, and advanced querying capabilities (e.g., Shi and Lai, 2013; Shin and Perdue, 2019). It indexes a selective set of scientific publications based on several criteria, such as the journal citation impact and peer-review process, and is widely recognized for its high-quality, high-impact research content (Davis and Ozanne, 2019; Zhang et al., 2020). The WoS has been extensively used to conduct literature review studies in different domains including supply chain management (e.g., Tseng et al., 2019; Xu et al., 2020) and emerging technologies (e.g., Choi et al., 2020; Zhou et al., 2021). Likewise, Google News has been used as a flexible and powerful platform for news data collection in a range of studies (e.g., Canito et al., 2018; Chu et al., 2020). It aggregates original, rich news content from thousands of recognized news publishers and websites. Google News applies different quality criteria, policies, and algorithms for publisher assessment based on transparency, accountability, and accuracy (Google, 2021; Stvilia, 2021). It also applies ranking to ensure reliability, originality, and consistency of the content based on factors such as the authoritativeness of the source. These, along with the comprehensiveness of coverage, make it the appropriate choice to collect the news articles (Lim and Maglio, 2018).

Two sets of relevant key terms were used concurrently to make the queries. The terms 'blockchain', 'block chain', and 'distributed ledger' were used to search for the BT-related content. The terms BT and distributed ledger technology have been used interchangeably by many scholars and practitioners (Pimentel and Boulianne, 2020), even though BT is only one type of distributed ledger technology (Sundarakani et al., 2021). For the SCM-related content, 'supply chain', 'logistics', 'procurement', 'manufacturing', 'inventory', and 'retailing' were chosen as a selective set of key terms that cover the range of upstream, downstream, and internal supply chain functionalities. More specifically, retailing was included which corresponds to the final stage of the supply chain and the part of it that faces consumers (Xiao et al., 2012; Tambo, 2014). It has been recognized as one of the key supply chain processes in research and practice (e.g., APICS, 2017; Fatorachian and Kazemi, 2021). Other terms such as 'sourcing' were also considered, but either quantity or relevance of the query results was not satisfactory. The term 'distribution', which could be a proxy for downstream supply chain activities, was not included due to its interference with distributed ledger and distribution terms that are commonly brought up in blockchain studies. The reduced forms of the terms were used to include all possible variations.

A query in the WoS Core Collection identified 1436 papers, written in English and indexed by the end of June 2021, that include both BT- and SCM-related terms in their titles, abstracts, or keywords. These are the areas that should mention the words that are relevant to the main topic of a paper (Moro et al., 2015). The PDFs of the identified papers were collected to extract their full-text content. The PDF file for 93 papers was not accessible due to the paywall. Besides, 10 PDFs were protected files; therefore, they were eliminated from the corpus. This resulted in 1333 full-text articles. The reference sections were removed from the full texts before proceeding to the subsequent data preparation stages. The corresponding query in Google News was conducted on a bi-weekly basis, beginning from the last two weeks of June 2021 back to earlier periods until no relevant news was found. Overall, 18,046 news items were identified. For each item, the headline, name of the media, date, and the URL of the source page were retrieved from Google News. The URLs were then used to extract the articles' full text. Those articles that were not retrievable in this way due to forbidden access or any other restrictions in the source page were discarded from the collection, resulting in a total of 16,589 full-text news articles.

The next preprocessing step comprised a relevance check to exclude non-relevant content from the initial corpora. This was done based on the number of occurrences of the key terms in each full-text article. For each corpus, different threshold values were tested, followed by a random manual check to determine the minimum count that works satisfactorily in filtering non-relevant articles. The resulting threshold for the papers was four, meaning that the papers containing less than four occurrences of any of the BT- and SCM-related key terms were deemed non-relevant. At this stage, 184 papers were dropped. Many of these papers mentioned one of the chosen key terms only as an exemplar, not the focus of their research. A similar procedure for the news articles resulted in the threshold of two and exclusion of 11,439 initially collected articles, including those that did not contain any of the key terms in the main body of the article, but in other parts of the source page such as the hyperlinks in the sidebar or footer of the page, menu items, website names, or advertisements. The remaining papers and news items were checked for potential duplicates and to ensure that the full article was in English. This resulted in identifying 16 duplicates in the news corpus and one duplicate record in papers. Four additional news items were also excluded due to being non-English. In total, 1148 full-text papers and 5130 news articles were considered relevant for analysis.

The collected data were further preprocessed by applying typical preprocessing tasks, including removing punctuations, building bigrams, and lemmatization. Another step was to remove stop words (Delen and Crossland, 2008). The terms 'blockchain', 'technology', 'information', and 'data' were added to the list of stop words as common words that might be repeated in topics without adding any meaning to the interpretation. The preprocessing also involved removing parts of speech other than nouns and verbs. The entire data cleaning and preprocessing was implemented in Python.

2.3. Analysis procedure

Many algorithms exist for topic modeling analysis. This study employed Latent Dirichlet allocation (LDA) for several reasons. As a generative model, it reduces the problem of overfitting, which is common in many other algorithms such as probabilistic latent semantic indexing (PLSI) (Chen et al., 2017). LDA is a well-suited algorithm for general topic modeling tasks, particularly when dealing with long documents (Vayansky and Kumar, 2020), which is the case with analyzing full-text articles in this research. It has other advantages in terms of the ability to mine semantic relations when developing the topics, speed, and scalability (Hoffman et al., 2010; Zhang et al., 2016). In addition, compared to other topic modeling algorithms, LDA has been applied much more commonly, and its rigor and reliability in analyzing literature data have been established with more confidence (Moro et al., 2015; Chen et al., 2016; Zhou et al., 2021). LDA applies a hierarchical Bayesian approach to create a multi-membership model in which each document is represented as a mixture of topics, and each topic is defined by a mixture of words. The algorithm calculates the probability of each document d belonging to each topic t in terms of the conditional probability $P(t|d)$. It considers each topic as a cluster and assigns each document to its most probable cluster (i.e., the cluster that corresponds to the highest $P(t|d)$) (Blei et al., 2003). Machine learning for language toolkit (MALLET) (McCallum, 2002) was also employed, allowing for an efficient implementation of Gibbs sampling to estimate LDA parameters. Such an approach enhances the quality and applicability of LDA results and enables the creation of more accurate and interpretable topic models, as indicated in several LDA studies (e.g., Asghari et al., 2020; Zhou et al., 2021). In this paper, Gensim Python library was used to implement the LDA MALLET model for each of the research and news corpora.

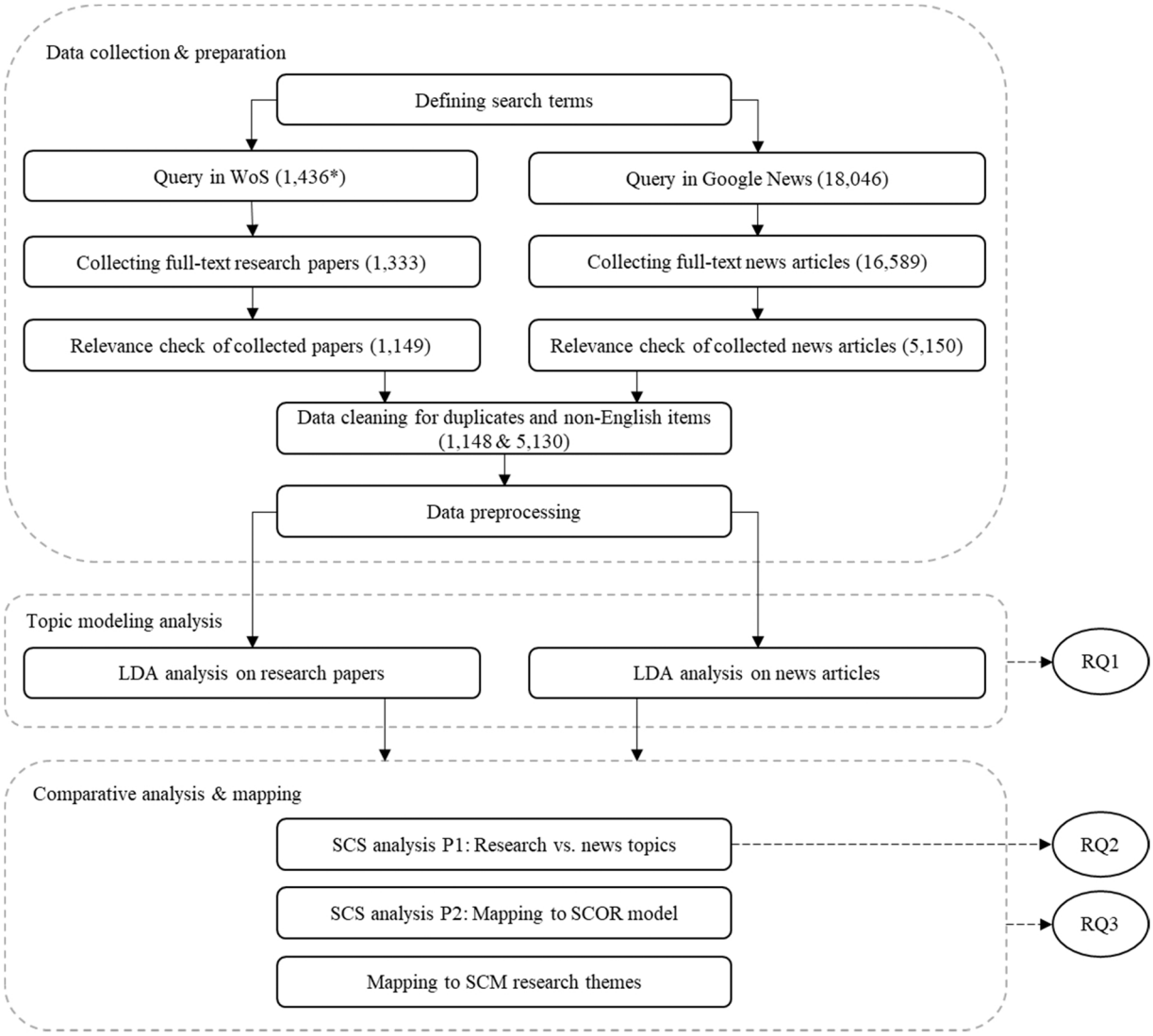
Soft cosine similarity (SCS), proposed by Sidorov et al. (2014), was used to compare the topics and analyze the depth and breadth of their association. The comparison is conducted between each pair of topics based on their top keywords and is independent from the size of the

corpora. SCS enables a more meaningful comparison and performs better than standard cosine and other measures in capturing semantic relations and similarities among the terms. Instead of learning from the data, SCS assumes that the similarities between the features are already known, for example from a pre-defined dictionary of synonyms. To this end, the popular fastText word embedding model, created from a large corpus of Wikipedia articles, was adopted.

To highlight existing gaps at the macro level, two complementary mappings of the identified topics were also conducted with respect to the SCM landscape. First, the supply chain operations reference (SCOR) model was adopted to examine how different supply chain processes and performance areas are addressed by the identified topics. It is well established as the de facto supply chain standard within both academia and industry (Vegter et al., 2020). SCOR 12.0 (APICS, 2017) recognizes BT as one of the emerging practices that introduce new ways of organizing supply chain processes and can yield big results in terms of supply chain performance. Second, the topics derived from the academic corpus were mapped to the scope of SCM research to further understand the dispersion and relevance of the existing BT-SCM body of research. To do so, a categorization of the main SCM research themes was created based on two literature reviews from well-recognized SCM journals (Wieland et al., 2016; Swanson et al., 2018). Although many literature review studies on SCM have been published, the majority are too old to provide a coherent picture of today's SCM research. The recent reviews on the other hand are typically focused on specific topics or aspects of SCM. Compared to those reviews, the chosen studies provide more relevant and comprehensive mappings of the research themes within the current SCM landscape. The themes identified in this way were further complemented and refined through matching to the topics mentioned in the aims and scope of the SCM journals that are among top 100 in the management category of InCites Journal Citation Reports (JCR) and ranked A/A* in the Australian Business Deans Council (ABDC) list. The topics were then assigned to their corresponding themes based on their top keywords and the focus of their most representative papers. Fig. 1 summarizes the steps of data collection and analysis.

3. Results

Fig. 2 shows the distribution of the articles. The average number of articles per month was calculated to make a consistent comparison over the years. As can be seen from these graphs, the volume of content follows a rather similar trend in both domains, but with a time lag in the academic literature. The relevant articles in the news records have first appeared in 2014 but no earlier than 2016 in the academic corpus. The



* The numbers in parentheses indicate the number of records retained in each step of data collection and cleaning

Fig. 1. Data collection and analysis framework

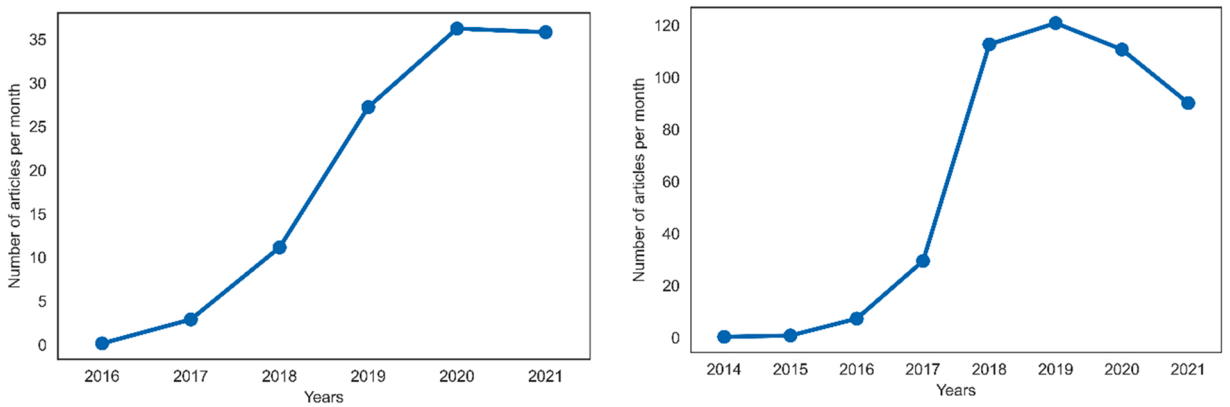


Fig. 2. Trends of BT-SCM articles.

jump in the volume of relevant content in news media has occurred in 2018, one year earlier than that in the scholarly context. A one-year lag is also observed for the time when the peak in the number of articles has occurred. The overall trend points to the spearheading role of industry in discussions around BT-SCM. It corresponds with the fact that BT – similar to many other technological advancements – has emerged outside academia. The number of articles in news media has been declining after 2019, which is an indication of ending the hype in business discussions and losing interest in BT-SCM as a news topic considering that the technology is becoming a more recognized component of the ecosystem. The sources that have published the highest number of BT-SCM articles are listed in Table 1.

To identify the optimal number of topics, the normalized pointwise mutual information (NPMI) metric was used. It evaluates topic coherence and correlates well with human interpretability, which fits the purpose of our topic modeling study (Lau et al., 2014). The models corresponding to the maximum coherence were chosen rather than the elbow criterion, allowing for the most interpretable, understandable, and usable topics. Such an approach is in line with several previous topic modeling studies (e.g., Ray et al., 2019; Savov et al., 2020). It also allows to choose models with a higher number of topics that produce more granular topics and better delineate between different foci of discussion in the corpora (Wallach et al., 2009). Moreover, it avoids the problems with the elbow method including the lack of reliability and controversies of choosing the right elbow point (Ketchen and Shook, 1996; Taecharungroj and Mathayomchan, 2019).

Fig. 3 shows graphs of the mean coherence values for the models with one to 50 topics. The model with 28 topics was chosen for the academic literature, and the model with 41 topics was chosen for news articles as they yield the highest mean NPMI scores. Such a result was anticipated in view of the larger number of records in our news corpus as well as a greater diversity of content which is typically the case with the news media. The topic models are given in Tables 2 and 3, respectively. For each topic, the top ten keywords, the number of articles in which that topic is dominant, and the distribution of those articles over the years are provided. Topic labels are assigned based on their top keywords and the focus of their most representative papers. Again, the distribution of articles was adjusted on a monthly basis to keep consistency. Tables 2 and 3 also contain the average and maximum SCS scores for each of the identified topics. The resulting SCS scores for each pair of research and news topics are given in Fig. 4. The cells with darker color reflect higher degree of similarity among the corresponding topics.

Relying upon the level-3 SCOR elements for an adequate amount of details, the SCS scores between the identified topics and supply chain processes and performance attributes were calculated. The maximum and average SCS scores are given in Table 4. Table 5 identifies relevant topics for each of the SCM research themes.

Table 1
Top ten sources for BT-SCM articles.

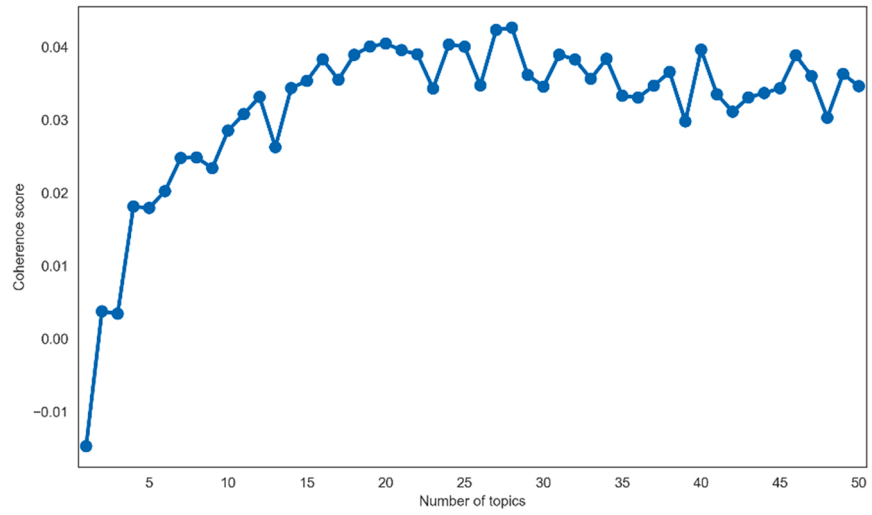
(a) WoS Core Collection		(b) Google News	
Source	No.	Source	No.
IEEE Access	74	Ledger Insights	379
Sustainability	44	Forbes	241
International Journal of Production Research	31	Cointelegraph	162
Computers & Industrial Engineering	16	Computerworld	66
IFAC-PapersOnLine; Sensors	15	CoinDesk	63
International Journal of Information Management	14	BTCMANAGER	62
Transportation Research Part E: Logistics and Transportation Review; Journal of Cleaner Production	12	FreightWaves	60
		Business Blockchain HQ	55
International Journal of Production Economics; Applied Sciences	9	Business Wire	49
		PR Newswire	45

4. Discussion and implications

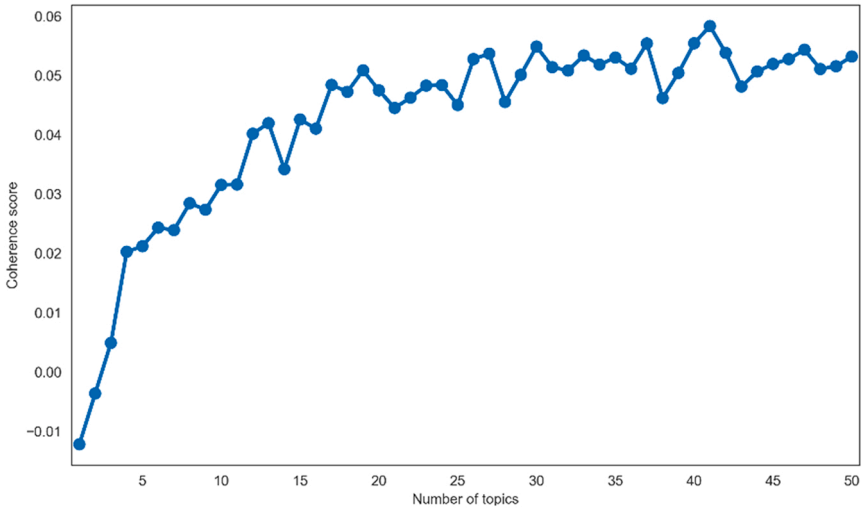
4.1. Insights from topic models

In the research corpus, the largest category (A19) consists of studies that explore the benefits and potential applications of BT in support of SCM practices (e.g., improving information security and record-keeping). The topic trend indicates that it still attracts attention from researchers in the field. Several other topics are focused on investigating BT-SCM in specific use-cases (A0, A2, A11, A14, A24, A25, and A27). Most of these use cases have received increasing research interest in recent years. In particular, BT applications in support of sustainability and environmental practices in supply chain has become a hot research topic. The use of BT in social and environmental audits (Castka et al., 2020) and sustainable SCM in the fishery industry (Howson, 2020) are among the most representative examples. A sharp rise is also observed in the number of papers published regarding BT applications in construction and engineering supply chains, particularly for composite materials and printed components (e.g., Pellegrini et al., 2020).

Topics A7, A16, A20, A21, and A26 specifically deal with technical aspects of BT-SCM. These studies address developing BT-based solutions for supply chain applications (e.g., Bader et al., 2021) or designing BT-SCM platforms and related information management and operation mechanisms (e.g., Fu and Zhu, 2019). The volume of articles on these topics has started to decline recently. On the other hand, topics A5, A6, A8, A10, A17, and A22 are positioned within the managerial side of BT-SCM. These topics reflect some hot areas of research, such as identifying determinants of BT adoption in supply chain (e.g., Queiroz and Wamba, 2019), optimization and coordination mechanisms for BT-based supply chains and online marketplaces (e.g., Shen et al., 2020),



(a) WoS Core Collection



(b) Google News

Fig. 3. Mean NPMI coherence scores based on the number of topics.

the use of BT in controlling the ripple effect and risks in supply chain operations (e.g., Ivanov et al., 2019), and the use of BT to develop SCM capabilities and practices (e.g., Gupta et al., 2021). Furthermore, the research on IoT-BT systems in the supply chain is recognized in a separate topic (A23), discussing technical and managerial aspects of such systems as well as merits and demerits of their application in practice (e.g., Shahzad et al., 2020).

A number of the identified topics investigate BT in support of specific SCM functions, including manufacturing operations (A1), supply chain finance (A4), demand and supply management (A12), and logistics operations (A13). Among these topics, the trend of publications on BT-enabled manufacturing and logistics shows a marked decline whilst an increasing number of commercial BT solutions is being developed and deployed in the industry. Table 6 provides a taxonomy of the high-level research questions based on an overview of the most representative papers for each topic. Considering that research in most of these topics is far from maturity, the proposed questions outline an overarching agenda for BT-SCM research.

The topics derived from news articles are more fine-grained and oriented towards the wide range of recent advancements in BT-SCM applications for business practice. They provide implications on the state-of-the-practice and trends of BT-SCM in the industry. The initial discussions on BT-SCM in the news media have emerged from the focus on BT as the underlying technology behind Bitcoin to explore possibilities that might exist beyond cryptocurrency. Similar to the scholarly publications, the largest portion of the content in news media (N40) elaborates on what BT and distributed ledgers can provide for SCM. The peak of discussion on this topic was in 2018. The second biggest group of articles (N22) covers news on joint BT projects and collaborative efforts on BT development. The volume of reports on such BT partnerships has continuously increased until 2020 but declined in 2021, which could be an indication of lower investment in such collaborative initiatives. On the other hand, the articles on BT-SCM market analysis and forecasting for different industries (N10) indicate an uptrend, as the technology penetrates into more industry sectors.

The majority of news topics correspond to domain-specific applications of BT-SCM. Topic N1 reflects one such example which is focused on BT-enabled transparency in the cobalt supply chain from where the material is mined to where it is used in batteries by end-manufacturers. The most representative articles report on the efforts made by Volvo and the joint project by LG, IBM, and Ford Motor Company. The application areas further highlight novel solutions such as cryptocurrency mining by electric vehicles and BT-based digital payment systems to facilitate cross-border transactions. These are among the topics that have received increasing attention after a decline in 2020.

The news topics identify other important trends of discussion in the

Table 2
Topics found from the research corpus.

Topic ID	Label	Top 10 keywords	No. of articles	Distribution of articles (%)						SCS	
				2016	2017	2018	2019	2020	2021	Avg	Max
A0	BT-enabled RFID solutions for agri-food supply chain traceability	farmer, agriculture, farm, tag, food, crop, figure, meat, animal, grain	13	–	–	5.9	11.8	35.3	47.1	0.12	0.60
A1	BT-enabled manufacturing operations	manufacturing, service, manufacture, process, production, resource, system, machine, product, base	50	–	5.6	16.7	27.8	35.2	14.8	0.37	0.64
A2	BT-enabled supply chain traceability for food quality and safety	product, food, traceability, system, consumer, supply_chain, quality, process, chain, production	89	1.0	2.0	7.8	31.4	32.4	25.5	0.33	0.72
A3	Impacts of BT as part of digital innovation	industry, company, system, process, application, development, business, increase, innovation, change	46	–	1.9	13.2	22.6	35.8	26.4	0.38	0.66
A4	BT benefits for supply chain finance	credit, payment, finance, bank, finance, risk, platform, customer, loan, sme	24	–	–	10.3	13.8	41.4	34.5	0.31	0.66
A5	BT-based supply chain coordination	product, retailer, manufacturer, platform, consumer, quality, cost, demand, supplier, customer	26	–	–	6.1	18.2	33.3	42.4	0.31	0.54
A6	BT-enabled supply chain resilience	risk, management, disruption, control, supply, operation, time, system, resilience, supply_chain	22	–	–	7.1	17.9	32.1	42.9	0.23	0.55
A7	BT solutions for smart technologies being used in SCM	device, message, attack, security, propose, send, signature, manufacturer, authentication, generate	44	–	–	20.0	24.0	32.0	24.0	0.20	0.38
A8	Managerial considerations in BT-SCM implementation	research, case, actor, study, theory, company, business, design, implementation, project	35	–	–	12.8	30.8	35.9	20.5	0.29	0.66
A9	Literature review studies	research, study, article, paper, management, analysis, review, author, application, search	37	–	–	2.0	12.0	34.0	52.0	0.19	0.43
A10	Multi-criteria assessment of BT-SCM implementation and performance	model, method, quality, evaluation, system, result, base, criterion, score, set	29	–	–	5.3	7.9	39.5	47.4	0.21	0.44
A11	BT for supply chain sustainability	sustainability, emission, carbon, industry, audit, report, reduce, base, diamond, fish	13	–	–	11.1	5.6	27.8	55.6	0.30	0.48
A12	BT-enabled demand and supply management	cost, time, model, demand, scenario, user, inventory, base, parameter, figure	20	–	4.0	–	8.0	48.0	40.0	0.25	0.48
A13	BT-enabled logistics operations	logistic, delivery, good, shipment, transport, shipping, process, transportation, container, ship	30	–	3.1	6.3	50.0	28.1	12.5	0.27	0.74
A14	BT-SCM in healthcare and pharmaceutical industry	drug, patient, healthcare, system, health, medicine, pharmaceutical, manufacturer, record, hospital	23	–	3.7	14.8	25.9	25.9	29.6	0.23	0.77
A15	Designing smart contracts	contract, smart_contract, system, function, transaction, base, ethereum, propose, state, address	46	–	3.7	11.1	31.5	24.1	29.6	0.31	0.50
A16	BT-enabled information transaction	transaction, system, network, peer, event, figure, process, user, store, base	69	–	3.7	3.7	30.9	32.1	29.6	0.27	0.55
A17	BT impacts on SCM practices and capabilities	management, supply_chain, study, performance, process, supplier, improve, barrier, customer, base	64	–	1.2	1.2	15.9	37.8	43.9	0.35	0.63
A18	Legal and regulatory considerations	law, regulation, government, market, article, rule, bitcoin, country, policy, case	29	–	2.9	14.7	32.4	20.6	29.4	0.34	0.57
A19	BT applications and potentials in SCM	transaction, application, network, trust, system, record, business, provide, smart_contract, participant	149	–	3.5	13.3	27.7	27.7	27.7	0.40	0.85
A20	Designing BT-SCM systems	system, base, enterprise, chain, management, application, model, problem, mechanism, node	69	–	3.8	8.9	30.4	31.6	25.3	0.34	0.59
A21	Specific technical features of BT	block, transaction, network, node, time, number, chain, consensus, miner, propose	41	–	8.7	21.7	30.4	17.4	21.7	0.28	0.58
A22	BT-SCM adoption	adoption, study, model, factor, construct, result, adopt, support, respondent, firm	31	–	–	7.7	12.8	38.5	41.0	0.21	0.40
A23	IoT-BT systems in supply chain	system, iot, security, device, base, sensor, network, application, communication, architecture	64	–	3.8	3.8	19.2	37.2	35.9	0.27	0.62
A24	BT applications in construction and engineering supply chains	product, material, design, construction, production, waste, process, component, print, building	23	–	6.7	16.7	13.3	16.7	46.7	0.27	0.48
A25	BT-enabled energy trading	energy, market, price, consumer, trading, electricity, power, prosumer, trade, grid	15	–	–	25.0	18.8	43.8	12.5	0.27	0.55
A26	BT for data privacy and trust in supply chain	access, trust, architecture, policy, privacy, requirement, approach, design, base, provide	34	2.6	2.6	13.2	26.3	34.2	21.1	0.28	0.49
A27	BT for vehicle information systems and smart mobility	vehicle, system, car, service, user, transportation, propose, base, city, insurance	13	–	–	5.6	16.7	22.2	55.6	0.27	0.55
		Overall	1148								

Table 3
Topics found from the news corpus.

Topic ID	Label	Top 10 keywords	No. of articles	Distribution of articles (%)								SCS	
				2014	2015	2016	2017	2018	2019	2020	2021	Avg	Max
N0	BT patenting activities	system, include, application, method, inventor, device, patent, base, provide, vehicle	6	–	–	–	–	16.7	33.3	50.0	–	0.32	0.47
N1	BT in cobalt supply chain	diamond, gold, mining, mineral, mine, cobalt, metal, source, battery, company	100	–	–	–	2.8	33.0	31.2	16.5	16.5	0.21	0.45
N2	Announcements made by BT companies	company, statement, result, business, investment, share, forward_looking, security, include, investor	69	–	–	–	4.9	23.5	23.5	18.5	29.6	0.29	0.45
N3	BT for security in digital transactions and storage	security, identity, user, device, wallet, attack, system, cybersecurity, access, store	31	–	–	–	–	27.8	25.0	19.4	27.8	0.23	0.40
N4	BT for food supply chain traceability	food, consumer, product, traceability, retailer, farm, industry, track, trace, store	246	–	–	1.6	8.0	32.7	38.2	15.5	4.0	0.28	0.70
N5	BT-enabled RFID for product tracking	sensor, temperature, track, rfid, delivery, location, tracking, tag, iot, drone	42	–	–	–	4.2	33.3	16.7	20.8	25.0	0.26	0.53
N6	BT-enabled supply chain finance and digital trade	trade, bank, finance, platform, transaction, financing, solution, sme, credit, supplier	164	–	–	1.1	5.6	24.9	31.1	22.6	14.7	0.33	0.63
N7	BT-enabled farming	farmer, farm, food, agriculture, product, crop, beef, consumer, produce, market	107	–	–	0.8	3.4	25.2	26.9	23.5	20.2	0.24	0.60
N8	NFT potentials in supply chain	game, patent, content, music, file, artist, play, art, sale, chain	13	–	–	5.6	11.1	11.1	16.7	–	55.6	0.12	0.21
N9	IoT-BT in SCM	device, ai, iot, internet, network, application, machine, cloud, system, connect	101	–	–	1.7	4.3	22.4	27.6	18.1	25.7	0.27	0.62
N10	BT-SCM market analysis and forecasting	market, report, growth, analysis, research, industry, forecast, application, management, segment	134	–	–	–	0.6	11.3	16.7	31.0	40.5	0.35	0.62
N11	BT for advertising and marketing supply chain	ad, advertising, cannabis, medium, industry, advertiser, transparency, brand, marketing, publisher	88	–	–	–	8.9	41.1	30.0	15.6	4.4	0.25	0.35
N12	Cryptocurrency issues	bitcoin, cryptocurrency, currency, crypto, transaction, mining, exchange, coin, miner, money	81	1.1	–	1.1	13.7	20.0	21.1	13.7	29.5	0.18	0.42
N13	Enterprise BT applications and platforms	solution, platform, enterprise, network, business, service, build, application, industry, provide	314	–	–	1.7	8.0	22.2	24.8	22.2	21.1	0.39	0.64
N14	BT-enabled supply chain sustainability	carbon, sustainability, emission, climate, waste, water, impact, change, plastic, recycle	84	–	–	–	0.9	8.0	12.4	27.4	51.3	0.26	0.48
N15	BT start-ups	company, startup, raise, investor, found, business, base, venture, funding, platform	72	–	–	1.2	6.3	18.8	27.6	26.2	20.0	0.28	0.44
N16	BT in healthcare and pharmaceutical supply chain	drug, patient, healthcare, health, vaccine, pharmaceutical, medicine, trial, hospital, care	118	–	0.8	–	4.6	25.4	24.6	26.2	18.5	0.27	0.77
N17	Price and market analysis for BT tokens	year, price, market, percent, increase, accord, rate, report, continue, month	48	–	–	–	5.3	7.0	21.1	35.1	31.6	0.17	0.35
N18	Potentials of smart contracts	contract, smart_contract, process, payment, party, procurement, agreement, construction, automate, term	53	–	–	5.4	–	21.4	33.9	28.6	10.7	0.31	0.50
N19	BT courses and training programs	team, work, program, job, event, learn, business, industry, firm, student	75	–	–	–	2.5	26.2	37.5	21.3	12.5	0.22	0.42
N20	BT for food supply chain sustainability	coffee, consumer, farmer, fish, seafood, traceability, transparency, product, producer, catch	131	–	–	1.4	1.4	15.6	36.9	30.5	14.2	0.26	0.51
N21	Tokenization of assets	asset, market, investor, token, trading, exchange, security, investment, crypto, fund	61	–	–	1.4	2.7	17.8	21.9	23.3	32.9	0.22	0.47
N22	Joint BT initiatives and collaborative BT developments	company, project, platform, base, firm, include, solution, work, announce, report	436	–	0.2	3.4	4.4	22.5	24.7	28.4	16.4	0.36	0.61
N23	BT-based digital payment	payment, bank, money, transaction, system, cash, account, currency, settlement, card	76	1.1	1.1	1.1	8.0	12.6	29.9	20.7	25.3	0.26	0.52
N24			161	–	–	–	4.6	16.0	36.6	26.9	16.0	0.34	0.66

(continued on next page)

Table 3 (*continued*)

Topic ID	Label	Top 10 keywords	No. of articles	Distribution of articles (%)								SCS	
				2014	2015	2016	2017	2018	2019	2020	2021	Avg	Max
	Issues with growing BT adoption in SCM	challenge, system, business, trust, enterprise, share, adoption, problem, require, model											
N25	BT opportunities for business and economy	industry, sector, business, world, change, innovation, increase, opportunity, make, year	214	–	0.4	1.3	4.6	23.9	25.6	23.9	20.2	0.29	0.65
N26	BT as part of digitized supply chain technology ecosystem	business, customer, company, management, process, service, cost, time, operation, make	194	–	–	1.4	3.3	18.4	33.5	26.4	17.0	0.42	0.66
N27	BT-enabled energy trading	energy, power, electricity, grid, market, trading, utility, peer, system, cost	61	–	–	1.5	15.2	27.3	19.7	21.2	15.2	0.27	0.55
N28	BT-enabled logistics and freight operations	logistic, shipping, industry, freight, port, carrier, ship, shipment, container, trade	179	–	–	0.5	11.8	38.5	23.0	17.6	8.6	0.27	0.74
N29	BT tokens and platforms used in SCM applications	network, project, platform, token, vechain, user, ethereum, developer, chain, decentralize	95	–	–	–	–	22.4	14.7	26.7	36.2	0.35	0.52
N30	BT-enabled solutions developed by automakers	vehicle, car, mobility, manufacturer, part, driver, auto, share, machine, drive	44	–	–	–	4.0	24.0	34.0	14.0	24.0	0.25	0.55
N31	BT in retail banking supply chain	bank, banking, fintech, customer, service, credit, loan, product, risk, payment	33	–	–	–	7.9	26.3	23.7	15.8	26.3	0.26	0.66
N32	BT in oil and gas SCM	oil, gas, company, carrier, base, award, statement, solution, service, provider	31	–	–	–	3.0	9.1	12.1	63.6	12.1	0.35	0.55
N33	BT possibilities for the development of digital economy	government, tax, country, year, provide, sector, city, service, state, economy	26	–	–	–	6.9	13.8	41.4	17.2	20.7	0.30	0.51
N34	BT-enabled manufacturing operations	part, manufacturing, manufacture, print, manufacturer, maintenance, aircraft, airline, production, process	48	–	–	–	1.9	19.2	26.9	36.5	15.4	0.25	0.50
N35	Opinions of experts and executives	people, make, work, company, thing, time, lot, start, year, world	256	–	1.1	3.2	13.3	29.5	20.5	16.5	15.8	0.25	0.40
N36	Legal issues and regulatory initiatives concerning BT	law, regulation, include, issue, state, rule, report, risk, security, policy	79	–	–	2.3	4.6	16.1	17.2	41.4	18.4	0.27	0.57
N37	BT possibilities in addressing public society problems	government, country, system, economy, people, world, develop, organisation, crisis, policy	103	–	–	–	6.1	19.3	13.2	42.1	19.3	0.30	0.52
N38	BT in fashion supply chain	product, consumer, brand, retailer, customer, fashion, industry, good, luxury, store	134	–	–	1.4	2.7	24.5	29.9	23.8	17.7	0.25	0.51
N39	BT-enabled supply chain tracking and transparency	product, supply_chain, track, supplier, system, company, transparency, process, industry, solution	276	–	0.3	1.0	4.6	20.9	27.5	28.5	17.2	0.39	0.72
N40	BT potentials in supply chain	transaction, record, network, system, block, process, make, application, database, store	546	0.3	0.3	3.9	12.2	32.4	20.3	15.6	14.9	0.41	0.85
		Overall	5130										

practical landscape. For example, with recent increase in cybersecurity concerns, the focus on BT applications to enhance security in digital transactions and storage (N3) has again grown to the same level as in 2018. In addition, considering an increase in IoT applications, discussions around IoT (N5 and N9) have shown a new upward trend in 2021. Topics N8, N21, and N29 correspond to a hot area of discussion emerging in business practice. These topics discuss about asset-backed tokens, tokenization of real-world assets for secure ownership and transaction, and potentials of non-fungible tokens (NFTs) in supply chain domain. Another group of articles (N12) provides insights into different aspects of cryptocurrencies such as mining and other technical or non-technical issues. The implications of this topic are particularly linked to retail applications. Discussions around legal issues and regulatory initiatives concerning BT development and use (N36) as well as BT potentials for governments to help address public society problems and crises such as the recent pandemic (N37) are among other main trends.

4.2. Insights from comparative analysis

The SCS scores provide insights into how the topics derived from the academic literature are aligned with trends of discussion in the business landscape. From Fig. 4, the most similar pairs of topics are [A19, N40], [A14, N16], and [A13, N28]. These topics indicate the most common foci of discussion in the academic and practical domains. Topics [A19, N40] address possible applications and potentials of the technology in supply chain domain. The very high similarity between the topics indicates a high level of agreement among researchers and practitioners around the opportunities provided by BT to help remediate some of the well-known challenges in SCM. It also implies that they both have a common understanding of BT as an emerging technology in this context. This is interesting in view of the fact that BT is a complex technology. Trends of articles belonging to these topics indicate that exploration of BT-SCM potentials has emerged in the industry much earlier than academia. While the volume of relevant research publications has

	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	A25	A26	A27
N0	0.19	0.40	0.38	0.35	0.17	0.23	0.24	0.35	0.27	0.30	0.44	0.25	0.33	0.23	0.24	0.35	0.39	0.33	0.26	0.33	0.47	0.34	0.26	0.41	0.37	0.26	0.40	0.35
N1	0.13	0.29	0.45	0.26	0.19	0.28	0.21	0.13	0.13	0.09	0.16	0.38	0.16	0.16	0.20	0.15	0.14	0.30	0.27	0.29	0.22	0.20	0.11	0.09	0.22	0.23	0.20	0.14
N2	0.10	0.39	0.31	0.43	0.45	0.42	0.26	0.19	0.32	0.21	0.21	0.31	0.27	0.30	0.20	0.30	0.24	0.35	0.40	0.36	0.35	0.28	0.25	0.19	0.29	0.30	0.30	0.27
N3	0.09	0.24	0.26	0.20	0.20	0.17	0.21	0.38	0.15	0.20	0.17	0.18	0.16	0.20	0.26	0.23	0.18	0.23	0.28	0.34	0.33	0.18	0.16	0.40	0.12	0.14	0.37	0.33
N4	0.26	0.40	0.70	0.33	0.29	0.38	0.16	0.19	0.19	0.11	0.20	0.40	0.17	0.24	0.32	0.27	0.22	0.36	0.26	0.42	0.30	0.26	0.16	0.16	0.35	0.25	0.30	0.21
N5	0.16	0.29	0.48	0.25	0.19	0.21	0.27	0.23	0.14	0.11	0.19	0.19	0.25	0.53	0.28	0.33	0.30	0.21	0.18	0.32	0.35	0.27	0.17	0.41	0.27	0.20	0.27	0.38
N6	0.10	0.41	0.38	0.43	0.63	0.44	0.23	0.19	0.28	0.19	0.20	0.27	0.25	0.40	0.29	0.46	0.27	0.43	0.43	0.49	0.38	0.29	0.17	0.26	0.29	0.49	0.32	0.31
N7	0.60	0.33	0.42	0.32	0.21	0.33	0.17	0.13	0.20	0.11	0.17	0.33	0.20	0.14	0.17	0.22	0.18	0.30	0.23	0.33	0.24	0.22	0.13	0.15	0.27	0.32	0.20	0.14
N8	0.02	0.08	0.13	0.12	0.21	0.11	0.04	0.08	0.09	0.15	0.09	0.08	0.11	0.11	0.12	0.17	0.19	0.08	0.18	0.18	0.17	0.13	0.08	0.17	0.08	0.15	0.11	0.15
N9	0.08	0.47	0.25	0.41	0.17	0.15	0.27	0.29	0.23	0.19	0.20	0.15	0.20	0.23	0.19	0.22	0.33	0.31	0.24	0.37	0.44	0.26	0.21	0.62	0.26	0.18	0.28	0.35
N10	0.14	0.45	0.31	0.62	0.43	0.42	0.34	0.17	0.43	0.33	0.26	0.39	0.37	0.35	0.28	0.28	0.28	0.53	0.41	0.42	0.49	0.24	0.40	0.27	0.31	0.29	0.32	0.33
N11	0.12	0.30	0.35	0.30	0.25	0.32	0.10	0.17	0.30	0.16	0.17	0.33	0.25	0.20	0.20	0.33	0.18	0.27	0.30	0.35	0.25	0.32	0.18	0.26	0.21	0.34	0.26	0.23
N12	0.06	0.15	0.15	0.17	0.40	0.21	0.10	0.14	0.09	0.04	0.06	0.13	0.19	0.17	0.10	0.37	0.18	0.12	0.39	0.30	0.16	0.35	0.07	0.11	0.07	0.42	0.12	0.16
N13	0.08	0.64	0.37	0.60	0.38	0.39	0.28	0.27	0.50	0.26	0.27	0.38	0.29	0.37	0.29	0.37	0.44	0.58	0.41	0.60	0.54	0.39	0.35	0.47	0.38	0.27	0.45	0.39
N14	0.16	0.40	0.32	0.45	0.23	0.30	0.26	0.12	0.28	0.13	0.16	0.48	0.23	0.15	0.17	0.25	0.19	0.38	0.24	0.37	0.25	0.30	0.19	0.18	0.36	0.27	0.22	0.16
N15	0.12	0.35	0.32	0.43	0.44	0.31	0.17	0.16	0.33	0.17	0.18	0.31	0.27	0.27	0.18	0.32	0.25	0.35	0.38	0.38	0.32	0.29	0.23	0.23	0.26	0.27	0.28	0.26
N16	0.12	0.32	0.33	0.32	0.24	0.28	0.20	0.18	0.27	0.22	0.22	0.29	0.23	0.21	0.77	0.26	0.22	0.30	0.27	0.38	0.31	0.24	0.20	0.24	0.22	0.23	0.31	0.27
N17	0.09	0.11	0.15	0.28	0.32	0.34	0.19	0.12	0.19	0.16	0.15	0.13	0.35	0.14	0.09	0.23	0.13	0.20	0.20	0.20	0.13	0.18	0.14	0.02	0.11	0.27	0.10	0.05
N18	0.06	0.41	0.31	0.41	0.32	0.43	0.30	0.21	0.29	0.14	0.24	0.25	0.31	0.33	0.23	0.50	0.36	0.43	0.30	0.41	0.41	0.26	0.19	0.25	0.46	0.26	0.25	0.23
N19	0.04	0.26	0.15	0.42	0.20	0.18	0.23	0.10	0.39	0.28	0.17	0.27	0.18	0.21	0.14	0.15	0.25	0.35	0.27	0.32	0.27	0.17	0.26	0.18	0.23	0.09	0.17	0.17
N20	0.22	0.37	0.51	0.34	0.25	0.32	0.14	0.14	0.28	0.13	0.20	0.47	0.18	0.17	0.22	0.27	0.18	0.34	0.29	0.40	0.22	0.27	0.18	0.20	0.26	0.30	0.28	0.17
N21	0.06	0.24	0.19	0.25	0.47	0.29	0.14	0.11	0.20	0.10	0.09	0.19	0.17	0.21	0.17	0.25	0.13	0.24	0.45	0.35	0.22	0.17	0.13	0.18	0.16	0.40	0.25	0.24
N22	0.13	0.45	0.34	0.61	0.28	0.34	0.32	0.27	0.51	0.33	0.31	0.43	0.35	0.32	0.27	0.34	0.41	0.53	0.38	0.48	0.50	0.35	0.30	0.32	0.36	0.21	0.30	0.28
N23	0.06	0.31	0.24	0.25	0.52	0.28	0.15	0.21	0.22	0.15	0.15	0.14	0.20	0.25	0.17	0.43	0.27	0.25	0.45	0.39	0.29	0.31	0.21	0.25	0.15	0.36	0.22	0.29
N24	0.09	0.36	0.20	0.39	0.22	0.38	0.33	0.25	0.66	0.43	0.36	0.28	0.40	0.23	0.23	0.25	0.33	0.46	0.43	0.47	0.46	0.32	0.40	0.41	0.23	0.19	0.40	0.32
N25	0.09	0.29	0.31	0.65	0.27	0.37	0.36	0.20	0.41	0.21	0.19	0.34	0.28	0.18	0.14	0.29	0.25	0.51	0.34	0.52	0.34	0.34	0.23	0.26	0.19	0.25	0.24	0.16
N26	0.12	0.58	0.47	0.66	0.39	0.54	0.55	0.33	0.46	0.22	0.33	0.38	0.48	0.41	0.26	0.45	0.45	0.63	0.33	0.60	0.54	0.39	0.31	0.40	0.42	0.38	0.41	0.34
N27	0.16	0.42	0.32	0.33	0.34	0.37	0.22	0.18	0.22	0.13	0.17	0.28	0.25	0.25	0.24	0.32	0.23	0.31	0.29	0.38	0.29	0.24	0.14	0.24	0.26	0.55	0.24	0.26
N28	0.09	0.32	0.34	0.37	0.27	0.34	0.21	0.17	0.20	0.12	0.20	0.28	0.16	0.74	0.19	0.26	0.21	0.38	0.26	0.40	0.33	0.22	0.16	0.21	0.26	0.21	0.20	0.34
N29	0.11	0.48	0.35	0.47	0.30	0.29	0.25	0.28	0.37	0.24	0.23	0.29	0.32	0.27	0.26	0.46	0.42	0.40	0.42	0.51	0.52	0.47	0.28	0.43	0.33	0.32	0.35	0.35
N30	0.04	0.39	0.28	0.29	0.31	0.28	0.13	0.19	0.16	0.12	0.17	0.20	0.20	0.36	0.19	0.34	0.23	0.24	0.24	0.34	0.29	0.23	0.16	0.23	0.28	0.28	0.20	0.55
N31	0.06	0.35	0.25	0.41	0.66	0.32	0.22	0.13	0.23	0.12	0.12	0.25	0.18	0.30	0.17	0.24	0.22	0.38	0.43	0.33	0.32	0.14	0.21	0.18	0.24	0.20	0.27	0.28
N32	0.12	0.48	0.38	0.55	0.41	0.38	0.21	0.24	0.36	0.24	0.27	0.35	0.26	0.43	0.28	0.39	0.36	0.44	0.37	0.48	0.42	0.33	0.26	0.35	0.30	0.29	0.31	0.41
N33	0.11	0.41	0.24	0.51	0.38	0.24	0.31	0.21	0.33	0.22	0.22	0.30	0.29	0.22	0.20	0.28	0.32	0.38	0.50	0.35	0.36	0.29	0.26	0.27	0.27	0.25	0.26	0.34
N34	0.12	0.50	0.33	0.31	0.19	0.29	0.23	0.20	0.18	0.13	0.19	0.27	0.25	0.25	0.17	0.27	0.30	0.30	0.22	0.30	0.33	0.22	0.12	0.23	0.48	0.20	0.22	0.23
N35	0.06	0.26	0.26	0.30	0.22	0.24	0.16	0.20	0.40	0.22	0.25	0.22	0.31	0.21	0.15	0.38	0.29	0.22	0.32	0.33	0.26	0.40	0.18	0.27	0.21	0.18	0.23	0.17
N36	0.09	0.29	0.22	0.23	0.17	0.25	0.22	0.19	0.39	0.30	0.25	0.32	0.23	0.16	0.22	0.26	0.25	0.27	0.57	0.29	0.24	0.32	0.22	0.33	0.16	0.18	0.45	0.37
N37	0.12	0.39	0.26	0.43	0.23	0.26	0.32	0.17	0.36	0.26	0.21	0.37	0.21	0.21	0.29	0.27	0.27	0.48	0.52	0.41	0.34	0.26	0.32	0.33	0.25	0.23	0.34	0.37
N38	0.10	0.35	0.51	0.34	0.30	0.40	0.10	0.22	0.22	0.08	0.18	0.40	0.18	0.26	0.20	0.32	0.21	0.25	0.27	0.34	0.24	0.23	0.12	0.19	0.35	0.34	0.23	0.15
N39	0.16	0.53	0.72	0.47	0.29	0.47	0.34	0.26	0.40	0.21	0.32	0.47	0.33	0.31	0.36	0.38	0.31	0.61	0.35	0.61	0.50	0.38	0.23	0.34	0.45	0.26	0.44	0.34
N40	0.14	0.48	0.47	0.52	0.37	0.33	0.35	0.38	0.35	0.28	0.31	0.38	0.33	0.33	0.36	0.50	0.55	0.49	0.40	0.85	0.59	0.58	0.30	0.47	0.27	0.32	0.49	0.36

Fig. 4. Mapping research versus news topics.

Table 4
Summary of topic mapping to the SCOR model.

(a) Supply chain processes

	Research topics		News topics	
	Max	Avg	Max	Avg
Plan	0.2359	0.1610	0.2444	0.1363
Source	0.4602	0.2309	0.4672	0.2304
Make	0.4736	0.2343	0.3858	0.2166
Deliver	0.3916	0.2335	0.3785	0.2277
Return	0.4057	0.2100	0.3476	0.1909
Enable	0.3927	0.2726	0.3982	0.2398

(b) Supply chain performance attributes

	Research topics		News topics	
	Max	Avg	Max	Avg
Reliability	0.2398	0.0986	0.2072	0.0926
Responsiveness	0.2077	0.1105	0.2541	0.1055
Agility	0.2697	0.1251	0.2998	0.1309
Cost	0.2528	0.0987	0.2720	0.1234
Assets	0.1802	0.0850	0.2117	0.0892

remained at a same level over recent years, discussions around the technology in the industry have shifted towards more specific issues. The same is anticipated to occur in scholarly research.

A similar trend is also observed for topics [A13, N28] that are focused on BT-enabled logistics and freight operations, where the peak in the number of articles in news media has appeared one year earlier than in the academic landscape. While the research on this topic has dealt with the development of models of BT platforms for logistics processes, the news content has mainly reported on advancements in the industrial side and commercial solutions. The marked decline in academic research on this topic, in parallel with reflection on more solutions being used in the industry, highlights a good example of how the content that appeared in news media can inform the researchers to shift away from the topics that are less useful in practice.

BT-SCM in the healthcare industry ([A14, N16]) corresponds to another major common focus of the academic and news corpora. Based on the similarity scores, it is the BT-SCM use case that has received the most scholarly attention among others. The research and practice in this domain are further aligned as their primary focus is on using BT to address issues in the supply chain of drug products and pharmaceuticals. In news media, the topic has received relatively consistent attention, followed by a declining trend. However, the volume of relevant research has been growing. This implies the existing complexities and unresolved challenges of BT-SCM in healthcare use-cases that deserve further scholarly consideration. Topics [A2, N4] and [A2, N39] are also among the highly related themes that are concerned with BT-enabled supply chain traceability. Such an alignment between research and news corpora gives an evidence that improving traceability is the most prominent motivation for BT adoption in supply chain. While addressing this topic in the food sector as a pioneer application exhibits the time lag between academic and practical domains, the pattern observed in topic N39 implies a focus on the use of the technology for supply chain

Table 5
Mapping BT-SCM research topics to the SCM research themes.

Research domain	Relevant topics
Contracts and coordination	A5, A12, A15, A19, A20, A21, A25
Customer service management	A1, A2, A5, A14, A15, A17, A20, A25
Demand management	A5, A12, A25
E-commerce and e-supply chain	A5, A12, A15
Global supply chain	A0, A2, A13
Humanitarian supply chain	A6
Integration, relationships, and collaboration	A0, A2, A4, A6, A14, A16, A17, A19, A20, A27
Inventory management	A0, A2, A5, A6, A7, A12, A13, A14
Logistics and transportation	A0, A2, A7, A13, A14, A20
Marketing and distribution channels	A5, A12, A14, A25
Network management	A1, A7, A13, A16, A19, A20, A21, A23, A25, A26, A27
People and human resources	
Performance management	A3, A17
Product and process innovation	A1, A3, A15, A23, A27
Production and manufacturing operations	A0, A1, A2, A3, A6, A7, A11, A14, A15, A20, A23, A24
Purchasing and procurement	A5, A14, A25
Quality management	A0, A2, A5, A14, A24
Resilience and risk management	A6, A7, A21, A23
Retailing operations	A2, A5, A12, A15, A25
Reverse and closed-loop supply chain	A24
Social and environmental sustainability	A11, A17, A25
Strategy	A5
Supply chain finance	A4, A5, A18

tracking and transparency in different sectors other than the food industry.

Among the research topics, A7, A22, A9, and A10 have the lowest maximum SCS scores over the news topics. Regardless of topic A9, for which such a low score seems reasonable, this highlights areas of BT-SCM research that need to increase their practical relevance more than others. Specifically, the proposed BT-based solutions under topic A7 demand further examination to see how they help with the issues arising in real-world applications and how they perform in actual practice. This is a critical consideration for scholarly research on the technical aspects of BT-SCM. There is a need to better position this type of academic research, particularly in association with extensive technical developments taking place across the industry. With respect to topics A10 and A22, the results indicate that further research is needed to bring practitioner perspectives and lessons learned from industry experiences into BT-SCM adoption studies. Such a need is further underscored due to the fact that BT-SCM is still in its early stages. Specifically, practice-oriented research is necessary to understand the drivers and barriers of BT adoption as well as the requirements of successful BT implementation in different supply chain applications. It is also the case with the performance assessment of BT-SCM systems. Because existing evidence on BT-SCM adoption is far from maturity, qualitative and case study methods are most suitable for research on these topics. In this sense, the news content is a valuable source to inform researchers about relevant cases and help them obtain initial information about industry experiences at the implementation and post-implementation stages of BT-SCM. Several of the identified topics from the news corpus, such as BT-enabled solutions in the auto industry (N30), oil and gas (N32), and cobalt supply chain (N1), highlight such cases that can be considered for empirical investigations.

On the other hand, the comparative analysis indicates that research on BT potentials and benefits in SCM (A19), BT-SCM in the healthcare and pharmaceutical sector (A14), BT-enabled logistics operations (A13), and BT for supply chain traceability in the food industry (A2) are more associated with industrial and business practices. Studies on these topics can provide good examples of how to improve the practical relevance of research in other BT-SCM domains. Likewise, the mean SCS scores indicate that topics N26 (BT within the context of SCM digitization) and

Table 6
Taxonomy of research questions corresponding to the identified topics.

Topic ID	Research questions	Perspective	
		Technical	Managerial
A0	How can BT be paired with RFID systems to enhance electronic traceability in the supply chain, particularly for agri-food products?	*	
A1	How can BT be utilized in the implementation of smart factory and intelligent manufacturing systems and new production paradigms within the frame of Industry 4.0?	*	
A2	How can BT implementation fulfill the requirements of transparency and traceability in the food supply chain?	*	*
A3	What are the benefits and impacts of using BT as a major component of digital SCM innovation?		*
A4	What and how much is the efficiency impact of using BT platforms for supply chain finance? What are the optimal strategies in BT-enabled supply chain finance?		*
A5	What are the optimal strategies and coordination mechanisms for BT-based supply chain systems and online marketplaces and how do they affect the profits of the members?		*
A6	How can BT contribute to enhanced supply chain risk management and resilience?		*
A7	How can BT-based solutions be designed to enhance security in the supply chain infrastructure, including network devices and information assets?	*	
A8	What are important managerial considerations for BT implementation in the supply chain? What lessons can be learned from BT-SCM implementations by early adopters?		*
A9	What research themes have been explored in the literature on BT application in SCM and what are the existing gaps?		*
A10	What are the performance measures for BT in SCM? How can BT for supply chain applications be evaluated?		*
A11	What new opportunities does BT provide to enhance social and environmental sustainability in the supply chain? How can BT-based solutions be designed to implement environmental and sustainable SCM practices more effectively and efficiently?	*	*
A12	What are the optimal mechanisms for BT-enabled demand and supply management? What are the benefits of using BT in inventory management?		*
A13	How can BT be utilized to enhance logistics and freight shipping systems?	*	
A14	What are the implications of BT to enhance the healthcare supply chain operations? How can BT be leveraged to tackle long-standing SCM issues in the healthcare and pharmaceutical sectors?	*	*
A15	How can smart contracts be designed to govern supply chain transactions and improve the efficiency of supply chain processes?		*
A16	What are the model architectures for BT platforms for supply chain information transactions?	*	
A17	What are the impacts of BT implementation on supply chain capabilities and practices?		*
A18	What are legal, regulatory, and policy issues in using BT, particularly in supply chain and global trade applications, and how can they be addressed?		*
A19	What are the opportunities and potential benefits of utilizing BT in SCM? How can BT	*	*

(*continued on next page*)

Table 6 (*continued*)

Topic ID	Research questions	Perspective	
		Technical	Managerial
	features help address common challenges in supply chain systems?		
A20	What are the model structures and operation mechanisms for emerging BT-enabled SCM systems?	*	
A21	What are the technical inefficiencies in BT systems and how can they be resolved?	*	
A22	What are the determinants of adoption of BT in supply chain applications?		*
A23	What are the potentials of BT to address current issues in emerging IoT-based supply chain applications? How can BT solutions be designed for IoT-based supply chain systems?	*	*
A24	What are the potentials of BT for digital transition in the engineering and construction supply chain? How can BT-based solutions be designed for intellectual property protection and anti-counterfeiting in additive manufacturing?	*	*
A25	What are emerging BT-based models and optimal market mechanisms for decentralized peer-to-peer energy trading?		*
A26	How can BT-based solutions be designed to overcome existing issues with information privacy and trust management in the supply chain?	*	
A27	How can BT-based information systems be designed for vehicle life-cycle tracking? What are the opportunities provided by BT for smart mobility systems?	*	*

N40 (BT potentials in the supply chain) have the highest relevance to the breadth of the content that appeared in the research corpus. These topics deal with more general aspects of BT-SCM that have been more or less discussed in a majority of related research. BT-enabled supply chain tracking and transparency (N39) is another news topic with higher similarity scores that again emphasizes traceability and transparency as the most salient aspect of BT in SCM research. Some other research topics such as BT for supply chain risk management and resilience (A6) also point out practical applications of the technology; however, they have not received high similarity scores over the news topics. This result indicates the lack of much practitioners' interest in such applications or that they have not been the primary drivers for BT adoption so far. They provide an expanded view of potential applications that may motivate future discussions around the technology in the business landscape.

Based on the SCS scores obtained for news topics, N8, N11, N17, and N12 are the least covered themes within the scholarly domain. These topics highlight the gaps that introduce avenues for future research endeavors. Topic N8 corresponds to an emerging stream of BT application. It indicates the need for scholarly investigations on how to realize the potentials of NFT in SCM. Considering the implications of topic N17 and the relatively low SCS score obtained for topic N21, it further calls for research on different aspects of tokenization of tangible and intangible supply chain assets, including the required supply chain transformations and existing challenges. This is a good example of trends appearing in news media that can inform researchers about popular topics in practical landscape. Topic N11 suggests research on the use of BT in digital advertising and marketing supply chains. Another existing gap is derived from topic N12, which pertains to different aspects of cryptocurrency use, particularly in retail and business-to-consumer (B2C) e-commerce. As the adoption of cryptocurrencies widens, it will be increasingly crucial to address the relevant issues that may arise.

Overall, the analysis confirms that news content and its evolution trend can be used as a rich source of information to highlight areas for scholarly attention and what needs to be done to enhance the practical relevance of BT-SCM research. Table 7 provides a summary of the main findings from the comparative analysis.

4.3. Insights from mapping analysis

The average SCS scores with regards to SCOR processes, given in Table 4, indicate a relatively same breadth of coverage by both research and news topics. The 'Enable' process has received the greatest attention of BT-SCM topics among supply chain processes. This agrees with the primary role of information technology in general, and BT in particular, as an enabler. The upstream, internal, and downstream supply chain processes (i.e., 'Source', 'Make', and 'Deliver') have received almost the same level of attention, implying the enabling role of BT throughout the entire value chain. In terms of the depth of coverage, the 'Source' process yields the highest maximum SCS score in news topics. This implies that discussions around BT-SCM are relatively more focused on using the technology to address challenges of the upstream supply chain. The maximum SCS scores also indicate that existing research on BT-SCM is more focused on elements of 'Make' and 'Source' than other supply chain processes. On the other hand, the SCS scores imply that BT has been less discussed within the context of 'Return' and 'Plan' processes, highlighting gaps in the current body of knowledge. Although there exist commonalities between forward and reverse supply chains and the ways they can benefit from BT, further research and practical evidence is needed to understand how the technology can help address the specific problems encountered in reverse logistics and closed-loop supply chain. This represents an area of further investigation in BT-SCM. With respect to the 'Plan' process, the adoption of BT and smart contracts makes it necessary to revisit existing supply chain planning practices and traditional supply chain decision-making models. However, it has not received much attention yet. There is a need to deeper understand the influences of BT-SCM implementation and the resulting supply chain transformations on optimal exploitation of supply chain resources to meet the requirements.

The identified topics from both research and news corpora have lower levels of closeness to supply chain performance attributes, demonstrating a lack of knowledge on performance outcomes of BT-SCM. This particularly calls for empirical evidence on actual versus anticipated improvements in supply chain performance at the post-adoption stage of the technology. The increasing adoption of BT-SCM applications in different industrial sectors can inform academic

Table 7
Main findings from comparative analysis.

Most common foci	BT potentials in SCM	A19, N40
	BT in healthcare supply chain	A14, N16
	BT-enabled logistics and freight operations	A13, N28
	BT-enabled supply chain traceability	A2, N4, N39
Research foci with highest practical relevance	BT applications and potentials in SCM	A19
	BT-SCM in healthcare and pharmaceutical industry	A14
	BT-enabled logistics operations	A13
	BT-enabled supply chain traceability for food quality and safety	A2
	Impacts of BT as part of digital innovation	A3
Research foci with lowest practical relevance	BT solutions for smart technologies being used in SCM	A7
	BT-SCM adoption	A22
	Assessment of BT-SCM implementation and performance	A10
Research gaps corresponding to news foci	NFT potentials in supply chain	N8
	BT for advertising and marketing supply chain	N11, N17
	Cryptocurrency issues in retail and B2C	N12

research in this stream. The obtained SCS scores show a relatively higher tendency to seize agile-enabling consequences of BT to enhance supply chain adaptability to external influences and mitigate negative impacts of supply chain risks. Contrarily, little is known about how and the extent to which BT may contribute to improved asset management capabilities in supply chain networks and reliability of supply chain processes.

The findings from the mapping analysis presented in Table 5 show that BT-SCM has been primarily discussed in support of production and manufacturing operations, managing networks of supply chain parties, and addressing issues with supply chain relationships, integration, and inter-firm collaborations. Furthermore, it has been relatively more investigated with regards to supply chain contracts and coordination mechanisms, inventory practices, and operations at the customer end of the supply chain. There exist more specific research questions that need to be addressed by scholars in these domains. On the other hand, there are substantial knowledge gaps on BT-SCM in relation to people and human resource elements of the supply chain systems and the changes that the technology brings into this aspect. BT use in addressing reverse and closed-loop supply chain challenges (also highlighted through SCOR mapping) and in humanitarian and relief chain logistics and operations – as a form of non-commercial supply chains – imply other major gaps in the existing literature. In addition, little is known about how BT is aligned with the requirements of different supply chain strategies. The findings also highlight the lack of theoretical and empirical studies on the performance outcomes of BT-SCM.

5. Conclusions

BT-SCM represents a young area of academic research, business practice, and technology development. At this point, a holistic classification and evaluation of the body of knowledge is insightful for both researchers and practitioners in BT and SCM fields as there is much yet to come in the future. This paper offered a comparative classification and analysis based on a systematic, unbiased scrutiny of large corpora of research papers and news articles using the strengths of machine learning and text mining algorithms. The existing knowledge gaps and several avenues for future research were identified based on this comparative assessment along with analysis of trends over time. Overall, the results highlight the need for inter-disciplinary studies that bring together technical, managerial, and domain-specific expertise to create a more nuanced understanding of BT-SCM systems and tap the real potentials of the technology well beyond the hype. The results also put emphasis on the need for research that builds upon the issues and questions that arise in the business and practical landscape when embarking on and pursuing BT-SCM initiatives.

The data-driven, comparative analysis presented in this paper offers an end-to-end framework that can be applied to assess the practical relevance of the research on other emerging trends and technologies in supply chain context. These correspond to domains where advances in practice is not only a valuable source of knowledge but also critically important in framing scholarly research. The proposed assessment helps better understand how academic research efforts are influenced and informed by the state-of-the-practice and what research topics and approaches are the ones to emphasize to address the needs and concerns in the practical landscape more effectively. It not only brings benefits for researchers by identifying existing gaps, but can also help research outlets and funding agencies realign their focus on topics that attract more practical interest.

Despite the several advantages of using computational text mining methods, this study has some limitations. First, the corpora used for the analysis were restricted to the articles appeared in WoS and Google News databases. Second, the list of keywords used to search for SCM-related content was not exhaustive. Third, the content presented in news media may also include biased arguments or hyped-up claims. Future research can investigate this and its trend after a new technology is introduced. Other limitations are related to the nature of text mining and topic modeling analysis. Although a relevance check was conducted to identify and filter out non-relevant articles, it is not as accurate as a full manual investigation. The retained corpora might still contain some non-relevant items which is inevitable when dealing with large collections of textual data. The other limitation is with the tagging and interpretation of the resulting topic models based on their top terms. While the most representative articles were also scrutinized along with the top terms to interpret and assign labels to the identified topics, it still required subjective work. Moreover, topic modeling analysis, as an unsupervised algorithm, is unable to identify the optimal number of topics. In this paper, a coherence metric was employed to maximize human interpretability of the topics in line with the purpose of the research; however, such metrics are not mature enough yet. Research is ongoing in this domain to develop more robust topic evaluation criteria.

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.

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