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Application of Social Media Data in Supply Chain Management: a Systematic Review

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Purpose: *Recently, big data has received considerable industrial and academic attention. Social media(SM) are becoming reliable big data sources that include various information such as customer's opinions, product reviews and trends. However, the supply chain management (SCM) field has been lagging behind other industries in adopting SM. Hence, this paper aims to explore the value of SM and its application in SCM with recommendation for future work.*

Methodology: *This paper reviews the existing literature systematically to highlight major research works and trends by using bibliometric analysis.*

Findings: *Our review results show that the research on SM and SCM has attracted significant attention over the decade. SM data has been used together with different analytical tools (e.g. text mining, sentiment analysis) to manage different supply chain activities (e.g. demand forecasting, production). However, the potential of SM has not been thoroughly investigated due to the inherent nature of SM data. Therefore, this study field is in its infancy. We suggest some directions can be considered for future research, e.g. sentiment indicators for SC related posts.*

Originality: *This paper is the first attempt to systematically analyse the interaction of SM data and SCM and to highlight the new approaches of adopting SM data for improving SCM.*

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1 Introduction

Traditional big data sources include machine data and transactional data, and so on. More recent calls to use big data in the SCM field (Aryal et al., 2018; Tsao, 2017; Wang et al., 2016) Web 2.0 applications (such as Facebook and Twitter) have grown explosively in recent years, contributing largely to the big data source (Chae, 2015). SM data is one of the most cost-effective and rapid methods of capturing the perspective of a larger audience on a particular subject (Singh et al., 2018). Although some academic articles have demonstrated the value of incorporating SM into SCM (e.g. Gruner et al., 2013; O'Leary, 2011), the practice of SM data in supply chain operations still needs further investigation. Indeed, few researchers have been able to draw on any systematic research into social media-based SCM (Huang et al., 2020). Therefore, this study provided a significant opportunity to advance our understanding of how SM data and supply chain integration work together.

To address this gap, the study aims to review the state-of-the-art of existing SM data and SCM literature from an academic view. To learn the current application of SM data and SCM, the prior researches are summarised and the knowledge gaps are identified in this study. Also, we attempt to suggest directions for future research and practice. This paper is informed by the following three research questions (RQs) to achieve the above aims:

- RQ1: What are the developments of SM data in SCM?
- RQ2: What type of supply chain activities might benefit from the SM data?
- RQ3: What are the potential research direction in this study area?

The remaining paper is structured as follows. Section 2 introduces the methodology used for searching and delimitation of the literature. Section 3 presents review results, including current research area development and classification of research topics based on different SCM activities. Section 4 discusses and suggests potential research directions. Finally, Section 5 describes the limitations and conclusions of this study.

2 Methodology

To address the research questions, the systematic literature review (SLR) / bibliometric analysis approach is adopted to explore the application of SM in SCM. SLR was first introduced in the medical research field, which is a method for conducting a structured, transparent, and reproducible review that adheres to a predefined and documented procedure (Devi and Ganguly, 2021; Durach et al., 2017). However, SLR is incapable of identifying the dynamics of knowledge evolution automatically. Therefore, this study will also adopt a bibliometric analysis to improve the review accuracy. The bibliometric method is used to bolster the SLR contribution through an objective assessment of academic papers, increased rigour, and the elimination of researcher bias (Phulwani et al., 2020). It has been widely used in the supply chain context (Aryal et al., 2018; Barbosa et al., 2018; Ben-Daya et al., 2019; Nguyen et al., 2018). This research method extends the scope of bibliometric study to levels higher than those found in traditional literature studies by screening and reviewing publications, thereby expanding our understanding of research areas and existing patterns (de Oliveira et al., 2018).

A set of inclusion and exclusion criteria should be predefined to help identify and prioritise relevant and significant research papers. According to Colicchia and Strozzi (2012), the following criteria were used:

- Select the papers published in English only.
- Limit the paper publishing period in the last decade.
- Ensure explicit relevance by requiring at least one keyword in the title or abstract of selected articles.
- Remove articles that are substantively irrelevant by excluding those that focus on extremely narrow aspects or contexts.
- Ensure the substantive and empirical relevance of the remaining abstracts by reading them.
- Ascertain that the remaining articles retain their substantive and empirical relevance by thoroughly reading them.

A combination of keywords including ‘Social media’, ‘Big data’, ‘Supply chain management’ were used to identify literature published in the past ten years (2011-2021)

from several well-known databases (e.g. Google Scholar, Web of Science, Elsevier, Scopus, Springer).

695 papers were identified from our initial search. We refined our search and carefully examined every single paper to ensure that only highly relevant research topics are included in our study. We are primarily interested in the user-generated data in SM platforms (e.g. comment and post) rather than the communication capabilities of SM (e.g. customer service). After removing duplicated papers, 172 papers are selected. Then we conducted a bibliometric analysis using Bibliometrix, a quantitative analysis software product, which contains a collection of tools for conducting quantitative research in bibliometrics and scientometrics (Aria and Cuccurullo, 2017; Moral-Muñoz et al., 2020). Figure 1 shows the process of our systematic review.

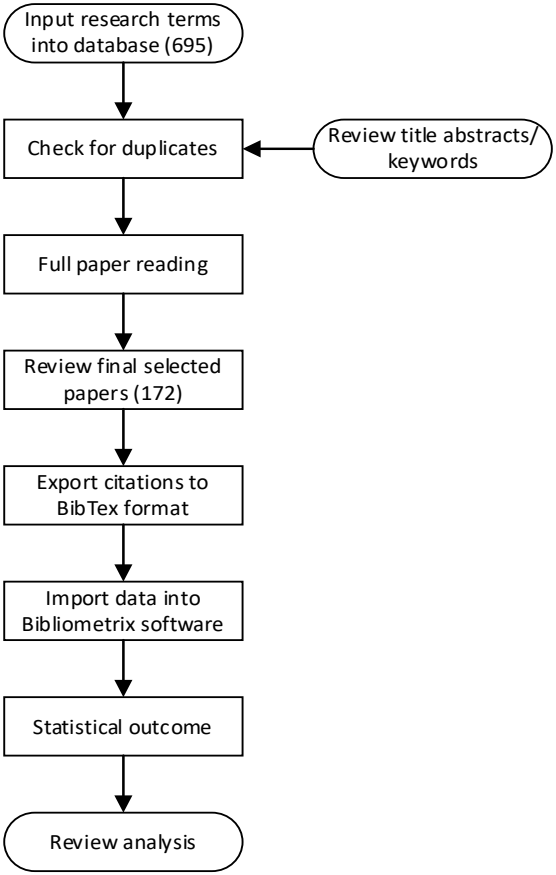

Figure 1: Process of systematic review

3 Result

Based on 172 selected papers, section 3 summarises the overall landscape of the study field by highlighting period, geospatial trends, and so on. Following that, we connect the selected samples to various supply chain activities and conclude with a detailed classification of social media functions.

3.1 Overview

To answer RQ1, this section analyses sets of statistical data from selected literature to ascertain the development and trend of our study field.

3.1.1 Number of publications by year

As illustrated in Figure 2, the literature on SM data and SCM is in its infancy with a 20.85% annual growth rate. Regarding SM in SCM, the first and the only one article appeared in 2011. Followed by no paper in 2012. Six to eight articles per year were published between 2013-2016. When it comes to 2017 to 2019, the number of published articles has increased to more than twenty papers every year. From 2020-2021 (till March), 65 papers have already been published. It obviously shows that the relevant research has increased significantly since 2017 because of the emergence of industry 4.0. This figure demonstrates that the use of SM continues to grow and has been widely considered and accepted by organisations and industries for improving SCM.

In the earlier year, most of the literature reported the applications of SM to retain information specific to SCM (Markova and Petkovska-Mirčevska, 2013). The current literature is increasingly focusing on the use of SM analytics to support decision-making, such as Singh et al. (2018), Tao et al. (2020), Tseng et al. (2019a).

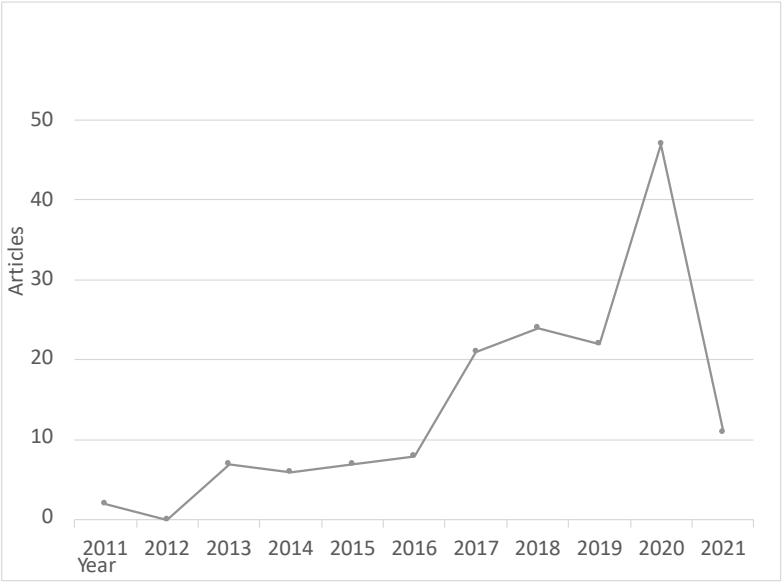

Figure 2: Number of papers published each year

3.1.2 Source dynamics

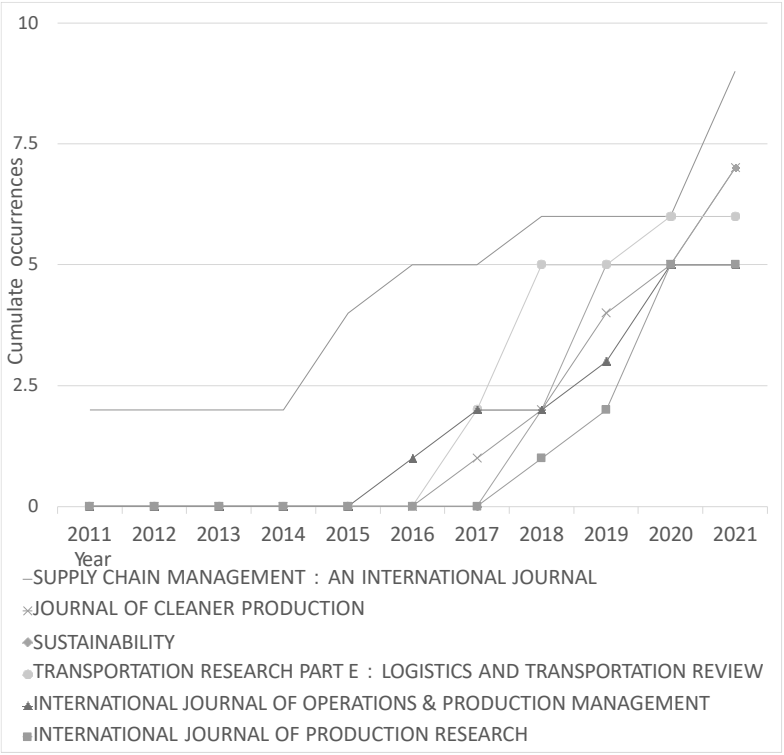

Figure 3: Source growth dynamics graphic

Figure 3 shows the annual growth of the most relevant papers published from the top six journals, such as Supply Chain Management: An International Journal, Transportation Research Part E: Logistics and Transportation Review, and International Journal of Operations Production Management. In addition, Table 1 shows the number of the paper published in different journals. They show an increasing trend as depicted by Figure . This topic is getting increasing attention in the academic field.

Table 1: Number of papers published in each journal

Source titles	No. of Articles	%
Supply Chain Management： An International Journal	9	5
Journal of Cleaner Production	7	4
Sustainability	7	4
Transportation Research Part E Logistics and Transportation Review	6	3
International Journal of Operations Production Management	5	3
International Journal of Production Research	5	3
Annals of Operations Research	4	2
International Journal of Information Management	4	2
International Journal of Production Economics	4	2
Production Planning Control	4	2
Operations and Supply Chain Management an International Journal	3	2
Production and Operations Management	3	2
Advances in Business Strategy and Competitive Advantage ABSCA Book Series	2	1
British Food Journal	2	1
Business Process Management Journal	2	1

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Source titles	No. of Articles	%
Computers Industrial Engineering	2	1
Decision Sciences	2	1
European Journal of Operational Research	2	1
IEEE Access	2	1
Industrial Marketing Management	2	1
Information Management	2	1
International Food and Agribusiness Management Review	2	1
International Journal of Physical Distribution Logistics Management	2	1
Journal of Big Data	2	1
Journal of Business Industrial Marketing	2	1
Journal of Fashion Marketing and Management	2	1
Journal of Global Information Management	2	1
Journal of Humanitarian Logistics and Supply Chain Management	2	1
New Medit	2	1
Journals with Single Paper	87	50
Total	172	100

3.1.3 Most relevant words

Figure 4 and Figure 5 show that the most frequently used terms in both the author's keywords and the abstract are SM, supply chain, big data, which conform to our research theme. It is important to note that sentiment analysis, Twitter, sustainability and knowledge sharing, are frequently mentioned.

Figure 4: Word cloud (Abstract)

Figure 5: Word cloud (Authors' keyword)

3.1.4 Papers published by document types

As Figure 6 shows, most of the published papers are research articles, while only 19 of them are review papers. This suggests a lack of SLR to comprehensively explore the application of SM analytics in SCM.

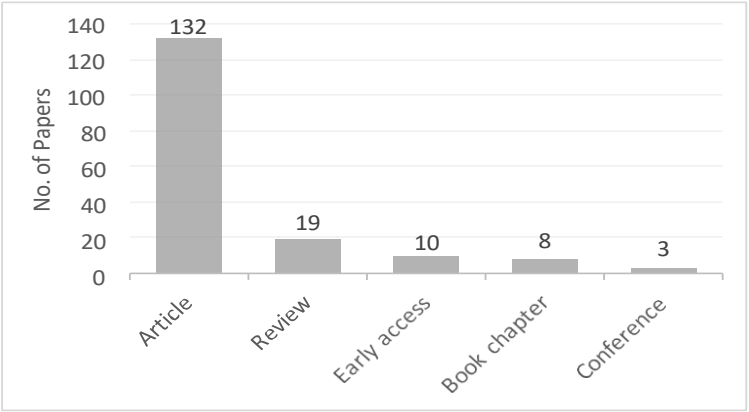

Figure 6: Papers published by document types

3.1.5 Paper Published by Country or Region

This section presents the number of studies in different countries or regions based on the corresponding author's country or region, including single country publications (intra country collaboration) and multiple country publications (inter-country collaboration). This figure aims to highlight countries or regions that have made higher contributions in this field. The United States and the United Kingdom have the most articles published, accounting for 19% and 18% of total publications respectively, followed by China, which contributes to 15% of them. According to Devi and Ganguly (2021), the United States and the United Kingdom are Industry 4.0 pioneers and have a stronger incentive to promote the application of user-generated data. As a result, researchers and practitioners have more opportunities and a more conducive environment for studying the relationship between SM data and the SCM. Other countries' low contribution may be due to a lack of resources and difficulties in acquiring SM data (Devi and Ganguly, 2021).

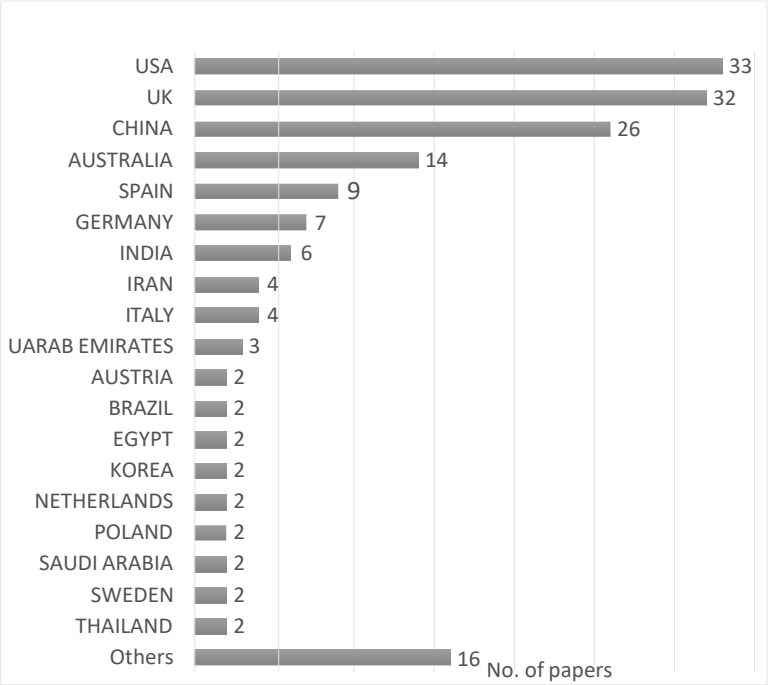

Figure7: Papers published by country or region

3.1.6 Trend topics by author's keywords

From Figure 8, it demonstrates a clear growth in the amount of topics from 2017. In particular, 'Big data/Big data analytics', 'Twitter', and 'Management' are among the top four author's keywords, and this indicates that:

- Big data is a connection between SM and SCM;
- Big data analytics could be applied to examine SM data;
- Twitter is a popular SM platform to provide data.

It is also worth mentioning that from 2020 the following keywords appear more and more frequently, including Twitter data, Facebook, industry 4.0, B2B, social media analytics, risk management and operation management. These high-frequency keywords may indicate future hot topics and development trends.

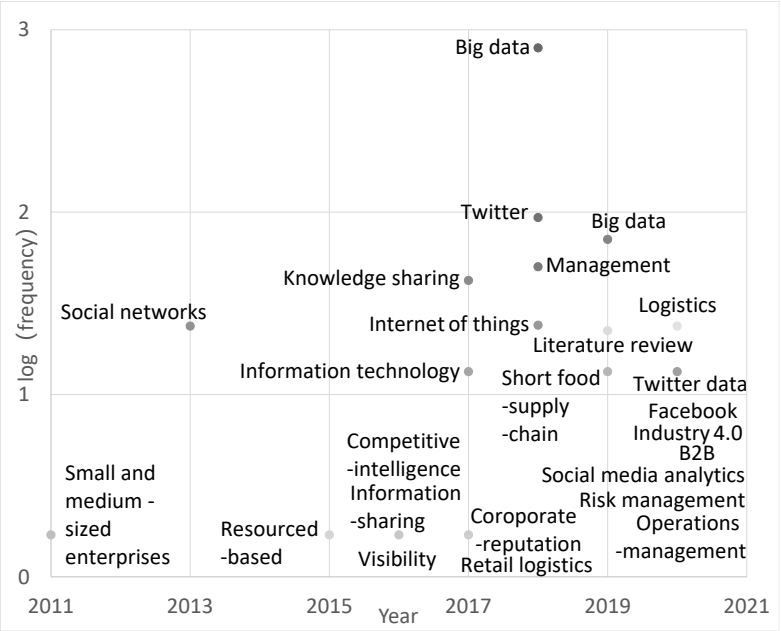

Figure 8: Trend topics by author's keywords

3.2 SCM activities

To address RQ2, this section summarises the supply chain activities related to the application of SM data based on 172 selected articles. Therefore, the primary supply chain activities that benefit from SM data can be identified.

3.2.1 Demand forecasting

Forecasting is a necessary component of planning and executing supply chain activities (Grant, 2017). An accurate forecast can significantly impact supply chain performance such as inventory cost and operational profitability (Cui et al., 2018; Devi and Ganguly, 2021; Huang et al., 2020). However, the complexity of forecast depends on many factors, such as product categories expansion, supply chain globalisation, shorter product life cycles, and increasing market competition (Boone et al., 2018).

To achieve accurate demand forecasting, a better understanding of customer need is required (Chong et al., 2016; Huang et al., 2020). In other words, the access to customer information plays an important role (Irani et al., 2017). Hence, some researchers proposed that SM information can be used as a new indicator to eliminate information asymmetry, thereby providing accuracy in demand forecasting and other supply chain activities such as inventory management. However, the internet/user-generated data is rarely used for prediction, perhaps due to the subjective nature of SM data (Cui et al., 2018; O'Leary, 2011; Risal et al., 2020).

More recently, the advancement in SM has enabled businesses to better understand customer behaviour through analysing data captured from various SM platforms. Traditionally, such analysis was done by conducting extensive market research (Boone et al., 2018). In fact, the rise of SM has significantly enhanced both the effectiveness and efficiency of demand prediction, thus helps to improve sales (Cui et al., 2018). As one of the big data sources, SM not only allows companies to capture the latest market trends in real-time but also helps them shape trends to influence customer behaviour (Boone et al., 2018; Huang et al., 2020).

SM platform allows user to freely express their attitude, opinions, thoughts, sentiments and share experiences (e.g. Twitter and Facebook) (Boone et al., 2018; Mishra and Singh, 2018). The size of SM data is enormous and scattered, but most data are unstructured data nature, such as texts, posts, pictures and videos (Mishra and Singh, 2018). Many researchers have attempt to uncover and analyse such information by using sentiment analysis, e.g. Singh et al. (2018), statistical analysis, e.g. Akundi et al. (2018), and machine learning algorithm, e.g. Chae (2015), He et al. (2013). For example, Cui et al. (2018) have

done an empirical study for forecast sales. They used the method based on natural language processing (NLP) techniques and introduced seven statistical models, such as simple linear regression, support vector and random forests.

3.2.2 Inventory management

The operations and SCM literature has been concerned with the issue of inventory management. Due to the immediacy and richness characteristic of SM data, it can provide timely shared information for the entire supply chain to help optimise inventory management (Huang et al., 2020). Inventory management and demand forecasting are closely related.

With the aid of big data techniques, businesses can collect data to help them coordinate demand and inventory volume (Irani et al., 2017). The information contributes to reducing the bullwhip effect and rationing pressure. For example, Choi (2016) explored that SM comments have an effect on a fashion retailer's confidence and belief in future product demand, which in turn affects the retailer's level of bounded rationality. The study result shows that positive comments on SM will give retailers more confidence to decide regarding inventory ordering. Therefore, SM has the potential to reduce the harm caused by the uncertainty of demand, thereby improving the supply chain effect.

3.2.3 Product development and production

Businesses can achieve higher customer satisfaction by developing and producing products that meet customer needs (Cheng and Krumwiede, 2018). SM data can suggest companies make better decisions about product development and production (Chong et al., 2017).

Huang et al. (2020) argued that by applying machine learning algorithms and data mining techniques to SM data, it is possible to automatically extract insights about customer preferences and requirements from SM posts, online review comments, and online community dialogues. To achieve an accurate understanding of SM data, many researchers suggested sentiment analysis, which determines the viewpoint and tone underlying a corpus of words to comprehend an individual's online attitude (Akundi et

al., 2018; Bhattacharjya et al., 2016; Mishra and Singh, 2018). Giannakis et al. (2020) examined how information gleaned from SM can aid in the decision-making process associated with new product development. In the study, the customer sentiments data is gathered through Twitter. The result shows that consumer sentiment can help identify the disadvantages of a new product or service.

In addition, big data analysis can also be used to identify more opportunities for manufacturing process improvement, thereby assisting process adjustment and product redesign (Giannakis et al., 2020; Huang et al., 2020).

3.2.4 Supply chain risk management

One major barrier to business is the risk of uncertainty. Supply chain risks are identified into various categories, such as risk source, risk consequence, risk probability or frequency, and risk detectability (Fu et al., 2014). There are four practices in supply chain risk management to cope with the risks and disruption, including risk identification, risk assessment, risk mitigation, and risk monitoring (Colicchia and Strozzi, 2012). Fu et al. (2014) proposed SM applications in supply chain risk management, including market uncertainty risk, social risk and SM risk, natural disaster risk, public health risk, labour risk, and network-related risk. The immediacy of SM data can help obtain information promptly to detect risks and disruptions (Wu et al., 2017).

Due to the outbreak of COVID-19 in 2019, many companies face the problem of supply chain disruption. Barman et al. (2021) studied the impact of COVID-19 on the food supply chain, and they found that SM platforms (such as Twitter, YouTube, Facebook) also serve as a conduit for outbreak prevention, crisis response, and disaster management personnel to manage and access basic data gathered by relevant organisations easily. During a disease outbreak, SM helps disseminate information from reliable sources and can be served as a source of opinions and experience (Fu et al., 2014). Therefore, SM is an essential tool for companies to make decisions and strategies during the emergency period. However, due to the unstructured nature of big data, it is also challenging to capture the accuracy of information (Akter and Wamba, 2019).

3.2.5 Other activities

Other uses of SM data in supply chain operations follow a similar pattern by using big data analytics, such as content analysis, sentiment analysis, text mining. As a result, we will not discuss each activity in detail in this section but will instead provide some supplements as follows:

- In the delivery and logistics aspect, transportation-related data can be gathered from SM in order to suggest vehicle routing and tracking updates (O'Leary, 2011).
- In the marketing aspect, companies can detect trend direction and know consumer preference by analysing customer SM posts and online comments (Mishra et al., 2017).
- Information and knowledge sharing on SM enable to improve the visibility and efficiency of the supply chain (Cui et al., 2018; Devi and Ganguly, 2021; Grant, 2016; Grant, 2017; Grant and Preston, 2019). For example, O'Leary (2011) proposed that creating an internal network can help employees or partners share information or knowledge in a timely manner.
- SM not only enables supply chain partners to share information about reverse logistics effectively but also enables companies to make timely decisions about product return predicting (Huang et al., 2020).
- Also, SM data allows companies to evaluate the supplier or partner's performance as a sourcing evaluation and selection (O'Leary, 2011).
- In human resources management, SM data analytic allow companies to find out the match candidates (Fisher et al., 2014).
- SM data can support companies to make the decision about sustainability development (Tseng et al., 2019b) For example, Tseng et al. (2019a) found that supply chain sustainability capabilities can be enhanced by integrating qualitative data and quantitative data in SM platforms.

4 Future research directions

To answer RQ3, this section discusses and suggests future directions. Our analysis results suggest that the research about SM data in SCM is still limited but growing rapidly. We believe this topic has great potential. Based on systematic and critical analysis of the topic, we propose the following future directions to researchers in SM/SCM :

- Developed countries publish more papers than developing countries. We propose that future research examine differences in consumers' SM usage habits or cultures across these countries and regions to determine whether these differences significantly affect SM effectiveness.
- Sentiment analysis is a critical technique for analysing SM data. Many pieces of literature discussed sentiment analysis, but few of them mentioned how to measure sentiment in the context of the supply chain. We suggest the future study consider/develop new sentiment indicators for supply chain actives related posts.
- Although SM data will bring certain benefits to SCM, its negative consequences and mitigation strategies are rarely discussed in detail. We suggest that future research examine the challenges of using SM data in SCM and develop potential solutions.
- The framework for SM analytics related to SCM lacks discussion in selected literature. Therefore, the relevant framework for specific supply chain activities must be reviewed and it may suggest the need of a new framework.

5 Conclusion and limitation

This study conducted a systematic review of the current literature on SM, big data, and SCM. The purpose of this study is to uncover the growth trend of this study field and to investigate the application of SM data in the context of SCM, as well as to describe its benefits. The findings indicate that, although the topic is still in its infancy, it has the potential to significantly improve the efficiency of companies' SCM, for example, it can help improve the accuracy of the demand forecasting and offer suggestions to product design. Industry 4.0 lays the groundwork for SM data analytics and SCM, and it can make companies improve their competitive edges. Although the study added some new insights to the existing literature, this study still has many limitations. We used a limited number of search terms, and future research may consider to include additional related terms to increase the number of results. Another limitation is that selected papers in this literature review are mainly from academic journals. Additional materials (e.g. industrial reports) may be included in the future to bolster the review's finding.

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