Big Data Analytics for Supply Chain Sustainability: Amid the Outbreak of the COVID-19 Pandemic

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Abstract

Sustainability of supply chains are current buzzwords globally and are now more important than ever. Big data analytics holds many promises to address supply chain issues. However, the potential of big data analytics to address COVID-19 pandemic issues, particularly supply chain sustainability, remains vague and understudied. This study highlights the challenges facing supply chains resulting from the COVID-19 outbreak and investigates the role of big data analytics in promoting supply chain sustainability. Our findings revealed that big data analytics can play a vital role in overcoming supply chain disruptions and enhancing the sustainability of supply chains during the COVID-19 pandemic.

1. Introduction

At the start of 2020, COVID-19 emerged and led to an unprecedented situation that affected every aspect of human life more than any before it. The World Health Organization (WHO) announced the outbreak of COVID-19 as a pandemic and 'a public health emergency of international concern' threatening health care systems worldwide (WHO, 2020). Despite rigorous containment and preventive measures, COVID-19 continues to rise exponentially posing full or temporary closures of businesses, factories, markets, borders and government agencies in many countries facing high levels of infection (Bartik et al., 2020). As a result, this pandemic has significantly affected the global economy, which has fallen to record lows (Ozili & Arun, 2020), sparking fears of an impending economic crisis (Nicola et al., 2020).

The toll that the global economy has taken is mostly related to the curfews and the consequent travel restrictions and unprecedented lockdown in several trade sectors. The global economic consequences have been devastating. There has been a huge dip in international trade, declining between 13 per cent and 32 per cent compared to 2019 (World Trade Organization [WTO], 2020). Millions of people lost their jobs across all economic sectors, and many stock markets suffered record losses (Laing, 2020). Some industries such as food, pharmaceutical, retail, logistics and freight strive to meet global demand, while other sectors, especially hospitality and aviation, have failed to survive due to a lockdown in trade, and have begun to suffer unimagined losses (Nicola et al., 2020).

Moreover, COVID-19 has caused drastic destabilisation and disruptions to supply chains globally by creating a misbalance between supply and demand of many crucial facilities and activities (Ivanov & Dolgui, 2020). Araz et al. (2020) mention that COVID-19 is breaking many international supply chains. As an example of supply chain disruptions, the sudden and huge increase in demand for food and safety personal protective equipment (PPE), offset by an acute shortage of raw materials for these items, has caused chaos in the markets because of an imbalance between demand and supply.

Conversely, in other industries (specifically the hotel, aviation and automotive industries), there has been a dramatic drop in demand making them vulnerable to bankruptcy. Therefore, COVID-19 has caused destabilisation of supply chains globally, making them unable to meet the population's needs.

Given its lean and globalised nature, the supply chains of numerous organisations worldwide have experienced a wave of disorders. For example, 94 per cent of the 1,000 largest American companies listed in Fortune magazine have been significantly influenced by COVID-19 pandemic-driven supply chain disruptions (Fortune, 2020). The World Economic Forum's Global Risks Report indicated that COVID-19 is among the significant risks that cause supply chain disruptions (World Economic Forum, 2020). Worse yet, the activities and facilities of global supply chains are prone to outbreaks of COVID-19 (Ivanov & Dolgui, 2020). According to Linton and Vakil (2020), the biggest 1,000 supply chains in the world have more than 12,000 facilities including warehouses, factories, logistics and other operations that are located in quarantine and lockdown areas of COVID-19.

As a result, the COVID-19 pandemic has shed light on supply chains as an important aspect and vital artery of the global economy, and put the value of sustainability into greater focus (Ivanov & Dolgui, 2020). While there have been some calls and efforts to make supply chains more sustainable and resilient in the past few years, most supply chains' parties did not consider the possibility of a pandemic in their strategies. Thus, most supply chains are labelled as not sufficiently resilient. The COVID-19 pandemic has also presented challenges beyond the capability of businesses and governments in supply chain sustainability and uncovered some coordination vulnerabilities between supply chain parties (Hakovirta & Denuwara, 2020). Nevertheless, one of the key questions looming today is how to ensure supply chain sustainability with the spread of COVID-19. According to Ivanov and Dolgui (2020), the answer to this question goes beyond the current capabilities of supply chain parties as it cannot be resolved from a narrow perspective, instead, it requires more sophisticated data analytics tools.

In the fight against the outbreak of COVID-19, big data analytics have played a prominent role in many disciplines (Zhou et al., 2020). This mainly included the health care sector in terms of the rapid collection of health data from multiple sources, spatial tracking of infected cases, visualisation and prediction of the pandemic and assessment of the prevention level and control (Wang et al., 2020). In the supply chain context, big data analytics has contributed to making supply chains more resilient in balancing the demand and supply of commodities. It also effectively supports the capabilities of supply chain actors in identifying potential risks, making more informed and smarter decisions, and finding alternative solutions (de Sousa Jabbour et al., 2020). However, the potential of big data analytics to face COVID-19 pandemic issues, particularly supply chain sustainability, remains vague and understudied (Zhou et al., 2020).

As a key actor positioned at borders, customs administrations worldwide play a pivotal role in global supply chains and ensuring their sustainability (Aman et al., 2017). Realising this importance, the World Customs Organization (WCO) devoted the year 2020 to promoting the sustainability concept among its members, and launched the slogan 'Sustainability for people, prosperity and the planet' with the aim of 'focusing on the contribution of Customs towards a sustainable future where social, economic, health and environmental needs are at the heart of its actions' (WCO, 2020, p. 1). In addition, the WCO has issued several tools and instruments to assist the customs community in fostering supply chain management and ensuring sustainability, and recently published guidelines to fight the COVID-19 pandemic. In response to that, many customs administrations around the world are listing supply chain sustainability as a top priority in their strategies. However, COVID-19 has created more burdens and pressures for both customs administrations and businesses (Weerth, 2020). Trade facilitation, supply chain security and sustainability are among key issues for customs administrations under this confused global health situation. Businesses are now facing many challenges regarding scarcity and increased costs of materials and shipping, workforce, logistics, as well as consumer

demand, marketing issues and cash flow. All this indicates unprecedented disruption of international trade and impedes its facilitation.

The COVID-19 outbreak has caused deliberation among academia and practitioners on the concept of sustainability as an interesting research topic. While the supply chain has gained considerable attention in recent literature, big data research on supply chain sustainability during the COVID-19 pandemic remains quite scarce and rather limited. Therefore, this study investigates how big data analytics can help address supply chain challenges and support their sustainability during the COVID-19 outbreak. The findings of this study will assist decision-makers and supply chain stakeholders, who are still struggling with the spread of the pandemic, to leverage big data analytics to promote sustainability of supply chains.

2. Literature review

2.1 Sustainability and supply chains

The term 'sustainability' is commonly defined as economic practices that meet the present needs without compromising the needs of future generations (World Commission on Environment and Development [WCED], 1987). Sustainability has been used to balance and take responsibility for development and economic activities (Hakovirta & Denuwara, 2020). Sustainability focuses mainly on three key pillars: social, environmental and economic development (Govindan et al., 2014). These pillars have been widely considered as the basis to develop many sustainability standards. Most recently, some researchers emphasised the importance of adding a fourth pillar of sustainability to include human health as a new sustainability goal as a result of the COVID-19 pandemic (Hakovirta & Denuwara, 2020).

During the last decade, many organisations from both public and private sectors have identified sustainability as a top priority in their supply chains and have adopted, or are in the process of adopting, programs to make their supply chains more sustainable (Govindan et al., 2014; Govindan et al., 2016; Luthra & Mangla, 2018). A supply chain can be defined as a network that links diverse entities, activities, systems, resources and information to produce and distribute a particular product or service to the final customer (Charkha & Jaju, 2014). Supply chain sustainability is a holistic view of supply chain processes, logistics networks and technologies that affects the environmental, social, economic and legal aspects of a supply chain's components (Giannakis & Papadopoulos, 2016). Most recently, global interest in supply chain sustainability has been raised by the increasing risks and level of uncertainty imposed by the outbreak of the COVID-19 pandemic on the global economy, business trends and social environment, which have induced disruptions in supply chains worldwide (Bartik et al., 2020; de Sousa Jabbour et al., 2020; Hakovirta & Denuwara, 2020).

The COVID-19 crisis has exposed vulnerabilities and risks across supply chain parties and their operations. The recent supply chain literature has identified a number of risks arising from COVID-19, which include disruptions and delays caused by the wide shutdowns of borders, manufacturers, suppliers and markets (Hakovirta & Denuwara, 2020; Ivanov & Das, 2020), supplier dependency, supply capacity constraints, demand and supply volatilities, stock accumulation or stockouts, logistics and transportation problems, supplier liquidity and money transfer, exchange rate volatility, breakdowns and machine malfunctions, information distortion and inaccurate forecasts (Ivanov, 2020; Queiroz et al., 2020). From these scenarios, the political and social consciousness has awakened to the negative economic and social impacts of COVID-19. Supply chain disruptions and risks along with global human health problems may lead to a point of no return. Therefore, the pursuit of sustainability is widely perceived as an effective strategy to address the contemporary challenges facing supply chains and mitigate the consequences resulting from the drastic events of the COVID-19 outbreak.

Sustainability has emerged as a key research topic in the recent supply chain literature. Environmental sustainability has gained much attention in supply chain research driven by growing concern arising from scarcity of natural resources, climate change and global warming (Caniato et al., 2012; Fransoo, Günther, & Jammernegg, 2014). Recently, there have been some research attempts to address sustainability issues in the context of supply chain management (Giannakis & Papadopoulos, 2016; Govindan et al., 2014; Govindan et al., 2016; Luthra & Mangla, 2018; Mota et al., 2015). However, although there have been calls among academics and practitioners to further investigate supply chain sustainability, studies that address this issue in relation to recent COVID-19 events are scarce (Hakovirta & Denuwara, 2020; Ivanov & Das, 2020).

2.2 Big data and supply chain sustainability

The increasing risks and uncertainty imposed by the outbreak of the COVID-19 pandemic on the global economy, health care and social environment, along with the high infectivity of the virus, data distortion and inaccurate forecasts, have led to an urgent need for more sophisticated data analytics tools and technological support to fight the spread of the pandemic (Hakovirta & Denuwara, 2020). The response to COVID-19 has created a bigger volume of data than ever before, and has seen a paradigm shift in the way that data is gathered, managed and analysed across different disciplines (Zhou et al., 2020). Data are no longer generated and collected from government entities, rather, they are gathered from multiple diverse sources (Jeble et al., 2018). As a result, globally, we are witnessing an unprecedented increase in the sheer volume of heterogeneous data in terms of diversity and complexity. As practitioners and academics look for every possible way to prevent and control the epidemic, big data analytics emerges as a plausible solution with the promise to mitigate the consequences resulting from the COVID-19 pandemic. Big data can be defined as an enormous amount of unstructured, diverse and complex data that cannot be processed using traditional analytical tools, which requires more sophisticated technology to analyse and extract meaningful insights and make informed decisions (Appelbaum, 2016).

Zhou et al. (2020) highlight the role of big data in addressing challenges facing geographic information systems in the fight against COVID-19. They summarise 10 potential responses of big data in mitigating the influence of the COVID-19 epidemic, namely, '1) rapid construction of a big data information system for the epidemic; 2) rapid problem-oriented big data acquisition and integration; 3) convenient multiscale dynamic mapping for epidemics; 4) comparison between spatial tracking and the spatiotemporal trajectory of big data; 5) spatiotemporal prediction of the transmission speed and scale of the epidemic; 6) spatial segmentation of the epidemic risk and prevention level; 7) spatial dynamic balancing of supply and demand for medical resources; 8) assessment of the supply of materials and transportation risk; 9) rapid estimation of the population flow and distribution; and 10) monitoring the spatial spread of social sentiment and detection' (p. 78).

Big data analytics is 'a field that consists of big data, analytical tools and techniques to derive actionable insights from the big data for delivering sustainable value, improving business performance and providing a competitive advantage' (Wamba et al., 2017, p. 357). In the last decade, big data analytics has earned considerable interest in several domains. However, big data in the context of supply chain sustainability has a very limited legacy in the existing literature. There has been some research on big data and sustainability in the automotive industry (Bughin, Chui, & Manyika, 2010), whereas other studies either provide a rhetorical and anecdotal perspective or offer a very limited depth of analysis. Some studies addressed the impact of big data analytics on environmental sustainability (Koo, Piratla, & Matthews, 2015; Koseleva & Ropaite, 2017; Lokers et al., 2016). Other research investigates the relationship between big data analytics and financial performance of organisations (Gunasekaran et al., 2017; Wamba et al., 2017). Only very limited studies examine the impact of big data on supply chain sustainability (Hazen et al., 2016; Jeble et al., 2018).

During the COVID-19 crisis, there has been a growing push to take advantage of big data analytics capabilities to promote sustainability in supply chains. However, practitioners are still unaware of how big data can enhance sustainability measures in supply chains, and there is a lack of empirical evidence as of yet to do so (Jeble et al., 2018). Moreover, this domain has yet to earn significant interest in academia. According to Hazen et al. (2016), studies that address the relationship between big data analytics and sustainability in the context of supply chains are contemporarily relevant and quite scant which requires further attention from practitioners and academia. This is particularly true considering the COVID-19 outbreak. Therefore, this study highlights how big data analytics can promote sustainability in the supply chain.

3. Methodology

This research adopts a qualitative interview approach as a data collection method. Considering the novelty of both big data analytics and sustainability in the context of supply chains, particularly under the complex and uncertain situation of the COVID-19 pandemic, qualitative interviews are the most appropriate approach to address such new, unexplained and complex phenomena (Creswell & Poth, 2016). This is consistent with Walsham (2006) who affirmed that qualitative interviews are an apt technique to gain insights into the nuances and difficulties of complicated social phenomena. Moreover, this study aims to provide an understanding of how big data analytics can promote supply chain sustainability. Thus, qualitative interviews are well placed to answer this research question (Merriam, 2015). Qualitative interviews provide an in-depth investigation of participants' perceptions and can grasp the meaning of their opinions and experiences regarding big data analytics capabilities to promote sustainability in supply chains. Hence, this interview technique offers an opportunity to understand the subtleties of participants' perceptions and experiences, and thereafter proceed to a comprehensive and complete understanding of the phenomena under investigation (Daymon & Holloway, 2011).

Beside qualitative interviews, this study relies on a triangulation approach of data collection using semistructured interviews as the prime data collection technique, along with observations and documents. The triangulation approach allows the development of detail-rich data, maintaining the improvement of converging lines of research and enhancing the research validity (Al-Shbail & Aman, 2018).

Interviews were conducted with 12 individuals, including supply chain and logistics experts (3), trade facilitation experts (2), customs managers (3), big data vendors (1), epidemiology experts (1) and academic experts in supply chain and data science (2). The interviewees were questioned on their opinion, experience and perception regarding the implication and consequence of COVID-19 on supply chain sustainability, the current challenges facing global supply chains and the role of big data analytics on supply chain sustainability during the COVID-19 outbreak. The following interview questions were used:

- Can you tell me please what are the current challenges facing global supply chains during the COVID-19 pandemic?
- In your opinion, what are the implications and consequences of COVID-19 on supply chain sustainability?
- Do you think that big data analytics assists in promoting supply chain sustainability (Please explain how)?
- Can you explain how big data analytics enhances supply chain sustainability during the COVID-19 outbreak?

- What are the key success elements of big data analytics that enhance supply chain sustainability during the COVID-19 outbreak?

Documents reviewed included many related international reports, by-laws, regulations, daily press reports, standard operating procedures (SOPs), press reports, guidelines and instructions. Observations included some photos including systems and the work processes in several ports and factories.

Data analysis was performed using a coding technique (Strauss & Corbin, 1998) of all transcripts of interviews and documents to identify relevant elements and themes. The process of coding involved three levels of coding, open coding, axial coding and selective coding (Strauss & Corbin, 1998). The coding process was repeatedly rechecked to identify final themes. Subsequently, the literature was reviewed to explain the themes. Thus, our findings are not *a priori*.

4. Findings

This section presents the findings of this study on how big data analytics promote sustainability in the supply chain amid the outbreak of the COVID-19 pandemic. Our findings revealed that the pandemic has transformed the way in which supply chains operate, which will have global economic, social and environmental ramifications. Sustainability became the major concern of politicians, decision-makers and supply chain stakeholders, as they are committed to a more sustainable future, and are currently looking closely at this issue for supply chains to be far more resilient and sustainable against global disruptions. Amid COVID-19, supply chains have become more complicated and generate a huge amount of complex trade data that only sophisticated technology can deal with. The interviewees believe that to ease the burden, supply chains need to leverage big data analytics, which will have a significant impact on making more informed and strategic decisions to promote supply chain sustainability.

The findings of this study indicate that big data analytics contributes to promoting social and environmental sustainability in supply chains. With the uncontrolled spread of COVID-19, restrictions and lockdowns may increase further and thousands of people will likely lose their jobs, which would destroy economic activity and supply chains. In response to these threats, many organisations worldwide have sought to transform the way in which they operate from traditional work towards fostering flexible working hours, teleworking and harnessing information and communication technology (such as e-commerce, online platforms and social media) to make earning a living easier for employees. This transformation in economic practices and supply chain activities has created a massive amount of unstructured data. From an experts' point of view, big data analytics, particularly data extracted from social media, improves the level of awareness among supply chain stakeholders about the work conditions, wages, health and living conditions of employees, and challenges faced by them. This may lead to an acknowledgment and realisation by organisations of the importance of social and environmental sustainability and its relevance for their activities. Thus, socially sustainable supply chain practices must be improved. Moreover, findings showed that big data analytics enables organisations to better-allocate resources, improve workplace conditions, reduce waste and raise living standards for both employees and society. For example, one interviewee said that big data analytics assists organisations on how to maintain customers, which may lead to enhanced job opportunities and reduced unemployment, which will lead to the survival of sustainable supply chains during the COVID-19 pandemic.

Moreover, our findings showed that the COVID-19 pandemic has affected the resiliency and sustainability of global supply chains relentlessly and caused wide demand-supply disruptions across all industries. The pandemic has caused a long-lasting struggle for all supply chain entities to survive during these challenging conditions, which poses challenges to the enhancement of sustainability

outcomes during and after the current COVID-19 situation. Demand-supply activities have been extensively disrupted because of an upsurge in demand for some products, such as personal protective equipment, pharmaceutical and agrifood products, and disinfectant. With wide-ranging shutdown policies, an increased demand for equipment and supplies by hospitals and mall shelves empty of essential goods have become distinctive features of the pandemic around the world. Other industries, however, such as clothing, furniture, jewellery and electronics have been substantially affected by COVID-19 directly, making them vulnerable to bankruptcy. Most interviewees stressed that big data analytics enhances supply chain resiliency and mitigates demand-supply disruptions caused by the COVID-19 crisis. Big data analytics helps to assess the environment, predict consumers' demands and the actual needs of people during lockdowns, and improve service delivery, which would enable supply chain stakeholders to manage and balance the demand and supply of essential goods and material resources. While the spatial spread of the pandemic is the key threat to supply chains, big data analytics provides meaningful information in a timely manner to better understand the endemic areas. For example, big data analytics provides near real-time prevention of COVID-19 outbreak at the borders, ports, manufacturing and warehouse areas (Zhou et al., 2020). Moreover, the rapid collection of diverse data from multiple sources and real-time analysis offers unique opportunities to develop flexible logistics systems, predict an epidemic outbreak and spatial segmentation of areas at epidemic risk, and draw appropriate dynamic maps for the spread of COVID-19. This enables decision-makers to set out a more sustainable and resilient strategy for supply chains. In addition, big data analytics provides smart and innovative solutions for sectors facing recession by offering meaningful insights into a more agile approach for sectors open to learning from their mistakes.

Another form of disruption revealed by our empirical investigation is that, amid the panic, many businesses are mistakenly or intentionally making multiple orders for the same goods without realising whether they will simply incur the additional costs or will be able to actually sell them. In addition, some suppliers intend to monopolise some essential materials in their warehouses. hoping to drive up prices in the near future. Some customers, on the other hand, sought to 'panic buy' items they feared would run out. These disruptions make it difficult for supply chain stakeholders, including manufacturers and governments, who are struggling to achieve for supply chain sustainability, to determine whether the quantity ordered by vendors and suppliers is consistent with the actual needs of consumers or indeed whether these goods are actually sold. Such practices may waste resources and threaten food security. The findings of this study showed that big data analytics provides more disciplined approaches to maintaining environmental sustainability, the elimination of resource waste and mitigating panic. For example, the interviewees stated that the sophisticated analysis techniques of big data could provide more predictive insights into the exact number of orders made by a particular supplier for a particular service or good, the exact quantity of the goods to be manufactured and shipped, and the extent to which the amount of goods being ordered fits with the population size in a certain area. Additionally, big data analytics helps in avoiding 'out of stock' situations, precisely identifying reorder points and effectively addresses dumping issues.

Furthermore, the interviewed experts affirmed that the COVID-19 outbreak has dramatically changed consumption patterns and customer behaviours because of isolation and changes in habits caused by the growing use of online shopping and social media. This result is confirmed in a survey by Ernst and Young in which '42% of respondents believe that the way they shop will fundamentally change because of the COVID-19 outbreak. When it comes to brands and products, 34% of consumers indicate that they would pay more for local products, 25% for trusted brands and 23% for ethical products' (Ernst and Young, 2020). As not all supply chain entities are able to readily manage and control all such disruptions using traditional methods, big data analytics arises as an effective tool to deal with this dilemma, which plagues global supply chains. Our findings revealed that big data analytics has a variety of advanced techniques such as artificial intelligence, machine learning and sentiment analysis.

These provide deeper business insights into social-emotional orientation and can be used to develop new interactive and integrated services models. They can also be used to develop an optimal approach based on accurate segmentation of customers according to 'what, who, when and where' for numerous services and products. These analytical techniques also offer new innovative methods to predict consumption patterns and identify consumer preferences.

Indeed, the COVID-19 pandemic has highlighted the imperative need to make supply chain operations more visible and agile than before. Our findings indicate that big data analytics is a powerful tool for real-time monitoring and tracking of materials and information throughout supply chain activities, which makes all the processes more visible. In addition, experts strongly believe that real-time analysis of big data shared with other supply chain stakeholders (for example, suppliers, logistics, distributors and government bodies) promotes collaboration and provides clear and common insights into the opportunities and challenges facing supply chains. This in turn leads to increased visibility, makes supply chains more adaptable and flexible, and creates a common understanding to assess the environmental, social and economic impacts of supply chain risks resulting from the COVID-19 crisis. Furthermore, we found that big data analytics enable supply chain entities to identify processes and activities that may be reduced or removed to ensure the flow of materials efficiently, which supports resilience and quick transformations in production in case disruptions occur.

Amid the uncertainty and disruptions caused by the COVID-19 pandemic, risks to the supply chain are more complicated than ever before. Currently, the most prominent risks undermining supply chains are operational risks, simultaneous and long-term disruption and epidemic outbreak propagation. These risks are distinguished by unpredictability and have a very hard and immediate effect on supply chain activities, causing a ripple effect on the sustainability of global supply chains. Thus, more sophisticated risk analysis is now urgently needed for promoting sustainability in supply chains. Experts claimed that organisations with high powered big data analytics in place can make better decisions and adjust their strategies to mitigate supply chain risks in real-time. Our findings indicate that big data analytics delivers enormous benefits to identify and assess supply chain risks during the disruptive events of the COVID-19 outbreak. For example, predictive analysis helps decision-makers better anticipate and respond to disruptions, forecast the potential risk areas and customers' behaviour, reveal new risk patterns in complex environments, understand disruptive conditions early on and prevent them from occurring. Big data analytics also has huge capabilities to gain valuable insights into the lessons learned and identify key areas for optimisation across the entire supply chain, which assists in planning for sustainability and immediate adaptation to changing conditions.

In the customs context, the increase in the epidemic outbreaks has set a great challenge for customs administrations worldwide to fulfil their responsibilities. This study shows that big data analytics can assist customs administrations to develop risk management systems that are able to balance the control of trade and trade facilitation, ensure survivability and sustainability of the supply chain and that can achieve better results with fewer resources. In addition, big data analytics delivers opportunities to handle the complex and huge amount of trade data effectively, to track and trace trade movement in affected areas, identify and to detect new emerging risk patterns such as strategic goods, and counterfeit and substandard commodities that harm the health and safety of society. Thus, this analytical approach enables customs administrations to set out proactive measures to mitigate risks in advance, instead of responding once they have occurred.

5. Conclusion

Amid the ongoing COVID-19 pandemic, supply chain sustainability has become a major concern for both politicians and decision-makers to ensure a more sustainable future for our continued existence and for that of the planet. This study addressed the challenges facing global supply chains caused by the outbreak of COVID-19 and highlighted the role of big data analytics in promoting the sustainability of supply chains. Our findings revealed that big data analytics plays a vital role in overcoming supply chain disruptions and enhancing the sustainability of supply chains during such situations. As a relatively new and innovative phenomenon, many organisations worldwide seek to benefit from big data analytics capabilities in their supply chains with the highly visible aim of surviving supply chains becoming more sustainable and providing high value and outstanding services to society. However, many have yet to leverage big data analytics to promote sustainability in their supply chain, while others are unaware of how to utilise big data analytics to achieve such sustainability.

The times we live in are filled with challenges, uncertainty and disruptions. Big data analytics is no longer perceived as a trendy optional practice that will soon fade, nor a new phenomenon requiring validation. It will continue to survive during the unpredictable future. Thus, big data analytics should be considered an imperative strategic option throughout supply chain activities as they face a rapidly changing reality, and be seen as a valuable asset to develop measures of supply chain sustainability. Therefore, we suggest that it is time to go beyond investigating the role of big data analytics in enhancing the financial and operational performance of supply chains, and that future research should focus on the use of big data analytics to address supply chain sustainability issues, which are becoming significantly important worldwide.

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