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Big data analytics and application for logistics and supply chain management

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ABSTRACT

This special issue explores big data analytics and applications for logistics and supply chain management by examining novel methods, practices, and opportunities. The articles present and analyse a variety of opportunities to improve big data analytics and applications for logistics and supply chain management, such as those through exploring technology-driven tracking strategies, financial performance relations with data driven supply chains, and implementation issues and supply chain capability maturity with big data. This editorial note summarizes the discussions on the big data attributes, on effective practices for implementation, and on evaluation and implementation methods.

1. Introduction

The inception of Web 2.0, together with Industry 4.0, the Internet of Things (IoT), and other digital technologies has ushered in a good deal of attention to big data and its analysis. This research topic is gaining popularity globally both to drive performance improvements and to benefit from new insights. Massive amounts of data are now collated from several sources, including enterprise resource planning (ERP) systems, distributed manufacturing environments, orders and shipment logistics, social media feeds, customer buying patterns, product lifecycle operations, and technology-driven data sources such as global positioning systems (GPS), radio frequency based identification (RFID) tracking, mobile devices, surveillance videos, and others. As such, organisations are currently dealing with big datasets characterized by 4Vs: large volume, velocity, variety, and veracity. A recent International Data Corporation (IDC) forecast suggests that the Big Data technology will grow at a rate of 26.4% compound annual growth, reaching $41.5 billion through 2018. The bigger the data, the more challenging it becomes to manage and analyse and to deliver useful business insights.

Recent studies in the field of big data analytics have come up with tools and techniques to make data-driven supply chain decisions. Analysing and interpreting results in real time can assist enterprises in making better and faster decisions to satisfy customer requirements. It will also help organisations to improve their supply chain design and management by reducing costs and mitigating risks. Recently, various research studies have indicated the benefits of using big data methods in logistics and supply chain management. Tan et al. (2015) proposed a big data analytics infrastructure based on deduction graph theory to enhance supply chain innovation capabilities. Cakici et al. (2011) used RFID data for redesigning an optimal inventory policy. Mishra and Singh (2016) proposed a big data analytics approach for waste minimization in food supply chains. Zhong et al. (2015) stated how big data information could be used in effective logistics planning, production planning, and scheduling. Shukla and Kiridena (2016) introduced a fuzzy rough sets-based multi-agent model for configuring supply chains in dynamic environments. Dutta and Bose (2015) presented the challenges of managing a big data project for a cement supply and logistics network. Singh et al. (2015) proposed a cloud computing framework for reducing the carbon footprint of a supply chain. Waller and Fawcett (2013a, 2013b) argued that use of data science, predictive analytics, and big data could help logistics managers to meet internal needs and adjust to changes in the supply chain environment. Along with these studies, there are many areas within supply chain management that could benefit from big data methods and technologies, including mitigation of bullwhip effect, multi-criteria decision making (Govindan et al., 2013), sustainable supply chain management (Kannan, 2018; Govindan et al., 2017), sensor data-based predictive maintenance in manufacturing, efficient logistics (Govindan et al., 2015), forecasting and demand management (Schoenherr and Speier-Pero, 2015), and

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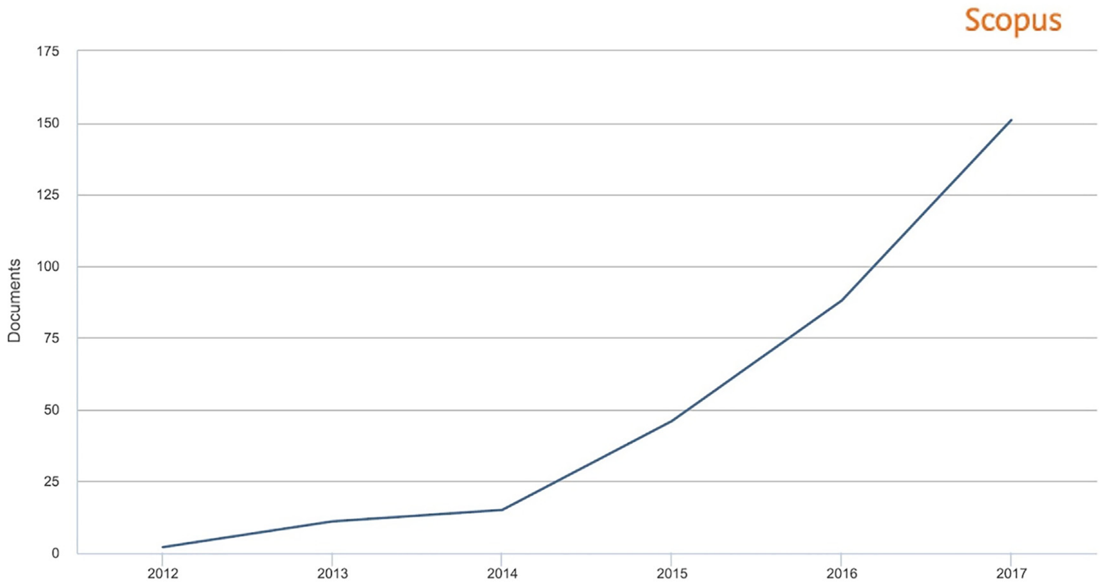

Fig. 1. Number of big data analytics papers published in various time periods (2012–14 March 2018) as revealed in (Scopus).

planning and scheduling (Chan et al., 2013). To improve operational efficiency, integrated production and distribution processes across different supply chain components, big data information and technologies need to be reassessed. Manufacturers, logistics, suppliers, and retailers should develop a holistic approach to add value to their customers and services.

2. Literature review on big data analytics

To provide the overview of this SI, initially a broad search was conducted to document the number of papers published in the area of 'Big data analytics' the search period used was from 2012 to 14 March 2018. An overview of the number of articles is presented in Fig. 1. After looking into the journal's specific search, Fig. 2 clearly demonstrates that the *Annals of Operations Research* was the leading journal in terms of the numbers of papers from Scopus.

In order to refine the search to identify the document type, the Scopus databases were investigated further. In this search, conference papers, notebook chapters, books, and short surveys were excluded. After excluding these items, a total of 313 were considered. The document types considered in this section included articles, articles in press, and reviews. The overview of document

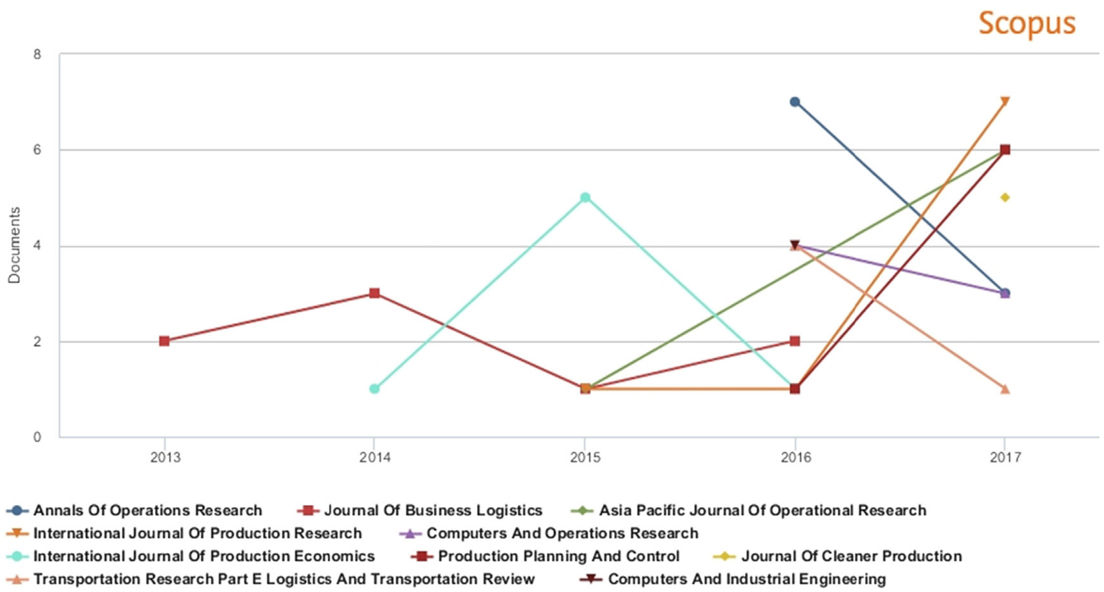

Fig. 2. Share of top international journals with highest contributions in publishing big data analytics topics as revealed in (Scopus).

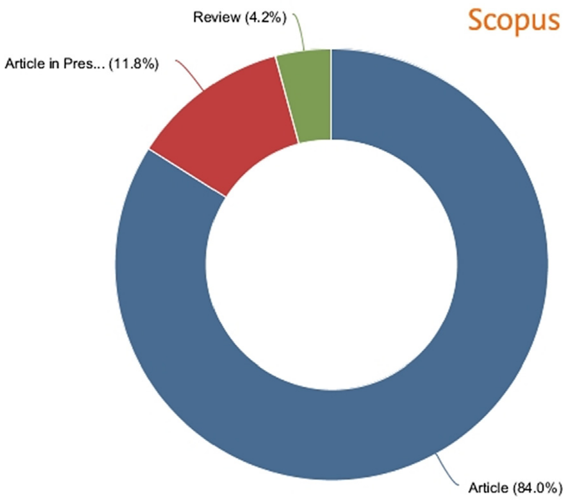

Fig. 3. Percentage Share of different document types of journal articles as revealed in (Scopus).

types is shown in Fig. 3.

The number of big data analytics papers contributed according to country of origin was also analyzed; the top ten countries are shown in Fig. 4. United States led the list with 94 documents, followed by the China with 88 documents, United Kingdom with 36 documents, India with fifteen documents, and Germany with fourteen documents. In addition, the subject classification of published big data analytics papers is shown in Fig. 5.

To conclude this section, a summary of the top twenty most frequently cited articles is provided in Table 1. The increasing interest in this research area provides solid evidence that this SI is timely and is especially relevant for the authors and readers of the *Transportation Research Part E: Logistics and Transportation Review*.

3. Application of big data analytics in supply chain management and logistics

This special issue is focused on publishing original research studies advancing conceptual understanding or application of innovative big data analytics to facilitate improvements in logistics and supply chains. Following a rigorous review process, we have selected five research papers to be included into this special issue. The following text introduces these papers.

Basole and Nowak (2017) studied the deployment of tracking technologies into the supply chain. They developed an understanding, based upon institutional theory and transactional costs, for the factors affecting tracking technology assimilation. They have

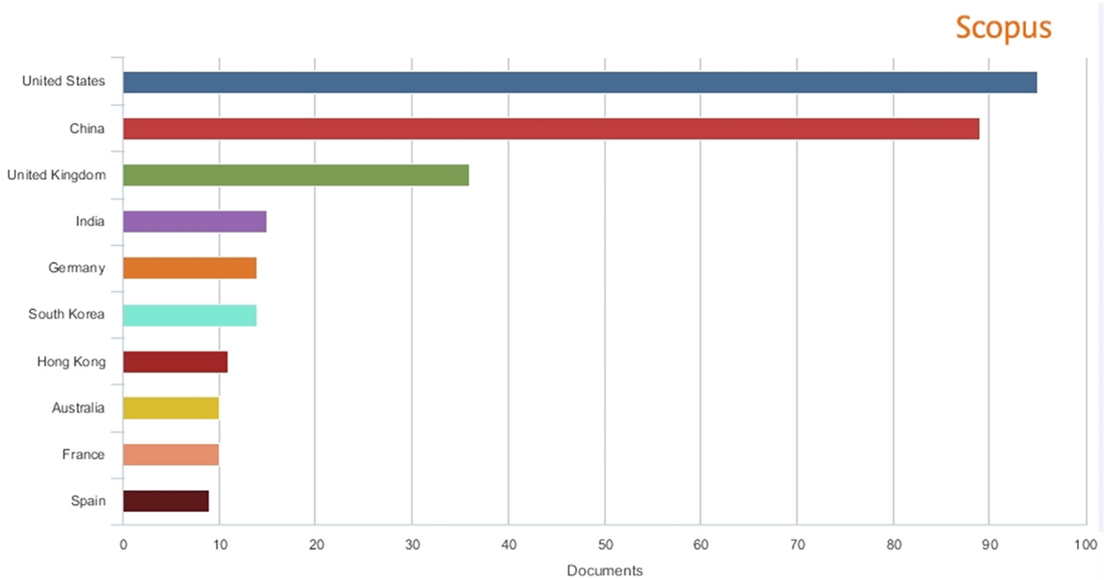

Fig. 4. Share of country origin publishing big data analytics topics as revealed in (Scopus).

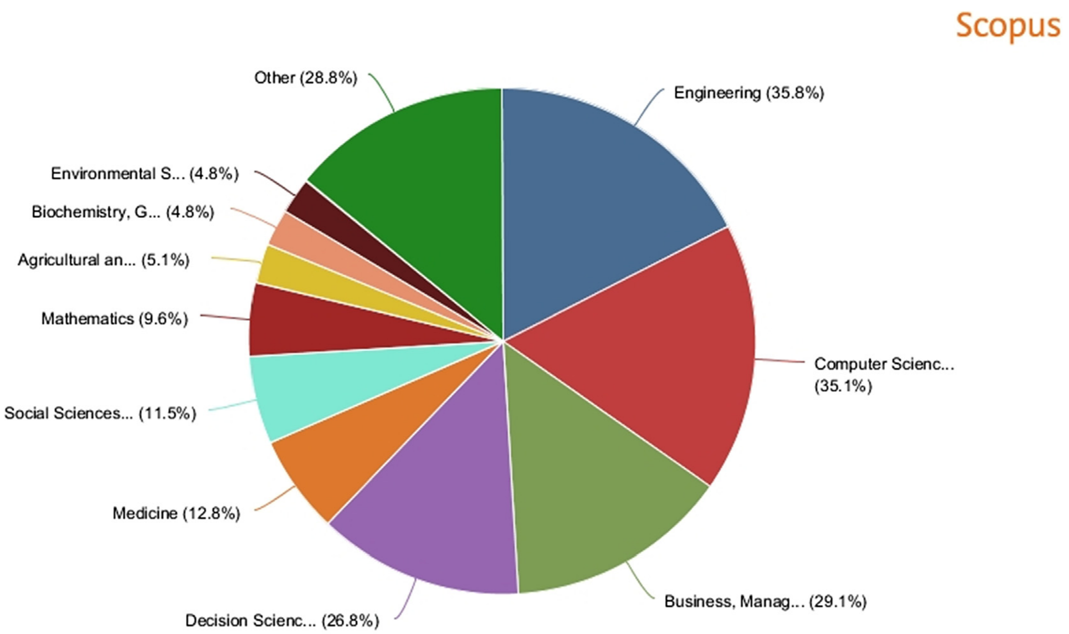

Fig. 5. Subject classification of big data analytics topics as revealed in (Scopus).

tested their model on a dataset comprising of 535 supply chain executives and decision makers. Based on their analysis it was prescribed that three contexts (product, supply network, and environment) have significant influence on each of the three phases of assimilation (initiation, adoption, and routinization). The results of this study could inform decision makers involved in deploying tracking technologies in a supply chain.

Yu et al. (2017) explored the effect of data-driven supply chain capabilities on financial performance for a Chinese manufacturing company. A structural equation modelling based data analysis method was proposed in this study. The results of this study indicate that coordination among supply chain partners and the responsiveness of the supply chain in terms of quickly responding to the shifts in market demand are positively associated with the better financial performance of an organisation.

Choi (2017) evaluated fashion's quick response program with the help of social media observations, demand forecasts updates, and a retailer with bounded rationality. With the help of analytical modelling, it was found that the likelihood of having good product reviews in social media affects the value of quick response. Further, the impact of such likelihood is mediated by the fashion retailer's prior attitude towards the market demand.

Singh et al. (2017) proposed a big data analytics methodology for analysing social media data from Twitter and for identifying issues with existing supply chains and logistics management of food products. They proposed a text analytics approach which includes a support vector machine and hierarchical clustering with multiscale bootstrap resampling for content analysis of the captured Twitter data. The results of this approach included significant cluster of words that can inform decision makers about improving various segments of food supply chain and logistics management.

Arunachalam et al. (2017) conducted a systematic literature review of big data analytics capabilities in the area of supply chains, and they developed a capability maturity model. They reviewed papers published from 2008 to 2016 to theorise big data analytics capabilities in the context of the supply chain and provided future research and development directions in this field. The authors reviewed 82 research papers and 13 maturity models available in literature. The results highlighted (i) understanding of big data in supply chain and optimising the data generation, (ii) importance of integrating and standardising heterogeneous data types in SCM, and (iii) the use of several types of analytics to assimilate the findings into the business processes.

To conclude, a dominant finding is that the application of big data analytics in supply chain and logistics management is more comprehensively explored through a variety of ways and within different fields of applications.

We are happy to guest edit this special issue and we believe that papers published in this special issue will help researchers and practitioners to have a better understanding of challenges associated with big data, as well as various aspects that could be improved in big data analysis to facilitate logistics and supply chain activities. We would like to thank Professor Jiuh-Biing Sheu (editor-in-chief) and the Editorial Board of *Transportation Research Part E: Logistics and Transportation Review* for accepting our special issue proposal. We extend our sincere thanks and appreciation to all contributors and anonymous referees for their valuable time and efforts in the review process.

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Table 1
Overview of first twenty highly cited papers.

S. No	Name of the article	Authors	Article type	Problem addressed	Methodology used	Scopus citation
1	Toward scalable systems for big data analytics: A technology tutorial	Hu et al. (2014)	Literature review	Discussed the concept of big data and highlighted the big data value chain, which covers the entire big data lifecycle	Literature survey and system tutorial	279
2	Data science, predictive analytics, and big data: A revolution that will transform supply chain design and management	Waller and Fawcett (2013a, 2013b)	Editorial	Proposal of definitions of data science and predictive analytics as applied to SCM and examined possible applications of DPB (Data Science, Predictive Analytics, and Big Data) in practice that stem from management theories		151
3	Data quality for data science, predictive analytics, and big data in supply chain management: An introduction to the problem and suggestions for research and applications	Hazen et al. (2014)	Empirical	Introduced the data quality problem in the context of supply chain management and proposed methods for monitoring and controlling data quality	Statistical process control	121
4	A big data approach for logistics trajectory discovery from RFID-enabled production data	Zhong et al. (2015)	Modelling	Proposal of holistic Big Data approach to excavate frequent trajectories from massive RFID-enabled shopfloor logistics data with several innovations highlighted	Holisitic big data approach	76
5	Insights from hashtag #supplychain and Twitter analytics: Considering Twitter and Twitter data for supply chain practice and research	Chae (2015)	Empirical	Proposed a novel, analytical framework (Twitter Analytics) for analysing supply chain tweets, highlighting the current use of Twitter in supply chain contexts	Descriptive analytics (DA), Content analytics (CA) integrating text mining and sentimentanalysis, and network analytics (NA)	55
6	The value of big data in servitization	Opresnik, and Taisch (2015)	Conceptual	Proposed a new basis for competitive advantage for manufacturing enterprises called a Big Data Strategy in Servitization and scrutinized how manufacturers can exploit the opportunity arising from combined Big Data and servitization	Conceptual simulation	55
7	Big data analytics in logistics and supply chain management: Certain investigations for research and applications	Wang et al. (2016)	Review	Proposal of maturity framework of Supply chain analytics (SCA), based on five capability levels, that is, functional, process-based, collaborative, agile SCA, and sustainable SCA	Literature review	52
8	Parallel selective algorithms for nonconvex big data optimization	Facchinei et al. (2015)	Modelling	Proposed a decomposition framework for the parallel optimization of the sum of a differentiable (possibly nonconvex) function and a (block) separable nonsmooth, convex one	Optimization	48
9	Harvesting big data to enhance supply chain innovation capabilities: An analytic infrastructure based on deduction graph	Tan et al. (2015)	Modelling & Empirical	Examined an analytic infrastructure for firms to incorporate their own competence sets with other firms	Deduction graph technique	47
10	Data science, predictive analytics, and big data in supply chain management: Current state and future potential	Schoenherr and Speier-Pero (2015)	Conceptual and Empirical	Investigated the current extent of use of SCM predictive analytics, underlying motivations, benefits andbarriers and next-generation data scientists training	SCM predictive analytics, ANOVA	38
11	Click here for a data scientist: Big data, predictive analytics, and theory development in the era of a maker movement supply chain	Waller and Fawcett (2013a, 2013b)	Editorial	Discussed how one disruptive trend, the maker movement, changes the nature of who the producers are in the supply chain, making big data even more valuable		38
12	Managing a big data project: The case of Ramco cements limited	Dutta and Bose (2015)	Empirical	Developed a novel framework to provide a holistic roadmap in conceptualizing, planning and implementing Big data projects	Descriptive case study	37

(*continued on next page*)

Table 1 (*continued*)

S. No	Name of the article	Authors	Article type	Problem addressed	Methodology used	Scopus citation
13	Simulation optimization: A review and exploration in the new era of cloud computing and big data	Xu et al. (2015)	Review	Classified simulation optimization techniques into four categories based on how the search is conducted and further reviewed the applications of simulation optimization	Literature review	36
14	Supply chain game changers–mega, nano, and virtual trends–and forces that impede supply chain design (i.e., Building a Winning Team)	Fawcett and Waller (2014)	Editorial	Explored the five emerging “game changers” that represent potential supply chain design inflection points: (1) Big Data and predictive analytics, (2) additive manufacturing, (3) autonomous vehicles, (4) materials science, and (5) borderless supply chains		32
15	Hazy: Making it easier to build and maintain big-data analytics	Kumar et al. (2013)	Conceptual	Investigated an approach to tackling the challenges that exist with the race to unleash the full potential of big data using statistical and machine learning processes		32
16	The supply chain becomes the demand chain	Christopher and Ryals (2014)	Conceptual	Discussed the emerging case for demand chain management, in which advanced manufacturing techniques (such as additive manufacturing) and enhanced information flows (big data) enable our supply chains to run, concurrently, with lower inventory and fast customer response		31
17	Big data for supply chain management in the service and manufacturing sectors: Challenges, opportunities, and future perspectives	Zhong et al. (2016a)	Conceptual	Investigated the representative Big Data applications from typical services like finance & economics, healthcare, supply chain management, and manufacturing sectors	Data statistics	29
18	Visualization of RFID-enabled shopfloor logistics Big data in Cloud Manufacturing	Zhong et al. (2016b)	Empirical	Proposed a visualization approach for the RFID-enabled shopfloor logistics Big Data from Cloud Manufacturing	Simulation model	26
19	Big data in Smart Farming – A review	Wolfert et al. (2017)	Review and Conceptual	Reviewed to gain insight into the state-of-the-art of Big Data applications in Smart Farming and identified the related socio-economic challenges to be addressed	Literature review	22
20	How the use of big data analytics affects value creation in supply chain management	Chen et al. (2015)	Empirical	Addressed how organizational bigdata analytics (BDA) usage affected value creation and identified the key antecedents of organizational-level BDA usage	Factor analysis	17

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.tre.2018.03.011.

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