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Impact of Big Data analytics on Supply Chain functions

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Abstract

Big data analytics becomes a new opportunity that is helpful in relevant decision makings. In recent years many research shows that big data analytics tools have a strong and significant effect on innovative products and the development of supply chain outcomes. Smart industry is more flexible, thanks to a high level of automation and integration of the entire digital supply chain. Supply Chain is specifically related to Big Data since the volume of different information is large. The amount of data gained from inception to delivery supply chains has increased substantially. Also, the present current competitive environment professionals of supply chain are exploring new approaches to collect, organize, and analyze data to provide innovative insights to various industries. The use of Big Data Analytics on a collection of massive data will produce strategic decision-making for predicting key opportunities and threats in Supply Chain. The objective of this paper is to critically review the two keywords: big data analytics, and supply chain analytics by presenting a comprehensive architecture of the connection between these keywords. This paper also highlights the previous research, challenges, current status, and futures directions of the use of big data in the supply chain.

Keywords
Smart Industry, Big data, big data analytics and Supply chain.

1. Introduction

With the new Industry known frequently as Industry 4.0 or the Fourth Industrial Revolution, production systems are evolving more efficiently in order to satisfy customer requirements, develop the degree of creativity and to gain in competitiveness. Accordingly, innovation is taking place between Supply Chain (SC), and Smart Manufacturing that has occurred the digitization of SC. Furthermore, as Industry 4.0 unfolds, computers and machines are linked with each other to eventually make decisions without even human involvement. Therefore, companies find an opportunity to boost their efficient capacities of production, to raise their level of international competition (Frank, et al. 2019). For this reason, the fourth industrial revolution, generates what is called "big data analytics"(BDA), which manages and analyses information and makes it accessible in real-time, thanks to connected objects (He and Wandand 2019). The BDA tools is pushing companies to move from a simple database to managing large amounts of data by creating new services and solutions for their customers. Due to its great importance, BDA has received rising attention. The objective is to improve the overall efficiency of companies (Saggi and Jain 2018). Based on the "Accenture survey" more than one-third of respondents reported participating in serious conversations to deploy analytics in SC. In addition, three out of ten have an analytics deployment initiative already in place (Accenture 2014). In order to face obstacles that can potentially lead to supply chain inefficiencies, companies try to capitalize on BDA in supply chain operations to improve visibility, efficiency, and global supply integration (Witkowski 2017). The BDA plays a crucial role in the strategic phase of supply chain planning (Nada 2016). It's used to help companies to make strategic choices in the area of procurement, network design, and product design. Furthermore, BDA is also used in the operational planning process, to assist management in making decisions about supply chain activities, often through demand planning, sourcing, production, inventory, and logistics (Richey et al. 2016). In this review paper, we have interested in showing the impact of using BDA, and their applications in SC which are growing exponentially, and summarizing the current trends and applications of BDA in every SC functions (operations and strategies). More precisely how they contribute to making SC operations (demand planning, Procurement, production, inventory, and SC strategies (strategic sourcing, product design, and development, supply chain network design) smarter, easier to be implemented in industry 4.0 context. This literature review is structured follows: In the second section, we mentioned a glimpse of the literature review on big data analytics in supply chain. While in the third section, the various big data analytics tools, characteristics, techniques, and technologies have been described. Whereas in the last, we mentioned sources, opportunities, and applications of big data analytics in supply chain functions.

1.1 Objectives

This overview highlights three issues, namely (2) Literature Review on big data analytics in supply chain; (3) historical perspectives, characteristics, types, tools, techniques, and applications of Big Data Analytics; and (4) Analytics techniques, opportunities, sources and applications of big data analytics in supply chain.. In more detail, our review article addressed and attempts to answer the following research questions presented in Table 1.

Table 1. RQs and their responding sections.

Research Questions	Motivation	Sections
How the publication evolution on big data analytics in supply chain?	Literature Review on big data analytics in supply chain;	Section2: Literature Review
What are the historical perspectives, characteristics, types, tools, techniques, applications, and technologies of Big Data Analytics?	Present detailed informations of BDA characteristics, types, tools, techniques and applications	Section 3: Big data analytics
What are the analytics techniques, opportunities, sources and applications of big data analytics in supply chain?	Identify the applications and contributions of BDA in SC operations &strategies.	Section 4: Big data analytics in supply chain

2. Literature review

There are different business sectors and markets that have benefited from technology for big data analytics. These fields produce a large amount of data for effective and efficient decision-making that needs a big data analytics method. Such fields of use include healthcare, telecommunications, network optimization, travel estimation, retail, financial industries,andenergy consumption.

To provide different viewpoints using schemes, a broad search in Scopus database was conducted, to identify papers published in the period 2010-2020, and in the areas of "Big data analytics", and "supply chain". We choose the search string (“big” AND “data” AND “analytics”) AND (“Supply” AND “Chain”).
The main objective of a comprehensive mapping analysis is to provide an overview of a field of research and to classify the amount, form and results of research available within it. Often to see patterns, one needs to chart publication frequencies over time. Figure 1 illustrates the number of papers published on the topic from 2012 to 2020.As shown in the figure, the frequencies of publications are high by the time. In terms of journal papers, Annals of operations research was a leading journal in the area with the most contributions on the topic (see Figure 2). Figure 3 classifies these publications into their types such as articles, conference proceeding, book chapters, reviews, books, editorial, and others. It can be seen that nearly half of the papers were articles papers with around 30.2% being conferences papers and 7.5% of conferences review.

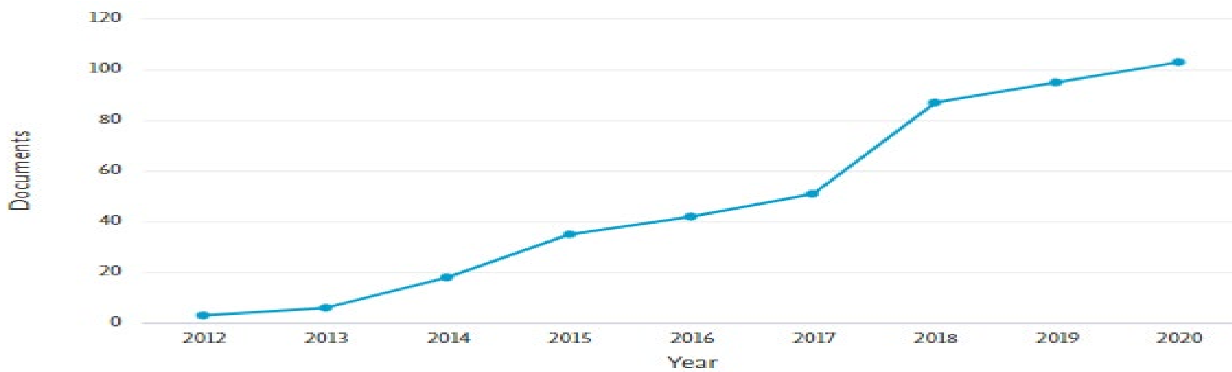

Figure 1. Number of big data analytics papers published in 2012-2020 periods as revealed in (Scopus).

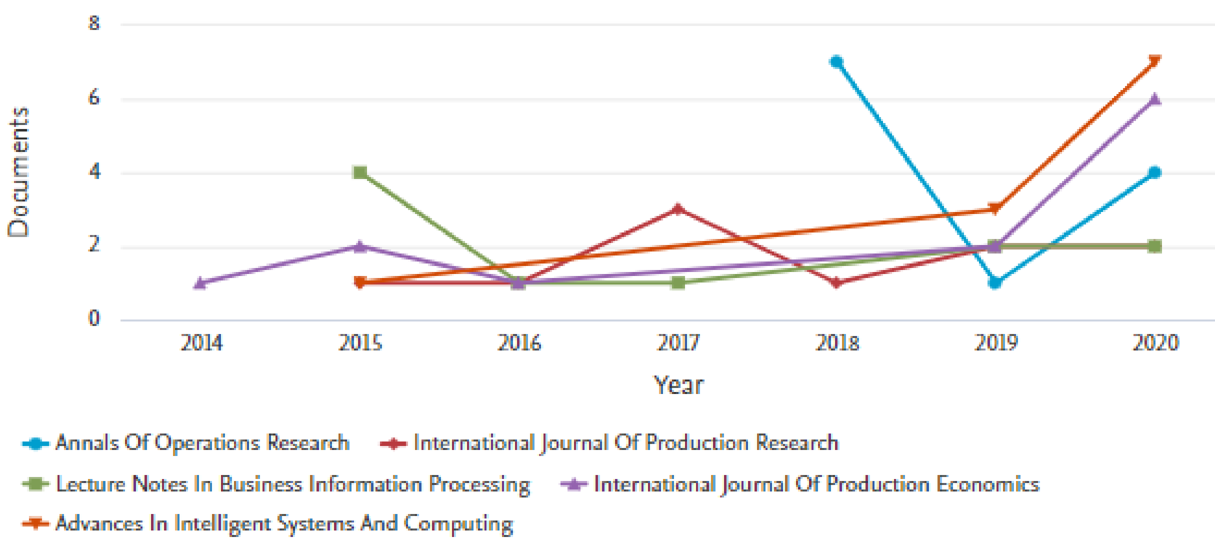

Figure 2. Share of top international journals with highest contributions in publishing big data analytics,and supply chain topics as revealed in (Scopus).

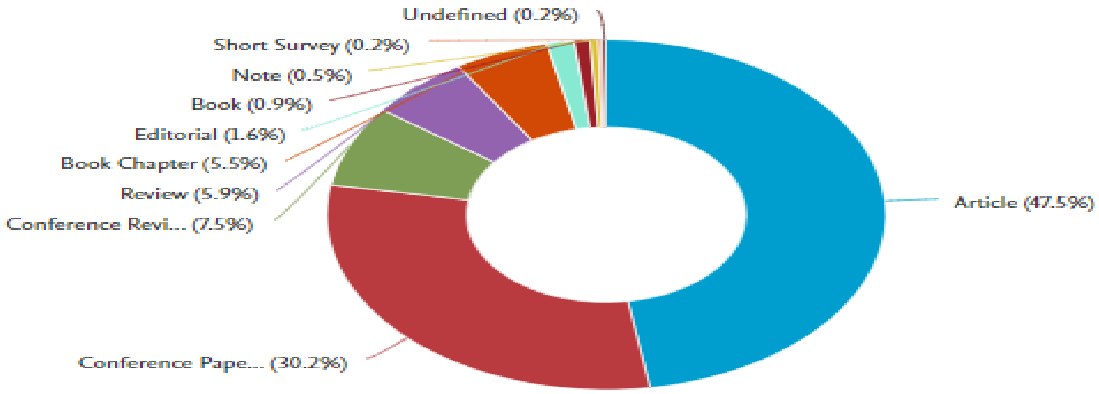

Figure 3. Percentage Share of different document types as revealed in (Scopus).

3. Big data analytics

3.1 Historical perspectives

Big data is just a huge amount of data without analytics. Analytics without big data are just mathematical and statistical techniques and applications. Many of these instruments, such as correlation and regression analysis, have been around for decades. It is the combination of big data and analytics, powered by the computing power of today. This combination creates the capacity to gain meaningful insights and transform knowledge into intelligence. The paradigm of Big Data Analytics (BDA) is inspired by underpinning new waves of creativity, data analytics tools, and stimulating technological advances during the last few decades (Nada 2016).Data Analytics (DA) is the original data science for making conclusions and facilitating decision-making. It aims to obtain useful insights through the modelization, transformation, simulation, and interpretation of the data collected. BDA's new technologies have attracted interest from many academic researchers, business professionals, and government departments. The BDA helps to gain a deep understanding and valuable insights from different sectors such as agriculture, healthcare, cyber-physical environment, smart cities and supply chain analytics, etc. This provides an insight in an accurate way using advanced BDA tools such as NoSQL, BigQuery, Map Reduce, Hadoop, Flume, Mahout, Spark, WibiData, and Skytree to enhance the capability and decision-making process in different fields such as the supply chain (Govindan et al. 2018). We present in Figure 4 a brief history on big data.

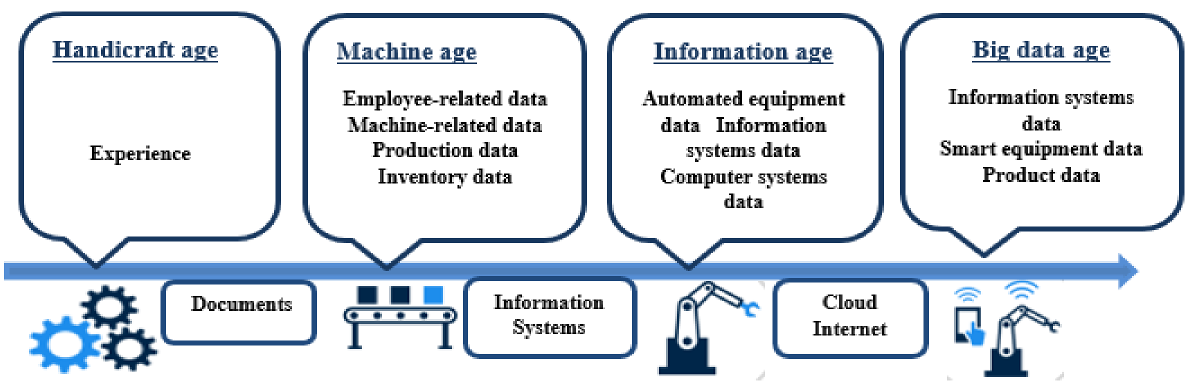

Figure 4. A brief history on Big data.

3.2 Characteristics

BDA's seven characteristics include some analysis of different data analytics measures and processes. These seven characteristics represent increasing difficulties in analyzing big data. Our primary objective is to get a detailed image ofeach trait. These seven BDA characteristics are shown in Figure 5.

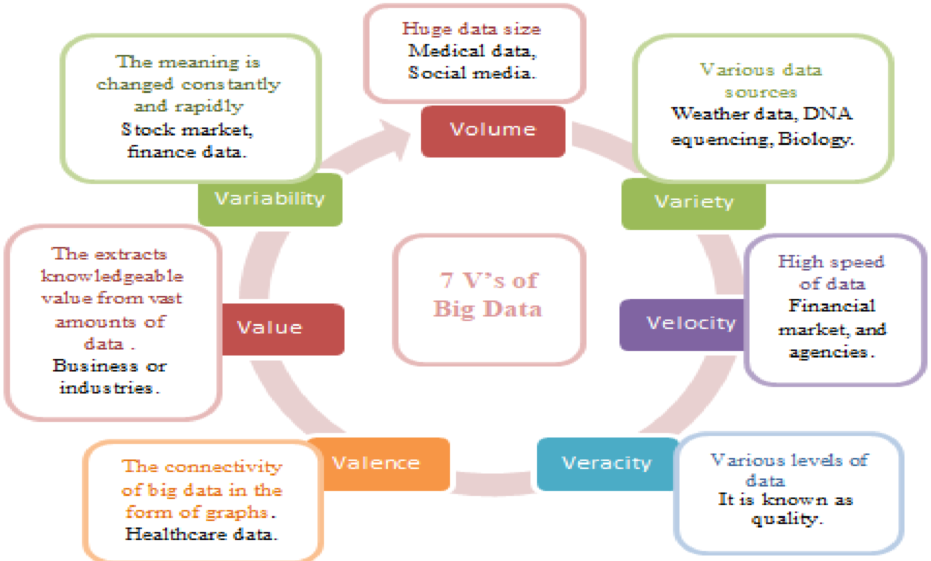

Figure 5. Big Data Analytics characteristics.

3.3 Types

Four key types of analytical approach have been established on the basis of Gartner study (Gartner 2014). It is possible to categorize these as: descriptive, diagnostic, predictive, and prescriptive. The progress of using the useful sub-set less of data from the first to the fourth to derive more valuable, higher levels of decision support, and greater benefit.

Descriptive analytics: The science of determining just what happened or is happening, using database queries or reporting and dashboards. It involves the presentation of the manufacturing data in a summarized or query form, to provide useful information.

Diagnostic analytics: Science of identification by simulation, data mining, and real-time analytics, etc, why it happened or is happening. It helps in identifying the causes contributing to the performance achieved.This can involve understanding the impacts of performance measures on input factors and organizational strategies.

Predictive analytics: The science of recognition of what is likely to happen by recruiting simulation, statistics, and linear regression, predictive data mining, forecasting and trend reporting, etc. It focuses primarily on predictions of performance based on planned inputs.

Prescriptive analytics: The science of using simulation, and optimization, focuses on how we can make it happen, and what the consequences. It deploys the power of operations research methodologies, applied mathematical techniques, management science, and decision science, to ensure the right use of allocated capital. It focuses on determining the policies and inputs that will contribute to the desired results.

3.4 Techniques

Recent advances in strategies and technology have made it necessary for many companies to manage big data effectively. Machine learning, data mining, statistics, artificial neural networks, extreme machine learning, natural language processing, and deep learning are the main data analytics techniques (Saggi and Jain 2018).

Advanced Machine Learning (ML): By definition, machine-learning technology is classified into two categories: logical and statistical interpretations. To build a predictive model and generate or validate model output, it necessary to select an input data technique. In advanced data analysis, the most predictive analysis methods used are classification, graph analysis, decision-making, association analysis, clustering, and regression. The predictive data analytic applications are supervised ML and unsupervised ML algorithms.

Advanced statistics: It is focused primarily on various methods and techniques for the collection, analysis, and visualization of large-scale data results. It contains many fields of study derived from statistics and data-driven analyzes executing the statistical algorithm. The statistical approach involves clustered analytics, predictive modeling, and data mining.

Advanced data mining: It is the most demanding technique for discovery and extraction. Data mining focused on techniques including: data statistics, machine learning approaches, and model recognition. The traditional data mining are also widely used, such as pattern Multiple linear regression, and logistic regression, which involves many techniques such as clustering of k-means, the study of correlations, and decision trees.

3.5 Tools

Data and business analytics are traditionally carried out using an integrated suite of algorithms for machine learning and data mining. These tools propose methods for analyzing small to large requirements for business decision-making. The algorithms for machine learning and data analytical tools can be widely divided into:

Clustering can be defined as an unsupervised machine learning method. Clustering algorithms have four major categories: grid-based, partitioning, hierarchical, and density-based(Yuan et al.2012). Cluster analysis techniques used not only in data mining but also used in other fields including statistics, image segmentation, pattern recognition, object recognition, and information retrieval (Tan et al.2009).

Classification: It is a method for grouping data into predefined groups based on either an analyst preselected or known characteristics by a clustering model. Several studies have also attempted to modify the traditional classification algorithms, to make them work well in a parallel computing environment (Tsai et al.2015).

Regression: It is used to define correlations between a dependent variable, and one or more independent variables, and helps evaluate the changes in the values of the variable dependent to the independent variable values. Regression techniques will be implemented to predict attribute value over time(Han et al.2012).

Association analyzes: It looks for associations (links) between datasets, and identifies data objects that can be realized collectively satisfying the least support and confidence levels. Association analysis algorithms can be either classical algorithms, condensed representation algorithms, or incomplete set algorithms (Tsai et al.2015).

Graph Analyzes: To find links between entities, it is necessary to use graphic structure. How to present the analysis results to a user is an important work, because if the user cannot easily understand the meaning of the results, the results will be entirely useless(Tsai et al.2015). The visual analytics for a commercial system can be separated into four main categories: exploration, dashboards, reports, and alerts(Zhang et al.2012).

4. Big data analytics in supply chain

4.1 Analytics techniques in supply chain

We will outline SCA in this section the basis for successful implementation of supply chain strategies and the key component of SCA are advanced analytics techniques in future research, that taxonomy can be further developed :

Statistical analysis basically, include two types of analysis: Descriptive and inferential. Data are used by descriptive statistics to summarize the population or sample characteristics by means of statistical modeling or graphs or tables. Inferential statistics use information to forecast and infer population properties as a function of past data. When managing uncertainty in the supply chain, statistical analysis is important. In production, distribution and risk analysis, for example, Statistical multivariate approaches are very useful taking into account the characteristics of Big Data in supply chain analysis, statistics should be robust and simple to adapt (Fan et al.2014). Traditional statistical methods are invalid because they are intended for moderate sample dimensions and small-dimensional data, but not for big data, large data lead to heterogeneity, noise accumulation etc. Thanks to big data, more attention has been paid to successful statistical procedures.

Simulation play an important role, in the development of big data applications. Under different device configurations and complexity, they assist developers to conduct the "what-if" analysis. By optimizing the configuration of hardware and software, one of the big data creation challenges is to balance its cost and performance. Within the research process, simulation empowers a decision-maker to conduct diagnostic, predictive and prescriptive analytics (Shao et al.2014). A simulation for data analytics was proposed in a smart manufacturing system. For example, simulation can help manufacturers predict the need for machines and additional equipment as a predictive tool. Supply chain analytics offers new simulation problem approaches with several data. (Lamasoft 2016)Examples of the potential simulations for a supply chain are outlined: predict service, test inventory policy, analyze production capacity, determine asset utilization, and validate optimization result.

Optimization techniques helps to make demand prediction and supply chain planning more effective. Optimization of BD is not only costly and unreliable, but also has slow convergence rates, making it difficult to effectively incorporate conventional SCA techniques .The optimization of dynamic systems can help analysis highly complex, multi-factor and data volumes, and gain insights that give decision-makers the right choice. In addition, optimization helps analyze the measures of supply chain performance such as cost reduction and demand fulfillment, among others. The ability to discover new data links, turn them into insights, and unlock more business value from large volumes of data is another advantage (Balaraj 2013).

4.2 Opportunities for big data analytics in supply chain

The primary reason for introducing Big Data Analytics in the Supply Chain is to address the prevalent challenges that cannot be resolved with conventional techniques. One of the main challenges that Big Data, and Big Data Analytics face in the Supply Chain is the complexity of the process and the unstructured data that has emerged from it. Supply Chain organizations are interlinked by a large physical flow that involves raw materials, process inventories, finished goods and returned objects, information flows, and financial flow. Managing the rising uncertainty of Supply Chains is important for businesses to thrive in the competitive global markets. Supply Chain Complexity is correlated with material and knowledge flows between various Supply Chain organizations. Previously, the flows of products were coordinated from producer to consumer. Today's flows are non-linear, or indirect. Information-Flow looks like a continuous communication between all the Supply Chain partners. These different elements and their interactions are important when it comes to the complexities occurring in a system. The different characteristic of complexity needs to be addressed in determining its impacts. The main features of supply-chain complexity include:

Uncertainty: The difference between the amounts of information required to complete a mission, and the amount of information that is already usable (Galbraith 1973).

Multiplicity: This feature of the complex provides an overview of the number of components such as objects (raw, produced, or end), processes, relationships, connections, objectives, locations, etc (Isik 2011).

Variability: Consists of specific members, who are distinct from other members. It draws attention to the dynamics of a system.

Size: Many businesses aim to create new companies and subsidiaries in various foreign countries. As a result, supply chain stretches out, it becomes more sophisticated, and the product line becomes more diversified.

Speed: Production speed is growing and product life cycles are becoming shorter, so with the advances in information and communication technology, it is becoming a critical concern for every business to thrive in the market.

Diversity: Concerning homogeneity or heterogeneity in a system. For example, High levels of diversity in the components (supplier, product, transport mode) across the supply chain result in the system's heterogeneity and complex performance (Bouhaddou and Benabdelhafid 2015)

4.3 The applications of BDA in supply chain operations & strategies

To maintain competitive advantage in a dynamic business environment, business organizations are increasingly practicing BDA tools as a strategic advantage for a growing and influential practice. A BDA applications are also useful in strategic management because it helps to coordinate organizational and supply chain strategies. Organizational Strategy is significant, because it provides the general path for the entire organization, and also outlines supply chain strategies, operations of an organization. The BDA can help with strategic planning by recognizing measures in the implementation phase. Furthermore, BDA is commonly applied in supply chain operations like demand planning, procurement, production, inventory and logistics. Based on our literature review, we have summarized in Table 2 the big data applications in supply chain strategies and in Table 3 the BDA applications in supply chain operations by mentioning the most used models and techniques in this field.

Table 2. Big data application in supply chain strategies.

Supply chain strategies	Contributions of different research
Strategic sourcing.	➢ BDA analyzes spend organizational profiles and procurement procedures to match sourcing methods to overall organizational priorities and objectives (Scott 2013). ➢ BDA helps companies to benchmark best practices, set performance goals, and incorporate customized metrics (Jain et al 2013). ➢ BDA assisted strategic decision by correctly gathering organizational expensese.g. big data can be used to assess return on investment (ROI) as well as supplier results (Panchmatia et al 2015). ➢ BDA processing ability is a major considered factor in analytic hierarchy process, and fussy synthetic evaluation for choosing supply chain partner (Jin and Ji 2013).
Productdesign anddevelopme nt.	➢ BDA conduct "what-if" analysis of product design and production costs to achieve the most cost-effective design that satisfies the quality and reliability requirements (Ma and Kim 2014). ➢ BDA in product design and development have received much attention recently (Afshari and Peng 2015). ➢ BDA can help improve product adaptability and build more confidence in designers. (Liu and Yi 2016). ➢ BDA defines product features and forecasts trends by using customer satisfaction data polarities (Johanson et al. 2014).
Supply chain network design.	➢ BDA is an important method to deal with supply chain network design issues where the design is formulated as a mixed-integer linear program (Jindal and Sangwan 2014). ➢ BDA has developed a non-linear mixed integer model for location-selection by randomly generated large data sets of customer demand, warehouse operation and transportation (Ngai et al.2007).

Table 3. Big data application in supply chain operations.

Supply chain Operations	Big data analytics and SCA
Demand planning	➢ BDA improve demand forecasting and production planning in many supply chain (Chase and Charles 2013). ➢ BDA helps companies to assess product demand signals, determine optimal pricing and trace customer loyalty data (Hassani and Silva 2015). ➢ BDA lead to the development of business service innovation by customer behavior forecast (Balar et al 2013). ➢ Using BDA they implemented a forecasting model, they integrated historical real-world traffic data and weather data. The model allows to estimate where and when charging demand is high, enabling utilities to plan and operate more efficiently (Arias and Bae 2016). ➢ Used big data from online searches to build a forecasting model, which allowed the airport to predict air passenger demand with an average error of 5.3% (Kim and Shin 2016).
Procurement	➢ BDA provides decision makers with accurate, data-oriented information for a wide range of important decisions (Souza 2014). ➢ Using statistical modeling and optimization to handle supplier relationships with disruptions (Khan 2013). ➢ BDA is a powerful tool in the sourcing management process that can help companies evaluate their suppliers' performance (Oruezabala and Rico 2012)

	➢ SCA can assess and analyze suppliers' performance in various fields, which helps organizations to make informed decisions (Yeniyurt et al. 2012). ➢ Proposed a new paradigm for early identification of supply chain risk by applying internal and external big data. The data generated enables real-time supply chain risk management, decision support, and emergency planning (Fan 2014). ➢ Proposed big data predictive analytics applied to managing supply chain risk, thus enabling the control of supply chain risk (Schlegel 2015).
Production	➢ BDA may be used to schedule aggregate supplies and operations scheduling at both the tactical and organizational levels (Souza 2014). ➢ BDA controls decision-making related to balancing demand and supply, inventory management, and budget forecasting (Li et al. 2013) ➢ BDAprovidesuseful insights to problems related tooperations schedulingproblems which can be formulated as mixed integer linear programming problems (Wang et al. 2015). ➢ BDA can help in routing problem e.g. modeling the sequence of operations and the work centers that perform the work and dispatching (Leung and Chen 2013). ➢ Explored BDA application in the production are to applied RFID-enable big data to support shop floor logistics planning and scheduling (Zhong 2014). ➢ Implemented the Physical Internet concept by using the Internet of Things (IoT), wireless technology, and big data analytics to create an RFID-enabled intelligent shop floor environment (Zhonget al.2015). ➢ Utilized internal and external big data to build a smart system to improve production efficiency and reduce carbon emission (Katchasuwanmanee et al.2015).
Invetory	➢ SCA aids in predicting accurately inventory requirements, and also helps developers analyze patterns in consumer demand, by using statistical forecasting techniques (Downing et al.2013) ➢ Supply chain analytics helps obtain a detailed view of inventory levels across supply chains, thus including input from inventory levels at any given echelon(Fernandeset al.2013). ➢ Improved the performance of big data in inventory management by using it to perform a coordinated inventory with the external partners (suppliers and consumers)(Cohen 2015). ➢ Discussed how automation in an inventory management system influences the processing of Big Data. The BDA can be gathered to assist with inventory ordering decisions (Sharma andGarg 2016).
Logistics and distributions	➢ Logistics data is provided from various sources in the distribution network such as shipping costs from suppliers' plants, net- work capacity, and forecasts from demand points (Najafi et al.2013). ➢ BDA tools and techniques are used to increase the overall efficiency of transportation by managing costs and margins, while still taking into account maintenance, and safety (Minis and Tatarakis 2011) ➢ More research on BDA is being conducted in logistics, distribution, and transportation. With a growing global market, the need to implement BDA in logistics and transportation companies is a requirement (Ayed et al. 2015). ➢ BDA Predictive and prescriptive have many advanced applications for planning a maritime companies (Brouer et al 2016) ➢ BDA used for transportation capacity sharing impact efficiently city health-care service (Mehmood and Graham 2015). ➢ The major third-party logistics suppliers were investing heavily in BDA, ensuring that a supply chain integration was seamless (Burnson 2013)

5. Conclusion

In today's competitive environment, supply chain professionals are struggling to manage enormous amount of data. They are exploring new techniques to study how data is generated, captured, organized. Big Data analysis is one of

the best techniques that can help them overcome this problem. The completion of the promising benefits of Big Data Analysis in the supply chain motivated us to write this paper review.
In this paper we provide an overview on the impact of big data analytics in supply chain functions. The growing volume of data in supply chain requires the use of tools and techniques of big data analytics. The Big data analytics has been developed as an important discipline and presented as a key component technology in smart industry. So big data can provide strategies for extracting additional useful knowledge and objectivity for decision-making. The paper discussed in the first thing the literature review on big data analytics in supply chain: In the second thing we present: historical perspectives, techniques, tools, and characteristics big data analytics. Finally we discussed the challenges and the opportunities in adopting big data analytics in supply chain, and the application of big data analytics in supply chain functions (strategies and operations.

However, it may also be noted that despite the use of big data, many supply chains are unable to harness the power of available data to generate useful information for their operations. The reasons are due to a lack of capacity to analyze large amounts of data and the use of erroneous data. Based on our review and findings, another potential opportunity for future research in the application of big data analytics to a particular industry. The other aspects of supply chain management should be thoroughly investigated using real data. Particular emphasis should be placed on big data analytics for strategic sourcing, product design and development procurement, and supply chain network design. Furthermore, it may be interesting to deal with the difficulties associated with big data analytics capabilities by proposing a comprehensive big data architecture for supply chain management.

References

Afshari, H.,and Peng,Q.,Using big data to minimize uncertainty effects in adaptable product design,*ASME International Design Engineering Technical Conferences and Computers and Information in Engineering Conference.* Boston, Massachusetts, USA. August 2–5, 2015

Arias,M. B.,and Bae,S.,Electric vehicle charging demand forecasting model based on big data technologies*, Applied Energy*., vol. 183, pp. 327–339, 2016.

Ayed. B., Halima. M. B., and Alimi. A. M., Big data analytics for logistics and transportation,*2015 4th International Conference on Advanced Logistics and Transport (ICALT)*, pp. 311-316, Valenciennes, France, 2015.

Balaraj,S.,Optimization model for improving supply chain visibility,*Infosys Labs Briefings–Big Data Challenges and Opportunities*, vol. 11, no. 1, pp. 9–19, 2013.

Balar, N.,Malviya, S., Prasad and Gangurde, A.,Forecasting consumer behavior with innovative value proposition for organizations using big data analytics,*IEEE International Conference on Computational Intelligence and Computing Research*, pp. 1-4, Enathi, India, 2013.

Bouhaddou,I. and Benabdelhafid,A. PLM (Product Lifecycle Management): a key to manage supply chain complexity,*In CS-DC'15 World e-conference*, Tempe, United States, Sep,2015.

Big Data Analytics in Supply Chain Hype or Here to Stay? , *Accenture Global Operations Megatrends Study*., 2014. [Online]Available:https://www.accenture.com/t20160106T194441__w__/fien/_acnmedia/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Digital_1/Accenture-Global-Operations-Megatrends-Study-Big-Data-Analytics-v2.pdf. Accessed on: Sep. 18, 2022.

Burnson, P. 3PLs investing heavily in big data capabilities to ensure seamless supply chain integration. 2013.

Brouer, B. D., VadKarsten, C., andPisinger, D. Big data optimization in maritime logistics. *Big data optimization: Recent developments and challenges*. 2016.

Chase, Jr., and Charles W.,Using big data to enhance demand-driven forecasting and planning,*The Journal of Business Forecasting*, vol. 32, no.2, 2013.

Cohen, M. A. Inventory management in the age of big data. Harvard business review, 2015, vol. 94, p. 1-5.

Downing, M., Chipulu, M., Ojiako, U., &Kaparis, D., Advanced inventory planning and forecasting solutions: a case study of the UKTLCS Chinook maintenance programme. *Production Planning & Control*, vol. 25*,* no.1, pp.73-90, 2014.

Fan,J. Han,F. and Liu,H.,Challenges of big data analysis,*National Science Review*, vol. 1, no. 2, pp. 293–314, 2014.

Fan, J., Han, F., and Liu, H., Challenges of big data analysis, *National Science Review*., vol. 1, no. 2, pp. 293–314, Feb. 2014.

Fernandes. R., Gouveia, B.,Pinho. C., Integrated inventory valuation in multi-echelon production/distribution systems, *International Journal of Production Research*, vol. 51, no 9, pp. 2578-2592, 2013

Frank, A. G.,Dalenogare,L. S.,and Ayala, N. F.,Industry 4.0 technologies: Implementation patterns in manufacturing companies,*International Journal of Production Economics, Elsevier*, vol. 210, no. C, pp. 15-26, Jan. 2019

Govindan,K.,.Cheng,T.C.E., Mishra,N., and Shuklad,N.,Big data analytics and application for logistics and supply chain Management, *Transportation Research Part E: Logistics and Transportation Review*, vol. 114, pp 343–349,Jun. 2018

GartnerBI: Analytics Moves to the Core, 2014. [Online]. Available: https://timoelliott.com/blog/2013/02/gartnerbi-emea-2013-part-1-analytics-moves-to-the-core.html. Accessed on: Jun. 5, 2022

Galbraith,J.,Designing complex organizations, Addison-Wesley, Massachusetts, 1973.

Han,J.W.,Kamber,M., and Pei,J., Data Processing,*in Data mining concepts and techniques*, 3rd ed. Morgan Kaufmann Publishers, Waltham. pp. 83-117, 2012.

Hassani, H.,and Silva, E. S.,Forecasting with big data: A review,*Annals of Data Science,* vol. 2, no. 1, pp. 5–19, 2015.

He,Q. P., and Wandand,J.,Statistical process monitoring as a big data analytics tool for smart manufacturing, *Journal of Process Control*, vol. 67, pp. 35-43, Jun. 2017.

Isik, F. (2011). Complexity in supply chains: a new approach to quantitative measurement of the supply-chain-complexity, *Supply chain management*, vol. 21, no 4, pp. 417-432, 2011

Jain, S., Lindskog, E., Andersson, J., & Johansson, B., A hierarchical approach for evaluating energy trade-offs in supply chains,*International Journal of Production Economics*, vol. 146, no. 2, pp. 411–422, 2013

Jin,Y. and Ji, S.,Partner choice of supply chain based on 3D printing and big data,*Information Technology Journal,*vol. 12, no. 22, pp. 6822–6826, 2013.

Johanson,M. Belenki,S.Jalminger,J.Fant,M. and Gjertz, M. Big Automotive Data: Leveraging large volumes of data for knowledge-driven product development,*IEEE International Conference on Big Data (Big Data)*, Washington, pp. 736-741, DC, USA, 2014.

Jindal, A., &Sangwan, K. S., Closed loop supply chain network design and optimisation using fuzzy mixed integer linear programming model,*International Journal of Production Research*, vol. 52, no. 14, pp. 4156–4173, 2014

Khan,K.,The transformative power of advanced analytics,*Supply Chain Management Review*, vol. 17, no. 3, pp.48–49, 2013.

Katchasuwanmanee, K., Bateman, R., and Cheng, K., Development of the energy smart production management system (e-ProMan): A big data driven approach, analysis and optimization, *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture*, vol. 230, no. 5, pp. 972-978, 2015.

Kim,S., and Shin,D. H. Forecasting short-term air passenger demand using big data from search engine queries,*Automation in Construction*,vol. 70, pp. 98–108, 2016.

LLamasoft. Supply chain simulation: why its time has come, 2016. [Online]Available: https://silo.tips/download/supply-chain-simulation-why-its-time-has-come. Accessed on Sep. 01, 2022.

Liu, P., & Yi, S. P., Investment decision-making and coordination of supply chain: a new research in the big data era. *Discrete Dynamics in Nature and Society*,vol. 2016, 2016

Leung, J. Y. T., and Chen, Z. L. (2013). Integrated production and distribution with fixed delivery departure dates, *Operations Research Letters*,Vol. 41, no. 3, pp. 290.293, Mar. 2013

Li, B., Wang, H., Yang, J., Guo, M., and Qi, C., A belief-rule-based inference method for aggregate production planning under uncertainty, *International Journal of Production Research*, vol. 51, no. 1, pp. 83–105, 2013.

Ma, J., & Kim, H. M., Continuous preference trend mining for optimal product design with multiple profit cycles, *Journal of Mechanical Design*, vol. 136, no. 6, pp. 1–14, 2014.

Minis, I., & Tatarakis, A. Stochastic single vehicle routing problem with delivery and pick up and a predefined customer sequence, *European journal of operational research*, vol. 213, no. 1, pp. 37-51, 2011

Mehmood. R., and Graham.G.,Big data logistics: A health-care transport capacity sharing model, *Procedia Computer Science*,vol. 64, pp. 1107–1114, 2015

Najafi, M., Eshghi, K., &Dullaert, W., A multi-objective robust optimization model for logistics planning in the earthquake response phase. *Transportation Research Part E: Logistics and Transportation Review*, vol. 49, no.1, pp. 217-249, 2013.

Nada,S.,How to Use Big Data to Drive Your Supply Chain,*California Management Review,* vol. 58, no. 3, pp. 26-48, 2016.

Nakatani, K., and Chuang, T. T., A web analytics tool selection method: an analytical hierarchy process approach. *Internet Research*, vol. 21, no. 2, pp. 171–186, 2011.

Ngai, E. W. T., Moon, K. K., Riggins, F. J., and Candace, Y. Y., RFID research: An academic literature review (1995–2005) and future research directions. *International Journal of Production Economics*, vol. 112, no 2, pp. 510-520, 2008.

Oruezabala,G. Rico,J.C., The impact of sustainable public procurement on supplier management: the case of French public hospitals,*Industrial marketing management*, vol. 41, no 4, pp. 573–578, May. 2012.

Panchmatia,M.Use big data to help procurement make a real difference, 2015. [Online]. Available: http://www.4cassociates.com. Accessed on: Oct.8, 2022.

Richey,R.G.,Morgan,T.R.,Lindsey-Hall, K., and Adams,F.G., A global exploration of Big Data in the supply chain,*International Journal of Physical Distribution & Logistics Management*, vol. 46, no 8, pp. 710-739, 2016.

Saggi,M.K., and Jain, S. A., survey towards an integration of big data analytics to big insights for value-creation,*Information Processing and Management,* vol. 54, no. 5, pp. 758-790, Feb. 2018.

Schlegel, G. L., Utilizing big data and predictive analytics to manage supply chain risk, *The Journal of Business Forecasting*, vol. 33, no. 4, pp.11–17, 2015.

Sharma, M., and Garg, N., Inventory control and big data. *In Optimal Inventory Control and Management Techniques*, pp. 222-235, IGI Global, 2016.

Souza, G. C. (2014). Supply chain analytics. *Business Horizons,*vol. 57, pp. 595–605, 2014.

Scott, J. A., Ho, W., &Dey, P. K., Strategic sourcing in the UK bioenergy industry,*International journal of production economics*, vol. 146, no. 2, pp. 478–490, 2013.

Shao,G. Shin,S. J. and Jain,S.Data analytics using simulation for smart manufacturing, in Proceeding of theWinter Simulation Conference,*IEEE Explore DigitalLibrary*, pp. 2192–2203, 2014.

Tan,K. C.,Teoh,E. J.,Yua, Q., and Goh,K.C.,A hybrid evolutionary algorithm for attribute selection in data mining, *Expert System with Applications*, vol. 36, no. 4, pp. 8616–8630, 2009.

Tsai, C.W., Lai,C.F.,Chao,H.C., and Vasilakoset al,A. V., Big data analytics: a survey, *Journal of big data*, vol. 2, no. 21, Oct. 2015.

Tsai, K. H., Hsieh, M. H., &Hultink, E. J., External technology acquisition and product innovativeness: The moderating roles of R&D investment and configurational context,*Journal of Engineering and Technology Management*,vol. 28, no. 3, pp. 184–200, 2011.

Wang, G., Lei, L., and Lee, K., Supply chain scheduling with receiving deadlines and non-linear penalty, *Journal of the Operational Research Society*, vol. 66, pp. 380–391, 2015.

Witkowski,K.,Internet of Things, Big Data, Industry 4.0 Innovative Solutions in Logistics and Supply Chains Management,*7th International Conference on Engineering, Project, and Production Management, Procedia Engineering*, vol. 182, pp:763 – 769, 2017

Yeniyurt, S., Henke Jr, J. W., and Cavusgil, E., Integrating global and local procurement for superior supplier working relations. International Business Review, vol. 22, no. 2, pp. 351-362, 2013.

Yuan,F. C., Shu,F. P., Yi,C. T.,Hao , C. S., Using hybrid data mining and machine learning clustering analysis to predict the turnover rate for technology professionals,*Expert System with Applications*, vol. 39, no. 10,pp. 8844–8851, 2012.

Zhang,L.,Stoffel,A.,Behrisch,M., Mittelstadt,S.,Schreck,T.,Pompl,R., Weber,S., Last,H., and Keim,D.,Visual analytics for the big data era a comparative review of state-of-the-art commercial systems,*in Proceedings of the IEEE Conference on Visual Analytics Science and Technology*, pp. 173–182, 2012.

Zhong, R. Y., Huang, G. Q., &Lan, S. L., Shopfloor logistics management using RFID-enabled big data under physical internet, *Proceeding of 1st International Physical Internet Conference*, pp. 1-14, May, 2014.

Zhong, R. Y., Huang, G. Q., Lan, S., Dai, Q. Y., Chen, X., & Zhang, T., A big data approach for logistics trajectory discovery from RFID-enabled production data. *International Journal of Production Economics*, vol. 165, pp.260-272, 2015.

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