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Usage of data analytics in improving sourcing of supply chain inputs

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Abstract

One of the most remarkable features in the 20th century was the digitalization of technical progress, which changed the output of companies worldwide and became a defining feature of the century. The growth of information technology systems and the implementation of new technical advances, which enhance the integrity, agility and long-term organizational performance of the supply chain, can distinguish a digital supply chain from other supply chains. For example, the Internet of Things (IoT)-enabled information exchange and Big Data analysis might be used to regulate the mismatch between supply and demand. In order to assess contemporary ideas and concepts in the field of data analysis in the context of supply chain management, this literary investigation has been decided. The research was conducted in the form of a comprehensive literature review. In the SLR investigation, a total of 71 papers from leading journals were used. SLR has found that data analytics integrate into supply chain management can have long-term benefits on supply chain management from the input side, i.e., improved strategic development, management and other areas.

Keywords: Data Analytics, Analytics, Supply Chain Input, Supply Chain, Data Science, Data

1 Introduction

1.1 Research background

The digitization of technical innovation in the 20th century, which changed the output of companies all over the world, was one of the characteristics of this time. As a result of digitization, this has influenced both businesses and the entire economy. The collection and shared knowledge through time is a key component in driving progress and innovation in today's fast-changing industrial environment, particularly in the service industry. Therefore, a digital transformation in the service industry is necessary to focus on the drivers of technology for exponential development, drivers of social expectations, the economic environment and business value demands (Travaglioni et al., 2020).

Management of the service supply chain (SCM) is often used in manufacturing enterprises, but is seldom used in the service sectors. In recent years, the importance of the service industry in the global economy has risen considerably. Along with the fast growth of the service industry, a substantial share of the labor force has gone to the service sector from the manufacturing sector. The literature on supply chains has been restricted despite the considerable quantity of scientific work in the supply chain management (SCM), which mostly concerns the establishment of supply chain networks. In recent decades, developed economies in service-oriented organizations, in order to better meet the requirements of customers, have undergoing a transformation. Service-specific SCM and attempts to address the functional differences between manufacturing and service sectors have been created.

The services supply chain, according to Schnetzler, Sennheiser and Schönsleben (2007), is a set of activities built through the use of information, content and money flows to satisfy the customer's need. In particular, the management of service supply chain is the collection of processes and activities connected to services, including inter-organizational supply chain networks, service development and other activities as well as the value chain (Attaran & Attaran, 2007). A effective service supply chain must include best-of-breed products and services, while incorporating a wide spectrum of players (Joshi, Sharma, & Rathi, 2017).

The importance of services in the financial prudence of a country underlines the necessity for greater research into services. The service industry is increasing rapidly in emerging nations (Thakur & Anbanandam, 2016). Suppliers, consumers and other support organizations establish a network which handles the resource transactions required to provide services, transforms these resources into forms of use and provides support and core services for clients (Nagariya, Kumar, & Kumar, 2020). As a key engine for economic growth in many industrialized nations, the services

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economy must be seen as a service supply chain management (SCM) (Fu, Flood, Bosak, Morris & O'Regan, 2013) as well as a component of the service economy.

Digitalization has evolved as a new phenomenon in our contemporary day with a difficult and dynamic environment and a competitive corporate world which affects many parts of life across the world. In the past, more than 90% of internet users have conducted online purchases, with about 40% using technological technologies to assess enormous volumes of information. In addition, the Internet of Devices has already made it possible to link 26 billion things until 2020. (Huber, Rentrop, & Felden, 2018). The change from a traditional supply chain to a digital supply chain (DSC) is without doubt a competitive edge that delivers long-term and sustainable value to companies. A number of industry studies will call for the adoption of a digital transformation technology for the supply chain in the next five years (Motashko, 2016).

Digital distribution networks can be distinguished by the growth of information-technology systems and the adoption of new technical breakthroughs that increase the integrity, agility and long-term organizational performance of the supply chain. The DSC will employ state-of-the-art technology, focus on consumers, decrease costs inside the company and produce increased organizational value. It is also important to address problems concerning DSC installation, optimization and development, as well as new management techniques to increase customer satisfaction. Although practitioners have studied these challenges extensively and DHL and DB have progressively dealt with them (e.g. DHL, DB), DSC is still in its early stages in academics (Büyüközkan & Göçer, 2018). Indeed, the notion of DSC has expressly been confined to a small number of studies and a wide variety of study areas still contain literature on this issue. Prior study focused mostly on the technological drivers of Industry 4,0 and DSC, including the Internet of Things (IoT), cloud computing (CC), Big Data (BD), and UAVs. Likewise, cloud computing is still being studied in the supply chain in digital technology only in theory and practice, as was the case before

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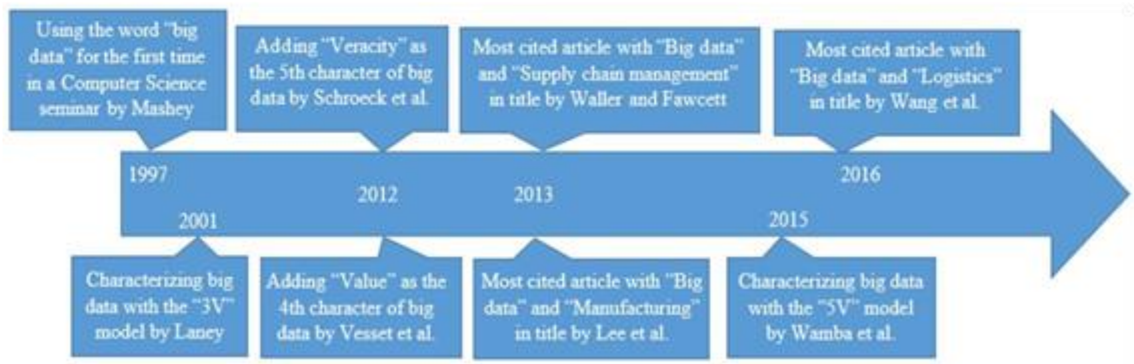

Figure 1 Evolution of big data with time

The few empirical study on this issue focused on characteristics that influence cloud computing adoption and the impact of cloud computing on the supply chain. Cloud computing, according to studies, helps to extend the supply network as well as to make supply chain operations in general more effective and responsive. (Bruque and Maqueira, Moyano-Fuentes, 2019).

1.2 Research question

- What is the effect of data analytics of supply chain on sourcing of inputs within the context of service supply chain?
- What is the most effective method in data analytics that can uplift service supply chain?

1.3 Research significance

The research has significant contribution in theoretical and practical perspectives.

1.3.1 Theoretical importance

All the prevailing theories regarding supply chain management are concerned towards conventional supply chains. In the prevailing conditions of big data, the present research will provide a significant addition to the theory of supply chain management.

1.3.2 Practical importance

Many industries are striving to manage their supply chains amid changing scenarios. The research will provide significant implication for these industries to include data analytics for optimization of their supply chains.

2 Literature review

2.1 Introduction

Supply chains constitute a uniting link across nations, composed of physical and transit networks that create a combined global network of links. According to the International Organization for Standardization (IOS), Supply chains are defined "in and among organizations' material flows, products and information that are linked by a wide range of tangible and intangible facilitators, such as links, processes, activities, and integrated information systems." In recent years, the literature on Industry 4.0 technology has grown substantially, although the vast majority of the articles continue to highlight the importance of these technologies (Simeonov, 2019).

A conventional supply chain is a network of systems, processes, and organizations that are involved in the production, delivery, and distribution of valuable commodities and services to their ultimate users (Liu et al., 2017). While, Supply Chain 4.0 reorganizes supply networks at all levels—design, design, production, distribution, consumption, and reverse logistics—to create a more efficient and efficient supply chain. These technologies, which were first launched in the twenty-first century, are primarily used by high-revenue firms that are pioneers in supply chain management and at the forefront of innovation (Zekhnini et al., 2020, Ghobakhloo, 2020).

In order to manage the incompatibility between supply and demand, for instance, IoT-enabled exchange of information and big data analysis might be utilized. The present literary research will examine contemporary ideas and concepts in the area of supply chain 4.0 and try to find the gap in literature review.

2.2 Supply chain

Today, corporate digitization shifts the way company works as well as the financial, information, labor and material flow management needs. In the viewpoint of involvement in global supply chains. (MIETHLICH and VESELITSKY, 2020) developed the idea of country digital developments in supply chain management (SCM). Digital SCM investments guarantee full, reliable information is available to execute logistics at all levels in an effective manner. It promotes the growth of market relations, secure the operation of national structures, and contribute generally to good qualitative improvements in the country's living standards.

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These are also based on transport systems, platforms and networks, as well as physical networks. Supply chains may typically be divided into three parts, namely procurement, manufacturing and distribution. Supply chains are part of the logistics idea, but are separate from it. As part of the continuous and integrated process, supply chains include sourcing, manufacture and distribution operations (Tay, 2015). In its integration into all essential business activities, the supply chain considers a logistical "place of origin to point of consummation." This involves process alignment and harmonization, electronic data exchange and the establishment of strategic relationships in the long term. Manufacturing processes have begun to acquire scalable flexibility, from huge stocks to low speed and postponed product setup, offering maximum value for money with high levels of flexibility in combination with demand management methods. The effects of new technology on distinct supply chain processes are identified by (Zekhnini et al., 2020) that SC4.0 is an advanced framework with interconnected processes, from unconnected applications to a wide-ranging, coordinated and effective interaction between SC stages.

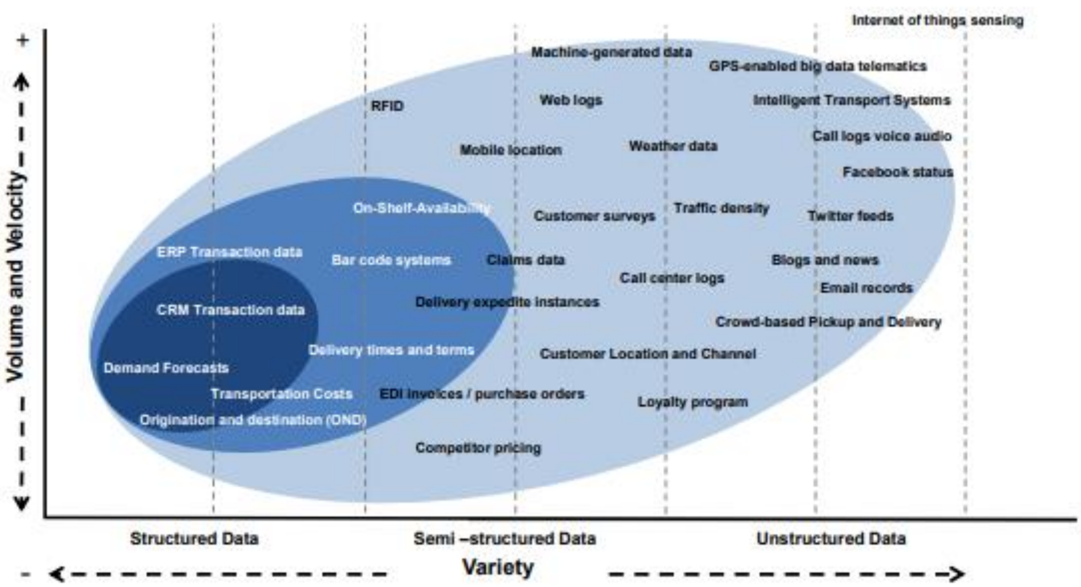


Figure 2SCM data volume and velocity vs veracity

2.3 Supply chain management

The performance of the supply chain must be separated into various components to analyse how overall performance is affected by the use of data analytics. Supply network management is based on an acceptable definition of the word "supply chain." In a 2001 article, Mentzer, DeWitt, Keebler, Min, Nix and Smith conducted a literature analysis on the issue of supply chain and supply chain management terminology.

The performance of a supply chain is harder to quantify since it has a variety of key performance indicators which indicate the efficiency of the supply chain. The study paradigm (Gunasekaran, Patel and McGaughey 2004) divides three kinds of processes: strategic, tactical and operational. There are several kinds of supply chain management processes and each contains several activities in these four categories: planning, procurement, production and delivery. SCOR, a 1996 PRTM model, is presently owned by PricewaterhouseCoopers LLP (PwC). The APICS Supply Chain Council is the leading supply chain framework in the world and states that the SCOR model links business processes, performance measures, practices and skills to one unified organization. Four times more likely, according to Benton, Zhou, Schilling and Milligan research, employees have the competencies needed if their business matures digitally (2011). The digitization means that workplaces are undergoing enormous shifts. The adoption of new concepts on intelligent production, intelligent contracts and intelligent services together with information sharing and information automation would drastically transform finance, sales, maintenance, the supply chain and logistics (Eller, Alford, Kallmünzer & Peters, 2020).

They will have extensive effects on jobs and jobs, as well as on the workplace and the environment. The increasing complexity of working procedures pushes employees to learn new capabilities. Automation, networking and interdisciplinarity need the development and acquisition of many disciplinary skills. These specific skills are technological competencies that are based on fundamental capabilities in ICT (Iomäki, Kantosalo, and Lakkala, 2011).

Additional skills, including cloud computing, data security and mobile technology These abilities are more behavioral and relate to employee incentives and traits. It's far more personal, interpersonal, and not almost as useful. Some of SC's skills in digital transition include leadership, communication, decision making, management of business processes, critical thinking and negotiation. This challenge to digitalize the supply chain occurs at various levels. As digitalization increases, it is more necessary for organizations to develop job descriptions that meet the growing requirements of SC digitization. They must also be able to help their personnel develop and improve their skills in order to fulfil their tasks. Human resources in sectors such as logistics and supply chain management are inadequate, which requires considerable recruiting focus. To be able to grow, people need to comprehend the different changes that have happened due to digitization to SC operations. Now that institutions need to train in the new scanning criteria for SC, they are obliged to tackle this problem. In order to complete digitalization, IC and Digital media are contributing to SC digitization, thus employees need different information, aids, defiance, competences, methods and responsiveness (Ageron, Bentahar, and Gunasekaran, 2020). (Gunasekaran, & Wamba, 2021).

2.4 Supply Chain Data Analytics

Everything inside the SC is crucial for financial concerns, information exchange and decision-making. The West introduced BI in the mid-20th century to enforce this competence. BI is a technology that supports business processes through data analysis. Effective data collection and analysis may be done using BI technologies that provide a library of analytical solutions. All aspects of the BIA process include data extraction and transformation, data base management, database mining and recovery, data reporting and visualization and multi-dimensional analysis. Processes like as OLAP are extremely essential when it comes to BI. Companies using BI methodologies may calculate their worth in real time, including stock volume, delivery costs, products costs and inventory turnover rates.

Organizations can make better decisions while carrying out business activities. Minimizing overall expenditures and increasing total sales is ensured via improved management and SC flexibility for customers and suppliers. A BI system may help an enterprise achieve a SC balance, which enables more cash flow. This assistance will allow firms to do data analysis in real time and develop predictive models that promote customer expectations, supply chain activities and the evaluation of supply chain participants with particular emphasis on suppliers. A high degree of integration in the supply chain allows company to gain a competitive edge and benefit all stakeholders, particularly in a dynamic and challenging market.

BI methods are used to the SC for SC performance analysis including the integration of various SC management operations such as planning, procurement, manufacture and delivery. The SCA aims to collect huge quantities of real-time data generated by the SC system and to utilise this data to provide meaningful information for SC decision-makers (Sahay and Ranjan, 2008). The figure on the right shows how BI supports business activities. In the first phase, data from different departments are assigned to four main processing stages. Extraction, cleaning, processing and loading. The business analyst then transforms the data into usable information for end users while entering the data in a data warehouse. Figure 1 is derived from the source in the previous section (Sahay and Ranjan, 2008). BI's four components are customer support, market research, distribution, profitability and inventories. These are crucial to comprehend and generate the data needed to manage a company. Significant information sources are ERP, SCM, CRM systems, customers, suppliers, manufacturing processes, new product testing and development, market prediction, demographic customer distribution, and other data sources. Companies are interested in Big Data Analytics and predictive analysis after the growth of BI and IT and complex SCs in real time to cap all of this.

In a poll which questioned U.S. businesses to find out what sort of corporate database they wanted (they may utilize their SCA applications) 57% of them opted for a warehouse, while 43% chose a separate SCA data warehouse. The technique of using vast volumes of data in quantitative and hypothesis investigations is known as predictive analysis of big data. Predictive analysis using BI is used for SCA operations involving the estimation of predicted inventory quantity, failure rate, time for failure, quantity of road commodities, customer orders and requests, and suppliers' strategies. SCM Big Data Predictive Analysis may enhance SC performance by forecasting the volume of future business by analyzing previous data (Waller and Fawcett, 2013).

The term 'supply chain 4.0' refers to the physical and technical integration of systems across a network that increases production, organization, and profitability characterized by independent action, widespread integration, diverse automated services and the capacity to react in context to the needs and requirements of customers (Shahin, 2010). The phrase "Industry 4.0" was used to describe in particular the fourth industrial revolution and the integration of intelligent systems in supply chains. Such systems are helpful in producing and manufacturing for business and the military, highlighting and safeguarding the worldwide networks that share models and information. The impact of the new digital era on the Fourth Industrial Revolution has led to the implementation of innovations required for digitization of industry, information and communication technologies, and the Internet of Things (IoT) cyber physical system (CPS) architecture, for production logistics and SC applications.(Ghobakhloo, 2020).

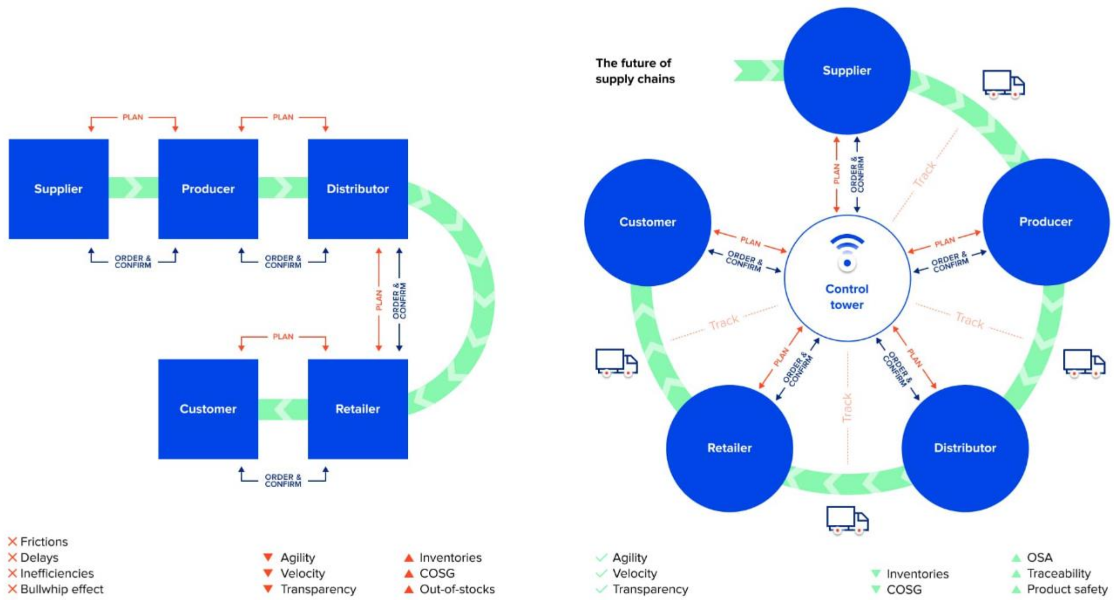
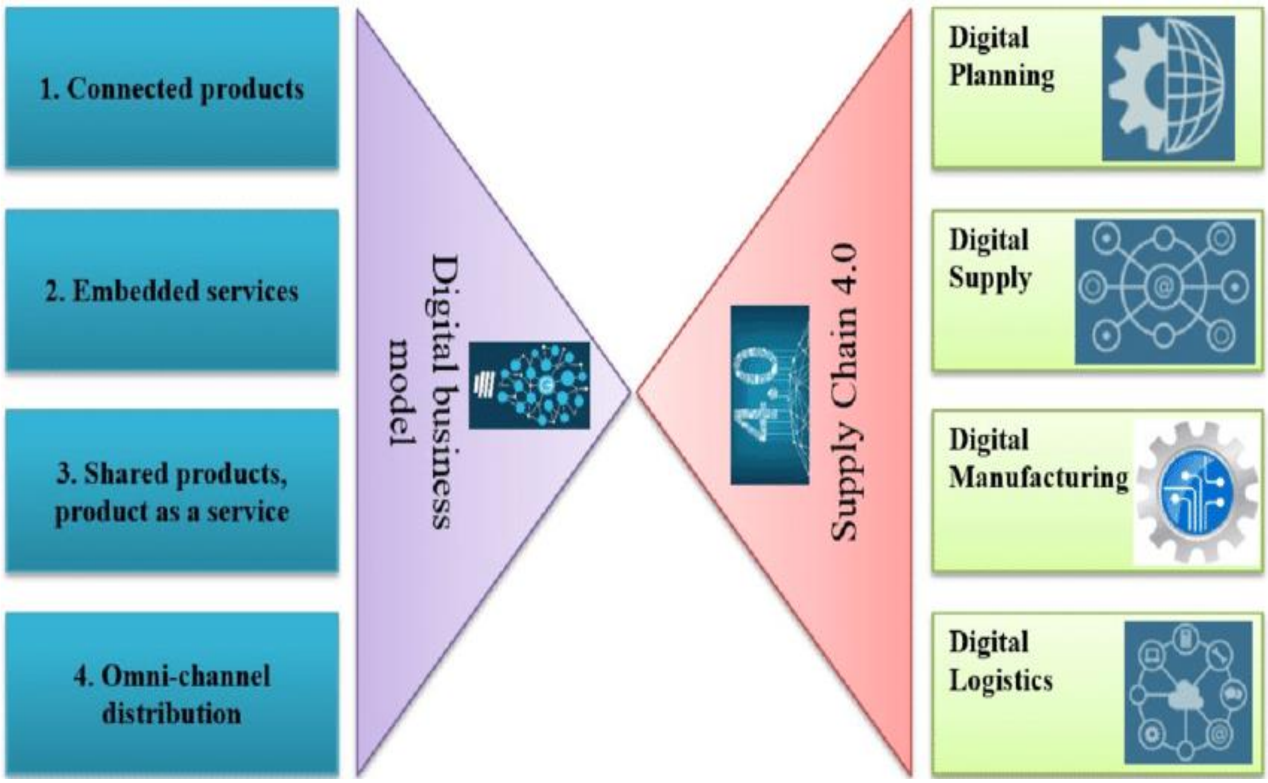


Figure 3Integration of data analytics into SCM

Supply chain 4.0 is the integration of manufacturing and communication technology which enhances traditional supply chain systems production through independent actions, prevailing integration, a variety of automated services and the capacity to adapt to demands and needs of the client (as depicted in figure below). However, Supply chain 4.0 creates a disturbance which causes firms to reconstruct their automated supply chain (Knut Alicke, 2019). Because of consumer expectations of speed, dependability and transparency, several approaches have evolved that update old procedures. Besides the need for adaptability, supply chains may also substantially improve operational efficiency and take use of the advantages offered by developing business models of the digital supply chain. Supply chains must become more rapid, clear, precise and agile in order for the advantages to be achieved (Belhadi et al., 2021)



The main drivers for development of Supply Chain 4.0 as illustrated by (Zekhnini, 2020) have been presented in the picture below.

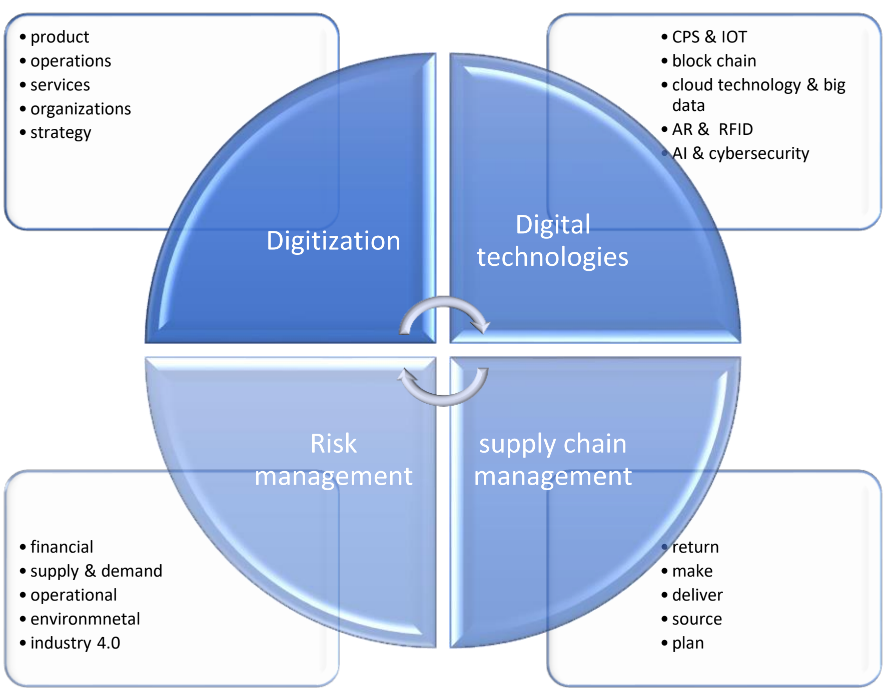


Figure 4 main drivers of SCM

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Six important features of SC4.0 that are meant to include all suppliers and customers in the supply chain (Zouari, 2020). The internet of things (IoT) seeks, by incorporating sensors, actuators and other devices that gather, transmit, and analyses data, to expand and link physical items to the internet. In SC, this technology links together business and web applications (like social media) and equipment, goods, materials and persons, thereby enabling the creation of an intelligent network spanning all industrial operations and consumers and suppliers. Cyber-physical systems contain digitally produced equipment, storage systems, and manufacturing facilities that are fully integrated on the basis of IT technology. The SC offers options to monitor production and logistics conditions in Realtime, enabling prognostics, remote diagnostics and management. Some other researcher added other variables such as decentralization and adaptability and autonomous behavior in these factors (Seyed Mojtaba Hosseini Bamakan 2021).

Garay-Rondero, (2019) enlisted material flows (e.g. production status, process and quality monitoring, inventory handling, logistics, research and development, and the provisioning and distribution of collective solutions) information flows (e.g. demand management, supply chain event management, seller negotiation, risk management, problem identifying, automated event management) (such as customer segmentation, demand modeling, new business model design, pricing and assortment, and financial aspects of human resources) in the application of Supply Chain 4.0. Other technologies that affect the SC in the context of Context 4.0 and that provide a competitive edge for the SC: manufacturing additives, automation and industrial robots, increasing reality, cyber security, blockchain, Internet data, people and services, somaticized technologies, simulation and modulization (Frederico et al., 2019). Through these technologies and associated subsystems and devices the whole SC (not just its customers and providers but also its assets, products and operational environment) is integrated and a wider volume of data with higher quality and speed is generated (Banerjee et al., 2021).

Furthermore, the technology allows organizations to enhance their flexibility, productivity, dependability and reaction. Moreover, firms may reduce the bullwhip effect and expenses associated with SC operations by facilitating a rearrangement of the entire operation in real time. In describing a technique for incorporating sensor-based quality data into supply chain event management in received many favorable responses. The utilization of sensor data in combination with event-driven material flow management can contribute to more stable inventory levels through a discrete event simulation. Finally, as previously indicated, sensor data may be utilized to improve quality monitoring of transport activities within car supply chains (Ali and Aboelmaged, 2021).

2.4.1 Service supply chain 4.0

An analogous systems approach is well suitable is Service Supply Chain Management (SSCM) to offer mobility services such as parcel delivery and cabling installation, as well as home health services (Seyed Mojtaba Hosseini Bamakan 2021). Bidirectional optimization, disreputability and simultaneous capability and demand management are the biggest distinctions between SSCM and SCM. Technologic developments such as Internet and wide-ranging wireless connectivity enable the service-oriented knowledge management (SSCM) to include customers in a new way into the knowledge management strategy of a service firm. The dynamic provision of individual customer requests and preferences and the ability to connect them to corporate cost and optimization goals in real time adds a new dimension to the knowledge management approach of service companies (Dhull and Narwal, 2016).

(João Barata Paulo Rupino Da Cunha 2018) described the fourth supply chain revolution (4SC) and suggests further research in this field. The examination of 65 literary reviews is done following three steps: Industry 4.0 bible analysis, the synergies with transformation of the supply chain and an up-to-date assessment of the current state of the art. 4-Scale Computing (4SC) is an organizational, cultural-oriented technological revolution that seeks to create more sustainable networks that will serve customers and foster responsible decisions throughout the whole supply cycle. In future, the proposed framework may be used for literature reviews and 4SC Digital Transformation Plans to structure their contexts and to incorporate changes resistance functions.

The research by (Lisa M. Ellrama, 2019) extends the SCOR model to the key functions of services supply management by incorporating capability and expertise, demand management, customer relationship management, supplier relationship management, service delivery management and cash flow management. Their model is illustrated in figure

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2.5 Recent trends in supply chain

Supply chains (SCs) and manufacturing processes are critical components of the day-to-day operations of a wide range of professional and personal activities in contemporary life, and they are critical in the growth of the world economy. Because of the upheaval caused by Industry 4.0, businesses must rethink how they build their supply chains. Several new technologies have developed that are changing old ways of doing business and doing business in general. The game is also being changed by megatrends and changing client expectations. Aside from the necessity of adapting, supply chains have the possibility to reach the next horizon of operational performance, to exploit developing digital supply chain business models, and to turn the organization into a digital supply chain(Knut Alicke, 2019).

A number of megatrends are having a significant impact on supply chain management, including the continued development of rural areas throughout the world, as well as the transfer of wealth into places that were previously unserved. Logistics is experiencing additional problems as a result of increasing pressure to decrease carbon emissions as well as traffic rules for socioeconomic reasons. As a result of shifting demographics, however, labor supply is being limited, and ergonomic standards are becoming more stringent as the workforce ages (Seyed Mojtaba Hosseini Bamakan 2021).

As a result of the online trend that has emerged in recent years, customers' service expectations have increased, while the granularization of orders has become much more pronounced as well. A very clear tendency towards further individualization and customization is also evident, which is driving the rapid expansion and continual change in the SKU portfolio. The openness afforded by the internet, as well as the ease of access to a plethora of alternatives for where to purchase and what to buy, is what drives supply chain competitiveness. Supply chains must become considerably quicker, more granular, and much more accurate in order to capitalize on these trends and adapt to changing demands (Perez-Franco et al., 2016).

(Perez-Franco et al., 2016) further provide a mathematical programming approach based on the idea of mathematical programming, which optimizes business process transactions in digital supply chains. Five programming models from the field of Process Systems Engineering (PES) may be utilized for planning the order processing in a simplified order-to-payment (OTP) business process, modelled as a parallel unit multi-stage network (agents). This document provides two case studies to evaluate the success of scheduling models in different sizes, representing the flexible workshop process of OTC in order to increase efficiency. The models are compared and resized to decide which models are most suited to this app. The Universal Precedence Continuous-Time model provides a realistic representation of the underlying system and works well for small instances. While it is well understood that discretion has limits, the State-Task Network for Discrete Times (STN) is the most tractably efficient. The stiffness of the linear programming (LP) in the discrete STN framework, as well as the capacity of trade solvers to pre-process and apply heuristics to the STN formula, enables the quick identification of nearly optimum solutions in a discreet time even in huge cases of STN formulation(Dmitry Ivanov, 2020).

Alexander Spieske (2021), present their findings after completing an extensive literary evaluation that contained 62 papers in high standard journals. A complete framework is being developed showing that the industry 4.0 has a history of supporting technologies and supply chain resilience. The current state-of-the-art framework is being explored based on an Industry 4.0 classification of enabling technology and the history of supply chain resilience. In order to evaluate the resilience potential that industry 4.0 offers in cases of large supply chain interruptions a real-world automotive model was adopted. The study concluded that BID analytics is especially suitable for improving supply chain resilience, while other technologies enabled by Industry 4.0, such as the manufacture of additives and cyber-physic systems, have yet to prove their efficiency. In addition, it demonstrated that visibility and speed are the precedents of resilience that gain most from Industry 4.0 (Alexander Spieske, 2021).

The road plan for new technologies in the context of SC 4.0 is further developed by (Martin Beaulieua, 2021). Previous researcher has utilized a mixed-method approach to construct a roadmap that incorporates both internal and external digitalization trajectories, which combines observations with an overall evaluation of the relevant literature. This approach may capture and show the research difficulties linked to the supply chain, as well as the ways in which digitalization projects can contribute to solving the obstacles. The ideas for digitalization that were made are prioritized and are focused on hospitals. These ideas can help managers to modify the supply chain and processes for health. The healthcare supply chain trails far behind the supply networks in other industries with regard to performance and best practice. Through digitization initiatives, managers

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may bridge this gap and improve the health services supply chain performance (Martin Beaulieua, 2021).

2.6 Digitization of supply chain

Digitalization has been helping to boost the expansion of the computerized industry. By using digitalization capabilities, a competitive advantage may be gained by reorganizing existing assets, adding new assets or integrating assets from other sources. Therefore, digitization can emphasize content, in which the industry determines what concept to use and digitality enables that concept to be implemented; performance indicates that reporting and collection times must be reduced; usability shows that delivery methods need to be improved, for example the dashboard context. Today's digitization is similar to the reading of the press, with the digitization of the information distribution center's instrumentation at the helm, where daily information flows and recorded revelations are created (Martin Beaulieua, 2021).

In recent years, the technological revolution has been driven by dynamic corporate issues, technical upheavals and quickly changes in customer demands. Four technological revolutions have occurred in global history. (Dmitry Ivanov, 2020) studied the circumstances of digital twin's design and implementation to manage interruption in supply chain organization's (SCs). The combination of model-based decision-making aid and data-based decision-making support has been a noteworthy research trend in recent years. The quality, compliancy, completeness, validity, consistency, and timely availability of model-based decision-making support is strongly dependent on the data.

According to (Anna Corinna Cagliano, 2021) have been recognized as part of a 4.0 industry paradigm the main patterns linked with the implementation of new Digital Supply Chain Technologies. A sample of DSC attempts to better understand the influence of different social and economic variables on the adoption of DSC solutions were done by an analysis of differences (ANOVA). The data suggest that all major drivers of DSC technology are the time factor and the per capita gross domestic product, the foreign investments and funds spent on research and development. In particular, Big Data, despite the fact that these two technologies, together with increased reality and artificial information, are generally connected with the latest application of these technologies, is related to a greater degree of economic effort than Blockchain (Anna Corinna Cagliano, 2021).

Moreover, thorough literature study, (Akanksha Choudhury 2021) identified 12 CSF. The ISM model has achieved six different stages, starting with the under-structure of organization and advancing. The TISM model emphasized why the reorganization is important to the achievement and implementation of creative agility in the supply chain. The following elements contributed to the success of the digital supply chain: sales and operational planning strategies, strategic sourcing tactics, intelligent production processes and warehouse management.

The SCR-SC Digitalization connection is further examined by (LimingXu, 2021) that the supply chain Triple-A has been one of the main themes for supply chain management practitioners and researchers in the previous decade. The objective of supply chains is to grow according to the characteristics of agility, flexibility, alignment and response, rather than focusing just on cost and efficiency improvements. Since then, other strategies were utilized for promoting the Triple-A supply chain in various sectors. However, both new issues and opportunities for the growth of the Triple-A supply chain arise from the digitization trend. Specifically, studied the C2M model, a new type of innovation in the supply chain, which will open up new possibilities for accessing digital supply chains of the Triple-A market. C2M uses a number of ways to decrease the information flow through the supply chain to build digital links between end customers and upstream manufacturers and product designers. (Dorsaf Zouari 2020)indicated that SC digitalization is mainly characterized by the level of digital maturity and the utilization of SC digital tools. The level of digitally matureness of a firm has a major influence on the use of digital instruments. Both have a favorable impact on SCR with respect to the level of digital maturity and the utilization of digital technology.

In order to foster collaboration throughout the food supply chain and enhance corporate performance, food supply chains rely on big-data management technology. (Alexander Spieske, 2021) conducted a qualitative study based on 18 extensive interviews with managers of large multinational and local organization's covering different and relevant roles on the digital food supply channel to investigate the effects of digitalization on food supply chain operations on organizational and food supply channel processes. Participants were managers of major international and local organization's covering various and crucial roles in the supply chain of digital food. By triangulating new results with literature on the supply chain management, examined several viewpoints on cooperation practice for the prevention of food waste in the food supply chain. Furthermore, provide information on reinterpretation of the supply chain architecture and operations in the use of digital technology, as well as institutional forces that reduce (barriers) and encourage (drivers) collaborative food waste prevention practices in the food supply chain.

The gap between present SCM models and models utilized in Industry 4.0 was examined by (Shahin, 2010). The proposed model offers an overdue of both the early phases and the present phase of new concepts and components that drive the development of DSCs. DDCs and the key elements for their formation and present functions have been developed as a consequence of the research. In the research, the initial activities to create and deploy collaborative SC clusters were also found.

A deeper understanding and evaluation of the revolution in industry provides management with the information needed to adapt to the complex structure of the railway sector and make sound choices regarding the future direction and continuous digital process (Mailasan Jayakrishnan, 2020) created an enterprise architecture high-performance RSC framework to visualize, analyses, and maintain the control over all RSC indicators, connecting and integrating a wide variety of systematic and structural information in a visual appearance that can construct an understandable and valuable framework for what is and what is.

2.7 Challenges and barriers to supply chain

Management of the supply chain (SC) has been widely explored and considerable attempts have been made to integrate and increase company competitiveness. Although the firm co-ordinates internal operations and customer-supplier relationships through the SC function, the SC function becomes more complicated and makes it harder to enhance business performances and decrease expenses. The need for integration of SC processes is not a new idea. Studies on two levels of SC integration have been carried out: (a) inter-organizational, which involves consumers and suppliers; and (b) intra-organizational, including internal businesses (Ali and Aboelmaged, 2021). The fourth industrial revolution known as Industry 4.0, a strong integration of information and communication technologies, links the physical world to the virtual world, giving companies and their respective resources great potential for integration and connection. The inclusion of SC procedures and visualization of information between customers and suppliers allows enterprises to take part in cooperation activities with consumers and suppliers (Dhull and Narwal, 2016). The

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outcomes were more flexibility, productivity and quality and the possibility to improve their activities. (Martin Beaulieua, 2021) elaborated following challenges in their research:

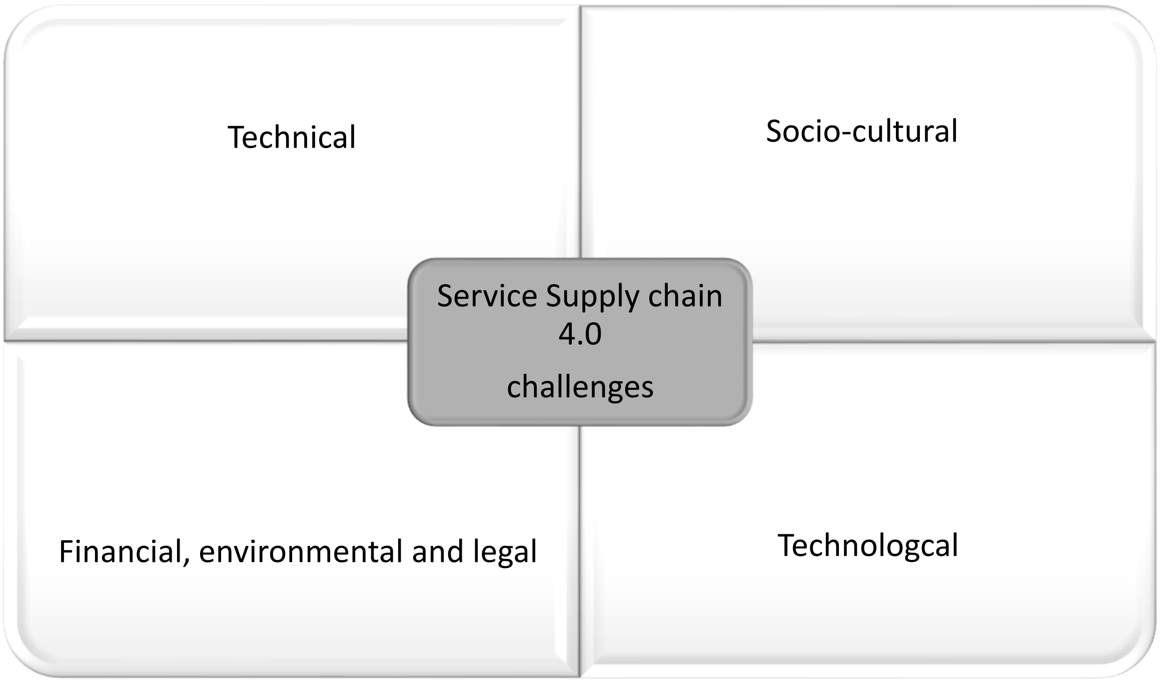

Figure 5: Challenges to supply chain

Different perspectives of these challenges of Service supply Chain 4.0 have been identified and explored by different authors as presented in table below;

Table 1; Challenges to digital supply chain

Challenges	Description	Author
Technical challenges	High degree of computerization Computing requirement and strategies Complexity of systems Scalability privacy	Ahram et al. (2017) Alotaibi & Mehmood (2017) Chen (2018)
Technological challenges	Different dynamics Different time structures Lack of skills	Casey & Wong (2017) Büyüközkan & Göçer (2018)

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Financial, environment and legal challenges	Environmental challenges Financial investment Standardization Legislative policies	Pishdar et al. (2018) Kynast & Marjanovic (2016)
Socio-cultural challenges	Low adaptation to new business models Strategic alignment Supply chain cooperation's Lack of ability to combine data Human resource replacement dismissal	Bienhaus & Haddud (2018) Kynast & Marjanovic (2016) Lee & Lee (2015)

Some more disadvantages of the digitalization of the supply chain 4.0 were also highlighted by (Mailasan Jayakrishnan, 2020). Service Supply Chain Digitalization was a time of great difficulty in building, maintenance and maintenance, and delivering transport and the safe, efficient and safe operation of the system. In this modern economy, the upper hand digitalization is not based on large-scale production, but cost reduction has advanced to the capacity of an organization to look for situations and to adjust for economic changes, to understand change through development and the installation of learning in the industry. It also pointed to an increase in the oversight of industry or administration through the appropriation of and emphasis on the enterprise's essential industrial strategy. In a rapidly developing atmosphere, the ability of the sector to find new techniques via digitalization is the key.

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3 Methodology

3.1 Research philosophy

Giving the writers a clearer grasp of the social relationships between the phenomena and players concerned, the adoption of an epistemological approach of social constructivism will help them to identify significant interpretations based on select interviewed people (Easterby-Smith et al., 2015)

3.2 Research design

The selected research design (Figure 6) is shown in accordance with the research design model given by myers.The progress of this study (2013). Considering Figure 3-1 it begins in 3.1 research philosophy with a philosophical presupposition. The selected study methods and the data collecting and analysis that are described more in the Data Collection and Data Analysis are then introduced.

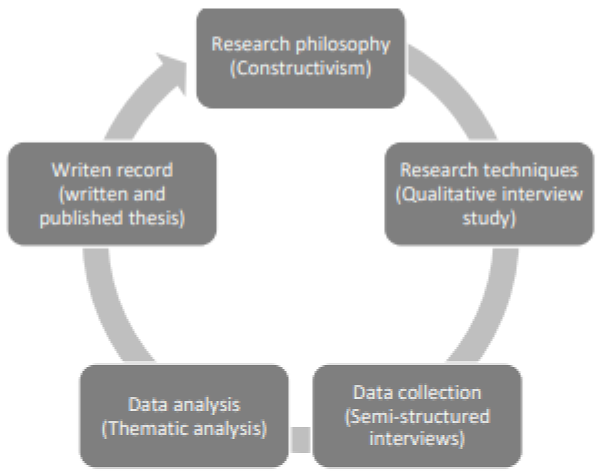

Figure 6:research design method adopted from Myers (2013)

In order to assess the potential of the use and analysis of big data, an examination of the literature will be conducted. The main applications used to get access for this research will consist of the WorldCat.org database, which is associated with Tilburg Universität, and Google Scholar. The following keywords identify related articles: big data; analysis of data, analysis of data; data science; analysis of companies; data integration; management (supply chain); business processes; and policy making. In the order they were asked, this thesis answers the research questions; as a result, it is organized accordingly: Initial study on the basis of existing literature will be carried out to identify recommended parameters such as data, big data, analysis of the data, supply chain,

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and supply chain performance. In the following stage, a review will take place of different kinds of data involved in supply chain management to report on the sorts of data important and crucial to the management of supply chain.

3.3 Sample & population

Population for this study include all research journals having papers with SCM and data analytics in topic.

3.4 Data collection method

In order to assess the potential of the application and analysis of big data in supply chain management, especially in the procurement of inputs, and raw materials, a full literature research will be undertaken. The major way of accessing vital material is Google Scholar and other comparable programs. Big data analysis, data analysis, data science, business analysis, data integration, supply chain (management), business processes and decision-making will be one of the themes of these articles. These are the topics of research handled in the following order in this thesis: In order to determine the recommended variables 'data,' 'big data,' 'data analytics,' 'supply chain' and 'supply chain performance,' current literature will be reviewed, as follows:

Thereafter, research will be carried out in order to report on the data kinds that are critical and vital for supply chains management in the various forms of data involved in supply chain management. The focus will be on the literature discussing techniques for analyzing data that can have an important impact on the supply chain process after determining the definition of the variables and the type of data involved. This will improve the level of insight within the supply chain process and the variables will be determined.

3.5 Ethical consideration

Following the selection of the most relevant data analysis tools, the emphasis will shift to the integration of data into decision-making and company operations. Last but not least, data, data-analysis tools, and business procedures will be brought together to provide an overview of how firms might eventually apply these elements to improve their performance in the core supply chain operations sector.

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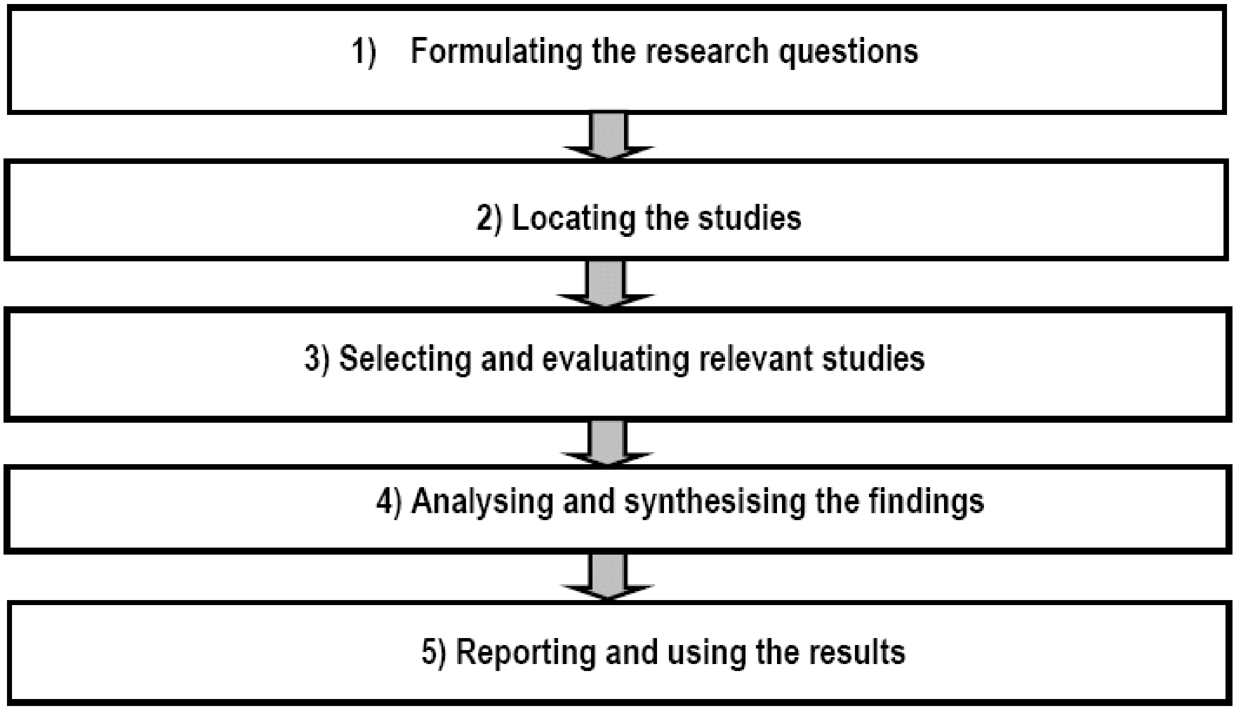

Figure 7 Research methodology for SLR

4 Findings and analysis

4.1 Data analysis

Data analysis sounds like a simple and uncomplicated procedure in which the input is the gathered data sample and the output is the information which can be acted upon. In fact, it's not that easy. "Information needs to be simpler to comprehend and to act upon," says Lavalle, Lesser, Schockley, Hopkins, and Kruschwitz (2011), stressing that while data has been examined, it still needs to be understood by managers and professionals to become active.

Lustig, Dietrich, Johnson and Dziekan (2010) say that companies need to approach data and information as a strategic asset before analytics can be conducted. Once the potential of data and information is recognized by organizations, the process of business analysis may start. The analysis of structured data was classified by Lustig et al. (2010) into three main categories:

4.1.1 descriptive Analysis

Descriptive analysis is a collection of technologies and procedures using data for company performance analysis and understanding. This technology is commonly used to acquire insight into past processes in order to approach the future more confidently. Descriptive analysis generally addresses the "what happened?" issue through data derivation.

Souza (2014) outlines the descriptive analysis and adds that 'real time information on the position and volume of products in the supply chain gives managers with the ability to alter delivery schedules, place refuelling orders, put emergency orders, change mode of transport, etc." This sort of information is highly valuable to managers and policymakers, because the response to the query "what is happening?" offers an overview of the situation. Integrating this kind of IT into company operations can assist to track everything that happens inside particular nodes in the supply chain.

4.1.2 Predictive Analysis

Predictive analysis is a technique that examines real time and historical data to forecast future occurrences as a probability (Rozados & Tjahjono, 2014). Statistical and mathematical approaches provide the basis for predictive analysis. The ability to foresee demand is one of the most essential components of predictive analysis.

Lora Cecere – founder and CEO of Supply Chain Insights LLC – stated in a 2012 large data study that (supply chain) executives look to new kinds of predictive analysis to map numerous ifs through learning systems. "Machine learning is characterized by statistic induction to produce strong prediction models," says Dhar (2013). Predictive analysis may be used to construct various 'if A, than B' circumstances to increase the company's accountability and flexibility to clarify the two prior assertions. Responsibility and flexibility are increased since, for example, firms have previously made forecasts of demand variations and may have already developed several strategies for specific scenarios. This means that policies only need to be implemented when a forecast circumstance happens. Cecere (2012) further argues that the integration of new models, optimization and learning systems enhance the organization's capacity to improve responsiveness.

The predictive analysis was categorized into six categories by Lustig et al. (2010). This categorization is shown in the supporting descriptions in Table 2. Table includes possible applications of strategies to increase supply chain performance and to which these techniques could correspond the primary supply chain process.

Table 2 Categories of predictive analysis

Analysis technique	**Possible application to improve supply chain performance**	**Supply Chain Process: Plan/Source/Make/Deliver/Return**
Data mining/Pattern recognition and alerts	Discover demand patterns to anticipate future demand levels (linked with forecasting)	Plan/Source/Make/Deliver/Return Discovering patterns in large data sets can lead to more efficient planning. For each supply chain process, patterns can be recognized that may provide insight or show weaknesses in the process.
Monte Carlo simulation	Evaluating risk by creating models that show assumed distributions of selected values. Wu & Olson (2008) used a Monte Carlo simulation for evaluating risk relating to different ordering plans.	Plan/Source/Make/Deliver – since a Monte Carlo simulation can give an assumed distribution of future events, it can be applied to any process to evaluate risk or show possible outcomes, given the right starting conditions.
Forecasting/Predictive modeling	Forecast demands using CPFR- Collaborative Planning, Forecasting and Replenishment systems.	Plan – Forecasting and predictive modeling belong to the area of planning since this process focuses on future demand levels so that policy can be adapted and adjusted to meet the requirements that are expected. Make (predictive modeling) – Responding to customer sentiment, supplier evaluation,

Root cause analysis	Analyzing the management of recalls to prevent them. (Kumar & Schmitz, 2011)	Return – Products that get returned because of flaws in design or products that do not 'work' are sent back to the manufacturer, therefore, root cause analysis can for instance be used in the area of the Return process. Deliver – Higher than average delivery costs on for instance a specific route may have an underlying cause, such as the number of traffic lights or crowded highways.

4.1.3 Prescriptive analysis

Prescriptive analysis employs data-based forecasts to advise and recommend proposed actions that might benefit or avoid a certain result (Rozados & Tjahjono, 2014). Some of the prescriptive analysis approaches overlap with predictive analysis techniques, since the possibility of 'prescribing' a future course of action first has to be predicted by employing a Monte Carlo simulation, for example, where all potential results are examined. A planned set of activities can be developed for the future in this way.

4.2 Integration of data from several sources into a process of decision making

Back in 1974, Galbraith explored organizational design through an information processing perspective. He claimed that uncertainty demanded further information processing to reach a higher level of performance: "The greater the uncertainty in the task the larger the quantity of information must be processed by decision makers in order for a given level of performance to be achieved." He also noted that ambiguity hinders an organization's capacity to prepare or decide in advance. Through greater planning and cooperation, companies can decrease this unpredictability.

The diversity of data is one of the distinguishing properties of data and especially of large data. If all these facts are properly incorporated in decision-making and management, they may be converted into information. If the integration of systems and data from automation and process simplification inside the company is done with expertise, it will enable decision-making to be supported (Kościelniak & Puto, 2015).

4.3 Systematic literature review on data analytics in SCM

A total of 71 papers were selected for the systematic literature review of service supply chain

4.3.1 Yearly contribution

Table below summarized the yearly contribution in the domain of services supply chain 4.0. This indicated that major research is carried out in the services supply chain in the year 2020 (29 articles) and 2021 (23). Previously there was few research articles off the selected category 2019 (13 articles) and 2018 (4 articles). Table below indicated that out of 71 articles, only 10 were published in Elsevier. In Springer journal only 4 articles were published. 8 were published in Taylor & Francis Journal.

Table 3 Yearly contribution of journals into SCM

Year	Number of papers published
2000	**1**
(blank)	1
2017	**1**
Taylor and Francis Ltd.	1
2018	**4**
Elsevier B.V.	1
Elsevier Ltd	1
Institute of Electrical and Electronics Engineers Inc.	1
MDPI AG	1
2019	**13**
Blue Eyes Intelligence Engineering and Sciences Publication	1
Elsevier Ltd	1
Emerald Group Holdings Ltd.	3
Frontiers Media S.A.	1
MDPI AG	2
Nicolaus Copernicus University	1
Science and Engineering Research Support Society	1
Taylor and Francis Ltd.	2
Vilnius Gediminas Technical University	1

2020	**29**
Brazilian Institute for Information in Science and Technology	1
Conscientia Beam	1
Elsevier Ltd	2
Emerald Group Holdings Ltd.	6
ExcelingTech	8
Inderscience Publishers	1
Institute of Electrical and Electronics Engineers Inc.	1
MDPI AG	2
Science and Engineering Research Support Society	1
Scientific Association for Infocommunications	1
Springer	1
Taylor and Francis Ltd.	3
World Academy of Research in Science and Engineering	1
2021	**23**
ECTI Association	1
Elsevier B.V.	1
Elsevier Inc.	2
Elsevier Ltd	2
Emerald Group Holdings Ltd.	10
John Wiley and Sons Inc	1
MDPI AG	2
Springer	1
Springer Science and Business Media Deutschland GmbH	1
Taylor and Francis Ltd.	2
Grand Total	**71**

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4.3.2 Identified categories

4.3.2.1 Digital technology

Analysis of data also indicated that out of 71 articles, 30 articles included Digital supply chain into their key words. Out of these 30 articles, 23 were published in year 2020 and 2021 indicating that major research in the realm of digital supply chain begins in 2020.

This includes Big Data, the Internet of Things, Cyber-Physical Systems, Mobile Applications, Cloud Computing (cloud-based ERP solutions, for example), Interface Human-Machine (IHM), Web technologies, e-Value Chain, Cyber security, Smart Sensors (RFID, for example), Autonomous Robotics (Automated Guided Vehicles, for example), Additive Manufacturing, Advanced Tracking and Routing Technologies (GPS, for example), and Advanced Tracking and Routing Technologies (GP (such as the use of digital twins, for example).

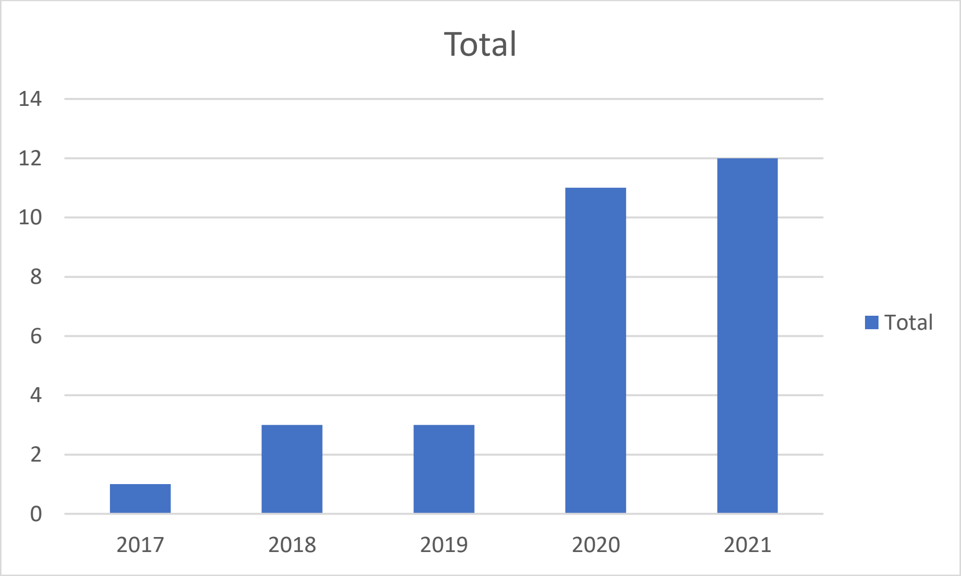

Figure 8: Percentage of articles presented ino the digital technologies

4.3.2.2 Block chain

The confluence of certain elements lately strengthened the demand to utilise data analyses in supply chains (Ittmann, 2015): 1- increasing data volume in the supply chain; 2- decreased data storage costs over recent years; 3- powerful hardware that can speeding up data analysis; 4- mobile data continuous access; 5- powerful tools that simplify data work; and 6- ways that can visually display huge amounts of data (advanced visualization). The information available in the supply chain mostly relates to customers, sales, markets, service levels, demand predictions, inventories, deployment of capacity, quality control, human resources, level of skills, logistics, resources, warehouse planning and priceing (Biswas & Sen, 2016).

Big data allows firms to assess their suppliers better and regulate the procurement process (Sanders, 2014). Big data also enables firms to simulate their supply networks. Simulation enables bottlenecks to be found, the production process may be practically performed at multiple sites and prototypes examined (Kynast & Marjanovic, 2016).

Big data may improve supply chain performance by enhancing the visibility, resilience, robustness (Brandon-Jones et al., 2014), and organizational performance of the supply chain (Schoenherr & Speier-Pero, 2015). Big data also enhances the management of knowledge in supply networks, which can improve the supply chains by enhancing product development. Big data may also impact demand projections, stock management, manufacturing and service scheduling and product development in a supply chain favourably (Lin, 2016).

Big data is used by supply chains to reduce cycle time, cross-functional perspectives, improve decision-making processes and optimise supply chain efficiency. Big data, for instance, can minimise the bullship impact in the supply chain by decreasing future demand uncertainty (Militaru et al., 2015). Using large data analytics, logistics and supply chain management procedures have been demonstrated to be helpful (Arunachalam et al., 2018; Brinch et al., 2018; Dubey et al., 2019b; El-Kassar & Singh, 2019). Thomson Reuters Web of Science uses big data analytics to analyse different contributions in the domains of supply chain management and logistics. Figure 5 illustrates the relative frequency in logistics and supply chain management of published works in big data analytics applications. Studies are classified

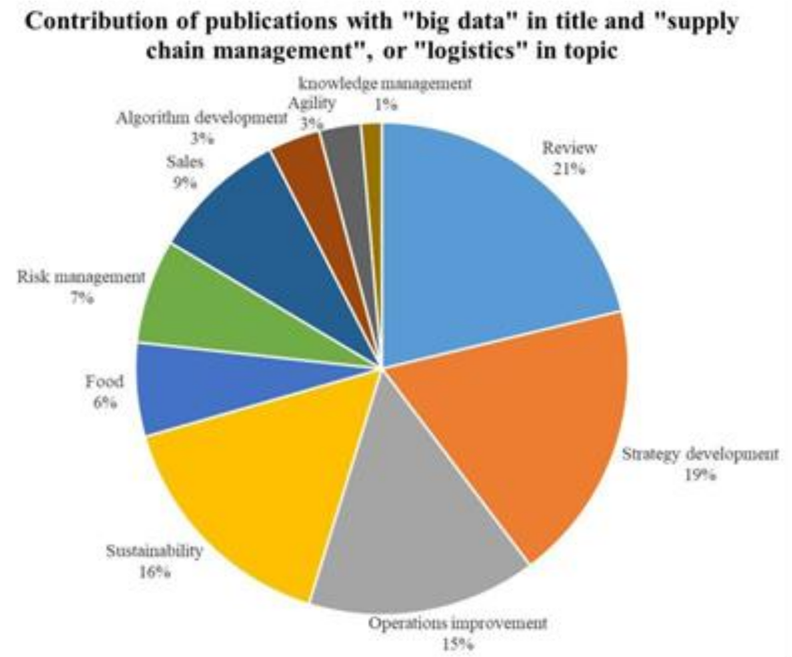

Figure 9 Contribution of publication with big data in title and SCM in topic

Based on their Figure research emphasis; most categories are discussed in further detail later. However, it is worthless that review publications are not further explored as we analyse research contributions in the literature; the "review" category is included in Figure 5 to help provide more information. In addition, the categories "knowledge management," "agility" and "algorithm development" are not explored further as fewer than 5 percent of all articles are included.

4.3.3 Development of strategies

It would be a strategic choice of management to employ Big Data Analytics in a firm. Management commitment has a favourable impact on the acceptance of big data analysis by a firm (Gunasekaran et al., 2017). Big data analytics enables the management to obtain dynamic data-based analysis and make the supply chain more competitive (Chen et al., 2015). Big data analytics can help coordinate and regulate the planning, decision making and supply chain preparation, alertness and flexibility of the supply networks in issue (Mandal, 2019). The topic of big data value generation was not widely explored in the literature of supply chain management. Brinch (2018) therefore examined value discovery, generation and capture in the corporate supply chain utilising big data analysis.

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All the advantages mentioned are insufficient actual research which applies big data analytics to supply chain management, therefore it is not possible to choose an educated strategy merely by comparing different approaches (Kache & Seuring, 2017). Investing money into the gear and software needed to implement Big Data Analytics might influence supply chain strategy. With regard to training, our education system can teach a number of data scientists, but the management capabilities of these data scientists have often been overlooked (Carillo, 2017). Consequently, turning the data provided into relevant information to minimize supply chain risks is still a barrier for many supply chains (Bumblauskas et al., 2017b).

4.3.4 Improvement of operations

Dealing with a variety of suppliers, manufacturers, logistic suppliers etc., produces large data sets which may be utilized to optimize supply chain initiatives. Big data analysis enhances demand predictions, decreases safety inventories and improves the management practices of a supplier (Roßmann et al., 2018). Big data predictive analytics were demonstrated to be integrated with other approaches such as company resource planning to improve the performance of supply chains (Gupta et al., 2019c). Oncioiu et al. (2019) investigated the role of apps for big data analytics on the performance and implementation of assessment procedures of Romanian supply chain firms. Boone et al. (2017) have also employed large-scale data analytics to enhance service component management procedures.

In a further research, Hofmann (2017) shows that the speed of big data may be utilized to decrease the bull wheat effect in supply chains (raising the degree of safety in upstream echelons). Working with supply chains of omni-channels creates a great deal of data from many sources. Big data analysis can make sales projections in various channels more accurate and build optimum delivery strategies to save transport expenses (Lee, 2017). Sharing data using a big data architecture may minimize uncertainty costs in a supply chain in another instance (Liu & Yi, 2016).

4.3.5 Sustainable

The optimization and modification of operations on the basis of sustainable objectives might be another use of big data analytics in supply chains. Big data can enhance the supply chain's environmental, financial and operational management in order to assist battle climate change (Seles et al., 2018). A Network Data Envelopment Analysis using Big Data was created by Badiezadeh et al. (2018) to assist analyses the effectiveness of sustainable supply chain management. Open access to Big Data may make innovation easier, build robust supply chains and improve distribution network efficiency (Weerakkody et al., 2017). Liu (2019) shows how the use of Big Data Analytics for targeted product promotion may minimise carbon emissions throughout the supply chain.

It should be noted that employing Big Data Analytics in all supply chains is not useful. There are numerous hurdles which might interact and impede the establishment of a sustainable system using big data analytics (Shukla & Mattar, 2019). Cheng et al (2018) examines a producer and retailer as a sustainable supply chain and shows that the competence of large data analysis is dependent on the retailer's quality of service. Big data from transport and logistic providers may be leveraged to fulfil delivery needs

4.3.6 Management of risk

Any supply chain that faces uncertainty in its decision-making processes employs some level of risk management strategies. Risk is one of the outcomes of information shortages, and large data may be used to minimize that information shortage. Transportation risk may be described as a variation from the expected delivery time in the context of logistics procedures. Big data analytics may be used to anticipate these delivery times and to reduce transport hazards like missing cargo planes (Shang et al., 2017). Big data analytics were employed by Engelseth & Wang in 2018 to control the risks in long-linked supply chains. They apply an analytical approach to reduce the hazards of a case study examining machine components that are imported into Norway from China.

Big data analysis can address negotiated problems between a supplier and a merchant. Tsao (2017) used large data analytics and game theory to illustrate how a supplier and retailer might select the time period to use their loans to minimize the risk of default. A kind of risk in shut down supply networks is that of dangerous materials and trash (supply chains with remanufacturers and recyclers) (Van Asselt et al., 2017). Big data analytics have also proved beneficial to recognize strong demand signals and minimize harmful environmental consequences (Wu et al., 2017).

4.3.7 Sales and marketing

In addition to predict demand, large-scale data analytics may help marketing managers analyses existing product sales patterns. For example, product reviews may be more readily approved in various studies, which may influence sales performance (Li et al., 2016). When Boone and colleagues investigated the sales enhancement effects of big data analysis, they observed that

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(2019). A new study by Sagaert et al. (2018) indicates that the market dynamic knowledge of sales managers may be improved by big data analytics. Researchers have found that big data analytics may enhance predictions by 16.1% compared to traditional techniques using a case study of a tyre manufacturer (Sagaert et al., 2018). Li and colleagues (2018) proved a much better way than normal supply chain management approaches of managing big data demand chain together with the electronic business sector.

The utilization of product data has been shown to minimize uncertainty in post-market demand planning (spare parts) (Andersson & Jonsson, 2018). The influence of new technology such as internet of things and large data analytics on the Indian retail sector has been explored by Gawankar and colleagues (2020). Their investigation has shown that the Indian retail business wants the retail environment to integrate new technology called the "Retail 4.0" study. Because of the link between the costs of items and their environmental friendliness Big Data Analytics (Liu & YI, 2017) were also employed. It shows how easily available data can be used to focus publicity in a supply chain context by showing how In the Big Data Pricing (Liu, 2017), new research was done which regarded the data enterprise to be a mainstay in the supply chain to find the benefits of Stackelberg's theory.

The study of social media information can help supplier chains to increase the number of system customers in their supply chain by providing personalized services. companies may examine the interaction between a consumer and a product on social networks, smartphone applications and Internet information (Agrahri et al., 2017). A high number of people are concerned about how much their personal data is obtained and how this might have a negative effect on the image of the business, according to the research of a group of retail consumers by Aloysius et al. (2018).

5 Conclusion

This thesis, as described in the introduction, aimed at gaining a better understanding of how organizations may successfully integrate and use data analytic techniques in order to improve supply chain performance. It has become clear that supply chain management teams face enormous quantities of different types of data across the supply chain that must be efficiently managed. Data analysis approaches must be utilized together with a comprehensive and goal-oriented thinking in order to extract (commercial) value from this data. This needs analytical thinking inside the organizational units to recognize and analyses prospective problems efficiently, with the aim of ultimately enhancing business processes. Employing professional data scientists with know-how in quantitative analytical methodologies and functional business understanding may make this approach easier and more efficient. In addition to developing solutions that have good repercussions on the business's internal operations, companies that rely on efficient supply chain management must work with upstream as well as downstream connections in the supply chain process to achieve maximum performance advantages. The "next link" in the supply chain can be better prepared to address future demand variations through the exchange of customer demand data and forecast analysis. This will result in enhanced performance both for individual enterprises and for the entire supply chain and in better performance for the entire supply chain. Business areas such as supply chain management are only a few instances of how data analysis may improve the operational environment, if not completely transform it. The fact that more than one firm participates in the whole business process is one of the reasons why this subject is particularly significant to the SCM sector. It is therefore highly attractive to seek for fresh and inventive approaches to increase the organization's performance considerably. The digitalization of society as a whole is another crucial element to consider. More and more information is generated and made available to organizations every day; nevertheless, the most essential component is the capacity to react when it is received on this data. Implementing data analytic techniques in business processes together with competent human resources to analyses the increasing amount of information will not only provide a better overview of the company, but will also help decide on the way business processes work, which can improve the overall performance of the company.

5.1 Challenges

Despite the advantages of Big Data for enterprises, many organizations still haven't widely used Big Data; this might be owing to the high initial cost of integrating Big Data that requires a

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significant initial investment. Management assistance is vital if a large data analysis system is to be installed successfully. An initial cost-benefit analysis of large data in the way it is utilised in the long run is a very tough assignment. It's not easy for companies with fewer transactions per day to find out if the big data analysis is useful, as is the case with many small firms. The fact, that traditional data analysis methodologies are not possible to be employed for information analytics since they are created by firms such as Amazon, Walmart, Google and others. Whereas in certain companies, the V features of Big Data are more doubtful, there is no guideline to assist management in convincing that the present data is appropriate for the establishment of a Big Data Analytical Framework.

A key difficulty is where to search for valuable data, how to acquire it and what techniques are needed in order to obtain it. Another difficulty is that vital information might be separated accidentally from the rest of the easily available content. Analysts must be aware of the information they wish to remove from the data and must be able to answer any queries they have concerning the information they can access. Another problem is to identify the most effective way to respond in the best possible way, while still costing considerable time and money. As companies adapt to the speed of technological progress, the demand for employees with an education in analysing huge volumes of data is rising. In addition, it is a challenging effort to build confidence between data analysts and management. Most systems initially are resistant to change, therefore assistance of superior managers is essential to adopt data analysis results in order to enhance the system.

It is likely that because traditional computers can only store and accurately analyse enormous amounts of data, a computer's Central Processing Unit (CPU) will be a barrier to Big Data Analysis. However, the accessible data are not always full and consistent; sufficient cleaning and integration procedures are thus necessary to make the dataset analytical.

The fifth "V" to the concept of vast data refers to the value derived by a large-scale data study. Unfortunately, there is also a chance of hacking whenever there is a potential for profit. Information security may be a challenging task when applying large-scale analyses within companies. A huge volume of information increases the likelihood of sensitive and valuable information in the system, therefore increasing system vulnerability and the risk of theft being able to access it (Spanish, 2014). [2014]; (Kshetri, 2014).

The most appropriate type of decision-making data for most of a system might also be determined as a challenge. For higher accuracy, not every choice is made using all the information available in a system. They determine which part of a data set to be used and what information should be included in the report based on the expertise and experience of the data analyst. It is also a regrettable truth that the intended audience may not necessarily create big data that are easily accessible. Although Twitter has an enormous number of contents, not everybody on a community has a Twitter account, like an example. In consequence, a portion of the community generates a huge number of information while the other half does not produce any of the data in a dataset. This fact emphasizes statistical uncertainty on a consistent basis such as skewed data.

If the results of a not-real-time data analysis are used for real-time data, the results of the analysis may differ considerably from those of the historical data to those of the real-time data; for example, the original premise of the prediction study is that the "future is past" could not be accurate. Furthermore, if data shows cost- and time-effectiveness of a transportation route (and many organizations have access to this data), it may start to be used by other firms in the same way. The demand for the above-mentioned technology may be rising and may lose its attraction both in cost and in time.

Another long-standing and ongoing problem is the inability to transmit information between supply chain levels or even between individual plant divisions. It might be difficult for parties to ensure that the advantages of this cooperation are rewarded through the exchange of data. A helpful IT department that can offer the hardware and software needed for big data operations is also essential. Data analysts educated in huge volumes of data should be employed as well as experienced teachers to train Big Data analysts for the demands of the facility.

5.2 Advantages

Big data analytics may help organizations understand their business demands more effectively. In accordance with a demand boom, many firms design their company growth strategy, which might result in business growth in general. However, they should realize that a shift in market growth might leave them with a number of vacant warehouses and idle factories. Big data allows these companies to forecast the guidance of the market and create development plans based on this analysis.

Big data allows firms to construct a digital model of a complete manufacturing process. Data from consumers collected may be utilized to enhance marketing and sales operations. Splitting consumers into different groups, offering service to each group's demands and utilizing customer information to target where and when these new goods are being advertised is the other big data uses in marketing.

Big data analysis is not negligible to improve consumer loyalty. Most consumers would be loyal to the firm for the first time providing a high-quality service. Companies may utilize large-scale data analysis to forecast and meet consumer requirements to make them loyal customers.

Optimizing operations outside the usual limits of the firm, such as the selection of suppliers or technologies, requires a high level of information exchange across players in the supply chain. Information sharing in supply chains has long been an impediment, but technical advancements in big data can simplify and speed up this process (Swaminathan, 2012).

Big data may be used from a logistical point of view for forecasting delivery times or optimizing delivery routing utilizing traffic, weather and drivers' information. A further use is to use product information for inventory management and sales choices (Waller & Fawcett, 2013).

5.3 Future research options

This thesis was prepared from an overview point of view to attempt to show the greatest contribution of data and data analysis to improving the performance of the supply chain. This technique did not make research too particular for some components of the principal supply chain operations. It is also one of the drawbacks to such a thesis; data analysis and data integration solutions specifically designed for each supply chain process are not discussed in detail, as that would lead to a very thorough, possibly very technical overview of certain solutions, and would not capture the overall use and value of such solutions. Future study might also incorporate empirical research in various business environments in order to better understand the requirements and challenges of using data analysis for a certain business field.

6 References

1. AKANKSHA CHOUDHURY , A. B., PRATIMA AMOL SHEOREY , ABHINAV PAL 2021. *Benchmarking: An International Journal Digital supply chain to unlock new agility: a TISM approach*, 28.

2. ALEXANDER SPIESKE, H. B. 2021. Improving supply chain resilience through industry 4.0: A systematic literature review under the impressions of the COVID-19 pandemic. *Computers & Industrial Engineering*, 158.
3. ALI, I. & ABOELMAGED, M. G. S. 2021. Implementation of supply chain 4.0 in the food and beverage industry: perceived drivers and barriers. *International Journal of Productivity and Performance Management*, ahead-of-print.
4. ANNA CORINNA CAGLIANO, G. M., CARLO RAFELE 2021. Determinants of digital technology adoption in supply chain. An exploratory analysis. *Supply Chain Forum: An International Journal*, 22**,** 14.
5. Agrahri, H., Ahmed, F., Verma, V. K., & Purohit, J. K. (2017). Benefits of implement big data driven supply chain management: an ISM based model. *International Journal of Engineering Science*, *7*(5), 11426-11431.

6. Akter, S., & Wamba, S. F. (2019). Big data and disaster management: a systematic review and agenda for future research. *Annals of Operations Research*, *283*(1-2), 939-959. http://dx.doi.org/10.1007/s10479-017-2584-2.

7. Aloysius, J. A., Hoehle, H., Goodarzi, S., & Venkatesh, V. (2018). Big data initiatives in retail environments: linking service process perceptions to shopping outcomes. *Annals of Operations Research*, *270*(1-2), 25-51. http://dx.doi.org/10.1007/s10479-016-2276-3.

8. Andersson, J., & Jonsson, P. (2018). Big data in spare parts supply chains. *International Journal of Physical Distribution & Logistics Management*, *48*(5), 524-544. http://dx.doi.org/10.1108/IJPDLM-01-2018-0025.

9. Arunachalam, D., Kumar, N., & Kawalek, J. P. (2018). Understanding big data analytics capabilities in supply chain management: unravelling the issues, challenges and implications for practice. *Transportation Research Part E, Logistics and Transportation Review*, *114*, 416-436. http://dx.doi.org/10.1016/j.tre.2017.04.001.

10. Ashton, K. (2009). That 'internet of things' thing. *RFID Journal*, *22*(7), 97-114.

11. Ayed, A. B., Halima, M. B., & Alimi, A. M. (2015). Big data analytics for logistics and transportation. In *Proceedings of the 4th International Conference on Advanced Logistics and Transport (ICALT)* (pp. 311-316). Piscataway: IEEE.

12. Badiezadeh, T., Saen, R. F., & Samavati, T. (2018). Assessing sustainability of supply chains by double frontier network DEA: a big data approach. *Computers & Operations Research*, *98*, 284-290. http://dx.doi.org/10.1016/j.cor.2017.06.003.

13. Barbosa, M. W., Vicente, A. C., Ladeira, M. B., & Oliveira, M. P. V. (2018). Managing supply chain resources with big data analytics: a systematic review. *International Journal of Logistics Research and Applications*, *21*(3), 177-200. http://dx.doi.org/10.1080/13675567.2017.1369501.

14. Barratt, M., & Oke, A. (2007). Antecedents of supply chain visibility in retail supply chains: a resource-based theory perspective. *Journal of Operations Management*, *25*(6), 1217-1233. http://dx.doi.org/10.1016/j.jom.2007.01.003.

15. Belhadi, A., Zkik, K., Cherrafi, A., & Yusof, M. (2019). Understanding the capabilities of big data analytics for manufacturing process: insights from literature review and multiple case study. *Computers & Industrial Engineering*, *137*, 106099. http://dx.doi.org/10.1016/j.cie.2019.106099.

16. Benhenni, A. L. (2017). Pragmatic big data and smart manufacturing. In *Proceedings of the 18th International Congress of Metrology*.

17. France: EDP Sciences. http://dx.doi.org/10.1051/metrology/201709002.

18. Biswas, S., & Sen, J. (2016). A proposed framework of next generation supply chain management using big data analytics. In *Proceedings of the National Conference on Emerging Trends in Business and Management: Issues and Challenges*. Rourkela: National Institute of Technology Rourkela.

19. Boone, C. A., Skipper, J. B., & Hazen, B. T. (2017). A framework for investigating the role of big data in service parts management.

20. *Journal of Cleaner Production*, *153*, 687-691. http://dx.doi.org/10.1016/j.jclepro.2016.09.201.

21. Boone, T., Ganeshan, R., Jain, A., & Sanders, N. R. (2019). Forecasting sales in the supply chain: consumer analytics in the big data era.

22. *International Journal of Forecasting*, *35*(1), 170-180. http://dx.doi.org/10.1016/j.ijforecast.2018.09.003.

23. Brandon-Jones, E., Squire, B., Autry, C. W., & Petersen, K. J. (2014). A contingent resource-based perspective of supply chain resilience and robustness. *The Journal of Supply Chain Management*, *50*(3), 55-73. http://dx.doi.org/10.1111/jscm.12050.

24. Briggs, E., Landry, T. D., & Daugherty, P. J. (2010). Investigating the influence of velocity performance on satisfaction with third party logistics service. *Industrial Marketing Management*, *39*(4), 640-649. http://dx.doi.org/10.1016/j.indmarman.2009.06.004.

25. Brinch, M. (2018). Understanding the value of big data in supply chain management and its business processes. *International Journal of Operations & Production Management*, *38*(7), 1589-1614. http://dx.doi.org/10.1108/IJOPM-05-2017-0268.

26. Brinch, M., Stentoft, J., Jensen, J. K., & Rajkumar, C. (2018). Practitioners understanding of big data and its applications in supply chain management. *International Journal of Logistics Management*, *29*(2), 555-574. http://dx.doi.org/10.1108/IJLM-05-2017-0115.

27. Bumblauskas, D., Gemmill, D., Igou, A., & Anzengruber, J. (2017a). Smart Maintenance Decision Support Systems (SMDSS) based on corporate big data analytics. *Expert Systems with Applications*, *90*, 303-317. http://dx.doi.org/10.1016/j.eswa.2017.08.025.

28. Bumblauskas, D., Nold, H., Bumblauskas, P., & Igou, A. (2017b). Big data analytics: transforming data to action. *Business Process Management Journal*, *23*(3), 703-720. http://dx.doi.org/10.1108/BPMJ-03-2016-0056.

29. Carillo, K. D. A. (2017). Let's stop trying to be "sexy": preparing managers for the (big) data-driven business era. *Business Process Management Journal*, *23*(3), 598-622. http://dx.doi.org/10.1108/BPMJ-09-2016-0188.

30. Chaudhuri, A., Dukovska-Popovska, I., Chan, H. K., Subramanian, N., Bai, R., & Pawar, K. S. (2016). Development of a framework for big data analytics in cold chain logistics. In *Proceedings of 21st International Symposium on Logistics (ISL 2016): Sustainable Transport and Supply Chain Innovation*. Nottingham: Centre for Concurrent Enterprise, Nottingham University Business School.

31. Chen, D. Q., Preston, D. S., & Swink, M. (2015). How the use of big data analytics affects value creation in supply chain management.

32. *Journal of Management Information Systems*, *32*(4), 4-39. http://dx.doi.org/10.1080/07421222.2015.1138364.

33. Chen, M., Mao, S., Zhang, Y., & Leung, V. C. (2014). *Big data: related technologies, challenges and future prospects*. Cham: Springer International Publishing.

34. Cheng, Y., Kuang, Y., Shi, X., & Dong, C. (2018). Sustainable investment in a supply chain in the big data era: an information updating approach. *Sustainability*, *10*(2), 403. http://dx.doi.org/10.3390/su10020403.
35. BANERJEE, A., LÜCKER, F. & RIES, J. M. 2021. An empirical analysis of suppliers' trade-off behaviour in adopting digital supply chain financing solutions. *International Journal of Operations & Production Management*, 41**,** 313-335.
36. BELHADI, A., KAMBLE, S., JABBOUR, C. J. C., GUNASEKARAN, A., NDUBISI, N. O. & VENKATESH, M. 2021. Manufacturing and service supply chain resilience to the COVID-19 outbreak: Lessons learned from the automobile and airline industries. *Technol Forecast Soc Change*, 163**,** 120447.
37. DHULL, S. & NARWAL, M. S. 2016. Drivers and barriers in green supply chain management adaptation: A state-of-art review. *Uncertain Supply Chain Management***,** 61-76.
38. DMITRY IVANOV, A. D. 2020. Viability of intertwined supply networks: extending the supply chain resilience angles towards survivability. A position paper motivated by COVID-19 outbreak. *International Journal of Production Research,*, 58**,** 11.

39. DORSAF ZOUARI , S. R., LAURENCE VIALE 2020. Does digitalising the supply chain contribute to its resilience? *International Journal of Physical Distribution & Logistics Management*, 51.
40. Dai, Q., Zhong, R., Huang, G. Q., Qu, T., Zhang, T., & Luo, T. Y. (2012). Radio frequency identification-enabled real-time manufacturing execution system: a case study in an automotive part manufacturer. *International Journal of Computer Integrated Manufacturing*, *25*(1), 51-65. http://dx.doi.org/10.1080/0951192X.2011.562546.

41. Deleris, L. A., Elkins, D., & Paté-Cornell, M. E. (2004). Analyzing losses from hazard exposure: a conservative probabilistic estimate using supply chain risk simulation. In *Proceedings of the 2004 Winter Simulation Conference* (pp. 1384-1391). Piscataway: IEEE. http://dx.doi.org/10.1109/WSC.2004.1371476.

42. Dubey, R., Gunasekaran, A., & Childe, S. J. (2019). Big data analytics capability in supply chain agility. *Management Decision*, *57*(8), 2092-2112. http://dx.doi.org/10.1108/MD-01-2018-0119.

43. Dubey, R., Gunasekaran, A., Childe, S. J., Luo, Z., Wamba, S. F., Roubaud, D., & Foropon, C. (2018a). Examining the role of big data and predictive analytics on collaborative performance in context to sustainable consumption and production behaviour. *Journal of Cleaner Production*, *196*, 1508-1521. http://dx.doi.org/10.1016/j.jclepro.2018.06.097.

44. Dubey, R., Luo, Z., Gunasekaran, A., Akter, S., Hazen, B. T., & Douglas, M. A. (2018b). Big data and predictive analytics in humanitarian supply chains. *International Journal of Logistics Management*, *29*(2), 485-512. http://dx.doi.org/10.1108/IJLM-02-2017-0039.

45. Dubey, R., Gunasekaran, A., Childe, S. J., Papadopoulos, T., Luo, Z., Wamba, S. F., & Roubaud, D. (2019a). Can big data and predictive analytics improve social and environmental sustainability? *Technological Forecasting and Social Change*, *144*, 534-545. http:// dx.doi.org/10.1016/j.techfore.2017.06.020.

46. Dubey, R., Gunasekaran, A., Childe, S. J., Roubaud, D., Fosso Wamba, S., Giannakis, M., & Foropon, C. (2019b). Big data analytics and organizational culture as complements to swift trust and collaborative performance in the humanitarian supply chain. *International Journal of Production Economics*, *210*, 120-136. http://dx.doi.org/10.1016/j.ijpe.2019.01.023.

47. Dubey, R., Gunasekaran, A., Childe, S. J., Wamba, S. F., & Papadopoulos, T. (2016). The impact of big data on world-class sustainable manufacturing. *International Journal of Advanced Manufacturing Technology*, *84*(1-4), 631-645. http://dx.doi.org/10.1007/s00170-015-7674-1.

48. Dutta, D., & Bose, I. (2015). Managing a big data project: the case of ramco cements limited. *International Journal of Production Economics*, *165*, 293-306. http://dx.doi.org/10.1016/j.ijpe.2014.12.032.

49. El-Kassar, A.-N., & Singh, S. K. (2019). Green innovation and organizational performance: the influence of big data and the moderating role of management commitment and HR practices. *Technological Forecasting and Social Change*, *144*, 483-498. http://dx.doi. org/10.1016/j.techfore.2017.12.016.

50. Engelseth, P., & Wang, H. (2018). Big data and connectivity in long-linked supply chains. *Journal of Business and Industrial Marketing*, *33*(8), 1201-1208. http://dx.doi.org/10.1108/JBIM-07-2017-0168.

51. Feng, Q., & Shanthikumar, J. G. (2018). How research in production and operations management may evolve in the era of big data.
52. *Production and Operations Management*, *27*(9), 1670-1684. http://dx.doi.org/10.1111/poms.12836.

53. Fisher, D., DeLine, R., Czerwinski, M., & Drucker, S. (2012). Interactions with big data analytics. *Interaction*, *19*(3), 50-59. http://dx.doi.

54. org/10.1145/2168931.2168943.

55. Gawankar, S. A., Gunasekaran, A., & Kamble, S. (2020). A study on investments in the big data-driven supply chain, performance measures and organisational performance in Indian retail 4.0 context. *International Journal of Production Research*, *58*(5), 1574-1593. http://dx.doi.org/10.1080/00207543.2019.1668070.

56. Giagnocavo, C., Bienvenido, F., Ming, L., Yurong, Z., Antonio Sanchez-Molina, J., & Xinting, Y. (2017). Agricultural cooperatives and the role of organisational models in new intelligent traceability systems and big data analysis. *International Journal of Agricultural and Biological Engineering*, *10*(5), 115-125. http://dx.doi.org/10.25165/j.ijabe.20171005.3089.

57. Giannakis, M., & Louis, M. (2016). A multi-agent based system with big data processing for enhanced supply chain agility. *Journal of Enterprise Information Management*, *29*(5), 706-727. http://dx.doi.org/10.1108/JEIM-06-2015-0050.

58. Gobble, M. M. (2013). Big data: the next big thing in innovation. *Research Technology Management*, *56*(1), 64-67. http://dx.doi.
59. org/10.5437/08956308X5601005.

60. Guha, S., & Kumar, S. (2018). Emergence of big data research in operations management, information systems, and healthcare: Past contributions and future roadmap. *Production and Operations Management*, *27*(9), 1724-1735. http://dx.doi.org/10.1111/poms.12833.

61. Gunasekaran, A., Papadopoulos, T., Dubey, R., Wamba, S. F., Childe, S. J., Hazen, B., & Akter, S. (2017). Big data and predictive analytics for supply chain and organizational performance. *Journal of Business Research*, *70*, 308-317. http://dx.doi.org/10.1016/j.jbusres.2016.08.004.

62. Gunasekaran, A., Yusuf, Y. Y., Adeleye, E. O., & Papadopoulos, T. (2018). Agile manufacturing practices: the role of big data and business analytics with multiple case studies. *International Journal of Production Research*, *56*(1-2), 385-397. http://dx.doi.org/1 0.1080/00207543.2017.1395488.

63. FREDERICO, G. F., GARZA-REYES, J. A., ANOSIKE, A. & KUMAR, V. 2019. Supply Chain 4.0: concepts, maturity and research agenda. *Supply Chain Management: An International Journal,* 25**,** 262-282.
64. GHOBAKHLOO, M. 2020. Industry 4.0, digitization, and opportunities for sustainability. *Journal of Cleaner Production,* 252.
65. JOÃO BARATA PAULO RUPINO DA CUNHA , J. S. 2018. Mobile supply chain management in the Industry 4.0 era: An annotated bibliography and guide for future research. *Journal of Enterprise Information Management.*
66. KNUT ALICKE, J. R., ANDREAS SEYFERT. 2019. Supply Chain 4.0 – the next-generation digital supply chain.
67. LIMINGXU, S., ALEXANDRA BRINTRUP 2021. Will bots take over the supply chain? Revisiting agent-based supply chain automation. *International Journal of Production Economics,*, 241.
68. LISA M. ELLRAMA, MONIQUE L. UELTSCHY MURFIELD 2019. Supply chain management in industrial marketing–Relationships matter. *Industrial Marketing Management*.
69. LIU, W., BAI, E., LIU, L. & WEI, W. 2017. A Framework of Sustainable Service Supply Chain Management: A Literature Review and Research Agenda. *Sustainability,* 9.
70. Laney, D. (2001a). Big 3D data management: Controlling data volume, velocity and variety. *META Group Research Note*, *6*(71), 1.

71. Laney, D. (2001b). *Application delivery strategies*. Stamford: META Group.

72. Lau, R. Y. K., Zhang, W., & Xu, W. (2018). Parallel aspect-oriented sentiment analysis for sales forecasting with big data. *Production and Operations Management*, *27*(10), 1775-1794. http://dx.doi.org/10.1111/poms.12737.

73. Lee, C. K. H. (2017). A GA-based optimisation model for big data analytics supporting anticipatory shipping in Retail 4.0. *International Journal of Production Research*, *55*(2), 593-605. http://dx.doi.org/10.1080/00207543.2016.1221162.

74. Lee, J., Lapira, E., Bagheri, B., & Kao, H. (2013). Recent advances and trends in predictive manufacturing systems in big data environment.

75. *Manufacturing Letters*, *1*(1), 38-41. http://dx.doi.org/10.1016/j.mfglet.2013.09.005.

76. Li, B., Ch'ng, E., Chong, A. Y.-L., & Bao, H. (2016). Predicting online e-marketplace sales performances: a big data approach. *Computers*

77. Industrial Engineering, *101*, 565-571. http://dx.doi.org/10.1016/j.cie.2016.08.009.

78. Li, L., Chi, T., Hao, T., & Yu, T. (2018). Customer demand analysis of the electronic commerce supply chain using Big Data. *Annals of Operations Research*, *268*(1-2), 113-128. http://dx.doi.org/10.1007/s10479-016-2342-x.

79. Li, S., Peng, G. C., & Xing, F. (2019). Barriers of embedding big data solutions in smart factories: insights from SAP consultants. *Industrial Management* & *Data Systems*, *119*(5), 1147-1164. http://dx.doi.org/10.1108/IMDS-11-2018-0532.

80. Lin, C. (2016). *Exploring big data capability: drivers and impact on supply chain performance*. Toledo, OH: University of Toledo.

81. Liu, C., Li, H., Tang, Y., Lin, D., & Liu, J. (2019). Next generation integrated smart manufacturing based on big data analytics, reinforced learning, and optimal routes planning methods. *International Journal of Computer Integrated Manufacturing*, *32*(9), 820-831. http:// dx.doi.org/10.1080/0951192X.2019.1636412.

82. Liu, P. (2017). Pricing strategies of a three-stage supply chain: a new research in the big data era. *Discrete Dynamics in Nature and Society*, *2017*, 2017. http://dx.doi.org/10.1155/2017/9024712.

83. Liu, P. (2019). Pricing policies and coordination of low-carbon supply chain considering targeted advertisement and carbon emission reduction costs in the big data environment. *Journal of Cleaner Production*, *210*, 343-357. http://dx.doi.org/10.1016/j.jclepro.2018.10.328.

84. Liu, P., & Yi, S. (2016). Investment decision-making and coordination of supply chain: a new research in the big data era. *Discrete Dynamics in Nature and Society*, *2016*, 2016. http://dx.doi.org/10.1155/2016/2026715.

85. Liu, P., & Yi, S. (2017). Pricing policies of green supply chain considering targeted advertising and product green degree in the big data environment. *Journal of Cleaner Production*, *164*, 1614-1622. http://dx.doi.org/10.1016/j.jclepro.2017.07.049.

86. Liu, Y.-P., Guo, J.-F., & Fan, Y. (2017). A big data study on emitting companies' performance in the first two phases of the European Union Emission Trading Scheme. *Journal of Cleaner Production*, *142*, 1028-1043. http://dx.doi.org/10.1016/j.jclepro.2016.05.121.
87. Mandal, S. (2019). The influence of big data analytics management capabilities on supply chain preparedness, alertness and agility.
88. *Information Technology* & *People*, *32*(2), 297-318. http://dx.doi.org/10.1108/ITP-11-2017-0386.
89. Mani, V., Delgado, C., Hazen, B. T., & Patel, P. (2017). Mitigating supply chain risk via sustainability using big data analytics: evidence from the manufacturing supply chain. *Sustainability*, *9*(4), 608. http://dx.doi.org/10.3390/su9040608.
90. Mashey, J. R. (1997). Big data... and the next wave of infrastress. In *Proceedings of the Computer Science Division Seminar*. Berkeley:University of California.
91. Mehmood, R., & Graham, G. (2015). Big data logistics: a health-care transport capacity sharing model. *Procedia Computer Science*, *64*, 1107-1114. http://dx.doi.org/10.1016/j.procs.2015.08.566.
92. Mikavicaa, B., Kostić-Ljubisavljevića, A., & Radonjić, V. (2015). Big data: challenges and opportunities in logistics systems. In *Proceedingsof the 2nd Logistics International Conference* (pp. 185-190). Belgrade, Serbia: LOGIC.
93. Militaru, G., Pollifroni, M., & Ioanid, A. (2015). Big data in supply chain management: an exploratory study. *Network Intelligence Studies*, (6), 103-108.
94. Mishra, D., Gunasekaran, A., Papadopoulos, T., & Childe, S. J. (2018). Big data and supply chain management: a review and bibliometric analysis. *Annals of Operations Research*, *270*(1-2), 313-336. http://dx.doi.org/10.1007/s10479-016-2236-y.

95. Mishra, N., Singh, A., Rana, N. P., & Dwivedi, Y. K. (2017). Interpretive structural modelling and fuzzy MICMAC approaches for customer centric beef supply chain: application of a big data technique. *Production Planning and Control*, *28*(11-12), 945-963. http://dx.doi. org/10.1080/09537287.2017.1336789.

96. Moktadir, M. A., Ali, S. M., Paul, S. K., & Shukla, N. (2019). Barriers to big data analytics in manufacturing supply chains: a case study from Bangladesh. *Computers & Industrial Engineering*, *128*, 1063-1075. http://dx.doi.org/10.1016/j.cie.2018.04.013.

97. Mourtzis, D., Vlachou, E., & Milas, N. (2016). industrial big data as a result of IoT adoption in manufacturing. *Procedia Cirp*, *55*, 290-295. http://dx.doi.org/10.1016/j.procir.2016.07.038.

98. MAILASAN JAYAKRISHNAN, A. K. M., MOKHTAR MOHD YUSOF2 2020. Digitalization Railway Supply Chain 4.0: Enterprise

99. Architecture Perspective. *International Journal of Advanced Trends in Computer Science and Engineering,* 9.

100. MARTIN BEAULIEUA, O. B. 2021. Digitalization of the healthcare supply chain: A roadmap to generate benefits and effectively support healthcare delivery.

101. *Technological Forecasting and Social Change,* 167.

102. MIETHLICH, B. B., DENIS 2; ABASOVA, SAMIRA 3; ZATSARINNAYA, ELENA 4; & VESELITSKY, O. 2020. Digital economy and its influence on competitiveness of countries and regions. 41**,** 20.

103. PEREZ-FRANCO, R., PHADNIS, S., CAPLICE, C. & SHEFFI, Y. 2016. Rethinking supply chain strategy as a conceptual system. *International Journal of Production Economics,*, 182.

104. SEYED MOJTABA HOSSEINI BAMAKAN , N. F. A. A. Z. R. 2021. Di-ANFIS: an integrated blockchain–IoT–big data-enabled framework for evaluating service supply chain performance. *Journal of Computational Design and Engineering,* 8**,** 13.

105. SHAHIN, A. 2010. SSCM: Service Supply Chain Management. *International Journal of Logistics Systems and Management,* 6.

106. SIMEONOV 2019. The System of Documents of the International Organization for Standardization: A Case Study. . *In International Documents for the 80's*

107. Terziovski, M. (2010). Innovation practice and its performance implications in small and medium enterprises (SMEs) in the manufacturing sector: a resource-based view. *Strategic Management Journal*, *31*(8), 892-902. http://dx.doi.org/10.1002/smj.841.

108. Tsao, Y.-C. (2017). Managing default risk under trade credit: Who should implement Big-Data analytics in supply chains? *Transportation Research Part E, Logistics and Transportation Review*, *106*, 276-293. http://dx.doi.org/10.1016/j.tre.2017.08.013.

109. Van Asselt, E. D., van der Fels-Klerx, H. J., Marvin, H. J. P., Van Bokhorst-van de Veen, H., & Groot, M. N. (2017). Overview of food safety hazards in the European dairy supply chain. *Comprehensive Reviews in Food Science and Food Safety*, *16*(1), 59-75. http:// dx.doi.org/10.1111/1541-4337.12245.

110. Van der Aalst, W. M. (2012). A decade of business process management conferences: personal reflections on a developing discipline.In *Proceedings of the International Conference on Business Process Management* (pp. 1-16). Berlin: Springer. http://dx.doi.org/10.1007/978-3-642-32885-5_1.

111. Vera-Baquero, A., Colomo Palacios, R., Stantchev, V., & Molloy, O. (2015). Leveraging big-data for business process analytics. *The Learning Organization*, *22*(4), 215-228. http://dx.doi.org/10.1108/TLO-05-2014-0023.
112. Waller, M. A., & Fawcett, S. E. (2013). Data science, predictive analytics, and big data: a revolution that will transform supply chain design and management. *Journal of Business Logistics*, *34*(2), 77-84. http://dx.doi.org/10.1111/jbl.12010.
113. Wamba, S. F., Akter, S., Edwards, A., Chopin, G., & Gnanzou, D. (2015). How 'big data'can make big impact: Findings from a systematic review and a longitudinal case study. *International Journal of Production Economics*, *165*, 234-246. http://dx.doi.org/10.1016/j. ijpe.2014.12.031.
114. Wang, G., Gunasekaran, A., Ngai, E. W., & Papadopoulos, T. (2016). Big data analytics in logistics and supply chain management: certain investigations for research and applications. *International Journal of Production Economics*, *176*, 98-110. http://dx.doi. org/10.1016/j.ijpe.2016.03.014.
115. Weerakkody, V., Kapoor, K., Balta, M. E., Irani, Z., & Dwivedi, Y. K. (2017). Factors influencing user acceptance of public sector big open data. *Production Planning and Control*, *28*(11-12), 891-905. http://dx.doi.org/10.1080/09537287.2017.1336802.
116. Weng, W.-H., & Weng, W.-T. (2013). Forecast of development trends in big data industry. In *Proceedings of the Institute of Industrial Engineers Asian Conference 2013* (pp. 1487-1494). Singapore: Springer. http://dx.doi.org/10.1007/978-981-4451-98-7_174.
117. Witkowski, K. (2017). Internet of things, big data, industry 4.0-: nnovative solutions in logistics and supply chains management. *Procedia Engineering*, *182*, 763-769. http://dx.doi.org/10.1016/j.proeng.2017.03.197.
118. Wolfert, S., Ge, L., Verdouw, C., & Bogaardt, M.-J. (2017). Big data in smart farming: a review. *Agricultural Systems*, *153*, 69-80. http:// dx.doi.org/10.1016/j.agsy.2017.01.023.
119. Wu, K.-J., Liao, C.-J., Tseng, M.-L., Lim, M. K., Hu, J., & Tan, K. (2017). Toward sustainability: using big data to explore the decisive attributes of supply chain risks and uncertainties. *Journal of Cleaner Production*, *142*, 663-676. http://dx.doi.org/10.1016/j. jclepro.2016.04.040.
120. Wu, P.-J., & Lin, K.-C. (2018). Unstructured big data analytics for retrieving e-commerce logistics knowledge. *Telematics and Informatics*, *35*(1), 237-244. http://dx.doi.org/10.1016/j.tele.2017.11.004.
121. Xu, F., Li, Y., & Feng, L. (2019). The influence of big data system for used product management on manufacturing: remanufacturing operations. *Journal of Cleaner Production*, *209*, 782-794. http://dx.doi.org/10.1016/j.jclepro.2018.10.240.

122. Xu, L. (2016). Construction mode of efficient logistics system under the big data environment. *Advanced Science and Technology Letters*, *138*, 150-155. http://dx.doi.org/10.14257/astl.2016.138.31.
123. Yadegaridehkordi, E., Hourmand, M., Nilashi, M., Shuib, L., Ahani, A., & Ibrahim, O. (2018). Influence of big data adoption on manufacturing companies' performance: an integrated DEMATEL-ANFIS approach. *Technological Forecasting and Social Change*, *137*, 199-210. http://dx.doi.org/10.1016/j.techfore.2018.07.043.

124. Yu, L., Zhao, Y., Tang, L., & Yang, Z. (2019). Online big data-driven oil consumption forecasting with Google trends. *International Journal of Forecasting*, *35*(1), 213-223. http://dx.doi.org/10.1016/j.ijforecast.2017.11.005.

125. Zaki, M., Theodoulidis, B., Shapira, P., Neely, A., & Tepel, M. F. (2019). Redistributed manufacturing and the impact of big data: a consumer goods perspective. *Production Planning and Control*, *30*(7), 568-581. http://dx.doi.org/10.1080/09537287.2018.1540068.

126. Zhan, Y., Tan, K. H., Li, Y., & Tse, Y. K. (2018). Unlocking the power of big data in new product development. *Annals of Operations Research*, *270*(1-2), 577-595. http://dx.doi.org/10.1007/s10479-016-2379-x.

127. Zhang, Y., Ren, S., Liu, Y., & Si, S. (2017). A big data analytics architecture for cleaner manufacturing and maintenance processes of complex products. *Journal of Cleaner Production*, *142*, 626-641. http://dx.doi.org/10.1016/j.jclepro.2016.07.123.

128. Zhao, R., Liu, Y., Zhang, N., & Huang, T. (2017). An optimization model for green supply chain management by using a big data analytic approach. *Journal of Cleaner Production*, *142*, 1085-1097. http://dx.doi.org/10.1016/j.jclepro.2016.03.006.

129. Zhong, R. Y., Huang, G. Q., Lan, S., Dai, Q. Y., Chen, X., & Zhang, T. (2015). A big data approach for logistics trajectory discovery from RFID-enabled production data. *International Journal of Production Economics*, *165*, 260-272. http://dx.doi.org/10.1016/j.ijpe.2015.02.014.

130. Zhong, R. Y., Xu, C., Chen, C., & Huang, G. Q. (2017). Big data analytics for physical internet-based intelligent manufacturing shop floors. *International Journal of Production Research*, *55*(9), 2610-2621. http://dx.doi.org/10.1080/00207543.2015.1086037.

131. ZEKHNINI, K., CHERRAFI, A., BOUHADDOU, I., BENGHABRIT, Y. & GARZA-REYES, J. A. 2020. Supply chain management 4.0: a literature review and research framework. *Benchmarking: An International Journal*, 28**,** 465-501.

132. ZOUARI, D., RUEL, S., & VIALE, L. (2020). 2020. Does digitalising the supply chain contribute to its resilience?. *International Journal of Physical Distribution & Logistics Management*.. *International Journal of Physical Distribution & Logistics Management*.