Efficiency and Performance of Big Data Analytics for Supply Chain Management

Elena PUICA
Bucharest University of Economic Studies, Romania
elenaa.puica@gmail.com

This paper aims to clarify the problem of Supply Chain Management (SCM) efficiency in the context of universal theoretical reflections relating to SCM and analyze the correlation between Big Data Analytics and the efficiency and performance of the supply chain. An adequate SCM has to be cost-effective (economic efficiency), functional (reducing processes, minimizing the number of links in the SCM to the necessary ones), and ensuring high quality of services and products (customer-oriented logistics systems). The efficiency of SCM is not only an activity for which the logistics department is in charge, as it is a strategic decision taken by the management regarding the method of future company operation. Correctly organized and fulfilled logistics tasks may advance the performance of an organization and the whole SCM. Essential enhancements in SCM efficiency may be ensured by analyzing theoretical models on the strategic level and implementing a selected concept.
Keywords: *Big Data Analytics, Big Data Analytics efficiency, Big Data Analytics in SCM, SCM Performance*
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1 Introduction

The expansion of information technology (IT) increases client outlooks; economic globalization has pushed organizations to adjust. Supply chain professionals are trying to handle the enormous amount of data to reach high effectiveness and performance in Supply Chain Management (SCM). The increase in volume and different forms of data all over the SCM has generated the necessity to advance technologies that can perceptively and rapidly analyze an enormous volume of data. Big Data Analytics (BDA) can support SCM to overcome their difficulty. BDA offers an instrument for extracting basic patterns and information in a vast volume of data. With BDA, SCM could better understand their client's requirements, offer convenient services to meet their requests, enhance sales and income, and access new markets.

The present study specifies the benefits of extensive data application in taking out new understandings and generating new methods of value that have influenced SCM relationships by growing efficiency and performance. Regarding this purpose, the first part of the research defines the SCM performance and efficiency. Second, it presents the BDA in its role and usage in SCM. Third, a model is presented to analyze the efficiency and performance of BDA usage in manufacturing, and lastly, the research ends with the conclusion and recommendations for future research.

2 Supply Chain Management efficiency and performance

Studies painted the importance of separate phases of delivery of quality, such as product design, procurement, and storage and delivery. The support of new complex product design procedures is indispensable for the whole production process and maintaining the quality of products. Managing storage and delivery is essential for supervising the demand uncertainty and delivery of quality. The talent development process for employees can be a vital factor for assessing the performance of SCM, and improving and investing in the employees' talent and knowledge results in quality performance.

Reducing instances of information asymmetry across the SCM and correctly identifying events that can create disruptions in the processes can be done by assessing the risk management, communicating, and sharing data in a reliable method. Since resources are limited,

SCM cannot sightlessly invest in quality activities to increase performance and efficiency. They are investigating buyers' SCM policies to diminish total SCM cost by defining target service levels.
Enhancement of the efficiency in SCM makes it necessary to observe the efficiency of buyers and suppliers. SCM practices, including level and quality of data sharing, can lead to improved operations. SCM performance is positively related to organizational performance; the quality of SCM requires providing the best quality products or services to customers across shared quality management of the SCM by its members, such as buyers and suppliers [1]. To acquire a competitive advantage and enhance SCM performance, the SCM responsible must monitor the efficiency [2]. The flat structure of an organization affects SCM planning and corporate coordination, which, in turn, directly improve manufacturing capability [3]. Critical success aspects for implementing SCM, verifying those organizational behaviors, such as culture, vision, and structure, broadly impact supply chain quality management.[4]
The method is another critical part of the performance of SCM; it comprises various elements: distribution of quality, aptitude development, and risk management. Distribution of quality is sequentially organized in product development, approval of production, purchasing, examination, storage, and delivery. SCM quality management in product design and the logistic process is essential in SCM operations [5]. Successful SCM is reliant on the continuous development of customer-friendly products and management quality [6].
Different factors of crucial significance for efficiency in SCM are the systems utilized, mission, organization culture, human resources, or incentive systems. Certain relations resultant in interaction effects are linked to these features, defining the efficiency of implemented logistics processes. A shortage and absence of information technology systems controlling the real-time efficiency of all processes may result in the absence of harmonious effects, which clarifies the low efficiency of logistics systems in the past. Whole logistics activity in the arrangement of a system generates benefits, involving the opportunity of defining close relations among nominated subsystems, making it likely to conduct in-depth research regarding effectiveness.

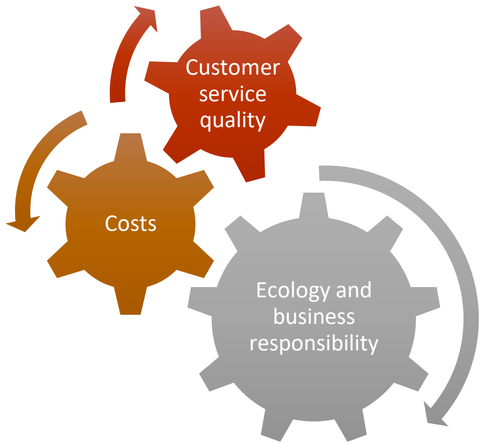

Fig. 1. Analytical extents of the efficiency in Supply Chain Management

An effective SCM should be cost-effective, ensure economic efficiency and function, reduce lean processes, minimize and adapt SCM teams and internal activities to a common purpose built on its efficiency. Functionality is explained as the correct preparation of goods facilitating their acceptance in warehouses or shops. Goods should be labeled to ensure their faultless and fast identification so that the time devoted to their acceptance reduces to the necessary minimum. Implementation of RFID-based technologies significantly accelerates this process, ensuring high quality of services (customer-oriented logistics systems); socially responsible (considering stakeholders' social interest and maximally reducing environmental impact). (see Figure 1.)
Factors, such as implementing Key Performance Indicators (KPI) measurements and accurate transfer of information to concerned parties involved, the outcome in a particular process and is becoming more effective.

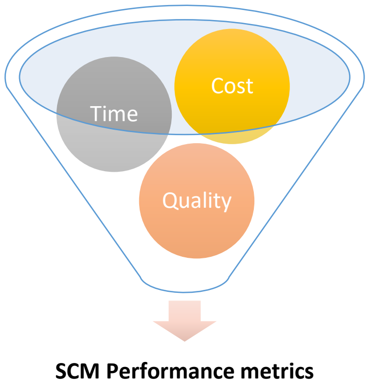

Fig. 2. Supply Chain Management Performance Metrics

SCM demands the flow of goods and services more efficiently; it contains all the steps involved in acquiring raw materials to the finished goods efficiently and provides value to the customer. SCM is a vital portion of operations; it creates robust communication and relationships with suppliers, avoiding shipment interruptions and diminishing logistical faults. An efficient SCM bounces an improved negotiating influence to get the best rates and products in the shortest time possible, reducing the inventory prices and improving the operations' overall planning and productivity within SCM.

Efficiency improvement of SCM processes necessitates dynamic and permanent action on SCM management; the competitiveness principally is founded on the suitability of answering to global trends and challenges for IT technologies. Due to the growing struggle of shippers distributing goods to customers, numerous SCM responsible have third-party logistics, which can advance the quality of customer service. In SCM, where the IT technologies implemented and used in their logistics activities have allowed improved control and coordination of the delivery of goods more effectively, optimized their departments' work, and reduced logistics costs [7].

3 Big Data Analytics and Supply Chain Management

Big Data produces productivity in businesses, which gives many opportunities to make significant progress [8]. The future competitions in business productivity and technologies will indeed converge into the Big Data explorations. According to Sahay and Ranjan (2008), "Supply chain analytics provides a broad view of an entire supply chain to reveal full product and component. Supply chain analytics provides a single view across the supply chain. It includes pre-packaged KPI, analytics." and O'Dwyer and Renner (2011) "advanced supply chain analytics represent an operational shift away from management models constructed on responding to data. Using proven analytical and mathematical techniques, Big Data Analytics in SCM can help professionals analyze increasingly larger data sets".

SCM has accelerated the Big Data Analytics (BDA) initiatives to gain critical insight into achieving competitive advantage. Practitioners and scholars have categorized BDA as a prospective frontier for innovation, competition, and productivity. [9] BDA can improve SCM performance by enhancing the visibility, resilience, robustness of the processes, and organizational performance. Achieving the goals of efficiency in SCM is possible because of IT technology based on logistics needs. IT focuses on resolving individual and complex activities (production and planning, process optimization, procurement activities, speed within the SCM, logistics activities, transportation management, Etc.) in SCM.

Fig. 3. Kamada-Kawai Network of the identified Big Data sources across SCM

In SCM, many components, processes, methods, and processes generate voluminous data, referenced as Big Data sources; some of the most relevant sources are described in Figure 3.

Developments in technology allow SCM to accumulate and analyze previously unavailable data to enhance business processes or create new ones. Predictive analytics, which generates refueling and maintenance schedules, can be implemented by all vehicle producers and could reduce the costs for client fuel while boosting the performance, efficiency, and life expectancy of future motor vehicles. Because of the automation, a high probability of occupations in the SCM is replaced by computer automation [10]. Enhanced IT functionalities in manufacturing firms mediate a positive relationship between inventory sharing and inventory efficiency [11]. SCM inventories are disposed to variations and instability; slight discrepancies in the end item request produce alternations that increase throughout the SCM. A significant effect is isolated demand forecasting executed at each level of SCM, and demand and forecast allocation strategies can drastically eliminate the bullwhip effect [12].

IT department technical quality, IT plan utilization, and top management of IT positively affected IT impact on the SCM, with a positive relationship between IT impact and firm performance [13]. To achieve the best operational performance, managers should pay attention to transferring knowledge, competencies, and cultural change [14]. IT is considered reasonable, powerful, and accessible, and without IT, an effective SCM is impossible to comply with. The advance and acceptance of IT have become a common phenomenon in the SCM [15]. Recent studies and interest in Big Data have conducted many SCM to develop BDA to enhance firm performance. BDA is a classified model, which consists of three primary dimensions (management, information technology, and talent capabilities) and eleven sub-dimensions (planning, investment, coordination, control, connectivity, compatibility, modularity, technology management knowledge, technical knowledge, business knowledge, and relational knowledge) [16]. BDA can function across all the levers of SCM, passing on information from one area to another area, but the combination of data requires accuracy, correctness, consistency, and completeness.

4 Analyzing the efficiency and performance of Big Data Analytics usage in manufacturing companies

SAP Analytics Cloud (SAC) has been utilized to build a model and analyze the efficiency and performance of BDA usage in manufacturing companies around European countries. SAP Analytics Cloud (SAC) has been utilized. SAC is platform-independent and permits functions to discover, analyze, plan, and predict the data. SAC offers various data sources to create models and develop reports with charts, including Geo Maps and tables.

4.1. Identification of the Business Problem

Business-specific understanding and problem recognition are essential to building a successful analytic model. The model for this research is applied to discover and gain insight into the correlation of Big Data Usage and the value of turnover for manufacturing companies in Europe.

4.2. Definition of the Hypotheses

The hypotheses are established from the business challenge; the purpose is to narrow down the business problem and make projections about the relationships between two or more data variables. In this study, the following objective is to discover a correlation between BDA usage percentage in manufacturing and the enterprises' performance and efficiency by analyzing the turnover index. Two control variables are included, and these variables are "Big Data Usage percentage" and the "turnover index" for manufacturing in European countries.

4.3. Data Collection

Data collected is in a structured format (spreadsheets), and it was extracted from the Eurostat database. Eurostat is the statistical database office of the European Union, is a world-leading database widely known for its extensive, reliable content and high-quality statistics and data on Europe. The quality of data is key to the success of the model. A helpful model must ensure the right (independent) variables and correct weights to create a helpful model.

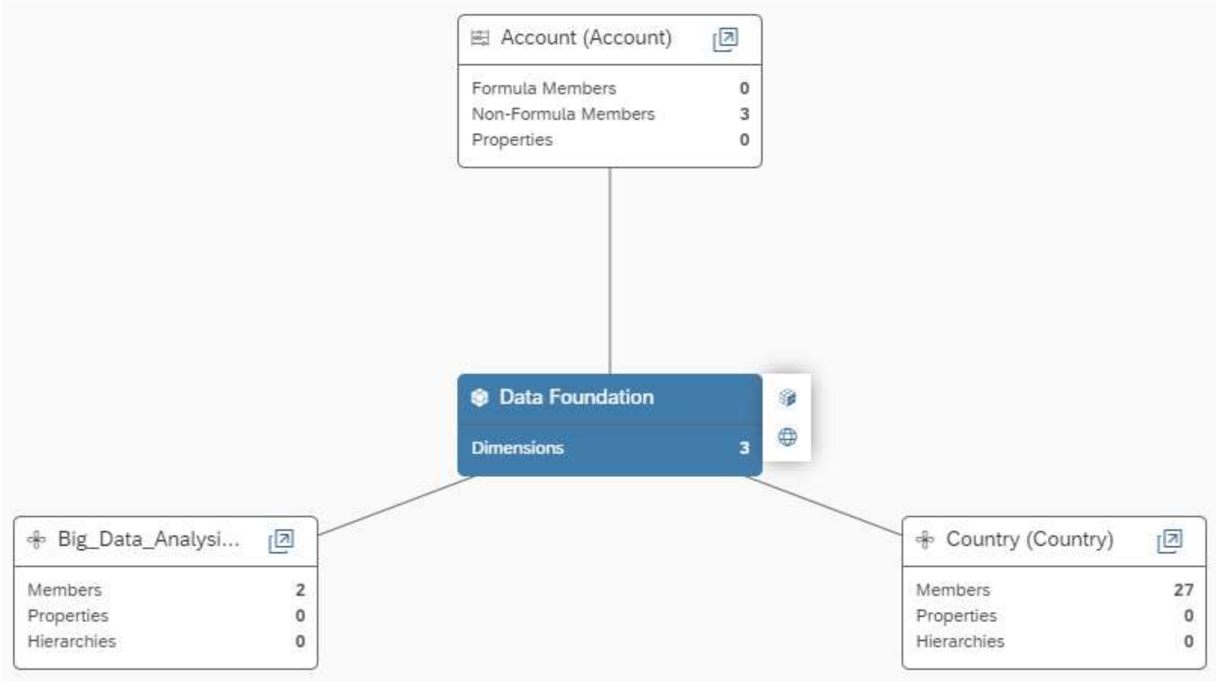

Fig. 4. SAP Analytics Cloud model measures and dimensions

Accomplishing this research study's objective, a model was built, and three measures were analyzed: Big Data usage percentage, turnover, and the number of employees. It was also analyzed two dimensions, the significant data analysis type (Percentage of enterprises analyzing big data internally or externally) and the country (European Countries). (see Figure 4)

4.4. Analyzing the Model Outcome

This case study has determined to build and train the model, which can be used to apply against a current business data set for making predictions about the current data and ultimately make business decisions based on the predictions. This study analyzed the percentage of manufacturing enterprises in different European countries that analyze Big Data internally or externally and the turnover index.

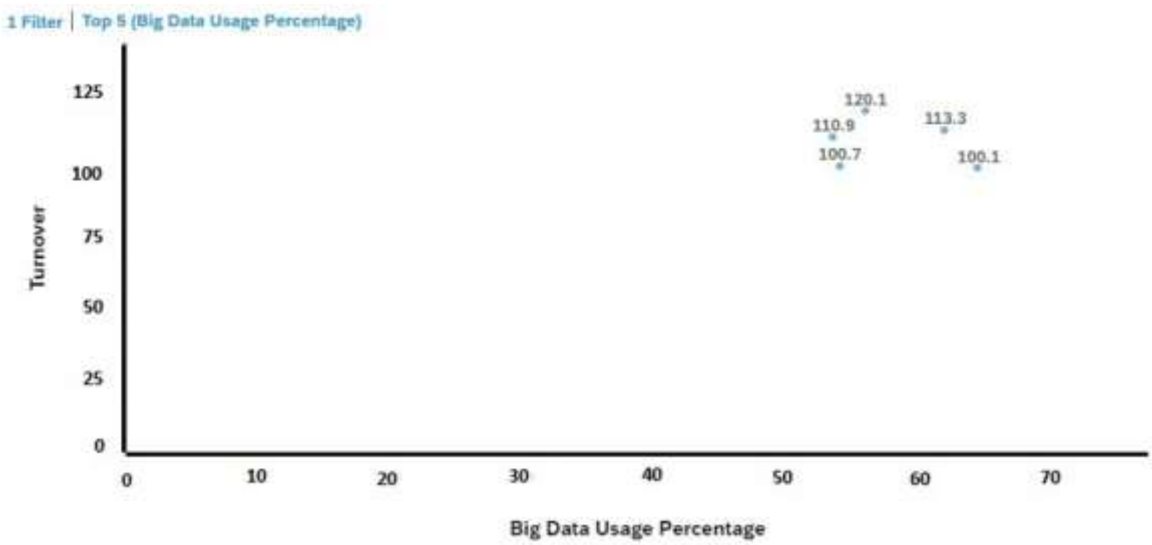

Fig. 5. Big Data Usage Percentage in European Countries and Turnover Index (Top 5)

The outcome of the model applied that analyzes the influence of Big Data usage (x axis) on the Turnover Index (y axis) in manufacturing European Countries shows that most of the countries that have a more considerable percentage of usage of Big Data in manufacturing industries have registered high values for the turnover index in the manufacturing sector. The countries that analyze big data internally or externally, with a Big Data usage percentage above 50%, it was found out that they also have high turnover than the countries with a Big Data usage percentage below 50%. (see Figure 5)

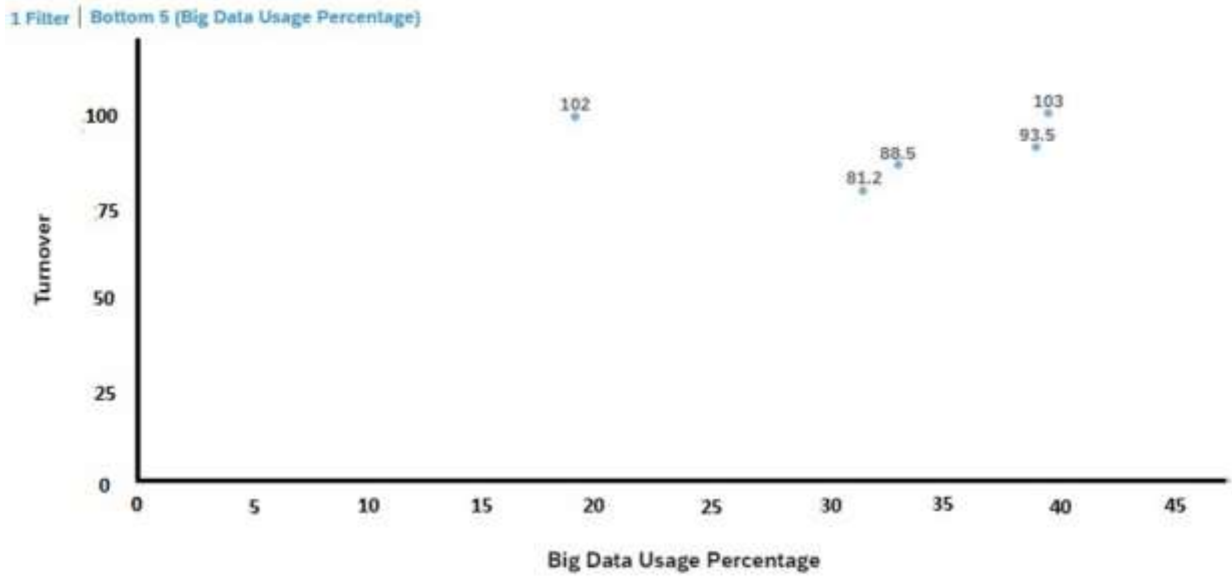

Fig. 6. Big Data Usage Percentage in European Countries and Turnover Index (Bottom 5)

On the other side, the countries that analyze big data internally or externally, with a Big Data usage percentage below 50%, noticed a low value of the turnover index than the countries with a Big Data usage percentage above 50%. An efficient SCM functions accurately on reliable, accurate, and optimized tools. Big Data teaches the software system, generates alerts when programmed, and makes it easy to gather information.

Cost reduction represents an essential task to every SCM and is one of the main reasons organizations implement Big Data and apply it in their processes. With Big Data analytics technology, SCM managers gain insights into new ways to optimize SCM efficiency, revise standards, and reduce overall costs. There are many challenges and lack of control capabilities that impact Big Data in the SCM. SCM managers do not have much experience with the Big Data Analysis methods that data scientists operate, often resulting in a lack of vision in seeing the potential of Big Data Analytics. Another challenge is the lack of a structured process to explore, evaluate and capture Big Data opportunities in SCM.

5 Conclusions

This study analyzes the efficiency of Big Data Analytics in SCM by grouping the index of turnover and the percentage of Big Data analytics used for manufacturing companies. The results show that the efficiency and performance of turnover are impacted by using big data analytics in a positive direction. This study is significant because it considers the perspective of the efficiency and performance in SCM, analyzing the different aspects of the SCM and their impact on providing successful results in SCM processes and how they influence efficiency. SCM responsible should recognize the firm's position within the SCM and perceive the efficiency of Big Data Analytics in the business processes. SCM responsible may have the requirement to consider that an SCM needs firstly to be planned effectively, considering several aspects that can influence the operations. SCM appropriately planned and fulfilled logistics activities may improve the performance and effectiveness of the whole chain. A strategic analysis process will make SCM less effective, disregarding the importance of designing and planning the activities effectively. Elaborating on an accurate new model or streamlining the existing SCM may be beneficial regarding its market position and financial results.

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Elena PUICA is a PhD student at the Economic Informatics Doctoral School, The Bucharest University of Economic Studies since 2020, and activating in the professional field as SAP Consultant.