

Big Data Analytics in Supply Chain Management

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INTRODUCTION

During the last several years there was an amazing progression in the amount of data produced within the supply chain information systems, but also externally. This poses many challenges related to data analysis specifically in terms of know-how, technology, infrastructure, software systems and development methods. The current business climate demands real-time analysis, faster, collaborative and more intelligent decision making.

The current approach to supply chain intelligence has some fundamental challenges when confronted with the scale and characteristics of big data. These include not only data volumes, velocity and variety, but also data veracity and value (Arunachalam, 2018).

The best way to effectively analyze these composite systems is the use of business intelligence (BI). Traditional BI systems face many challenges that include processing of vast data volumes, demand for real-time analytics, enhanced decision making, insight discovery and optimization of supply chain processes. Big Data initiatives promise to answer these challenges by incorporating various methods, tools and services for more agile and flexible analytics and decision making. Nevertheless, potential value of big data in supply chain management (SCM) has not yet been fully realized and requires establishing new BI infrastructures, architectures, models and tools (Marr, 2016).

Supply chain BI system proved to be very useful in extracting information and knowledge from existing enterprise information systems, but in recent years, organizations face new challenges in term of huge data volumes generated through supply chain and externally, variety (different kind of structured and unstructured data), as well as data velocity (batch processing, streaming and real-time data). Most of the existing analytical systems are incapable to cope with these new dynamics (Larson & Chang 2016).

On the other hand, we have seen tremendous advancements in technology like in-memory computing, cloud computing, Internet of Things (IoT), NoSQL databases, distributed computing, machine learning, etc. Big data is a term that underpins a raft of these technologies that have been created in the drive to better analyze and derive meaning from data at a dramatically lower cost and while delivering new insights and products for organizations in the supply chain.

The key challenges for modern supply chain analytical systems include (Wang et al., 2016):

- § Data explosion – supply chains need the right tools to make sense of the overwhelming amount of data generated by a growing set of data internal and external sources.
- § Growing variety of data – most of the new data is unstructured or comes in different types and forms.
- § Data speed – data is being generated at high velocity which makes data processing even more challenging.

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- § Real-time analysis - in today's turbulent business climate the ability to make the right decisions in real-time brings real competitive advantage. Yet many supply chains do not have the infrastructure, tools and applications to make timely and accurate decisions.
- § Achieving simplified deployment and management – despite its promise, big data systems can be complex, costly and difficult to deploy and maintain. Supply chains need more flexible, scalable and cost-effective infrastructure, platforms and services, such as those offered in cloud

In this chapter, challenges and new trends in supply chain big data analytics are discussed and background research of big data initiatives related to SCM is provided. The chapter also describes the main technologies, methods and tools for big data analytics. The methodology and the unified model for supply chain big data analytics which comprises the whole BI lifecycle is presented. Architecture of the model is scalable and layered in such a way to provide necessary agility and adaptivity. The proposed big data model encompasses supply chain process model, data and analytical models, as well as insights delivery. It enables creation of the next-generation cloud-based big data systems that can create strategic value and improve performance of supply chains. An example of supply chain big data solution that illustrates applicability and effectiveness of the model is presented. Finally, future trends, directions and technologies are presented.

BACKGROUND

As the globalized business environment is forcing supply chain networks to adapt to new business models, collaboration, integration and information sharing are becoming even more critical for the ultimate success. Supply chains enterprise systems are experiencing a major structural shift as more organizations rely on a community of partners to perform complex supply chain processes. While supply chains are growing increasingly complex, from linear arrangements to interconnected, multi-echelon, collaborative networks of companies, there is much more information that needs to be stored, processed and analyzed than there was just a few years ago (Tiwari et al., 2018).

Supply chain business intelligence is a collection of activities to understand business situations by performing various types of analysis on the organization data as well as on external data from supply chain partners and other data sources (devices, sensors, social networks, etc.) to help make strategic, tactical, and operational business decisions and take necessary actions for improving supply chain performance. This includes gathering, analyzing, understanding, and managing high volumes of variety data about operation performance, customer and supplier activities, financial performance, production, competition, regulatory compliance, quality controls, device data and Internet (Stefanovic & Milosevic, 2018).

Over the past few decades, the way in which companies need to collate, analyze, report and share their data has changed dramatically. Organizations need to be more adaptive, have increased access to information for decision-making, and effectively deal with a rapidly growing volume of data. Today's business environment demands fast supply chain decisions and reduced time from raw data to insights and actions. Typically, supply chains are capturing enormous data volumes - including vast amounts of unstructured data such as files, images, videos, blogs, clickstreams and geo-spatial data, as well as data coming from various sensors, devices, and social networks (Stefanovic & Milosevic, 2017).

During the past two decades organizations have made large investments in SCM information systems in order to improve their businesses. However, these systems usually provide only transaction-based functionality and mostly maintain operational view of the business. They lack sophisticated analytical

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