# Big Data Analysis for Supply Chain Management: Evidence from Finance, Retailing and Logistics Industry

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**Abstract.** With the development of big data and the increasing abundance of content derived from it, applications linking big data to supply chain management are gaining increasing attention. Some researchers however believe technology of big data is not quite grown up enough. This paper therefore investigates and summarizes the recent progress in terms of big data analysis (BDA) and supply chain management (SCM). To be specific, it concludes with the state-of-art exploration of the application of BDA in SCM from the fields of financial institutions, the retail industry and the logistics industry. According to the analysis, it is found that the state-of-art BDA approaches and scenarios can meet the needs and requirements of SCA, which can effectively improve the deficiencies, increase efficiency, and reduce costs. This paper will provide recommendations and examples for users who are still skeptical about big data and shed light on guiding further exploration of BDA in SCM.

**Keywords:** Big data; SCM; logistic; retailer; application.

## 1. Introduction

The speed of technological advancement and the role of data in e-commerce has had an explosive impact on traditional brick and mortar operations. Since data often contains a wealth of resources, analyzing it effectively and linking it to business decisions can be of great benefit to businesses. However, not all businesses can make good use of big data resources. At the moment, big data is used in enterprise resource planning and supply chains. Sales, inventory and operational planning are the most big data-driven parts of the supply chain. Guidelines for inventory levels are provided by using big data to combine past sales trends with forecasting techniques. As a result, this helps to reduce the cost outlay so that the supply chain can order enough supply without having to order too much or too little, resulting in waste or not enough sales.

In the contribution by Sunil Tiwari et al [1], the authors surveyed research and applications of data in supply chains in different industries over a six-year period by reviewing 100 peer-reviewed articles in the literature. The study focused on the use of large volumes of customer information in supply chain management and the publication and updating of big data analytics in supply chains, as well as the governance implications of data applications in SCM. In the publication by Kuldeep Lamba et al [2], the authors explore the current state of research on big data in three key areas of the supply chain (sourcing, manufacturing and logistics) by reviewing the appropriate papers on the topic of combining big data with management of applications in operations and supply chains. In addition, facility layout issues, sourcing issues and joint sourcing in which vendor and provider options are considered under these three key sectors are examined in detail, and the link between order allocation and big data. In Truong Nguyen et al. investigate in which areas of the supply chain big data is expected to play a role and to what extent it will be used [3]. The paper uses techniques from BDA to develop these models following Schoenherr et al. by means of a questionnaire survey of professionals in supply chain management, appended with observations of students who had previously studied related courses [4]. Answers were obtained on the scope and basic motivations for the current use of predictive analytics in supply chain management. Hans W. Ittmann [5] demonstrate the benefits of data for providing creative ideas and different approaches to value, and talks about how it is affecting the way supply chain relationships are conducted. The usefulness of data for predicting trends is described in detail. And the applications in management are mentioned. They provide information on the use of BDA in

many types of SCM. Finally, the authors offer some insights into the combined application of big data and supply chains.

This article will inform the potential applications of big data in the supply chain so that more managers from different industries and organizations can see the feasibility of combining big data with supply chain applications and utilize them. This paper will first focus on the definition and benefits of big data and supply chain management, as well as the links between them and the benefits that can be derived from applying big data in supply chain management. Secondly, it will show the way of big data is used in the supply chain of financial institutions. The current state and future of big data and financial supply chains will be explored as well as the advantages and disadvantages of combining big data and supply chains for institutions. Then, an introduction will be given to what retail is and the specific processes and importance of it. It will show how retail has been defined in the past and how it differs now and the specific ways in which data can be combined with the retail supply chain and explore impact of the combination on the retail industry. Subsequently, an introduction to the logistics industry and the importance of each component will be presented. This is followed by a demonstration of the current situation and the advantages and disadvantages of applying big data to the logistics supply chain. Next, the limitations of applying big data to industry supply chains and some future changes and outlooks will be explored. It will be concluded with a concise conclusion.

## 2. Descriptions of BDA in SCM

Big data describes a large and diverse set of information in an ever-growing volume. It encompasses the amount of information, the speed at which it is created and collected, and the diversity or range of data points covered. The richness of the data set gives companies the opportunity to conduct more in-depth analysis and understanding of consumers. Based on the increased volume of data, companies can design and produce products or services that are more popular with customers. Nevertheless, companies can also be overloaded and disturbed by the increase in data, thus reducing the usefulness of the data. Companies must be able to handle more data and decide which data is the key factor. In addition, due to the nature and format of the data, special handling and processing may be required before it can be manipulated [6, 7].

The management of goods or services and the process of transforming and processing raw materials into a final consumer-oriented product is known as supply chain management. It includes forecasting and streamlining the supply activities of a company to maximise available resources and gain a competitive advantage in the marketplace. Supply chain management links the five most critical elements, namely strategy development, sourcing raw materials, production, distribution and returns. The most important function of supply chain management is responsible for controlling and reducing costs and avoiding shortages of supply that prevent delivery to customers or oversupply that leads to additional expenditure and wastage. In order to achieve these functions, companies must monitor raw material inventories, production distribution, sales and supplier inventories [8, 9].

Although supply chains have been around for many years, the combined use with big data has only emerged in recent years. First of all, big data enables companies to take advantage of opportunities as they arise, primarily by predicting inventory. Predicting sales trends and stock fluctuations requires a wealth of data and intelligent predictive analytics. The second is that big data enables monitoring of order fulfilment and tracking of completion. This is key to business productivity and customer satisfaction. Moreover, big data systems, by combining with IoT devices, can reflect the existence of problems in time to avoid losses [10].

## 3. Application in the Financial Institutions

Financial institutions are working on integrating big data into the financial supply chain in recent years in order to remain competitive in the industry. The financial supply chain is a management

concept that has been derived by global companies in order to reduce costs. In the context of big data, financial institutions can keep an eye on the state of supply chain operations and have a comprehensive and specific grasp of the weak links in the supply chain in particular. In the past, financial institutions simply made a risk assessment of a single enterprise and thus judged whether to grant credit. This approach is changing with the increasing integration of data analytics and supply chains. By analysing the data, financial institutions are able to make effective predictions about some of the debt risks in the service chain, as well as the choices of core companies and clusters in the chain [11]. They can track the cash flow and logistics of the chain's production and operations, stabilisation and trading activities in a timely manner. A typical skecth of the procedure is shown in Fig. 1.

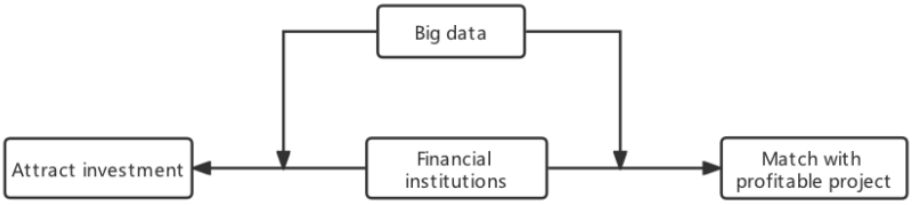


**Fig. 1** A sketch of the procedure for BDA in financial institutions.

The present and future in the finance about big data and SCM is to strengthen and improve the credit rating system, establish credit risk guarantee mechanism, maximize the risk management in the supply chain, and effectively guarantee the stable development of the enterprises in the supply chain [12]. The long-term development of supply chain finance cannot be achieved without data as support. In the supply chain of finance, there are mostly some relevant data from suppliers or core enterprise customers, and some financial data from internet platforms. Only by integrating these data can the value of them be discovered and contribute to the good development of supply chain finance.

Financial institutions can hedge their losses with the help of big data [13]. The small size of small and medium-sized enterprises (SMEs), low credit ratings, irregular financial data and poor quality collateral are factors that make the transaction costs and risks too high for banks and other financial institutions to extend credit to them. As big data and supply chains operate simultaneously, the risks faced by institutions will become manageable. This is because financial institutions can screen out companies with hidden risks by analysing the big data collected from upstream and downstream companies. Financial institutions can better help the supply chain run and invest through big data analysis information [14]. The market is often mixed with good and bad when there is a large amount of investment information. By using big data to analyse the source of the information and make a future-oriented map, institutions will be able to see more intuitively where the information is coming from. This will help the agency to see more visually where the investment is going. Nevertheless, companies must comply with data conservation measures and laws when collecting data. Campaigns to protect customer privacy are growing. This was demonstrated by the various pieces of legislation that have been introduced recently, such as the EU's GDPR. As legislation and rules become more detailed, it is creating a problem for institutions to collect valid data while complying with all the laws. In addition, institutions must use the newest technology available. Technology is a fundamental part of big data analytics. Modern technology has a significant impact on the validity of the results of the analysis. To assure more reliable insights from big data, financial institutions require to keep updated with the constant development of the technologies, which if not properly assisted and invested in, can be a cause for decline.

## 4. Application in the Retail Industry

The retail supply chain is defined as the process by which a company gets its products into the hands of consumers [15] . It covers all processes involved from acquiring raw materials to getting the

product to the customer. The supply chain of a retail business usually starts with the creation and execution of a transportation strategy. Companies propose reasonable production quantities and raw material requirements by tracking the market on previous big data and data collected for the current sale. Raw materials enter the warehouse for inventory management, reducing cost losses before the product is produced and ensuring fast, reliable product delivery and quality control. The retail industry can reduce operational costs, reduce inventory requirements and improve performance by bringing together the supply chain and big data. A sketch of the applications in retail industry is presented in Fig. 2.

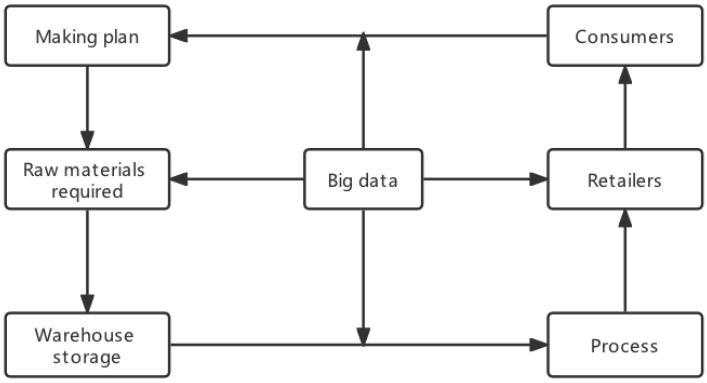


**Fig. 2** Bigdata analysis in retail industry.

Prior to technological innovation and development, traditional retailing involved only three parties: the manufacturer, the retailer and the consumer. As Technology grows, today's retail industry will add big data tools to the existing supply chain to help organisations grow better. Customer suggestions will be created, from the purchase history collected by the retail company, after data analysis. And by analysing customer data, supply chain analytics helps companies to better predict future demand. It helps companies to better allocate production plans for different products with the aim of optimal profitability. Or understand what customers' needs will be after the order. This leads to a personalised shopping experience and improved customer service. At the same time, these large data sets help to forecast trends and strategic decisions are made on the basis of market analysis. Big data analytics can be used not only to improve the customer service encounter, but also to improve internal efficiency. Cloud data is being used by many companies to track stock levels and avoid backlogs of goods.

The support that retail businesses receive through the combination of big data and supply chain runs concurrently from improving lead times to identifying ways to minimise barriers to communication between suppliers and manufacturers. From analysing returns to achieve operational efficiencies for decision makers, to monitoring compliance to boost profitability. Yet, there are still some issues that companies need to be aware of when using big data. Firstly, it should be ensured that accurate data is collected. When collecting any amount of data, low quality and quantity can lead to inaccurate conclusions that can be easily misinterpreted. In the retail sector, the main categories of valuable data will be: sales volume, number of customers, profitability, inventory stock and effectiveness of promotional efforts. Variety of datasource contributes to the sophistication and hence the need to use different methods to collect data. Next, retailers need to build sufficient credibility from their client. For a retailer to gain access to client data on a massive basis, there is a critical need for it to establish a level of trust, that can be achieved by offering sole interest to its customers for the client data.

## 5. Application in the Logistic Industry

Logistics can be defined as the business science of gaining, manufacturing and allocating goods and products at the right place and in the right volume. The logistics industry is often divided into

two parts: storage and transportation. During transportation, Big Data is used to locate the origin and destination of goods, their weight, content, dimensions, and location. In addition to this, logistics companies have access to data such as traffic, weather, vehicle diagnostics, driving patterns and location through Big Data. This big data lays the foundation for transport. The use of Big Data in storage is often used to monitor changes in the warehouse environment and to prevent transported goods from deteriorating before they reach the signatory.

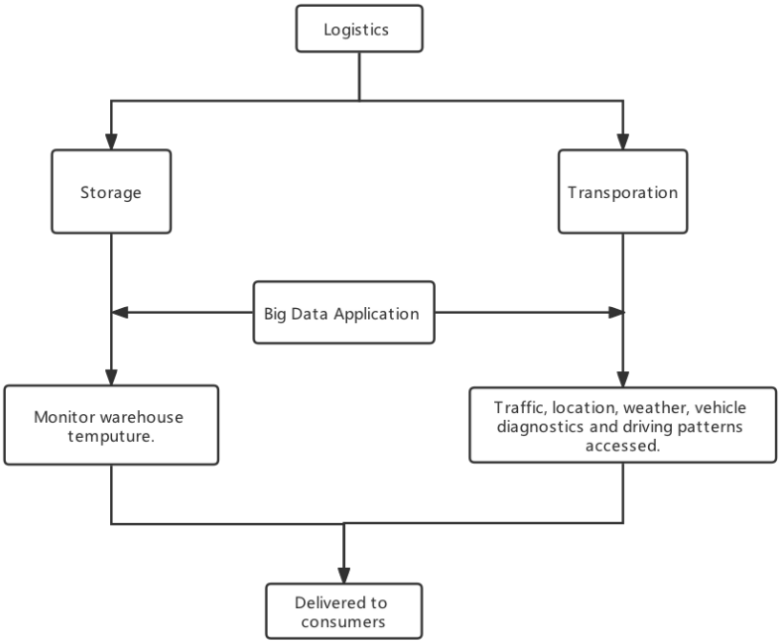


**Fig. 3** Bigdata analysis in logistic industry.

When logistics supply chains are combined with big data, the quality of sensitive goods being transported improves [16]. Maintaining the freshness of perishable goods has always posed a priority problem for logistics firms. Yet, using large data and the Industrial Internet of Things (IoT) can provide managers with better solutions and they can guard against the expenses incurred by spoilage of shipments. Secondly, big data provides automation of warehouses and supply chains for storing goods. Large data permits automated systems to operate by smartly rerouting many diverse datasets and data flows. For instance, Amazon has automated its fulfilment centers by using small and orange KIVA robots to pick up items of goods from the shelf [17].

As big data is connected to the logistics supply chain, it will make the reliability of operations more concrete and transparent. This type of clarity is valuable to both shippers, carriers and customers. Carriers will expect to know very quickly if a shipment is late in order to prevent bottlenecks in the supply chain. Secondly, routes in transport will be optimized. The optimization of routes will not only speed up transport for the customer, but also save the company transport costs. At the same time, big data analytics tools can help logistics companies identify and measure existing industry trends and help them stay on top of the competition. A further advantage of big data technologies is then that they can take duplicate tasks and procedures out of the equation and automate them. Human employees spend less time working and employees can spend that time on activities that require cognitive skills. Yet, what this says is not that big data is always positive. The use of Big Data has a delayed nature in the transport process. As the data is collected and analyzed over a specific timeframe, the output is not updated dynamically but over a period due to cost as well as time. As a result, it cannot be updated according to the latest status. This can be somewhat misleading when planning routes

## 6. Limitations & Prospects

There are still some limitations, i.e., when organisations decide to combine the BDA and SCM. For a start, as the data collected is presented in the form of random information. More variation in unstructured data can make it a struggle to process results and generate solutions. If the information is fragmented or unstructured, many users may be missed when deriving future results or analysing the present situation. The second most feared weakness of big data is the issue of security. Highly secure networks are required to transmit and store highly secure data or confidential information about an organisation. Leaked data can be used by competitors as an advantage, which is why it is vital to maintain its security. Then, the process of data generation and analysis is expensive without any guarantee of a favourable outcome. The cost of setting up supercomputers is a major drawback of big data analytics. Moreover, the information that usually resides in the cloud has to be arranged and needs to be maintained. In the end, the ability of companies to employ skilled analysts is key to the manifestation of BDA in SCM. The expertise needed to conduct research and run complex software is hard to find. Despite the expanding scope of knowledge in this field, people skilled in the work of data analysts are scarce.

It has to be acknowledged that the prospect of combining big data and supply chain management is promising. The way in which companies collect information needs to be carefully designed to avoid collecting too much unstructured data that creates challenges for subsequent processing and analysis. In addition, companies need to prevent the leakage of information not only internally, but also to take responsibility for the information of those who share it, and establish a dedicated information security department to ensure the security. At the same time, companies can train specialised information analysts to prepare for accurate analysis of information.

## 7. Conclusion

In conclusion, the usage of BDA in SCM can lead to positive feedback. According to the analysis, it is found that different industries can improve customer service and demand fulfilment when using big data in the first place. It can also provide more timely and effective responses to supply chain problems. Besides, the ability to improve the efficiency of the supply chain can be enhanced. Ultimately it can improve the integration and fluidity of the entire supply chain through optimisation of inventory and asset productivity. Yet the research in this paper builds on established supply chain management processes already in place in the industry and there are no technical issues in utilising big data. Organizations when deciding to apply BDA scenarios in SCM should, however, be prepared financially and technically for the new challenges they will have to encounter. The research in this paper can help organisational management to better judge the improvements that big data can make to an organisation's supply chain management.

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