Analysis for Supply Chain Management: Evidence from Toyota

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Abstract. Along with the increasing demand for automotive products, automobile manufacturing's cost begins to grow higher, while the cost of the vehicle product profit becomes lower. Automobile manufacturers are more inclined to optimize production processes through supply chain integration, strengthen the collaboration among organizations within the chain, and improve operational efficiency to consolidate the overall benefit of the supply chain. In terms of the implementation of big data and relevant techniques, it is feasible to achieve integration of the supply chain, within the enterprise to realize information sharing, and outside the enterprise to develop the working efficiency of the whole supply chain, optimize and reduce the loss of enterprise interior. In this paper, the Toyota is selected as a special case to illustrate the points that how to implement the big data techniques into supply chain management. According to the analysis, it improves the competitive strength of enterprises and increases income and profit. The possible limitations and defects are also discussed with the possible solutions for further improvements. These results shed light on guiding further exploration of supply chain management in vehicle industry.

Keywords: Toyota Production System, SCM, big data, lean thinking

1. Introduction

The supply chain shows the capability of maintaining an uninterrupted flow of goods and materials. Liang illustrates that supply chain management systems have necessarily become more dynamic and complex in globally dispersed production economies [1]. Huge competition and fluctuating demand patterns have increased the flow of data generated in the supply chain, which pushes enterprises to accept supply chain analytics to gain a competitive vantage connected with the use of big data [2-4]. As a resilient supply chain has become an essential part for companies to ensure stable supplies for the manufacturing process, using BDA for SCM monitoring of supply chains has gained increasing attention [5].

The impact of big data can be found in the steadily increasing number of publications and research relating to big data applications over these years. The lean collaboration mode of Toyota in Japan regards the supplier‘s activities as an organic part of the production process to control and coordinates them. Toyota's complete supply chain management covers all parts of the whole industry. As a result, Toyota has become an essential part to help to find out the factors that help to develop dynamic capabilities related to big data in enterprises through the analysis of its successful supply chain. New technology has brought effects on the service supply chain at Toyota. This paper aims to claim how big data and other new technology bring influence the supply chain of firms by analyzing Toyota‘s supply chain management.

2. Analysis

2.1 Methodology

2.1.1 Descriptioniption of big data in SCM

SCM has risen to the top as an efficient way to deal with the woes faced by enterprises, for example, labor shortages and fast iteration cycles [6]. A new frontier in IT-enabled SCM has aroused the interest of practitioners due to it allowing the increase in the value delivered to customers [7]. Analyzing the results originating from electronic commerce can help them to understand customers' needs and possible changes at once and more clearly [8]. The constant changing demands of

customers cause it harder to forecast and keep up with the market by using traditional supply chain management. Business processes have become increasingly data-dependent influenced by this situation, and to improve supply chain performance, data-derived insights are used as one of the key instruments. There is no doubt that firm-level and process-level performance are improved due to better decision-making practices provided by concepts of big data and business analytics [8-12]. Researchers have already introduced a few aspects of the concept of big data in SCM. The term "SCM data science" is used in the description of Waller and Fawcett and is described as an application [13]. A holistic big data SCM framework is shown in Fig. 1.

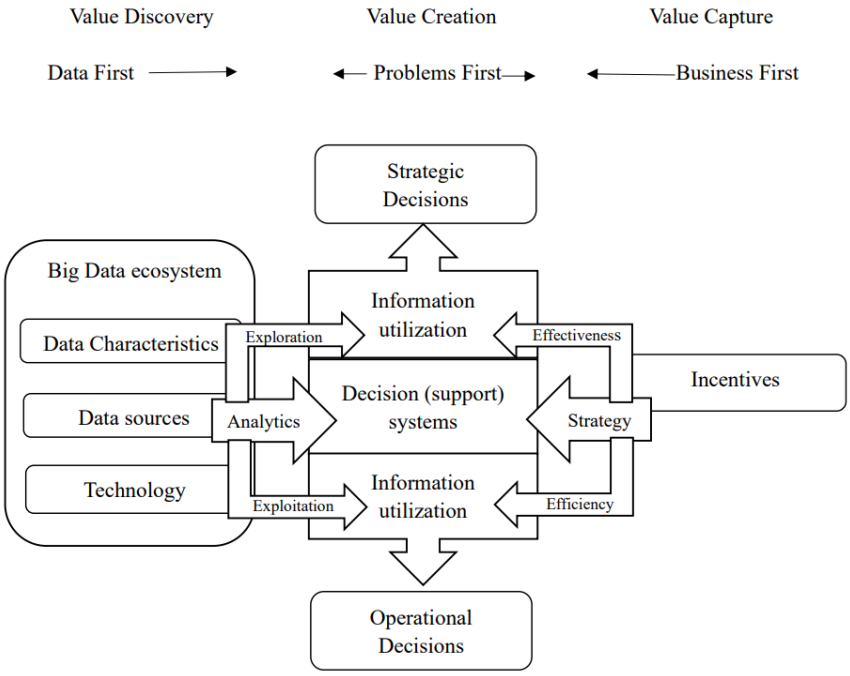

Fig. 1 A holistic big data SCM framework.

2.1.2 Background of Toyota SCM-TPS

In this era of intense business competition, there is growing momentum to increase competitiveness through enhanced SCM. There are some significant examples, such as the Japanese automobile industry, various factories have solved many operational problems by strengthening supply chain management, which plays a key role in differentiating themselves from other enterprises. Especially Toyota, through the Kanban method to drive the supply chain integration management, is able to correspond to market changes of pull-type supply chain system to solve the inventory and other problems, which makes it achieve the world's top enterprises due income [14].

Since its establishment in 1937, Toyota has made great achievements. Its core product is automobiles. Toyota has become a benchmark in the automobile industry with its advanced production model and management philosophy. The competitive advantage of Toyota does not mainly lie in the production and manufacturing technology it adopts but depends on its production organization and management. Toyota adopts a series of advanced production and operation concepts, which is called TPS.

Western industries have implemented Lean-TPS in different sectors and organizations over the past decades and have achieved interesting results in terms of performance [15]. TPS management may be used to improve quality and reduce inefficiencies and costs in various industries. , To achieve maximum efficiency, highly integrated assembly lines have been built by Japanese automakers, epitomized by the famous Toyota line [16]. Assemblers of custom components and their suppliers will work together from the stage of product design, and attribute this close and intimate supplier

relationship to the high quality of products and competitive costs due to common specifications to remove waste [17].

To coordinate the entire supply chain, Toyota built its network of suppliers into a multi-layered pyramid with Toyota on its pinnacle [17]. First-layer suppliers interact directly and closely with Toyota and Toyota gets supply key sub-assembled components from them. Additionally, single sourcing is in principle avoided by Toyota through a closed membership of qualified suppliers. This is to mitigate the high risk of supply disruptions associated with single sourcing and maintain improvement incentives.

2.2 Analysis of TPS

Both material flow components and operational and planning processes are included in a supply chain. TPS contains three core logistics concepts that use big data to reduce costs and improve its efficiency. Firstly, TPS allows Toyota to achieve the precision of production quantity and delivery time. Accurate quantity and delivery time control by the system based on the use of big data helps Toyota achieve "zero inventory", where the true meaning of zero inventory is that there is no excess inventory, instead of stating the actual inventory is zero.

The constantly flowing inventory causes the loading storage of the transit base will be maintained for one to two days to ensure normal production only for rare abnormal situations such as traffic or transportation obstruction caused by abnormal weather [18-20]. Toyota sets up three independent business modules to adjust its internal structure and arranges professionals to be responsible for the management of each module. Otherwise, to improve business efficiency, Toyota has restructured its parts business through modular management. Through the adjustment of internal structure, and the optimization of production, research and development, the company's existing resources are fully utilized, with the core capabilities constantly enhanced, to save costs and reduce the research and development cycle. Through the lean production method and this unified management, the effective coordination and normal operation of the whole process of the supply chain are ensured.

Secondly, it is obvious that the digitization business system makes efforts to improve the efficiency of the production process. Compare with the traditional manual repair order that is used to create job orders for the repair and maintenance of customer‘s vehicles, the SAP, which is currently used by the Toyota Dasmarinas-Cavite service, is one of the latest technologies Toyota has implemented during service initiation and reception when collecting customer and vehicle information based on the use of big data [19]. The accurate data provided by customers makes service processes easier and it is more convenient to identify areas for improvement. This shows that the use of big data and other new technologies has a significant impact. Not only does it makes the working process faster and easier than traditional methods of performing these missions, but it also helps operations to increase productivity, which contributes significantly to the company's profit. Fig. 2 demonstrates the framework that exhits the way that variables may relate to each other in the supply chain management proces.

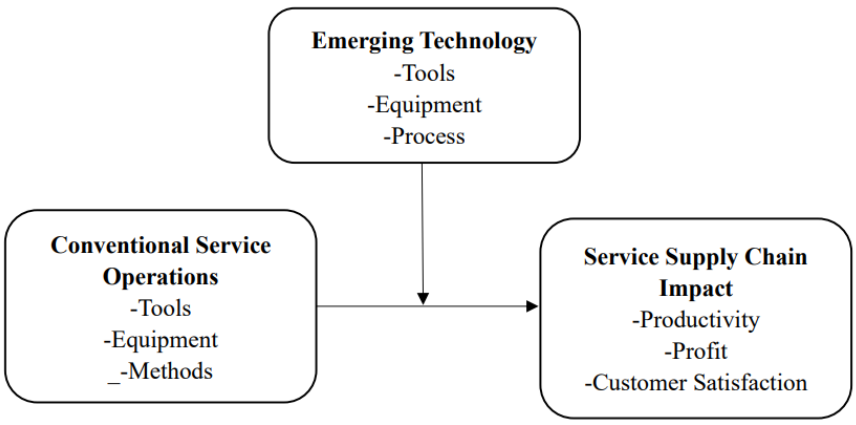

Fig. 2 Variables that may relate to each other in the supply chain management proces.

Last but not least, the information and sources allowed by the worldwide web cannot be underestimated. In external integration, Toyota has set up a completely opposite management strategy of the supply chain to that of GM and Ford. When selecting suppliers, Toyota not only selects those with high-quality enterprises [20]. Moreover, Toyota cooperates with Panasonic, Grab, Uber, and other companies, which increases its publicity and fulfill its product experience. Through the data collected from the drivers‘ and passengers‘ experiences, it can continue extending its industrial chain, constantly expanding its scale in the fierce competition, and improving its business scope and scale by acquiring resources through alliances and integrating resources, to improve its comprehensive competitiveness. The concepts of bigdata that cover in Toyota is presented in Fig. 3.

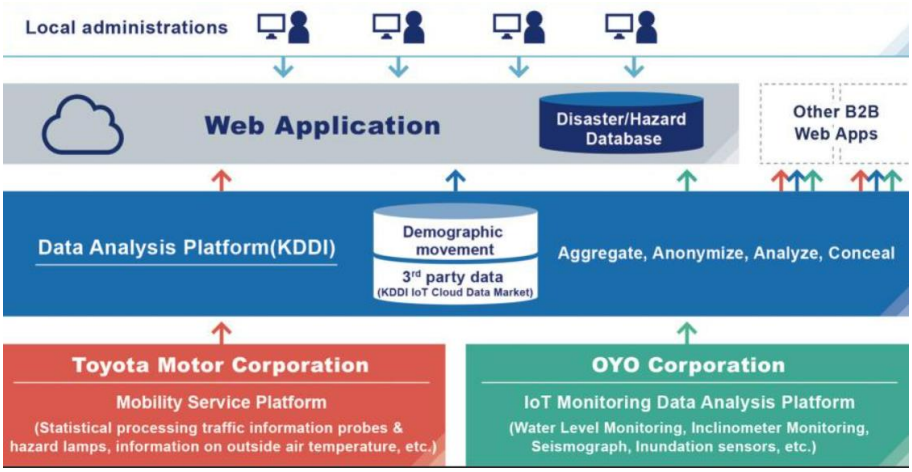

Fig. 3 Concepts of bigdata in Toyota.

3. Limitations

A myriad of supply chains reveals their sufficiency when the pandemic begins. Improving resilience becomes one of the most important goals. Here are the limitations that cannot be ignored and may become threats to supply chains:

Transportation times. Unexpected delays in raw materials will face a high risk of running out of inventory. Since global supply chains usually take weeks or even months to transport, the company’s reaction is limited, hence, the company must develop a prophetic vision. Setting up storage becomes the perfect solution. Cooperating with companies all over the world will also help.

Diversity. It is also important to keep the source of the company diverse so that if one source occurs accident, the company will not lose the entire supply. Despite sources, the company can also cooperate with multiple transportation companies and develop diverse products to create more different supply chains.

Visibility. Ensuring the security of supply chains also requires enhancing the visibility of the chains. Keeping the company’s inventory on track will reduce the rate of lost ingredients and unexpected financial losses. It is feasible for companies to enhance the supply chains’ transparency by cooperating with reliable sources and setting up a proper system of supervision.

4. Summary

In conclusion, the discussion of Toyota supply chain management offers useful references to many researchers and enterprises. Companies need to keep up with the changing market and meet the demands of customers only by using big data and other new technologies to forecast these trends. According to the analysis, the low concentration degree of the automobile industry, and the complexity of the supply chain, coupled with the uncertainty of the external environment, cause high requirements on the response-ability of the supply chain. Economic and social value can be developed by effective supply chain integration to enterprises, and it also has a profound impact on their

development. Overall, these results offer a guideline for bigdata analysis implementation in supply chain management of vehicle industry.

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