A Framework for Analyzing Operational Performance in Healthcare Industry

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Abstract

The present paper focused on designing a framework to study the impact of Big Data analytics on service supply chain management and in turn improving operational performance. Different parameters for all the three major areas have been identified to study the impact on each other. First, for Big Data Analytics, different techniques for data collection, data reposition, and data analysis were identified. For Service Chain Management, there are two types of Service Supply Chains i.e. Service Only Supply Chain and Product Service Supply chain. In the healthcare industry, Service Only Chain is applicable and therefore, it was analyzed. Also, the role of data analytics in performing different steps of service chain management namely, planning, sourcing, and delivery were studied and last, the impact on operational performance was analyzed by identifying three parameters for measuring operational performance namely Turn Around Time (TAT), Order Fill Rate (OFR), and Accuracy.

Keywords: Big Ddta analytics, operational performance, service supply chain management

I. INTRODUCTION

Earlier in the healthcare industry there was no focus on data management and data analytics but nowadays due to increasing competition and uncertainty hospitals are becoming more process driven and are using analytics to increase their operational performance and in turn patient satisfaction. In the healthcare industry supply chain department is not given much importance as per them it is just a support function but now there is a tremendous change in the thought process and supply chain is as important as the other departments [1]. Supply chain processes are now planned and implemented in accordance with advancements and specially designed methodology has been used to improve the efficiency of the process. Big Data Analytics (BDA) is a universally accepted term which refers to the vast range of analytical techniques and methodologies and data driven analytics methods to solve different types of business issues.BDA focuses on utilization of data, quantitative techniques and tools to enhance and improve performance [2]. These analytics and techniques serve as beneficial tools for planning of supply chain activities. BDA consists basically of data acquisition, data repository, and data determination [3]. Data has been considered a very important asset for any organization. Thus, for any organization data management is a very important and critical task [4]. Any mismanagement may lead to sharing of data with others, which in turn can hamper the firm's processes and performance as people may misuse the data and can harm the organization in many ways [5]. Data gives the exact view of the situation which can help in proper planning and execution of the process [6]. For data collection tools like Radio Frequency Identification Device (RFID) have been used to collect data automatically and in less time. For data reposition tools like ERP (Enterprise Resource Planning) have been used to store data as it is easy to collect the data but its storage is very critical as improper storage may also lead to loss of data or improper use of data [7]. Data is analyzed which helps in proper planning of the process and execution and it gives measures to overcome the operational challenges [8]. In short, the more technologies are sophisticated, the more data analytic techniques and data access capabilities are embedded. Thus, BDA helps in monitoring execution and helps in controlling the variability of performance. It keeps

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improving the quality of planning and execution [9].

In recent years services give much importance to operational research literature as the world economy has been oriented more towards services. Service plays an important role in supply chain processes. Supply chain process is defined as a 'product' which is created at "the point of origin" and is delivered at "the point of consumption". Service Supply Chain management is basically of two types : 1) Service Only Supply Chains (SOSCs) and 2) Product Service Supply Chains (PSSCs). In healthcare industry service only supply chain is followed [10].

Many authors have given numerous definitions of service supply chain as per their understanding. Baltacioglu, Ada, Kaplan, Yurt, and Kaplan said, "service supply chain is a network of suppliers, service providers, consumers, and other supporting units that perform the functions of transactions of resources required to produce services; the transformation of these resources into supporting and core services; and the delivery of these services to customers" [11]. Sampson [12] described a service supply chain as a bi-directional system consisting of a customer, a service provider, and an initial service producer". Similarly, Demirkan and Cheng said, “service supply chain is a system composed of three parties, the service producer for infrastructure, the retail service provider, and the customer” [13]. As per my understanding service supply chain can be defined as the planning and sourcing of goods and services of topmost quality at an affordable price and ensuring timely delivery to the end user.

II. LITERATURE REVIEW

In today's world customer's perception towards service performance is gaining importance and is an important factor for the growth of any organization as it is now getting tough to maintain service level agreements. It is now becoming important to develop a robust framework for supply chain management in services. This will positively benefit all organizations by reducing costs and thereby, increase revenue and will also help in improving dependability, delivery, and service quality. All this can be achieved by an effective Service Supply Chain Management [17].

In SOSC's, services are the only product, so supply chain management is very critical as suppliers play a very important role. In various service supply chains, the distributors are just brokers and the suppliers give services directly to the end user. In an effective service supply chain, it is important for each member to work together and in coordination with other members in the system. Although, focus on coordination and collaboration among members of supply chain members makes the modern supply chain management different from classical supply chain management [18].

In healthcare, service only supply chain process is being followed. Basically, it is divided into three measure steps: planning, sourcing, and delivery to the end user i.e. the patient. There are many issues which arise during the completion of the whole process which hamper performance. Thus, to overcome this BDA has been utilized [19].

It is difficult to visualize and measure services as the vast range of services provided by the service sector makes it tough to produce a unifying services framework [20]. To achieve the objectives and ensure continuous improvement there should be proper measurement of the performance of the processes. Moreover, it is not possible to manage a process if its performance is not measured [21].

According to Surie & Wagner [22], it is important to measure performance at regular intervals. Performance measures work two ways and have two mid effects. First, these provide present understanding which is comparable to past processes. Secondly, it can be used to establish future goals and steps for improvement. It is important to develop a framework for performance measurement of service supply chain to analyze changes and further development performance of the whole operational process [23].

Big data analytics has emerged as a critical tool for different organizations to get valued information from huge amount of data and get advantage to cope up with increasing competition. This is required because of the increase in the usage of digital technologies. "Big data refers to the ability to process data with the qualities: velocity, variety, and variety. Analytics refers to the ability to gain insight from data by applying different statistical tools, econometrics, optimization, mathematics, simulations, and different techniques which help organizations in decision making” [24].

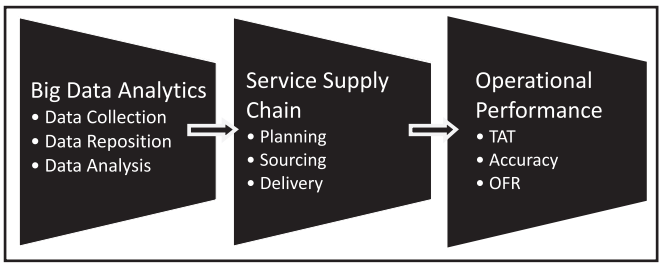
Data management is the main building block of Business Analytics. Organizational performance is found to be positively affected by the organization's data management capability [25]. BDA helps in creating knowledge by providing insights and helps in reducing uncertainty in business as it increases the capability of the management in effective strategic decisions for the betterment of operational processes [26].

Big data analytics has great capability of improving the forecasting methods for demand. It helps in finding the disruptions in supply chain process and helps in improvement of communication in the whole supply chain process globally.

III. APPROACH

A model was designed to study the impact of Big data analytics on service supply chain and in turn, on operational performance for better understanding.

Fig. 1 . Operational Model



IV. DISCUSSION

A. Big Data Analytics

There are three main steps for data analytics which are as follows. Earlier manual data used to be collected but it didn't get the real picture as it may lead to improper entries and incomplete entries. So, to get real data different tools have been analyzed to collect data.

1) Data Collection: Data collection is a very crucial step as collection of proper data is a major problem as organizations don't get proper tools to get dataFurther different parameters for each area have been identified to study the impact on each other.

2) Radio Frequency Identification Device (RFID): "It is a technology that incorporates the use of electromagnetic or electrostatic coupling in the Radio Frequency (RF) portion of the electromagnetic spectrum to uniquely identify an object, animal, or person". It provides many benefits [27].

3) Bar-coding: A barcode is an optical, machine-readable, representation of data; the data usually describes something about the object that carries the barcode. Originally barcodes systematically represent data by varying the width and spacing of parallel lines and may be referred to as linear or one-dimensional (1D). Later, two-dimensional (2D) codes were developed using rectangles, dots, hexagons, and other geometric patterns in two dimensions, usually called barcodes although they do not use bars as such. Barcodes were originally scanned by special optical scanners called barcode readers. Later application software became available for devices such as smart phones with cameras that can read images". It has a great capability for data collection and makes work easier, faster, and error free [28].

These techniques have been used to collect data for better visibility.

1) Data Reposition: After collection of data, another major challenge is storage of data as it is important to store data properly otherwise it may lead to loss of data and improper management can lead to misuse of data. So, tools like ERP (Enterprise Resource Planning) have been utilized to store data. It is a cloud based software in which all the transactions are done and data are saved in the cloud and can be accessed anytime as per requirement [29].

2) Data Analysis: After collection and storage of data the next major step is analysis of data. The data is used to analyze different requirements and analyze gap to increase operational performance. It also helps in decision making for further improvement of processes and systems and thus, overall performance. It provides new opportunities to survive in huge competition in the market by providing significant information by analyzing data [30].

B. Service Supply Chain Management

Basically, there are two types of Service Supply Chains that are Service Only Supply Chains (SOSC's) and Product Service Supply Chains (PSSCs). In the healthcare industry, SOSCs i.e. Service Only Supply Chain systems are followed as in these "products" pure services play an important role and physical products are involved but they are only used for providing services. [31]. In studied healthcare organization, there is a centralized purchase system which is being followed. There is a warehouse from where all the goods are purchased and delivered to vendors and then from there goods are dispatched to different units as per their requirements. The whole process is quite critical and many operational challenges arise. Data Analytics is

utilized to overcome these. The data is collected and stored and is analyzed for performing the following steps:

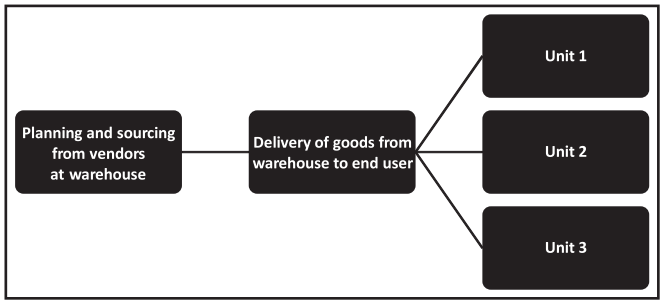
1) Planning: Planning involves quality, quantity, and type of products and services required by patients. Data gives information regarding the usage pattern, types of services, and products and quantity of products required. It answers all questions of what, when and how much is required which are very important at the time of planning [32].

2) Sourcing: After planning, the next step is sourcing. Sourcing involves getting products of best quality, affordable price, and timely availability for patients. The data gives precious view of vendors from whom products are purchased, and rates and timeliness of delivery by vendors. This helps in taking decisions for further purchases [33].

3) Delivery: The next major step after planning and sourcing is delivery of products to the end user. This can only be done if planning and sourcing happens correctly and on time. Only then products can be delivered to the end user on time [34].

In healthcare, consumables and other surgical and non-surgical items are purchased which are used in operations, treatments, and procedures. Therefore, proper planning, sourcing and on time delivery are very critical for providing the best services to patients. An effective supply chain process is very important to achieve the best outcome.

Fig. 2. Service Supply Chain Process



C. Operational Performance

After implementing all the techniques, it is very important to measure operational performance. No technique can help if performance is not measured. Therefore, performance is measured on a timely basis for continuous performance improvement. Thus, three parameters have been identified to measure performance [35]. These parameters are studied with data analytic techniques of the data generated from the ERP system.

1) TAT (Turn Around Time): This factor analyzes the time taken by the warehouse to fulfill the requirement of different units. It gives the exact details of the transition time for the dispatch of each item.

2) Accuracy: Accuracy is the fulfillment of exact requirement of the user by the warehouse. A situation arises when sometimes due to non-availability of any item its substitute is provided. So, this parameter reflects the consumption pattern for each item so that its stocks can be maintained as per requirement.

3) Order Fill Rate (OFR): OFR is the fulfillment of exact quantity of items as required by the user. This parameter focuses on the quantity demanded, whether it is fulfilled by the exact item available or its substitute. This helps in maintaining stock levels at the unit so that stock-out doesn't happen.

These performance indicators help in measuring operational performance effectively and provides the real view of the whole process and further helps in analyzing gaps [15].

V. CONCLUSION

The results show that using BDA techniques in Service Supply Chain process is relatively an innovation and BDA which is being used in data collection, storage, and analyses for studying the three performance indicators play a critical role in decision making for planning and execution of supply chain process [36]. These parameters reflect whether decision taken and planning are fruitful for the process. The parameters also help in improving operational performance of the supply chain process. Supplying the material on time in the healthcare industry is very critical as the consumables help in treatment and cure of the patient. So, for this proper planning and execution are important to ensure timely supplies as any deficiency will directly affect patient life. So, it is important for hospitals to maintain efficiency and quality by continuously following processes and keep on updating as per the developing need [37]. This can be done by proper data management and data is utilized continuously by analyzing performance indicators. Continuously performing this gives space for continuous improvement of the supply chain process and minimizes

operational challenges [16]. Thus, BDA helps in enhancing the efficiency and effectiveness of the service supply chain process and further improves operational performance [15].

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