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Impact of Big Data on Supply Chain Performance through Demand Forecasting

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A R T I C L E   I N F O

A B S T R A C T

By enabling more precise demand forecasting, the use of big data has changed the field of supply chain management. Companies may more accurately predict customer demand by gathering and analyzing enormous amounts of data from many sources, including customer behaviors and market trends, and then adjusting their production and inventory levels accordingly. By ensuring that goods and services are accessible when and where they are required, this improves customer happiness in addition to the efficiency and cost-effectiveness of the supply chain. The data collected from both primary and secondary sources to achieve the research objectives. The data collected from hospitality industry and evaluated through SmartPLS software to investigate the hypothesized model. An online survey through a questionnaire was the data collection tools used for attaining data. A survey analysis was conducted on the individuals employed to the supply chain departments. In addition, the findings revealed a positive significant of big data on supply chain performance through demand forecasting. Overall, the impact of big data on supply chain performance through demand forecasting is significant and continues to drive innovation and improvement in the hospitality sector.

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1. INTRODUCTION

Big data in terms of supply chain management can be defined as the analytics that is used in quantitative methods to enhance the decision making abilities of the management across different activities of the company. Big data helps the overall supply chain management to expand its operational dataset. This helps in internal analysis out of the traditional aspect. Hence, the SCM (Supply chain management) of the organizations get benefits to do forecasting (Frederico et al., 2021). In addition to this, Big data in supply chain management also helps apply statistical methods to existing and new data sources. New insights are induced, which becomes effective in the decision making abilities of supply chain management.

Hence, based on the strategic choices, the front-line operations are improved, i.e. identifying significant operating models for a proper supply chain. The main aim of the research is to understand the impact or role of big data over supply chain management, through demand forecasting (Kaisler et al., 2013).

Furthermore, big data is said to be one of the most effective factors in the supply chain industry in the present business world. Big data can also be said as the combination of processing systems, tools and several algorithms to interpret the insights of organizational data and information. It is taken as a key step in the modern organization as it may help the management of the company to minimize

the costs and improve the efficiency. Therefore, based on the big data analytics and statistical aspect, the decision making abilities of the company can be improved (Bahrami and Shokouhyar, 2021). (Khalid et al., 2023) give insightful information on the use of machine learning for fileless malware detection, which can help in understanding the possible effects of big data analytics on supply chain performance through improved cybersecurity measures. (Ali et al., 2020) and (Latif et al., 2020) offers insights that can contribute to understanding the potential impact of big data analytics on supply chain performance through improved demand forecasting

In addition to this, in terms of SCM (Supply Chain Management), the landscapes are being difficult with respect to time. Organizations use the ERP system and several storage systems in their data storage management. Moreover, the traditional systems in supply chain management are being inaccurate and inadequate. This is one of the major reasons companies are adopting big data to improve the performance of supply chain management. Hence, in the present business world, big data in supply chain management helps in creating unstructured and structured formats using the real-time data. Also, big data enables the collaboration of 3Vs (Velocity, volume and Variety) and supply chain analytics for end-to-end integration and supplier networks (Feizabadi, 2022). Forecasting helps this combination and in understanding the insights of supply streamlining. This ultimately helps the management of an organization to make decisions that would be eBay for operational aspects, i.e. stock inventory, budget planning, cargo booking, budget expansion etc. In other words, forecasting is an effective technique to predict and take data for future value based on unique trends.

2. LITERATURE REVIEW

2.1 Big data

Big data is a key component for the organization that can be utilized in a wide range of aspects. Big data is used for planning, development and sourcing, execution, delivery and return. All these separated steps act as major influencing factors of supply chain performance. Moreover, these factors are also related to forecasting. In the case of

planning, big data helps to integrate the data and information across the total network of the supply chain. This may also include statistical data to have a forecasted demand with more accuracy, including inventory levels, sales numbers etc. In terms of development and sourcing, big data helps in reducing the potential costs of the company. Therefore, the overall revenue or profit rate gets improvised. According to (Shamout, 2019), big data in supply chain analytics helps to evaluate the compliance and performance of contractors based on real time aspects. Big data also helps in reconfiguring the available resources such as tools, space, people, materials etc. hence, the predictions of scheduled maintenance or estimation cost can be adjusted or minimized by the organization. In terms of the delivery stage, big data is effective in inducing accuracy, speed and efficiency. With the help of external data, the real-time delivery is superimposed. It is said that big data also helps in getting a good return on supply chain performance (Bag et al., 2020). Lastly, big data analytics can be useful in minimizing the overall operational cost to provide a seamless return by the combination of sales system and inventory, outbound and inbound flows. Three dimensions are incorporated to measure the big data efficiency are as follow:

2.1.1. Technological Innovation

Several sectors, corporations, and economies around the world have grown and developed as a result of technological innovation. The elements that spur innovation are a significant topic of study in the literature on technological advancement. Many elements, including technological ability, market demand, intellectual property protection, and availability of money and resources, have been noted as having an impact on innovation by several academics (Azubuike, 2013). For instance, businesses with great technological capabilities and a creative culture are more likely to create novel products and services.

2.1.2. Internet of Things (IoT)

The term "Internet of Things" (IoT) describes a network of interconnected systems, objects, and gadgets that have sensors and software built into them so they can communicate and collect data. IoT literature is extensive and varied, covering a wide

range of subjects including IoT applications and advantages, risks and issues related to IoT, and IoT design and standards. The uses and advantages of IoT are a major topic of study in the IoT literature. The potential advantages of IoT across a variety of sectors, including industry, healthcare, transportation, and agriculture, have been emphasized in numerous studies. By delivering real-time data and insights, for instance, IoT can increase operational efficiency by facilitating improved decision-making and resource optimization (Hussein et al., 2018).

2.1.3. Blockchain Based Data

Much study has recently been conducted on blockchain-based data. The literature on blockchain-based data includes a wide range of issues, such as the characteristics of blockchain technology, its uses in various fields, and the difficulties and advantages of its uptake. The characteristics of blockchain technology are a significant field of study in the body of literature on blockchain-based data. Many studies have emphasized how decentralized and secure blockchain technology is, making it the best choice for managing and storing sensitive data (Rawat, 2022). Data integrity can be guaranteed using blockchain technology, which uses cryptographic methods to construct an immutable and tamper-proof ledger (Francisco and Swanson, 2018).

2.2 Supply Chain Performance

Supply chain performance is the outcome of operational excellence. This completely depends on balanced scorecards, strategy development, supply chain management, investment etc. This is usually dependent on the quantifying process of effectiveness and efficiency. Effectiveness is related to the requirements of the customers, whereas organizational efficiency is the utilization of economic resources by the company to get a predetermined customer satisfaction level. If the supply chain performance is effective and beneficial for the company, it will enrich the supply chain management and the overall business operation of the company (Alzoubi, 2018). However, a lack of performance measurement in the supply chain system can be a severe obstacle for an organization. There are a few significant

importance of supply chain performance as follows:

- *Drive actions of the organizations:* Supply chain performance can be the reason for driving two major actions. Firstly, it helps in getting high visibility in the workplace. The employees would strive to get high level performance. Secondly, it helps to improve the decision making abilities of the company. Hence, the management of the companies can adopt correct action plans for the company.

- *Decision-making abilities:* Supply chain performance measurement can help the company to evaluate the proper set of decision criteria and the alternatives. The measurement system's structure drives the actions and decisions at the tactical, strategic and operational levels. Therefore, an accurate supply chain performance measurement helps the management to target and optimize the performance throughout multiple objectives.

- *Closed-loop control:* It is said that feedback should be an integral part of the business process. Effective supply chain performance would have the necessary feedback to reveal progress, facilitate inter-understandings, and identify potential opportunities and communications among the employees. This helps to try and adopt new and innovative strategies as well.

2.3 Forecasting

Forecasting is the process of predicting the pricing or supply and demand of a particular product in an industry. Statistical data and information related to forecasting can help an organization to understand the market condition and demand. Based on the statistical forecast, an organization can increase or decrease its production. It can be related to cost performance, inventory and capacity process, financial performance etc. Also, the forecast also helps in supply chain management to understand the areas of lacking to meet the expectations and demands of the customers (Feizabadi, 2022). Therefore, the customer's relationship gets improvised.
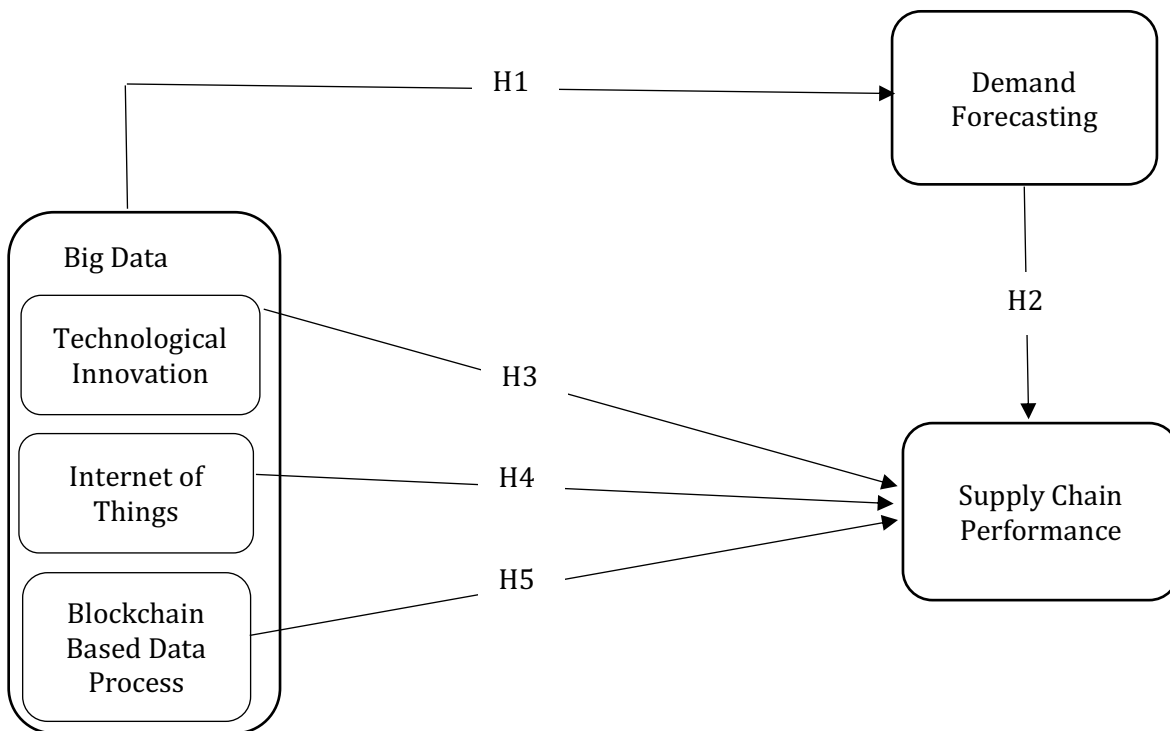
2.4 Research Model

Figure 1: Research Model

2.5. Research Hypotheses

H1: Big Data positively influence the Demand Forecasting

H2: Demand Forecasting positively influence the Supply Chain Performance

H3: Technological Innovation positively influence Supply Chain Performance

H4: Internet of Things Positively Influence Supply Chain Performance

H5: Blockchain Data positively influence Supply Chain Performance

2.6 Methods and Materials

In order to conduct the research, a quantitative approach was used. Through an online survey with the employees working to the hospitality industry in the context of the primary data collection. We have developed a various survey questions for the study and distributed them to survey respondents using a survey-monkey link. Additionally, we have carried out the research while adhering to all ethical standards. The research has been explained and interpreted using a descriptive research design. The researcher was able to obtain significant and necessary information through the use of a descriptive strategy. For this purpose, a convenient random sampling considered to identify the number of participants for the survey. The survey was conducted with 160 participants in the hospitality industry based in UAE. For the

purpose of statistical analysis, SmartPLS software was used to examine the research hypothesis. Model validity and reliability was also checked before testing the model hypothesis.

3. EMPIRICAL ANALYSIS

3.1. Convergent Validity and Discriminant Validity

The measurement's internal consistency dependability was initially assessed using Cronbach's alpha and composite reliability (CR). The CR threshold and Cronbach's alpha are both 0.70. All of the constructs have CR values and Cronbach's alpha coefficients above 0.70, as indicated in Table 1, demonstrating good internal consistency dependability. Also, when assessing convergent validity, factor loadings and extracted average variance were taken into consideration (AVE). All factor loadings are higher than the suggested value of 0.70, and AVE values are higher than the recommended value of 0.50, according to Table 1, which supports the convergent validity (Hair et al., 2018). Also, the discriminant validity was evaluated using the heterotrait-monotrait ratio of correlations (HTMT). In the model validity process, no construct's HTMT score should be more than the recommended value of 0.85. According to Table 1, the HTMT ratio satisfied the recommended criteria, demonstrating the discriminant validity.

Table 1: Composite Reliability, AVE, HTMT

Variables	Cronbach's Alpha	AVE	CR(rho c)	BD	TI	IoT	BCD	DF	SCP
Big Data	0.873	0.898	0.922	-					
Technical Innovation	0.842	0.761	0.905	0.564	-				
Internet of Things	0.739	0.793	0.923	0.619	0.459	-			
Blockchain Based Data	0.895	0.588	0.935	0.655	0.681	0.554	-		
Demand Forecasting	0.888	0.751	0.885	0.722	0.634	0.611	0.639	-	
Supply Chain Performance	0.936	0.724	0.948	0.598	0.797	0.723	0.765	0.583	-

BD=Big Data, TI=Technological Innovation, IoT=Internet of Things, DF=Demand Forecasting, SCP=Supply Chain Performance, CR=Composite Reliability, AVE=Average Variance Extracted, CA=Cronbach's Alpha

3.2. Structured Equation Modeling

The PLS method was used to generate the path coefficients, however the PLS boot-strapping approach with a resampling of 5000 was used to regulate the implication of the path coefficients at significance level (0.05). The chi-square value (R2 value) was first assessed in order to confirm the explanatory power of exogenous factors on endogenous variables. As a result, the model was able to account for 93% of the variance in supply chain performance, which exhibits a high variance rate, and 72% of the variance in Big Data. The R2 values showing the exploratory power are shown in Figure 2.
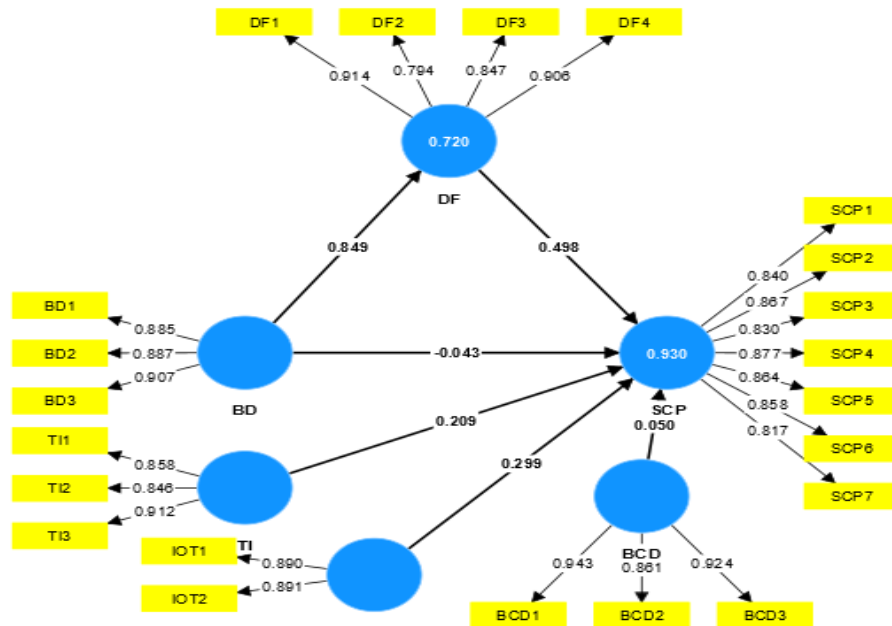
Figure 2: Structured Model Measurement

Additionally, the hypothesis testing findings exhibited, big data positively influence the demand forecasting (Big Data->Demand Forecasting = 0.450, t = 3.30, p 0.000) supporting the H1. The relationship of demand forecasting is positively associated with supply chain performance (DF->SCP = 0.849, t = 15.1, p 0.003), supporting H2. This is demonstrated in Table 2. Moreover, H3, H4 and H5 associated with big data dimensions indicating the relationship with supply chain performance as (TI->SCP= 0.347, t=2.17, p=0.000), (IoT->SCP= 0.502, t=2.88, p=0.000), and (BCD->SCP= 0.370, t=3.05, p=0.000) indicating the significant relationship supporting H3, H4, and H5 respectively.

Table 2: Hypothesis Testing using Bootstrapping Method

Hypothesis	Paths	Beta	R^2	t-value	p-value	Decision
H1	Big Data Industry → Demand Forecasting	0.450	0.720	3.30	0.000	Supported
H2	Demand Forecasting → Supply Chain Performance	0.849	0.930	15.1	0.003	Supported
H3	Technological Innovation → Supply Chain Performance	0.347		2.17	0.000	Supported
H4	Internet of Things → Supply Chain Performance	0.502		2.88	0.000	Supported
H4	Blockchain Based Data → Supply Chain Performance	0.370		3.05	0.000	Supported

*Note: Level of significance at $p<0.05$***, critical value <1.69.*

4. DISCUSSION

4.1. Implementation of Big Data to improve Supply Chain Performance

The research findings covered a variety of topics that can enhance the effectiveness of the supply chain. But big data's impact on supply chain effectiveness has drawn a lot of attention lately. Big data, which includes information on consumers, sales, and social media interactions, refers to the vast amount of structured and unstructured data that businesses and organizations produce. Big data analytics may help firms make informed decisions and streamline their operations, which will increase production and efficiency.

In addition, findings suggested the ability of big data to improve visibility and transparency throughout the entire supply chain is one of the key advantages it has for supply chain management. Organizations can better understand their

operations and spot potential development areas by examining data from a variety of sources. Data analysis, for instance, can help detect supply chain bottlenecks, such as delays in production or shipment, enabling firms to take remedial action to enhance performance.

H1: Big Data positively influence the Demand Forecasting

The findings of the research exposed demand forecasting using big data analytics can help businesses make wise decisions and streamline their operations for better performance and more efficiency. The capacity of big data to improve accuracy and dependability in demand forecasting is one of its primary advantages. Conventional forecasting techniques rely on past data and patterns, which could not accurately reflect the state of the market or consumer trends. Contrarily, big data analytics enables businesses to examine real-time data from numerous sources, such as social media, site analytics, and online reviews, in order to better understand consumer behavior and preferences. This makes it possible for companies to create demand estimates that are more precise, improving resource allocation, production planning, and inventory management.

H2: Demand Forecasting positively influence the Supply Chain Performance

It has evidenced through the study analysis that demand forecasting, which entails projecting future consumer demand for goods or services, is a crucial component of supply chain management. Organizations may improve the performance of their supply chains by optimizing their inventory management, production planning, and resource allocation. It has examined the effect of demand forecasting on supply chain efficiency in this important discussion. Improved inventory management is one of the most important effects of demand forecasting on supply chain efficiency. Organizations may maintain ideal inventory levels by using accurate demand forecasting, which helps them avoid overstocking and unnecessarily tying up money while yet having enough inventory to meet customer demand. This aids businesses in preventing stockouts and lowers the danger of having too much inventory, improving productivity and profitability.

H3: Technological Innovation positively influence Supply Chain Performance

The findings contributed to carry the concept that clarifies one of the most significant impacts of technological innovation on supply chain performance is the improvement in efficiency. Automation and robotics have made it possible to streamline processes and reduce the time and labor required to complete tasks. This has resulted in faster production cycles, reduced lead times, and improved delivery times, which can improve customer satisfaction and reduce costs for businesses. Another key impact of technological innovation is the increased visibility and traceability of products throughout the supply chain. IoT sensors and tracking technologies allow businesses to monitor the location, condition, and status of products in real-time, which can help prevent delays, reduce waste, and improve inventory management.

H4: Internet of Things Positively Influence Supply Chain Performance

According to the empirical findings and the prior studies, it is noticed that the Internet of Things (IoT) has had a significant impact on supply chain performance in recent years (Rejeb et al., 2020). IoT refers to the connection of physical devices and sensors to the internet, enabling them to communicate and share data with each other. This technology has the potential to revolutionize supply chain management by improving efficiency, reducing costs, and enhancing visibility and control. In addition, IoT can also improve supply chain efficiency by automating processes and reducing manual intervention. For example, IoT-enabled machines and robots can monitor and control production processes, reducing errors and improving quality. IoT can also enable predictive maintenance, where machines can alert operators when maintenance is required, reducing downtime and improving overall efficiency.

H5: Blockchain Data positively influence Supply Chain Performance

According to the final hypothesis being investigated, the immutable and transparent record of every transaction that takes place along

the supply chain could revolutionize supply chain management. The performance of supply chain management can be enhanced by using this technology in a number of ways, including by boosting productivity, cutting expenses, and enhancing transparency. The results also revealed that one further significant advantage of blockchain technology is its capacity to lower supply chain costs. Blockchain technology can assist to lessen the need for middlemen in the supply chain by offering a safe and open ledger of all transactions.

5. CONCLUSION

It is evident that Big Data and Forecasting have a significant impact on improving the overall performance of the Supply chain. It has been pointed out that with the implementation of Big Data in the supply chain, the decision-making ability of the organization can be improved. Big data can help in the various aspects of the SCM, such as planning, delivery, manufacturing, development and return of the products. With the help of the data acquired from Big data, the organization can forecast the market value and demand. This would help the organization in earning much higher revenues and help in reducing the wastage of the products.

In addition, big data analytics has the potential to greatly impact supply chain performance in the hospitality industry through demand forecasting. The ability to collect and analyze vast amounts of data from various sources allows for more accurate and timely predictions of customer demand, enabling hotels and other businesses in the industry to optimize their inventory levels and supply chain operations. This can result in reduced costs, increased efficiency, and improved customer satisfaction. Yet before leveraging customer data for demand forecasting, organizations must carefully evaluate the moral and privacy ramifications. It will be intriguing to see how supply chain management techniques in the hotel sector change as big data analytics continues to advance.

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