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BIG DATA ANALYTICS IN SUPPLY CHAIN MANAGEMENT OF MANUFACTURING FIRMS IN PAKISTAN

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I hereby declare that I have compiled the thesis independently
and all works, important standpoints and data by other authors
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LIST OF ABBREVIATIONS

Particulars	Abbreviation
ANOVA	Analysis of variance
BDA	Big data analytics
BDA-SCM	Big data analytics-Supply chain management
CRM	Customer relationship management
IT	Information technology
NOR	Number of respondents
SC	Supply chain
SCM	Supply chain management
SME	Small medium enterprises
TOE	technological-organizational-environmental
S	Significant
NS	Not significant

ABSTRACT

Pakistan is the least country that has a very low in adopting technological advancement in the manufacturing sector. Manufacturing companies have to process both structured and unstructured data. However, Supply chain management in manufacturing companies has to create and maintain links among different entities. The entire operation involves a massive amount of data. Managing the data and integrating it is critical in resolving the challenges faced in the supply chain management system. It isn't effortless for the companies to visualize the data and predict the insights of the market. To address such issues, companies start adopting big data analytics in the manufacturing sector. The study aims to identify the attributes that influence big data analytics in the supply chain management of manufacturing companies in Pakistan. The study also attempts to find out the constraints in adopting big data analytics in the supply chain management of manufacturing companies in Pakistan.

To address the research objective, the researcher assumes a quantitative research strategy in which web surveys have been conducted among manufacturing companies in Pakistan. The assessment of respondents' opinions provides insights that big data analytics increases the adoption rate, especially in technological aspects. Organizational perspective, big data analytics helps to monitor the real-time markets, which helps meet time needs. The second objective is to find out the constraints in big data analytics. BDA faces constraints, especially in technological aspects, expertise, investment aspects, data, and organizational aspects. Factors like Low acceptance, routine, and BDA assimilation by SCM organizations and partners, lack of funds and facilities for research and development of BDA instruments, the complexity of data integration and data quality, and lack of training facilities and time constraints influence big data analytics in supply chain management of manufacturing companies in Pakistan.

Keywords: Big data analytics, supply chain management, manufacturing companies

INTRODUCTION

Big data refers to a collection of massive data that is unstructured, complex through data sources. The application of big data in the manufacturing industry paves the way to increase the companies' growth prospects in the market. Manufacturing industries have both structured and unstructured data; companies find it difficult to assess the data. Big data applications in the respective industries to resolve the issues and identify the insights from the data. Big data refers to visualizing the considerable volume of data (Manyika *et al.* 2011). Besides, the author stated that big data could store, manage and process the data efficiently (*Ibid.).* Big data is also a collection of data that acquires both traditional and digital sources that present insides and outside the company.

The data acquires from the sources uses for ongoing discovery and analysis. Various studies pinpoint that big data considers as the new form of capital in the present market (Mayer-Schönberger, Cukier 2013; Satell, Greg 2014). With the help of big data, the organization can monitor the acceptance of products in the marketplace. It helps to recognize the business environment and forecast the potential aspects of the products in the market. Assessment of the attributes assists the organization in gaining a competitive advantage (Verma, Bhattacharyya 2017). Big data also have the prospects of impacting business in terms of diminishing business cost, identifying the business insights, and unraveling strategic information. Consequently, it directs the organization to boost the quality and make effective decision making (Chen *et al.* 2012; Kwon *et al.* 2014). Thus, the aspects induce the manufacturing companies to consider big data as the essential technology which directs the organization to gain competitive advantage.

Big data analytics in the manufacturing industry have a market value of 1,01,99,281.11 Euro in 2019, and it estimates to reach 51,297.99 Euro in 2025. Also, it anticipates having a CAGR to be 30.9%for the forecast period between 2020 and 2025. (Intelligence…2021) indicates the market value increment in the manufacturing industry made with the high rate of adoption of sensors and connected devices. The increase in the use of new technology in the manufacturing

industry increases big data analytics in the manufacturing industry. Nowadays, industries are aggressive towards the adoption of big data analytics in their respective organization. Thus, the researcher identifies the factors that induce the manufacturing companies to use big data analytics in the organization.

(Insights… 2021) has indicated that the regional analysis made globally based on demographics like North America, Latin America, Europe, Asia Pacific followed by the Middle East and Africa. Out of all the regions, North America occupies the highest big data in manufacturing industries. Followed by Asia pacific region and Europe witness considerable progression in the upcoming years. Thus, the analysis helps to pick out the second region, which has created big data analytics in the global market. Globally, the Asia Pacific region is gaining the highest growth, which in turn the countries of the respective region have an increasing ground in regional business. Some of the countries belonging to the Asia Pacific region include China, South Korea, India, and Japan as the major manufacturing hub for big data analytics. According to the recent statistics, the Asia Pacific region has the prospects of digital transformation, which paves the way to increase the whole region's GDP to 3,18,91,23,03,600.00 Euro. Thus, the aspects induce the researcher to assess big data analytics in the manufacturing sector.

Mubarak *et al.* (2019) have assessed industry 4.0 technologies' role and how the technologies influence the business performance. The study considers the technologies like big data, cyber-physical systems, the internet of things, and interoperability. It observes that the above-stated technologies have a significant association with the business performance in Pakistan. Out of four technologies, the researcher picks out the big data because the variable has the least impact on business performance. Therefore, the study assists the researcher in evaluating, especially in the manufacturing industry in Pakistan.

Statement of the problem: The industry 4.0 revolution make a significant change in the manufacturing sector. The introduction of the concept has provided a paradigm shift in the working environment of the business and converted it into a different form. Nowadays, manufacturing firm focuses more on adapting digitization and technological advancement in supply chain operations. The main intention behind the adoption of new technology is not vanishing from the industry. Supply chain management is highly responsible for creating and maintaining links among different entities. Besides, the department is responsible for purchasing raw materials for final product delivery. The entire operation involves a massive amount of data.

The organization needs to have adequate data management and manage it efficiently. Managing the data and integrating it is critical in resolving the challenges faced in the supply chain management system. Effective management of data ensures visibility among producers, suppliers, and partners. Many companies failed to manage supply chain data. To address such issues, companies starts adopting big data analytics in supply chain management. Therefore, the present study makes an effort to assess the big data analytics in supply chain management in manufacturing companies.

However, Pakistan is one of the 67th global nations to face intense technological competition. (Getzoff…2021). The fact induces the researcher to assess how the industries are adopting big data and the barriers the companies face in implementing big data analytics in Supply chain management.

Research aim

The purpose of the study is to identify the barriers to implementing big data analytics in supply chain management.

Research objectives

The objective of the study is to identify the attributes which influence the adoption of big data analytics in the supply chain management of manufacturing companies in Pakistan. The study also attempts to find out the constraints in adopting big data analytics in the supply chain management of manufacturing companies in Pakistan. Finally, it offers an appropriate solution in overcoming the constraints in supply chain analytics.

Research questions

How do the attributes influence big data analytics's adoption of manufacturing companies' supply chain management in Pakistan?

What are the challenges do the company faces in adopting big data analytics in Pakistan?

1. THEORETICAL BACKGROUND OF THE STUDY

Data integrated with the new oil paves the way to have a business value that supports organization growth (Rotella 2012). Companies have to deal with the data; refining it helps the firm gain financial prospects and gain business value. The present market is filled up with competition, and hence the firm needs to adopt state-of-the-art information technologies to gain a competitive advantage (Low *et al.* 2011). Implementing technologies helps to accumulate an enormous amount of data at a rapid speed. The action, in turn, emerges the concept of big data. The concept considers being a powerful technology to process a wide array of data. Big data is defined as the large data sets in structured or semi or unstructured data. All the data have been acquired from unrelated resources. The best instance for unrelated resources like sensor data and the content extracted from social media (Malaka, Brown 2015)

Definition of big data analytics: There is no general definition for big data analytics. The description has been started from a technical perspective. Big data analytics considers acquiring information flow from various processes, which is very big (Jiao *et al.* 2013; Liu 2013). The users can do anything with the big large datasets (Kwon 2013; Tien 2013).

Others stated as it is a type of business analytics that direct the organization in investigating the complete data sets on time (Boubeta-Puig *et al.* 2014)

The business perspective defines big data analytics as a function that creates value for the business. The action is possible with unique tools and support capabilities that help deal with complete data that could not be processed with traditional approaches (Chen *et al.* 2013; Gobble 2013). It is vital to get consistent support from conventional software tools to process extensive data (Manyika *et al.* 2011). Investment is high to get help from agencies because it relates to big data technology. Though investment is vast, it provides benefits like accelerated competitiveness, increased innovation, and sky-high efficiency (Braganza *et al.*

2017). It covers the advanced technologies and tools to deal with big data, which helps to gain insights that accelerate the decision-making process (Malaka, Brown 2015).

Big data analytics is defined by Chen *et al.* (2015) described it as a unique information processing capability. It brings about a competitive advantage to a particular organization. Besides, it accelerates the performance to a great extent (Kwon *et al.* 2014).

Characteristics of big data analytics: Big data denominate as the volume which deals with more massive data sets. It is also described as diversifying the data in the form of structured or semi-structured or unstructured data. We are applying data analytics tools to make a faster decision than before.

First, represent volume. It means generating more amount of data, store it, and operate it within the respective system. Increment in volume explained through the increment in data generation and holding it. The main intention is to meet the need whenever it arises.

The second one is the variety. It defines the multiplication of data types managed in an information system. The action of multiplication guide to identifying the complexity of links and link types integrated with the data

Velocity defines as the frequency at which generating the data, capture it and share it in the platform

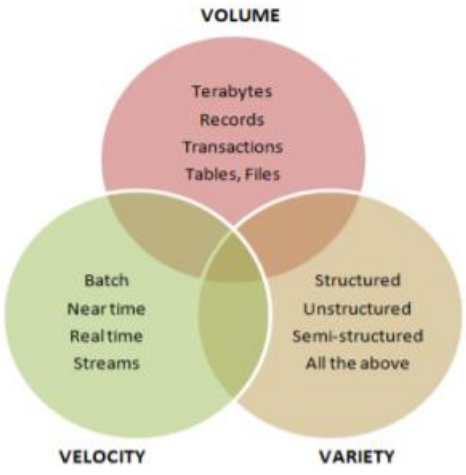

Figure 1. Characteristics of big data analytics
Source: (Youssra, Sara 2018)

Benefits: Using big data analytics assist the organization in improving the existing process. Besides, it directs the organization to focus on business-related practices and procedures, which accelerates competitive pressure (Chen *et al.* 2018; Davenport 2006). Big data analytics's main intention is to examine the large data sets that help extract similarities, market trends, and hidden patterns. Also, it assists in knowing the customer's expectations, which helps to make a business decision. It also helps the organization gain a business advantage in providing an effective service to customers, increasing the operating performance, accelerating the revenue prospects, and upsurge the competitive pressure on rivals.

Big data analytics adoption: It defines the data that transcend the particular storage level, processing, and computing capacity of traditional databases and their techniques. It is considered that cant resources can investigate and extract large-scale data with less time (Najafabadi *et al.* 2015). It refers to two technical entities, namely advanced analytics and big data combined, whereas advanced analytical techniques help to work with large scale data (Russom 2011). The organization allows big strategies to integrate the analytics with the organization. The primary intention is to measure and manage what the organization performs (McAfee *et al.* 2012).

Consequently, in the literature, Kwon *et al.* (2014) refers to data as methods and technologies to investigate complex and large data sets. Besides, the utilization of such data leads to improve performance. Wamba *et al.* (2015) has put forward a definition for BDA as an integrated process. It includes analysis, compilation, handling, and interpretation of function division data. It paves the way to extract valuable insights, which increases business value and competitive pressure in the environment.

1.1. Big data analytics: Supply chain management

SCM: Supply chain management tends to be used to refer to a bi-direction flow of information followed by-products and money. All the things process from suppliers to

customers but with the help of the various organization. SCM process contains planning the flow, implementing it, and controlling it (Nurmilaakso 2008). In the present digital era, the supply chain considers as the key driver to gain a competitive advantage (Gunasekaran 2004).

Technology impact on SCM: SCM plays a crucial role in reducing the companies to face risk, fraud, and bribery (Kenny 2014). It is because of adoption and innovation in IT. Integrating IT with the supply chain helps share end-to-end information with various stakeholders (Sahin, Robinson 2002; Wang, Wei 2007). Besides, it assists in making business process transformation, which accelerates the decision making within supply chain members. Also, the action increases efficiency and company revenue (Rai *et al.* 2006; Reddy *et al.* 2017).

BDA-SCM: It anticipates to transform the supply chain process to get precise information from the stakeholders. Applying tools on such information extracts the insights which help to use it for competitive advantage. Also, it assists the stakeholder in diminishing the risks of fraud and misconduct. Besides, it increases efficiency, profitability, enhances the relationship, and improve supply chain agility (Vasan 2014). Finally, it plays a crucial role in getting an outcome from the market faster. It has the potential for superior revenue recognition for the organization (Reddy *et al.* 2017)

1.2. Background of the study

The study relates to the technological-organizational-environmental framework. First, the concept was coined in the book "The processes of technological innovation" by Tornatzy and Fleischer (Tornatzky 1990). The framework helps determine the attributes that integrate with the adoption of technological innovation in the below-stated context. There are three contexts in the TOE framework.

Technology context which defines as the technologies available for the organization to have a possible adoption
Organization context refers to the characteristics of the organization
The environment context relates to the organization's pressure from competitors to suppliers (Sam 2018).

All constructs were framed to assess BDA adoption in SCM, getting consistent guidance from the TOE framework.

1.3. Literature review

Ittmann (2015) noted the vital impact of big data and analytics on supply chain management. The study assumes that learning about the nature of supply chain fraternity, increasing productivity, and gaining competitive advantage in the industry is required. The author is keen to apply qualitative research, in particular case studies, to learn the significant effect of big data analysis on supply chain efficiency. Case studies have used confidence and skepticism concepts to alert tech supply chain managers. Approaches evaluated using descriptive statistics, predictive analysis, and prescriptive analysis showed that the assistance included improved visibility, the ability to track and forecast supplies, reduce delays in delayed delivery, forecast the optimum inventory needed for pricing, and suggest pricing where data is not available. The research shows supply chain managers are aware of the current developments and apply them to the business to stay competitive. From the paper, the researcher finds that Big Data Analytics is one of the innovations in supply chain management that provides the company with considerable benefits. The primary justification for picking the thesis is the authors' lack of enthusiasm for big data analytics. Generalized effects on the services obtained from and implemented in the organization have encouraged managers to make decisions based on data. Hence, the researcher supports the argument in the article.

Oncioiu *et al.* (2019) focused on evaluating big data analytics in supply chain management, defining the challenges and approaches of businesses in applying big data analytics in Romanian firms. During the time from January to March 2019, the authors addressed the thesis using quantitative analysis. The study considered the independent variables (experience, sales revenue, policy, professional abilities, and industry) and the purpose of using tools and technologies as a dependent variable in the future. Binary logistic regression has resulted in a high chance of investment with new tools and technologies. The firms have strong professional skills and therefore increase sales revenue for the companies on the market. Companies faced other restrictions such as defense and lack of support from the executives.

Additionally, finding difficulties in embracing the organization's technologies. The study clarifies that 80 percent of the companies that use it in the enterprise and the businesses have spent heavily incorporating it in the organization. The researcher identifies from the study that there's no strong argument for the study's findings. The researcher finds the article useful for knowing the factors used to measure the supply chain's performance. Therefore the investigator replicates the same thing in the analysis.

Moktadir *et al.* (2019) reported that in Bangladesh, recognizing the obstacles present in big data analytics. The authors performed the analysis using the Delphi-based analytical hierarchy method, which resulted in higher barriers being acquired second place in collecting data that technology-related barriers. Furthermore, there were other obstacles such as lack of resources, the difficulty of system management, data protection, lack of availability of robust data analytics software, and high investment costs. The study showed that managers need to consider the obstacles and create strategies to take advantage of BDA in the enterprise. The writer found that the report is being used to learn the challenges present in its acceptance through the research. The report notes the most significant challenges in supply chain management encountered by companies. The researcher thus makes use of the hurdles in their analysis.

Akter, Wamba (2019) found out how big data analytics provides various opportunities that can be measured using literature reviews. The essence of the thesis is thus qualitative, and the researcher acknowledges the problems it poses and makes recommendations for it to be solved in the future. The study concluded that the application of big data analytics in supply chain management was relevant.

Maroufkhani *et al.* (2020) reported that the goal was to evaluate big data analytics's implementation on small and medium-sized businesses in Iran. The research assessed quantitative factors and produced findings that qualities such as sophistication, ambiguity, vulnerability, trial capacity, observability, top management support, and preparation for company and external assistance have a significant impact on implementing big data analytics. Eventually, embracing BDA speeds up marketing and financial results, and ultimately, the business can gain a competitive market advantage. The researcher recognizes the characteristics that drive big data analytics for the organization's adoption from the

report. The explanation of why the sample is chosen is to reproduce the same features in the sample.

Lai *et al*. (2018) reported that the company's characteristics to implement comprehensive data analytics for the enterprise were identified. The research classifies opportunities in terms of the innovations accompanied by the enterprise's features and the environment, and the supply chain. The study was subjective, resulting in potential gains and promotion for top management, having an apparent positive effect on the company's lousy acceptance. The supply chain's environmental qualities and features have a balanced relationship between the driving rates and its plan to implement big data analytics. Throughout the report, the analyst recognizes expected gains and senior management are the essential qualities. These factors have a significant impact on the organization's implementation of big data analytics. The writer then uses the same thing in the analysis.

Benefits of big data analytics: Elgendy (2014) showed that the vast array of data available for the users in the present information era and the users need to classify the data and utilize it to make a significant decision. Handling an enormous amount of data is not only big, but it has the prerequisites of variety and velocity. The presence of speed and type makes it quite complex to handle it with conventional tools and techniques. Besides, there is significant growth in the data every day. Hence, it is essential to manage the data and different knowledgeable sources from the concerned data set. Big data is vital to handle daily transactions, customer interaction data, and social network data to tackle extensive data handling. Big data tools help to resolve the data within few minutes and derive out valuable insights from it. Thus, the researcher recognizes that big data has significant progress in recent days. But there is no clear information regarding methods used, tools used to derive the outcome. Unfortunately, it does not address the big data antics tools and reaps the benefits of making a significant decision. Their study's main weakness is that they do not explain the methodologies used to derive the outcome.

Wang *et al.* (2018) claim that how five big strategies help companies benefit from big data analytics. The study uses content analysis to derive the five capabilities, including analytical capability and unstructured data analytical capability, decision support capability, predictive capability, and traceability. All the capabilities help derive the organization's benefits in IT, infrastructure, operational, managerial, organizational, and strategic areas. The study outcome

allows the organization to recognize its capabilities and services to make effective data-driven analytics strategies. Thus, the researcher understands that big data analytics plays a crucial role in creating a significant decision. At the same time, it drives the organization to get beneficial from a management perspective, operational, and infrastructure perspective. Therefore, the researcher seems the study to be reliable to derive the benefits from various perspectives.

Raguseo (2018) Proposes that the adoption of big data technologies in the companies and how they used significant data sources. Companies have to deal with the transformation from a business, customers, and management perspective. The action can create a data-driven revolution in management. The emergence of the process was made because of the many data and fast changes made in big data technologies. Hence the authors assess big data analytics from a consumer perspective. They give more importance to benefits like strategic, followed by transactional, transformation, and informational services. Besides, it also measures the risks involved in using big data technologies for companies. From the findings, the study observes that benefits and risks may vary based on company size and industries related sector. All the attributes were statistically significant. The outcomes provided in the study are accurate and comprehensive. But there is still ambiguity about applying methodologies, and the approach followed in the study—one question raised in the study that which kind of industries do the survey considered. Companies reap more benefits and risks and reap fewer benefits and risks related to big data analytics.

Adoption of big data analytics: Agrawal (2015) underlines how the determinants impact the BDA adoption of China and India. The study also had a framework using technology - organization-environment- how it helped the author derive the outcome. Antecedents of BDA evaluate from technology followed by organization and environment perspective. There were six attributes: compatibility followed by complexity, organization size, competition intensity, regulatory support, and environmental uncertainty. With the help of logistic regression, the authors find that compatibility followed by organization size, ecological suspense, and competition intensity impacts big data analytics in the organizations. Also, regulatory support is considered to be the most influential attribute to adopt BDA in the organization. The researcher recognizes that the outcome was justified based on a firm opinion from China and the Indian context. Hence the features seem plausible, paving the way to incorporate statistically significant variables in the study.

In his paper, Verma (2017) shows how the attributes influenced prominent data analytics utilization and adopt BDA in Indian firms. The study finds that the non-adopters failed to recognize the strategic value of big data analytics, and hence they were not ready to meet the firms' changes. Besides, they were considered constraints related to technological followed by organization and environmental difficulties. The study finds that complexity followed by compatibility, IT assets, perceived cots, pressure from the external environment, and industry type created an impact on BDA adoption. One of the advantages of finds in the study that all the factors were precisely defined as how it influences big data analytics. From the study, the researcher recognizes that attributes are playing a pivotal role in determining the adoption of big data analytics.

Cabrera-Sanchez (2019) investigates how the companies impacted behavioral intention to use big data analytics. The study uses attributes like performance expectancy, social influence, facilitating conditions, and resistance to independent variables. Behavioral intention is considered as a dependent variable. The outcome shows that enabling conditions and performance expectancy had the most substantial impact on behavioral intention. Resistance to use decreases, the social influence of using technology increases in the organization.

Tien *et al.* (2019) demonstrated that big data analytics helped investigate and examine the complete data sets. The main intention is to extract the vital information that improves the users' decision-making. Besides, it helps to predict sales and enhance CRM and increase revenue and profits. The study focuses more on investigating the adoption of BDA on small and medium enterprises in Malaysia. The findings of the study stated that BDA adoption was low among SMEs in Malaysia. Hence, it is essential to induce companies to utilize big data analytics to reap a competitive advantage in the market. The researcher observes that there is still an uncertainty in how the authors explained that BDA was low in Malaysia. There are no observations made on the attributes that influenced SMEs to have a low intention to adopt BDA in the country.

Hong (2020) has been widely addressed how BDA impacts organization performance in Malaysia. Identifying the objectives, the authors have framed the conceptual framework, which describes BDA as an independent variable, agility as a mediating variable, and organization performance as a dependent variable. The outcome has stated that big data

analytics have an impact on organization performance but mediated with agility. SME still at the exploration stage, whereas big multinational companies started implementing it to enhance the performance.

Challenges of big data analytics: Acharjya (2016) is to identify the impact of significant data challenges and how tools are associated with it. The study's findings pinpoint that statistical tools, machine learning, cloud computing, data mining, and data stream processing are used to investigate big data analytics. Some of the constraints associated with big data analytics were hardware and software, leading to parallel computing, visualization, and scalability.

Gahi *et al.* (2016) have gained much attention due to security and privacy violations associated with a complete data volume. Big data analytics is used to derive out valuable information and to make the appropriate decision making. Besides, it is useful in tracking specific behavior and detecting threat attacks. Processing the data with multiple techniques helps to change the content in a structured way. Hence, companies use BDA to make an appropriate decision. Risk arises because of tools that contain storing, managing, and investigating data from the sources. Big data analytics uses to collect comprehensive data, but it may lead to avoiding security and privacy violations. With the help of the study, the authors provided an outcome of how to safeguard the data through big data analytics.

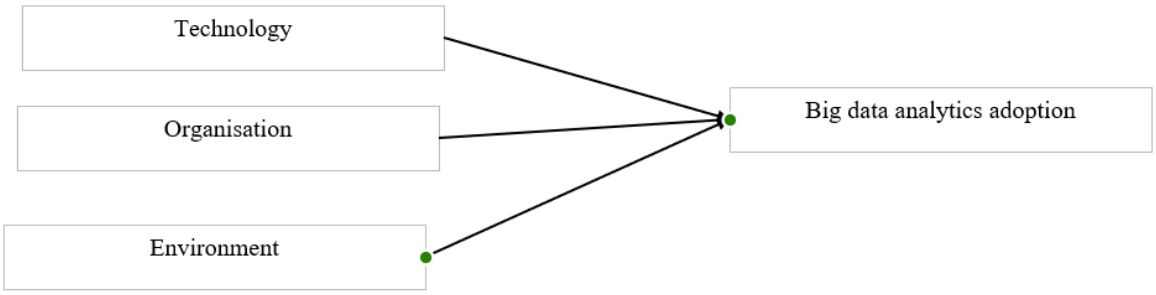

Figure 2. Conceptual framework
Source: Author own preparation

The researcher considers technology, organization, and environmental perspective as the independent variable and adoption of big data analytics as a dependent variable in this study.

2. RESEARCH METHODOLOGY

2.1. Introduction

In this section, the researcher makes significant efforts to describe the technique and its uses to achieve the study's goals. The methodology of science refers to the organized method of addressing the research problem. The present section provides a detailed explanation of ways of carrying out the research to address the research concern.

2.2. Research techniques and procedures

Research design: The report uses a descriptive research design because it addresses big data implementation in supply chain management of manufacturing firms in Pakistan.

Research strategy: The study adopts quantitative research methods to derive the conclusion through a statistical way. The technique proposed by (Ardito *et al.* 2019; Christ *et al.* 2019) was inspirational to analyze the present study.

Hypothesis:
There is a significant difference of attributes motivating to invest in BDA based on department
There is a significant difference in usage of big data analytics at SCM based on departments
There is a significant difference of advantages of using big data analytics based on departments.
There is a significant difference in technological factors based on departments.
There is a significant difference in organizational factors based on departments.
Technological barriers have a significant difference from the department.
Expertise and investment barriers have a significant difference in departments.
Data barriers have significant differences with the department.
There is a significant difference in organization barriers based on departments

Population: It refers to the target population of the study group. (Majid 2018). The present study considers the population as the manufacturing companies in Pakistan.

Sampling: It defines picking out a statistically representative sample of respondents from the population of interested manufacturing companies in Pakistan. The study has the sampling as the manufacturing companies who have big data analytics in Supply chain management. The researcher gets consistent support from (EW 1986), who has the companies which support big data analytics in the organization as the sample.

Sampling technique: It represents the taking of the samples from the chosen sampling. It is of two types, namely probability and non-probability sampling. Out of two sampling methods, non-probability sampling techniques have been adopted. Out of many non-probability sampling technique methods, the most suited technique is convenience sampling. It selects the readily available respondents. (Taherdoost 2016)

Sample size: Once samples and sampling technique decides, the next step is to determine the sample size. The researcher approaches 100 respondants in which 70 respondants take part in the study. It encompasses small to medium to large enterprises in Pakistan involved in manufacturing jobs. The study determines the response rate is 70%.

Data collection: The researcher determines the research instrument is a questionnaire. It includes open-ended questions and Likert scale questions. The study frames the research instrument in a web survey. It sends the web survey link to all the respective company personnel working in the supply chain department of manufacturing companies in Pakistan.

The researcher records the respondents' opinions in Google form, and hence the nature of the collected data is original. It is made up for the first time. The objective of using the primary data is to get a higher accuracy rate. The researcher receives the opinion from the respective personnel, transforms it into an excel sheet, coding is done, and transform it to SPSS. Thereafter, statistical tools like descriptive statistics and ANOVA were performed to evaluate the variables used in the study. The study also relies on secondary sources to gain insights from the other authors to support the research concern of the present study. Using secondary sources of data gives an idea to develop the theoretical framework of the study.

Validity: The study measures the validity of the questionnaire through the experts. The researcher evaluates the validity using the Kappa coefficient. The outcome of the constructs lies between 0.85 to 0.95. All the variables indicate that the constructs show perfect agreement. Therefore, it is highly suitable to measure the big data analytics of Supply chain management.

Reliability: It refers to evaluating constructs and checks whether the constructs are dependable on the variable or not. The researcher measures the reliability of the constructs through Cronbach Alpha. The study considers the dependent and independent variables of the constructs and constructs the Cronbach alpha using the SPSS package. It gets an outcome that 0.857, which is relatively higher than the standard limit. The standard limit of Cronbach alpha is 0.7, and thus the results portray that the constructs have the higher internal consistency.

3. ANALYSIS

3.1. Profile of respondents

Table 1. Profile of respondents

Particulars		nor	%
Place	Rural	23	32.9
	Urban	20	28.6
	Semi-urban	27	38.6
Size of staff	Low	25	35.7
	Moderate	23	32.9
	High	22	31.4
Turnover	Low	25	35.7
	Moderate	28	40.0
	High	17	24.3
Sources of data prefer for big data analytics	Internal sources (Business IT system and database)	37	52.9
	External references (Social media)	33	47.1
Areas of using big data analytics in SCM	Procurement	26	37.1
	transportation	20	28.6
	Warehousing	24	34.3
Importance of inputs in BDA	Strategic inputs	20	28.6
	Tactical inputs	22	31.4
	Operational inputs	28	40.0
Total		70	100.0

Source: Author's calculations

Place: The above table indicates that 32.9% of participants are rural, while 28.6% of urban, and then 38.6% are semi-urban. It then concluded that the majority of participants are in semi-urban places.

Size of staff: 35.7% of the participants are the team's small size, while 32.9% of moderate size and 31.4% of the staff's large size. Hence it is evident that the highest numbers of participants are the small size of the team.

Turnover: From the above table, it indicated that 35.7% of participants are low turnover, while 40% of moderate turnover, and 24.3% of high turnover. It thus inferred that the largest

number of participants is average turnover. The study picks out 70 manufacturing firms out of which the average turnover of 23,676.00 Euro is low turnover, 23,676.00 Euro - 4,72,392.50 Euro is moderate turnover and the above turnover of 4,72,392.50 Euro is high turnover.

Data sources prefer big data analytics: The table shows that 52.9% of participants are internal sources (Business IT system and database), and 47.1% are external references (Social media). Therefore, most respondents prefer big data analytics are internal sources (Business IT systems and database).

Areas of using big data analytics in SCM: 37.1% of participants are procurement while 28.6% of transportation and 34.3% of warehousing. It then inferred that the highest number of participants in areas using big data analytics in SCM is procurement.

Importance of inputs in BDA: The table above reveals that 28.6% of participants are strategic inputs, while 31.4% of tactical inputs and 40% of operational inputs. Therefore it is inferred that the largest number of participants are operational inputs in BDA.

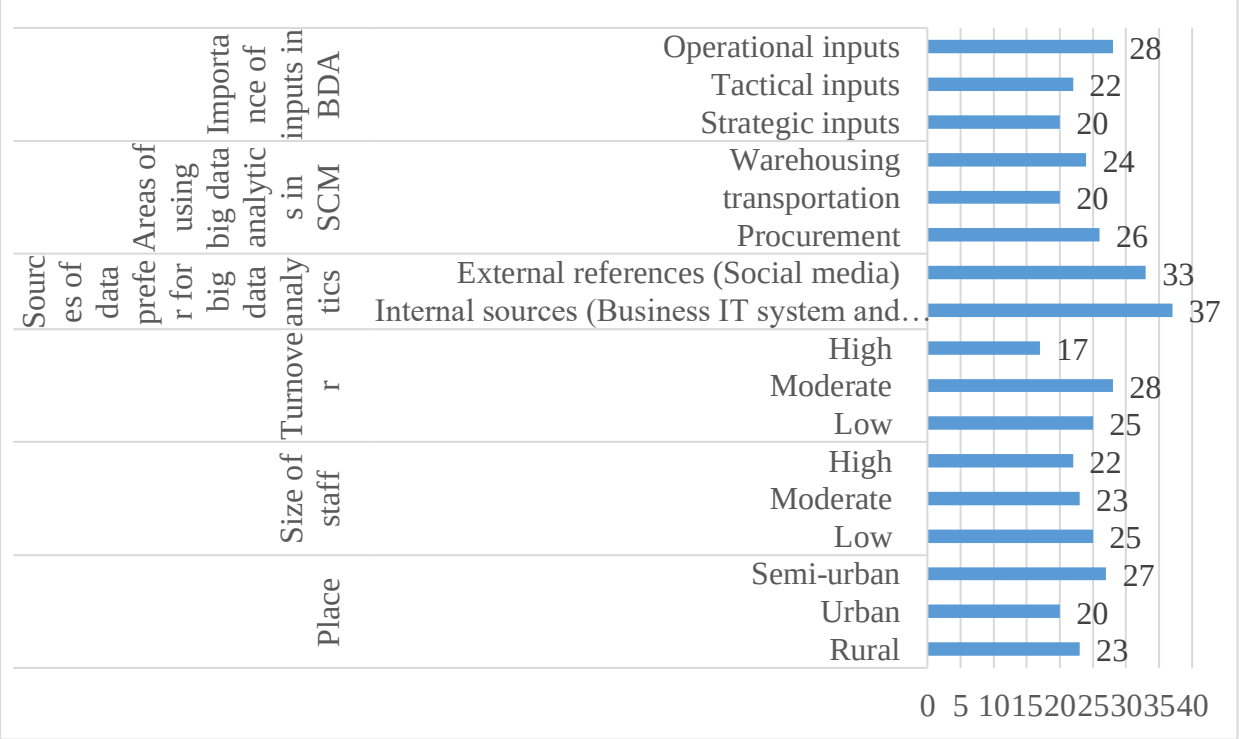

Figure 3. Profile of respondents
Source: Author's calculations

3.2. Current Information technology Infrastructure and Existing Information Systems

Current IT infrastructure and existing information system measures using statements like "IT infrastructure flexibility considers as the organization capability. Because it supports to integrate the information using various information technology and services", "The current system can have the ability in sharing any type of information using technology devices", "The current system ability of any technology to attach to any of the other technology component" and "the ability to quickly build or modify software applications in order to easily support changes in product development". The values of mean score ranged between 2.8-3.3. The highest mean value for the statement "The current system can have the ability in sharing any type of information using technology devices" has the accuracy to be very lower. However, the lowest mean value for the statement "the ability to quickly build or modify software applications in order to easily support changes in product development" os 2.8857 which has highest accuracy.

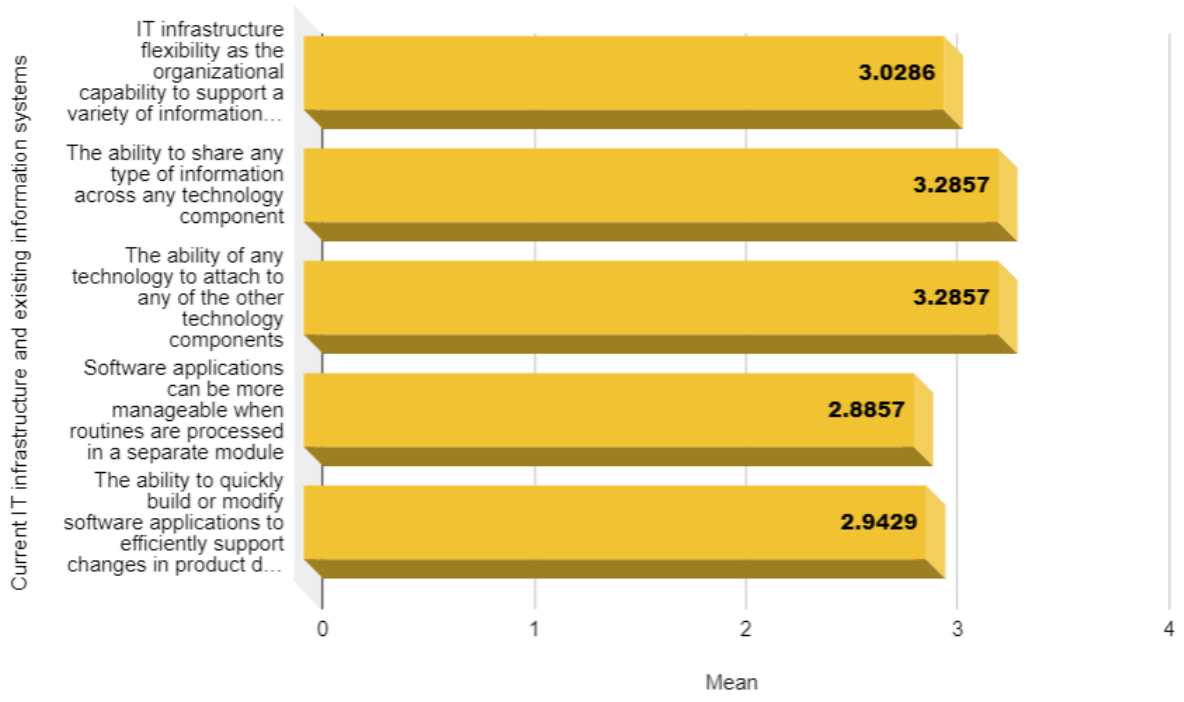

Figure 4. Current IT infrastructure and existing information system

Source: Author's calculations

3.3. Perspectives of Big data analytics

Technology: The technological perspective of big data analytics measures in terms of two aspects. It includes complexity and compatibility. The term compatibility secures the highest mean value, 4.14, which has the lowest accuracy in the organization. However, the lowest mean for the statement "complexity" is 3.9, which has the highest accuracy in the organization

Organization: The study assesses an organization perspective using two statements. Statements like "Availability of readiness of technology" and "Organization data environment support." The highest mean value for the statement is "Organization data environment support," which has the highest mean score of 4, which has the lowest standard deviation. Thus the statement has the highest accuracy. However, the statement "Availability of readiness of technology" secures the lowest mean score (3.8) and has a standard deviation (2.11), which indicates the highest accuracy.

Environment: Statements like "Rivalry pressure" and "Suppliers pressure" denotes an environmental perspective. The highest mean value(4.1) indicates the statement "suppliers pressure" having the highest accuracy in the organization. The lowest mean value (3.8) indicates the statement "Rivalry pressure," which secures the most insufficient accuracy (2.08).

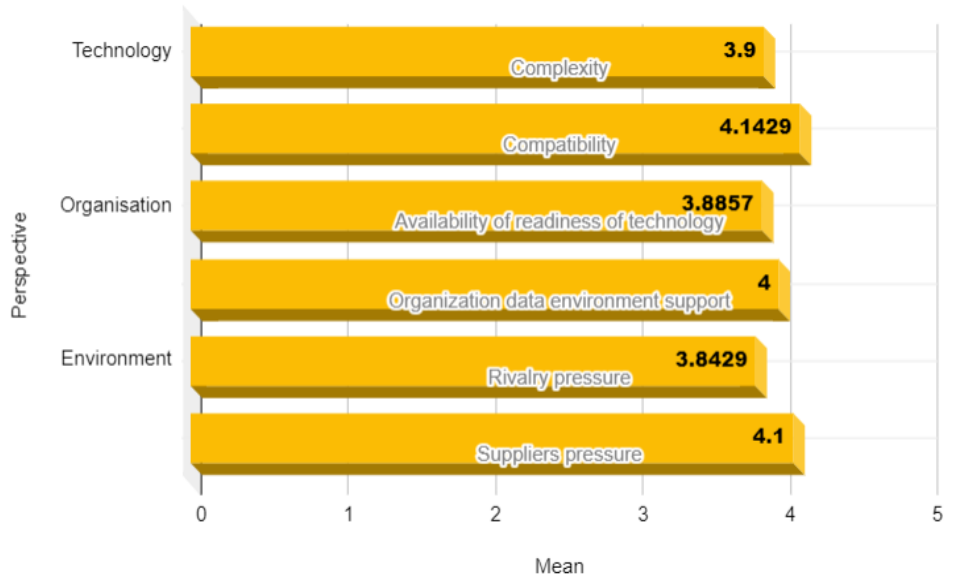

Figure 5. Environment perspective
Source: Author's calculations

3.6. Big data analytics in SCM

Statements like "BDA is the process of extracting and presenting SC information in ensuring measurement, monitoring, forecasting, and SCM", "BDA is disclosing component or full production, which includes analyses and key performance indicators" and "BDA uses quantitative methods in obtaining prospective information from data to understand upstream and downstream in assessing operational decision making" denotes big data analytics in SCM. The average mean values ranged between 2.8-3.2. Highest mean value for the statement "BDA is the process of extracting and presenting SC information in ensuring measurement, monitoring, forecasting, and SCM" has a lowest precision in the organisation. Lowest mean value for the statement is" BDA uses quantitative methods in obtaining prospective information from data to understand upstream and downstream in assessing operational decision making" (2.85) which has highest precision in the organisation.

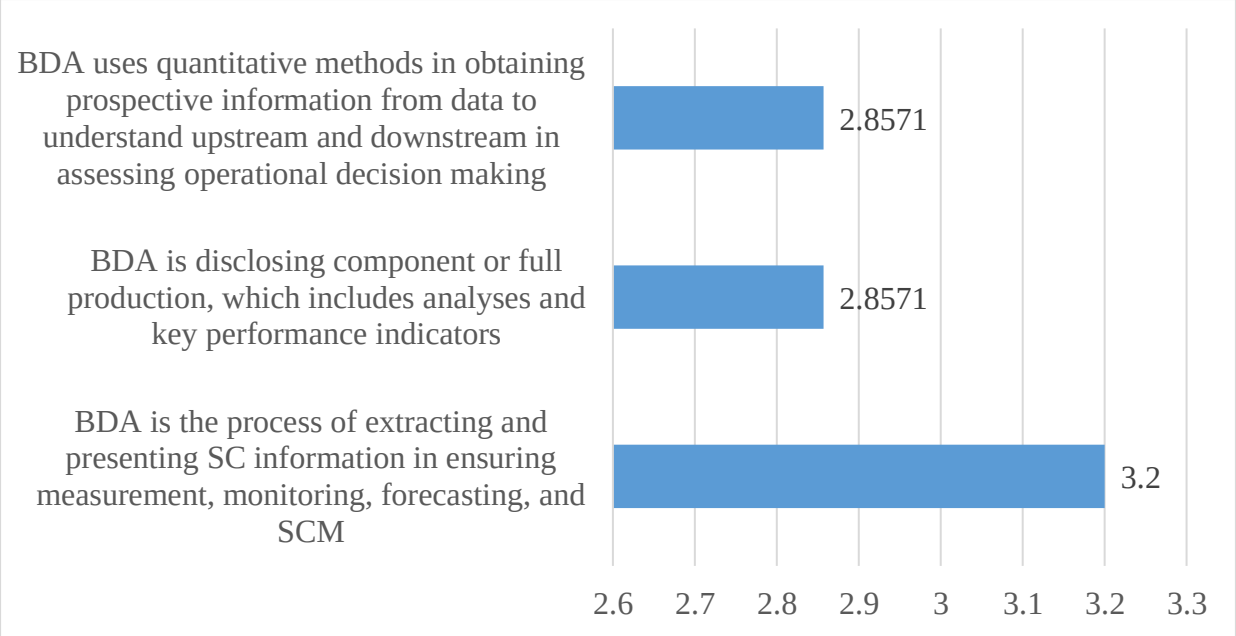

Figure 6. Big data analytics in SCM
Source: Author's calculations

3.7. Attributes influence the organization to make an investment in big data analytics

Subsequent Statements indicating as the attributes influence the organization to invest in big data analytics. It includes "It promotes and coordinates the supply chain members", "It minimizes the bottlenecks present in supply chain activities", "It helps to predict the current trends in supply chain management", "It helps to measure the sustainability of the supply chain", "It improves traceability in the supply chain", and "It improves reaction time" . The average mean value of the statement ranged between 3.6-4.12. The highest mean value for the statement is "It improves reaction time" whereas the least mean value indicates "It helps to measure the sustainability of the supply chain". Highest accuracy for the statement is "It promotes and coordinates the supply chain members" whereas lowest accuracy for the statement is "It helps to measure the sustainability of the supply chain"

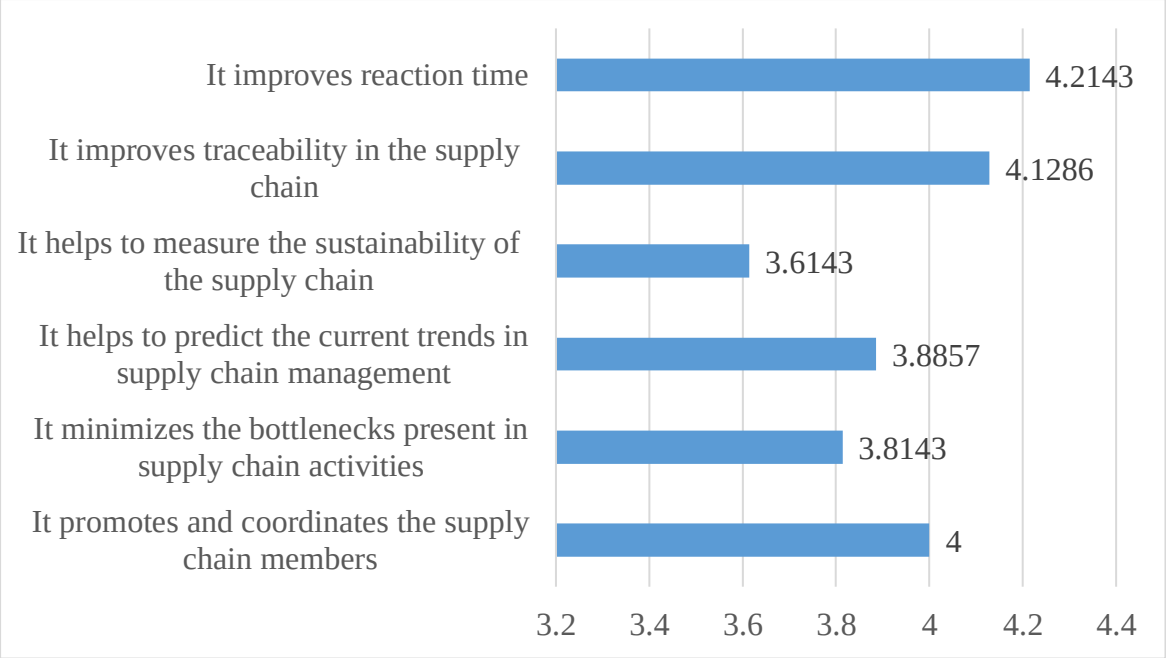

Figure 7. The attributes influence the organization to invest in big data analytics
Source: Author's calculations

3.8. Purpose of using big data analytics in SCM

The study measures the purpose of using BDA in various statements. It contains "electronic data interchange", "vendor managed inventory", "efficient consumer response", "Collaborative planning, forecasting, and replenishment"," Collaborative planning system", "Salesforce automation", "point of sales". The average value of the statements ranged between 3.5-4.5. The highest mean value for the statement is "efficient consumer response" has lowest precision in the organization. The lowest mean value for the statement is "electronic data interchange which has highest accuracy in the organisation.

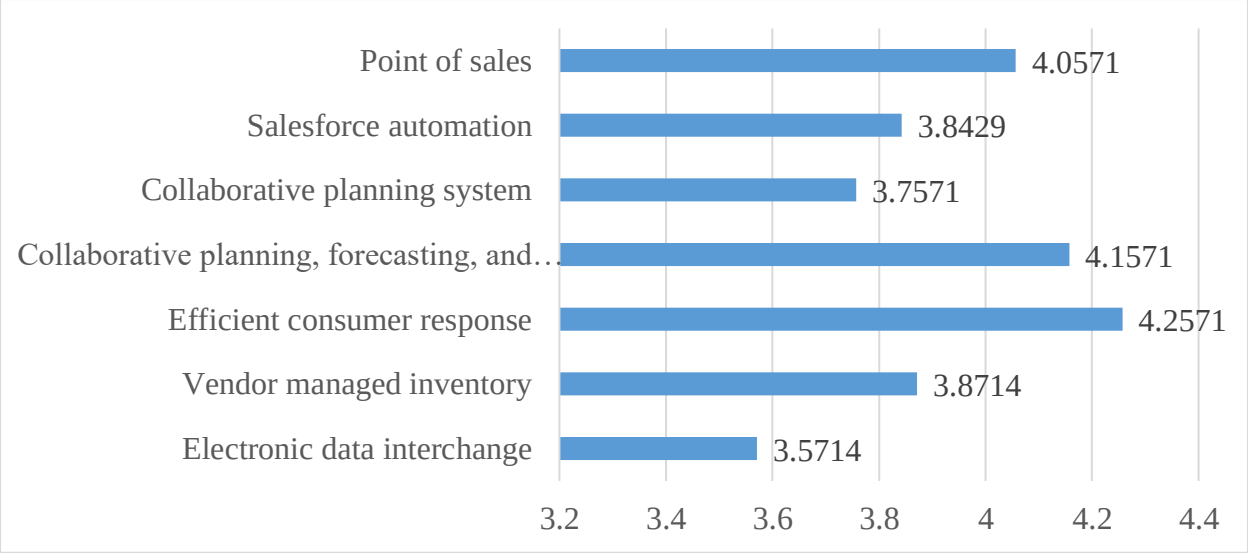

Figure 8. Purpose of using BDA
Source: Author's calculations

3.9. Factors

Technology: The study measures the technological attributes using statements like "increases adoption rate", "user friendly", "compatible" and "consistent with organization value and technology". The above stated statements represents how technological attributes influence the organization to use big data analytics in SCM. The statements have the average mean value ranged between 3.7-4.5. The highest mean value for the statement "User friendly and easy to use" has lowest accuracy. However, the lowest mean value for the statement "increases adoption rate" has highest accuracy in the organization.

Organisation factors assesses with the help of subsequent statements. It contains "It helps to monitor the markets in real-time", "It reduces the costs involved in the maintenance"," It helps to enforce data integrity", "It helps to create taxonomies with practical mining of data". The factors was reported with highest mean value is 4.37 for "It helps to create taxonomies with practical mining of data". Also, the statement has lowest accuracy. However, least men value for the statement is "It helps to monitor the markets in real-time" which has highest precision in the organisation.

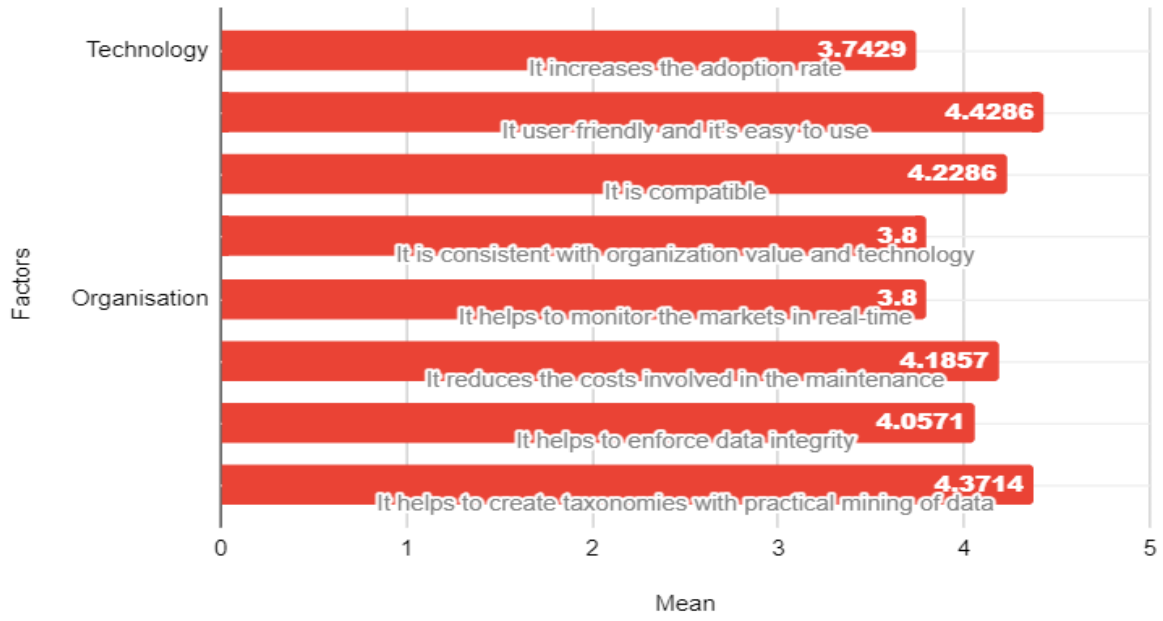

Figure 9. Organisation factors
Source: Author's calculations

3.11. Benefits of using BDA in SCM

Big data analytics in Supply chain management measures using statements like " It helps to maintain a competitive position in the market", "Entities interconnected with electronic information exchanged simultaneously with supply chain partners", "It reduces operational costs", "It increases supply chain agility". All the statements have mean values ranged from 3.8 to 4.01. The highest mean value for the statement is "It helps to maintain a competitive position in the market" is 4.01 which indicates lowest accuracy. The lowest mean value for the statement is "It increases supply chain agility" which has highest accuracy.

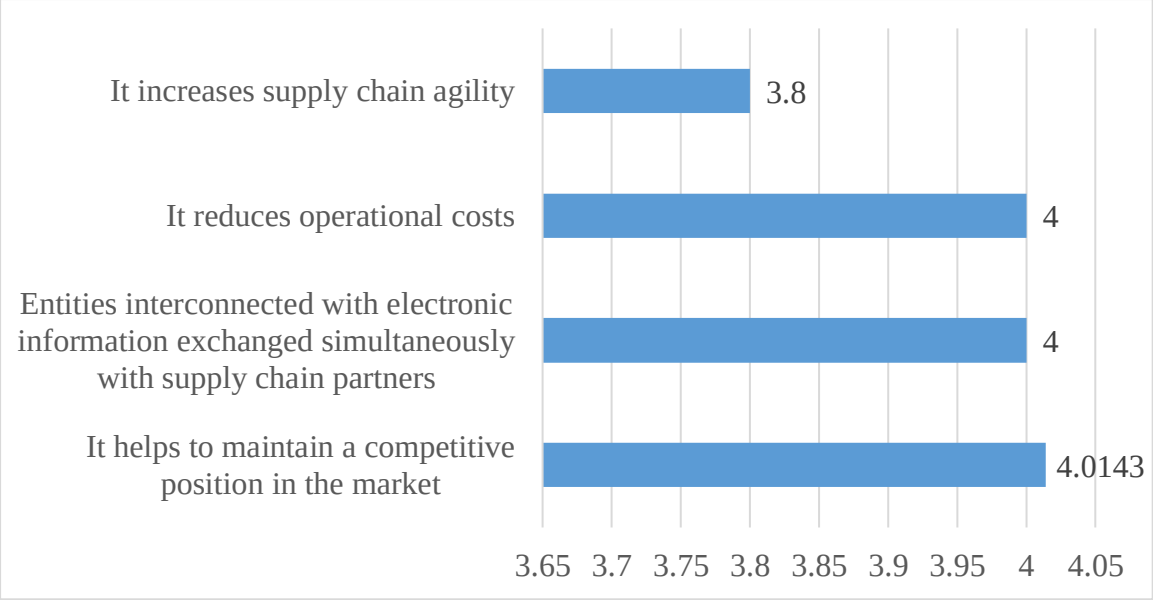

Figure 10. Benefits of using BDA in SCM
Source: Author's calculations

3.12. Barriers

Technological barriers: Technological barriers make an assessment using statements like "Lack of understanding of the implementation of new technologies or a lack of tools needed to implement BDA in SCM," "A lack of infrastructure facilities," Low acceptance, routine, and BDA assimilation by SCM organizations and partners" and "Data security." The statements secure mean value which ranged between 3.7-4.5. The highest mean value is 4.5 for "data security," which has the lowest accuracy. However, the lowest mean value is 3.7 for "Low acceptance, routine, and BDA assimilation by SCM organizations and partners," has the highest accuracy.

Expertise and investment barriers: It measures using the statements like "Lack of qualified IT staff and high investment cost" and "A lack of funds and facilities for research and development of BDA instruments." The highest mean value for the statement "Lack of qualified IT staff and high investment cost" has the lowest accuracy. However, "A lack of funds and facilities for research and development of BDA instruments" has the lowest accuracy.

Data barriers: It evaluate using statements like “The complexity of data integration and data quality” and “Data security, confidentiality, performance, and scalability.” The highest mean value for the statement “Data security, confidentiality, performance, and scalability” have the lowest accuracy. However, “The complexity of data integration and data quality” has the lowest mean value as 4.18, which has the highest accuracy.

Organization barriers: It measures using the statements like “Absence of a data-sharing policy between organizations and a lack of thinking in terms of extensive data” and “Lack of training facilities and time constraints.” The highest mean value for the statement is “Absence of a data-sharing policy between organizations and a lack of thinking in terms of extensive data,” has the lowest accuracy. However, the lowest mean value for the statement is “Lack of training facilities and time constraints” with the highest accuracy.

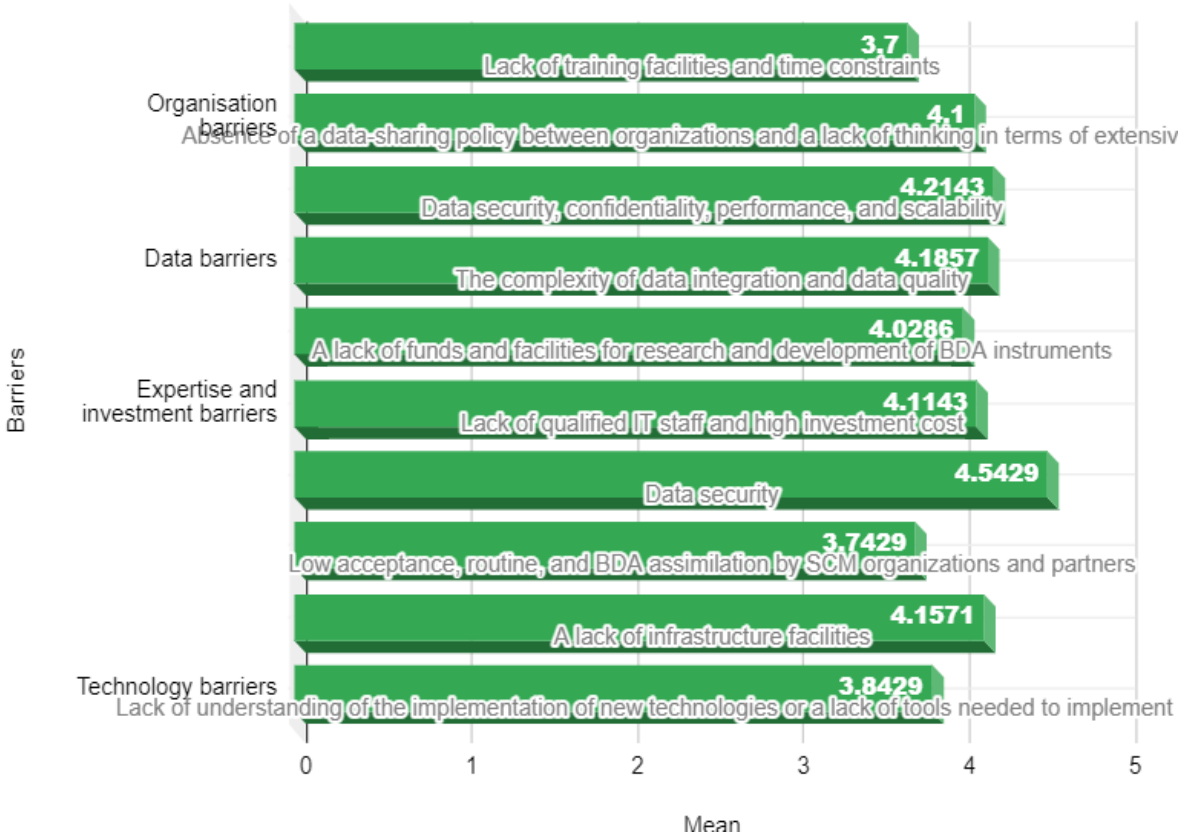

Figure 11. Organisation barriers
Source: Author’s calculations

3.16. Differences of attributes motivating to invest in big data analytics based on department

Table 2. Differences of attributes motivating to invest in BDA based on department

Particulars	f	Sig
Attributes of motivating to invest in BDA	1.152	0.004

Source: Authors calculation

The study assesses the motivating attributes to invest in big data analytics based on departments. Departments include procurement, transportation, and warehousing.

The first motivating attribute is "It promotes and coordinates the supply chain members," which secures the procurement department's highest mean value (4.385). The least mean value secured for the transportation department is 3.650. Thus, the procurement department uses big data analytics to promote and coordinate supply chain members than other departments (Transportation and warehousing).

The second statement is, "It minimizes the bottlenecks present in supply chain activities," which has the highest mean value is 4.125 for the warehousing department, whereas least for procurement. Thus, warehousing departments have the attributes to invest in big data analytics to minimize the supply chain bottlenecks than other departments (procurement and transportation).

The third statement is, "It helps predict the current trends in supply chain management," The highest mean value for procurement is 4.250, whereas the least for transportation is 3.615. Therefore, it is clear that the procurement department can invest in predicting the trends than the procurement and transportation department.

The fourth statement is, "It helps to measure the sustainability of the supply chain," which secures the highest mean value as 4.458 for warehousing whereas less for the transportation department (2.900). Thus, it is clear that big data analytics measure the sustainability of the

supply chain higher in the warehousing department than procurement and transportation department.

The fifth statement is, "It improves traceability in the supply chain," which has the highest mean value for the warehousing department as 4.292 whereas less for the transportation department (3.750). Big data analytics helps to improve traceability higher in warehousing than transportation and procurement department.

The sixth statement is, "It improves reaction time," which has the highest mean value for warehousing as4.5 whereas less for procurement time. Thus, big data analytics improves the reaction time of warehousing than the procurement and transportation department.

One way ANOVA secures F value as 1.152 and significance as 0.004, which is lesser than the significance value. Thus, it concludes that different attributes motivate to invest in big data analytics based on departments.

Table 3. Purpose of using big data analytics in SCM

Particulars	f	Sig
Purpose of using BDA	1.1691	0.001

Source: Author's calculations

In this study, the researcher evaluates the purpose of using big data analytics in SCM based on department. It requires procurement, transportation, and warehousing.

The first statement is "Electronic data interchange" secures the highest mean value in the warehousing department (3.792), and the least one is in the transportation department (3.10). It also concludes that the warehouse department intends to use SCM big data analytics related to other departments.

The second statement is "Vendor managed inventory," which secures the highest mean value is 4.077 for the procurement department whereas the least for transportation. It is then clear that the procurement department has the vendor managed inventory using SCM big data analytics compared to other departments.

The third attribute is “Efficient consumer response,” which has the highest average value for the warehousing department is 4.583, whereas the least for procurement is 3.769. Thus, the warehousing department has efficient consumer response targets to use big data analytics in SCM than the procurement and transportation department.

The fourth statement is “Collaborative planning, forecasting, and replenishment,” secures the highest average value is 4.3 for transportation department whereas the least is warehousing department. It thus concluded that the Collaborative planning, forecasting, and replenishment have the maximum big data analytics in the transport department than other departments.

The fifth statement is “Collaborative planning system” has the highest mean value of 4.039 in the procurement department while the least in the warehouse department. The collaborative planning system has a high intent to use big data analytics in the procurement department.

The sixth statement is “Salesforce automation” has the highest mean value for warehousing as 4.208, whereas less for procurement time. Thus, big data analytics of sales force automation higher in warehousing than procurement and transportation department.

The last statement is “Point of sales,” which has the highest mean value of 4.039 for the procurement department and the least in the warehousing department. Hence it is inferred that the sales point has a higher aim to use big data analytics in SCM than other departments.

ANOVA secures F value as 1.691 and significance as 0.001, which is lesser than its significance value. Hence it is evident that there is a significant difference in usage of big data analytics at SCM based on departments

Table 4. Benefits of using BDA in SCM

Particulars	f	Sig
Benefits	1.164	0.004

Source: Author’s calculations

The study evaluates the benefits of using BDA in SCM based on various departments, including procurement, transportation, and warehousing.

The first statement is, “It helps to maintain a competitive position in the market,” ensuring the highest mean value is 4.333 in the warehouse department. In contrast, the least is in the transportation department. It also concludes that the warehouse departments benefit from having BDA over the other departments to retain a competitive industry position.

The second statement is “Entities interconnected with electronic information exchanged simultaneously with supply chain partners,” which has the highest mean value for the procurement department, 4.423, and the least in the transportation department. It is also concluded that the procurement department of the entities interconnected with electronic data shared simultaneously with supply chain partners having BDA over the other departments.

The third statement is, “It reduces operational costs,” which secures the highest mean value for the procurement department is 4.577 while the least is in the transportation department. Therefore it concludes that the BDA reduces operational costs in the procurement department other than the transportation and warehousing department.

The last statement for the benefits is “It increases supply chain agility,” which has the highest mean value of 4.083 in the warehousing department and the least in the transportation department. Therefore it concluded that the warehousing department increases supply chain agility other than the department.

ANOVA secures the F value as 1.164 and significance as 0.004, which is lesser than the significance value. Thus, it concludes that there is a significant difference of advantages of using big data analytics based on departments.

Table 5. Technological attributes

Particulars	f	Sig
Technological attributes	3.245	0.004

Source: Author’s calculations

In this study, the researcher found the contrast of technological factors based on department.

The first statement for this factor is “It increases the adoption rate,” secure the highest mean value is 3.885 in the procurement department while the least in the transportation department.

The procurement department has variables that improve the rate of approval over the other department.

The second statement is, “It user-friendly and easy to use,” which has the highest mean value in the procurement department (4.539) and the least in the warehouse department. Thus it inferred that the procurement department is user friendly and it’s easy to use than other departments.

The third statement is, “It is compatible,” which secures the highest mean value for the transportation department is 4.292 while the least is in the procurement department. Therefore it concludes that the transportation department is compatible with the procurement and warehousing department.

The last statement for the benefits is “It is consistent with organization value and technology,” which has the highest mean value in the transportation department and the least in the warehousing department. Therefore it concluded that the transportation department is consistent with organization value and technology other than the department.

ANOVA secures the F value as 3.245 and significance as 0.004, which is lesser than the significance value. Thus, it concludes that there is a significant difference in technological factors based on departments.

Table 6. Organisation attributes

Particulars	f	Sig
Organisation attributes	2.056	0.000

Source: Author’s calculations

The study assesses the difference in organizational factors based on department. It includes the procurement, transportation, and warehousing department.

The first statement is, “It helps to monitor the markets in real-time,” which has the highest mean value of 4.205 in the warehousing department while the least in the procurement department. It thus concludes that the warehousing department helps to monitor the markets in real-time over the other department.

The second statement is, “It reduces the costs involved in the maintenance,” which has the highest mean value in the transportation department (4.450) and the least in the warehouse department. Thus it inferred that the transportation department reduces the costs involved in the maintenance than the procurement and warehousing department.

The third statement is, “It helps to enforce data integrity,” which ensures the highest mean value for the transportation department is 4.700 while the least is in the procurement department. Therefore it concludes that the transportation department helps to enforce data integrity than the procurement and warehousing department.

The last statement for the benefits is “It helps to create taxonomies with practical mining of data,” which has the highest mean value in the transportation department and the least in the procurement department. Therefore it concluded that the transportation department helps create taxonomies with practical mining of data other than the department.

ANOVA secures F value as 2.056 and significance as 0.000, which is lesser than its significance value. Thus, it concludes that there is a significant difference in organizational factors based on departments.

Table 7. Technological barriers

Particulars	f	Sig
Technological barriers	1.003	0.004

Source: Author’s calculations

The study assesses the difference in technological barriers based on department. It includes the procurement, transportation, and warehousing department

The first statement is” lack of understanding of the implementation of new technologies or a lack of tools needed to implement BDA in SCM” has the highest mean value in the procurement department and the least in the transportation department. Thus it inferred that the procurement department has a high absence of understanding of the implementation of new technologies or a lack of tools needed to implement BDA in SCM over the other department

The second statement is “A lack of infrastructure facilities,” which secures the highest mean value in the warehousing department (4.667) and the least in the transportation department. Thus the warehousing department has a lack of infrastructure facilities than other departments.

The third statement is “Low acceptance, routine, and BDA assimilation by SCM organizations and partners,” with the highest mean value in the warehousing department is 4.167 and the least in the procurement department. It thus concludes that the warehousing department has a low acceptance and BDA assimilation by SCM organizations and partners than the procurement and transportation department.

The last statement is “Data security,” which secures the highest mean value in the transportation department (4.850) and the least in the warehousing department. It therefore evident that the transportation department has data security than other departments.

Finally, it is inferred that the one-way ANOVA shows the F-value is 1.003 and the P-value is 0.004. It then concludes that technological barriers have a significant difference from the department.

Table 8. Expertise and investment barriers

Particulars	f	Sig
Expertise and investment barriers	0.360	0.003

Source: Author’s calculations

The table finds that the study evaluates the difference in expertise and investment barriers based on departments and includes transportation, procurement, and warehousing.

The first statement is “Lack of qualified IT staff and high investment cost” has the highest mean in the transportation department (4.450) and the least in the procurement department. Therefore, the high lack of qualified IT staff and high investment costs in the transportation department.

The last statement is, “A lack of funds and facilities for research and development of BDA instruments,” which secure the highest mean value in the warehousing department and least in the transportation department. Thus, the warehousing department lacks funds and facilities for research and development of BDA instruments than other departments.

The one way ANOVA indicated the F value is 0.360, and the P-value is 0.003. It, therefore, concluded that the expertise and investment barriers have a significant difference in department.

Table 9. Data barriers

Particulars	f	Sig
Data barriers	0.737	0.003

Source: Author’s calculations

It observed from the table that the study evaluate the significant difference of Data barriers based on procurement, transportation, and warehousing departments.

The first statement is “The complexity of data integration and data quality,” which has the highest mean value in the transportation department (4.550) while the least is 3.792 in the warehousing department. It, therefore, concluded that the transportation departments have the complexity of data integration and data quality than another department.

The last statement is “Data security, confidentiality, performance, and scalability,” which has the highest mean value in the transportation department (4.550) while the least is 3.917 in the warehousing department. It then evident that the transportation department has high data security over the other department.

Finally, the one-way ANOVA shows the F value is 0.737, and the P-value is 0.003. Hence it concludes that data barriers have significant differences with the department.

Table 10. Organisation barriers

Particulars	f	Sig
Organisation barriers	1.292	0.001

Source: Author’s calculations

The researcher found a significant difference in organization barriers based on procurement, transportation, and warehousing department in the study.

The first statement for these barriers is "Absence of a data-sharing policy between organizations, and a lack of thinking in terms of extensive data" has the maximum mean value of 4.5 in warehousing department and the lesser ones in the procurement department. Hence it is evident that the warehousing departments have the absence of a data-sharing policy between organizations and a lack of thinking in terms of extensive data than the other department.

The last one is "Lack of training facilities and time constraints," which secure the highest mean value in the warehousing department (3.792) and the least in the transportation department. The warehousing department has a lack of training facilities and time constraints than other departments.

Finally, it shows the difference of organizational barriers and organization barriers one way ANOVA secures F value as 1.292 and significance as 0.001, which is lesser than the significance value. Hence it concludes that there is a significant difference between the variables.

3.17. Results

The researchers were reported the data by the respondents. The study shows the results in the percentage are listed below. It concluded that the maximum number of respondents belong to semi-urban places. The highest numbers of respondents are the small size of the team. Most respondents prefer big data analytics are internal sources (Business IT systems and database). The highest number of participants in areas using big data analytics in SCM is procurement. The largest number of participants are operational inputs in BDA.

The descriptive statistics in this study show that the IT infrastructure and existing information systems assess the average values ranging from 2.8 to 3.3. However, the highest standard

deviation is 1.59, which indicates that the ability to quickly build or modify software applications to support product development changes efficiently has the lowest precision.

Perspective: The technology perspective attributes show the average value from 3.9 to 4.2. Thus the lowest standard deviation for the statement is 1.96 for complexity with the highest accuracy. The organization's perspective attributes the organization's perspective attributes. Hence the organization's data environment is 2.08 in standard deviation, which has the highest accuracy. The features of the environmental perspective describe the mean value between 3.8 and 4.2. As a result, the lowest standard deviation for 2.05 is the supplier pressure, which has the highest precision.

BDA: The big data analytics in the SCM attributes indicates the average value from 2.8 to 3.2. As a result, the standard deviation for BDA is 1.39 since the processing and presentation of SC details are of the most incredible precision.

Motivation: The motivation to invest in big data analytics describes the average value ranging from 3.6 to 4.3. Therefore the lowest standard deviation for promoting the supply chain members is 1.88 and has the highest precision.

Features: The features used in SCM Big Data Analytics indicates an average value between 3.5 and 4.3. Thus The highest standard deviation for the argument is also 2.17 for the Collaborative Planning System, which has the lowest precision. The lowest standard deviation is 1.99 for the point of sale with the highest accuracy

Factors: The technological factors indicate that the average value ranges from 3.7 to 4.5. The highest standard deviation for the statement is also 2.03 for consistency and is of the lowest precision. The lowest standard deviation for user friendly with the best accuracy is 1.77. The operational factors were suggesting that the average rating ranges from 3.8 to 4.4. Thus, the highest standard deviation for the assertion is 2.24 for real-time monitors, with the lowest precision. The lowest standard deviation for the statement is 1.88 for reducing costs with the highest accuracy.

The advantages of using BDA in the SCM attribute describes that the mean value varies from 3.8 to 4.1. The highest standard deviation for the statement is also 2.08 for reducing operating

costs with the lowest accuracy. The lowest standard deviation for the statement is 1.94 for the electronic information shared with the highest accuracy.

Barriers: The characteristics of technological barriers indicate that the average value is from 3.8 to 4.6. As a result, the maximum standard deviation for the statement is 2.21 due to a lack of awareness of emerging technology's introduction with the lowest precision. The lowest standard deviation for statements is 1.97, for low acceptance, routine, and BDA assimilation with the highest accuracy. The expertise and investment barriers determine the average value from 4 to 4.2. The highest standard deviation for the assertion is 2,049 due to a lack of funds and facilities for the lowest accuracy. The lowest standard deviation for the assertion is 2,046 due to the lack of trained IT workers with the highest accuracy. The data barriers were determining the average value from 4.1 to 4.3. The highest standard deviation for the assertion is 1.97, for data integration has the lowest accuracy. The lowest standard deviation for the assertion is 1.86 for data security, confidentiality, performance, and scalability with the highest accuracy. The organization's barriers indicate the average value from 3.7 to 4.2. The highest standard deviation for the assertion is 1.95, for lack of training facilities has the lowest accuracy. The lowest standard deviation for the assertion is 1.86 for the absence of a data-sharing policy with the highest accuracy

The One-way ANOVA test shows that the Attributes motivate to invest in BDA based on departments: F value is 1.152 and p-value is 0.004 that is lesser than my chosen significance level 0.05 and thereby H1 is valid. Hence, it concluded that there were statistically differences between group means.

Usage of BDA based on departments:

F value as 1.691 and significance as 0.001, which is lesser than its significance value. Hence it is evident that there is a significant difference in usage of big data analytics at SCM based on departments

F value as 1.164 and significance as 0.004, which is lesser than the significance value. Thus, it concludes that there is a significant difference of advantages of using big data analytics based on departments.

F value as 3.245 and significance as 0.004, which is lesser than the significance value. Thus, it concludes that there is a significant difference in technological factors based on departments

F value as 2.056 and significance as 0.000, which is lesser than its significance value. Thus, it concludes that there is a significant difference in organizational factors based on departments

F-value is 1.003, and the P-value is 0.004. It then concludes that technological barriers have a significant difference from the department.

F value is 0.360, and the P-value is 0.003. It, therefore, concluded that the expertise and investment barriers have a significant difference in department.

The F value is 0.737, and the P-value is 0.003. Hence it concludes that data barriers have significant differences with the department

F value as 1.292 and significance as 0.001, which is lesser than the significance value. Hence it concludes that there is a significant difference between the variables.

3.17. Discussion

The study objective is to identify the attributes that influence big data analytics in the supply chain management of manufacturing companies in Pakistan. The study measures three attributes, namely, organization perspective, environmental perspective, and technology perspective. Technology attributes measuring using complexity and compatibility. Consequently, the organization perspective measures using Statements like "Availability of readiness of technology" and "Organization data environment support." Lastly, Statements like "Rivalry pressure" and "Suppliers pressure" denotes an environmental perspective. The researcher gets consistent support from various studies (Agrawal 2015; Verma 2017; Tien *et al.* 2019) to derive the appropriate attributes for all three factors.

Secondly, it focuses on finding out the constraints in adopting big data analytics in the supply chain management of manufacturing companies in Pakistan. The study observes the barriers in four aspects. Technological barrier, expertise, and investment barrier, data, and organization barrier. Similar obstacles were found in the subsequent studies (Oncioiu *et al.* 2019; Moktadir *et al.* 2019) reported similar obstacles in their study

Thirdly, it focuses on offering an appropriate solution in overcoming the constraints in supply chain analytics, Addressing the barriers by appointing skilled personnel, and creating awareness. Of how big data analytics diminish the data barriers in terms of the complexity of data integration, data quality, data security, and confidentiality. The outcome supports previous findings in the subsequent literature (Acharjya 2016; Gahi *et al.* 2016).

There are many barriers to adopting big data analytics. The researcher assesses technology, organization, data and expertise, and investment barriers. Technology barriers measures using statements like "Lack of understanding of the implementation of new technologies or a lack of tools needed to implement BDA in SCM," "A lack of infrastructure facilities," Low acceptance, routine, and BDA assimilation by SCM organizations and partners" and "Data security." Such a statement has been shown in the studies that assessing it can produce appropriate technological barriers for a manufacturing organization (Trelles *et al.* 2011; Malaka 2015; Alharthi 2017; Gunasekaran *et al.* 2017) Among the barriers; data security is the primary barrier that ruins the manufacturing organization. The outcome matches well with (Moro Visconti 2019; Dubey *et al.* 2016) the previous studies.

Expertise and investment barriers measures using the statements like "Lack of qualified IT staff and high investment cost" and "A lack of funds and facilities for research and development of BDA instruments." As proposed by the evidence of the study finds that the lack of qualified IT staff and high investment cost is the major constraint for the manufacturing organization. **(**Alharthi *et al.* 2017; Malaka 2015)

Data barriers evaluate using statements like "The complexity of data integration and data quality" and "Data security, confidentiality, performance, and scalability." All the aspects have created a considerable constraint for the manufacturing organization.

Organization barriers: The absence of a data-sharing policy between organizations and a lack of extensive data in the organization was high. The above-stated barriers have several similarities with the studies (Malaka, 2015; Alharthi *et al*. 2017).

Our findings are somewhat surprising that the barriers may vary based on departments. Addressing such barriers in each department can pave the way to resolve the issues and influence the organization to accelerate the business process.

CONCLUSION

The purpose of the study is to assess the big data analytics in the supply chain management of manufacturing companies in Pakistan. With the help of analysis, the study finds that big data analytics promotes and coordinates the supply chain members. It integrates the cordial relationship with the respective team members. Using big data analytics helps to get an electronic data interchange in a faster and efficient way. The study aims to identify the attributes that influence the adoption of big data analytics in the supply chain management of manufacturing companies in Pakistan. It identifies three attributes through the TOE framework, i.e., technology, organization, and environment. It finds that big data analytics increases the adoption rate, especially in technological aspects. However, big data analytics helps to monitor the real-time markets, which helps meet time needs from an organization's perspective.

One of the objectives of the study is to find out the constraints in big data analytics. BDA faces constraints, especially in technological aspects, expertise, investment aspects, data, and organizational aspects. Factors like Low acceptance, routine, and BDA assimilation by SCM organizations and partners, lack of funds and facilities for research and development of BDA instruments, the complexity of data integration and data quality, and Lack of training facilities and time constraints influence big data analytics in supply chain management of manufacturing companies in Pakistan. Big data analysis has challenges that may vary based on procurement, transportation, and warehousing.

Technological barrier: The major constraint in the technological barrier is data security, which is high in the transportation department compared to the procurement and warehousing department. Expertise and investment barriers: Lack of qualified IT staff and high investment cost is high in the transportation department. Lack of funds and facilities for research and development of BDA instruments was high in the procurement department.

Data barriers: Complexity of data integration, data quality, data security, confidentiality was the significant constraints for the transportation department.

Organization barriers: The absence of a data-sharing policy between organizations and a lack of thinking in extensive data was high in the transportation department.

Thus, the study concludes that significant big data analytics constraints vary based on department. The highest constraints were found in the transportation department. To resolve the constraints, it is vital to appoint skilled personnel in the supply chain department. Consequently, it is crucial to create awareness of big data analytics and its applications to employees. The action can directly diminish the data barriers in terms of complexity of data integration, data quality, data security, and confidentiality. Diminishing data barriers in an organisation increase the usage among manufacturing firms in Pakistan.

Scope for further research: The study focuses on three aspects, namely organization, technological, and environmental factors. Further improvements are expected to improve the understanding of adding attributes like physical capital; human capital impacts the organization. However, the impact of big data analytics on company performance is not considered here and is left as an area for future work. Assessing the aspect can provide a direction to the companies that how much impact does big data analytics have on company performance? The question's outcome can direct the companies to make such massive investments in big data analytics.

Limitations of the study: The study uses a less sample from the population. Using fewer samples leads to create more generalization in the outcome. Some of the companies did not show any interest in providing their opinion on big data analytics. Thus, the study finds it quite complex to search for the companies and get opinions from the respective companies.

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APPENDICES

Appendix 1. Questionnaire

1. Name of the organization

2. Place

a. Rural

b. Urban

c. Semi-urban

3. Size of staff …….

4. Field of operations ……

5. Turnover …….

6. Evaluation of current IT infrastructure and current information systems

Particulars	5	4	3	2	1
IT infrastructure flexibility considers as the organization capability. Because it supports to integrate the information using various information technology and services					
The ability to share any type of information across any technology component					
The ability of any technology to attach to any of the other technology component					
Software applications can be more manageable when routines are processed in a separate module					
The ability to quickly build or modify software application to efficiently support changes in product development					

7. BDA is the process of extracting and presenting SC information in ensuring measurement, monitoring, forecasting, and SCM

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

8. BDA is disclosing component or full production, which includes analyses and key performance indicators

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

9. BDA uses quantitative methods in obtaining prospective information from data to understand upstream and downstream in assessing operational decision making

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

10. Which of the following segment do you give more importance in big data analytics?

a. Strategic inputs
b. Tactical inputs
c. Operational inputs

11. What is the reason to adopt big data analytics in your organization? (7- Strongly agree to 1- Strongly disagree)

Technology perspective

Particulars	7	6	5	4	3	2	1

Complexity							
Compatibility							
What is your general opinion on big data analytics from technology perspective?							

Organization perspective

Particulars	7	6	5	4	3	2	1
Availability of readiness of technology							
Organization data environment support							
What is your general opinion on big data analytics from organization perspective?							

Environment perspective

Particulars	**7**	**6**	**5**	**4**	**3**	**2**	**1**
Rivalry pressure							
Suppliers pressure							
What is your general opinion on big data analytics from environment perspective?							

12. Years of using big data analytics in your organization? ……

13. Which sources of data do you prefer for big data analytics?

a. Internal sources (Business IT system and database)

b. External references (social media)

14. Which areas do you use big data analytics in SCM?

Particulars	Yes	To minor extent	No
Procurement			
Transportation			
Warehousing			
Others			

15. What are the attributes of motivating to invest in big data analytics? (3- Strongly agree to -3- Strongly disagree)

Particulars	-3	-2	-1	0	1	2	3
It promotes and coordinates the supply chain members							
It minimizes the bottlenecks present in supply chain activities							
It helps to predict the current trends in supply chain management							
It helps to measure the sustainability of the supply chain							
It improves traceability in the supply chain							
It improves reaction time							

16. What is the purpose of using big data analytics in SCM? (7- Strongly agree to 1- Strongly disagree)

Particulars	7	6	5	4	3	2	1
Electronic data interchange							
Vendor managed inventory							
Efficient consumer response							
Collaborative planning, forecasting, and replenishment							
Collaborative planning system							
Salesforce automation							
Point of sales							

17. What are the attributes that influence you to use BDA in SCM? (7- Strongly agree to 1- Strongly disagree)

Technological factors

Particulars	7	6	5	4	3	2	1
It increases the adoption rate							
It user friendly and it's easy to use							
It is compatible							
It is consistent with organization value and technology							

Organization factors

Particulars	7	6	5	4	3	2	1
It helps to monitor the markets in real-time							
It reduces the costs involved in the maintenance							
It helps to enforce data integrity							
It helps to create taxonomies with practical mining of data							

18. What are the benefits of using BDA in SCM? (7- Strongly agree to 1- Strongly disagree)

Particulars	7	6	5	4	3	2	1
It helps to maintain a competitive position in the market							
Entities interconnected with electronic information exchanged simultaneously with supply chain partners							
It reduces operational costs							
It increases supply chain agility							

19. What are the constraints do you face while implementing BDA in SCM? (7- Strongly agree to 1- Strongly disagree)

Particulars	7	6	5	4	3	2	1
Technological barriers							
lack of understanding of the implementation of new technologies or a lack of tools needed to implement BDA in SCM							

a lack of infrastructure facilities							
low acceptance, routine, and BDA assimilation by SCM organizations and partners							
Data security							
Expertise and investment barriers							
lack of qualified IT staff and high investment cost							
a lack of funds and facilities for research and development of BDA instruments							
Data barriers							
the complexity of data integration and data quality							
data security, confidentiality, performance, and scalability							
Organization barriers							
absence of a data-sharing policy between organizations and a lack of thinking in terms of extensive data							
lack of training facilities and time constraints							

20. Please provide your suggestions for making developments in big data analytics?

…….

Appendix 2. ANOVA outcome

Attributes of motivating to invest in BDA

Particulars		procurement	transportation	warehousing	f	sig
Attributes of motivating to invest in big data analytics						
It promotes and coordinates the supply chain members	Mean	4.385	3.650	3.875	1.152	0.004
	Standard deviation	1.981	2.007	1.650		
It minimizes the bottlenecks present in supply chain activities	Mean	3.423	3.950	4.125		
	Standard deviation	1.901	1.986	1.872		
It helps to predict the current trends in supply chain management	Mean	4.250	3.615	3.875		
	Standard deviation	2.359	1.835	1.895		
It helps to measure the sustainability of the supply chain	Mean	3.385	2.900	4.458		
	Standard deviation	1.961	1.944	2.187		
It improves traceability in the supply chain	Mean	4.269	3.750	4.292		
	Standard deviation	1.867	2.245	2.095		
It improves reaction time	Mean	3.923	4.250	4.500		
	Standard deviation	2.058	1.803	1.842		

Purpose of using big data analytics in SCM

Particulars		procurement	transportation	warehousing	f	sig
Electronic data interchange	Mean	3.731	3.100	3.792	1.691	0.001
	Standard deviation	1.971	2.125	1.956		
Vendor managed inventory	Mean	4.077	3.400	4.042		
	Standard deviation	2.134	2.210	1.876		
Efficient consumer response	Mean	3.769	4.500	4.583		
	Standard deviation	1.945	1.878	1.863		
Collaborative	Mean	4.192	4.300	4.000		

planning, forecasting, and replenishment	Standard deviation	2.209	2.055	2.043		
Collaborative planning system	Mean	4.039	3.850	3.375		
	Standard deviation	2.200	2.277	2.081		
Salesforce automation	Mean	3.346	4.050	4.208		
	Standard deviation	1.999	2.305	1.978		
Point of sales	Mean	4.039	4.150	4.000		
	Standard deviation	1.969	1.785	2.246		

Benefits of using BDA in SCM

Particulars		procurement	transportation	warehousing	f	Sig
It helps to maintain a competitive position in the market	Mean	3.923	3.750	4.333	1.164	0.004
	Standard deviation	1.875	2.245	2.078		
Entities interconnected with electronic information exchanged simultaneously with supply chain partners	Mean	4.423	3.600	3.875		
	Standard deviation	1.922	1.903	1.985		
It reduces operational costs	Mean	4.577	3.350	3.917		
	Standard deviation	2.062	2.033	2.062		
It increases supply chain agility	Mean	3.962	3.250	4.083		
	Standard deviation	1.587	2.149	2.376		
It helps to maintain a competitive position in the market	Mean	3.923	3.750	4.333		
	Standard deviation	1.735	1.982	2.126		

Technology factors

Particulars		procurement	transportation	warehousing	f	Sig
It increases the	Mean	3.885	3.450	3.833	3.245	0.004

adoption rate	Standard deviation	1.925	2.038	1.949		
It user friendly and it's easy to use	Mean	4.539	4.450	4.292		
	Standard deviation	1.794	1.877	1.732		
It is compatible	Mean	4.154	4.250	4.292		
	Standard deviation	1.912	1.803	2.095		
It is consistent with organization value and technology	Mean	3.962	4.000	3.458		
	Standard deviation	1.949	2.200	2.021		
It increases the adoption rate	Mean	3.885	3.450	3.833		
	Standard deviation	1.672	2.891	1.827		

Organisation factors

Particulars		procurement	transportation	warehousing	f	Sig
It helps to monitor the markets in real-time	Mean	3.308	3.950	4.208	2.056	0.000
	Standard deviation	2.241	2.544	1.933		
It reduces the costs involved in the maintenance	Mean	4.115	4.450	4.042		
	Standard deviation	1.966	1.905	1.829		
It is compatible	Mean	3.423	4.700	4.208		
It helps to enforce data integrity	Standard deviation	1.983	1.809	2.146		
It is consistent with organization value and technology	Mean	4.192	4.750	4.250		
It helps to create taxonomies with practical mining of data	Standard deviation	2.136	1.943	2.270		
It increases the adoption rate	Mean	3.308	3.950	4.208		
It helps to monitor the markets in real-time						

Technological barriers

Particulars		procurement	transportation	warehousing	f	Sig
Lack of understanding of the implementation of new technologies or a lack of tools needed to implement BDA in SCM A lack of infrastructure facilities	Mean	4.231	3.450	3.750	1.003	0.004
	Standard deviation	2.233	2.395	2.048		
It is compatible It helps to enforce data integrity Low acceptance, routine, and BDA assimilation by SCM organizations and partners	Mean	4.039	3.700	4.667		
	Standard deviation	2.107	2.105	1.949		
It is consistent with organization value and technology It helps to create taxonomies with practical mining of data Data security	Mean	3.192	3.950	4.167		
	Standard deviation	1.812	1.820	2.200		
It increases the adoption rate It helps to monitor the markets in real-time Lack of understanding of the implementation of new technologies or a lack of tools needed to implement BDA in SCM	Mean	4.423	4.850	4.417		
	Standard deviation	2.301	2.007	1.976		
	Mean	4.231	3.450	3.750		

Expertise and investment barriers

Particulars		procurement	transportation	warehousing	f	sig
Lack of qualified IT staff and high investment cost A lack of funds and facilities for research	Mean	3.769	4.450	4.208	0.360	0.003
	Standard deviation	1.986	2.089	2.105		
	Mean	4.039	3.900	4.125		

and development of BDA instruments						
It is compatible	Standard deviation	2.126	1.997	2.092		
It helps to enforce data integrity Low acceptance, routine, and BDA assimilation by SCM organizations and partners Lack of qualified IT staff and high investment cost	Mean	3.769	4.450	4.208		

Data barriers

Particulars		procurement	transportation	warehousing	f	sig
The complexity of data integration and data quality	Mean	4.269	4.550	3.792	0.737	0.003
	Standard deviation	1.589	2.417	1.933		
Data security, confidentiality, performance, and scalability	Mean	4.231	4.550	3.917		
It is compatible	Standard deviation	1.966	1.638	1.932		
It helps to enforce data integrity Low acceptance, routine, and BDA assimilation by SCM organizations and partners Lack of qualified IT staff and high investment cost The complexity of data integration and data quality	Mean	4.269	4.550	3.792		

Organisation barriers

Particulars		procurement	transportation	warehousing	f	sig
Absence of a data-	Mean	3.462	4.450	4.500	1.292	0.001

sharing policy between organizations and a lack of thinking in terms of extensive data Lack of training facilities and time constraints	Standard deviation	1.985	1.701	1.745		
	Mean	3.692	3.600	3.792		
It is compatible It helps to enforce data integrity Low acceptance, routine, and BDA assimilation by SCM organizations and partners Lack of qualified IT staff and high investment cost The complexity of data integration and data quality Absence of a data-sharing policy between organizations and a lack of thinking in terms of extensive data	Standard deviation	1.975	1.818	2.105		
	Mean	3.462	4.450	4.500		

Appendix 3. Post hoc outcome

Technological barriers

Particulars			Mean difference (i-j)	Std. Error	Sig.	S/NS
lack of understanding of the implementation of new technologies or a lack of tools needed to implement BDA in SCM	Procurement	Procurement	.78077	.66015	.000	S
		Transportation	.48077	.62828	.747	NS
		Warehousing	-	-	-	-
	Transportation	Procurement	-.78077	.66015	.500	NS
		Transportation	-	-	-	-
		Warehousing	-.30000	.67200	.905	NS
	Warehousing	Procurement	-.48077	.62828	.747	NS
		Transportation	.30000	.67200	.905	NS
		Warehousing	-	-	-	-
a lack of infrastructure facilities	Procurement	Procurement	-	-	-	-
		Transportation	.33846	.61072	.858	NS
		Warehousing	-.62821	.58125	.560	NS
	Transportation	Procurement	-.33846	.61072	.858	NS
		Transportation	-	-	-	-
		Warehousing	-.96667	.62169	.305	NS
	Warehousing	Procurement	-	-	-	-
		Transportation	.62821	.58125	.560	NS
		Warehousing	.96667	.62169	.005	S
low acceptance, routine, and BDA assimilation by SCM organizations and partners	Procurement	Procurement	-	-	-	-
		Transportation	-.75769	.58174	.433	NS
		Warehousing	-.97436	.55367	.220	NS
	Transportation	Procurement	.75769	.58174	.433	NS
		Transportation	-	-	-	-
		Warehousing	-.21667	.59219	.935	NS
	Warehousing	Procurement	-	-	-	-
		Transportation	.97436	.55367	.220	NS
		Warehousing	.21667	.59219	.003	S
Data security	Procurement	Procurement	-	-	-	-
		Transportation	-.42692	.62803	.794	NS
		Warehousing	.00641	.59772	1.000	NS
	Transportation	Procurement	-	-	-	-
		Transportation	.42692	.62803	.004	S
		Warehousing	.43333	.63930	.795	NS

	Warehousing	Procurement	-.00641	.59772	1.000	NS
		Transportation	-.43333	.63930	.795	NS
		Warehousing	-	-	-	-

Expertise and investment barriers

Particulars			Mean Difference (I-J)	Std. Error	Sig.	S/NS
lack of qualified IT staff and high investment cost	Procurement	Procurement	-	-	-	-
		Transportation	-.68077	.61184	.542	NS
		Warehousing	-.43910	.58230	.753	NS
	Transportation	Procurement	-	-	-	-
		Transportation	.68077	.61184	.002	S
		Warehousing	.24167	.62282	.928	NS
	Warehousing	Procurement	.43910	.58230	.753	NS
		Transportation	-.24167	.62282	.928	NS
		Warehousing	-	-	-	-
a lack of funds and facilities for research and development of BDA instruments	Procurement	Procurement	-	-	-	-
		Transportation	.13846	.61813	.975	NS
		Warehousing	-.08654	.58829	.989	NS
	Transportation	Procurement	-.13846	.61813	.975	NS
		Transportation	-	-	-	-
		Warehousing	-.22500	.62923	.938	NS
	Warehousing	Procurement	-	-	-	-
		Transportation	.08654	.58829	.989	NS
		Warehousing	.22500	.62923	.008	S

Data barriers

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	S/NS
the complexity of data integration and data quality	Procurement	Procurement	-	-	-	-
		Transportation	-.28077	.58593	.892	NS
		Warehousing	.47756	.55765	.694	NS
	Transportation	Procurement	-	-	-	-
		Transportation	.28077	.58593	.012	S
		Warehousing	.75833	.59645	.450	

	Warehousing	Procurement	-.47756	.55765	.694	NS
		Transportation	-.75833	.59645	.450	NS
		Warehousing	-	-	-	-
data security, confidentiality, performance, and scalability	Procurement	Procurement	-	-	-	-
		Transportation	-.31923	.55512	.848	NS
		Warehousing	.31410	.52833	.838	NS
	Transportation	Procurement	-	-	-	-
		Transportation	.31923	.55512	.008	S
		Warehousing	.63333	.56509	.537	NS
	Warehousing	Procurement	-.31410	.52833	.838	NS
		Transportation	-.63333	.56509	.537	NS
		Warehousing	-	-	-	-

Organisational barriers

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	S/NS
absence of a data-sharing policy between organizations and a lack of thinking in terms of extensive data	Procurement	Procurement	-	-	-	-
		Transportation	-.98846	.54312	.199	NS
		Warehousing	-1.03846	.51690	.141	NS
	Transportation	Procurement	.98846	.54312	.199	NS
		Transportation	-	-	-	-
		Warehousing	-.05000	.55287	.996	NS
	Warehousing	Procurement	-	-	-	-
		Transportation	1.03846	.51690	.141	NS
		Warehousing	.05000	.55287	.006	S
lack of training facilities and time constraints	Procurement	Procurement	-	-	-	-
		Transportation	.09231	.58849	.988	NS
		Warehousing	-.09936	.56008	.984	NS
	Transportation	Procurement	-.09231	.58849	.988	NS
		Transportation	-	-	-	-
		Warehousing	-.19167	.59905	.950	NS
	Warehousing	Procurement	-	-	-	-
		Transportation	.09936	.56008	.984	NS
		Warehousing	.19167	.59905	.000	S

Benefits of using BDA in SCM

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	S/NS
It helps to maintain a competitive position in the market	Procurement	Procurement	-	-	-	-
		Transportation	.17308	.61119	.961	NS
		Warehousing	-.41026	.58169	.781	NS
	Transportation	Procurement	-.17308	.61119	.961	NS
		Transportation	-	-	-	-
		Warehousing	-.58333	.62217	.646	NS
	Warehousing	Procurement	-	-	-	-
		Transportation	.41026	.58169	.781	NS
		Warehousing	.58333	.62217	.006	S
Entities interconnected with electronic information exchanged simultaneously with supply chain partners	Procurement	Procurement	.82308	.57656	.018	S
		Transportation	.54808	.54873	.609	NS
		Warehousing	-	-	-	-
	Transportation	Procurement	-.82308	.57656	.366	NS
		Transportation	-	-	-	-
		Warehousing	-.27500	.58691	.896	NS
	Warehousing	Procurement	-	-	-	-
		Transportation	-.54808	.54873	.609	NS
		Warehousing	.27500	.58691	.006	S
It reduces operational costs	Procurement	Procurement	1.22692	.61098	.001	S
		Transportation	.66026	.58149	.528	NS
		Warehousing	-	-	-	-
	Transportation	Procurement	-1.22692	.61098	.141	NS
		Transportation	-	-	-	-
		Warehousing	-.56667	.62195	.662	NS
	Warehousing	Procurement	-.66026	.58149	.528	NS
		Transportation	.56667	.62195	.662	NS
		Warehousing	-	-	-	-
It increases supply chain agility	Procurement	Procurement	-	-	-	-
		Transportation	.71154	.60861	.508	NS
		Warehousing	-.12179	.57924	.978	NS
	Transportation	Procurement	-.71154	.60861	.508	NS
		Transportation	-	-	-	-
		Warehousing	-.83333	.61954	.410	NS
	Warehousing	Procurement	-	-	-	-
		Transportation	.12179	.57924	.978	NS
		Warehousing	.83333	.61954	.010	S

Technological factors

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	S/NS
It increases the adoption rate	Procurement	Procurement	.43462	.58471	.009	S
		Transportation	.05128	.55648	.996	NS
		Warehousing	-	-	-	-
	Transportation	Procurement	-.43462	.58471	.759	
		Transportation	-	-	-	-
		Warehousing	-.38333	.59520	.813	NS
	Warehousing	Procurement	-.05128	.55648	.996	NS
		Transportation	.38333	.59520	.813	NS
		Warehousing	-	-	-	-
It user friendly and it's easy to use	Procurement	Procurement	.08846	.53449	.006	S
		Transportation	.24679	.50869	.889	NS
		Warehousing	-	-	-	-
	Transportation	Procurement	-.08846	.53449	.986	NS
		Transportation	-	-	-	-
		Warehousing	.15833	.54408	.959	NS
	Warehousing	Procurement	-.24679	.50869	.889	NS
		Transportation	-.15833	.54408	.959	NS
		Warehousing	-	-	-	-
It is compatible	Procurement	Procurement	-	-	-	-
		Transportation	-.09615	.57921	.986	NS
		Warehousing	-.13782	.55125	.969	NS
	Transportation	Procurement	-	-	-	-
		Transportation	.09615	.57921	.006	S
		Warehousing	-.04167	.58961	.998	NS
	Warehousing	Procurement	.13782	.55125	.969	NS
		Transportation	.04167	.58961	.998	NS
		Warehousing	-	-	-	-
It is consistent with organization value and technology	Procurement	Procurement	-	-	-	-
		Transportation	-.03846	.60902	.998	NS
		Warehousing	.50321	.57962	.687	NS
	Transportation	Procurement	-	-	-	-
		Transportation	.03846	.60902	.008	S
		Warehousing	.54167	.61995	.684	NS
	Warehousing	Procurement	-.50321	.57962	.687	NS
		Transportation	-.54167	.61995	.684	NS
		Warehousing	-	-	-	-

Organisation factors

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	S/NS
It helps to monitor the markets in real-time	Procurement	Procurement	-	-	-	-
		Transportation	-.64231	.66451	.629	NS
		Warehousing	-.90064	.63244	.368	NS
	Transportation	Procurement	.64231	.66451	.629	NS
		Transportation	-	-	-	-
		Warehousing	-.25833	.67644	.930	NS
	Warehousing	Procurement	-	-	-	-
		Transportation	.90064	.63244	.368	NS
		Warehousing	.25833	.67644	.005	S
It reduces the costs involved in the maintenance	Procurement	Procurement	-	-	-	-
		Transportation	-.33462	.56592	.840	NS
		Warehousing	.07372	.53860	.991	NS
	Transportation	Procurement	-	-	-	-
		Transportation	.33462	.56592	.040	S
		Warehousing	.40833	.57608	.779	NS
	Warehousing	Procurement	-.07372	.53860	.991	NS
		Transportation	-.40833	.57608	.779	NS
		Warehousing	-	-	-	-
It helps to enforce data integrity	Procurement	Procurement	-	-	-	-
		Transportation	-1.27692	.59319	.106	NS
		Warehousing	-.78526	.56456	.385	NS
	Transportation	Procurement	-	-	-	-
		Transportation	1.27692	.59319	.006	S
		Warehousing	.49167	.60384	.719	NS
	Warehousing	Procurement	.78526	.56456	.385	NS
		Transportation	-.49167	.60384	.719	NS
		Warehousing	-	-	-	-
It helps to create taxonomies with practical mining of data	Procurement	Procurement	-	-	-	-
		Transportation	-.55769	.63384	.681	NS
		Warehousing	-.05769	.60325	.995	NS
	Transportation	Procurement	-	-	-	-
		Transportation	.55769	.63384	.018	S
		Warehousing	.50000	.64522	.742	NS
	Warehousing	Procurement	.05769	.60325	.995	NS
		Transportation	-.50000	.64522	.742	NS
		Warehousing	-	-	-	-

Purposes of using BDA in SCM

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	S/NS
Electronic data interchange	Procurement	Procurement	-	-	-	-
		Transportation	.63077	.59803	.576	NS
		Warehousing	-.06090	.56917	.994	NS
	Transportation	Procurement	-.63077	.59803	.576	NS
		Transportation	-	-	-	-
		Warehousing	-.69167	.60877	.528	NS
	Warehousing	Procurement	-	-	-	-
		Transportation	.06090	.56917	.994	NS
		Warehousing	.69167	.60877	.028	S
Vendor managed inventory	Procurement	Procurement	.67692	.61622	.000	S
		Transportation	.03526	.58648	.998	NS
		Warehousing	-	-	-	-
	Transportation	Procurement	-.67692	.61622	.550	NS
		Transportation	-	-	-	-
		Warehousing	-.64167	.62729	.595	NS
	Warehousing	Procurement	-.03526	.58648	.998	NS
		Transportation	.64167	.62729	.595	NS
		Warehousing	-	-	-	-
Efficient consumer response	Procurement	Procurement	-	-	-	-
		Transportation	-.73077	.56461	.437	NS
		Warehousing	-.81410	.53736	.324	NS
	Transportation	Procurement	.73077	.56461	.437	NS
		Transportation	-	-	-	-
		Warehousing	-.08333	.57475	.990	NS
	Warehousing	Procurement	-	-	-	-
		Transportation	.81410	.53736	.324	NS
		Warehousing	.08333	.57475	.009	S
Collaborative planning, forecasting, and replenishment	Procurement	Procurement	-	-	-	-
		Transportation	-.10769	.62751	.985	NS
		Warehousing	.19231	.59722	.950	NS
	Transportation	Procurement	-	-	-	-
		Transportation	.10769	.62751	.035	S
		Warehousing	.30000	.63878	.896	NS
	Warehousing	Procurement	-.19231	.59722	.950	NS
		Transportation	-.30000	.63878	.896	NS
		Warehousing	-	-	-	-
Collaborative planning system	Procurement	Procurement	.18846	.64912	.009	S
		Transportation	-	-	-	-
		Warehousing	.66346	.61779	.565	NS

	Transportation	Procurement	-.18846	.64912	.959	NS
		Transportation	-	-	-	-
		Warehousing	.47500	.66078	.773	NS
	Warehousing	Procurement	-.66346	.61779	.565	NS
		Transportation	-	-	-	-
		Warehousing	-.47500	.66078	.003	S
Salesforce automation	Procurement	Procurement	-	-	-	-
		Transportation	-.70385	.61963	.528	NS
		Warehousing	-.86218	.58972	.349	NS
	Transportation	Procurement	.70385	.61963	.528	NS
		Transportation	-	-	-	-
		Warehousing	-.15833	.63075	.969	NS
	Warehousing	Procurement	.86218	.58972	.349	NS
		Transportation	-	-	-	-
		Warehousing	.15833	.63075	.009	S
Point of sales	Procurement	Procurement	-.11154	.60094	.003	S
		Transportation	-	-	-	-
		Warehousing	.03846	.57193	.998	NS
	Transportation	Procurement	.11154	.60094	.983	NS
		Transportation	-	-	-	-
		Warehousing	.15000	.61172	.970	NS
	Warehousing	Procurement	-.03846	.57193	.998	NS
		Transportation	-.15000	.61172	.970	NS
		Warehousing	-	-	-	-

Attributes of motivating to invest in BDA

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	S/NS
It promotes and coordinates the supply chain members	Procurement	Procurement	.73462	.55978	.027	S
		Transportation	-	-	-	-
		Warehousing	.50962	.53276	.635	NS
	Transportation	Procurement	-.73462	.55978	.427	NS
		Transportation	-	-	-	-
		Warehousing	-.22500	.56983	.925	NS
	Warehousing	Procurement	-.50962	.53276	.635	NS
		Transportation	.22500	.56983	.925	NS
		Warehousing	-	-	-	-
It minimizes the bottlenecks present in supply chain activities	Procurement	Procurement	-	-	-	-
		Transportation	-.52692	.56982	.654	NS
		Warehousing	-.70192	.54232	.437	NS

	Transportation	Procurement	.52692	.56982	.654	NS
		Transportation	-	-	-	-
		Warehousing	-.17500	.58005	.956	NS
	Warehousing	Procurement	.70192	.54232	.437	NS
		Transportation	-	-	-	-
		Warehousing	.17500	.58005	.006	S
It helps to predict the current trends in supply chain management	Procurement	Procurement	.63462	.59985	.004	S
		Transportation	-	-	-	-
		Warehousing	-.25962	.57090	.902	NS
	Transportation	Procurement	.63462	.59985	.574	NS
		Transportation	-	-	-	-
		Warehousing	.37500	.61062	.829	NS
	Warehousing	Procurement	.25962	.57090	.902	NS
		Transportation	-.37500	.61062	.829	NS
		Warehousing	-	-	-	-
It helps to measure the sustainability of the supply chain	Procurement	Procurement	-	-	-	-
		Transportation	.48462	.60575	.727	NS
		Warehousing	-1.07372	.57651	.184	NS
	Transportation	Procurement	-.48462	.60575	.727	NS
		Transportation	-	-	-	-
		Warehousing	-1.55833*	.61663	.047	NS
	Warehousing	Procurement	1.07372	.57651	.184	NS
		Transportation	-	-	-	-
		Warehousing	1.55833*	.61663	.040	S
It improves traceability in the supply chain	Procurement	Procurement	-	-	-	-
		Transportation	.51923	.61216	.699	NS
		Warehousing	-.02244	.58261	.999	NS
	Transportation	Procurement	-.51923	.61216	.699	NS
		Transportation	-	-	-	-
		Warehousing	-.54167	.62315	.687	NS
	Warehousing	Procurement	.02244	.58261	.999	NS
		Transportation	-	-	-	-
		Warehousing	.54167	.62315	.007	S
It improves reaction time	Procurement	Procurement	-	-	-	-
		Transportation	-.32692	.56944	.848	NS
		Warehousing	-.57692	.54196	.570	NS
	Transportation	Procurement	.32692	.56944	.848	NS
		Transportation	-	-	-	-
		Warehousing	-.25000	.57967	.911	NS
	Warehousing	Procurement	.57692	.54196	.570	NS
		Transportation	-	-	-	-
		Warehousing	.25000	.57967	.001	S

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