

A COMPARATIVE STUDY TO MEASURE THE IMPACT OF BIG DATA ANALYTICS ON SERVICE SUPPLY CHAIN PROCESS

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Abstract: *Big data analytics is becoming a key to success for many organization as it extracts the productive value from a huge amount of raw data. This data helps in strategic decision making for continuous process improvements and advancement. This study also focusses on the impact of big data analytics on one of the most important process of an organization which is service supply chain process. ERP (Enterprise Resource Planning) is the tool which is used for big data analytics and based on that study was initiated for pre- and post-implementation of ERP for the years 2015 and 2017 respectively. Null hypothesis and H1 hypothesis are formed. Then, ten major factors have been identified which act as performance indicators for service supply chain process. Based on these factors data has been collected and analyzed. After obtaining the values one-way ANNOVA technique has been applied for testing of hypothesis. It has been observed that F calculated value comes out to be very high in comparison to the F table value which rejects the null hypothesis and proves that Big data analytics has an impact on service supply process.*

Keywords: *Big data analytics, Service supply chain process, Enterprise Resource Planning (ERP), ANNOVA (Analysis of Variance), Individual efficiency, Lead Time, Decision Making, Data Transparency, Customer Satisfaction, Return on investment, Inventory Management, Order Fulfillment, Cost Reduction and Vendor Management*

1. INTRODUCTION

Big data analytics is a revolution which cannot be bypass. It is a technique to take out value from a huge amount of raw data. The emergence of data analytics is related to use of measuring performance by testing several hypotheses about business (Drucker, 1990). “Business analytics includes the application of more sophisticated mathematical, statistical, and economical methods to test and verify proposed causal relationships and work on multiple sources from drill-down data to more sophisticated sources for understanding and exploring performance driver’s dynamics and can therefore contribute to strategic planning success” (Klatt, Schlaefke, & Moeller, 2011).

There is an increase in demand for business analytics tools from various departments of organization like supply chain, marketing, operations, sales and so on. The capabilities of analytics are being utilized in different aspects like customer relationship management, vendor relationship management, enterprise resource planning and performance management. There are many big data analytics tools out of which ERP emerges out to be a dynamic and revolutionary tool which is helping organizations in solving almost every problem related to data collection, data segregation, data storage, data maintenance and data analytics.

ERP helps in getting the exposure of real time data which is previously not possible easily. There is a strong linkage between data collection process and data quality. It is always important to focus on high quality collection of data as once if it is being compromised then it is difficult to overcome the faults created (Redman, 2013).

The application of big data helps in conversion of raw data into informative data which can be utilized for decision making, strategy making and process improvement. Supply chain process especially in-service industry is very critical department although it plays an important role in other industry also therefore it should be properly maintained as here the end users are the patients. There are many major areas which needs to be taken care off like supplier management, inventory management, demand management, order fulfillment, purchase management, forecasting, warehousing, transportation, distribution, logistics and so on. If we have the exposure to correct data then these areas can be taken care off in a well-planned and efficient manner (Ward, Marsolo, & Froehle, 2014). Data Analytics technique used by the organizations demonstrates that it has an impact on cost by forecasting the dynamics related to it. (Innes, Mitchell, & Sinclair, 2000).

As per report from (IBM (2010), 2012) “Organizations might, however, need to acquire new skills like mathematical, statistical, econometrics and IT to develop the ability to use data analytics for decision making as these abilities and skills could add value to organizations and have an impact on various processes in the organization”. ERP has given organization a direction to organization to survive in the competitive by providing correct amount of data.

There are many empirical methods like surveys, case studies which are being used to analyze the impact of ERP on supply chain performance but these methods prove to be inadequate for measuring supply chain performance across multiple organizations environment (Davenport & Brooks, 2004). Big data is used by supply chain managers to expose the big data’s key success factors and enablers in management of supply chain process (Teece, 2009).

2. LITERATURE REVIEW

Nowadays companies are inclining more towards technology specially the healthcare industries as they are dealing with large amount of data which they will be requiring in important decision making so they are adapting new big data techniques for smoothening their processes, improving their efficiency and strategy making. ERP (Enterprise Resource Planning) proves to be the best big data technique for handling large amount of data. ERP systems provides financial and operational analysis of different processes (Huang & Handfield, 2015). There is a tremendous decrease in operational costs and improvement in productivity when ERP systems have been associated with different internal processes (Mabert, et al., 2000). ERP systems also plays a critical role by using huge amount of transactional data for connecting strategic and tactical performance measures (Bendoly, Rosenzeig, & Stratman, 2007). As the existing business processes are complicated and it is not easy to move the complete process spontaneous into a new tool so to focus on ERP implementation is a major area to work on (Hawley, 2016).

Big Data in prospect of supply chain is defined as “structured and unstructured relationship-based information unique to its holder because of the information’s volume, velocity, variety, and veracity” (Glenn, Tyler, Morgan, Hall, & Adams, 2016). In general, impact of Big data is

quite new to management. It is believed by managers that relationship of big data with supply chain will from synergy which will allows firms to reduce their costs or increase in revenue apart from what they achieve earlier. Therefore, it is necessary to understand both the positive and negative consequences that can impact a firm's performance. This is very much essential for supply chain departments but it is unfocussed as managers and technical developers have constraints as they have limited opportunities in their departments (George, Haas, & Pentland, 2014).

Healthcare has taken a quite longer time than other industries to incorporate the use of big data techniques but adoption of this has taken the healthcare industry at another step changing healthcare deliveries for better and advanced. ERP gives the transparency of data, decision making, strategy planning, disaster planning, forecasting, asset tracking, coordination of one department with another (Ward, Marsolo, & Froehle, 2014).

(Giannakis & Louis, 2016) describes "ERP systems are characterized by low investments costs, adaptability to changes, high level of computational efficiency to manage complex and decentralized supply chains, to provide high levels of cross organizational collaborations". Furthermore, whole supply chain process can be re-configured in reality in a timely manner with low costs as there are various ERP solutions available in the market with low cost but fulfilling all the requirements. One can take that for an option with small set up and once they will start growing they can move to a better solution like SAP, Oracle, Hana as these big software's has certain requirement of minimum business values per year (Berkovich & Liao, 2012).

(Startman & Roth, 2002), (Hendricks, Singhal, & Stratman, The impact of enterprise systems on corporate performance : a study of ERP, SCM and CRM systems implementations" , 2006) utilizes publicly available data to analyze the impact of ERP system on organization's performance for a period of three years after its implementation and found that there is no change in performance even after adapting the ERP. On the other hand, (Hunton, Lippincott, & Reck, 2004) performed a longitudinal study to measure the effectiveness of ERP systems by analyzing sample of 63 companies. He found that there is a tremendous improvement in performance of the firm as there is improvement in processes, inventory management, cost reduction, vendor management and improved coordination with different departments thus providing better services. Their study also revealed that immediately after implementation of ERP performance cannot be measured and three years is very short span of time so it takes time for the users also to adapt the new system. Moreover, it has been observed that performance of ERP non-users decreased over a period.

Big Data Analytics provides a competitive advantage by providing good amount of information from huge amount of data. The most important use of big data analytics is strategic management means that it helps in formulation of strategic alignment between firms and supply chain strategies. Firms strategy is very much important as it gives the over view of the organization and thus gives the roots of individual department's strategies. Strategy management is becoming more effective using BDA it makes the strategy execution processes more defined by providing advanced predictive insights (Wang, Gunasekaran, Ngai, & Papadopoulos, 2016).

ERP systems provides the exact data which further help in measuring and analyzing performance of supply chain process. It helps in procurement planning, inventory management, demand forecasting, decision making, logistics execution and vendor management. All these parameters are achieved by flawless coordination between different department's stakeholders. Moreover, predictive and prescriptive analysis of the data helps in effective decision making for the organization (Demirkan & Delen, 2013).

Volume, veracity, velocity and variety are the major characteristics of big data hence traditional decision-making approaches will not be able to help in solving the problems hence innovative and algorithms analytical approaches will be needed in improving and incorporating more human intelligence for effective decision making (Chircu, Kononchuk, Li, Qi, & Stavrulaki).

The technique used for data collection is an important area of concern as data analytics gives direction for organizational decision making. It is difficult to measure intangible values which are important performance drivers. Therefore, companies whose data is intangible value is unable to have good amount of data like others hence not able to use big data analytics in a right way. Use of past data for business analytics is not appropriate as past data can be misleading and can hamper current and future predictions for measuring performance. These problems reflect that opting for a good big data technique should be the priority for an organization irrespective of other things as data plays an important role in decision making of an organization (Davenport & Harris, 2007).

ERP helps in getting the information that organization can utilize for measuring, analyzing and managing their supplier's performance for good procurement planning. (Oruezabala & Rico, 2012). Data plays a very critical role so choosing the best technique for its collection and maintenance is very much important that is why companies invest huge amount of capital in getting the best ERP solution so that they can have the visibility of the data across the organization.

3. RESEARCH METHODOLOGY

The aim behind this study is to analyze the impact of big data analytics on service supply chain process. As ERP is one of the major tool for collecting and analyzing data so a comparative study has been done between the pre- and post-implementation of ERP. The methodology for this study is divided into three sections:

3.1 Hypothesis Formation

To initiate the study null hypothesis and H1 has been formed.

The hypothesis is represented as follows:

Null Hypothesis: ERP implementation has no impact on service supply chain process

H1: ERP implementation has an impact on service supply chain process

3.2 Factor Analysis

In the second phase ten major factors have been identified which are used for evaluating the performance of service supply chain process- Individual efficiency, Lead time, Decision making, Data transparency, Customer satisfaction, Return on investment, Inventory management, Order fulfillment, cost reduction and vendor management. Based on these factors data will be collected and calculated and then ANNOVA technique will be applied for testing of hypothesis.

3.3 Hypothesis Testing

In the third phase ANNOVA technique has been applied for testing of hypothesis.

The hypothesis testing is done by one-way classification of ANNOVA (Analysis of Variance) technique. One-way classification has been chosen since a single factor or variable is controlled in this case it is “ERP” and its impact on the elementary units has been observed.

4. DATA COLLECTION

The data has been collected from the database of the 5 major organizations. Data prior to implementation of ERP had been maintained manually by maintaining excel sheets and after the ERP implementation several reports are present which gives the consolidated view of transactions occurred.

5. DATA INTERPRETATION

The data collected from the organizations is analyzed based on ten major factors which contributes to the performance of service supply chain process. Data is collected for year 2015 when ERP is not implemented and 2017 when ERP is implemented. The ERP implemented in all the organizations is SAP which is a quite vast ERP comprising of all the modules related to supply chain process and other departments as well which is required in any organization. Modules related to service supply chain process are Source to Pay (STP), Order to Cash (OTC), Production Planning (PP), Plan to Deliver (PTD) and Logistics Execution (LE).

After the analysis of data, hypothesis testing has been conducted by using the one-way classification of ANNOVA technique. The “one-factor analysis of variance” is based on the fact that a single variable is controlled and its impact on other variables is being analyzed. There are 4 major steps involved in performing the analysis which are as follows:

1. Calculation of variance between the samples (SSB)
2. Calculation of variance within the samples (SSW)
3. Calculation of F ratio
4. Comparison of calculated F value with table value

5.1 Implementation of ANNOVA technique

Step 1: Analysis of data (in %) based on five factors:

Table 1 Data analyzed based on 10 factors

Factors	2015 (Before ERP)	2017 (After ERP)
Individual Efficiency	55	63
Lead Time	42	69
Decision making	68	89
Data Transparency	52	90
Customer satisfaction	62	79
Return on Investment	63	82
Order Fulfillment	67	91
Cost reduction	50	65
Inventory Control	30	65
Vendor management	63	95

Step 2: For making the calculation convenient the data is simplified by subtracting 70 from all the values.

Table 2 Values after simplification

Factors	2015 (Before ERP)	2017 (After ERP)
Individual Efficiency	-15	-7
Lead Time	-28	-1
Decision Making	-2	19
Data Transparency	-18	20
Customer Satisfaction	-8	9
Return on Investment	-7	12
Order Fulfillment	-3	21
Cost reduction	-20	-5
Inventory Control	-40	-5
Vendor management	-7	25

Step 3: Squares of each samples is calculated

Table 3 Calculation of squares of values for both the years

Factors	2015 (X_1)	2015 (X_1^2)	2017 (X_2)	2017 (X_2^2)
Individual Efficiency	-15	225	-7	49
Lead Time	-28	784	-1	1
Decision Making	-2	4	19	361
Data Transparency	-18	324	20	400
Customer Satisfaction	-8	64	9	81
Return on Investment	-7	49	12	144
Order Fulfillment	-3	9	21	441
Cost reduction	-20	400	-5	25
Inventory Control	-40	1600	-5	25
Vendor management	-7	49	25	625
Total	-148	3508	88	2152

Step 4: Sum of all the values (T) of 2015 and 2017

$$T = [(-148) + (88)] = -60$$

Step 5: Calculation of correlation factor

$$C = T^2 / N = (-60)^2 / 100 = 3600 / 100 = 36$$

Step 5: Calculation of Total Sum of Squares (SST)

$$SST = 3508 + 2152 = 5660 - T^2 / N = 5660 - 36 = 5624$$

Step 6: Calculation of sum of squares between the samples

$$SSB = [(-148)^2 + (88)^2] / 10 = (2190.4 + 774.4) / 10 = 2964.8$$

$$= 2964.8 - T^2 / N = 2964.8 - 36 = 2928.8$$

Step 7: Calculation of sum of squares within the samples

$$SSW = SST - SSB = 5624 - 2928.8 = 2695.2$$

Step 8: Calculation of ANNOVA TABLE

Table 4 Calculation of ANNOVA table values

Source of variation	Sum of Squares	Degrees of Freedom	Mean Square
Between the samples	2928.8	2-1 = 1	2928.8/1= 2928.8
Within the samples	2695.2	20-2 =18	2695.2/18= 149.733
Total	5624	19	

Step 9: Calculation of F ratio

$$F \text{ ratio} = \text{Mean of squares between the samples} / \text{Mean of squares within the samples}$$

$$= 2928.8 / 149.733$$

$$= 19.56010$$

Step 10: Comparison of calculated F ration with table value

$$F_{(1,18)} \text{ Table value} = 4.4139$$

$$F_{(1,18)} \text{ Calculated value} = 19.56010$$

It has been observed that calculated value of F is significantly larger than the table value hence null hypothesis is rejected, and we can conclude that ERP implementation has an impact on service supply chain process.

6. RESULT AND DISCUSSION

Big data analytics is turning out be a boom for every industry whether it is small or big. Its wide variety of tools give organizations a direction to monitor and evaluate their processes. ERP which is Enterprise Resource Planning is a tool in which all the transactions has been executed which generates the data that gives a clear visibility of every aspect of the different processes followed in an organization. There are numerous ERP's available in the market like SAP, Oracle, Sales Force and many more. The organizations in which the study has been conducted has implemented SAP as it gives a common platform for many processes which can be executed in one ERP.

The data obtained from the organizations is calculated based on 10 major factors. Figure 1 demonstrates the values of pre- and post-implementation of ERP for the years 2015 and 2017 respectively.

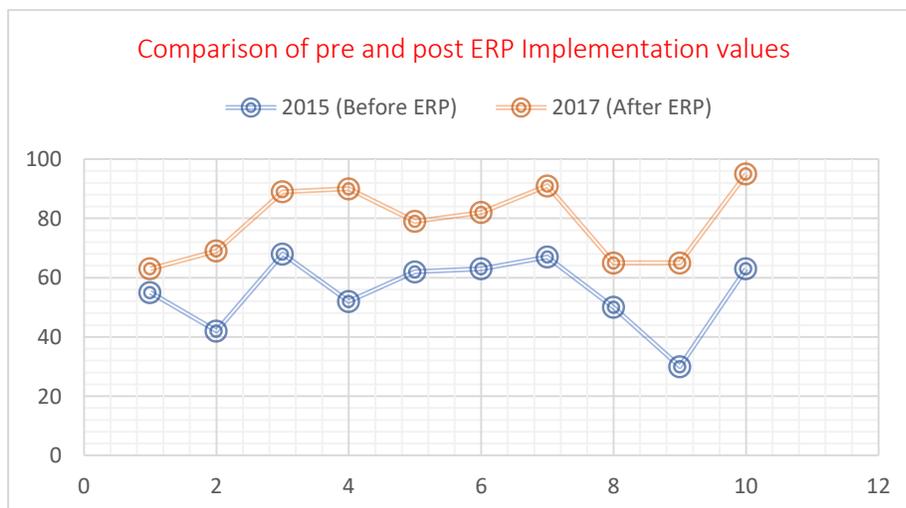


Figure 1 Comparison of pre- and post-ERP implementation values

After the calculation of data based on 10 major factors null and H1 hypothesis are formed and testing is done by one-way ANNOVA classification. The correlation factor comes out to be 36 which is as per the accepted values. Degrees of freedom for between the samples is calculated by subtracting 1 from number of years i.e. 2 and for within the sample by subtracting 1 from total number of observations i.e. 20. At last F ratio is calculated by dividing the mean of squares between the samples by mean of squares within the samples which comes out to be 19.56010. The F table value at (1,18) is 4.4139 which is far less than the calculated value. This rejects the null hypothesis and proves that ERP implementation has an impact on service supply chain process.

Integration of business and automation of transactions have tremendous valuable capabilities which can be measured tangibly. The studied organizations have a positive feedback after ERP implementation as they have experiencing a huge difference in the performance of their process. This statement is strongly supported by the data obtained and calculated from their organizations and testing of the hypothesis By ANNOVA technique. With the advancement of technologies, it is the need of hour to upgrade the systems which will help in improving the performance of the processes.

7. MANAGERIAL IMPLICATION

The aim of every organization is customer satisfaction as the customers are the ones for which the complete set up is working thus to ensure the satisfaction it is the responsibility of the management to adhere to the effective functioning of the processes. Big data analytics is a very useful tool for measuring performance of any ongoing process in the organizations. Managers can use this technique to evaluate the performance of their processes. It will also help in identifying the gap and thus help in decision making. ERP is one of the best tool which is used by most of the organizations and nowadays more and more organizations are leaning towards the implementation of ERP as it gives the visibility of data which in turn help in evaluating the performance and thus taking decisions for rectifying the gaps.

8. LIMITATIONS OF THE STUDY

While the study being conducted there were many limitations which came across.

It is difficult to obtain the data from the organization as it is quite confidential so many approvals have been taken for collecting the data.

Prior to ERP implementation it is difficult to collect the data as either the data is maintained in registers or in excels. It doesn't have any specific format so it is quite difficult to consolidate the data in a single format.

As the working hours of the employees is quite hectic so taking time from them between their busy schedule is a difficult task.

Some more factors can be included while doing the data analysis.

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