IMPACT OF ANALYTICS ON SUPPLY CHAIN MANAGEMENT

Subhaash Chandrakumara Roy [*1], Medinimohan Vishakhu Abhiskara[2]

[1]*Indian Institute of Management, Kohikode, Kerala, India, subhaash@protonmail.com*
[2]*Indian Institute of Management, Kohikode, Kerala, India*

Abstract

Abstract - The study bridges the gap in between the 2 intersecting domains, information science and supply chain management. The information can be examined for management, forecasting and prediction, that is in the type of accounts, forecasts, and queries. Due to the cost, weather patterns, complex nature and economic volatility of business, the forecasts might not be accurate. This has led to the development of Supply chain analytics. It is the application of quantitative and qualitative techniques to resolve related issues and to foresee the results by considering quality of information. The problems like improved effort between companies, customers, governmental organizations and retailers, businesses are developing Big Data strategies. Big Data uses will be connected for Supply Chain Management throughout the fields as procurement, warehouse operations, transportation, advertising as well as for smart logistics. As supply chain networks getting great, much more complicated and driven by needs for more demanding service levels, the kind of information which is handled as well as examined likewise gets to be more complicated. The existing labor aims at providing an introduction of adoption of abilities of Data Analytics included in a "next generation" architecture by creating a linear regression type on a sales-data. The paper additionally covers the survey of how big data techniques may be used for storage, managing, processing, visualization, and interpretation of data in Supply chain.

Keywords

Big Data, Supply Chain Management, Supply Chain Analytics

JEL Classification

M21, M23

Introduction

Once the 1990s good modifications in the working regulations of world economic system as well as industry competition patterns, businesses have determined the demand for globalization of economic development. Companies must depend on the integration of their external and own resources available on the market (Choi, Wallace, & Wang, 2018). This integration enables the functioning pattern of a method which gives fast response to the requirements of the market (Sazu & Jahan, The impact of big data analytics on supply chain management practices in fast moving consumer goods industry: evidence from developing countries, 2022). Additionally, the ad hoc situations that arise on the market. Such a product is described as Supply Chain Management. SCM is described as managing the flow of info, resources, and material across within the network of downstream and upstream organizations. Supply chain could be described as network of flow of network, customer services, financial deliverables, and products of info, resources, and material (Antons & Breidbach, 2018). Management of several associations in supply chain is described as supply chain management. Several of the factors as product success, client satisfaction, growth of a company depends on the profitable execution of SCM.

Big data analytics has proceeded the need of it's for the Supply chain management of many companies and any organization are striving to unveil the business value (Sazu & Jahan, Impact of big data analytics on distributed manufacturing: does big data help?, 2022). Big data analytics problem is analyzing the unusual patterns of information arriving alongside the existing massive data sets (Ambigavathi & Sridharan, 2018). BDA is essential in producing an integrated view of functional functionality as well as client satisfaction of both sender and receiver in the SCM. It is truly difficult to meet completely the Supply chain susceptibility due to the intricacy in Supply chain pieces, procedure, services and supplier (Shakya & Smys, 2021). Supply chain analytics was created the own identity of its at supply chain management by utilizing the business Intelligence tools for the evaluation of customer behavior, optimization of downstream and upstream operations as well as awareness on innovative routing strategies. Examples are part complexity, service complexity, process complexity and supplier complexity.

Based on the professionalism, behavior, attitude, reliability, flexibility, skills, integrity and reputation of human resources in logistics businesses are generally crucial coming from the client 's point of view. Fig.1 exhibits the flow of supply chain management. It explains different activities associated with producing something as well as services beginning from preparing until delivery of materials to conclude client. Really speaking, SCM is not a chain of processes rather it's a system of several relationships and businesses.
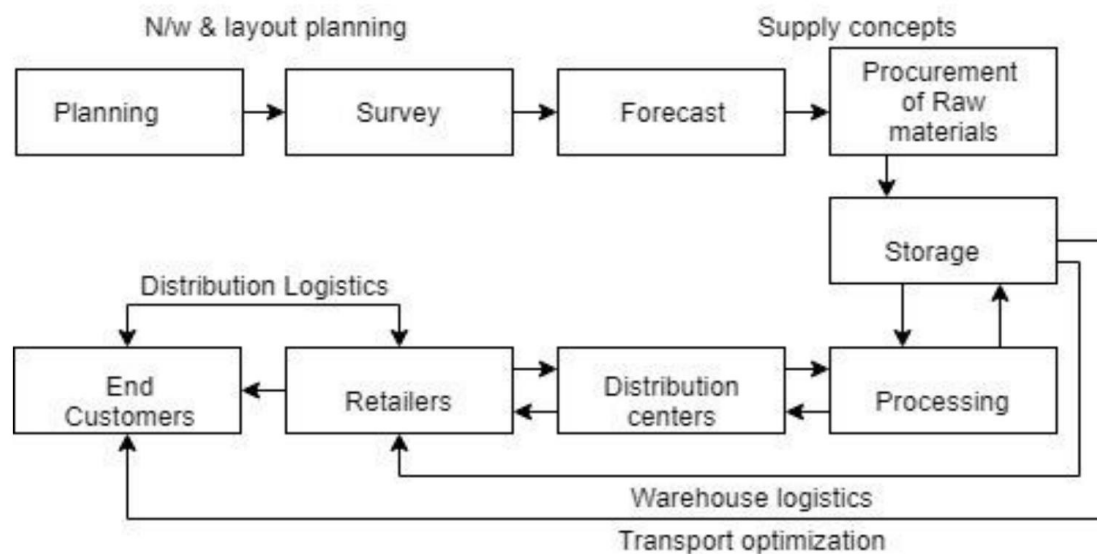
Figure 1: Process of supply chain management

Literature Review

Big Data

In information planning phase, the title Big Data is used initially by 2 NASA researchers in 1997 as challenging for visualizing big data sets. There after specialists and researchers in the area of Information Management are slowly focusing on Big Data.

Big Data has a good effect in various domains: aids in reconditioning the supply chain, boosting marketing and sales, true route etc (Sazu & Jahan, Impact of big data analytics on business performance, 2022). Big data analytics procedure continues to be explained from the viewpoint of supply chain information. The next part supplies the taxonomy of 10 primary characteristics of big data uses in Supply Chain management.

1. Volume:

Volume refers to the massive amount of information generated from emails, photos, twitter, and videos every next. In SCM, Volume could be associated with the information generated out of the usage of Sensors, ERP, bar codes, Transport management system as well as database technologies. Previously volume is calculated in Gigabytes that is currently measured in Zettabytes and even Yottabytes (Niebel, Rasel, & Viete, 2019)

2. Velocity:

It primarily refers to the pace of the information collected, analyzed as well as transferred. It impacts on the effectiveness as well as decision making algorithms and models around SCM (Silva, Hassani, & Madsen, 2020).

3. Variety:

It describes the various forms of information such as structured, unstructured or even semi structured. Additionally, it provides various data types from XML to video clip to SMS. The variety of details around SCM consists of data from several sources as retailers, sales, inventory, suppliers, distributors, consumer etc (Bresciani, Ciampi, Meli, & Ferraris, 2021). Big Data collection procedure in SCM includes two variety of sources: Downstream and upstream sources.

Data Analytics and supply chain management

Model Despite the biggest development in the area of data analytics that is happening to client awareness, Analytics has numerous uses across end to end supply chain. As the acquisition as well as transportation cost per entry is pushed to be least, there's an unavoidably corrupted errors and measurements in the massive scale information was discovered. Since the information resources constantly produce info in time that is real, analytics should come to be performed (Sazu, Does Big Data Drive Innovation In E-Commerce: A Global Perspective?, 2022). Applications of innovative analytic methods was discussed to supply chain management. Supply Chain Data Analytics was classified in 3 types of Analytics: Prescriptive, Predictive, and Descriptive analytics.

A. Descriptive Analytics:

Descriptive Analytics is primarily used-to examine "what is happening" today to be able to answer the question of "What happened" in previous times. This's the very first degree of analytics in which ninety % of organizations implement the method for betterment of the long term. DA identifies the historical information and analyzes the design (Gunasekaran, et al., 2017). Descriptive Analytics mostly aims at identifying the issues as well as opportunities in the area of SCM in the existing functions and processes.

Descriptive Analytics utilizes the methods like

• Data Modeling

• Regression Analysis

• Visualization

• OLAP operations as drill down, up and across to determine the places.

OLAP businesses for Supply chain can include shipments, customers, logistics, products, other dimensions and suppliers as cost and rates. The uses of Descriptive analytics supply the supervisors with true time information about the number of location and goods in the supply chain (Nguyen, Li, Spiegler, Ieromonachou, & Lin, 2018).

B. Predictive Analytics:

Predictive analytics use both qualitative and quantitative techniques to evaluate the actual time as well as historic information to calculate future levels and the past of integration of business processes amongst companies or functions, and the associated costs as well as service levels (Jiang, Zhi, & Wang, 2017). Predictive analytics aims at projecting what'll occur down the road and exactly why it might occur. PA contains algorithms/techniques like

1. Time series techniques & Advanced forecasting. These techniques are utilized for forecasting the product sales in SCM.

2. Statistical algorithms like Discriminant Analysis, Bayes Networks, Naive Bayes and k-NN.

3. Decision trees, Cart along with Random Forests utilizes the hierarchical sequential structure

4. Clustering algorithms used-to cluster homogeneous components in a data set.

5. Frequent pattern mining algorithms

Predictive analytics mostly centered on forecasting at strategic, strategy and functional levels, that is based on the preparation activity in terminology of community layout, manufacturing preparation,

inventory control as well as capacity preparation (Haque & Akter, 2022). Predictive analytics utilizes mathematical algorithms as well as programming to be able to foresee the patterns within data (Hermon & Williams, 2014). To learn the Predictive and descriptive Analytics, an experimental is carried out on product sales data, which happens to be a benchmark dataset obtainable. The end result are discovered to be interesting. A predictive item is developed according to regression analysis.

C. Prescriptive Analytics:

PA and DA are centered on what and once it is going to happen, whereas Prescriptive Analytics anticipates on "why it's happened". It records the information constantly to re predict the activities that allow the decision makers to boost the prediction accuracy for snapping much better choices. Prescriptive analytics describes the reasons behind events.

RESEARCH Finding 1: BDA tools for supply chain analytics mostly used for information exploration, integration of information, proper visualization methods, statistical analysis and knowing the data warehouse system. Not many of them are R prog, Informatica, PASW (LaValle, Lesser, Shockley, Hopkins, & Kruschwitz, 2011). The primary observation is all about LINGO, DSM, which are generally employed for information objective based on client support process. Pentaho is utilized to handle unstructured and structured volumes of data. To summarize the integration of all resources is a crucial job of SCA for creating a choice support system

Sustainable smart logistics

Logistics is a component of supply chain management. Logistics are often described as procedure for handling the procurement, movement and storage of goods together with the associated info flow to capitalize on the benefit of the business via affordable fulfillment of orders. Logistics was labeled as a primary component of supply chain management Besides the planning, controlling and managing the items as well as materials of strategies, likewise the aggregation as well as processing of the collected information is a crucial job of Smart logistics (Sazu & Jahan, 2022).

RFID is utilized to guarantee a secure identification of the various objects in all phases of supply chain. For instance, in the use situation of automobile growth process up to fifty individual goods are positioned in a single vehicle, which must be securely identified. Smart logistics with RFID could be utilized to recognize objects placed in the automobile. Among the use of RFID is recording the ID sensed temperature provided by the sensors during conveyance (Sazu, Does Big Data Drive Innovation In E-Commerce: A Global Perspective?, 2022).

R programming It is an item oriented, absolutely free, open-source software program green instrument for statistical analysis as well as visuals. It primarily according to command line interfaces. It's utilized by statisticians as well as information miners that supports for statistical tests, nonlinear and linear modeling and for time sequence evaluation. Mongo DB It is a document focused database that replaces the idea of a "row" with an adaptable model (Chiang & Yang, 2018)

Hadoop Map reduce It is a way utilized to process huge quantities of information as well as additionally a version based on java for distributed computing (Hao, Zhang, & Song, 2019). Map-reduce algorithm contains two primary tasksMap and lower. This method splits the enter information sets into impartial chunks that are prepared by the chart undertaking in a parallel manner, sort the information and provided as an input for the lessen task. This framework concentrates on booking the chores, monitoring the regular job as well as re executing the activities that will fail during execution (Ittmann, 2015)

Challenges of Supply Chain Management

Based on Jahan et al, the wide open research issue in supply chain management together with logistics could be examined from the view of executive business and stake holders components, where critical company capabilities are forecasting, inventory management, transportation control as well as human resources (Jahan & Sazu, 2022). Big data are able to target the problems of Supply chain like appropriate response, time distribution, real time preparation, provider as well as customer relationship management etc (Sazu & Akter Jahan, Impact of big data analytics on government organizations, 2022). Operating a good supply chain involves constant flow of info, which in turn helps you to produce better components flow. The primary focus in supply chain will be the customer. Therefore, achieving a great customer focused product is among the target of SCM. The primary key supply chain processes/ conflicts are listed as well as shown in the Fig two.
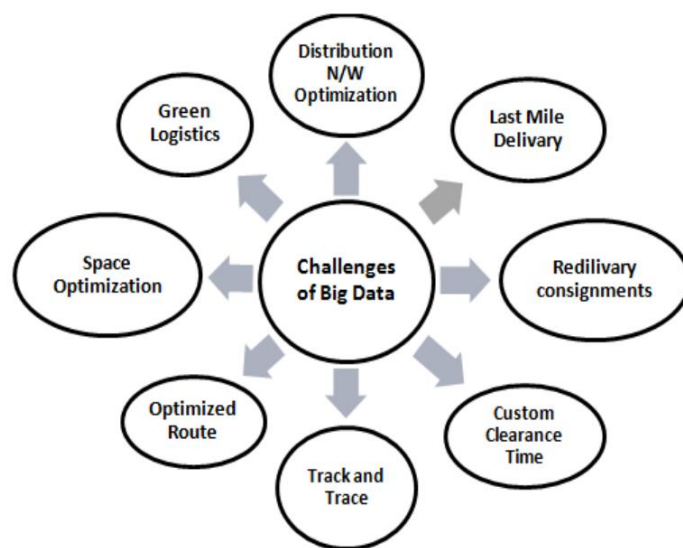

Figure 2: Big data challenges in logistics

A. Distribution Network Optimization

Division system will involve locating warehouses as well as output plants and additionally to determine the technique for distribution of things from provider to warehouses and from warehouses to clients (Mikalef, Pappas, Krogstie, & Giannakos, 2018). The primary key issues of Distribution system are of domestic transportation system, achieve flexibility in community redeployment when network modifications and additionally to lessen the entire price of distribution network. The positives of n/w optimization by obtaining above conflicts would be the Optimized Network.

B. Green Logistics

It implies performance in using conveyance equipment 's. Several of the primary key characteristics in Green logistics are Minimization of carbon dioxide emission, Cost reduction from environmental externalities and resource saving (Khanra, Dhir, Islam, & Mäntymäki, 2020). The positives by conquering the mentioned challenges are much better utilization of resources, social and setting duty etc. Adopting or introducing eco-friendly logistics is an intricate process which involves cross disciplinary coordination as well as changes in the present operation process. This may be likewise being accomplished by introducing new methods in the region of supply as well as distribution which links them to various other participants as customers and suppliers in the value chain. This hyperlink

should be backed by management staff 's, the characteristics of theirs and additionally by human resources (Kumar, Sood, Kaul, & Vasuja, 2020).

C. Route Optimization

Route would be the really important aspect to manage effectively the actual physical flow of supply chain. Several of the problems are as Optimization of individual course trucking journey, Allocate proper sources a trip, Cost reduction. By obtaining these goals, the benefits from Route is Route Efficiency (Janssen, Voort, & Wahyudi, 2017).

D. Space Optimization

The primary key parameters in Space are Maximizing room utilization, enhance efficiency and additionally to reduce the cost. The positives from Space Optimization is utilization of room for a far better way.

Regression

Based Regression is a set of data mining or maybe statistical modelling technique used for describing the actions of random adjustable by using one plus quantitative variables. The Linear regression utilizes the technique or perhaps associated with a straight line to be able to foresee the importance of y by identifying the correct values for m c dependent upon the importance of given x. y turns into a dependent varying along with other variables becomes a predictor or perhaps impartial adjustable. The relationships among goal adjustable as well as the predictors are summarized in model. This connection was put on to number of datasets whose target values are unfamiliar. Several of the apps of regression evaluation running a business are predictive analytics, supporting decisions, operation efficiency, fixing new insights and errors. Regression examination is primarily utilized to identify the values of details for a characteristic which will result in the performance to best match of asset information that we offer. Equation mentioned below describes the relationships in terminology of symbols. Equation describes that regression is a characteristic of estimating the importance of a consistent goal expressed as Y, a function of 1 or maybe more predictors, a pair of variables as well as a degree of errors as.

$Y = F*e$.

The target variable is known as reliant variables or maybe predictors and response variables as explanatory or independent variables. Parameters of regression can also be referred to as regression coefficients.

Experiments & Results

This section includes debate on tests, outcomes, information set description, summary of scatter plot representation and about PSPP.

A. Data Set Description:

The sample sales information set size had for regression examination is twenty five. The information set is in.csv structure. The attributes of sales-data as well as the description of theirs is provided.

PSPP is an open source program that can be utilized for the evaluation of sampled information. Initially created in late 1990s, intended as a totally free option for IBM SPSS Statistics. It's a graphical user interface as well as typical command-line interface. It's written in C and employs GNU Scientific Library for the mathematical routines of its. PSPP is utilized for statistical analysis of sampled datasets.

This tool reads the information, analyzes based on the commands and writes the end result to output window. The language is akin to SPSS statistical products. The key options that come with PSPP are frequencies, cross-tabs comparison of means; linear regression, logistic regression and many others.

B. Scatter plot:

To ascertain the linear connection between the variables, it's recommended to operate a scatter plot on the specified information set. In case the graph has no linear connection, then no demand for linear regression. From Fig three, it's discovered that areas on the graph are linear. This suggests that linear relationship exists between simple regression and the variables can be applied. The scatter plot acquired is displayed in Fig.3
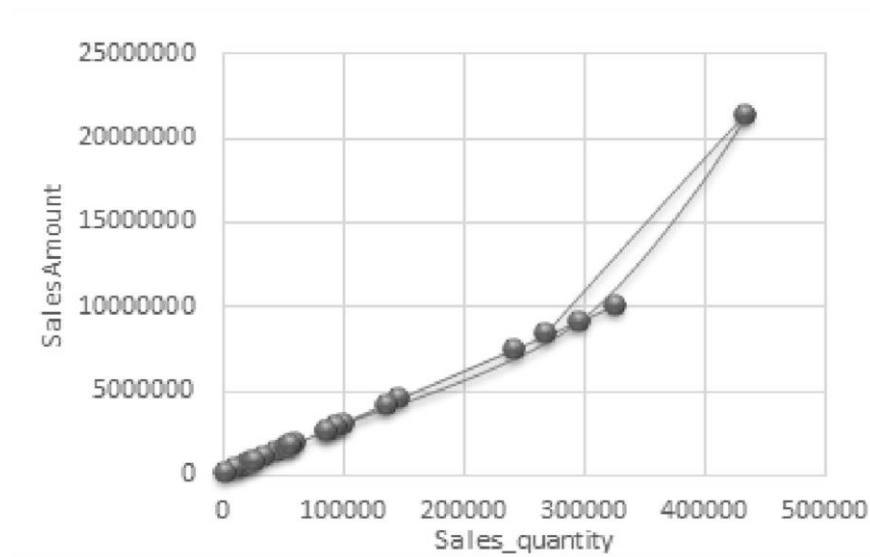

Figure 3: Scatter plot to check linearity

C. Interpretation of Results:

The results from regression version run on PSPP are depicted. The tabulations are regarding unit summary, Coefficients, ANOVA. It depicts the effects generated from straightforward linear regression in addition to a scatter plot of Fig four. Based on the data, predictions are nearly nearing to the real values. It's approximately eighty %.
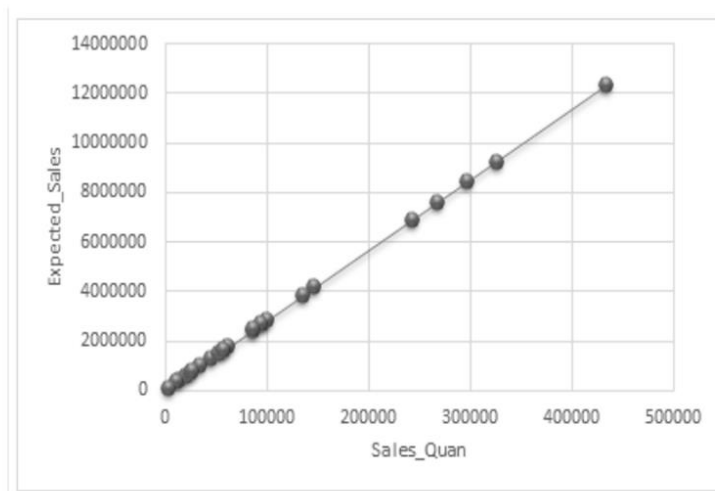

Figure 4: Scatter plot after prediction

The interpretation of coefficient of dedication R from unit summary is in the assortment of zero 1, that's 0.96. This shows the dependent variable could be predicted. In the present experiment the dependent variable is sales_quan_Feb. Analysis of variance will be the group of statistical models and the related procedures of theirs. It's utilized to analyze the differences of all the group means. It is discovered out of the figure which the significance of ANOVA for sales_quan_Feb is discovered to be zero. The regression coefficients because of the predictor depicts the distinction in reaction every device distinction in the predictor (Choi, Wallace, & Wang, 2018).

Conclusion

The bibliographic survey conducted in this article mostly concentrates on the Supply chain management activities regarding information warehouse, transportation, and marketing. The company transformation as well as advancements in operation expense have contributed to the improvement of the Supply chain analytics (Haque & Akter, 2022). A predictive model created on sample sales-data utilizing linear regression technique is discovered to be eighty % nearer to the readily available outcomes. The unit additionally offers info about the descriptive data whereby the descriptive analytics are done. Additionally, the tasks are enhanced using polynomial and multiple regression methods. The existing labor offers an excellent platform for the big data analytics as well as potential integration of SC. and BDA It is able to serve as an excellent support program.

References

[1] AMBIGAVATHI, M., & Sridharan, D. (2018). Big data analytics in healthcare. *Tenth International Conference on Advanced Computing (ICoAC)* (pp. 269-276). IEEE.

[2] ANTONS, D., & Breidbach, C. F. (2018). Big data, big insights? Advancing service innovation and design with machine learning. *Journal of Service Research, 21*(1), 17-39. doi:https://doi.org/10.1177/1094670517738373

[3] BRESCIANI, S., Ciampi, F., Meli, F., & Ferraris, A. (2021). Using big data for co-innovation processes: Mapping the field of data-driven innovation, proposing theoretical developments and providing a research agenda. *International Journal of Information Management, 60*. doi:https://doi.org/10.1016/j.ijinfomgt.2021.102347

[4] CHIANG, L. L., & Yang, C. S. (2018). Does country-of-origin brand personality generate retail customer lifetime value? A Big Data analytics approach. *Technological Forecasting and Social Change, 130*, 177-187. doi:https://doi.org/10.1016/j.techfore.2017.06.034

[5] SAZU, M. H., & Jahan, S. A. (2022). How Big Data Analytics Impacts the Retail Management on the European and American Markets. *CECCAR Business Review*, *3*(6), 62-72.

[6] CHOI, T. M., Wallace, S. W., & Wang, Y. (2018). Big data analytics in operations management. *Production and Operations Management, 27*(10), 1868-1883. doi:https://doi.org/10.1111/poms.12838

[7] GUNASEKARAN, A., Papadopoulos, T., Dubey, R., Wamba, S. F., Childe, S. J., Hazen, B., & Akter, S. (2017). Big data and predictive analytics for supply chain and organizational performance. *Journal of Business Research, 70*, 308-317. doi:https://doi.org/10.1016/j.jbusres.2016.08.004

[8] HAO, S., Zhang, H., & Song, M. (2019). Big data, big data analytics capability, and sustainable innovation performance. *Sustainability*.

[9] HAQUE, S. M., & Akter, J. S. (2022). Big Data Analytics & Artificial Intelligence In Management Of Healthcare: Impacts & Current State. *Management of Sustainable Development, 14*(1), 36-42. doi:https://doi.org/10.54989/msd-2022-0006

[10] HERMON, R., & Williams, P. A. (2014). Big data in healthcare: What is it used for?. *Australian eHealth Informatics and Security Conference.* Perth: Edith Cowan University.

[11] ITTMANN, H. W. (2015). The impact of big data and business analytics on supply chain management. *Journal of Transport and Supply Chain Management, 9*(1), 1-9. doi:https://hdl.handle.net/10520/EJC169773

[12] JAHAN, S. A., & Sazu, M. H. (2022). Role of IoTs and Analytics in Efficient Sustainable Manufacturing of Consumer Electronics. *International Journal of Computing Sciences Research, 6*. doi:10.25147/ijcsr.2017.001.1.105

[13] JANSSEN, M., Voort, H., & Wahyudi, A. (2017). Factors influencing big data decision-making quality. *Journal of Business Research, 70*(1). doi:https://doi.org/10.1016/j.jbusres.2016.08.007

[14] SAZU, M. H., & Jahan, S. A. (2022). Can big data analytics improve the quality of decision-making in businesses?. *Iberoamerican Business Journal*, *6*(1), 04-27.

[15] JIANG, F., Zhi, H., & Wang, Y. (2017). Artificial intelligence in healthcare: past, present and future. *Stroke Vascular Neurology, 2*(4), 230-243. doi:https://doi.org/10.1136/svn-2017-000101

[16] KHANRA, S., Dhir, A., Islam, A. N., & Mäntymäki, M. (2020). Big data analytics in healthcare: a systematic literature review. *Enterprise Information Systems*, 878-912.

[17] KUMAR, Y., Sood, K., Kaul, S., & Vasuja, R. (2020). Big data analytics and its benefits in healthcare. *Springer*, 3-21.

[18] SAZU, M. H., & Jahan, S. A. (2022). How Analytics Can Improve Logistics And Supply Chain In Multinational Companies: Perspectives From Europe And America. *Business Excellence and Management*, *12*(3), 91-107.

[19] LAVALLE, S., Lesser, E., Shockley, R., Hopkins, M. S., & Kruschwitz, N. (2011). Big data, analytics and the path from insights to value. *MIT sloan management review, 52*(2), 21-32. Retrieved from https://sloanreview.mit.edu/article/big-data-analytics-and-the-path-from-insights-to-value/

[20] MIKALEF, P., Pappas, I. O., Krogstie, J., & Giannakos, M. (2018). Big data analytics capabilities: a systematic literature review and research agenda. *Information Systems and e-Business Management*, 547-578. doi:https://doi.org/10.1007/s10257-017-0362-y

[21] SAZU, M. H., & Jahan, S. A. (2022). The impact of big data analytics on supply chain management practices in fast moving consumer goods industry: evidence from developing countries. *International Journal of Business Reflections*, *3*(1).

[22] NGUYEN, T., Li, Z. H., Spiegler, V., Ieromonachou, P., & Lin, Y. (2018). Big data analytics in supply chain management: A state-of-the-art literature review. *Computers & Operations Research, 80*, 254-264. doi:https://doi.org/10.1016/j.cor.2017.07.004

[23] SAZU, M. H., & Jahan, S. A. (2022). High efficiency public transportation system: role of big data in making recommendations. *Journal of process management and new technologies*, *10*(3-4), 9-21.

[24] NIEBEL, T., Rasel, F., & Viete, S. (2019). BIG data–BIG gains? Understanding the link between big data analytics and innovation. *Economics of Innovation and New Technology, 28*(3), 296-316. doi:https://doi.org/10.1080/10438599.2018.1493075

[25] SAZU, M. H. (2022). Does Big Data Drive Innovation In E-Commerce: A Global Perspective? *SEISENSE Business Review, 2*(1), 55-66. doi:https://doi.org/10.33215/sbr.v2i1.797

[26] SAZU, M. H., & Akter Jahan, S. (2022). Impact of big data analytics on government organizations. *Management & Datascience, 6*(2). doi:https://doi.org/10.36863/mds.a.20157

[27] SAZU, M. H., & Jahan, S. A. (2022). THE IMPACT OF BIG DATA ANALYTICS ON SUPPLY CHAIN MANAGEMENT PRACTICES IN FAST MOVING CONSUMER GOODS INDUSTRY: EVIDENCE FROM DEVELOPING COUNTRIES. *International Journal of Business Reflections, 3*(1), 112-128. doi:https://doi.org/10.56249/ijbr.03.01.30

[28] SHAKYA, S., & Smys, S. (2021). Big Data Analytics for Improved Risk Management and Customer Segregation in Banking Applications. *Journal of ISMAC, 3*(3), 235-249. doi:https://doi.org/10.36548/jismac.2021.3.005

[29] SILVA, E., Hassani, H., & Madsen, D. (2020). Big Data in fashion: transforming the retail sector. *Journal of Business Strategy, 41*(4), 21-27. doi:https://doi.org/10.1108/JBS-04-2019-0062