PROJECT REPORT

On

Optimizing Supply Chain Operations Using Data Science: A Study on Inventory and Logistics Management

SUBMITED TO THE

INDIAN INSTITUTE OF MATERIALS MANAGEMENT

IN PARTIAL FULLFILLMENT OF THE REQUIREMENTSFOR THE POST GRADUATE DIPLOMA IN MATERIALS MANAGEMENT/POST GRADUATE DIPLOMA IN SUPPLYCHAIN MANAGMENT & LOGISTICS

Under the supervision of

Name of the Supervisor/Guide

Designation

By

Name.....

Enrolment No.....

Indian Institute of Materials Management

NATIONAL HEADQUARTERS (EDUCATION WING)

CBD Belapur, Navi Mumbai - 400 614.

Academic Year: 20_____

CERTIFICATE OF SUPERVISOR (GUIDE)

Certified that the work incorporated in this Project Report …….....(Title) submitted by ……..(Student's name) is his/her original work and is satisfactorily completedunder my supervision.

Material obtained from other sources has been duly acknowledged in the Project Report.

Date :

Signature of Guide : _____

DECLARATION BY THE STUDENT

This is to declare that I have carried out this project work myself for ……..... Programof Indian Institute of Materials Management. . The work is original, has not been copied from anywhere else and it has not been submitted toany other University/Institute for an award of any degree/diploma.

Date :

Place :

Name :

Signature :

Table of Contents

ABSTRACT / EXECUTIVE SUMMARY

Most distribution firms' workflows consist of three primary operations: procurement, warehousing, and delivery. In the first group, you'll find tasks like inventory needs assessment, planning, and production. The next step, after procurement, is to store, manage, and retrieve the items in accordance with the orders that are now pending. These procedures fall within the second group. Delivery of products to end users is the last group. A specialized Supply Chain Management system records and analyzes these procedures since they constitute the backbone of most distribution organizations. This research proposes and details the implementation of a system that has been developed and implemented in various large distribution companies. The system is based on data science methods, advanced analytics, optimization, metaheuristics, and machine learning algorithms.

In order to develop a functional and economical system, supply chain management (SCM) must undergo a number of modifications. From manufacturing to distribution to end users, SCM encompasses the whole process. The system as a whole includes distribution businesses. Supply chain management (SCM) include the activities of arranging orders, storage, and transporting goods to consumers if distribution businesses alone are considered.

A crucial factor in an organization's success in today's global business landscape is efficient supply chain management. However, conventional inventory management systems aren't up to the task of keeping up with the ever-changing needs of the modern market. As a foundational component of supply chain quality, this research aims to investigate the adaptability of real-time process control. The ever-evolving market dynamics and shifting consumer tastes are posing serious difficulties to the current state of inventory management practices, which rely on static data analytics and periodic updates. Poor inventory levels, extended lead times, and increased operational expenses are common outcomes of using such antiquated methods, which in turn reduce an organization's agility to react to changes in the market. Examining the needs and advantages of switching from static models of inventory management to real-time methods that are dynamic is the main goal of this research.

CHAPTER 1: INTRODUCTION

1.1 Introduction

In order to keep overhead low and revenue high, almost every store—big or small—has to regularly handle thousands of distinct goods (Seaman, 2018). Inventory control, or the act of determining whether and when to place an order for a certain item and the quantity to be ordered, is an essential aspect of the management process. Product availability and loss likelihood of sales are both improved by shorter review times and bigger orders, but inventory expenses, including stock holding and ordering costs, are negatively affected. Handling such a complex trade-off requires item-specific optimization of inventory rules with respect to criteria such as review period, lead time, and desired service level. In order to back up such decisions, numerical approaches like dynamic programming based methods can be utilized. However, these techniques can become extremely time consuming and obsolete when the optimization problem dimensions grow, such as when there are more series and sets of inventory policy parameters. Plus, most of these methods aren't data-driven, so they make a lot of assumptions about how demand is distributed and how to replace supplies, which may lead to problems with data availability and the consequences of stock-outs or delivery delays. Machine learning (ML) techniques provide a viable substitute for numerical methods. Algorithms like these may learn from massive datasets and then use that information to make predictions or suggestions, thereby generalizing non-linear processes. Importantly, ML algorithms don't dictate how data is generated; instead, they base their suggestions on patterns that have already been detected, without making any assumptions about the data. Many parts of supply chain management have benefited greatly from the use of ML algorithms. Machine learning (ML) algorithms have several potential applications; for example, they have been suggested as a substitute for statistical approaches in demand data forecasting, inventories item classification, and transportation issue optimum route prediction, among others. There has been very little use of machine learning in optimization settings for inventory management, despite its enormous promise in other areas.

1.2 Research Problem

Complexity in supply chain operations is on the rise as a result of globalization, varied consumer expectations, and the need for instantaneous responses. Problems including overstocking, stockouts, and less-than-ideal transportation routes are common results of inefficient inventory control and logistics, which are common in traditional management systems. Data science has the ability to revolutionize these processes by providing real-time insights and sophisticated analytics. Nevertheless, a major obstacle still stands in the way of data science's actual incorporation into SCM. Disjointed data sources, insufficient analytical skills, and organizational opposition to change are major roadblocks. The purpose of this research is to find out how to overcome these obstacles and show how data science can increase operational efficiency and cost-effectiveness in logistics and inventory management. The study will delve into data-driven tactics that may improve decision-making, simplify logistics, and achieve balanced inventory levels. The ultimate goal is to make supply chain operations more robust and adaptable.

CHAPTER 2: THEORETICAL PERSPECTIVE & LITERATURE REVIEW

Retail outlets Supply Chain Overview

General Trends

Businesses that deal in the sale of goods to the general public are often known as retail outlets. We investigate the relationships between retail outlets and their customers as part of our research on supply chain practices; these relationships drive the activities that occur between retailers and their suppliers. A network of suppliers that service multiple relays and relays that are serviced by many suppliers makes up a supply chain for relays. Wholesalers, other intermediaries, and suppliers often sit between retail outlets and suppliers, and vice versa. The fourth major player that drives these changes, the customer of retail outlets, has altered the dynamics of the relationship between the three key players in the supply chain. Retail outlets provide the expected level of customer service via their spending habits. The ability to provide that requested service is the driving force behind any shipping retail outlet. Recent shifts in consumer spending have redirected attention in the retail outlets supply chain. beginning with managing customer demands at the inventory level to manage customer demand by implementing technological changes throughout their supply chain and reevaluating their trading partner relationships. By studying shifts in consumer behavior, the researcher identifies a number of trends influencing the supply chain of the supermarket business. Retail outlets that cater to customers' convenience and price sensitivity are becoming more popular, for instance. Retail outlets are starting to realize how important on-shelf availability is as the amount of time consumers spend in certain stores declines.

Supplier and Retailer Collaboration

The danger of stockouts has traditionally been reduced by retailers carrying buffer inventory for high-demand items. An adjustment in supply chain strategy has been made to handle quickly moving inventory as retail outlets have come to understand the cost of holding these stocks. Suppliers and retail outlets have joined together to combat fluctuations in demand. Collaborative efforts have been made to better respond to demand fluctuations, thanks to the bullwhip effect. This effect allows suppliers to get a disproportionate amount of variability based on retailer consumer demand. Shipping retail outlet and supplier costs are the targets of these initiatives. An investigation on the current tendencies in supply chain structural changes

is underway. By using information sharing, suppliers may anticipate what return otlets customers will order with the use of Quick Response. By linking the two parties with cutting-edge technology, QR transforms the supplier-retailer dynamic. The authors demonstrate how the communication level between suppliers and retail outlets is altered by point-of-sale (PťS) data and electronic data interchange (EDI). Point of sale data is becoming more and more important since it lets suppliers know what fast-moving items are currently in demand. This, in turn, allows suppliers to prepare for the next order before the shipping return team makes the order. Faster information sharing results in shorter order cycle times due to the electronic connection between the two entities via the use of PDI.

Technology usage in SCM

Businesses in the supermarket sector are stepping up their use of information technology to bolster and enhance their supply chain management initiatives. Starting in the 1990s, with electronic data interchange and the use of scanning barcodes to maintain more precise sales tracking throughout the business, this trend was mentioned before. Information technology has aided in speeding up activities within the retail supply chain by providing more accurate data and a faster method of transmitting this data. Thanks to technological advancements, responding to customer changes and other sources of supply chain variability has become more efficient.

The growing realization that information between partners is crucial to communication and cost-cutting efforts has led to a shift toward a supply chain partnership that is more tech-dependent. The researcher elucidated this trend toward a supply chain that is driven by technology by using inter-organizational information technology (IIT). The procedure of information sharing between participants is facilitated by IAIT. A supply chain example of this kind of technology is video distribution infrastructure (VDI). Kent investigates how investments on IIT have impacted the relationship between participants and the impact of these investments on the receipt of investments. According to his research, the participants The supply chain participants' investments in IèIT enhance the level of trust among themselves. If other participants see an investment, it means that someone is willing to put money into improving the channel. Both the trust and commitment levels fall when the investment amount is little.

CHAPTER 3: RESEARCH METHODOLOGY

Data Collection

Primary and secondary sources of information are both necessary for the project to accomplish its goals. Thus, the project made use of both primary and secondary sources of information. The questionnaire method is used to gather primary data, while secondary data is gathered from a variety of sources such as books, periodicals, websites, etc.

1. Primary Data: In order to determine how well data science works for improving SCM, the main data was gathered. The workers' responses to the questionnaire served as the foundation for the examination of the main data. The questionnaire has been thoughtfully constructed to allow for easy measurement of efficacy and input by workers.

2. Secondary Data: To optimize retail supply chain management, we set out to gather secondary data in the hopes that data science would prove useful.

Sample size – 50 employees were selected.

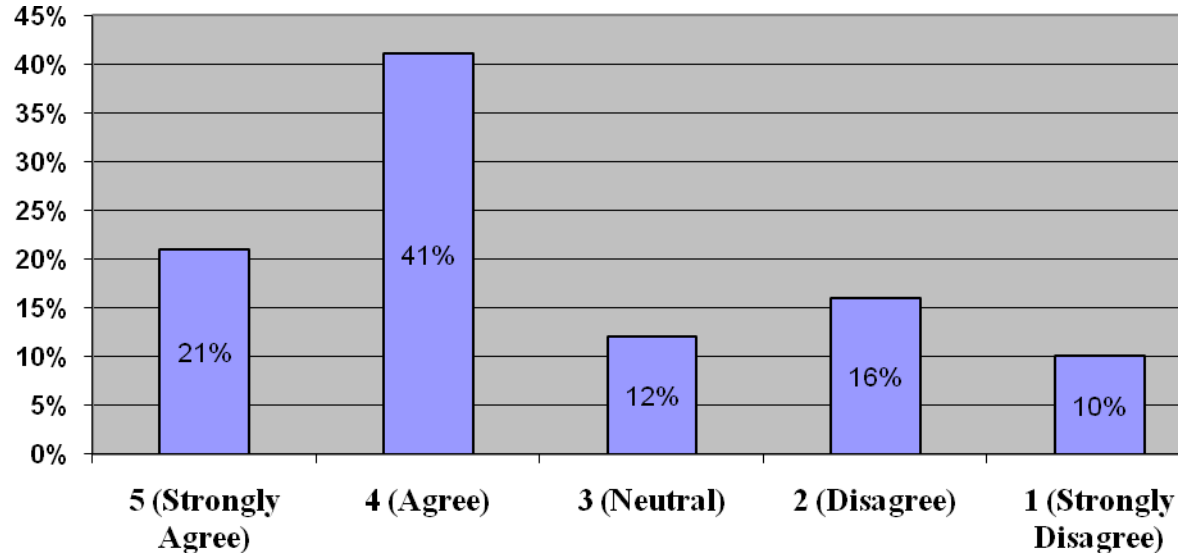
Sampling Technique – Convenient sampling.

Analysis and Interpretation

Compilation, classification, and tabulation were done manually and with the use of a computer after data gathering. After that, using the percentage and pictorial technique, we were able to complete the job of drawing inferences.

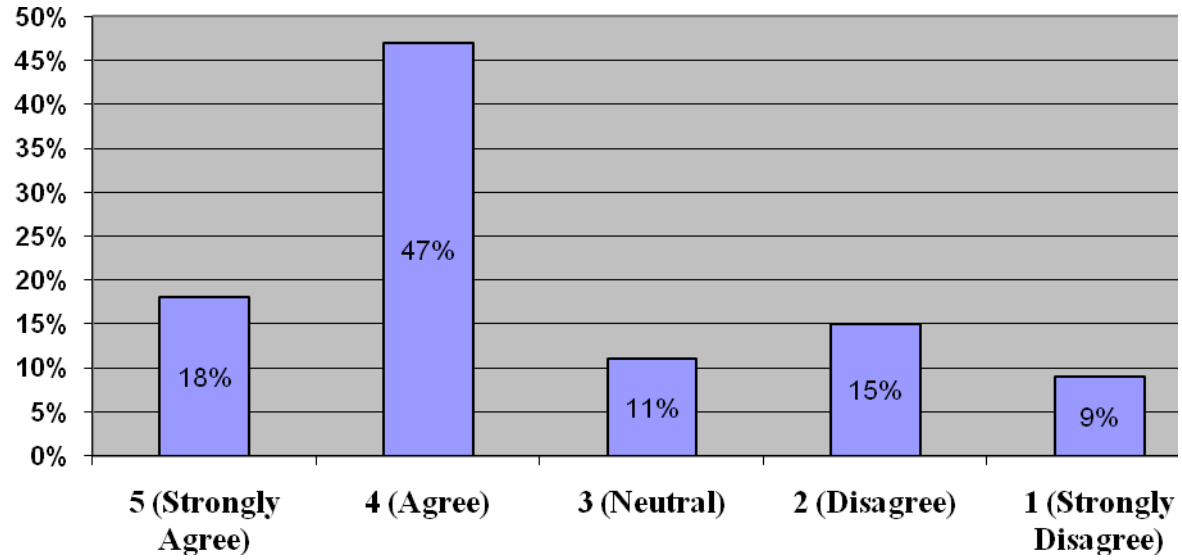
CHAPTER 4: DATA ANALYSIS AND DISCUSSION

Q1. In supply chain operations, data science greatly increases the accuracy of demand forecasts.



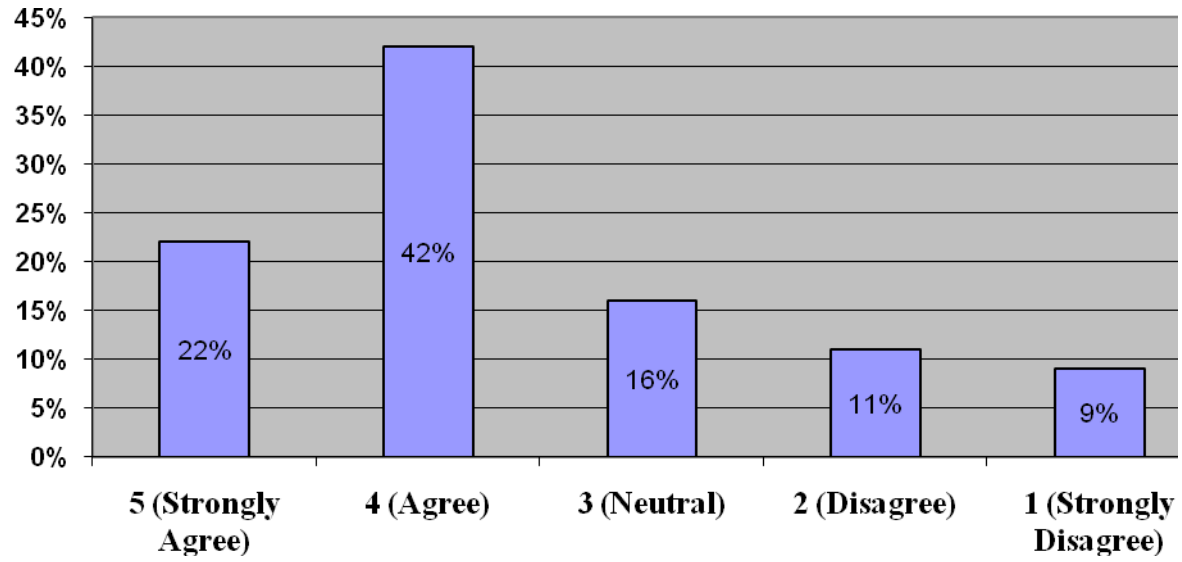
Although 16% of respondents disagreed with the aforementioned statement, 21% of respondents strongly agreed with it.

Q2. Optimizing logistics and transportation routes requires the use of real-time data analytics.



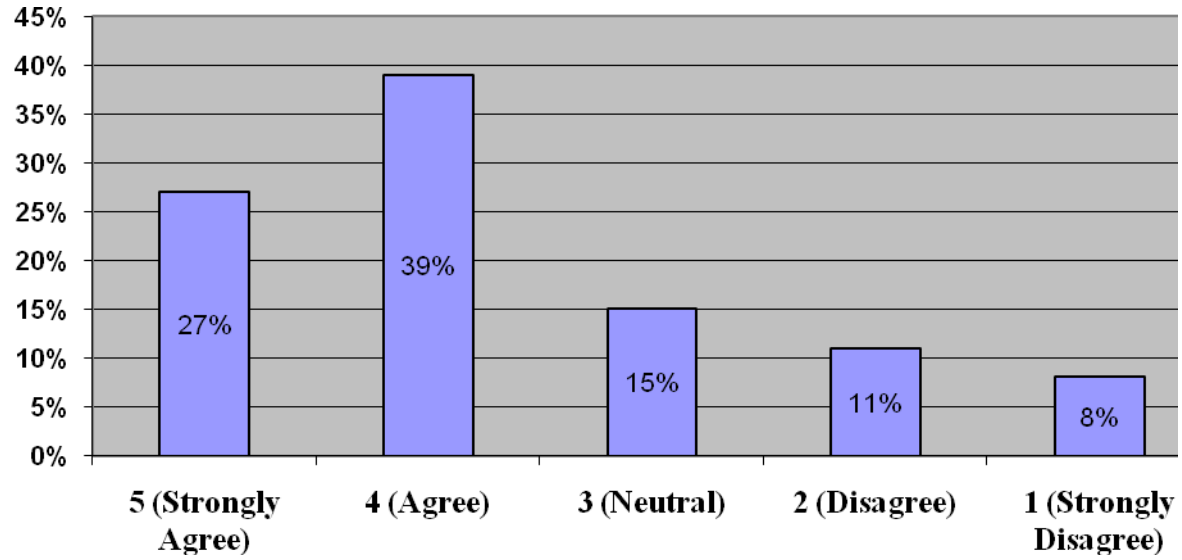
Only 15% of respondents disagreed with the aforementioned statement, while 18% strongly agreed with it.

Q3. Overall supply chain costs are decreased via data-driven decision-making.



While 11% of respondents disagreed with the aforementioned statement, 22% of respondents strongly agreed with it.

Q4. The effectiveness of inventory management is improved by sophisticated prediction models.



While 11% of respondents disagreed with the aforementioned statement, 27% of respondents strongly agreed with it.

CHAPTER 5: CONCLUSION, FINDINGS AND SUGGESTIONS

5.1 Conclusion

The report "Optimizing Supply Chain Operations Using Data Science: A Study on Inventory and Logistics Management" highlights how data science may revolutionize supply networks by increasing their resilience, cost-effectiveness, and efficiency. It has been shown that incorporating cutting-edge analytical methods and real-time data processing into supply chain operations greatly enhances a number of areas, including logistics, risk mitigation, inventory control, and demand forecasting.

Improving the accuracy of demand forecasting is one of the main advantages of using data science to supply chain management. Complex patterns and seasonal fluctuations are sometimes difficult to capture using traditional approaches. In order to more precisely forecast future demand, machine learning methods—such as time series analysis, regression models, and neural networks—can examine past sales data, industry trends, and outside variables. Better inventory planning results in less overstocking and stockouts, which are essential for maintaining ideal inventory levels and successfully satisfying consumer demand.

By allowing automated replenishment systems and real-time monitoring, data science approaches have completely transformed inventory management. Continuous data on inventory levels, movements, and conditions is made possible by the integration of Internet of Things (IoT) sensors in warehouses. Real-time processing of this data by sophisticated analytics tools may avert stockouts and initiate automated reorder points. Better inventory turnover and lower holding costs are made possible by this real-time inventory visibility, which also aids in detecting outdated and slow-moving commodities.

Another area where data science has had a big influence is logistics efficiency. Delivery windows, traffic, vehicle capacity, and fuel prices are just a few of the many factors that affect the intricate processes of scheduling and routing. Simultaneous optimization of various variables is often not possible using traditional approaches. To effectively handle these challenging routing issues, data science makes use of techniques such as deep learning models, ant colony optimization, and genetic algorithms. These algorithms may provide the best routes that cut down on journey time, fuel consumption, and total transportation costs by evaluating real-time traffic data, weather, and delivery limitations.

5.2 Suggestions

1. **Invest in Advanced Analytics Tools and Technologies:** In order to truly profit from data science, businesses need invest in state-of-the-art analytics tools and technology. This comprises IoT devices for inventory monitoring, real-time data processing frameworks, and machine learning platforms. Businesses may improve their capacity for demand forecasting, inventory control, and logistics optimization by putting these cutting-edge technology into practice.

2. **Create systems for quality management and data integration:** A key component of successful data science applications in supply chain management is ensuring high-quality, integrated data. Strong data governance frameworks including procedures for data integration, validation, and cleansing should be established by businesses. Data warehousing systems and ETL (Extract, Transform, Load) technologies may assist in combining data from several sources into a single, precise dataset for analysis.

3. **Encourage a Data-Driven Culture:** Organizations must change their culture in order to successfully implement data science approaches. All organizational levels should adopt a data-driven attitude, according to businesses. This entails educating staff members about the importance of making decisions based on data, promoting the use of analytics in routine business processes, and guaranteeing that leadership is committed to data science projects.

4. **Use Real-Time Inventory Management Solutions:** Stockouts and overstocking may be considerably decreased by using real-time inventory level monitoring and management. IoT devices and real-time data analytics systems should be integrated by businesses to continually monitor inventory movements and conditions. By establishing reorder points in response to real-time data, automated replenishment systems may further increase efficiency and guarantee ideal inventory levels.

BIBLIOGRAPHY

1. **Choi, T.-M. (2018).** "Innovative Supply Chain Management via Digitalization and Artificial Intelligence." International Journal of Production Economics, 206, 33-35. https://doi.org/10.1016/j.ijpe.2018.09.001

2. **Wang, G., Gunasekaran, A., Ngai, E.W.T., & Papadopoulos, T. (2016).** "Big Data Analytics in Logistics and Supply Chain Management: Certain Investigations for Research and Applications." International Journal of Production Economics, 176, 98-110. https://doi.org/10.1016/j.ijpe.2016.03.014

3. **Zhong, R.Y., Newman, S.T., Huang, G.Q., & Lan, S. (2016).** "Big Data for Supply Chain Management in the Service and Manufacturing Sectors: Challenges, Opportunities, and Future Perspectives." Computers & Industrial Engineering, 101, 572-591. https://doi.org/10.1016/j.cie.2016.07.013

4. **Ivanov, D., & Dolgui, A. (2020).** "A Digital Supply Chain Twin for Managing the Disruption Risks and Resilience in the Era of Industry 4.0." Production Planning & Control, 31(8), 573-586. https://doi.org/10.1080/09537287.2020.1768450

5. **Srinivasan, R., & Swink, M. (2018).** "An Investigation of Visibility and Flexibility as Complements to Supply Chain Analytics: An Organizational Information Processing Theory Perspective." Production and Operations Management, 27(10), 1849-1867. https://doi.org/10.1111/poms.12856

6. **Mishra, D., Gunasekaran, A., Papadopoulos, T., & Childe, S.J. (2018).** "Big Data and Supply Chain Management: A Review and Bibliometric Analysis." Annals of Operations Research, 270, 313-336. https://doi.org/10.1007/s10479-016-2376-7

7. **Kamble, S.S., Gunasekaran, A., & Gawankar, S.A. (2020).** "Achieving Sustainable Performance in a Data-Driven Agriculture Supply Chain: A Review for Research and Applications." International Journal of Production Economics, 219, 179-194. https://doi.org/10.1016/j.ijpe.2019.05.022

8. **Wamba, S.F., Akter, S., Edwards, A., Chopin, G., & Gnanzou, D. (2015).** "How 'Big Data' Can Make Big Impact: Findings from a Systematic Review and a

Longitudinal Case Study." International Journal of Production Economics, 165, 234-246. https://doi.org/10.1016/j.ijpe.2014.12.031

9. **Christopher, M., & Peck, H. (2004).** "Building the Resilient Supply Chain." International Journal of Logistics Management, 15(2), 1-14. https://doi.org/10.1108/09574090410700275

10. **Hofmann, E., & Rüsch, M. (2017).** "Industry 4.0 and the Current Status as well as Future Prospects on Logistics." Computers in Industry, 89, 23-34. https://doi.org/10.1016/j.compind.2017.04.002

ANNEXURE-QUESTIONNAIRE

Q1.Data science significantly improves demand forecasting accuracy in supply chain operations.

Strongly Agree

Agree

Neutral

Disagree

Strongly Disagree

Q2.Implementing real-time data analytics is essential for optimizing logistics and transportation routes.

Strongly Agree

Agree

Neutral

Disagree

Strongly Disagree

Q3.Data-driven decision-making reduces overall supply chain costs.

Strongly Agree

Agree

Neutral

Disagree

Strongly Disagree

Q4.Advanced predictive models enhance inventory management efficiency.

Strongly Agree

Agree

Neutral

Disagree

Strongly Disagree

Q5.Integration of data science methodologies faces significant barriers within organizations.

Strongly Agree

Agree

Neutral

Disagree

Strongly Disagree

Q6.Real-time monitoring of inventory levels prevents stockouts and overstocking.

Strongly Agree

Agree

Neutral

Disagree

Strongly Disagree