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# Major Research Report
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# Understanding The Impact of Artificial Intelligence on Supply Chain Management"


*Submitted By*

**Bhavya Pratap Bhadauria**

2K22/DMBA/32


*Under the Guidance of*

**Dr. Saurabh Agarwal**



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# CERTIFICATE

This is to certify that Bhavya Pratap Bhadauria (2K22/DMBA/32) has submitted the report titled **“Understanding The Impact of Artificial Intelligence on Supply Chain Management""** in partial fulfillment of the requirements for the award of the degree of Master of Business Administration (MBA) from Delhi School of Management, Delhi Technological University, Delhi during the academic year 2023-24.

**Dr. Saurabh Agarwal**

**HoD, DSM, DTU**

# DECLARATION

I, Bhavya Pratap Bhadauria, hereby declare that the presented report titled **"Understanding The Impact of Artificial Intelligence on Supply Chain Management""** is uniquely prepared by me as a part of Master of Business Administration (MBA) curriculum of Delhi School of Management, Delhi Technological University, New Delhi. This is an original piece of work and has not been submitted elsewhere.

I also confirm that the report is only prepared for my academic requirement, not for any other purpose. It might not be used with the interest of the opposite party of the corporation.

…….

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Once again, I extend my heartfelt appreciation to Dr. Saurabh Agarwal for his invaluable guidance and commitment to nurturing the academic and personal growth of his students.

## Executive Summary

The retail industry is experiencing a significant transformation driven by increasing complexity, competitive pressures, and evolving consumer preferences. Traditional statistical frameworks for performance evaluation and operational enhancement are giving way to innovative methodologies that push the sector beyond conventional boundaries. Manufacturers are bypassing intermediaries to engage directly with consumers, reshaping product markets and presenting both challenges and opportunities for retailers.

In this dynamic landscape, the efficiency of supply chain orchestration emerges as a critical determinant of competitive advantage. Retail supply chains, historically viewed as cost centers, are now under pressure to prioritize speed, responsiveness, and cost-effectiveness. However, achieving these objectives often involves trade-offs and complexities.

Operations research offers a systematic approach to addressing the multifaceted challenges inherent in retail supply chain management. By harnessing analytical tools and methodologies, retailers can optimize decision-making processes, improve operational efficiency, and advance strategic goals in a rapidly evolving marketplace.

This paper investigates the evolving role of operations research in navigating the intricate dynamics of retail supply chain management. Drawing upon insights from recent studies and incorporating a case study on disposition decisions in reverse logistics, we aim to provide valuable insights to supply chain managers and researchers. Our findings facilitate informed decision-making, contributing to the advancement of sustainable supply chain practices within the retail sector.

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Introduction-

The retail trade is an industry that is going through profound changes at the present time because of growing dynamism, intensifying competition, and changing customer demand. The conventional approaches to establishing performance benchmarks and programme improvement are slowly being replaced by newer methods that are challenging the standards set in this field. Sellers are now targeting the consumer directly instead of going through the middlemen and this has the potential to revolutionize product markets, something that may will pose both threats and opportunities to the retailers.
In this environment, the effectiveness of supply chain management comes out as a key factor influencing competitive advantage. Players in the value network of retail supply chains, which were once cost centers, have now become pressured to emphasize on speed, flexibility and cost. Nevertheless, the attainment of these objectives comes with some trade offs and dynamism.
The study of operations research helps in providing a better solution for number of complexities involved in the retail supply chain management. It is important to note that various methods of analysis can be obtained and implemented by retailers to enable them make right decisions, increase efficiency and enhance strategic objectives within the emerging global competitive environment.
This paper aims to examine the developing trend of how operations research contributes to the growing complexity of managing retail supply chain. Utilizing findings from the current literature and reporting a case study on disposition decisions in reverse logistics, this paper is expected to contain useful information for both SCM and researchers. The study conclusions support best decision making aimed at improving sustainable supply chain management for the retail industry.

## Background

A historic background of the retail industry Although hundreds of thousands of small retail businesses are established across the globe, there is evidence that reveals the history of the retail industry as originating nearly four millennia ago.

This study focuses on the retail industry, which is a foundational pillar of modern economic markets and will be further discussed in the subsequent sections. It was identified as a prime example of the formalisation of supply chain management, maintaining operations involving different product flow processes. Compared to other production industries, the procedure of inventory management in retail environment requires the proper positioning of the stocks at several stocking points, with the purpose of increasing the product accessibility while at the same time minimizing the expenses associated with stock holding.

Retail SCs are complex fluent structures composed by a high number of stocking points and a high level of cross docking. Cross-docking is a technique used in the management of products to sort them and dispatch them quickly to meet demand at relatively low cost. In addition, the retail industry comprises the service parts logistics, and it employs many movement products, including just-in-time and third-party logistics trends. Due to the complexity of the Retailing industry in relation to the Supply chain methods, the issue of optimization is therefore inevitable to enhance efficiency in supplies.

Hence, this paper established an evolving nature of retail supply chain management due to various factors that include; Technology, Consumers and Global markets. Initially, key activities of retailers were more or less confined to the stock management and transportation. However, the internet selling and thus the omnichannel selling shifted the focus of supply chain management towards order fulfilment, last mile delivery and, customer experience improvement.

The digital advancement such as data analytics and artificial intelligence impacted the supply chain forecasting and the demand planning in the retail sector significantly. Today, retailers rely on sophisticated algorithms and use predictive models with the aim of making forecasts on consumers' behavior as well as efficient distribution of stocks in various stocking points. Similarly, supply chain programs like VMI and CPFR that involved the retailer and its vendors have provided efficient ways of working more closely, which in the

long run will lead to better performance and cost reduction.

Nevertheless, the retail supply chain has several issues that need to be addressed; these issues include fluctuating demand, disruptions of the supply chain, and generally rising customer expectations on delivery of products.

## 2. Understanding Graph Theory

Graph theory is a significant and increasingly important subject in mathematics that examines graphs, which are distinct mathematical structures that mirror symbiotic and generalized relations of items. These objects can include anything within the levels of real world entities, including geographical areas such as cities and roads to facets, which are abstract concepts such as the relations between two or more people in the social network, or interactions of molecules in a chemical compound. Fundamentally, graph theory extends then a pertinent model that adequately conceptualizes as well as characterizes these structural and relational patterns.

### 2. 1. Definition and Concepts

Graphs, the foundational elements of graph theory, are comprised of two fundamental components: nodes and; links, also referred to as arcs. Vertexes, nodes, or points are the basic structural unit, in the case of the graph, it refers to the individual parts or entities while the connections or relationship between those entities are described as edges. These edges are simply defined as a connection between two vertices and are used to illustrate a particular interaction between nodes.

The use of graphs in various fields is mainly due to its applicability, in aspects such as computer science, social sciences, biological technologies, and transportation logistics studies. In the field of computer science, graphs are used to represent a large number of sophisticated relationships; for instance in developing networks, databases, and decision trees. Data modelling for social scientists aid in mapping social networks, [revealing] the social relations between members of a society or group of people. Likewise, biologists utilize diagrams in order to analyse such things as molecular architecture or patterns of protein-protein bonding or genealogy. In addition, in the field of transportation engineering, graphs are also excellent methods used in the development of transport systems, selection of the best routes, and examination of transport flows.

The basic concepts in graph theory are degree of a vertex which is associated with the number of edges touching a vertex. In graph theory, the degree of a vertex means the number of edges connected with this vertex, and a vertex with a high degree is regarded as a densely connected vertex. Furthermore, the kind of graphs may be described, for instance by the structure of the edges which may have directions in the case of digraphs and the presence of numerical values (weights) for the edges of weighted graphs.

Likewise, different algorithm and techniques have been found in graph theory to deal different types of problems that may range from graph traversing problems, shortest path problems, graph coloring problems and many more problems related to network flow. These algorithms are essential in a wide range of areas including computer communication and information transfer, operations research, and application in machine learning.

**2. 2. Applications in Operations Research**

In operations, research particularly in supply chain, graph theory is essential since it is branch of mathematics dealing with graphs. This provides a basic framework that is flexible to model, and solve the optimisation problems that are inherently associated with the supply chain processes.

Optimization is the key purpose of operations research as it seeks to improve functions and choices made. These challenges occur because the networks of supplies are complex, and graph theory offers a capable tool for solving the problems by using graph methods. In this paper, nodes of these graphs refer to the entities such as suppliers, manufacturers and warehouses while the links denoting the relationships or flows between these entities are referred as edges.

Viewing supply chain networks as graph structures allows OR practitioners to more fully understand the configurations and changes occurring within their systems. Because of its position in the supply chain, they can review the direction and speed of material, information and resources and determine weak links within the supply chain and ways to optimize the effective supply chain performance.

Graph theory in its turn enables making effective decisions, as it offers a possibility of solving problems on graphs in terms of algorithms. Sequential operations like Dijkstra operation or the minimum spanning tree procedure can

assist in isolating the shortest connections or the best route within the supply chain networks, meaning low transportation costs and short delivery times.

In addition, the supply chain systems can be modeled and analyzed, utilizing parameters obtained from graph theory, such as the multi-echelon inventory systems and problems of network design. Studying complex supply chain problems utilizes a precise logic which is based on new technologies like graph-based algorithms and optimization techniques.

Thus, graph theory in operations research specifically supply chain network has significant importance and multiple uses. In effect, using the theoretical background and methods of graph theory introduced at the beginning of this paper, operations researchers are able to determine the most suitable approaches for supply chain networks in order to respond to new demands within the business world and beyond.

## 3. Graph Theory Matrix Approach in Retail Supply Chain Management

### 3.1. Overview of Graph Theory Matrix Approach

The GTMA is an advanced methodological tool that stands for Graph Theory Matrix Approach and can be applied for the analysis and optimization of supply chain configurations in the context of the retail field. The principles that are employed by GTMA include graph theory, as well as complex matrix algebra to obtain a well-developed and systematic framework in supply chain management.

Fundamentally, GTMA models supply chains as graphs with nodes representing key stake holders or entities such as, suppliers, depots, distribution centers, and stores. The nodes correspond with other nodes through edges: goods, information, and resources are depicted to be flowing within the SCN.

They include the following:- This aspect adds a uniqueness to the GTMA model due to the application of matrices that maps connections between nodes in the supply chain graph. The cells of a matrix represent the characteristic of the link or connection between two nodes, which can include features such as cost for transportation, lead times, and inventory.

By the help of this matrix representation, GTMA makes it easier to review and

improve some of the most crucial and critical supply chain processes. Supply chain planners and people doing operations research can understand the physical layout of the supply chain network, visualize perhaps, potential pinch points and come up with a plan on how to deal with these and improve on the overall lead times.

In addition, using GTMA, supply chain scenarios can be designed and tested for management decisions to suit certain conditions and occasions which makes it a handy tool for effective supply chain management simulation. In this case, input parameters and constraints within the matrix representation can be manipulated to offer a different what-if analysis of other feasible options, allowing for a format for rational decision making for management to minimize risk and maximize gains.

In the retail industry, the Graph Theory Matrix Approach is a substantive synthesis offering powerful tools for supply chain optimization. Through the integration and application of graph theory concepts in combination with matrix algebra, GTMA provides a formal and sequential methodology for considering the design and analysis of supply chain networks within the retail context to achieve enhanced performance, robustness and competitiveness.

### 3.2. Benefits of Applying Graph Theory in Supply Chain Management

The application of graph theory in supply chain management offers several compelling benefits:The application of graph theory in supply chain management offers several compelling benefits:

1-Enhanced Visualization and Understanding: Some of the reasons include: Graph-based representations offer easy to understand visual representations of supply chain networks thus allowing the various stakeholders interested in the complex network structures, dependence and flow to gain a better understanding.

2-Facilitation of Efficient Resource Allocation and Routing Decisions: From the supply of chain networks, it is shown that graph theory can be used to optimize resource allocation, find paths that can be used for transport and even the costs of holding inventory, the costs of transport and the costs of warehousing.

3-Support for Dynamic Modeling and Simulation: The application of the graph

theory in supply chain management enables the stakeholders to capture and model complex supply system scenarios for evaluating the effects of particular decision-making/actuating strategies, or changes in the markets, and driving the system performance to its best in real time.

4-Optimization of Inventory Levels, Transportation Routes, and Production Schedules: Using graph-based optimization techniques, supply chain managers can estimate the amount of inventory that is needed, identify the most cost-effective transportation mode and path, and plan production operations all with the same goal — to reduce costs and increase service levels.

5-With the help of graph theory, supply chain management provides tactical's and strategic's solutions that boost up the operational performance of an organization and help the management to take better decisions to gain competitive advantage in currently complex and global world.

## 4. Optimization of Retail Supply Chain Operations

### 4.1. Network Design and Layout Optimization

In today's highly-saturated world of retail stores, the implementation of the best supply chain network can either be a major contributing factor to the success of a retail store or an indifferent factor. Graph theory is discovered to be useful to optimize this factor by carefully isolating, where it is most economical to place essential facilities like distribution centers, warehouses, as well as retail outlets . In graph modeling each node represent a facility and edge denote the connectivity between two nodes which is transport connectivity. Companies take advantage of the advanced mathematical computation to make decisions with regards to factors like the closeness of the supplier, the rate of consumption, and cost of moving products from one place to another. This endowed position enables retailers to optimally place their facilities in order to reduce the costs of transportation, stocks holding, and lead times and thereby improving the overall service delivery to the customers.

### 4.2. Inventory Management and Distribution Optimization

Effective inventory management is a critical function when it comes to the effective running of a retail business since it helps in maintaining stock to full fill customers need while avoiding excess skyrocketing costs. Concepts and tools originating from the field of graph theory are particularly useful here due to their capability to assist in the optimization of inventory and distribution activities. Through the diagnosis of the material flow on the supply chain level, the management of retailers can work out new ideal stocks, reorder-points and transport routings. Indeed, by using graphs, retailers can identify specific points that allow for streamlining of distribution channels as well as avoiding the related threats of stockouts and overstock among… This strategic optimization ensures that retailers keep mission-critical inventory levels so that there is always an adequate stock of products to meet the customers' demands as they avert situations whereby they will have to pay huge amounts to get rid of inventory they do not need.

### 4.3. Transportation and Routing Optimization

the decisions on transport and routes are critical to the efficiency and expenditures of the supply chain in retailing markets. Here graph theory, arises as a critical facilitator in optimization campagnes. Employing analysis of the transports routes as graphs and using progressive methods such as the shortest path or minimum spanning tree algorithms to reach to a decision may be beneficial to the retailers in an endeavor to decentralizing their freedom ratio because this hence implies that transportation costs and delivery lead times are likely to be minimized. This approach comprises of features or factors such as distance, capacity restrictions and vehicle restraints. Employment of the graph based optimization in logistics results in grouping shipments, adjusting the delivery schedules, and improving the environment of the retailers logistics at large. he has reduced his overall costs and passed those savings onto the consumer by way of coordinated and effective and timely delivery of goods.

To conclude then, it is possible to say that this paper aimed at introducing a new approach to managing supply chain in retail industry and showed that the measure of distance between key elements set within the framework of graph theory is a concept that must be treated as a strategist for modern retail companies. Through the use of graphs, it is then possible to arrange the design of the network and the planning of inventory and transportation facilities in a

much more efficient manner and reduce the overall cost, thereby providing better total value to the customer.

## 5. Enhancing Efficiency and Performance

Just like any business, efficiency and performance is of the essence for any retailer that hopes to survive in today's competitive market environment. Graph theory hence becomes very useful to retailers in opening new vistas of enhancement, and input of improvement in therefore areas of operation that they deal with.

### 5.1. Demand Forecasting and Inventory Planning

Buying and inventory management is the most significant element in retail operations that cannot be dismissed. The mathematical approach known as graph theory can benefit these processes further; retailers can use it to analyze past sales and forecast future trends and patterns. Using algorithms based on graph theory, retailers can come up with efficient demand forecasting methodologies, implement appropriate inventory management strategies that minimize the threats posed by the occurrence of stockouts and overstock conditions whereby a firm holds more inventory than is required to meet customer demand in the future. This paper strives to elucidate the ways in which product-component interactions, consumer characteristics and, market trends aid retailers in optimizing the placement of their stores' inventory based on demand, carrying costs, and profitability.

### 5.2. Order Fulfillment and Customer Service Optimization

Easily, order fulfilment and customer service are two of the most important points of interaction with the retail customer. Several methodologies in graph theory help retailers to enhance these methods and also improve the services being offered to their clients. Through capturing and representing order processing cycles and supply chain networks as graphs, the retailers can achieve better integration in optimizing order fulfilment, cutting shorter cycle time for orders, and improving order precision and delivery dependability. Some of the fundamental benefits of using graphs in analyzing retailers include; It is possible to detect weak links or areas prone to interruptions hence allowing retailers to fast-forward operations while working closely with associated actors in the supply chain. This optimization not only helps to increase the operational efficiency but at the same time it also works positively for the relation with the customers and helps to increase the rate of satisfaction among them.

### 5.3. Warehouse and Distribution Center Optimization

Proper operation of warehouse as well as the distribution center is key consideration to make sure that the supply chain flows as planned. These operations are especially important and graph theory has the ability to model these to optimality since a warehouse layout and the material handling system can be represented using graphs. The analysis of graph theory can provide valuable insights to retailers by enabling them to determine space –consuming items to look for methods of minimizing on material costs incurred on movement of the shelves, and also to optimize on the order picking and packing of items. Knowledge of product positions and coordination of traffic lanes for objects in inventory ensure operational efficiencies in the configurations, cuts operating costs and increases output in the retail stores' warehouses.

By optimizing its purchasing, a retailer can satisfy the needs of the consumer effectively while minimizing the costs of doing business at every stage of the chain.
In general, using graph theory in retailing leads to the improvement of effectiveness as well as efficiency in essential tasks across demand estimating, stock management, order processing, and warehouse management.

Graphing-based models and optimisations can be used by the retailers to achieve greater efficiency and effectiveness in the retail operation and thereby enable it to better meet customer demand and requirements hence making it more competitive in the current retail markets.

## 6. Real-Time Monitoring and Decision Making

### 6.1. Tracking and Tracing Technologies

In today's flow of products to the consumer market, it is impossible to do without real-time tracking and tracing systems for supply chain visibility and flexibility. The integration of these technologies is facilitated through the use of graph theory techniques towards enabling the retailers. In this aspect, several tracking devices and sensors installed in the supply chain network enable retailers to gather real-time data concerning the movement of inventories, status of shipments and delivery places. By applying graph theory algorithms to the data generated from the interaction of supply chain partners, one can gain critical insights into supply chain performance and make informed decisions in advance. For example, retailers can painfully know the slow moving or delayed causes, change the transportation plan, or flexibly manage the inventory levels based on consumers' demand. It is possible to increase operational

effectiveness, lower expenses and make clients happy by applying graph theory for tracking and tracing.

### 6.2. Data Analytics and Visualization

Since retail supply chain management is all about dealing with data, a great tool to use in the field is graph theory. Through the structural method of modeling and using graph theory, retailers have the ability to translate supply chain networks into graphs where various elements and members of the network are illustrated. They are particularly useful in identifying patterns, trends, and other factors that may be unique to a specific retailer in a supply chain network and can assist companies in formulating strategies on how to proceed. For example, the graph analytical approach can be applied to plot the various stages of supply chain management in retail industry; determine the most effective location of the outlets, and design the most efficient way of storing and distributing stock. Also, the modern graph algorithms ensure retailers in the ability to perform predictive analytics, scenario planning, and what–if modeling that will help to assess future trends and threats that may cause disruptions to the business model, let alone adjust strategies and counter potential threats effectively.

### 6.3. Decision Support Systems

DSS based on graph theory is one of the most important forms used effectively to support decision making in the diagnosis of the problems of the supply chain of the retail business in real time. These systems combine graph-based structures, algorithms, as well as real-time data feed to offer the retailers the recommendations together with insights they require to enhance the supply chain processes. Through the use of graph theory DSS is able to undertake routine decision making activities requiring processing of large data sets for instance in inventory replenishment, order routing and transport optimization thus reducing the workload of human beings that could engage in more important decision making tasks. Also, DSS assist retailers in the techniques of sales forecasting actual performance, cost and service level, and customer satisfaction that come out with predicting impacts of various decisions, such as situation evaluation and determination. As we shall discuss later, when applied to retail scenarios, DSS powered by graph theory provide the required independent decision making for real time visibility, coupled with prescriptive recommendations to aid the retailer achieve her supply chain goals in ways that helped her remain competitive in today’s fast changing market environment.

## 7. Challenges and Limitations

### 7.1. Data Availability and Quality Issues

The use of graph theory in managing supply chain in the context of retail operations is not without its unique disadvantages which among them include; Retail supply chains require numerous inputs through various forms of data concerning point-of-sale transactions, inventory details, and logistics information. However, the most notable challenge will be to ensure that the current value chain has timely, accurate and relevant data. However, due to the nature of big data, there are times when data collected is inaccurate, inconsistent, or incomplete and these issues have the potential to greatly affect graph-based models and analysis. To overcome these challenges , several -, retailers have to pay more attention on data capturing, cleaning, and integrating processes since data are primary sources for most models. In addition, retailers should also provide appropriate data governance policies that guarantee data quality.

### 7.2. Complexity and Scalability Challenges

This work tried to establish how graph theory could be used in the management of retail supply chain but due to the large size and connectivity of supply chain nodes, graph theory struggled to effectively fit into the model. Since the links between the supply chain members can incorporate widely and deepen in closer cooperation, the scale and the extent of the supply chain networks expand vastly. Other work suggests that both managing and analyzing complex supply chain systems involve the employment of graph theory models and algorithms that can effectively address the extensiveness and sophistication of real-life supply chains. Furthermore, analysing and optimizing SCNs is also challenging due to the nature of the networks such as dynamics such as fluctuations in demand, supply andestructures of the SCN. Scarce attention and investment in graph analytics for retailers to deal with these challenges requires scalable platforms and algorithms for processing large amounts of data in real-time.

### 7.3. Implementation, Integration, Regulatory, and Ethical Considerations

Difficulties of implementing and integrating graph theory based solutions with the current trends of supply chain management systems in retail domain context. Some potential limitations of graph-based models and algorithms are prospective for retailers, concerning fit to the existing IT environment and business models. However, a review of the literature shows that designing graph theory-based solutions for logistics networks and integrating them with other complex technologies like artificial intelligence, block chain, and Internet of Things is a complex undertaknening. This is due to strategic importance of integration pathways and middleware in the context of retailers' environments where graph theory's applications have to be easily integrated and adapted in the concept of best practices. Also, where the retailer is selling its services to customers or sourcing products from them, it must implement data privacy regulation such as the GDPR and CCPA to protect customer and supplier information. However, the applicators of the graph-based models and algorithms also needs to put into consideration other ethical angles such as bias and discrimination in the developing and deployment phases. These risks can only be addressed if the retailers put themselves under effective data governance mechanisms that are both transparent and accountable to their stakeholders and ensure that the stakeholders embrace good ethical procedures in their decision-making processes in their supply chain activity. Also, the retailing corporations must strive to be aware of the changing regulatory measures and policies as well as industry guidelines that relate in the current complex world of managing and analyzing the unlimited colossal datasets.

## Chapter 8: Future Trends and Directions

### 8.1. Advancements in Graph Theory Applications

Specifically, the context is bound to undergo dramatic changes in the retail supply chain management primarily due to the development of graph theory. Previous and current practice and research have continued to discover fresh graph-based model, heuristic and models that may help in the unending search for solutions to extraordinary complexities involved in managing supply chain. From improving the design of the networks that connect the multiple sites of global retail organizations, to integrating better ways of inventory control, or improving demand forecasting, graph theory provides a powerful set of tools for innovation and optimization in the retail industry.

With the evolution of graph theory over time, it will be highly likely for researchers to come up with complex models and use advanced algorithms that are readily applicable and suited for the retail supply chains. These approaches will effectively address issues involving large and complex networks, and assist retail businesses in managing today's globalized supply chains. Also, the advances in computational means will increase the volume and quality of supply chain data, so that it becomes possible to identify key trends and make more informed decisions in real time, for the retailers.

### 8.2. Integration with Emerging Technologies

It is anticipated that with world raised graph theory as a primary tool for the management of technologies that are new in the retail supply chain. These classes will possibly revolutionize the supply chain through the introduction of graph theory combined with artificial intelligence, machine learning, blockchain, and IoT. When integrated with the graph-based models, companies are set to benefit from key features in monitoring, decision making and optimisation in the retail supply chain through the application of these superior technologies.

For example, through using deep learning on graphs, and other effective structures in the software it is possible to identify the hidden patterns in the supply chain networks leading to informed decisions at a very high level of precision. Likewise, blockchain can help to create supply chain visualization and provide clear information on the sources of goods, and IoT devices can help to gather information on stocks and conditions. These integrations enhance graph-orientated approaches and provide an understanding of the supply chain.

### 8.3. Potential Impacts on the Retail Industry

The use of the graph theory concepts is expected to revolutionalise the retail industry and the competition, innovation, and the shopping experience. Graph theory can be used to improve supply chain processes in retail, increase efficiency, and improve customer experience. In addition, they can respond effectively to changes in the market, its trends, and customers' preferences and prepare for the future.

The efficiency, agility and resilience enabled by graph theory help retailers to spur growth and innovation. Through the use of analytics, statistical modeling

and optimization, they proactively identify trends, risks, and opportunities. Here, the application of graph theory in the field of retail supply chain demonstrates hope for a future that is innovative and excellent.

# CHAPTER 9

## CASE STUDY REFERENCE

### DISPOSITION DECISIONS IN REVERSE LOGISTICS: GRAPH THEORY AND MATRIX APPROACH

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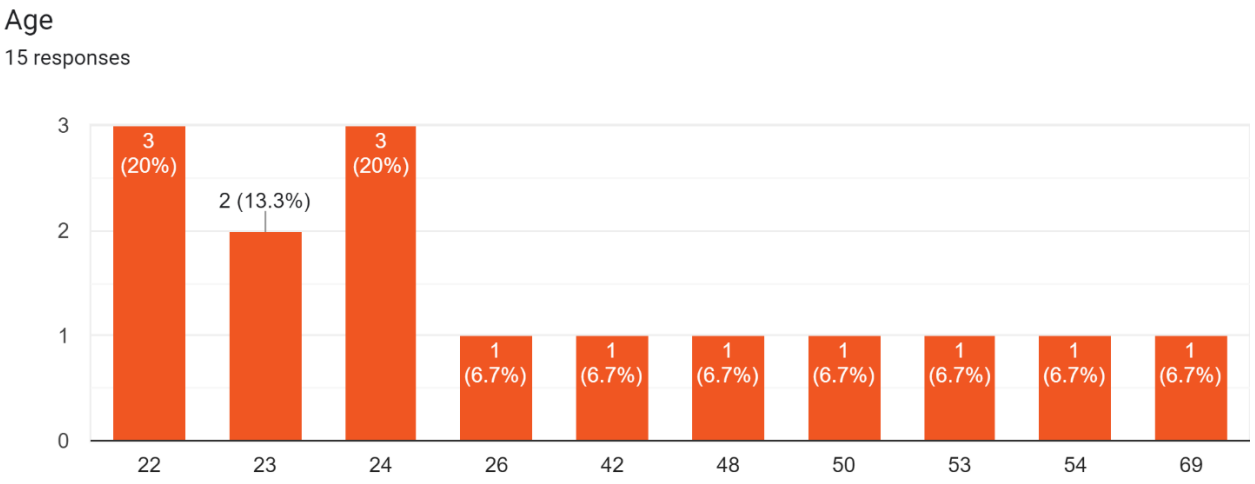
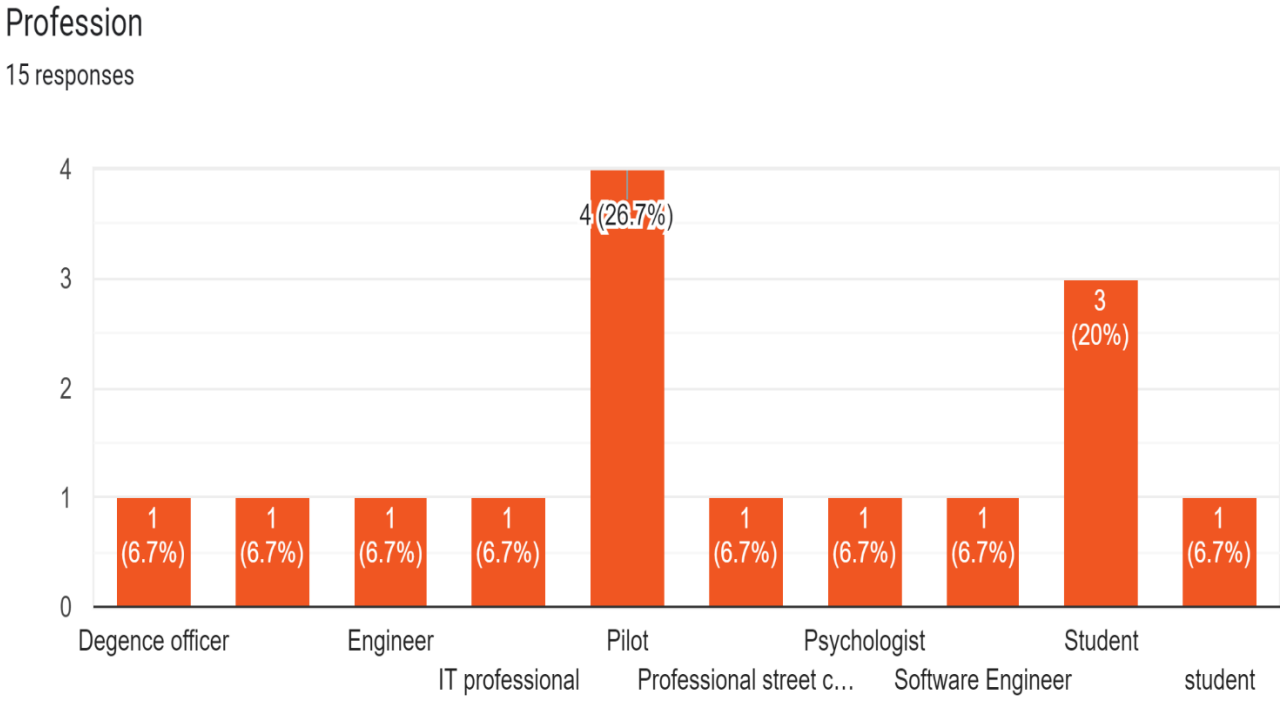
Reverse logistics has become an essential part of business because of legislation, environmental con- cerns, and corporate social responsibility. Reverse logistics activities involve the collection of returned products, inspection and sorting out into different categories, and disposition them for reuse, repair, remanufacturing or recycling. One of the important decisions is to disposition returned products appropriately for the success of reverse logistics. Disposition decision plays an important role in the performance of reverse logistics. Perusal of previous literature indicates that there are very few studies related to disposition of returned products in reverse logistics. This paper attempts to explore the various disposition alternatives and develop an approach for the selection of best disposition alternative using graph theory and matrix approach. A case of mobile manufacturing firm is discussed for the illustration of this approach. The firm has to select best disposition alternative among four identified alternatives such as returned products for repair or reuse and resell as new; or repair or refurbish and resell; or re- manufacture and sell; or recycle. Different disposition attributes are identified based on literature review and experts opinion. Graph theory and matrix approach has been applied to select the best alternative. Permanent function value, referred as “Disposition Index” was evaluated for each alternative with the help of Cþþ program and alternatives were prioritized based on these values. The results show that firm
must repair or reuse and resell the returned mobile phones as new in present business scenario in India. In addition, recycling must be preferred over remanufacturing of returned mobile phones. The study prioritized alternatives for disposition of returned products in reverse logistics appropriately. The find- ings of the study will provide useful insight to the supply chain managers and researchers for disposition decision-making in reverse logistics.

Chapter 10
Appendix / Key Findings

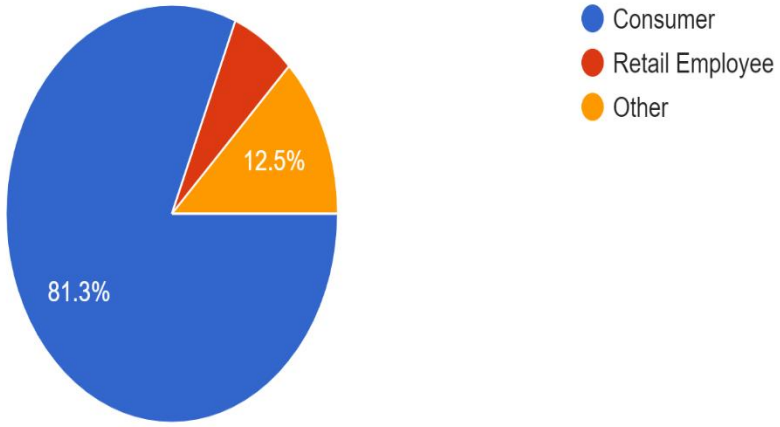
Survey results-



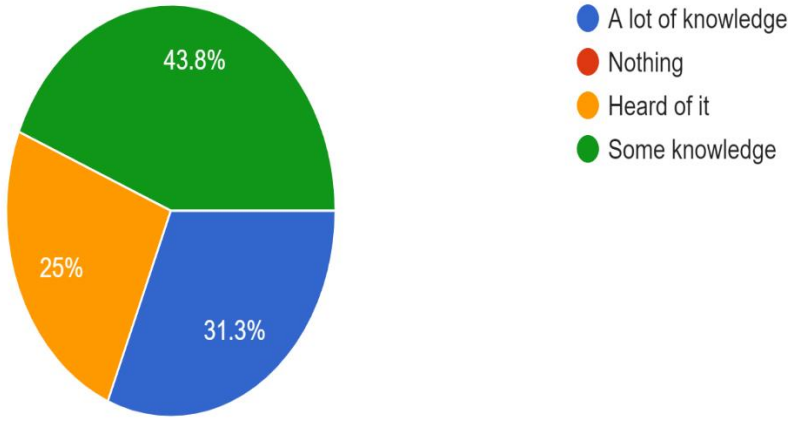
What is your current role?

16 responses



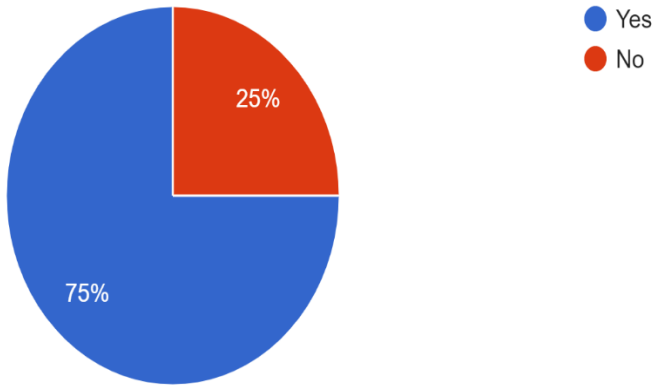

How much do you know about supply chain management?

16 responses



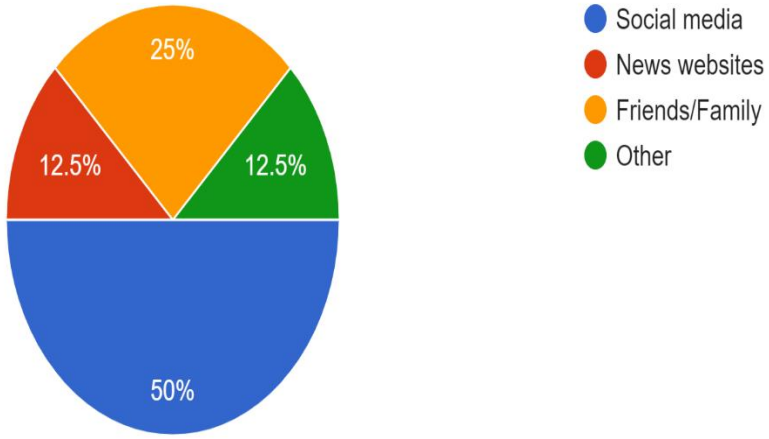
Have you heard about artificial intelligence (AI) being used in supply chain management before?

16 responses



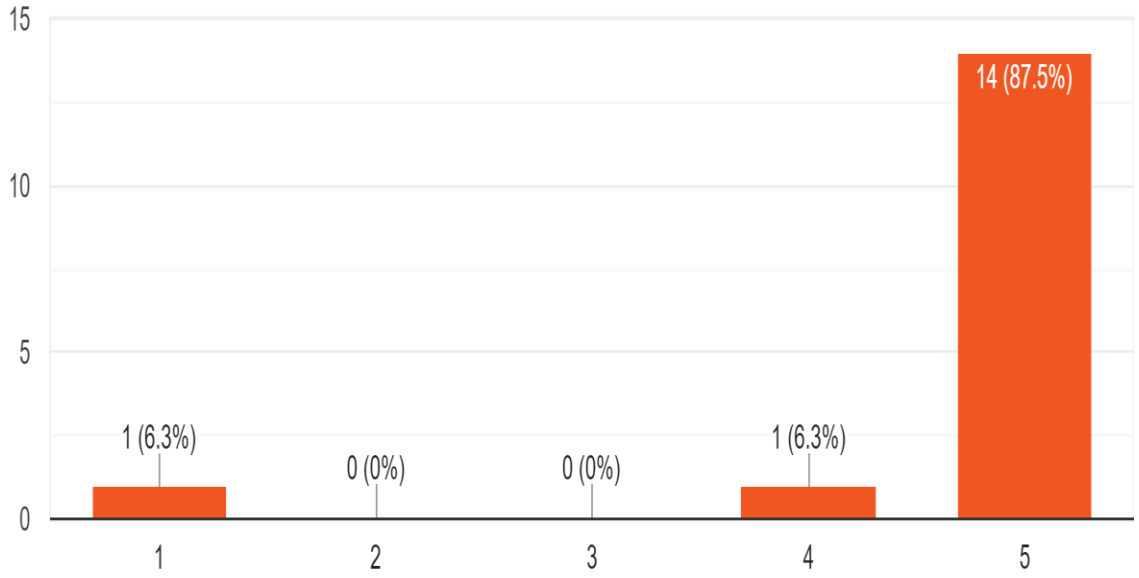

Where do you usually get information about retail and shopping?

16 responses



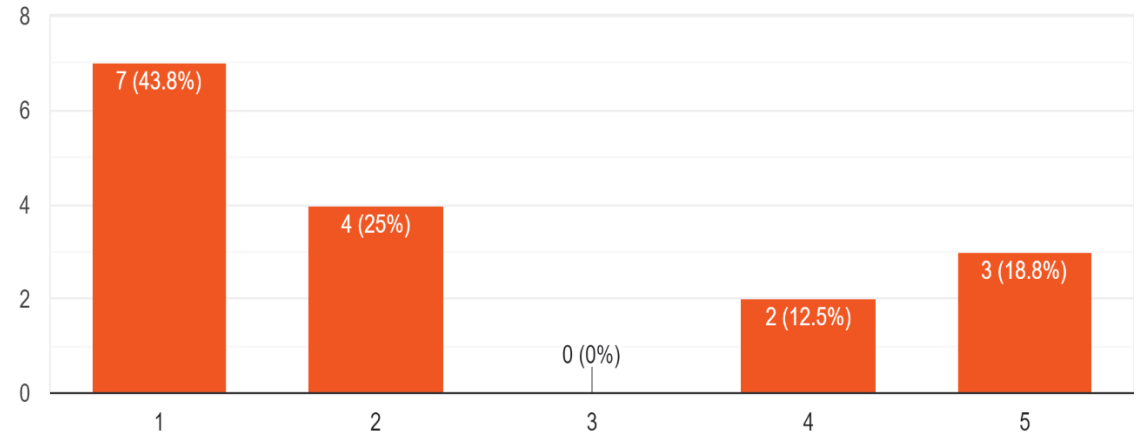
How important do you think it is for stores to manage their supplies efficiently?

16 responses



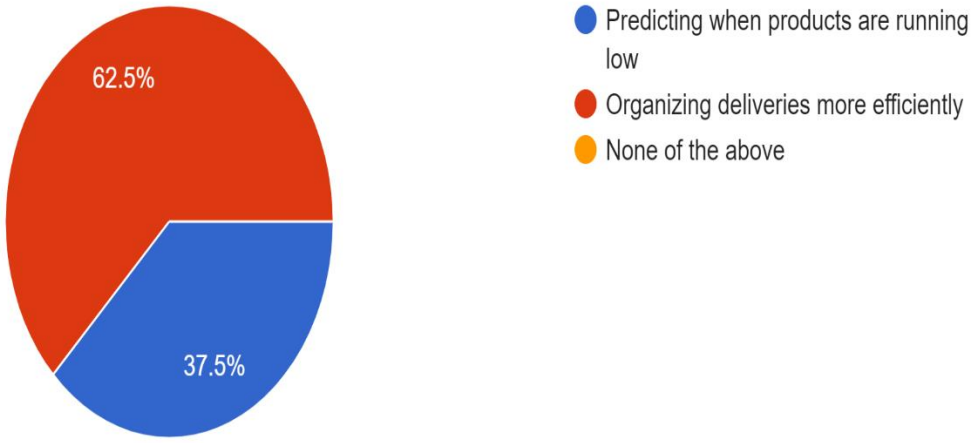

Do you think AI could help stores manage their supplies better?

16 responses



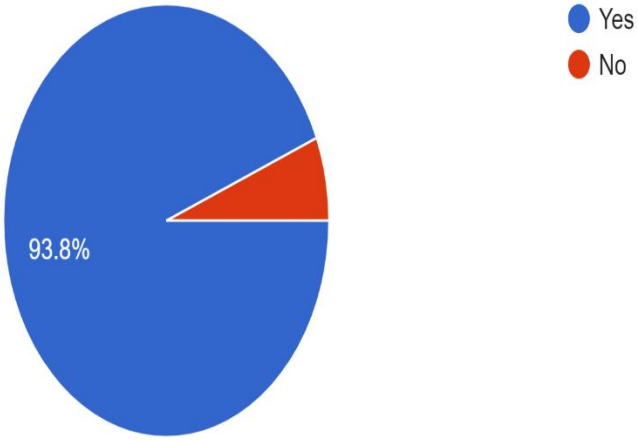
What do you think AI could help with in a store's supply management?

16 responses



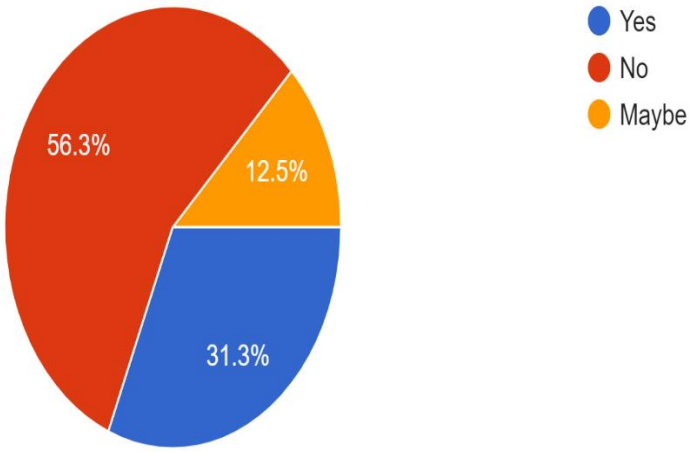

Have you ever faced any issues in a store where they were out of stock of a product you wanted?

16 responses



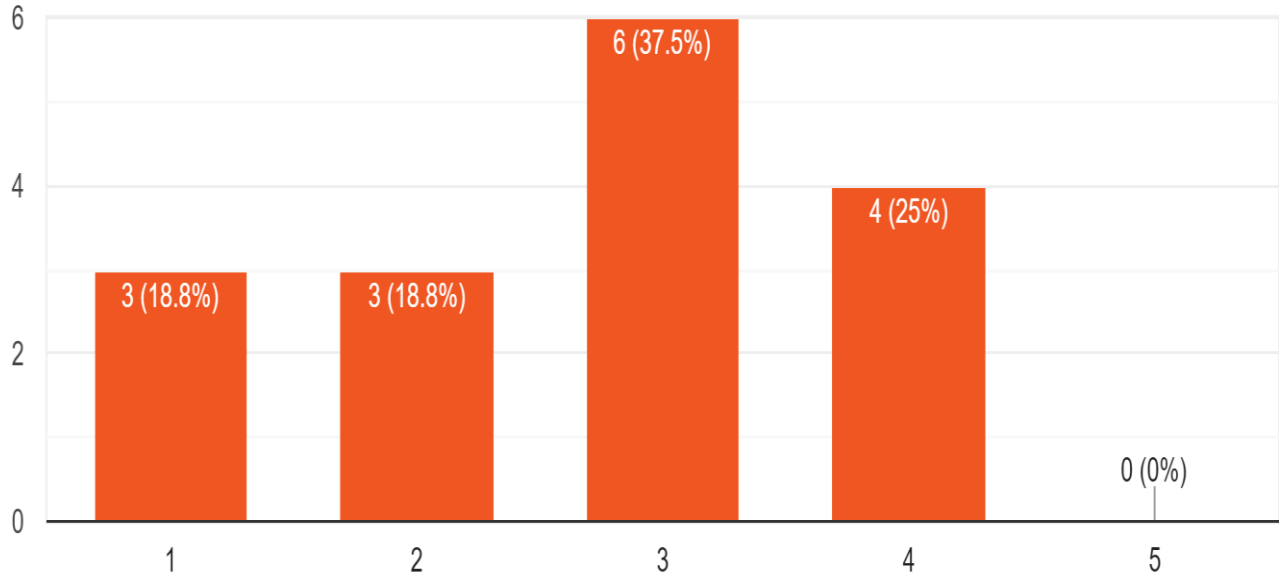
Have you ever heard of graph theory before?

16 responses



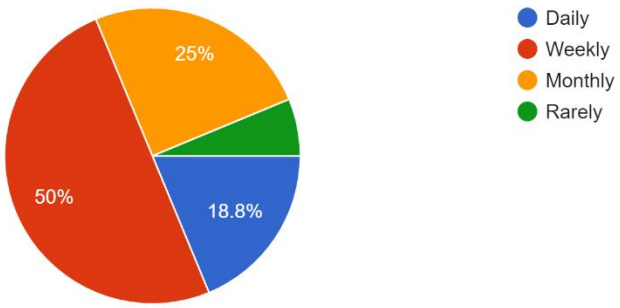

Do you think graph theory could be useful in managing a store's supplies?

16 responses



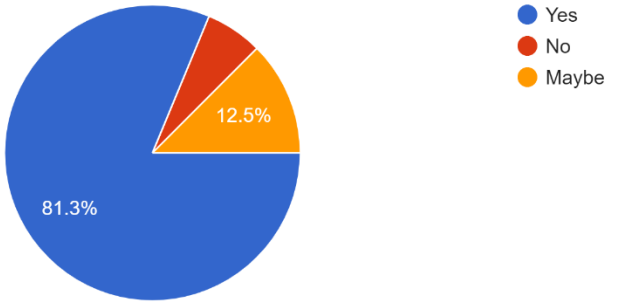
How often do you shop at a retail store?

16 responses



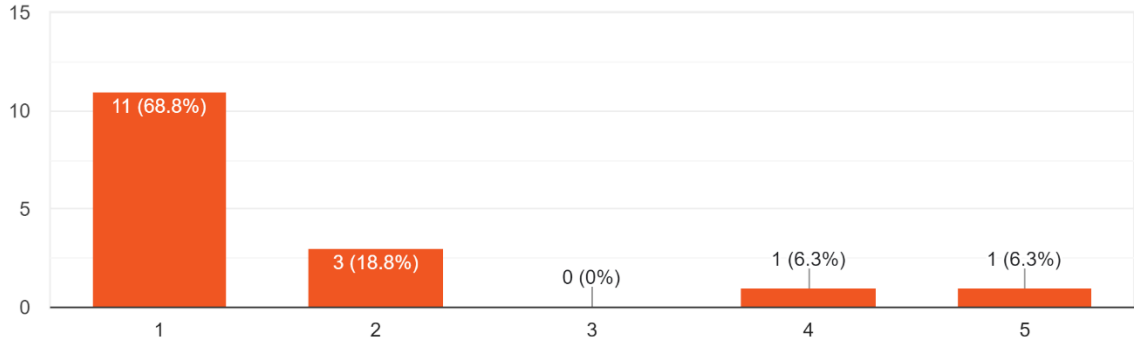

Have you ever noticed products being out of stock at the stores you shop at?

16 responses



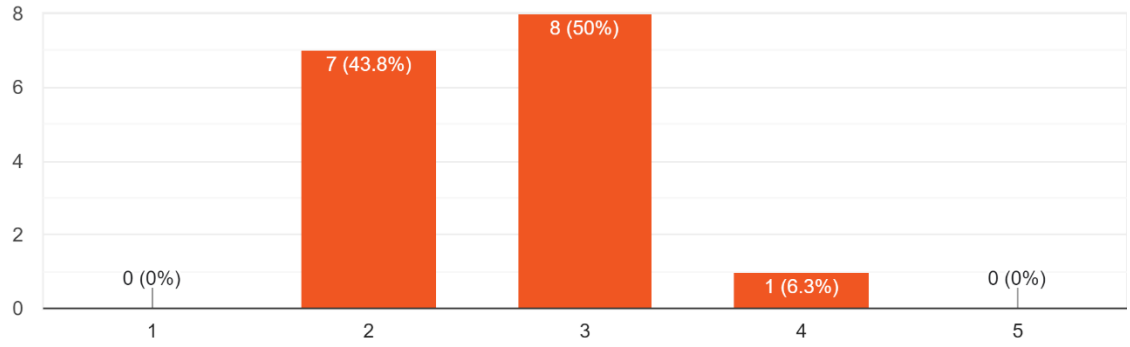

Do you think it's important for stores to have products in stock when you want to buy them?

16 responses



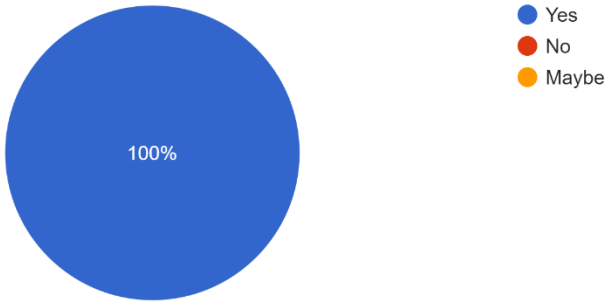
How satisfied are you with the availability of products at the stores you shop at?

16 responses



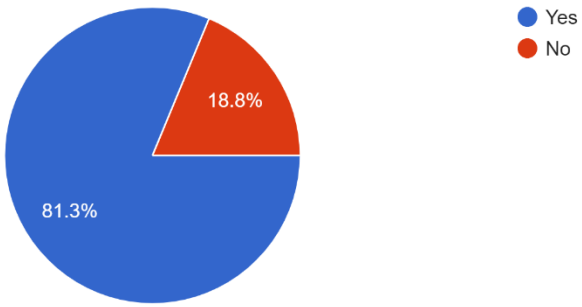

Do you think stores could use technology to predict when they need to restock products?

16 responses



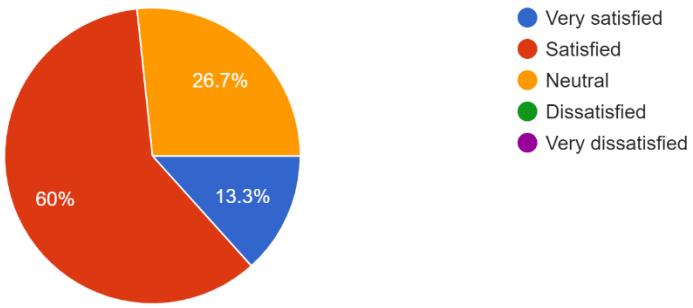

Have you ever used a mobile app or website to shop from a retail store?

16 responses



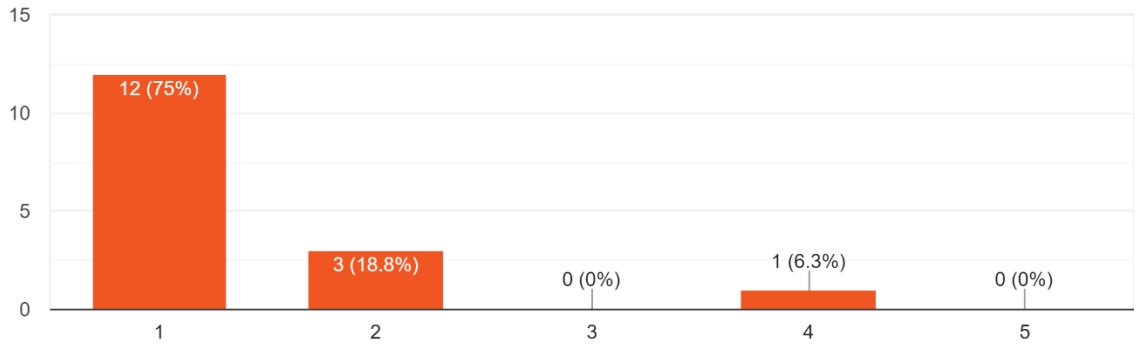
How satisfied are you with the ease of finding and purchasing products online from retail stores?

15 responses



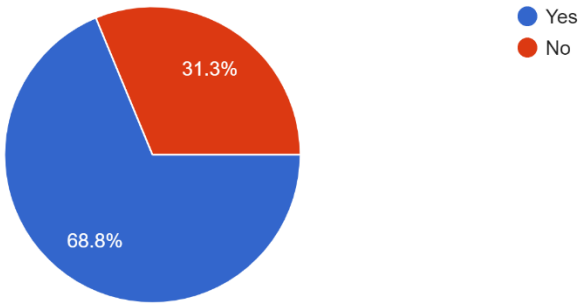

Do you think it's important for stores to use technology to make sure they have products available for customers

16 responses



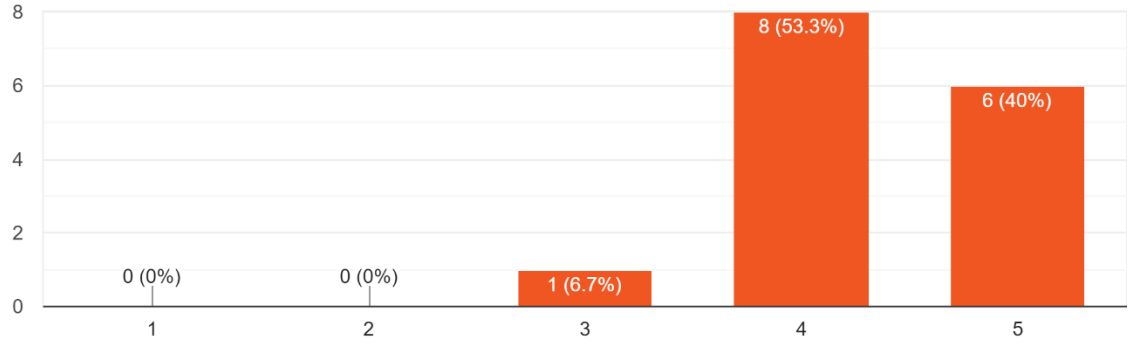

Have you ever experienced a situation where a store told you they didn't have a product in stock, but you later found out they did?

16 responses



How likely are you to continue shopping at a store if they frequently run out of products you want to buy?

15 responses



References –


1. Agrawal, S., Singh, R.K., Murtaza, Q., 2016. Outsourcing decisions in reverse logistics: sustainable balanced scorecard and graph theoretic approach. Resour. Conserv. Recycl 108, 41e53.
2. Agrawal, S., Singh, R.K., Murtaza, Q., 2015. A literature review and perspectives in reverse logistics. Resour. Conserv. Recycl 97, 76e92.
3. Agrawal, S., Singh, R.K., Murtaza, Q., 2014. Forecasting product returns for recycling in Indian electronics industry. J. Adv. Manag. Res. 11 (1), 102e114.
4. Abraham, N., 2011. The apparel aftermarket in India - a case study focusing on reverse logistics. J. Fash. Mark. Manag. 5 (2), 211e227.
5. Alumur, S.A., Nickel, S., Saldanha-da-Gama, F., Verter, V., 2012. Multi-period reverse logistics network design. Eur. J. Oper. Res. 220 (1), 67e78.
6. Amini, M.M., Retzlaff-Roberts, D., Bienstock, C.C., 2005. Designing a reverse logistics operation for short cycle time repair services. Int. J. Prod. Econ. 96 (3), 367e380.
7. Andrew, M.K., Burges, S., Ijomah, W., McMahon, C., 2006. Reducing waste: repair, recondition, remanufacture or Recycle? Sustain. Dev. 14 (4), 257e267.
8. Aras, N., Boyaci, T., Verter, V., 2004. The effect of categorizing returned products in remanufacturing. IIE Trans. 36 (4), 319e331.
9. Ardeshirilajimi, A., Azadivar, F., 2015. Reverse supply chain plan for remanufacturing commercial returns. Int. J. Adv. Manuf. Tech. 77 (9e12), 1767e1779.
10. Atasu, A., Guide Jr., V.D.R., Van Wassenhove, L.N., 2010. So what if remanufacturing cannibalizes my new product sales? Calif. Manag. Rev. 52 (2), 1e21.
11. Attia, A., 2015. The impact of returned product disposition strategies on organizational performance applied to the Egyptian household appliance industry. Int. J. Bus. Manag. 10 (9), 143.
12. Barsky, N.P., Ellinger, A.E., 2001. Unleashing the value in the supply chain. Strat. Fin. 82 (7), 32e37.
13. Bell, O.E., Mollenkopf, D.A., Stolze, H.J., 2013. Natural resource scarcity and the closed-loop supply chain: a resource-advantage view. Int. J. Phys. Distrib. Logist. Manag. 43 (5/6), 351e379.
14. Blackburn, J.D., Guide Jr., V.D.R., Souza, G.C., Wassenhove, L.N.W., 2004. Reverse supply chains for commercial returns. Calif. Manag. Rev. 46 (2), 6e22.
15. Carter, C.R., Ellram, L.M., 1998. Reverse logistics: a review of the literature and framework for future investigation. J. Bus. Logist. 19 (1), 85e102.
16. Chen, W.K., 1997. Digraph Theory and its Engineering Applications. University of Illinois, Chicago.
17. Chunga, C.J., Weeb, H.M., 2011. Short life-cycle deteriorating product remanufacturing in a green supply chain inventory control system. Int. J. Prod. Econ. 129 (1), 195e203.
18. Darvish, M., Yasaei, M., Saeedi, A., 2009. Application of the graph theory and matrix methods to contractor ranking. Int. J. Proj. Manag. 27 (6), 610e619.
19. De Brito, M.P., Dekker, R., 2002. Reverse Logistics: a Framework. Econometric Institute Report EI, 2002-38.
20. Defee, C.C., Esper, T., Mollenkopf, D., 2009. Leveraging closed-loop orientation and leadership for environmental sustainability. Supply Chain Manag. 14 (2), 87e98.
21. Dehghanbaghi, M., Hosseininasab, H., Sadeghieh, A., 2016. A hybrid approach to support recovery strategies (A case study). J. Clean. Prod. 113, 717e729.

22. Dowlatshahi, S., 2005. A strategic framework for the design and implementation of remanufacturing operations in reverse logistics. Int. J. Prod. Res. 43 (16), 3455e3480.
23. Faisal, M.N., 2012. Sustainability metrics for a supply chain: the case of small and medium enterprises. Int. J. Serv. Oper. Manag. 13 (3), 392e414.
24. Ferrer, G., Whybark, D.C., 2000. From garbage to goods: successful remanufacturing systems and skills. Bus. Horizons 43 (6), 55e64.
25. Fleischmann, M., Krikke, H.R., Dekker, R., Flapper, S.D.P., 2000. A characterization of logistics networks for product recovery. Omega 28 (6), 653e666.
26. Fleischmann, M., Van Wassenhove, L.N., Van Nunen, J.A.E.E., van der Laan, E.A., Dekker, R., Bloemhof-Ruwaard, J.M., 1997. Quantitative models for reverse logistics: a review. Eur. J. Oper. Res. s103 (1), 1e17.
27. Forbert, H., Marx, D., 2003. Calculation of the permanent of a sparse positive matrix. Comp. Phys. Comm. 150 (3), 267e273.
28. Franke, C., Basdere, B., Ciupek, M., Seliger, S., 2006. Remanufacturing of mobile phones-capacity, program and facility adaptation planning. Omega 34 (6), 562e570.
29. Geyer, R., Van Wassenhove, L.N., Atalay, A., 2007. The economics of remanufacturing under limited component durability and finite product life cycles. Manag. Sci. 53 (1), 88e100.
30. Geyer, R., Blass, V.D., 2010. The economies of cell phone reuse and recycling. Int. J. Adv. Manuf. Tech. 47, 515e525.
31. Gehin, A., Zwolinski, P., Brissaud, D., 2008. A tool to implement sustainable end-of life strategies in the product development phase. J. Clean. Prod. 16 (5), 566e576.
32. Gobbi, C., 2011. Designing the Reverse Supply Chain: the impact of the product residual value. Int. J. Phys. Distrib. Logist. Manag. 41 (8), 768e796.
33. Govindan, K., Popiuc, M.N., 2014. Reverse supply chain coordination by revenue sharing contract: a case for the personal computers industry. Eur. J. Oper. Res. 233 (2), 326e336.

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