A COMPARATIVE ANALYSIS BETWEEN SMART WAREHOUSING AND TRADITIONAL WAREHOUSING

Submitted for the partial fulfilment of the requirement for the degree of

MASTER OF BUSINESS ADMINISTRATION

in

International Transportation and Logistics Management

Submitted By

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Under the Guidance of

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DECLARATION

I, Anchita Moni hereby declare that the project work entitled "**A comparative analysis between smart warehousing and traditional warehousing**" submitted to the department of M.B.A (International Transportation and logistics management) of **Miss Riya Ghosh, (Faculty**) in partial fulfilment of the requirement for the award of the M.B.A (International Transportation and logistics management) in school of maritime management at Indian Maritime University Kolkata campus, Kolkata. It is a record of original project work done by me during the period of study (2022-23).

Name of the student

Anchita Moni (MBA)

CERTIFICATE OF GUIDE

I have the pleasure in certifying that Miss Anchita Moni is a student of INDIAN MARITIME UNIVERSITY (KOLKATA) doing her Master ‘s in Business Administration (MBA). Her University Roll No is. 2101305003. She has completed her Research work Title as " **A comparative analysis between smart warehousing and traditional warehousing** " under my guidance. I certify that, this paper is her original effort & has not been copied from any other source. This project has also not been submitted in any other university for the purpose of award of any Degree. This project fulfils the requirement of the curriculum prescribed by INDIAN MARITIME UNIVERSITY (KOLKATA), for the said course. I recommend this project work for evaluation & consideration for the award of Degree to the student.

Signature

Name of the guide:

Miss Riya Ghosh

ACKNOWLEDGEMENT

In the accomplishment of this project successfully, many people have bestowed upon me their blessings and the heart pledged support, this time I am utilizing to thank all the people who have been concerned with this project. It is great pleasure for me to undertake this project. I feel highly doing the project entitled- " Better efficiency of smart warehousing in compare to traditional warehousing". I am grateful to my project guide Miss Riya Ghosh. This project would not have completed without his enormous help and worthy experience. I wish to record my sincere thanks to all my batchmates for their help and cooperation throughout my project.

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ANCHITA MONI

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EXECUTIVE SUMMARY

Warehousing is regarded as the most important component of supply chain management because to its commitment and capacity to establish seamless and effective logistic operations. While logistic costs are regarded as an essential component of the overall production costs, organisations and such operations are crucial in defining a company& competitiveness. Numerous businesses are thinking about how to operate their warehouses cost-effectively and efficiently, especially in light of recent advancements in supply chain and logistics technology. Warehousing is the act of taking on the duty of storing finished items, raw materials, work in progress, and spare components. The concept of warehousing is the process of arranging and managing everything in the warehouse to make sure everything functions as efficiently as possible.

In addition, maintaining the proper items, managing new stock entering the facility, packaging and shipping orders, tracking and improving overall storage, and arranging for dispatching finished goods to end customers are the key actions and responsibilities of having a warehouse. Hence, warehousing is essential to ensuring that the desired goods are kept until they are delivered to clients, which is what any organisation wants most of all. Moreover, the changes in operations and processes of warehouses should cover every activity in warehousing which includes Receiving, Storage, Replenish, pick upon, shipping, cross dock, and value-added logistics.

The warehouse is built to fit into a space where the amount of accessible surface area is limited and to meet all needs for daily operations in the warehouse. The most crucial elements of the warehouse& layout are constructed to meet the following requirements: Loading and unloading zones, a reception area for new receipts, a storage zone for items, a picking zone for assembly, and a delivery dispatch zone. The warehouse was constructed by the business to maximise efficiency and space utilisation. By making the most of the space that is available, minimising the handling of goods, facilitating simple access to the stored goods, and achieving the highest rotation ratio are all desirable. Docks, picking storage, and racking systems for storing goods are some of the features used in the plan to facilitate the smooth inbound and outflow of supplies. In addition, there is the given the size of the warehouse, the building& ability to accommodate the number of pallets that can be arranged on the racking system there. The warehouse has open storage spaces and three docks for loading and unloading cargo. The operators collect or transport the necessary commodities from/to their storage area as the delivery or pickup trucks and RMs arrive at one of the loadings /unloading ports. The inspector & responsibility is to examine all incoming and outgoing merchandise for quality,

quantity, packing, and invoicing. On the other hand, the Inventory Encoder & responsibility is to update inventories into the system in both cases—in and out. Also,

forklift operators are knowledgeable about how to control the handling procedure and where to store the items, which are typically located closer to the docks. The warehouse

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Here I have done various researches including major functions of the warehouses and how did the transformation take place from manual to smart warehousing. Efficiency of smart warehouses and how it has a huge impact on the industry.

Primary research consists of the followings: a basic idea about smart warehouse, discriminatory factors between smart and manual warehouse, the main reasons for transformation from manual to smart warehouse and the main factors impacting the efficiency of smart warehouse.

CHAPTER 1

INTRODUCTION

India has been one of the fastest-growing economies in the world in recent years, with a high GDP growth rate. The country's GDP (Gross Domestic Product) growth rate has been consistently high over the last few decades, with an average annual growth rate of around 7% over the last ten years. The GDP also depends on the total supply chain of this country. Supply chain plays a major part in adding GDP of this country.

The GDP can play an important role in the total supply chain in several ways:

1.Demand for goods and services: The level of GDP can indicate the level of demand for goods and services in the economy. As GDP grows, it is likely that demand for goods and services will increase, which can lead to an expansion in the supply chain to meet this increased demand.

2.Investment in infrastructure: A higher GDP can lead to increased investment in infrastructure, such as roads, railways, ports, and airports, which can improve the efficiency and effectiveness of the supply chain.

3.Investment in technology: Higher GDP can lead to increased investment in technology, which can help to improve supply chain efficiency and reduce costs through automation, digitalization, and other technological advancements.

4.Improved credit availability: A higher GDP can lead to improved credit availability for businesses, which can help to finance the expansion of the supply chain.

In the total supply chain management, from procuring raw materials till the end user we need to store these materials securely to some place in this whole process of supply chain management so here comes the use of warehouses where goods can be kept safely and securely. A warehouse is a structure used to store commodities. Manufacturers, importers, exporters, wholesalers, transport companies, customs, etc. all use warehouses. In industrial parks on the outskirts of cities, towns, or villages, they are typically big, basic buildings.

Typically, warehouses feature docks where trucks may load and unload cargo. Occasionally, warehouses are built so that cargo can be loaded and unloaded directly from planes, trains, or ships. For transporting items, which are often loaded into pallet racks and placed on ISO standard pallets, they frequently include cranes and forklifts. Any raw materials, packing supplies, spare parts, pieces, or finished products connected to manufacturing, agriculture, or production might be classified as stored goods. A warehouse may be referred to as a "go down" in India and Hong Kong.

Warehouse planning is crucial to a smooth daily movement across the supply chain based.

A warehouse, particularly a large warehouse may be considered to be an admission that a Company is failing to manage its supply chain because it needs to hold stock of raw materials or finished goods and therefore needs a Warehouse to hold it in. There are of course good reasons for having Warehouses.

Some of the recent industry news are given below:

- Welspun one logistics Parks (WOLP) is planning to raise its second fund of Rs 2000 crore including a green shoe option of Rs 1000 crore. This is the largest alternative investment fund (AIF) being raised for the warehousing and logistics sector in india. The first fund has delivered robust performance with a track record of 100 % commitment across a portfoliuo of 6 investments, aggregating to around 6.5 million sq ft within nearly 1.
- Snowman Logistics takes 50000sq. ft warehousing space at Hosur industrial park. SLL has one of the widest temperature-controlled warehouse networks in India spread across 41 facilities in 19 cities. its network of 130202 pallets capacity a fleet size of over 400 helps reach over 500 cities across the country.
- Bobba Group forays into warehousing with 75000 sq.0 ft facility in Bengaluru. Bobba logistics warehouse near the city centre will help companies reduce their transportation costs and improve their delivery time. The managing director said that the warehouse also houses a cold zone with 452 pallet capacity, eight docking stations and a remote monitoring system. It has a complete provision to manage end to end supply chain needs including newer strategies like micro fulfilment.

NEED FOR WAREHOUSING

Nowadays, storage is regarded as one of the most crucial aspects of commerce. Certain goods are only manufactured during a specific season. Storage is necessary to guarantee their availability during the off-season. Although some products are manufactured year-round, their demand varies according on the season. In situations like this, warehousing is crucial.

Warehouses are an inescapable component for businesses that choose to produce on a large scale and supply in enormous quantities. Companies that use warehousing can guarantee a prompt supply of popular products. For businesses to continue producing commodities, the manufacturing of items and their movement are crucial. Storage is essential for maintaining prices. The government keeps necessary items in warehouses

and manages market supply in accordance with price changes. For bulk breaking, warehousing is essential. A trade agent importing products comes to mind.

TYPES OF WAREHOUSES

- **Private Warehouse-** Private warehouses are just that private. They are privately owned, usually by big retailers to store their extra inventory in bulk, especially during busy seasons. Private warehousing requires big investments from the owner. But they most likely prove to be very cost-effective in the long run.

- **Government Warehouse-** The government warehouses are owned, managed and governed by Central or State government. They are therefore also considered a form of public warehouses owned by government. Government warehouses provide better security and safety of goods as there is direct involvement of government.

- **Public Warehouse-** A public warehouse is a large warehouse that allows businesses to rent space to store and fulfil their products. Space is usually rented according to the amount of square footage occupied by the product, and fulfilment services are provided for an additional fee by the warehouse.

- **Smart warehouse-** A smart warehouse uses automation systems and interconnected technologies to receive products, put them away, pick them for orders, ship them, and keep an accurate inventory count. Smart warehouses use technology to increase production, decrease errors, and minimize the number of humans needed to run the warehouse.

- **Cold storage-** It is a temperature-controlled warehouse where it stores temperature sensitive items at low temperatures. Cold storage warehouses allow medicine, perishable foods, plants, cosmetics, artwork, and candles to have longer lives. Cold storage warehouses also use refrigerated shipping for inbound and outbound shipping.

- **Bonded warehouse-** Bonded warehouses can also be called as customs warehouses. a bonded warehouse is a building in which imported goods may be stored, manipulated, or undergo manufacturing operations without payment of duty for five years from date of acceptance. The duty on imported goods can be very high so the bonded warehouse allows the products to be sold first, and then duty is paid from the proceeds of the sale.

MAJOR FUNCTIONS OF A WAREHOUSE

- **Storage of goods**- Goods can be stored in this warehouse safely and securely. Warehousing is the act of taking on the duty of storing finished items, raw materials, work in progress, and spare components. The concept of warehousing is the process of arranging and managing everything in the warehouse to make sure everything functions as efficiently as possible. In addition, maintaining the proper items, managing new stock entering the facility, packaging and shipping orders, tracking and improving overall storage, and arranging for dispatching finished goods to end customers are the key actions and responsibilities of having a warehouse. Hence, warehousing is essential to ensuring that the desired goods are kept until they are delivered to clients, which is what any organisation wants most of all.

- **Protection of goods**- Goods can be protected in a warehouse against loss, theft, or weather-related damage such heat, wind, dust, and moisture. A warehouse can set up specific configurations for various products in accordance with their characteristics. For instance, it can arrange for cold storage for perishable items, utilise pesticides for preservation, and build fire-fighting equipment to prevent any fire incidents. If all of these cases are considered prudently and addressed carefully, a warehouse can significantly cut down losses due to spoilage of goods and wastage during storage.

- **Financing-** Financing is another one of the diverse functions of a warehouse. A manufacturer, business, or processor receives a loan from a financial institution as part of warehouse finance, a sort of inventory financing. Commodities, inventory, or other goods are deposited in a warehouse and utilised as collateral for the loan in this situation. A receipt that serves as proof of the deposit of goods is given to the depositor when the products are moved to any warehouse. The warehouse may also issue a document known as a "Warehouse-keeper's warrant" that certifies ownership of the goods in the warehouse's favour.

  This is a document of title and can be passed on by simple endorsement and delivery. So, while the goods are in the custody of the warehouse-keeper, the owner can procure loans from banks and other financial institutions, pledging this warrant as security.

- **Processing** - It refers to the process that certain goods go through to make them consumable. For example, seasoning of timber, ripening of fruits, processing of coffee beans, polishing of paddy, etc. Sometimes warehouses perform such activities on behalf of the owners.
- **Grading and branding**- Warehouses also undertake the functions of grading and branding goods on behalf of the wholesaler, importer or manufacturer of goods.

They also offer services for mixing, blending and co-packing or repacking service. Here goods can be segregated and graded according to their standards and their brands.

- **Transportation**- It refers to the movement of goods which consists of inbound activity, outbound activity and transfer to storage.
  Inbound activity– It means unloading of goods received by the warehouse.
  Transfer to storage– It refers to transferring the goods from the inbound area to the storage area.
- **Order selecting**– It means choosing the item in the storage corresponding to the order to be shipped and moving it to the shipment area.
- **Outbound activity**– Lastly, we have 'outbound activity', which means inspecting and loading the goods for shipment. The movement of goods inside a warehouse must be as seamless as possible to ensure uninterrupted orders. Hence, the infrastructure of the warehouse, as well as the software systems used by it, should be upgraded regularly.

TRANSFORMATION FROM MANUAL TO SMART WAREHOUSING

The deployment of cutting-edge technologies to automate and improve warehouse operations is necessary to make the transition from manual to smart warehousing. Warehouses may benefit from this change in terms of increased accuracy, cost savings, and efficiency. Below are the steps involved in this transformation:

- **Analyse the present situation**: The first step is to evaluate the warehouse's current situation and pinpoint any areas that could use some automation. This includes assessing the existing procedures, inventory management, and resource use.
- **Create a technology strategy:** Based on the assessment, a plan outlining the technological solutions required to automate and optimise the warehouse should be created. This might involve robotics, IoT sensors, automated storage and retrieval systems, warehouse management systems, and other technologies.
- **Implement technology solutions:** Following the creation of the technology plan, the next stage is to put the selected technology solutions into practise. This comprises connecting the technology with the existing warehouse management systems, training personnel on how to utilise the technology, and ensuring that the equipment is properly maintained.
- After implementing technology solutions, it is crucial to analyse their effectiveness and make any necessary adjustments. Making improvements to increase efficiency entails assessing data on inventory levels, order processing times, and resource utilisation.

- The conversion to a smart warehouse is a process that is always being improved. It's crucial to continually assess the technology solutions in use and find new ways to make them better.
- Thus, to attain maximum efficiency and effectiveness, the transition from manual to smart warehousing necessitates careful planning, investment in technology, and continuing optimization.

One of the most common issues that business analysts face is the lack of access to reliable and timely information about business processes. This information is vital for decision-making yet it is blocked or hindered due to many challenges of a traditional warehouse. The classic data warehouse uses ETL (Extract, Transform, Load) to move data from source to destination. It is made up of on-premise IT resources, often servers and system software. However, a classic data warehouse is frequently regarded as being inappropriate for fulfilling modern data requirements due to its rigid structure and complex architecture. On the other hand, cloud data warehouses are a lot faster, consist of unified data sources, and more efficient due to the use of optimized data clusters. Some of the shortfalls of the traditional warehouses are higher costs and it is not rigid and has inflexible architecture. It is more complex and technologies are outdated. So, to ensure faster delivery and to increase the efficiency smart warehouses have been introduced to meet these challenges of the traditional warehouses.

Smart warehouses, on the other hand, integrate automation technologies like robotics, AI, and IoT sensors to enhance inventory management, expedite operations, and increase supply chain visibility. As a result, orders may be filled more quickly and accurately, inventory can be better controlled, and labour expenses can be decreased.

The need to boost productivity and efficiency while cutting costs is the fundamental driver behind the switch from manual to smart warehouses. Manual warehouses can't handle big amounts of goods and can be labour-intensive, which results in longer order processing times and more mistakes.

Smart warehouses, on the other hand, integrate automation technologies like robotics, AI, and IoT sensors to enhance inventory management, expedite operations, and increase supply chain visibility. As a result, orders may be filled more quickly and accurately, inventory can be better controlled, and labour expenses can be decreased.
Further advantages of smart warehouses include increased security, better space management, and the capacity to handle more complex processes. They are a desirable alternative for businesses looking to because of these benefits.

CONCEPT OF SMART WAREHOUSING

A "smart warehouse" is a sizable structure used for storing manufactured items and raw materials that automates routine warehouse tasks that were previously done by workers. These tasks include recognising and accepting orders, counting goods, keeping track of goods in storage and recalling their whereabouts later, and transmitting orders to the appropriate location. The most efficient smart warehouses virtually automate every step of the process and route that items take from supplier to client, with very few errors. Smart warehouses adopt a similar data-driven atmosphere and are influenced by smart factories. In order to establish a technical environment where items and requests can be collected, sorted, organised, recognised, and prepared for transportation automatically, they integrate a variety of automated and networked technologies. This collaboration of technologies allows warehouse workers to increase the productivity, quality and efficiency of their facility while decreasing the number of errors that occur and minimizing the number of human workers needed. The retail industry has been undergoing a digital transformation coupled with customers' expectations of shorter lead times that is to deliver on the same day to meet the high rising demand of the customers. High product availability, flexibility when and where to shop, and varying delivery and return options and home delivery. To meet these demands, the logistics network, particularly the warehouse, has been highlighted as a critical component. The warehouse, previously viewed as a "necessary evil" in the supply chain, now plays a key role in fulfilling customer orders and significantly influences both logistics costs and service levels. The efficiency and effectiveness in any distribution network. To improve warehouse operations, large investments in automated material-handling technology. With increased competition and more mature and varied technologies, the automation trend also has spread among retailers and logistics service providers worldwide. To improve warehouse operations further, retailers couple automated material handling with digitalization and connectivity of information platforms. This combination of technologies sometimes is termed smart warehousing. It is used in tech blogs, industry reports, conference proceedings, and scientific journal papers. To improve warehouse operations' efficacy and efficiency, several configuration aspects are considered, including physical layout like placement of docks, aisle configuration, and lane depth and storage and handling equipment like racks and forklifts for put-away and picking. Important resources also include labour management like scheduling, rotation, and shifts. Warehouse management systems [WMS] and warehouse-control systems, and automation technologies, like conveyors and robots. These configurations' goal is to improve utilization of resources and capacities like labour, space, and equipment, increase throughput, reduce material-handling time, and increase operations and design flexibility.

Here are some of the top companies with the most innovative warehouse systems. Some of them are Amazon, Ikea, Tesla, DHL, Coca Cola etc.

EFFICIENCY OF SMART WAREHOUSE

How well a smart warehouse may use its resources to achieve its operational objectives is referred to as efficiency. A smart warehouse optimises its processes and reduces manual intervention by using cutting-edge technology including automated systems, Internet of Things (IoT) gadgets, artificial intelligence (AI), and machine learning (ML).

Efficiency can be assessed using several metrics, including:

- **Inventory accuracy:** This gauge how effectively the warehouse manages its stock. A smart warehouse automates this procedure and maintains a high level of accuracy using technology like RFID tags and barcode scanners.
- **Order fulfilment speed** evaluates the efficiency with which the warehouse can handle and complete customer orders. Automation can help a smart warehouse expedite picking and packaging tasks and shorten the time it takes to ship orders.
- **Utilization of resources:** This gauge how effectively the warehouse uses its equipment, space, and labour resources. The layout of a smart warehouse may be optimised, predictive maintenance can be used to minimise downtime, and machine learning algorithms can be used to plan personnel and equipment.
- **Error rates** are a measure of how frequently mistakes like wrong shipments or damaged items happen in the warehouse. Automation and AI can be used in a smart warehouse to increase quality control and lower error rates. Essentially, a smart warehouse's effectiveness depends on how well it can use technology to streamline its operations and make the most of its resources.


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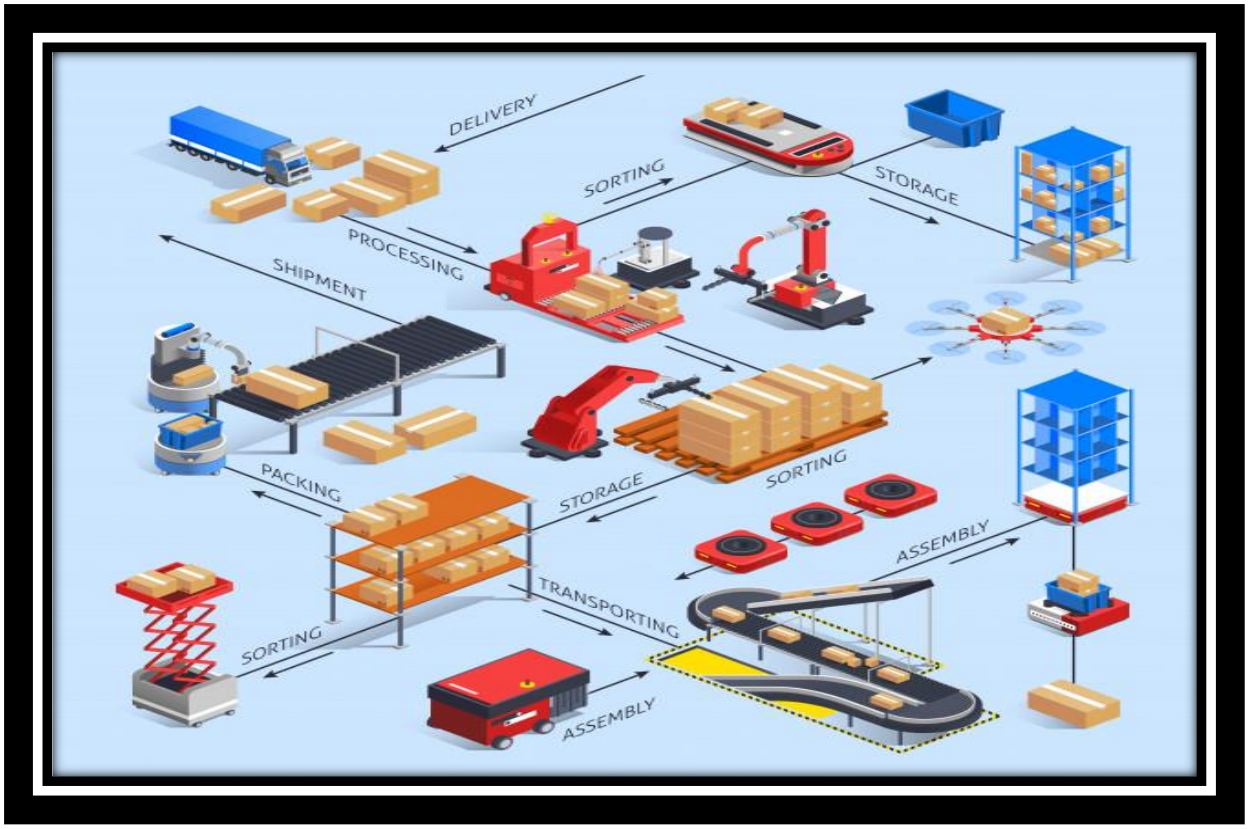
Logistics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BACKGROUND OF THE STUDY

Smart warehousing is the process of optimising and automating warehouse operations via the use of cutting-edge technology like the Internet of Things (IoT), robotics, artificial intelligence (AI), and cloud computing. As a result, orders may be filled more quickly, inventory can be tracked and managed more effectively, and overall efficiency is boosted.

The need for quicker and more effective supply chain management led to the development of the idea of smart warehousing. Traditional warehousing techniques were no longer able to keep up with the expansion of e-commerce and the rise in consumer expectations for quick delivery.

Companies started employing new technology and procedures to streamline their warehouse operations in order to address these issues. This includes the use of robotics and AI to automate processes like picking and packing, as well as the use of sensors and other IoT devices to monitor inventory levels and track products across the supply chain.

Smart warehouses are able to handle orders more quickly and precisely, lower the possibility of mistakes and delays, and increase overall productivity by utilising these cutting-edge technologies. Flexibility has become increasingly vital in today's fast-paced and competitive business environment, as organisations need to be able to adapt quickly and respond to changing market needs in order to stay competitive.

Smart warehousing has had a tremendous impact on the industry, revolutionising the way warehouses work and enhancing supply chain efficiency in a number of ways.

Some of the significant impacts of smart warehousing include:

Enhanced Efficiency: Robotics, automated material handling, real-time tracking, and inventory management are some examples of smart warehousing technologies that have significantly improved the speed and accuracy of warehouse operations. This has decreased the time needed to complete orders and increased overall productivity.

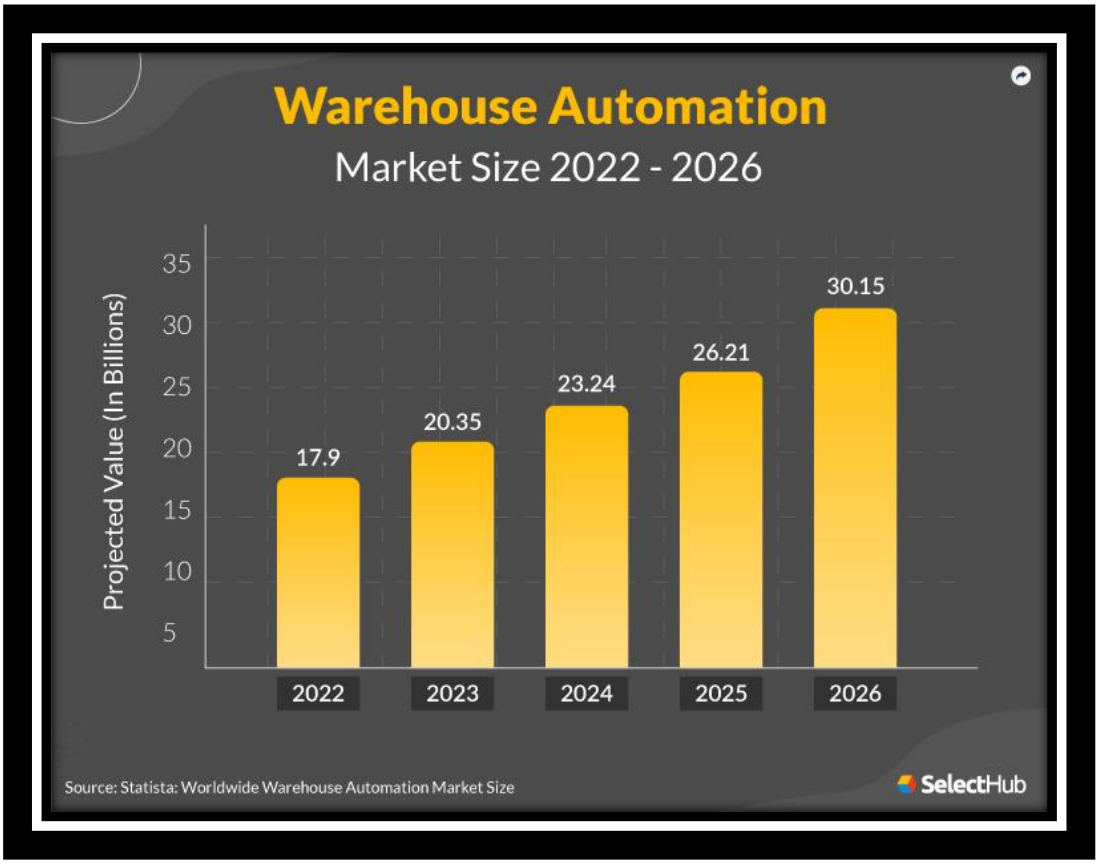
Cost Savings: Smart warehousing has decreased labour expenses and increased efficiency, which has led to cost savings for organisations by automating processes that were previously carried out manually.

Greater Customer Satisfaction: Smart warehousing has assisted businesses in exceeding customers' expectations for prompt delivery by reducing order processing and delivery times.

Improved Safety and Security: Smart warehousing technology such as sensors and cameras have enhanced safety and security in warehouses by monitoring equipment and products, recognising possible risks, and detecting theft and other security breaches.

Increased Visibility and Control: Smart warehousing systems that use real-time data and analytics give businesses greater insight and control over their supply chains, empowering them to make strategic decisions and improve operations.

Overall, smart warehousing has transformed the sector, allowing firms to increase productivity, cut expenses, boost security and safety, and improve customer experience. As a result, it has emerged as a crucial tactic for companies trying to maintain their competitiveness in today's quick-paced and constantly evolving business environment. Therefore, there is a massive requirement to understand and explore more about smart warehousing and it was found during literature review that not too many studies have been conducted in this particular field.



CHAPTER 2

LITERATURE REVIEW

Kamali Ali (2020) said that warehousing is regarded as the most important component of supply chain management because to its commitment and capacity to establish seamless and effective logistic operations. While logistic costs are regarded as an essential component of the overall production costs, organisations and such operations are crucial in defining a company's competitiveness. Numerous businesses are thinking about how to operate their warehouses cost-effectively and efficiently, especially in light of recent advancements in supply chain and logistics technology. According to the public and academic literature, warehouse management is a crucial component of the supply chain that has received increased attention. Regarding warehousing and inventory optimization in India, the logistics industries in India are spending 13% of GDP on the development of the logistics framework as of 2018. The concept of warehousing is the process of arranging and managing everything in the warehouse to make sure everything functions as efficiently as possible. In addition, maintaining the proper items, managing new stock entering the facility, packaging and shipping orders, tracking and improving overall storage, and arranging for dispatching finished goods to end customers are the key actions and responsibilities of having a warehouse. Hence, warehousing is essential to ensuring that the desired goods are kept until they are delivered to clients, which is what any organisation wants most of all.

Hasan Zafar (2018) said that the basic characteristics of smart warehouses can be classified into the following perspectives: Designing intelligent warehouses at the highest-level need's information linkage. It serves as the framework for operational management and smart warehousing. according to technologies borrowed from the Information flow from developing technologies such as the Internet of Things (IoT), cyber-physical systems (CPS), and others can be exchanged, analysed, and produced by a large number of logistical nodes. The goal of process integration is to establish comprehensive planning across all warehouse processes, with a particular emphasis on the new operational issues brought on by the operation of smart warehouses. Process integration seeks to coordinate warehouse operations management while removing any inconsistencies. Environmental sustainability is the future of smart warehouses, supported by equipment automation and process integration. The sustainable development of smart warehouses concerns the problems relevant to the environment, such as energy consumption and carbon emission. The operations management of smart warehouses on strategic, tactical, and operational levels should implement in an eco-friendly way to create a sustainable roadmap in the warehouse section.

Li Haolin Lu Zhen (2021) said that Smart technologies have given rise to smart warehouses, igniting a wave of industry transformation that could bring about significant changes. According to the e-commerce boom, e-commerce warehouses are one of the most promising uses for different smart warehouses. In order to make warehouses run in a "smarter" manner, smart warehouses are a collection of smart technologies in the warehouse area and a series of operations management practises. Modern technology, warehouse procedures, and the administration of warehouse operations all now include smart warehouses. The following categories can be used to group the fundamental traits of smart warehouses: Information interconnection, Equipment automation, process integration, and Environmental sustainability.

Chinna Rajan. P et.al. (2022) said that a few studies have concentrated on how industry 4.0 will affect warehouse management by increasing overall efficiency, security, product safety standards, and lowering prices. Industry 4.0 adoption in warehouses is still a challenge. With the adoption of SLR-based research, the current study thoroughly analysed the advantages, problems, and challenges of industry 4.0 in warehouse studies on achieving SDGs and provided the variables for future research to continue growth in this field. Our SLR of 64 articles suggests that operational effectiveness, product monitoring and tracking, product safety considerations, and staff are the top factors influencing industry 4.0's advantages in warehouses. The main problems include a lack of government backing, legal challenges, a shortage of skilled labour, political issues, and outdated/traditional warehouses.

Tekinerdogan Bedir et. al. (2020) said that the detailed domain study has been used to support the architecture design, producing a domain model for expressing the family of different warehouses. A detailed list of common and alternative aspects of warehouses are covered by the domain model's feature diagram. We can characterise a variety of warehouses using the domain model, which also supports the architecture design of smart warehouses. We have also supplied a business process model that can be instantiated for various smart warehouses in addition to the domain model. We used architectural stances established by the software architecture design community when creating the reference architecture. This study aids in giving attention on the architecture of smart warehouse designs and lays the groundwork for future studies in this area.

Tiwari Saurabh (2023) said that by identifying the key terms like Industry 4.0, Artificial Intelligence, Augmented Reality, Sustainability, Internet of Things, Logistics 4.0, Smart Logistics, Big Data, Smart Manufacturing, Data Analytics, Embedded Systems, Big Data Analytics, Digital transformation, Blockchain, Innovation, Automation, Warehouse, Intelligent Manufacturing, Logistics, Decision making, Decision support systems, these provide the new and likely directions for future research. Stock keeping units (SKUs) are no longer the only thing allowed in warehouses. Current orders usually

come in tiny numbers and with few options. Modern warehouses must have quick order turnaround times, fewer operating expenses, and superior customer service. In a dynamic environment, flexibility is crucial, and cutting down on total cycle time provides smooth inbound and outbound logistics, including accurate stock, effective process management, efficient use of available space, and optimal picking. The objective is to "allocate minimal warehouse resources and promptly satisfy customer demands." For optimal order selecting, the idea of order batching is crucial.

Mumba Chileya Dora (2020) said that the research paper examined several warehousing theories, with a primary focus on both automated and traditional storage, and it offered a summary of the gaps that were all identified from the literature review. In order to have uncompromised research findings on the research issue, it is important to have a well-defined research technique.

Cereska Audrius et.al. (2022) said that warehouses have a significant role in modern society, playing an important role in logistics and the whole supply chain. The review of the literature reveals that the transition from conventional to modern warehousing takes time. IoT integration enables businesses to gain a competitive edge, enhance financial metrics, boost customer satisfaction, and enhance the calibre of services offered. Intelligent management solutions must be implemented by all warehouse businesses. The development of an IoT-based warehouse strategy results in paperless inventory, which reduces harmful environmental effects, eliminates error at work, promotes transparent functioning, a pleasant workplace, and increases productivity. The implementation of IoT (Internet of things) technologies in warehousing will depend on a number of critical elements, including the complexity of warehouse operations and the handling of large quantities of commodities. IoT has a lot to offer warehouse and logistics businesses. However, it is first necessary to look into the potential advantages and disadvantages of IoT. This study looked at whether the size of a corporation affected how IoT effects warehouse management and its costs and advantages. It is impossible to get comprehensive results without taking a company's size into account. Such knowledge gaps make it impossible to determine the true effects of IoT and its adoption.

CHAPTER 3

RESEARCH GAP

There are many reasons why someone might choose to investigate smart warehouse storage because the demand for e-commerce is growing, thus there is a greater need for warehouse operations that are optimised and can quickly complete orders and ship them to customers and with the development of robotics, automation, and the Internet of Things (IoT), warehouses may now be more intelligent and efficient than ever. By implementing smart storage solutions, businesses can lower labour costs, eliminate errors, and enhance their supply chain processes. Smart warehousing can help firms lessen their impact on the environment by consuming less energy and waste. Effective storage solutions can give firms a competitive advantage by enabling them to supply items more quickly and reliably than their competitors. After reviewing the literatures, it was found that very few researches have been conducted to understand about smart warehousing and to identify the areas which need to be focussed upon in order to improve the efficiency of the same.

OBJECTIVES OF THE STUDY

1. To develop a basic idea about smart warehouse
2. To determine the discriminatory factors between smart and manual warehouse
3. To determine the main reasons for transformation from manual to smart warehouse
4. To determine the main factors impacting the efficiency of smart warehouse

RESEARCH METHODOLOGY

This research was conducted based on the secondary data that has been collected from various sources as well as from various websites and from other research papers that was available in the internet. The research methodology for studying efficiency in smart warehousing should be systematic, rigorous, and tailored to the research question and available data. By following this methodology, researchers can provide valuable insights into the factors that impact efficiency in smart warehousing and suggest recommendations for improving warehouse operations. The research has been done based upon the literature review that contains various facts and to identify the existing knowledge and gaps in the literature related to efficiency in smart warehousing. Since there was a limited access to the data as limited research has been done in this field so based upon some available research papers data has been taken. The analysis should be tailored to the research question and should provide insights into the factors that impact efficiency in smart warehousing.

CHAPTER 4

RESEARCH ON SMART WAREHOUSING

4.1 -A BASIC IDEA ABOUT SMART WAREHOUSE

A modern, technologically sophisticated warehouse that uses a variety of automated systems and technologies to streamline operations is known as a smart warehouse. Advanced robots, Artificial intelligence (AI), the internet of things (IoT), and data analytics are frequently used in smart warehouses to increase productivity, accuracy, and speed in managing inventory, completing orders, and shipping goods. Several jobs that were formerly completed by humans, such as picking and packing orders, transporting, and sorting inventory, and even controlling and monitoring the warehouse itself, can now be carried out by robots and automated systems in a smart warehouse. These systems are interconnected with one another and with a central control system that employs data analytics and artificial intelligence to enhance the efficiency of the warehouse.

. Smart warehouses are becoming more and more common and essential as a result of the rising demand for quick and dependable shipment from online retailers. The need to boost productivity and efficiency while cutting costs is the fundamental driver behind the switch from manual to smart warehouses. Manual warehouses can't handle big amounts of goods and can be labour-intensive, which results in longer order processing times and more mistakes.

4.2-DISCRIMINATORY FACTORS BETWEEN SMART AND MANUAL WAREHOUSE

Manual warehouses and smart warehouses differ in several ways, including the following:

- **Labour costs**: In a manual warehouse, labour costs are usually greater since more people are required to complete jobs like picking, packaging, and inventory control. Several of these jobs can be completed by automation and robotics in a smart warehouse, eliminating the need for human labour.
- **Efficiency**: Because of automation and robotics can carry out activities more quickly and correctly than humans, smart warehouses are often more efficient than manual warehouses. This may lead to quicker order fulfilment times and greater levels of customer satisfaction. Accurate inventory tracking is possible because of smart warehouses& usage of cutting-edge technologies like RFID

(Radio Frequency Identification). This makes inventory management more accurate and lowers the chance of overstocking or stockouts.

- **Safety**: Automated equipment and safety measures like sensors and alarms are included in the design of smart warehouses to help prevent accidents. Workers in a manual warehouse are more prone to mishaps like slips, falls, and machine collisions.
- **Scalability**: Because automation and robotics may be readily added to or withdrawn to match changing levels of demand, smart warehouses are more easily scalable than manual warehouses. Increasing capacity in a manual warehouse frequently necessitates hiring more personnel and enlarging the facility.
- **Data analytics**: Smart warehouses utilise data analytics to monitor performance indicators including inventory turnover, order fulfilment times, and customer satisfaction. This information can be utilised to pinpoint problem areas and improve warehouse operations.
- **Cost**: While smart warehouses need a bigger initial investment in technology and equipment, they can eventually save money thanks to better inventory management, labour cost reductions, and efficiency gains.

4.3- THE MAIN REASONS FOR TRANSFORMATION FROM MANUAL TO SMART WAREHOUSE

Smart warehouses, on the other hand, integrate automation technologies like robotics, AI, and IoT sensors to enhance inventory management, expedite operations, and increase supply chain visibility. As a result, orders may be filled more quickly and accurately, inventory can be better controlled, and labour expenses can be decreased. The need to boost productivity and efficiency while cutting costs is the fundamental driver behind the switch from manual to smart warehouses. Manual warehouses can handle big amounts of goods and can be labour-intensive, which results in longer order processing times and more mistakes.

Smart warehouses, on the other hand, integrate automation technologies like robotics, AI, and IoT sensors to enhance inventory management, expedite operations, and increase supply chain visibility. As a result, orders may be filled more quickly and accurately, inventory can be better controlled, and labour expenses can be decreased. Further advantages of smart warehouses include increased security, better space management, and the capacity to handle more complex processes. They are a desirable alternative for businesses looking to because of these benefits. The need to boost productivity and efficiency while cutting costs is the fundamental driver behind the switch from manual to smart warehouses. Manual warehouses cannot handle big amounts of goods and can be labour-intensive, which results in longer order processing times and more mistakes. Smart warehouses, on the other hand, integrate automation technologies like robotics, AI, and (IoT) sensors to enhance inventory management,

expedite operations, and increase supply chain visibility. As a result, orders may be filled more quickly and accurately, inventory can be better controlled, and labour expenses can be decreased.

4.4-THE MAIN FACTORS IMPACTING THE EFFICIENCY OF SMART WAREHOUSE

The efficiency of a smart warehouse can be impacted by a variety of factors, such as technology, processes, equipment, and workforce management. Here are some of the main factors that can impact the efficiency of a smart warehouse:

- **Technology**: The technology used in a smart warehouse plays a crucial role in determining its efficiency. For example, the use of automated material handling systems, such as conveyor belts, robots, and autonomous vehicles, can improve the speed and accuracy of warehouse operations. Additionally, the use of warehouse management systems (WMS) and inventory management systems can help streamline processes and reduce errors.
- **Processes**: Efficient processes are essential for maximizing the productivity of a smart warehouse. This includes optimizing the layout of the warehouse to minimize travel time and distance for workers and equipment, as well as ensuring that inventory is organized and labelled correctly for easy retrieval. Additionally, the use of lean principles and continuous improvement methodologies can help identify inefficiencies and eliminate waste in warehouse operations.
- **Equipment**: The equipment used in a smart warehouse can also impact its efficiency. For example, using energy-efficient lighting and HVAC systems can reduce operating costs, while investing in high-quality pallets and storage systems can help prevent damage to inventory and equipment.
- **Workforce management**: The efficiency of a smart warehouse is also influenced by the way its workforce is managed. This includes training employees on how to use equipment and software effectively, as well as implementing performance metrics and incentives to motivate workers to perform at their best.

Thus, the overall optimizing the technology, processes, equipment, and workforce management of a smart warehouse can help improve its efficiency and productivity.

CHAPTER 5

KEY FINDINGS

- Smart warehouses can offer faster and more accurate order fulfilment three times faster than traditional warehousing. However, in general, smart warehouses can offer order fulfilment times that are up to three to five times faster than manual warehouses. For example, according to some research papers a smart warehouse equipped with automated picking robots and conveyor belts can process and fulfil orders in a matter of hours, whereas a manual warehouse with human pickers and packers may take several days to fulfil the same order.
- Labour costs are lower, higher worker safety in compared to traditional warehouses.
  According to some authors and it has been seen that labour costs may be higher in smart warehouses compared to manual warehouses; the long-term benefits of automation technologies may outweigh these costs for many warehouse operators.
- Manual warehouses are more labour intensive in compared to smart warehouses
- Manual warehouses cannot handle big amounts of goods at a time as per the literature reviews smart warehouses perform four times faster than the manual warehouse.
- Smart warehouses can handle more orders at a time and work at a faster pace.
- Although Smart warehousing is four times costly but still it has several benefits in compared to manual warehousing.
- Smart warehousing is a rapidly evolving field that leverages technology to increase efficiency, accuracy, and productivity in warehouse operations as per the recent news.

CONCLUSION

Based on the current state of technology and logistics industry trends, smart warehousing has the potential to significantly improve efficiency and productivity in

warehouse operations. By implementing advanced technologies such as automated guided vehicles, drones, sensors, and machine learning algorithms, smart warehouses can streamline processes, reduce manual labour, and improve accuracy.

Smart warehousing can also enhance inventory management by providing real-time visibility into stock levels, reducing the risk of overstocking or stockouts, and optimizing inventory placement for faster fulfilment. This can ultimately lead to better customer satisfaction and loyalty. However, the implementation of smart warehousing requires significant investment in technology and infrastructure, as well as the training of personnel to operate and maintain the systems. Additionally, data security and privacy concerns must be addressed to ensure the protection of sensitive information.

Overall, while there are challenges and costs associated with implementing smart warehousing, the potential benefits in terms of efficiency, accuracy, and customer satisfaction make it a promising option for the future of warehouse operations.

Traditional warehousing has several drawbacks that can limit its efficiency and effectiveness. One of the main issues is the reliance on manual labour, which can lead to slower and less accurate processes, as well as higher labour costs.

In addition, traditional warehousing often involves a high degree of paper-based documentation, which can be time-consuming and prone to errors. This can also result in difficulties in tracking inventory and managing orders, leading to inefficiencies and potential stockouts.

Another drawback of traditional warehousing is the limited visibility into inventory levels and movements, which can make it difficult to optimize inventory placement and fulfil orders quickly.

Finally, traditional warehousing can be hindered by limited connectivity between different systems and stakeholders, which can lead to communication breakdowns and delays in decision-making. Overall, while traditional warehousing may have served its purpose in the past, its drawbacks can limit its effectiveness in meeting the demands of modern logistics and supply chain management. As a result, many companies are now exploring the benefits of smart warehousing and other advanced technologies to optimize their warehouse operations.

RECOMMENDATIONS

Based on the current state of the industry, here are some recommendations for smart warehousing:

- **Invest in automation technology**: Automation technology, such as robotics and automated material handling systems, can help increase efficiency and accuracy in warehouse operations. Companies should consider investing in these technologies to optimize their warehouse operations.
- **Adopt smart inventory management systems**: Smart inventory management systems can help companies track inventory levels in real-time, reducing the risk of stockouts and overstocking. Companies should consider implementing these systems to improve their inventory management practices.
- **To Implement data analytics**: Data analytics can help companies make better decisions by providing insights into warehouse operations. Companies should consider implementing data analytics tools to optimize their operations and identify opportunities for improvement.
- **Focus on training employees**: Technology is only effective if employees know how to use it. Companies should focus on providing adequate training to employees to ensure they are proficient in using the technology and software used in the warehouse.
- **Ensure cybersecurity**: Smart warehousing involves the use of internet-connected devices and software, which can be vulnerable to cyber threats. Companies should ensure that their systems and networks are secure to protect against cyberattacks.
- **Embrace sustainability**: Companies should prioritize sustainability in their smart warehousing practices by adopting energy-efficient technologies, reducing waste, and implementing sustainable packaging solutions.

Overall, adopting these recommendations can help companies improve their efficiency, accuracy, and sustainability in their warehouse operations, leading to a more competitive and successful business.

FUTURE SCOPE

The study of smart warehousing is an evolving field with many potential future research opportunities. The study of smart warehousing is a rapidly evolving field with many potential future research opportunities. By exploring these opportunities, researchers can continue to improve and innovate the smart warehousing industry, leading to more efficient and sustainable warehouse operations. Here are some of the followings. The main areas that can be covered by the researchers (omit) are Integration of emerging technologies, sustainability in smart warehousing, human factors in smart warehousing, cross functional collaboration, impact on supply chain management.

LIMITATIONS

Due to the limitations of time and other resources I have kept my research this much. There were several constraints and that is why I have done my research this much. The study of smart warehousing is a complex and multifaceted field, and there are several limitations that researchers should be aware of. Some limitations of the study of smart warehousing include:

- **Limited research**: Despite the growing interest in smart warehousing, there is still a limited amount of research available, especially in terms of empirical studies. This limits the depth and breadth of knowledge available in the field.
- **Rapidly changing technology**: Smart warehousing relies heavily on emerging technology, which is evolving at a rapid pace. This can make it difficult for researchers to keep up with the latest trends and technologies, and to accurately predict their impact on the industry.
- **Industry-specific challenges**: Smart warehousing is heavily influenced by the specific needs and challenges of the industry it serves. This can make it difficult to generalize research findings across different sectors and industries.
- **Privacy and security concerns**: Smart warehousing involves the use of sensitive data, which can be vulnerable to privacy and security breaches. Researchers must be mindful of these concerns and take appropriate measures to protect participant confidentiality.
- **Limited access to data**: Smart warehousing involves the collection and analysis of large amounts of data, which can be challenging to access and analyse. Researchers may face difficulties in obtaining access to relevant data sets.
- **Cost constraints**: Smart warehousing often requires significant investment in technology and infrastructure, which can be a barrier for smaller companies. This may limit the generalizability of research findings to larger companies.

However, while the study of smart warehousing holds great potential for improving warehouse efficiency and sustainability, researchers should be aware of these limitations and work to overcome them through rigorous and thoughtful research practices.

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CERTIFICATE OF ORIGINALITY

This is to certify, that the research paper submitted by me is an outcome of my independent and original work. I have duly acknowledged all the sources from which the ideas and extracts have been taken.

The project is checked and it has been found that it is less than 15% plagiarism.