A STUDY ON GREEN WAREHOUSING

The project report submitted for partial fulfillment of the requirement for the

degree of

Master Of Business Administration

(INTERNATIONAL TRANSPORTATION AND LOGISTICS MANAGEMENT)

BY

ATHUL SEKHAR US

Registration No.: 2105305012

Under the Supervision of

DR. JAYAN P.A

Assistant Professor

SCHOOL OF MARITIME MANAGEMENT

INDIAN MARITIME UNIVERSITY

KOCHI CAMPUS

MAY 2023

CERTIFICATE

SCHOOL OF MARITIME MANAGEMENT

INDIAN MARITIME UNIVERSITY, KOCHI CAMPUS

This is to certify that the report entitled "A STUDY ON GREEN WAREHOUSING" submitted to the School of Maritime Management, Indian Maritime University, KOCHI Campus, in partial fulfillment for the award of the degree of Master of Business Administration in International Transportation and Logistics Management, is a record of project work carried out entirely by

ATHUL SEKHAR US, Reg No. 2105305012.

DR. JAYAN P.A

PROJECT GUIDE

SCHOOL OF MARITIME MANAGEMENT

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DECLARATION

The project titled "**A STUDY ON GREEN WAREHOUSING**" has been carried out under the direction of Dr. Jayan P.A in partial fulfillment of the requirements for the award of the degree of Master of Business Administration in International Transportation and Logistics Management to be submitted to the School of Maritime Management, Indian Maritime University, Kochi Campus.

PLACE:

DATE: **ATHUL SEKHAR US**

ACKNOWLEDGMENT

It brings me great pleasure to thank everyone who contributed to the successful conclusion of this project. I want to start by expressing my gratitude to God Almighty for his gracious leadership during the project's development.

I express my sincere thanks to Dr. Yogamala. H.L., Head of the School of Maritime Management, Indian Maritime University is a person who needs to be thanked at every stage of my project.

I wish to show my gratitude to Dr. Jayan P.A**,** Faculty, School of Maritime Management, Indian Maritime University – Kochi campus, for his enormous encouragement, help, and guidance, throughout the period of my project and led this work to its successful completion.

I would like to express my sincere gratitude to my loving parents for their blessing, as well as to my classmates and friends for their assistance and good vibes.

Finally, I'd want to use this chance to express my appreciation to everyone who has helped in a variety of ways and for their vital advice and support during every stage of this project.

ATHUL SEKHAR US

ABBREVIATIONS

- ESG **-** Environmental, Social, and Governance
- WMS **-** warehouse management system
- LCA **-** life cycle assessment
- RFID **-** Radio Frequency Identifying Device
- LED – Light Emitting Diode
- RES - Renewable Energy Sources
- DC - Distribution center
- CPG- Consumer Packaged Goods
- FMCG- Fast-Moving Consumer Goods
- SCM- Supply Chain Management
- WIS- Warehouse Inventory System
- WD- Warehouse Distribution
- ASRS- Advanced Shipment Notification
- POD- Point of Delivery

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EXECUTIVE SUMMARY

A warehouse that focuses on reducing its effect on the environment is referred to as a "green warehouse." This is accomplished using a variety of tactics, including the installation of energy-efficient HVAC and lighting systems, the use of green energy sources, the reduction of trash and emissions, and the use of environmentally friendly materials in building and operation. Green warehouses can lower their running expenses and carbon footprint by implementing sustainable practices, which will also increase their total effectiveness and marketability. Additionally, by pushing vendors and clients to implement environmentally responsible practices, green warehouses can contribute to the sustainability of the entire supply chain.

Overall, as more companies realize the value of sustainability and environmental duty in today's world, the idea of green storage is growing in acceptance. Distribution administrators have been working with inventory management for a long time. The consumer goods market, which Kimberly-Clark contends, is sizable and cutthroat. The need for demand forecasting, a reduction in material processing costs, and FDA rules must all be understood by Kimberly-Clark. The transportation and storage of goods within a facility are managed by a warehouse management system (WMS), which also handles the related transactions' e advantages of task interleaving, cross-docking, and automatic data capture can be combined with this monitoring to help consumer goods businesses better their inventory management procedure and stay competitive. However, businesses must exercise caution when putting a WMS system into place. They take a lot of preparation and are very data-intensive. Kimberly-Clark and the WMS system's implementation will be advantageous for the consumer goods business. Their client relations will also improve as a result of this application, which will increase speed and accuracy.

CHAPTER I

INTRODUCTION

INTRODUCTION

1.1 INTRODUCTION OF WAREHOUSE

Warehouses are crucial nodes in almost every industry's delivery network. Even more warehouse space and structures are required as the e-commerce industry expands and the demand for mass customization rises (Angel et al., 2006), especially to meet the continuous demand. Due to the widespread expansion of the e-commerce industry, JingDong, the second biggest e-commerce firm in China, constructed 166 warehouses up until 2015. (Yu et al., 2017). The typical area of freshly constructed warehouses in the United States grew by 143% between 2007 and 2017, or by an additional 10,095 square meters. (CBRE, 2017). Due to these changes, it is now clear that bigger regional centers and smaller urban warehouses are necessary to improve logistics area efficiency and facilitate the flow of products to customers who require faster delivery.

(Deloitte, 2014). By reshaping their warehouse network to be closer to their consumers, who are demanding a faster last-mile delivery service, e-commerce merchants are focusing more and more on enhancing last-mile delivery. Warehouses generate greenhouse gases (GHG) as part of every logistical activity, and their connection to global warming is now undeniable. According to Doherty & Hoyle (2009), the transportation industry globally generates 11% of its total GHG emissions from warehousing operations. As a result, businesses are focusing more on warehouse environmental and societal problems than just operational and financial goals. Many businesses have historically disregarded these two facets of sustainability as significant KPIs (cf. Elkington, 1998). Governments and businesses have generally become more and more conscious of the need for environmental understanding. For instance, the Paris Climate Agreement, which was signed in December 2015 and aimed to provide strong responses to the effects of climate change, has achieved a global agreement among nations toward a net reduction of GHG emissions with the pursuit of keeping global warming below two degrees Celsius above pre-industrial levels. (Rogelj et al., 2016).

Additionally, with an average temperature of 0.99 Celsius degrees higher than in the middle of the twentieth century, 2016.

Which has been recorded as the warmest year since 1880, (NASA, 2016). Additionally, some European states have established clear goals for energy conservation. The German government, for instance, declared that the main energy usage of private households, businesses, and municipal governments must be reduced by 20% by the year 2020. Outside of Europe, the Chinese government is also working to advance climate change policies by increasing funding for this type of study (Kitagawa, 2017). Following this global tendency, more study has been done on management theories, technologies, and tools as a consequence of the increased focus on eco-friendly and sustainable warehousing practices. to lessen the carbon footprint of warehouses, or the overall amount of GHG emissions in carbon equivalents brought on immediately by warehouse activity (Carbon Trust, 2007; Wiedmann & Minx, 2008). Green warehousing has lately been mentioned by some writers as one of the supply chain's ecologically friendly operations (Rostamzadeh et al., 2015; Kumar et al., 2015), but the term has not yet been given a formal meaning. The word "green warehousing" (GW) is used in this article to refer to a management idea that integrates and implements environmentally favorable operations to reduce a warehouse's energy usage, energy costs, and GHG emissions.

Since the late 1990s, writing on supply chain management has given more attention to sustainability as a whole. (Rajeev et al., 2018). Green supply chain management (GSCM), which is the integration of "environmental thinking into supply-chain management, including product design, material sourcing, and selection, manufacturing processes, delivery of the final product to the consumers as well as the end-of-life management of the product after it is used has been defined as the development of a managerial approach that incorporates sustainable practices into the companies' strategies" (de Oliveira, 2018). (Srivastava, 2007).

1.2 RESEARCH METHODOLOGY

Rhoades (2011), Hochrein & Glock (2012), and Kable et al.'s work, as well as other authors, served as the foundation for the methods used to find the studies pertinent to this study. (2012). To make sure that all relevant articles are included, three separate databases—EBSCOhost, Google Scholar, and Scopus—were used to look for relevant literature. (Crossan & Apaydin, 2010) Finding terms that enable finding all papers that are pertinent to the research goals is a basic problem when performing database searches. (Aveyard, 2010). Examining the most common search terms for the subject at hand in the peer-reviewed literature is one method to deal with this problem. Ries et al. (2017) examined the most commonly used keywords for the GW topic; this research was used as the foundation for choosing the keywords to be used in this paper.

The following two categories were created from these keywords:

- The broad terms "warehouses*," "automated storage," "material handling," "order-picking," and "AS/RS" are included in Group A keywords along with other terms that are connected to warehousing and its essential functions and processes.

- Group B phrases include words like "sustain*," "carbon," "green," "energy," "environment," "emission," "eco," "CO2," and "life cycle" which are related to environmental sustainability.

Each keyword from Group A was merged with each term from Group B to perform the queries. It was deemed pertinent if a paper's title, abstract, or keywords include at least one search phrase from both categories. The time period for publishing was left unrestricted. We obtained a total of 118 articles from EBSCOhost, 131 from Google Scholar, and 174 from Scopus by

executing the aforementioned searches. (All numbers effective September 2018).

First, identical studies (those that were obtained from multiple databases or those that were the outcome of various keyword combos) were weeded out from this list of papers. Then, for articles to be included in the final sample, we employed the following criteria:

- only works that were published in peer-reviewed scholarly journals and meeting proceedings and were written in English were kept.

- The only articles that were deemed pertinent were those that expressed GW clearly. On the other hand, papers that only briefly referenced GW-related subjects in various fields (such as GSCM) were not included in the evaluation.

PRE-HISTORY AND ANCIENT HISTORY

Functionally, a warehouse is a structure used to keep large quantities of produce or other goods (wares) for business use. The constructed shape of warehouse buildings has changed over time depending on a variety of contexts: Resources, tools, locations, and civilizations. In this way, the warehouse predates the requirement for large collective or government-based food storage. For the protection of extra food, prehistoric societies depended on family- or community-owned storage pits or "palace" storerooms, like those at Knossos. Collecting and preserving farming surpluses in Bronze Age Minoan "palaces," according to archaeologist Colin Renfrew, was a crucial step in the development of proto-state authority.

MEDIEVAL EUROPE

The requirement for a warehouse denotes the presence of product amounts too large to be kept in a residential storeroom. However, as evidenced by laws pertaining to the imposition of duties, some medieval merchants throughout Europe frequently stored products in their sizable domestic storerooms, frequently on the ground level or in basements. It included a residence, a warehouse, a market, and lodging for travelers. To enable extensive trade, special warehouses were built near harbors and other commercial centers starting in the Middle Ages. Although what is left today was largely restored in the same traditional manner after major fires in 1702 and 1955, the warehouses of the trading harbor Bryggen in Bergen, Norway (now a World Heritage site) exhibit distinctive European gabled wood forms originating from the late Middle Ages.

INDUSTRIAL REVOLUTION

The role of warehouses changed and developed during the mid-18th century industrial transformation. Larger and more specialized warehouses were developed as a result of the industrial transformation in the 18th and 19th centuries. The factory system, which emerged in British textile factories and potteries in the middle and late 1700s, is characterized by the specialization of jobs. Factory procedures sped up work and deskilled labor, increasing capital investment's returns. The Manchester cotton warehouses and the Australian wool stores are two examples of how warehouses perform a variety of commercial tasks in addition to storing goods. These tasks include receiving, stockpiling, and despatching goods, displaying goods for commercial buyers, packing, and Che-originated dispatching orders.

20TH CENTURY

The end of the 19th century and the beginning of the 20th century saw a change in warehouse architecture and behavior due to the introduction of two new power sources: hydraulics and electricity.

Manchester is one of many major industrial towns around the globe that built public hydraulic power networks in the 1870s and 1880s. They were very efficient at driving cranes and lifts, and their use in depots facilitated the construction of higher structures and introduced new labor efficiency the 1890s, public power networks first appeared. They were initially primarily used for illumination, but soon elevators were electrified, allowing for higher, more productive warehouses. It took several decades for electrical power to be extensively spread throughout Western world towns. Technology advancements in the 20th century increased storage efficiency. From the 1900s onward, as electricity became more broadly accessible, it changed illumination, protection, lifting, and transportation. Starting in the 1910s, mass-produced cars were equipped with the internal combustion engine, which was invented in the late 19th century. It not only changed transportation modes but also made it possible to use tiny motors almost anywhere thanks to its many uses as a portable, portable power source.

The forklift vehicle was created in the early 20th century, and after World War II, it was widely used. For greater storage capacity in larger, single-level steel-framed structures, forklifts expanded the options for multi-level pallet stacking. The development of logistical methods for storing in the latter 20th century was made possible by the forklift and its cargo that was attached to a standard pallet.

1.3 ANALYSIS TOOL

For the descriptive statistics displayed in Section 3, the pertinent information from the 38 articles that made up the final collection was stored in a Microsoft ExcelTM spreadsheet. Gephi and R were the two software programs we used to analyze the selected articles. Gephi 0.9.1 (https://gephi.org/), a program that can be used to create network analyses and present the findings in graph format, was used to discover the network of author collaborations and the connections between the various GW subjects. R (https://www.r-project.org), a computer tool for creating statistical analyses, was combined with Gephi to carry out the analysis detailed was used to create the graphs in Section.

1.4 DESCRIPTIVE RESULTS

1. Increases E-commerce activity in the world

   Global e-commerce is expected to increase by 16.8% in 2021, reaching a valuation of $4.921 trillion USD. As e-commerce expands, more transportation equipment is required to meet demand. Scaling up with an ecologically sound infrastructure is becoming more and more crucial as companies strive to optimize their logistics processes and support rising online buy quantities.

2. Consumer demand for accountability

   The same customers who are propelling significant development in e-commerce are also aware of how their consumption patterns affect the ecosystem. Consumer perceptions of companies, as well as their propensity to make additional purchases in the future, are influenced by preferences for sustainability.

Despite the fact that consumers are less directly exposed to the environmental effects of the warehouse than touchpoints like packaging, businesses' overall energy consumption does have an impact on ESG performance, and the stories surrounding overall energy use and carbon footprint reduction are central to their public image.

3. Opportunity for cost optimizations through efficiency

For businesses that maximize efficiency and cut back on energy use, green warehousing methods can have a beneficial effect on the bottom line in addition to being good for the ecosystem. With improvements in green energy's effectiveness, more energy can be generated with fewer emissions. A good first move in lowering carbon footprints is to look into how the warehouse can use green energy buying.

Through increased productivity, advancements in technology throughout the warehouse setting can also support greener practices. Thanks to technological advancements like computer vision and machine learning, even difficult jobs like selecting and placing can now be partly or completely automated. These technologies may benefit the implementation of Industry 4.0 in a variety of ways.

1.5 RESEARCH DESIGN

The goal of this study was to examine the connection between information technology and the adoption of GWH and the parties involved (managers, employees, the government, suppliers, and customers) (IT).
Based on the efficiency-related green warehousing industry efforts in Malaysia, the adoption of GWH was determined. The quantitative technique was applied in this essay. This technique was frequently employed to establish the mathematical connection between the independent variable (IV) and the dependent variable (DV).

The survey was created for warehouse employees with supervisory or managerial positions based in Malaysia to clarify the green initiatives or practices that have been implemented in their warehouse. The researchers wanted to investigate the level of awareness in the industry as it was still a new concept and idea for an organization based in Malaysia. Warehouse managers and senior position holders considered internal stakeholders were selected as survey participants based on their knowledge and experience.

1.6 SURVEY DEVELOPMENT

A closed-ended questionnaire or a query with a fixed alternative was used in this study's questionnaire design. Since the responses to these questions were already known, they were perfect for calculating the statistical and mathematical data. The questions were developed using the green warehousing material that is currently available.

1.7 DATA COLLECTION

In this study, Google and Internet databases were used to locate warehouse employees' phone numbers so that they could be contacted and requested to participate in an online survey on behalf of the company. A general survey software program was used to develop an online version of the survey. The Google Form was developed and designed by the researcher for the respondents before being sent to the specified organizations. The benefits of online design included the ability to control answer ordering, require answer completion, pop-up or skip options based on the response, and a variety of question formats.

CHAPTER II

LITERATURE REVIEW

2.1 LITERATURE REVIEW

The green warehouse management macro-theme examines environmental standards, as well as access programs and environmental certifications, all of which aim to assess the factors influencing the performance of the warehouse. the effects of constructing warehouses on the Environment exam examine essential qualities of warehouses that affect energy use and environmental pollution. These qualities include warehouse size, room utilization, lighting, heating, ventilation, and air conditioning (HVAC) as well as building structure in terms of roof insulation, walls, and doors (Fichitinger,2015). (James & James, 2009). Although they are not the primary subjects covered, complementary aspects, such as building manufacturing or maintenance, are occasionally addressed in those papers; The overall goal of the different initiatives under the energy saving in warehousing macro-theme is to increase energy efficiency in a warehouse. GHG pollutants can be produced from energy use. (Ries et al., 2017). The effectiveness of particular material handling systems, whose use in warehouses consumes a significant is also assessed. Fixed material handling equipment (FMHE) and mobile material handling equipment are examples of these devices. (MMHE).

The paper by Ukic et al. (2010), which examined how various technologies and order-picking techniques, such as routing, storage assignment, and order batching, can improve energy efficiency and operational performance within warehouses, was one of the first to address GW from a management perspective. Three warehouse layouts—basic traditional, traditional with one cross-aisle, and fish bone—were compared for their energy efficiency using a simulation that took order quantity and routing distance into account. Tan et al. (2010) used a modeling tool that supports system dynamics to create important sustainability indicators to establish a connection between social, economic, and environmental problems. To evaluate the model's applicability, data from a case business that offers storage and transportation services were used. Similarly, to this, Amjed and Harrison (2013) concentrated on the definition of best practices in order to create a model for assessing the primary problems with GW while taking into account environmental, social, and economic viewpoints. It was determined which aspects of the TBL approach needed to be modernized in order to execute sustainable actions in warehouses. The authors offered a road map for improving the trade-off between these dimensions in the direction of GW as well as a summary of best practices for each problem.

The adoption of sustainability guidelines intended to lower GHG emissions is another problem in this macro-theme. Bank and Murphy (2013) emphasized creating and implementing a sustainability standard for storage operations. Through the introduction of so-called Sustainable Logistics Initiatives, the writers found metrics and measurements for raising sustainability standards for warehouses. (SLI). The International Warehouse Logistics Association (IWLA) created this initiative to show how implementing green practices in warehouse facilities can lower GHG emissions while also improving financial performance metrics.

The primary environmental measures of the SLI were thought to be water consumption, liquid fuel use, recycling, and electricity use. Similarly, to this, Ruediger et al. (2016) investigated a technique for estimating GHG emissions of warehousing and transshipment operations while taking into account a collection of environmental performance indicators. (EPI). The writers provided a comprehensive analysis of the energy use in logistics centers, broken down into electricity, maintenance, and packaging/waste.

In addition to requirements, government-sponsored green construction certifications can encourage the implementation of sustainable practices. (Colicchia et al., 2013). There are currently some qualifications in storage. For instance, Zuchowski (2015) discussed sustainable factors for lowering harmful emissions and resource consumption in warehouses, outlining certification methodologies that may be used to evaluate the impact of the various environmental factors in terms of their effects in a warehouse building. In order to assess the warehouse's sustainability performance, the author first offered three sustainable solutions that could be used in a warehouse. The author then proposed a comparison of four certification methodologies, including Building Research Establishment Environmental Assessment Methodology (BREEAM), Haute Quality Environmental (HQE), Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB), and Leadership in Energy and Environmental Design (LEED), to do so. The acceptance of sustainability standards and the observance of cap-and-trade emission policy, specifically the global control policy plans put into place resulting in an improved environmental warehouse performance, are additional issues explored in this macro-theme. Chen et al. (2016) explored the role of green technology investments in reaching the sustainability goals of warehouse operations and addressed the influence of a cap-and-trade emission policy on management choices regarding warehouse operations. The writers evaluated the warehouse's GHG pollution using case study data.

The findings demonstrated that carbon emissions cap-and-trade rates and associated control measures can effectively lower the carbon impact of warehouses.

Two sub-themes—warehouse structure and lighting and HVAC—make up the macro-theme of the environmental effect of warehouse buildings. The ensuing subsections go into more depth about them.

2.2 WAREHOUSE BUILDING

Since structures require energy throughout their entire life cycle, from creation to demolition, the warehouse building is one of the elements that contribute most to the usage of energy and natural resources. (Rai et al, 2011). Due to the relationship between outside circumstances and warehouse temperature, energy usage is also influenced by the environment; in the summer, the energy consumption of warehouse buildings can rise by more than 100% during the day. (Huang & Gurney, 2016). In papers concentrating on warehouse construction, problems with GHG emissions decrease, building design, and effective material installation have been assessed. In this situation, Daheng (2010) suggested using grey relational analysis—a unique approach for solving multiple-decision problems—to maximize the warehouse building's construction plan in order to save energy. Building orientation, roof insulation, and natural airflow were among the eleven quantifiable Green Building Evaluation (GBE) indices that were assessed.

In addition, as these markers were found inadequate to assess the whole viability of the warehouse structure, four economic and management variables were added. The result of the grey relation analysis, which weighed and assessed each factor's value, was a ratio that indicated how that factor affected the amount of energy saved in the warehouse.

It was demonstrated that in this instance, the architectural design parameters have less of an effect on reducing energy usage than the building control parameters do. According to Fikiin et al. (2016), there are opportunities for the food refrigeration industry to integrate renewable energy sources (RES). They described how this can be done by utilizing an innovative cryogenic energy storage technology to transform a conventional refrigerated warehouse for chilled and frozen goods into a smart energy hub, improving the sustainability of industrial food refrigeration. To determine the most effective sizing (width, length, height), as well as to minimize the cycle time, overall cost, and carbon footprint of the warehouse during its construction, Accorsi et al. (2017) proposed a multi-objective model for warehouse building design.

By using Pareto frontier analysis, the model attempted to optimize building dimensions, storage space, and material processing efficiency. With an empirical method to choose the Pareto points, the final answer was reached, leading to a particular building dimension that revealed a rise in world costs of 0.23% and a rise in the carbon impact of 0.03% relative to their respective single-objective optimums. Ries et al. (2017) examined how various warehouse design variables, such as building characteristics and technologies, impact GHG emissions using actual data from the US.

It was suggested to conduct a simulation analysis of three distinct facilities. Specific situations that enable the reduction of warehouse emissions were found by a factorial long-term analysis. Seifhashemi et al. (2018) focused on shopping structures, which account for 35% of Australia's energy consumption. Many of these structures are single-story sheds, where the main source of heat is the ceiling. In order to assess how the installation of cool rooftops affects warehouse energy usage, the writers created a computational technique. The findings indicated that this technology has numerous advantages in terms of lower energy costs and usage, improved

thermal comfort inside the structure, and lower cooling energy requirements for warehouses across all studied climatic zones.

2.3 LIGHTING AND HVAC

Another factor influencing the GHG emissions of storage structures is the materials used. Adjusting warehouse lighting and heating systems is one of the main energy-efficiency efforts from an environmentally responsible standpoint, not to mention air conditioning and airflow in warmer settings (Colicchia et al., 2013). (Fichtinger et al., 2015). Also noted are HVAC and lighting plans designed to lessen the environmental effect of buildings.
Dhooma & Baker (2012), for example, provided a case study of energy usage by warehousing end-use consumption types (i.e., lighting, equipment, HVAC, and plug loads), designed a framework to identify energy-saving opportunities, and applied it to four warehouses operating in the same sector. The application's results showed how energy could be saved for specific end-use usages types, like lighting and HVAC. Similarly, to this, Dadhich et al. (2015) used a mixed life cycle assessment (LCA) method to identify direct and indirect lifetime GHG emissions within plasterboard storage. The findings indicated that handling operations—which involved using gasoline trucks to load, unload, and store the plasterboard—and energy usage for illumination are where storage activities produce the most carbon emissions.

CHAPTER III
INDUSTRY PROFILE

3.1 WAREHOUSE

A storehouse is a structure used to store products. Manufacturers, importers, exporters, dealers, transit companies, immigration, etc. all use warehouses. In industrial areas on the edges of cities, towns, or villages, they are typically big, plain structures. Typically, warehouses have docks where vehicles can transfer and discharge cargo. Occasionally, depots are built so that cargo can be loaded and unloaded straight from planes, trains, or ships. For transporting products, which are typically put into pallet racks and set on ISO-standard containers, they frequently have cranes and forklifts. Any raw materials, packing supplies, spare parts, pieces, or completed products connected to manufacturing, farmland, or output can be classified as stored commodities. A storehouse may be referred to as a godown in India and Hong Kong. The Shanghai Bund also has godowns.

In communities where commerce increased to a point where storage was necessary at some stage in the transaction process, the need for warehouses emerged. This was particularly clear in ancient Rome, where the horreum (plural Correa) evolved into a common structure type. Ostia, the port settlement that serviced Rome, is home to the most researched specimens.

They could be sizable even by contemporary standards, as evidenced by the Horrea Galbae, a warehouse facility on the route to Ostia. The bottom level of Galba's Correa building alone had 140 rooms, totaling about 225,000 square feet (21,000 m2). As a point of comparison, fewer than 50% of buildings in the United States currently are bigger than 100,000 square feet (9290 m2).

3.2 TYPES OF WAREHOUSES

DISTRIBUTION WAREHOUSE

The words "warehouse" and "distribution center" are frequently used equally. A distribution center holds products for a brief time while seeing a much greater velocity of products coming in and moving out than a warehouse, which may store items for a long time.

Since distribution centers are frequently situated near end users, goods are delivered to them quickly and in excellent condition. Additionally, a distribution center might provide value-added services like cross-docking, pick-and-pack, or straightforward product blending or packing. A distribution center provides more services than storage, so it also has much more sophisticated technology to speed up the processes taking place there.

PICK PACK & SHIP WAREHOUSE

Pick, pack, and send is the procedure carried out in a warehouse following the receipt of an order from either an internet shop or a physical store. People or automatic systems locate the goods on a pick list that is delivered to the storage. They are then labeled, packaged for shipment, and delivered to the client.

COLD STORAGE WAREHOUSE

As the term suggests, cold storage keeps things that are sensitive to temperature changes at low levels. Medicine, fragile foods, plants, cosmetics, works of art, and candles can all survive longer thanks to cold storage facilities. For both incoming and outbound shipments, cold storage facilities use refrigerated transportation.

BONDED WAREHOUSE

A bonded warehouse, also known as a "customs" warehouse, is a structure where imported products may be handled, manufactured, or kept without paying duty for five years starting from the date of receipt. Because the duty on foreign goods may be very expensive, the bonded warehouse permits the products to be sold first, and the duty is then paid from the sales profits.
There are many various kinds of buildings, and they serve a variety of purposes. Jarrett can assist you if you need storage services. Get in touch with us to find out more about our Ohio, Indiana, and Pennsylvania warehouses that provide full-service inventory management, order processing, and warehouse management services to make your company operate more efficiently.

PUBLIC WAREHOUSE

The ones held by the government or semi-government entities are considered public depots. After spending a certain sum in rent, they are rented to private sector businesses so they can stock up on products.
It's a fantastic choice for small businesses or eCommerce startups that need to temporarily keep their products but do not have access to a warehouse.

Until they are prepared to own an extra building, small companies can manage the excess inventory by using this storage facility.

PRIVATE WAREHOUSE

Private warehouses, as the term implies, are privately held by major store chains, dealers, producers, or marketers. Large online markets can keep goods in privately held facilities as well.

For the busy season, these private businesses buy goods in quantity and keep them in the warehouse to be distributed systematically to the orders that are sure to come their way. The proprietor must make financial expenditures in private warehousing, also referred to as proprietary warehousing. So, it works best for proven businesses. Even though it requires an initial expenditure, it ends up being very cost-effective over time.

SMART WAREHOUSE

These days, facilities aren't far behind when it comes to technology. Artificial intelligence is used in the storing and delivery processes in smart warehouses. Everything is automated, from the packaging of products to their delivery to consumers.

These warehouses use the most recent technologies, so little human monitoring is needed. eCommerce behemoths like Amazon and Alibaba are using smart facilities more and more.

3.3 GREEN WAREHOUSE

In traditional warehousing, things like shipment timetables, storage rooms, and packaging materials are taken into consideration. Anything that ensures timely delivery of purchases through the center is okay. The concept of "green warehousing" contends that distribution centers are capable of more than just contributing to pollution. Any warehouse can lessen its carbon impact with particular tactics. According to a recent study, California's 3,000 big buildings are concentrated in the most polluting areas and produce the majority of the state's emissions. Local airborne emissions from a warehouse's equipment and transit fleets rapidly impact the entire globe.
Teams responsible for warehousing must also take into account the volume of waste produced daily as well as the facility's operational requirements for water and energy. Standard procedures that disregard these elements add to storage pollution that is bad for the environment. Product storage uses energy and materials. The functioning of other facility components such as lighting, climate management, and lighting all contribute to the overall number of resources used. Green storage describes improvements that lower energy consumption, use renewable energy and materials, and lower the amount of non-recyclable trash generated during warehouse operations. By pursuing building standards that will assess performance across measures frequently connected to Environmental, Social, and Governance (ESG) criteria, progress toward a greener warehouse can be quantified concretely.

It makes sense to think of the idea of green warehousing as an essential component of their strategy for many companies seeking to cut costs as well as their environmental impacts.

3.4 WAREHOUSE IN INDIA

By 2025, the Grade-A storage market in India is anticipated to increase by 15%. In the near future, the storage sector is anticipated to grow to a US$2.8 billion business, according to the India storage Report by CREDAI and Anarock. According to the study, the increase will be fueled by rising demand for Grade-B and Grade-C office spaces, which are insufficient for the upcoming demands for large, contemporary infrastructure. "Government efforts to make doing business easier, with an emphasis on the land allotment, single window approvals by many states, and even faster environmental clearances, are greatly assisting this industry. This is the cause of its quickly rising demand in tier-II and tier-III towns in addition to metro areas, according to Harsh Vardhan Patodia, president of CREDAI.

India has changed its perspective on the warehousing industry over the past ten years, going from disorganized godown systems to a significant asset class. According to the study, Grade-A warehouse space totaling 48.5 million square feet was leased in the top 7 locations in 2021, and by the end of 2023, that space is anticipated to rise to 55.8 million square feet. It stated that there had been 160 million square feet of Grade-A warehouse space contracted in seven locations, with Mumbai and Pune accounting for 37% of that total, and the southern region accounting for 32%. (Bengaluru, Chennai, and Hyderabad). Third-party logistics, e-commerce, and manufacturing are the top three industries that contribute to the total amount of storage space leased across seven locations.

3.5 WAREHOUSE HANDLING EQUIPMENT

- Manual panel trolley
- Forklift and reach truck
- Crane
- Lift
- Conveyor system
- Robotics
- Protective covers and Safety measures

Manual Panel Trolley

Pallet carts that are handled by hand have wheels and a strong fork up front. They are ergonomically made to raise boxes from below, transfer them, and lower them as needed by pumping the handle. Pallets are moved over small distances using these pallet vehicles inside warehouses.

FIG 3.1 Manual panel Trolley

Forklift and Reach TRUCK

Forklifts, also known as lift trucks, are powered industrial vehicles used to raise, lower, and transport cargo over small distances or inside warehouses. Loads up to 50,000 kilos can be carried by forklifts. The powerful ones are used to transport freight vessels and other items.

A reach vehicle is considerably smaller and easier to maneuver than a crane. It can take up or put down a load by rapidly moving down tight aisles. To lift or place down cargo, double-reach vehicles with telescopic mechanisms can reach two pallets deep into a rack.

FIG 3.2 Forklift and reach truck

Crane

The bridge crane and the jib crane are the two kinds of cranes most frequently used in stores.

Bridge crane

In production and assemblies, bridge cranes are typically used to raise and transport big, weighty items. It is made up of two tracks that typically span the length of the building and a hoist on a bridge. Additionally, products stored below the bridge can be accessed using bridge cranes.

FIG 3.3 Bridge Crane

Jib crane

Jib cranes are hoists placed on booms or jibs that are typically fastened to a wall or reliable vertical support. Since the hoist only travels along the length of the boom, its entry area is constrained.

FIG 3.4 Jib Crane

Lift

Small supports called lifts can be moved around manually or with an engine. These are used to transport products up or down a vertical axis, where they are then placed on a pallet trolley for further placement.

Conveyor System

This is an additional piece of machinery used to transport products along a metal or plastic belt. In warehouses or production lines, conveyor systems usually move objects horizontally between set locations. Some methods, though, use friction or gravity to nudge it in a lower or upward direction. For instance, roller and belt conveyors are frequently utilized in stores.

FIG 3.5 Conveyor System

Robotics

These days, it's usual to see robots or machines that carry out some of the jobs that people used to do. They are most helpful when performing repetitious chores or when working in dangerous environments. Robots can be designed to carry out tasks accurately and securely.

They play a crucial role in the storage and management of hazardous substances or biological materials.

FIG 3.6 Robotics

Protective and Safety Equipment

Some items need to be shielded from the elements, particularly when being transported, like rain or sunshine. The simplest and most popular way to safeguard such things is to keep them covered. Typically, heavy-duty coverings made of tarpaulin, polyester, or plastic are employed for this purpose.

FIG 3.7 Protective and Safety Equipment

3.6 GREEN WAREHOUSE IN INDIA

For a long time, "Green" has served as a convenient prefix for almost everything that has to do with protecting the environment. This has allowed companies and policymakers to demonstrate their dedication to safeguarding the environment. And the transportation industry is no exception to this; after all, it is a significant source of environmental contamination, which strengthens the case for seriously considering "Green logistics".

Even though logistics also involves infrastructure like storage, transit terminals, packing, distribution, material processing, and even disposal, discussions about green logistics are typically limited to transportation. Only when we escape the misconception that transportation and logistics are interchangeable can we truly comprehend the environmental effect of logistics operations, in reality, the environmental effect of logistics goes far beyond just moving goods within supply networks

Some of the warehouses in India:

- Go Green warehouse
- DSV
- IGBC
- Stock area
- B2B Logistics
- Gati limited

FIG 3.8 Go Green Warehouse

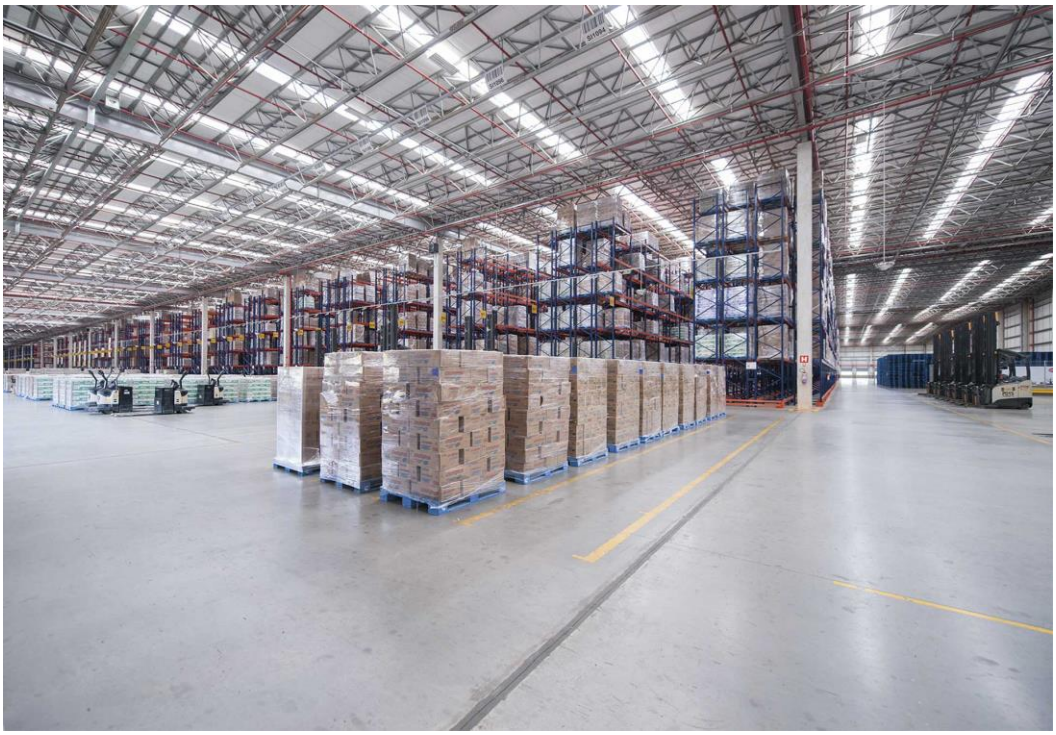

FIG 3.9 Stock area logistics

3.7 BEST WAREHOUSES IN THE WORLD

Best Warehouse companies in the world:

- **DHL**

  Currently, DHL is the top transportation provider in the globe. Every day, our 380,000 employees in more than 220 nations and regions labor to assist you in navigating borders, finding new markets, and expanding your company. Or you could just write your loved ones a note.

FIG 3.10 DHL

- **FED EX**

  FedEx Corporation, also known as Federal Express Corporation and subsequently FDX Corporation, is a Memphis, Tennessee-based global conglomerate holding firm with an emphasis on business services, e-commerce, and transportation.

FIG 3.11 FED EX

- **XPO LOGISTICS**

  The business offers services for less-than-truckload transportation, intermodal, drayage, managed transportation, international forwarding, last mile logistics, engineered supply chain solutions, high-value-add warehousing, and distribution, ground, and air expedite, and truckload brokerage and transportation.

FIG 3.12 XPO Logistics Warehouse

3.8 IMPORTANCE OF GREEN WAREHOUSING

- **HIGH-EFFICIENCY LIGHTING**

By replacing conventional lights in warehouses with LED (light-emitting diode) lights, which use less energy, greenhouse gas pollution can be reduced. LED illumination is reliable and effective because it saves money and energy. Even though LED lights cost more upfront, they have a longer lifespan, are highly efficient, and have a quick response time. They lessen warmth, which solves several other issues. In addition, sensors and natural tube illumination are energy-saving methods. When areas are not in use, sensors monitor usage to save energy, and natural tube lighting, which increases visibility, can reduce midday energy consumption.

➢ SOLAR POWER

The cleanest sustainable energy source that decreases prices reduces carbon emissions and controls power usage is solar energy. PV panels, also referred to as energy-saving solar panels, are gaining popularity as they aid in energy optimization. The wide, flat roofs of most buildings make for ideal locations to install solar power generation equipment. Due to its strategic position in the tropical zone and abundant natural sunshine, India is also among the best locations to put solar systems.

➢ PAPERLESS OPERATIONS

Reducing the use of single-use paper in stores is another environmentally friendly strategy that increases the viability of the supply chain. Warehouse paper consumption can be significantly decreased while increasing productivity with paperless dock management and mobile technologies. To cut back on unnecessary paper use, warehouses in India must adopt computerized order picking, barcoding, and RFID Utilizing technological advancements will greatly reduce the use of single-use paper.

➢ BETTER INVENTORY CONTROL

A (WMS) makes it possible to digitally coordinate shipment and transportation, as well as stores and warehouses. With inventory management offered by a WMS, green stores can operate with the ideal amount of stock, reducing unnecessary inventory and maximizing storage space.

- **TAKE AWAY**

Consumers in the millennial generation today are conscious of how their purchasing behaviors affect the ecosystem and are actively searching for greener alternatives. Such customers are always drawn to sustainable supply chain methods in addition to eco-friendly goods. Logistics professionals gain a great deal from green storage techniques because they use less energy and produce less waste and useless stock.

3.9 TODAY'S GREEN WAREHOUSING PRACTICES

The main sources of environmental contamination in facilities in global supply networks are heating, ventilation, and illumination. The carbon impact of a building increases generally with its size. By taking into account the following key performance indicators: emissions, natural resource use, the quantity of trash, and recycling, warehouse managers can assess the carbon impact of their activities. Companies can implement green efforts by researching overall carbon dioxide emissions, as well as energy use, water use, and rate of product or material use.

For instance, a warehouse with a high-power rate might find that using different illumination choices, such as automatic lights, natural light, or other green energy sources, can result in cost savings. The finding that a building uses a lot of water from a natural resource could also spur change. Using water discharge restriction equipment.

3.10 FUTURE OF GREEN WAREHOUSING

Given that more and more businesses are realizing the value of sustainability and environmental responsibility, the future of green warehousing appears bright. Here are some possible developments that could shape the future of green warehousing:

- Solar, wind, and geothermal energy are examples of renewable energy sources whose use is likely to rise. Warehouses may also adopt energy storage solutions like batteries or hydrogen fuel cells to store excess renewable energy for later use.

- Sustainable Building Materials: Reclaimed wood, bamboo, and recycled steel are examples of sustainable building materials that could be used to build warehouses. These materials are not only durable and cost-efficient but also environmentally friendly.

- Smart technology can be used to maximize energy use, reduce waste, and improve working productivity in warehouses. Sensors and automated lighting, for instance, can assist warehouses in saving energy and money.

- Green Logistics: Warehouses could collaborate with transportation companies to optimize their supply chain and reduce their carbon footprint. utilizing electric vehicles

3.11 IMPACT OF TECHNOLOGY ON GREEN WAREHOUSE

Technology has significantly influenced green storage, making processes more effective and sustainable. The following are a few ways that technology has aided the green storage movement:

- One of the biggest ways that technology has influenced green facilities is through smart illumination. Sensors are used by smart lighting systems to determine when a room is empty and change the illumination appropriately. As a consequence, there are substantial energy reductions and a decrease in carbon emissions.

- Solar Energy: With the installation of solar cells, warehouses can now produce their energy and lessen their reliance on fossil fuels. Advances in photovoltaic technology have also reduced the cost of making this expenditure for warehouses.

- Electric Vehicles: By using electric vehicles for transit and material processing, warehouses can now lessen their ecological impact. Electric cars are a more environmentally friendly choice than conventional gas-powered vehicles because they use less energy and emit no emissions.

3.12 THE LATEST PRACTICES OF GREEN INVENTORY IN WESTERN COUNTRIES

The activity of monitoring and controlling an organization's inventory or supply chain's environmental effect is referred to as "green inventory," also known as sustainable inventory or "eco-inventory." This entails keeping track of how much water, energy, and materials are being used, as well as how much trash and emissions are being produced.

Companies are using a number of the most recent green inventory practices in Western nations to lessen their environmental effect. Some examples of these techniques are:

- LCA is a technique used to assess a product's environmental effect over the course of its full life cycle. This covers raw material extraction, production, distribution, usage, and disposal.

- Carbon Footprint Analysis: A carbon footprint analysis counts the number of greenhouse gases that are emitted during the production of a certain good or service. Companies may find strategies to cut emissions and enhance their sustainability performance by measuring their carbon footprint.

- Sustainable Packaging: To decrease waste and lessen its influence on the environment, businesses are increasingly embracing sustainable packaging materials, such as biodegradable or recyclable materials.

- Green procurement: Businesses are implementing strategies that give suppliers sustainable practices and goods priority.

- Lean Manufacturing: Lean manufacturing is a technique that seeks to reduce waste and increase industrial efficiency.

3.13 THE LATEST DEVELOPMENTS ON GREEN INVENTORY IN INDIA

Additionally, India is working to keep up with the most recent innovations in supply chain sustainability and green inventories. Indian businesses and the government are taking a number of measures, including:

- Carbon Footprint Management: To track and lower their greenhouse gas emissions, Indian businesses are increasingly implementing carbon footprint management strategies. To lessen their carbon impact, businesses are investing in renewable energy and adopting carbon reduction goals.

- The Green Public Procurement (GPP) policy, which requires the acquisition of products and services with a lower environmental effect, was introduced by the Indian government. The goal of the policy is to encourage suppliers to employ sustainable practices and to promote the usage of environmentally friendly goods and services.

- Sustainable Packaging: Indian businesses are looking towards using environmentally friendly packaging materials like recycled paper and biodegradable plastics. A few businesses are also implementing cutting-edge package designs to boost recycling.

- Sustainable Transportation: Businesses are looking at ways to lessen the impact of transportation on the environment, including employing electric or hybrid vehicles, streamlining delivery routes, and utilizing alternate forms of transportation like rail or water transport.

CHAPTER IV
SWOT ANALYSIS

SWOT ANALYSIS

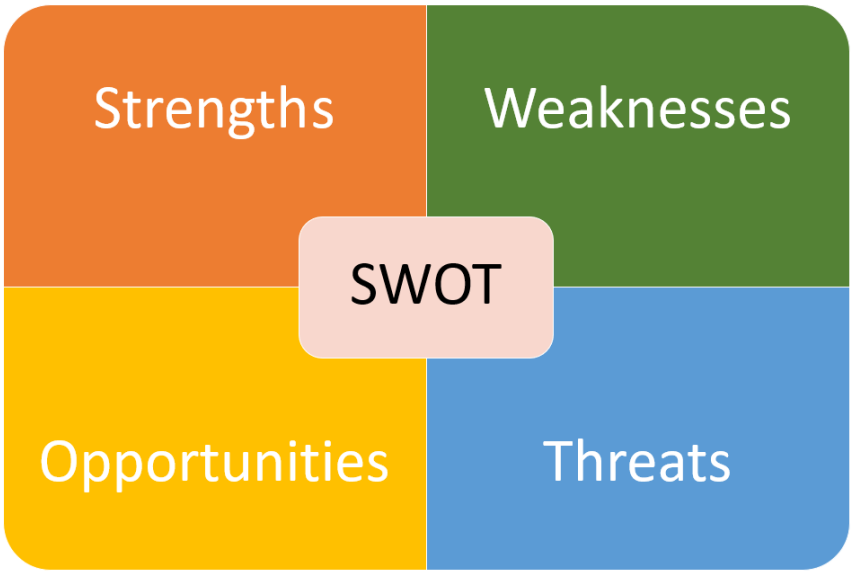

FIG 4 SWOT ANALYSIS

Many individuals in the corporate world are aware that if you work hard, you can do amazing things. However, there is no disputing that to accomplish those wonderful things, you must also be willing to take some risks. Consider the owners of warehouses. They are aware that having a warehouse may have both favorable and unfavorable effects. They are aware, however, that no matter what kind of business they are in, as long as you can solve their difficulties, you may succeed in your endeavors.

4.1 STRENGTH

- One of the organization's key strengths can be its geographic influence in various areas. It establishes the company's market penetration and guarantees simple ease.

- Due to the organization's diverse product offering, it may be possible to increase the client base and balance out losses from one product area with gains from another.

- Effective social media management and a strong online presence on various social networking sites can increase the impact of good e-WOM and foster long-lasting relationships with consumers.

- The locational edge can boost the company's competitive positioning in a number of ways, including reduced costs, better accessibility, or improved brand perception.

- Strong financial standing and overall wellness could enable the business to make additional expenditures.

- The total effectiveness of the company can be increased by having access to suppliers who provide raw materials at a reduced cost.

- The practical effectiveness and understanding of current market patterns can both be enhanced by a well-developed and seamlessly integrated IT system.

- When a company is service-oriented, competent and dedicated human capital can be a potent source of economic advantage. Diversity in the workplace can be a significant competitive advantage, especially if the company plans to expand internationally.

- Vertical and/or horizontal integration can improve access to basic materials, increase control over the entire value chain, and hasten the distribution of finished goods to the consumer.

- It may be possible for a company to hold a variety of intellectual property rights that make its product products distinctive and difficult for rivals to copy.

4.2 WEAKNESS

- Environmentalists may criticize the organization for its bad waste management procedures and failure to incorporate sustainability into business practices.

- Poor inventory management techniques might cause the business to become less efficient. Either a lack or an overabundance of inventory

- A lack of cash or insufficient current assets has a detrimental impact on the liquidity situation and the overall effectiveness of the organization.

- The ability of the business to grow its client base and promote repeat business is weakened by a lack of funding for marketing and advertising activities.

- Less money spent on R&D might cause a company's performance to suffer from a lack of understanding of the local and global markets.

- An inefficient process of strategic decision-making results from a lack of understanding of the requirements and demands of customers. Due to this weakness, the company might not be able to recognize the product/service mix's possible growth regions.

4.3 OPPORTUNITIES

- The population's exponential increase, especially in the existing or potential client categories, presents a significant opportunity for corporate organizations to expand.

- If the company organization has excellent market expertise, the changing customer requirements, tastes, and preferences may present a chance.

- It is possible to use the creation of new technologies to aid in the production and distribution of goods and services to integrate innovation into business processes. Integration of cutting-edge technology may save costs, boost productivity, and hasten the release of new goods.

- A chance to offer more high-end goods can be seen in the rise in consumer disposable income and the affluent clientele.

- It is simpler to raise money and obtain finance at a lesser cost when interest rates are lower.

- Opportunities for business and product line development arise with the introduction of new market niches.
- The firm can join the worldwide market, target a geographically dispersed consumer base, and boost profitability due to the thinning of borders and increasing global interconnection.

4.4 THREATS

- It complicates and makes it harder for the corporate organization to comply with the law. The possibility of expensive litigation increases when requirements are not followed.

- The firm may find it challenging to acquire personnel with the appropriate skill set due to a shortage of competent labor on the market.

- The organization's capacity to maintain and grow its client base is impacted by the rising number of direct and/or indirect rivals.

- When they have a direct impact on customers' spending habits and purchasing power, the deteriorating economic conditions hurt business success.

- The profitability of businesses is impacted by the growth in inflation-related costs of production.

CHAPTER V
CONCLUSION

5.1 SUMMARY OF FINDINGS

Green warehousing: a comprehensive survey of the literature and bibliometric analysis Eleonora Bottani, Eric Grosse, and Maicol Bartolini Abstract In supply networks, warehouses play a significant role in the increase of greenhouse gas emissions. Therefore, it is not unexpected that scholarly study has begun to pay more attention to green and sustainable warehousing in recent years. This interest has resulted in an increase in papers in this area, which is why the current article suggests conducting a systematic literature analysis on the subject of green warehousing. This study offers a thorough analysis and categorization of the extant knowledge on green storage, compiles and synthesizes it, and finds key trends. Promising concepts for additional study are identified based on the assessment of the literature. The relationships between the subjects discussed are assessed using citation and network analyses. The findings indicate a growing interest in sustainability issues in the literature on warehousing, where energy conservation has been the most frequently researched goal, followed by research on the environmental effects of warehouse structures and green warehouse management in general. However, case studies and actual information are lacking in the research on green warehousing. The main contribution of this paper is a thorough overview of the current state of knowledge on green warehousing in terms of the macro-themes addressed, the particular topics investigated, and the methodological approaches, including a thorough and systematic classification of the pertinent literature. The suggestions for additional research projects and a summary of administrative principles for green warehouse management contribute to the further growth of this new area of study.

5.2 SUGGESTIONS

There are numerous recommendations for setting up and running a green warehouse. Here are a few examples:

- Conduct an energy assessment to find out where energy is being squandered and where improvements can be made to become more energy-efficient.

- Use green energy sources to lessen your dependence on non-renewable energy sources, such as installing solar panels, wind generators, or geothermal energy.

- Use energy-efficient lighting: Install motion monitors to switch off lights in vacant spaces and replace conventional lighting with LED bulbs.

- Invest in insulation and weatherization: These measures can help prevent heat loss, increase energy efficiency, and cut heating and cooling expenses.

- Reduce waste and implement recycling programs: By reducing waste and recycling programs, a warehouse can produce less garbage and have a smaller environmental effect.

- Use sustainable construction materials that have a reduced effect on the ecosystem to construct your structure.

- Promote the use of low-emission transportation methods, such as electric or hybrid cars, to promote ecological mobility.

- Adopt water-saving practices by installing rainfall collection devices and low-flow plumbing fittings.

5.3 CONCLUSION

There are many advantages to using an inventory management system. These could include improved output or effectiveness, expense savings, error-proofing, or real-time inventory access. It's accurate that prices vary based on your requirements and the solution**.** To determine your requirements, it's critical to formulate the appropriate queries. After that, a WMS implementation can go easy if you work with a skilled provider. Supply networks that are complex increase the demand for facilities.

A sustainable and environmentally friendly method of managing warehouses, green warehousing seeks to lessen the effect that warehouses have on the ecosystem. It entails putting into practice a variety of waste- and energy-reduction strategies, including maximizing storage layout, using green energy, and minimizing packaging. Adopting green warehousing techniques can have several advantages, such as decreased energy use, cheaper operating costs, better worker health and safety, and improved brand image. Additionally, it can assist companies in reducing their carbon footprint and adhering to environmental laws. Overall, green warehousing is a hopeful method of managing warehouses that can help make the future more viable for both companies and the environment. In the future years, more businesses are likely to implement green warehousing techniques as consumers and investors place a growing emphasis on sus

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