"THE ROLE OF AUTOMATION IN WAREHOUSE OPERATIONS AND ITS IMPACT ON LABOR."

PROJECT REPORT

Submitted in partial fulfillment of the requirements for the award of the Degree of

MASTER OF BUSINESS ADMINISTRATION

(International Transportation and Logistics Management)

Submitted by,

NAMITHA.K.G.

Registration No.: **2105305022**

Under the esteemed guidance of

DR. SREEJITH U.

Assistant Professor

SCHOOL OF MARITIME MANAGEMENT

INDIAN MARITIME UNIVERSITY

COCHIN CAMPUS

APRIL 2023

INDIAN MARITIME UNIVERSITY

(A Central University under Ministry of Port, Shipping and Waterways)

SCHOOL OF MARITIME MANAGEMENT

Dr. Sreejith U.

Faculty of Maritime Management — Kochi

School of Maritime Management — Date: 09 / 05 / 2023

Indian Maritime University, Kochi Campus

CERTIFICATE

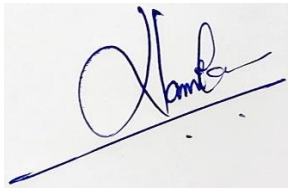
This is to certify that the project report titled **"THE ROLE OF AUTOMATION IN WAREHOUSE OPERATIONS AND ITS IMPACT ON LABOR"** submitted by **NAMITHA.K.G.**, Register Number.: **2105305022** student of MBA International Transportation and Logistics Management is a bonafide record of her project report and submitted to the School of Maritime Management, Indian Maritime University, Kochi Campus, under the supervision of Dr. Sreejith U., Faculty IMU, Kochi campus. It is also certifying that the above work has not previously formed or submitted for the award of any degree, diploma, associateship, fellowship or other similar titles, and it is an independent work done by the candidate.

Dr. Sreejith. U

(Project Guide)

DECLARATION

I hereby declare that the project report titled **"THE ROLE OF AUTOMATION IN WAREHOUSE OPERATIONS AND ITS IMPACT ON LABOR"** is a bonafide work done by myself under the guidance and the supervision of **Dr. SREEJITH U.**, Assistant Professor, School of Maritime Management, Indian Maritime University, Cochin campus. This report neither in full nor in part has ever been submitted for award of any other Degree of either this university or any other university.



Place: COCHIN **NAMITHA K G**

Date: 09 / 05 / 2023 **Reg. No.: 2105305022**

ACKNOWLEDGEMENT

It gives immense pleasure to express my thanks to all those who helped for the successful completion of this project. First and foremost, I thank the **GOD ALMIGHTY** for his gracious guidance throughout the project work.

It has been a great privilege and honor to work under **PROF. DR. SREEJITH U.**, School of Maritime Management, Indian Maritime University, Cochin for his timely advice and guidance which made me to work with successfully.

My heartfelt gratitude towards **Dr. YOGAMALA H L**, Head of the department, School of Maritime Management, Cochin campus, for the moral support, useful suggestions and guidance throughout my academics.

I also like to thank to all the faculties and staffs of Indian Maritime University for their active support to complete this project and to all the teachers and friends for their encouragement at various stages of this project period.

I express my deep sense of gratitude to my beloved Parents, whose support has enabled me to concentrate on my study and project work.

NAMITHA.K.G.

EXECUTIVE SUMMARY

Automation has become increasingly prevalent in warehouse operations, with the use of robotics, artificial intelligence, and other technologies. This trend has been driven by the need to improve efficiency, accuracy, and speed of operations, as well as reduce costs and improve safety.

While automation has many benefits, including increased productivity and reduced error rates, it also has a significant impact on labor. Some jobs that were previously done by humans are now being replaced by machines, leading to job losses and concerns about the future of work.

However, automation can also create new job opportunities, such as the need for technicians and engineers to maintain and repair automated systems. Additionally, it can lead to more fulfilling and higher-paying jobs as workers are freed from repetitive, low-skill tasks and can focus on more complex and challenging work.

To minimize the negative impact of automation on labor, it is important for companies to invest in training and reskilling programs to help workers adapt to new roles and technologies. This can help ensure a smoother transition to a more automated warehouse and a more sustainable future for both workers and businesses.

CONTENTS

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Automation in warehouse operations refer to the use of technology and machinery to perform tasks that were previously done manually. Automation has changed the way warehouses operate by making it faster, more efficient, and less prone to errors. Warehouse automation has become increasingly popular in recent years, and its impact on labor has been significant.

One of the most significant impacts of warehouse automation on labor has been the reduction in manual labor requirements. With the use of automated systems such as conveyors, automated guided vehicles (AGVs), and robotics, the need for manual labor has decreased significantly. This has led to a reduction to perform the same tasks, which has had an impact on employment levels.

However, automation has also created new job opportunities in the warehouse industry, such as maintenance technicians, automation engineers, and software developers. These jobs require specialized skills and knowledge, which has led to a shift in the skill sets required for warehouse workers.

Another impact of automation on labor has been the improvement in working conditions. Automated systems have led to a safer working environment for warehouse workers, reducing the risk of injuries caused by manual handling of heavy goods. It has also led to a reduction in the physical strain on workers, making it easier for them to perform their jobs for longer periods.

In conclusion, the role of automation in warehouse operations has had a significant impact on labor, both positive and negative. While it has led to a reduction in manual labor requirements, it has also created new job opportunities and improved working conditions. As the warehouse industry continues to evolve, it is essential to strike a balance between the use of automation and the need for human workers to ensure the continued success of the industry.

1.2 STATEMENT OF PROBLEM.

With the increasing adoption of automation in warehouse operations, there is a concern about its impact on labor. While automation can improve efficiency, reduce costs, and enhance safety, it may lead to job displacement and inequality which is considered as a major drawback in the economy.

Therefore, the study is focused on the problem to assess the role of automation in warehouse operations and its impact on labor, in terms of old working nature with laborers, current changes after automation, advantages and disadvantages of both and government policies supporting automation and laborer in warehouses.

1.3 SIGNIFICANCE OF THE STUDY.

The study is attempted to address the role of automation in warehouse operations and its impact on labors. This signifies how the increasing use of automation in warehouse operations affects the job market and the workforce. As more and more companies adopt automation technologies to increase efficiency, reduce costs, and improve productivity, there is a growing concern about the potential negative impact on the labor force, including the displacement of workers and changes in the nature of work.

1.4 SCOPE OF THE STUDY.

The scope of the study, on the role of automation in warehouse operations and its impact on labor involves examining the various types of automation technologies currently used in warehouses and their effects on the workforce. This includes analyzing the impact of automation on job opportunities, working conditions, and wages, as well as exploring how automation is changing the nature of work and the skills required for warehouse jobs. The study will also examine the benefits

and drawbacks of automation in warehouse operations, including its impact on productivity, efficiency, and safety.

1.5 OBJECTIVES OF THE STUDY.

The study aims at the following objectives:

1. Old warehouse functioning with labor.
2. Current warehousing after automation.
3. Advantages and disadvantages of both.
4. Government policies supporting labour and automation in warehouses.

1.6 RESEARCH METHODOLOGY.

Research Methodology provides various techniques that can be adopted by the researcher in his/her research process. It is a way to systematically solve a research problem. This study is conducted by using Primary and Secondary data.

1.7 LIMITATIONS OF THE STUDY.

Following are the limitations of the study;

1. Limited access to data: Data sources provide the necessary information required for the study, and there may be limitations in accessing certain data.
2. Data accuracy: Data may not be accurate, reliable, or up-to-date, which could impact the validity of the study's findings.
3. Lack of control: There has no control over the collection and interpretation of data. The quality and relevance of the data are dependent on the methods used by the original data collector.

4. Lack of depth: Data may not provide a comprehensive understanding of the context of the research topic, which can limit the depth of the study.
5. Time period limitations: Secondary data may be limited to a particular time period, which may limit the generalizability of the findings to other time periods.
6. Limited ability to generalize: The findings of the study may be limited to the specific context of the data used, which may limit the ability to generalize the results to other contexts.
7. Inability to access data for all relevant variables: It may be difficult to access data for all relevant variables, which may limit the ability to fully understand the impact of automation on labor in warehouse operations.

CHAPTER 2

REVIEW OF LITERATURE

1. ‘Negotiating the Algorithm’: Automation, Artificial Intelligence and Labour Protection

   Comparative Labor Law & Policy Journal, Vol. 41, No. 1, 2019

This paper aims at filling some gaps in the mainstream debate on automation, the introduction of new technologies at the workplace and the future of work. This debate has concentrated, so far, on how many jobs will be lost as a consequence of technological innovation. This paper examines instead issues related to the quality of jobs in future labour markets. It addresses the detrimental effects on workers of awarding legal capacity and rights and obligation to robots. It examines the implications of practices such as People Analytics and the use of big data and artificial intelligence to manage the workforce. concludes by highlighting the crucial role of collective regulation and social partners in governing automation and the impact of technology at the workplace.

2. Artificial Intelligence: The Ambiguous Labor Market Impact of Automating Prediction

   Ajay Agrawal

   Joshua S. Gans

   Avi Goldfarb

   Journal of economic perspectives

   Vol. 33, no. 2, spring 2019

Recent advances in artificial intelligence are primarily driven by machine learning, a prediction technology. Prediction is useful because it is an input into decision-making. In order to appreciate the impact of artificial intelligence on jobs, it is important to understand the relative roles of prediction and decision

tasks. We describe and provide examples of how artificial intelligence will affect labor, emphasizing differences between when the automation of prediction leads to automating decisions versus enhancing decision-making by humans.

3. Why Are There Still So Many Jobs? The History and Future of Workplace Automation

   David H. Autor

   Journal of economic perspectives

   Vol. 29, no. 3, summer 2015

In this essay, I begin by identifying the reasons that automation has not wiped out a majority of jobs over the decades and centuries. Automation does indeed substitute for labor—as it is typically intended to do. However, automation also complements labor, raises output in ways that leads to higher demand for labor, and interacts with adjustments in labor supply. Journalists and even expert commentators tend to overstate the extent of machine substitution for human labor and ignore the strong complementarities between automation and labor that increase productivity, raise earnings, and augment demand for labor. Changes in technology do alter the types of jobs available and what those jobs pay. In the last few decades, one noticeable change has been a "polarization" of the labor market, in which wage gains went disproportionately to those at the top and at the bottom of the income and skill distribution, not to those in the middle; however, I also argue, this polarization is unlikely to continue very far into future. The final section of this paper reflects on how recent and future advances in artificial intelligence and robotics should shape our thinking about the likely trajectory of occupational change and employment growth. I argue that the interplay between machine and human comparative advantage allows computers to substitute for

workers in performing routine, codifiable tasks while amplifying the comparative advantage of workers in supplying problem-solving skills, adaptability, and creativity.

4. The Impact of Artificial Intelligence on the Labor Market

Michael Webb

Stanford University - Department of Economics

I develop a new method to predict the impacts of a technology on occupations. I use the overlap between the text of job task descriptions and the text of patents to construct a measure of the exposure of tasks to automation. I first apply the method to historical cases such as software and industrial robots. I establish that occupations I measure as highly exposed to previous automation technologies saw declines in employment and wages over the relevant periods. I use the fitted parameters from the case studies to predict the impacts of artificial intelligence. I find that, in contrast to software and robots, AI is directed at high-skilled tasks. Under the assumption that the historical pattern of long-run substitution will continue, I estimate that AI will reduce 90:10 wage inequality, but will not affect the top 1%.

5. Automatic Reaction - What Happens to Workers at Firms that Automate?

James Bessen

Boston University School of Law

Martin Goos

Utrecht University

Anna Salomons

Utrecht University

Wiljan van den Berge

CPB

We provide the first estimate of the impacts of automation on individual workers by combining Dutch micro-data with a direct measure of automation expenditures covering firms in all private non-financial industries over 2000-2016. Using an event study differences-indifferences design, we find that automation at the firm increases the probability of workers separating from their employers and decreases days worked, leading to a 5-year cumulative wage income loss of about 8% of one year's earnings for incumbent workers. We find little change in wage rates. Further, lost wage earnings are only partially offset by various benefits systems and are disproportionately borne by older workers and workers with longer firm tenure. Compared to findings from a literature on mass layoffs, the effects of automation are more gradual and automation displaces far fewer workers, both at the individual firms and in the workforce overall.

6. The Impact of Automation on Employment: Just the Usual Structural Change?

   Dr. Ben Vermeulen

   Jan Kesselhut

   Prof. Andreas Pyka

   Pier-Paolo Saviotti

We study the projected impact of automation on employment in the forthcoming decade, both at the macro-level and in actual (types of) sectors. Hereto, we unite an evolutionary economic model of multisectoral structural change with labor economic theory. We thus get a comprehensive framework of how displacement

of labor in sectors of application is compensated by intra- and intersectoral countervailing effects and notably mopped up by newly created, labor-intensive sectors. We use several reputable datasets with expert projections on employment in occupations affected by automation (and notably by the introduction of robotics and AI) to pinpoint which and how sectors and occupations face employment shifts. This reveals how potential job loss due to automation in "applying" sectors is counterbalanced by job creation in "making" sectors as well in complementary and quaternary, spillover sectors. Finally, we study several macro-level scenarios on employment and find that mankind is facing "the usual structural change" rather than the "end of work". We provide recommendations on policy instruments that enhance the dynamic efficiency of structural change.

7. How Technology Is Destroying Jobs

   By David Rotman

   MIT Technology Review Magazine, July/August 2013

Given his calm and reasoned academic demeanor, it is easy to miss just how provocative Erik Brynjolfsson's contention really is. Brynjolfsson, a professor at the MIT Sloan School of Management, and his collaborator and coauthor Andrew McAfee have been arguing for the last year and a half that impressive advances in computer technology—from improved industrial robotics to automated translation services—are largely behind the sluggish employment growth of the last 10 to 15 years. Even more ominous for workers, the MIT academics foresee dismal prospects for many types of jobs as these powerful new technologies are increasingly adopted not only in manufacturing, clerical, and retail work but in professions such as law, financial services, education, and medicine.

CHAPTER 3

OLD WAREHOUSE FUNCTIONING WITH LABOR.

3.1 INTRODUCTION.

A Warehouse Worker plays a vital role in any company that stores and handles orders or products. Their responsibilities include supervising the receipt and processing of new stock, selecting and organizing orders from the warehouse inventory, and overseeing their management.

3.2 TRADITIONAL WAREHOUSE SYSTEM.

A traditional warehouse system refers to a physical storage facility where goods are stored and managed manually, without the use of automated technology. In this type of system, inventory is managed using paper-based systems, such as spreadsheets or handwritten logs. Warehouse staff typically use forklifts or other manual equipment to move goods around the warehouse.

A traditional warehouse system requires a lot of manual labor and is often time-consuming and inefficient. It can also be prone to human error, which can lead to inaccuracies in inventory management and order fulfillment. However, traditional warehouse systems can be a good option for small businesses with low inventory volumes and limited resources, as they can be more cost-effective than automated systems.

Many companies are now transitioning from traditional warehouse systems to automated systems that use advanced technologies such as robotics, artificial intelligence, and cloud-based software, Forklifts, Equipment. These systems offer greater efficiency, accuracy, and scalability, but can also require significant upfront investment and ongoing maintenance costs.

Figure: Traditional Warehousing

3.3 MODERN WAREHOUSE SYSTEM.

A modern warehouse system refers to a highly automated storage and logistics facility that utilizes advanced technologies and software to manage inventory and fulfill orders. These systems are designed to be more efficient, accurate, and scalable than traditional warehouse systems.

A modern warehouse system typically includes features such as automated conveyor systems, robotic picking and sorting, and real-time inventory tracking using barcode or RFID technology. The system can also be integrated with advanced software such as warehouse management systems (WMS), transportation management systems (TMS), and enterprise resource planning (ERP) systems.

- Modern warehouse systems can offer several benefits to businesses, including:

a) Improved efficiency: Automated systems can move goods faster and with fewer errors than manual labor, resulting in increased productivity and throughput.
b) Enhanced accuracy: Automated systems are less prone to human error, leading to more accurate inventory management and order fulfillment.
c) Increased scalability: Automated systems can be easily scaled up or down to accommodate changing business needs, making them a good option for growing businesses.
d) Improved safety: Automated systems can reduce the risk of workplace injuries, as they eliminate the need for manual lifting and handling of heavy items.

Therefore, in general, contemporary warehouse systems are gaining widespread popularity among companies of various scales and sectors, owing to their capacity to enhance operational effectiveness, lower expenses, and offer superior customer service.

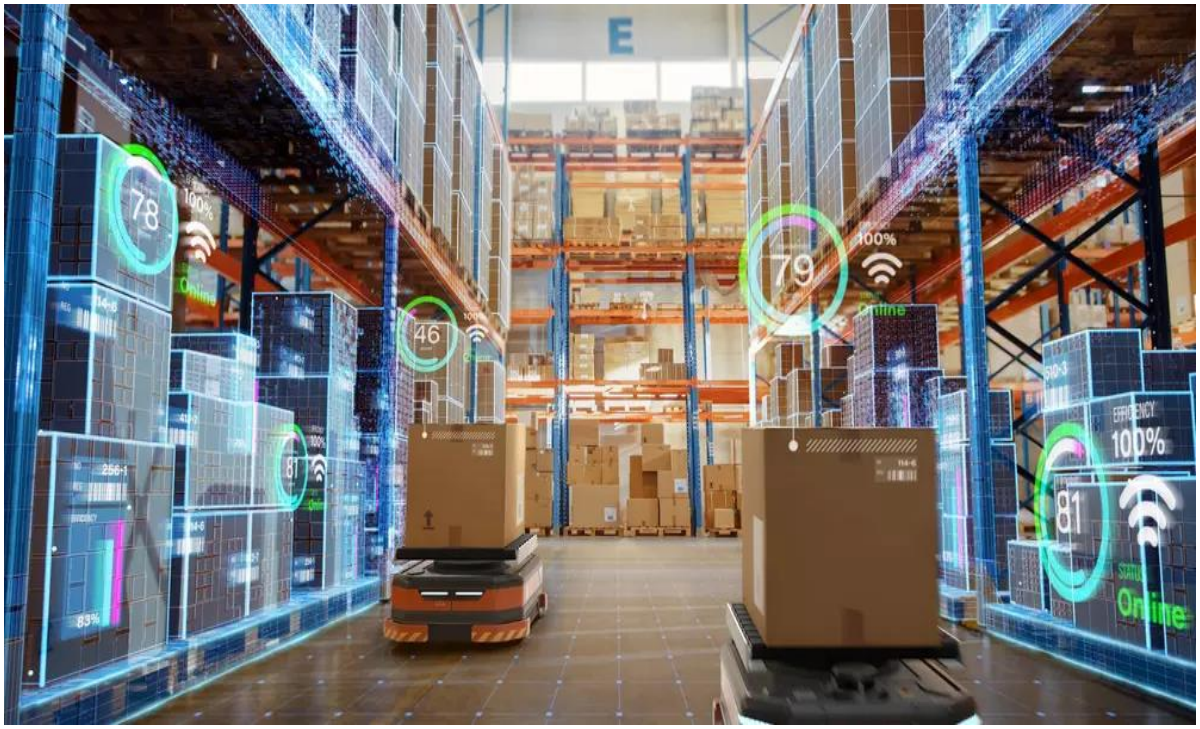


Figure: Automated Warehousing

3.4 TRADITIONAL LABOR PRACTICES IN WAREHOUSES.

Following are some of the traditional labor practices commonly used in warehouses:

- ASSEMBLY LINE WORK:

This practice involves dividing a manufacturing process into a series of tasks that are performed by different workers. Each worker is responsible for performing the same task repeatedly as the product moves along the assembly line. This kind of job often requires physical exertion and repetitive tasks, which can result in injuries related to repetitive movements, such as carpal tunnel syndrome, and disorders affecting the musculoskeletal system.

- PIECE WORK:

This payment system incentivizes workers to produce as much as possible in a given period. However, it can also result in low wages for workers who are unable to produce at high rates due to factors such as age, physical limitations, or lack of experience. Furthermore, employers might deliberately establish low rates for piecework to maximize their profits, which can lead to the exploitation of workers.

- SHIFT WORK:

Many warehouses operate around the clock, so shift work is a common practice. This can lead to disrupted sleep patterns, which can negatively impact physical and mental health. Moreover, employees who have families may encounter challenges in managing their work schedules alongside their familial responsibilities, resulting in stress and exhaustion.

- OVERTIME:

Overtime is often required in warehouses during peak seasons or periods of increased demand. While this can provide workers with additional income, it can also lead to fatigue, decreased job satisfaction, and increased risk of injury.

- LIMITED BREAKS:

In some warehouses, breaks may be limited due to productivity goals or understaffing. Workers who are unable to take adequate breaks may experience physical and mental fatigue, leading to decreased productivity and increased risk of injury.

In general, while conventional labor practices in warehouses have been in use for an extended period, they may adversely affect workers' health and welfare. Consequently, several businesses are adopting modern and worker-oriented labor practices to establish safer and more comfortable working conditions for their employees.

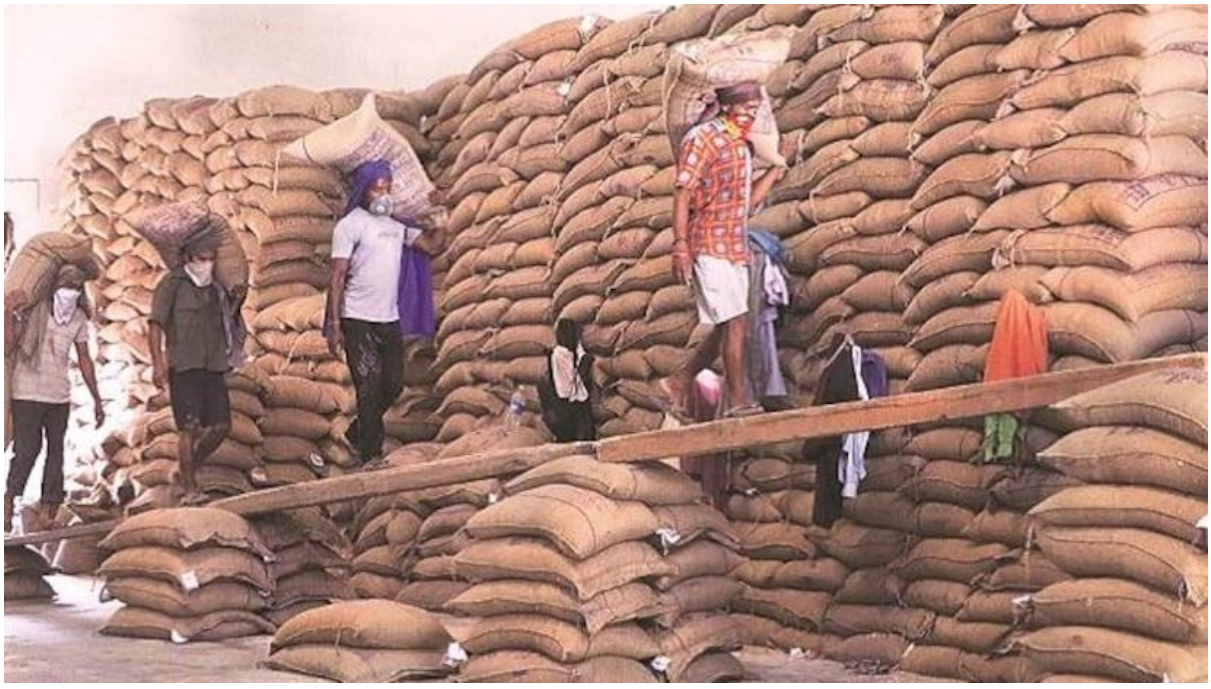


Figure: Traditional labor practices

3.5 HOW EMPLOYEES ARE TREATED IN TRADITIONAL WAREHOUSES?

Some common issues with traditional warehouse labor practices include:

- POOR WORKING CONDITIONS:

Some traditional warehouses may have unsatisfactory working conditions, with insufficient safety measures, lighting, or ventilation. Employees may encounter physical dangers such as exposure to hazardous substances, extreme temperatures, or other work-related risks.

- LOW WAGES:

Employees in traditional warehouses might receive low remunerations, especially if their pay is based on piecework or if they have limited ability to negotiate wages. This can create financial difficulties, making it hard for workers to meet their financial obligations and leading to financial stress.

- LIMITED JOB SECURITY:

In some traditional warehouses, workers may be employed on a temporary or casual basis, with little job security. This can make it difficult for workers to plan for the future or access benefits such as health insurance or retirement savings.

- LIMITED OPPORTUNITIES FOR ADVANCEMENT:

Workers in traditional warehouses may have limited opportunities for career advancement, with little opportunity for training or development. A consequence of this can be reduced motivation and job satisfaction.

3.6 EMPLOYEE EMPLOYER RELATION IN TRADITIONAL WAREHOUSING.

The relationship between employees and employers in traditional warehousing can be complex and is frequently influenced by aspects such as local labor regulations, the particular industry, and the hierarchical dynamics between workers and management. Some common aspects of the employee-employer relationship in traditional warehousing include:

- HIERARCHICAL MANAGEMENT STRUCTURE:

Traditional warehouses often have a hierarchical management structure, with a clear chain of command and strict reporting lines. Workers may be expected to follow orders and may have limited input into decision-making processes, resulting in a lack of independence and job satisfaction.

- LIMITED COMMUNICATION:

Communication between workers and management in traditional warehouses may be limited, particularly if management is not present on the warehouse floor or if workers are afraid to speak up about workplace issues. This can lead to a lack of transparency and accountability, with workers feeling disconnected from the decision-making process.

- LIMITED BENEFITS:

Traditional warehouses may offer limited benefits to workers, particularly if workers are employed on a temporary or casual basis. Workers may not have access to health insurance, retirement savings, or paid time off, which can make it difficult for them to manage their health and well-being.

- LIMITED JOB SECURITY:

Workers in traditional warehouses may have limited job security, particularly if they are employed on a temporary or casual basis. This can create a power imbalance between workers and management, with workers feeling vulnerable to exploitation or abuse.

- LIMITED OPPORTUNITIES FOR ADVANCEMENT:

Traditional warehouses may have limited opportunities for career advancement, particularly for workers in lower-level positions. This can create a sense of stagnation and lack of motivation, with workers feeling that there is no clear path for advancement within the company.

Overall, the employee-employer relationship in traditional warehousing can be characterized by a lack of communication, limited benefits and job security, and a hierarchical management structure. However, some companies have taken steps to improve this relationship by providing more benefits, training opportunities, and opportunities for communication and feedback.

CHAPTER 4

CURRENT WAREHOUSING AFTER AUTOMATION.

Warehouse automation is a rapidly growing trend that is transforming the way warehouses operate. With the help of advanced technologies such as robotics, automation, and data analytics, warehouses are becoming more efficient, productive, and cost-effective. Automation has brought about many changes in warehouses, including increased efficiency, improved safety, reduced labor costs, increased capacity, and improved data collection. In this era of Industry 4.0, warehouses are embracing the benefits of automation to keep pace with the demands of the modern business landscape. In this context, it is important to understand the current changes in warehouses after automation, to appreciate the transformative impact that this trend is having on the logistics and supply chain industries.

4.1 USE OF ROBOTICS AND TECHNOLOGIES IN WAREHOUSE.

The use of robotics and automation technologies in warehouses has become increasingly popular in recent years. These technologies are being used to perform a wide range of tasks, from order picking and packing to inventory management and shipping. Here are some of the ways in which robotics and automation technologies are being used in warehouses:

- ORDER PICKING:

Robots can be used to pick and move products around the warehouse, reducing the need for human workers to perform these tasks. Automated picking systems can be used to select products from shelves and move them to a designated location for packing and shipping.

- PACKING AND SHIPPING:

Automated systems can be used to pack products into boxes or pallets and prepare them for shipping. This can include the use of robotic arms to stack boxes or pallets, and automated conveyors to move products to the loading dock.

- INVENTORY MANAGEMENT:

Automated systems can be used to track the movement of goods and materials in the warehouse. This includes the use of Radio Frequency Identification (RFID) technology to track inventory levels, and automated systems to move products from one location to another.

- INSPECTION AND QUALITY CONTROL:

Robotics can be used to inspect products for defects or damage, improving the accuracy of quality control processes. Automated systems can also be used to detect errors in packing and shipping, reducing the risk of errors and improving customer satisfaction.

- MAINTENANCE AND REPAIRS:

Robotics and automation technologies can be used to perform maintenance and repairs on warehouse equipment, reducing the need for human workers to perform these tasks.

In general, the utilization of robotics and automation technologies in warehouses can enhance efficiency, velocity, and precision while decreasing labor expenses and advancing safety. By automating monotonous and physically exhausting tasks, human workers can concentrate on more intricate and value-adding tasks, leading to enhanced job gratification and amplified productivity.

Figure: Use of robotics and technologies

4.2 AUTOMATED GUIDED VEHICLES (AGVS)

Automated Guided Vehicles (AGVs) are robotic vehicles that are designed to transport goods and materials around a warehouse or manufacturing facility. AGVs are equipped with sensors, cameras, and other technologies that allow them to navigate through the warehouse without the need for human intervention. AGVs come in a variety of shapes and sizes, from small carts to large pallet movers, and can be customized to fit the specific needs of a warehouse.

AGVs are being used in warehouses to transport goods and materials in a number of ways:

- PALLET AND CASE HANDLING:

AGVs can be used to move pallets and cases of products from one location to another. They can also be used to load and unload trucks, reducing the need for human workers to perform these tasks.

- ORDER PICKING:

AGVs can be used to transport goods and materials to picking stations, where human workers can then select the required items. This can speed up the picking process and reduce errors.

- ASSEMBLY LINE TRANSPORT:

AGVs can be used to transport materials and parts to assembly lines, where they can be used in the manufacturing process. This can improve the efficiency of the assembly line and reduce the risk of errors.

- INVENTORY MANAGEMENT:

AGVs can be used to track the movement of goods and materials in the warehouse, helping to improve inventory accuracy and reduce the risk of stockouts.

- HAZARDOUS MATERIAL HANDLING:

AGVs can be used to transport hazardous materials, reducing the risk of injury to human workers.

Figure: AVGs

4.3 INVENTORY MANAGEMNET SYSTEM.

Automated inventory management systems are being used in warehouses to improve the efficiency and accuracy of warehouse operations. These systems use a combination of sensors, cameras, and software to track the movement of goods and materials in real-time. Here are some of the ways in which automated inventory management systems are improving warehouse operations:

- REAL-TIME TRACKING:

Automated inventory management systems allow warehouse managers to track inventory levels in real-time. This can help to reduce the possibility of experiencing a shortage of stock or inventory and ensure that products are always available for order fulfillment.

- REDUCED LABOR COSTS:

Automated inventory management systems can reduce the need for human workers to perform inventory counts and stock checks. This can help to reduce labor costs and free up human workers to perform other tasks.

- IMPROVED ACCURACY:

Automated inventory management systems can improve the accuracy of inventory counts and reduce the risk of errors. By using sensors and cameras to track the movement of goods and materials, these systems can provide more accurate inventory counts than manual counts.

- INCREASED EFFICIENCY:

Automated inventory management systems can help to improve the efficiency of warehouse operations by reducing the time required for inventory counts and

stock checks. This can help to speed up the order fulfillment process and reduce the risk of delays.

- BETTER DEMAND PLANNING:

Automated inventory management systems can provide valuable data on inventory levels, demand patterns, and order trends. This can help warehouse managers to better plan for future demand and ensure that they have enough stock on hand to meet customer needs.

4.4 WAREHOUSE MANAGEMENT SYSTEM(WMS).

Warehouse Management Systems (WMS) are software applications that are designed to optimize the operations of a warehouse. A WMS typically includes a range of features and functionalities, such as inventory management, order processing, receiving and putaway, picking and shipping, and labor management. Here are some of the ways in which WMS are being used to optimize warehouse operations:

- INVENTORY MANAGEMENT:

WMS can help to optimize inventory management by providing real-time visibility into inventory levels, locations, and movements. This can help warehouse managers to reduce the possibility of experiencing a shortage of stock or inventory and surplus stock and ensure that products are always available for order fulfillment.

- ORDER PROCESSING:

WMS can help to optimize order processing by automating the process of order picking, packing, and shipping. This can help to reduce the time required for order fulfillment and improve the accuracy of order processing.

- RECEIVING AND PUTAWAY:

WMS can help to optimize the receiving and putaway process by automating the process of receiving goods, assigning them to specific locations, and updating inventory records. This can help to reduce errors and improve the efficiency of the receiving process.

- PICKING AND SHIPPING:

WMS can help to optimize the picking and shipping process by providing real-time visibility into order statuses and inventory levels. This can help warehouse managers to optimize the picking process and ensure that orders are shipped on time and accurately.

- LABOR MANAGEMENT:

WMS can help to optimize labor management by providing real-time data on labor productivity, task completion rates, and worker availability. This can help warehouse managers to better allocate resources and optimize the use of human workers in the warehouse.

4.5 ARTIFICIAL INTELLIGENCE (AI) AND MACHINE LEARNING (ML).

AI (Artificial Intelligence) and ML (Machine Learning) are being increasingly used in warehouses to optimize processes and improve efficiency. Here are some of the ways in which AI and ML are being used in warehouses:

- PREDICTIVE MAINTENANCE:

The utilization of AI and ML algorithms can predict potential equipment failure, enabling warehouse managers to schedule maintenance in advance. As a result, this approach can diminish downtime, advance the lifespan of equipment, and reduce repair costs.

- INVENTORY OPTIMIZATION:

AI and ML algorithms can analyze data on past demand patterns and order volumes to predict future demand and optimize inventory levels. This can help to reduce inventory carrying costs and avoid stockouts.

- ROBOTICS AND AUTOMATION:

AI and ML algorithms can be used to optimize the performance of robots and automated systems in the warehouse. These algorithms can analyze data on past performance and adjust operations in real-time to optimize efficiency and reduce errors.

4.6 IMPACT ON WORKERS.

Warehouse automation has significant implications for human workers, both positive and negative. Here are some of the ways in which warehouse automation can impact human workers and how businesses can ensure the safety and well-being of their employees:

- JOB LOSSES:

Automation can lead to job losses as machines and robots replace human workers. Companies must develop a strategy to provide additional training and education to their employees to assist them in adapting to new job roles or sectors.

- WORKFORCE TRANSFORMATION:

Automation can also lead to the transformation of the workforce, with new job roles emerging that require different skills and capabilities. Businesses should invest in employee training and development to ensure that their workers are equipped with the necessary skills to work together with machines and robots.

- HEALTH AND SAFETY RISKS:

The implementation of warehouse automation has the potential to create safety hazards for workers, including incidents involving machinery and robots, the risk of exposure to dangerous substances and so on. Businesses should conduct regular risk assessments and provide appropriate training and protective equipment to mitigate these risks.

- MENTAL HEALTH:

The implementation of automation in the warehouse can also lead to stress, anxiety, and job insecurity among workers. Businesses should provide support

for their employees, such as counseling services, to help them cope with the changes.

- COLLABORATION AND COMMUNICATION:

Warehouse automation can change the way workers collaborate and communicate with each other. Businesses should encourage open communication and collaboration between human workers and machines to ensure that work is done safely and efficiently.

To ensure the safety and well-being of their employees, businesses should involve their workers in the implementation of automation in the warehouse, provide appropriate training and development opportunities, prioritize health and safety, and offer support for employees affected by the changes. By prioritizing the well-being of their employees, businesses can ensure a smooth transition to warehouse automation while maintaining a positive and productive work environment.

CHAPTER 5

ADVANTAGES AND DISADVANTAGES

5.1 ADVANTAGES OF TRADITIONAL WAREHOUSING

There are several advantages of traditional warehousing that businesses may consider, even in the face of increasing automation and technological advancements. Here are some of the advantages:

- Flexibility: Traditional warehousing offers businesses a great degree of adaptability to modify their operations according to shifting market needs. For example, if a company suddenly needs more space or workers in the warehouse to meet a high demand, traditional warehousing allows them to quickly and easily make these adjustments.
- Cost-effectiveness: For businesses that have smaller warehouses or lower inventory levels, traditional warehousing may be a more economical option. This is because it does not necessitate significant investments in automated technologies, and labor expenses can be more efficiently controlled.
- Personalized Service: Traditional warehousing provides the opportunity for personalized service. Human workers can provide customized services to meet individual customer needs, such as packing, labeling, and even hand delivery.
- Location: Traditional warehousing can be located closer to customers or transportation hubs, reducing transportation costs and lead times.
- Scalability: The flexibility of traditional warehousing enables it to be adjusted according to the changing requirements of a business. It can be conveniently restructured to accommodate new product lines or variations in inventory levels.
- Job Creation: Traditional warehousing creates jobs for human workers, which can benefit local economies and provide opportunities for workers.

5.2 DISADVANTAGES OF TRADITIONAL WAREHOUSING.

While traditional warehousing has its advantages, it also has some disadvantages that businesses should consider. Here are some of the disadvantages:

- Labor Costs: Traditional warehousing is heavily dependent on human labor, which can be expensive and prone to mistakes. This may lead to increased labor expenses and reduced precision in managing inventory.
- Limited Efficiency: Traditional warehousing may not be as efficient as automated warehouses, as manual processes can be slower and more prone to errors. This can result in longer lead times and reduced productivity.
- Limited Scalability: Traditional warehousing may not be as easily scalable as automated warehouses, as increasing warehouse space and staff may require significant investments of time and money.
- Limited Data Collection: Traditional warehousing may not be able to collect and analyze data as effectively as automated warehouses, as data collection may rely on manual processes and paper records.
- Limited Space Utilization: Traditional warehousing may not be able to make optimal use of warehouse space, as human workers may not be able to stack products as high or as densely as automated systems.
- Limited Agility: Traditional warehousing may not be as agile as automated warehouses, as it may take longer to adapt to changes in demand or product lines.

Businesses should weigh the advantages and disadvantages of traditional warehousing and consider their specific needs and goals when making decisions about their supply chain operations. While automation and technological

advancements offer significant benefits; traditional warehousing may still be a viable option for some businesses.

5.3 ADVANTAGES OF AUTOMATED WAREHOUSING.

Automated warehousing provides several advantages for businesses that can help improve their functioning. Here are some of the advantages of automated warehousing:

- Increased Efficiency: Automated warehousing can significantly increase the efficiency of warehouse operations by reducing the time it takes to move products and materials, and improving inventory management accuracy.
- Improved Productivity: Automated systems have the ability to operate continuously without interruption, leading to increased productivity and reduced lead times.
- Space Utilization: Automated systems can optimize the use of warehouse space by stacking products higher and more densely than human workers, which can increase warehouse capacity.
- Cost Savings: Automated systems can help reduce labor costs and decrease the number of errors associated with manual processes. Businesses can achieve considerable cost reductions in the long run as a consequence of this.
- Real-time Data Collection: Automated systems can collect and analyze real-time data, allowing businesses to monitor and optimize warehouse operations in real-time, resulting in better decision-making.

- Reduced Workplace Injuries: Automated systems can help reduce the risk of workplace injuries associated with manual handling of heavy products or working at heights.
- Scalability: Automated systems can be easily scaled up or down to meet changing business needs, which can help businesses stay agile and adaptable to changing market conditions.

5.4 DISADVANTAGES OF AUTOMATED WAREHOUSING.

While automated warehousing offers many advantages, there are also some disadvantages that businesses should consider when deciding whether to invest in automation. Here are some of the disadvantages of automated warehousing:

- High Initial Investment Costs: The initial investment costs of automated warehousing can be high, which can be a significant barrier for small and medium-sized businesses.
- Complexity of System: Automated systems are complex, which requires specialized knowledge and skills to operate and maintain. This can lead to increased training costs and the need to hire specialized personnel.
- Limited Flexibility: Automated systems are designed to perform specific tasks, which can limit their flexibility when it comes to adapting to changes in product lines or shifts in market demand.
- System Downtime: Automated systems can experience downtime due to software or hardware failures, which can disrupt warehouse operations and lead to lost productivity.

- Cybersecurity Risks: The security and integrity of warehouse data and operations can be at risk due to cybersecurity threats that can exploit vulnerabilities in automated systems.
- Limited Human Interaction: Automated systems can limit human interaction, which can lead to a loss of job opportunities for human workers.
- Environmental Impact: Automated systems consume significant amounts of energy, which can have an impact on the environment and lead to increased operating costs.

Overall, businesses should weigh the advantages and disadvantages of automated warehousing and consider their specific needs and goals when making decisions about their supply chain operations. While automation can provide many benefits, it may not be suitable for all businesses or situations.

CHAPTER 6

GOVERNMENT POLICIES SUPPORTING LABOUR AND AUTOMATION IN WAREHOUSES.

There are a variety of government policies that can support both labor and automation in warehouses, depending on the specific goals and priorities of policymakers. Here are some of government policies supporting automation in warehouses:

- WORKFORCE TRAINING PROGRAMS:

Many governments offer workforce training programs that can help warehouse workers acquire the skills needed to work effectively with automated systems. These programs can be funded through a variety of sources, such as government grants, employer contributions, or public-private partnerships.

- LABOR PROTECTIONS AND WAGE SUBSIDIES:

Governments can also implement policies to protect the rights and wages of warehouse workers. This can include minimum wage laws, overtime regulations, and safety standards that ensure workers are not exploited or put in harm's way. At the same time, governments can offer wage subsidies or other financial support to help workers transition to new roles or acquire new skills as automation becomes more prevalent in the industry.

- COLLABORATIVE APPROACHES TO AUTOMATION:

Governments can encourage collaboration between labor unions, employers, and other stakeholders in the warehouse industry to develop policies and practices that support both labor and automation. This can include initiatives such as joint training programs or task forces focused on addressing the social and economic impacts of automation on workers and communities.

- SUPPORT FOR DISPLACED WORKERS:

Governments can provide support for workers who are displaced by automation. This can include retraining programs, job placement services, and financial

assistance to help workers transition to new roles or industries. By supporting workers during this period of transition, governments can help to minimize the social and economic impacts of automation on affected communities.

- PUBLIC-PRIVATE PARTNERSHIPS:

Governments can also partner with private companies to develop and implement automation solutions in warehouses. This can include joint research and development efforts, as well as pilot projects that test new technologies in real-world settings. These partnerships can help to accelerate the adoption of automation while also creating new opportunities for workers and businesses.

- FLEXIBLE WORK ARRANGEMENTS:

With the rise of automation, some warehouse workers may be concerned about job security or changes to their working conditions. Governments can address these concerns by promoting flexible work arrangements, such as part-time or remote work options, that allow workers to adapt to changes in the industry.

- TRADE AGREEMENTS:

Governments may negotiate trade agreements that promote the adoption of automation technologies in the logistics and supply chain sector. For example, the United States-Mexico-Canada Agreement (USMCA) includes provisions to support the development of e-commerce and digital trade, which can drive the adoption of automation technologies in warehouses.

- GRANTS AND SUBSIDIES:

Governments may offer grants and subsidies to businesses that invest in automation technologies. For example, the European Union's Horizon 2020 program offers funding for research and innovation projects related to automation in logistics and supply chain management.

- STANDARDS AND CERTIFICATION PROGRAMS:

Governments may establish standards and certification programs to ensure the safety and quality of automated systems used in warehouses. For example, the International Organization for Standardization (ISO) has developed standards for the safety of industrial robots, which can help businesses ensure the safety of their employees when using automated systems.

- INNOVATION HUBS:

Governments may establish innovation hubs or technology parks to support the development of new automation technologies and solutions for warehouses. For example, the Advanced Robotics for Manufacturing (ARM) Institute in the United States is a public-private partnership that aims to advance the adoption of robotics in manufacturing and supply chain operations.

- RESEARCH AND DEVELOPMENT FUNDING:

Governments may provide funding for research and development of new technologies and automation solutions for warehouses.

- INFRASTRUCTURE SUPPORT:

Governments may provide support for the development of infrastructure to support automated systems, such as high-speed internet connectivity and other technologies required for automation.

- REGULATORY FRAMEWORKS:

Governments may establish regulatory frameworks to ensure the safety and reliability of automated systems, as well as to promote the ethical use of these technologies.

Overall, government policies and initiatives can play an important role in driving the adoption of automation technologies in warehouses, helping businesses to improve their efficiency, productivity, and competitiveness.

CHAPTER 7

FINDINGS AND SOLUTIONS

7.1 FINDINGS.

The study of the role of automation in warehouse operations and its impact on labor has revealed several findings:

1. Increased Efficiency: Automation technologies such as AGVs, robotics, and inventory management systems have improved the speed and accuracy of warehouse operations, resulting in increased efficiency and productivity.
2. Reduced Labor Costs: Automated systems can perform tasks that were previously done manually by human workers, resulting in reduced labor costs for businesses.
3. Changes in Job Requirements: As more tasks become automated, the role of human workers in warehouses is changing. Workers may need to be trained in new skills, such as programming and operating automated systems, to remain competitive in the workforce.
4. Safety Concerns: Automated systems can improve safety in warehouses by reducing the risk of accidents and injuries. However, there are also concerns about the safety of human workers working alongside automated systems, and businesses need to ensure that adequate safety measures are in place.
5. Potential Job Losses: Automation technologies can replace some jobs previously done by human workers, leading to potential job losses in the industry. However, some studies suggest that automation can also create new job opportunities, particularly in areas such as programming and maintenance of automated systems.
6. Increased Demand for Skilled Workers: As automation technologies become more prevalent in warehouses, the demand for skilled workers with expertise in robotics, programming, and data analytics is likely to

increase. This can create new job opportunities for workers with these skills.

7. Shifts in Workforce Demographics: Introducing automation technologies in warehouses can cause changes in the composition of the workforce. Senior employees who have less exposure to modern technologies may encounter difficulties in adjusting to the new automated systems, whereas younger employees who are more familiar with technology might have an edge.
8. Improved Working Conditions: Automation technologies can also improve working conditions for warehouse workers by reducing physical strain and the risk of injuries associated with manual labor. This can lead to a healthier and more satisfied workforce.
9. Greater Customization: Automated systems can also enable greater customization of warehouse operations to meet the specific needs of customers. This can result in more personalized service and greater customer satisfaction.
10. Increased Flexibility: Automation technologies can also increase the flexibility of warehouse operations, enabling businesses to quickly adapt to changing market conditions and customer demands. This can help businesses remain competitive in a rapidly changing business environment.

7.2 SOLUTIONS.

Based on the findings of the study, here are some potential solutions to mitigate the impact of automation on labor in warehouse operations:

1. Provide Training and Support: Businesses should provide training and support to employees to ensure they have the necessary skills and knowledge to operate and maintain automated systems. This will help workers adapt to new job requirements and take advantage of new job opportunities that arise from the adoption of automation.
2. Invest in Safety Measures: Safety measures should be implemented to protect workers who are working alongside automated systems. This may include barriers, warning signs, and other safety equipment. Regular safety training and audits should also be conducted to ensure that workers are aware of the potential risks and how to avoid them.
3. Ensure Job Security: Businesses should provide job security for workers who are at risk of being replaced by automation technologies. This may include retraining workers for new roles, or finding new job opportunities within the company.
4. Create New Job Opportunities: Automation technologies can create new job opportunities in areas such as programming, data analytics, and system maintenance. Businesses should actively seek to create these new job opportunities and invest in training programs to ensure that workers are equipped with the necessary skills.
5. Involve Workers in the Transition Process: Workers should be involved in the transition process to automation, and their feedback and input should be taken into account when implementing new technologies. This will help

to ensure that the transition is smooth and that workers feel valued and supported during the process.

6. Promote Collaboration: Collaboration between human workers and automated systems can lead to more efficient and effective warehouse operations. Businesses should encourage collaboration between workers and automated systems, and invest in technologies that enable this collaboration, such as wearables and IoT devices.

Overall, by taking these steps, businesses can mitigate the impact of automation on labor in warehouse operations and ensure that the transition to new automated systems is a positive one for both workers and the business as a whole.

7.3 SUGGESTIONS.

- Laborers should be known and updated with the advancement in warehouse industry.
- Provide training and workshop sections to the laborers.
- Establishment of new technologies should be with less impact on laborers.
- Increase of automation in warehouses increase the total productivity and efficiency of the industry.
- Adopting robotics, technologies, AGVs make warehouse operations in a better standardized systematic manner.
- Laborers who lose their jobs must either be trained for the same or employed for some other jobs.
- More supporting constraints must be provided by government to the laborers and automated warehouse in order for the development of warehouse industry as a whole.

7.4 CONCLUSION.

In conclusion, automation technologies are rapidly transforming warehouse operations, enabling businesses to increase efficiency, reduce costs, and improve customer service. However, the adoption of automation technologies also has a significant impact on labor in warehouse operations. The study has found that automation can lead to job displacement and increased job insecurity for workers.

To mitigate these impacts, businesses should prioritize worker training and support, invest in safety measures, provide job security, create new job opportunities, involve workers in the transition process, and promote collaboration between workers and automated systems. By taking these steps, businesses can ensure that the transition to automation is a positive one for both workers and the business as a whole.

It is important to note that the impact of automation on labor is complex and diverse, and further research is needed to fully understand the implications of automation on workers in different contexts. Nevertheless, this study provides valuable insights into the challenges and opportunities presented by automation in warehouse operations, and highlights the importance of balancing the benefits of automation with the well-being of workers.

CHAPTER 8

BIBLIOGRAPHY

➢ BOOKS

- Warehousing in the Global Supply Chain: Advanced Models, Tools and Applications for Storage Systems by Jyoti Gondek and David A. Collier
- Robotics and Automation in the Food Industry: Current and Future Technologies by Darwin G. Caldwell and Siu-Chung Wong
- Automation in Warehouse Development by John M. Bartholdi III

➢ WEBSITES

- Robotics Business Review - https://www.roboticsbusinessreview.com/
- Material Handling & Logistics - https://www.mhlnews.com/
- Supply Chain Dive - https://www.supplychaindive.com/
- Logistics Management - https://www.logisticsmgmt.com/
- Warehouse Automation News - https://warehouseautomationnews.com/
- Forbes - https://www.forbes.com/technology/
- Harvard Business Review - https://hbr.org/topic/supply-chain
- Gartner - https://www.gartner.com/en/supply-chain