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Study of Automation and Technology in Warehouse Management

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Abstract:- This report explores the potential benefits of new technology for the sustainable management of warehouse operations in the context of Quick Delivery E-Commerce, using Swiggy Instamart Rohini as a case study. Two research questions have been developed to explore how the increased use of technology impacts the management of warehouses, and how it can affect sustainability. Lean manufacturing is a production method aimed at streamlining production processes and reducing response times to customers and suppliers, and by implementing Lean Manufacturing in conjunction with Industry 4.0, firms can achieve significant improvements in their warehouse operations. Automation and 3D design software can help firms design efficient warehouse layouts, ultimately increasing efficiency rates and contributing to sustainable warehouse management.

Keywords:- *Warehouse operations, technology, Industry 4.0 , internal logistics and Lean Manufacturing.*

I. INTRODUCTION

Industry 4.0 is transforming warehouse operations by incorporating new technologies like the Internet of Things (IoT), big data analytics, and artificial intelligence (AI). This allows warehouses to be more agile and responsive to customer needs, with improved efficiency. It also enables businesses to gain a competitive advantage in the market and provide better service to their customers. Additionally, it can provide real-time information on inventory location and quantity, integrate data sharing between ERP modules and standalone software products, monitor and report productivity, and simplify daily warehouse processes. Industry 4.0 technologies are revolutionizing warehouse management by enabling warehouses to optimize their space utilization, reduce storage costs, and increase capacity.

This is achieved through the use of smart sensors, AI algorithms, and other advanced technologies such as the Internet of Things, digital communication, and are new models of warehouse management that utilize cutting-edge technology to streamline processes and increase efficiency, optimizing efficiency and performance. They offer enhanced capabilities and a more sophisticated approach to warehouse management, with sensors for capturing product and process information, real-time communication, energy-efficient installations, and integrated management platforms for processing and analyzing large amounts of data. Industry 4.0 warehouse functions are a comprehensive system that utilizes advanced technologies such as Artificial Intelligence and Machine Learning to reduce unnecessary steps and increase productivity. It also includes sensors, real-time communication, energy-efficient installations, and integrated management platforms. Benefits of automation include resource optimization, efficient warehousing, error reduction, improved inventory control, and swift production. Automated systems can reduce costs, streamline processes, optimize inventory management, and increase the speed of production.

II. LITERATUREREVIEW

The warehousing function has become an important business issue due to the competitive global business environment and its impact on return on assets (ROA). To address this, organizations are turning to technology and warehouse management systems (WMSs) to attain a competitive advantage. WMSs are software used to support and optimize warehouse processes and management, which mainly contain four processes: receiving, storage, order picking, and shipping. The benefits of introducing technology in warehouses include improved control, reduced operational costs, coordinated flows of products, better use of space, and fewer manual handling operations.Task complexity and market dynamics are key drivers of warehouse management, with task complexity being the stronger driver. Technology can upgrade current systems and increase efficiency, productivity, and quality of work, leading to a reduction in the risk of errors. Organizations must understand how to use technology to improve performance and capture benefits efficiently

III. METHODOLOGY

A. Research Design

The research design chosen for this research report is a case study. This type of research involves examining a specific situation in great detail and is considered descriptive. Multiple data collection techniques are utilized, such as interviews, observations, document analysis, and literature review. Case study research is holistic and inductive, starting with a general standpoint and moving towards a specific entity. However, there are also challenges to the validity of findings when collecting and analyzing data in a case study.

Despite this, the choice of a single case study was made for this research project. This type of research is appropriate for exploratory research, allowing for a more in-depth understanding of the subject matter. The research project will focus specifically on a single case study conducted at the Swiggy Insta mart warehouse in Rohini, India, using a single case study approach.

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B. Methods for Collecting Data

This section describes the various methods used to collect data for the research. Semi-structured interviews were conducted to gain a comprehensive understanding of the warehouse processes and its current state. Observation was used to provide insight into people's behavior and events in a setting. Scan and behavior observation techniques were used to quickly scan a whole group or individualat regular intervals and record information. The duration of each interview varied from 15 to 60 minutes depending on the response of the interviewee and the amount of information they shared.

Behavior observation involves selecting a particular behavior and recording who displays it and when. Both participant and non-participant observation approaches were used, and a semi-structured approach was found to be most advantageous. Document analysis was performed to gain a better understanding of the subject matter. Literature review was conducted to present previous theories and studies relevant to the research topic. The process involved identifying, locating, synthesizing, and analyzing relevant literature, such as research reports, articles, books, and other materials. The data obtained through the literature review was analyzeusing a content analysis approach.

C. Data Analysis

Data analysis was conducted to compare and draw relevant conclusions from interviews, observations, documents, and literature review data. Interview data was carefully analyzed to compare and draw relevant conclusions, while observation data was analyzed both conscious and unconscious. Document data was analyzed with care and discussed to ensure a clear understanding and interpretation of the information. Literature review data was analyzed using a systematic approach to assess the relevance of articles sourced from databases such as ProQuest, Scopus, and Primo. Search words and keywords from the research questions were used as guidelines to select relevant articles. The information collected was analyzed and compared to draw relevant conclusions

IV. CASE STUDY

Swiggy Instamart is an online grocery delivery platform that operates under the Swiggy brand name. It is a new addition to Swiggy's range of services and was launched in August 2020 in select locations in India. Swiggy Instamart aims to deliver groceries and household essentials to customers within 30 minutes of placing an order.

A. The Challenges:

The most important details in this text are the major challenges in the current process that hinder the smooth flow of the process. These include manual data entry, congestion in the storage room, inefficient order picking, poor visibility, and limited automation. Manual data entry is a time-consuming process and prone to errors, congestion in the storage room is due to limited storage space, inefficient order picking is inefficient and time-consuming, poor visibility is due to lack of visibility in terms of stock levels, and limited automation is due to limited use of automation technologies such as conveyor belts or automated storage.

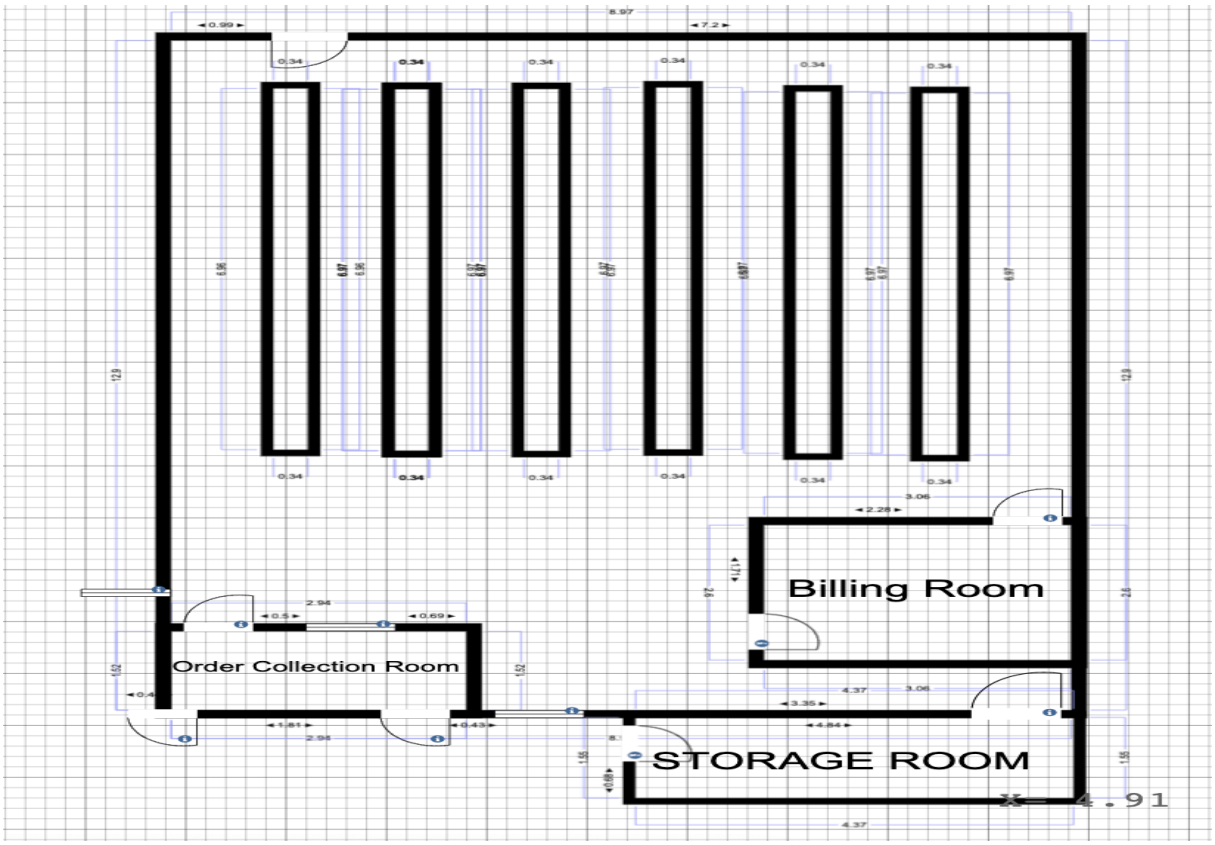

Fig. 1: Floor Layout (Current)

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B. Proposed Improvements:

The most important details in this text are the proposed improvements to address the challenges mentioned above. These include automated data entry, improved storage space, optimized order picking process, increased visibility, and increased automation. Automated data entry involves barcode scanning technology to reduce the time required to enter data and reduce the chances of errors. Improved storage space involves an automated storage and retrieval system to allow for efficient use of vertical space and improve accessibility and traceability of goods. Optimized order picking process involves a pick-to-light system to guide employees to the exact location of the item, increased visibility involves a real-time inventory management system to provide accurate information about stock levels, and increased automation involves conveyor belts and automated storage systems to reduce reliance on manual labor.

C. Expected Benefit:

The proposed improvements are expected to bring about the following benefits: improved efficiency, increased accuracy, better space utilization, improved customer satisfaction, and cost savings. The proposed improvements will reduce the time required to

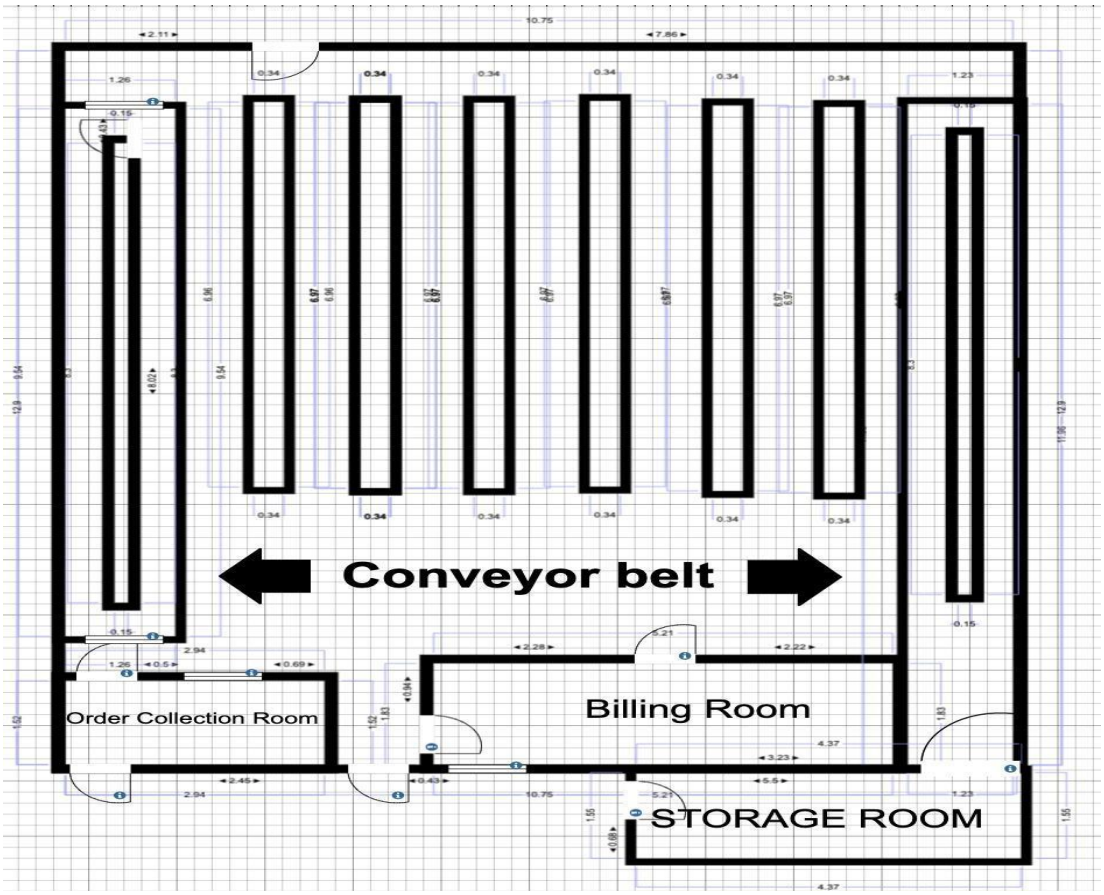

Fig. 2: Floor Layout (Proposed)

Improve space utilization, improve customer satisfaction, and increase cost savings. Additionally, the optimized order picking process and real-time inventory management system will lead to faster and more accurate delivery, improving customer satisfaction.

A. Current Layout Cycle Time Computations

➢ *Process 1:*

Receiving and entry cycle time (for 1 pallet/carton) (in sec) = 15 (for unloading pallet from truck and placing in storage room)+ 5 (reaching back to truck) + 15 (taking pallet from storage to the computer for entry) + 10 (entry of goods to computer) = 45 secs

Taking a 5 sec allowance. So total time = 50 sec

➢ *Process 2:*

Order cycle time = 0 (order received at warehouse) + 7 (printing of order receipt) +5 (employee reaching receipt counter) + 90 (collecting of order items) + 10 (reaching packing section) + 10 (packing order) + 10 (reaching order collection center)

= 132 secs

Taking a 20 sec allowance. So time = **152 sec** equates to a reduction in CO2 emissions by almost110-130 tonsperannum! This is also equivalent to a saving of almost 15-20paise per litre of milk.

B. Proposed Layout Cycle Time Computations

- *Process 1:*
  Receiving and entry cycle time (for 1 pallet/carton) (in sec)

  = 10 (for unloading pallet from truck and taking it to barcode scan area) + 5 (scanning barcode and auto entry of received goods) + 5 (placing it in storage) + 5 (reaching back to truck) = 25 secs

  Taking a 5 sec allowance. So total time = **30 sec**

  Hence cycle time gets reduced by 20 secs

- *Process 2 :*
  Order cycle time

  = 0 (order received at device of order collector) + 90 (collecting of order items) + 10 (reaching packing section) + 10 (packing order) + 0 (placing order on conveyor) = 110 secs

  Taking a 20 sec allowance. So time = **130 sec**

  Hence cycle time is reduced by 20 secs

V. ECONOMICAL ANALYSIS

Based on the proposed layout and implementation of smart devices, the economic analysis suggests a positive impact on the company's bottom line. The reduction in cycle time of 40 seconds for 1 pallet/box unloading and storage and preparing 1 customer order combined can increase the overall throughput of the system.

The implementation cost of the smart devices and the new layout will need to be taken into consideration, including the costs of equipment, installation, and labor. However, the benefits of increased efficiency and reduced cycle time can outweigh the costs in the long run.

In addition to the direct benefits of cost savings, the improved cycle time can result in faster turnaround times, leading to improved customer satisfaction and potentially increased sales. It can also enable the company to handle a larger volume of orders, leading to increased revenue.

Therefore, it is recommended to conduct a detailed cost-benefit analysis before implementing the proposed layout and smart devices to ensure that the investment is economically viable for the company.

VI. CONCLUSION AND FUTURE RECOMMENDATIONS

In conclusion, this report highlights the potential benefits of integrating technology into warehouse operations for SMEs like Quick Delivery E-Commerce. The study showed that technology can significantly enhance warehouse operations by improving efficiency, reducing errors, and increasing customer satisfaction. By leveraging Industry 4.0 technologies such as smart devices and automation, Quick Delivery E-Commerce can streamline its warehouse processes and remain competitive in the market.

Moreover, the implementation of technology in the warehouse requires a user-focused approach and a commitment from all employees to ensure successful adoption. It is essential to have a clear understanding of the goals and challenges of integrating technology and to develop a strategy that aligns with the company's overall objectives.

VII. FUTURE RECOMMENDATIONS

Based on the findings of this study, several recommendations can be made for Quick Delivery E-Commerce to effectively adopt technology in its warehouse operations:

- Collaborate with technology vendors and experts to stay up-to-date with the latest advancements and potential solutions.
- Develop a clear strategy that aligns with the company's overall objectives andgoals.
- Continuously evaluate the effectiveness of the implemented technology and make necessary adjustments to maximize its potential benefits.

By following these recommendations, Quick Delivery E-Commerce can ensure a successful implementation of technology in its warehouse operations and realize the potential benefits of increased efficiency and sustainability.

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