Impact of Material Handling Equipment on Warehouse Performance- A Case of Indian Warehouses located in Metro Cities

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ABSTRACT

Focusing on Indian warehouses, this paper looks at how Material Handling Equipment (MHE) affects warehouse performance. The study assesses the dependability and validity of the relevant constructs using structural equation modelling. The data was collected from 142 samples i.e., employees working in warehouse companies in Bangalore, Chennai and Hyderabad cities in India. The findings show that although both MHE and warehouse performance constructs show reasonable internal consistency, warehouse performance shows especially strong construct reliability and convergent validity, with Cronbach's Alpha (0.801), rho_A (0.808), Composite Reliability (0.909), and AVE (0.834) well above standard thresholds. By comparison, MHE shows average convergent validity with an AVE of 0.464. With a path coefficient of -0.824 and a p-value of 0.000, structural model analysis shows a strong and statistically significant negative correlation between MHE and warehouse performance. Increased use or mismanagement of MHE could thereby harm warehouse efficiency, whether because of inadequate equipment choice, maintenance problems, or operational discrepancies. The results underline the need of a more calculated approach to MHE planning and management to maximize warehouse performance in the Indian logistics sector.

Keywords: Material Handling, Warehouse Management, Logistics, Supply Chain Management.

1. Introduction:

The efficient orchestration of material flow within a warehouse environment is undeniably contingent upon the synergistic interplay of various material handling equipment, directly influencing critical performance indicators such as throughput, storage density, order fulfilment accuracy, and overall operational costs (Shah & Khanzode, 2017). Therefore, the choice and use of suitable material handling technologies are crucial for optimal warehouse performance, so requiring a thorough knowledge of the operational needs, physical limitations, and financial constraints of the warehousing setting. Well-defined material handling plans covering issues including equipment choice, layout design, and process optimization can help warehouses to be more efficient and responsive, therefore improving customer happiness and profitability (Dobos et al., 2016). Material management techniques have a major impact on the needs for warehouse storage space, hence stressing the need of looking at materials standards, inventory control, and material storage and organization (Joshi, 1990). Poor management of the

warehousing process can result in increased time, distance, and internal transportation expenses as well as impact the need for workers and transportation tools for these tasks (Ramos-Valle et al., 2022).

The optimization of warehouse layout and material handling systems are closely related and call for a comprehensive approach that includes the spatial arrangement of storage areas, picking zones, and receiving/shipping docks as well as the choice of suitable material handling equipment (Tarigan et al., 2021). Minimizing material handling expenses while maximizing storage use and throughput efficiency is the main emphasis (Venkitasubramony & Adil, 2015). Optimizing storage density and retrieval speed requires using automated storage and retrieval systems (AS/RS), efficient picking techniques like zone picking or wave picking, and smart placement of high-velocity products closer to shipping locations. Moreover, the combination of material handling equipment with warehouse management systems enables real-time inventory tracking, equipment routing and scheduling optimization, and generation of useful data for performance analysis and ongoing development. A key component of logistics supply chain management, warehouse management helps to attain transportation and production economies, support customer service policies, and bridge time and geographical gaps between manufacturers and consumers (Viskup & Gálová, 2019). Companies of all sizes can readily implement a committed storage policy to enhance warehouse management without having to spend on costly IT systems (Fumi et al., 2013).

Adopting warehouse management systems is a turning point in improving warehouse performance since it allows real-time view of inventory levels, storage and retrieval process optimization, and order fulfilment operation efficiency (Autry et al., 2005). These systems provide useful data for performance monitoring and decision-making as well as help to effectively manage warehouse operations including receiving, put-away, picking, packing, and shipping (Chang, 2016). Warehouse Management Systems enhance operational efficiencies, coordinate resources, and guide storage and retrieval (Kčera, 2017; Mills, 2000). Often, warehouse management systems are put into place and used with these objectives in mind (Autry et al., 2005). But just the effective use of a WMS could assist in reaching the intended objectives (Andiyappillai, 2020). These systems lower the risk of human error, enhance accuracy, and speed up processing times by automating many of the manual chores related to warehouse management, hence generating notable cost reductions and bettering customer service levels.

Advanced technologies including radio-frequency identification, autonomous guided vehicles, and robotics together have significant promise to transform warehouse operations by allowing more automation, efficiency, and accuracy (Junhong, 2020). Warehouse operations are enhanced by RFID technology (Chen & Hao, 2012). RFID helps warehouse management systems to properly cut manual labour, hence enabling more efficient and convenient inventory data and control for pertinent personnel to access and utilize (Jin et al., 2013; Junhong, 2020). While robotics can be used for activities like picking, packing, and palletizing, so increasing productivity and throughput (Junhong, 2020), automated guided vehicles can control the movement of items inside the warehouse, lowering labour costs and promoting safety. Intralogistics in a warehouse is also influenced by Industry 4.0 since the efficiency of procedures like product picking can be maximized by adopting new technologies including robots, voice picking, and augmented reality (Lorenc & Lerher, 2020). These technologies have the potential to turn warehouses into very efficient and responsive centres in the supply chain able to satisfy the always rising needs of modern business.

To maximize the flow of materials from suppliers to consumers, hence guaranteeing timely delivery of high-quality products at reasonable prices, material engineering, supply chain management, and warehouse management concepts must combine. This holistic strategy enables companies to make educated decisions about material selection, sourcing, production planning, and distribution strategies by requiring a thorough knowledge of material properties, manufacturing processes, logistics networks, and warehousing operations (Andiyappillai, 2020). Growing complexity and diversity of consumer orders call for changes in warehouse operations (Lee et al., 2017). Moreover, preventing faults, reducing waste, and preserving consumer happiness depend on the application of strong quality control policies all along the supply chain. Organizations can open great possibilities for invention, efficiency, and competitive advantage by adopting a whole view including all facets of the material flow.

Furthermore, by enabling real-time information about the location and characteristics of tagged items, radio frequency identification technology has shown the capacity to transform supply chain management

and so improve warehouse operations (Ballestín et al., 2013). RFID use in warehouse environments helps to automate inventory tracking, improve stock control accuracy, and lower the need for manual data entry (Junhong, 2020). As a result, this lowers operating costs, increases inventory control efficiency, and improves supply chain visibility (Koul, 2019). Managing warehouse storage and retrieval processes with RFID technology offers important data that could guide choices about the technology's application (Ballestín et al., 2013). RFID systems have been found to significantly shorten data processing time at receiving and shipping ports, with reductions of more than 90% (Chen et al., 2011). Moreover, RFID technology has been said to increase the efficiency and speed of processes as well as the accuracy of data (Sarac et al., 2010). RFID technology's use into warehouse management systems not only maximizes operational efficiency but also improves the general supply chain performance (J. C. Chen et al., 2011; N. Chen & Hao, 2012; Scalia et al., 2010).

2. Review of literature:

The impact of Radio Frequency Identification Technology in Logistic, Inventory Control and Supply Chain will provide some insight on it (Amoozad-Khalili et al., 2010; Chen et al., 2011). Using distribution facilities can greatly enhance supply chain operations (Cheng et al., 2021). Distribution centers help companies to simplify product flow, reduce transportation expenses, and attain economies of scale, all of which improve efficiency and customer happiness. Supply chains and logistics depend on warehouse operations. Acting as intermediate storage locations where products are received, sorted, and sent to their last destinations, warehouses are vital nodes in supply chain networks. All these facilities help to streamline shipment consolidation, reduce lead times, and maximize inventory levels, hence enhancing the reactivity and efficiency of the whole supply chain. Warehouse management includes a wide spectrum of tasks all of which must be done efficiently and properly to satisfy consumer needs and reduce costs: receiving, put-away, storage, picking, packaging, and shipping. Moreover, efficient warehouse management calls for close attention to elements including warehouse design, storage plans, equipment choice, and labour management, all of which can greatly affect operational efficiency and output.

3. Objectives of the research:

- To investigate how Material Handling Equipment (MHE) affects performance of warehouses in the Indian logistics sector. Using structural equation modelling (SEM), to assess the validity and dependability of MHE and warehouse performance components.
- Statistical indicators such Cronbach's Alpha, Composite Reliability, and Average Variance Extracted (AVE) help to examine the internal consistency and convergent validity of the measurement constructs. Path coefficient analysis will help to clarify the type and degree of the association between MHE consumption and warehouse performance.
- To underline the consequences of MHE mishandling or overuse on operational effectiveness inside Indian warehouses. To suggest the requirement of a strategic and data-informed approach to MHE design and execution to improve general warehouse performance.

4. Signification of the Study

Monitoring food quality assurance activities by means of radio frequency identification technologies, case-based reasoning, and fuzzy reasoning approaches (Lao et al., 2011). A basic engineering task that significantly affects the performance, dependability, and general efficacy of many engineering systems is material selection. Including smart materials, nanomaterials, and composites among advanced materials opens possibilities for improving product performance, lowering weight, and increasing durability for a range of uses.

Warehouse operations that are optimized can result in significant cost reductions, better service levels, and more competitiveness (Gunasekaran et al., 1999). Modern logistics depends on warehouse management systems, which are the foundation for good inventory control, order fulfilment, and general operating efficiency (Li & Cheng, 2013). Warehouse design is a broad collection of choices involving layout limitations and operational concerns that significantly impact performance and general logistics expenses (Accorsi et al., 2013). Travel distance and labour needs can be greatly decreased by optimizing warehouse layout and strategically locating pick sites (Raghuram & Singh, 2020). The use of warehouse management systems has been linked to a notable decrease in order cycle times, better inventory accuracy, and higher levels of customer satisfaction (Junhong, 2020). Warehouse management solutions

have been shown to significantly lower order cycle times, increase inventory accuracy, and raise customer satisfaction ratings (Junhong, 2020). From raw material suppliers to end consumers, a whole approach that examines the whole network of companies involved in manufacturing and delivering goods and services would enable effective supply chain management. A well-managed supply chain lets companies cut costs, make the most of their resources, shorten lead times, and react quickly to market needs (Abdul-Azeez et al., 2024). Furthermore, it means overseeing and coordinating the conversion of raw materials into completed goods and guaranteeing their quick delivery from suppliers to end users (We, 2024).

Moreover, by using strong risk management techniques, encouraging cooperation among supply chain partners, and using creative technology, companies can improve their resilience, reduce disturbances, and keep a competitive advantage (Rahmanasari et al., 2021). Implementing warehouse management systems helps companies lower total logistics costs and expand warehouse management to other areas of the logistics chain (Kčera, 2017). To stay competitive in the worldwide market, companies must maximize their material engineering methods, supply chain management plans, logistics operations, warehouse management approaches, and general performance indicators (Bučková et al., 2017; Bullinger et al., 2002; Kasemset & Petchalalai, 2018; Quesada et al., 2012).

5. Scope of the study:

The scope externed to human resource management, general management, international business, financial management, marketing management, and logistics and supply chain management. Spanning many sectors—manufacturing, distribution, retail, healthcare, and e-commerce—this study addresses issues and possibilities for maximizing material flow, information interchange, and general supply chain effectiveness in each.

Including supply chain management ideas into corporate strategy helps companies to reach higher degrees of operational efficiency and competitive advantage (Aslam & Rashid, 2018). Many well-known American businesses have been seen adopting an integrated strategic approach to purchasing and logistics management, sometimes known as supply chain management (Tan et al., 2002). For the sake of enhancing the long-term performance of the individual companies and the supply chain, supply chain management is the systematic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain (Li et al., 2004). Businesses must efficiently control their supply chains to enhance customer service and balance expenses and services if they want to gain a competitive edge (Althaqafi, 2020; Stevens, 1990).

Improving efficiencies inside a company is insufficient; their complete supply chain must be made competitive (Li et al., 2004). Management studies and the education of worldwide companies have seen growing interest in supply chain management (Vollmann et al., 2000). Supply chain management maximizes the entire value for the end consumers by integrating operations necessary to control the flow of products, information, and finances among all involved parties. To guarantee the effective movement of goods and services from suppliers to end consumers, supply chain management requires the seamless coordination of several departments including logistics, operations, and marketing (Borges, 2015).

To guarantee product quality, lifetime, and safety, companies must have a thorough knowledge of material qualities and their behavior under different circumstances. This paper aims to examine and assess the consequences of material engineering, supply chain management, logistics, warehouse management, and performance metrics in the framework of modern corporate operations (Nazifa & Ramachandran, 2019). Supply-chain management affects many different areas of the life cycle of goods and resources (Balkau & Sonnem, 2011). Managing a supply chain comprises actions required to plan, carry out, and control sourcing, production, and delivery operations from the point of raw material origin to the point of final consumption (Borges, 2015). Moreover, it emphasizes the need of cooperation and information exchange across supply chain stakeholders to reach common objectives and enhance general performance (We, 2024). Supply chain management's main goal is to match goods with customer expectations (Khalifa et al., 2021).

By offering real-time visibility, predictive analytics, and improved decision-making power, the

combination of technology developments such artificial intelligence, machine learning, and blockchain might transform supply chain operations. Modern supply chain management has become increasingly dependent on the integration of information technology, which enables data collecting, information sharing, and process optimization (Neubert et al., 2004). Trade's past globalization and the companies involved in it have grown more complicated and larger in scale (Lara & Wassick, 2023; Vidrová, 2020). Especially for tangible cause: our planet is growing more and more linked (Vidrová, 2020). Companies are starting to understand that competition is not only a company vs company issue but a supply chain against supply chain phenomenon as markets get more global and rivalry grows (Turcu et al., 2009). Modern supply chains are quite intricate corporate networks that must be managed cooperatively and optimized worldwide (Stefanović, 2014).

Constant and fast changing, the global business scene in the 21st century is marked by uncertainty, increasing rivalry, shorter cycle times, more demanding consumers, and cost-cutting pressure (Stefanović, 2014). The uncertainties linked to the resulting worldwide supply chain network include those directly connected to suppliers of cash, materials and services, movement across borders and the channels of consumers and customers (Aigbavboa & Ojadi, 2019). Apart from these rising risks and uncertainties, the demand to reduce prices and shorten lead times keeps rising. Managers now accept that, at least in some measure, a company's performance is linked to the strength of its most underperforming supply chain partner (Spekman et al., 1998). Almost every company today includes supply chains. Companies have tried to increase cooperation with their many partners, including suppliers and customers, by adding their materials, information, and harmonizing their inter-organizational processes, which is believed to enhance the efficiency of supply chain operations (Lee, 2021). Modern supply chains are quite complicated (Feng & Hao, 2018). Involved are activities from the purchase of raw materials, manufacturing, assembly, and warehousing to inventory tracking, order entry and order management, distribution across all channels, and delivery to the consumer (Büyüközkan & Göçer, 2018).

Maintaining inventory accuracy, reducing handling costs, and maximizing order fulfilment procedures all depend on good management of warehouse operations. Conversely, material engineering includes the choice, processing, and characterisation of materials to fit performance criteria in many uses. The quest for competitive advantage and the rising pace of change in technologies and markets have driven a renewed emphasis on logistics strategy and management (Lambert, 1992). It is essential that companies know how logistics and supply chain management help to generate time and place utility since consumers now want better service than before. Therefore, companies aiming to succeed in dynamic and unpredictable marketplaces must have supply chain agility (Christopher, 2000). Events like the COVID-19 epidemic can create environmental uncertainty by disrupting corporate operations (Srinivasan et al., 2021). Many companies were unexpectedly quick to return to their pre-pandemic levels; some were more flexible than others (Nel, 2024). This required changes in distribution networks and bankruptcy of supply chain intermediaries (Raj et al., 2023). Supply chain management is fraught with uncertainty, which must be handled in actual operational circumstances (Gonçalves et al., 2020). From natural disasters to geopolitical unrest to supplier breakdowns, supply chain interruptions can take many shapes with notable consequences for corporate continuity and profitability (Umar & Wilson, 2021). Getting the greatest connection across all entities depends on good supply chain management (Bahebshi & Almaktoom, 2019).

Companies must understand that living in the contemporary corporate climate is a question of one supply chain vying against another (Faisal, 2009). A supply chain's competitiveness can be compromised by factors including turbulence, deliberate threats, outside pressures, limited resources, sensitivity, and supplier/customer disturbances (Anđelković et al., 2015). To change the way, they are built and linked, they must develop their supply chains into strong systems capable of managing unanticipated occurrences (Fornasiero et al., 2020). Among other crises, the COVID-19 epidemic and the Russian Ukrainian war have driven the worldwide supply chain system into a condition of great complexity, high uncertainty, and disturbance (Wu et al., 2023). These events led many companies to reconsider their supply chain plans since they became conscious of their dependence on one source of supply (Zinn & Goldsby, 2020). In the end, these modifications provide major difficulties for supply chains whether they are actively engaged in international trade or domestic supply chains affected by worldwide players (Zinn & Goldsby, 2020). Though it could make it more vulnerable to unanticipated events, the design of

an effective supply chain network has the possibility to greatly lower its operating costs (Moadab et al., 2023).

Organizations are progressively using sustainable and resilient supply chain methods that give risk reduction, redundancy, and cooperation top priority to meet these difficulties (Blackhurst et al., 2005; Lee, 2021; Suryawanshi et al., 2021). This means investing in cutting-edge technologies for real-time monitoring and predictive analytics, enhancing visibility throughout the supply chain, and diversifying sourcing possibilities (Cabrera et al., 2023). Furthermore, companies are understanding the need of matching supply chain plans with more general company goals, including sustainability and social responsibility, to provide long-term value and competitive edge (Mzougui et al., 2020). Given the unpredictable external environment and the rapid digital technology development, the creation of flexible and sustainable supply chains depends on the inclusion of digital technologies including big data analytics, cloud computing, artificial intelligence, IoT, blockchain, and 5G (Ning & Yao, 2023). While those who resisted the digital shift were consigned to a passive part in market competition, companies that welcomed digital transformation gained a competitive advantage; for example, during the COVID-19 epidemic, the digital economy thrived, pushing expansion in the digital transformation of supply chains (Ning & Yao, 2023). Given the constant flow of disturbances the world has seen, supply systems must be resilient (Cordón, 2023).

6. Concept Framework:

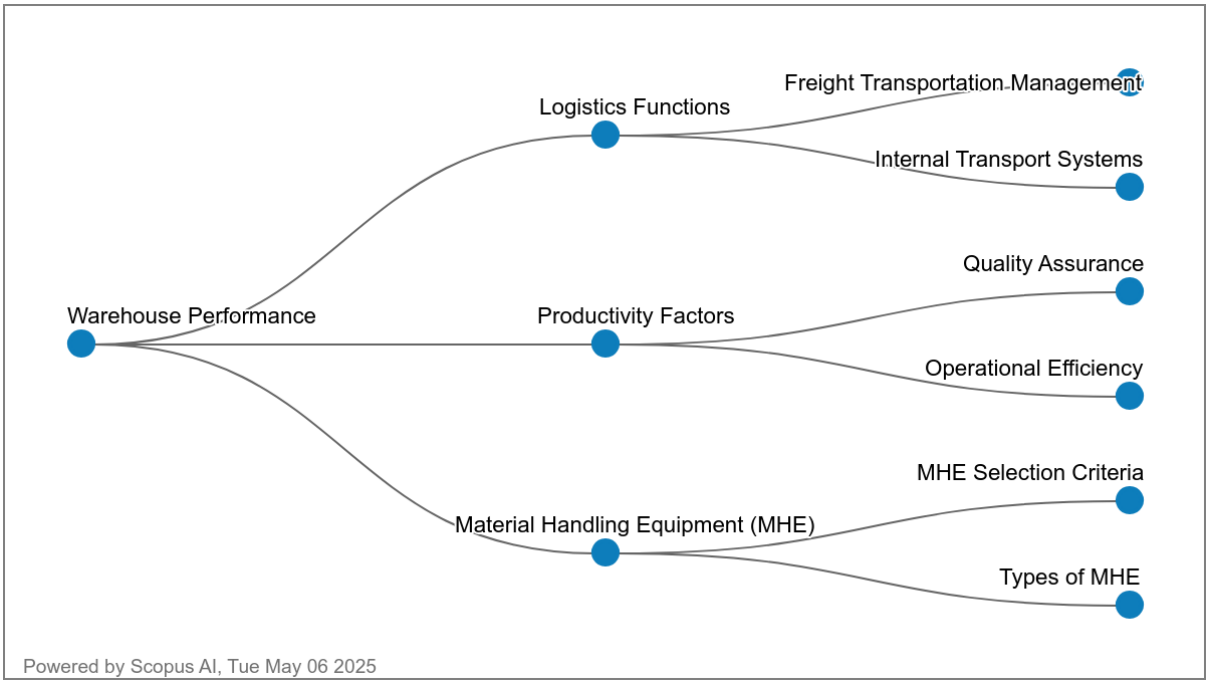

Figure 1: Concept Framework

The figure 1 show that the primary elements affecting warehouse performance, grouped into three categories: logistical functions, productivity variables, and material handling equipment (MHE). Highlighted under logistics functions are two key elements: freight transportation management and internal transport systems, both of which are vital for the seamless and effective flow of items inside and outside the warehouse. Emphasizing the need of keeping high standards and efficient procedures to improve general warehouse output, the productivity elements include quality assurance and operational efficiency. Finally, the category of material handling equipment emphasizes the various kinds of equipment available and the MHE selection criteria, both of which have a major impact on the warehouse's capacity to handle products safely and efficiently. Together, these related components offer a whole framework for comprehending and enhancing warehouse efficiency. Supply chain resilience is the capacity of a supply chain to bounce back to its original—or a better desirable—state after a disturbance. Resilient supply chains guarantee business continuity and reduce the effect of unplanned occurrences by means of their capacity to endure and recover from disturbances (Li et al., 2017). The importance of supply chain resilience and its influence on organizational performance have been

investigated in several research (Singh et al., 2019). Many dangers confront supply chains; if these risks come true, they will negatively affect the supply chain, which will cause competitive disadvantage and lower profitability (Mensah & Merkuryev, 2014). Building supply chain resilience calls for a whole approach including risk assessment, mitigation plans, and contingency planning. The idea frame was built on warehouse performance effects on logistics function, productivity elements, material handling equipment and supply chain management. Riad and colleagues, 2024 Organizations must actively plan and design their supply chain networks to forecast possible disruptions, react adaptively to those disruptions while preserving control over structure and function, and rise to a post-event resilient state of operations if they are to attain a state of supply chain resilience (Ponis & Koronis, 2012). Managers in the pharmaceutical supply chain consider adaptability, flexibility, agility, and cooperation to be the most vital components of supply chain resilience (Faggioni et al., 2023). Supply chain resilience is crucial for companies aiming to keep a competitive edge and effectively manage the complexity of the current market in a world growing more and more linked. Resilient supply chain methods help companies to lower risks, increase operational efficiency, and promote long-term sustainability (Güngör et al., 2022; Sawik, 2020). As underlined by several studies and analyses in recent years, supply chain resilience has become a vital issue for companies and lawmakers (Lücker et al., 2024). By knowing the vital elements of supply chain resilience—including capabilities and vulnerabilities—organizations may assess and strengthen their resilience (Pettit et al., 2010).

7. Data Analysis:

Table No. 1: Analysis between the Material Handling Equipment on Warehouse Performance: The total samples were collected from 142 employees working in the warehouse in Bangalore, Chennai & Hyderabad locations in India.

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Material Handling Equipment's	0.711	0.762	0.810	0.464
Warehouse Performance	0.801	0.808	0.909	0.834

Interpretation: Employed in structural equation modelling (SEM) or partial least squares (PLS) analysis, the table No. 1, shows reliability and validity measures for two constructs: Material Handling Equipment's and Warehouse Performance.

Material Handling Equipment's: Acceptable internal consistency is shown by Cronbach's Alpha (0.711) and Composite Reliability (0.810). rho_A (0.762) confirms the dependability of the construct. Slightly below the usually accepted level of 0.50, average variance extracted (AVE = 0.464) implies that the indicators account for less than 50% of the variance on average. This could call into question convergent validity and imply that item measurements must be improved.

Warehouse Efficiency: Strong internal consistency and construct reliability are indicated by Cronbach's Alpha (0.801), rho_A (0.808), and Composite Reliability (0.909). Well over the 0.50 criterion, AVE (0.834) shows outstanding convergent validity, or the indicators sufficiently reflect the underlying construct. Although both concepts exhibit consistent measurement, Warehouse Performance shows better validity and dependability. By contrast, Material Handling Equipment's demonstrates reasonable consistency.

Testing of Hypothesis:
Hypothesis Statement: Material Handling Equipment has impact on the Warehouse performance

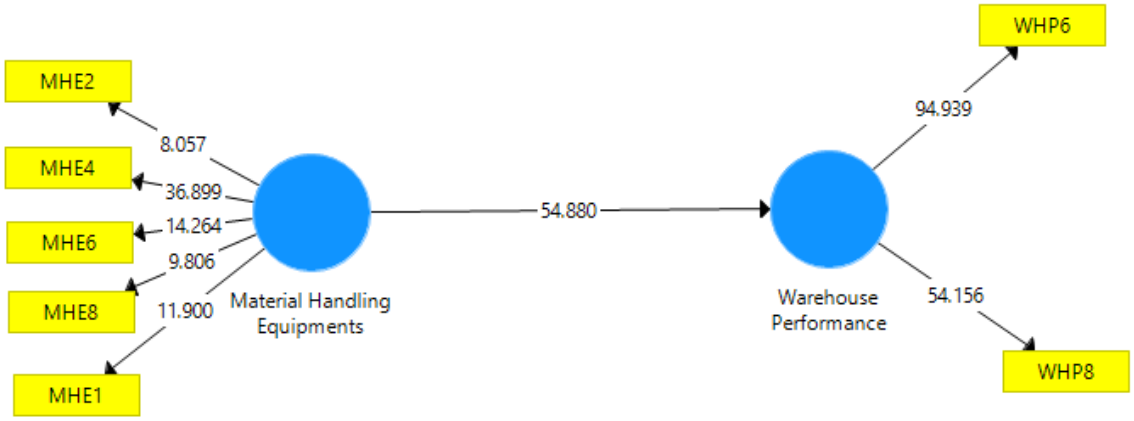

Figure 2: Analysis between the material handling equipment and Warehouse Performance

Interpretation: The structural model assessment reveals that Material Handling Equipment (MHE) has a strong and statistically significant negative impact on Warehouse Performance, with an initial path coefficient of -0.824. The sample mean of -0.827 verifies the constancy of the relationship across bootstrapped samples. With a standard deviation of 0.015, the computed route coefficients show relatively little variation. A T-statistic of 54.880, much over the 1.96 threshold (at a 95% confidence level), and a p-value of 0.000 show that the link is very statistically significant. The negative coefficient, on the other hand, indicates that warehouse performance could suffer if certain MHE components are used more or relied upon more, whether because of inefficiencies, subpar equipment choice, or maintenance issues. This result calls for more research on the kind, use, and control of MHE in the warehouse setting.

8. Conclusion & discussion:

Moreover, developing a robust supply chain calls both technological and infrastructural investment, including sophisticated planning and scheduling tools, real-time tracking and monitoring systems, and backup transportation and distribution networks. These solutions give companies the insight and control required to rapidly spot and react to disturbances, reduce downtime, and keep supply continuity. To keep their competitiveness and meet the often-changing needs of modern consumers, companies must be able to quickly react to changing market conditions and client expectations. Se-gu et al., 2020 Companies may build supply chains that are flexible, adaptable, and ready to meet any challenge by carefully evaluating risks, putting mitigation strategies into action, and making investments in technology and infrastructure (Barmuta et al., 2022). Efficient materials management techniques have a direct effect on needs for warehouse storage space (Joshi, 1990). Some businesses can delay or avoid warehouse expansions by means of prudent materials management procedures (Joshi, 1990). Warehouse performance must be enhanced if strategic objectives such shorter lead times, reduced supply chain inventory, and greater degrees of customer satisfaction are to be promoted (Mills, 2000). Determining the optimal layout design and an effective material handling system depends on how a warehouse's organizational phases are managed (Fumi et al., 2013). Managing materials used in producing and keeping finished products depends on warehouse layout design and effective storage systems (Viskup & Gálová, 2019). The need of materials management inside the company is underlined; the role of computers in maximizing resource use is stressed (Cheng, 1986). Moreover, companies must be proactive in their risk management, always checking their supply chains for possible weaknesses and taking actions to reduce these risks. Today's supply chain is a complex and linked system with many different players including manufacturers, suppliers, distributors, and retailers. By putting efficient materials management techniques into practice, companies can enhance their supply chain performance and assist them run warehouses (Ndubuisi, 2021). Effective material management calls for quick problem resolution and risk management, as well as proper outsourcing level identification, product procurement handling, supplier and customer relationship management (Nainggolan, 2019). By ensuring that resources are used efficiently and effectively, materials management helps to reduce waste and expenses, hence improving general organizational performance (G.KANIMOZHI & P.LATHA, 2011). Supply chain management's complexity is rising, therefore planning techniques like Material

Requirements Planning are becoming more important (Quesada et al., 2012). Accounting for supply amounts and arranging material resources—both internal and external—including those of internal and external sources helps to guarantee that manufacturing and other activities are finished as intended (Chang, 2016). A safer workplace, better quality and production, less prices, and more consistent project results follow from a thorough materials management system (Caldas et al., 2014). The material handling equipment in the Indian warehouse is manual and semi-automated; so, the warehouse performance was adversely affected (Charistheo et al., 2020). Any sector depends on material handling, which helps to provide materials for manufacturing by means of a significant role. Material handling is defined as activities such as moving, storing, safeguarding, and controlling materials within a facility (Salah et al., 2021). Effective material handling guarantees efficient operations and reduces hazards from receiving raw materials to shipping completed products (Skilling & Munro, 2016). Material management is significantly influenced by the timely flow of materials (Tadesse et al., 2020). Many companies have begun managing their raw material supply, manufacturing, and distribution systems using an integrated approach known supply chain management to achieve company-wide goals like enhanced customer satisfaction and loyalty, quicker business operations, and lower inventory and costs (Lockamy et al., 2000). Gaining major advantages from SCM calls for establishing a common understanding of supply chain goals, building a supply chain definition, designing a supply chain implementation process, and specifying measures to monitor progress. Companies can cut expenses, increase efficiency, and get a market edge by means of supply chain process optimization (Badillo et al., 2015). Particularly in the retail and industrial industries of Western countries, the integration of supply chain management into corporate operations has become more common since the 1990s (Bloemhof-Ruwaard & Soysal, 2016).

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