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Figure 1: Digitization in intralogistics (Siemens: LogiMAT, 2020)

Intralogistics:
Making Optimized and Automated Internal Logistics and Advanced Technology Attainable

Intralogistics as a Fast-growing concept

Intralogistics is an emerging concept which is constantly subject to technological developments and changes. It is an art of automating, optimizing, integrating, and organizing the logistics flow within the walls of the warehouse or fulfillment center. In simple terms, intralogistics is the process of moving the materials inside the facility using the most efficient methods.

Along with industry 4.0 and extended involvement of information and communication technologies, converting warehouses into smart environments has become a trend. Supply chains have more complex and dynamic systems in the present day [1]. Therefore, logistics systems play an important role in implying efficient coordination throughout the supply network. Currently, intralogistics has proven it's importance due to the ascendancy of industry 4.0 and digital transformation (Figure 1).

Today, a key challenge in warehouses is to capture the movement of physical goods in real-time and control stock replenishment as per the demands. Warehouse management systems assist on controlling the material flow in order to execute order fulfillment properly. Integrating warehouse systems with intralogistics solutions that are developed in the form of optimization and automation will enhance the functionality of handling materials [2]. Intralogistics consist of state-of-the-

art equipment to handle the materials. Aside from the physical items, computer systems, and information technology (IT) tools are utilized for completing more efficient order fulfillment. Intralogistics face new challenges due to the rapid growth in the e-commerce sector. Growing inventory turnover rates with shorter storage periods, large number of orders, and small quantities with faster deliveries require flexible intralogistics operations with higher throughput and higher productivity.

Industry 4.0 & Intralogistics

Even though most companies identified the physical flow of material components through the supply chain as a separate information flow and then consider how to coordinate and synchronize them, there will no longer be a difference between information flow and material flows after the fourth industrial revolution. All the materials will be inextricably linked to their information allowing high level of data transparency and stock-flow optimization. The interaction between industry 4.0 technologies such as Internet of Things (IoT) and Artificial Intelligence (AI), Big data, and Cyber-Physical Systems (CPS) has largely enabled robust connectivity between physical processes and systems. These integrated technologies contribute to executing logistic activities minimizing human intervention while planning and controling the workflow in a modern warehouse environment. It serves the warehouses and manufacturing units in diverse operations from the receiving of the component until it is properly ready to be delivered to the customer.

Modern Material Handling

In former times, barcode technology was applied to areas such as receiving, put away, replenishment, picking, packing, shipping, cycle counts, value-added functions, and labor tracking in warehouses. Nowadays, with the growing requirements for mobility and transparency, radio technologies are employed with wireless sensor networks to monitor the stock movements.

Further, the use of Autonomous Mobile Robots (AMR) as in Figure 2 and Automated Guided Vehicles (AGVs) are currently being increased in intralogistics operations in manufacturing fields, warehouses, cross docks, terminals, and in service fields like hospitals [3]. These systems react dynamically to all the changes in these fields taking control of scheduling, routing, and dispatching. Automated Storage & Retrieval Systems (AR/SR) is another system similar to AGVs which brings their control mechanism to goods replenishment [4].

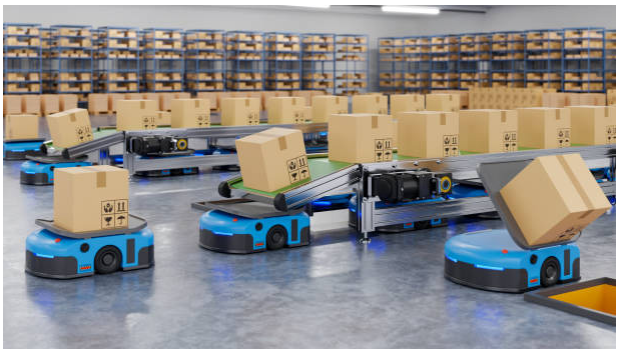

Figure 2: Future of Automated Mobile Robots in supply chain (3plcentral.com, 2022)

“Nowadays, with the growing requirements for mobility and transparency, radio technologies are employed with wireless sensor networks to monitor the stock movements.”

The factories and warehouses became more resource-efficient by using multi-agent simulation, cellular transport systems, and smart boxes. These systems ensure the continuous and immediate exchange of information and consequently coordinate the autonomous design for material flow needs [3]. Digital twin is a noticeable simulation technology that virtually represents physical systems while updating real-time and assisting decision-making [5]. The logistics train is one of the interesting applications in intralogistics domain based on the “milk run” delivery method. The trolleys of the train operated as per the double Ackermann steering system when moving materials in-

side the warehouse. The geometric arrangement and the linkages of the double Ackermann steering system is designed to follow the given path without colliding with surrounding objects.

Future of warehousing with intralogistics

Even though optimization and automation are not new ideas, intralogistics is still a trendy term in the 3PL sector in Sri Lanka. With the emergent trend of adapting technological advancements in industries, Sri Lanka has the capability of applying intralogistics concepts further to convert warehouses into smart factories. However there is a challenge of fostering intralogistics by promoting digital infrastructure and investing in professional training to make a significant influence on companies.

Intralogistics systems would be an ideal solution to eliminate the inefficiencies while creating greater reliability and accuracy for warehouse operations [3]. In order to reach a smart warehouse environment with maximum flexibility and full automation, intralogistics is evolving from large rigid systems to modular, technology-driven solutions that are robot-supported and capable of self-optimizing. It is evident that advanced design principles such as virtuality, interoperability, and real-time capabilities will shape the future of intralogistics.

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