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WAYS TO IMPROVE THE EFFICIENCY OF STORAGE AND WAREHOUSING OPERATIONS OF MATERIAL AND TECHNICAL RESOURCES

Today one of the key components of logistics is the warehousing system, which plays a critical role in managing inventory and ensuring that products are delivered to customers on time.

A modern large warehouse is a complex technical facility that consists of numerous interconnected elements, has a certain structure and fulfils a number of functions to transform material flows, as well as to accumulate, process and distribute goods between consumers [1].

At the same time, a variety of parameters of technological and volume-planning solutions, equipment designs and characteristics of a diverse range of cargoes processed in warehouses is possible, which makes it possible to refer warehouses to complex systems. At the same time, the warehouse system is just an element of a higher-level system – the logistics chain, which forms the basic and technical requirements for the warehouse system, sets the goals and criteria for its optimal functioning, and dictates the conditions of cargo processing [2].

By considering the warehouse not in isolation, but as an integrated part of the logistics chain, it is possible to ensure the successful fulfilment of the main warehouse functions and the achievement of a high level of profitability of both the warehouse and the entire logistics chain.

The main task of the warehouse is to concentrate stocks, store them and form an uninterrupted and rhythmic supply of customer orders.

The following basic principle should always guide the creation of a warehouse system: only a customized solution, taking into account all influencing factors, can make a warehouse system profitable [3]. The prerequisite for this is a clear definition of the functional tasks and a thorough analysis of the handling of goods both inside and outside the warehouse. The variation in the realization of the warehouse's capabilities must be limited to reasonable practical benefits. This means that any costs must be economically justified, i.e. the implementation of any technological and technical solution involving capital investment must be based on rational feasibility and not on fashionable trends and technical possibilities on the market. The most important parameter of a storage system is the material flow.

Material flow is a product (in the form of cargo, parts, inventory) considered in the process of applying to it various logistic (transport, warehousing, etc.) and/or technological (machining, assembly, etc.) operations and attributed to a certain time interval. The material flow attributed to a point in time goes to the stock [1].

The movement of material flow, also called material and technical resources (MTR) in the warehouse is associated with the expenditure of living and embodied labor, which increases the final cost of goods. In this regard, the problems associated with the functioning of warehouses have a significant impact on the rationalization of material flows in the logistics chain. The increase in the cost of goods in the warehouse link of the logistics chain is mainly related to the technology of warehousing and inventory storage operations.

The main directions for improving the efficiency of warehousing and storage operations are:

- technical improvement and modernization of equipment;
- improving the structure of fixed assets by increasing the share of machinery and equipment;

- increasing the intensity of equipment operation;
- optimization of operational planning;
- improving the qualifications of the company's employees
- reducing the number of operations and, accordingly, the time of goods handling;
- reduction of storage time and, accordingly, of stocks, which will lead to a reduction in storage costs.

Various measures can be aimed at realizing the increase in the efficiency of warehouse operations, which are used both in combination and separately.

- Labor rationing of warehouse workers (norms of time, output, number of employees) on the basis of state laws, Regulations on the organization of labor rationing, Interindustry norms of time for loading vehicles and warehouse operations.
- timekeeping of operations, collection of statistical information on operations, predictive calculations (volumes, productivity, etc.)
- development of the warehouse organizational structure and its updating in case of changes in the technological process.

The profit of the warehouse P is equal to the difference of income I and total costs C total.

$$P = I - C(total) \tag{1}$$

In turn, total costs are made up of conditionally variable and conditionally fixed costs

$$Ctotal = Cvar + Cfixed \tag{2}$$

Fixed costs do not depend on the cargo turnover of the warehouse. They include expenses for the purchase of warehouse premises (bank payments, if a loan is taken for the purchase of a warehouse), depreciation of machinery (C am.), electricity (C el.), salaries of management personnel and specialists (C s.).

$$Cfixed = Cam + Cel + Ss \tag{3}$$

Variable costs depend on the cargo turnover (Q) of the warehouse and the cost of cargo processing at the warehouse (C), i.e. the cost of warehouse operations, which is determined by the ratio of

$$Cvar = \frac{Cpr}{Q} \tag{4}$$

where C- cost of warehouse operations, rubles/m3;

The cost of cargo operations includes salaries of personnel directly involved in the logistics process of the warehouse, the cost of transportation and reloading operations and other warehouse costs.

Reduction of the share of manual labor and improvement of mechanization means in the warehouse contribute to the reduction of the cost of warehouse operations.

The 12 ways to improve warehouse efficiency were discussed below:

Implementing a Warehouse Management System (WMS): A WMS is a software application that helps manage and control warehouse operations, including inventory management, order processing, picking, packing, and shipping. By implementing a WMS, businesses can improve inventory accuracy, reduce stock outs, optimize storage space, and increase overall operational efficiency. A company that implements a WMS software like SAP EWM (Extended Warehouse Management) can automate inventory tracking, optimize picking routes, and improve order accuracy in their warehouse operations. Amazon utilizes SAP EWM to manage its vast network of fulfillment centers and streamline its warehouse operations.

Utilizing Vertical Storage Solutions: Vertical storage solutions involve maximizing vertical space in the warehouse by using pallet racking, mezzanines, and automated storage systems. By storing items vertically, businesses can increase storage capacity, improve accessibility to inventory, and streamline picking processes. Home Depot implements pallet racking systems in its warehouses to optimize storage space and improve inventory management for its wide range of home improvement products.

Implementing FIFO and LIFO Inventory Management: FIFO and LIFO are inventory management methods that dictate the order in which goods are received and sold. FIFO ensures that older stock is sold first, reducing the risk of obsolescence, while LIFO allows for newer stock to be sold first. By implementing these strategies, businesses can manage inventory effectively and minimize waste. Whole Foods Market uses FIFO for its fresh produce section to ensure older items are sold first, while employing LIFO for non-perishable goods to manage inventory turnover efficiently.

Conducting Regular Inventory Audits: Regular inventory audits involve physically counting and reconciling inventory levels to identify discrepancies, prevent stock outs, and improve inventory accuracy. By conducting regular audits, businesses can maintain optimal inventory levels and ensure that the right products are available when needed. Walmart conducts monthly physical inventory audits in its distribution centers to maintain accurate stock levels and prevent stock outs in its retail stores.

Optimizing Slotting and Picking Processes: slotting optimization involves strategically placing high-demand items closer to the picking area to reduce travel time and improve picking efficiency. By optimizing slotting and picking processes, businesses can enhance workflow efficiency and reduce operational costs. A fulfillment center optimizes its slotting strategy by placing high-demand items closer to the shipping area. Best Buy optimizes its slotting strategy by placing high-demand electronics closer to the shipping area in its warehouses to improve order fulfillment speed.

Implementing Cross-Docking: Cross-docking is a logistics strategy that involves transferring goods directly from receiving to shipping without storing them in the warehouse. This process helps reduce handling and storage time, improve order fulfillment speed, and streamline the flow of goods through the supply chain. A logistics company implements cross-docking to transfer incoming goods directly to outgoing shipments without storing them in the warehouse, reducing handling time and improving order processing efficiency. FedEx implements cross-docking in its logistics operations to transfer packages directly from inbound to outbound trucks, reducing handling time and improving shipment efficiency.

Utilizing RFID Technology for Inventory Tracking: RFID technology uses radio frequency identification tags to track inventory in real-time. By implementing RFID technology, businesses can improve inventory visibility, reduce manual data entry errors, and enhance inventory accuracy. An electronics manufacturer uses RFID tags to track inventory movement in real-time, enabling them to monitor stock levels accurately, reduce errors, and improve inventory visibility throughout their supply chain. Apple uses RFID tags to track inventory movement in its supply chain, enabling real-time visibility and accurate monitoring of product stock levels.

Implementing Lean Principles: Lean principles focus on eliminating waste, optimizing processes, and improving efficiency. By applying lean principles such as 5S methodology (Sort, Set in order, Shine, Standardize, Sustain), Kanban systems, and value stream mapping, businesses can streamline operations, reduce costs, and enhance overall productivity. Toyota applies lean principles in its manufacturing plants by implementing 5S methodology and Kanban systems to eliminate waste, improve workflow efficiency, and reduce operational costs.

Investing in Material Handling Equipment: Material handling equipment such as forklifts, conveyors, pallet jacks, and AGVs help streamline material movement within the warehouse. By invest-

ing in the right equipment, businesses can improve operational efficiency, reduce manual labor requirements, and enhance safety. UPS invests in automated guided vehicles (AGVs) to transport packages within its distribution centers, enhancing efficiency and safety for its workers.

Training Warehouse Staff: Providing training programs for warehouse staff on efficient storage practices, safety protocols, and proper handling of technical resources is essential for improving productivity and reducing errors. Well-trained staff can contribute to a more efficient and effective warehouse operation. Coca-Cola provides training programs for its warehouse staff on safe material handling practices and efficient storage techniques to improve productivity and reduce errors in its beverage production facilities.

Implementing Demand Forecasting: Demand forecasting involves using historical data and market trends to predict future demand for products. By implementing demand forecasting tools, businesses can optimize inventory levels, reduce stock outs, and ensure that the right amount of materials and resources are available to meet customer demand. Target uses demand forecasting tools to analyze sales data and market trends accurately, ensuring optimal inventory levels and minimizing stock outs in its retail stores.

Partnering with Suppliers and Logistics Providers: Collaborating with suppliers and logistics providers helps establish efficient inbound transportation processes, reduce lead times, and improve overall supply chain efficiency. By building strong partnerships with key stakeholders, businesses can enhance supply chain visibility, reduce costs, and improve operational performance. Nike establishes strong partnerships with key suppliers and logistics providers to streamline inbound transportation processes, reduce lead times, and ensure timely delivery of materials for its athletic footwear and apparel production.

Effective warehouse management practices play a crucial role in optimizing operations, improving efficiency, and enhancing customer satisfaction for companies across various industries. By implementing advanced technologies, utilizing innovative storage solutions, conducting regular audits, and investing in employee training, organizations can streamline their supply chain processes, reduce costs, and maintain optimal inventory levels. Additionally, leveraging data-driven insights, implementing lean principles, and fostering strategic partnerships with suppliers and logistics providers are key strategies to achieve operational excellence and drive sustainable growth in today's competitive business environment.

Effective warehouse management is a critical component of a successful supply chain strategy that can significantly impact a company's bottom line and overall competitiveness. By leveraging advanced technologies, optimizing storage systems, implementing efficient processes, and investing in employee training, organizations can streamline their operations, reduce costs, minimize errors, and enhance customer satisfaction.

Furthermore, the integration of data analytics, automation, and artificial intelligence in warehouse management can provide valuable insights, improve decision-making, and drive continuous improvement in operational efficiency. By adopting lean principles, conducting regular audits, and fostering collaborative relationships with suppliers and logistics partners, companies can further enhance their supply chain performance and achieve sustainable growth in today's dynamic business landscape.

Ultimately, by prioritizing effective warehouse management practices and embracing industry best practices, organizations can position themselves for success, adapt to changing market demands, and deliver superior value to their customers. With a strategic focus on optimizing inventory levels, maximizing space utilization, and ensuring timely order fulfillment, companies can stay ahead of the competition, drive operational excellence, and achieve long-term success in the ever-evolving global marketplace.

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