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WAREHOUSE MANAGEMENT SYSTEM AND ITS IMPACT ON DATA ACCURACY

ABSTRACT

In manufacturing companies, companies produce / process raw materials into finished goods. Raw materials obtained from suppliers will be stored, to meet the production needs. Warehouse as a place to store goods requires data accuracy for every transaction of goods that exist. Along with the growth of information technology, it is increasingly easy to process existing information, not least for manufacturing warehouses, especially in warehousing management. In warehousing management, existing transaction data is required for accuracy and speed in processing using a system. Warehouse Management System System is now a necessity because it can improve warehouse efficiency and accuracy, thus providing solutions to problems that exist in the warehouse.

Keywords: Manufacture, Warehouse Management System, Transaction

INTRODUCTION

In manufacturing companies, companies produce / process raw materials into finished goods. Raw materials obtained from suppliers will be stored, to meet the production needs. Warehouse as a place to store goods requires data accuracy for every transaction of goods that exist. A warehouse is a facility in the supply chain to consolidate products to reduce transportation cost, achieve economies of scale in manufacturing or in purchasing or provide value-added processes and shorten response time (Bartholdi & Hackman, 2019). Warehouse have many operations or transacations with some general pattern of material flow, and typical warehouse operations include: receiving, putaway, internal replenishment, order picking, accumulating and sorting, packing, cross docking, and shipping.

With the growth of information technology, it is increasingly easy to process existing information, not least for manufacturing warehouses, especially in warehousing management. A warehouse management system or WMS primarily aims to control the movement and storage of materials within a warehouse and process the associated transactions, including shipping, receiving, put-away and picking. A warehouse management system (WMS) is a database driven computer application, to improve the efficiency of the warehouse by directing cutaways and to maintain accurate inventory by recording warehouse transactions. The systems also direct and optimize stock based on real-time information about the status of bin utilization (Ramaa et al, 2012).

INVENTORY AND DATA ACCURACY

Inventory is one of the important factors in business activities and its availability cannot be avoided. Inventories arise because these items cannot be obtained instantly, but a grace period is required to obtain them. Inventories can also be caused by asynchronous demand with the supply and time spent to process raw materials. With the inventory, the company can meet customer demand in a timely manner (Wahyudi, 2015).

Proper inventory system control will make it easier for companies to carry out operational activities and maintain a smooth operation cycle of the company (Singh & Singh, 2015). Organizing inventory needs to be done to avoid inefficient work and create regularity of inventory. In organizing inventory, it is necessary to have a system of control and recording of supplies because it will affect the production process and the company's financial statements (Wambua et al, 2015). The inventory control and recording system included in it is related to the type of inventory, the amount of inventory, and the location of inventory.

Inventory control and recording systems are part of warehousing management. The implementation of this management is the process of managing receiving goods the warehouse and put away goods the warehouse. This process is carried out in a warehouse with a certain administrative record (Kusuma et al, 2017). Warehouse management is designed for the benefit of processing warehousing activities that will affect the entire production process. Well-managed warehousing management will be able to increase the efficiency of material control or material handling in the warehouse (Azizi et al, 2018). Coupled with technological advances, handling of materials and supplies in warehouses will be faster and more practical (Ogbo et al, 2014). Complex warehousing management activities, will be very complicated if done manually. The impact of manual recording is the possibility of the emergence of information that is of less quality and not timely, giving rise to a biased assessment of inventory (Chow et

al, 2016). Advances in technology become a solution to make it easier to access and control warehousing activities, namely by using a computerized warehousing system that is considered to have effective workmanship and accuracy in processing data (Alyahya et al, 2016). The implementation of a computerized warehousing system can improve the effectiveness of warehouse operators' work, data accuracy, facilitate the search for goods, process data better and faster, and better inventory recording and storage.

WAREHOUSE MANAGEMENT SYSTEM (WMS)

Warehouse is an area that functions to store goods for production or production results in a certain amount and time span which is then distributed to the intended location based on demand on Warehouse management system (WMS) or PPIC. There are various types of warehouses: they can be classified into production warehouses and distribution centers (Ghiani et al, 2004) and by their roles in the supply chain they can be classified as raw materials warehouses, work-in-process warehouses, finished good warehouses, distribution warehouses, fulfillment warehouses, local warehouses direct to customer demand, and value-added service warehouses (Frazelle, 2001).

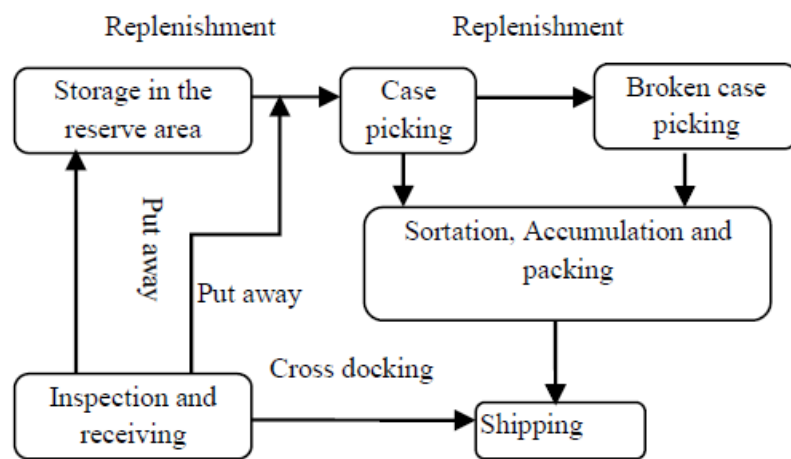


Figure 1. Typical warehouse functions

Source: Ramaa, A., Subramanya, K. N., & Rangaswamy, T. M. (2012). Impact of Warehouse Management System in a Supply Chain. *International Journal of Computer Applications*, 54(1), 14-20.

Warehouse Management System (WMS) is a database-based computer application system, which is used to improve warehouse efficiency in maintaining the accuracy of inventory data by recording every transaction in a warehouse (Ramaa et al, 2012). Warehouse Management System (WMS) acts as a system that regulates warehousing activities in the

supply chain, such as receiving stock, storing stock and managing order take out of stock (Wiyono et al., 2011). The purpose of this system is to control the movement and storage of inventory in a warehouse and process transactions related to receiving, selecting, taking and shipping inventory in a warehouse (Faber, 2013).

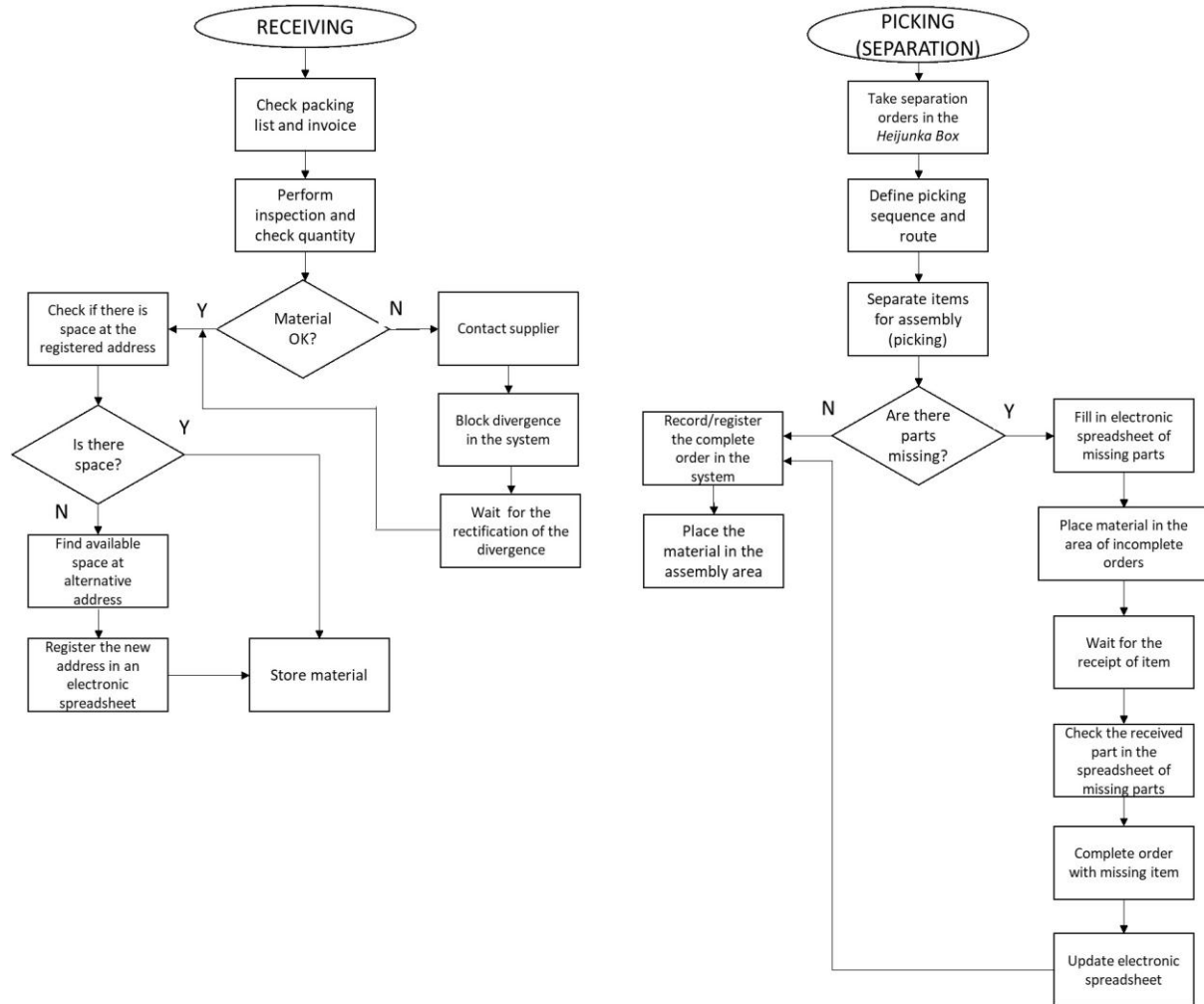


Figure 2. Receiving and material separation flowcharts

Source: Assis, R. de, & Sagawa, J. K. (2018). Assessment of the Implementation of a Warehouse Management System in a Multinational Company of Industrial Gears and Drives. *Gestão & Produção*, 25(2), 370–383. doi:10.1590/0104-530x3315-18.

This system was developed to meet the needs of users to be more efficient than a system that is done manually (Tamas et al, 2017). WMS is becoming a relevant system in use today compared to warehouse operations carried out manually to improve efficiency and optimal order fulfillment (Lee et al, 2017). The application of the Warehouse Management System can facilitate the warehousing system by increasing efficiency in terms of recording and processing data, increasing data security and data accuracy. This system can also be a means of exchanging

information between admins, users and warehouses, if there is a change in stock in the warehouse will be quickly identified (Lukman & Sunoto, 2016).

WMS often utilize Auto ID Data Capture (AIDC) technology, such as barcode scanners, mobile computers, wireless LANs (Local Area Network) and potentially Radio-frequency identification (RFID) to efficiently monitor the flow of products. Once data has been collected, there is either batch synchronization with, or a real-time wireless transmission to a central database. The database can then provide useful reports about the status of goods in the warehouse (Ramaa et al, 2012).



Figure 3. Warehouse Management System

Source: <https://www.hashmicro.com/blog/how-warehouse-management-will-improve-your-business/>

In barcode technology (containing the unique code / packing list and case of the item which functions as an item identification) as its ingredients and is integrated in all their branches. This WMS will tell the location which will be the location of the item or the warehouse warehouse can be placed anywhere because the move or placement will be recorded in the system by scanning the barcode of the goods as long as the location is updated on the system.



Figure 4. Barcode system

Source: www.academia.edu/9072255/Jurnal_Pembuatan_Aplikasi_WMS_pada_MWH_Plumpang

TYPES OF WAREHOUSE MANAGEMENT SYSTEMS

Warehouse management systems come in a variety of types and implementation methods, and the type typically depends on the size and nature of the organization. Based on warehouse control system, literature distinguishes three types of warehouse management systems (Faber et al, 2002):

- **Basic WMS** – This system is apt to support stock and location control only. It is mainly used to register information. Storing and picking instructions may be generated by the system and possibly displayed on RF-terminals. The warehouse management information is simple and focuses on throughput mainly.
- **Advanced WMS** – Above the functionality offered by a basic WMS, an advanced WMS is able to plan resources and activities to synchronize the flow of goods in the warehouse. The WMS focuses on throughput, stock and capacity analysis.
- **Complex WMS** – With a complex WMS the warehouse or group of warehouses can be optimized. Information is available about each product in terms of where it is located (tracking and tracing), what is its destination and why (planning, execution and control). Further, a complex system offers additional functionality like transportation, dock door, and value added logistics planning which help to optimize the warehouse operations as a whole.

Warehouse management systems can be stand alone systems or modules of an ERP (Enterprise Resource Planning) system or supply chain execution suite. The primary purpose of a WMS is to control the movement and storage of materials within a warehouse. The WMS can be deployed as a paper-based, RF/wireless based or combination of both.

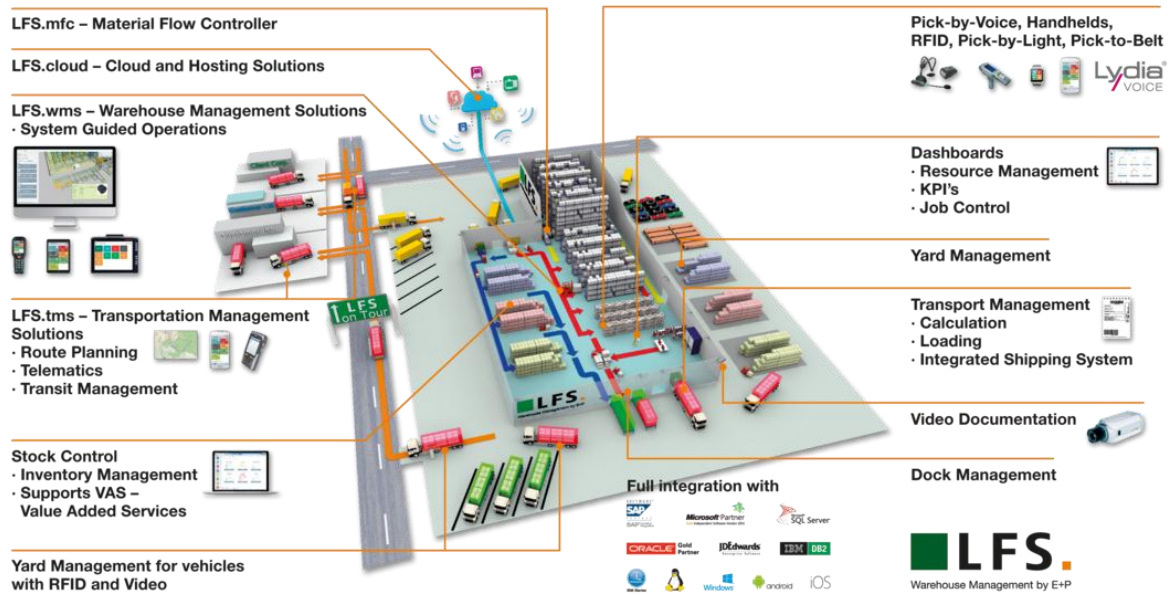


Figure 5. Warehouse Management System with its functions

Source: <https://www.epg.com/gb/logisticssoftware/warehouse-management-system-lfswms/warehouse-management-system/>

PRINCIPLES OF WAREHOUSE MANAGEMENT SYSTEMS

The transactions or process warehousing like shipping, receiving, putaway, move, and picking of stoks can be done with several concepts. In WMS itself there are three concepts that are commonly used:

- FIFO (first in first out) often means that the goods or material that first enters the warehouse must be the first to exit.
- LIFO (Last In First Out) items that were the last time entered must first come out.
- FEFO (First Expired First Out) The fastest expired items must first come out.

Of the three concepts above, usually the most widely used concept is FIFO (first in first out), but for now almost all products will begin to lead to the FEFO system even for spare-part products though. Of course this FEFO is needed for warehouse functions that function as many relationships in and out of various sources.

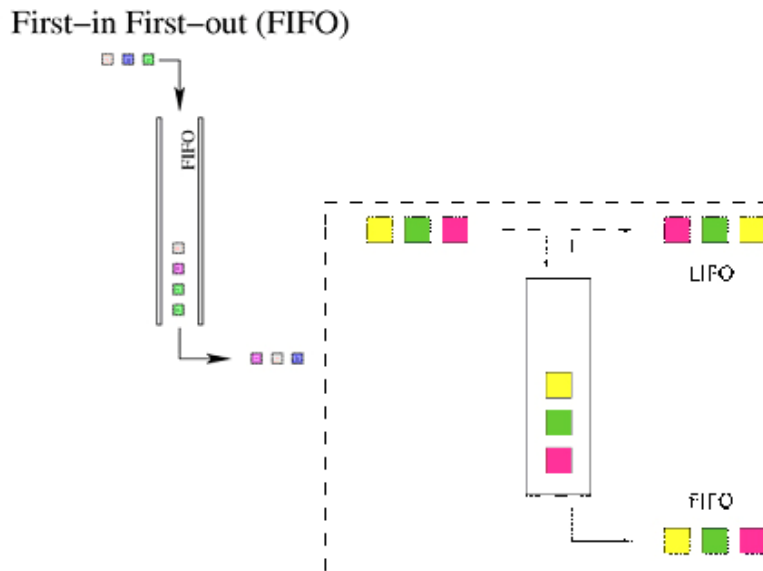


Figure 6. FIFO and LIFO

Source: <https://www.flickr.com/photos/14312763@N04/>

FEFO (First Expired First Out)

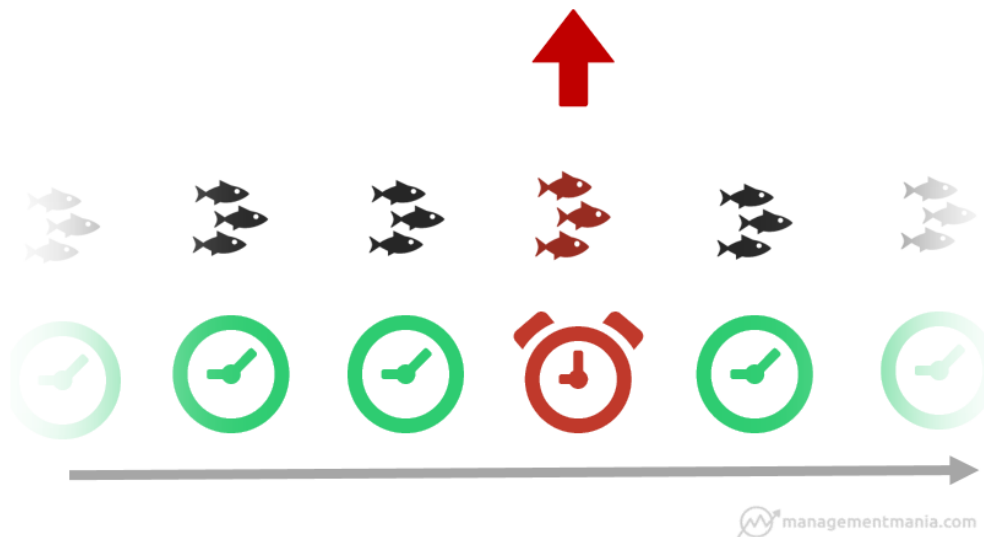


Figure 7. FEFO

Source: <https://managementmania.com/en/fefo-first-expired-first-out>

WAREHOUSE PERFORMANCE MEASUREMENT

Measuring warehouse metrics is critical for providing managers with a clear vision of potential issues and opportunities for improvements. Metrics are tied directly to the business strategy and operation's success drives the financial results of the organization. If warehouses are going to contribute to be a source for adding value to the supply chain then they need to measure their performance with perfect metrics.

The metrics for measuring performance in a warehouse fall into three main categories which includes order fulfillment, inventory management and warehouse productivity.

The establishment of metrics for auditing warehouse performance and assessment of WMS potential as a basis for investment justification should be the first steps in any WMS project (Caplice & Sheffi, 1995). The identification of proper metrics and opportunities for improvement can be a preliminary justification to determine potential payback (Hill, 2002). The following metrics supplements the above process.

Table 1. Performance metrics of a warehouse

Category	Measure	Definition
Order fulfillment	On time delivery	Orders delivered on time per customer requested date
	Order fill rate	Orders filled completely on first shipment
	Order accuracy	Order picked, packed and shipped perfectly
	Line accuracy	Lines picked, packed and shipped perfectly
	Order cycle time	Time from order placement to shipment
	Perfect order completion	Orders delivered without changes, damage or invoice errors.
Inventory management measures	Inventory Accuracy	Actual inventory quantity to system- reported quantity
	Damaged inventory	Damage measure as a % of inventory value
	Storage utilization	Occupied space (square footage) as a % of storage capacity (square footage)
	Dock to stock time	Avg. time from carrier arrival until product is available for order picking
	Inventory visibility	Time from physical receipt to customer service notice of availability

Warehouse productivity	Orders per hour	Avg. number of orders picked and packed per person - hour
	Lines per hour	Avg. number of orders lines picked and packed per person – hour
	Items per hour	Avg. number of orders items picked and packed per person – hour
	Cost per order	Total warehousing costs – Fixed: space, utilities and depreciation Variable: labor / supplies
	Cost as a % of sales	Total warehousing cost as a percent of total company sales

Source: Ramaa, A., Subramanya, K. N., & Rangaswamy, T. M. (2012). Impact of Warehouse Management System in a Supply Chain. *International Journal of Computer Applications*, 54(1), 14-20.

IMPACT/BENEFIT OF USING WAREHOUSE MANAGEMENT SYSTEM

Warehouse management system have impacts that will make benefit for the company. Some researches have implemented and made resume on it. From Assis & Sagawa (2018), the WMS showed its efficiency and the employees adapted to the new way of working. Some results that can see, there are:

- There was a significant improvement in the picking process due to the WMS system tools, which, together with the use of a supermarket (stock area closed to the assembly stations), allowed the separation/picking time to be reduced by almost half.
- A decrease of the operation average time, the reduction of people engaged in the process and the increase of productivity.
- The practice of using fixed addresses and supermarkets, linked to the new warehousing policy considering the proximity to the assembly stations and the turnover of the items reduced the time of forklift use.
- The delimitation of the routes by the system optimizes the use of time, and the radio frequency system guarantees the reliability of the operations.
- The high stock accuracy guarantees the speed in the process. The accuracy of inventory information was the most significant result. The high variety of items and addresses brings greater complexity to the management of the the warehouse. The WMS brought tools that enabled better traceability and the possibility of performing the cyclic counting with the company still in operation. To maximize efficiency, a logistic operator has been dedicated to

full-time cyclic counting. The result was reduction of divergences by more than 96%, and an accuracy of 98% of the total stock value, at the time this study was closed.

- In the previous inbound process, it took approximately 20 hours for all daily material loading to be checked and stored (but this value could be higher depending on the problems encountered during the conference); after consolidating the WMS system, this time has dropped to approximately 8 hours.
- The outbound process presented an improvement in the information reliability and waiting time for shipment of the final product.

Table 2. Summary of the results

Evaluated factors	Situation prior to the deployment of WMS	Situation posterior to the deployment of WMS
Traceability of materials and information	Low traceability and low inventory accuracy	Total traceability of the logistic operations
Inventory accuracy	Reliability of 87%	Reliability of 98% with a projection of 99% for the next year
Picking route	Random. The operator chooses the route, leading to excessive and repeated displacements/movements	Route planned by the system according to the location of the itens, optimizing the displacements and movements
Bureaucracy level	High. Very manual process, many parallel electronic worksheets and papers	Low, without the use of papers; transactions automatically recorded
Delivery performance	Delayed deliveries, caused by failures in the process and lack of inventory accuracy	On time in full deliveries
Quality of the logistics operations	Low; average grade of 4.76 out of 10	High, average grade of 8.63 out of 10
Main financial impact potentials	Rework, overtime, loss of orders and freight courtesies	Reduction of picking time, reduction of overtime and increase of productivity
Degree of employee satisfaction with the logistics system	Regular	Very satisfied
Picking performance	On average 8 min/order	On average 5 min/order
Lead time of the receiving operations	20 hours per day	8 hours per day
Organization and standardization	Low	High
Evaluated factors	Disadvantages and difficulties	
Reversing operations	In the WMS, requires several transactions	
Dependence on the radio frequency system	All operations stop without radio frequency	
Investment	High investment of hardware e software	
Difficulties of implantation	Cultural change	
	Organization and standardization	
	Infrastructure	
	Interface with ERP	
	Recording itens (for the first time)	
	Labelling	

Source: Assis, R. de, & Sagawa, J. K. (2018). Assessment of the Implementation of a Warehouse Management System in a Multinational Company of Industrial Gears and Drives. *Gestão & Produção*, 25(2), 370–383.

That study showed some benefits obtained with the system implementation are concrete, as expressed by the indicators monitored. But there are also some disadvantages like the WMS system requires a high investment. The main negative points mentioned were the disorder and various adjustments needed during the implantation and transition phase. Some tasks that are not very common have become more complex such as charge-backs, but not to the point of interfering with the efficiency and operation quality.

Warehouse management system is the main key of warehouse supply. Now many companies apply this management in the business they run. The benefits of a warehouse management system as mentioned above are (Hitchings, 2017):

1. Optimized Processes

Choosing the correct WMS for the business will allow you to seamlessly optimize processes within the warehouse. That means not only finding the right processes to suit business itself, but also those that fit the types of materials you manage. As sample, by linking WMS with transportation management system, or TMS, company can form a holistic outlook that extends beyond walls and racks.

2. Efficient Labor Allocation

With variables such as the size of facility and special material handling requirements, it need to approach efficiency differently at each stage of the workflow. WMS should be able to assist—if not outright allocate—these on the floor tasks in the most logical, efficient way possible. Time, effort, and resources are increasingly becoming a point of difference in busy marketplaces; "winging it" can be disastrous for long-term profits.

3. Employee Morale

A WMS helps provide structure in the workplace, both literally and figuratively. This type of structural support boosts employee morale. Through a well-built WMS, these same employees enjoy more efficient task allocation, autonomy within their roles, and better accuracy in their work.

4. Improved Supplier and Customer Relationships

An efficiently run warehouse helps reduce delivery lead times and order accuracy errors, and that means more customers are satisfied with their orders, which in turn means more sales. It because our partners can move on to their next task or delivery that much faster.

5. Reduced Operational Expenses

If we have perishables or other date-restricted stock in warehouse, a good WMS can help reduce waste by identifying which units need to be picked first, and which may need a sales

push. The more effective we can make our people: a) the more volume you can push out, b) The fewer people you need to be allocated to each part of the supply chain.

6. Better Inventory Balance

Inventory, when stored in the proper environment and used in the best order, eliminates scrap, waste, and obsolescence. We'll never have to worry about keeping too much safety stock on hand or shooting ourselves in the foot by running short of a SKU during a "crunch" period. Effective team is a self-fulfilling prophecy regarding lean operation, and it's a goal well worth pursuing for the sake of our bottom line.

7. ERP Integration

When our outgoing orders are accurate, our demand history isn't bogged down with repeat shipments, replacements, or shipping issues, which gives us a clearer view of overall operations. The right WMS should scale with your business without breaking a sweat. Because ERP handles everything from financials to HR, demand planning to market tracking; it needs clean data to work properly.

8. Improved Security and Safety

A modern WMS system should require workers to enter transactions using their own unique user account, for an audit trail too. It helps to reduce pilferage and other forms of shrinkage.

9. Transparency and Visibility

When suppliers have access to their own inventory use and on-hand SKUs, they gain the ability to plan and implement their own production. By shedding some redundancy, they reduce lead time and minimize the costs associated with holding excess warehouse inventory. Rather than periodic reports that run long after they could be used for correction, companies on a well-built WMS setup can tap into reports delivered as frequently as necessary.

10. Continuous Improvement

In company, improvement rests on many different aspects, we always have an opportunity to do better and achieve more. If we find ourselves working around it rather than alongside it, it may be time for an upgrade, to keep abreast of trends in the industry.

CONCLUSION

In warehousing management, existing transaction data is required for accuracy and speed in processing using a system. Warehouse management system is an essential replacement for a manual management system. The main purpose of automating the warehouse system is to control the movement and storage of the products, together with the benefit of enhanced security and quicker handling. Currently, the stored data can be organized according to serial

number, activated easily assuring the FIFO concept, and handed to the dealers accurately with the least amount of possible errors. Warehouse Management System System is now a necessity because it can improve warehouse efficiency and accuracy, thus providing solutions to problems that exist in the warehouse. And also the warehouse system has become more reliable and efficient after the automation, simplifying the process for the operators, the supplier and the dealers.

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