

KEY PERFORMANCE INDICATORS (KPIs) AND TYPES OF MATERIAL HANDLING EQUIPMENTS (MHEs) OF A WAREHOUSE

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KEY PERFORMANCE INDICATORS (KPIs) OF A WAREHOUSE

KEY PERFORMANCE INDICATORS (KPIs)

The main attributes for identifying performance are performance indicators, also named key performance indicators. They are specific characteristics of the process which are measured in order to describe if the process is comprehended according to pre-established standards (Liviu, Ana-Maria, Emil, nd, p. 307-308).

ORDER FILL RATE

- ✘ It is the rate per day of fulfilling orders.
- ✘ A higher rate shows that the warehouse is fast and efficient in completing orders.

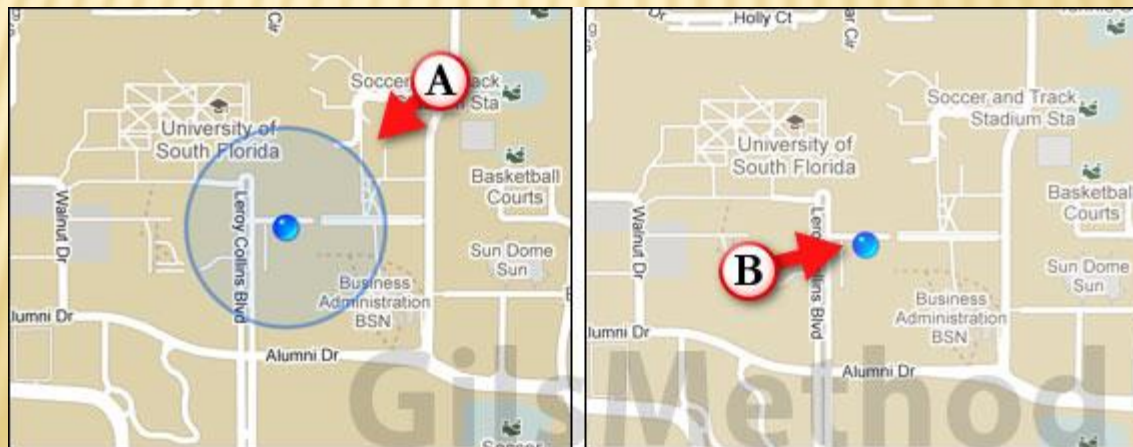
ORDER ACCURACY

- ✘ The number of orders which are completed with no mistakes, things are packed and shipped out correctly.
- ✘ A higher number of accurate orders show how meticulous the warehouse staffs are.



LOCATION ACCURACY

- ✘ Storing of goods/parts in the correct location so that it is easy to find them and pickers can do their job more efficiently.
- ✘ This shows that they have planned and recorded the information locations well.



ORDER CYCLE TIME

- ✘ Cycle time is the total elapse time to move a unit of work from the beginning to the end of a physical process.
- ✘ It includes process time and delay time during which a unit of work is spent waiting to take the next action.

CHANGE ORDERS

- ✘ This refers to orders which are changed even finalization.
- ✘ Changing orders incurs cost and thus it is best to not have any changed orders.



BACK ORDER RATE

- ✘ It measures the amount of orders that cannot be filled at the time they are placed.
- ✘ Back order rates cause your customers to wait while you attempt to fill an order and a high back order rate will affect customer retention over the long run.

PERFECT ORDER COMPLETION

- ✘ The number of orders completed with no mistakes or other problems.
- ✘ A higher number of perfect orders completed reflects better on the warehouse.

ON-TIME DELIVERY

- ✘ This is the amount of deliveries that are on time.
- ✘ A higher on-time delivery shows that warehouse is reliable and does the planning of transportation well.



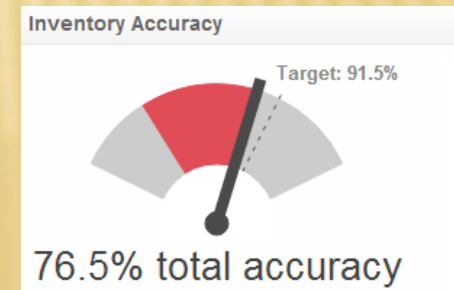
INVENTORY TURNOVER RATIO

- ✘ It calculates how many goods go out compared to incoming goods, it shows how fast inventory moves and the higher the better.



INVENTORY ACCURACY

- ✘ It is when physical count matches inventory records.
- ✘ Accurate inventory records show that the warehouse has good storage systems and keeps records meticulously.
- ✘ Results of poor inventory accuracy are wasted time, wasted money and dissatisfied customers.



COST PER ORDER

- ✘ It is the cost of fulfilling customers' orders.
- ✘ It is important to keep costs low.

**WHAT IS
COST PER
ORDER
(CPO)?**

PROCESS COST

- ✘ Process cost is the cost incurred for processes.
- ✘ The higher the process cost as compared to other warehouses and distribution centers, the more ineffective is the warehouse. If the process cost of a certain warehouse is higher, it means that the activities of the warehouse and distribution center is not being managed well.
- ✘ Thus process cost proves to be an important factor to determine an effective warehouse and distribution center.

PILFERAGE/LOST/DAMAGED INVENTORY

- ✘ This is the number of damaged, stolen, or lost goods in a lot.
- ✘ It is better if this number is lower as it shows that the warehouse has proper equipment and procedures to keep inventory safe and has good security.

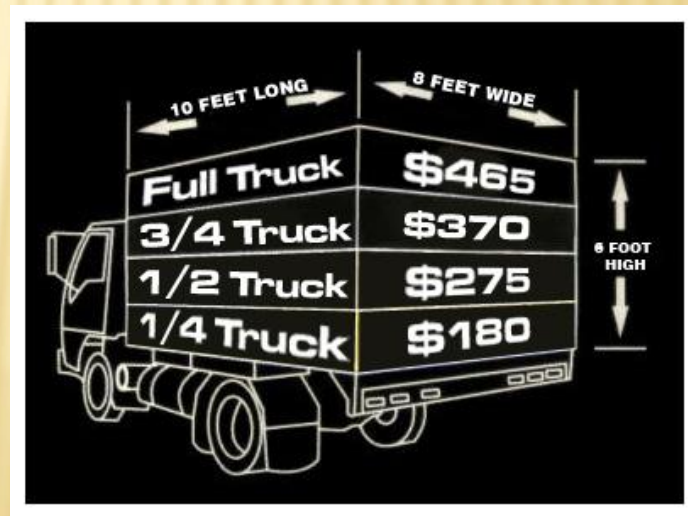


DAYS ON HAND

- ✘ The number of days inventory is on hand affects holding costs.
- ✘ The fewer number of days the inventory is on hand, the better.

NUMBER OF FULL TRUCKLOADS (FTL)

- ✘ Number of fully utilized trucks (fully packed).
- ✘ More FTL compared to less-than-truckloads (LTL) shows that utilization of trucks are maximized.



LOTS ACCEPTANCE RATE

- ✘ This is the number of goods that pass quality checks.
- ✘ A higher number shows that warehouse or DC is capable of delivering goods that arrive in good condition.

DOCK TO STOCK TIME

- ✘ It is the time taken from unloading to storing the goods as inventory.
- ✘ A shorter time shows how efficient the warehouse staff and equipment are.

INVENTORY VISIBILITY

- ✘ It is the ability to view inventory situations at different locations across the supply chain.
- ✘ By having inventory visibility, management can make decisions to optimize their inventory levels. This helps to prevent excess inventory or stock outs which are key to decreasing operational costs and increasing profit margins.



STORAGE UTILIZATION

- ✘ It is the measure of how well the available data storage space in an enterprise is used and is especially important during peak inventory times.
- ✘ It is measured by the percent of cubic space available used for storage, and the higher the number, the better.



MACHINE AND LABOUR UTILIZATION

- ✘ The higher the utilization rate on machines will mean that the per unit cost will be lesser. Thus resulting in savings for the warehouse.
- ✘ Poor machine and labour utilization rate may be due to factors like high absenteeism or large amounts of staff turning up late for work. Extra sums of money may even be spent to complete operations because of regular staff absenteeism.

THROUGHPUT LEVEL

- ✘ Throughput level will measure the productivity of a warehouse or distribution center.
- ✘ If it has a high throughput level it will mean that the warehouse or distribution center is an effective and productive one.

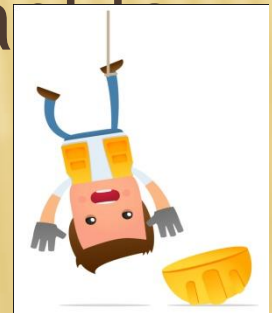
QUALITY AND SERVICE

- ✘ Quality and service will directly affect warehouse or distribution center if it is not of a proper standard. The reputation of a company, warehouse or DC will be affected if it does not provide good quality and service.
- ✘ Thus, it is important for a warehouse and distribution center to not only produce quality, but also service. Hence, the effectiveness of a warehouse and distribution center can be measured by its quality and service provided.



EMPLOYEES SAFETY

- ✘ A warehouse or DC that strives to keep employees safe at the workplace will have separate exits for employees and goods, safety equipments like fire extinguishers, hoses and sprinklers and also set safety regulations.
- ✘ Safety is calculated by the number of accidents occurring and it is important to keep the warehouse a safe place to



TYPES OF MATERIAL HANDLING EQUIPMENTS (MHEs) OF A WAREHOUSE

Material handling is defined as the movement of materials to, through and from productive processes; in warehouses and storage; and in receiving and shipping areas. Material handling concerns material flow and warehousing(Berg, Zijm, 1999, np).

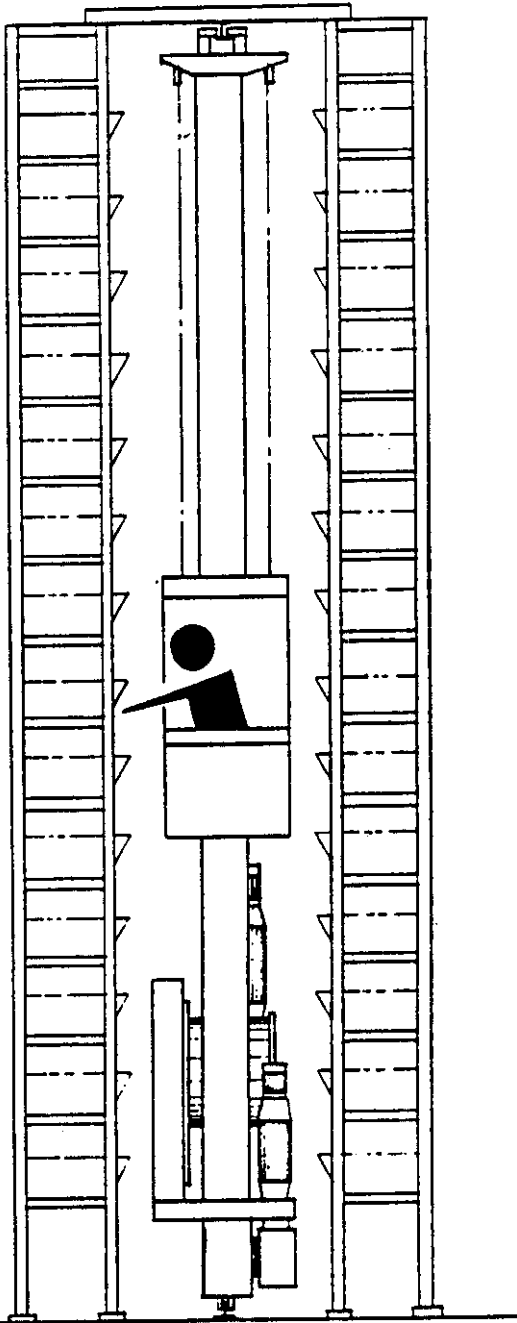
Typical material flow devices are conveyors, fork lifts, automated guided vehicles (AGVs), shuttles, overhead cranes and power-and-free conveyors.

MANUAL WAREHOUSING SYSTEMS

- ✘ In a manual warehousing system (picker-to-product system), the order picker rides a vehicle along pick locations (Berg, Zijm, 1999, np).
- ✘ A wide variety of vehicles is available: **pick carts** or **container carts** for manual horizontal item picking and **man aboard storage/retrieval (S/R) machines** for both horizontal and vertical item picking. For storage/retrieval operations (of complete pallet loads), **fork lift trucks** and a variety of **reach trucks** are often used (Berg, Zijm, 1999, np).



pick carts



**man aboard
storage/retrieval (S/R)
machines**



fork lift truck



reach truck

AUTOMATED WAREHOUSING SYSTEMS

- ✘ The systems that are also known as product-to-picker systems. A **carousel** is an example of this system. A carousel is a computer-controlled warehousing system that is used for storage and order picking of small to medium-sized products.
- ✘ A carousel may hold many different products stored in bins or drawers that rotate around a closed loop. The order picker may effectively use the rotation time of the carousel for activities such as sorting, packaging and labeling of the retrieved goods (Berg, Zijm, 1999, np).



AUTOMATED WAREHOUSING SYSTEMS (CONT'D)

- ✘ The **rotary rack** is an expensive version of the horizontal carousel.
- ✘ In rotary rack, every storage level can rotate independently (this is an extra feature), thus this system is reducing the waiting time of the order picker significantly (Berg, Zijm, 1999, np).



rotary rack

AUTOMATED WAREHOUSING SYSTEMS (CONT'D)

- ✘ **The automated storage/retrieval system (AS/RS)** is also a product-to-picker system. The AS/RS consists of one or multiple parallel aisles with two high bay pallet racks alongside each aisle. Within the aisle travels a **storage/retrieval (S/R) machine** or **automated stacker crane**. The S/R machine travels on rails that are mounted to the floor and the ceiling (Berg, Zijm, 1999, np).



**automated
stacker crane**



**storage/retrieval
(S/R) machine**



**automated
storage/retrieval
system (AS/RS)**

AUTOMATED WAREHOUSING SYSTEMS (CONT'D)

- ✘ A **mini load AS/RS** is an AS/RS that is designed for the storage and order picking of small items.
- ✘ The items are stored in modular storage drawers or in bins. These containers may be subdivided into multiple compartments each containing a specific SKU (Berg, Zijm, 1999, np).

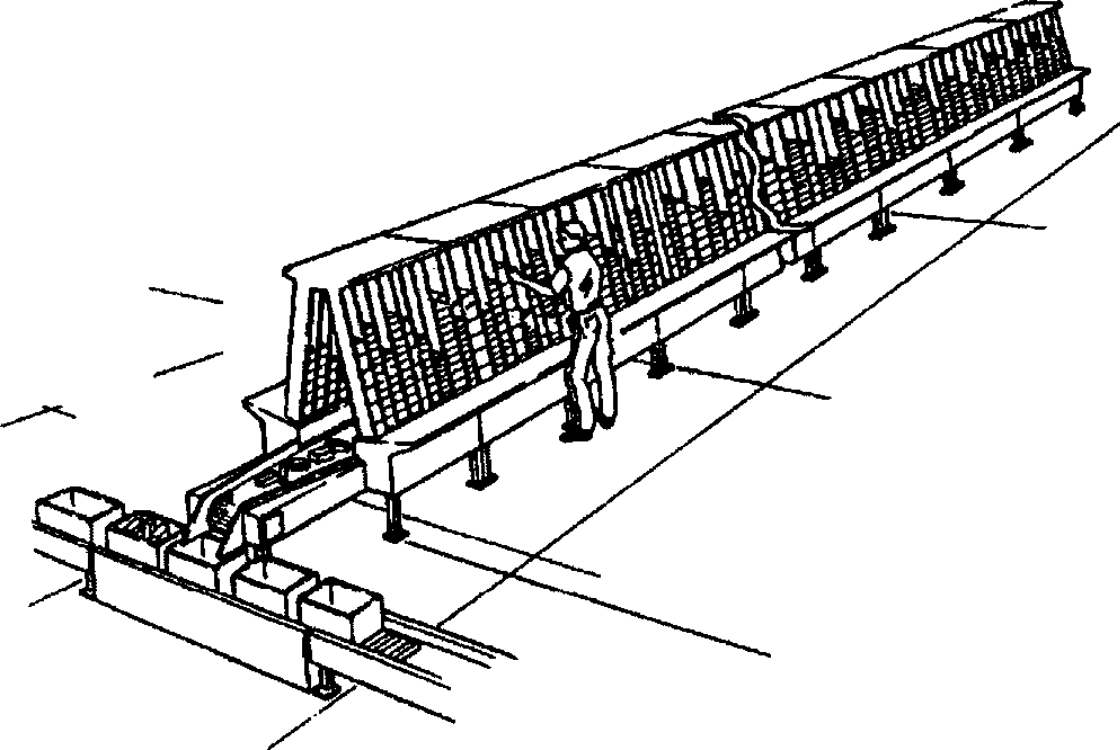


mini load AS/RS



AUTOMATIC WAREHOUSING SYSTEMS

- ✘ Automatic order-picking systems perform high-speed picking of small or medium-sized non-fragile items of uniform size and shape (e.g., compact disks or pharmaceuticals). If we replace the order picker of a carousel system or rotary rack by a robot, then we obtain an automatic order-picking system.
- ✘ An **A-frame automatic dispenser machine** is another order-picking device without order-pickers. The A-frame consists of a conveyor belt with magazines arranged in A-frame style on either side of the belt. Each magazine contains a powered mechanism that automatically dispenses items onto the belt (Berg, Zijm, 1999, np).



A-frame automatic dispenser machines



ORDER ACCUMULATION AND SORTING SYSTEMS

- ✘ Order accumulation and sorting systems (OASSs) are used to establish order integrity when orders are not picked in a single-order fashion. OASSs exist in various types, ranging from manual staging using a kitting matrix to high volume automatic systems.
- ✘ An automatic OASS usually consists of a closed-loop conveyor with automatic divert mechanisms and accumulation lanes. A sensor scans SKUs that enter the loop. SKUs corresponding to the same order are then automatically diverted into one lane (Berg, Zijm, 1999, np).
- ✘ Also **carousels** and **rotary racks** are used for the accumulation and sorting of orders.

REFERENCES

- ✘ <http://www.sciencedirect.com/science/article/pii/S0925527398001145#>
- ✘ <http://steconomice.uoradea.ro/anale/volume/2009/v4-management-and-marketing/50.pdf>
- ✘ <http://www.klipfolio.com/resources/kpi-examples-top-inventory-metrics>
- ✘ <http://tpdcm04.blogspot.com/2009/01/key-performance-indicators-kpi-of.html>
- ✘ <http://dcm-e.blogspot.com/2009/01/key-performance-indicators-for-managing.html>

THANK YOU

