Zaiko Warehouse Management Systems Application Platform

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Abstract: Inventory management is a discipline primarily about specifying the shape and placement of stocked goods. For any warehouse and logistics company, inventory is the heart of the warehouse. It is required at different locations within a facility or within many locations of a supply network to precede the regular and planned course of production and stock of materials. The scope of inventory management concerns the balance between replenishment lead time, carrying costs of inventory, asset management, inventory forecasting, inventory valuation, inventory visibility, future inventory price forecasting, physical inventory, available physical space, quality management, replenishment, returns and defective goods, and demand forecasting. Balancing these competing requirements leads to optimal inventory levels, which is an ongoing process as the business needs shift and react to the wider environment. This paper auto inventories without human involvement auto inventories in warehouse. Auto inventory benefit is warehouse stock and operation easily conducts.

Keywords: Auto inventory, supply chain, logistics, materials management.

1. Introduction

In a supply chain, warehousing function is very critical as it acts as a node in linking the material flows between the supplier and customer. In today’s competitive market environment companies are continuously forced to improve their warehousing operations. Many companies have also customized their value proposition to increase their customerservice levels, which has led to changes in the role of warehouses.

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 [1] or provide value-added processes and shorten response time [2]. Warehousing has also been recognized as one of the main operations where companies can provide tailored services for their customers and gain competitive advantage. There are various types of warehouses: they can be classified into production warehouses and distribution centers [3] 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 [4].

Storage and inventory control include the activities related to holding materials and processes of counting and transacting the materials as it move through warehouse. Best practice attributes for following processes: 1) location management and review 2) product data and special requirements 3) inventory control systems 4) Transaction process 5) cycle count 6) inventory strategy.

A recent case study revealed that 40% of IT managers believe telecom asset management is an area that needs improvement to have a better

Figure 1: Enterprise Database

Network implementation processes and speed up the process.

Today, majority of Communications Service Providers’ (CSP) procurement, planning and implementation teams are functioning in silos with their own operational activities. Each department maintains their own database and follows different methodologies to track their own departmental activities and their day to day operations. Usually, planners do not have clear visibility of the available inventory and shipment progress. It will result in delays in work order construction due to unavailability of required inventory, lengthy procurement process, difficulty for re-plan, etc.

Therefore, it is recommended for communications service providers to have an improved PNI system that can track, manage and report on all their assets and operations including warehouse system. General Communications service providers will have separate database systems to store procurement related data and GIS inventory data. ZWMS solution provides the facility to integrate the
procurement data. Usually all PNI systems will have an in-built work order life cycle that is flexible enough to configure to the CSPs implementation life cycle requirements like planning, approval, release for construction and construction complete etc.,

As part of planning process, the planner will analyze the requirements and plan the site location, structure, cable and equipment etc., inventories required in PNI system. This planning is done in planning phase of work order. In this stage, ZWMS supports the planner to know the available inventory in warehouse system and provides the facility to reserve the required inventory in ZWMS and ensures the inventory availability during construction phase. During the planning stage, planner can change the plan with alternative inventory if the required inventory is not available.

During the transition from Planning to Construction, ZWMS will check the final list of planned inventories and automatically reserve or release required inventory[9-11]. ZWMS provides a facility to raise a purchase request for the inventories which are not available in the WMS. The ZWMS will not allow the planner to transition the job from planning to construction until the inventory is made available or indented. This way, ZWMS provides full control on planning till it gets roll out. ZWMS has the facilities to configure the inventory threshold values. By using the threshold values ZWMS will check the availability of the inventories with respect to threshold values on a periodic basis and automatically will raise an alert / indent to the responsible authorities if any of the inventories falls below the threshold value.

Warehouse operation and inventory flow.
This application suite designed to optimize warehouse operations. These solutions manage the entire warehouse operation cycle in a real time mode. System controls warehouse personnel as well as material handling equipment, and operatively generates tasks for users based on a current situation. Leading-edge system capable of generating recommendations on the optimization of the technological operations in a warehouse as well as manage personnel and material handling equipment in order to achieve highest performance [11-15].

The Z (WMS) system eliminates the need for paper documentation. All documentation is generated, transmitted, processed and optimized in the system and transformed into precise tasks sent individually to operators’ RF terminal screens. Every operation is confirmed and logged into the system by the operator through either scanning a bar code, or entering data via the RF terminal keyboard. Therefore, information on product quantity and allocation in the warehouse is always accurate and up-to-date, so any mistakes or exceptions can be noted and immediately corrected. The objective is automation of the entire warehouse management cycle – from the point that goods are received at the warehouse up to the delivery of customer's orders. The scope of implementations can vary from basic warehouse control (management system based on paper task-lists) to a complex, full-scale warehouse management system in real time mode using barcode, RF data transmission and material handling equipment that supports technologies and other automation depending on the customers' needs[16-18].

The Warehouse Management System optimizes the put away and storage of inventory through dividing the warehouse into designated areas and utilizing space in the most efficient way. The ability to conduct cycle counting during the regular workday reduces or eliminates the need to shut down operations to conduct a physical inventory count. Z (WMS) allows customers to increase quantitative and stowage data accuracy to 99.9% while reducing the duration of receiving and shipping operations by 2-3 times.

Adaptability is one of the most significant features of Z (WMS). The system can be configured in order to meet the specific operational and business requirements of the customer[19-21]. The system is integrated with RF and barcode equipment, electronic scales, printers and scanners. A warehouse management system or Z (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 [20-21].

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 [22-25].

Warehousing takes up to between 2% and 5% of the cost of sales of a corporation and with today’s highly competitive global business environment organizations are emphasizing Return on Assets, and hence minimizing warehousing costs has become an important business issue. Many firms are automating their basic warehousing functions to achieve the increase in throughput rates or inventory turns required for their warehousing operations to be cost effective. It is necessary to allocate warehouse resources efficiently and effectively to enhance the productivity and reduce the operation costs of the warehouse. One vital area determining the efficiency of the warehouse is the determination of the proper storage locations for potentially thousands of products in a warehouse. Various factors affecting the storage assignment like order picking method, size and layout of the storage system, material handling system, product characteristics, demand trends, turnover rates and space requirements are been extensively studied. It has been suggested that selecting appropriate storage assignment policies (i.e., random, dedicated or class-based) and routing methods (i.e., transversal, return or combined) with regards to above factors is a possible solution to improve the efficiency. Various decision support models and solution algorithms have also been established to solve warehouse operation planning problems [5-8].

The use of information systems for warehousing management has been studied extensively in literature. Complexity of warehouse management is indicated among others by amount and heterogeneity of handled products, the extent of overlap between them, amount and type of technology as well as characteristics of associated processes. As the complexity increases it becomes necessary to use Warehouse management systems for handling warehouse resources and to monitor warehouse operations. The warehouses with a high amount of processed order lines and amount of stock keeping units will be best supported by customized software. It is difficult to update daily operations of inventory level, locations of forklifts and stock keeping units (SKUs) in real-time by using the bar code-based or manual-based warehouse management systems [26-28].

Best practice attributes for the following process groups are covered:


All warehousing software runs on data; therefore, product and storage location data must be kept current and accurate. Product data should include all characteristics including cube data and lot/serial number information. Special requirements should also be noted in the system so that product can be directed to special storage areas.

Special storage areas may segregate items with odor transfer, fire risk or those that require temperature control. High-value product might require caged and/or controlled access storage. Best practice companies maintain all information on a single system of record and keep it current and accurate. It’s often said that inventory is money; and that you should keep track of inventory as you would money. The activities and technology to maintain inventory accuracy are typically referred to as inventory control. The automated storage and retrieval system is a material handling mechanism which is a key element of automated warehouses or distribution centers. The RFID-enabled automated storage and retrieval racks as core component of the proposed warehousing system [29-31]. The module is designed as an standardized element for manufacturing and assembly, although each module can be of different sizes and arrays in a module can be configured easily in many different ways, i.e., capacity of a warehouse is adjustable. In the warehouse, items are pre-loaded onto pallets named totes; totes need not be of identical sizes. Each item in a tote (or a tote containing identical items) is attached with an RFID tag and each item in a tote is thereafter tracked and manipulated by the developed RFID-inventory management system throughout the warehouse.

A typical RFID reader is a microcontroller-based radiotransceiver that powers an RFID tag using the time-varying electro-magnetic fields (EMF) generated from an RFID antenna. Once an RFID tag is powered, it can receive commands from an RFID reader. An RFID tag is composed of two essential components: an antenna and a computer chip. The computer chip is used to store data while the antenna allows data communication between an RFID tag and an RFID reader through a wireless signal transmission [32-36]. Each RFID tag has a unique identification (UID), which can be used to uniquely identify an RFID tagged item. The collected RFID information data by an RFID reader can be transferred to a host PC as database for data processing and storage.
Thus, the hardware of the proposed RFID-based warehouse management system consists of the following key elements: 1) RFID Readers 2) RFID tags 3) A host computer two types of RFID tags (active and passive RFID tags) can be used depending on a range of RFID reading performance at a location of an A/B. By using RFID tags in the proposed automated warehouse, SKUs can be distributed evenly and dispatched randomly at varying locations wherever a place is available for incoming and outgoing goods. This design significantly facilitates operations of storage, retrieval, and replenishment in the warehouse shown in figure: 2 simplified RFID inventory management system for the proposed automatic warehousing system in adistribution center at which an RFID reader is mounted on the portal gate and it takes a reading of RFID-tagged incoming and outgoing goods each time these items enter or exit from the distribution center. Each pushermounted on an AS/RR also contains an RFID reader that communicates with a local controller, which transmits collected data via a middleware to a central warehousing database. The middleware is the software translation layer between an RFID reader and an enterprise system. Once an in-store item is ordered by a customer online, the RFID inventory management system is notified after receiving the order and it checks availability from the warehousing database, which contains real-time information collected by RFID readers via an indoor wireless local area network (iWLAN) through the controller. The collected information data include a unique identity and a description of each ordered item as well as an SKU number of the warehouse. Once an ordered item is identified by the RFID inventory management system, a pusher is actuated by a PLC (programmable logic controller) to push the selected item in a tote onto an output conveyor. The item will then be transported by the output conveyor and it travels along a guided route to a specified destination (collection point) for packaging. The warehouse RFID-inventory database will then be updated as soon as this ordered item is shifted out of the distribution center through the gate equipped by the RFID-reader.

Automated material-handling activities of a pusher are determined by a mechanical control system that generates an order by executing pre-defined assignment policies, which are a set of selection rules. These rules include such as availability of the selected item, its location closest to a collection point, a shortest route for the selected item traveling to a specified collection point, expiry dates of products if applicable and so on. If an item is selected from a group of the same type of items stored in multiple locations of the warehouse, the system will issue a priority based on the pre-defined selection rules to be given to the selected item to initialize a demand to push it onto the output conveyor. Job scheduling plays an important role in efficiency and productivity of warehousing operations. As stated previously, the proposed RFID-enabled warehousing system allows an item to be stored randomly at varying locations wherever a storage place is available, i.e., the same type of items may have multiple locations. Hence, the developed RFID-inventory management system has capability of identifying a dispatched item by issuing a priority to the selected item based on assignment policies as described above. In order to schedule a job priority for the selected item to be dispatched from the warehousing system, an algorithm was developed to seek an optimal solution for a selected item which has a priority over other items of the same type based on variables in terms of such as expire date and a least travel time to a specified collection point and so on.

Under this integrated RFID-enabled warehousing management system, customers place their orders on-line through a web-based platform and the RFID-inventory management system automatically checks its database in terms of availability of each ordered item. As soon as these available items are reordered by a customer after making a payment online, the warehousing system then performs an automatic item-selection process without any human interference. [36-38]

ZWMS is an application suite designed to optimize warehouse operations. Manage the entire warehouse operation cycle in a real-time mode. The System controls warehouse personnel as well as material handling equipment, and operatively generates tasks for users based on a current situation. ZWMS is based on automatic identification technologies (such as barcoding and others), the principle of mapping warehouse locations and assigning unique storage locations to inventory and remote personnel management. Every warehouse operator is equipped with an RF terminal - a mobile computer which can either be handheld or mounted on a forklift. Tasks are automatically generated in ZWMS and are sent to RF terminal screens as a set of elementary sequential commands. Commands/directions can also be set and sent by the warehouse manager, who may control the task assignment process. The operator confirms task fulfillment by scanning a label barcode at the processed location. IRRFID technology is deployed, task fulfillment is confirmed by scanning RFID mark. Using the ZWMS your warehouse will be functioning as an integrated and well-controlled complex, bringing

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together all the resources and capable of interaction with other elements of the logistics chain. WMS will be a key component of the complex[39-40].

2. Functions of ZWMS

Optimization principles
- Automatic identification of loads/identity control
- Warehouse zoning
- Control operations in real time mode
- Workflow optimization
- Remote personnel management
- Authority levels and privileges control
- Labor standards
- Keep record of any event and action
- Material handling equipment control
- Routing optimization and load tracking and tracing
- Order staging by optimal vehicle routes (task interleaving)
- Graphical representation of the warehouse layout 13
- System configuration
- Report generation
- System of help
- Support of RF and bar code equipment
- Integration with ERP system
- Statistics exchange
- OLAP (online analytical processing)

Inbound management
- Advanced notification
- Receive the nonstandard, unpacked product and returns
- Cross-docking

Operations on product in stock
- Automation and goods stocking and warehouse operations
- Put away and inventory storage rules
- Inventory allocation priority definition
- Inventory control
- Product age and expiration date control
- Load status control
- Load reallocation
- Sorting
- QC & quarantine
- Inventory management
- Inventory management by FIFO or by expiration date/shelf life
- Inventory by various units of measure
- Warehouse balance management/optimal safety stock level
- Stock inventory
- Physical counting
- Cycle counting
- Writing-off scrap and rejects
- Inventory update and elimination of load lost

Order processing
- Order planning
- Goods reservation/backup
- Picking
- Staging
- Reserving for special orders
- Kitting/assembling
- Wave processing
- Shipment
- Direct loading regardless of order continuity
- Prior consolidated order shipment
- Forward picking and replenishment
- Order re-planning
- Order cancellation and processing changes
- Handling exceptional situations
- Screening

Personnel management
- Labor productivity analysis
- Reports on every warehouse operation during certain period of time
- Keep record on every fulfilled task.

More available functionality
- Virtual warehouses (stocks) support
- Preparation of the warehouse for put away
- Receiving extra ware
- Receiving measuring product by parts
- Weight control
- Certification control
- Control during process of manufacturing
- Random control
- Single control
- Integration with the product manufacturing processes
- ISM (in stock manufacturing)
- Integration with conveyor (interfaces to control conveyor diverts and other MHE requirements)
- Goods compatibility control
- Handling loads of extreme dimensions
- Loads labeling
- Palletizer and Applicator handling
- Vehicle loading optimization
- Re-loading[40-44].

The warehouse is divided into specified areas according to technological operations in order to automate inbound, outbound and in-stock operations. The system enables the client to create a series of work algorithms to assign personnel in the most efficient manner, to accomplish warehousing and inventory movement responsibilities.

ZWMS controls task fulfillment through the scanning of a bar code. Storage locations/storage units, loads and vehicles are all marked with bar codes. The system supports any bar code type, and labels with internal bar codes can be printed out. Material handling equipment and operators are equipped with data collection devices – RF handheld scanners and vehicle mounted terminals that wireless transmit data to the system.

The system considers many storage condition requirements while assigning product to put away. Temperature and humidity modes, product age and expiration date, vendors and suppliers, compatibility rules and many other parameters are considered by ZWMS. Through following designated put away rules, ZWMS automatically chooses the appropriate
storage place for loads that are received and generates tasks for operators to move the loads. The tasks are sent to the specific operator’s RF terminal screen according to the sequential elementary commands. The operator confirms that the task was completed by scanning a barcode code. The system controls the operator’s actions to eliminate the misplacement of loads as well as errors during order picking. When generating tasks, ZWMS considers the most optimal vehicle routes and subsequently reduces empty runs. ZWMS then optimally assigns the appropriate vehicle to the task. The system controls the movement of every employee and is able to eliminate errors in order picking, inventory put away as well as the period movement of goods in the warehouse. Information on load allocation, availability of products, personnel activity and completed tasks are continuously updated in the system. A twodimensional graphic representation of the warehouse layout is available at the warehouse manager’s response.

The system generates reports on current warehouse status or fulfilled operations. The reports can be printed out or sent to the client’s ERP. The customer can choose the type and number of reports during the requirement specification and development stage [46–48].

Database
The system can be integrated with the following DBMS: Oracle, Sybase, MS SQL, and Postgres SQL&IBM DB2. Integration with any of the above listed DBMS allows customers the possibility to reduce total ownership costs and use customary DBMS.

3. Operational System

The system is based on Unix (Linux) platform, while clients applications are run under Windows or Unix.

Barcode technology
A label with a barcode is applied to loads. Depending on the standard, the barcode can encode any information such as product profile, expiration date and others. It is used for unique identification of the loads. A barcode is a series of varying width vertical lines (called bars) and spaces. Barcodetechnology encompasses the symbologies that encode data to be optically read, the printingechnologies that produce machine-readable symbols, the scanners and decoders that capture visual images of the symbologies and convert them to computer-compatible digital data, and the verifiers that validate symbol quality. Coupled with the improvements in data accuracy that accompanies the adoption of bar code technology over keyboard data entry, bar code systems are critical elements in conducting business in today’s global economy. Tracking physical assets, inventory, and personnel with automated systems can save money and improve operations.

RF equipment
RFID systems work very much the same way as barcode systems, except that a clear line-of-sight between the scanner and the tag is not necessary, because product information is read by a wireless reader instead of scanning a label. The information that is transmitted via radio signals is able to travel through most materials. RF tag, RFID scanner and a decoding device computer are the attributes of RFID. RFID allow for non-contact reading and are effective in manufacturing and other hostile environments where bar code labels could not survive. The technology is able to track remote and moving objects and to encode more information in comparison to usual bar code label. Wireless networking and mobile computers are an integral part of a bar code or RFID data collection systems.

Economy efficiency

1) Integration

Integration methodology with ERP systems was developed during numerous project implementations. ZWMS successfully integrated with SAP R/3, Axapta, 1C, Monolit, Glaktica and others.

2) Customer Relations Management

- Eliminate non-standard order shipment, create reports of extra shipment or order return
- Reduce expired product write off costs
- Increase quality of services.

3) Logistics

- Optimize warehouse inventory flow
- Increases quantitative and stowage data accuracy to 99.9%
- Complete control over inventory flow
- Warehouse space optimization (increase warehouse utilization by 5 to 25%)
- Increase inventory through put and turns
- Employ best put away strategies.

4) Maintenance costs

- Material handling equipment rational utilization
- Equipment deployment optimization
- Reduce transportation costs (save fuel and electricity, reduce maintenance costs and extend the life of material handling equipment).

5) Personnel management

- Increase employee efficiency
- Eliminate employee errors and increase accountability
- Reduce time required for warehouse processes
- Enhance labor productivity by an average of 20%, 30%

6) Management accounting and document circulation

- Speed up data interchange
- Data access in real time mode
- Reduce paper work
- Inventory control without interrupting warehouse operation
- Integration with corporate systems.

Advantage of ZWMS

1) Leading-edge world-wide business algorithms implementation
2) Individual approach
3) Use the most known development tools and operational systems
4) Best world-wide business algorithms implementation
5) High performance and elevated system operability
6) Advanced functionality
7) Integration with various processes and systems through a developed integration methodology
8) Proven implementation technology and training methodology
4. Improvement of warehouse

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 ZWMS potential as a basis for investment justification should be the first steps in any WMS project. The identification of proper metrics and opportunities for improvement can be a preliminary justification to determine potential payback. The following metrics supplements the above process.

**Order fulfillment**
1) On time delivery, Orders delivered on time per customer requested date.
2) Order fill, Orders filled completely on first shipment.
3) Rate Order, Order picked, packed and shipped perfectly.
4) Accuracy Line, Lines picked, packed and shipped perfectly.
5) Accuracy Order cycle time, Time from order placement to shipment.
6) Perfect order completion, Orders delivered without changes, damage or invoice errors.

**Inventory management measures**
1) Inventory Accuracy, Actual inventory quantity to system-reported quantity.
2) Damaged inventory, Damage measure as a % of inventory value.
3) Storage utilization, occupied space (square footage) as a % of storage capacity (square footage).
4) Dock to stock time, Avg. time from carrier arrival until product is available for order picking.
5) Inventory visibility, Time from physical receipt to customer service notice of availability.

**Warehouse productivity**
1) Orders per hour, Avg. number of orders picked and packed per person hour.
2) Lines per hour, Avg. number of orders lines picked and packed per person hour.
3) Items per hour, Avg. number of orders items picked and packed per person hour.

**Performance Improvements at Warehouse after WMS Implementation**

<table>
<thead>
<tr>
<th>Process</th>
<th>Time Savings per Order (in mins)</th>
<th>Process Improvement (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiving</td>
<td>188</td>
<td>79</td>
</tr>
<tr>
<td>Put-Away</td>
<td>26</td>
<td>90.44</td>
</tr>
<tr>
<td>Picking</td>
<td>79</td>
<td>88.66</td>
</tr>
<tr>
<td>Packaging</td>
<td>58</td>
<td>79.09</td>
</tr>
<tr>
<td>Dispatch</td>
<td>504</td>
<td>98.02</td>
</tr>
</tbody>
</table>

1) Optimized processes
2) Improved supplier and customer relationships
3) Reduced operational expenses
4) Reduce plan to roll out time
5) Better demand planning
6) Transparency and visibility
7) Monitor and control the consumption of inventory
8) Alerting on short fall
9) Controls work flow based on availability
10) Facility to raise and track the Inventory Indents

5. Conclusion

As an impact of large product varieties and shortened customer response times there is a greater emphasis on the ability of the organizations to establish smooth and efficient logistics operations. ZWMS (Ware House Management) is the solution that enhances the existing Physical Network Inventory system functionality and enables the planner to choose the required inventory based on the availability instead during the planning or provides the facility to raise the indent for planning inventory.

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