Evolution of Warehouse Management Systems

Overview

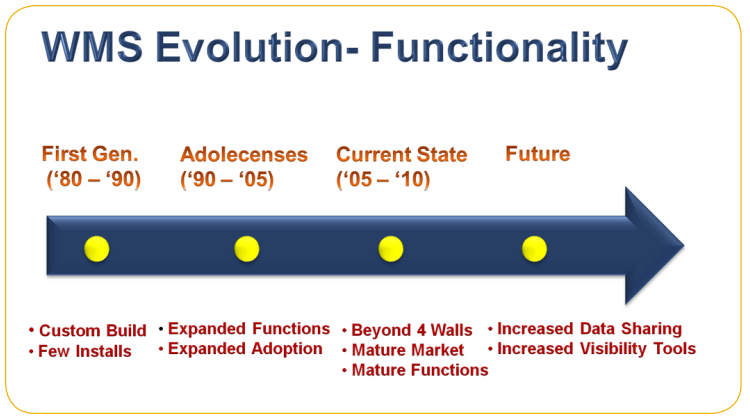
Warehouse Management Systems (WMS) are highly specialized business applications whose purpose is to control the flow of inventory into, within, and out of a company's distribution center (DC). The application typically controls inventory within the "four walls" of the DC, but can be used to control the movement of goods between multiple DCs within the same company. WMS applications track inventory by discrete location and in real time. Meaning, the WMS knows where all product is located, and at all times.

WMS applications are viewed as mature products. The foundational principles, upon which the applications are based, as well as the technology tool sets employed, are stable and well tested. But how did these applications get to this point? What were some of the significant milestones in WMS evolution? What about the future? What may happen next? We will explore these questions, but first what are the key benefits of these systems?

WMS Value Drivers

A WMS adds value and provides a good return on investment. Typical value points are:

- More accurate inventory thereby reducing safety stock levels
- Reduced order processing cycle thereby improving customer satisfaction
- More accurate order fulfillment thereby reducing back orders and miss-ships
- Improved worker productivity by being able to accurately assign work that can be completed
- Improved worker productivity by being able to issue tasks so that travel time is reduced (task interleaving)
- Potential elimination of yearly physical counts as a result of using WMS cycle counting process



WMS Progression

The two major components that make up any WMS application are the functionality that is developed and the computer platform on which the system is deployed.

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Functionality Review

First Generation

Warehouse management principles have existed for as long as man has sold and shipped products. It really all boils down to knowing what you have, where it is, and how much can be sold. Inventory control principles and tools were developed in response to this need (i.e. perpetual inventory balances, inventory tracking cards, etc.). Early WMS applications were more accurate and timely than the old card type records, but still there were limits and draw backs. These early systems required people to key in critical information. With the typical human entry error rate of 1 per 300 key strokes, a high degree of accuracy required double and triple checks. This added age to the data. In a fast paced warehouse where product has to be shipped workers couldn't wait for the system to be updated. So, inaccurate inventory levels were tolerated, which translated into more safety stock.

First generation WMS applications tended to be custom built by either a company's internal IT staff, or built by the few companies that began to specialize in this area. However, the core concepts on which the systems were built were not unique to a given company or industry. As a result, true, standardized systems began to be developed and marketed. However, while standardized, early systems only met sixty to seventy percent of a company's requirements, thereby requiring either drastic changes to a company's way of doing business or modifications to the system. Most chose the modification option. This resulted in a semi-proprietary system which, as time passed, limited the company's options with respect to upgrades and support.

First generation systems focused on the primary functions required to manage the DC. These included receiving, putaway, order planning/allocation, selecting/picking, and shipping. Also, WMS vendors generally focused their applications to serve specific vertical markets (i.e. retail, consumer package goods, third party logistics providers).

Adolescences

During the late 1980s through the mid to late 1990s the WMS industry experienced great growth as most companies fully realized the value these systems could provide. Base functionality offerings expanded to include greater degrees of freedom in configuration of key functions (i.e. putaway rules, allocation rules, etc.) as well as expanding core features. Examples of these included:

- Standardized Interface Tools and Interface Transaction Sets – enabled faster implementations based on pre-defined interfaces to the leading enterprise resource planning applications (SAP, Oracle, etc.).
- Task Interleaving – the assignment of warehouse tasks by the WMS to workers based on what tasks the worker can perform, the worker's current location, and equipment limitations.
- Cartonization – the process by which the system determines the optimal shipping carton into which product should be placed thus supporting single touch pick/pack.
- Cross-Docking – the ability to move inventory directly from receipt to shipping.
- Work Orders and Kitting – light manufacturing functionality that supports maintaining Bills of Materials, processing steps, part ancestry tracking.
- Postponement Processes - where base items are configured into differing models. This allows the warehouse to house fewer finished goods.
- Compliance Labeling – ability to support downstream receipt of items by customers given the shipments are labeled in a consistent manor.

Also, during this phase WMS applications began to be tied to other applications that

impacted the warehouse. These included labor management systems, transportation management systems, product slotting systems, distribution resource planning systems and others.

Lastly, the major ERP vendors began to take notice of the WMS market and either built or acquired WMS solutions as add-ons. The appeal of having one vendor for both WMS, financials, order management, manufacturing management, etc., was enough to cause serious consideration.

Current State

WMS applications are now viewed as mature applications with systems now supporting eighty to ninety percent of most warehousing functional requirements. The WMS market is viewed as mature as well, with systems installed by approximately 80 percent of large companies. Two trends, aside from functionality, are positive indicators for added growth for these applications. These are emerging countries and smaller companies using software as a service (SaaS) based applications (see Technology/Future State section). A third trend, the age of existing installations, will also contribute as older systems built on outdated technology become cost prohibitive to support.

Systems today can be configured to view and control movements between warehouses, as well as what is in transit. This allows for inventory commitments to potentially occur prior to the inventory actually reaching the DC, thereby improving cross-dock opportunities.

To summarize, most applications now offer:

- Functionality to manage multiple physical warehouses within a single installation of the database and application server
- Integrated voice directed features for supports of picking processes
- Integration points to warehouse automation equipment (pick to light, conveyor controllers, etc.)
- Exception based alerts and messaging event management
- External data visibility plug-ins that allow remote users to view WMS data via the internet
- Integrated RFID support
- Integrated business intelligence views that incorporate data not only from the WMS, but other business applications as well (customer relationship management tools, financials, forecasting, labor management, etc.)

Technology Review

First Generation

In the late 1970s and early 1980s a number of key technological events helped usher in the development of WMS applications as we know them today. These included bar codes and laser scanners, networking technologies, improved and less expensive computers and data storage, and radio frequency (RF) data collection terminals. It now became possible to collect very accurate data via bar codes, pass the data in real-time to the computer, verify the information as correct, and update the inventory records accordingly. Users knew, with a high degree of precision, what was stored where. However significant obstacles still remained.

The first early WMS applications were built on centralized, character user interface, mainframe based, systems that required specialized resource skills to operate and maintain (networking standards were still in a state of flux). The first generation of RF terminals operated on a preset "narrow band" radio frequency with a data transfer rate of 1200 baud. Even though real time communications was possible, message conflicts/delay time could be significant (and discouraging to users). The print quality of early bar codes caused problems, as the only printers available were mainframe based line printers not designed to produce the fine edges required for optimal scanning.

Adolescences

In the 1980s and 1990s more technology milestones occurred that built on earlier efforts. These included UNIX based operating systems, relational data base engines, standardized networking protocols, client /server architecture, graphical based user interface (GUI), spread spectrum based RF terminals, more ruggedized bar code scanners, and improved printers (laser, thermal transfer, and direct thermal).

Current State

The majority of systems installed today employ client/server architecture. This configuration has been improved by employing clustering and virtual machine software.

With the continual proliferation of the internet and supporting tools, WMS applications are being re-engineered and the base software is being constructed using services oriented architecture (SOA) methodology. This approach allows for greater software modularity, which, in turn, promotes greater degrees of system configuration and reduces the need for customization.

Another current technological trend is the notion of software as a service (SaaS), where the WMS application is not licensed, but is provided as a service. The pricing model typically is based on a monthly fee to be paid to the provider. Other models include pricing for transactions, or users, or a combination thereof. Also, in most cases, the system is installed on servers that reside within a remote data center. The cost of the servers is usually bore by the customer, or factored into the monthly fee. Initial capital outlay mitigation is typically the principle advantage of this model. However, a thorough total cost of ownership analysis is recommended to determine total project /system outlays.

Summary and Future State

Warehouse management systems have grown from being custom built, highly specialized applications, to standardized systems that offer a high degree of warehouse operations functional support. These applications now are integral components of most company's supply chain solution set, and operate day in and day out with little, if any down time. We all benefit daily from the efficiencies delivered by warehouse management systems since practically everything we buy and use was planned and controlled by one.
WMS applications of the future will continue to be web centric with systems providing more web visibility into application data. Both the SaaS deployment model and the underlying SOA architecture will contribute to this trend. Also, systems will continue to reach outside of the traditional four walls of the warehouse to actively manage stock from source to end consumer, as well as provide more seamless integration with other business applications to support planning and execution.

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