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WHITE PAPER

WMS Planning, Design and Procurement

Supply Chain Forum
White Paper Series

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THE CASE FOR WMS

Warehouse management systems provide a bridge between enterprise-level purchasing, manufacturing planning, manufacturing execution and customer service systems and the warehouse or distribution center. With real-time visibility of available inventory, the WMS marshals people, space and equipment to efficiently receive, store, pick and ship components and raw materials to production and finished goods to wholesalers, distributors and end customers. Against this backdrop, it seems clear that most, if not all warehouses could benefit from some form of WMS. How do you know if you need one and, if you do, how do you characterize requirements to ensure that you get the one you need?

Installing a WMS on time and at a cost that can be justified requires a plan and rigorous attention to detail. The array of systems packages and tools available for warehouse management is mind-boggling. While exciting for prospective users, the very number and diversity of potential WMS solutions create serious challenges for the engineer or analyst trying to match them against his or her warehouse management requirements.

Successful WMS installations are not fortuitous accidents. Rather they are the result of solid preparation, painstaking attention to detail and an organizational commitment from the time of opportunity identification to and through installation and acceptance.

This document has been prepared to assist the user with leveling the playing field and moving towards informed assessment of WMS opportunities and alternatives. It provides a roadmap for needs analysis, requirements definition, functional specification development, alternative evaluation, technology and system selection, installation, training, acceptance testing, documentation and downstream performance auditing.

WMS OPPORTUNITY IDENTIFICATION

Challenges most frequently cited as the basis for WMS investment include:

- Receiving, picking and shipping errors
- Long search times due to misplaced or lost stock
- Manual transaction recording
- High direct and indirect labor costs as measured by cost per dollar shipped
- Inventory accuracy below 99%
- Low inventory turn
- Shrinkage
- Lot tracking and shelf life management issues
- Lengthy order cycle times, low fill rates and related customer service problems
- Poor space utilization, increasing use of outside storage and related shuttle costs
- Performance measurement issues
- Customer demands

- Internal/external survey feedback.

GETTING STARTED

If any or all of the foregoing areas are keeping you up at night, you are a candidate for a WMS, but where do you start? As a first step, you need to identify and quantify opportunities for improvement and prepare a preliminary justification to determine potential payback.

The tables below outline several performance criteria that will enable you to benchmark current operations and establish targets for improvement.

Order Fulfillment Performance

Measure	Definition	Calculation	Current	Target	Value
On-time Delivery	Orders delivered on time per customer requested arrival date	Total Orders On Time / Total Orders Shipped	%	%	$
Order Fill Rate	Orders filled completely on first shipment to customer	Orders Filled Complete / Total Orders Shipped	%	%	$
Order Accuracy	Orders picked, packed, and shipped perfectly.	Ord. Shipped w/o Errors / Total Orders Shipped	%	%	$
Line Accuracy	Lines picked, packed and shipped perfectly	Lines Shipped w/o Errors / Total Lines Shipped	%	%	$
Order Cycle Time	Time from order placement to customer shipment	Actual Ship Date (minus) Customer Order Date	Hrs	Hrs	$
Perfect Order Completion	Orders delivered without changes, damage or invoice errors	Perfect Delivery Orders / Total Orders	%	%	$

Inventory Management Performance

Measure	Definition	Calculation	Current	Target	Value
Inventory Accuracy	Actual inventory quantity versus system-reported quantity	Actual Quantity/SKU / Reported Qty. by SKU	%	%	$
Damaged Inventory	Damage measured as a % of inventory value (cost)	Total Damage $ / Total Inventory Value $	%	%	$
Days on Hand	Avg. sales days of inventory on hand based on historical sales	Avg Inventory Value ($) / Avg. Daily Sales During Past Month ($)	Days	Days	$
Storage Utilization	Occupied square footage as a % of storage capacity square footage.	Avg. Inventory Sq. Ft. / Storage Capacity Sq. Ft.	%	%	$
Dock-to-Stock Time	Average time from carrier arrival until product is available for order picking	Average Dock-to-Stock Hours Per Receipt	Hrs	Hrs	$
Inventory Visibility	Time from physical receipt to customer service notice of availability.	Time of Host System Receipt Data Entry – (minus) Time of Physical Receipt	Hrs	Hrs	$

Warehouse Productivity

Measure	Definition	Calculation	Current	Target	Value
Orders per Hour	Average number of orders picked and packed per person-hour	Orders Picked/Packed / Total Whse Labor Hrs	Ord/Hr	Ord/Hr	$
Lines per Hour	Average number of order lines picked and packed per person-hour	Total Lines Picked/Packed / Total Whse Labor Hrs	Lines/Hr	Lines/Hr	$
Items per Hour	Average number of order items picked and packed per person-hour	Total Items Picked/Packed / Total Whse Labor Hrs	Items/Hr	Items/Hr	$
Cost per Order	Total warehousing costs Fixed: space, utilities, and depreciation. Variable: labor/supplies	Total Warehousing Costs / Total Orders	$/Order	$/Order	$
Cost as a % of Sales	Total warehousing cost as a percent of total company sales	Total Warehousing Cost / Total Revenue	%	%	$

CHARACTERIZING PERFORMANCE

Much of the data required for characterizing current performance should be available in the sales order archives on your host computer system. The challenge, of course, is extracting the data and processing it in a fashion that will permit ready analysis. Many firms use spreadsheets and brute force for these analyses. Others use "activity profiling" tools that are beginning to emerge in the marketplace. Whatever tools are used, the end product is a picture of current performance and future opportunity that can be used as a basis for preliminary quantification of potential benefits.

In the process of your analysis, take a look at the number of times a given item is handled as it moves into and through the facility. How many people are involved? Are aisles congested and traffic patterns undefined? What kind of paperwork is generated? Who completes and processes it? On the warehouse floor? In the office? How are storage locations selected? How long does it take an operator to store an item once it has been received? How are inventory records maintained? What view of inventory is available to customer service for allocation to incoming orders? How are orders released and transmitted to the warehouse for picking? How long does it take an operator to locate line items for order filling? How many orders are lost because inventory cannot be located in time for shipment? How do you handle multiple orders for the same product when demand exceeds available quantity? Are picked items staged or loaded directly on trailers or delivery vehicles? How is shipping paperwork generated? How long does it take?

IDENTIFYING PERFORMANCE IMPROVEMENT OPPORTUNITIES

From this evaluation, identify realistic performance improvement targets and calculate the potential cost savings that are likely to accrue when they are achieved. What, for example:

- Is the value of a real-time view of empty storage locations to improved space utilization?
- Is the value of a real-time view of available inventory by SKU, quantity, expiration date or lot number and exact location to customer service?

- Is the value of a system whose inventory accuracy permits you to replace full physicals with scheduled and event-driven cycle counts?
- Is the value of a system that accepts receipts as they arrive and tasks available operators to store or crossdock to reduced dock congestion and improved operator productivity?
- Is the value of a system that can task an operator who has completed a storage move to perform a pick as opposed to deadheading back to the dock?
- Is the value of a system that automatically generates shipping paperwork for an order once the last line item is moved to the dock or trailer to reducing yard congestion and improving trailer throughput?
- Is the value of a system that date and time stamps each transaction and identifies the operator who performed it to measuring performance and resolving anomalies?

QUANTIFYING POTENTIAL BENEFITS

Once your list is complete, develop realistic targets or goals for each of the metrics in the foregoing tables. Note that, with the right combination of physical layout, process flow and WMS, a twenty percent improvement is not an unrealistic expectation. Then, total the current costs of warehouse operation and administration and match this total against the reduced costs anticipated with improved performance. The difference between the two, in effect, provides you with a preliminary justification for moving forward - or, alternatively, confirmation of a world-class warehousing operation. Assuming the former, what's the next step?

A "GLOBAL" APPROACH

The myriad alternatives available to tackle any WMS opportunity share many features, but differ widely as to flexibility, adaptability and user friendliness. Given the variations, it is critical that you take a measured approach to assessment and articulation of your requirements in order to better assess the suitability of alternative solutions.

Further, you cannot develop a warehouse management system in a vacuum. The relationship of the system to corporate level financial, planning and order management systems is critical. Equally important, development of a WMS without a hard look at facility layout, handling systems and methods will almost certainly produce a sub-optimal implementation. Information system designers rarely consider modifications to facility layout, handling systems or methods in developing solutions for warehouse resource management. The result? Sub-optimal layouts and sub-optimal systems. To avoid this trap, build a profile of current operations (or "green field" plans) that includes:

Facility Layout
Size: Usable Square Feet, Clear Height

Storage Locations (# Locations, Size)
Floor
Pallet Rack & Flow Rack
Carton Flow Rack
Bins & Shelving
AS/RS, Mini-Load, Carousel

Activities (Current & Projected)
Receipts/Hour/Day/Peak
Trucks, Railcar, Other
Orders, Lines, Items
Pallets, Cartons, Rolls, Other
Picks/Hour/Day/Peak
Orders, Lines, Items
Eaches, Cartons, Pallets, Other
Shipments
Trucks, Rail, Courier, Other

Product Profile (Current & Projected)
Dims. & Wts. of SKUs by Handling Unit
Classifications; e.g., Hazardous
ABC Percentages

Product Considerations
Shelf Life
Lot and/or Date Codes
Serial Numbers
Seasonal Issues
Quality Control

Movement (Number, Description)
Lift Truck, Pallet Jack, Other
Conveyor, Guided Vehicle

Data Collection (Number, Description)
Bar Code Scanners
Radio Frequency Data Terminals
VDTs, CRTs
Clipboards & Pencils

Human Resources (Shift & Total)
Supervisory
Lift Truck Operators
Receiving Clerks
Order Pickers (Non-Lift Truck)
Replenishment (Non-Lift Truck)
Inventory Checkers
Shipping Personnel
Data Entry Clerks
Other

Other Systems
Types
Applications
Interfaces
Upload/Download Content & Frequency

Warehouse Environment
Congestion
Product Damage
Safety
Other

ACTIVITY PROFILING

In building your profile, it is critically important that you accurately characterize transaction activity, both historical and projected. Historical profiling data along with corresponding projections of future SKU unit volume facilitate precise analysis and design of the warehouse physical layout, process flows, and labor, equipment and systems requirements. Profiling lays the foundation for evaluation of existing and proposed operations to identify optimum operating strategies. Steps include:

Populate Profiling Database:

- Collect 12 months of historical receipt, order and item activity data from the host database.
- Develop relevant activity projections for the next three to five years.
- Translate and summarize the data into a profiling database.
- Using the baseline profile, identify the amount of activity to be handled at each site.
- Audit and validate the data with the project team.

Analyze Order/SKU Characteristics by Site:

- Order size and volumes by handling unit, ship method, and customer type.
- Receipt sizes and volumes by handling unit and material type.
- SKU popularity, volume, and daily activity by handling unit and product family.

With a "global" view of the operation, you can begin to assess alternatives with an eye to developing an optimum blend of space, people, and equipment to execute the warehouse mission.

Layout and process flow changes, equipment modifications and a fresh look at staffing are likely to lead to improved performance **before investment in a WMS.** Areas to investigate include:

- Storage method alternatives.
- Product storage mode assignments and slotting.
- Pick method alternatives.
- Pick zoning strategies and space requirements.
- Forward pick area options.
- SKU pick face sizing.
- Pick face sequencing alternatives.
- Replenishment levels.
- Reserve storage zoning and space requirements.
- Slow moving inventory space requirements.
- QC, returns, packing and staging space needs.
- Transportation (e.g., lift truck, pallet jack, conveyor) requirements.
- Labor requirements by alternative.

Analysis of these alternatives is typically an iterative process that may, indeed, lead to a new facility layout

Once you have identified and quantified the combination of changes to layout, material flow, storage and picking procedures that offers the greatest potential, it's time to begin your investigation of the likely impact of a WMS upon performance. In other words, an optimized warehouse layout and operating strategy can be enhanced by implementation of a WMS. Combining a WMS with a flawed layout and ill-defined operating procedures, however, will only magnify inefficiencies -- faster.

THE WMS ROADMAP

Successful implementation of a warehouse management system is always the result of rigorous attention to detail, a clear vision of where the WMS fits within the enterprise and a **corporate-wide commitment** that builds organizational ownership from the time of opportunity identification to and through installation, acceptance and operation. There are no shortcuts, but, given the commitment, there is an approach that will increase the probability of "on-time, within budget" successful execution. Its elements include:

WMS Project Team Formation

Properly (or, improperly) constructed, WMS performance will impact all components of your organization. Accordingly, it is critical that the project has broad endorsement and support. Led by the user and championed by senior management, then, a two-tier Project Team including representatives from all impacted elements of the organization is recommended. The first or management tier acts as a corporate steering committee while the second or core tier is vested with responsibility and authority to execute the actual project. Depending upon the company, the core group is relatively small and composed of representatives from operations, logistics and the warehouse. Note that core team members must have a clear charter and a commitment from management that ensures adequate insulation from distractions.

WMS Needs Identification

Formal *needs identification* expands upon the benchmarking performed at project inception with a detailed assessment of data flow. Frequently, there is a lack of correlation between material and data flow -- material goes one way and information goes another. This disparity creates time lags that impact the accuracy of inventory and affect space and labor utilization, order processing and shipping efficiency.

Assuming that you have identified desired changes to layout and process flow, disparity analysis not only lays the foundation for development of the functional specification that defines WMS performance requirements, but also further highlights opportunities for cost reduction and avoidance.

For example, could the introduction of bar codes, RFDC or other automatic data collection technology simplify, speed and enhance the accuracy of data entry? Where should ADC be implemented and what functions will it support -- in receiving, storage, inventory management, workload management, picking and shipping?

Given layout revisions, are there enhancements to the current information system that could contribute to improved utilization of space, people and equipment -- e.g., task interleaving, random storage, automatic replenishment, location consolidation, scheduled and exception-based cycle counting, etc.? Might the system permit further refinement of the layout and procedures and additional productivity gains? (Remember, it is an iterative process.) Might these functions be better addressed by a WMS specifically designed to handle them? Features and functions to be addressed include:

Yard Management
- Carrier Appointment Scheduling
- Trailer Staging/Spotting

Receiving
- Blind/Unanticipated Receiving
- ASN Receiving
- Purchase Order Receiving
- Pre-tagged Receipts Handling
- Load Tagging/Labeling
- Non-stock item receipts
- Returns

Putaway
- Crossdocking
- WMS-Directed Storage Selection
- Mixed Material (Container) Putaway
- RDT Putaway
- Putaway Verification

Quality Assurance
- Sampling Rules
- Quarantine
- Material Status Management
- Material Hold & Recall

Replenishment
- Forward Pick Locations
- Floating Forward Pick
- Replenishment Trigger Controls
- Demand Replenishment
- Batch Replenishment

Order Planning
- Host Download Format & Frequency
- Order Changes and Cancellations
- Wave & Batch Planning
- Material Selection & Allocation
- Order/Shipment Release
- Workload Management

Picking
- RF Picking/List Picking
- Order, Batch, Wave, Cluster Picking
- Pick and Pack
- Pack Station Routing
- Value Added Processing

Staging
- Staging Location Management
- Staged Load Verification / Confirmation
- Door/Truck Verification

Shipping
- Shipping Confirmation
- Shipping Labels
- Manifests/Bills of Lading
- Trailer Scheduling & Processing

Material Movement
- Operator-Directed/System-Directed
- Relocation/Consolidation

Material Tracking
- Bills of Material/Material Substitution
- User-Defined Unit of Measure
- Lot Tracking/Serial Number Tracking
- Date Code Processing
- Catch Weight

Labor Management
- Labor Standards
- Labor by Order
- Labor by Work Area

Workload Management
- Equipment Profiles
- Material Profiles
- Location Profiles
- Operator/Equipment Prioritized Task Profile

Inventory Management
- WMS Cycle Count Generation
- List Cycle Counting
- RF Cycle Counting
- Slotting Management

Material Handling Interfaces
- Conveyor
- Sortation
- AGVS
- Carousel
- Pick to Light
- Palletizer
- Automated Storage (AS/RS)

External Interfaces
- ERP
- Order Management
- Transportation Management
- Supply Chain Visibility / Event Management

Labels/Bar Codes
- Location Labels
- Inbound Load “License Plates”
- Picking & Shipping Labels
- Compliance Labels

Reports
- Standard Reports & Report Writer

As the WMS functional profile evolves, keep an eye on its potential impact upon process flow as well as additional efficiencies that might be realized in terms of people, equipment and space utilization. This will enable you to fine tune planned changes to the physical plant as well as to your investment proposal.

Requirements Statement

The Requirements Statement delineates task-by-task WMS performance characteristics including material and data flow. It also covers computer and data collection hardware sizing and deployment, operator and machine interfaces and so on. To obtain the response times that a real-time system should provide, prospective users must pay particular attention to the following areas in charting their requirements:

Area	Description
Transaction Volume	Number of discrete transactions (receipts, puts, internal moves, transfers, picks and shipments per hour, shift, day) at peak.
Number of Users	Number of personnel who will be interacting with the WMS including warehouse staff, customer service, administration and management.
Data Entry Devices	Number of bar code scanners and other ADC devices, radio frequency data communications terminals, and CRTs/VDTs.
Equipment Interfaces	Interfaces to controllers for conveyors, carousels, AS/RS, guided vehicles and pick-to-light systems.
Systems Interfaces	Host and other systems interfaces, anticipated transaction frequency.
Response Times	Expected amount of time the WMS will take to process radio data terminal transactions (2 seconds or less typical) and CRT/VDT inquiries & report requests.

Computer hardware is relatively inexpensive. Clear definition of the foregoing will ensure that it is properly sized to provide the level of performance needed in the contemporary warehouse.

Alternative Evaluation

Here you will be reviewing third party WMS products as well as in-house information system resources, experience and workload. Note that as a basis for discussion, a high-level view of anticipated WMS operation as well as presentation of your operating profile, below, will enable developers and prospective suppliers to provide more substantive responses. Additionally, your initial assessment of alternatives should include meetings with suppliers. Brochure and catalog reviews are unlikely to provide sufficient insight for an informed decision.

Make Or Buy?

In determining resources to be used for WMS development, look at your internal information systems team to assess whether or not they have the skill set, experience and time to tackle the project. Material handling and warehouse operational experience is definitely a requirement. An understanding of the role the WMS will play in supply chain management as well as its relationship to other corporate systems is also important. An appreciation of the differences between real-time execution systems and archival, batch data processing systems is critical.

Note that some firms, particularly those with multiple sites, are now purchasing baseline WMS licenses, teaming on the first site and, then, taking the lead on subsequent sites. If a decision is made to pursue procurement of a third-party WMS package, recognize that it will require as much attention to detail as if the project were undertaken in-house. Once determination of the

best approach has been made, retune your budget, justification and schedule and obtain management approval **before** moving to the next step.

Supplier Selection

If outside procurement or, alternatively, procurement of a license for a WMS package to be used as a baseline for internal development is determined to be the appropriate direction:

1. Using an RFI (Request for Information), narrow the field to the three or four suppliers that your initial legwork identified as most likely to meet your needs.
2. Using the Requirements document, prepare and distribute a Request for Proposal that clearly asks candidates to describe how their WMS will address your specific needs.
3. Include a "Conformance Table" that requires bidders to identify by page and paragraph how they propose to handle each of your functional needs. Boilerplate responses rarely hit the mark and often lead to disaster.
4. Schedule separate visits to your site for suppliers for detailed review of requirements and a first-hand look at the application environment.
5. Give suppliers sufficient time to produce their proposals.
6. Prepare an evaluation document similar to that on the last page to facilitate objective assessment of responses.
7. Invite suppliers to your site for formal presentation of their proposals.
8. Select finalists and arrange site visits to accounts recommended for the similarity of their systems to your requirements.
9. Evaluate site visits and supplier chemistry (you will be partnering for years to come).
10. Select supplier.

Development

The development phase typically begins with a conference room pilot during which the supplier's baseline software is matched function by function to your requirements, necessary modifications are documented, and a final system specification is published. Software development, integration and testing follow with active user-driven project/ milestone management. Parallel activities should include:

- *Preparing employees for system ownership*

  Operators can make or break any system. Accordingly, they play a significant role during initial requirements analysis and throughout a project. After the system specification and WMS equipment configuration have been completed, consider development of a WMS **"walk through"**. Use the specification to script WMS tasks for all distribution center personnel. Use props to designate system components (e.g., RF

terminals, bar code labels and readers, printers, etc.) and their locations. The "walk - through" is a role playing session that runs operators through a typical day with the WMS -- receiving, storage, picking, order consolidation, truck loading, shipping -- the entire process.

In addition to being an effective **training** device, the "walk through" normally reveals procedural flaws -- nothing dramatic, but fine points that, if modified, can improve system performance. Most of the changes will involve system equipment location and the integration of physical and data entry tasks rather than information processing. Changes should be made to the specification and implemented during development and **before** the system is shipped to the site.

- *Risk management*

A recommended approach involves review of the functional specification with IS, financial and operating personnel to identify what could possibly go wrong -- and, the development of appropriate back-up procedures. Step through every system element, determine the probability of problem occurrence and the cost of resolution. At the end of the process, you'll have a lengthy document that details what might go wrong, solution cost and whether or not the risk warrants an additional investment. Adjust the specification and equipment configuration accordingly. A by-product of the process is a plan that permits continued facility operation in the event of a minor problem or major system failure.

Pre-Shipment Acceptance

System functionality and performance testing are fundamental to surprise avoidance. Test plans should be prepared in parallel with system development and executed as development milestones are completed. Communications interfaces should be fully tested and the completed package run through its paces prior to release for delivery to the site.

Implementation

Another critical ingredient of the development process is the Conversion Plan that details the steps that must be taken in preparation for cutover to the new WMS. The conversion plan provides procedures and timing for everything from the part master data base build to laying cable, bar code labeling of storage locations, employee training, installation and system start-up. A conversion plan may wind up being half the length of the full specification, but, properly managed, it is worth every page.

On the subject of training, most suppliers now advocate a *train the trainer* approach that places responsibility for operator training in the hands of your supervisory personnel. While this approach makes sense for a number of reasons, it is important that you work with the supplier to ensure that training manuals and handbooks are tailored to your application, your site and your people. Further, members of your project team as well as the supplier should be available as resources during operator training sessions. Finally, trainers and training materials should be

regularly reviewed after the system is operating to ensure that they continue to reflect the actual situation. This is particularly important as new personnel are brought on-board.

On-site Testing/Acceptance

On-site functional, reliability and performance testing should be performed by **your** personnel to assure that the WMS meets expectations. Final test plans are derived from those used in pre-shipment testing. The critical difference is that the system is now on-site.

Documentation

The typical documentation package includes the final specification, a system design manual, an as-built software programs manual, hardware specifications and maintenance, user and operator manuals. Your project manager should pay close attention to the preparation of these documents and ensure that final versions are delivered in timely fashion.

Performance Audits

We began the process by analyzing current operations and establishing performance targets based upon measurable indicators. Accordingly, do not neglect periodic system performance audits and evaluation of actual versus expected results. If there are variances, dig into the reasons and develop action plans for resolution. It may be the layout, operating procedures or the system. If so, make the necessary modifications and stay focused on meeting your objectives. *Note that it is not unusual for performance to deteriorate for a brief time after installation as operators become familiar with the system. Make sure that management is alerted to this phenomenon and that their expectations have been set accordingly!*

The WMS Time Line

How long is the process? Schedules vary dramatically with the size and complexity of the system, the thoroughness with which the homework has been done, the level of effort invested in employee training and management's commitment to the project. A range of schedules by project phase is shown below.

WMS IMPLEMENTATION CYCLE

Project Phase	Small System[1]	Mid-Range[2]	Complex[3]
Requirements Analysis	1 - 2 Months	3 Months	3 - 6 Months
System Design	2 - 4 Weeks	3 Months	3 - 6 Months
Hardware Selection		1 Month	1 Month
Application Programming	2 - 8 Weeks	3 Months	6 - 12 Months
Installation	2 Weeks	1 Month	1 - 3 Months
Testing/Acceptance	2 Weeks	1 Month	1 - 2 Months
On-Stream	3 - 6 Months	12 Months	15 - 30 Months

1. **Small System**: Basic WMS functionality (receiving, putaway, picking and shipping) with no or minor modifications. Low transaction volume; i.e., <200/hour. Three to ten users. Paper-based or small number of radio data terminals. Standard reports. System runs on a PC or small workstation. Standalone or simple host interface.

2. **Mid-Range System:** Basic WMS functionality with some site or user-specific modifications. Moderate transaction volume (200 to 1000/hour). Ten to forty users. Ten to twenty radio data terminals. Standard reports plus report writer. System runs on a mid-range computer platform or workstation in a client-server environment. Host interface plus simple material handling device interface or link to standard manifesting subsystem.

3. **Complex System:** Full range of WMS functions plus significant user-specific modifications. Large number of products with moderate to high transaction volume (1000 or more/hour). Forty or more users. Twenty or more radio data terminals. Standard and custom reports as well as report writer. Large computer platform with host, material handling device controller and manifesting subsystem interfaces.

After Word

For some companies, realization of the benefits of supply chain integration is not so much technology constrained as it is stymied by the inability of the organization to logically and cost-effectively implement the tools and systems available. Clearly, success with warehouse management systems is no longer technology constrained. In order to maximize their potential, however, you need a solid plan and a broad commitment to:

- Think "globally"
- Analyze before design
- Design before selection
- Clear specifications
- Realistic performance expectations
- Well-defined user/supplier roles & partnership
- Project/milestone management
- Measurable acceptance criteria
- Training, training, training!

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30 years in manufacturing, warehousing and distribution management systems. Former CEO of data collection and warehouse management systems firm with over 50 successful WMS installations. Founder of the Automatic Identification Manufacturers (AIM) Trade Association. Former president of the Material Handling Education Foundation, Inc. and the Material Handling Institute, Inc. (MHI). Co-founder of MHI's Logistics Execution Systems Association (LESA). 1997 recipient of the Norman L. Cahners award for contributions to the U. S. material handling industry and material handling education. Inductee into Modern Material Handling magazine's 20th Century Material Handling Hall of Fame. Current member of the Board of Governors of the Material Handling Industry of America. Principal and member of the Board of Directors at eSYNC International, a systems integration firm focused upon supporting clients with requirements analysis, specification, selection, and implementation of real-time data collection and information systems in warehousing and logistics.

ABOUT ESYNC

ESYNC is a systems integration and consulting services company dedicated to delivering supply chain solutions that work. ESYNC specializes in both operations optimization and software deployment. Our service offerings include facility engineering, material handling system design, software selection and the implementation of supply chain execution software solutions for warehousing, labor, transportation, supply chain visibility and event management.

ESYNC offers a unique value proposition emphasizing the rapid deployment of projects through the utilization of seasoned, hands-on professionals, value-based pricing and an unsurpassed track record of success. We serve companies across a broad spectrum of horizontal and vertical markets. A list of our clients can be found on our website, www.esync.com.

For questions on this white paper or our professional services, please contact us.

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