

WHITE PAPER

WAREHOUSE CONTROL SYSTEM: ORCHESTRATING WAREHOUSE EFFICIENCY



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EXECUTIVE SUMMARY

Reducing costs while improving productivity and customer satisfaction is the goal of every company, and one of the challenges facing warehouse managers on a daily basis. Many companies, especially those with high-volume pick, pack, and ship requirements, have invested in material handling equipment (MHE) and implemented warehouse management systems (WMS) to drive cost reduction and improve operational efficiency. While these changes have yielded numerous benefits, companies are still looking to achieve more savings and efficiency.

We have written this white paper specifically for warehouse managers, vice presidents of distribution, and system integrators and consultants working in the field of warehouse management. We examine the role of the Warehouse Control System (WCS) and how it interacts and integrates with corporate systems such as WMS and MHE.

Warehouse **Management** System and Warehouse **Control** System may seem similar, but they perform very different tasks in managing the entire warehouse operation. Implementing a WCS can be a cost effective alternative to adding more equipment, or upgrading/replacing a WMS. With a WCS, you can fine-tune your operations, and optimize your current investment in software and material handling equipment. This paper will help you decide if a WCS is right for your warehouse, and some of the key questions you should ask potential software vendors.

BUSINESS CHALLENGES

Managing distribution and warehouse operations today requires that you do more with less. Senior management is demanding cost reductions year-over-year in labor, shipping, and space, with continuous improvement in productivity, throughput, and inventory accuracy. Customers are demanding compliance, value-added services, and shorter delivery lead times. Your company must address these cost challenges to remain competitive.

As part of the solution, companies are using some combination of automated equipment and software. Material handling automation equipment such as conveyors, sorters, carousels, AS/RS, RF, Pick-to-Light, A-frame, and other technologies have enabled many companies to increase throughput, reduce labor costs, and decrease order lead times.

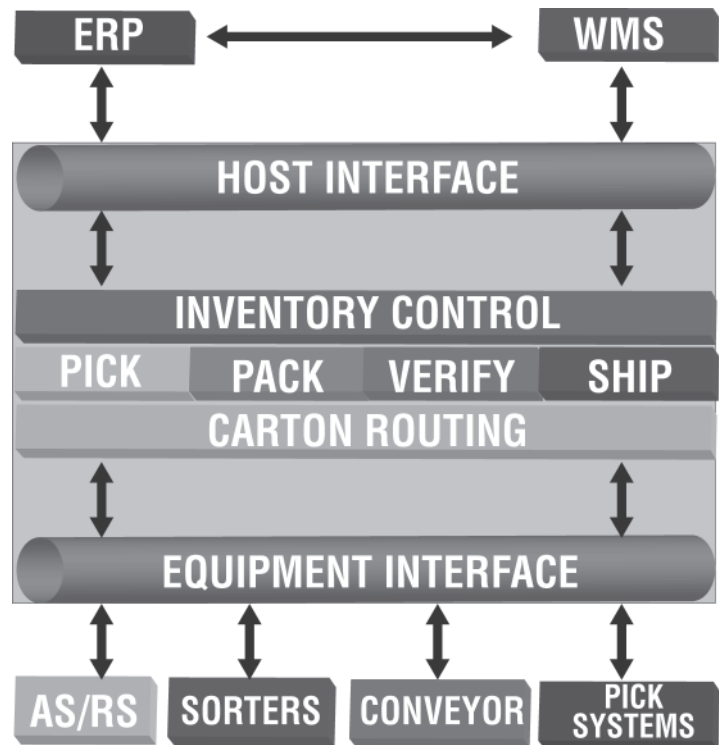
Many companies are also be using software systems, such as Enterprise Resource Planning (ERP) and Warehouse Management Systems (WMS), to get greater visibility over operations, and the tools to plan and manage orders and inventory. These systems have much to offer, including increased inventory accuracy, forecasting, productivity and on-time deliveries, and the ability to accommodate value-added services.

According to a Benchmark Performance study conducted by the Georgia Institute of Technology, only 20-30 percent of warehouse operations are considered "efficient", and as investment in equipment goes up, system efficiency goes down.

The problem is that while material handling equipment and WMS/ERP software systems can independently deliver considerable benefits, they are often unable to communicate effectively with each other, leading to inefficiencies. To address this issue, many companies are now turning to the Warehouse Control System (WCS).

WHAT IS THE ROLE OF A WCS?

A WCS bridges the gap between corporate software applications such as ERP and WMS Host systems, and the Programmable Logic Controllers (PLC) and/or PC-based cell controllers that control the material handling equipment. The WCS provides a single point of control to efficiently direct and manage automated material handling and order processing within your warehouse. This will enable you to fine-tune your operations, and optimize your current investment in software and material handling equipment. Implementing warehouse control software can be a cost effective alternative to adding more equipment, or upgrading/replacing a WMS or ERP system.



The shaded area of the diagram (right) highlights the functionality and capabilities typically found in a WCS.

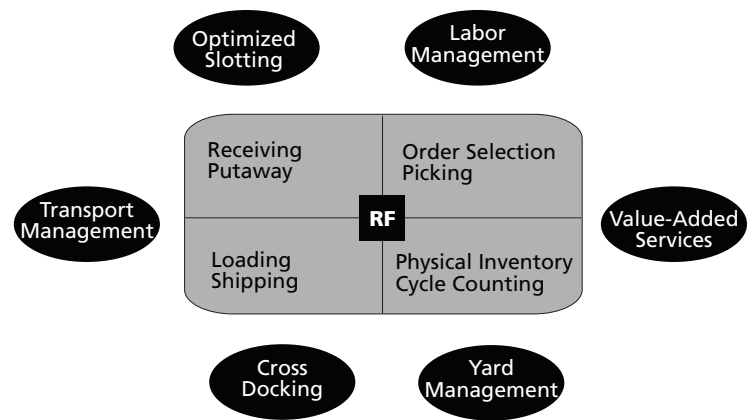
KEEPING THE TEMPO

Think of a symphony orchestra. What would happen to the sound if every musician ignored the other members of the orchestra and performed the music according to their own preferences? Each instrument on its own is capable of producing beautiful music. But the sound produced by all of the musicians tuning up during the pre-performance warm up sounds dreadful. It's the conductor who unites the individual performers into one cohesive and harmonic production. In a warehouse, the WCS performs the role of a conductor, by ensuring the individual pieces of material handling equipment (conveyors, sorters, Pick-to-Light, etc.) perform with harmony, precision, and efficiency. Conducting is a means of communicating real-time information to performers. In an orchestra, the conductor communicates the beat and tempo to the musical ensemble with hand movements. The WCS performs the same function in the warehouse by exchanging real-time data with the material handling equipment, ensuring that everything works in harmony.

WHAT IS THE ROLE OF THE WMS?

The primary purpose of a WMS is to manage the overall activity within a warehouse and process the associated transactions, including receiving, putaway, order selection, and shipping. A WMS also handles the movement of materials from one location to another, physical inventories, and cycle counting. Although WMS functionality differs from one vendor to another, all address the same basic needs of a warehouse operation. Warehouse management systems often utilize technology such as barcode scanners, RF terminals, mobile computers, wireless LANs, and potentially RFID to monitor the flow of products. Depending on the scope and cost of the WMS, it may include advanced functionality such as cross-docking, labor management, yard management, slotting, transportation management, and value-added services. Warehouse management systems can be stand-alone systems, or modules of an ERP system. Benefits claimed include reduced inventory, cost savings, improved space utilization, higher productivity, and improved customer satisfaction.

Although WMS functionality may differ from one vendor to another, all address the same basic needs of a warehouse operation. Depending on the scope and cost of the WMS, it may include advanced functionality as shown by the outer elements in the diagram (right).



WHEN TO CONSIDER A WCS

Consider a WCS if the individual pieces of your “orchestra” have trouble “playing” at the same consistent tempo. Ask yourself if any of the following statements apply to your company:

- Your current system is inefficient and it takes too long to get an order out the door.
- You’re growing fast and can’t handle the volume, especially during peak times.
- Your conveyor system looks like the freeway during rush hour (cartons everywhere, but going nowhere).
- You’re losing customers to your competitors because you can’t ship orders fast enough.
- You’re creating back-orders even though the product is in stock.
- You’re losing products because you have no visibility of order status.
- You’re shipping products to the wrong place.
- Dealing with multiple material handling equipment vendors is causing support problems.
- You are concerned that your WMS is remote (off-site) and/or connectivity problems may bring your warehouse operations to a halt.
- Continually modifying your WMS is too expensive.
- You want to improve your warehouse operations, but can’t afford a new WMS or more equipment.

If your company has invested in material handling equipment and software, but still has significant operational problems or inefficiencies, a WCS may help. A WCS is especially suitable for companies that have high-volume pick, pack, and ship operations. A company that could benefit from a WCS tends to have the following characteristics:

- In excess of \$50 million in sales
- Warehouse of 100,000 sq. ft. or greater
- Conveyor system with multiple sortation points
- Multiple “islands” of material handling equipment
- More than an average of three SKUs per order
- Greater than 1,000 orders per day

Smaller companies that don’t have automated material handling equipment, or a WMS, may also be able to take advantage of many of the capabilities a WCS has to offer. For example, it is possible to use the order fulfillment, inventory control, and shipping capabilities without material handling equipment. Smaller companies can also take advantage of advanced techniques such as batch and cluster picking. The WCS will provide manual picking lists and support RF picking.

WMS VS. WCS

The distinctions between a WCS and a WMS are significant. WMS systems are designed to manage information—they are planning systems versus execution systems. The WCS evolved because warehouse managers were trying to make the WMS do too much, and the technology just could not cope. Routing, sorting, and processing cartons through a conveyor system are very different tasks from tracking inventory and planning orders. The WMS maintains a vast amount of information such as inventory data, customer orders, and historical data. It processes large amounts of data in a non real-time mode, to arrive at the daily workload plan for what needs to be processed by the warehouse on a day-to-day basis. Today, the trend is for the WMS to handle the strategic planning while the WCS becomes the execution engine on the warehouse floor.

The chart below shows some of the key functions performed in a warehouse and identifies which system is best equipped to handle the task. In some cases, the same function may be performed in both systems, but with a different objective—for example, order wave management vs. pick scheduling. The WMS may apply waving to group certain orders together to ensure they are picked and ready for shipment by a certain time to coincide with the shipping schedule. However, the WMS creates the planned pick schedule far in advance. The WCS provides more finite control over the large group of orders scheduled by the WMS, reacting to actual events on the warehouse floor.

WMS (Planning)	WCS (Execution)
Yard & Dock Management	MHE Management
Order Wave Management	Pick Scheduling
Outbound Loading/Shipping	Order Consolidation
External Quality Control (Vendors)	Internal Quality Control (Orders)
Cross-Docking	Sortation Management
Labor Standards & Management	Labor Reporting
Order Selection	Order Fulfillment
Carrier Selection & Tracking	Shipment Manifesting
Slotting / SKU Balance	Pick Location Balancing
Full Case Picking	Split Case Picking
Inventory Management / Cycle Counting	Order Verification / Auditing
Task Generation: Receiving, Put-Away, Cycle Counting, Replenishment	Task Execution: Receiving, Put-Away, Cycle Counting, Replenishment

WMS/WCS FUNCTIONALITY OVERLAP

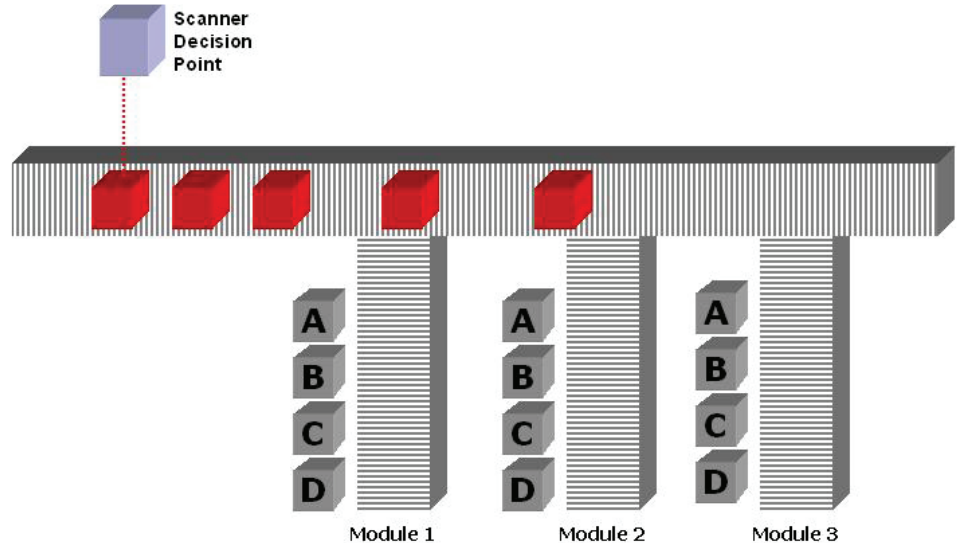
Introducing a WCS with a WMS may result in an overlap of functionality between systems. Where multiple software products make up the overall solution, there is usually some duplication of functionality between systems. This is inevitable as software vendors add more capabilities, and extend the scope of their products. For example, an ERP, WMS, and WCS may all have an inventory control module. The basic functions of product movements are addressed in all three systems. But each system is focused on its own specific requirements. An ERP system uses inventory control for order promising, material and production planning, and inventory valuation. A WMS may select which warehouse is best suited to fulfill the order based on inventory availability and shipping location. The WCS is more focused on the activities within the warehouse relating to order fulfillment and shipping. Determining the best place to perform each distinct level of activity will avoid any conflict. However, there are still areas of functional overlap. Each must be considered carefully for optimum system performance.

For example, both the WMS and WCS can control product picking. Traditionally, the WMS determines the pick location for a product as part of the order allocation process, and then downloads the pick tasks to the WCS for execution. However, by the time the order trickles through the system from initial order allocation, scheduling (WMS and/or WCS waving), to order activation/release, carton induction, transportation, and finally to the pick location, considerable time may have elapsed. Any system balancing that the WMS may have been trying to accomplish through order allocation has been lost.

LOAD BALANCING

As the WCS is managing the various islands of automation, it is better suited to managing the flow of work throughout the warehouse by deciding what orders are released, based on current system activity. Further productivity gains can be realized if high velocity SKUs are available in multiple locations, and the WCS selects the pick location of the items. The WCS is better suited to determine the pick location, because it can wait until the last possible moment based on current system activity. In addition, if the selected pick location becomes unavailable (for example, due to equipment failure) the WCS can search for an alternate location. If the product is picked from a single location, or dictated by the WMS hours in advance, the result is that zones can get flooded with cartons, while other zones are empty.

The WCS can mitigate these problems with dynamic pick allocation and workload balancing. Let's assume an order requires four SKUs (A, B, C, and D), and all four SKUs are available in the three pick modules (see diagram left). Now, let's assume that module 2 is not available because of a conveyor problem. If the WCS determines the pick location, it would bypass module 2 and pick everything from modules 1 and 3. If the WMS determines the pick location, either the cartons recirculate and congestion builds or everything grinds to a halt. In another example, let's assume that SKU D is only available in module 3 because the locations in modules 1 and 2 are waiting for replenishment. If the WCS determines the pick location, it will select module 3, but if the WMS pre-determines the location and it's not module 3, then again the cartons will recirculate until the location is replenished.



WCS BENEFITS – HARMONY & PRECISION

Implementing a WCS can help address the problems highlighted above, and provide numerous and immediate benefits including:

Flexibility in Equipment Purchase Decisions – The ability to tie together equipment from multiple suppliers allows you purchase the best equipment for your facility instead of choosing all the equipment from a single supplier.

Real-Time Operation – Because the WCS interacts with the MHE controllers in real-time, it

instantaneously reacts to status information from the material handling equipment, making adjustments to maintain an efficient product flow.

System Redundancy – In many cases, the WMS/ERP system is not physically located at the warehouse. This is particularly true when there are multiple warehouses in different geographical locations. In the event of communication problems, the warehouse stops working. Since the WCS is always located at the warehouse, it can maintain warehouse operations in the event that the connection between the warehouse and the corporate WMS/ERP system goes down.

Eliminates Islands of Automation – The WCS provides the middleware to connect your WMS/ERP to the material handling equipment via a single interface. This provides a single point of monitoring and control for the entire warehouse, thereby eliminating the islands of automation.

Dynamic Pick Allocation – Traditionally, the WMS allocates the pick location hours before the actual pick happens, and therefore it cannot react to problems on the floor. However, if the WCS selects the pick location, it can make a “last minute” determination based on the current activity and operational status. For example, if a pick zone is full or unavailable due to equipment failure, the WCS can select another location. This dynamic pick allocation helps balance the load on the system and increases productivity.

Cartonization – By analyzing the make-up of each order, the WCS selects the smallest possible size container, reducing shipping and dunnage costs. Cartonization also helps eliminate overweight boxes that can cause problems on the conveyor system.

Quality Control – Imagine your customer’s frustration when they open the long-awaited package and find you’ve shipped the wrong product! Not only do you incur the additional cost of the return, but also and more importantly, you incur the wrath of the customer. A WCS can help eliminate this problem in some industries by providing real-time order verification ensuring that the carton contents are correct for that order using an in-line scale. The WCS knows the expected weight of each order based on the items picked. Boxes outside of a user-defined tolerance can be diverted for manual QC inspection. This method only applies where there is a measurable difference in weight, and not if the products are the same size and weight and the variance is in appearance, for example, picking a blue one instead of red.

Reduce Theft and Fraud – The WCS can help manage not only the product in the warehouse to reduce theft, but also help uncover and eliminate fraud. One company discovered that 80 percent of complaints for missing items were coming from a small number of their sales agents. Suspecting fraud, the company routed the suspected agents’ orders for 100 percent QC inspection, thereby eliminating the problem.

Tracking – The real-time aspect of the WCS provides order status so that you can track a product anytime, anywhere in the system.

Shipping – With a WCS, you can dynamically change the ship method at the time of shipping, ensuring the most cost-effective method is used. For example, perhaps an order originally scheduled for a small parcel carrier actually weighs less than a pound, allowing it to be shipped parcel post. Or, if an important customer needs their package sooner, customer service can upgrade the service level while the order is in the process of fulfillment. The WCS can also prevent double shipment of orders, verify that the package is sent to correct address, and eliminate common shipping errors, such as trying to ship a package to a P.O. Box via UPS.

System Diagnostics and Problem Resolution – The WCS can consolidate operational statistics and diagnostics across the entire warehouse, and provide improved visibility of equipment status and order tracking. These diagnostic capabilities help you get to the root cause of problems, such as incorrect carton routing or excessive recirculation. By identifying inefficiencies in the warehouse system, the WCS helps increase productivity and throughput.

ALTERNATIVES TO A WCS

Much like an orchestra without a conductor, the warehouse without a WCS operates “islands of automation,” with each “system” working independently of each other. For example, without a WCS installed, the conveyor system may decide the carton routing with no intelligence. The decision to divert or not divert a carton to a specific zone will depend on using a “1” or “0” in the barcode. Another approach is to load a routing table into the PLC. This is a fixed table and does not allow any flexibility. Both of these techniques are very basic and give little or no control.

One alternative is to use a single supplier to provide all of your material handling equipment. The equipment provider will supply the control software and interfaces to the host system. The system will however be very basic, and any changes to the equipment layout will require changes to the software code. This is perhaps the easiest option, but may well be among the most expensive, and will mean that you are locked into a single supplier. Your business will also be constrained by the range of equipment they provide.

Another alternative is to choose a WMS that already has built-in integration to your MHE systems. Some equipment suppliers provide interfaces to some of the larger and more popular WMS systems, and vice versa. But what if you have selected a piece of equipment not supported by your WMS? Typically, this means customized modifications to the WMS that can be extremely costly. Making modifications to any software package is always a double-edged sword. On the one hand, modifications can make your system more closely fit your requirements. On the down side, you now have the maintenance problem of reapplying those modifications every time you upgrade to a new release. The cost of upgrading may prevent you from taking advantage of some new functionality that would benefit your company.

You could also have a system integrator build a complete system for you, selecting the best WMS and material handling equipment for your needs. In this scenario, the system integrator will develop the software to integrate the WMS to the material handling equipment, in effect building a “custom WCS.” This has all the inherent problems of any custom software project including bugs, delays, maintenance, and will without a doubt be the most expensive option.

WHAT TO LOOK FOR IN A WCS SUPPLIER

The first step in selecting any software system is to ensure that the product can address your business needs and is the best functional fit. But the service and support you receive from your software supplier can mean the difference between success and failure. You are buying the vendor’s expertise, service, and support, not just their software. Does the vendor have a deep understanding of warehouse operations and business issues? Consider not just the sales team, but also the implementation consultants and senior management. Remember, it is people who provide services. Interview the personnel who will be actually working on your project. The vendor may have many good people, but will you have access to them?

Speak to their CEO, who is, in effect, the conductor of their orchestra. That’s who will be guiding the direction of the product you are buying. Do you get the sense that this person really understands the issues facing warehouse managers today? Is it “music to your ears,” or just general platitudes? Can you talk directly with senior management, or are you relegated to the insulation layer of middle managers? Feeling comfortable with your vendor should be a key decision factor.

Since a warehouse is not a static operation, ask potential vendors about the flexibility of the system. Can the WCS easily handle changes in operations and physical layout, for example, adding a new sorter or lane? Can the WCS accommodate increased production demands? How often does the vendor add new and innovative features to the system?

The implementation of a WCS requires an experienced supplier who has a solid track record, and experience gained from a history of successful projects. Before making any significant investment, it’s sensible to perform due diligence and check out references. Reference checking should be the final stage of the evaluation, as a confirmation that you are making the right choice. The WCS vendor should be able to point you to other companies in your industry that are similar to yours and around the same size.

Insist on talking to your counterpart at the reference company. Talking to your counterpart gives you a greater understanding of the challenges and opportunities you may face when dealing with the vendor and during the implementation.

SUMMARY

A WCS is an essential component of running an efficient warehouse or distribution center today. The WCS acts as the conductor of your warehouse orchestra, ensuring the individual pieces of material handling equipment perform with harmony, precision, and efficiency.

If you are charged with doing more with less, reducing costs year-over-year while improving productivity, throughput, and customer satisfaction, a WCS is a cost-effective solution to removing inefficiencies and streamlining your warehouse operations. Installing a WCS is typically less expensive than modifying a WMS. This means that you can keep your WMS software “vanilla,” eliminating the problem of maintenance and upgrades.

The WCS is not a replacement for your WMS, but can supplement it with additional functionality, such as advanced picking technologies to improve efficiency. By providing capabilities that may be missing, a WCS can extend the life of your WMS, therefore protecting your investment.

An orchestra without a conductor usually does not perform very well, or for very long. The WCS provides that essential, unified view of your entire warehouse operation, eliminating the “islands of automation,” and provides you with the information to monitor and manage your operational processes and diagnose problems. Acting upon that information, you can make changes to equipment, staffing, and operational procedures to improve efficiency.

ABOUT THE AUTHORS

Rich Hite founded QC Software, Inc., in 1996. From his previous experience developing supervisory software for carousels, high-speed sorting systems, and real-time inventory management systems, Hite observed that each system was custom designed for every project, and each new system introduced new bugs. His vision was to provide a standard software solution that was modular, easy to configure, platform independent, and economical.

Jerry List, vice president, QC Software, has over 25 years experience in the material handling industry, designing and implementing complex control systems for a wide variety of material handling equipment. He has implemented control software solutions ranging from real-time machine controls through higher-level supervisory systems.



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