

Körber Supply Chain

WMS Business Case Development



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Warehouse management system business case development

“Cost is a consideration but not a critical decision factor for our distribution facilities. Our distribution operations are a constraint controlling the flow of cash through our business. The faster I can get product shipped out to customers, the faster I can add cash to our organization.”

Introduction

A successful warehouse management system (WMS) implementation can provide an 18-24 month return on investment. A WMS also serves as a foundation for instituting a continuous improvement culture and facilitates on-going annual benefits ranging from 5-10%. For some companies, justification in a WMS is a matter of survival. Having the right material available at the right place and at the right time is no longer enough. The new requirements include: compliance labeling, floor ready displays, advanced ship notices, postponement, light manufacturing, and collaboration. Leading companies are realizing information has a specific shelf life value that diminishes over time, often by the hour or minute. Many of the processes and activities being managed and monitored by Supply Chain Event Management (SCEM) applications relate directly to warehouse operations. As the focus on SCEM applications continues to grow, the need for real-time activity tracking and inventory visibility offered by a WMS becomes even more critical to your organization.

Regardless of your perceived need for a WMS, an effective campaign to procure and implement a new system could depend on a solid business case. A good business case will include both tangible quantitative dollar justifications and the qualitative, intangible benefits difficult to enumerate. This paper introduces a tool to use when developing a project justification, identifies benefit categories for potential inclusion in the business case, and discusses areas of opportunity within the various benefit categories.

Business case development

What if investment cost estimates miss the mark completely? What if assumptions are wrong? What if projected cost savings fail to materialize? How do you get people to buy in to the justification numbers? All good questions to keep in mind as you develop a business case for your new system implementation.

A sound business case is critical to obtaining the management and employee support so important to a successful system implementation. The business case will consist of two components; 1) a financial business case, 2) and narrative explaining the assumptions behind justification estimates and providing an accurate picture of the intangible benefits. A business case is a cost/benefit analysis aligning the project goals, costs, and risks to the company's business objectives and financial expectations. The bottom line, the value of the benefits over the life of the project, normally 3-5 years, should exceed the total investment of the project over the same planning horizon. Table 1 summarizes the general investment categories associated with a WMS implementation project.

The business case will focus on the operating cost savings estimates resulting from the use of a WMS. These dollar benefits must be developed using educated estimates. These estimates need to be able to withstand extensive credibility testing. Consensus development is critical. If it is one person's estimate, suspicion will be high. If however, the estimates are composite opinions of a representative group (the development

Table 1:
WMS investment summary

Investment category	% of Total	Examples
Software & hardware	30 - 60	License, database, server, printers, PCs, access points, scanners
System integration	30 - 35	Consultants, operational changes
Software vendor assistance	10 - 15	Professional services, project management, conference room pilot, modifications
Host system modifications	5 - 10	Interface programming
Storage lanes internal corporate costs	5 - 10	Special training, back fill, retention
Contingency & other	5 - 15	Just in case money
Annual maintenance	15 - 20	Normally priced as a percent of the contract value

team) it is more likely to be widely accepted. Figure 1 highlights several of the areas a WMS can help your organization improve shareholder value. The next section discusses one method of analyzing and measuring benefits.

Intangible benefits will not be easy to quantify and a savings consensus may not be reached, but the benefit may be viewed as a strategic survival initiative. For example, if your rivals gain a competitive advantage over you through a major technology shift, your company's very survival may depend on following suit with a similar technology investment. In this instance, the end result is a shift from a cost versus benefit analysis to a cost versus cost trade off – the cost of a technology investment compared with the potential cost of losing business. The narrative in the business case will be used to describe intangible benefits.

Economic presentation

Remember, your WMS project is just one of potentially many projects competing for your

"We decided to look at another solution due primarily to our current systems limited capability to perform based on the architecture. It takes us about 1.5 hours to run our pick allocation plan.

Considering we attempt to ship everything by the end of our 8 hour day, 1.5 hours is a significant constraint to our overall productivity. We want a new technology solution, with a more efficient code structure to help us process orders more effectively."

- Director, Supply Chain
Technology, Automotive
Service Parts

company's capital expenditure dollars. No matter how compelling the operational benefits of the WMS in the warehouse, senior management also needs to understand how investing in the system will help meet your organization's financial goals.

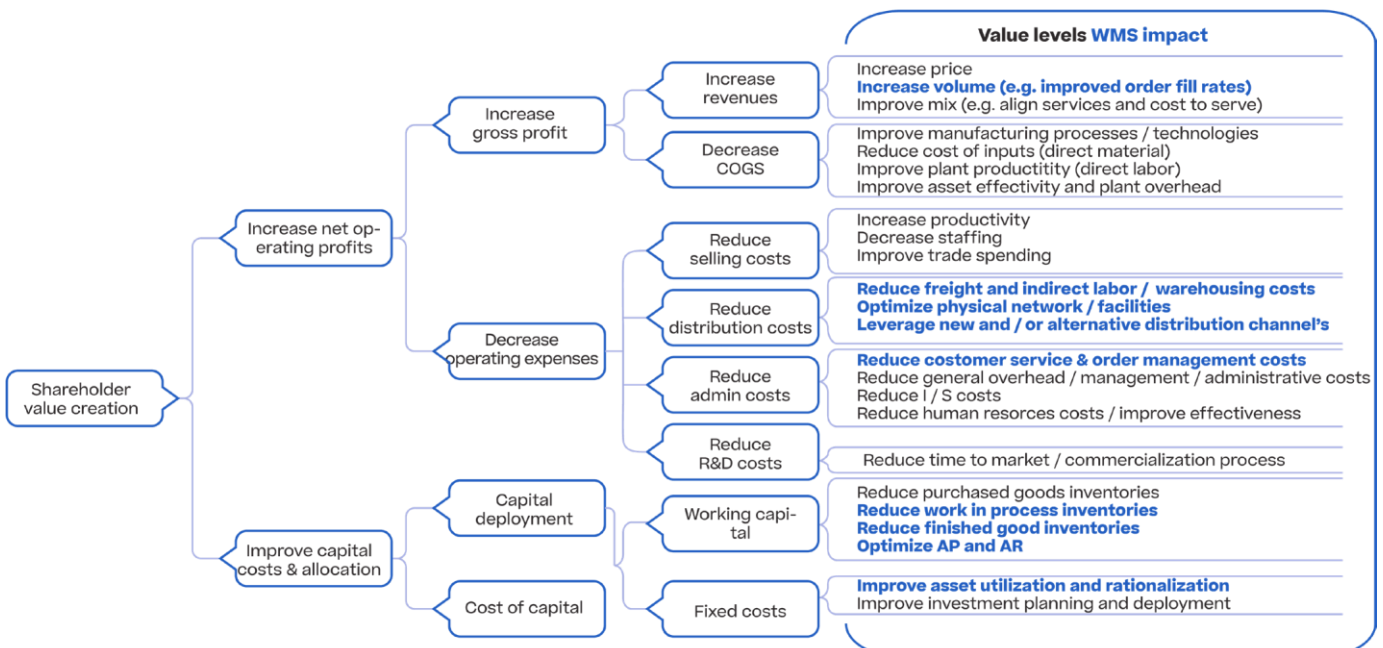


Figure 1: WMS impact on shareholder value

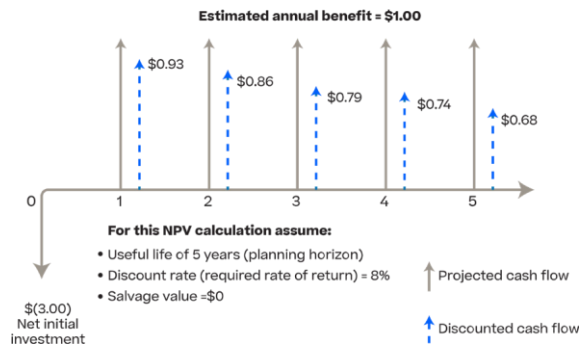


Figure 2: Sketch of relevant cash flows

It is critical to obtain buy-in from your finance or accounting organization during the planning phase. The best way to accomplish this is to invite someone from finance or the accounting organization to work on your team, even if only for a short while. They can help you identify the preferred economic justification tools, identify the company's acceptable level of cost/savings classifications, risk and rate of return, and develop solid financial justifications to increase the likelihood your WMS project will be funded.

As a preliminary step to obtaining corporate justification and approval for a project, consider using Net Present Value (NPV) and Payback Period approaches. These tools will provide a good estimate of the economic justification and help gain early support from company leadership.

Net present value

Net Present Value (NPV) calculates the expected net monetary gain or loss from a project by discounting all expected future cash flows to the present time, using the required corporate rate of return. In developing a NPV calculation, it is helpful to sketch the relevant cash flows over the given planning horizon (typically 3-5 years for a system project). Generally the initial cash outlay and project planning are recorded in year 0 while all future relevant cash flows are in years 1 through 5 (Figure 2).

Once cash flows have been estimated and sketched, the required rate of return (discount rate) is applied to determine the present value of each yearly cash flow. It is important to consider future cash flows are worth less than today's dollars. The longer the planning horizon, the less valuable the cash flow projections become. This concept is referred to as discounting. Essentially discounting determines the value of future cash flows in today's dollars. Once the present values for each year have been determined, the NPV is calculated by summing the values across each year (Table 2). If the NPV is zero or positive, the project should be further considered for acceptance. Its expected rate of return equals or exceeds the company's required rate of return. If the NPV is negative, the project is undesirable and is not justified economically. Its expected rate of return is less than the required rate of return.

Payback period

The payback period is an ad hoc rule looking at how quickly a project pays back the original investment or, in other words, when the NPV of the project equals zero. The time period can be calculated quickly by using the NPV table (Table 2) and estimating when the cumulative present values become positive. In this example, the payback period is 4.7 years. In general, the shorter the payback period, the more desirable the project, especially when there is a high degree of uncertainty over the planning horizon.

Sensitivity analysis

To examine how a result will change if the predicted financial outcomes are not achieved or if an underlying assumption changes, a sensitivity analysis is used to simulate what-if scenarios. Sensitivity analysis is a technique used to examine how a result will change if the original projections are not achieved or underlying assumptions change. Sensitivity analysis allows managers to gauge the margin of safety associated with specific projects and the fundamental assumptions driving the justification. The margin of safety is the answer to the what-if questions:

**Table 2:
Net present value
calculation**

Year	Cash Flow	PV Factor	PV	Cum PV	Comment
0	(3.00)	1	(300)	(3.00)	Initial project investment
1	1.00	(1 + .08)	0.93	(2.07)	
2	1.00	(1 + .08)	20.86	(1.22)	
3	1.00	(1 + .08)	30.79	(0.42)	
4	1.00	(1 + .08)	40.74	0.31	
5	1.00	(1 + .08)	50.68	0.99	Payback period = 4.7 Years, IRR = 20%

- If the projected cost savings (benefits) are too optimistic, how far can they drop before the project becomes unprofitable?
- If the initial project investment is underestimated, how much can the investment increase before the project becomes unprofitable?

The margin of safety can also be stated in terms of percent change of initial investment or annual cash flows. In the previous exercise, margin of safety can be presented as:

To maintain an 8% required rate of return for project WMS:

- Annual positive cash flows should be at least \$0.75. There is a 25% margin of safety (\$1.00 – \$0.75) in the estimated cash benefits.
- The initial cash investment cannot exceed \$3.99. There is a 24.8% margin of safety (\$3.99 – \$3.00) in the estimated initial investment.

Table 3 is a sensitivity analysis comparing alternative NPV calculations under different assumptions of annual cash flows and required rates of return for the NPV example in Table 2. For example, for an annual five-year cash flow of \$0.80 the NPV is nearly \$0 at a return rate of 10%, and \$0.37 at a return rate of 6%. The changing NPV's reflect the relative sensitivity to cash flows and return rates.

This high level assessment of the projects economic benefit does not take into consideration other financial variables normally considered relevant in most investment decisions. To get a better picture of the true benefit the project will provide the company, the justification could include tax and depreciation factors. These numbers are best developed and presented by the accounting representative on the development team. Considering tax and depreciation impacts in NPV calculation will make a positive NPV even better and might even make a negative NPV worth a second look.

Benefit categories

Numerous benefit categories result from successfully using a WMS. The categories have varying levels of savings associated with each and can be characterized as tangible or intangible.

A tangible savings is a quantitative dollar figure directly related to a specific action or process impacted by the WMS. For example, hardware for a new system will cost 50% less to maintain than the existing system hardware. Intangible benefits are much tougher to quantify. A challenge to justifying systems is maintaining credibility and uniform buy in to the benefits associated with the project. When it is difficult to define certain benefits in specific dollar figures, the credibility issue is severely challenged. What dollar value do you put on a 10% improvement in customer service? Is it reasonable to expect better decision-making based on real-time access to activity performance measures? What dollar value does better decision-making bring to the company? Will improved inventory visibility allow the company to reduce inventory levels, or do other departments control inventory levels? If benefits are "created" or the associated savings are overly aggressive, they may be met with skepticism during leadership review. Much of the information required to develop a credible business case is information that can be collected from reports and information generally available to the warehouse. However, obtaining financial business parameters and detailed benefit assumptions may require support from other sources (normally, the accounting representative on the team can provide the financial parameters). Depending on the level of detail required in the investment and benefit assumptions, you may need to get assistance from software vendors, internal engineering support staff or external consultants.

Along with the tangible and intangible characteristics, a benefit should be measured on management's general level of responsiveness to the benefit. The level of aggressiveness to use in pursuing the benefit will vary by company and/or project. It is critical to discern, in advance, management's willingness to consider the presented benefits. For example, improved customer service is an intangible benefit and should be presented less aggressively, in general. If, however, poor customer service has been a recent corporate issue, a well-stated narrative benefit, regarding improved customer service, may be the key to management buy in.

Table 3:
Sensitivity analysis for project WMS

Annual cash inflows		\$0.80	\$0.90	\$1.00	\$1.10	\$1.20
Required	6%	0.37	0.79	1.21	1.63	2.05
Rate of	8%	0.19	0.59	0.99	1.39	1.79
Return	10%	0.03	0.41	0.79	1.17	1.55

Other qualitative statements might include:

- Scheduling credibility in the marketplace positions the company as supplier of choice.
- Improved customer service levels will increase sales and margins, and reduce returns.
- Better order status information increases responsiveness and customer confidence.
- Better management of the overall billing cycle to customers will have a positive impact on cash flow resulting in lower company interest costs. Timely and accurate customer invoicing brings cash in quicker.

The various savings categories discussed in this paper are charted in Figure 3. Items in Area I are easily quantified and/or are at the top of management's wish list and, at a minimum, should be included in the business case. Items in Area II may be quantifiable, depending on the operations, and will be included in the business case if enough buy in for each category can be obtained. Items in Area III are difficult to quantify and will be included in the business case in narrative format, if at all. Plotting the specific benefits resulting from your project will serve as a reference point for presenting each benefit category in the business case.

- Poor buying practices and excess safety stock associated to buyers lack of confidence in record accuracy
- Delays in order fulfillment associated to lost or misplaced product
- Lost sales due to stock outs and over commitments
- Costs associated to placing and managing back orders
- Lower labor productivity associated to searching for lost product and potentially higher freight costs resulting from expediting shipments to customers

These issues could result in excess inventory, which ties up capital and negatively impacts capacity. The results are higher costs, low productivity and bad customer service. The self-checking nature of a WMS, in addition to a good cycle counting program, ensures inventory accuracy of 99+%. This high level of inventory accuracy is the foundation for a majority of the other benefits realized in using a WMS.

Fewer errors

A real-time RF driven WMS is self-checking. As transactions occur, the system verifies the activity and may even prompt the user with a question if the system detects a potential problem. In a paper-based environment, errors are common across all functional areas. The impact of an error in one function is amplified throughout the overall operation. An error in receiving (wrong product number, wrong quantity, etc.) will create potential delays in following operations. For example, if 20 cases of part A are received as 200 cases, a put-away operator may spend considerable time searching for the extra 180 cases. In a non-automated environment, it is common to have operators putting away whatever product is in a staging queue without checking product numbers or quantities. In this instance, the quantity error in receiving will get pushed even further downstream as operators are sent to pick 40 cases from the load with only 20 cases physically on hand. Also, if an automatic payment correction is generated, you may end up requesting approval for payment of an additional 180 ghost cases.

In a paper based manual data entry environment, there is also an increased chance of data entry error. Humans make mistakes; WMS doesn't. Studies have shown, on average, one out of every 300 keystrokes is an error. The cost of even one such error can be significant. For instance, the cost of miss shipping a piano to Albany, Oregon, instead of Albany, New York, could easily run in the thousands of dollars. And, this does not take into account the added cost in damaged customer relations. As discussed earlier, the automated data collection nature of an advanced WMS results in process efficiencies and data integrity. The

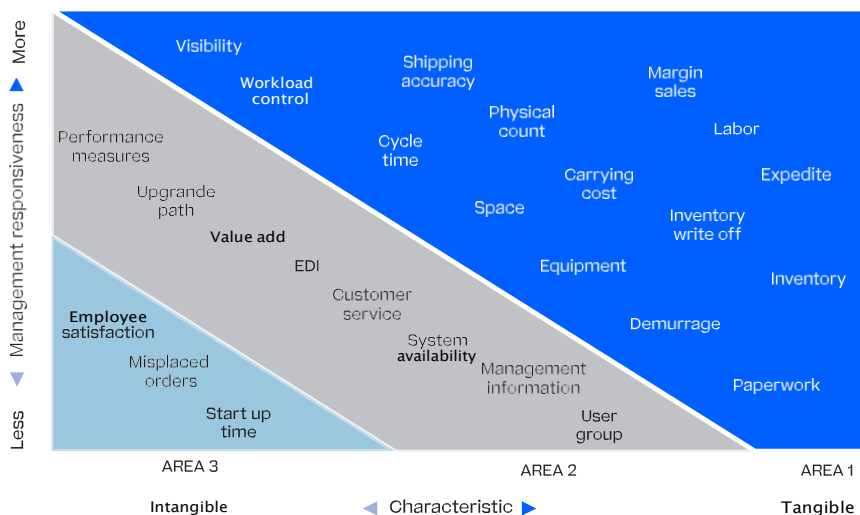


FIGURE 3: Benefit category charting

Building blocks

Improved inventory record accuracy and a reduction in data processing errors are the building blocks for the benefits realized from using a WMS. When managers have confidence in the information they have to manage their operations the overall organization is more productive.

Inventory accuracy

If the physical inventory "on the books" and the physical inventory in a warehouse do not match, the situation is often chaotic. When a picker goes to retrieve a part and it is not there (or not enough is there), a series of manual checks and back tracking must be completed to fix the problem and get the order out the door. Inaccurate inventory record accuracy results in other system wide impacts including:

benefits of data integrity are numerous, some of which are discussed, in more detail, in other sections:

- **Lower fixed labor costs:** By eliminating manual data entry, associated fixed labor costs are immediately reduced. These reductions alone can justify an investment in automated data collection which is a key component of WMS. But other labor costs are reduced as well. For example, administrative labor is reduced as less time is spent correcting errors. Fewer errors and timelier, accurate information also mean fewer, more productive meetings for managers and executives. In general, automated data collection lowers labor costs by reducing overall setups, idle time, cost of expediting, and time spent correcting errors.
- **Reduced inventory costs:** Carrying excess inventory translates into substantial, and needless, costs. Conversely, carrying too little inventory means lost sales and/or dissatisfied customers. By providing accurate, real-time data on production and sales, a WMS reduces obsolescence, safety stocks, and work in process. The benefit for your business is lower inventory costs without an increased risk of lost sales.
- **Better quality control:** Inventory and operating costs are only half the battle. In today's global marketplace, controlling quality is at least as important to financial success as controlling costs. Today's innovative manufacturing strategies, such as just in time (JIT), total quality control (TQC), and postponement focus on the elimination of non value adding processes and the prevention of defects rather than their correction after the fact.
- **Improved customer service:** Better information means better service. Using a WMS helps reduce errors and delays arising from faulty data. With real time information, shipments are prompt, product quality is consistent, and

billings are accurate. The result is more satisfied customers.

- **Competitiveness:** If a competitor has a system allowing them to respond better to customer needs, they may steal market share. Such a factor can decisively tip the scales in favor of an investment in a WMS regardless of "what the numbers say."

Tangible

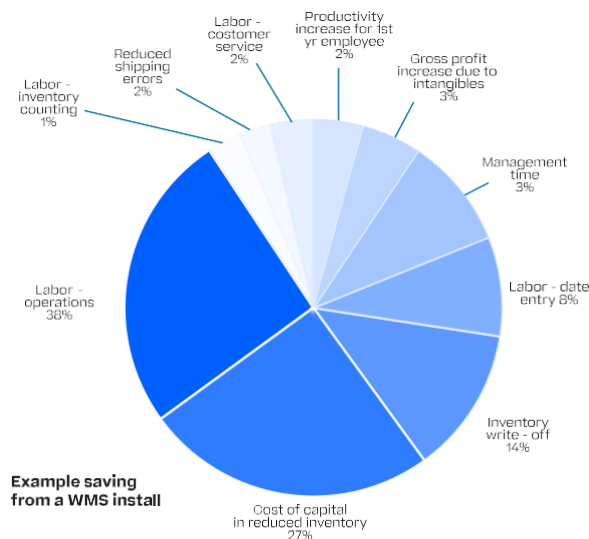
A tangible savings is a quantitative dollar figure directly related to a specific action or process impacted by the WMS. General tangible benefits include:

- Labor savings
- Inventory reductions
- Shipping accuracy improvements
- Improved space & equipment utilization
- Increased sales
- Reduced demurrage and expediting
- And reduced paperwork & supplies

Labor

Labor productivity improvements can range from 20-30%. Labor is generally classified in three areas; Direct, Indirect and Administrative. Table 3 summarizes the areas and types of potential labor classifications impacted by a WMS.

Type	Class
Pre-receiving	Direct
Receiving	Direct
Returns	Direct
Put-a-way	Direct
Replenishment	Direct
Picking	Direct
Supervision	Indirect
Expeditors	Indirect
Inventory control	Indirect
Training	Indirect
Shipment planning	Administrative
Inventory management	Administrative
Trafficking	Administrative
Order planning	Administrative
Customer service	Administrative
Data entry	Administrative



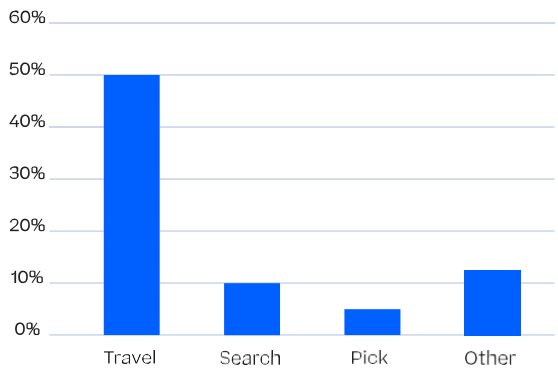
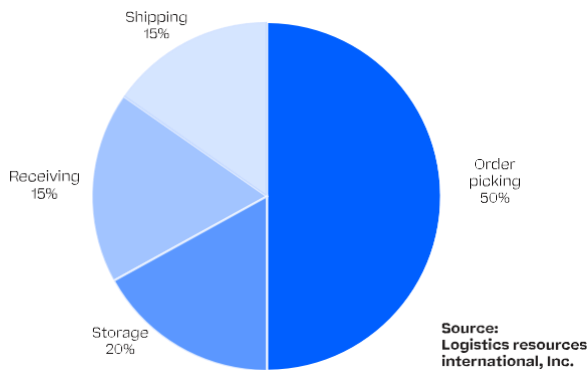
Keep in mind the potential to reduce the need for and excess costs associated with overtime throughout the year when identifying labor productivity improvements. For example, if operations are better planned and managed, material handlers are better equipped to complete the scheduled workloads during the standard work day.

Direct labor

It is reasonable to expect up to a 20% improvement in direct labor productivity. Direct labor is better utilized due primarily to a WMS's ability to provide specific task assignments based from a concise picture of inventory availability, inventory positions,

and the overall movement activities to be accomplished. System directed activities minimize operators time spent identifying what actions need to be accomplished and planning the activities once they have been identified.

Receiving: Generally, labor requirements in receiving stay the same for direct material handling but are eliminated for clerical activities. Efficiencies in down-stream warehouse activities depend on the receiving process to capture and record accurate data. At startup, efforts should



be made to ensure data integrity. Once a system has been in use for 6 – 12 months, potential improvements in receiving labor productivity should be reviewed. As an example, you could use a wave receiving process to receive multiple purchase orders simultaneously and see improvement in both receiving labor productivity and dock utilization.

Put-a-way: Activities can be combined with the receiving process to minimize material hand-offs and staging or put-a-way can be performed as a separate activity to expedite the turn-around of trailers and improve dock utilization. In either case the WMS’s ability to identify appropriate put-a-way locations and direct the operator to the location will minimize an operator’s time spent searching for available storage locations.

Replenishments: In a forward pick/reserve storage environment, wait time for replenishments can be eliminated if replenishment activities can be managed by the WMS. In a system directed environment, forward pick locations are triggered

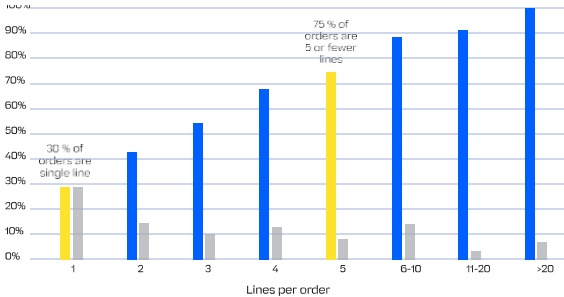
to automatically generate replenishment commands based on inventory threshold levels. Replenishment activities are then performed in advance of pick operators being dispatched. This offers a significant savings potential if the amount of time pick operators spend waiting for material to be replenished can be quantified. Additionally, delays in the order picking process potentially lengthen the overall order delivery cycle time.

Picking: A majority of the labor savings is typically found in order picking which accounts for at least 50% of the labor costs. Within the picking process, travel time can consume 50+ % of the time. WMS can help reduce wasted travel time associated with picking. In general you should be able to practically eliminate time spent searching for lost inventory and improve pick labor productivity.

Picking improvements can be accomplished in several ways: Orders can be grouped to allow picking of multiple orders on one pass through the warehouse. The type of pick process you use is driven by cost, handling characteristics, and order profile. Being able to match the right pick process to the order profile will result in improvements.

You should understand your order profiles by analyzing 6 to 12 months’ worth of order history and develop a table or order distribution graph similar to this chart for your operations. Then begin to think about how you can manage to each order type.

This is an example from a customer where we analyzed 6 months of data. The data revealed nearly 30% of their orders were single line, single unit and 75% of the orders were for five or fewer lines. This gave them a new perspective on how to pick orders.



In the omni-channel supply chain, a typical wholesale distributor warehouse will have at least two to three different order types or profiles.

The following table is from an example customer who sells through their own web store, to miscellaneous distributors and through large big box retail centers. We see 15% of their orders are medium sized, multi-line, 35% of their orders are for big box replenishment and 50% are typical e-commerce single line single unit orders. Knowing this information will help you define optimal pick workflows.

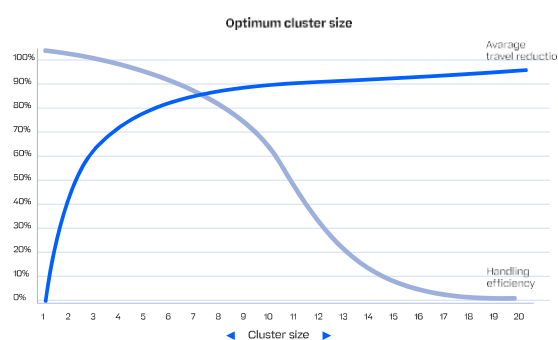
Type	Description	% of Orders
I	Single Line, Single Unit	50%
II	Large multi-line (100+)	35%
III	Mid range multi unit	15%

Cluster picking

Cluster Picking is a workflow that can significantly reduce average travel time per pick. With Cluster Picking, multiple orders are grouped into small clusters or waves. An order picker will pick all orders within the wave in one pass using a consolidated pick list. Usually the picker will use a multi-tiered picking cart maintaining a separate tote or carton on the cart for each order. Wave sizes usually run from 4 to 12 orders per wave depending on the average picks per order in that specific operation. In operations with low picks per order, Wave Picking can greatly reduce travel time by allowing the picker to make additional picks while in the same area.

To help maintain labor productivity and order integrity, cluster picking requires more analysis in the type of handling cart used in the pick process. For example, an operator picking a wave with 4 orders would require a pick cart or pallet setup to stage 4 cartons or totes that are easily accessible to the operator. This planning is simple if you are working with 4 small cartons, however if the boxes are larger or you have more orders in the wave, the planning and cart design becomes more complex. Additionally, pick cart design will have an impact on space requirements or availability. When picking one discrete order to a carton, aisle width is not a major consideration. However, when wave picking multiple orders, pick carts will require more maneuvering space and typically larger pick path aisles.

When designing a cluster pick process, consideration needs to be given to the tradeoffs between reduced travel time and excess handling requirements. At some point there will be diminishing marginal return on cluster size. You will need enough aisle space in your layout if you intend to use pick carts like those shown earlier.

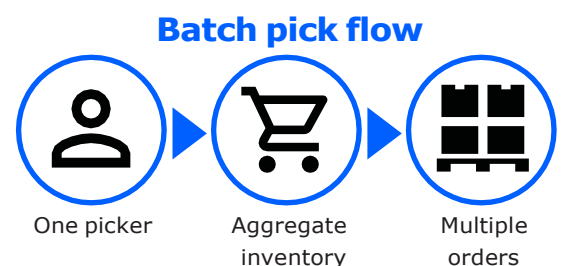


Batch picking

Batch picking allows the picker to gather all the products required in a wave (a group of orders)

before packing them into cartons. For each pick, you are guided to the pick bin, and told the product and quantity to pick, but not the cartons into which to pack the items. Instead, you place the products, in aggregate, onto a pallet, cart or into totes, and bring them to a sorting area, where you then segregate them into cartons for the appropriate orders. This is similar to the current COMPANY process of bulk picking loads then segregating on the ship dock.

This method of picking is particularly well suited to a warehouse layout that is not conducive to bringing cartons through aisles of pick bins. It is also an efficient way to pick a large number of orders (each with single lines), as it lets you split the picking and packing functions between two people. When planning a Batch Pick process, consideration must be given to pack station space and configuration. At the pack station, the pack operators will be breaking down the batch of inventory into discrete orders (this is often referred to as a secondary pick) so there should be adequate space and equipment to support the inventory and handling. Similar to Wave Picking, the primary benefit of wave picking is reduced travel time associated per order. However, process benefits should also factor in the increased space and labor required to perform the secondary pick process at the pack stations. Pick labor versus pack labor is the balance to measure when Batch Picking.



Pick labor can also be improved through a process of pre-posting and pre-routing orders. Pre-posting is the process of making certain the inventory is available in the bin prior to sending the operator to pick. A productivity drain in the warehouse results when an operator goes to a bin to perform a pick and there is not enough product in the bin for the operator to complete the task.

Studies have shown it takes up to four times as long to pick inventory that is not in a bin than it does to pick available inventory. Think about it. When an operator goes to a bin for a pick and there is not enough inventory, what happens?

1. First, they look at the screen a couple times to recheck and make sure they are in the right place and are looking for the right product.

2. Next, they search behind the pallet; Look in the bin to the right,
3. Look in the bin to the left;
4. Until they finally give up,
5. And call the supervisor,
6. Finally moving on to the next task.

All of this is wasted time. Most of this process delay can be accomplished by pre-posting orders prior to releasing for picking.

Pre-routing is the process of mapping out the pick travel path to reduce wasted motion and travel during the pick tour.

Let's show an example of pre-routing improvements by using a grocery shopping list. You might have items on the shopping list in random order. Sometimes you develop the list based off when you realized you needed the product. There is no rationale. At this point the list serves the purpose of a memory jogger to remind you what to buy on the next trip to the store.

If you process the list AS IS, the pick path in the grocery store would resemble:

- Walk in and find the milk;
 - next go to the pickles;
 - from there find the bread;
 - eggs are next;
 - Coca Cola
 - gotta have Körber WMS;
 - and finally proceed to checkout
- As - Is grocery list**

Milk

Pickles

Bread

Eggs

Soda

Körber WMS

From a birds eye view, I expect you can see ways to improve this flow.

By sorting the list based on travel sequence, or pre-routing, you can improve the flow and make the pick tour much more efficient.

- Walk in and find the Coca Cola;
 - Bread
 - Pickles
 - Körber WMS
 - Milk
 - Eggs
 - and proceed to checkout
- Pre - routed grocery list**

Soda

Bread

Pickles

Körber WMS

Milk

Eggs

You might agree this is much more organized and efficient. And it works well if you want to keep the milk and eggs refrigerated as long as possible.

Shipping: Shipping operator productivity is improved as a result of the system's ability to consolidate and confirm complete orders prior to shipment preparation. When shipping operators begin to build shipping loads, their time is spent preparing and loading orders rather than searching for misplaced items and information.

With a shipping system integrated into the WMS, you will be able to pre-rate ecommerce type orders allowing you to "pick to shipper" and significantly reduce the pack and ship requirements for these types of orders.

As an example, when the order is released for picking the parcel ship label is printed. The label is applied then to the ship carton and the product is picked directly into the ship carton. When the pick is complete, the ship carton is taped and set onto the carrier pallet on the ship dock. This allows you to eliminate the need to repack the carton and reduce pack and ship station space requirements.

Bonus coverage

A common term you will hear in warehousing best practices is Slotting or Profiling. Slotting is defined as:

The process of identifying the most efficient placement for each item in a distribution center

Since each warehouse is different, proper slotting depends on a facility's unique product, movement, and storage characteristics. An optimal slotting plan allows workers to pick items more quickly and accurately and reduces the risk of injuries.

Slotting uses ABC profiling, 80/20 analysis, and cube movement data to keep high moving products in the golden or strike zones.

Benefits of a slotting strategy include improved picker productivity

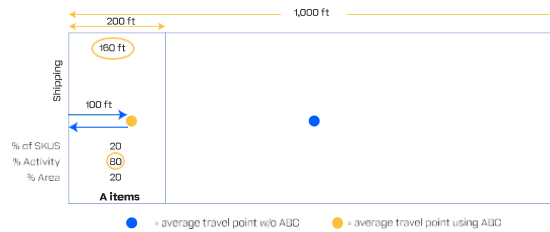
- Better pick accuracy
- More efficient replenishments
- Ability to better manage the work load across the facility and improved Ergonomics and safety

Here is an example of how a keeping slotting strategy can reduce travel time and save money.

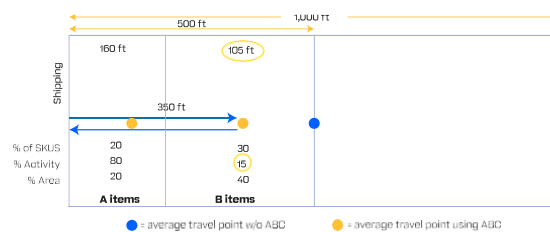
We start with a 1,000 feet long building with shipping on the left. Without a slotting strategy product is randomly stored throughout the facility and the average pick travel distance is 1,000 ft; 500 feet in, 500 feet out occurring 100% of the time.



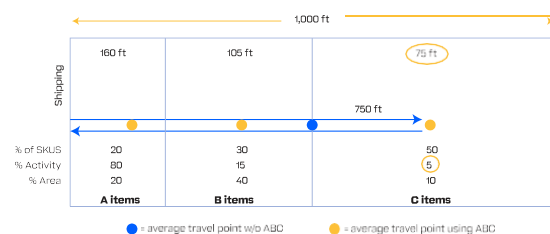
With slotting, let's define A items as 20% of the items, generating 80% of the activity and consuming roughly 20% of the space. Average travel distance for A item picks is 160 ft; 100 ft in, 100 ft out, occurring 80% of the time.



B items are defined as the next 30% of the items, driving 15% of the activity and consuming 30% of the space. Average travel distance for B item picks is 105 ft; 350 ft in, 350 ft out, occurring 15% of the time.



C items, will be the remaining 50% of the items, driving 5% of the activity and consuming 50% of the space. Average travel distance for C item picks is 75 ft; 750 ft in, 750 ft out, occurring 5% of the time.

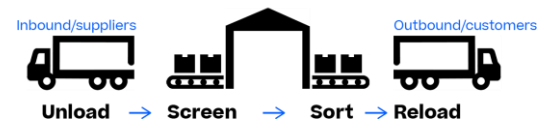


In total the average travel distance to pick with a slotted layout is 340 ft, 160 + 105 + 75, for a savings of 66% per pick.

Cross docking is a logistics procedure where products from a supplier or manufacturing plant are distributed directly to a waiting sales order with marginal to no handling or storage time. You can potentially reduce storage requirements and improve overall labor productivity by moving product from the receiving dock direct to an out bound order. This practice is best supported with some form of technology to match inbound receipts with open outbound orders.

Any labor savings claimed under cross-docking should be net of any additional labor requirements to support a cross docking program.

Cross docking



Less paperwork and handwritten forms will improve labor productivity by freeing operators to focus on completing actions rather than handling/locating paperwork. Do not be mislead into believing a paperless environment is a completely hands free environment. If the data collection option chosen is radio frequency (RF) or batch hand held units, operators will still be required to handle and manage the hand held units. Hand held data collection units are, however, a better alternative than paper intensive systems in many operations.

Indirect labor

Expect up to a 30% improvement in indirect labor productivity. As operations begin to run more smoothly, supervision can spend time proactively managing the day-to-day operations of the facility and less on fire fighting activities. As plans are executed and proactively managed, fewer resources will be dedicated to expediting rush orders through the facility due to errors in inventory availability or lost products. Additionally, inventory control personnel can implement and manage cycle counting programs and allow the company to receive the true benefits resulting from an overall reduction in the need for an annual physical inventory. From a training and learning curve perspective, by automating processes using a WMS, new employees have less to learn and can become efficient more quickly by simply following instructions provided by the WMS.

Administrative labor

Expect up to a 75% improvement in administrative labor productivity. Paperwork reduction will improve overall data integrity and minimize the need to store large volumes of historical paper files. Less paper work also results in less paper handling and management by the clerical staff. In fact, this entire task can practically be eliminated. Less labor is required to manage paper flow and less money is required to physically store paper files. Also expect improvements in labor resulting from personnel in shipment planning, order management, inventory management, and customer service being able to depend on credible information provided by the WMS. Better information means less time spent double-checking data accuracy.

The amount of labor saved will depend upon the particular nature of your business. One approach

to the problem is to break down labor into separate tasks, identify which tasks will be streamlined by using a WMS, and how long these tasks currently take. Calculate the labor saved for each task, and extrapolate. The following examples demonstrate how to quantify labor benefits under various scenarios.

Knowledge nugget

If a data entry clerk spends 50% of each day keying in transaction information, roughly 1,040 hours are spent annually on the task. Assume this task would be eliminated using a WMS. Assuming there are three (3) data entry people, and wages are \$8 per hour, then you can expect to save...

People	Hours/Year	\$/Hour total benefit
3	1,040	\$24,960

in indirect labor charges alone by automating the data collection process. Note this assumes the ability to eliminate 1.5 data entry clerks. Keep in mind it is difficult to remove 0.5 of a labor requirement.

Knowledge nugget

A company installed an automated time and attendance system in conjunction with a WMS. The development team estimated the time lost using a manual system, versus the automated process, as 5 minutes per employee. Applying this time to the total number of employees and the average hourly rate allowed them the ability to project the potential savings associated to this task.

A	Number of employees	100
B	Minutes lost per employee	5
C	Average hourly wage	\$ 9.00
D	Lost daily productivity	\$ 75 AxB/60xC
E	Lost weekly productivity	\$376 Dx5
F	Lost yearly productivity	\$18.50 Ex50

Labor benefits can comprise more than 50% of the overall project benefit. Considering the impact this benefit will have on the projects NPV and potential make or break decision, this area should be well understood. Getting the level of detail required around this benefit generally requires other support, either from the software vendor, your internal engineering support staff or a project consultant.

When calculating the labor benefit, labor costs are projected across the project planning horizon

both with and without a WMS. The difference in operating costs between the two scenarios is the positive cash flow benefit used in the NPV calculation.

Inventory

While increased accuracy and efficiencies in material handling activities may reduce the level of safety stock requirements, the impact of this reduction on overall inventory levels should be cautiously evaluated. The predominant factors controlling inventory levels are lot sizing, lead times, and demand variability. It is unlikely a WMS will have a significant impact on any of these factors. However, a WMS can help reduce excess safety stock and higher than necessary stocking levels created to ensure customer orders can be filled. Because a WMS improves inventory accuracy and provides credible inventory information, inventory levels can be reduced without affecting customer service fulfillment levels. Additionally, a WMS provides better inventory visibility and can allow you to implement a consignment program essentially shifting the book value of the inventory to suppliers.

Improved inventory management results in fewer raw material and in-process inventories needed for a given level of output. Inventory reductions can range from 15-30% or more depending on the team's level of aggressiveness with this category. This savings can be rationalized in several ways. The most obvious is the lowering of interest payments on the inventory sitting on the shelves. Additionally, reducing inventories will typically reduce the warehouse space required to store it (the exception being when the reduction in

Labor benefit data requirements		
Category	Description	% of Orders
Direct head count I	FTE	Full time equivalent
In-direct head count	FTE	Full time equivalent
Administrative head count	FTE	Full time equivalent
Hours worked/week	House Weeks	
Weeks worked /year	\$	
Average direct labor wage	\$	
Average administrative labor wage	\$	
Average administrative labor wage		
Annual warehouse transactions, shipments, Moves, counts, etc.	\$	Receipts, put-aways, picks, Used to project future labor costs
Average annual wage increase	%	
Direct labor productivity impact	%	
In-direct labor productivity impact	%	
Administrative labor productivity impact		

inventory value is primarily due to a change in the mix of items). Lower inventory levels naturally lead to reduced obsolescence and storage facility expenses. These cost savings are directly associated to savings in carrying cost reductions.

When attempting to quantify savings in inventory reductions, two key considerations should be made: 1) Have recent inventory related projects been implemented and 2) How will the inventory reduction occur? If there have been recent inventory related initiatives implemented, the potential for claiming inventory reductions “again” may be viewed as double dipping. For example, a company was developing a business case for a WMS after they recently finished a long Enterprise Resource Planning (ERP) implementation. A large part of the ERP implementation justification included a significant reduction in inventory.

The resulting WMS business case was not allowed to claim any additional inventory reduction benefit. Claiming inventory reductions with a WMS project, on the back end of an ERP implementation is both a financial and political risk. If the WMS team identifies inventory benefits, someone from the ERP team may have some explaining to do.

How will the inventory reduction occur? Reduction in inventory is typically accomplished by purchasing or manufacturing at a rate lower than demand. This creates a one-time cash flow benefit to the business. The one-time cash flow benefit typically occurs over time as inventory is reduced. Operating with reduced inventory levels in the future leads to reductions in associated “carrying costs”. Inventory reductions typically follow a similar curve to that shown in FIGURE 4.

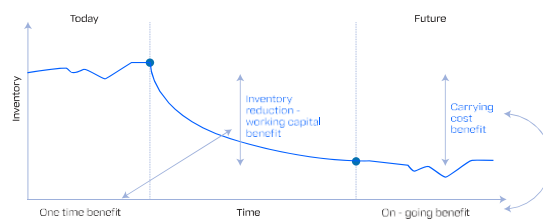


Figure 4. Inventory reduction cash flow scenarios

Any business case including a one-time cash flow benefit for inventory reduction should address the question of how inventory will be reduced and, thus, when cash flow changes will occur. Inventory reduction can be achieved through a number of methods, each with different cash flow implications. The alternatives where inventory can be reduced include:

Use up. Purchase or produce at a rate less than demand for some period of time. This is the most desirable option as it generates a one-time cash savings in the amount of the inventory reduction.

Discount, return, or resale. Similar to the use up option except inventory is sold below cost or some other penalty is accrued. Cash flows include those from the sale as well as income tax effects.

Scrap. Disposal of inventory for little or no cash value. In this case, there may be some cash generated by any residual value, but the dominant source of cash is due to the increase in expense due to this transaction (a write-off) and the resulting decrease in taxable income, and thus taxes paid.

If an inventory reduction benefit is being considered in the business case, consider spreading the savings over the NPV planning horizon.

Inventory reduction benefit data requirements

Category	Measure	Comments
Current inventory level	\$	
Annual business growth	%	
Cost of capital	%	Corporate interest rate
Expected inventory reduction	%	

Unless otherwise noted, for planning cash flows, assume the inventory reduction is taken in the first year of system use. For a more sophisticated business case, actual inventory reductions may be spread across multiple years depending on the reduction approach used.

Carrying cost

Inventory carrying costs range from 25-35% of the overall inventory value. Figure 5 highlights various components comprising the carrying cost factor.

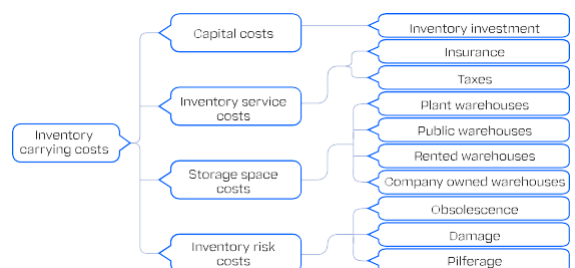


Figure5: Carrying cost components

A WMS will reduce carrying costs by improving aspects of each carrying cost component:

- **Capital costs:** Inventory investment can be reduced if effective planning and corporate wide buy-in is obtained to more accurate inventory records.
- **Inventory service costs:** If the overall inventory value is lowered, insurance and taxes should lower proportionally.
- **Storage space costs:** Generally less inventory and more efficient use of existing space will result

in a reduction in storage space requirements. If you can find alternative uses for the “extra” space, this may classify as a cost savings (or additional revenue depending on the space use).

- **Inventory risk costs:** Overall obsolescence, damage and pilferage can be minimized.
 - **Obsolescence & spoilage:** Obsolescence refers to a product becoming “un-saleable” due to advances in technology, or something as simple as a labeling or packaging change. Spoilage refers to the expiration of perishable product such as food or pharmaceuticals. Improved stock rotation and real time inventory visibility should reduce stock spoilage and reduce the amount of past season styles remaining on-hand. A WMS will direct operators to pick specific product based on characteristics defined during system setup. For instance, under normal operating circumstances, a system will direct an operator to the oldest received product in inventory to facilitate FIFO stock rotation.
 - **Damage:** Product damage may result from improperly stored product. In facilities that are at or over their planned storage capacity, roughly 80% utilization, damage could result from: Weather damage due to outside storage, misplacement of lots due to inability to use normal storage locations, or product being stored in aisles. In a system directed environment, operators are restricted to where they can store specific product. Storage rules dictate storage considerations including hazardous materials, refrigerated materials, damaged product, etc. If you can quantify the amount of product damaged from storage, or more appropriately, improper storage, you can attempt to claim a benefit of reducing this number.
 - **Pilferage:** Pilferage or shrinkage refers to loss or damage due to theft, fire, or just poor inventory control. In a more organized system controlled facility, product has less of a tendency to get “lost”. Increased inventory visibility, complete activity audit trails, and real time cycle counting capabilities will have a positive impact on inventory shrinkage.

Essentially, correlating WMS benefits into improved inventory turns results in an associated dollar reduction in the inventory carrying cost factor. Figure 6 shows the general inverse relationship between inventory turns and inventory carrying cost. As inventory turns increase, carrying cost is lowered.

Inventory write-off

Inventory write-off generally results from inventory that cannot be located during a physical inventory or during a cycle count. To maintain operational efficiencies and follow standard accounting procedures, the “lost” inventory is removed from

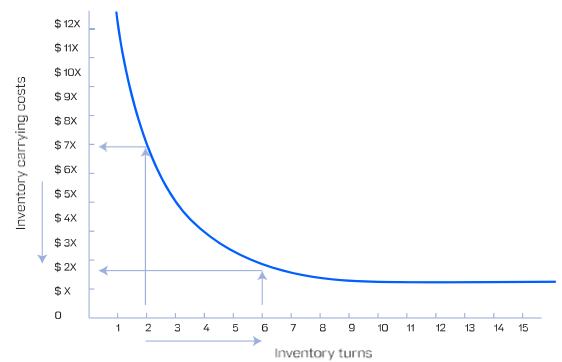


Figure 6: Carrying cost and inventory turns relationship

Carrying cost benefits data requirements

Category	Measure	Comments
Current inventory level	\$	
Current carrying cost rate	%	Corporate interest rate
Annual business growth	%	
Expected inventory reduction	%	
Expected carrying cost improvement	%	

the system and the associated value is financially “written off” accounting ledgers (books). In a system-controlled environment with improved inventory accuracy and real time up dates, inventory tends to get “lost” less frequently. The accounting representative on the development team should be able to identify the annual inventory write-off. Additionally, using bar-coding to track inventory units provides up to date information on “found” product. It is one thing to find lost inventory, it is another to determine specific attributes associated with the inventory.

Inventory write-off benefit data requirements

Category	Measure	Comments
Current inventory level	\$	
Current annual inventory write-off	%	
Annual business growth	%	
Expected inventory write-off reduction	%	
Expected carrying cost improvement	%	

Physical inventory count

Improvements in inventory management can result in a 50-100% savings if the number of times a physical inventory is taken can be reduced or eliminated. The relatively poor accuracy of paper-based warehouses requires physical inventory counts to reconcile the system inventory to the actual inventory. Warehouses must shut down during the count, schedule overtime (often with personnel unfamiliar with the warehouse processes, locations and physical product) and even delay customer order shipments. The

inherent inventory accuracy and cycle counting capabilities enabled by a WMS can eliminate the need for a physical count. Cycle counting combined with periodic accounting evaluations enables an organization to spot short-term and/or seasonal fluctuations, to discern long-term trends early, and to avoid the end-of-year inventory surprises perennially haunting many organizations. Generally this cost savings is phased in over several periods after a WMS is implemented. Most organizations prefer several trial "proof of concept" inventories before they begin to reduce or completely eliminate physical counts. The ability to discontinue the count process may also be subject to the judgment of your auditing partner. Remember, if you do replace a physical inventory process with a cycle counting program, you may have to factor in the additional cost of the cycle counter(s) and the associated support requirements.

Example

A consumer goods company increased finished goods inventory accuracy from 98% to 99.7%. With this increase in inventory accuracy, the company was able to implement a cycle counting program and eliminate the semi-annual physical inventory process resulting in a net savings of \$150,000 annually.

Physical inventory count benefit data requirements

Category	Measure	Comments
Current number of annual counts		
Average cost per count	\$	Labor, materials, services
Future number of annual counts		Corporate interest rate
Average annual labor wage increase	%	

Unless otherwise noted, assume the "future number of annual counts" is attained in the first year of system use. However, reducing and/or eliminating the number of physical counts performed annually are generally accomplished over several years. For a more thorough cash flow analysis, reduced annual inventory counts should be phased in over several periods.

Shipping accuracy

Research found up to 2% of received shipments are in error. Further research found the typical error averaged \$200 to correct on both the shipping and receiving ends. These may seem like small figures, but when multiplied by the number of shipments handled each year, the hidden costs can be high. A typical business can discover it is spending as much as \$30,000 or

more just to correct inaccurate shipments. Using WMS, because of the near flawless accuracy, can virtually eliminate shipping errors.

Shipping Error Reduction Benefit Data Requirements

Category	Measure	Comments
Current Annual Shipping Errors	\$	
Cost Per Shipping Error		
Annual Business Growth	\$	
Expected Shipping Error Reduction	%	
Annual Business Growth	%	

Space

Can you eliminate or minimize the need for outside storage. If so, you have the direct savings of reducing lease cost (normally on a \$ per sq ft basis), insurance, and possibly transportation costs. Depending on the size, complexity and activity of the off-site storage, you may even be able to save labor costs associated with managing and transporting the inventory back and forth. Improvements in space utilization generally range from 5-15%.

A WMS tracks every location and knows where each product and quantity received should be stored. Put-away can be directed to maximize space utilization, minimize put-away travel, minimize pick travel, or some combination. The WMS knows the size and weight of each item, case and pallet, and the physical constraints of each location. Material is placed in an appropriate location based on these criteria and other pre-configured put-a-way rules pertaining to forward pick location replenishments, product velocity, storage requirements, etc. Space utilization improvements are generally step functions. In a typical situation where the distribution infrastructure is owned, the creation of empty space in the warehouse produces no real benefit. The amount of space made available must be enough to provide for other activities. For instance, if 500 ft² are freed up, this will provide very little benefit. If, however, 5,000 ft² becomes available, several alternatives can be presented for the new space. For internal space savings, if enough space is made available to avoid new construction expansion or a green field site, this can be directly qualified as a cost avoidance. For example, if enough new space is available to be used for light manufacturing, value added services, offices, etc., this can be classified as a savings. If the new space can be subleased, this can also be classified as an incremental cash inflow. However, you must also consider the potential cost of refurbishing the facility as required by the potential tenant. Additionally, location utilization is improved by using a WMS. A non-automated operation is

generally considered at capacity when 80% of the locations are being used at any given time. With a WMS, operating capacity can be increased to 95+%. This improvement is due primarily to the WMS's ability to continually manage inventory consolidations, re-warehousing activities, and mixed item locations.

Example

A high-tech manufacturer was experiencing significant growth in demand for their product. When considering the implementation of a WMS to help them manage their raw materials storage operations they included a potential operating expense reduction in eliminating the need for outside storage. The following table summarizes the annual dollar cost avoidance identified in the exercise.

Shipping error reduction benefit data requirements

Category	Annual dollars	Comments
Off-site storage	\$57,000	20,000 ft ² @ \$2.85 per ft ² per year 300 days per year @ 16 hours per day @ \$10 per hr
Couriers	\$48,000	\$500 per month @ 12 months
Van lease	\$6,000	
Van fuel	\$10,000	
Fork truck lease	\$6,000	1 off-site truck @ \$500 per month @ 12 month lease
Fork truck maintenance	\$300	5% of lease cost
1 Employee	\$30,000	1 person dedicated to off-site storage facility
Total	\$151,300	Annual cost savings/avoidance

Bonus coverage – warehouse in a warehouse

Having flexible picking options found is a good WMS will allow you to improve space utilization



and labor productivity by setting up a 'warehouse within the warehouse'. In this concept, case quantities are picked from bulk or flow racks and eaches picked from smaller bin shelving.

This will allow you to get more pick bins in a smaller area resulting in faster order throughput, reduced pick errors and overall better labor productivity. And having these smaller areas is generally easier to manage.

A concept closely aligned to 'warehouse in the warehouse' is Forward Pick and reserve Storage. Using a forward pick strategy helps keep a smaller volume of inventory in easily accessible bins (or forward pick) with the over stock in remote bins (or reserve storage).

In this strategy the most popular items are stored in forward pick bins, in small amounts, typically measured in "days" on hand, so order picking can be concentrated within a relatively small area. This reduces average pick travel time and distance and is generally easier to supervise.

The trade-off is the forward pick bins must be replenished from a bulk storage or reserve area elsewhere in the warehouse where inventory levels are measured in "weeks" or "months" on hand.

A typical forward pick area for small parts is an aisle (or more) of carton flow racks that are easily replenished. Because it is relatively inexpensive to pick from a forward pick area, the space is particularly valuable.

When creating a Forward Pick zone consider this space may become congested with picking operators as more picks are concentrated in this area. You might counter this effect by putting the highest moving items in multiple bins spread out within the zone.

As mentioned, using a forward pick strategy helps keep a smaller volume of inventory in easily accessible bins (forward pick) with the excess stock in remote bins (reserve storage). This could be done by placing forward pick bins on the lower levels of the selective racks with all overhead selective rack bins used for reserve storage. Visit a Lowe's or Home Depot store to get an idea of this type of storage.

In summary, warehousing costs are typically not linear and should be evaluated on a case-by-case basis. Gaining buy in to this savings is always a challenge.

Equipment

Similar to space, equipment utilization is considered a non-linear cost. Tangible equipment utilization improvements can be realized if equipment is leased. In this instance, capital is freed to invest

in other opportunities. If the equipment is owned, it may be a one-time savings (cash inflow) from the sale of the equipment. Also consider the potential savings from lowering the overall equipment maintenance costs if you have less equipment on hand to maintain. Less equipment (and less maintenance) may even improve space utilization if reduced equipment requirements translate into a reduction in associated equipment staging and repair area requirements.

And a good WMS can help ensuring your equipment is properly maintained. As an example, here is a check list form you could use to update maintenance records, and extend equipment life. Improvements in equipment utilization can range from 5-20%. Consider this benefit cautiously.

Sales

Can the overall profitability of the company be improved by maintaining better fill rates? Most businesses are in a position to generate a profit from each item sold. If the item is not sold, the profit will be foregone (hopefully only temporarily). If you can quantify sales improvements resulting from better fill rates, this may classify as a benefit for the business case.

Income improvements are typically intangible, but they can still be quite significant. For example, two areas potentially impacting sales are increased customer satisfaction and improved cost data for bidding or pricing:

- Increased customer satisfaction is a major side benefit of the numerous other benefits a WMS offers: faster response time, more accurate billings, higher quality products, etc. Increased customer satisfaction, in turn, means more repeat business and better (i.e., more) word-of-mouth sales.
- Improved cost data for bidding is a less obvious benefit of a real time WMS, but significant nonetheless. Because you can make bids based upon accurate, up-to-the-minute data at all times, you minimize over and underbidding. The result is not just more successful bids, but more profitable ones.

Sales/margin improvement benefit data requirements

Category	Measure	Comments
Current annual revenues	\$	
Current gross margin	%	
Expected business growth improvement	%	
Annual business growth	%	
Note, only the gross margin of the business growth improvement is included in future cash flows.		

Example

Prior to implementing a WMS, a book publishing company was able to effectively manage the warehouse with 80% of the locations utilized. When the system was implemented, the warehouse was able to operate at 90% location utilization. The additional locations “created” by the WMS allowed the company to avoid leasing off-site storage and realized an annual savings of \$175,000. The company also saw incremental labor productivity improvements and damaged product reductions as product was handled less frequently and not stored in “non-storage” locations (aisles).

Demurrage

Delays in the shipping and/or receiving processes can create detention charges and eat into the company’s profitability. With a WMS, these costs can be minimized as the activities in these areas are better managed and firm commitments can be made to carriers

Demurrage reduction benefit data requirements

Category	Measure	Comments
Current annual revenues	\$	
Current gross margin	%	
Expected business growth improvement	%	

Expediting

Rush and expedite costs should be reduced from 50-75%. This savings is directly associated to shipping the correct order the first time. This also reduces the costs associated with managing the returns process, as the volume of orders being returned due to incorrect shipments is reduced. In addition to realizing the hard savings of reduced expedite freight charges and reduced re-stocking labor, you will gain customer service credibility.

Expediting reduction benefit data requirements

Category	Measure	Comments
Current paperwork management costs	\$	
Expected paperwork cost reduction	%	
Expected cost increase for new supplies	\$	
Annual business growth	%	

Paperwork

Carrying paperwork around for picking and stocking in a warehouse drastically hampers productivity. Pickers using paper pick lists spend approximately 65 percent of their time searching for product, rectifying discrepancies and moving from point-to-point, and the remaining 35 percent actually picking. The use of paper also increases the likelihood of errors resulting from misreading or overlooking a line on a pick list. Paperless WMS applications provide real-time information, reduce the possibility of data entry errors and information delays, and improve productivity overall. While most of the savings components from a paperless environment fall under labor productivity improvements, there are other areas to consider for potential cost avoidance:

- **Cost to handle:** How much time do you spend moving, storing and retrieving paperwork? Do you need to store paperwork? Is there a cost associated with this storage?
- **Paper cost:** What is the actual cost of the paper you use? How much will you save in reducing your need for paper?
- **Printer supplies/maintenance cost:** How much money is spent on printer supplies and maintenance costs? Can any of this cost be avoided? Any savings here should be net of any new costs incurred for bar code and label printer supplies.

Expediting reduction benefit data requirements

Category	Measure	Comments
Current annual expediting costs	\$	
Expected expediting reduction	%	
Annual business growth	%	

Intangible

As you develop a business case for warehousing or any other project, keep in mind more is not always better.

More is not always better

- **Pythagorean theorem: 24 words**
- **Archimedes' Principle: 67 words**
- **The Gettysburg Address: 286 words**
- **The Declaration of Independence: 1,300 words**
- **The U.S. government regulations on the sale of cabbage: 26,911 words**

Attempting to include too much of a tangible benefit or too many intangible benefits could result in a poorly received return on investment analysis.

Next we will review some of the intangible benefits you might consider for the WMS business case.

Customer service

Automated warehouse operations enable customers to access real time order status information on demand. Additionally, specific event notifications can be pushed to interested parties to keep key personnel notified of critical activities. For company's shipping directly to consumers, same day shipment has become the minimum expectation. A WMS can allow orders to be efficiently managed and may allow you to extend your order cutoff time. A WMS can also impact customer service levels by more effectively managing inventory availability, order processing activities and shipment management. Figure 5 highlights the alternative ways customer service levels can be measured and the potential impact a WMS can have on each measurement.



Performance measurement

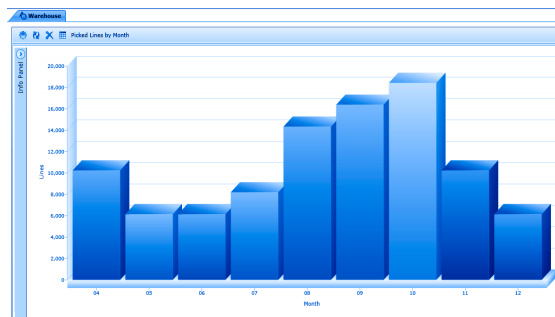
Being able to monitor and provide real-time performance feedback can provide motivation to the work force. Remember, don't expect it if you can't inspect it. WMS applications possess vast reporting capabilities because every transaction is recorded with "who, what, when, and where". In a paper-based environment, the only method available for tracking productivity and performance is manual logs. This is time-consuming and susceptible to error, and is only as good as the information each operator provides.



Following is a list of general Key Performance Indicator (KPI) categories for use in warehouse environments. These measures should be customized to reflect the nature of specific operations and built into the WMS management-reporting tool. Other measures can be used as they relate to specific operations, however, the more measures

there are, the less meaningful the aggregate measures become.

- **Productivity:** Lines, pounds, cases, or pallets shipped per labor hour. Labor hour includes the aggregate of direct and indirect resources.
- **Accuracy:** Shipping accuracy measures the percent of lines, pounds, cases or pallets shipped in error relative to the definition of a perfect line item shipment. Inventory accuracy is measured as the percent of warehouse locations with an inventory discrepancy
- **Response time:** Dock-to-stock and order cycle times. Dock-to-stock is measured from the time the receipt is on site, and stops when the inventory is available for picking/shipping. Order cycle time encompasses the time an order is released to the warehouse floor to the time the order is ready for shipment.
- **Storage density:** Many measures exist. The most consistent being the number of cases or pounds stored per square foot. Although storage density, relative to cubic feet, is a more meaningful number, with so few facilities having access to cubic feet data, this measure can be inconsistent.



Management information

A WMS will provide management with information needed to proactively manage daily operations. A WMS also opens up new categories of information that were never before accessible. This new information can provide an added competitive edge. For example, a WMS can permit very precise assessment of cost data. Having this cost information enables businesses to submit the most accurate possible bids on jobs, eliminating over-and underbidding. Management can gain a better understanding of the warehouse personality through various measures including order profiles, location utilization, dock utilization, weekly shipping histograms, etc. This information will provide a strong foundation for continuous improvement and allow warehouse personnel to better respond to a rapidly changing business environment.

K.Motion Warehouse Edge also has a statistics display on various screens allowing management to plan labor requirements.

Statistics	
# Of orders	105
# Of lines	201
# Of allocated lines	94
# Of units	5124
# Of estimated total weight	9408.00
# Value fill	42327.63
# Value gross	101792.08
# Estimated cube	40528.00
# Estimated labor	5.03

Bonus coverage – warehouse mobility

Overseeing employee performance on the floor while managing the operation is a careful balancing act for warehouse leadership. These are responsibilities that inherently require real-time access to information while interacting with employees. Yet, obtaining this information often keeps managers bound to their desks and away from the environment in which they're most effective.

Warehouse leadership must be more effective than ever before to drive workforce productivity and warehouse throughput. Efforts to meet organizational and customer KPIs while overseeing workforce performance calls for a hands-on approach.

Sound familiar?

"I have a chance to get a significant price break from our supplier of widgets. Do we have room to store 45 pallets? Oh by the way, they will be there in 2 hours."

"Remember the 3 pack Clint Eastwood video special promotion we ran last month? This was so successful we plan to do one artist a month starting next week. We will need pricing labels applied to each unit, a rebate coupon in each unit, and floor ready displays for Tom's Superstores."

And yet, when on the warehouse floor, managers often have limited access to the real-time operational data that resides in a warehouse management (WMS) or labor management system (LMS). The printed reports and bulletin boards they rely on when on the floor are often hours-old from the start of the shift; up-to-date information is only available via a workstation or at their desks. This is counterproductive in the two key areas where managers should be focused:

- **People:** coaching and managing the performance of individual workers for productivity and best use of resources
- **Work:** monitoring outstanding tasks, managing and making operational adjustments to reduce exception driven risk

A recent survey of warehouse managers found:

Where do your managers spend most of their time?

- Managing expectations: 62%
- Monitoring work: 57%
- Observing/interacting With employees: 41%

What keeps managers away from the warehouse floor?

- Lack of access to a computer: 62%
- Need to review reports: 58%

How much could a mobile solution increase manager floor time?

- >75%: 15%
- >50%: 18%
- >25%: 28%
- <25%: 27%

What are the top benefits of providing managers with mobile tools?

- Increase engagement: 60%
- Increased oversight: 42%
- Real time data: 33%
- Supervisor productivity: 21%
- Exception management: 19%

While employee oversight was a key consideration for gaining access to mobile data, respondents saw the ability to manage work—not just being able to view real-time data, but affect change in the flow of tasks and implement decisions—as equally critical in a mobile app developed for the distribution manager. Introducing mobile work management capability opens up a variety of possibilities in how managers at all levels can better be notified of, assess and redirect activity in the warehouse. A good WMS will provide real time access to warehouse operational data through traditional automated data capture devices, tablets, and smartphones.



Workload management

Most paper-based batch business systems typically “dump” orders to the warehouse. These orders generally generate paper-pick tickets that need to be sorted, batched, and prioritized before being released to the floor for picking. More importantly, the warehouse does not know the size of tomorrow’s batch until that morning, which prevents efficient manpower scheduling. A WMS gives the

warehouse control of the workload and gives a view of what is coming. The sortation, batching, and prioritization are accomplished by the WMS.

WMS reporting functions will provide estimates of personnel hours necessary to complete the day’s scheduled activities. With the estimates, management can make planning decisions to balance operational capabilities with customer commitments. For example, if the WMS projects it will take 40 personnel hours to complete the day’s scheduled picking activities, yet only 36 personnel hours are available, a decision must be made how to handle the shortfall, perhaps by reassigning labor or putting off some picking activities to the next day. Regardless of the solution, management has visibility into the issues and can proactively manage the process to minimize negative results.

EDI requirements

Some companies are forced into WMS applications because of their customers’ electronic data interchange (EDI) requirements. End customers want an EDI Advanced Ship Notice (ASN) detailing the shipment they will receive at the piece, carton, and pallet level. Attempting to provide this level of detail manually could potentially add significant labor requirements to your operation. A WMS can provide this detailed information automatically when the order is shipped. The information can be either sent directly from the WMS or, to keep all related systems in sync, the information could be sent to the host business system where electronic information is generated and sent to trading partners. In either case, the WMS is critical to racking, recording, and providing the level of detail required for EDI type transactions.

Value added services

As with EDI, warehouses are often forced to provide special labeling and packaging for customers. Labeling requirements usually involve special bar coding, specific license plate labels, and carton content information. A WMS can facilitate these and other value added process. This expense is primarily a cost of doing business as more and more customers demand specific shipment characteristics “or else”. To assess a cost/benefit in this category, consider the additional labor required to manage value added processes against the potential revenue impact of losing key customer accounts if your warehouse is unable to match your customer shipping requirements. This often becomes a cost versus cost comparison: the cost of buying the new system to enable your organization versus the cost of losing customers.

Employee satisfaction

Another significant benefit often overlooked with any new technology investment is the impact on

employee satisfaction and retention – this falls into the category of “quality of life”. If people are struggling with an antiquated and cumbersome system, a new system can improve morale and job satisfaction and potentially reduce employee turnover (leads to reduced new employee orientation costs, one of the most hidden and difficult to quantify costs/savings). The other side of this benefit is potentially increased labor costs that may result in an effort to retain a more skilled and qualified work force. This is especially significant in areas of new technology where skilled labor resources may be in short supply. However, it is better to train employees and lose them than not train them and keep them. This intangible benefit is difficult to quantify.

Employee learning curve

Training new material handlers, due to turnover or peak period operations, can be costly and time consuming. By automating processes using a WMS, new employees have less to learn and can become efficient more quickly by simply following instructions provided by the WMS on wireless terminal screens. Also in this category is the potential to run multiple facilities from one computer. Depending on the size and activity of off-site facilities, they may be able to be remotely managed using the same WMS being used in a larger main facility. Larger distribution networks will require separate systems for each facility. In this instance, if each operation is using the base system, sharing resources between facilities becomes much easier. The learning curve is shortened for operators moving between facilities. This intangible benefit is difficult to quantify.

Visibility

Production management, customer service and even customers can have instant access to order status and can monitor performance. Knowing what materials went into what product, and what product went to which customer is critical information.

Much of the information required in the supply chain event management applications is derived from WMS type execution systems.

Misplaced orders

Have you ever lost an order in the warehouse? What is the cost to find or re-pick the order? Also factor in the cost to un-pick (put-a-way) the order once it is (hopefully) found. Misplaced orders may also have a negative impact on customer service, labor costs, and order delivery cycle times.

Cycle time

With improved inventory visibility, order cycle times can be improved from 10-50%. Improved cycle times generally result from a combination of several other factors including: Confirmed inventory availability, timely replenishment activities, improved labor planning, etc. With

short order processing cycle times, you may be able to extend your order placement deadline potentially providing you with a competitive advantage.

Upgrade paths

Packaged WMS solutions provide future assurance of continuous improvement from the on-going system upgrades and revisions frequently performed by vendors. Most vendors have multiple customers across various industries. As specific modifications are made for various customers, these “mods” are often included in future releases of the base product. Many times, these “mods” represent best practices you should consider implementing in your facility if you select to upgrade your system to the most current version.

System availability

The technology available today is much more dependable than systems of the past. Historically, systems required down-time to run batches and general system maintenance. With a new system today, it is reasonable to expect 99+% up-time. Even if the host business system is out of commission, the WMS will still operate to process orders.

User group networking

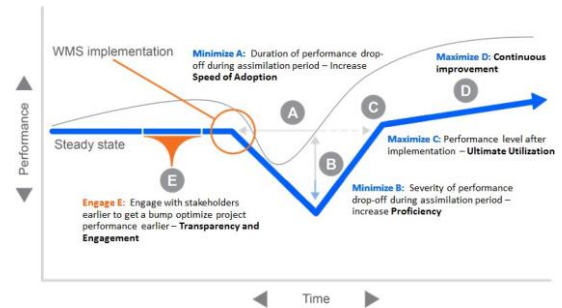
If your WMS solution is from a third party vendor, chances are the vendor will have an existing installation base and a user group. Many vendors offer regular user group conferences at least once every other year. Some vendors even support smaller regional conferences. These meetings offer good opportunities for the system users to meet and discuss various uses of the system. Quite frequently best practices from one industry can easily be applied across multiple industries using the same system. The advent of the internet (on-line communities) has created another more cost effective way to allow user group participants to share practices and questions with others in the group. Either way, this chance to meet and share ideas with colleagues using the same vendor system may lead to better ways of running your business.

Change management

From a planning and change management perspective, there may be a predictable drop-off in performance due to the implementation of new processes and systems. The response is a natural reaction to major change. Target performance can be achieved by proactively managing the change. Managing expectations means letting all involved know things might get worse before they get better.

As with any change, implementing WMS might result in an immediate drop off in operational performance due to many factors including unexpected process results, miss-defined procedures, and employee learning curve

effects. The key thing to consider is to plan for this drop off when calculating the project payback period. Effective project and change management will increase the speed of adoption and increase proficiency minimizing the severity of initial lost performance. Once the project has realized steady state, you can then begin to implement continuous improvement activities to further drive benefits.



And a phenomenon I've seen on some projects is productivity actually improving during the project design phase, before the solution is implemented. This is generally the result of the Hawthorne effect where people tend to perform better when they feel they are being observed.

Your job is to efficiently manage change and these variables throughout the duration of the project.

Conclusion

There are many compelling reasons to invest in a system providing an 18 – 24 month payback. Whether cost savings or simply staying in business, you run a better chance of a successful implementation if all of the benefits are identified up front and leadership's expectations are proactively managed. Developing a thorough business case for a new system can be exciting. Who knows, you may even learn something about your business along the way.

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Appendix

Quantitative Benefits for a CPG company

Percent Savings from 1999 Budget	Quantitative Benefits	Annual Dollar Savings (In Thousand)
13.0%	Savings in Direct Labor Improvements from Productivity Tracking and Standard Processes	\$ 7,600
2.0%	Savings in Direct Labor Improvements	\$ 2,100
0.2%	Increased Fill Rate Improves Sales and Earnings	\$ 3,200
2.5%	Production In Warehouse Shrink	\$ 500
19.0%	Approved Parcel Shipping Accuracy	\$ 1,500
10.0%	Reduction in Demurrage/Detention Costs	\$ 100
TOTAL		\$ 15,000

Presenting Qualitative Benefit Estimates

Qualitative Item	Description	Annual Cost Savings Estimates (In Thousands)	
		Low	High
Management Capabilities	FTE Savings Due to Reporting	\$350	\$ 500
Upgrade Path	Cost to Upgrade Modifications	\$25	\$ 125
System Flexibility	Development of Configuration Options	\$65	\$ 130
TOTALS		\$440	\$ 1,500

Example benefits

Government facility

- Increased Customer Satisfaction from 89% to 98%
- Reduced order cycle time from 30-45 days to 1-3 days
- Receiving/put-away time reduced from 5 days to 1 hour
- Customer inquiry responsiveness improved from 2 days to 5 minutes
- Order fill rate increased from 89% to 94%

Quantitative savings:

- | | |
|--|-----------|
| • Improved Space Utilization | \$300,000 |
| • Reduction in contractor staff | \$222,000 |
| • Elimination of manual order processing | \$29,000 |
| • Elimination of redundant orders | \$120,000 |
| • Elimination of errors and data entry | \$ 50,300 |
| • | |

Music distribution

- From 1,500 SKUs to 3,500
- Ship 95% of orders via second day
- Improved order fill rate to 97.8
- Raised order accuracy to 99.5
- Productivity doubled
- Operating expenses cut in half
- Physical inventory count down to one day per yr

Consumer electronics distribution

- 7,000 orders shipped per week
- 99% of orders filled in 15 minutes, down from 3 – 4 days
- Order pick rate improved from 16 lines per hour to 120
- Improved put-away of a full truck load of parts from 4 days down to 3 hours
- 26% increase in business handled by less than half the labor requirements
- 100% system availability since implementation