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Golden Retrieval
The Truce between Lean and IT
In Search of Lillian

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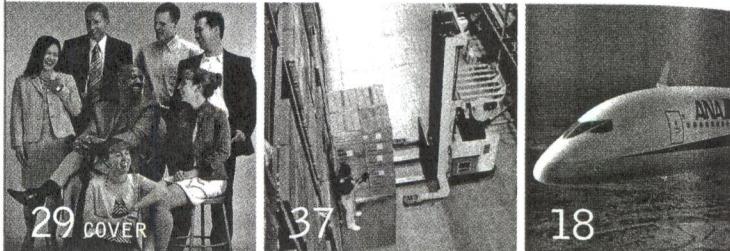
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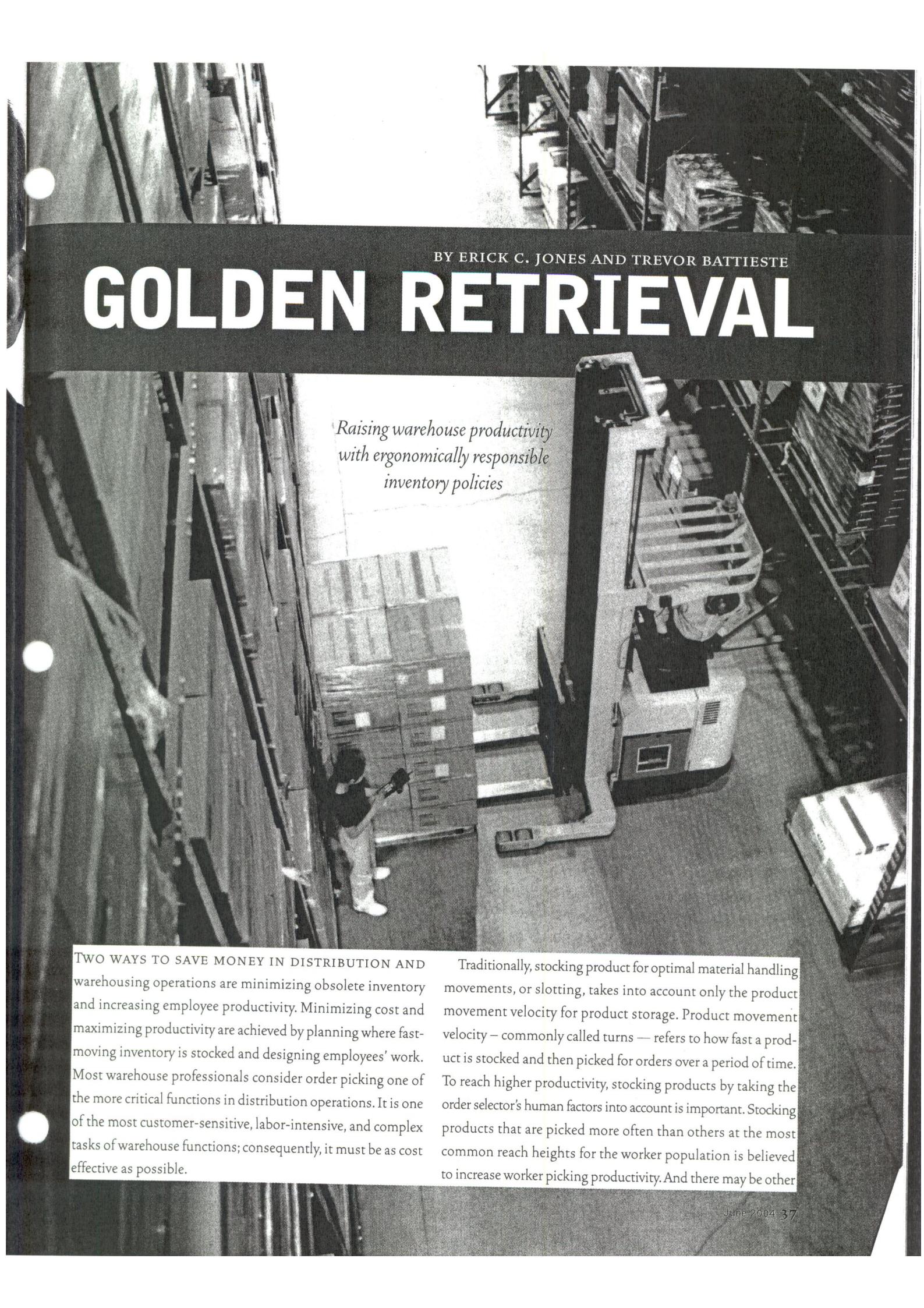
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Award Winner





BY ERICK C. JONES AND TREVOR BATTIESTE

GOLDEN RETRIEVAL

*Raising warehouse productivity
with ergonomically responsible
inventory policies*

TWO WAYS TO SAVE MONEY IN DISTRIBUTION AND warehousing operations are minimizing obsolete inventory and increasing employee productivity. Minimizing cost and maximizing productivity are achieved by planning where fast-moving inventory is stocked and designing employees' work. Most warehouse professionals consider order picking one of the more critical functions in distribution operations. It is one of the most customer-sensitive, labor-intensive, and complex tasks of warehouse functions; consequently, it must be as cost effective as possible.

Traditionally, stocking product for optimal material handling movements, or slotting, takes into account only the product movement velocity for product storage. Product movement velocity — commonly called turns — refers to how fast a product is stocked and then picked for orders over a period of time. To reach higher productivity, stocking products by taking the order selector's human factors into account is important. Stocking products that are picked more often than others at the most common reach heights for the worker population is believed to increase worker picking productivity. And there may be other

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This article lays out best practices for slotting inventory to get optimal picking performance while minimizing picking labor. It also describes how to conduct a study to stock products with respect to ergonomics so that manual order picking can be performed productively. The following warehousing and distribution background elucidate the impact of this kind of study.

Slotting or storage layout planning of the warehouse is crucial to warehouse cost efficiency. The relationship of slotting to order picking is often overlooked, but warehousing best practices emphasize the relationship. Because order picking is time sensitive, it is important that clients get orders within promised lead-times. Warehouses have to stock products so that order picking can be optimal. It may be a trade-off to take more time to stock inventory in an optimal picking location rather than minimize stocking time. But sacrificing customer lead-times when making order selection less efficient is not a wise choice.

According to the book *Facilities Planning* by James Tompkins and John White, optimal slotting usually takes into account five principles: popularity, similarity, size, characteristics, and space utilization. Typically, warehouse managers focus only on popularity or the inventory turns of the product. Popularity means stocking the most popular material in ways that minimize travel distance. Most warehouses use this philosophy and stock the fast movers close to the outbound location but often overlook the possible ergonomics of stocking in the golden zone.

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Material handling techniques are used to make the warehouse and distribution operation more efficient. When used effectively, they can improve storage capacity, minimize equipment travel, and improve order selection productivity. Some of the techniques used in advanced operation are pick-and-pass, pick-to-belt, and pick pods. The warehouse control systems are used to ensure inventory accuracy and minimize labor.

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Warehouse control techniques are most effective in large distribution operations. Because of the cost associated with implementing a control system, the return on investment should be justified. The business case for control systems is that they direct personnel to move product and update information,

FIVE STEPS TO A SUCCESSFUL WMS

BY KEVIN TEDFORD



1. Understand your requirements.

Develop a detailed map of your current business processes, and make sure the WMS can satisfy them. Be open to using existing WMS functions and features that satisfy your business process needs even if the steps in a process have to change. Remember, it's the end result that matters — meeting customer service requirements, achieving productivity targets while maintaining high levels of inventory accuracy.

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Plan to succeed and follow your plan. An old philosopher said, "If you don't know where you are going, any road will get you there." This is especially true with WMS implementations. Many details must be planned and managed. Spend the time up front to define a detailed plan and then manage your project to the plan.

4. Test your configuration.

After

determining which WMS features you will implement, you will spend a significant amount of time entering parameters and configuration data. Validate business processes using test scenarios for all of them. Verify that your training material is accurate. Resolve all configuration problems prior to system startup and transition. Starting up and testing with a small set of items or a piece of your business can be very helpful.

5. Train people.

Develop training material and then train users. If you do only on-the-job training without a complementary formal training program, you will be sorry. People come and go over time; this is another area where a formal, repeatable training program pays off.

Kevin Tedford is the vice president of consulting services for Forte Industries. He holds a B.S. in mathematics and physics from Carroll College.

which results in up to 20 percent labor reduction and up to 99 percent inventory accuracy levels. Two of the most effective warehouse control systems are warehouse management and pick-to-light control.

- A warehouse management system uses computer-based algorithms for directed receiving, stocking, picking, consolidating, and shipping operations in a warehouse. It also tracks all inventory and labor moves for the operations. By defining procedures of where to move inventory, the warehouse operations can be automated. And when partnered with other control systems, orders can be sent to specific devices such as a pick-to-light control system or an automatic storage and retrieval device.

- Pick-to-light uses a visual display to lead the picker to the

product that needs to be picked and the amount that needs to be picked. A display is located in each rack bay to indicate the correct pick quantity. A pick confirmation pad and indicator light is located at each stock location. Its benefit is that it allows for efficient and correct inventory accuracy.

Considering ergonomics

Labor picking efficiency can be greatly improved with human factors and ergonomics. By designing an operation in which personnel can perform standard routines safely and efficiently, operations usually become safer and more cost effective. Stocking in the golden zone allows organizations to realize these benefits.

In 1971, E.R. Tichauer studied methods of lifting weights off the floor as measured by electromyography recordings of

golden retrieval

Lifts	90	75	Percent of population	50	25	10
<i>Floor to knuckle height</i>						
Males	37 LBS	42 LBS		53 LBS	65 LBS	76 LBS
Females	19 LBS	21 LBS		33 LBS	39 LBS	46 LBS
<i>Knuckle to shoulder height</i>						
Males	40 LBS	47 LBS		55 LBS	62 LBS	69 LBS
Females	23 LBS	25 LBS		27 LBS	30 LBS	31 LBS
<i>Shoulder to reach height</i>						
Males	36 LBS	42 LBS		42 LBS	56 LBS	49 LBS
Females	18 LBS	22 LBS		27 LBS	31 LBS	35 LBS

Source: Kodak's *Ergonomic Design for People at Work*, John Wiley & Sons, 2004

Figure 1. Distribution of the maximum acceptable weights that can be lifted by male and female industrial workers

muscles and activities. He found less muscle activity involved when the load was close to the body while squatting and lifting with the legs. The subsequent year, B.T. Davies reported research by S.W. Frederick dealing with the efficient methods of lifting boxes with two hands to various heights as measured by energy extended per foot-pound. In general, lifting weights from 40 inches to 60 inches requires less energy than lifting them from the floor to 20 inches, from 20 inches to 40 inches, or overhead 60 inches to 80 inches. In work situations where workers must lift a number of heavy boxes, they should be located within the range of 40 inches to 60 inches. Industrial engineers should use the National Institute of Occupational Safety and Health manual lifting guidelines of 1994 for calculating maximum acceptable weights for lifting. A rule of thumb illustrated in Figure 1 uses a chart that provides the maximum acceptable weights that can be lifted by male and female industrial workers in various height ranges.

In a 1975 *Industrial Engineering* article, D.B. Chaffin and M.M. Ayoub cited the four components of manual materials handling: the characteristics of the worker, the material container, the task, and the work practices. Worker characteristics include age, sex, body build, sensory motor skills, training, and health. Material container characteristics include dimensions, location of the center of gravity with respect to the worker, grasping aids such as handles, and stability of the load (e.g., liquids). Task characteristics include the movement distance, frequency, duration and pace of movement, foot traction, and work environment. Work practices include posture and lifting technique, administration, and organization of the safety/hygiene function. All of these characteristics should be taken into account when

setting a work standard for warehouse personnel.

Deep containers tend to increase the horizontal distance between the center of gravity of the person and the center of gravity of the object being lifted. Workers often stoop over to pick large cardboard boxes stacked in columns some distance from the worker's center of gravity. If the weight is over 35 pounds, excessive stress is placed on the lower back.

- When lifting, a worker's hands should be no lower than 20 inches from the floor, nor should they be higher than the shoulders (to decrease the possibility of dropping the load).
- Lifting loads asymmetrically from one side of the body should always be avoided.
- Two people should carry a load (with handles) if it is more than 20 inches in breadth or requires a single worker's hands to be extended more than 16 inches in front of the hips.

When picking or constant lifting and asymmetrical lifting, other ergonomics considerations include the impact of quick lifting, sustained muscular exertion and performance, shoulder abduction angle, hand positions, and head tilt.

Understanding the golden zone

One measure of an item's quality is how frequently it is requested. If an item is requested frequently, it is logical to keep that item in an easily accessible location. But if the item is heavy, it may be too time consuming to double- or triple-handle that product. According to *Facilities Planning*, a best practice for order picking is to assign the most popular items to the most easily accessible locations in the warehouse. We call this picking in the golden zone.

Once items have been assigned to storage modes such as

GOLDEN ZONE CONCEPT

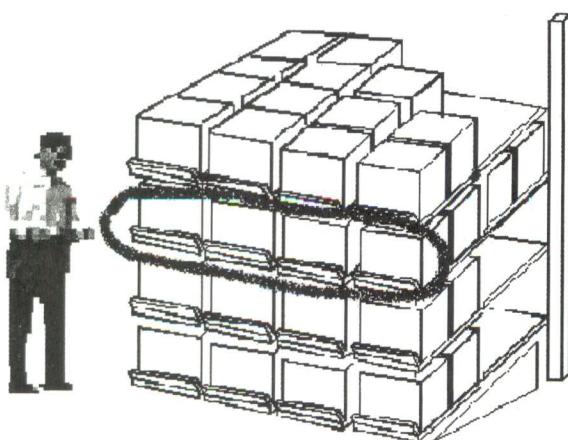


Figure 2. Pick height for the golden zone

reserve locations and primary locations, the assignment of forward pick locations can be approached.

Because 15 percent of the items produce the majority of picking activity, the order picking travel time and bending moves can be minimized. By focusing on popularity storage, the amount of stooping and bending can be reduced, possibly reducing worker fatigue and improving picking accuracy. The most popular items should be assigned to the picking locations at or near waist height. A goal may be to stock as much as 70 percent of fast moving picks at waist height. Be sure that the product has characteristics that will allow for ergonomically safe selecting per NIOSH standards.

Another basic rule in assigning products to selection locations is taking dimensions into consideration. Cube matching of the items with the selection locations is essential to eliminate space inefficiencies. Shelf dimensions should be spacious enough to allow easy picking, but tight enough to avoid excessive unused space. Figure 2 shows how the row indicated would be a more efficient reach and selection location than the others because of the reaching dimensions.

Conducting a study

A study involves collecting data from selectors picking items from both inside and outside of the golden zone. For example, in a pick pod configuration you would define the length and width of aisles; define the pick-faces and designate which are in the golden zone; define the items used for the study; and define the pick method.

Next, collect biometric data for order selectors at a minimum average height as well as standard deviation data. Then use

statistics to measure the labor time variance of picking in the golden zone vs. picking outside of it. Hypothesis testing generally tests for a 95 percent confidence level that there is a statistical difference in the labor times of the two methods. This is important in validating that this kind of stocking philosophy can save the company money.

The benefit of this type of study is that it tests whether high-velocity items stocked in the golden zone will take less time to pick for an order selector in comparison to not stocking high-velocity items in the golden zone. Specifically, the study tests if the picking mean time has a significance variance. There could be up to a 20 percent difference in labor time, which implies a 20 percent opportunity for cost savings if there is a difference in picking times.

The study should strive to exemplify how a better job design can increase productivity for workers. It may also demonstrate how making an easily implementable change to inventory stocking policies can be accomplished and make a significant difference. The true benefits are that companies can save both hard and soft costs in labor and soft-tissue injury reductions, respectively. And the ergonomic design of the order selecting task will help employees work in a safer, healthier environment. □

For further reading

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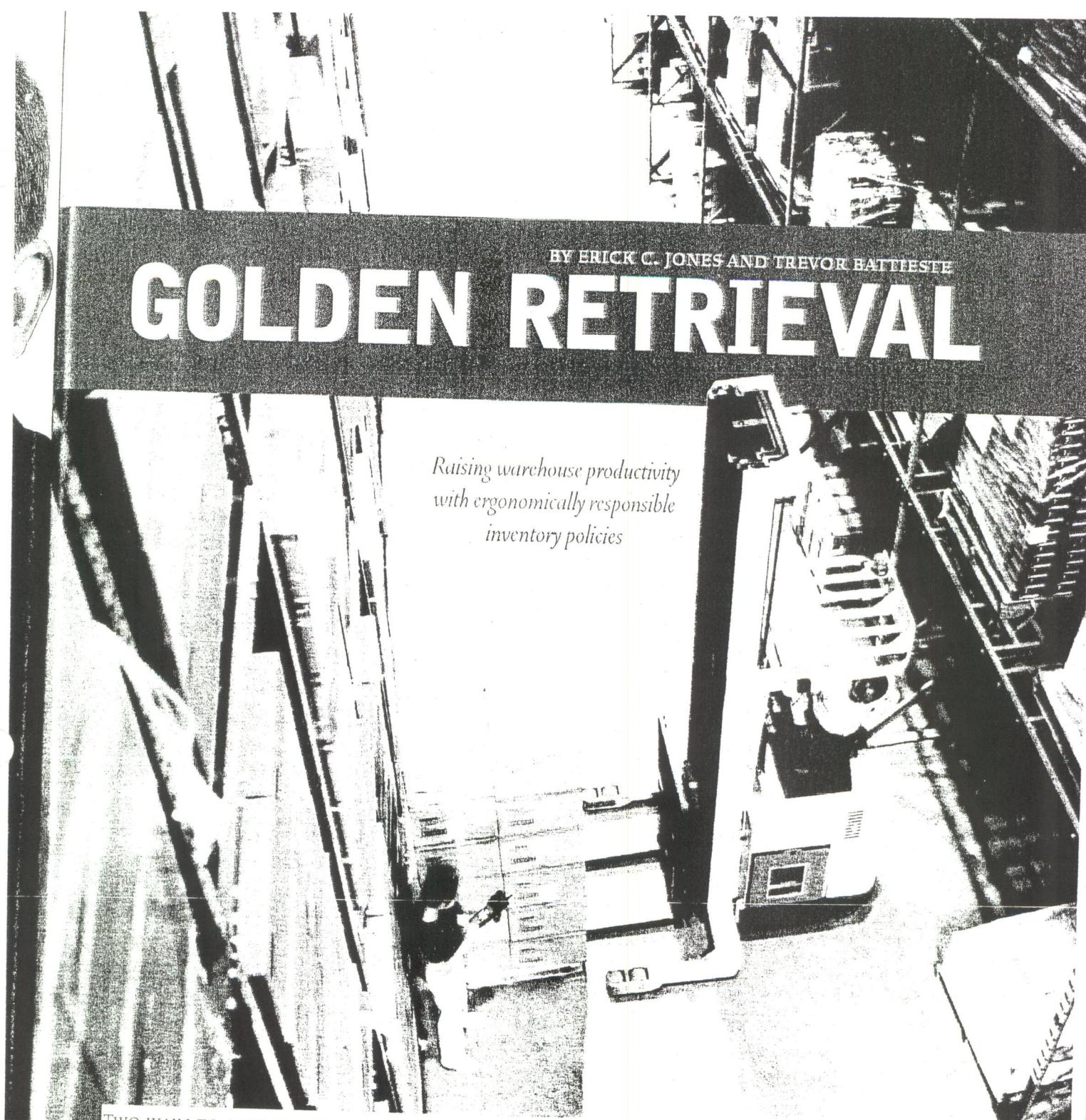
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Trevor Battiste is a practicing industrial engineer at Home Interiors & Gifts. He has worked as a time study and work measurement consultant at companies such as EXE Warehouse Management Software Co. and UPS.



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which results in up to 20 percent labor reduction and up to 99 percent inventory accuracy levels. Two of the most effective warehouse control systems are warehouse management and pick-to-light control.

- A *warehouse management system* uses computer-based algorithms for directed receiving, stocking, picking, consolidating, and shipping operations in a warehouse. It also tracks all inventory and labor moves for the operations. By defining procedures of where to move inventory, the warehouse operations can be automated. And when partnered with other control systems, orders can be sent to specific devices such as a pick-to-light control system or an automatic storage and retrieval device.

- *Pick-to-light* uses a visual display to lead the picker to the

product that needs to be picked and the amount that needs to be picked. A display is located in each rack bay to indicate the correct pick quantity. A pick confirmation pad and indicator light is located at each stock location. Its benefit is that it allows for efficient and correct inventory accuracy.

Considering ergonomics

Labor picking efficiency can be greatly improved with human factors and ergonomics. By designing an operation in which personnel can perform standard routines safely and efficiently, operations usually become safer and more cost effective. Stocking in the golden zone allows organizations to realize these benefits.

In 1971, E.R. Tichauer studied methods of lifting weights off the floor as measured by electromyography recordings of

golden retrieval

Lifts	90	75	50	25	10
<i>Floor to knuckle height</i>					
Males	37 LBS	42 LBS	53 LBS	65 LBS	76 LBS
Females	19 LBS	21 LBS	33 LBS	39 LBS	46 LBS
<i>Knuckle to shoulder height</i>					
Males	40 LBS	47 LBS	55 LBS	62 LBS	69 LBS
Females	23 LBS	25 LBS	27 LBS	30 LBS	31 LBS
<i>Shoulder to reach height</i>					
Males	36 LBS	42 LBS	42 LBS	56 LBS	49 LBS
Females	18 LBS	22 LBS	27 LBS	31 LBS	35 LBS

Source: Kodak's *Ergonomic Design for People at Work*, John Wiley & Sons, 2004

Figure 1. Distribution of the maximum acceptable weights that can be lifted by male and female industrial workers

muscles and activities. He found less muscle activity involved when the load was close to the body while squatting and lifting with the legs. The subsequent year, B.T. Davies reported research by S.W. Frederick dealing with the efficient methods of lifting boxes with two hands to various heights as measured by energy extended per foot-pound. In general, lifting weights from 40 inches to 60 inches requires less energy than lifting them from the floor to 20 inches, from 20 inches to 40 inches, or overhead 60 inches to 80 inches. In work situations where workers must lift a number of heavy boxes, they should be located within the range of 40 inches to 60 inches. Industrial engineers should use the National Institute of Occupational Safety and Health manual lifting guidelines of 1994 for calculating maximum acceptable weights for lifting. A rule of thumb illustrated in Figure 1 uses a chart that provides the maximum acceptable weights that can be lifted by male and female industrial workers in various height ranges.

In a 1975 *Industrial Engineering* article, D.B. Chaffin and M.M. Ayoub cited the four components of manual materials handling: the characteristics of the worker, the material container, the task, and the work practices. Worker characteristics include age, sex, body build, sensory motor skills, training, and health. Material container characteristics include dimensions, location of the center of gravity with respect to the worker, grasping aids such as handles, and stability of the load (e.g., liquids). Task characteristics include the movement distance, frequency, duration and pace of movement, foot traction, and work environment. Work practices include posture and lifting technique, administration, and organization of the safety/hygiene function. All of these characteristics should be taken into account when

setting a work standard for warehouse personnel.

Deep containers tend to increase the horizontal distance between the center of gravity of the person and the center of gravity of the object being lifted. Workers often stoop over to pick large cardboard boxes stacked in columns some distance from the worker's center of gravity. If the weight is over 35 pounds, excessive stress is placed on the lower back.

- When lifting, a worker's hands should be no lower than 20 inches from the floor, nor should they be higher than the shoulders (to decrease the possibility of dropping the load).
- Lifting loads asymmetrically from one side of the body should always be avoided.
- Two people should carry a load (with handles) if it is more than 20 inches in breadth or requires a single worker's hands to be extended more than 16 inches in front of the hips.

When picking or constant lifting and asymmetrical lifting, other ergonomics considerations include the impact of quick lifting, sustained muscular exertion and performance, shoulder abduction angle, hand positions, and head tilt.

Understanding the golden zone

One measure of an item's quality is how frequently it is requested. If an item is requested frequently, it is logical to keep that item in an easily accessible location. But if the item is heavy, it may be too time consuming to double- or triple-handle that product. According to *Facilities Planning*, a best practice for order picking is to assign the most popular items to the most easily accessible locations in the warehouse. We call this picking in the golden zone.

Once items have been assigned to storage modes such as

GOLDEN ZONE CONCEPT

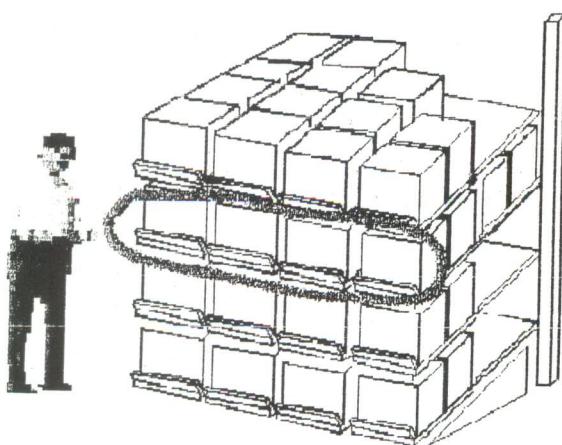


Figure 2. Pick height for the golden zone

reserve locations and primary locations, the assignment of forward pick locations can be approached.

Because 15 percent of the items produce the majority of picking activity, the order picking travel time and bending moves can be minimized. By focusing on popularity storage, the amount of stooping and bending can be reduced, possibly reducing worker fatigue and improving picking accuracy. The most popular items should be assigned to the picking locations at or near waist height. A goal may be to stock as much as 70 percent of fast moving picks at waist height. Be sure that the product has characteristics that will allow for ergonomically safe selecting per NIOSH standards.

Another basic rule in assigning products to selection locations is taking dimensions into consideration. Cube matching of the items with the selection locations is essential to eliminate space inefficiencies. Shelf dimensions should be spacious enough to allow easy picking, but tight enough to avoid excessive unused space. Figure 2 shows how the row indicated would be a more efficient reach and selection location than the others because of the reaching dimensions.

Conducting a study

A study involves collecting data from selectors picking items from both inside and outside of the golden zone. For example, in a pick pod configuration you would define the length and width of aisles; define the pick-faces and designate which are in the golden zone; define the items used for the study; and define the pick method.

Next, collect biometric data for order selectors at a minimum average height as well as standard deviation data. Then use

statistics to measure the labor time variance of picking in the golden zone vs. picking outside of it. Hypothesis testing generally tests for a 95 percent confidence level that there is a statistical difference in the labor times of the two methods. This is important in validating that this kind of stocking philosophy can save the company money.

The benefit of this type of study is that it tests whether high-velocity items stocked in the golden zone will take less time to pick for an order selector in comparison to not stocking high-velocity items in the golden zone. Specifically, the study tests if the picking mean time has a significance variance. There could be up to a 20 percent difference in labor time, which implies a 20 percent opportunity for cost savings if there is a difference in picking times.

The study should strive to exemplify how a better job design can increase productivity for workers. It may also demonstrate how making an easily implementable change to inventory stocking policies can be accomplished and make a significant difference. The true benefits are that companies can save both hard and soft costs in labor and soft-tissue injury reductions, respectively. And the ergonomic design of the order selecting task will help employees work in a safer, healthier environment.

For further reading

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