Order Picking: Methods and Equipment for Piece Pick, Case Pick, and Pallet Pick Operations.

By Dave Piasecki

Of all warehouse processes, order picking tends to get the most attention. It's just the nature of distribution and fulfillment that you generally have more outbound transactions than inbound transactions, and the labor associated with the outbound transactions is likely a big piece of the total warehouse labor budget. Another reason for the high level of importance placed on order picking operations is its direct connection to customer satisfaction. The ability to quickly and accurately process customer orders has become an essential part of doing business.

The methods for order picking vary greatly and the level of difficulty in choosing the best method for your operation will depend on the type of operation you have. The characteristics of the product being handled, total number of transactions, total number of orders, picks per order, quantity per pick, picks per SKU, total number of SKUs, value-added processing such as private labeling, and whether you are handling piece pick, case pick, or full-pallet loads are all factors that will affect your decision on a method for order picking. Many times a combination of picking methods is needed to handle diverse product and order characteristics.

Key objectives in designing an order picking operation include increases in productivity, reduction of cycle time, and increases in accuracy. Often times these objectives may conflict with one another in that a method that focuses on productivity may not provide a short enough cycle time, or a method that focuses on accuracy may sacrifice productivity.

> **Productivity**. Productivity in order picking is measured by the pick rate. Piece pick operations usually measure the pick rate in line items picked per hour while case pick operations may measure cases per hour and line items per hour. In pallet pick operations the best measure is actual pallets picked per hour. Since the actual amount of time it takes to physically remove the product from the location tends to be fixed regardless of the picking method used, productivity gains are usually in the form of reducing the travel time.
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> **Cycle Time**. Cycle time is the amount of time it takes to get an order from order entry to the shipping dock. In recent years, customer's expectations of companies to provide same day shipment has put greater emphasis on reducing cycle times from days to hours or minutes. Immediate release of orders to the warehouse for picking and methods that provide concurrent picking of items within large orders are ways to reduce cycle times.
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> **Accuracy**. Regardless of the type of operation you are running, accuracy will be a key objective. Virtually every decision you make in setting up a warehouse will have some impact on accuracy, from the product numbering scheme, to the design of product labels, product packaging, the design of picking documents, location numbering scheme, storage equipment, lighting conditions, and picking method used. Technologies that aide in picking accuracy include pick-to-light systems, counting scales, and bar code scanners. Beyond the design aspects of an order picking operation, employee training, accuracy tracking, and accountability are essential to achieving high levels of accuracy.

Piece Picking

Piece-picking methods. Piece picking, also known as broken case picking or pick/pack operations, describes systems where individual items are picked. Piece pick operations usually have a large sku base in the thousands or tens of thousands of items, small quantities per pick, and short cycle times. Mail order catalog companies and repair parts distributors are good examples of piece pick operations.

> **Basic order picking**. In the most basic order-picking method, product is stored in fixed locations on static shelving or pallet rack. An order picker picks one order at a time following a route up and down each aisle until the entire order is picked. The order picker will usually use some type of picking cart. The design of the picking flow should be such that the order picker ends up fairly close to the original starting point. The picking document should have the picks

sorted in the same sequence as the picking flow. Fast moving product should be stored close to the main cross aisle and additional cross aisles put in to allow short cuts. Larger bulkier items would be stored towards the end of the pick flow. This basic order picking method can work well in operations with a small total number of orders and a high number of picks per order. Operations with low picks per order will find the travel time excessive in this type of picking and operations with large numbers of orders will find that the congestion from many pickers working in the same areas slows down the processing.

Batch picking / Multi-order picking In batch picking, multiple orders are grouped into small batches. An order picker will pick all orders within the batch 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. Batch sizes usually run from 4 to 12 orders per batch depending on the average picks per order in that specific operation. Batch picking systems may use extensive logic programmed to consolidate orders with the same items. In operations with low picks per order, batch picking can greatly reduce travel time by allowing the picker to make additional picks while in the same area. Since you are picking multiple orders at the same time, systems and procedures will be required to prevent mixing of orders. In very busy operations, batch picking is often used in conjunction with zone picking and automated material handling equipment. In order to get maximum productivity in batch pick operations, orders must be accumulated in the system until there are enough similar picks to create the batches. This delay in processing may not be acceptable in same day shipping operations.

Zone picking. Zone picking is the order picking version of the assembly line. In zone picking, the picking area is broken up into individual pick zones. Order pickers are assigned a specific zone, and only pick items within that zone. Orders are moved from one zone to the next as the picking from the previous zone is completed (also known as "pick-and-pass"). Usually, conveyor systems are used to move orders from zone to zone. In zone picking it's important to balance the number of picks from zone to zone to maintain a consistent flow. Zones are usually sized to accommodate enough picks for one or two order pickers. Creating fast pick areas close to the conveyor is essential in achieving high productivity in zone picking. Zone picking is most effective in large operations with high total numbers of skus, high total numbers of orders, and low to moderate picks per order. Separate zones also provide for specialization of picking techniques such as having automated material handling systems in one zone and manual handling in the next.

Wave picking. A variation on zone picking and batch picking where rather than orders moving from one zone to the next for picking, all zones are picked at the same time and the items are later sorted and consolidated into individual orders/shipments. Wave picking is the quickest method (shortest cycle time) for picking multi item orders however the sorting and consolidation process can be tricky. Operations with high total number of SKUs and moderate to high picks per order may benefit from wave picking. Wave picking may be used to isolate orders by specific carriers, routes, or zones.

Basic Order Picking	Total Orders: Low Picks Per Order: Moderate to High
Batch Picking	Total Orders: Low to High Picks Per Order: Low
Zone Picking	Total Orders: Moderate to High Picks Per Order: Low to Moderate
Wave Picking	Total Orders: Low to High Picks Per Order: Moderate to High

Piece-picking equipment: As with the picking methods, the picking equipment used will also depend on a variety of factors.

Static shelving. The most common equipment for storage in piece pick operations, static shelving is designed with depths from 12" to 24". Product is either placed directly on the shelving or in corrugated, plastic, or steel parts bins. Static shelving is economical and is the best method where there are few picks per SKU or where parts are very small.

Carton flow rack. Carton flow rack is similar to static shelving with the exception that rather than shelves, there are small sections of gravity conveyor mounted at a slight angle. Product is stocked from the rear of the flow rack and picking is done from the face. Product can be

stocked in cartons or small totes or bins. As a carton or tote is emptied, it is removed from the rack and another one will roll into place. Carton flow rack is most useful where there is a very high number of picks per SKU.

Carousels. Horizontal carousels are a version of the same equipment used by dry cleaners to store and retrieve clothing. They have racks hanging from them that can be configured to accommodate various size storage bins. Generally an operator will run 2 to 4 carousels at a time avoiding the need for the operator to wait while one unit is turning. Picking is usually performed in batches with orders downloaded from the host system to the carousel software. Horizontal carousels are most common in picking operations with very high number of orders, low to moderate picks per order, and low to moderate picks per sku. Horizontal carousels provide very high pick rates as well as high storage density. Pick-to-light systems are often integrated into carousels. **Vertical Carousels** are frequently used in laboratories and specialty manufacturing operations and are rarely used in regular order picking operations.

Automatic storage and retrieval systems (ASRS). An ASRS is a system of rows of rack, each row having a dedicated retrieval unit that moves vertically and horizontally along the rack, picking and putting away loads. ASRS systems are available in mini-load types that store and transfer product on some type of tray or in bins, and unit-load types that transfer and store pallet loads or other large unitized loads. In addition to the automation features, ASRS units can provide extremely high storage density with capabilities to work in racking up to 100 feet high. Unfortunately the high costs of ASRS equipment and the length of the retrieval times make it difficult to incorporate into a piece picking operation.

Automatic picking machines. Fully automated picking machines (such as A-frames) are still pretty rare and are used only where very high volumes of similar products are picked such as music CDs, or, where high volume in combination with high accuracy requirements exist such as pharmaceutical fulfillment.

Pick-to-light. Pick-to light systems consist of lights and LED displays for each pick location. The system uses software to light the next pick and display the quantity to pick. Pick-to-light systems have the advantage of not only increasing accuracy, but also increasing productivity. Since hardware is required for each pick location, pick-to-light systems are easier to cost justify where very high picks per SKU occur. Carton flow rack and horizontal carousels are good applications for pick to light. In batch picking, put-to-light is also incorporated into the cart or rack that holds the cartons or totes that you are picking in to. The light will designate which order you should be placing the picked items in.

Bar-code scanners. Though very useful in increasing accuracy levels, bar-code scanners in a fast-paced piece-pick operation tend to become cumbersome and can significantly reduce your pick rates. With proper training, tracking, and accountability, you can get very high accuracy rates in order picking without scanners. I find they are better suited to case pick, pallet load, putaway, and order checking operations.

Voice-directed picking. Voice technology has come of age in recent years and is now a very viable solution for piece pick, case pick, or pallet pick operations.

Automated conveyor and sortation Systems. Automated conveyor systems and sortation systems will be integral to any large-scale piece pick operation. The variety of equipment and system designs is enormous.

Case Picking

Case-picking methods. Case picking operations tend to have less diversity in product characteristics than piece picking operations, with fewer SKUs and higher picks per SKU.

Basic case-picking method. This is the most common method for case-picking operations. Rather than product stored on static shelving, case-pick operations will have the product stored in pallet rack or in bulk in floor locations. The simplest picking method is to use a hand pallet jack (or motorized pallet truck) and pick cases out of bulk floor locations however many operations will find that going to very narrow aisle (VNA) pallet racking and using man-up order selectors or turret trucks will provide high storage density and high pick rates.

Batch picking. Batch picking is rarely used in case pick operations primarily because of the physical size of the picks. You are unlikely to have enough room on a pallet to pick multiple orders.

Zone picking. Zone picking can be used in case-picking operations, however, like batch

picking, the size of the picks and the size of the orders in most case-pick operations do not lend themselves well to zone picking. If you do have a case pick operation where you have a large number of SKUs, and orders with small quantities per SKU, or where you have enough cases per order per zone to fill a pallet, you may find zone picking applicable.

Wave picking. Wave picking can be applied to case picking operations where you have very large orders with many picks per order and are looking for ways to reduce cycle time.

Case-picking equipment.

Pallet rack. Pallet rack is the most common storage system for case pick operations.

Flow rack. Although carton flow rack rarely applies to case pick operations, pallet flow rack or push back rack can be useful.

Carousels. Although you can incorporate unit-load carousels into a case pick operation, it tends to be an unlikely match-up. If doing batch picking where you have many picks per SKU and few pieces per pick you can pick from an ASRS unit onto a unit-load carousel.

Automated storage and retrieval systems (ASRS). Unit-load ASRS systems can be useful in case-pick operations, especially if you can provide storage heights of 40 to 100 feet.

Pick-to-light. Pick-to-light can be used in case-pick operations, however, its application is significantly less than in piece pick operations.

Bar-code scanners. Bar-code scanners are frequently used in case-pick operations. Since the time to physically pick the product is higher in case-pick operations, the time spent scanning tends to have little impact on productivity and therefore the accuracy benefits will usually outweigh any reduction in productivity.

Voice-directed picking. Voice technology has come of age in recent years and is now a very viable solution for piece pick, case pick, or pallet pick operations.

Automated conveyor and sortation systems. If using zone or wave picking, automated conveyor and sortation systems will likely be a part of your system. In case picking, you may use standard conveyors to transport individual cases or unit-load conveyors to transport pallets.

Lift trucks. As previously mentioned, motorized pallet trucks, man-up order selectors, and man-up turret trucks are the vehicles of choice for case-pick operations.

Pallet Picking

Full-pallet-picking methods. Full-pallet picking is also known as unit-load picking. The systematic methods for full-pallet picking are much simpler that either piece pick or case pick, however, the choices in storage equipment, storage configurations, and types of lift trucks used are many.

Basic pallet picking. This is the most common method for full-pallet picking. Orders are picked one at a time. The order picker will use some type of lift truck, retrieve the pallet load and stage it in a shipping area in a staging lane designated for that order, or just pick and load directly into an outbound trailer or container..

Batch picking. Since the nature of pallet picking is a single pick per trip, batch picking has no application in pallet-picking operations.

Zone and wave picking. Although the normal definition of zone picking where an order is moved from zone to zone as picks are accumulated doesn't apply to pallet picking, pick zones are used in wave picking in pallet-picking operations. The storage area is broken into zones to eliminate multiple lift-truck operators from picking in the same aisle. The lift truck operator may pick the pallet and deliver it directly to the designated staging lane or place it on a unit-load conveyor that will deliver it to the sorting/staging area.

Task interleaving. Task interleaving is a method of combining picking and putaway. Warehouse Management Systems (WMS) use logic to direct a lift truck operator to put away a pallet en route to the next pick.

Pallet-picking equipment.

Pallet rack. There are numerous pallet rack configurations used in full pallet operations, from standard back-to-back single pallet depth configurations to double-deep rack, push-back rack, drive-in/drive-thru rack, and flow rack. The best racking configuration for your operation will be based on the total number of pallets per sku, pallets per pick, and the length of time the product is in the rack prior to shipment. There are a lot of tradeoffs in choosing a racking configuration including storage density, picking productivity, equipment costs, and the ability to maintain first-in first-out.

ASRS. Unit-load ASRS units when combined with unit-load conveyors and sortation systems can provide fully automatic pallet picking operations. And again, the ability to store product in racking up to 100 feet high gives excellent storage density.

Automated conveyor and sortation systems. Automated conveyor and sortation systems can be combined with ASRS units or used in conjunction with manual picking with lift trucks in zone/wave picking systems. Either the ASRS or the lift truck operator delivers the pallet load to the conveyor. The conveyor system then delivers the pallet to the shipping area where it is either manually sorted by lift trucks into the designated staging lane, or a sortation system automatically sorts into a staging lane. Staging lanes can be equipped with automated or gravity fed unit-load conveyor.

Bar-code scanners. Bar-code scanners are very commonly used in pallet-pick operations.

Voice-directed picking. Voice technology has come of age in recent years and is now a very viable solution for piece pick, case pick, or pallet pick operations.

Lift trucks. The lift trucks used for pallet picking will depend upon the storage configuration. Standard lift trucks are used in bulk floor storage and wide-aisle pallet rack storage in singe-depth, push-back, drive-in/drive-thru, and flow rack. Reach trucks are used in narrow-aisle storage in single-depth, double-deep, push-back, drive-in/drive-thru, and flow rack. Swing mast and turret trucks are used in very narrow aisle storage in single depth pallet rack.

General Information

Regardless of the product handled, or the picking method and equipment used, locating product by the frequency of picks should be incorporated into the system design. The fastest moving product should be stocked as close to the pick point as possible and at the levels that are easiest to pick from. Even if you are using an ASRS unit, the retrieval time will be less the closer the location is to the pick point, and in a horizontal carousel, the picking time will be less if the order picker does not need to bend down or reach up to pick.

In fixed location picking, you designate a specific picking location for each SKU. Fixed picking locations are most commonly used in piece-pick operations, however, they may also be used in case picking and pallet picking where flow rack is incorporated. Slotting in fixed picking locations needs to be reviewed on a regular bases to ensure high levels of productivity. The frequency of review will depend upon product life cycles and seasonality. In random storage operations, a WMS system can direct fast movers to the closest open location to the pick point.

Operations using fixed picking locations will generally also have a reserve or overflow storage area. The overflow storage area will usually use a system of random storage. A replenishment system will need to be put in place to move product to the fixed picking locations as inventory levels drop to predetermined levels.

Outbound shipments should always have some type of a check in place. The type of check will vary from operation to operation. In a high-volume low-value shipping operation, a simple "looking over" the shipment may be all that's feasible, while in a lower-volume high-value shipping operation, I've had as many as three people performing redundant checks of each shipment prior to loading.

Extensive data analysis is necessary in determining the best methods for order picking. Historical data on picks per SKU, quantity per pick, picks per order, total picks, total orders, orders received by time of day, etc. will be important in not only the initial plan, but also in the ongoing operation of the system.

It will also be very important to project growth, especially in automated systems. While you can throw more people into a manual system when transactions increase, automated systems such as carousels

and ASRS units will have capacity limits.

Order-picking systems can be very simple systems in small operations or become very complex systems using a little bit of everything. In a large operation you may have totes start as batch pick in a carousel picking area for your medium moving piece-pick items, and then move individually to a manual picking area for slow moving small-parts piece picking out of static shelving (possibly in a mezzanine). Then move to a carton-flow rack area for your fastest moving items, and finally to a shipping staging/consolidation area where it is matched up with cases and bulkier items from a case-pick ASRS unit and full pallets from a racked warehouse.

Also visit Equipment Pics Pages for graphics of the equipment referenced in this article.

Related Articles I have written:
Warehouse Management Systems WMS
Inventory Accuracy
Cycle Counting

Recommended Reading:

David E Mulcahy, *Warehouse Distribution & Operations Handbook*, McGraw-Hill, .1994

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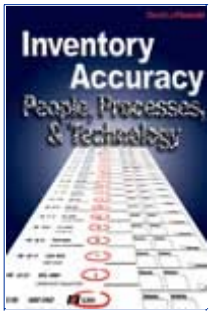

Inventory Accuracy: People, Processes, & Technology

I'm pleased to announce the release of my first book.

Inventory Accuracy: People, Processes, & Technology is a comprehensive treatment of Inventory Accuracy and Cycle Counting in distribution, fulfillment, and manufacturing environments. I have long known that many businesses struggle with accuracy and are often unclear as to what they should be doing to improve operations. The interest I have received on the articles I have written related to inventory accuracy inspired me to write what I like to refer to as **"the ultimate resource on inventory accuracy."** Rather than just writing a little book on cycle counting or bar coding, I decided to write a book that not only comprehensively covers these topics, but also goes beyond bar codes and cycle counts to cover many other key facets of accuracy.

For more detailed information, sample pages, and ordering information go to **www.accuracybook.com.**

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