Supply Chain Digest Thought Leadership Series




Automated Case Picking 2009

The Next Frontier in Distribution Center Management

SupplyChainDigest™
Your First Stop for Supply Chain Information

About the Report Authors

Dan Gilmore is editor of *Supply Chain Digest* and a lead researcher at CSCO Insights. He has nearly 20 years experience in many areas of the supply chain, from his early days as a practitioner to roles in marketing, consulting, and as a supply chain industry analyst.

He was Chief Marketing Officer at a leading supply chain software company before founding SCDigest in 2003. He is known as one of the industry's most important thought leaders, as well as being among its most prolific writers and speakers.

Cliff Holste is Supply Chain Digest's Material Handling Editor and lead editor of the Distribution Digest web site. With more than 30 years experience in designing and implementing material handling and order picking systems in distribution, Holste has worked with dozens of large and smaller companies to improve distribution performance before joining SCDigest in 2007.

Table of Contents

Executive Summary 3

Data Shows Growing Interest..... 5

Case Picking Survey Data 7

Current Case Picking Methods and Trends..... 8
Case Picking Costs and Issues..... 11
Interest in Case Pick Automation 14
What Are the Barriers? 15
Summing Up the Data 16

Understanding the Case Picking Solution Landscape 17

Traditional "Mechanized" Case Picking with Auto Sortation..... 18
AGV/Mobile Robot-Based Case Picking Solutions 19
Conveyor-Based Automated Case Picking Systems..... 22
Gantry Robot-Based Automated Case Picking Solutions..... 24
AS/RS-Based Case Picking Systems 26
Case Sequencing Systems 27
Automatic and Semi-Automatic Palletizers 29
Summing It Up..... 30
Before You Get Started 30
Benefits You Should Expect from ACP..... 33
Criteria for System/Vendor Selection 34

Closing Thoughts 35

Solution Profiles 36

Seegrid 36
RMT Robotics..... 38
HK Systems..... 39

About Supply Chain Digest 40

Executive Summary

The Next Frontier in Distribution Center Management

Distribution centers continue to be under significant operational pressure – and a frequent target for executives looking to reduce supply chain and logistics costs.

Technology has always played a critical role in distribution center processes and continuous improvement goals, with billions of dollars being spent annually on software (Warehouse Management Systems, Labor Management Systems, Slotting Optimization, etc.), data collection and communication technologies (bar code scanning, RFID, wireless systems), and of course automated material handling systems, ranging from fork trucks to high speed conveyors and much more.

Over the past few years, "full case picking" has received more and more attention as a source of cost and perhaps opportunity for many distribution managers across industry sectors. That's because for many of them, case picking volumes and costs as a percent of total facility expenses are going up, as many customers order in smaller, more frequent quantities to better manage inventories. SKU proliferation can also play a role here, especially for those in the consumer goods industries, as the expansion in SKU counts often leads to lower volumes (and hence fewer full pallet picks) for some products.

Naturally, then, many companies look to technology to improve the efficiency and reduce the costs of full case picking and multi-SKU pallet building processes in their DCs.

A Warehouse Management System can help by more effectively directing workers through the case picking processes. "Hands free" voice technology is an increasing popular alternative for case picking at many companies.

For three decades or more, many companies have implemented systems that "mechanized" the case picking process. Typically, this involved "batch pick-to-belt systems," in which cases were selected across orders in specialized "pick modules" and then conveyed to a high speed sorter, where they were distributed down various divert lanes based on specific customer orders. These systems have delivered solid ROI, reduced operational costs, and increased throughput potential in many companies.

Over time, there have been consistent improvements in the overall technology related to this type of mechanized case picking solution. Recent years, for example, have seen industry leaders significantly increase manageable conveyor speeds and reduce the length of separation required between each carton on a sorter, which both serve to increase total system throughput.

However, the basic case picking process itself has been little changed by technology over the past 20 years, since the development of today's modern WMS and wireless data terminals (with the possible exception of the increased use of voice over the past few years rather than scanning). More fully automating the case picking process and mixed-SKU pallet creation has in fact been something of a "Holy Grail" for the automated material handling industry – as logistics managers waited for new technologies and options.

At long last, there has been a change in the status quo. An entirely new generation of more truly automated case picking systems – for which we recommend a new acronym "ACP" - has come to market, along

More fully automating the case picking process and mixed-SKU pallet creation has in fact been something of a "Holy Grail" for the automated material handling industry

with new alternatives for mechanized solutions (the distinction between the two being that little or no manpower is required for truly automated solutions).

These changes have come as the result of clear investments in R&D for case picking solutions, in many cases with material handling vendors working directly with specific customers to develop solutions that meet their case picking needs.

It is fair to say, however, that in some respects many of the core technologies or even solution approaches have been available in the market for some period of time. But in general, they were too inflexible and too slow, and as a result simply did not provide the right ROI or risk-reward trade-offs necessary for adoption by most companies.

But just in the past few years, substantial technology improvements have been made. This is especially true in the area of software controls and raw computing power, which is enabling the throughput of these solutions to match the dynamic and high volume nature of today's distribution environments. There have also been important advances on the mechanical side, enabling a much greater level of flexibility

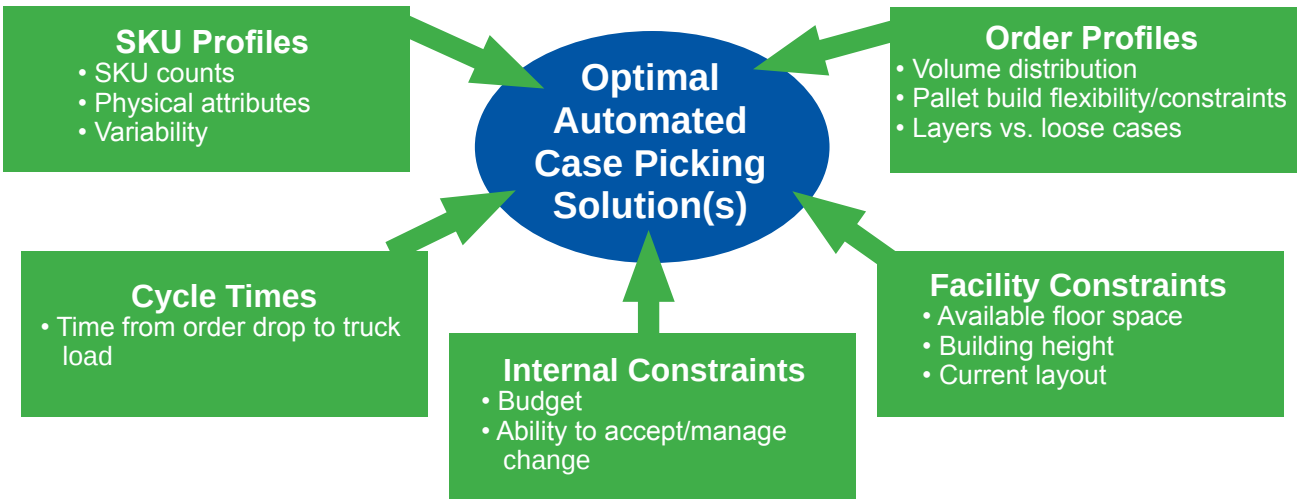
This is clearly an exciting development – especially as there are several different categories of currently available ACP solutions, giving distribution center managers a number of choices to consider.

The breadth of the available and emerging case picking solutions is a positive development not only to give users multiple choices, but because the characteristics of different industry sectors and/or the distribution operating models of specific companies will vary, sometimes substantially. As shown in the graphic below, a company's SKU mix and physical characteristics; order profiles and volumes; cycle time requirements; facility constraints; and other factors will all impact needs and what ACP solution - or combination of solutions - will have the best fit for them. Of course, budget, appetite for risk, and level of operational change that can be added will also play a role.

To illustrate the point, a beverage distributor with a SKU count perhaps in the low hundreds but with very large volumes for many of those SKUs is likely to have very different needs than an apparel manufacturer that has thousands of SKUs and comparatively lower case volumes for each.

Speaking of the beverage sector, clearly this is where much of the automated case picking focus is right now in terms of vendors and their customers. Of the ACP solutions that have actually been implemented to date, a high percent come from

Drivers of Case Picking Automation Requirements



beverage companies, whether beer, soft drinks, or other categories.

Why? Not only do beverage companies have challenging case picking environments (e.g., volumes, case weight) that could highly benefit from automated solutions, but the sector also sees the opportunity for breakthrough logistics improvements resulting from ACP. The capability, for example, to cost-effectively create customer specific mixed-SKU pallets in distribution can substantially reduce delivery costs. Drivers would be able to deliver pre-picked pallets without the need to build those pallets at each stop, reducing the need for the number of drivers and vehicles. It would also enable them to move in some scenarios to more efficient traditional straight trucks versus the side-loaded vehicles common to the industry.

But beverage companies are certainly not the only ones interested in these technologies, and the R&D and investment there will ultimately benefit companies in virtually every other sector.

Data Shows Growing Interest

There is clearly growing interest in more automated case picking solutions, as evidenced in part from the survey data compiled specifically for this report. (See text box below). As detailed in section 2, for example, 56% of respondents handling between 20,000 and 40,000 cases per day at peak have a high or fairly high level of interest in automated picking; for those handling more than 40,000, that number jumps to 76%.

We believe these and future developments in ACP technologies will over time have a substantial impact on distribution center thinking and practice – perhaps dramatically so for some companies.

As a result, Supply Chain Digest and its sister web site Distribution Digest have teamed up to develop this substantial report on the new generation of full case picking solutions. That includes feedback from over 200 logistics professionals who took our survey on this topic; detailed, one-on-one interviews with a number of senior and mid-level executives as a follow up to the survey; and a significant analysis of the types of solutions available on the market.

In this next section of the report, we look at the data and feedback from the logistics professionals. In part two, we will organize and describe the different types of case picking solutions. In the

What's Driving the Interest in Automated Case Picking?

In general, distribution managers are always looking for ways to reduce costs, and to consider additional automation to get that job done. However, a variety of factors are in play right now, according to our survey and one-on-one interviews, to specifically increase the interest in ACP:

- Increasing percent of case picks for many companies
- Improving price-performance curve of available case picking solutions
- Growing general concern about DC labor issues (availability, aging labor base)
- Card Check/unionization potential
- Total labor costs growth often exceeding growth in system costs, which in some cases are falling, changing ROI environment over time
- Interest in reducing variability in DC operational performance
- Concern about physical demands on operators/safety/workmen's compensation issue
- General trend towards larger DCs, which can more easily justify automation

last section, we will profile a few of the vendors of this technology and their specific solutions and approaches, to offer additional insight into how and where this technology may be applied.

While change always takes time, we were surprised to find there are actually more implementations of this type of technology than we realized, and are convinced the industry will see much greater levels of deployment over the next 3-5 years – and that in the end, the processes, flows and cost structures of hundreds of distribution centers will be much changed as a result.

This leads to an important point: many of these solutions are based on a substantially different operating and automation paradigm than almost anyone in the distribution and logistics industry has experience with. Even in initially reviewing some of these solutions, and certainly when taking more active steps to consider them for your operations, this disconnect with your experience and world of the familiar will likely be strong – and likely cause some discomfort because it seems so different and hard to imagine in your DC.

That is OK, and to be expected. It is better to recognize that such feelings may arise, and to be prepared to deal with them in a logical way, rather than pretend they won't exist.

Over the next five years, many companies are likely to adopt this high level of DC automation, very different from today's world. This has already started to happen to a degree in areas of Europe.

A new more automated DC paradigm is coming – it is time to get ready for the opportunity and challenges.

"While change always takes time, we were surprised to find there are actually more implementations of this type of technology than we realized, and are convinced the industry will see much greater levels of deployment over the next 3-5 years..."

Case Picking Survey Data

Recently, as part of this report, SCDigest and Distribution Digest surveyed 210 managers and executives regarding case picking automation.

We had respondents from a wide variety of industries, most heavily populated by consumer goods and food and beverage companies, as well as retailers. However, virtually every industry was represented, including a number of 3PLs managing facilities for clients, pharmaceutical, wholesale distribution, industrial supply and more.

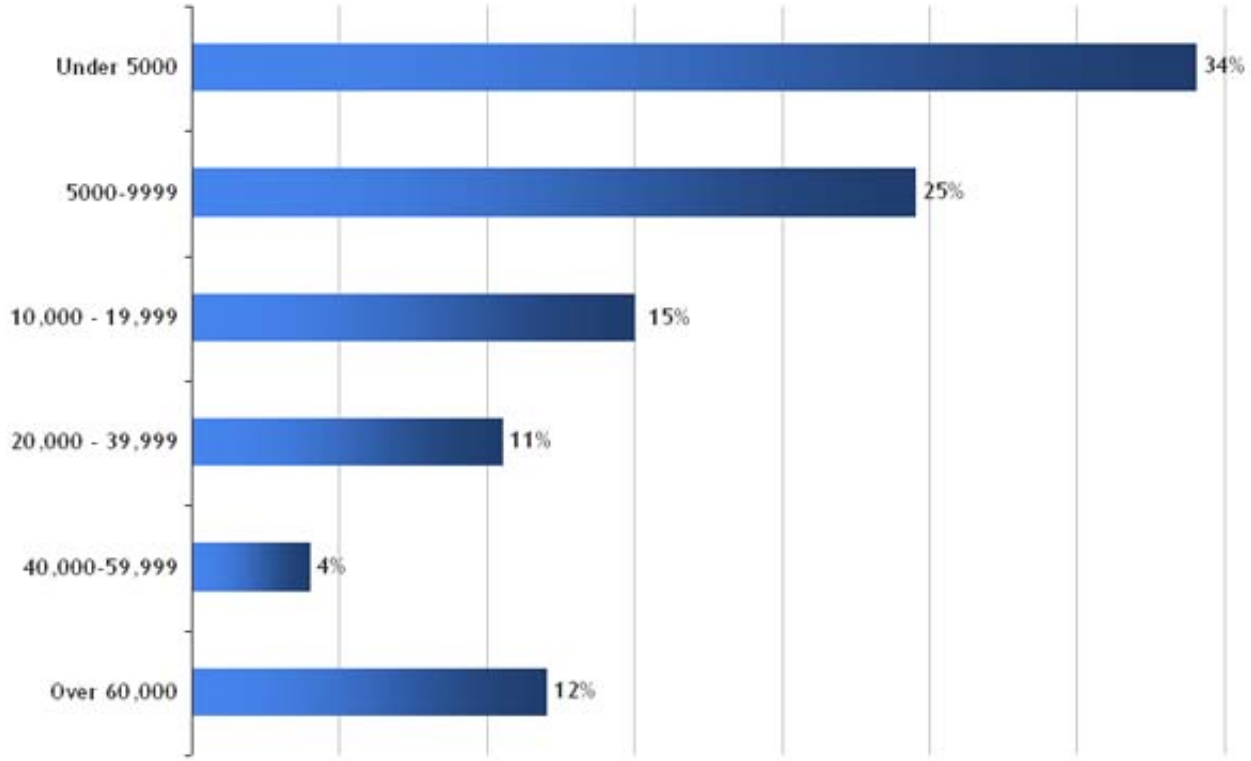
Specific companies that took part in the survey include the following (partial listing below). There was also a wide range of case pick volumes among survey participants in terms of cases per day, which we defined as the average for "peak days."

While 34% of respondents had fewer than 5,000 cases per day, and 59% had under 10,000 cases per day, many had substantial case pick volumes.

15% of respondents had between 10,000 and 20,000 cases per day; 11% had between 20,000 and 40,000 per day; 4% had between 40,000 and 60,000 per day, and (surprising to us) 12% were handling over 60,000 cases per day.

Example Survey Participants		
ACCO Brands, Inc	Herman Miller, Inc	Oregon Scientific
Ballina Beverages	Huntsman	Packaging Incorporated
Beiersdorf Inc	IKEA	Parts Central
BP	Immunotec Inc.	Peters Imports
Bridgeport Distribution, Inc.	Johnson & Johnson	Primark
CEVA Logistics	Jacobson Companies	Restoration Hardware
Coca Cola	JD Smith	Rustan Supercenters Inc.
Columbia Sportswear	Kaiser Permanente	SC Johnson
PA Liquor Control Board	Kellwood Company	Schenck Company
Continental Mills	Keystone Foods	Shell
Covidien	LifeWay	Sherwin-Williams
Dairyland USA Corp	Lowes Companies Inc	Smith & Nephew
Delta Faucet Company	Lutron Electronics	Sobeys
DHL	MARS Snackfood U.S.	Starbucks Coffee
Disney	MBM Corporation	Tech Data Corp.
Do it Best Corp	McCormick and Company	The Chefs' Warehouse
Dow Chemicals	McMaster-Carr Supply Company	The Hershey Co.
Dreyer's Grand Ice Cream	McNeilus Companies	Things Remembered
E & J Gallo Winery	Merck	Valvoline Chemicals
Elkay Manufacturing	Mizuno USA	ULINE
Exel Logistics	Moen	UPS
GlaxoSmithKline	Nestle	Valspar
Gordon Food Service Inc.	Next Day Gourmet	Viscosity Oil
H J Heinz Co.	Nissan	VWR International
H.E. Butt Grocery Company	OfficeMax	Winn-Dixie Stores, Inc.

Average Peak Day Case Picking Volumes per Distribution Center



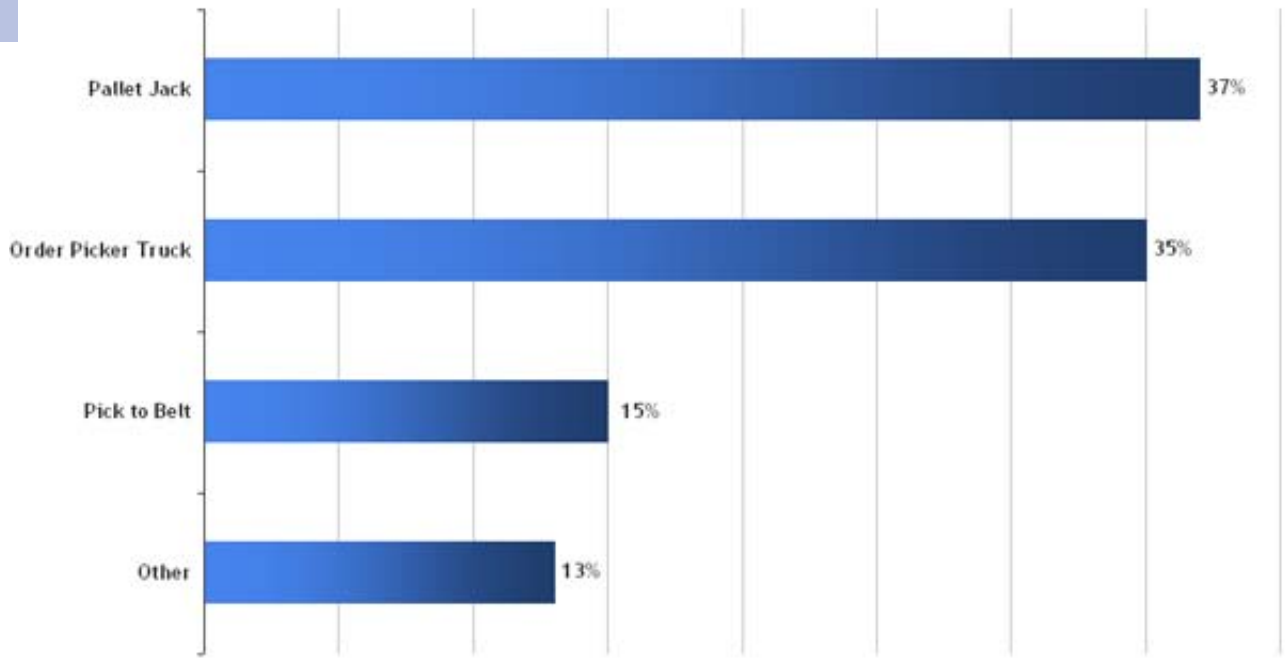
Current Case Picking Methods and Trends

We next wanted to understand how respondents currently performed case pick tasks. The questionnaire asked respondents to estimate how much of their case picking volumes were performed currently using one of several different methods.

On average, 37% of full case picks were performed via pallet jack, followed closely by order picker truck at 35%. 15% of picks were done using pick-to-Belt, on average, and 13% used some other method, including a few companies already using some of the newer automated solutions.
As expected, individual companies had widely different numbers; some, for example, were using pallet jacks for 100% of case pick volumes, while others had very high percentages coming from mechanized pick-to-belt systems.

But the overall averages did not change much across the different tiers of case pick volumes. For example, we would have expected to have found a greater disparity in the percentage of case pick volumes using pick-to-belt between those companies with lower daily volumes versus the higher ones. While there was certainly some disparity, the gap was smaller than we would have predicted, as shown in the chart below. That may be in part because the majority of companies even at the highest levels of case volumes had no pick-to-belt activity (bringing the average down), even though several companies were doing more than 80% of their total using that method.

Case Picking Methods



We also asked respondents what was going on with overall case pick volumes as a percent of the total. Here, the results were mixed.

A little over one-third (34%) of respondents said their percentage of case pick volume was increasing, versus 26% who said it was decreasing and 41% who said their case pick percentage was flat (adds up to 101% due to rounding).

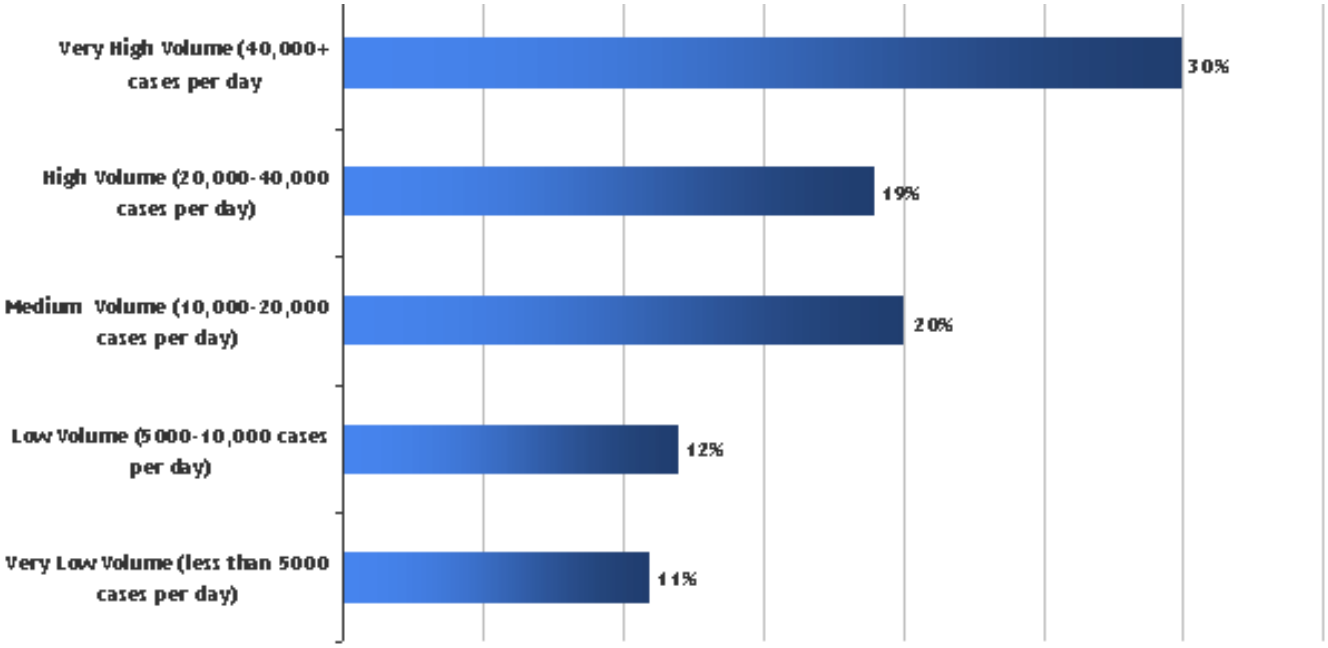
One respondent in the industrial products industry noted their case pick volumes were increasing as they had started to "provide incentives for customers to go from kitting to full cases." Another consumer goods company respondent said that "Hazardous regulations and smaller case sizes are helping to increase case movement for us."

One wholesaler added that "Our switch from commodity to value-added items (with higher price-point and margin) has shrunk "full-pallet" pick volumes and increased full case picks."

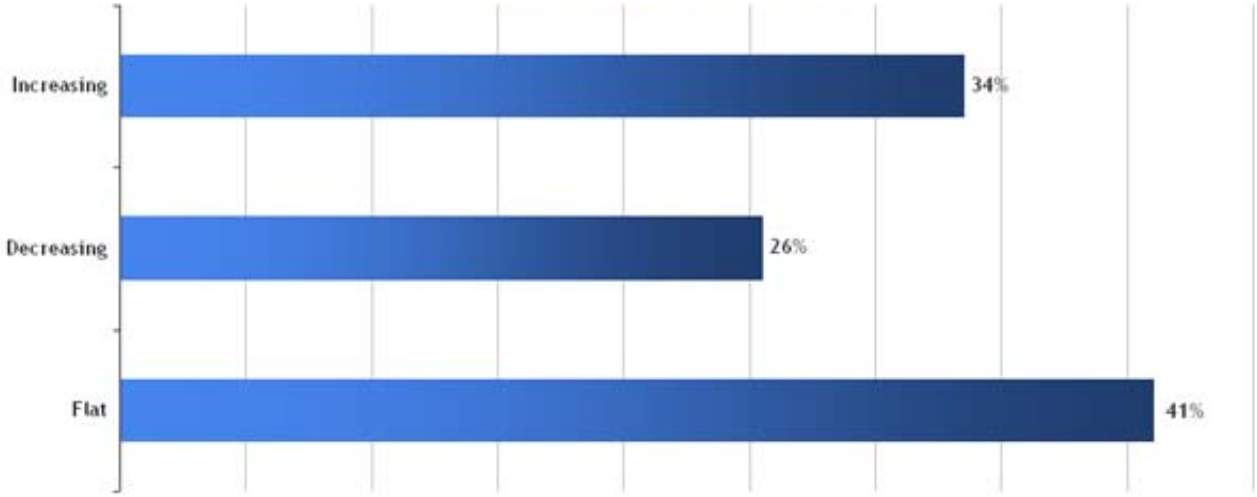
However, another consumer goods industry respondent said that "Increasing requests from customers for Vendor Managed Inventory and Direct-to-Store services will gradually increase piece-pick requirements over full case."

Another respondent noted the economy was causing his company to "to do inner case picking" rather than full cases.

Percent of Total Case Picks Using Pick-to-Belt by Level of DC Peak Case Volumes



Are Your Case Picking Volumes Increasing or Decreasing?



Case Picking Costs and Issues

Obviously, case picking costs and concerns will be tightly correlated to overall case pick volumes and the percent of case picking as a total.

Below, we show percentage of total DC order picking costs by volume of case picks among respondents. Every volume tier except the "under 5,000 cases per day" level reported that case picking represented more than 50% of total DC labor expense, with the highest levels (over 40,000 cases per day) seeing costs of more than 60% of the total.

We also wanted to measure the level of concern around case picking costs, as seen in the chart below.

41% of respondents said they had "high" levels of concern about case picking costs, versus 35% that had medium concern, and 25% that had low levels of concern (adds up to 101% due to rounding).

One 3PL operator managing a facility for a food company told us that "Labor or manpower cost is the second highest expense for us, due to the manual case pick operation. The highest cost though is warehouse rental cost."

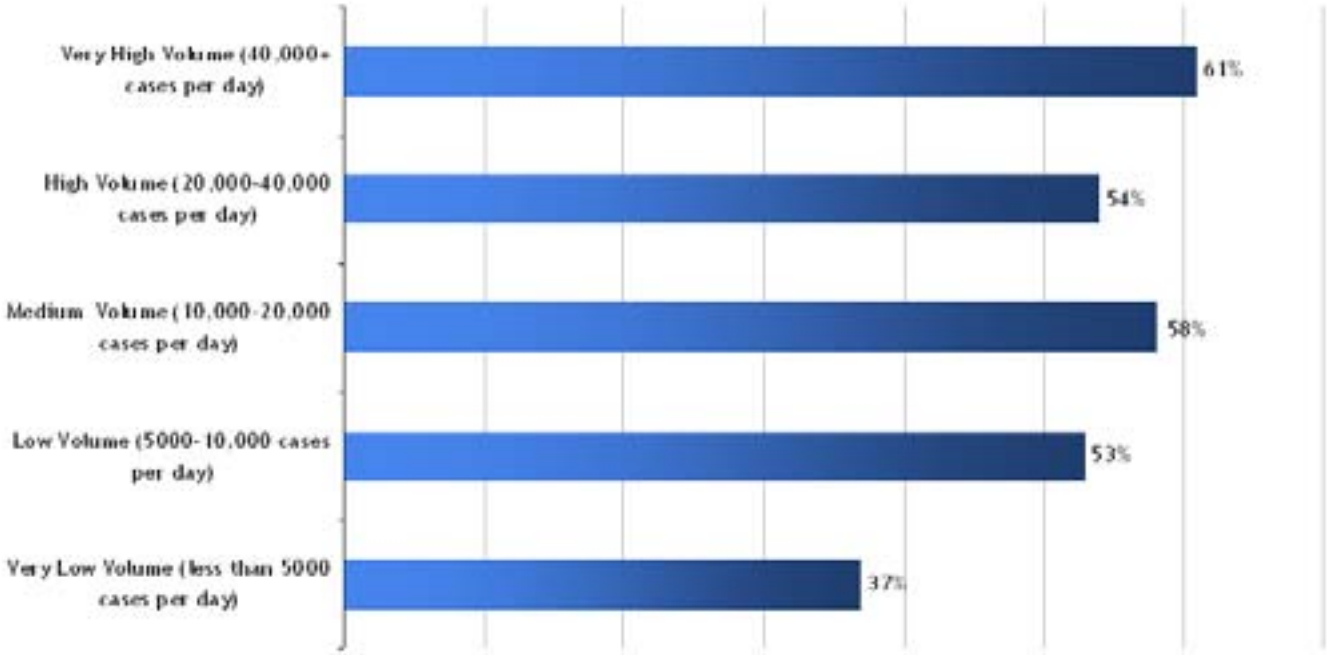
Another retail industry respondent noted that "full case picking costs have been stubbornly resistant to improvement, and are a major concern for us."

However, several respondents with high piece pick volumes noted that costs in that area were currently of greater concern.

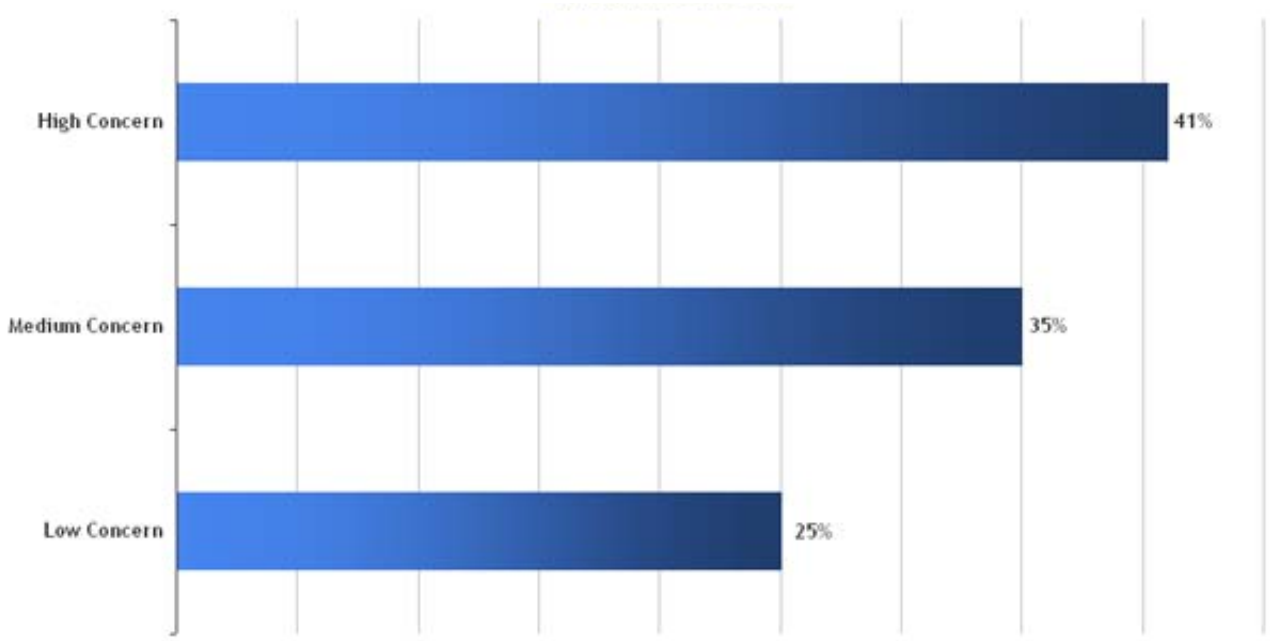
Another respondent from the pharmaceutical industry said that "Although we are very efficient at picking loose cases, the costs are still a concern and we would like to automate if possible."

Another respondent from a consumer products company noted that "cost" can be measured in several ways – including the toll on workers.

Case Picking Costs as Percent of Total Picking Costs by Case Pick Volumes



Case Picking Costs Versus Other Distribution Costs



"The biggest cost we have is employee capital, meaning wear and tear on the body, which we are working very hard to minimize," he said. "We have reduced the weight of case picking by 40% using robotics and lift assist devices."

Not surprisingly, the concern over case picking costs was even greater for those DCs with medium to high case picking volume, which we defined as more than 20,000 cases per day at peak.

As seen in the graphic, 51% of respondents from that group had a high concern over case picking costs, and another 29% had a medium level of concern.

The data was similar for the level of concern about accuracy and inventory management in case pick processes.

43% of respondents rated such concerns as very high, versus 17% that said they were of medium concern, and 40% who said they were of low concern.

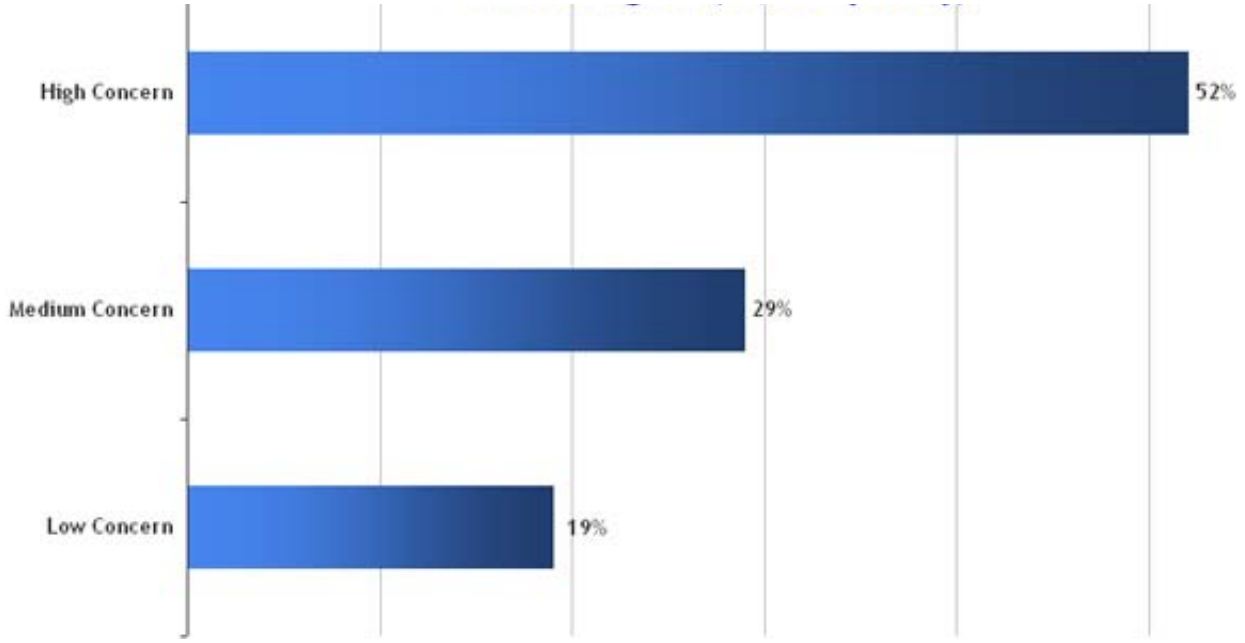
"We have much more accuracy issues in the piece pick area," one consumer goods company noted.

However, a respondent from the food industry referred to the practice of "count back," which many companies in that sector employ when they have 3PLs running the DC. In "count back," a picker does a fast cycle count after each case pick is complete to substantially reduce inventory and shipping errors in full cases picking – even at the cost of some productivity loss.

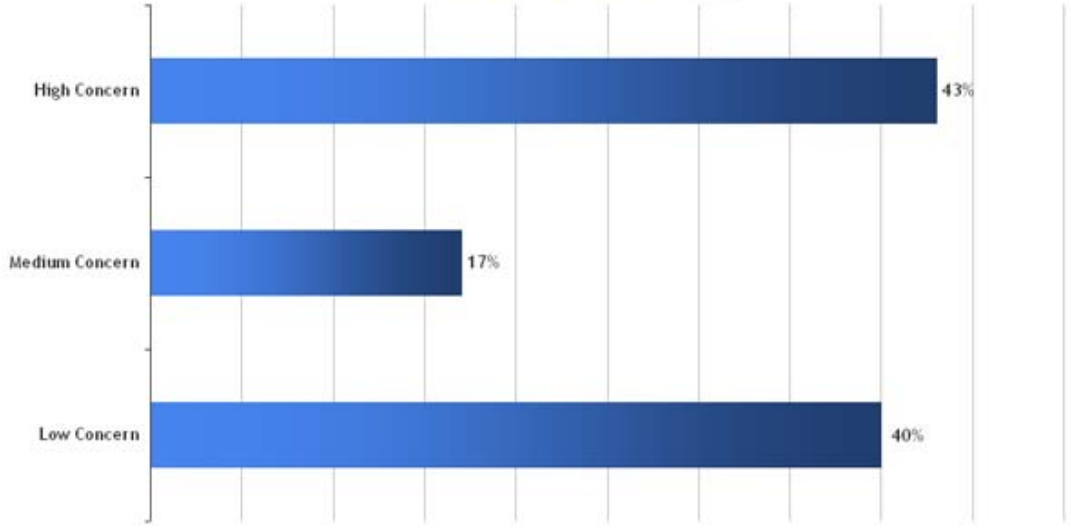
"Would we say case pick accuracy is a concern for us? With count back it clearly is," the respondent said.

Another retail industry respondent noted that "full case picking costs have been stubbornly resistant to improvement, and are a major concern for us."

Case Picking Costs Versus Other Distribution Costs for Medium-High Volume Case Picking DCs (20,000+ per day)



Accuracy and Inventory Management Issues Related to Case Picking



Interest in Case Pick Automation

Clearly, there is strong interest among companies in new technology to automate case picking.

As seen below, a combined 40% rated their interest in case picking automation as either high or fairly high, versus 33% with only a modest level of interest, and 27% with a low level of interest.

Given the range of case pick volumes, we think this data all told indicated a very high level of interest.

"We have been patiently waiting for new developments in this area," one VP of Logistics for a wholesaler told us.

One modest surprise from our one-on-one interviews: the potential for the so called "Card Check" legislation and the impact it might have on unionization of DCs is already a real driver of interest in case pick automation.

One food wholesaler told us that "We have not invested much in automation anywhere in our DCs to date, but if Card Check happens and we are facing potential unionization, our interest in this type of technology would increase substantially."

Another retail respondent said that overall labor and demographic concerns are important factors.

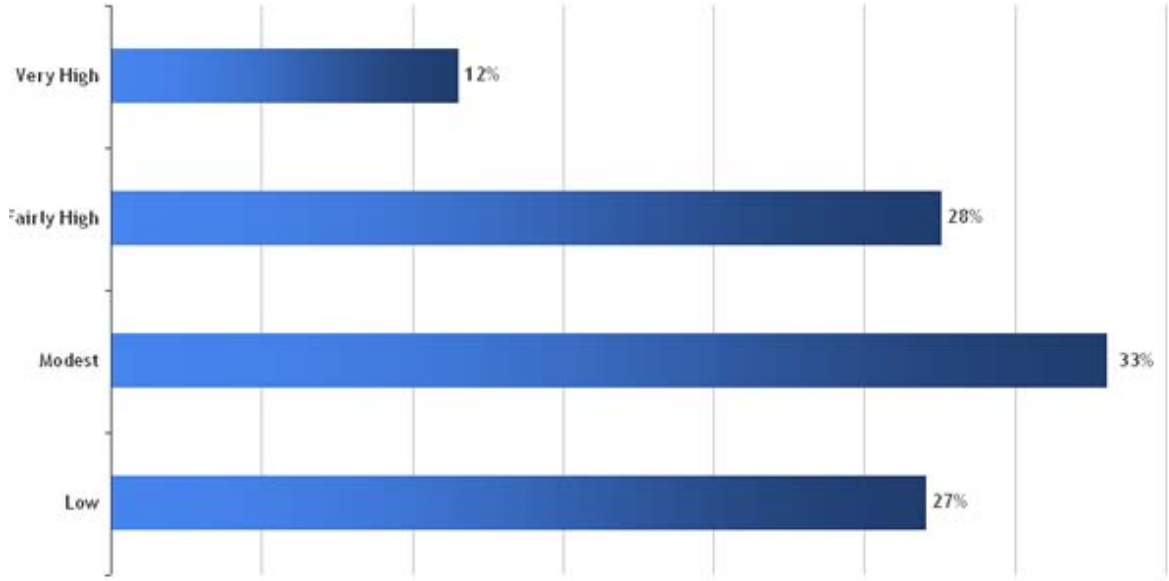
"We have many more labor headaches today than we did 10 years ago, and see a changing workforce with even more turnover," the respondent said. "So across the board we are relooking at automation, and we have heavy case pick volumes."

Not surprisingly, interest in case pick automation is even higher for companies with heavy full case pick volumes.

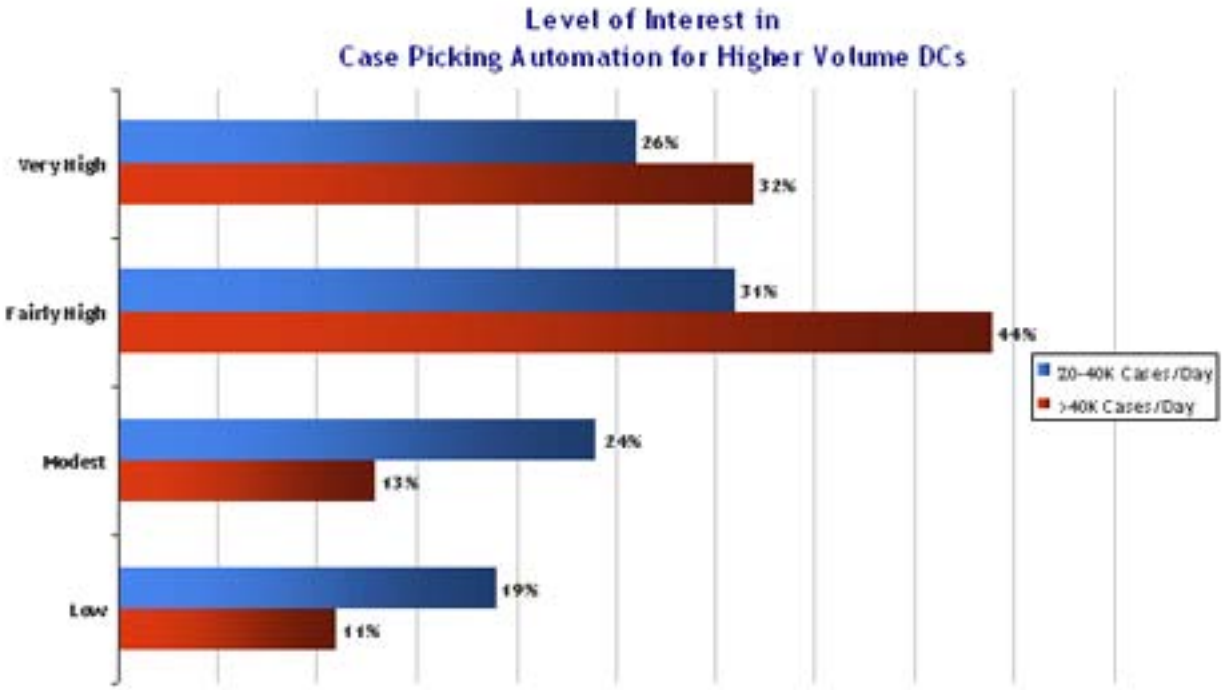
A remarkable 76% of DCs doing more than 40,000 full case picks per day had either a high or fairly high level of interest in case pick automation; that number is 57% for companies with DCs doing 20,000 to 40,000 full case picks per day.

"In the end, we will have to evaluate our costs and may choose a solution that has the potential to demonstrate the highest cost effectiveness in driving efficiency, reducing manpower, and eliminating picking errors or pilferages," one executive from a large wholesaler/retailer with a "very high interest" in case pick automation said.

Level of Interest in Case Picking Automation



Level of Interest in Case Picking Automation for Higher Volume DCs



What Are the Barriers?

What would be the barriers to adopting next generation case pick automation? Of course, the potential lack of ROI is the number one barrier cited by our survey respondents, with 73% of respondents noting that as a potential issue.

"We are very interested in potential new solutions, but don't well understand the level of investment required," one respondent said.

Relatedly, 47% of respondents were concerned that they simply would not have enough volume to justify investment in case pick automation.

19% said they were concerned that such automation simply wouldn't work with their products or processes – a common concern for almost any type of DC automation.

"Our case sizes are highly varied and change frequently," one consumer products company respondent said.

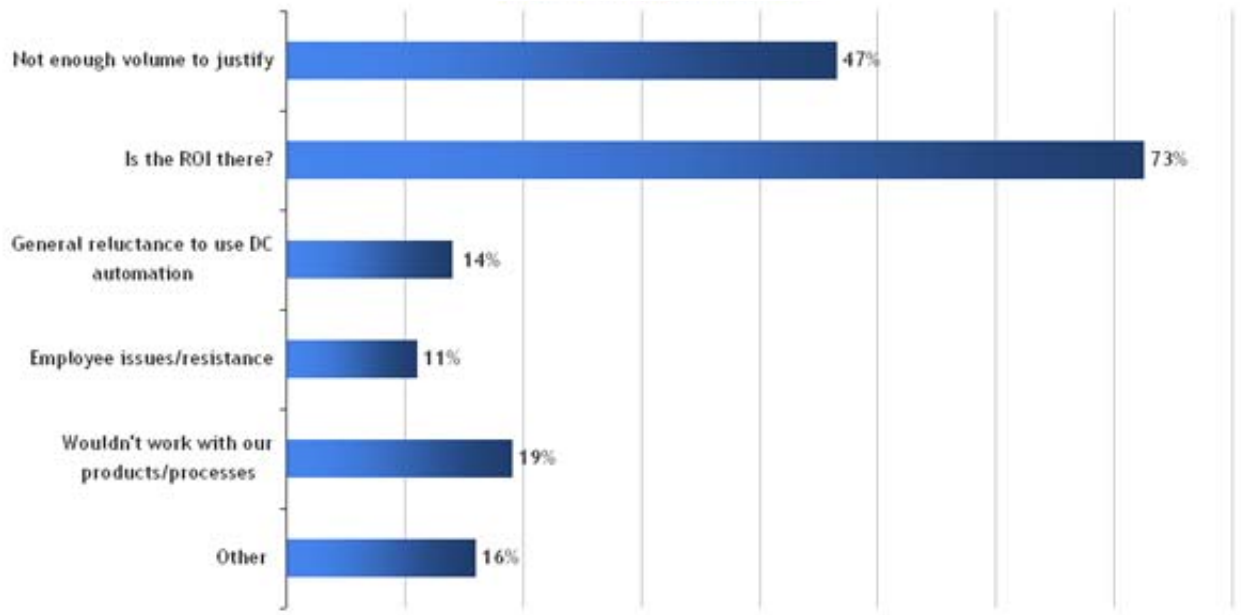
14% said that historically, there has just been a general reluctance to invest in DC automation, and 11% were worried that there might be issues with employee acceptance of such new technology.

16% cited other factors, including one we had not really considered – the increasing variable requirements for retail compliance labeling, an issue that SCDigest has subsequently done quite a bit of research on. The biggest issue is around variable requirements for placing labels on the case – which at its worst could make it much more difficult to handle in an automated case pick environment.

Others cited such issues as their current DC building potentially not being well suited for such automation, concerns about flexibility over time, and how reliable such a system would be (up-time).

It is of course to be expected that potential customers will have such concerns – and it is incumbent upon automation vendors to address in their solutions and communications with prospects how well their systems can overcome these perceived or potential issues.

Areas of Potential Concern about Case Picking Automation



Summing Up the Data

The distribution market in both the US and globally is a giant and complex set of companies, processes, volumes, potential solutions, and concerns.

We believe that overall, however, there does appear to be substantial interest in new solutions that can automate case picking – and many companies with substantial case pick volumes that might have an excellent shot at significant returns from such an investment.

The percent of respondents, especially at the upper end of the volume curve, that expressed either high or fairly high interest seems strong to us. At the same time, especially in the one-on-one interviews, it was clear that the potential for DC unionization via something like Card Check, and growing concerns about DC labor issues generally, were causing an increasing number of companies to look or relook at DC automation.

"We pay some of the highest wage rates in the industry, and we still have very high turnover rates," one DC manager in the Los Angeles area for a major food company told us. "We were never that big on automation before, but now we look to automate first, and only don't go that route if we just can't or the ROI is simply lacking. But the ROI is becoming increasingly attractive in general due to the labor issues we face."

The potential concerns over case pick automation aren't surprising, and frankly are not much different than those that have been common in the past for other types of distribution solutions.

System providers should take heed to well address these concerns, however, especially those around flexibility in this increasingly dynamic logistics environment.

The great news is that there are a number of different approaches to case pick automation. That means there will be different solutions that have attributes that will make some of them more suited to a given company's specific needs and challenges. It also means companies will be able to balance more trade-offs among different solutions, and potentially pick one where the investment/return/risk curve fits best for them.

In the next section, we overview the major categories and types of these new automated case picking solutions.

Understanding the Case Picking Solution Landscape

As noted above, there are a number of different technologies for automating some aspect of the case picking process, each with its own approach to solving the problem. While "robotics" of some type are at the heart of many of these, that is not always the "case" – though it may indeed be the future for many distribution centers.

As mentioned in the introduction, to a large extent many of the basic technologies and approaches in this new generation of case picking solutions have been around for some years. However, recent advances in both the software/computing area and in the physical "dexterity" and flexibility of these technologies have substantially changed the ACP game and made such case picking solutions much more attractive and viable.

To help explain the different options and how they fit, below we use a simple diagram to illustrate the basic steps of the case picking process.

Step 1: The storage system or picking area must be "charged" with inventory and replenished over time.

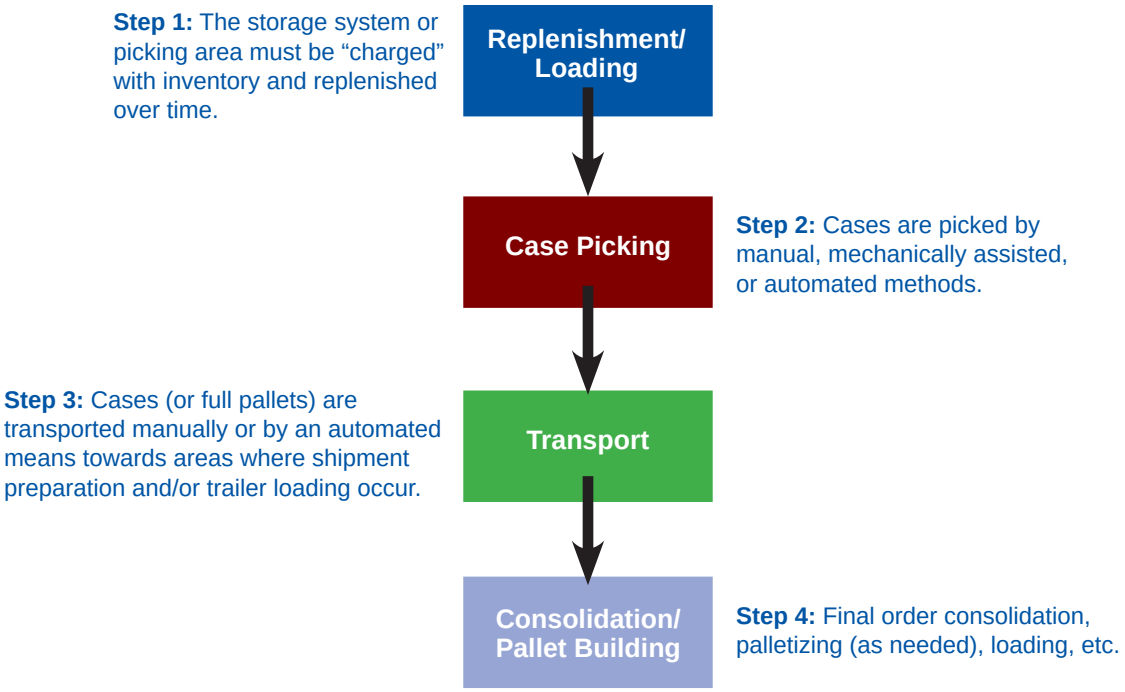
Step 2: Cases are picked by manual, mechanically assisted, or automated methods.

Step 3: Cases (or full pallets) are transported manually or by an automated means towards areas where shipment preparation and/or trailer loading occur.

Step 4: Final order consolidation, palletizing (as needed), loading, etc.

Of course, there are many nuances and permutations of these basic steps, but this simple process will be useful enough for this analysis.

Simplified Case Picking Process



Why is this important? For several reasons. First, how some or all of these steps are handled in each type of ACP solution can vary – sometimes dramatically. In some solutions, all of these steps are directly prescribed or envisioned – in others, only some of the steps are directly addressed.

Also, it is interesting to consider that in a highly manual case picking environment, the order selection and palletization processes are often combined. An order picker on a pallet jack or order picker truck may not only pick the full cases required for an order, but then deliver a ship-ready pallet for shrink-wrapping and shipping. (In other DCs, especially those that use some form of zone case picking, picked pallets may need to be consolidated before shipment.)

Therefore, in this report we also include mix-SKU case palletization as part of the potential solution set, even if it happens "after" case pick selection.

It is also important to note that we are including what we might consider "mechanized" rather than more fully automated systems. This is for two reasons. First, the term "automation" has been used for many years for systems such as batch pick-to-belt with downstream sortation, and indeed, after picking, such systems do automate the transport and consolidation steps of the process, even if the case picking is only mechanically assisted to a degree (e.g., use of the pick belt).

Second, these more mechanized solutions have enjoyed widespread adoption and are certainly among the potentially attractive options, in addition to more fully automated systems, for companies that want to improve total case picking productivity and throughput.

Below, we organize the mechanized and automated case picking solution space, roughly in increasing order of automation. At the end of each section, we provide a short summary of the general pros and cons. Please consider, however, these are high level and very generic, and may not apply to your specific situation, and that the "cons" can often be reduced/eliminated by clever system design.

Traditional "Mechanized" Case Picking with Auto Sortation

While there are many variants to the basic concept, case pick-to-belt with downstream sortation has been a mainstay of the materials handling industry for decades and has been deployed in hundreds or perhaps thousands of distribution centers.

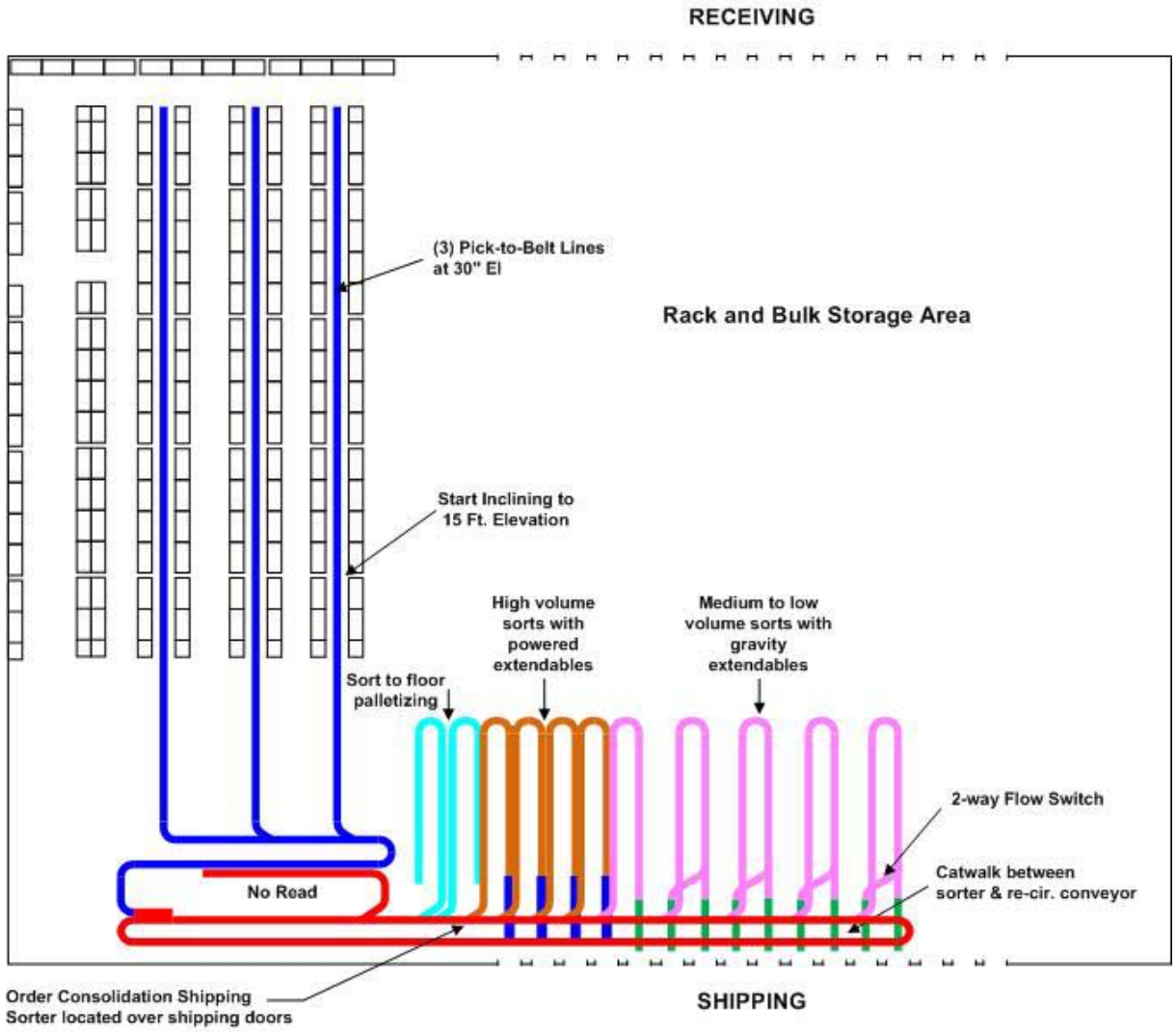
In most deployments, the fundamental concept is to improve the "case picking" process by adopting some form of batch order picking. That is as opposed to traditional discrete order picking systems, in which associates pick at an individual order level, with each picker visiting a picking location separately for each order line.

With batch picking, orders are combined, often in a "wave," but increasingly with a more continuous form of order release. All the picks within that order wave/block are combined, with a picker directed (usually by a Warehouse Management System) to go to the location one time, and pick all of the cases for that product needed across orders. This generally happens with a "pick-to-belt" approach, in which the picker puts the picked cases on a conveyor, which transports them out of the pick area for eventual merge onto the sortation conveyor itself. There, it will be combined with cases coming from other areas, such as "split case" picking, as necessary.

By enabling pickers to visit a location just one time per wave or other picking period, case picking labor costs can be significantly reduced. The sortation system does the work of separating the product back into discrete orders. Sometimes, the cases flow directly into a truck (such as for parcel shipments or dedicated dock doors, as is sometimes found in retail); more often, the product is palletized for shipment at the end of the divert lane.

Companies considering more automated case picking can start with this approach as something of the default, and compare alternatives to this well understood and proven solution.

Example Case Pick-to-Belt with Auto Sortation System



Pros of Pick-to-Belt Systems:

- Highly proven/understood/mature solution
- Can usually scale manpower used up and down to manage changing volumes
- Relatively scalable

Cons of Pick-to-Belt Systems:

- Uses manual pick methods
- Operational issues sometimes lead to under utilization of equipment
- Pick face replenishment can be an issue

AGV/Mobile Robot-Based Case Picking Solutions

Automated Guided Vehicles (AGVs), a form of robot in a sense, have been around for decades, and are generally used to automatically transport full pallets/ unit loads, especially in manufacturing.

Now, a new generation of AGVs has come to market with flexibility improvements that make them much more suitable for distribution center deployment (working alongside workers on the floor), including case (and piece) order picking (as well as basic transport functions in a DC). These advances include

much more sophisticated controls, allowing flexible and dynamic movement paths, and in some cases "optical" guidance systems that enhance flexibility and safety.

This new class of automation really should be considered a more "mobile robot" than AGV, though they share a heritage.

Below, we look at two options for use of AGVs/ mobile robots to automate the case picking process.

Product-to-Picker Systems

One way AGV/robot-based case and piece picking works is by bringing pallets of product to workers for case (or piece) picking, as described below:

1. AGVs/robots pick up full pallets of product from some staging point and return to a dedicated picking area of the DC.
2. Order pickers, meanwhile, are placed at stationary workstations where the case picking will be performed. They would normally have several pallet positions at each station.
3. Based on orders and likely pre-determined pallet build sequences, the AGVs/robots deliver the full pallets to the workstations. Pick instructions delivered via a display, voice, etc. are given to the operator, who places the requested number of cases for that SKU on each pallet in the station requiring them. This implies batch picking across orders is being performed.
4. After the picks are complete, the AGV/robot either moves on to another station requiring picks for that SKU, or returns to a stationary position until that SKU is required again. Generally, that is close enough to workstations that the travel time to each station is minimal.
5. When a mix-SKU pallet is complete, it is moved on to staging/shipping, potentially by another AGV/robot, or conventional fork truck.

Though this type of system still uses manual case picking, the approach eliminates order picking travel time and fatigue versus say a pick-to-belt system. Additional features in the work station displays can also improve case picking accuracy.

Pros of Product-to-Picker Robot-based Systems:

- Eliminates worker travel
- Increases picker productivity
- Reduces labor costs, worker fatigue and injury
- Supports batch picking
- Easy to pilot and start incrementally
- A ready-to-ship pallet is created, requiring no sortation or further palletization

Cons of Product-to-Picker Robot-based Systems::

- Manual picking still required
- New applications with relatively few implementations to date

Picker-to-Product Systems

Another opportunity to use AGV-like technology in support of case picking is to use AGVs or what some call a new generation of "mobile robots" as vehicle support for case picking, rather than manual or motorized pallet jacks. This is enabled by the new, more flexible technology in terms of movement paths than traditional AGV systems.

In this application, the worker manages one or more of these mobile robots in order to complete a wave or batch of orders. The robot (or several robots assigned to one picker) automatically moves along with the operator down the case pick aisle, where the picker will select the order cases and place them on the robot's pallet. This process continues throughout the remainder of this order's pick path.

This automated vehicle support increases productivity by eliminating the need for the picker to get on and drive the vehicle when there are short distances between picks. This approach simply uses existing

"Now, a new generation of AGVs has come to market with flexibility improvements that make them much more suitable for distribution center deployment... including case (and piece) order picking..."

technology and process flow, so the scope of the change is minimal.

For example, as indicated earlier with "hands free" voice picking, workers can still be directed through the order picking process via the Voice solution or RF solution (driven by the business flow of the WMS), and the robots provide the batch order pallets for completing the orders.

Further, such an approach enables a completed mix-SKU pallet to be automatically delivered to shipping by the robot, enabling the picker to employ another robot from the last pick stage and return to picking activity immediately, without needing to deliver the picked pallet to the loading dock. Savings with this methodology include increased productivity, reduced travel time and reduced labor costs.

One interesting application of robot-based picking is the employment of a zone-based picking model, where the robots are sent throughout various pick locations based on orders assigned via the WMS. The unit would navigate the pick path based on the optimal path determined by the robot control system and would arrive at a "zone" where a picker would pick and place the cases on the robot's pallet.

In this example, the pickers manage "zones" of pick faces in the warehouse and are directed (via voice or RF) to pick the proper item/quantity to the correct order pallet. The robots travel on their own, and dedicated zone pickers complete the picking activity. After picking, the robot then transports the pallets either to a shrink wrapping machine and/or outbound shipping. This application is similar to a pick-to-tote on a conveyor belt process application utilized in many case and piece pick environments.

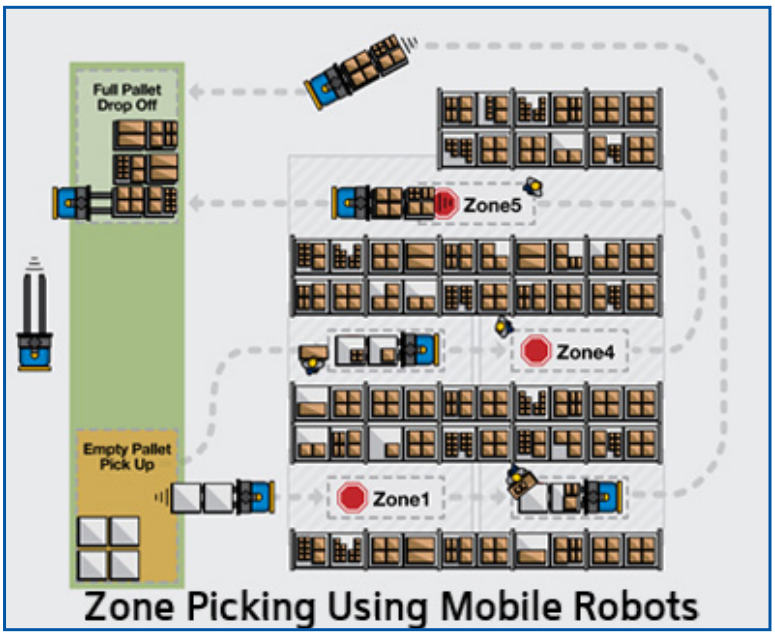
In this new application the robots can be thought of as a "flexible conveyor" that provides the transport while pickers can be focused on pick productivity within a defined (zone) area. Expectations for this application are increased picking efficiency, reduced travel time, reduced labor costs, and reduced worker fatigue and injuries.

Pros of Picker-to-Product Mobile Robot-based Solutions:

- Reduces worker travel time
- Increases picker productivity
- Easy to pilot and start incrementally
- A ready-to-ship pallet is created, requiring no sortation or further palletization
- Little DC process change

Cons of Picker-to-Product Mobile Robot-based Solutions:

- Manual picking still required
- New applications with relatively few implementations to date



Conveyor-Based Automated Case Picking Systems

Several types of automated case picking solutions largely use traditional conveyor principles, but more fully automate the picking process than pick-to-belt systems. We classify this category into two primary types: horizontally-oriented systems and vertically oriented systems, as described below.

Horizontal Order Release Systems

What we call the "Horizontal Order Release System" for automated case picking has actually been available for many years, and enjoyed some popularity, especially in the grocery industry, as far back as the 1970s. However, operational concerns, especially around replenishment and product damage, caused the concept to subsequently fall out of favor.

Improved conveyor engineering and controls, however, have again made the Horizontal Release approach of interest to many distribution operations.

The concept is fairly simple, actually, even though it can involve a substantial amount of hardware to get the job done.

One such approach is illustrated in the example nearby.

At the heart of this system are perhaps hundreds of conveyor lines, at any one time each dedicated and "charged" with a specific full case SKU. These conveyor lines can be thought of in a sense as being conceptually similar to carton flow racks, but in practice gravity flow or low-pressure accumulation conveyors are used.

An additional "module," with an equal number of lines, can be added above the floor-level system either initially or at a later date to increase system capacity or the number of SKUs handled.

Each lane might be about 30-feet long and hold 20 to 30 cases. Stacked in levels with about 30 inches between them, the system provides very dense storage of thousands of cases.

To fill the SKU lines, pallets of product are de-palletized either automatically or manually; however, the justification for automatic de-palletization in such a system is usually very high.

After de-palletization, cases are transported via conveyor to a sorter that is behind the full case SKU

Example Horizontal Order Release System

1. Goods Receipt
2. Pallet Storage
3. Automatic De-Palletization
4. Input Lanes
5. SKU Conveyor Lanes
6. Output Lanes
7. Sorting/Shipping

lines, which sends cases into their appropriate SKU position.

Based on order requirements from a WMS, cases are released from the lines, generally again in "batches" across orders. Typically the system uses a combination of gravity and drive motors to advance cases to the opposite end from where they entered the lane. "Picked" cases are released from the lane one at a time, which permits cases to be gapped properly and in an ideal SKU sequence. Heavier items can be released first to ensure they'll be positioned on the bottom of a pallet.

Typically, released cases would then be transported via conveyor to an outbound sorter, which would distribute them according to specific orders, after which they are palletized and shipped.

Overall, these horizontal systems are very similar to traditional pick-to-belt approaches, but automate the physical case picking process.

Pros of the Horizontal Release System:

- Relatively mature and proven concept
- Overall approach not dissimilar to well-understood systems
- Automatic case picking

Cons of the Horizontal Release System:

- Only for very high volume operations
- Entry point cost likely the highest of potential solutions profiled
- Requires relatively large footprint
- Potential low storage utilization

Vertical Cascading Order Release System:

A relatively new and intriguing concept, what we call a "Vertical Cascading Order Release System," functions like a giant vertical dispenser to automatically "pick" and release cases onto takeaway conveyors for downstream sortation.

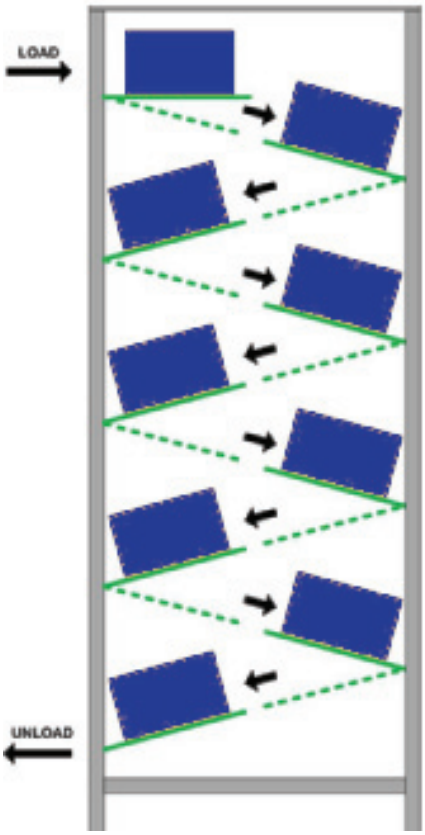
The key innovation of this solution is the design of vertical SKU "pick towers," which consists of short cascading trays or gravity flow conveyor sections.

The towers are loaded with product at the top, and (as shown in the illustration below) dispense cases at the bottom in any sequence required for customer orders and pallet building.

The pick towers consist of a series of short flipper (pivoting) trays or roller conveyor sections that raise and lower to accept and discharge cases. As the case enters the pick tower charge end (i.e., the top), the case is received in angled position and is stored in the flat position.

As the pick control system releases a case from the pick tower bottom level, the next pick tower level case tray pivots, allowing the cases to index (move forward) from the ready reserve level to the next lower ready reserve level or pick position. The next case from the same SKU tower or a case from the next required SKU pick tower on the customer's order will be released. These cases then travel on the shipping conveyor system from the pick area to the order consolidation shipping sorter.

Vertical Cascading Order Release System



The height of the pick towers is flexible, depending on needs and building design.

The towers can be filled and replenished either automatically, via a conveyor running across the top of the towers, or manually via operators.

This approach is conceptually very much like a full case pick module in a traditional pick-to-belt system, but with towers replacing pallet storage and the dispensing mechanism replacing the human order pickers.

After picking, the system and options would basically be identical to that of a pick-to-belt system.

Pros of the Vertical Cascading Order Release System:

- Basic design is very simple and reliable
- Very well suited to varying case sizes and weights
- Automates the case pick and potentially the replenishment process

Cons of the Vertical Cascading Order Release System:

- Relatively limited implementations to date, mostly in the beverage industry
- May require large footprint for fragile items or slower moving SKUs
- May not be suitable for fragile items

Gantry Robot-Based Automated Case Picking Solutions:

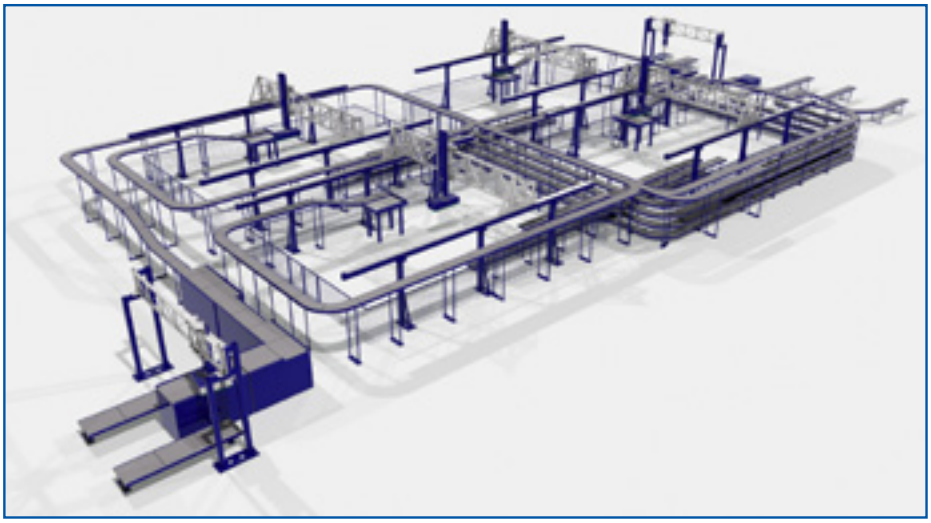
This category represents another very interesting and relatively new development in the area of automatic case picking.

In short summary, these systems involve use of a "gantry." For these purposes, we will define a gantry as a bridge-like structure which moves horizontally back and forth along a set of overhead tracks. Attached to the gantry are any of various devices capable of selecting individual cases or groups of cases – typically using some form of vacuum head. Picked cases are then delivered by the gantry to a takeaway conveyor for sorting/shipping (see illustration below).

As this approach is very different than what distribution managers are used to, we thought it would be good to walk through one potential design/example, using the illustration of such a system on the next page.

1. In this example, a lift truck first delivers replenishment loads of SKUs for upcoming orders to an automatic case de-palletizing station. As the cases are stripped from the pallet, a conveyor system transports them to a dedicated area of the conveyor at the end, from which they will be grabbed by the gantry.

Example Gantry Robot System



2. The gantry robot picks up, transports and stacks cases on the warehouse floor in tight, discrete SKU columns, which creates a temporary "active" inventory location. This is necessary to position and align the cases very precisely for subsequent picking.

3. Based on customer orders, the gantry then rapidly selects one or multiple cases from the active area, and deposits them on a takeaway conveyor. Using the control system software, the cases can be selected and delivered in exact pallet building sequence.

4. Cases are transported for palletization, which can be manual or automatic. Because cases are delivered in sequence, with a high level of throughput, the system lends itself well to automatic palletization.

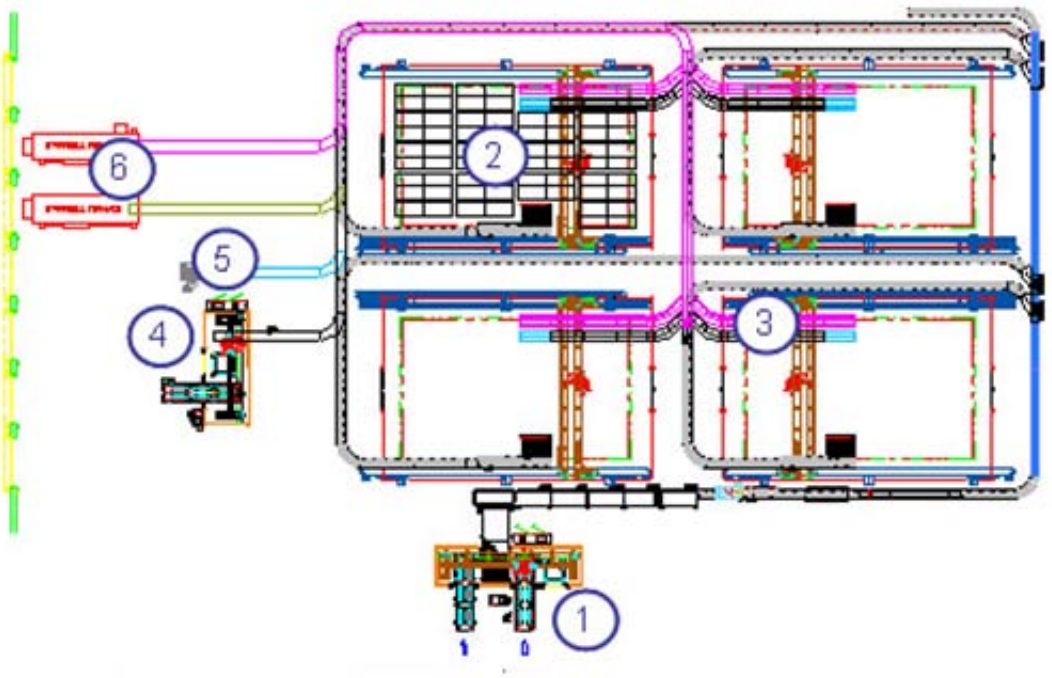
So, let's review again what is happening here. Full pallets are stripped, and the cases repositioned on the floor by the gantry system in very dense storage, with near perfect case alignment that is tracked by picking system software.

At high speeds, the gantry then selects cases from this active area in order/pallet build sequence, and delivers them to a conveyor for takeaway and palletization per order.

In a sense then, this "active" storage area can be thought of the same way as any dedicated full case pick area that is replenished from reserve and then picked from using traditional manual methods. With this solution though, that storage is very dense, and the case picking is automatic.

Our diagram shows four "pods," each with its own gantry, but a company could start with a single pod and expand over time.

Potential Picking Flow with Gantry-Based System



(1) Goods receipt/de-palletization
(2) Active inventory zone
(3) Outfeed conveyors
(4) Palletizing robot
(5) Manual palletization
(6) Fluid Loading

Pros of the Gantry Robot-Based Automated Case Picking Solutions:

- Very automated case picking
- Relatively small footprint requirements
- Flexible layouts
- Highly scalable/incremental

Cons of the Gantry Robot-Based Automated Case Picking Solutions:

- New sort of paradigm that will require a different mindset
- Relatively few implementations to date
- May not be suitable for cases with weak bottoms

AS/RS-Based Case Picking Systems

Automatic Storage & Retrieval (AS/RS) systems in general have been around for several decades, generally used to manage full pallet loads. Here we look at two types of these systems: the traditional mini-load AS/RS, a category which has seen significant improvements in recent years, and a new type of AS/RS-like system we call a "Crane-less AS/RS."

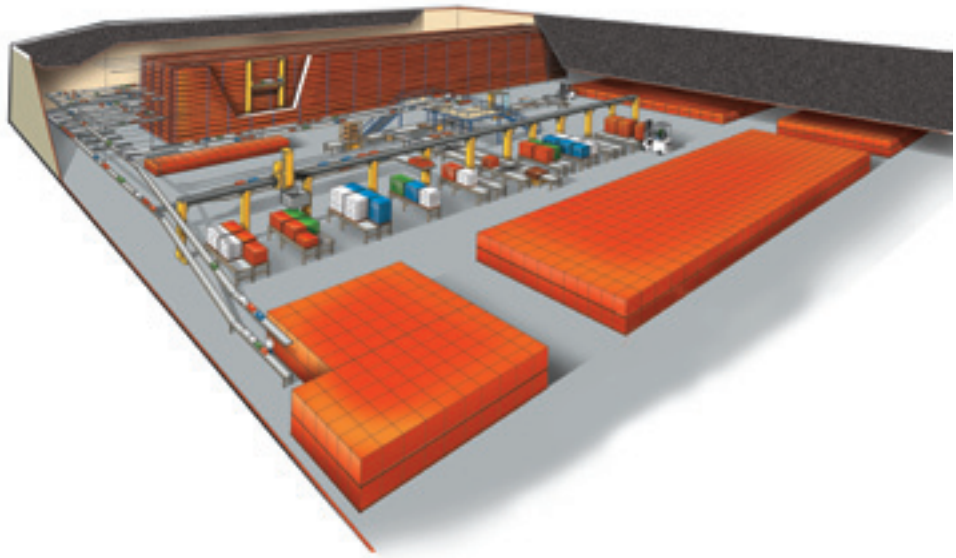
So called "mini-load" AS/RS systems that could deal with smaller load sizes have also been around for years, but in general were primarily used in niche applications, often in manufacturing environments, rather than in distribution. Frequently, the load unit was a standard container, such as a tote or tray. Example applications include bringing parts to manufacturing work cells or repair centers.

While there have been advances in the speed and flexibility of traditional mini-load AS/RS systems for case picking, the relatively large upfront cost of these systems and relatively low throughput capacity has in practice meant that their deployment in distribution applications has been minimal, though certainly there are some examples.

The good news is that there have recently been some major advances in design, engineering and controls that have substantially changed the profile of AS/RS-based systems and made them much more applicable for distribution center environments and case picking applications.

The illustration below shows an example of a Mini-Load AS/RS system integrated with upstream picking systems and downstream automated or semi-automated palletizing systems. Such Mini-Load case picking systems can be especially effective for "B and C" movers.

Integrated Mini-Load AS/RS



One More AS/RS-based Option

We will also note that there have been a few implementations of another version of AS/RS based case picking, mostly in Europe, in which the crane automatically moves a human order picker in some type of "cage," to a series of full pallet storage locations for case picking.

Finally, AS/RS-based solutions are sometimes also used not for final case picking, but to deliver full cases for downstream piece-picking activity, either as the only function performed or as another function in addition to case picking for customer orders.

Pros of Mini-Load AS/RS-Based Picking Systems:

- Basic concept is mature and well understood, with recent improvement for case picking
- Fully automated case picking
- May be good for delivering cases for piece picking activity
- Replenishment can be handled on off-shifts

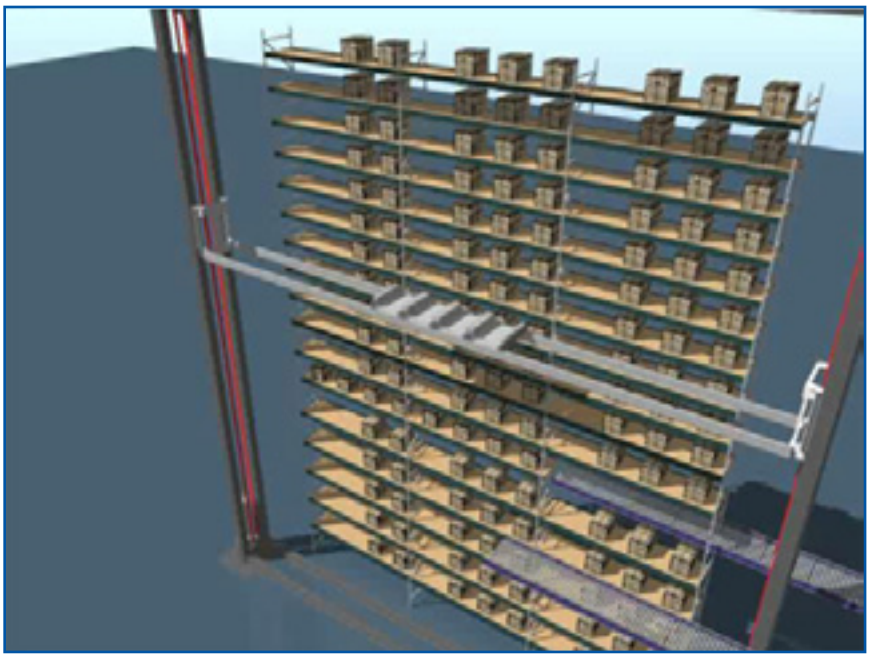
Cons of Mini-Load AS/RS-Based Picking Systems:

- Not many implementations in high volume case pick applications to date.
- Can be good alternative for dealing with many medium and slower moving SKUs
- Replenishment may be an issue for some
- Generally not good for fast-moving SKUs.

Case Sequencing Systems

Recently, some material handling solution providers have taken a new approach and adapted traditional AS/RS technology to provide a cost effective means of sorting and sequencing cases in high volume environments. While not case picking solutions per se, as any of a number of methods can be used to actually pick the cases, the systems can play a key role in case picking automation by allowing a random stream of picked cases to be buffered and re-sequenced to support automatic or semi-automatic palletizing applications.

Case Sequencer



For our purposes, we will call them Buffer/Sorter/Sequencer (BSS) systems, with Sequencer Systems as shorthand for the approach.

In a sense, these systems can be thought of as another form of "sorter" that has many advantages over traditional sorters in terms of pallet building and high volume case handling operations.

These systems have Mini-Load AS/RS concepts at their roots. However, unlike an AS/RS system, sequencing systems are more focused on speed and therefore have limited storage capacities – which can also reduce equipment costs.

Their primary purpose is to buffer a select volume of cases and retrieve them in a precise sequence. The sequencing machines provide selective access to each individual case within the buffer, which makes them an interesting alternative to the traditional conveyor/sortation based systems in mix-case palletizing applications where precise sequencing of cases is critical.

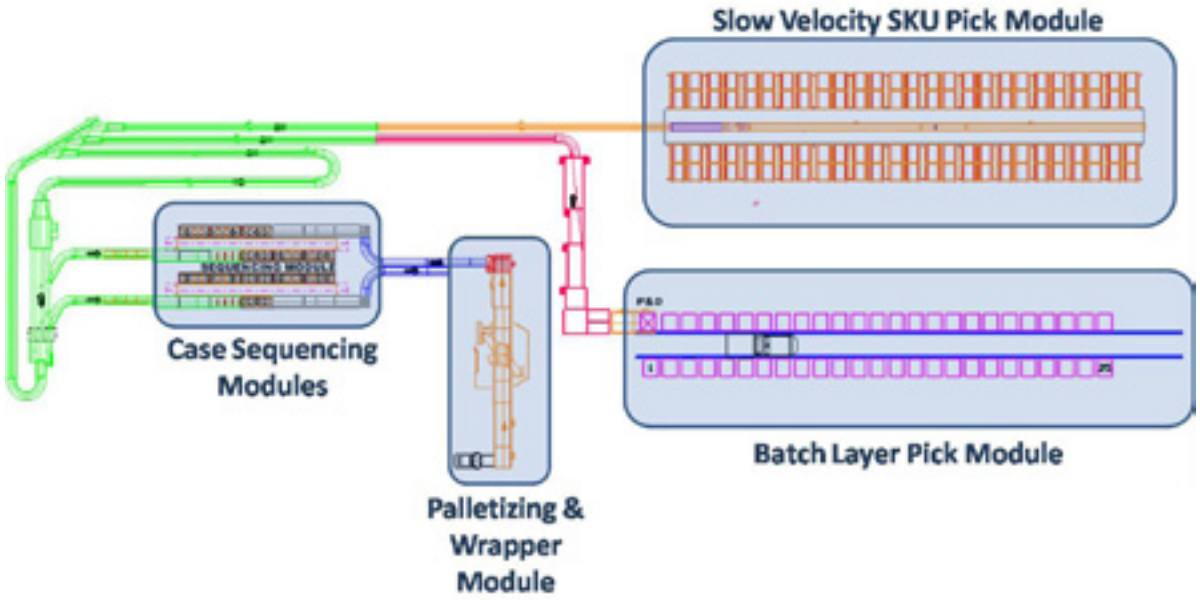
A typical sequencing machine is configured along the same principles as the Mini-Load AS/RS but at a substantially lower cost. It does not use traditional cranes that move up and down the length of the module. Instead, these systems use two stationary masts to support a horizontal beam that moves vertically up and down to access various levels of the rack structure. The beam supports a number of case extractors that can put away or pick individual cartons to/from the rack.

To charge the system, cartons are picked using whatever approach makes the most sense given SKU profiles and velocities, with batch picking being the norm. The random stream of cases are singulated, identified (based on bar code scans or RFID), and stored in the sequencing buffer. The cases are then picked and delivered to the palletizing station in the required order.

The diagram on the previous page is an example of a case sequencing machine being fed by a combination of manual pick-to-belt and a layer picking device.

The versatility and case handling characteristics of the BSS approach helps to reduce mixed SKU pallet building complexity by buffering product in a case storage module prior to releasing them to the pallet build operation.

ACP with Sequencer Module



In applications where pallet load stability is not an issue, cases are randomly presented to the robot one at a time to be placed onto the best possible position on the pallet, which is a lower cost solution.

Pros of Case Sequencing Systems:

- Basic AS/RS-based concept is mature and well understood, with recent improvement for case picking
- Much faster throughput than traditional mini-load systems
- Lower cost than traditional mini-load AS/RS systems
- Interesting alternative to traditional sortation systems
- Especially good for high volume SKUs and/or need for customer-specific mixed-SKU-pallets

Cons of Case Sequencing Systems:

- Not truly automated case picking
- Not many implementations to date
- Replenishment may be an issue for some

Automatic and Semi-Automatic Palletizers

As noted in the introduction, we are including the category of automatic and semi-automatic palletizers in the description of automatic case picking solutions for two reasons:

The full case picking cycle must include the palletization step, and use of automatic palletizers makes perfect sense in several of these systems.

The same robotic technology being used to palletize Mixed-SKU cases is also being considered for full case picking in some applications.

Automated Palletizers

For our purposes here, we are going to refer to a class of robots that do this job. As shown in the illustration nearby, these machines do look very much like a "classical" industrial robot, with a vertical profile and automated arms and case grabbers. Again, it is improved software controls and processing speeds, plus greater agility in the range of carton types and sizes the robots can grab, that has changed the dynamics with regard to using this type of automation in distribution.

Typically used at the end of a sorter divert lane, today's palletizing robots can optimize a given mixed-SKU pallet build and select cartons in the proper sequence for that pallet.

These robots are increasingly fast, and would generally be positioned between two divert lanes, working both of them. Today's robots can handle upwards of 600 cartons per hour.

If a company decides to invest in any of several of the options for automated case picking described in this report, they should definitely evaluate the return in cost and throughput from automating the pallet build process at the end of a highly efficient case picking system.

Pros of Automated Robotic Palletizers:

- Natural add-on to many of the other solutions
- Can reduce number of sorter diverts needed through gains in speed
- Can be considered for direct case picking in some scenarios

Cons of Automated Robotic Palletizers:

- Not directly a case picking solution, though it could be in some situations
- Especially suited for mix case picking from manufacturing lines

Semi-Automatic Palletizers

Substantially less expensive than fully automatic palletizing solutions, semi-automated palletizing machines are designed to reduce worker fatigue and eliminate potential injury from lifting and stacking cases onto shipping pallets. Typically, cases are delivered to the in-feed station of the machine via conveyors where an operator positions them on the ball caster transfer table forming a layer. Once a layer is completed, the operator pushes a button and the machine places the layer onto the pallet load and lowers the pallet so that the next layer can be built.

For customer specific, mixed case pallet loads, the operator forms each layer using pattern information displayed in 3D graphics on a monitor. Because the graphics are displayed in real time with the delivery of cases to the machine, the operator can see where each case goes when forming the layers. This feature greatly speeds-up pallet building productivity to achieve 800 to 900 cases per hour.

When completed, full pallets can be discharged automatically and replaced with an empty pallet.

Summing It Up

With the recent increase in options for automating the case picking processes, just getting your arms around the various types of available solutions is challenging – as we discovered ourselves.

In the introduction of this report we presented information that there is an entirely new generation of more truly automated case picking systems that has come to market. Older core technologies were too inflexible and too slow, and as a result simply did not provide the right return or contribute the value necessary for adoption by most companies. This new generation of products require another level of evaluation over the traditional methods used in the past for assessing distribution center automation.

No standard automated case picking classification scheme exists within the industry; the one developed for this report provides one scheme for organizing the different types of solutions by the primary distinguishing characteristics.

On the following pages are tables that offer a summary of the key attributes and features of the different types of solutions covered in this report.

Initially, we considered trying to add to this matrix some idea of relative cost of each approach, but soon abandoned that effort due to the fact that the specifics of each implementation are much more important drivers of system cost than the underlying technology approach.

In the next section, we offer some thoughts on how to evaluate whether any of these types of solutions are right for you, along with some of the most important evaluation criteria.

Before You Get Started

Companies that have an interest in automating the case picking process should assess their level of readiness for this level of process automation. Below you will find some self-assessment criteria:

Even after a carefully designed system is successfully installed and tested, managing the synchronization of manual activities that feed and are served by the system is critical to maintaining high utilization of the system.

Case Picking Method/Technology	Replenishment Approach	Case Picking Approach	Palletization Approach
Pick-to-Belt	Generally via lift truck or order picker truck from reserve storage	Manual, using AIDC technologies, and generally batch picking to a takeaway belt	Automated sorter delivers picked cartons by order to divert lanes; manual or automated systems can then be used (see Palletization Systems below)
AGV-based Systems: Product to Picker Approach	Systems access full pallets in dedicated reserve area	Pallets are delivered to stationary pickers, who remove quantities needed for one or more pallets. Picks can be indicated by displays/lights; can also be used as auto-replacement for pallet jacks	Generally, ship ready pallets are built during order picking
AGV-Based Systems: Picker to Product Approach	Mobile robots could be used to deliver replenishment pallets	Mobile robots provide automated vehicle support to workers in full case pick areas/zones	Generally, ship ready pallets are built during order picking; robots can then deliver pallets to staging.
Mini-Load AS/RS Systems	The AS/RS system replenishes storage locations using the same mechanisms as are used to pick cases; generally, just one case per storage location	Just as with a pallet-based AS/RS, a crane (or shuttle car) moves rapidly between locations, and picks cases, generally for delivery to a take-away conveyor	Manual or automatic palletizers; in some scenario, these systems are used to pick cases from which pieces are picked downstream
Case Sequencing Systems	The AS/RS system replenishes storage locations using the same mechanisms as are used to pick cases	More a system for case sequencing than true case picking, sequencing systems can work with a wide variety of upstream case picking methods; in effect, replaces a traditional sorter and/or automates mixed-SKU or customer-specific pallets.	This type of system is focused on "sequencing" cases in precise pallet build order. As such, automatic or semi-automatic palletizing is often justified.
Horizontal Conveyor-Based Systems	Manual or automatic depalletization charges SKU-specific conveyor lines	Systems release cases needed for orders, usually in batches, to takeaway conveyor that leads to an automatic sorter	Automated sorter delivers picked cartons by order to divert lanes; manual or automated systems can then be used (see Palletization Systems below)
Vertical Conveyor-Based Systems	After manual or automatic depalletization onto conveyor, system fills its own full case pick "dispenser" trays in pick "towers"	Electronic pick instructions cause the system to release cases, in almost vending machine fashion, to a takeaway conveyor; cases cascade from the top of the tower to lower level positions	Automated sorter delivers picked cartons by order to divert lanes; manual or automated systems can then be used (see Palletization Systems below)
Robotic Systems	Operators bring full pallets to auto-depalletization station; system then removes and singulates cartons onto conveyors; at that point, a "gantry" floor loads cartons into a special "picking warehouse"	Gantry selects one or more cases using vacuum heads and places them on takeaway conveyor, where they are transported to a palletizing area in pallet build sequence	Manual or automatic palletizers can be used, but system lends itself well to auto palletization
Palletizing Systems	Usually used at end of conveyor divert lane; when used for full case picking, full pallets need to be delivered to special staging area near robots	Selects cases from the end of a conveyor using robotics using a mechanical grabber/arm; cases are then placed by the robot on pallets	Automating the palletization process is what these systems do; if used for case picking, usually would build pallets as part of picking process

Case Picking Method/Technology	Recent Advances	Key Benefits	Incremental Implementation
Pick-to-Belt	Use of voice for hands-free picking; much higher speed sorters; better controls that reduces needed gap between cartons on sorter	Increased productivity from batch case picking	Generally by adding new pick modules with additional SKUs
AGV-based Systems: Product to Picker Approach	Significant enhancement in control logic to manage complex AGV moves; robot movement guided by optics rather than tradition, fixed path means (adds flexibility)	Eliminates picker travel time; enables batch picking; can also be used for piece picking; system manages it own replenishment	AGVs/SKUs can be added incrementally
AGV-Based Systems: Picker to Product Approach	Significant enhancement in control logic to manage complex AGV moves; robot movement guided by optics rather than tradition, fixed path means (adds flexibility)	Improves picker productivity; supports zone and batch picking; does not require major process change	AGVs/SKUs can be added incrementally
Mini-Load AS/RS Systems	Significant increase in crane speeds; much greater flexibility in extractors, arms, etc. to accommodate different case types	Fully automated picking; can replenish the system in off-shifts	Would generally add a new AS/RS area, with its own crane, to handle more SKUs
Case Sequencing Systems	This is a newer approach that can deliver higher throughput than mini-load systems - at a lower cost	Eliminates picker travel time; enables batch picking, sequencing for pallet build; system manages its own replenishment	Can start with a single module and mast system, add more over time.
Horizontal Conveyor-Based Systems	These systems have been around for many years; improvements in cost-performance now changing ROI picture for many companies	Is like a traditional pick-to-belt system, except automates the picking process	Generally, the increments would be large, such as a new level of pick conveyors
Vertical Conveyor-Based Systems	While such systems have been around in theory for many years, only recently have real, working systems of this type come to market, aided by software advances and improved system engineering	Fully automated picking; relative simplicity and highly reliable	Can add new towers over time, usually as a fairly large group (like a pick module)
Robotic Systems	While such systems have been around in theory for many years, only recently have real, working systems of this type come to market, aided by software advances and improved system engineering	Fully automated picking; low picking area footprint versus traditional pick modules; flexible layouts	Yes - could start with a single gantry, for example, and add more later
Palletizing Systems	Speed and flexibility of robot mechanics; software to optimize pallet construction	Eliminates manual pallet build labor and often constructs better pallets; may enable fewer diverts through improved pallet building efficiency	Easy to start with one robot and add more later

Criteria You Need For ACP:

1. **Can you define your materials handling problem well?** Designing an ACP system requires a clear definition of process steps, projection of activity rates, analysis of order characteristics and decision rules for choosing alternative processes. Ultimately, these process changes must be converted to precise control system logic and code. This step in the design process always takes much more time than one might think. But, it is an opportunity to get cross-functional alignment on how your business really operates.
2. **Do you have a repetitive primary process that is straight forward enough to automate?** Although it is possible to design an automated system that helps cope with highly variable processes and demands, it is generally far more expensive than one in which the same steps are repeated. Not all flows will fall into this, but most should.
3. **Can exceptions be integrated easily into the primary process?** Once you have an ACP system concept for the primary flow, consider small modifications to handle exceptional flows. When routing complexity or buffer requirements begin to add significantly to the cost and/or risk, handling these flows manually off-line should be considered.
4. **Do you have the time and skills to design the system and to manage its implementation?** Successful ACP systems require the dedication of a project manager and team. The time commitment will vary based on the system size and complexity, but could easily last for a year, or more. People who are capable of filling these slots are generally those who have been key players in the normal on-going operation, so their replacements must also be identified.
5. **Do you have the skills and discipline to manage an ACP operation?** Even after a carefully designed system is successfully installed and tested, managing the synchronization of manual activities that feed and are served by the system is critical to maintaining high utilization of the system.

Once you have answered those five readiness questions, there are two more considerations to take into account. Both relate to the actual system design.

It is imperative that the proposed system be sensitive to changes in your business. This is not easy. As hard as you try, predictions for the future will be off. As a result, any new system must be sufficiently robust to adapt to a reasonable range of variation.

The other consideration has to do with the system's capacity. How much is enough? Can you level the peaks by deferring or advancing work? Can you handle a portion of the peak off of the system?

Benefits You Should Expect From ACP

Clearly, the primary goal of any new ACP system will be to lower operating costs and to generate a solid ROI from the project.

You likely will also achieve a number of the following other types of quantifiable benefits:

- Increased throughput capacity
- Reduction in picking errors
- Better space and cube utilization
- Improved safety and lower workmen's compensation cost.
- Less congested work areas or perhaps improved quality of working life
- Less product damage
- Improved inventory security
- Improved inventory accuracy

In addition, other important but less recognized benefits might also be achieved:

- **Ability to respond to fluctuations in demand:** This relates to the system's ability to rapidly ramp up to satisfy peak demands and also adjust to reduced demand while providing high productivity levels.

- **Improved cost data capture:** An ACP system that tracks product thru the DC with greater accuracy will enhance management's ability to establish the "real" cost of storing and handling individual items.
- **Reduce order processing lead time:** ACP should significantly reduce order turnaround times.
- **Improve image and expand customer base:** An investment of this magnitude is often measured by how much improvement in market share can be realized by the buyer adopting a new state-of-the-art technology.
- **Reduced business risk:** Hard to define but, for example, the consequence of not investing in ACP if the competition does invest in it may be considered to be a business risk.
- **Reduced market risk:** Has to do with flexibility of ACP to handle changes in products and customer order profiles.
- **Improved communication:** ACP capacity to provide management with data that will result in improved decision-making.
- **Value of real time information:** ACP improves production control so that more effective management decisions can be made.

Criteria for System/Vendor Selection

Whether you are considering an automated case picking approach across solution categories, or evaluating more than one provider within a category, distribution managers must obviously find a way to organize the evaluation criteria.

Below, we offer a starting point by listing a number of the key variables or attributes that can differ across categories or providers. Some are obvious (such as total system cost), while others are more subtle factors.

- **Initial System Cost:** Hardware, software, implementation, building modifications, training, etc.
- **Throughput (cases per hour):** This can be tricky to calculate due to the incremental way systems can be implemented.
- **Supporting Labor Cost:** How much floor level labor will be needed to run and replenish the system, or in other work processes upstream and downstream from the new automation?
- **Process Complexity/Replenishment:** How complex will the system be to manage, especially around replenishment (an often overlooked factor).
- **Footprint Requirements:** How much floor space and vertical height is require and optimal (these are usually two different numbers)? You might also assign a cost to this space usage.
- **Changes Required to Existing Building:** Scope and cost of any building changes needed for each system.
- **Expansion Capability (ease and cost):** How "small" can you start, and how easy and expensive will it be to expand the system over time?
- **Maintenance Issues/Uptime:** What sort of system maintenance will be required, what are the skills required (can you do it yourself?), and what is the projected level of uptime?
- **Flexibility:** How will the system handle business changes, and varying carton sizes and weights?
- **Percent of Total Facility Volume That Potentially Could Be Handled:** The systems will likely vary in terms of how much of your total case picking volumes that they can handle, either physically or financially.
- **Proven Implementations:** How and where has each solution been implemented, both generally and within your industry or type of distribution model.
- **Power Consumption:** How much energy will each system use?
- **Safety:** Are there important differences in the level of safety and risk of injury between the different alternatives?
- **TCO and Total ROI:** What is the project total cost of ownership (TCO) over five years, and then what is the total ROI for each solution?

Of course, other criteria can be added, but we think this is a good list from which to start.

Closing Thoughts

Clearly, we are on the cusp of a new era of distribution center automation – and case pick automation will be at the forefront of this inflection point.

The sheer number of alternatives, the level of vendor R&D, and growing interest from logistics managers are combining to the point that we fully expect to see substantial interest and deployments of ACP systems over the next several years.

This report (which will be updated and released going forward on an annual basis) we believe for the first time has comprehensively organized these multiple and varied case picking solutions and technologies.

In conclusion, we think it is important to emphasize or re-emphasize several key points:

It is critically important to well consider your specific SKU and order profiles as well as operational constraints when considering potential case picking solutions. While there may be several options that can potentially work for you, thorough analysis will often point to one as the best fit for a given application. It is possible that a combination of technologies will be most appropriate for a given DC – for example, an automated layer picking system combined with something else for loose cases. Another possibility would be one approach for very high volume SKUs and another for slower movers.

Our one-on-one interviews confirmed that most companies are likely to look for outside help in evaluating and implementing these solutions. Do not assume, however, that even a highly experienced distribution consultant is well familiar with most or even any of the newer technologies – few are currently. The point is just that right now, you and most consultants will be starting largely from the same place. Keep that in mind and ensure you get exposure to a broad selection of alternatives.

As we have noted, many of these systems are possible today due to the sophistication of the control systems and related software. Be sure to fully understand and evaluate the software components of any solution, with support from the IT organization as required.

In many situations, the largest barrier to potential adoption will not be the technology or the cost or ROI, but rather psychological – can a company make the mental leap needed to adopt what may be substantially new process models, even if well proven in other deployments? Robots, for example, are commonplace in many manufacturing operations, but relatively new to distribution. Be ready to deal with the cognitive resistance.

For many, the distribution centers of the future will look much different than they do today. At long last, automated case picking is here – we encourage you to take a look at the possibilities.

RMT Robotics

RMT Robotics, headquartered near Toronto, Ontario with a global presence, has a variety of automated solutions for warehouses and distribution centers.

Using innovative and flexible robotic gantry technology, RMT's solutions focus on high-SKU, high-rate case and layer picking applications. By using large and fast gantries to temporarily store product as well as creative application of case conveyor systems, RMT can reduce the footprint of standard pick modules by over half and pick in exact customer sequences, which is often difficult for conventional high speed case pick applications.

RMT's Robotic Case Picking (RCP) system is a gantry-based robotic system, and is designed for high volume case pick operations.

As illustrated in the graphic below, gantry robots move at high speeds within a dynamic storage area, both to replenish the area with inventory, and to pick cases in the sequence required for orders or specific pallet builds.

The system is capable of picking individual or multiple cases out of active storage, from which they are deposited on a takeaway conveyor for manual or automatic palletization. Since cases can be delivered in exactly the desired pallet-build sequence, automated mixed palletizing at the dock becomes much more feasible.

RMT's Robotic Case Picking System

The end effector is typically either vacuum or clamp based and is designed to handle the wide variety of case sizes and types typically seen in the food and beverage industry. Tooling can often be demonstrated with customer product at the RMT facility.

Considering the wide variety of building shapes and sizes out there, RMT's systems are extremely flexible dimensionally and can be tailored to fit into most building column widths and ceiling heights. The system is also well-suited for incremental implementation or "pilots", allowing companies to start small and add additional modules over time.

Solution Provider: RMT Robotics

Contact Information:
Derek Rickard, Distribution Systems Manager
RMT Robotics Ltd.
635 South Service Road
Grimsby, Ontario, Canada L3M 4E8
905.643.9700
www.rmtrobotics.com

Example Customers: Automated case picking customers cannot be name publicly yet due to confidentiality agreements.

Solution Provider Perspective: RMT takes a customer-driven approach to our solutions; for us that means we start with one of our robotic solutions and work with each customer to tailor it to their needs. RMT is not only an OEM, but also a systems integrator often supplying conveyor systems, wrappers, labelers and WMS integration. This allows us to offer our customers a single source of responsibility and lower overall risk.

On many of our larger systems, RMT offers engineering studies, physical demonstrations and computerized simulation, all done in house by experienced industry professionals.

About Supply Chain Digest

Supply Chain Digest™ is the industry's premier interactive knowledge source, providing timely, relevant, in-context information. Reaching tens of thousands of supply chain and logistics decision-makers each week, our flagship publications - ***Supply Chain Digest, Supply Chain Digest –On-Target,*** and ***The Supply Chain Digest Letter*** - and web sites (www.scdigest.com, www.distributiondigest.com. and TheGreenSupplyChain.com) deliver news, opinions and information to help end users improve supply chain processes and find technology solutions.

For more information, contact Supply Chain Digest at:

www.scdigest.com
email: info@scdigest.com