



Aberdeen *Group*

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Warehouse Automation—What's Really Working For Pallet, Case, and Piece-pick Operations

*A Comprehensive Look at Bar Coding, Pick to Light, Voice, Conveyors,
Carousels, and AS/RS*

January 2007

Executive Summary

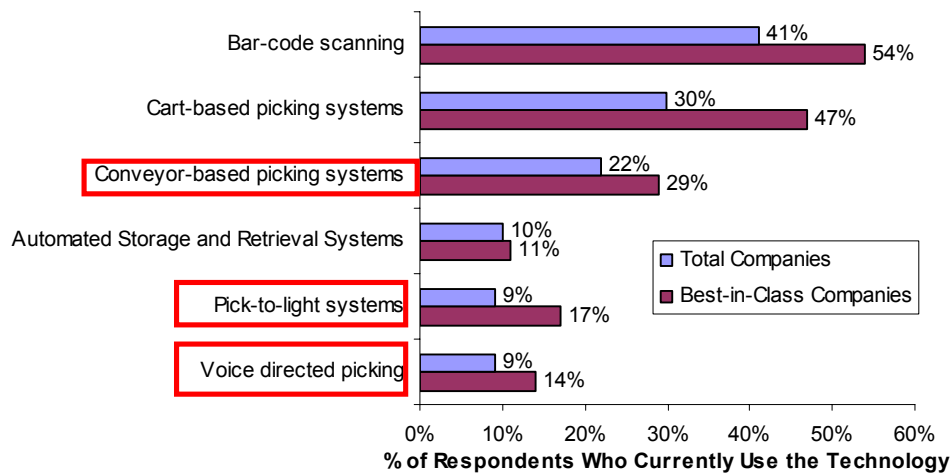
Properly carried out, a warehouse automation project can be a home run that drives a company towards increased profitability. On the other hand, poorly thought-out automation projects have driven companies out of business. Determining the right technology and processes to automate is vital to remaining competitive. Practicing the right methodology for system design, integration, and procurement will ensure that the project will be completed on time, on budget, and will meet expectations.

Key Business Value Findings

Aberdeen benchmark research has uncovered many compelling correlations between the adoption of automated warehouse solutions and their profound effect on labor costs, order turn-around times, and pick-accuracy.

Best in Class companies have moved beyond using bar-code scanning and are supplementing it with technologies such as pick-to-light and voice to reduce labor costs and improve accuracy (Figure 1).

Figure 1: What Order Picking Technologies Are Best in Class Companies Using?



Source: AberdeenGroup, January 2007

Top performers have already built-out their inventory control and order picking processes, and are now turning to innovations in put-away, replenishment, and returns processing to stand-out above the competition. Those companies that have made large investments in high-dollar technologies such as parcel sortation and AS/RS have consistently reaped benefits through reduced labor costs and improved levels of on-time shipments.



Implications & Analysis

Despite the strong correlation to improved performance, overall adoption rates for warehouse automation remain fairly low. Some technologies still suffer from outdated misconceptions about up-front cost or lack of flexibility. Piece pick operations are a key sector with tremendous untapped potential to improve their bottom line through utilizing warehouse automation to a greater extent.

Recommendations for Action

Companies should evaluate their processes to ensure they effectively accomplish the following:

- **Case-pick and piece-pick operations** that are struggling to reduce labor costs and improve accuracy should consider voice-directed picking or pick-to-light systems.
- **Companies seeking to boost pick accuracy** should also address the problem from the inbound side, focusing on put-away and replenishment accuracy to reach the 99%+ level.
- **High volume case-pick and piece pick operations** should strongly consider parcel sortation, as it correlates strongly with reduced labor costs and on-time and complete shipments.
- **Companies undertaking large warehouse automation projects** should follow Best in Class practices and consider using a systems integrator to manage the complexities of combining multiple forms of mechanical equipment and control systems in a single system.

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Chapter One: Issue at Hand

Key Takeaways

- Shorter order turn-around times and space concerns are driving companies towards automation.
- Fears about high investment costs and lack of flexibility are cited as the main reasons companies have chosen not to automate yet.

The warehouse has long been a key component of the supply chain. At top performing operations, automated warehouse equipment and software are linked to achieve the highest possible productivity. Recent Aberdeen research has placed the spotlight on warehouse management systems and accompanying software (see [The Warehouse Productivity Benchmark](#) and [The Extended Warehouse Benchmark](#)). To discover the best practices in automated warehouse equipment solutions, Aberdeen conducted a new study in January 2007 across 134 companies.

This research has uncovered several compelling correlations between the adoption of automated solutions and their profound effect on labor costs, order turn-around times, and pick-accuracy.

Aberdeen has further analyzed the survey results based upon the type of warehousing operation, and divided the respondents into three categories:

- Pallet-pick operations
- Case-pick operations
- Piece-pick operations

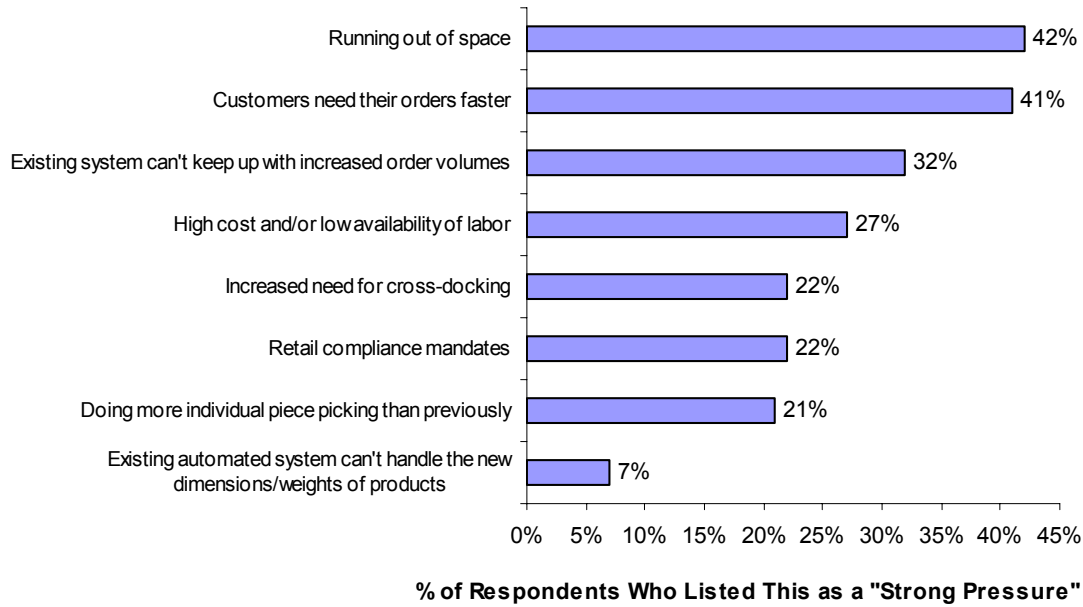
Key differences among these operations' automation approaches are identified throughout this report. In addition, a detailed discussion of warehouse automation best practices for each of these operations is featured in Chapter Four.

Top Warehouse Pressures

Aberdeen has found that warehousing executives are faced with a myriad of market pressures they must address in the immediate future to ensure that their operation meets customer expectations (Figure 2). In short, many companies surveyed indicate that they are reaching their operational limits in terms of space and capacity to fill orders in a timely manner. Labor issues and compliance mandates present additional challenges. And, with many supply chain leaders looking to trim costs from every portion of their operation, warehouses are seeking solutions that will allow for more efficient processes, while scaling performance to meet demand.



Figure 2: Top Warehouse Pressures Pushing Automation



Source: AberdeenGroup, January 2007

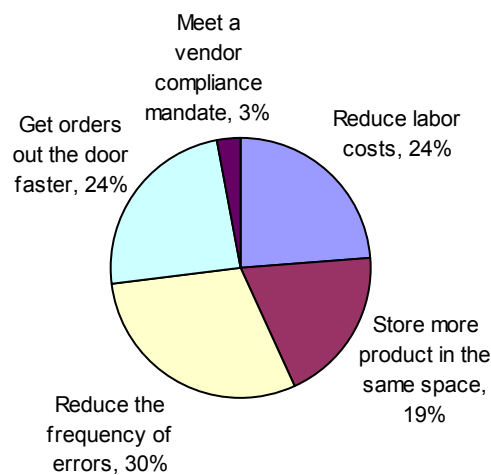
Faster turn-around requirements and space concerns were a virtual tie for the number one pressure facing warehouses today, with about 42% of companies listing them as “strong pressures”. However, when the respondents are broken down by their operational type (pallet, case, or piece pick), it is evident that these three different types of businesses each face a unique set of pressures. For example, pallet pick operations feel the “speed and space” demands less than the average operation, with only around 13% of respondents listing these factors as having a strong influence on their long-term planning. Instead, pallet pick operations are more concerned with **meeting retail compliance mandates**—as a group, 40% of these types of operations cited it as a strong pressure. This is probably due to the fact that full pallet pick operations are often more likely to be shipping to major retailers, rather than being engaged in direct-to-consumer or other businesses with no compliance mandates.

Overall, space concerns are the #2 pressure, followed by concerns regarding volume capabilities of their current material handling systems.

Warehouse Initiatives in 2007

After factoring in all of the market pressures, companies were asked to pick just one top warehouse goal for 2007 to deal with those pressures (Figure 3). What’s especially interesting to note, is that warehouses were nearly evenly divided on which goals they will address throughout the year.

Figure 3: Companies’ Warehouse Improvement Initiatives for 2007



Source: Aberdeen Group, January 2007

Speed, accuracy, and reduced labor costs were the biggest warehousing goals for 2007. *Storage density* was somewhat less important, and meeting vendor compliance mandates was far less important for most companies, although, as noted, this varied by operational type.

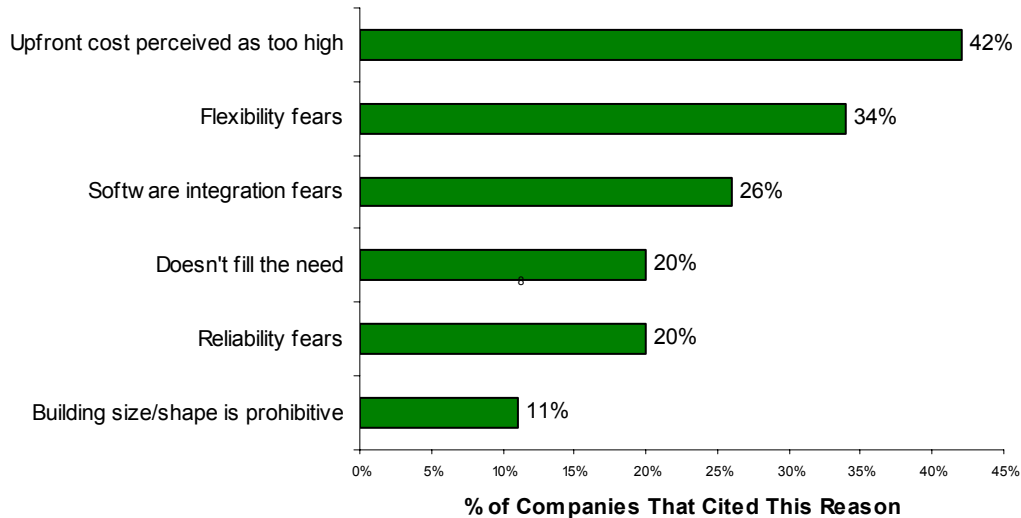
Automation Trepidation

Despite the promise of increased productivity that automation and its many forms can provide, there are real (and perceived) barriers keeping supply chain professionals from investing in these solutions (Figure 4). Companies were first asked if they had investigated warehousing automation in the past and chosen *not* to proceed with the project. Then, that sub-set of respondents were asked why they chose against automation.

Nearly half of these companies cite *cost issues* as their primary reason for not investing in automated warehouse solutions, with another 34% of companies saying *flexibility* was their biggest concern. With SKU proliferation, shorter product life cycles, and high levels of seasonality in some industries, it is vital for many warehouses to create agile operations and not lock themselves into a form of automation that will not be able to adapt to change easily



Figure 4: Companies’ Top Reason for Not Investing in Warehouse Automation



Source: AberdeenGroup, January 2007

Chapter 2 discusses the fact that despite these barriers to automation, a large percentage of companies have slashed costs, boosted pick rates and improved pick accuracy through the adoption of automated equipment.

Technology Landscape

“Warehouse Automation” is a broad term that encompasses many different individual technologies. The following is a list of the primary technologies Aberdeen has analyzed for this benchmark report:

Bar-Code Scanning

Bar-coding has been used in distribution centers for decades, and it remains the most commonly adopted form of warehouse automation today. It is reliable and relatively inexpensive. Bar-coding is typically used in a real-time environment, with data being transmitted back and forth via a Wireless Local Area Network (WLAN).



Voice-Directed Picking

Voice-Directed Picking was widely introduced in distribution center environments in the 1990’s and now is used heavily in certain industries such as grocery distribution. It is used in areas where workers benefit from being able to use both hands to perform their work, without ever having to take their eyes off of the task at hand.



Pick-to-Light Systems

Pick-to-Light technology has been widely used for order fulfillment since the early 1980's. It is most commonly used in high-speed piece pick operations with a very high SKU density in the forward pick area. It also has application in full case pick, pallet pick, and put situations.

Cart-Based Picking

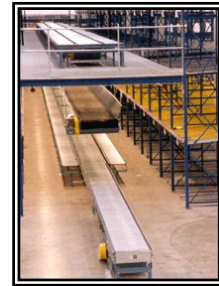
Cart-Based Picking is both a technology and excels in cluster pick operations, where same time with a single pick path through the which items belong in which orders can be cluster picking often involves secondary scanning, voice-directed picking, and pick-



a methodology. Cart picking several orders are picked at the warehouse. Keeping track of challenging; hence, cart-based technology such as bar-code to-light systems.

Conveyor-Based Picking

Conveyor-Based Picking is generally used in zone-pick environments, where multiple workers may pick various components of each order. The conveyor is used to transport the picking container from one zone to the next. Completed orders are then transported away from the pick area to the next function, such as consolidation, packing, or shipping. Conveyor-based picking also frequently involves secondary technologies like bar-code scanning, voice-directed picking, and pick-to-light systems.

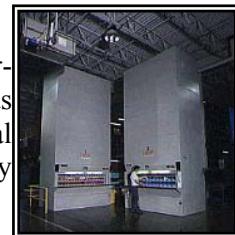


Horizontal Carousels

Horizontal carousels are most frequently used in ultra-high speed piece-pick operations. Horizontal carousels also improve storage density in operations that may have previously used static shelving systems.

Vertical Carousels and Vertical Lift Modules

Vertical carousels are often used in similar ways as their horizontal counterparts. However, vertical carousels tend to be used more commonly in areas where storage density, rather than pick speed, is the driving factor. Vertical Lift Modules (VLMs) are used in similar applications, but are functionally different from carousels.





Automated Storage and Retrieval Systems (AS/RS)



AS/RS technology can be broken into two broad categories—pallet handling (unit load) and tote handling (mini-load) systems. Some in the industry would actually consider Vertical Lift Modules to be a form of AS/RS. In pallet handling systems, a storage and retrieval mechanism (often a stacker crane) transports full pallets into and out of a pallet racking system. It is used to achieve extremely high storage density and greatly reduce labor costs. Mini-load systems function similarly to Vertical Lift Modules, except, instead of bringing an entire shelf of product to a pick station, the AS/RS can usually bring a single tote or case of product. AS/RS is used both as a means of primary picking, and as a means of replenishing a forward pick area.

Parcel Sortation

Parcel sortation can be used in a variety of areas in the warehouse, but most high-speed sorters are found after the picking process in the shipping area of a distribution center. When cases of product must be routed to specific dock doors, palletizing areas, or packing areas, sortation technology allows this process to occur in a high-volume environment with minimal labor requirements. Each case of product is scanned by a bar-code reader at induction. The sorter control system determines the correct destination for each case, and diverts that case to the right lane at the right time. There are a number of different mechanisms that actually perform the divert, depending upon volume requirements and the characteristics of the product to be conveyed.





Chapter Two: Key Business Value Findings

Key Takeaways

- Best in Class companies have moved beyond using bar-code scanning and are supplementing it with technologies like pick-to-light and voice to reduce labor costs and improve accuracy.
- Top companies have already built-out their inventory control and order picking processes, and are now turning to innovations in put-away, replenishment and returns processing to stand-out above the competition.
- Those companies that have made large investments in high-dollar technologies like parcel sortation and AS/RS have consistently reaped benefits through reduced labor costs and improved levels of on-time shipments.

For those companies that have taken the plunge in warehouse automation, the benefits are tangible. Aberdeen interviewed prominent warehouse executives on how automation is boosting their bottom line – and how to get started.

- "We use a variety of automation--voice, pick-to-light, and horizontal carousels. We've been able to see some extremely high pick rates out of the carousels and pick-to-light. The voice system is almost as fast, but, dollar-for-dollar, it's the best value for the type of picking that we do." A Logistics Manager for a large retail distributor
- "We recently installed vertical lift modules and were able to solve two problems--they gave us very high storage density, and allowed us to see pick rates that we couldn't get otherwise. We were also able to use the technology without having to invest in a full WMS." Director of Logistics for a large industrial parts distributor

What Makes a Company Best in Class?

Aberdeen has broken out its Best in Class framework according to three key metrics:

- Labor cost reduction
- Percentage of on-time and complete shipments
- Pick accuracy

Very few companies were Best in Class for all three categories – meaning that there is more than ample opportunity for even those considered top performers to improve their operations.



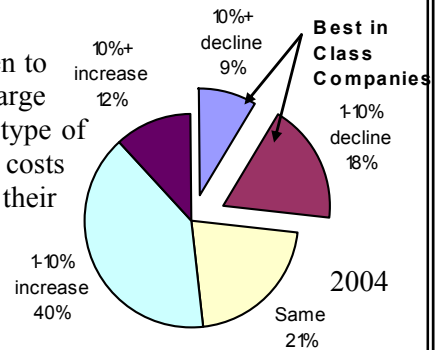
Best in Class Category #1--Labor Cost Reduction

Figure 5: Changes in Warehouse Labor Costs Since 2004

Source: AberdeenGroup, January 2007

Those enterprises looking to reduce their labor costs have chosen to automate portions of their warehouse that typically require a large human capital investment. Although the up-front costs for this type of automation can be relatively high, the benefits in reducing labor costs are compelling. Overall, more than 70% of all companies saw their labor costs increase or remain flat since 2004.

A small group, 27%, was able to decrease its labor costs since (Figure 5). These companies were considered Best in Class, and their choices for automation were analyzed.



Best in Class Category #2--On-Time and Complete Shipments

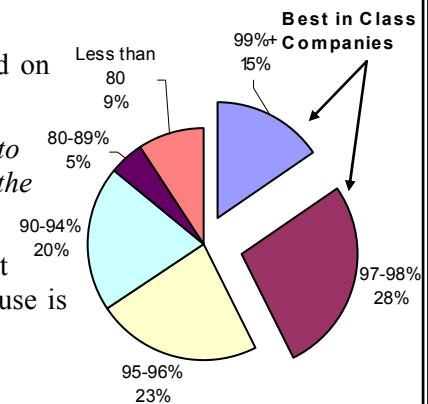
Figure 6: On-Time and Complete Shipment Rates

Source: AberdeenGroup, January 20

Enterprises seeking to please their customer base have focused on improving their on-time and complete shipments.

Aberdeen’s Best in Class companies in this category are able to deliver their shipments complete and on-time more than 97% of the time.

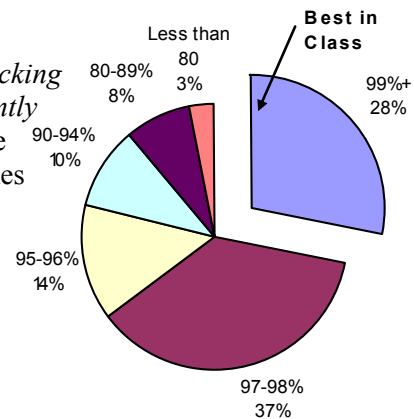
As Figure 6 indicates, an alarmingly high number indicate that more than one out of every 20 shipments leaving their warehouse is either late, incomplete, or both.



Best in Class Category #3—Pick Accuracy**Figure 7: Pick Accuracy Rates**

Source: AberdeenGroup, January 2007

A full 72% of companies have still yet to reach the 99%+ picking accuracy threshold that Aberdeen’s Best in Class currently achieve. More strikingly, more than 20% of companies are experiencing pick errors more than one out of every 10 times they pick.

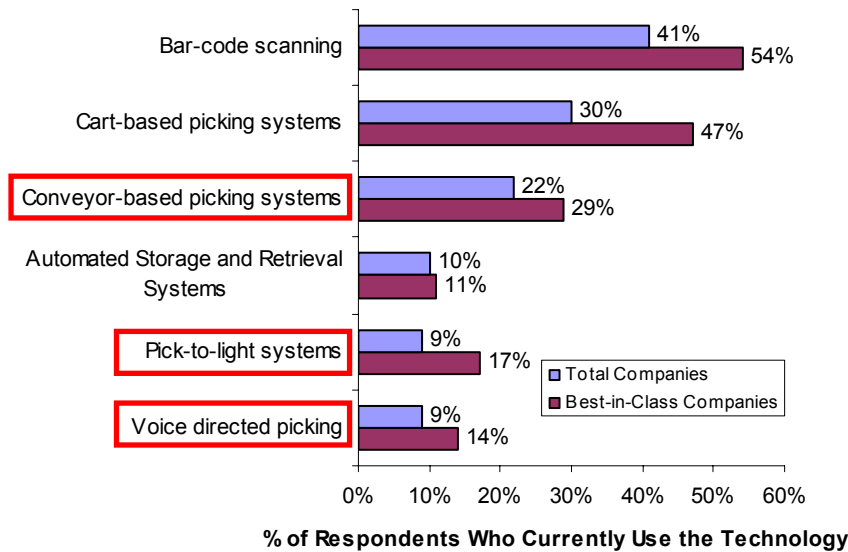
**What Picking Technologies Are Best in Class Companies Using?**

Aberdeen research shows that companies that are Best in Class for labor cost reduction are nearly 90% more likely to be using a *pick-to-light* system than their counterparts (Figure 8). Pick-to-light systems are shown to significantly boost lines-per-hour pick rates in forward pick areas with high SKU-density, and for Best in Class companies, this has translated into real, tangible benefits to the bottom line.

The benchmark results also indicate that *voice-directed picking*, when properly applied, can go a long way towards reducing labor costs. Best in Class companies were 56% more likely to be using voice-directed picking than companies in general.



Figure 8: Key Differentiators for Labor Cost Reduction



Source: AberdeenGroup, January 2007

Case Study: Lights Illuminate Productivity

In an industry that demands being first to market, Urban Outfitters relies on innovative material handling technology to quickly process the hottest fashions for its Urban Outfitters, Anthropologie and Free People stores in the U.S., Canada and the British Isles.

Its primary store distribution center in Gap, Pennsylvania, is responsible for processing some 90,000 units each day at over 99.75% accuracy. In addition, this facility has seen an average annual growth rate of over 20% since beginning operations in 1996.

“We’re opening 35-40 stores this year,” says Ken McKinney, director of distribution. “When we moved into this facility we had only 30 stores. We are now processing for just shy of 180 stores, so it is effectively six times the volume that was here when we originally moved in.”

The DC’s ability to handle such a leap in throughput is due in large part to a pack-to-light solution. The application enables Urban’s staff to productively, quickly and accurately fulfill the orders bound for its stores. In fact, 85% of all merchandise processed in the facility passes through the system.

“What this technology has allowed us to do is to grow without expanding the building,” adds McKinney. “We really haven’t even had to add a shift yet and we still have a lot more capacity on this system than we are currently utilizing.”

Using the system, workers at Urban Outfitters achieve a remarkable 1,200 picks per man hour. “We can monitor each lane to assure that work reaches our standards,” explains Steve Wolanin, retail distribution manager. “We can then allocate work where needed.”



(Note: “picks per hour” can be measured in a variety of ways, including lines per hour, as well as units per hour.)

“Product moves through this building a full day faster than in our old facility,” adds McKinney. “Once it hits inbound, it is like greased lightning.”

Enterprises looking to minimize late or incomplete shipments would do well to follow the example of their higher-performing peers. Companies with over 97% on-time and complete shipments are 41% more likely to be using *conveyor-based picking* and 44% more likely to be using *pick-to-light* technology. These two technologies used together make for a powerful combination. Conveyors often allow the use of zone-picking, which drastically reduces walking and speeds the order from one functional area to the next. At the individual zone level, pick-to-light further reduces walking and eliminates the need to flip back and forth to pick documents. The result is higher system throughput, and greater instances of orders shipping on time.

AS/RS also correlated strongly with on-time shipments. Best in Class companies in this metric were 20% more likely to be using AS/RS. This technology also correlated well with reduced labor requirements. This shows that despite high up-front costs, AS/RS has provided real, concrete cost savings for those companies that have chosen to implement them.

In a related vein, there is a strong correlation between *pick-to-light* and *cart-based picking* with improved pick accuracy. Companies using one or both of these technologies were each over 50% more likely to have pick accuracy of 99% or greater. A plethora of companies now offer wireless carts equipped with “put-to-light” equipment to push cart-based picking into Best in Class accuracy standards.

Voice-directed picking also showed a strong correlation with ultra-high accuracy rates. Companies with Best in Class pick accuracy were 22% more likely to be using voice. Voice picking allows for continuous eye-contact with the task at hand, with much less chance of a picking mistake being made.

Case Study: Listening for Higher Performance

Dunkin’ Donuts is the world’s largest coffee and baked goods chain, serving more than two million customers a day. And, when the restaurant franchisee owners call the Dunkin’ Donuts Mid Atlantic Distribution Center (MADC) for raw goods, including flour, yeast, glaze, muffin mix and boxes of coffee beans, they are sure to get exactly what they order - thanks to a voice picking solution now in place in the MADDC.

The enterprise implemented a voice-directed handling application that delivered significant benefits in workforce utilization, and enabled Dunkin’ Donuts MADDC to manage its growth while maintaining extremely high service levels.

The voice application in use at Dunkin’ Donuts MADDC is a sophisticated solution supporting multiple modes of picking. Order selectors can pick discrete orders, or multiple orders in a single pick trip. In addition, batch picking operations are supported. Workers are assigned to one of three zones: freezer, cooler or dry. All zones are picked independently and simultaneously in waves and are sent to a staging area where they are merged into a route and loaded onto the trucks.

“The accuracy is great,” says Craig Setter, Executive Vice President & COO. “Last week, on the dry side, we had 99.94% accuracy on about 285,000 pieces-and that’s phenome-



nal. We’ve gone from 21 hours of picking down to nine or 10 hours, because of (our voice solution) and the layout of our new facility.”

“We are getting much higher productivity than in the past - so our cost to move the same amount of goods is less than it was before, which is good because our business growth is so aggressive,” says Warren Engard, Director of Distribution Operations, at Dunkin’ Donuts MADC.

With the voice solution, Dunkin’ Donuts MADC has a technology solution that maximizes the contribution of each individual worker in the warehouse labor force. Management has access to real time information about productivity, order fills, and operational status that supports decision-making at moments when time is critical. Labor dollars are conserved, customers are well-supplied, and the entire operation is positioned for accelerated growth.

“In fact, we’re so thrilled with the results of using voice technology we initiated some program change requests because we intend to do receiving, putaway, replenishment, cycle counting and system directed loading with voice,” says Engard.

Interestingly, bar-code scanning, which was for years the “gold standard” for pick accuracy, has a much less compelling correlation to Best in Class accuracy of 99% of above. The Achilles heel of bar-coding lies in the hardware that pickers must carry with them. Pick instructions are typically received on the screen of a handheld computer, meaning that to complete a pick, a worker often has to take his hands—and his eyes—off of his work.

Does this mean that bar-coding isn’t a good way to confirm pick transactions? No—it simply means that other technologies like voice and pick-to-light offer alternatives that allow the picker to maintain the all-important eye-contact with the task at hand. Many bar-coding technology providers are now offering wearable scanners mounted to the wrist and finger, to prevent the picker from having to repeatedly un-holster the scanner during a pick sequence. These devices should be considered in an operation where both hands are required to pick product.

Picking Technologies that Work

ASRS, despite its hefty up-front cost, is shown to correlate well to reduced labor costs and improved on-time and complete orders. AS/RS also has application as a buffering tool to stage and sequence product prior to shipment. Because of its high storage density, AS/RS can help a company remain in their existing space, rather than make an expensive move to a new facility. Companies that have freezer or cooler space should consider AS/RS, as the high cost of expanding a freezer area may help cost-justify the investment in automation.

Pick-to-Light was the only electronic technology that strongly correlated to success in all three Best in Class areas. It has shown to reduce labor costs by boosting lines-picked-per hour per worker. The technology can improve on-time and complete shipments by increasing overall system throughput. Accuracy is also improved, since workers do not have to take their eyes off of their work to consult written instructions.

Voice-directed picking also correlated strongly to improved accuracy for some of the same reasons. Eye contact with the task at hand is maintained. Pickers have both hands free to complete their work, which also causes this technology to correlate well with reduced labor costs.

Cart-based picking, for many companies, is an inexpensive next step up from simple bar-code scanning. It has the all-important aspect of flexibility, so highly sought after in warehousing to-



day. There is no conveyor bolted to the floor, and no power and data cables to be strung across the warehouse. It is shown to correlate well with all three Best in Class categories. Cart-based picking can be boosted by using secondary technologies like voice and pick to light for even greater performance.

Conveyor-based picking strongly correlates with on-time shipments. Conveyor systems, when used properly, can be a valuable tool for boosting overall system throughput and balancing work across multiple pick zones to guarantee that pick requirements are matched to available labor.

Bar-coding still correlates to success in all three categories. However, it is no longer a key differentiating technology that is only used by Best in Class companies. Bar-coding is now the Industry Norm, rather than technology that can give a company an “edge” over the competition. Best in Class companies have moved beyond bar-coding and are now using bar-coding in conjunction with technologies such as pick to light, voice-directed picking, AS/RS, and conveyor-based picking.

What Shipping Technologies Are Best in Class Companies Using?

As more and more companies automate their picking operations, it is increasingly important to consider packing and shipping automation in order to gain an edge over the competition.

Companies considered Best in Class for reduced labor costs were 78% more likely to be using **parcel sortation systems** than their counterparts. Manual sortation is labor intense and prone to error. Companies that have automated this process were far more likely to have offset the cost of the equipment with significant labor savings.

Parcel sortation also correlated well with companies that were Best-in Class for On-Time and Complete Shipments. These companies were over 60% more likely to be using sortation systems.

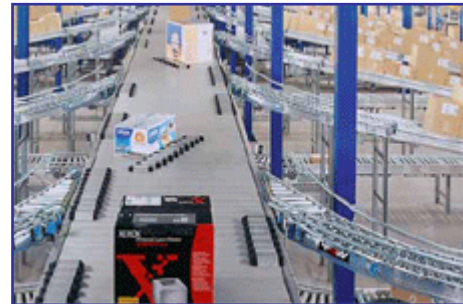
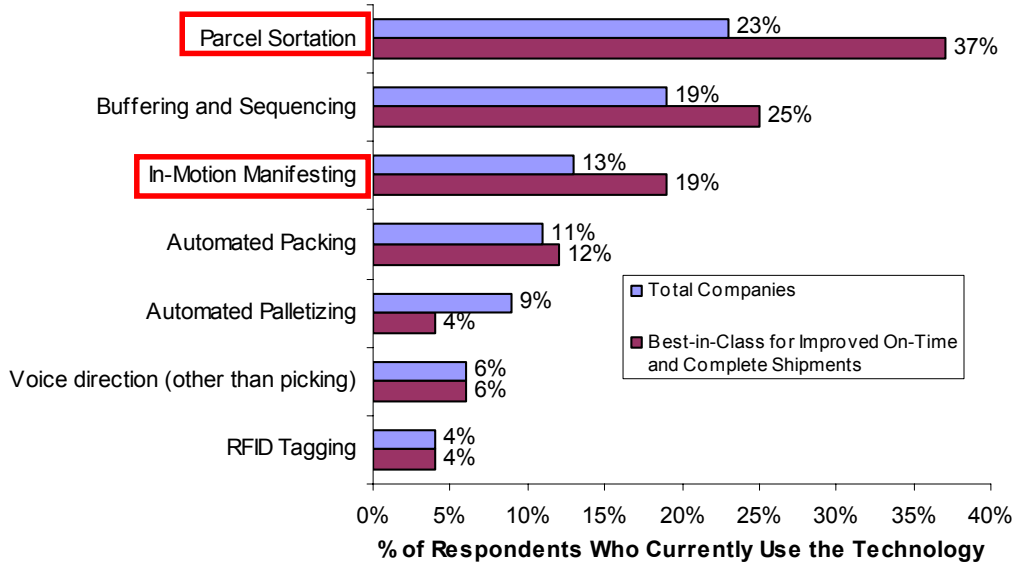




Figure 9: Key Differentiators for On-Time Shipments (Shipping Automation)



Source: AberdeenGroup, January 2007

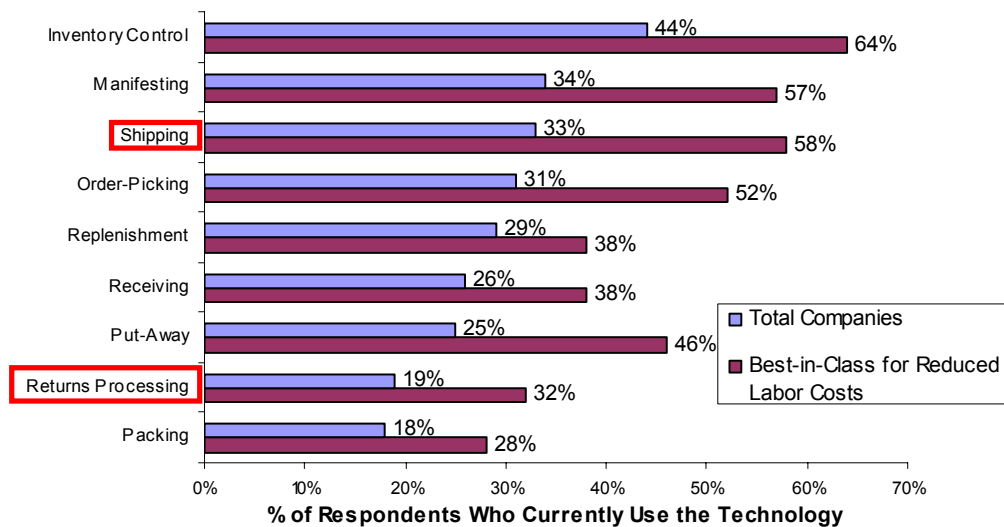
This same group is also 46% more likely to be using *In-Motion Manifesting Systems*. Manifesting tends to be a bottleneck in many operations. When order volume unexpectedly picks up, it is difficult to simply “throw labor” at manifesting, as this position typically requires a certain level of training and job familiarity that may not be present in other warehouse positions. In-Motion Manifesting Systems have been shown to greatly improve throughput, which, in-turn, improves the likelihood of an order being shipped on-time and complete.

What Warehouse Processes Have Best in Class Companies Automated?

Best-in Class companies have clearly moved beyond automating just the picking process. When it comes to warehouse excellence, one message is clear—*it’s all about inbound processes!*

When companies were asked which processes they had automated, there was a 100% correlation in all processes to more automation and reduced labor costs and improved on-time shipments. A few processes, however, had an especially strong affect on performance.

Although order-picking automation still correlates strongly with reduced labor costs, it is now an “Industry Norm” practice, and is no longer a key differentiator across the board.

Figure 10: Best in Class Reduced Labor Costs Automation Adoption

Source: AberdeenGroup, January 2007

Companies that are Best in Class for reduced labor costs were far more likely to have automated *put-away* (81% more likely) and *returns processing* (75% more likely) than their counterparts. Figure 10 compares Best in Class companies for Labor Cost Reduction to the total group of respondents.

Furthermore, automating *put-away* and *returns processing* is now the top predictor of excellence in On-Time Shipments. With faster order turn-around times, product often needs to be picked as soon as it is received. A fast and accurate system for getting that product to the right bin location can be a key factor in getting orders out the door on time.

Inbound process automation also correlates with improved pick accuracy. Using automatic data capture technologies during the picking process only does so much to improve accuracy. To truly break through the 99% accuracy barrier, companies need to realize that accuracy starts with *put-away, returns processing and replenishment*—the right item must be placed in the bin location to be begin with to ensure that it is selected correctly later in the process.

Case Study: Integration Coupled for Success

When apparel retailer Tween Brands Inc. decided to overhaul its fulfillment processes, it chose a put-to-light fulfillment system and to upgrade its best-of-breed solution simultaneously.

Twewen Brands retails girls' apparel and accessories from almost 700 stores—including 573 Limited Too and 154 Justice—as well as directly to consumers through its Web site and catalogs. Twewen scheduled the implementation of the put-to-light system during a relatively quiet time for the distributor



"The actual go live was a non-event," shared Carol Brouillette, manager of special projects at Tween Brands. "We assigned a focused internal project team and strictly adhered to the structured upgrade methodology provided to us by (our WMS provider)."

Completing the project on schedule and under budget, Tween Brands Inc. has increased productivity 25% and achieved more than 99.9% accuracy in order fulfillment.

"We succeeded by first defining what we wanted to get from the implementation and then sticking to the plan," said Brouillette. "We scheduled the project at a time that would least impact business, and we stuck to the timeline."

She added, "The upgrade of the WMS went live and, two weeks later, the put-to-light system went live. There was no negative impact whatsoever on production."

The new supply chain processes deliver time and labor savings that help Tween Brands move product from receiving to stores within 1 to 4 business days, depending on where stores are located in the country. Incoming goods are either cross docked or sent into the put-to-light system. Almost 60% are ready to ship out again within 24 hours.

Chapter Three: Implications & Analysis

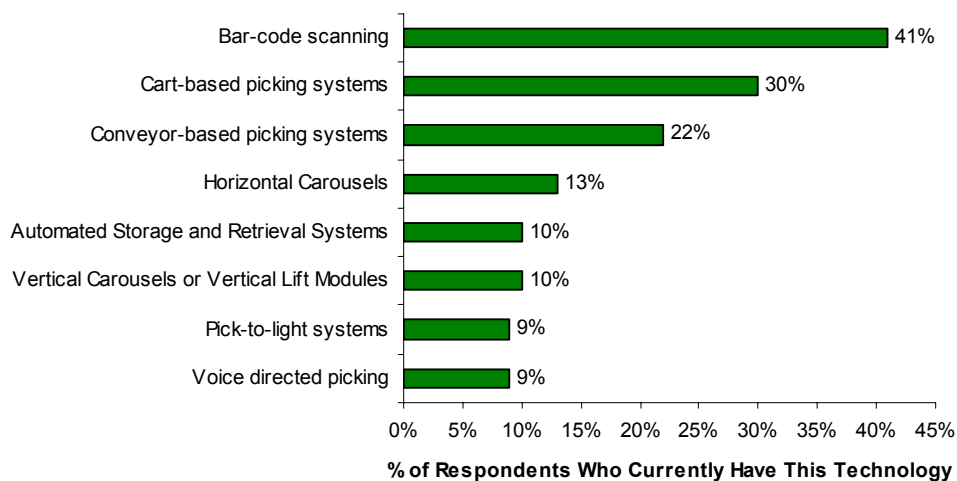
Key Takeaways

- Despite the proven ability for warehouse automation solutions to boost performance in critical metrics, there is significant capacity for more adoption in the marketplace.
- Pallet-pick operations are highly concerned with pick accuracy, and plan to adopt voice-directed picking more heavily than other operations.
- Case-pick operations are the most highly automated group of companies, and have been more willing to take the leap into technologies such as pick-to-light and voice-directed picking.
- Piece-pick operations represent the largest area of potential for further automation.

Despite the proven ability for warehouse automation solutions to boost performance in critical metrics, there is significant capacity for more adoption in the marketplace.

Although bar-coding has become an “Industry Norm” technology, only 41% of companies report having a bar code technology infrastructure. Interestingly, following bar-coding, only slightly more than a quarter of all companies reported to having any other individual technology. This point attests to the fact that the multitude of automated equipment technologies offer companies a myriad of options in automation – keeping adoption rates relatively low for a single technology (Figure 11).

Figure 11: Warehouse Automation Equipment Adoption Rates



Source: AberdeenGroup, January 2007



Future Adoption Plans

While Table 1 indicates that adoption for warehouse automation is a carefully calculated movement for most companies, their long-term plans are surprising. Despite a lofty price point, automated storage and retrieval ranks second only to voice-directed picking in terms of long-term adoption plans. Also compelling is that voice technology is now being viewed as a viable picking solution, as opposed to a “newfangled” technology on the cutting edge.

Table 1: Warehouse Automation Adoption Plans

Technology	% of Companies that Plan to Adopt Within 18 Months	% of Companies That Have Longer-Term Adoption Plans
Bar code scanning	23%	28%
Conveyor-based picking	12%	24%
Cart-based picking	10%	20%
Voice-directed picking	10%	37%
Horizontal carousels	7%	22%
Vertical carousels or VLMs	7%	27%
Pick-to-light	7%	32%
AS/RS	4%	33%

Source: AberdeenGroup, January 2007

Adoption Roadmap

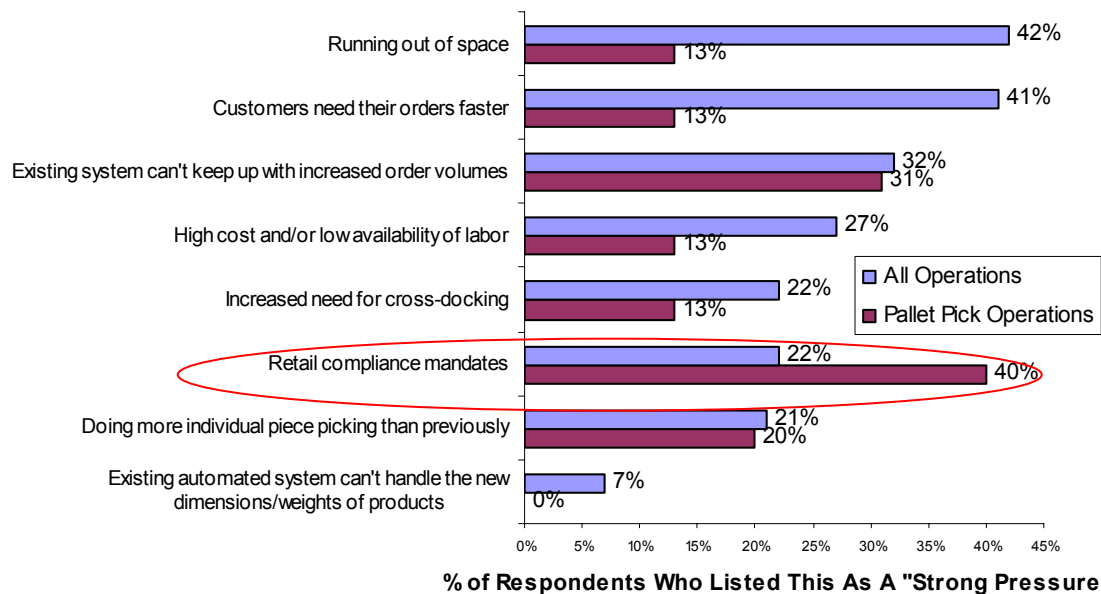
It would be short-sighted to establish an automated equipment adoption roadmap for all warehouse executives in a “one-size-fits-all” format. Instead, Aberdeen has broken down individual automation adoption strategies for pallet-pick, case-pick and piece-pick enterprises.

Pallet-Pick Operations

Approximately 12% of respondents report picking primarily pallets in their operations. These enterprises are more susceptible to pressure from retail compliance mandates than other types of operations – with 40% reporting compliance as a strong pressure (Figure 12). This may be due to the fact that pallet-pick operations are more likely to be shipping product to major retailers than those who pick cases or pieces.

Furthermore, these operations report that their #2 pressure is that their current automated system cannot keep pace with their increased volumes.

Figure 12: Pressures for Pallet Pick Operations



Source: AberdeenGroup, January 2007

Pallet pick operations’ top goal for 2007 was to improve accuracy, likely in part to help avoid customer back-charges or invoice deductions. Furthermore, pallet pick operations report that their #2 pressure is that their current automated system cannot keep pace with their increased volumes.

With nearly half (47%) of pallet pick operations using *bar-coding* for order fulfillment and nearly a third (27%) planning on adopting it in the next 18 months, bar-coding is clearly the technology of choice for these companies. Many of the other forms of automation considered in this report do not apply to pure pallet-pick operations, such as carousels and parcel sortation.

A notable exception is *voice-directed picking*. As noted in Chapter 2, voice-directed picking correlates well with improved accuracy rates. Not surprisingly, this is one of the top technologies that is making inroads in this space, with 13% of pallet-pick companies currently using it. An additional 13% planning to implement it in the next 18 months (only 9% of users in general currently use voice).

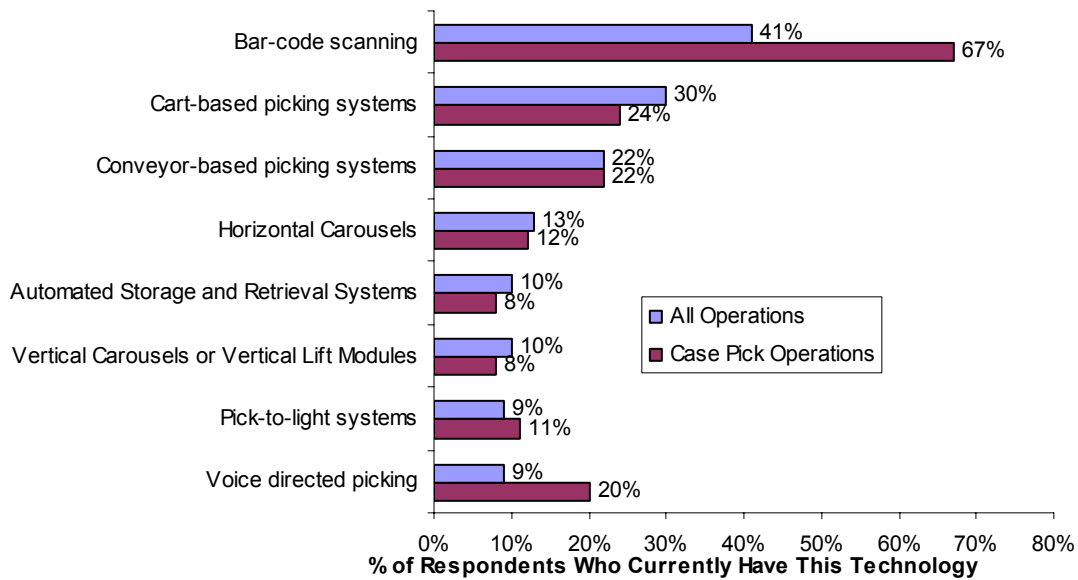


Case-Pick Operations

The top concern of case-pick operations is getting orders out the door faster, with 47% reporting it as a strong pressure. Space and labor concerns are also important to these enterprises.

Case pick operations are currently the most highly automated group of companies, according to Aberdeen’s research (Figure 13).

Figure 13: Technology Adoption Among Case Pick Operations



Source: AberdeenGroup, January 2007

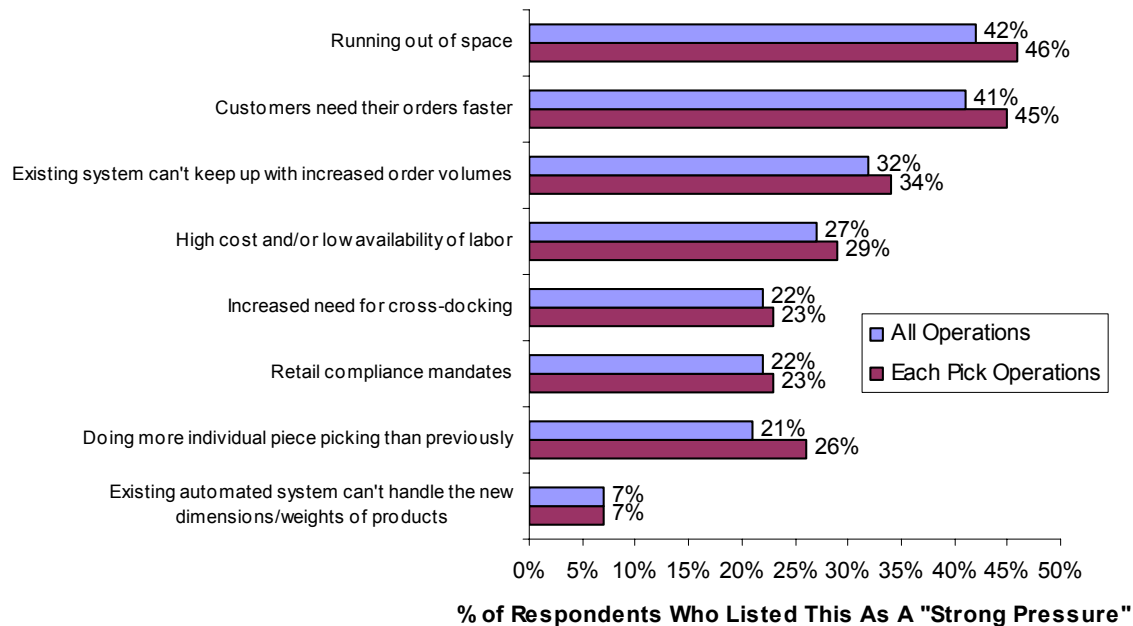
Approximately 67% of case pick operations currently use **bar-coding** to pick orders, the highest of any technology for any category. Case pick operations are also the most likely to be using alternative forms of automation as well with 24% of such operations using **cart-based picking**, and 22% employing **conveyor-based picking**.

Voice-directed picking is a major enabling technology, with 20% of operations currently using voice, and 20% of companies planning to adopt it within 18 months. Roughly 40% of the remaining companies have voice-directed picking on the wish list of future automation adoption. **Pick-to-light** is also popular with this group, with 11% of case pick enterprises utilizing the technology.

Piece-Pick Operations

Piece pick customers are beset by the widest array of pressures—everything from order turn around time and space issues to retail compliance mandates (Figure 14). For some of these companies, piece picking is a fairly new part of their business, and they are adjusting to the new challenges that are inherent in its operation.

Figure 14: Pressures Driving Piece Pick Operations Toward Automation

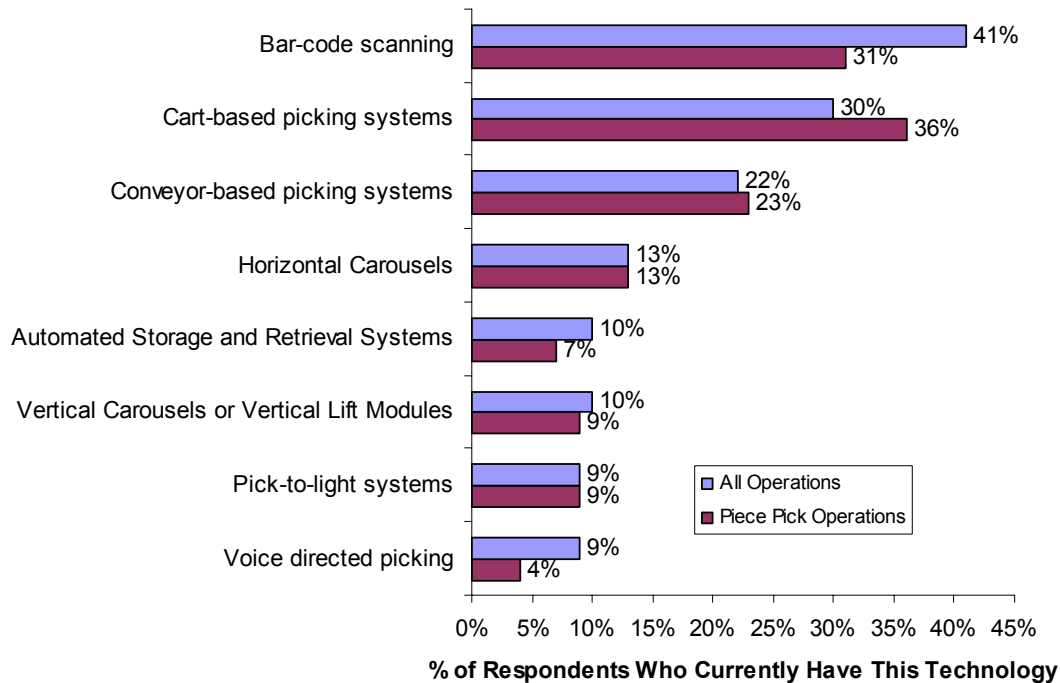


Source: Aberdeen Group, January 2007

Piece pick companies have interesting adoption rates when it comes to automation. Piece pick operations are less likely than companies in general to be using bar-code scanning for order picking. Some of these enterprises may operate under the assumption that paper-based picking is a faster way to work in high SKU-density areas. **Cart-based picking** seems to be the “next step up” for most piece pick operations. At 36%, it is used more frequently than bar-code picking (Figure 15). It is worth noting that many companies who may be using bar-coding, pick-to-light, and voice technology are also using them in conjunction with carts.



Figure 15: Automation Adoption Rates for Piece Pick Operations



Source: AberdeenGroup, January 2007

Conveyor-based picking is used relatively heavily by nearly one-quarter of all piece pick companies. Voice picking has still not caught on to a great extent in piece-pick operations.

Pick-to-light, and carousels, which are tailored to piece-pick operations, are used by about 10% of these companies. Distribution centers that have adopted these technologies have measurably better warehouse performance—the technology has simply been slower to catch on with piece pick operations. A case can be made that piece-pick operations are actually better suited for these forms of automation than either case or pallet-pick operations, due to the higher amount of labor required to process smaller orders.”

Chapter Four: Recommendations for Action

Key Takeaways

- Laggard companies need to automate inventory control and order fulfillment now to remain competitive.
- Industry average companies should utilize technology like voice-directed picking and pick-to-light systems to stand out above their peers.
- To maintain their position, Best in Class companies should consider shipping technologies such as in-motion manifesting, parcel sortation, and buffering systems.

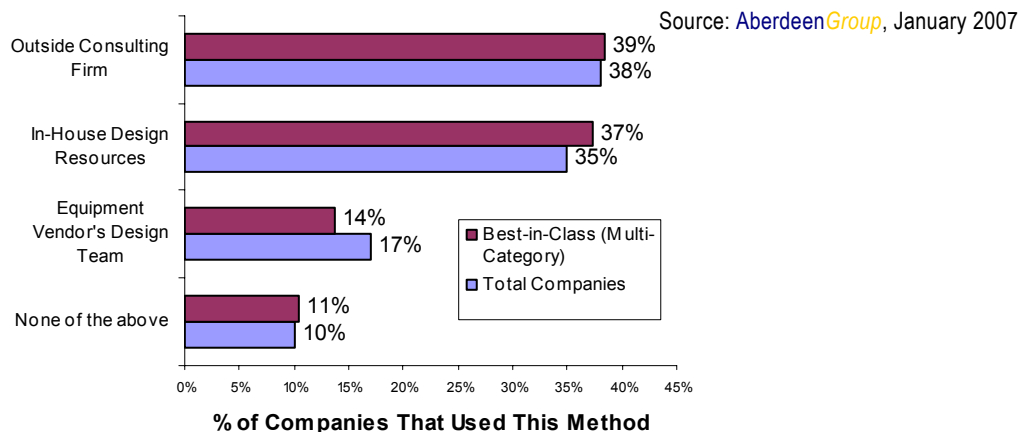
Choosing the best way to incorporate automation requires making several decisions in terms of design and integration strategies. To investigate the impact of these choices on project success, Aberdeen surveyed companies’ project management methodologies in three key areas.

About half of the survey respondents have undertaken a major warehouse automation project within the last two years. That group of companies was asked to describe their strategy for design, integration, and procurement. The total body of respondents for these questions were then analyzed against a “composite” Best in Class response that factored in all of the major best in class categories (reduced labor costs, on-time and complete shipments, and pick accuracy), as well as the extent to which they were able to improve distribution center throughput as a result of the project.

Design Strategy

Companies showed a clear preference towards having either professional consultants or in-house resources design their automated system. Approximately 38% of companies surveyed chose to have an outside consultant design the system for them, while 35% employed in-house resources to design the system, while only 14% had an equipment vendor design the system (Figure 11).

Figure 16: Automation Design Strategies





Those companies that had successful implementations were eager to share some of what they had learned about the design process:

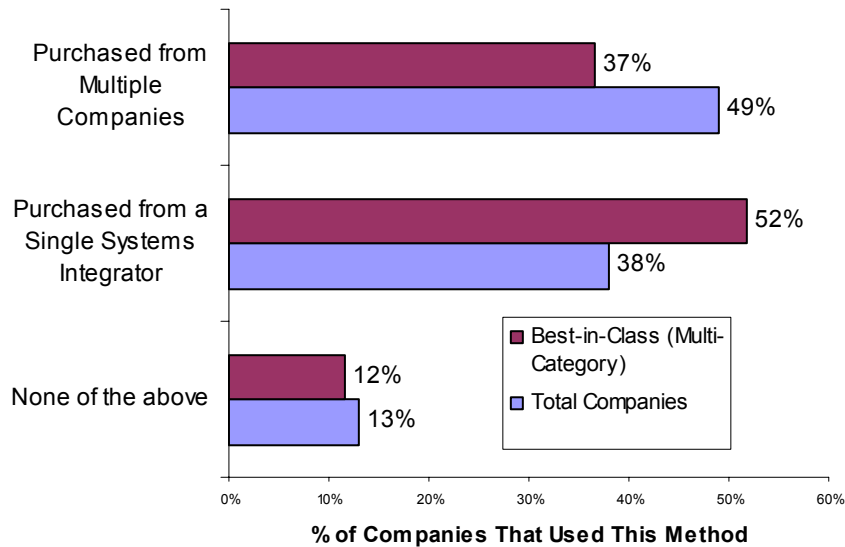
- "Our company recently implemented a WMS, along with a high-speed tilt-tray sorter. The projects were successful because everybody at Quicksilver had their fingerprints on the project the whole way through. When you're handling 600,000 units per day, you can't afford to have a system that isn't truly built around your business processes." Gene Elias, Senior Vice President, IS/IT, Quicksilver
- "Know what you want, and visit other companies that are using what you want to see how it's working for them." Director of Logistics for a large manufacturer of business equipment.

Integration Strategy

Overall, 38% of companies report using a systems integrator to manage their automation project, while 49% chose to play the integrator role themselves and deal directly with multiple different vendors.

A key finding of Aberdeen’s research was that Best in Class companies followed a very different integration methodology. Best in Class companies were significantly more likely to use an outside systems integration firm, with 52% reporting that they chose this route. Only 37% of Best in Class companies chose to wear the integrator hat themselves (Figure 17).

Figure 17: Best in Class vs. All Others in Systems Integration Strategy



Source: AberdeenGroup, January 2007



Procurement Strategy

Not surprisingly, the most popular procurement method was to hold a competitive bidding process with multiple companies, with 63% of respondents choosing this method. A smaller group, (23%) of companies chose to do business with a single supplier for each technology and not solicit competitive bids. Only 2% of companies chose to use a “cost plus” arrangement to procure the equipment. There was no significant difference in strategy between best in class companies and the general group of respondents, although Best in Class companies were slightly more likely to use “cost plus” arrangements.

Aberdeen’s PACE Framework

Based on Aberdeen’s hypothesis, the following are a compendium of warehouse stressors and actions to address these challenges based on the report analysis.

Table 2: PACE (Pressures, Actions, Capabilities, Enablers)

Priorities	Prioritized Pressures	Prioritized Actions	Prioritized Capabilities	Prioritized Enablers
1	Warehouses are running low on available space	Companies must store more in the same amount of space without compromising accessibility to product.	Companies must be able to utilize the full height of the warehouse, with minimal aisle space and maximum SKU density.	Unit load AS/RS systems provide dense pallet storage while still preserving access. Vertical carousels and Vertical Lift Modules allow storage of smaller SKUs while maximizing the full height of the warehouse. Double-stacked horizontal carousels allow dense storage of small parts.
2	Customers need orders faster	Order turn-around times need to decrease.	Companies must have ready access to product in a forward pick area, and maximize their pick rates.	Technologies like voice-directed picking, pick-to-light, and bar-coding can allow rapid picking in a forward pick area while preserving accuracy.
3	Existing order fulfillment systems cannot handle the increased volume of orders	System throughput must be increased.	Existing material handling system must be retrofitted and upgraded to allow for increased throughput. Companies that haven’t automated need to do so.	Conveyor-based picking allows for rapid transmission of product through the pick area. High-speed sortation in the shipping area allows cases to be quickly and accurately routed to their destinations in the dock area. New sortation technology allows for increased speeds at lower prices than in the past.



Priorities	Prioritized Pressures	Prioritized Actions	Prioritized Capabilities	Prioritized Enablers
4	Labor costs are increasing at the same time that availability is low	Companies must automate order fulfillment wherever practical.	Maximize pick rates to keep labor costs down. Allow for rapid training of new staff so that less skilled labor can be used.	Voice directed picking and pick-to-light can boost pick rates. These technologies are very easy to learn for inexperienced workers, and can be utilized in operations with high turnover. Carousels and AS/RS boost pick rates even higher without adding head-count.
5	Retail customers are imposing compliance mandates	Companies must be able to pick accurately, on-time, and in compliance with the retailers data transfer demands.	Automatic data capture must be utilized to confirm warehouse transactions; business process rules must be enforced to comply with mandates.	Bar-coding, voice, and pick-to-light, can all be used in various forms to ensure accuracy. A Warehouse Management System (WMS) can manage customer rules to ensure compliance. In RFID compliance station can label and verify reads for tagged product.

Source: AberdeenGroup, January 2007

Assessing Your Warehouse Automation Maturity

Companies should use Table 3 to identify their maturity levels across the various areas of warehouse automation. Areas in which your company is not Best in Class can be targeted for improvement.

Note: although the topic of warehouse management systems (WMS) is not discussed heavily in this report, a good WMS is often the backbone that enables further advances in automation. See the “Knowledge” section of the table below to assess your company’s capabilities in this regard.

Table 3: Warehouse Automation Competitive Framework

	Laggards	Industry Average	Best in Class
Process	<i>Inventory control</i> is semi-automated with either paper-based or automatic transaction confirmation.	<i>Order picking</i> is fully automated and system directed; inbound processes (<i>receiving, put-away, replenishment</i>) are semi-automated with transaction confirmation only.	Outbound and inbound functions are fully automated and system-directed. <i>Returns processing</i> is fully automated.
Organization	Primary warehouse goal: just keep up with daily volume.	Primary warehouse goal: reduce order-turn around time and improve pick accuracy.	Primary warehouse goal: Exceed customer service expectations while keeping labor costs and storage space to a minimum.
Knowledge	Only have visibility into what inventory is in the warehouse, with no knowledge of bin locations.	WMS tracks inventory down to the bin location in real-time.	WMS tracks inventory in multi-tier environment, with forward picking, overstock, and system directed replenishment.
Order picking automation	Pick with paper pick tickets.	All warehouse transactions are confirmed via bar-code scanning.	Bar-code scanning is supplemented with technology like pick-to-light, voice-directed picking, carousels, or AS/RS.



	Laggards	Industry Average	Best in Class
Shipping automation (for case and piece pick operations)	All orders are manually checked; packers perform several functions for each order; manifesting is manual; Manual sort in shipping.	Automatic data capture at point of pick makes checking unnecessary; packing functions are specialized; manifesting is manual. Manual sort in shipping.	Selective checking only; case seal, manifesting are fully automated; parcel sortation used in shipping.

Source: AberdeenGroup, January 2007

Recommendations for Action

Warehouse automation is a complex, broad topic. There is no one technology to use or process to automate that will guarantee success. The decision as to how to automate a warehouse should only be made after a careful and comprehensive business process review and evaluation of the technology options which are available. The recommendations below are general in nature, and are meant to serve as a starting point for companies considering automation.

Laggard Steps to Success

1. *Adopt bar-coding technology*

This technology is relatively inexpensive and comes with fewer barriers to adoption. Utilizing real-time bar-coding often means changing the software system that manages the warehouse -- either switching to a new ERP system or a Best of Breed warehouse management system (WMS). Taking these steps can provide an excellent foundation to build on for later expansion into other areas of automation.

2. *Automate Inventory Control and Order Fulfillment*

Little real progress can be made in the field of automation until inventory control has been automated. This involves tracking items down to their specific bin locations in the warehouse, setting up multi-tier locations systems, and tracking all movement of product in real time.

Order fulfillment is often the most labor-intensive part of an operation. It is also usually the most time critical, so it is natural to automate this process before all others. This can involve using processes such as batch picking and cluster picking, in conjunction with pick path optimization.

3. *Utilize labor specialization for portions of the packing operation*

Once bar-coding or some other form of automatic data capture has been deployed at picking, “checking” requirements at packing can be greatly reduced. This labor can often be re-deployed elsewhere.



Functions like case sealing, void fill, and manifesting are often handled most efficiently with an in-line system with specialization. Basic equipment such as semi-automated case sealers and dunnage dispensers can speed throughput. Bar-code scanning at manifesting, along with a simple interface back to the ERP/WMS can reduce key strokes and improve throughput.

4. *Consider using an outside consulting firm to develop a long-term plan for warehouse automation.*

Laggard companies often do not have the internal resources required to fully evaluate their operation and develop a plan for success. Poorly planned initiatives often result in “islands of automation” they can be hard to expand to other functional areas down the road. A good supply chain consultant can help develop a more comprehensive approach.

Industry Norm Steps to Success

1. *Supplement bar coding with secondary order fulfillment methodologies.*

Cluster picking with carts can be a logical next step to reduce walking and improve pick rates. Technologies like pick-to-light systems and voice-directed picking can be deployed to further improve speed and accuracy, especially in case-pick and piece-pick operations. Conveyor-based zone-picking can be implemented to reduce walking even further.

2. *Implement greater automation in put-away and replenishment functions*

These functions must have at least a basic nature of automation in order to have proper inventory control. However, Industry Average companies have moved beyond operator directed put-away and visual replenishment. Most WMS systems can now support system-directed put-away based upon intelligent business rules. Advanced replenishment methodologies such as demand-based and min/max replenishment can ensure that the right product is in the forward pick area at the right time. Technologies like bar-code scanning, pick to light, voice systems, and conveyors can facilitate both of these inbound processes. Evidence shows that automation on inbound processes can greatly contribute to pick accuracy downstream.

3. *Consider parcel sortation in the shipping area if applicable*

Parcel sortation has been shown to have a very strong correlation to reduced labor costs, and improvements in on time shipments and accuracy. Case-pick and piece-pick operations that currently deploy excessive amounts of labor to sort and handle outbound cases should strongly consider sortation to automate this function.

4. *Use a systems integrator on complex projects for better results.*

Dealing with multiple equipment suppliers and software developers can be a labor intense approach that can overwhelm a company’s internal project management group. Systems integrators can often leverage a large team of resources to manage the complex mechanical integration and software interfaces for larger automated projects. Best in

Competitive Framework Key

The Aberdeen Competitive Framework defines enterprises as falling into one of the three following levels of practices and performance:

Laggards (30%) —practices that are significantly behind the average of the industry

Industry norm (50%) — practices that represent the average or norm

Best in Class (20%) — practices that are the best currently being employed and significantly superior to the industry norm



Class companies are far more likely to use a systems integrator so as to have a single point of project accountability.

Best in Class Next Steps

1. Take order picking to the next level through more efficient pick methodology

Companies that have invested in cart-based picking systems can supplement them with voice and light technology for improved accuracy and throughput.

Companies that have invested in conveyor-based picking should consider zone-routing technology to speed order turn-around times. Newer photo-cell accumulation allows a greater range of sizes and weights of product to be handled, at a lower price point than previously.

An AS/RS can greatly reduce labor requirements across various functions. Mini-load systems allow for a large SKU set to be handled in a compact forward pick area. Unit-load systems allow for ultra-high density storage of pallets with minimal labor requirements. Companies that need to maximize their storage density or that operate in freezer or cooler environments should strongly consider AS/RS.

Piece-pick operations should consider horizontal carousels to boost their pick rates and improve storage density. When used in conjunction with batch or cluster picking, these systems can yield some of the highest pick rates in the industry.

2. Consider upgrading existing automated systems in the shipping area

Parcel shippers should consider In-Motion Manifesting Systems, as these have been shown to have a significant affect on improved throughput and on-time shipments.

Recent advances in sortation technology have made higher sort rates available at a more reasonable price. Companies should take a fresh look at the new technology landscape and consider retrofits to boost throughput and improve conveyability.

Buffering and Sequencing technology is vital for companies engaged in route deliveries, or that practice simultaneous zone picking. Rather than manually consolidating product, consider light-directed carton flow buffers, or even horizontal carousel buffering systems for high throughput with a reduced footprint.

3. Consider automating reverse logistics functions for improved performance

Even in many highly automated warehouses, returns and reverse logistics is a neglected function that operates outside of the normal warehouse processes. Best in Class companies should consider automating this process through improved visibility and stricter put-away discipline to realize gains in operational accuracy.

4. Consider a “cost reimbursable” procurement strategy

Creative procurement arrangements such as “cost-plus” or “open book” contracts are still only used by a fraction of companies. However, Best in Class companies are more likely to be using these arrangements than the general population. These contracts can often allow companies to drastically shorten the design engineering and procurement cycle while still ensuring an equitable system price for the end-user.

Warehouse automation is a complex, broad topic. There is no one technology to use or process to automate that will guarantee success. The decision as to how to automate a warehouse should

only be made after a careful and comprehensive business process review and evaluation of the technology options which are available. The recommendations below are general in nature, and are meant to serve as a starting point for companies considering automation.

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Appendix A: Research Methodology

Between December, 2006 and January, 2007, Aberdeen Group examined the technology priorities, productivity barriers, and key performance indicators of 134 logistics professionals at all size companies in various industries.

Responding supply chain, logistics, and operations executives completed an online survey that included questions designed to determine the following:

- What correlation, if any, exists between warehouse automation and high productivity
- What warehouse automation technologies are currently used by various types of companies, and what their planned expenditures were
- What methods of designing, integrating, and procuring automated systems have proven most effective.

In January, further in-depth interviews were conducted with additional organizations on their warehouse automation practices and plans for innovation.

The study aimed to identify emerging best practices for warehouse automation and provide a framework by which readers could assess their own extended warehouse management capabilities.

Responding enterprises included the following:

- **Job title/function:** The research sample included respondents with the following job titles: Senior Management, Director, Manager. Functional areas of responsibility were predominantly Logistics/Supply Chain, but also included Information Technology and Business Process Management.
- **Industry:** The research sample included respondents from a variety of industries including:
 - Retail/Wholesale: 38%
 - Transportation/logistics: 13%
 - Industrial Manufacturing: 39%
 - Note: respondents could choose more than one category
 - Distribution: 22%
 - Consumer Goods: 67%
- **Geography:** The respondents were primarily located in from North America (75%). Remaining respondents were from Europe (10%), Asia-Pacific region (8%), and a small percentage from both South America and the Middle East/Africa.
- **Company size:** About 28% of respondents were from large enterprises (annual revenues above US\$1 billion); 45% were from midsize enterprises (annual revenues between \$50 million and \$1 billion); and 28% of respondents were from small businesses (annual revenues of \$50 million or less).



Appendix B: **Related Research**

[The Extended Warehouse Benchmark Report](#); December, 2006

[The Warehouse Productivity Benchmark Report](#); October, 2006

[The Transportation Management Benchmark Report](#); September, 2006



Authors

Ian Hobkirk, Senior Analyst, Supply Chain

As the Senior Analyst in Aberdeen's Logistics practice, Ian Hobkirk researches and analyzes how Best in Class supply chain professionals and their distribution and logistics partners employ technology and process changes to drive improved fulfillment results. Ian's current research agenda includes benchmark research on warehousing throughput strategies, methods for managing multiple distribution facilities, and transportation management.

Ian's career in manufacturing and distribution logistics spans thirteen years. He has spent nine years working with material handling systems integrators, in capacities ranging from engineering to sales and project management. He spent two years as the Director of Supply Chain Consulting for a Boston-based company, and helped numerous firms reduce their operating costs by implementing Best Practices in their fulfillment operations.

His areas of expertise include process flow analysis, space utilization, supply chain execution software, and material handling system design. Mr. Hobkirk has lectured at a variety of industry forums including the National Conference on Operations and Fulfillment, APICS, the Parcel Shipping and Distribution Forum, and ProMat.

Jeff O'Neill, Research Analyst, Supply Chain

As a research analyst, Jeff O'Neill researches and analyzes how Best in Class supply chain professionals and their distribution and logistics partners employ technology and process changes to drive improved fulfillment results. Jeff's current research agenda includes benchmark research on warehousing throughput strategies, extended warehouse processes, reverse logistics, and dynamic distribution networks. Mr. O'Neill has presented in various warehouse research settings, including the Warehousing Education and Research Council, The International Warehouse Logistics Association and Promat.

Jeff brings over six years of research experience to Aberdeen on a range of supply chain and warehousing topics. Prior to joining Aberdeen, Jeff was with Modern Materials Handling, where he covered trends in supply chain execution software and hardware equipment associated with distribution processes.



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