**Automated Warehousing and Logistics Whitepaper**

# The Amazon Effect:

Staying Relevant in a Changing Marketplace

**Bastian**
SOLUTIONS

# INTRODUCTION

Consumer preferences are changing amid a massive retail shift toward e-commerce. Amazon's inventory selection and Prime shipping have forced other businesses to pivot in their go-to-market strategies. Consumers demand items to be delivered more quickly and accurately than ever before, and these preferences are not felt exclusively in the retail space. People make decisions in business transactions, and their at-home experiences are brought to work, influencing their business decisions. As such, even organizations primarily in B2B relationships must react to the changing marketplace.

Throughout the supply chain, companies are pressured to increase order fulfillment speed. In addition, those orders are frequently smaller (driven by B2C relationships), which increases operational complexity in fulfillment centers. Nevertheless, even with expedited return procedures, customers have a lower tolerance for inaccurate orders more than they have before. Business executives must realize the difference in cost between customer retention and new customer acquisition.

Technology—both hardware and software—have changed the pace of fulfillment operations. Many businesses are finding difficulty maximizing their operational efficiency when deciding which technologies would be a best fit for their application. This white paper dives into methods of selecting appropriate technologies and how to execute a phased implementation.

# SCALABLE SOLUTIONS

With a wide range of available technologies aimed at increasing the performance of an automated warehouse, it is natural that some products will have various pros and cons in different applications. The people planning the operations for a business should evaluate the merits of given technologies not just through raw data, but how those technologies will integrate with the overall business model. At a minimum, the following factors should be considered:
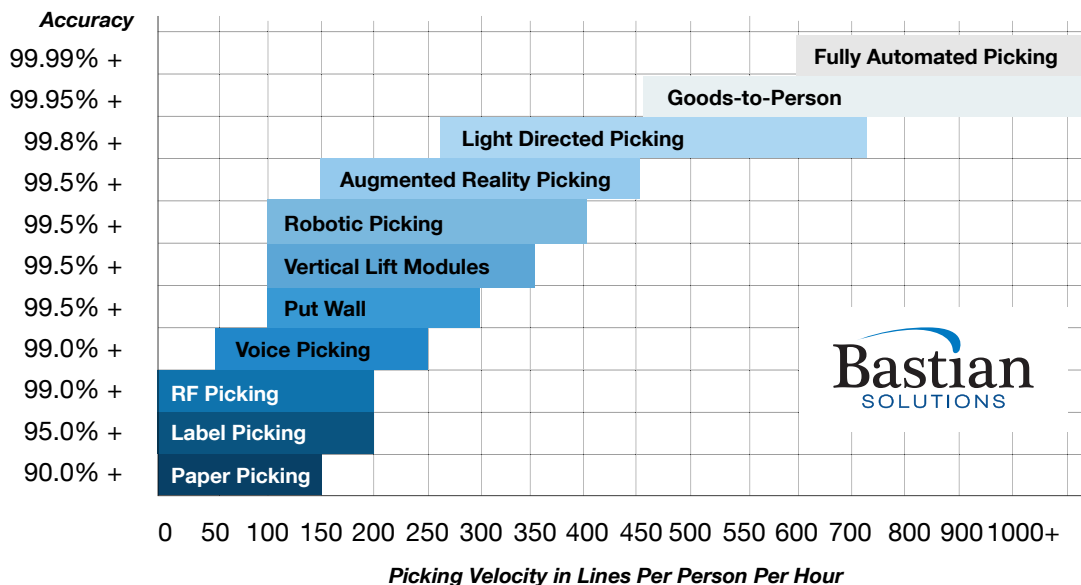
- Integration costs, both from a time-based and financial standpoint
- Flexibility required by the business operation
- Scalability needed based on growth models
- Performance against alternative technologies
- Organizational adoption plan

The below graph tracks warehouse picking rate versus accuracy for various levels of automation in picking technologies. When evaluating the current operation in a business, it is important to consider all of the "touches" that go into order fulfillment. For example, paper picking on the graph shows a 90% accuracy rate. Very few businesses ship out 10% of orders incorrectly, but it is perfectly reasonable that a picker using a manual, paper-based process could make a mistake 10% of the time. The picker will often realize their own mistake (mis-pick, miscount, etc.) and take corrective action. If that fails, an internal quality control (QC) procedure will catch some of the other mistakes. In either case, though, productivity falls due to rework, and incorrect orders are still shipped to customers. Besides the obvious costs of returns and replacements, there is an associated cost of customer retention that will vary from one industry to another.



Lower Cost — Faster Delivery — Higher Quality

In the graph, many options require an integration of hardware and software. In practice, the specifics of an operation can have an impact on both parts of the equation. For example, an extremely complex operation could have a software suite that runs every facet of the operation and still find that a medium level of hardware automation, such as voice picking, is a best fit. On the other hand, a leaner operation could realize a huge benefit from a goods-to-person system running with a limited software interface. Software and hardware do not necessarily have to scale at the same rate within an organization. As such, looking at each independently (while still planning for the integration) will yield the highest ROI.



*Accuracy*

| | |
|---|---|
| 99.99% + | Fully Automated Picking |
| 99.95% + | Goods-to-Person |
| 99.8% + | Light Directed Picking |
| 99.5% + | Augmented Reality Picking |
| 99.5% + | Robotic Picking |
| 99.5% + | Vertical Lift Modules |
| 99.5% + | Put Wall |
| 99.0% + | Voice Picking |
| 99.0% + | RF Picking |
| 95.0% + | Label Picking |
| 90.0% + | Paper Picking |

0   50   100   150   200   250   300   350   400   450   500   550   600   700   800   900   1000+

**Picking Velocity in Lines Per Person Per Hour**

# HARDWARE

When evaluating ways to increase efficiency, there are two main objectives—increased throughput with a given set of resources or a reduced labor cost. Frequently, both objectives are on the agenda, but with a given set of current operational practices and market conditions, one factor will prevail over the other. Either (or both) of these objectives can be realized to varying degrees with different changes (both process-related and equipment-related) within an operation.

While no operation is perfect, there are frequently processes that can be changed to either reduce waste (cost) or increase productivity. Methodologies such as Six Sigma, Lean, 3P, and others are frequently successfully implemented to achieve these efficiency goals.

However, there is a ceiling to throughput with a manual process. At a certain point, throwing more labor at a problem has diminishing returns, and greater improvements can be realized with machine-based automation.

# ENTRY-LEVEL HARDWARE

Entry-level automation solutions frequently include changing over from paper-based order fulfillment to an RF-based solution. While this hardware solution is generally integrated with software, (discussed later in the paper), the speed and accuracy of a scanner reading a SKU instead of a person reading numbers is evident.

A person could easily transpose a number or accidentally pick a product in a location above a label when the location below the label should be used, for example. Additionally, people working in an area for a lengthy period of time become accustomed to picking the same products repeatedly.

While there are speed gains with this familiarity, there is also an increased chance of that person picking a memorized or an assumed product without taking the time to fully read or double-check numbers, resulting in increased mis-picks. Computer-based technology (such as RF scanners) can help alleviate

a large number of these errors, resulting in lower costs for QC processes and returns on incorrectly shipped merchandise, not to mention higher customer retention. If shipments are frequently done incorrectly, online reviews will show this low accuracy rate, resulting in people spending their e-commerce dollars elsewhere.

Additional entry-level technologies can also include basic levels of "smart" conveyor that are able to achieve higher buffering capacity and automated movement beyond a basic on/off setting with a belt mated to a motor.

Even at an entry-level price point, conveyors make use of photo eyes and individually-driven conveyor zones to accomplish "zero pressure accumulation" where products (pallets, cartons, totes, etc.) are automatically indexed forward to maximize the buffering capacity in a given space.



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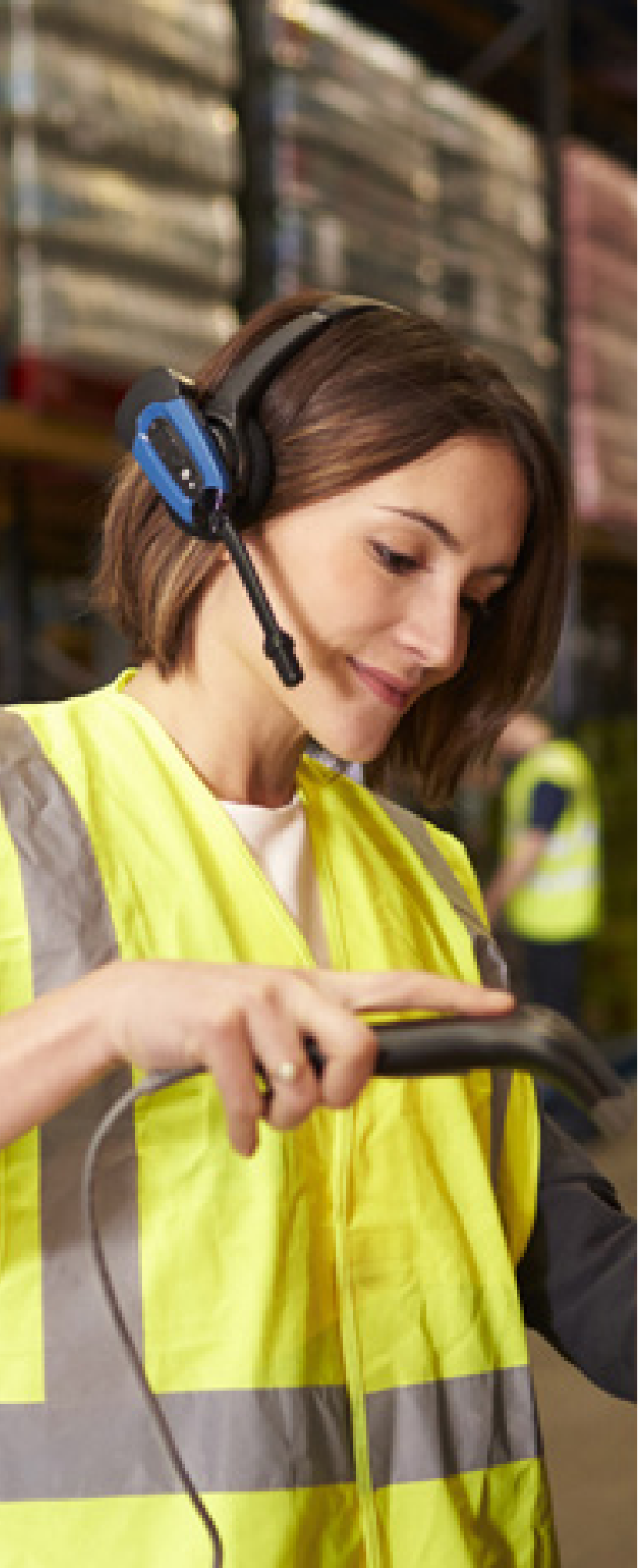


Put wall applications decouple the picking and packing process of order fulfillment maximizing the efficiency of each application.



Handheld technology such as RF scanners can help alleviate a large number of mis-picks.



Scanners combined with put walls can help operations go from paper-based to software driven with 99% order accuracy.

# MID-LEVEL HARDWARE

At an increased level of automation, fulfillment speed at the operator level can again be increased in a move toward pick-to-light (PTL) or pick-to-voice (PTV).  Just like RF picking, these technologies are optimized with a software solution, these technologies leave the operator free to work with both hands, reduce time scanning each product, and can further increase picking accuracy in some cases (for instance, when an RF scanner is scanning a location instead of a product, which can still result in mis-picks if controlling measures are not in place).

On the conveyor side, systems of multiple transport lines are integrated with software control to achieve automatic order routing (AOR).  This can allow a single order to be filled in multiple locations where operators specialize in their area.

For example, a single tote can receive an item from one pick aisle with carton flow and an expert in the area, then be routed to have additional products placed from a separate pick location from static shelving and that area's associated operator.  The result is having highly-efficient operators spending a higher percentage of their time actively fulfilling orders instead of walking around a facility.

The conveyor system can be optimized to allow the order to make its way through a facility and only stop in the locations where it is needed, reducing congestion for operators and increasing the speed of order fulfillment.

# ADVANCED HARDWARE

At the higher end of automation hardware, we can see newer technologies that are pushing innovative limits, as well as more established technologies that require a larger amount of infrastructure.  In these cases medium- to large-scale operations can realize a drastic reduction in labor and increase in throughput if they have the order demand to support.

One example of an innovative technology being applied is augmented reality (AR) picking where an operator wears a headset that overlays critical information for order picking.  While PTL technologies are fast, having individual lights and pushbuttons and hundreds of product locations can be prohibitively expensive.  On the other hand, outfitting just a handful of operators with AR headsets can be more within reach while also providing additional order information to increase picking accuracy, such as product pictures as seen in the below example with the bottle of nail polish remover.



One example of an innovative technology is augmented reality (AR) picking where an operator wears a headset that overlays critical information for order picking.

Other advanced technologies have been proven in industry for many years, such as goods-to-person systems.  These include storage grids with robotic shuttles that bring products to a picker, virtually eliminating wasted time walking.  With products being directly presented to pickers, the chance for mis-picking an order is practically removed.  In the below photo, pickers stand at the end of an aisle while batch-picking products from the gray totes presented on the blue shuttles.  These operations are software-directed with a user-interface (including pick quantities and order box location) on a computer screen.  Picking speeds with this type of system are frequently an order of magnitude faster than manual processes, while greatly reducing any errors.

To further augment the labor savings realized from a goods-to-person system with a robotic picking unit can be integrated in place of an operator station.  This type of technology is newly being implemented in the field, but allows a vision-enabled robot (note the camera on the end-of-arm tool below) to fulfill orders.  New camera technologies and processing algorithms allow a camera to take a quick glance at a pile of products while the software processes which one will be "easiest" for the robot to pick.  The software passes information to the robotic arm to make the best selection and moves items from a product storage location (such as a goods-to-person tote) to an order location (such as a corrugated box for shipping).



Goods-to-person and goods-to-robot systems provide incredible picking speeds, while reducing errors and improving overall system flexibility.

# SOFTWARE

Except for some basic implementations of "smart" conveyor, most automated systems will require some implementation of software to direct the fulfillment operation. However, not every software implementation is a multi-million-dollar, network-wide ERP. Just like hardware options, there are ways to scale a software suite with a growing business.

Software-directed operations allow for a computer to make order routing and picking assignment decisions faster, and more efficiently, than a person using a manual system could do. The optimization decisions are moved from the operator to an algorithm optimized based on management priorities. These can include factors such as:

• **Reduced walking time**

• **Passing orders between pickers (zone picking)**

• **Batching orders for increased picks per location stop**

• **Sequencing based on priority**
  **(shipping time, route optimization, order priority, etc.)**

These benefits are achieved through the implementation of a warehouse management system (WMS) to help direct the floor-level execution of the fulfillment operation in accordance with expected practices of the facility management.

# WMS / ERP

The next level in software automation of a fulfillment operation is an in-house WMS integrated with a host Enterprise Resource Planning (ERP) suite such as Oracle, SAP, or MS Dynamics. The WMS is configured for the operation's specific needs, often including several of the following functionalities:

Additionally, the software integration team should take the time to understand an operation to ensure the configuration (and any customization) is optimized to achieve the organization's goals.

- **Inventory Control**
- **Shipping & Receiving**
- **Putaway**
- **Quality Control**
- **Order Cubing**
- **Automated Picking**
- **Labor Management**
- **Order Release**
- **Wave Management**
- **Location Management**
- **Workload Balancing**



A good software provider will only implement the modules that are needed for an operation without forcing a customer to pay for functionality that will not be used.

# WAREHOUSE CONTROL & EXECUTION

Once a WMS is in place, higher levels of automated hardware can be implemented in a system. This hardware will need to be controlled, though. While operator button-pushes are possible to control this equipment (such as a vertical lift module), there is a large amount of efficiency to be gained by removing operator decisions from the material flow process. Algorithms can direct the movement of the equipment, automatically selecting the most efficient equipment moves, product routing, and other factors.

This automated control system comes in the form of a warehouse control system (WCS) or warehouse execution system (WES). There is a good deal of industry confusion of what these terms really mean, but to simplify a bit, they can be summarized (and differentiated) as follows:

**WMS:** Controls inventory levels with functions such as receiving, shipping, and cycle counting

**WCS:** Controls equipment direction such as automated order routing within a conveying and sortation system

**WES:** a single software suite that performs functions of both a WMS and a WCS. There is no requirement to have all of these systems. In fact, if a separate WMS and WCS are working harmoniously, a WES would not be needed.

Likewise, if a standalone WES is providing enough equipment control and inventory visibility, a different WMS or WCS would not be needed.

# PHASED IMPLEMENTATION

Due to cash flow restrictions, an operation may forego the decision to automate an entire facility in a given period of time.  There is opportunity to spread capital expenditures from quarter to quarter (or even year to year) by leveraging a phased implementation plan.

By planning multiple phases up front, an organization can prevent costly retrofits—both in the form of equipment modifications and downtime.  Factors that should be included in a phased implementation plan should include the following:



- **Growth Milestones**
- **Equipment Scalability**
- **Floorspace Considerations**
- **Building Expansions**
- **Location of Services (i.e. air, plumbing, dock doors)**
- **ROI Calculations on all Potential Solutions**
- **Investigation into Multiple Technologies**
- **Cost of Expansion vs. Cost of Increased Storage Density of Highest Revenue Earners, Volume, or Greatest Cost Centers**

# CONCLUSION

Today's marketplace has multiple options in both hardware and software for automating fulfillment operations.  Great care should be taken to evaluate solutions from multiple manufacturers from a design and implementation standpoint.  ROI calculations taking into account business growth and cost-mitigation from future expansions should be driving factors in a decision with technology selection.
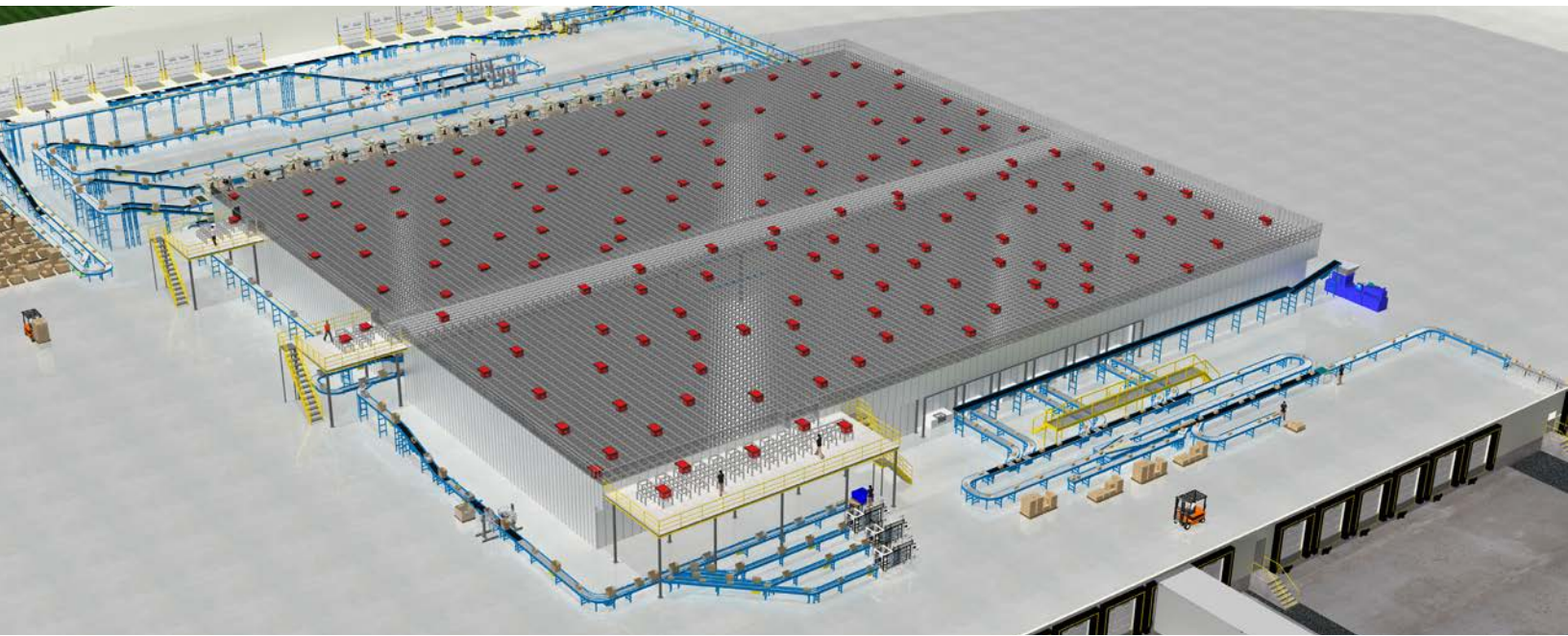


Options for scalable hardware and software are allowing more companies than ever before to create automated fulfillment systems that are successfully and cost-effectively responding to changing consumer demands.

## ABOUT BASTIAN SOLUTIONS

Bastian Solutions, a Toyota Advanced Logistics North America company, is a material handling systems integrator, providing automated solutions for distribution, manufacturing and order fulfillment centers around the world. The company specializes in e-Commerce, mobile robotics, IoT, consulting, warehouse software, and high-speed conveyor sortation systems. Today, the company engineers and manufactures many of its own products including ZiPline Conveyor, Rogue Composite Pallets, BlueHound IoT pallet trackers and Exacta Supply Chain Software.

Founded in 1952 and headquartered in Indianapolis, Indiana, USA, Bastian Solutions has established itself as an innovator in the field of material handling automation, supply chain software and controls. The company includes 18 U.S. offices as well as 8 international offices.

For more information, visit https://www.bastiansolutions.com



## ABOUT THE AUTHOR



Matt Greene is the regional manager for Bastian Solutions' Southeast office in Atlanta. He studied nuclear engineering at the University of Florida and holds Master's degrees from the Naval Postgraduate School (nuclear engineering) and Florida (business). Matt is a certified PMP and Lean Six Sigma Black Belt. He was a surface warfare officer for the U.S. Navy and now specializes in material handling technology with Bastian Solutions. His team typically serves the markets in Georgia, North Carolina, South Carolina, Tennessee, Alabama, and Florida.