Getting Robots to Pay for Themselves

Crimson&Co

Robots, in some form or another, have been a feature of warehouses for over 50 years, but the technology has hardly been ubiquitous.

Yet in just 2 years, almost all of Crimson & Co's large North American clients have gone from thinking robots are an inflexible, overly expensive technology that should remain in manufacturing to deploying them somewhere within their warehouse operations.

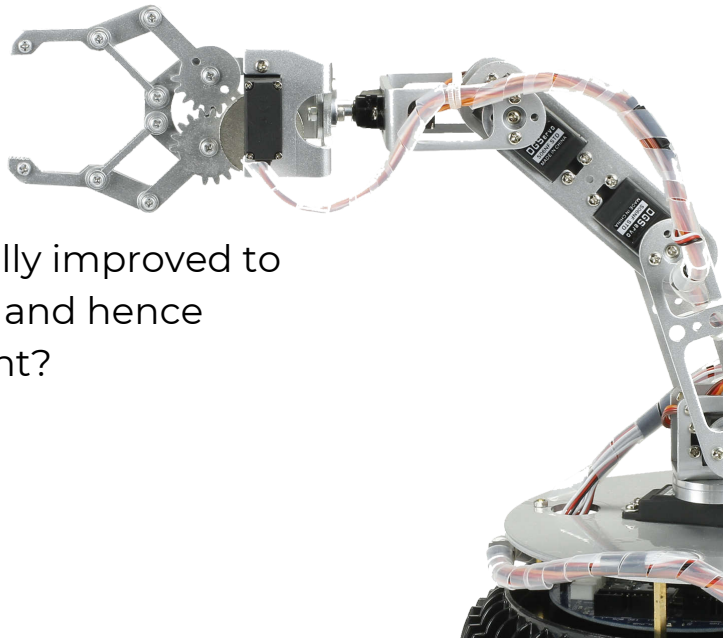
Robots are now the hottest question on the minds of many warehouse managers and logistics executives. What makes today's technology so different? And how can modern warehouse robots pay for themselves?

To answer those questions, we need to take a brief look back at the history of robots and their use in warehousing.

A little robot history

Historically industrial robots were organized into two categories:

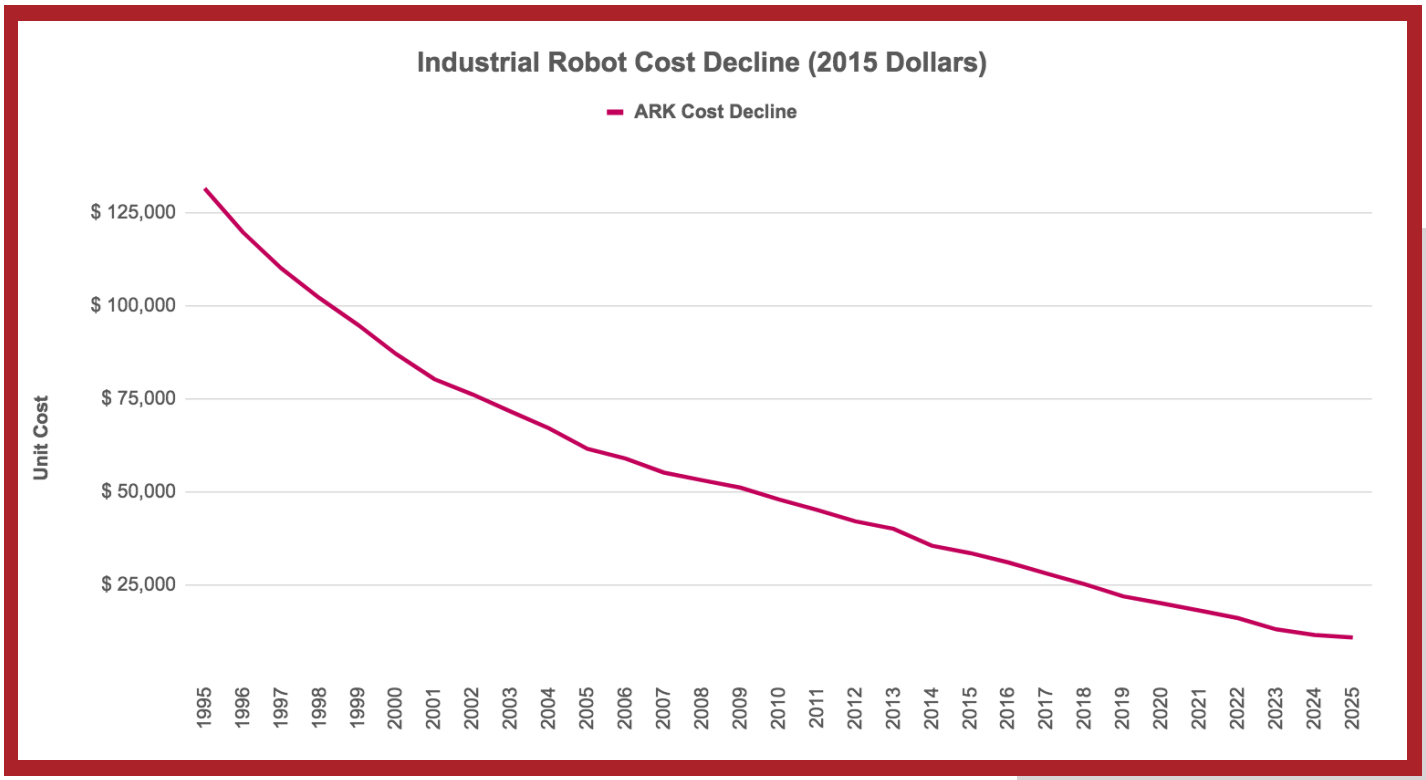
- AGVs
- Multi-Axis, Armed Robots



These are still around but are dramatically improved to be more suitable for warehousing tasks and hence installation in more sites. What's different?

Robot cost

One of the leading drivers of this change is cost. Robots often are used to replace labor. As they become less expensive they can be justified in more situations. According to a study by the Ark Investment Group in 2017, since 1995 the cost of a robot has fallen by 75% in real terms.



This cost reduction is driven off of simply learning how to build cheaper robots and developing smarter robots that take less effort to deploy. Warehousing firms are deploying more robots today because they are cheaper and easier to justify.

Robot intelligence

But being cheap wouldn't earn robots a way into more DC's if they weren't smarter than yesterday's robots. Today's robots are much more flexible than yesterday's. They are fast to deploy because they adapt to your existing layout and processes and if you move the robots can go with you. Crimson believes this is probably the most significant factor in their rise.

For instance in the 1990's, AGVs required long setup times and firms had to bury steel cables in the concrete or paint special paths on the floor to use them. AGVs struggled with the world of distribution where travel paths changed quarterly or more often. They also were hindered by only being able to stop when something crossed their path as opposed to driving around obstacles.

Leveraging the inexpensive sensors of cell phones and new technology developed for autonomous cars, AGVs (now referred to as autonomous mobile robots (AMRs)) can be deployed in a few weeks because they can "learn" their environment by carefully wandering around. Today's AMRs can also travel around obstacles instead of stopping, and this is important as one major retail firm who deployed AMRs discovered.

The company's report stated that 90% of the AMR trips in their DC encountered a person and thus they needed the added sensors on AMRs to navigate around a human and other obstacles to maintain throughput. If the path between two points changes, it is also easy to change an AMRs "map" of the building accordingly.

You can also take AMRs with you when you move a process or a facility.

Crimson has one customer where the robots literally drove up onto a truck and left the old facility for the new.

Multi-Axis robots are also smarter.

It used to be that armed robots demanded that pieces and products they pick up be presented to them in a highly, consistent manner. Robots were quite finicky perfectionists.

If objects were in a slightly different orientation or the tote delivering them to the robot was off by a mere inch or two, the robot could not adapt. This requirement limited their deployment in many warehouses because it was hard to guarantee the consistency of conditions they needed to be successful.

With improved vision and high speed computers, armed robots are now able to pick up objects without these regimented conditions. If the product is randomly dropped into a tote and presented to a robot the robot will almost always pick it up.

Today's robots also don't need to be "taught" or programmed how to pickup objects beforehand, they can make that determination just like people do, i.e. by looking at the object.

Finally, if the tote or pallet feeding a robot comes in off kilter or is even turned 90 degrees; it doesn't matter. The robot adapts.

Robots are smaller.

In addition to being cheaper and smarter, today's robots can be smaller which makes them feasible for more applications. For instance, AMRs can be a third of the size of their AGV parents. Much of this is due to improved battery technology. Thus AMRs can be used to carry a few totes instead of a whole pallet.

This makes robots safer and has given rise to the term "cobots" which are robots that cohabitate and work with people side by side. "Smallness" has also led to innovative combinations of robots. Armed AMRs like those from Invia, IAMRobotics, or Magazino are now wandering around warehouses grabbing things off conventional shelves, and this simply did not exist in 1995.

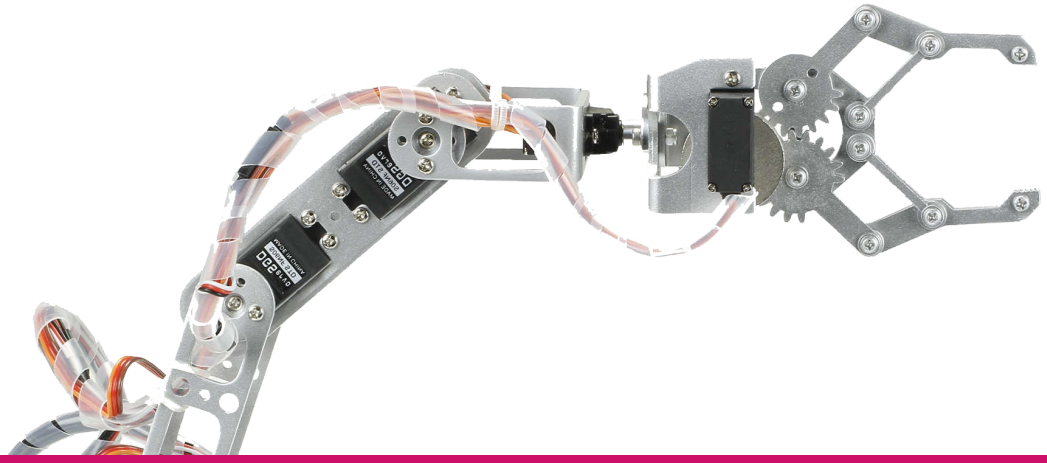
Robots ARMS are also smaller.

Whereas most robots were used for case picking or palletization in earlier warehouses and auto assembly lines, today's multi-axis robots are working hard to improve the efficiency of ecommerce warehouses and small-to-mid-size manufacturers where they manipulate very small objects.

Warehouse applications like putwalls, sorter induction, decant are all feasible because today's robots are safer and smaller than yesterday's.

All of these changes together are making robots much more viable for warehouses than ever before.

What's Your Strategy?



So the hoopla around robots working in warehouses is worth listening to. Every mid-size or larger firm needs to have a robot strategy for their DC. Robots can now make a significant impact in distribution centers. The question is "How?"

Crimson surveyed the market and uncovered three strategies for using robots.

We believe you should consider all three when deciding on your own for deploying this emerging technology:

- **One-for-one**
- **Process support**
- **Game changing**

As stated above, with the improvement in sensor technology and the addition of faster processors that can analyze visual and sensor information quickly, robots have finally broken out of the manufacturing plant and are drifting into distribution centers. The results to date, however, have been mixed. Crimson has surveyed our clients who have installed this technology as well as met with numerous robotics companies to understand:

a) What leads to a successful robotics project?
b) When do robots really pay for themselves in DCs?

The answers to these questions depend less on the robot that a firm chooses and more on how the company chooses to use the technology. Whereas most material handling equipment has a well-known history indicating where it should be used and where it should not go, despite all the hype new robot deployments are still few and mostly unpublicized.

Very few firms really take the time to understand the limits of the technology and with little history as guidance, they may choose wrong. Our survey suggests this happens more often than you would think. By reading this white paper, we believe you will dramatically increase your chances of success.

One-for-One Approach

There tend to be three ways in which companies pursue robots for warehouse use. The first group is called the "One-for-One Companies." These are the companies that are looking to replace individual people who work within a given process, but they don't intend to change the process. They literally would like to pluck an individual from the DC and replace them with a robot.

The jobs usually targeted by this approach are sedentary like packing, sorting to a putwall, decant or sorter induction, but they also can involve jobs where operators move around but don't do much with their hands like shuttling pallets from one end of the building to the dock.

Most companies Crimson consults with are looking for a payback on automation in 2-3 years. In an example where warehouse workers are paid $15 / hour plus benefits (full-timers) or fees (temporaries), then a person costs a warehouse about $42,570 per year. Most of the new robots used in one-to-one situations are running about $100,000 plus integration.

Fortunately, integration is light, so it runs about $20,000 to $40,000. This makes the payback at firm's using this strategy and operating one shift easily more than 2 years. The payback can be slightly faster if more robots are implemented and the cost of the integration is spread over more units.

Annual Cost of a Person
$15.00 Per Hour Wage 32% Burden or Fee
$19.80 Per Man-hour 8 Paid Hours 7.5 Hours of work 2000 Paid Reg Hours 100 Paid Overtime Hours
$42,570 **Per Person Annually**

If a facility operates two shifts, the chances at a 2-year payback improve, but you still need to factor in the rate at which the robot works.

In some jobs, the robots can match human speeds, but in some they may only be 65% to 75% as fast or they require people to come around and help when they are stuck or bewildered.

For this reason, a key to companies pursuing the one-for-one strategy is having or envisioning a 3-shift operation.

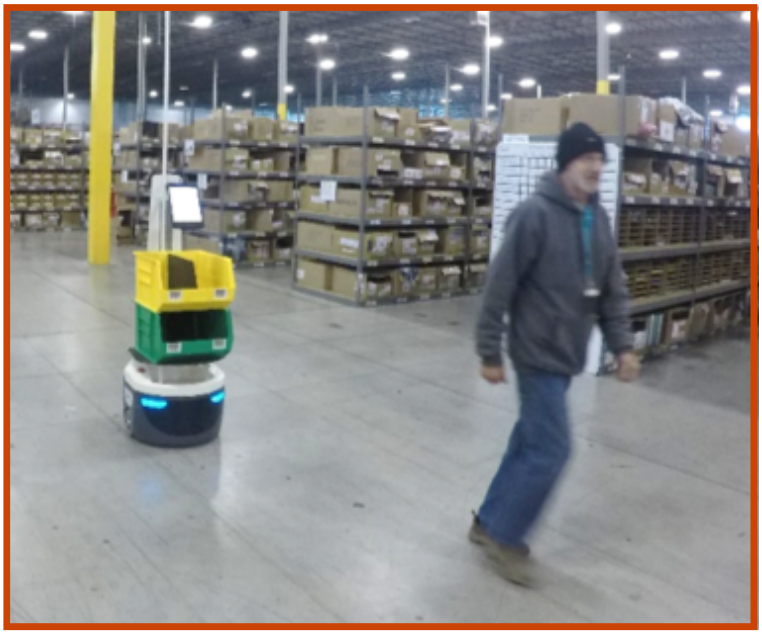
Process Support Approach

The area where the market is seeing the most activity, and some published success, is with customers who pursue the Process Support approach to robot deployment. Like the one-for-one buyer, these companies don't intend to change a process but instead use the robot to perform part of the job that a person performs.

For this reason, the robots are frequently referred to as "cobots," because they work alongside people in a cooperative fashion. The robots don't directly replace people but the part of the job that the person performs changes and they can become more productive.

While there are different types of cobots, all these solutions force a new "work pattern" onto the people that can be beneficial. They don't change the process but they change how the people execute it. For example, a cobot may lead the picker to his pick location and it knows if the picker doesn't follow. This can be reported to management if it happens regularly.

The cobot also travels at a set pace so the picker must walk at that pace to keep up. The cobot's screen can present the picker with a big picture of the item to quickly decide if this is the right item to pick; this compares to a handheld or wrist mounted small, green screen with characters used by most warehouses today.



Another common reported benefit of cobots has been a reduction in associate training time. This is not to be ignored.

A well-trained worker is often 35%+ faster than a new worker. Such a gap is not uncommon in places that use OJT and lots of short-term temporary workers. It can take 6 weeks to close that gap at many sites. If cobots shorten this learning curve they add still more value.

Companies with well-managed and motivated operations may notice that all the above could be addressed with good management and training in a manual system. Consequently, these solutions tend to be successful only when brought into sites that do not perform very well due to poor design implementation, insufficient management or unmotivated workforces.

Based on our experience in conducting labor studies and performing turnaround work in warehouses, we know of many under-optimized manual operations where this technology can really shine. Cobot solutions are also being deployed in new sites where there are no established expectations for pick rates, etc.

The key to this approach is to understand how good your existing operation is and how much effort it would take to turn it around if it is underperforming. Sometimes cobots are the right answer because they represent the fastest, lowest-risk path to improvement. We help clients decide this before every robot project.

This begs the question: Why don't cobots pay off in well run operations? If you look at the time impact that cobots have in picking, their limited value emerges. Consider the traditional, well-run, multi-order piece picking process below:

	Seconds	
Time to start Pick Tour	0.95	Per Line
Time to walk to 1st pick	0.42	Per Line
Time to walk to pick face	5.85	Per Line
Pick Product from pick face	2.39	Per Line
Time to walk back to cart	1.69	Per Line
Time to drop product in tote	1.22	Per Line
Time to confirm pick	0.14	Per Line
Finish Tour	1.15	Per Line
Delay	5%	
Total Time Per Line	**14.4**	Per Line
	249	**LPH**

A Well-run Cart Picking Operation

Batches orders properly

Uses labor standards or observation to ensure good walking pace

Trains pickers to confirm picks walking back to pick face

Doesn't unload totes but parks cart next to pack station

Looking at the elements that are impacted by cobots (red), they will save you 29%. These steps occur at the start and end of the pick tour. The robots bring you the totes you need to pick into, so there is no need for the picker to set up a pick cart at the start of a tour or drop them off at the end. But the rest is pretty much the same today assuming the facility has a well designed and managed multi-order cart picking operation .

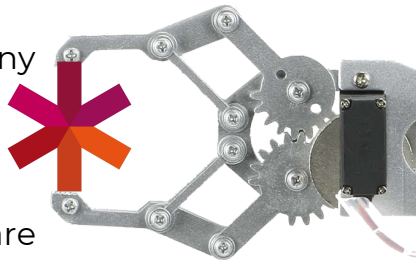
But this turns out to be insufficient to make the robots pay for themselves. Multiple factors erode the potential savings. First, you need someone (other than the picker) at the start (or end) of the tour to load (or unload) the totes off the cobot. Currently, the operator scans the item on the way back to the cart from the pick face, but now they will have to add 2.5 seconds to scan the item once they get to the cart.

More importantly, while the cobots are about $35,000 each, as a rule of thumb you need 4 cobots per picker to keep the pickers busy (fewer in smaller facilities). This is because the bots don't travel much faster than people, and there are fewer totes on a cobot compared to a pick-cart pulled by a person. This is not to say cobots won't ever pay off in well-run operations, but you should do the homework to see if yours is a special case.

Game Changing

Undoubtedly, the most exciting segment of customers are the firms that are looking towards robots to provide step function changes in performance. These are companies that are willing to bulldoze the current process and do something quite different—something better. What is equally exciting is the number of young robotics companies that are willing to engage with these customers. This is the segment of the market to watch most closely. It is also why the two largest retailers are so active in this space. Robots could create a revolution in ecommerce fulfillment.

Crimson believes the game-changing approach has merit for a couple of very solid reasons. First, most of the processes employed in warehouses today are limited to the tried & true offerings of the existing material handling and software companies that sell into warehouses. These processes were designed, built, and coded many years ago.



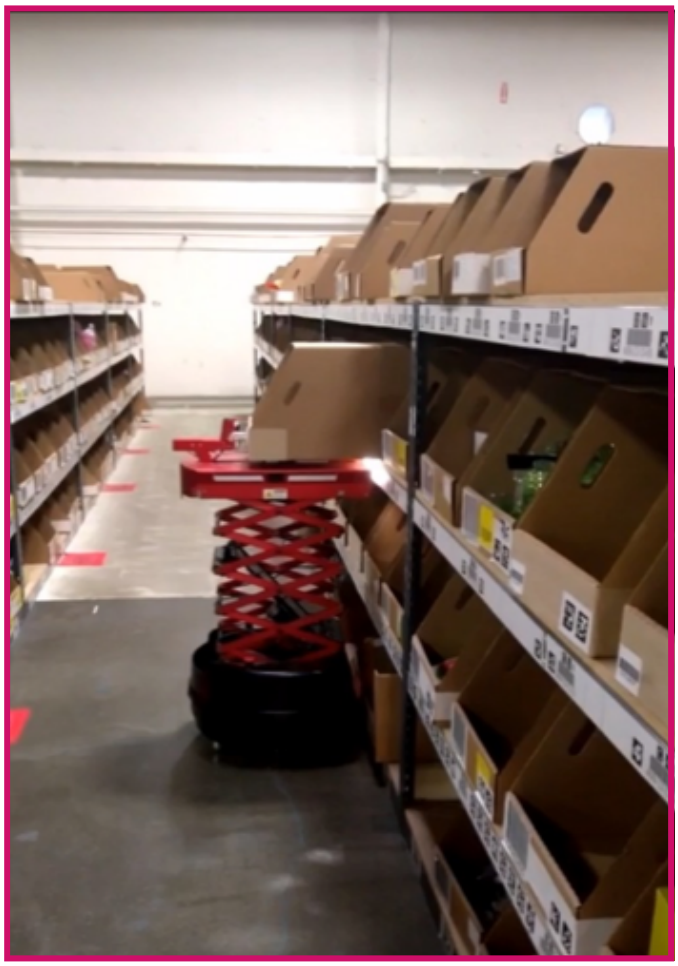
While Crimson is acknowledged as one of the more innovative designers in the warehouse space, we often run up against software and MHE limitations from the legacy vendor community. This changes our design process from one based on raw creativity to more of a menu-choice evaluation where we help clients choose from an array of existing processes that we flourish with creative tweaks as opposed to designing something entirely new. This limitation is generally not present with robots and robot companies.

Removing this limitation unveils all sorts of new ways to pick and process orders. For example, instead of just picking one order at a time, multiple orders at a time, zone picking or wave picking, new choices can and will emerge. We know these exist; just a tiny subset of warehouses have ever used some of them.

Robot companies are also looking at even more eye-opening new options.

Robots have no learning curve. Assuming a workforce that mainly involves robots, this allows a robot company to reconfigure your warehouse process in real time. We have historically thought about the output of the warehouse design process as something static, but the design could change instantly based on the order pool content. Think how valuable this would be at places with marketing spikes in activity or where the peak profile is substantially different from off peak periods.

The second reason we think the game-changing approach has merit is due to what we call “robot synergy.”



Recently, we have been involved in process support and one-for-one robot projects for clients.

One of the limitations to both approaches is that that robots are no more productive than the people that are feeding work to them. This limitation takes a couple of different forms.

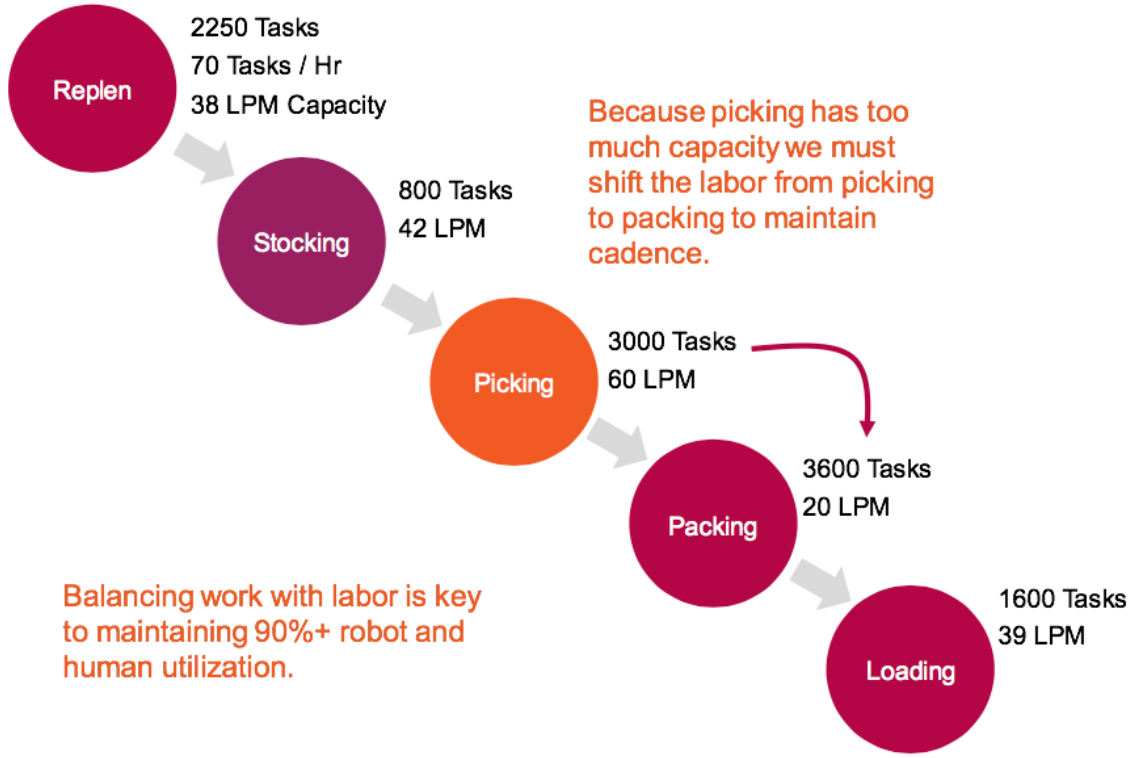
People do not work all the time.

In very high-volume operations this can be a large portion of the day! Look at the info below, which documents how many hours on a peak day the associates were not working in a high-volume site.

This DC ran two long shifts around the clock:

- 1.00 hours between shifts to enable parking lot flow
- 0.50 hours to get RF terminals, MHE equipment and job assignments
- 0.50 hours in breaks x 2
- 0.50 hours in lunch x 2
- 0.25 hours putting up equipment and walking to time clock at end of shift x2

In a 24-hour peak day this adds up to 5.5 hours per day or 22%! If robots are feeding work to robots then this gain materializes, and there is still more opportunity with robot synergy.



The second gain occurs because when people are working, they are not all that productive often due to no fault of their own. Again, Crimson knows from installing labor management systems in warehouses that workers can be underproductive due to a lack of orders to pick, pallets to put away, etc. They may also be less productive because there are too many associates in a given area for the work on hand.

Robot companies are developing WES-like functionality to dole out the work and move resources around to keep the network flows balanced and everyone and every bot working. This provides even more payback over the classic one-for-one and process support approaches. At one wholesaler of footwear, an additional 24% of throughput was possible if the client could get better at releasing work and moving people from operation to operation as demand needed. We foresee this sort of utilization dividend at many sites using robots and the game-changing approach.

Other Considerations

While we have been surveying the marketplace, we feel we need to point out a few truths about this emerging technology. First, robots are not the equal of people, at least not just yet. With every vendor we have encountered there are some sort of "gotcha" or subtle limitations. You need to know these to avoid surprises in the middle of design or worse during implementation. For instance, some robots cannot reach below "X"; others cannot see color; some can only travel one direction; others can see obstacles in the floor and will stop while others will drive around the obstacles, etc. These may or may not matter to you. It depends on the design goals.

Second, we have been surprised at how many of the products shown on YouTube and elsewhere are not yet available for sale or have not even been piloted anywhere. Do not misinterpret this — there are good products available that work and can be deployed right now. You may be surprised by how many are only in research labs or available for sale to researchers, etc. compared with the more MHE market ready products.

Finally, robots should not be taken as technology that is "permabonded" to the floor. When you move, the robots can go with you; just let them drive onto the truck. We have seen this actually happen. This opens up creative uses for them in urban distribution centers and popup DCs. They can be literally wheeled over to a new location in a warehouse and quickly repurposed for something new without fanfare.

How Crimson Can Help

Crimson & Co is a supply chain/logistics consulting firm with offices around the world. We believe robots are a key ingredient in the digital transformation underway globally in warehousing and manufacturing. We are spending a lot of effort to understand the capabilities of vendors in this space, their costs, strengths and weaknesses.

We are also excited to help clients in their search for solutions employing robots. Whether you are looking for point solutions or a game-changing transformation, please contact us. The latter is particularly enticing because we feel the need for a creative design partner has never been stronger.

Traditional integrators are hampered by a bias toward historical solutions that they can copy and profit from quickly. They often view game changing opportunities as science projects and not money-making activity. The robot vendors are young and often don't have the design experience that an older, unbiased firm like Crimson can bring to the table.

Creativity is less risky or expensive if done by a firm that has been delivering innovative designs for decades and understands the limitations and opportunities very much in today's traditional models. If you are looking to really generate a step change in performance, please call or email us.

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