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Seven Truths about the Business Case for Collaborative Picking Robots

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Collaborative picking robots (bots) are gaining a lot of attention with a few, high-profile applications[1]. It's exciting to think about the ways bots can be used to reduce labor and costs, but you should be aware that every operation is unique and not all applications of bots can be supported by a solid business case.

In discussing the business case for their technology, manufacturers often state that using bots will reduce the number of workers by 50% using 3 to 4 bots per worker. In this article, we explore the business case for bots – where they are a good application and where they may not be the best solution. This goes beyond the industry rule-of-thumb. While this article focuses exclusively on the tangible, productivity-related advantages of bot applications, it may not be the only reason for deploying bots. Limited availability of labor, labor acquisition costs, the desire to innovate to support new business opportunities, reduced worker training time and worker retention can also factor into the decision to deploy bots in the DC.

EXAMINING THE "ONE-SIZE-FITS-ALL" RULE-OF-THUMB

Bots can be acquired or leased with a variety of payment schedules but in general, the annual cost is approximately $12,000-$15,000 per bot. The loaded labor cost of a worker can be $35,000 to 50,000 per year depending on the employer, location, and other factors like benefits and training cost. Applying the industry rule-of-thumb of reducing one worker for every 3 to 4 bots suggests a tradeoff of an annual reduction of $35,000 to 50,000 in labor cost compared with a $36,000 to $60,000 annual bot expense for a one-shift operation.

Bots are like other automation options in that a two- or three-shift operation provides the strongest business case for deploying the technology. And as the cost of labor increases and/or labor availability is constrained (trends that are expected to continue) and the cost of the technology decreases (as it also certainly will), the business case will improve.

[1] NextGen Supply Chain at DHL, Modern Materials Handling, March 13, 2018
A Robot Can Be a Warehouse Worker's Best Friend, Wall Street Journal, August 3, 2017

Given the potential business case for this technology, it's important to fully understand the labor reduction and bots needed to achieve it. Rules of thumb offer some general guidelines but on closer inspection, the size of the picking area, the density of the picks, the number of orders on a bot, and the number of lines per order will affect the potential business case. Fortna has developed both analytical and simulation models to allow us to evaluate a number of potential use cases based on combinations of these parameters. In creating the models, we didn't try to exactly mimic any particular bot technology (or comparable smart cart manual system). The goal was to build a model that was robust in capturing the fundamental dynamics of the system.

Here is the framework we used for our comparisons. First, the baseline operation for comparison is a pick to smart cart, cluster picking operation, which we compare to a bot system, which is also executing a cluster picking operation. Cluster picking is the process of picking multiple orders in the same picking trip into distinct totes or bins. Generally, multi-tote or multi-bin car/carts are used to execute a cluster pick batch. In a bot cluster picking operation a worker is still required to perform the picking operation. Therefore, these systems can be thought of as "worker-supported bot picking systems." This is key because it helps to articulate a number of fundamental truths about the system.

Truth 1: The advantage of a bot system lies in the ability to eliminate the travel associated with humans pushing carts past aisles with no picks.

We ran thousands of systems through our analytical and simulation models to compare the cost trade-off between the pick-to-cart system and a bot system. What is clear from our results is that the benefit of a bot system increases as the relative percentage of walking in the total cycle time increases. That is, as the pick density decreases (because the size of the picking area increases, or the totes assigned to a bot decreases or some combination thereof), it would be wiser to invest in a bot for that non-productive travel than to have a human pushing a cart over this distance.

Over our many examples we did find, in general, that labor was reduced by about 50% and the number of bots per worker was about 3 to 4. But as noted above, although this held "in general," for any individual example the percentage reduction in labor ranged from 25% to 75% and the bots per worker ranged from 2 to 8. Clearly, it is the combination of these values that drive the business case (or the lack thereof).

> **"Given the potential business case for this technology, it's important to fully understand the labor reduction and bots needed to achieve it."**

Truth 2: Individual bot manufacturers will continue to be differentiated with respect to their ability to minimize the negative aspect of the bot system – the dwell time for the bots as they wait for a human to perform the pick.

The primary disadvantage of a bot system is that the bot waits for a worker to perform the pick. This wait time is referred to as the dwell time. Bot manufacturers are investing heavily in algorithms to reduce bot dwell time. That is, by knowing the real-time location of workers and bots, it may be advantageous to direct the bot to an area where there is a worker – to reduce dwell time. If the dwell time reduction is greater than any increase in travel time, this kind of intervention can be advantageous. Such improvements will expand the number of applications where bots provide a positive business case.

Truth 3: Adding a worker to a bot system, in general, reduces the number of bots needed (and vice versa).

Due to the dwell-time issue, the number of bots needed in a system is dependent on the number of workers in the bot system. That is, increasing the number of workers, in general, decreases the dwell time for bots, which then leads to a reduction in the number of bots needed to support the throughput. The opposite holds as well: decreasing the number of workers in the bot system will increase the dwell time and thus, the number of bots needed. Therefore, the optimization problem that needs to be solved in designing a bot system is determining the correct application of workers. Too few workers will lead to long dwell times and a level of bot investment that cannot be supported. Too many workers and the labor reduction will be negated and the investment in bots will not be justified.

Truth 4: When bots and workers have similar travel speeds and are assigned equivalent work content, at any given time, there will be more bots in the bot system than workers in a comparable manual system.

This is due to the added dwell time associated with waiting for a worker to travel to the bot to complete the pick. This can be used to estimate the minimum number of bots in a system.

Truth 5: When bots and workers have similar travel speeds and are assigned equivalent work content, the cycle time of a bot in the bot system will be longer than the cycle time of a worker in a comparable manual system.

The reason behind Truth 5 is the same as with Truth 4 – the dwell time puts the bot system at a disadvantage as compared to a manual system. This can be used to estimate the minimum cycle time in a system.

Truth 6: Manual picking operations have an advantage in terms of work content that can be assigned to the cart vs. a bot.

The first five truths all assume that the same work content is assigned to the bot and the cart. However, many of the bot technologies that are currently on the market are limited in regard to how many orders can be assigned (by space, but also by the maximum payload of the bot). For example, it is not unusual to design manual cluster-picking operations with two dozen or more orders assigned to each cart. In the absence of a significant cycle time concern, such high workload assignments have a significant positive impact on the productivity of the manual system and make it extremely difficult for a bot application with as few as 4 to 6 orders to compete on a business case perspective.

Truth 7: There is a business case for bot-picking applications, but not ALL applications have a good business case. Fortna has developed a set of models that move beyond a one-size-fits-all rule-of-thumb in evaluating these systems. The design considerations discussed in this article are key to achieving the correct balance of labor and technology determined by the unique requirements of your business.

The Business Case for Picking Bots

Strong Business Case:

Truth 1 tells us that the best application for bots will be when pick density is low. These are situations, typically, where the SKU count is high and the lines per cart or bot are low. This is true for eComm fulfillment over a large number of SKUs and short cycle times (e.g., same-day fulfillment with trucks departing throughout the day). This could also be a good application for goods-to-person technologies (e.g., aisle-based shuttle systems delivering to goods-to-person workstations), so that leads us to the third criteria for a good bot application and that is the desire to retain maximum flexibility. And a strong business case will get even stronger as shifts per day are two or three.

Weak Business Case:

By contrast, when pick density is high – because either there is a low number of SKUs and/or many orders can be assigned to the picking cart – the business case for bots will be weak.

FORTNA CAN HELP

Are you trying to decide how bots might be a fit for your distribution operations? Fortna helps companies assess their operations, evaluate the suitability of different technologies and build a business case for investment.

For more information, contact The Distribution Experts at info@fortna.com.

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