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SIMULATING WAREHOUSE OPERATIONS: GOODS TO PERSON PICKING USING A MULTI LEVEL SHUTTLE

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ABSTRACT

Order fulfillment operations, including E-Commerce, are under constant pressure to deliver high customer service levels. Companies like Amazon continue to raise the bar of online customer expectations, driving other companies to adapt to the rapidly changing world of online commerce. Traditional picking systems are labor intensive and may not always be the best solution for handling certain order types. Some fulfillment center managers are employing automation to increase pick rates and to handle the large number of products. Goods to Person (GTP) stations can be configured with multi-level shuttle systems to meet this need. Roar Simulation and Logistics Automation system and Technology (LAsT) have recently worked on several Shuttle-GTP projects. This case study is a summary of some of those projects, showing the value that a simulation model can provide when making the decision to purchase automation, and also on how to operate the equipment more efficiently as business changes.

1 SYSTEM DESCRIPTION

Please see Figure 1 below a typical GTP system served by a multi-level shuttle. The picking stations are in the foreground, with the shuttle system in the background. A typical picking station configuration allows for one or more orders to be picked at a time by each operator. “Source” totes from the shuttle system are transported by conveyor to the pick stations. Each source tote holds multiple packages of what is usually a single stock keeping unit (SKU). A replenishment operation, shown on the right side of the layout, is used to add items to the source totes to maintain inventory in the shuttle.

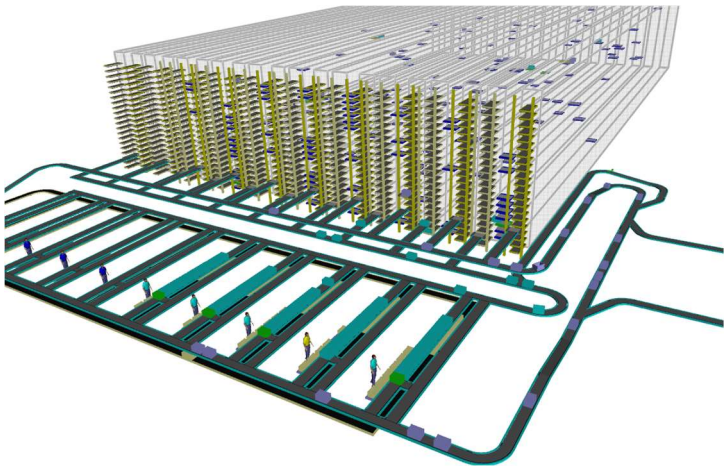

Figure 1: Goods to person picking system.

In the shuttle system, each level has a cart, sometimes called a bot, that moves horizontally in the shuttle aisle. In the system shown there are 10 aisles and 20 levels. The bots retrieve and store totes on the shelves in the rack, and the interface between the 20 level shuttle and the two level conveyor is a vertical lift. These shuttle systems typically include sophisticated control software that uses data from the system, including SKU velocity, to decide where in the rack to store a tote. For example, higher volume SKUs are typically stored closer to the front of the rack, and sometimes on a level closer to the conveyor interface so that these totes can be accessed quickly for picking.

2 JUSTIFICATION FOR SIMULATING SHUTTLE GTP SYSTEMS

The capital investment in a new shuttle GTP system can be millions of dollars. In addition, companies typically add one of these systems to their existing operations, and need to make decisions about which orders and SKUs will be best suited for using the shuttle GTP system. Additionally, the shuttle GTP system will need to interface with other warehouse functions. In a typical warehouse there will be several types of picking operations running simultaneously.

Shuttle GTP systems are highly dynamic in nature. For example, an order might contain a single pick, or might contain picks of 10 different items. The picking time for a single item is obviously shorter than the pick time for 10 items, and in some cases if the picker has a high number of single item picks in a row, the picker will need source totes for all of those picks. In this situation, the shuttle system can become the constraint for short periods of time. As order profiles change, balancing picking with the automation can present challenges for the warehouse manager. In a scenario, where a customer tote contains 10 different items, the 10 source totes need to come to the operator within a short time window to keep the operator working efficiently. Prioritizing retrieval orders is paramount for a successful GTP system operation.

Many E-Commerce environments, like apparel, are seasonal. As order characteristics change, the effectiveness of the shuttle GTP system is tested. Managers need tools to anticipate changes in their business and their ability to meet customer expectations. Simulation based “Digital Twin” models use data from the actual operation, combined with forecasted changes, to evaluate how the system will perform tomorrow, next month, or next year. Simulation models run much faster than real time, and can include some of the stochastic and dynamic behavior seen in the actual system to give warehouse operations teams better insight into their assets.

Various picking strategies can be evaluated with simulation. For example, in some systems a “batch pick” operation is performed, with order consolidation taking place downstream from the picking system. Another type of picking is called discrete, where each individual customer order is picked completely. In addition to the types of picking supported, the order release methodology can be evaluated. Warehouse Management Software (WMS) drives the operation and may release “waves” of orders to be processed. Simulation is an excellent tool for evaluating some of the software driven behavior for shuttle GTP systems.

3 CONCLUSIONS

Shuttle GTP systems are becoming more popular in order fulfillment. Companies need to have confidence that the investment will pay off in improved customer service levels and in reducing demands on the manual labor force. Online customers expect orders to ship soon after they are placed, often the same day, and competition for rapid fulfillment continues to increase.

As companies look to acquire new automation to improve their operations, simulation models can add value before the decision is made, and as they operate the new assets through the changes in their business. Domain experts using simulation technology can provide a tremendous amount of insight for companies that need to adapt and grow.