Proceedings of the 2020 Winter Simulation Conference
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REFRIGERATED PALLET ORDER FULFILLMENT: EVALUATING A FULLY AUTOMATED FACILITY USING SIMULATION

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ABSTRACT

A large multinational food processing and distribution company is evaluating automation concepts for facilities in the U.S. The facilities receive pallets for 1000s of products, store them, build mixed-case pallets to customer order, and then ship those pallets to other distribution centers and end customers. The automation design is developed by viastore systems, a leading international provider of automated solutions. Roar Simulation built the simulation model. The automated system included several functional areas tied together with a pallet handling monorail system. Simulation was instrumental in validating and refining the design, identifying system constraints, and in determining the number of ASRS machines and monorail vehicles required during peak and average demand periods. Since most of the storage area was Frozen and functional areas are at a chilled temperature, the simulation model also tracked the cold chain for pallets having to exit and then re-enter the different temperature zones in the facility.

1 SYSTEM DESCRIPTION

Please see Figure 1 below for a layout of the facility. Received pallets are stored in the Automated Storage and Retrieval System (ASRS). Order pallets are built in either the robotic or manual palletizing areas. Source pallets with a single product or SKU come from storage and layers are moved from source to order pallets in the automated pallet build cells. Partial layer picks are done in the case picking area. All pallets use the monorail to get between functional areas of the system. Mixed case order pallets, sometimes called "rainbow" pallets, are stored in the automated storage system after they have been built. The simulation

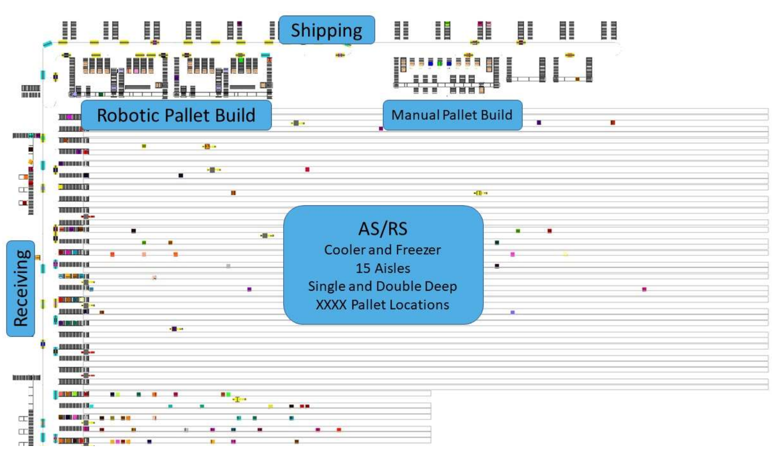

Figure 1: Facility layout.

uses the client's historical data, and the simulation period is one week. Orders with mixed SKU pallets are available to be built the day before the orders need to be shipped.

2 SIMULATION MODEL HIGHLIGHTS AND RESULTS

The simulation is built in AutoMod, and one of the early benefits is in the robotic palletizing area. Loose cases are removed and stored temporarily prior to full layers being transferred from source pallets to order pallets. Once full layers are picked, the source pallets proceed back to a point where the loose cases can be placed back on the top of the pallet. The 3D animation is valuable in helping the project team refine the design of the loose case removal automation.

The model also helps the project team better understand the scheduling of order pallet building and shipping. Balancing these two functions is important to getting the most out of the equipment and to finish shipping within the expected shipping window. Once an order pallet has been started, all of the source pallets used to build that order need to be retrieved and transported to the pallet build area as quickly as possible. On average the order pallet waits about a minute for a donor pallet to be in position for the layer(s) to be picked. In some cases the order build pallet positions can become a constraint, as the automated robot build cells can only be working on eight (8) order pallets at a time. When rainbow pallets built the previous day are requested to be shipped, these pallets "compete" for automation resources, including the ASRS cranes, conveyor pickup and delivery (P&D) stands, and the monorail carriers. Pallets destined for shipping can potentially "block" pallets bound for the order building area. The maximum time an order pallet waits for a source pallet is tracked by the model, and the model input parameters are tuned to minimize this waiting time.

Another constraint in the system is the number of dock doors in the shipping area. Once a truck is "spotted' at the shipping dock, pallets for that shipment are requested from the AS/RS. Ten (10) staging conveyor pairs are assigned for shipping, and on average about 24 pallets are required for each truck. Some of the pallets are "stacked" before they are loaded on the trailer. Combining these factors with the occasional surge of a higher than average number of pallets per trailer can create peaks in the utilization of the shipping area. Rudimentary Warehouse Execution System (WES) level controls are built into the simulation to help hold shipping pallets from being retrieved until there is capacity in the shipping area.

The model is also used to determine the number of monorail trolleys to meet throughput requirements. Monorail systems provide increased flexibility over other types of automation, as additional vehicles can be added during peak periods or when expanding the system. As with any automated vehicle system, there is a "sweet spot" where just the right number of trolleys will meet throughput requirements while minimizing congestion.

3 CONCLUSIONS

Simulation is an important tool that will minimize risk and improve operational performance of more complex automated material handling systems. Systems, like the one described in the paper, have a large number of "moving parts", and any of the sub-systems can become a constraint during peak demand. As system constraints shift over time, these detailed models will assist system designers to gain insight into system performance and will be used to fine tune the design.

Driving models with actual client data increases the value derived from a simulation project. In addition to client data, this model is built to be highly configurable using input data parameters. The teams from viastore and Roar Simulation simulate many "what if" scenarios to evaluate several different characteristics of the customer's operation and using several varying weeks of data. The model provides the client confidence in the system design.