Proceedings of the 2019 Winter Simulation Conference
N. Mustafee, K.-H.G. Bae, S. Lazarova-Molnar, M. Rabe, C. Szabo, P. Haas, and Y.-J. Son, eds.

DISTRIBUTION CENTER SLOTTING AND OPTIMIZATION USING SIMULATION

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ABSTRACT

Warehouse simulation and optimization have been used for many years to improve the internal operations, from receiving to shipping, in distribution centers. Most of these simulation environments are built on distributions and potential scenarios, rather than actual warehouse flow[1]. This case study presents an improved method to optimize the warehouse using an actual outbound dataset that takes into consideration seasonality, SKU slotting, rack types, and pick path. Moreover, the generated simulation model is used for slotting analysis and optimization.

1 INTRODUCTION AND PROJECT GOALS

The distribution center analyzed consists of 3 main areas: freezer, cooler, and a general rack pick area. All orders that are picked will be delivered to a limited space staging area before they are put on trucks for delivery. Received pallets are consolidated and sent to their appropriate locations based on type. Shelves are replenished from top to bottom when needed. Picking is always from the bottom 2 shelves, also known as the strike zone.

As a rule, all receiving occurs early in the day, before 10AM. Pallets are unloaded, consolidated when needed, then stored in top shelves. All receiving activities are completed by 11 AM every day. During the storage/receiving process, all bottom shelves are replenished to full capacity. Picking begins at 11 AM daily and is split into 2 main components, Parcels and LTL orders. Parcels are small orders that normally fit in a few boxes and are shipped through overnight delivery. LTL orders are palletized for truck delivery.

The goal of the simulation was to resolve a number of issues in the operation:

1. Receiving issues based on the 10 docks currently available and define a method where receiving consistently completes by 11AM. The current situation is prone to truck delays, consolidation, movement to storage, and the size of the staging area.
2. Improving the overall order release process to minimize the outbound staging and optimize the pick path. The main goal for pick path optimization is in reducing the travel distance, reducing the empty resource travel, and maximizing the grab factor.
3. Re-slotting the warehouse as needed in order to achieve the first 2 issues.

2 SIMULATION APPROACH AND METHOD

Simcad Pro, an interactive on-the-fly simulator[2], a full representation of the warehouse is built that includes the following:

- identifying each rack location within the model, while allowing multiple SKUs to be in a single rack space;
- defining the racking based on the physical characteristics in volume and functionality;

- defining the aisle of travel to allow pickers traverse the warehouse and perform the picking cycle; and
- expanding the docks and staging area to perform both inbound and outbound staging.

In order to simplify the data transition from the WMS to the simulation model, all existing warehouse rack and SKU naming conventions where used. From a modeling perspective, the modeler used the existing rack and path building wizards in Simcad Pro to create the warehouse structure. Moreover, an existing CAD layout of the facility was used as a background layer and to properly compute the travel distances.

3 MODEL VALIDATION

The validation process of the model requires the run of the model for a full year in order to account for the seasonality. Hence, the model was initially validated using a single week of operation, amounting to about 750,000 transactions. The data was directly loaded from the WMS system[2]. Validation consisted of 2 phases. Phase 1 included running the model based on the WMS generated pick sequence and storage moves. Hence the model used the built in constraints to drive the WMS simulation. The resulting validation shows a model accuracy of 99.91% as compared to the real-time performance of the analyzed week. The process was repeated for 4 different weeks, accounting for the seasonality change, and the model accuracy was within 0.02% of the initial week run accuracy. Phase 2 of the validation process required the model to start with basic outbound and inbound datasets. The imported dataset is then used to create the orders, picking, consolidation, and storage based on the defined constraints. This type of data generation helped in expanding the model in order to quickly perform increased capacity analysis and re-slotting.

4 SCENARIOS AND ANALYSIS

Before proceeding to the warehouse analysis phase, a detailed spaghetti diagram, congestion analysis, and heat map were generated through the Simcad Pro interface. All maps and diagram were generated per pick zone and operation type[1].

Based on the analysis performed, and overall optimization, the following were the benefits of the analysis:

1. The current slotting implementation did not take into consideration the grab factor and congestion generated by the pick path. Using Simcad Pro, two paths slotting optimization, and a re-slotting of each zone resulted in a 7%, 9%, and 6.5% efficiency increase in the pick path for the freezer, cooler, and floor pick areas respectively. Moreover, replenishment cycles where reduced by 35% throughout the warehouse. This optimization did not require any additional racking.
2. The inbound staging area was reorganized based on truck arrival and the type or location of the product. Specific rules regarding when to dock, the number of personnel in the consolidation area, and put-away personnel was defined.
3. Order release to the freezer, cooler, and floor pick area were modified to correspond to the expected pick time of each order. Order release was performed based on the each order pick duration.

All modifications resulted in a 22.3% reduction in congestion in the outbound area and decreased truck dock to ship time of 15 minute on average.

REFERENCES

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