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SIMULATION OF SKU SLOTTING IN LIFT TRUCK MANUFACTURING FACILITY WAREHOUSE: RAYMOND CORPORATION, IOWA

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1 INTRODUCTION

Executives at the Raymond Iowa lift truck manufacturing facility were tasked with increasing production throughput. This required a proportional increase in warehouse picking. A capital expenditure proposal was approved to establish an additional off-site warehouse to supplement existing picking throughput. However, the off-site warehouse would take several months to become operational. This objective of this simulation was to estimate the impact of optimizing parts slotting on picking throughput within the existing warehouse. “Slotting” refers to optimizing the location of stock keeping units (SKUs) in a warehouse to increase overall picking throughput (Reyes et al. 2019). The scope of this analysis is exclusively focused on the rack portion of the warehouse, where pickers pick parts using Raymond Orderpicker lift trucks.

2 SLOTTING METHODOLOGY

SKUs were categorized based on their pick frequency over a 12-month period. 10% of SKUs accounted for 80% of picks—these SKUs were categorized as A Class SKUs. 20% of SKUs accounted for 15% of picks and were categorized as B Class SKUs. All other SKUs were categorized as C Class SKUs.

Picking time varies by bin location due to both vertical lift truck travel time and ergonomic considerations. As a result, bin locations were divided into three zones—gold, silver, and bronze. Gold zone bin locations require the least picking time as they are both ergonomic (Petersen et al. 2005) and involve no vertical travel time. Bronze zones require the longest picking time. A side view of the rack showing bin location zones is illustrated in 2. Current and future state slotting pattern are summarized in Table 1.

Table 1: Current and future state slotting patterns.

	Current State			Future State		
SKU ABC Category	Gold Zone	Silver Zone	Bronze Zone	Gold Zone	Silver Zone	Bronze Zone
A SKU	26%	37%	37%	100%	-	-
B SKU	27%	40%	33%	-	100%	-
C SKU	28%	38%	33%	-	-	100%

3 SIMULATION APPROACH

Picking was simulated using `SimPy`. Thirty simulation runs of 1000 minutes each were conducted for each slotting pattern. Three lift trucks were generated in each run. All lift trucks followed the same unidirectional picking path, as shown in Figure 1, and could not overtake one another. Lift trucks enter "waiting" status if they are unable access their next assigned bin location due to picking path congestion.

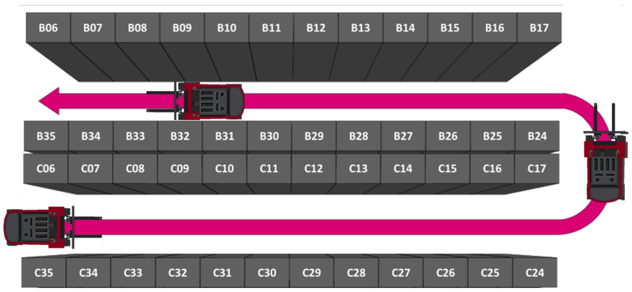

Figure 1: Top down view of picking path.

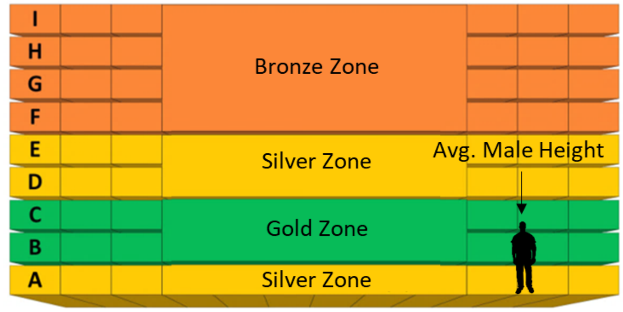

Figure 2: Side view of rack bin zones.

4 RESULTS AND CONCLUSION

The simulation indicated that trucks currently wait an average of 23.6% of the time. This was reduced to 19.5% after slotting, as shown in Figure 3. At first glance, this may seem trivial. However, Figure 4 demonstrates that this results in a 67.89% increase in picking throughput—from 853 to 1433 picks per run. This increase exceeded production requirements and eliminated the need to outsource picking.

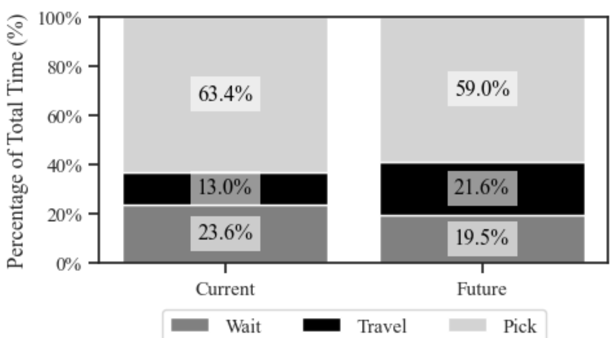

Figure 3: Percentage of Waiting Time, Picking Time, and Travel Time by state.

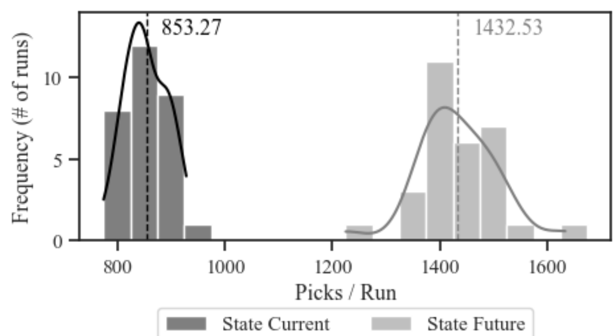

Figure 4: Histogram of Total Picks per Run.

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