Optimizing Product Group Segmentation

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Summary: In this capstone, we applied a two-staged ABC analysis for SKU segmentation and slotting assignment for our sponsor company, CVS. Simulating the slotting implementation revealed that the segmentation would result in an average saving of 27.62% in travel distance to fulfill picking assignments and would increase piece-picking efficiency. Therefore, the proposed methodology offers a novel perspective on piece-picking optimization and improves cost effectiveness.

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INTRODUCTION

Piece picking is integral to the daily operations of a warehouse or distribution center. It is also the most labor-intensive operation in manual picking. Our capstone sponsor, CVS Health Corporation, is a retailer of pharmaceuticals and general health and beauty care products. Manual piece-picking is used in their DCs to replenish their stores. To improve picking efficiency, they asked us to segment SKUs in CVS's Woonsocket DC and formulate a new slotting assignment.

OPERATIONAL CONTEXT

CVS processes and ships orders to 9,800 retail locations nationwide through a network of 19 Distribution Centers (DCs). Piece picking is one of the components in CVS's DC operations. Piece picking operations are the largest component in the CVS Retail Logistics payroll. Most picks are done from paper documents indicating the location, store, item, and order quantity. Piece picking consists of 2 basic activities – 1) travelling to the pick location and 2) picking product from

KEY INSIGHTS

1. ABC analysis can determine which SKUs generate more orders so that the company can slot them close to each other in the distribution centre.

2. Slot assignment based on moving speed and family group segmentation can reduce the travel distance to fulfil picking assignments and improve the piece-picking productivity.

3. Simulation modelling simulates the real world picking operations and compares the slotting models in terms of travel distance.

the flow rack location and placing it into the store order tote. All pick lists are generated daily from a Warehouse Management System and are automatically assigned to specific pickers.
The layout of the products in the pick racks is typically in product "family groupings" with other constraints introduced for store service efficiencies. The product layout is subject to the following set of constraints:

1) No changes to current operation process
2) No more than 4 family groups per tote
3) Consider put-on-shelf efficiency for stores
4) One quadrant per tote

The current layout results in a significant walk for the pickers. Thus, the process is extremely labour intensive. The current product "slotting" and assignment planning needs to be improved to reduce labour expenses and improve space utilization.

METHODOLOGY

Site Visit & Data Collection

We toured the CVS Distribution Center in Woonsocket, Rhode Island and conducted interviews with the DC operations staff to become familiar with the design and operation of the pick lines. We identified the slow-moving lines based on observation and narrowed down our examination on one slowing-moving line, Section 2E.

CVS provided us with 50 weeks of weekly shipment quantities for every SKU in Section 2E. We also received item “Quadrant affinity” for the DC, current slotting assignment for SKUs on Section 2E, picking assignments and pick activities for a randomly selected date for Section 2E.

SKU Segmentation & Slot Assignment

We developed a two-staged ABC analysis to segment SKUs on Section 2E:

Stage 1: Conducted Initial ABC segmentation on Section 2E to categorize the fast movers (Group A that makes up 70% of aggregated orders), medium-slow movers (Group B that makes up 75 to 90% of aggregated orders) and slow movers (Group C that makes up 90% to 100%of aggregated orders) based on the most recent data.

Stage 2: Conducted an additional ABC segmentation on the medium-slow and slowest movers from stage 1 respectively. Following the same method as in Stage 1, we identified and categorized the fast, medium-slow, and slowest movers within the medium slow and slowest movers.

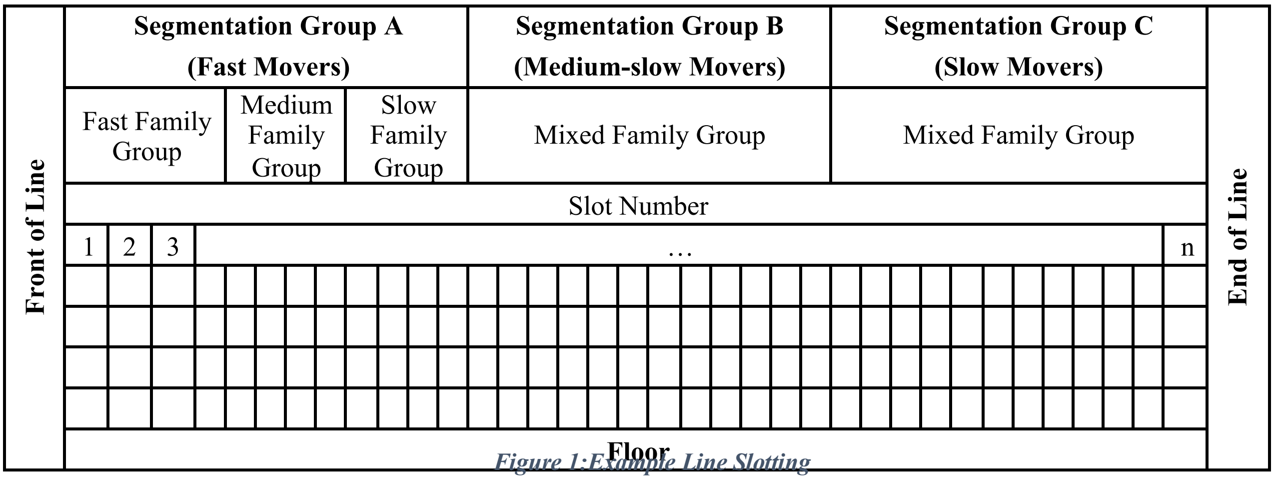

Figure 1:Example Line Slotting

Segmentation Group A					Segmentation Group B				Segmentation Group C			
(Fast Movers)					(Medium-slow Movers)				(Slow Movers)			
Non-Stationary Group	Stationary Family Group				Mixed Family Group				Mixed Family Group			
Slot Number												
1	2	…	23	24	25	…	80	81	82	…	183	184
843387	871509		295436	897850	417075		889949	343380	167700		926077	848267
799520	206417	…	239527	137143	561293	…	967097	167415	416152	…	990516	871418
408683	610709		959533	873828	107367		315030	392922	889965		847681	887813
	848686		841156	455087	854441		268971	870709	974595		848093	986038

Front of Line

End of Line

Floor

Figure 2: Slotting Assignment for Model B

We assigned SKUs slotting as per Figure 1. The line is divided into three sections: Fast Movers, Medium-slow Movers and Slow Movers derived from 1st stage segmentation.

Each slot consists of 4 levels and therefore is able to contain 4 SKUs. The fast movers are slotted first per family groups and then per moving speed. Namely, the family groups with relatively fast-moving speeds are slotted in the front; the SKUs within the same family group with relatively fast-moving speeds are slotted in the front within the slot designated for the family group. The medium-slow and slow movers are slotted solely based on moving speed. SKUs belonging to all family groups are mixed together; the SKUs with relatively fast-moving speed are slotted in the front.

Simulation Modelling

To understand the effect of the new slotting, we ran a simulation to compare the travel distance with the old layout and the new proposed layout. We first created 50 randomly generated pick lists based on the probability of products being selected. We then created Model A and Model B for old and new slotting assignment respectively. In our models, we assumed all SKU items take up the same amount of space on the racks due to lack of information on exact dimensions. Then we took each pick list and found the distance travelled with the two models. The distance is defined as the number of slots between the furthest SKU and nearest SKU to the front. Taking the range of the distances for both layouts allowed us to compare the total distance travelled.

RESULTS

Out of 737 SKUs in Section 2E, fast movers (Group A) account for 13.18%, while medium-slow movers (Group B) account for 30.84%, and slow movers (Group C) account for 55.98%. There are 4 family groups in group A. Of these groups, stationary moves the fastest,

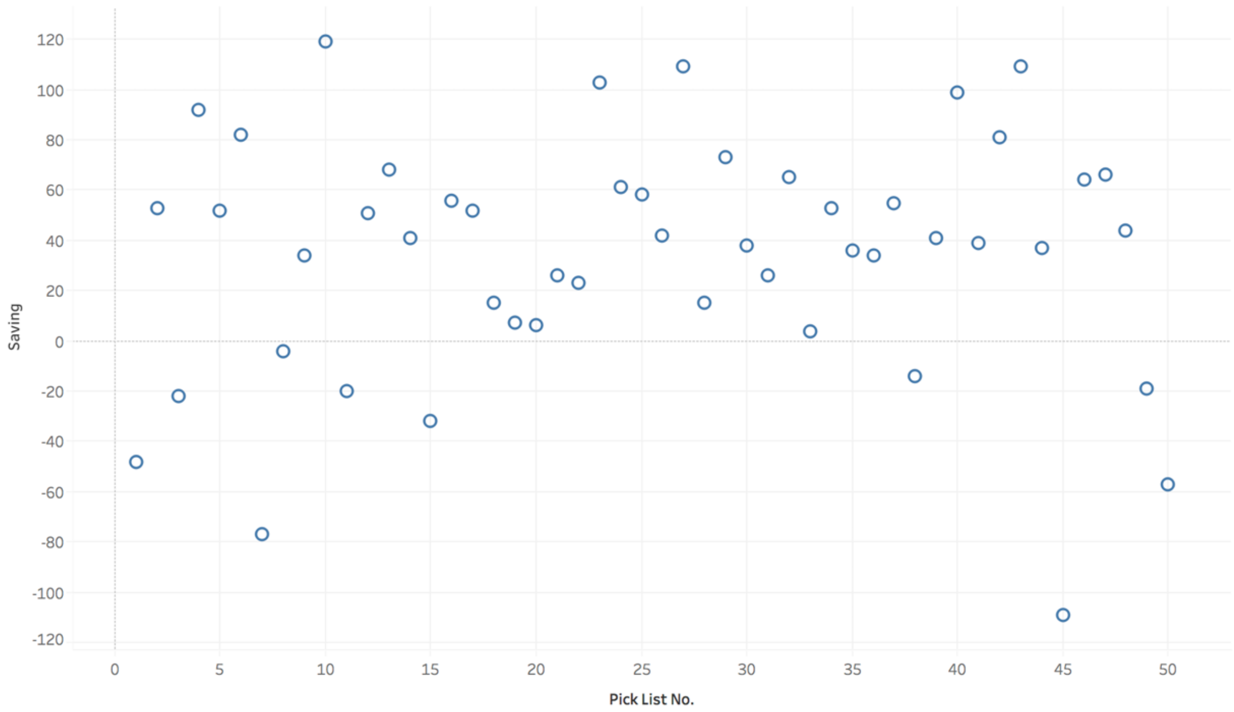

Figure 3: Distance Savings on 50 Pick Lists

with a weekly average order of 2,145. We separated Group B and C from the 1st stage segmentation and conducted the 2nd ABC analysis. Then we built simulation models A and B for new and old slotting with segmentation results. The Model B is shown in Figure 2.

We ran the simulation using 50 randomly generated pick lists and obtained the difference in distance travelled between Model A and Model B. Figure 3 displays the saving in terms of distance travelled for all 50 pick lists generated. Positive savings are generated for 72% of the pick lists. Compared to Model A, Model B generates an average distance saving of 27.62%. On average, Model B saves 34.54 slots per picklist.

We then conducted a rough conversion from slot distance saved to feet saved, which yields 1 slot as equal to 1.086 feet. Applying this conversion rate, the average distance saving of Model B as compared to Model A is 37.51 feet per picklist.

CONCLUSION

The main objective of our project was to improve the CVS DC's merchandise slotting and assignment planning to optimize space utilization and decrease labor costs. We utilized the double segmentation method to reduce the distance and time spent on piece picking activities.

The project resulted in average distance saving of 27.62 feet. Future improvement could be made by including the travel distance between consecutive pick lists and by analyzing the effect of the size variation of pick lists on distance saving. CVS can further analyze the results to understand the savings in terms of costs and labor. Given the high capital expenditure on automation, our capstone provides a good alternative time saving method for CVS to consider.