Improving the Warehouse Picking Operations at Arvato SCS

arvato BERTELSMANN Supply Chain Solutions

Sabancı Üniversitesi — FACULTY OF ENGINEERING AND NATURAL SCIENCES

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ABSTRACT

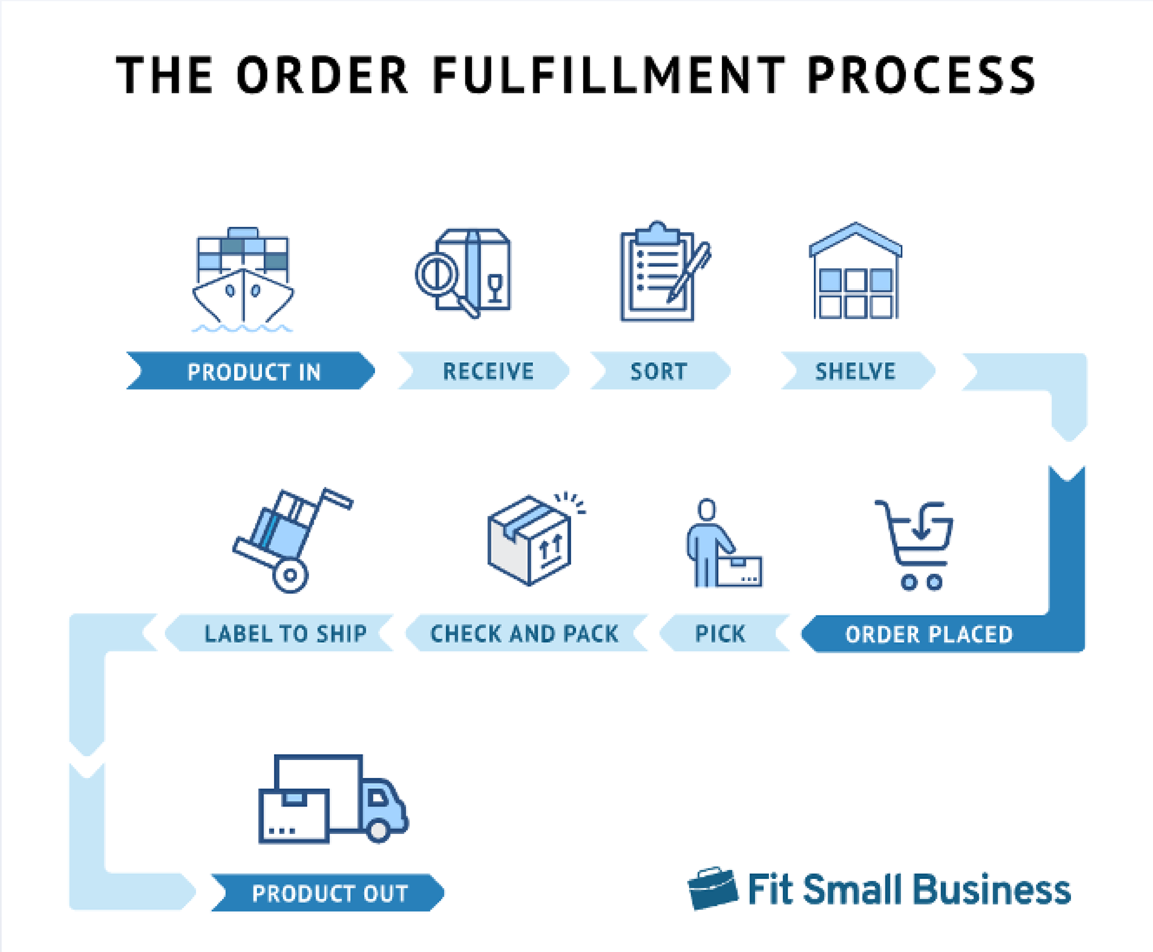

Figure 1: Operations Flowchart

Warehousing and inventory management are some of the key and integral parts of any logistics system. Therefore, any disruption in warehousing can cause serious problems for the whole business. The aim of this project is to optimize picking operations for Arvato SCS, a third-party e-commerce supply chain operations firm located in Tuzla, Istanbul.

The picking process is the most time-consuming and most costly operation which takes up to 55% percent of operating expenses in a warehouse and firms are always looking for ways to optimize this process. Operations at a warehouse could be divided into 5 main categories: Receiving, shelving, picking, packing, and shipping. The flowchart can be seen above in *Figure 1*.

We aimed to optimize the picking operations in Arvato Supply Chain Solutions Company warehouse by analyzing the picking process data and suggesting solutions to problems that can be improved efficiently and help to reduce time required for the operations. We used literature scanning, observation of existing processes and also experienced the operation in the warehouse, data analysis (by using such tools like Microsoft Excel, Python), and used regression techniques.

OBJECTIVES

We intended to spot the impurities and disruptions in the picking process of the Arvato warehouse by analyzing picking process data and suggesting solutions on how to smoothly conduct this process by overcoming those impurities.

PROJECT DETAILS

Minutes Between 2 Picking Operations	Adjusted R^2 Value
1	0,880
4	0,7624
6	0,7413
10	0,7608

Table 1: Threshold levels and corresponding adjusted R^2 values

	Results (Adjusted R^2 values)	
Picker name	Regression with one independent variable (distinct count of location)	Regression with two independent variables (distinct count of location & quantity/location measure)
hulyagnr	0.711	0.709
furkan1	0.855	0.859
burakk1	0.796	0.797
burakk	0.765	0.789
huseyin52	0.884	0.885
asim52	0.834	0.839
yasin52	0.872	0.874
sinan40	0.884	0.886
furkan52	0.851	0.863
selim25	0.826	0.852

Table 2:Comparison of Adjusted R^2 values of regression with 2 different independent variables (quantity/location ratio)

Throughout the project, many tasks regarding data analysis has been performed, below there is a list and brief explanations of them:

- **Determination of the Threshold Level of time in-between 2 Picking Operations**

In *Table 1*, there are 4 trials of the regression of one picking worker (username: burak) for a representation of the whole case. As the threshold level increases, the R2 of the regression between the time and distinct count of location decreases, meaning that the relationship gets weaker. So, it is safe to say that a lower threshold level would be more preferable.

- **Regression Analysis with Distinct Count of Location Variable**

In this regression analysis with the distinct count of location variables, our hypothesis is that with more and more distinct locations visited during a picking process, the total time of the picking process would increase. In order to observe the correctness of this hypothesis we performed a linear regression analysis.

PROJECT DETAILS

- **Regression analysis comparison with quantity/location measure**

In this analysis, the focus was on examining the influence of the quantity/location ratio on time spent in a specific job list. In *Table 2*, Comparison of Adjusted R^2 values of regression with 2 different independent variables can be seen.

- **Regression Analysis Comparison with Problematic Location Proportion in a Job List**

Our hypothesis was that where there are more than 10 types of products, that location qualifies as a "problematic location" as it causes delay in time. To test this hypothesis, we conducted regression analysis on problematic locations and observed its relationship with time.

- **Elimination of the Largest and Smallest Data of Distinct Count of Location (the independent variable)**

The aim of this practice was obtaining a higher R^2 value for the regression analysis. *Figure 2* below shows scatter plot of huseyin52 regression data before and after elimination.

- **Elimination of the Largest and Smallest Data of Sum of Delta (the dependent variable)**

Our aim was to obtain a better solution and an improvement in R^2. Our hypothesis is, if we eliminate the outliers, we increase the value of R^2, this way we provide improvement, we get a good correlation between dependent and independent variables, which makes it easier to estimate the picking operation time when the specific job list is given.

- **Heat Map Analysis**

To find the areas with high traffic, to visualize which corridors are visited the most and whether there is an inconsistent and uneven distribution of corridors amongst the job lists, heatmaps were created by using November and December data for each picker by using Excel's various tools. *Table 3* below shows the total number of items picked from each corridor in November 2022.

Koridor	tüm iş listeleri				
-01	51	A02	19760	C05	34722
-02	16665	A03	13301	C06	26135
-03	26589	A04	36022	C07	25682
-04	25730	A05	32809	C08	24309
-05	74305	A06	37372	C09	25952
-06	71895	A07	38298	C10	24844
-R0	60	A08	37588	C11	4307
-R1	29	A09	40549	PX-	3607
-R2	50	A10	32923	R10	44
-R3	62	A11	23426	R11	72
-R7	27	C01	30019	R12	1
-R8	13	C02	18182	WTS	17
-R9	8	C03	25782	X-M	0
A01	21050	C04	23459	X-W	23

Table 3: Total number of items picked from each corridor

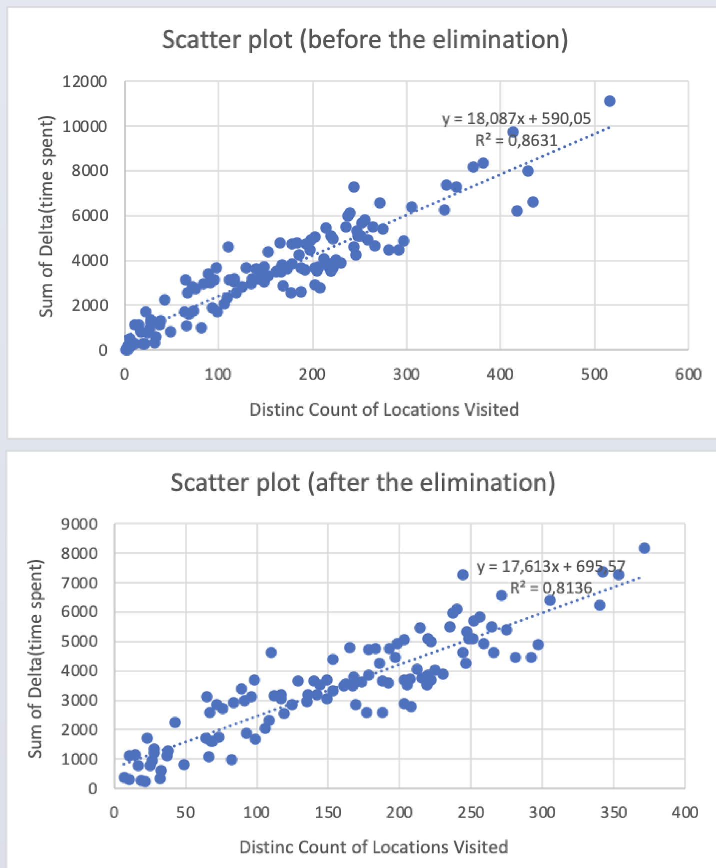

Figure 2:Scatter plot of huseyin52 regression data before and after elimination

CONCLUSIONS

- Threshold level of time: We found that a 3-minute threshold for uninterrupted picking operations were sufficient with minimal data loss when compared to a 4-minute threshold. This threshold level led to an increased R^2 value, which indicates that this is a better threshold level when compared to 4-minute threshold and 5-minute threshold.
- Relationship between distinct count of locations and picking time: Our analysis confirmed that there is a positive correlation between the number of visited locations and time spent during picking operations. The results indicated that higher work tempo and workload during peak periods resulted in increased picking time.
- Quantity/Location ratio and problematic locations: The inclusion of quantity/location ratio did not improve our regression model, and the presence of problematic locations had a negative correlation with picking time which is contrary to our initial hypothesis. Therefore, these variables are not included in the final analysis.

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