

System integration with slotting and ABC analysis

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Abstract:

Logistics companies operating in the service sector want to provide services to their customers for storing their ready-to-sell products (if the customer does not have their own warehouse) and manage the end-to-end supply chain in order to provide better service to their existing or new customers. They provide this service to their customers in their own warehouses and with their own systems in order to offer the supply, storage and shipping links together. Within the scope of this study, it was aimed to make a shelving plan so that the area of an automotive spare parts warehouse that will provide this service can be used at the highest efficiency. After the designed shelf modeling area was put into use, ABC analyses and Slotting analyses were applied to increase its efficiency. As a result of the studies conducted; the efficiency increase in the goods acceptance and shipping processes was measured. It was determined that an average of 20% efficiency was achieved for goods acceptance, 25% efficiency for shipping and 30% efficiency was achieved for the efficient use of shelf capacity.

1. Introduction

Today, many logistics companies want to provide engineering services that will add value to them, not just freight transportation. They even develop special software in this direction. They establish R&D Departments in order to take their work even further and provide more niche services, and they make scientific progress here with the work they do. At the point where all their devoted work has evolved, it has come to the point of not only transporting products, but also providing services that will meet the customer's special needs and meet other needs. Therefore, this study subject includes a study carried out to provide supply, storage and shipping services to customers who do not have their own warehouses or do not want to do their own storage.

2. Warehouse Management Processes

Warehouse involves daily operations, high level organization and optimizing inventory, orders and processes.

Warehouse design and layout is one of the important elements of warehouse management, and effective warehouse layout significantly reduces operational costs.

Therefore, companies are increasingly paying attention to warehouse design and layout in the face of increasing competition [1].

This is a critical component to increase the efficiency of the business and reduce costs. Warehouse management involves effectively managing warehouse inventory and operational processes. With proper warehouse management, businesses can increase the accuracy and efficiency of inventory management. By optimizing warehouse processes, they can use warehouse space more efficiently.

Warehouse management helps businesses reduce costs by making operations within the warehouse more efficient. If this process is carried out correctly, businesses will see lower inventory costs and faster delivery processes. This helps businesses gain a competitive advantage.

It will be useful to consider the following definitions for effective and efficient warehouse management.

2.1. Customer-Focused Storage

It is necessary to establish and manage a flexible storage system that can adapt to customer needs. It is necessary to be able to provide services to customers at the desired time, capacity and product detail. For this, product placement and management within the warehouse is an extremely important process.

2.2. Consolidating Storage Activities

Logistics companies that provide services used to provide services with small regional warehouses when advanced warehouse management did not yet exist. Later, they combined multiple warehouses and established a central large warehouse facility. Companies that discovered the economic advantages of warehouse management started to use special software developed by reducing stock quantities and the number of warehouse facilities.

2.3. Flexible Warehouse Design

In warehouse management; flexible designs, efficient workflow and more effective warehouse use are targeted elements. In order to provide flexibility in warehouse systems, the involvement of all departments in the process is an important factor.

2.4. Warehouse Management System or Software Usage

Businesses use warehouse management systems (software) to make storage management easier. These software, which are preferred for a more accurate warehouse management; connect processes such as production, planning, shipment and ordering to each other and ensure the management of the process.

It is also considered that the costs that will arise on the customer's side in terms of both stocking and security costs for the product ready for sale are reduced. Because when the customer purchases the storage service, all the processes that address the product, making it ready for shipment on time, ensuring its security and many similar products are offered to the customer by the service provider.

3. Studies Conducted Within the Scope of the Study

In order for the area where the storage service will be provided to be used with the highest efficiency, the shelving must be planned correctly. While making this plan, many factors such as the equipment that will move between the shelves, the distances of the shelves to the collection areas, the aisle order and heights of the shelves, the types and characteristics of the materials to be stocked on the

shelves, shelf models and capacities must be taken into consideration and the planning must be made [2].

3.1. Analysis

First of all, shelf modeling was done in the warehouse where the study was conducted. After the warehouse area started to be used, in order to increase efficiency; ABC Analysis, Slotting Analysis and depending on these analyzes, the system's shelf recommendation or shelf combination algorithms were studied.

In order to use shelves efficiently in warehouses, in addition to standard ABC analysis, product types and qualities are examined in detail and Slotting analysis, in which shelf capacity and features are also checked, was used together to increase efficiency to a higher level. It was aimed to benefit from customer integration by working in a way that the structure can be continuously active in shelf planning.

What information is possessed and the accuracy of the data possessed were checked in detail. If there is missing information, it was analyzed how it can be fed into the system with customer integration or how it will be entered into the system if it is not. While these analyzes continue, the details of the parameters to be used in the Slotting analysis (information was collected) were extracted regarding the types and features of the shelves used for stocking the product without the responsibility of the customer.

ABC Analysis

The ABC classification method, which has become quite valid in recent years and was developed by the General Electric Company in the 1950s, also helps businesses in stock management when deciding between different options. This method is a simple control system that separates stocks that require close control from stocks that do not require control [2].

Pareto Analysis is a type of analysis that separates the important from the general, based on the assumption that not every decision in our lives has the same return, not every minute has the same importance, and not every person has the same value. We usually use a clever technique called ABC Analysis to apply the Pareto principle to the supply chain. ABC inventory analysis is essentially the process of classifying inventory according to certain criteria priorities.

Category A: Products that are important and therefore require close control.

Category B: Products of lower importance, but still need to be managed with a moderate level of control.

Category C: Products of lower importance and only require the simplest level of control

The first method to be used to increase efficiency in a storage area where shelving is done correctly is to perform ABC Analysis. Since ABC Analysis is based on the speed of movement of the product, it will be able to easily suggest the closest locations to the collection area according to the speed of movement.

If this calculation is made incorrectly, reviewing the shelves and re-making shelves if there is an error will create additional costs for the businesses, and this additional cost will not be covered by the customer receiving the service.

Our target purpose is the basis of ABC analysis within the following three items.

- It has been determined which products are important
- It has been determined which customers are important
- It has been determined how the warehouse layout should be.

Information regarding ABC calculations based on part analysis is shared in figure 1.

```

FROM ABC_SUMMARY
ORDER BY LINE DESC
OPEN CURSOR
FROM PART_CLASSES
SELECT PART_CLASSES,LINE,QUANTITY,UNIT_PRICE,DEPT,DEPT_CODE,ST
WHERE @PART_CLASSES = 1
END

SET @PART_CLASSES = @PART_CLASSES + @LINE
SET @PERCENT = @PERCENT + @QUANTITY * @UNIT_PRICE / @TOTAL_LINES * 100

IF @PERCENT <= 80
    SET @PART_CLASSES = 1
IF @PERCENT > 80 AND @PERCENT <= 90
    SET @PART_CLASSES = 2
IF @PERCENT > 90
    SET @PART_CLASSES = 3
SET @PERCENT = 0

IF @PART_CLASSES < @PART_CLASSES
    SET @PART_CLASSES = @PART_CLASSES + 1

INSERT INTO ABC_SUMMARY
(PART_CLASSES,LINE,UNIT_PRICE,QUANTITY,AREA,LOC,TYPE,DEPT_CODE,ST,QUANTITY,LINE,QUANTITY,PERCENT,PART_CLASSES,DEPT_CODE)
VALUES (@PART_CLASSES,LINE,UNIT_PRICE,QUANTITY,AREA,LOC,TYPE,DEPT_CODE,ST,QUANTITY,LINE,QUANTITY,PERCENT,PART_CLASSES,DEPT_CODE)

FROM PART_CLASSES
ORDER BY LINE DESC

```

Figure 1. Information on ABC calculations

Slotting Analysis

It is of great importance that the location strategies of the products are determined correctly and that the location feeds are made efficiently and on time [3]. An efficient ‘slotting’, i.e. warehouse location strategy, will shorten order picking times, increase service levels, allow you to better manage seasonal or situational demand fluctuations and use your warehouse volume efficiently.

The main factors affecting warehouse location strategies in this study are as follows:

- Product life
- Seasonality
- Demand fluctuations
- Employee productivity
- Warehouse layout efficiency

Before starting the Slotting Analysis, the more accurate and complete the information needed for the product and shelf will be, the more positively it will affect the productivity increase after the analysis. For this reason, preparations were made primarily on a product and shelf/location basis. These are;

Preparations Based on Product;

- 1- Part Class Groups
- 2- Attribute Groups
- 3- Part Classes
- 4- Part Product Families
- 5- Packaging Types
- 6- Attribute Types

Preparations Based on Shelf/Location;

- 1- Shelf Class Groups
- 2- Shelf Types
- 3- Shelf Features
- 4- Shelf Volumes
- 5- Shelf Capacities

Since ABC Analysis and Slotting Analysis will be used together, our products with high movement speed have been determined with ABC Analysis. Considering the product list, detailed information about the products and shelves, the most suitable shelf, or even the storage of more than one product on a shelf if the shelf is suitable, will be selected with Slotting Analysis, and thus gains will be made to increase shelf efficiency. In parallel with this, since the priority in ABC Analysis is always the products with high movement speed, products that are stationary in the warehouse will be determined and the shelf arrangement will be additionally beneficial in this study, allowing the shelves of these products to be used for moving products with Slotting Analysis.

3.2. Design

Screens where product features and qualifications will be entered into the system have been prepared. While preparing these screens, the database infrastructure needed for the integration of information that can be received from the customer through integration into the system has been prepared.

Similarly, the screens and database infrastructure for information to be entered into the system on a

shelf/location basis have been prepared. For customers who will use it for goods acceptance and shipment integration, database and API infrastructures have been prepared so that the information coming from the customer will be used in ABC and Slotting Analysis without any re-development for each customer.

3.3. Development

Screens where data entries will be made in accordance with the infrastructure determined in the design and analysis processes have been developed. Parameter definition screens have been developed for customers who will have goods acceptance and shipment integration. Monitoring screens have been developed so that the results of the analyses that the system will automatically perform can be seen by the user and accordingly, shelf transportation orders can be dropped into the WMS system either manually or automatically according to the parameter definition to be made in the system.

3.4. Test and Commissioning

Tests were conducted in the automotive spare parts warehouse where the study was considered to be taken into consideration for testing and where it was anticipated that it would provide benefits. In the tests, unforeseen exceptions were noticed during the analysis phase and new parameters were added to the system for these situations. As an example of this situation encountered, it was noticed that only small equipment could enter the locations where the shelves were Mezzanine. Considering this existing parameter, the shelf change orders of the relevant locations were assigned to the appropriate equipment. Since there was customer integration in the facility where the tests were conducted, ABC and Slotting analyses were run by using the goods acceptance and shipment data and foreseeing the future.

4. Results and Discussions

In the tests, unforeseen exceptions were noticed during the analysis phase and new parameters were added to the system for these situations. As an example of this encountered situation, it was noticed that only small equipment could enter the locations where the shelves were Mezzanine. Considering this existing parameter, the shelf change orders of the relevant locations were assigned to the appropriate equipment. By running ABC and Slotting analyses together, it was possible to perform appropriate shelf analyses before the product arrived at the warehouse. Similarly, empty shelves and dedicated shelves were detected in the warehouse. If there are constantly

moving parts here, dedicated shelves were separated in the warehouse to increase the speed of access to the part and the part was always shelved at this location. The ABC analysis made according to 1-month shipment quantities is shared in table 1. Information regarding the part features defined for slotting analysis is shared in table 2. Again, information regarding the part features defined for Slotting studies is shared in table 3. Some of the studies on defining location features for Slotting are shared below in table 4.

5. Conclusions

Customer satisfaction has been increased due to the outputs such as shelf efficiency in the warehouse, collection and shipment efficiency. At the same time, customer satisfaction has been increased even more due to outputs such as shelf efficiency in the warehouse, collection and shipment efficiency. If we share numerical data, as a result of all the studies conducted; the increase in efficiency in goods acceptance and shipment processes has been measured. It has been determined that an average of 20% efficiency has been achieved for goods acceptance, an average of 25% for shipment, and 30% efficiency has been achieved for the efficient use of shelf capacity. Similar works performed and reported in the literature [4-9].

Author Statements:

- **Ethical approval:** The conducted research is not related to either human or animal use.
- **Conflict of interest:** The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper
- **Acknowledgement:** The authors declare that they have nobody or no-company to acknowledge.

Table 1. ABC Analysis Based on Monthly Shipment Quantities

The image shows a screenshot of a software-generated ABC analysis table. The table has multiple columns, including item names, quantities, and various classification metrics. The data is organized into rows, with some items highlighted in yellow. The table appears to be a standard spreadsheet format used for inventory management analysis.

Table 2. Defining part features for slotting analysis



Table 3. Detail of defining part features in slotting study

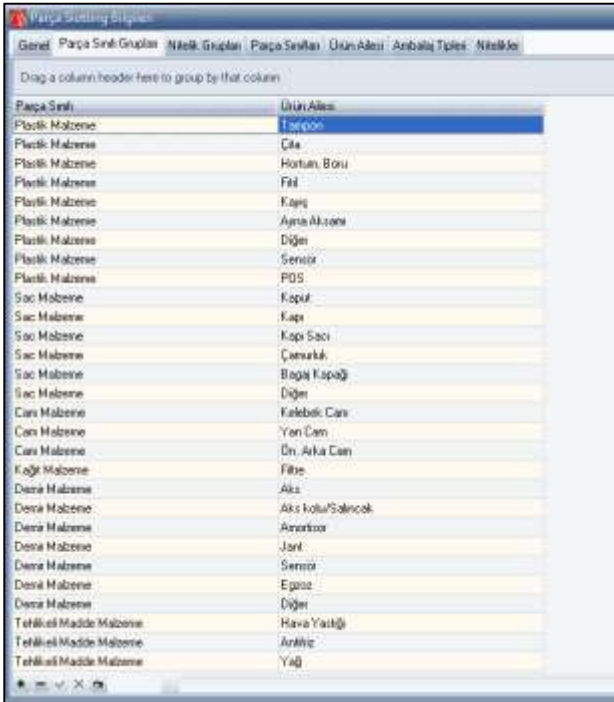
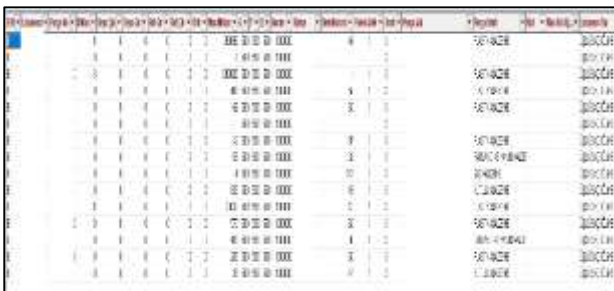


Table 4. Defining location features for slotting



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