DOKUZ EYLÜL UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

IMPROVING THE PERFORMANCE OF MANUAL ORDER PICKING IN THE WAREHOUSE: A CASE STUDY

by
Cemile VATANSEVER

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İZMİR

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We have read the thesis entitled **"IMPROVING THE PERFORMANCE OF MANUAL ORDER PICKING IN THE WAREHOUSE: A CASE STUDY"** completed by **CEMİLE VATANSEVER** under supervision of **ASST. PROF. DR. SEREN ÖZMEHMET TAŞAN** and we certify that in our opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

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IMPROVING THE PERFORMANCE OF MANUAL ORDER PICKING IN THE WAREHOUSE: A CASE STUDY

ABSTRACT

Nowadays, warehouses provide both keeping and protecting products and also help serving products to customers quickly. To deliver products on time, the products must be picked effectively in the warehouses. For that reason, the efficiency of order picking process becomes very important. Furthermore, order picking affects other warehouse operations and also affects the transportation of products to customers on time. The aim of this study is to decide on a storage allocation policy for minimizing the travelling distance while picking orders in a retail warehouse. In the study, firstly, the existing storage allocation in the warehouse is examined. Later, different storage allocation models are proposed and analyzed according to travelling distance while picking orders. In the proposed storage allocation models, the products are assinged to shelves according to class based storage policy in the first model, according to family grouping storage policy in second model and according to combination of these two storage policies in the third model. These three different storage allocation models are designed according to similarity of groups and ABC analysis. Group similarity means, similar products are stored close to each other, i.e water group and soda water group are stored close to each other. The stock output rate is used for ABC analysis. The products with the highest stock output rate are stored to close the depot. Additionally, in order to evaluate the performance of these three models, two routing policies, i.e. A star and Dijkstra's algorithm are used for picking the orders. By applying, the routing policies, the travelling distance for the existing and three proposed storage allocation models are compared statistically. According to the results, it can be stated that for warehouse under study in this thesis, the best storage allocation model is the one that was arranged according to combination of the class based storage policy and the family grouping storage policy.

Keywords: Order picking performance, storage allocation policies, family storage policy, class based policy, ABC analysis, Dijkstra's algorithm, A star algorithm.

DEPODA ELLE SİPARİŞ TOPLAMA PERFORMANSININ GELİŞTİRİLMESİ: BİR VAKA ÇALIŞMASI

ÖZ

Günümüzde, depolar ürünlerin saklanması ve korunması dışında ürünlerin müşteriye hızlı ulaşmasını sağlar. Ürünleri, müşterilere zamanında ulaştırmak için ürünler depolarda etkin biçimde toplanmalıdır. Bu nedenle sipariş toplama sürecinin etkinliği çok önem kazanmaktadır.Ayrıca sipariş toplama, diğer depo operasyonlarını ve ürünlerin müşterilere zamanında ulaştırılmasını da etkiler. Bu çalışmanın amacı, bir perakende deposunda sipariş toplarken gezinme mesafesini en aza indirgemek için, depolama atama politikasına karar vermektir. Çalışmada ilk olarak bir marketler zincirinin ana deposundaki mevcut ürün yerleşimi incelenmiştir. Daha sonra sipariş toplarken gezinme mesafesini azaltmak amacıyla farklı depolama politikaları analiz edilmiştir. Önerilen depolama modellerinde, ilk modelde, sınıf tabanlı depolama atama politikasına göre, ikinci modelde aile gruplama depolama politikasına göre ve üçüncü modelde bu iki depolama politikasının kombinasyonuna göre, ürünler raflarda depolanır. Bu üç farklı depolama modeli, grupların benzerliği ve ABC analizine göre tasarlanmıştır. Grup benzerliği, benzer ürünlerin birbirine yakın yerlerde depolanması gerektiği anlamına gelir, örneğin su ve maden suyu grubu birbirine yakın olarak depolanır. ABC analizi için, ürünlerin çıkış hızı oranı kullanılır. En yüksek çıkış hızına sahip ürünler giriş/çıkışa yakın yerlerde depolanır. Daha sonra, bu üç modelin performansını değerlendirmek için, rotalama politikası olarak A star ve Dijkstra algoritması kullanılmıştır. Bu rotalama algoritmalarına göre, mevcut ve önerilen üç depolama politikasının gezinme mesafesi hesaplanmıştır. Elde edilen sonuçlara göre, bu tez çalışmasında, sınıf tabanlı ve aile gruplama politikasının kombinasyonuna göre düzenlenen model, en iyi depolama modelidir.

Anahtar kelimeler: Sipariş toplama performansı, stok atama politikaları, grup tabanlı depolama politikası, sınıf tabanlı depolama politikası, ABC analizi, Dijkstra algoritması, A star algoritması.

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CHAPTER ONE
INTRODUCTION

Warehouses are transition locations between the supplier and the customer. They provide product and material flow from supplier to customers. Organizing warehouse activities effectively has direct impacts on customer service level, warehouse cost which usually will be advantageous when competitions among warehouses exist. Specifically, warehousing has particular influences on an entire supply chain. Therefore, the possible improvements in warehouse systems becomes important for the success of supply chain.

The main activities in warehouse are *receiving, putting/storage, order picking* and *shipping*. In *receiving*, the products are unloaded from supplier's transport vehicle. Also this process includes counting, inspecting the quality of products and preparing the products to storage location. In *putting/storage,* the products are transferred and put in storage location. O*rder picking* is the main operation. It can be described as, retrieving products from shelves to respond customer orders. In the warehouses, approximately % 50 of total operation cost comes from order picking cost. Also, order picking affects all other processes. If the products that are ordered by customers aren't picked on time, the shipping process delays. Thus, the orders aren't sent to stores on time and this causes customer dissatisfiction and sales rate falls. So, the factors that affect order picking performance are examined in detail in warehouses. Storage allocation policy, routing, zoning, batcing and warehouse layout influence the order picker performance. For this study, the order picking performance is to minimize travelling distance while picking orders and we will examine the storage allocation policy for improving order picking performance. Last activity is *shipping*. The picked products are palletized and they are labeled according to where it will be sent and later they are loaded to shipping vehicle.

In this chapter, there is general information about the study. The objective and methodology of the study, research question and lastly outline of the study are presented.

1.1 Research Objective

The companies nowadays want to reduce cost of warehouse operations. Order picking cost yield to the highest expense in the warehouses; consequently, the improvement in order picking is crucially needed in warehouses. Usually, order picking is done by humans in lots of warehouses. To increase productivity of the humans, the factors that affect order picking performance should be examined thoroughly. Storage allocation policy, routing strategy and warehouse layout are some of the factors that affect order picking performance. Hence, the main objective in this study is to determine which storage allocation policy helps minimize total distance travelled by the order pickers.

In this study, the performance measure used for the performance evaluation of the order picking process is the traveling distance. There are various storage allocation policies that are applied in the warehouses. Random storage, closest open location storage, full-turnover storage, dedicated storage, class based storage, and family grouping storage is the storage allocation policies. We deal with minimizing travel distance for order picking by performing new storage allocation policies. Determining the best storage allocation policy for minimizing travel distance of the order pickers is the main objective in this study.

A real life warehouse problem will be solved in this study. First, the existing storage allocation is examined and the travelling distance for the existing allocation is calculated. Later, three new storage allocation models are proposed. Class based storage policy, family grouping storage policy and using these two storage policies at the same time are the proposed storage policies. Travelling distance while picking orders are calculated for the existing and other three proposed storage policies by using Dijkstra’s algorithm and A star algorithm as routing policy. Later, travelling distance results are compared statistically. The travelling distance results of Dijkstra’s algorithm are better than the results of A star algorithm. So, while evaluating the proposed allocation models in terms of travelling distance, Dijkstra’s algorithm’s results are used.

As a conclusion, by performing statistical analysis, the best storage allocation policy that minimizes travelling distance for order picking is selected. Combination of class based and family grouping storage allocation policy at the same time minimizes the travelling distance. So, this is the best allocation policy for this study and this allocation model provides the highest improvement for minimizing travelling distance.

1.2 Research Methodology

In this part, there is the background of case study and the data that is used in case study is gotten from the retail warehouse. Historical data are gathered and analysed for getting a solution to the problem.

I. Background of the Case Study:

The case study chosen in this study was performed in a retail warehouse. The products of a market chain are stored in this warehouse. There are four main operations for the products in the warehouse. The operation processes are; (i) the products are received, (ii) the products are transferred and stored, (iii) the products are picked, (iv) the products are shipped. In this study, storage and picking issues are studied.

In this warehouse, there are lots of product types but there is no criterion while allocating products in the shelves. The products are stored randomly in the shelves this results with storage allocation problem. Because of inappropriate storage allocation, order picker has difficulty in finding products and he has to travel more distance while picking orders. As this travel distance of order picker increases, the order picker picks the products in longer time and as a result of this, order picking performance decreases. So, more travelling distance means low order picking performance. For preventing longer travelling distance, the existing storage allocation should be rearranged. This existing storage allocation will be developed by analyzing historical data and proposing new storage allocation models.

II. Data Collection and Analysis

This study is a real life problem. The data was collected from customer's order history. One-year data was used. The analyzing of data can be explained in the followings. In this study, there are lots of product types so we put each product type in a group. The order of each product type was examined. Thus, we got stock output rate of each product type. There are 710 product types and we group them in categories. For example, drinks are clustered in one group and detergents are clustered in another group. We get 35 categories at the end of grouping. Categories are also grouped in subgroups. So, we get 135 subgroups. For example, water category has three water subgroups. All categories are grouped in this way. Later, we allocated the products in the shelves using these subgrops.

After grouping, the products were located in the shelves according to some criteria. Locating similar groups close to each other and the stock output rate are the criteria that are used. Firstly, family grouping storage, secondly, classed based storage and thirdly combination of them are used as proposed storage allocation models. For family grouping storage, similar product groups are allocated close to each other in the warehouse. For classed based storage, the products are allocated according to classificaton of ABC analysis. In last storage allocation policy, family grouping and classed based storage allocation are used together. For calculating travelling distance between product locations according to these storage allocation policies, we use A star and Dijkstra's algorithm. It is programmed using C#.NET. Dijkstra's algorithm gives better results than A star algorithm. So, by using Dijkstra's algorithm results, the best storage allocation policy is determined that minimizes travelling distance while picking orders.

Consequently, the storage allocation has an important influence on order picking performance. For that reason, appropriate storage allocation policy should be chosen for improving order picking performance. The aim with this study is to determine the best storage allocation that improves order picking performance.

1.3 Research Question

There are alternative ways of improving order picking performance. Storage allocation is one of them. Random storage, closest open location storage, full-turnover storage, dedicated storage, class based storage, and family grouping storage are the storage allocation policies in warehouses from literature. These storage policies influence order picking performance. The order picking performance can be measured in different ways but here we determine travelling distance as performance indicator. So, appropriate storage allocation policy should be selected for minimizing travelling distance for order picking. In order to accomplish this objective, following question must be answered:

*Does the stock allocation policy affect order picking? How the order picking performance can be improved and which storage allocation strategy is the most effective in proposed allocation models for this retail warehouse?

For this retail warehouse, we know that, the random storage is used for allocating products. We observed that the order pickers waste time for searching the products and it results with more travelling distance while picking. Because of random storage allocation, they have difficulty for learning each of product location. This random storage allocation policy should be rearranged. So, different storage allocation policies should be adopted to find products easily and to minimize travelling distance in the warehouse.

As a solution, we have made new storage allocation models and performed them in the warehouse. For this, historical data should be examined, analysed and also grouped using some criteria. New storage allocations are made by using them. These are explained in Chapter 4 in details.

After analyzing the products, the products are stored in the shelves according to different proposed storage allocation policies. At this point, proposed storage policies should be compared according to order picking performance indicator. For our study, the order picking performance indicator is the travelled distance while picking orders. A programme is made for comparing the proposed allocation models. This programme is done in C#.NET programming language. This programme calculates travelling distance for picking orders by using different storage allocation policies. As a result, we can determine the best storage allocation that minimizes travelling distance for this warehouse.

1.4 Implications of the Study in the Warehouse

Warehouses use different performance indicators for measuring the improvements. The purpose of performance measurement is to learm whether the activities or operations are performing by the right way. If the performance is poor or there is a problem, some solutions have to be found for improving. For this study, according to observations and examinations, we understand that there is problem on storage allocation and this affects travelling distance. The travelling distance is order picking performance.

When an appropriate storage allocation policy is made, this will affect order picking performance positively. In the beginning of the study, the products will be grouped and organized into categories. The stock output rate will be calculated with the help of one year's data. Later, each product category will be located on the shelves using different storage policies. In this warehouse, random storage allocation policy is applied and this has negative affect on travelling distance. But if the products allocation policy is changed with another proposed allocation policies, the order picker can easily find the location of the products before picking. So, the order picker won’t walk too much for finding products in the picking area. So, the searching time for finding the products will decrease. Depending on this, the amount picked by the order picker in one hour will increase. That is, amount of products picked per person will increase. Besides this, there is another effect in terms of order pickers. The order picker will not get tired because he will not walk too far for searching products.

Another contribution is that. With this study, we classify products according to ABC classification so we have developed a control mechanism on products. The products in A class are the most important. These products need to be well controlled. Thanks to ABC classification, the products will be prevented from being lost and damaged. Classifying is also useful for inventory count. For example, the products that are in class C do not need to be counted at frequent intervals. Therefore, the order pickers will not work overtime. So, storage allocation policies affect lots of operation in the warehouse.

1.5 Outline of the Thesis

Storage policy, routing strategy and warehouse layout are some of the factors that affect order picking performance. These factors will be examined in details. There are various storage policies that are applied in the warehouses. Random storage, closest open location storage, full-turnover storage, dedicated storage, class based storage, family grouping storage are the storage policies. In this thesis, we study about minimizing travel distance for order picking. A real life case study is examined by performing storage policies. Travelling distance while picking orders are calculated for the existing and other three proposed storage policies by using Dijkstra's algorithms routing policy and later all of them are compared. As a result, the best storage allocation policy is selected that minimizes travelling distance for order picking.

The remainder of this thesis organized as follows;

In Chapter 2, warehouse operations are explained in details. There are warehouse functions, classisfication and objectives of order picking systems. Order picking process is affected from layout of warehouse, storage allocation, zoning, batching and routing methods. These are explained. Handling equipments and types of warehouse racking systems that are used in warehouses are also handled in chapter 2.

In Chapter 3, there is literature review about warehouse layout design, zoning, batching, routing, storage allocation policy, order picking and general conclusion of literature.

In Chapter 4, a real life case study will be submitted. This case study is made in a warehouse of retail chain markets. OBASE Warehouse Management System is used for order picking. The steps of used warehouse management system are explained in this part. Later, the problem of case study is defined. The data that is used for this problem is analyzed. The aim of this case study is minimizing travel distance while picking orders in the warehouse. To get a solution to this problem, new proposed storage allocation models are developed. These models are evaluated and compared in detail. At the end of this chapter, the problem is solved, that is, travelling distance is minimized.

Chapter 5 includes conclusions about the study. There is summary of the study. This case study has many contributions on warehouse. These are explained in this part and also some suggestions are performed for future study.

CHAPTER TWO
WAREHOUSE OPERATIONS

Warehouses are defined as places where the products are preserved and stored until the moment of need. Warehouses play strategic role between suppliers and customers. So, management of warehouse operations is one of the important parts most of the company's logistics efforts. Warehouse operations include four major operations; receiving, storage, picking and shipping. These operations are explained in this part.

Order picking is the most noticeable operation within all warehouse operations because it affects all other operations. Also, it is a large part of total warehouse labor cost and another reason why ordering is so important is that order picking plays a big role in customer satisfaction. The order picking systems are affected from some factors. Also, these factors will be explained in this chapter.

2.1 Importance of Storage in Logistics Systems

Warehouses are important part of the firms' logistics systems. They are generally used for buffering and storing products (raw materials, goods in process, finished goods). If the main function is storage and buffering of the products, the term "warehouse" is used and if the main function is distrubution, "distribution center" term is used. We focus on "storage allocation and order picking" in this thesis, so we will use "warehouse".

Although warehouses involve in large operational costs and investments, they provide important contribution to the logistics firms like below (De Koster, Le-Duc, & Roodbergen, 2007).

Fundamentally, warehouses have two main functions. The first of them, if suppliers' shipments to be sent to customers aren't big volume that will fill big truck, big volume shipment is divided into small shipments in the warehouses. Small trucks are sent to the customers. It is called as “breakbulk”. This provides decrasing transport cost. The second one is “consolidation”. Shipments from different suppliers are combined in the warehouse and sent to customers. This is called as “full truck load”.

Other functions of warehouses are below (Ertek, 2012);

-Receiving of incoming products and controlling of quantity and quality.

-Preventing of deterioration, breakage and damaging of the products.

-Keeping at minimum level the risk factors such as heat, humidity, light.

-Producing and purchasing large volume instead of small volume so that cost is reduced.

-Meeting customer demand in short time.

-Overcoming changing market conditions like seasonality demand fluctuations.

-Sending a mix of products instead of sending single product for each order to the customers.

-Shortening time between producers and customers.

-Providing a buffer location for transshipments. (Crossdocking, direct delivery)

-Providing temporary storage of material to be disposed or recycled.

2.2 Warehouse Functions and Flows

The basic function of a warehouse includes these; receiving customer orders, retrieving required products, preparing these products and shipping them. There are various ways to organize these functions but the main phases are the followings. Warehouse functions and flows are shortly explained in this section. Figure 2.1 shows functional areas and flows in a typical warehouse (Heragu et. al., 2005). Receiving, transferring/puttting away, order picking/selection, accumulation/sortation, cross-docking, and shipping are the main warehouse functions.

-*Receiving* activity includes unloading products from transporter, inspecting for damage and quantity-quality inconsistency and updating inventory control.

-*Transfer/putaway* involves defining the appropriate locations for products and transferring them a specified location to wait for order picking.

-*Order picking* means retrieving products from shelves according to any customer requests. The most important part of the warehouses process is order picking because it is the most costly and time consuming activity for warehouse operations. Underperformance of order picking leads to unsatisfactory service and high operational cost in the warehouse (De Koster et al., 2007). If the order picking is done in batches, *accumulation* and *sortation* process is necessary. In this process, the batches are grouped according to customer orders. Later, the orders are packed and labelled on the pallets. Pallets are taken away shipping area.

-The last process is the *shipping*. This process includes loading the pallets in vehicles and scheduling vehicles. As a result, traditional warehouse process includes receiving, transfer/putaway, order picking/selection, accumulation/sortation and shipping.

Receiving and putaway are inbound logistics process because flow of products is coming into the warehouse; on the other hand, order picking and shipping are outbound logistics process because products are moving out of the warehouse.

Cross docking is the alternative of the traditional warehouse. It includes only receiving and shipping functions. There is no order picking in cross docking and the coming goods must be shipped in 24 hours.

There are four material flows that are applied in the warehouses. The *first flow* is the cross-docking activity, the products come to receiving area and sometimes the products are stored in the staging area for a while and sometimes they are sent to shipping area directly. *The second flow* is that the products are stored in the reserve area and according to customer orders; order picking is done in the reserve area. The *third flow* is the common flow in the warehouses. The products are stored in the pallets in reserve area and pallets are seperated to boxes and pockets to speed up order picking. Later the products are moved to forward area to consolidate orders. The *fourth flow* can be thougt as transfer operation. When the products come to warehouse, they are sent to forward for consolidating orders.

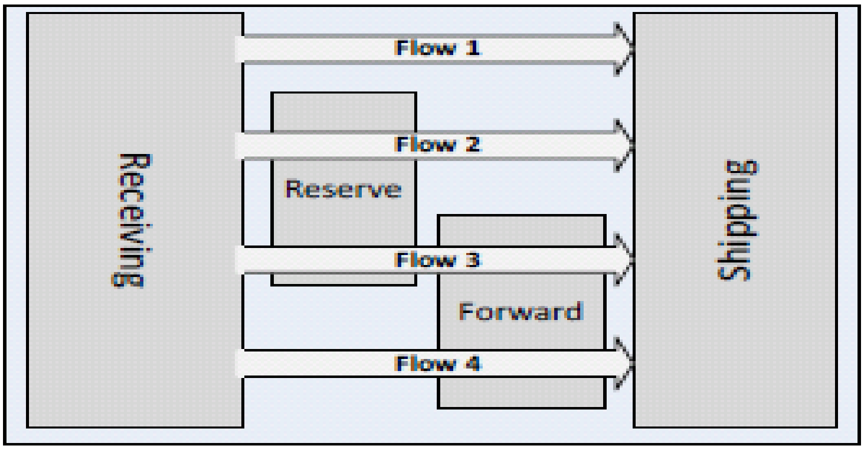

Figure 2.1 Typical flows in a warehouse (Heragu et. al., 2005)

2.3 Order Picking Systems in the Warehouse

The most important process is the order picking in the warehouses. The issues that are related with order picking are explained in details in this part. Order picking involves the process of retrieving products from storage to respond customer orders (De Koster et al., 2007). It also consists of scheduling and grouping of the customer orders. Order picking process starts with the customer demands. It is called as order line. Each order line represents name and quantity of the customer demand. A warehouse management system checks the availability of inventory for customer orders. If there is sufficient product in inventory, warehouse managements system converts order lines to pick lines for order pickers. The pick lines can be single or multiple lines depending on the number of location to be visited by pickers. When the pick lines are created, Warehouse Management System (WMS) sequences the lines to reduce travel time. Later, pick lists are made that consists of order lines. Printed sheet of papers, radio frequeny and voice transmission are the tools that are used for organizing pick lists. The next step is batching or splitting of orders. When the batching and splitting of requested orders are completed, the picking can be started by humans or automated equipment. In order to provide high customer service level, the accuracy of the requested orders are important while picking, so orders must be picked in the right amount and right product. Lastly, consolidation of orders is done and then products are sent to shipping area (Tsige, 2013).

Order picking is the most labor intensive and costly activity in the warehouse operations. 55% of the total warehouse operating expenses is related to order picking operations so order picking is the most important function in warehouse functions.

2.3.1 Classification of the Order Picking Systems

Order picking systems are classfied whether human or automated machine are used. Figure 2.2 shows this classification. In this part, classifications of order picking systems are explained. There are five types of order picking systems (Dallari, Marchet & Melacini, 2009).

a) Picker-to-parts
b) Parts-to-picker
c) Pick-to-box
d) Pick-and-sort
e) Automated and Robotised Picking

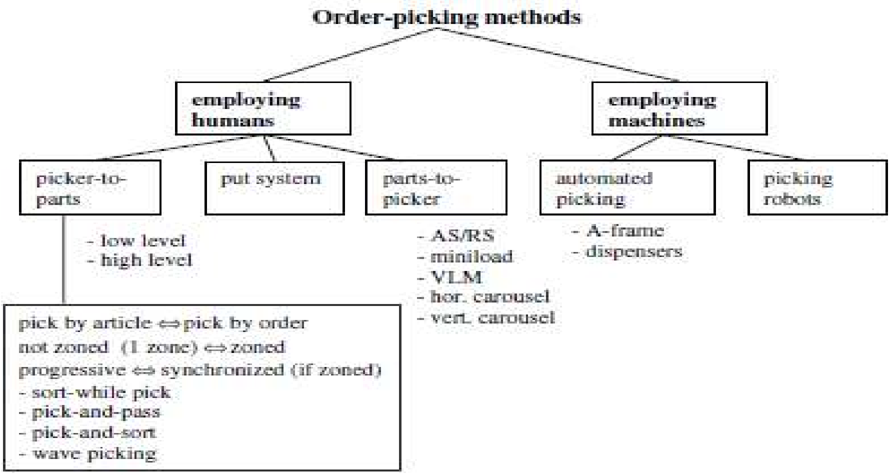

Figure 2.2 Classification of order-picking systems (De Koster, 2004)

a) Picker-to-Parts: Most common system that is used in warehouses is picker-to-parts. The picker walks and drives a vehicle along aisles for picking orders. Picker to parts are also grouped as low-level and high-level picking. In low-level, the picker walks along the aisle and picks requested items from storage shelves. In high-level picking, items on the high storage shelves are picked by the pickers helping of a lift and a crane. The lift stops in front of appropriate pick location and waits the picker for picking. This is also called man-on-board system.

b) Parts-to-Picker: An automated vehicle transports required items from storage area to picking area. The pickers take the requested orders and the automated vehicle transports the remaining items to storage area. This system is also called as a-unit-load and or end-of-aisle order picking system. AS/RS (Automated Storage/Retrieval Systems), carousels and cranes are the equipments that are used for parts-to-picker method. Low order picking cost is advantage of this system. Consequently, it will result in the labor hours and the need for storage space reductions. But, there is a disadvantage of this system. Bottlenecks can appear at the picking point. The products to be picked big volume and less flow are suitable for this system.

c) Pick-to-Box: Order picking area split into zones and order pickers are assigned to each zones. All order picking zones are connected to each other with conveyors. The boxes picked for customer orders are carried on the conveyors. In this system, it doesn't need sorting after order picking. Storage of a large number of products in small size and also low order quantity are preferred is for this system. When the number of orders increase, the movement of many boxes causes complexity and management of boxes become difficult.

d) Pick-and-Sort: Order pickers send products sortation area using the conveyors. Products are sorted on the conveyors according to customer orders. The balance between picking, sortation and packing is important for this system. This system is effective than picker-to-parts but automated sortation system has high cost.

e) Automated and Robotised Picking: Automated machines and robots are used instead of humans for picking. This picking system is used for small, valuable and sensitive items. Although this picking system provides low product damage, high picking rate and integrates with easily other warehouse operations, it requires high level technology, management abilty and investment cost (Chang, Xin & Liu, 2007).

Low level and pickter-to-parts order picking systems are used generally and humans are employed for order picking in the %80 of warehouse worldwide.

The design of real order picking system is complex. There are internal and external factors. External factors consist of customer demand, supplier replenishment state, inventory level, demand for a product and state of the economy. Internal factors include system organization, characteristics and operational policies of order picking. System characteristics include mechanisation level, information availability and warehouse dimensionality. The organization and operational policies include routing, storage, batching, zoning and order release mode. The complexity of order picking system is showed by axis system in Figure 2.3. The farther distance from origin, the complexity of system increases (Goetschalckx & Ashayeri, 1989).

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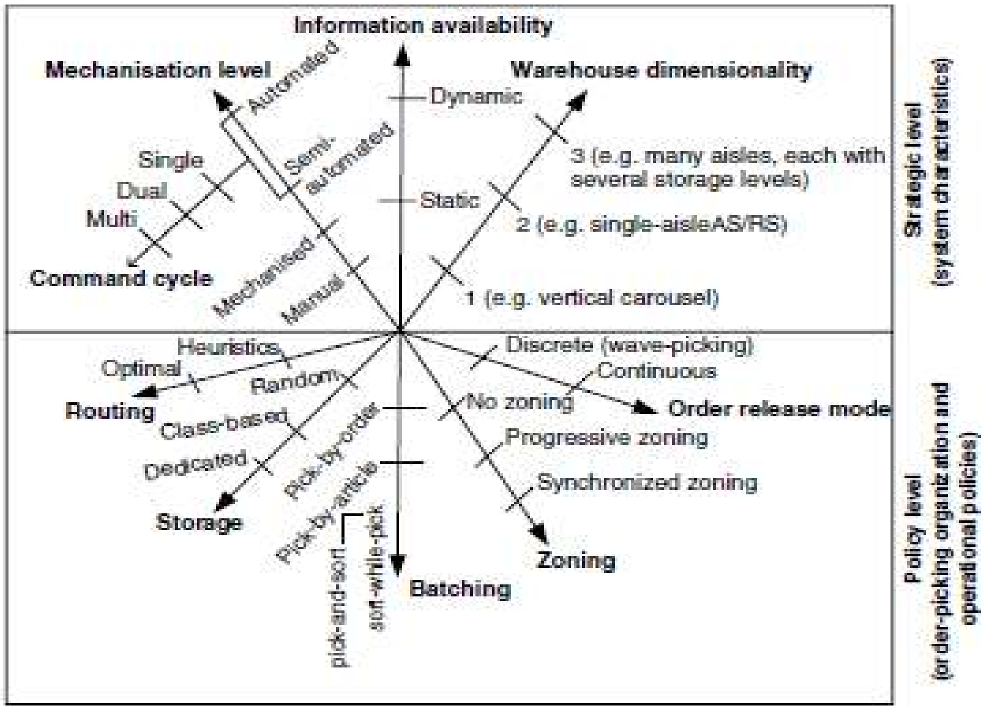

Figure 2.3 Complexity of order picking systems (De Koster, 2007)

2.3.2 Order Picking Objectives

Order picking is the most important process for the warehouse operations. When it is improved, the resources such as labor, machinery and money are used more efficiently. There are various performance criteria for order picking. One of them is order picking time. Order picking time includes travel time, search time, pick time and setup time. Figure 2.4 shows the percentage distribution of order picker's time. Travel time is the most important component to be improved. It is the waste time and doesn't add value. The travel time is interrelated with travel distance. When the travel distance decreases, the travel time also decreases.

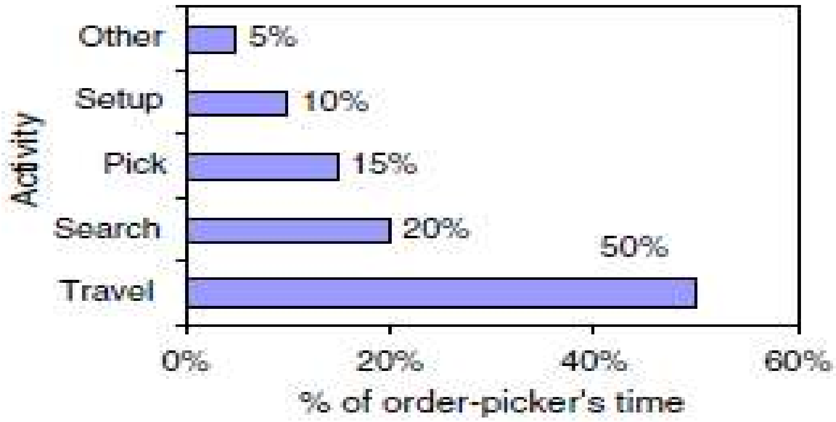

Figure 2.4 Distribution of order picker's time (Tompkins, White, Bozer & Tanchoco, 2003)

The travel time is an increasing function of travel distance for manual order picking systems (Hall, 1993; Jarvis & McDowell, 1991; Petersen, 1999; Roodbergen & De Koster, 2001a, b; Petersen & Aase, 2004). As a result, the travel distance is the most important objective for optimization in warehouses. The common objective of order picking system is to minimize total travel distance or miminize average travel distance of a picking tour.

The other objectives are in the followings:

-Minimize total cost,

-Maximize the use of labour, equipment, space,

-Minimize the completion time of a batch of orders,

-Minimize the completion time of an order,

-Maximize the accessebility to all products.

2.3.3 Planning of Order Picking Process

Researches show that the issues related to warehouse design and operations improve system performance and reduce warehouse costs. Commonly three questions are considered. These are; how products are stored; how products are picked; and how pickers route to the products. So, storing, picking and routing are related issues in the warehouses. Order picking is most important and costly operation in the warehouses. So, some factors must be planned before order picking process starts. In order to increase the performance of order picking process, some improvements and changes should be made about below factors.

The main factors that affect performance of order picking systems are:

-Layout of warehouse,

-Storage allocation,

- Zoning,

-Batching,

-Routing methods

2.3.3.1 Layout of Warehouse

Warehouse layout problem consists of two sub problems. First one is, deciding where receiving, picking, storage, sorting and shipping areas will locate in the warehouse. It is also called as *facility layout problem*. For the facility layout problem, the main objective is to minimize handling cost and transporting cost. Second one is *internal layout design*. This is also called as *aisle configuration*. This layout planning includes deciding number of storage blocks, the number, length and width of the each aisle in order picking area (Figure 2.5). The main aim is making the best warehouse layout with respect to objective function. The commonly used objective function is minimizing travel distance (Dallari, 2009).

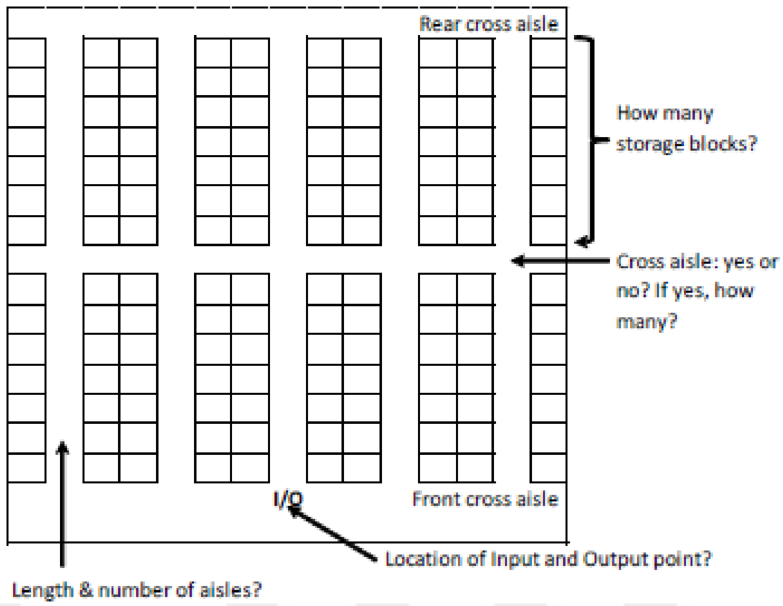

Figure 2.5 Typical layout decisions in order picking system design (De Koster, 2007)

2.3.3.2 Storage Allocation

Products are put into storage locations before they are picked. A storage allocation method is a set of rules that can be used to allocate products into storage locations. However, before such an allocation is made, it must be decided which pick activities will be used in storage system.

There are various ways of storage allocation methods for storing the products in the warehouses. The storage allocation methods are; random allocation, closest open location storage, dedicated storage, full turnover storage, class-based storage, family grouping storage. Researchers say that; nowadays random storage, class-based storage, and dedicated storage are very popular in warehousing management.

Before storage allocation methods are made, there is forward-reserve allocation that is used for speeding up the picking process. First, forward-reserve allocation and later types of storage allocation methods are explained in this part.

a) Forward-Reserve Allocation

For speeding picking process, separating bulk stock (*reserve area*) from pick stock (*forward area*) is necessary in many cases. Size of the forward area must be restricted because the order pickers spend less travel time in the smaller area. If a product's customer demand is high or demand frequency is low, storing this productin reserve area is advantageous. Dividing areas into multiple areas provides regular internal replenishments from the reserve area to the forward area. These decisions that are defined above are handled in *forward-reserve problem.*

Forward-reserve problem is *dynamic storage*. Products in the picking area change dynamically because of small picking area. This problem aims making smaller picking area and thus by using this smaller area, it tries to reduce travel time. The storage allocation is used dynamically because automated crane, carousel are used for bringing SKUs to the storage locations. The number of forward area storage locations is usually smaller than the total number of SKUs. Since these systems can achieve very high picker efficiency, they are becoming very popular.

b) Random Allocation Method

The incoming pallets can be assigned with equal probability to any empty location randomly. This method provides using storage area efficiently but it increases total travel distance for order picking. This policy would only work if the warehouse is controlled with computer (Choe & Sharp, 1991; Petersen, 1997). Otherwise, the search-time of the products and travelling distance of order pickers during picking process would be seriously affected.

The greatest advantage of the random storage policy is due to high space utilization, because any incoming product is stored any space in the picking area. Thus, it minimizes space requirements in the picking area.

Random allocation can be useful if the product variety is low and the same products are constantly coming and also it can be used if coming products need to be put away immediately. Travelling distance of manual picker increases with this allocation, so random storage is useful for *automated picking* environments as: AS/RS, VLM's, or carousels.

c) Closest Open Location Storage

The closest open location method is similar to random assignment but it stores products in the first empty location in the storage area. The operators store the products to the closest location from I/O point. So, the closest shelves from I/O point are full and gradually the back of the warehouse becomes empty (Hausman et al., 1976). If products are only transported with full pallets, closest open storage and random storage perform similarly. Closest open location storage looks like random allocation method for long travelling distance and high space utilization. Like in the random allocation method, computer system is necessary for tracking the products in the warehouse.

d) Dedicated Storage

For this storage strategy, products are allocated to specific locations that are decided before. A product can not be stored any location instead of another product, even if location is empty. The disadvantegous of dedicated storage allocation is that, the storage space is allocated to products not available in stock continues waiting as empty. Every product storage location has to be large enough for storing maximum inventory level. So, space utilization is the lowest among all storage allocation strategies. The advantegous of this strategy is order pickers are familiar with products' storage location. Retail warehouses use dedicated storage. Products are grouped and these groups have dedicated stores in the shelves (De Koster & Neuteboom, 2001). The dedicated storage can be helpful for storing products in different weight and volume. Heavy products are stored on the bottom of shelves and light products are on top.

e) Full Turnover Storage

Products are stored in warehouses according to their turnover. While the products have the highest sales rate are stored in quickly accessible locations, slow moving products are stored toward back of the warehouse. Full turnover storage is determined with Cube per Order Index ratio (Hescett, 1963, 1964). It is the ratio of the item's total required space for storage to demand frequency per period. The lowest COI ratio is located the closest I/O. Full turnover storage or other storage allocations based on demand frequency needs updating information than random storage. The main disadvantage of full turnover storage is that as demand changes, new allocation storage policy requires.

f) Class-based Storage

Class based storage policy is commonly used in practise. The class based storage is combination of random and dedicated storage allocations. This policy divides the inventory products into classes. Each class has a dedicated area but the products in each class are allocated randomly. Class-based and random storage policy are also called as *shared storage policies*.

The classes are made in different ways. Classes can be made according to the products life. For example, perishable products are grouped together and non-perishable products are grouped together. Classes can be made according to the incoming sequence of products. For example, first-in first-out (FIFO) and last-in first-out (LIFO) rule can be performed to dividing products into classes. And also, classes can be made according to Pareto principle. The most popular used strategy for dividing products into classes is Pareto principle. For Pareto principle, the products are grouped to classes according to fast moving products. The fastest moving products are only about 15 % of all stored products but these products are about 85 % of the turnover. In other words, the number of these products are small but moving of products are high. This group is called as class A. On the other hand, if the number of products are high but moving of products are small, this group is called as class C. Products are between above two classes are called as class B. The products in A class will be located more convenient locations that are close to input/output points or close to shipping door. The products in class B will be located the next most convenient locations after A class products. The products in class C will be located the furthest location from input/output points.

ABC class-based storage divides items into different classes. Each class is assigned to dedicated area in the warehouse. The products in each area are assigned randomly. Classes are determined by some measure of demand frequency like COI and pick volume. This policy has the advantage that fast moving products stored close the depot and also the flexibility and low storage space requirements of random storage can be applied for these products. For locating the incoming product in the correct class region, empty locations are necessary. So, space requirements increase by the number of classes. As a result, class-based storage policy requires more shelf location than randomize storage policy.

There are various ways for positioning A, B, C areas in the shelves for the low-level picker-to-part systems. If each aisle contains only one class, this is called as *within-aisle storage*. If each aisle contains multiple classes, this is called as *across-aisle storage*. Across-aisle storage is better than within-aisle storage.

Commonly, three classes are used for dividing products but in some cases more classes can be used. The use of more storage classes leads to shorter travel time for storing and retrieving items. Hausman et al. (1976) formulated a travel time model for class- based storage and analyzed benefits of two and three class-based storage. Rosenblatt & Eynan (1989) generalize the model for n classed-based storage and develop an algorithm for finding optimal boundaries of all classes.

There is no definite rule in the warehouse literature to define number of classes, percentage of items and the percentage of total picking volume per class.

g) Family Grouping Storage

The policies discussed up to now, there was no relationship between the products. Family grouping allocation is performed by considering possible relationships between products. For example, if customers order certain products with other certain products, these similar products are located close to each other. This is called family grouping storage. The main idea for this storage, the products that are required simultaneously are located close to each other. The statistical correlation between the properties of products must be known for applying family group storage. For example, the frequency of ordering the certain products together must be predictable or known.

Family grouping strategy can be combined with other storage assignments. For instance, class-based storage and family grouping storage can be used together. The products that have relation between them can be grouped in the same class and are located close in the warehouse.

2.3.3.3 Zoning

Zoning is an alternative to single-order picking. Picking area is divided into zones. Each order picker is assigned to zones to pick a part of order. Although zoning has important effect on the order picking performance, it hasn't been focused on so much. Advantegous of zoning method is that: (i) Order picker has to travel short distance in his zone. (ii) Traffic problem in order picking area decreases. (iii) Order picker recognize bettter the products in his zone because generally same pickers are assigned to same zones. The main disadvantegous of zoning is that orders are split and later combined again in the shipping area before sending customers.

There are two approaches that are used to deal with this problem. The first one of these approaches is *progressive assembly* of an order. Order picker picks the producst in the list that belongs to his zone and he hands the order list another picker for completing rest of order. Thus, the products in picking list are completed. This system is also called *pick-and-pass*. The other zoning approach is *parallel or (synchronized)* order picking method. In this method, each order picker picks the products for the same order at the same time. After all pickers finish picking, partial orders are combined before shipping. In practise, zoning is performed if the product properties like size, weight, and temperature requirement and expiration date are important (De Koster et al., 2007).

2.3.3.4 Batching

When customer orders are large or contain large number of products, each order can be picked individually without mergeing. This picking strategy is called as single-order picking policy (or discrete picking or picking-by-order). When the orders are small, a set of orders are picked in a single picking tour to reduce travel time. Batching is a kind of grouping method. The orders are grouped into a number of sub-sets then each of sub-sets can be retrieved by a single-picking tour.

The merged orders according to the clustering method can be picked in one single-picking tour. Merging of orders is performed according to two criteria. There are two criteria for solving batching problems. These are: *The proximity of pick locations and time window* (Choe & Sharp, 1991). For proximity of pick locations, the orders are assigned to in a batch according to proximity in the storage location. The objective is generally, to minimize the maximum lead time of any batch. The other criterion is time window. The customer orders arrived at the same time interval are grouped in a batch. These customer orders are processed simultaneously.Thus, each picker picks combined orders in one picking tour.

2.3.3.5 Routing Methods

The objective of routing policies is to determine the sequence of products on the pick list for creating a good route in the storage area. Order picker route problem is a special kind of Travelling Sales Problem (Lawler, 1995). Salesman visits the cities on his route only one. He starts visitig from a city and after completing his route, he comes back again in his starting point. Salesman knows the distance between two cities so he wants to minimize total travel distance. Travelling salesman problems have similarities with order picking problem. Order picker starts picking from depot and he picks the products according to picking list and he visits all locations on the pick list and finally he returns to depot. But also, there are some differences between classical travelling salesman problem and order picking problem. When we look at Figure 2.6 white points show not have to be visited. Black nodes indicate the locations that have to be visited and sometimes these nodes can be visited more than once so this is different from the classical travelling sales problem. This order picking problem is called as Steiner Travelling Salesman Problem. Difficulty of this problem is that it is not solved in polynomial time.

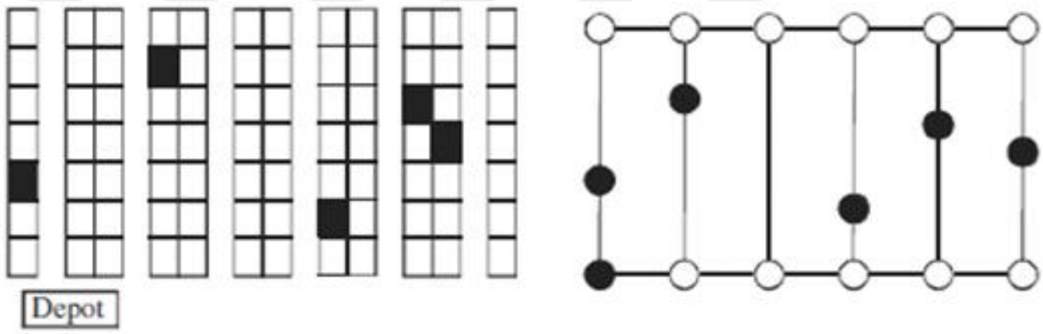

Figure 2.6 Illustration of an order picking situation and its graph representation (Ratliff & Rosenthall, 1983)

In practise, there are some heuristics for solving routing problems because it is difficult to find the best route in limited time and also there are some disadvantegous of optimal routings. First of all, there isn't an optimal algorithm for all layouts. Secondly, some optimal routings can include some unfit solutions and it causes changing optimal route of order picker. Following heuristic approaches that are used mostly in the literature.

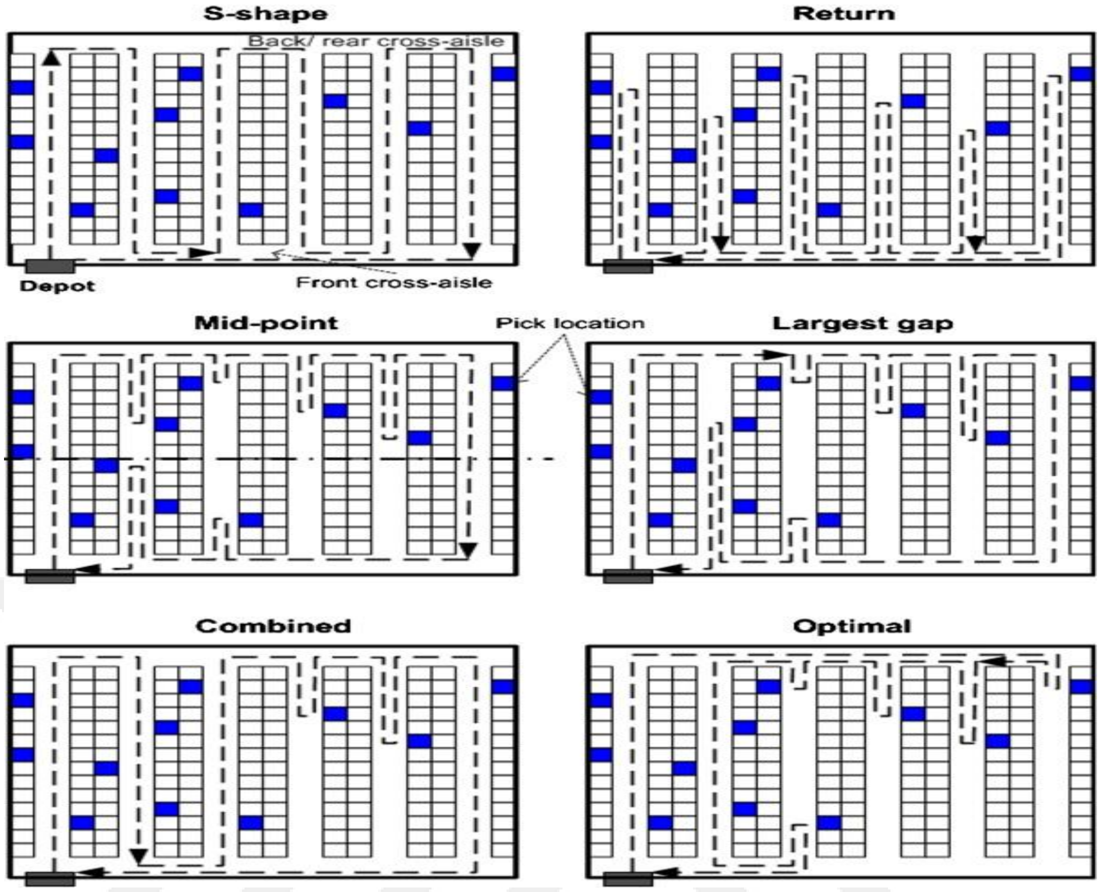

Figure 2.7 Routing methods for single block warehouse (Roodbergen, 2001)

I. S-Shaped (or traversal) Heuristic: This routing heuristic is the one of the simplest methods and is mostly used in practise. An order picker visits aisles containing at least one item. Order picker enters in the aisle and after the last item is picked in this aisle, order picker exits from the front of the aisle. If the aisle doesn't have any item, the order picker doesn't need to enter this aisle.

II. Return Heuristic: Another simple routing heuristic method is return heuristic method. The order picker enters the aisle and after finishing order picking, the picker exits from the same aisle. Deciding between S–shaped heuristic and return heuristic is depended on picking items from one side or both sides. If the aisles are designed as wide, using return heuristic is more appropriate because one side is picked firstly and in return the other side is picked. If the aisles are designed narrow and order picking is suitable for both sides, it is more advantageous using S-shaped heuristic (Goetschalckx & Ratliff, 1988).

III. Mid-Point Heuristic: The warehouse is divided into two areas. Items in the front half are picked from the front aisle and items in the back half are picked from the back aisle. When the number of picks per aisle is small, mid-point heuristic gives better results than s-shaped heuristic (Hall, 1993).

IV. Largest-Gap Heuristic: This strategy is similar to midpoint strategy. The order picker enters the aisle and picks the products until the largest gap. The largest gap can be calculated in three ways: (i) the largest gap between any two adjacent picks, (ii) the gap between the first pick and the front aisle, (iii) the gap between the last pick and the back aisle. The largest distance is chosen as largest gap according to these three ways. If the largest gap is between adjacent picks, order picker applies return route policy. The orders are picked from back aisles until the largestst gap and the order picker traverse to front of warehouse from last aisle included orders. In the front of warehouse, the order picker enters in the aisles included orders untill the largest gap and after picking he returns. In practise, the midpoint method is simpler than the largest gap but largest gap heurisitic performs better than midpoint method (Hall, 1993).

V. Combined (or Composite) Heuristic: This method combines features of s-shaped and return heuristic. The travelling distance between two item locations in successive aisles is compared. The distance between two farthest parts in separate aisles are calculated according to s-shaped and return heuristic. Which one of distance is the minimum according to s-shaped or return heuristic; this heuristic is used about transverse to the next aisle.

Petersen (1997) applied a numerical experiment for comparing the S-shaped, return, largest gap, mid-point, combined and optimal routing methods with random storage in the warehouse. According to his study, the best heuristic gives approximately %5 same results with optimal solution.

The routing methods explained above are generally used for single-block warehouses but with some modifications these methods can be used for multiple-block warehouses (Roodbergen & De Koster, 2001a). Also, a study was made for multiple-block warehouses (Vaughan & Petersen 1999). Roodbergen & De Koster (2001a) compared six routing methods in 80 warehouses, with varying aisle numbers 7 and 15, cross aisle number between 2 and 11, and pick list size between 10 and 30. They concluded that the combined heuristic routing method gives the best results 74 of 80 instances.

2.4 Handling Equipments and Types of Warehouse Racking Systems

The mostly used equipments in the warehouses and racking types are explained in this part. Order picking is done by helping of some handling equipments in the warehouses. There are various handling and storage equipments for loading, unloading and transporting. Also, suitable racks must be chosen to unload, locate, pick and load products easier. Selecting suitable racks is important because of using warehouse racks efficiently.

2.4.1 Handling Equipments

There are various equipments that are used in the warehouse. These are the equipments mostly used in the warehouses.

-Forklift

-Reachtruck,

-Stacker,

-Transpalet,

-Narrow Aisle Truck,

-Conveyor.

Forklift: It is used for moving and lifting the objects inside and outside of the warehouse in Figure 2.9. Forks of forkIift enter below of the pallets and pallets are transported and lifted. It moves in the wide area. Forklifts are bigger than the other handling equipments so it requires big area to move. It needs 3.5 metres widen aisle to be able to move within the warehouse. There are two types of forklifts which are big model and small model. Big model lifting capacity is between 1000 kgs and 4500 kgs. Small model lifting capacity is between 1000 kgs and 1500 kgs. Forklifts are durable, very useful in vehicle loading and unloading operations but they need wide aisle, for that reason they aren't generally used for operations inside of warehouse.

Figure 2.9 Forklift

Reachtruck: It works with battery and can turn easily in the warehouses that have narrow aisles up to 3 metres. It lifts and moves the objects. Reachtruck forks have the ability to move back and forth. Lifting capacity of reachtruck changes from 1.2 tonnes to 3 tonnes. It lifts the objets up to 11 metres (Figure 2.10).

Figure 2.10 Reachtruck

Stacker: It has low lifting and loading capacity (Figure 2.11). The maximum lifting capacity of stacker is 2000 kg and it works with battery. It can be used in two ways by sitting down and standing up. Reachtruck forks haven't the ability to move back and forth but forks of stacker are placed under the pallets and pallets are transported.

Figure 2.11 Stacker

Transpallet: It is used for moving lightweight pallets. There are two types of transpallet as manual and electrical. These types are shown in Figure 2.12. It is small and it has flexible ability to move.

Figure 2.12 Hydrolic transpallet and electrical transpallet

Narrow Aisle Truck: It is ideal for order picking in narrow aisles and useful for handling full pallets in narrow aisles. It lifts the objects without turning and up to 14 metres (Figure 2.13).

Figure 2.13 Narrow aisle truck (Trusty, 2014)

Conveyor: Conveyor systems move materials from one point to another without manual labor (Figure 2.14). Right and appropriate conveyor type is chosen according to product dimensions, product weight, product throughput, product variability, surrounding environment and power requirements. Belt, roller and gravity conveyor are types of conveyors (Trusty, 2014).

Figure 2.14 Belt roller and gravity conveyor (Trusty, 2014)

2.4.2 Types of Warehouse Racking Systems

When the products enter in the warehouse, they are preserved in different racking systems. In this part, racking systems are explained.

- Back to back rack systems
-Double deep rack systems
-Drive-in/Drive-through rack systems
- Push back racking systems

Back-to-back Rack Systems: The warehouse that has more product varieties uses this rack systems.This system supports FIFO. The aisle between two racks changes from 2.7 to 3.3 metres. The maximum height of the racks is 30 metres for this system. This is the most common rack system in the warehouses (Figure 2.15).

Figure 2.15 Back-to-back rack systems

Double Deep Rack Systems: This system look likes back-to-back systems and supports LIFO and FIFO. It allows pallets to be stored two deep but still accessible from the same aisle (Figure 2.16)

Figure 2.16 Double deep rack systems

Drive-in/Drive-through Rack Systems: This system is appropriate for high density storage and useful for the products that have small product variety. This static system has rails running the depth of the rack for pallet placement. When drive-in warehouse racking systems load and retrieve from the same side, Last-In-First-Out (LIFO) inventory method is applied. When drive-in/through warehouse racking systems is loaded from one side and unloaded from the other side, First-In-First-Out(FIFO) inventory method can be applied. Forklifts can enter from two-way aisle.This systems are shown in Figure 2.17. (Drive-In/Drive Through Pallet Racking Systems, n.d.).

Figure 2.17 Drive-in/Drive-through rack systems

Push-back Racking Systems: Pallets are loaded from one way and retrieved from another way. Pushed back system has rollers and along inclined beds. Pallets can be stored up to 10 deep and when a load is retrieved, the remaining pallets roll forward into position at the picking face. “First in Last out” method is used for selection each product. Figure 2.18 shows push-back racking systems.

Figure 2.18 Push-back racking systems

CHAPTER THREE
LITERATURE REVIEW

The literature about warehousing is wide and there are lots of studies about it. Order picking performance is affected from other operations mostly. Related topics with order picking and the issues that influence order picking performance are reviewed in this chapter.

There are various operations in warehouses. Order picking is the most important within the operations. The cost of order picking makes a large part of warehouse operaion cost. Hence, warehouse managers and academics who study about warehouse operations focus on the factors that affect order picking.

Studies about order picking performance and studies on factors affecting picking performance have increased in recent years. Layout of warehouse, storage allocation strategy, routing strategy, batching and zoning are the factors that affect order picking performance. Lots of studies are done about order picking performance and designing of order picking systems. The studies about warehouse layout, routing policies, batching, and zoning and storage allocation policies are handled in this part. So, the issues are related to order picking performance are reviewed.

Literature on order picking and on warehouse layout, routing policies, batching, zoning and storage allocation will be reviewed in this part.

3.1 Literature Review on Warehouse Layout Design

One of the important factors that affect order picking process is warehouse layout. Caron, Marchet, & Perego (2000) studied about warehouse layout design that has significant influence on travel distance. They also pointed out that layout design affects more than 60% on the total travel distance and they added that there is a relationship between warehouse layout and order picking travel distance. So, while designing order picking systems, warehouse layout is important subject.

Caron et al. (2000) suggested different types of warehouse layouts. For the first type, there are parallel storage aisles and input/output point is in the middle of the warehouse. There are vertical aisles for the second and third type. Input/output point is located in the middle and lower left corner, respectively. In another study, Roodbergen & De Koster (2001b) found that putting a cross aisle between parallel aisle provide improvement for travelling distance (Figure 3.1).

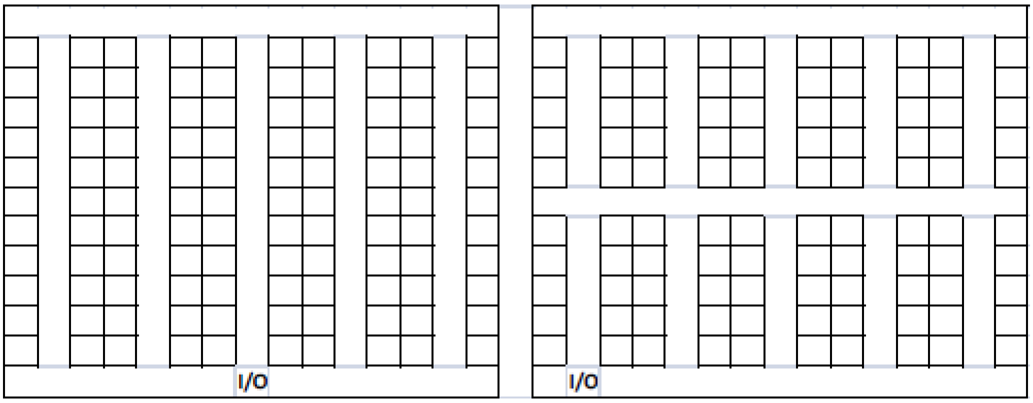

Figure 3.1 Typical warehouse layout

Roodbergen (2001) suggested a nonlinear objective funtion for determining aisle configuration for random storage warehouses to minimize average tour length. The other one of the important objective is minimizing the average tour length for 2-block warehouses. Coran (2000) studied this objective for COI based storage assignment and Le Duc & De Koster (2005b) studied for class based storage assignment. Petersen (2002) studied effect of the aisle length and aisle number on total travel time by using simulation for random and volume based storage assignment.

Gue & Meller (2009) designed layout different from typical warehouse design. One of them is Flying-V design and the other type is Fishbone design (Figure 3.2). The Flying-V design provides 10% reduction and Fishbone design provides 20 % reduction for travelling distance. Hence, the input/output is the same point. But these layout designs aren't used in practical. For instance, if there are more than two material handling devices, travel starts and ends with two or more points. Gue, Ivanović & Meller (2012) suggested new warehouse layout designs to facilitate the flow between multiple input/output and location points. One of the new layout is modifying Flying-V cross aisle and the other one is inverting V cross aisle. The new designs decreased travel distance lower than 3% when compared to conventional designs with single I/O-point. Eisenstein (2008) studied this topic for multiple input/output points.

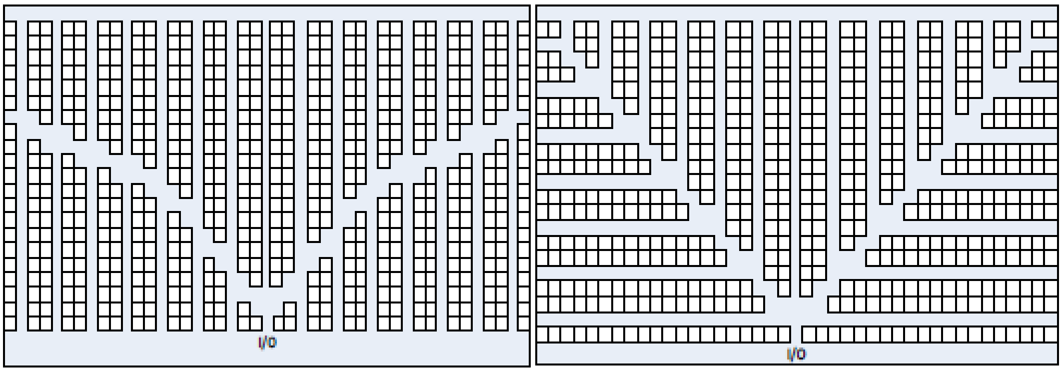

Figure 3.2 The Flying-V and Fishbone designs (Gue & Meller, 2009)

3.2 Literature Review on Zoning

One of the other factors that affect order picking is zoning. The order picking area is divided into zones and order pickers are assigned to zones. There are two approaches for zonig. One of them is *progressive picking*. This is also called as pick-and-pass. One order picker starts picking on the picking list. He picks the products on his zone and after finishing his zone he gives the order list to another picker. So, picking for an order list is completed after the products in relevant zoning is picked. The other approach is *parallel or synchronised picking.* Each order picker picks the products in his own zone at the same time and the partial products are combined after picking is completed. Although zoning has significant impact on order picking, it isn't considered as much as other factors. So, there is a little literature on zoning.

Mellema & Smith (1988) studied the effects of the aisle configuration on the zoning and also they studied about stocking policy and batching with simulation. They found that using zoning and batching together increases efficiency. Petersen (2002) showed that the travel distance in a zone is affected by the aisles number of per zone, aisle lengths and the number of products on the pick-list. Brynze´r & Johansson (1995) described a study about distrubuting the workload equally for progressive zone. Jane (2000) suggested several heuristiscs for balancing the workload on order picker and also she determined the zone size according to order amount for progressive zoning sytstem. Jane & Laih (2005) assigned the products heuristically on synchronised picking. Jewkes et al. (2004) assigned the products by using dynamic programming on progressive picking. Le-Duc & De Koster (2005a) studied to determine optimal number zones on synchronised picking by using a mixed-integer linear program and in the result of study, they minimized the total order picking time and assembly time.

3.3 Literature Review on Batching

In the case of orders are too large, each order can be picked separately. This is called *single order picking* policy. If the orders are small, we can take a set of orders in a single order picking for reducing travel distance. *Order batching is* defined as making a set of orders in a group for picking them in a single picking tour. Choe & Sharp (1991) made two approaches for batching. One of them is *the proximity of pick locations* and the other one is *time windows.* For proximity of pick locations, each order is assigned in a batch according to proximity of storage location. Gademann & Van de Velde (2005) studied for reducing the total travel time on batching problem. In the case of number of orders are more than 2 in a batch, the problem is still NP-hard problem. Chen & Wu (2005) made the proximity of orders according to relationship between orders. Namely, orders which have more similarities are assigned to in a batch. They studied to maximize the total relationship of batches by 0-1 integer programming.

Because of order batching is a NP-hard problem, researchers developed heuristic approaches for getting solution on manual picking systems. These heuristic approaches are: *seed* and *savings algorithms*. *Seed algorithms* has two methods: *seed selection* and *order congruency*. *Seed selection* rules construct a seed order for each batch. There are some rules for seed selection. These are; a random order; an order that has multiple storage locations; an order that has longest picking tour; an order that has located longest distance, etc. are some of the rules of *seed selection. Order* *congruency* rules help which unassigned order will be assigned to the current batch. An order is selected, this seed order in a batch and according distance, other orders are assigned to this batch. The major criterion is the "distance" between orders to assign in a batch. For instance, the total travel distance between of every product location in an order for a batch.

Saving algorithm is root of vehicle routing problem. Saving on travelling distance is obtained by merging the set of small tours. Elsayed & Unal (1989) suggested a heuristic algorithm that combines small orders with large orders for getting smallest travel distance. De Koster et al. (1999b) compared the seed and time savings heuristics in the warehouse which has multiple aisles for picker-to-parts systems. They used two different routing heuristics for evaluating algorithm performance. The algorithm performances are travel time, number of batches and also according to practicability. As a result, they reported that simple order batching methods are better than first-come first-serve batching rule and also said that the seed algorithms are the best when S-shape routing method and large capacity of the pick device are used. But the time savings algorithms are the best when largest gap routing method and small capacity of the pick device are used.

Time window batching, the orders which arrive at the same time is grouped in a batch. These orders are picked at the same time. If the orders aren't allowed to dividing, the orders are picked in one picking tour. If the products are sorted during the picking process, this strategy is called as *sort-while-pick picking* strategy. If the orders are allowed to dividing, the products are sorted after picking. This strategy is called as *pick-and-sort* strategy. A study was performed by fixing product number in a batch with stochastic orders on manual picking systems. This model is called as batch size problem. For determining each batch size, the time between first and second service is predicted. According to this times, a random order time in system can be calculated. This approach can be applied in practice easily. In another study, order-batching problem is performed in man a board system for reducing penalties and tardiness. A heuristic is suggested for solving these penalties and tardiness. The heuristic first establishes batches and later decides the releasing time for the batches.

3.4 Literature Review on Routing Policy

The main aim of routing policy is to sequence products on the pick lists to make appropriate route in the warehouse. Routing problem is a kind of travelling salesman problem. In travelling salesman problem, a salesman starts travelling from his home, he visits all cities but visits only once and returns his home. He knows the distances between cities. He wants to minimize total travelling distance by deciding on the order of the cities to be visited. So, travelling salesman has many similarities with order picker in a warehouse. The order picker starts from depot and the salesman starts from home city; the order picker visits the product location in picking list and the salesman visits cities; and finally order picker has to return to the depot, salesman has to return home city. These are similarities between order picker and salesman. There are also some differences between Travelling Salesman Problem and order picking problem. The order picker is permissible to visit the pick locations and depot more than once but this is not valid for travelling salesman because he visits cities only once. So, the order picking problem can be classified as Steiner Travelling Salesman Problem because some of locations do not have to be visited and the other locations can be visited more than once. The Steiner Travelling Salesman Problem is not solved in polynomial time. There is an algorithm that can solve the problem in linear time.

Routing of order pickers are performed with heuristics methods. Optimal routing has some disadvantages. These are; there is no optimal algorithm for every layout; some optimal routes can not be appropriate for order pickers so they can choose different route from determined route (Gademann & Van de Velde, 2005). Aisle congestion is not handled in the optimal route but in heuristics it is considered.
There are some heuristic methods that are used in single-block warehouses.

First of the routing methods is *S-shape* (or *traversal*) *heuristic*. For this method, if the picker enters from beginning of the aisle and he exists from the end of aisle. If the picker enters from the end of the aisle and he exists from beginning of aisle. If there are no picks in an aisle, this aisle is not visited.

Second of the routing methods is *return heuristic* in which the picker enters from beginning of the aisle and exists from beginning of the aisle.

Third of the routing methods is *midpoint heuristic*. The picking area is divided into two as the front and as the back. It is assumed that there is a line in the middle of aisles. If the products are in the front aisles, they are picked from front. If the products are in the back aisles, they are picked from the back. If the aisles include small number picks, the midpoint heuristic performs better than S-shaped.

Forth of the routing methods is *largest gap heuristic*. This method look likes midpoint heuristic. Instead of going to midpoint, in this method the picker goes an aisle as far as the largest gap. The largest gap shows largest distance between the two points. The largest gap method always better than the midpoint method (Hall, 1993).

Fifth of the routing methods is *combined heuristic*. This heuristic is combination of any heuristics. Dynamic programming is used to select the visited aisle in the methods (Roodbergen & De Koster, 2001a).

Petersen (1997) performed a study to compare the other routing policies. He applied random storage policy for routing heuristics. As a result, the best heuristic method is better 5% over the optimal solution.

The routing methods mentioned up to now are for warehouses which have narrow aisles. Goetschalckx & Ratliff (1988b) studied on developing a polynomial-time optimal algorithm for warehouses which have wide aisles. In another problem, if the products are stored in multiple locations in the warehouse, a choice is necessary for which locations the products will be retrieved first. Daniels et al. (1998) studied on a model for assigning the products in the locations and routing of order pickers. They used heuristics methods. Another problem in routing is to provide multiple picking when order picker stops at a point. When the order picker stops with vehicle, he picks the products by walking back and forth. After each picking, he goes on the another location. The aim of this method is to regulate the time between the starting and stopping of vehicle and travelled distance that is walked by the order pickers. Goetschalckx & Ratliff (1988a) solved this problem optimally.

There are studies about routing for estimating travel time. An estimation of order picking travel distance and time can be got by using statistics and operations research. There are also studies for estimating travel time in single and dual command cycles in multiple aisles.

There are few studies for estimating for travel time of picking with multiple aisles and multiple picks per route. Three routing heuristics are used in one blocked warehouse to estimate the travel time (Kunder & Gudehus, 1975). This study is developed by Hall (1993) with using more advanced routing heuristics. Additionally, in an optimal algorithm, Ratliff & Rosenthal (1983) determined a lower bound for travel time. De Koster et al. (1998) formalized average travel time in decentralised warehouse. From Hall's study, the largest gap is better than S-shape in the case of pick densities less than 4 picks per aisle. In another research, the optimal and S-shape methods are compared with simulation for several single-block random storage warehouses. The results showed that S-shape routing, on average, 7% to 33% longer than optimal solutions. This can be proven by using statistical techniques. Determining an upper bound of S-shape average routes length is resulted with two times the average length of optimal routes. Also for estimation of travel time in each aisle, fast moving and slow moving of products localization is determined. For return heuristics, samely the travel time estimation is also made. In another study, travel time for product-to-location assignment is analysed. Because, every product demands can change for each warehouse and the travel time estimates are used for determining batching strategies. For two routing methods, Caron et al. (1998) gave expected travel distances in the warehouse that has two blocks. In this study, the depot is assumed to be located between the two blocks according to the cube-per-order index. There are analytical expressions studies about return, S-shape, midpoint routing methods under the cube-per-order index.

3.5 Literature Review on Storage Allocation Policy

Products are put into storage locations before they are picked from shelves. These allocation methods are used to allocate products to storage locations. There are various storage allocation policies that are applied in the warehouses. We are interested in six frequently used types of storage allocation policies; random storage, closest open location storage, dedicated storage, full turnover storage, class-based storage, family grouping storage.

For *random storage allocation policy,* incoming products are assigned to any empty location in the picking area. This location is selected randomly from all empty locations. The random allocation method provides high space utilization but it results with the increase of travelling distance (Petersen & Aase, 2004).The random storage policy works only in a computer-controlled environment.

For *closest open location storage policy*, order pickers store the products the first empty location. If the order pickers choose the location hemselves, they are likely to choose close to input/output point. This leads to more empty location far from input/output point. Namely, the shelves that are in the back of warehouse will have empty locations.

For *dedicated storage policy*, if the products are stored in a fixed location, this storage policy is called as dedicated storage policy. For this policy, a product type is not allowed to assign in the location of another product type. Every product type has a specific location in the shelves. So, the order pickers become familiar with product locations. Even if a product type is out of stock, the location of this product type has to be reserved. This is disadvantage of dedicated storage policy. Space utilization is lower than other storage assignmet policies.

For *full-turnover storage* policy, the products are located in the shelves according to turnover ratio. Turnover ratio means sales rates or stock output rates. Products with high sales rates or stock output rates are located in easy accessible locations in other words close to depot. Slow moving products are located towards the back of warehouse. In full-turnover storage policy, also the cube-per-order index (COI) rule is used (Heskett, 1963).Cube-per-order index is the ratio of the total required space of the products to demand frequency during a specific period. The products with the lowest COI is located close to depot. If the turnover policy is combined with dedicated storage policy, it will be practical to implementing it. The main disadvantage of this policy is that demand rates change constantly, it requires rearranging of the product locations over again. COI- storage assignment policy or other storage policies based on demand frequency requires a more "information-approach" than random storage. Since, in this policy the storage data needs to be processed for assigning products to shelves (Caron, 1998).

Fifth storage policy is *class-based storage.* The class-based storage is composition of between random and dedicated storage. Increasing space utilization, decreasing material handling cost, increasing storage flexibilty are some of the advantageous of class based storage policy (Petersen et al., 2005). In this storage policy, the products are assigned to classes according to certain criteria such as stock output rate, product type, size or weight. Generally, Pareto's method is used for dividing items into classes. According to this method, the fastest moving class contains only about 15% of the products but 85% of the product turnover. Each class is assigned to a dedicated area in the warehouse but the storage of classes is random. Classes can be determined according to COI ratio, pick volume or other criteria. Fast moving products are called in A-class. Next moving category of products is called as B-class. The remaining products are called in C-class. Generally, the classes are restricted with three.

Petersen et al. (2004) made simulation study for travelling distance, according to them full turnover storage assignment peforms better than class-based storage in a manual order picking system. They remark that there is a gap between turnover storage and class based storage are about for deciding classes. For example, number of classes, percentage of total volume per class. They suggest using with 2 to 4 classes for class-based storage. Yang (1988), Van Den Berg & Gademann (2000) studied for AS/RS and they found that 6 class is better than other options. According to them storing fast moving products to close I/ O is advantageous and at the same time storing randomly provides low storage space and provide flexibility. Graves et al. (1977) stated that to store the incoming products in the correct class region requires more space than randomised storage. In other words, space requirements increases with the number of classses. Various possibilities exist for locating A, B and C class in the aisles for low level picker to parts systems. Jarvis & McDowell (1991) proposed that each aisle should have only one class (Figure 3.3). This called as within-aisle storage. Petersen (1999, 2002), Petersen & Schmenner (1999), Petersen & Aase (2004) and Petersen et al. (2004) studied about for across aisle storage. In cross aisle storage, an aisle has multiple classes. Roodbergen (2005) made a study using multiple cross aisle for storage assignment strategies. Le-Duc & De Koster (2005c) studied about optimising the storage class positioning and they claimed that the across-aisle storage method is the closest optimal. Later, Le-Duc (2005) extends this result for other routing policies and he said optimal storage strategy is connected to routing policy, warehouse size and number of SKUs per pick route. In warehouse literature, there is no strict rule for determining number of classes and number of products in each class.

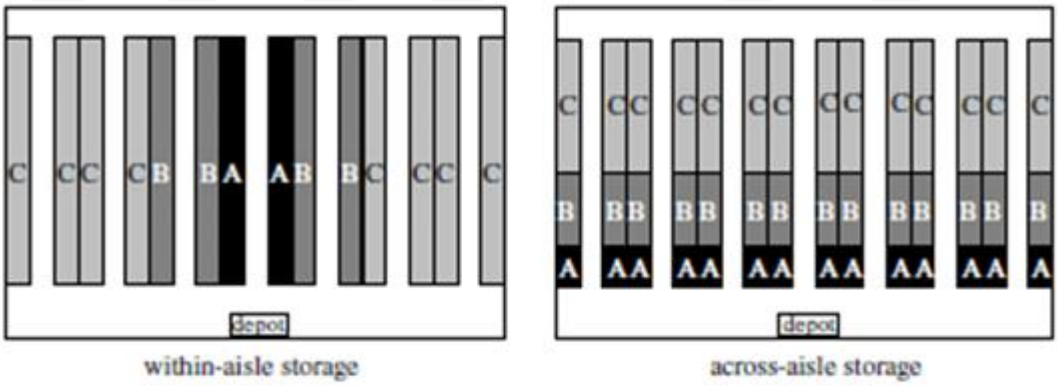

Figure 3.3 Two common ways for implementing class-based storage (Jarvis & McDowell, 1991)

Family grouping storage is the last storage policy. For other discussed storage policies so far, there is no relations between products. For example, customers tend to demand some product types together. In this case, it is logical to locate these product types close to each other.If the similar products are located in same region, this is called family grouping storage. This family grouping storage can be used with another previously explained storage policies. For instance, class-based storage and family groping can be applied together while locating products.

Roll & Rosenblatt (1983)compared space requirements for the random and family grouping storage and they found that the family grouping storage assignment requires more space than random storage assignment. Rosenblatt & Roll (1984) made a model for warehousing cost and examined the effects of space requirement on warehouse cost. Frazelle & Sharp (1989), Brynzér & Johansson (1996) said that the statistical correlation between products must be known or can be predictable for applying family grouping. There are two types of family grouping in the literature. The first method is the *complementary-based* method and it is made from two major phases. In the first phase, it clusters the products into groups according to demand. Namely, complementary products are grouped together and in the same group. In the second phase, the products within one cluster are located close to each other as much as possible (Wäscher, 2004). Rosenwein (1994) showed that the clustering problem can be formulated as a p-median problem. Liu (1999) suggested that the products with the high demand rate should be located close to the depot. Lee (1992) suggested locating products according to Cube-per-Order Index. The second type of family-grouping method is *contact-based* method. This method is similar to *complementary based* method. It uses contact frequencies to cluster the products into groups. For a given optimal routing solution, if there is a contact frequency product type *i* and product type *j,* order picker picks either product type *i* directly after product type *j* or product type *j* directly after item type *i.* However, there is a strong interrelationship between product location and routing for this contact based method. Due to the fact that finding an optimal solution for both problems is difficult in practical.

3.6 Literature Review on Order Picking

In this part, there is general literature related with order picking and other issues. Lots of studies are done in recent years about order picking performance and designing of order picking systems. Order picking problems can be solved with two approaches. They are optimal and heuristic methods. Branch-bound and dynamic programming is optimal methods that find the best solutions.

In the last ten years, the researchers focus on heuristic methods.These studies are on manual and automated warehouse management systems. Armstrong (1979) studied about order batching problem in half automated order picking systems and the objective of this problem is minimizing total order completion time and he used mix integer programming model. The developed model is solved using Benders decomposition method (Benders, 1962).

Ratliff & Roshental (1983) studied about shortening order picking time and they developed a dynamic programming algorithm for this problem. They applied dynamic algorithm for rectangle warehouse that has single block. Also, Goetschalckx & Ratliff (1988) studied about this problem, it is permitted that more than one order picker's moving at the same time in the aisles and the assumptions are in the followings. Order picker can pick products from only one side and there is no traffic in the aisles. They decided optimal order picking route considering these assumptions.

Size of the order list, physical structure of storage area and location of picking/releasing are the factors that affect performance of order picking systems. Petersen (1997) examined these factors on the random storage policy and studied about developing alternative storage policy. In another study, Petersen & Schmenner (1999) made similar analysis for class based and cube per index storage policy. Vaughan & Petersen (1999) made a simulation model for determining number of equal sized horizantal aisles between blocks. The aim of this study is increasing order picking efficiency by using random storage policy. For determining order picking routes, they suggested routing heuristics based on dynamic programming.

Roodbergen & De Koster (2001a) expanded the study by making a simulation study using same assumptions for different routing policies. According to results, combined routing heuristics give better solution than other routing heuristics.

Roodbergen & De Koster (2001b) studied how the horizontal aisle between two blocks affects the picking performance. Also they used random storage policy and the order list size shows variety.

In the another study, Petersen & Aase (2004) evaluated effects of order batching policies, storage strategies and routing policies on the order picking performance. Roodbergen (2005) studied minimizing travelling distance by improving two different order picking route in the storage area which has more than one horizantal aisle. In this study, it is assumed that the numbers of aisles are optimal in the warehouse. Le Duc & Koster (2005) investigated effects of storage layout, storage structure, order picking list size on performance of order picking system in a warehouse that has only central horizontal aisle and applied class-based storage assignment and return heuristic. Manzini (2005) developed expert systems by using artificial systems techniques to improve order picking process. This study uses genetic algorithm and statistical analysis methods and examines effects of routing, storage policies and product order profiles on the performance of order picking systems for both “picker-to-parts” and “parts-to-picker”.Researchers considered the average cycle time of order picking as performance measure.

Hwang & Cho (2006) suggested two-staged solution methods for order picking problem. First, they developed a mathemetical model to minimize total cost by considering storage capacity constraint and order demand that must be met per unit time. Later, they made a simulation model. They examined the affects of warehouse size, dimensions of shelves, number of order pickers on the design of order picking systems. Roodbergen & Vis (2006) studied to find optimal warehouse structure for single blocked warehouse by applying random storage policy and s-shaped and largest gap routing heuristics. In the study, objective function is to minimize average order picking time. When application results are analyzed, there are powerful relationship between optimal aisle number, order batch size, order picking route and required storage area.

The order picking system that has single order picker is oftenly handled in literature. Pan & Shih (2008) examined traffic problem in the warehouse that has more than one picker. Researchers studied to increase the average number of orders completed per unit time while solving traffic problem in the aisles. Pan & Wu (2009) developed an analytical model for predicting total travelling distance for ”pick-to-box” order picking system that is mostly used in e-trade and time-based competition. Based on this model, three different algorithms are developed for assigning the products to storage area. In the study, frequency of order picking, traffic problem of order picker, decomposing of picked orders' effects are examined on a problem.

Parick & Meller (2008) developed a cost model for making choice between batching and zoning. In this model, the load imbalance of the order to be picked, order picking velocity, traffic problem of the order picker, decomposition need after order picking systems are the factors that are evaluated. In another study, Yu & De Koster (2009) analysed effects of order batching and zoning on the total order picking time and they made a model based on queuing network theory. In their study, “box-to-pick”and s-shaped routing strategy are applied and products are assigned randomly to storage area. Developed model includes decomposing of order batches in the basis of orders. According to application results, suggested model gives acceptable results for small number of picking zones. If the number of picking zones increases, deviation in results grows. The approach in the study can be used in practise for evaluating alternative order picking systems.

Bindi (2009) studied about storage policy based on storing similar products together. He evaluated this policy according to the correlation analysis based on similarity index and he did performance comparison. Hsieh & Huang (2011) studied about two order batching heuristics. They compared performance criteria which are average usage of order picking vehicle and total travelling distance. Also in the study, they made simulation model to obtain the best combination of storage policy, order batching and picking routes.

Roodbergen & Vis (2009) examined the literature of the design of automated storage and retrieval systems, products assignment policy, sequencing of order picking demand, predicting of storage/retrieval vehicle travelling distance for ”parts-to-picker” order picking systems. They examined solution methods for these problems.

In the another examined study of ”parts-to-picker” order picking systems, Lerher (2010) developed different analytical models by considering the acceleration and deceleration parameters of automated storage and retrieval vehicle. He made simulation models for evaluating these analytical models. Performance criteria of suggested models are the order picking time. In the next study, Lehrer (2011) made anaytical models for designing ”parts-to-picker” order picking systems for the products entered with containers and multiple load carrier are used. This system is used for storage of small volume products and conveyor system works together with automated stacked vehicles. Performance of analytic models represented in the study is compared with simulation study for different warehouse layout structures.

Chan & Chan (2011) handled real life order picking problem. For this problem, the warehouse has multi-level shelf systems and order picking is done with by operators. Alternative storage policies (random, class based, reserved area storage) and routing heuristics(s-shaped, return and composite), different order intensity levels are compared for system performance by simulation model. Total travel distance and total order picking time are the performance criteria of this simulation model.

In recently years, Pan (2012) examined total travelling distance and total order completion time for various storage policies by assuming that there are more than one order picker and “picker-to-parts” order picker system is applied. This order picking system is modelled as queuing network.

De Koster (2007), Dallari (2009) & Gu (2007) made a wide literature review for design and control of order picking systems in the warehouse management. When the studies are examined in the literature, there is a few study about the effect of aisle designing on order picking system efficiency and also there are a few studies about warehouse layout design for low-leveled and manuel order picking systems.

3.7 Results of Literature Review

After reviewing the literature, we get some conclusions. There are two types of warehouse management. These are operational system management and layout management. Most researchers study on operational system. Because, order picking is a key operation in warehouse operations. So, many researhers studied on factors that support order picking. The studies about order picking as follows:

Order batching is studied in order picking systems for minimizing total order completion time. The order list size, physical structure of storage area, the location of picking affect performance of order picking systems. These factors are examined on random storage policy, class based and cube per index storage policy. Effect of horizontal aisle between two blocks on order picking system is also studied. In the another study, effects of order batching policies, storage strategies and routing policies on the order picking performance is studied. The effects of warehouse size, dimensions of shelves, number of order pickers on the design of order picking systems, are also examined. Effects of order batching and zoning on the total order picking time are studied. The optimal warehouse structure was tried to be found by applying random storage policy and s-shaped and largest gap routing heuristics. Generally, the objective is travelling distance, order picking time, total order completion time.

The pickers-to-parts systems are mostly used in practice. But, when the order picking systems are examined in literature, there is little study on pikers-to-parts compared to parts-to-pikers systems. The reasons of this, pikers-to-parts systems are complex and there is more variety on pikers-to-parts order-picking systems but in parts-to-pikers systems, automated systems are completely or partially used so the researchers focus on this order picking system.

There are also some studies about the topics that affect order picking systems. These topics are warehouse layout, storage allocation policies, zoning, batching, routing policies. But the studies about storage allocation policies and routing policies have begun in recent years.

In the previous sections, we have already reviewed the studies in detail. We can say the following briefly.

The researchers studying on warehouse layout design mentioned that. There is a relationship between warehouse layout and order picking travel distance. Layout design affects more than 60% on the total travel distance. Different types of warehouse layouts are suggested for minimizing for travelling distance. In some studies, putting a cross aisle between parallel aisle provide improvement on travelling distance. Flying-V design and Fishbone design also provide improvements on travelling distance. In another research, minimizing average tour length for random storage assignment, for COI based storage assignment and for class based storage assignment is studied. Also there are studies about how the aisle length and aisle number affect total travel time for random and volume based storage assignment.

The researchers studying on zoning mentioned that. Although zoning has significant impact on order picking, it isn't considered as much as other factors. So, there is a little literature on zoning. There are studies about the effects of the aisle configuration on the zoning. The aisles number of per zone, aisles lengths and the number of products on the pick-list affect travelling distance in the warehouses. There are studies for balancing the workload on order picker and the heuristics methods are applied for this. In a study, the researchers stated that optimal number zones on synchronised picking provides minimizing order picking time and assembly time. The effects of the aisle configuration, stocking policy and batching and zoning were examined for productivity in the warehouse. In the result of study, it is stated that to use batching and zoning together increase productivity.

The researchers studying on batching mentioned that. Order batching is a NP-hard problem so they developed heuristic methods for solving it. They used two types of order-batching heuristics that are seed and savings algorithms. They studied for reducing the total travel time and they tried to minimize travelling distance by merging the set of small tours. Also there are studies for deciding batch size, for minimizing penalties and for minimizing tardiness.

The researchers studying on routing policy mentioned that. They are performed with heuristics methods. These methods are S-shape (or traversal) heuristic, return heuristic, midpoint heuristic, largest gap heuristic, combined heuristic. When these heuristics are compared with the optimal solution, the best heuristic method is better 5% over the optimal solution. In other studies, routing methods are performed on wide aisles and narrow aisles. There are studies about routing which includes travel time estimation and order picking travel distance.

The storage allocation policies include random storage, closest open location storage, dedicated storage, full turnover storage, class-based storage, family grouping storage. The storage allocation policies influence all the warehouse performance. The studies show that the random assignment method results with the increase of travelling distance. The classed based storage policy is more effective than other storage policies.

In the literature, there are not so much studies about warehouse layout, batching, zoning, storage allocation policies but their number is increasing. The great number of studies was about order picking and also with the years the studies about storage assignment and routing is growing. Mostly the existing studies are focused on random storage assignments in picker-to-parts order-picking systems. There is a gap in the literature about using of combination storage allocation policies. For example, there is not enough studies about using dedicated and class-based storage allocation model together. And also, storage allocation has an effect on routing policy but this effect is neglected in the studies. The researchers in the studies discussed performance of routing methods by using random storage assignment. Nearly all studies, the orders are assumed as it is known but in the truth the orders are stochastic because the orders come in a small amount and need to be shipped in a small time. In daily practise, the orders sent with mail so the orders can come everytime. For this reason, optimization problems with order picking should be solved as stochasticly not deterministically. Lastly, the general optimization for order picking is not possible because one specific situation is not appropriate to another specific situation. As a result, for order picking general optimization model is still lacking.

The studies done can be shown by classifying in the following table. Table 3.1 is general overview of the studies in the literature.

Table 3.1 Literature overview

a) General literature review on warehouse layout design	
Rosenblatt and Roll (1984)	Study of the effect of storage policy on the internal layout of warehouse (using both analytical and simulation methods).
Rosenblatt and Roll (1988)	Effects of stochastic demands and different service levels on the warehouse layout and storage capacity.
Roodbergen (2001)	Determining the aisle configuration for random storage warehouses that minimises the average tour length (using a non-linear objective function).
Caron et al. (2000)	Minimization of the average tour length in 2-block warehouses (i.e., one middle cross aisle) under the COI-based storage assignment.
Le-Duc and De Koster (2005a)	Minimisation of the average tour length in class-based storage assignment warehouses.
Petersen (2002)	Simulation of the total travel time with different aisle length and number of aisles, for both random and volume-based storage assignment methods.

b) General literature review on zoning	
De Koster (1994)	Models a zoned pick-and-pass system determining the number of zones and the system size.
Mellema and Smith (1988)	Examination of the effects of the aisle configuration, stocking policy and batching and zoning rules by using simulation. Results suggest that a combination of batching and zoning can significantly increase the productivity (pieces per man-hour).
Petersen (2002)	Effects of zone shape (number of aisles per zone, the aisle lengths), the number of items on the pick-list and the storage policy on the average travel distance within the zone, using simulation.
Choe et al. (1993)	Effects of three strategies in an aisle-based order-picking system: single-order-pick, sort-while-pick, and pick-and-sort.
Brynzer and Johansson (1995)	A case study with zoning and batching.
Yu and De Koster (2009)	Impact of order batching and picking area zoning on order picking system performance.
Jane (2000)	Heuristic algorithms to balance the workloads and to adjust the zone size for order volume fluctuation in a progressive zoning system.
Jane and Laih (2005)	Assigning products to zones in a synchronised system (using heuristics).
Jewkes et al. (2004)	Product assignment problem (as well as zone sizing and picker home base location) for a progressive system, using dynamic programming.
Le-Duc and De Koster (2005b	Optimal number of zones in a synchronised zoning system such that the total order-picking and assembly time is minimized.

Table 3.1 Literature overview (Continued)

c) General literature review on proximity batching	
Gademann et al. (2001)	Study of the proximity order-batching problem in a manual-pick wave-picking warehouse, with the objective of minimising the maximum lead-time of any batch. They propose a branch-and-bound algorithm to solve the order-batching problem exactly for small instances and a 2-opt heuristic procedure for large instances.
Gademann and Van de Velde (2005)	Minimising the total travel time using order batching on a manual picking system. A branch-and-price algorithm is designed to solve instances of modest size to optimality. For larger instances, it is suggested to use an iterated descent approximation algorithm.
Chen and Wu (2005)	They develop an association-based order-clustering model based on 0-1 integer programming.
Chen et al. (2005)	Aggregation of orders in distribution centers using data mining.
Hsu et al. (2005)	Batching orders in warehouses by minimizing travel distance with genetic algorithms.

d) Literature on order-batching heuristics.	
1)Seed algorithms literature	
Elsayed (1981)	Single aisle man-on-board AS/RS systems.
Pan and Liu (1995)	
Rosenwein (1994)	
De Koster et al. (1999)	
2)Saving algorithms literature	
De Koster et al. (1999)	Comparative study for the seed and savings heuristics for multiple-aisle picker-to-parts systems. They conclude that: order batching methods improve significantly when compared to the first-come first-serve batching rule; seed algorithms are best in conjunction with the s-shape routing and a large capacity pick device; time savings algorithms perform best in conjunction with the largest gap routing and a small pick device capacity.
3)Review on time window batching.	**Variable time window order batching with stochastic order arrivals for manual picking systems**
Tang and Chew (1997),	Problem is modelled as a batch service. For each possible picking batch size, they first estimate the first and second moments of the service time. Then using these moments, they can find the time in system of a random order. The optimal picking batch size is then determined in a straightforward manner. Results from the simulation experiments show this approach provides a high accuracy level. Furthermore, it is simple and can be easily applied in practice.
Le-Duc and De Koster (2007)	

e) General literature review on routing	
Ratliff and Rosenthal (1983)	Solve, using an algorithm, the traveling salesman problem in a rectangular warehouse.
Roodbergen and De Koster (2001a)	Routing methods for warehouses with multiple cross aisles.
Roodbergen and De Koster (2001b)	Routing order-pickers in a warehouse with a middle aisle.
Goetschalckx and Ratliff (1988a)	Analysis and solves optimally the problem of allowing the order picker to do multiple picks per stop. There is a trade-off between the time to stop and start the vehicle and the increased walking distance if fewer vehicle stops are made.
Goetschalckx and Ratliff (1988b)	Polynomial-time optimal algorithm that solves the problem of routing order pickers in wide aisles (where the picker cannot retrieve products from both sides of the aisle without changing position).
Daniels et al. (1998)	Tackles, using heuristics, the routing problem that may arise if products are stored at multiple locations in a warehouse. In this case a choice has to be made from which location the products have to be retrieved.

Table 3.1 Literature overview (Continued)

f) General literature review on storage allocation policies	
Jarvis and McDowell (1991)	Travel time estimates are determined and used to determine which products (fast moving, slow moving) should be located in which aisles.
Le-Duc and De Koster (2004)	Travel time estimates in picker-to-parts narrow-storage-aisle ABC-storage strategy warehouses, using the return heuristic as routing policy.
Caron et al. (1998)	Expected travel distances for two routing methods in a warehouse consisting of two blocks (items are distributed according to the cube- per-order index).
Hwang et al. (2004)	Analytical expressions for three routing methods (return, S-shape, midpoint) under various COI-based storage rules.
Jarvis and McDowell (1991)	Suggest that each aisle should contain only one class, resulting in the within-aisle storage.
Petersen (1999, 2002)	Comparison of multiple configurations, among which across-aisles storage.
Petersen and Aase (2004)	Comparison of multiple configurations, among which across-aisles storage.
Roodbergen (2005)	Compares various storage assignment policies for warehouse layouts with multiple cross aisles.
Chan and Chan (2011)	Improving the productivity of order picking of a manual-pick and multi-level rack distribution warehouse through the implementation of class-based storage.
Le-Duc and De Koster (2005c)	Optimization of storage-class positioning based on average travel distance estimate for the return routing policy. They claim that the across-aisle storage method is close to optimal.
Le-Duc (2005)	Extends Le-Duc and De Koster (2005c) results for other routing policies.

g) General literature on order accumulation and sorting	
Meller (1997)	Proposes an integer formulation for the order-to-lane assignment problem in an A/S system.
Le-Duc and De Koster (2005b)	Present an integer-programming model to minimise the total picking and order accumulation time.

CHAPTER FOUR
A CASE STUDY IN A WAREHOUSE FOR IMPROVING ORDER PICKING

The case study was done in a warehouse belonging to the logistics company, which is one of the biggest Turkish companies in this sector. The company has lots of customers. For the application purposes, a warehouse of the logistics company and a customer that owns a chain of retail markets were considered in this study. All products of this customer are delivered from this warehouse to the customer's retail chain. Specifically, this retail warehouse is the main focus of this thesis study. This warehouse like all the warehouses of the logistic company uses Warehouse Management System (WMS) to perform various warehouse processes. In this chapter, first, brief information about the services and operations of the company was introduced. Later, the steps of warehouse management system were explained in detail. Additionally, the order picking process for the retail warehouse was defined since one of the most important issues in a retail warehouse is to improve order picking performance. Following, the bi-phase proposed solution methodology was introduced together with alternative models. Finally, the solutions for alternative models were presented and results were discussed.

4.1 Information about Company

The main logistic company was established in 2005. It has various branches in Turkey and also abroad. Particularly, the company services to various customers that belongs to dry food, cold chain, textile, automotive, chemical, pharmaceuticals, construction and technology sectors. The main company has 2700 vehicles, 6750 employees together with 74 warehouses all over Turkey. Within the main company, there are a total of 14 subsidiary companies, which provide five main service concepts and additional supporting services to customers as explained below.

The first type of service provided by the company is global freight management, the main functions of which are transportation, air freight, sea freight and special territories. Within this context, 358 trucks and 450 trailers operate in its international road freight division and 550 staff works to provide its customers international trucking services between Turkey and 38 countries. The road freight services include Western Europe, Eastern Europe, Caucasian Countries and Middle East. Another service is the air freight services of the company, where the customer's cargo is freighted to its final destination as fast as possible and damage free via air.Sea freight service of the company organizes the freigth process from the starting point to the destination point.

The second type of service provided by the company is the food products logistics. For this sole purpose, the company operates 51 warehouses in 16 cities of Turkey and with a total pallet storage capacity of +390 000 pallets and 420 000 sqm indoor storage capacity.The company picks over 50 millions boxes every month and loads over 1 000 truckloads of shipments every day. It has 1 050 owned transport fleet and 550 dedicated sub-contractor fleet and a network of 12 000 vehicles registered in its selected and approved contractor list. It transports oil within owned fleet of 60 tankers and carries over 2 500 tons of milk with 250 dedicated subcontractor fleet. This makes the company the largest logistics service provider in liquid food transportation.

As the third type of service, the company also services in form of cold chain transportation. This requires critical knowledge since the the goods to be stored are food products, the importance of the criticality increases. An improper stored product can cause serious harm to human health. The company is the leader in cool (+12/+16 C°), cold (0/+4 C°) and frozen (-18/-25C°) storagein Turkey. The company is an essential solutions partner for producers of food products that need to be kept at a certain temperature with a floor area of 35000 square meters in 16 warehouses.

Forth type of service provided by the company is general logistics services. It includes archive management, textile logistics, technology logistics and oil transportation. Archive management presents economical, quality services to medium-sized and large companies for information and document management, document storage, information security, and fast data access. It allows you to save on labor and time without having to invest in storage of any kind. It offers you a system that allows you to access your data and information whenever you please by systematically organizing and storing them at the highest level of security in warehouses suited for archival storage. Textile logistics of the company has proven its success with its information processing, vehicle and warehouse infrastructure required for textile logistics. Technology logistics of the company is one of Turkey's foremost companies in the field of high tech logistics.

Fifth type service provided by the company is procurement and sourcing solutions and this service includes operational leasing services, construction & contracting and food procurement services and operational leasing services. The company is the first in Turkey offering the operational fleet rental system, which is used especially for cars, in the light commercial, heavy commercial, and warehouse equipment category. Companies that wish to fulfill all of their transport needs, or only some services, with their own vehicles can rent such transport equipment as forklifts, trucks, pickup trucks, minivans, tow trucks, and trailers from the company, making use of operational rental services and advantages. Additionally, the construction team helps to construct warehouses and production facilities. The team consists of professional engineers and architectures and it builds useful and cost effective constructions to the warehouse owners and hirers. Furthermore, the company acts as a wholesaler and supply chain management company which mission is to serve and distribute food and non-food products to food service operations in remote, hostile or delicate environments. It has exhaustive experience with food service industry on long-term supply chain projects. It engages with clients on a long-term supply agreement.

In this study, a subsidiary company, which operates in the context of warehouse manegement in food logistics, is considered as the main focus. In particular, the case study focuses on the stock allocation policies for improving order picking process in the warehouse for a retail supermarket chain as the customer of the subsidiary.

4.2 Warehouse Management System

As stated above, the main company operates in various fields. However, the main focus of this case study is the food logistics services provided to a retail supermarket chain. Therefore, the warehouse management system is explained within this focus.

The customer, which is retail supermarket chain, uses the company's warehouse for delivering the products that come from suppliers. Fresh foods, dry foods, fruit and vegetables are the products to be stored in warehouses, which is usually called retail warehouse. The retail supermarket chain orders products from suppliers according to its customer demands. Suppliers send the products to warehouse. The products are stored in the warehouse according to warehouse processes. Receiving, transfer/put away, order picking/selection, accumulation/sortation, and shipping are the main warehouse processes of the products that come from suppliers.

OBASE Warehouse System is used as warehouse management system in this retail warehouse. In Obase system, receiving is the first warehouse process. The products that come from suppliers are contolled by receiving personnel. If there is a problem about orders, receiving personnel consult to procurement specialists. Figure 4.1 shows order inquiry screen that is done by receiving personel.

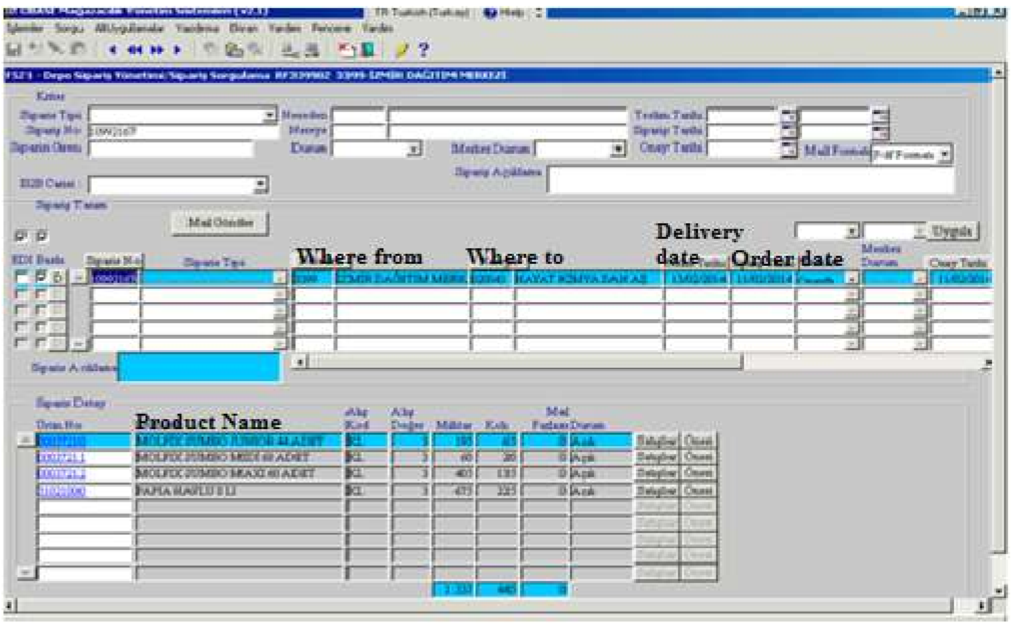

Figure 4.1 Order inquiry screen

After checking the accuracy of orders, vehicle’s license plate, name and telephone number of driver, coming and enterance date of driver, waiting time on the gate, type of loading and product type are recorded. Situation of driver is tranformed from “waiting“ to “within doors”on the screen in the system. The next step is done with hand terminal for receving process (Figure 4.2).

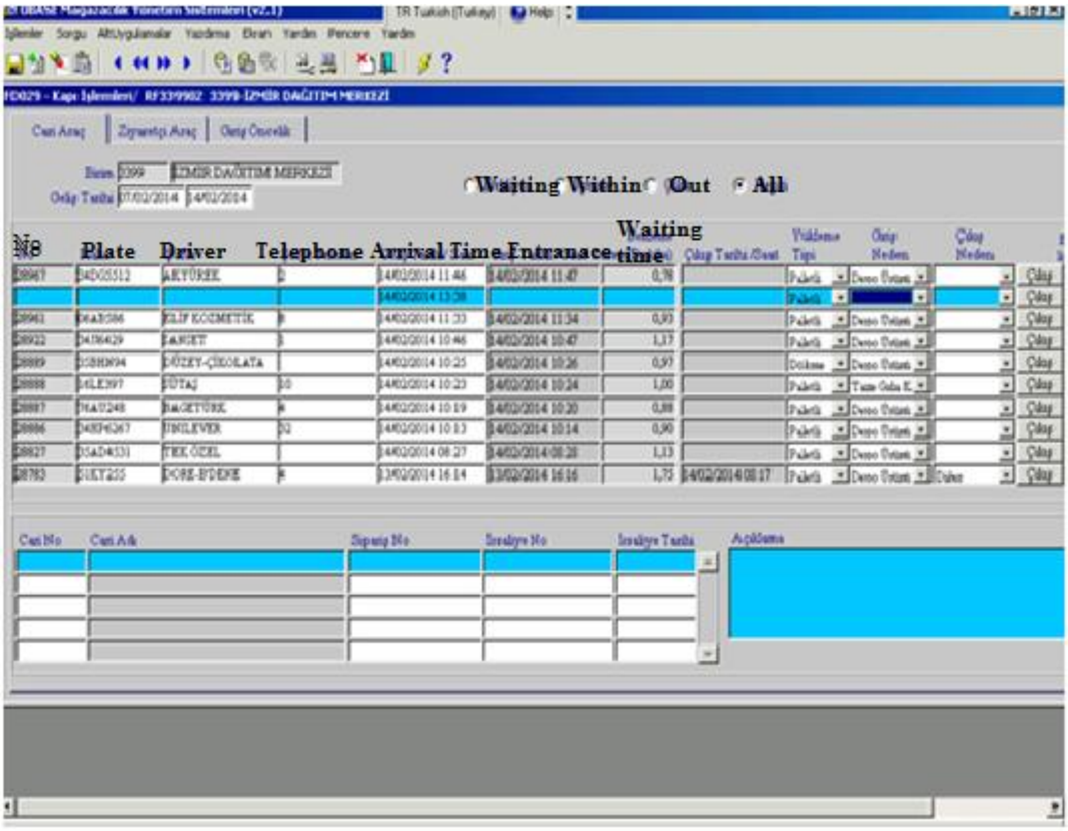

Figure 4.2 Gate operations screen

Figure 4.3 shows the hand terminal screen, which is used for receiving process. For starting receiving process, the button with red circle should be clicked. In the following secreen in (Figure 4.4), the type of receving is shown on the screen and what type of product entry is going to be done is chosen from the menu. Since the coming product type and information about coming vehicle are already recorded on the gate, the product receipt type that shows type of the products can be selected (Figure 4.5).

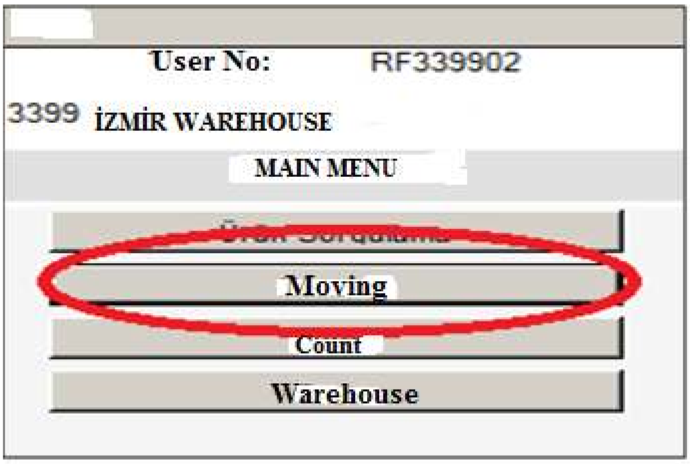

Figure 4.3 Receiving process screen on hand terminal

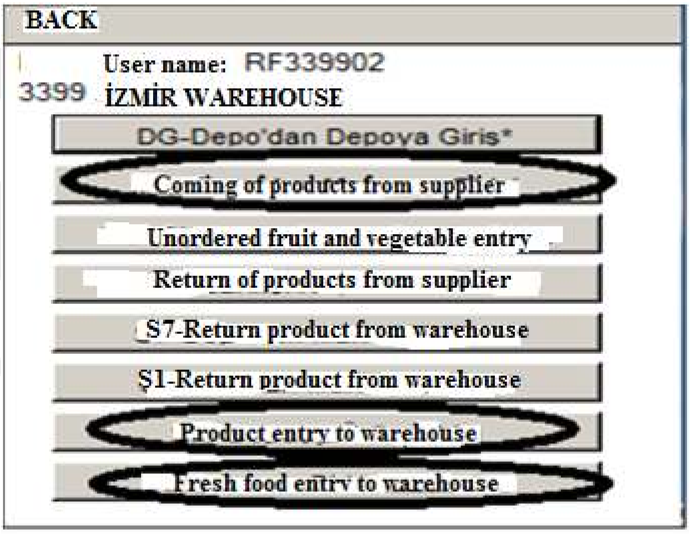

Figure 4.4 Choosing type of receiving process screen on hand terminal

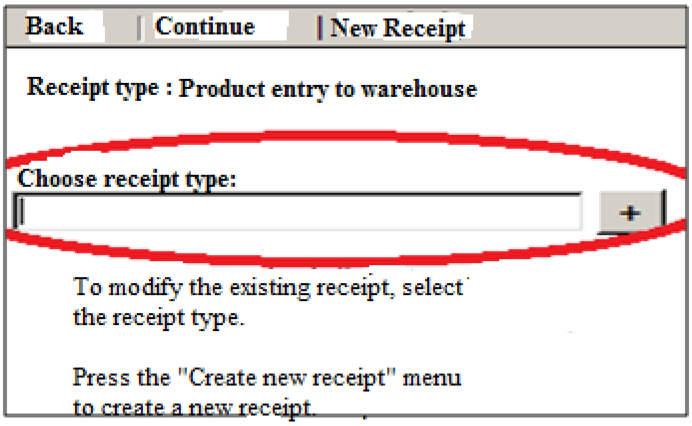

Figure 4.5 Choosing receipt type

After selecting the product receipt type, the product information about the coming vehicle from the menu can be seen. There are order number, waybill date and number, licance plate of vehicle, the route of the vehicle from where to where on the menu. The information on the screen is controlled and if there was a mistake it should be corrected (Figure 4.6).

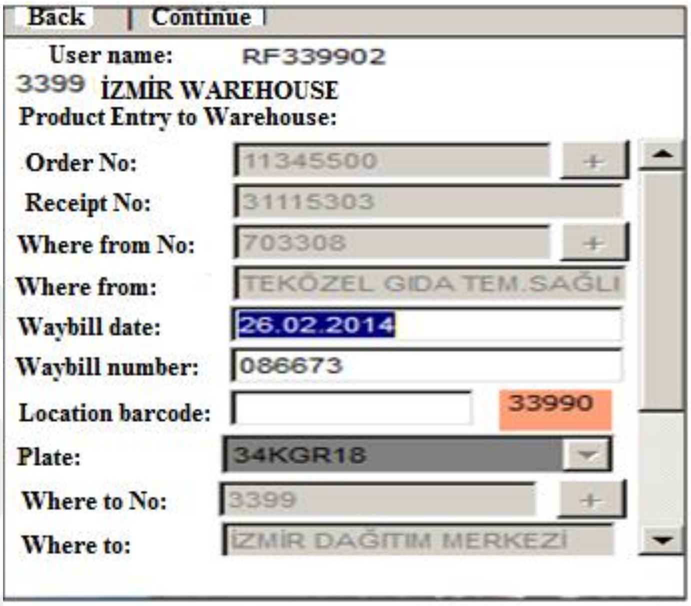

Figure 4.6 Registration of coming vehicle screen

After the receipt is controlled, the “continue buton” is clicked on hand terminal and details are seen on the screen. So, counting process is started (Figure 4.7).

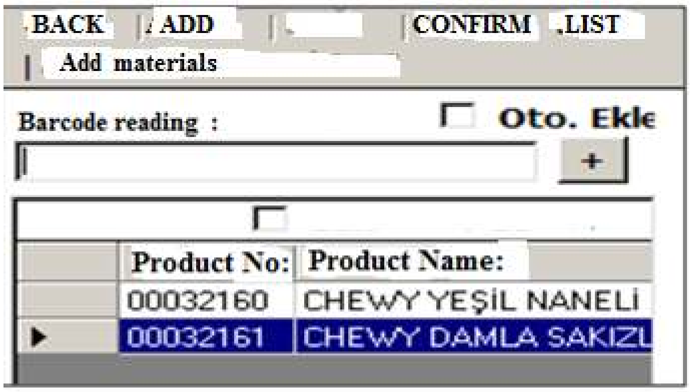

Figure 4.7 Starting counting process on hand terminal screen

Various necessary criteria like expiration date are then entered into the system. The screen below shows entering criteria before starting counting process (Figure 4.8).

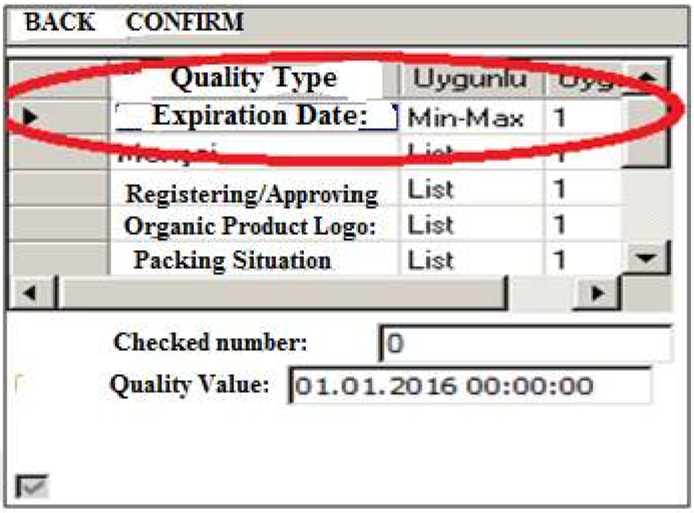

Figure 4.8 Counting process screen

Following screen in Figure 4.9 shows barcode registering of pallets. After completion of products count for coming pallet, barcode registering is done for this pallet. Expiration date, box and product quantity are loaded to barcode.Thus, receiving process is completed. This pallet waits in the pool for storing. Pallets are taken away in the shelves by forklift operator.

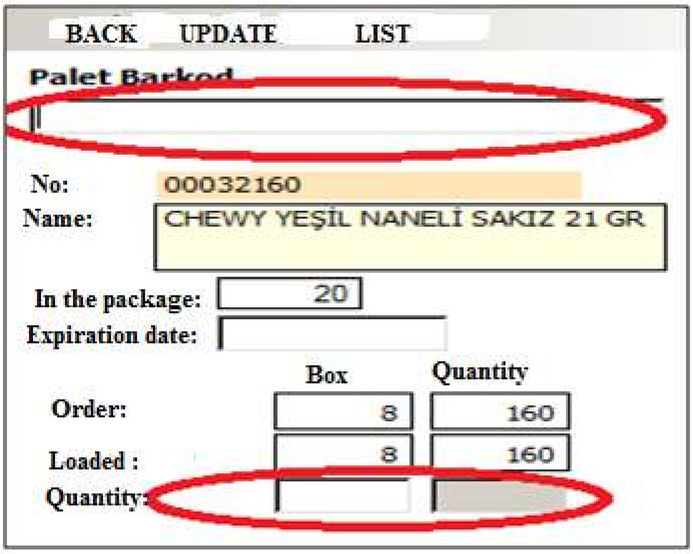

Figure 4.9 Barcode registering screen

Palletts registered in the stock location are automatically assigned to picking cell in the system. Anymore, the products which are in picking cell are ready for order picking. Order picking starts with screen shown in Figure 4.10.

Figure 4.10 Order picking screen

The orders that come from retail supermarkets reflect to below screen. The name of supermarket, quantities of ordered products, order date and product delivery date are shown in this screen. Which market gives orders and how much quantity of orders are seen from this screen. The products are divided into groups. Dry foods, fresh foods and fruits & vegetables are the groups. Dry foods are also separated into categories as non-food, floured food, snacks, drinks and breakfast food. These groups are controlled from the warehouse management system operators. After categorizing products that come from markets, picking lists are made. Thus, order picking process starts and order picking personnels are planned for picking (Figure 4.11).

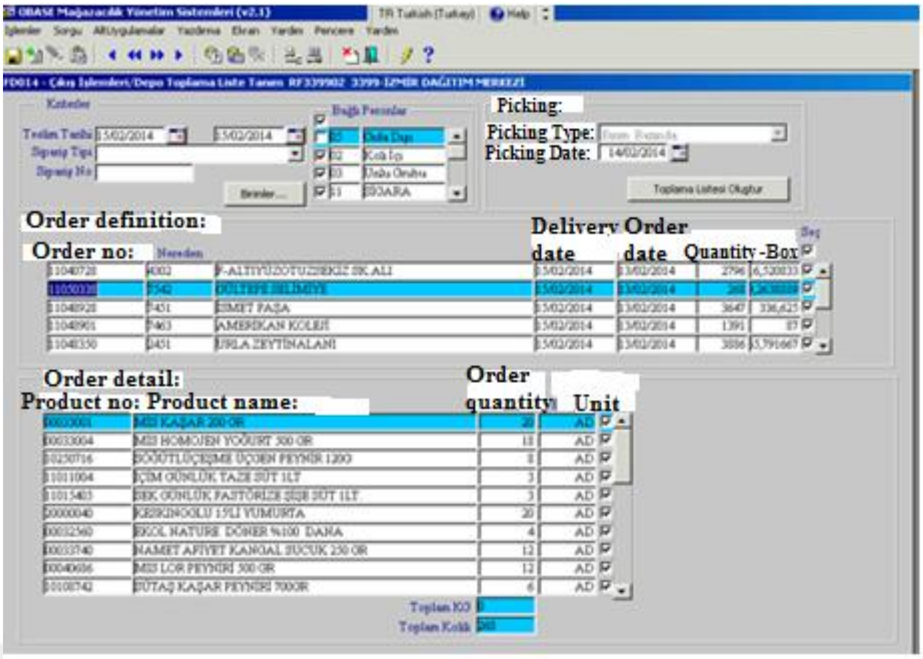

Figure 4.11 Supermarket order screen

The orders of all markets come at the same time to the screen and all orders aren’t picked at the same time. So, priority rules should be determined for deciding which market orders will be picked first. Priority definition starts with screen shown in Figure 4.12.

Figure 4.12 Priority definition screen

The screen in Figure 4.13 shows which market orders will be picked firstly. Picking sequences of orders are determined according to priority criteria. Markets are ranked according to distance from warehouse. Orders of the nearest market are picked first. Next, the process will continue with hand terminal of order picker.

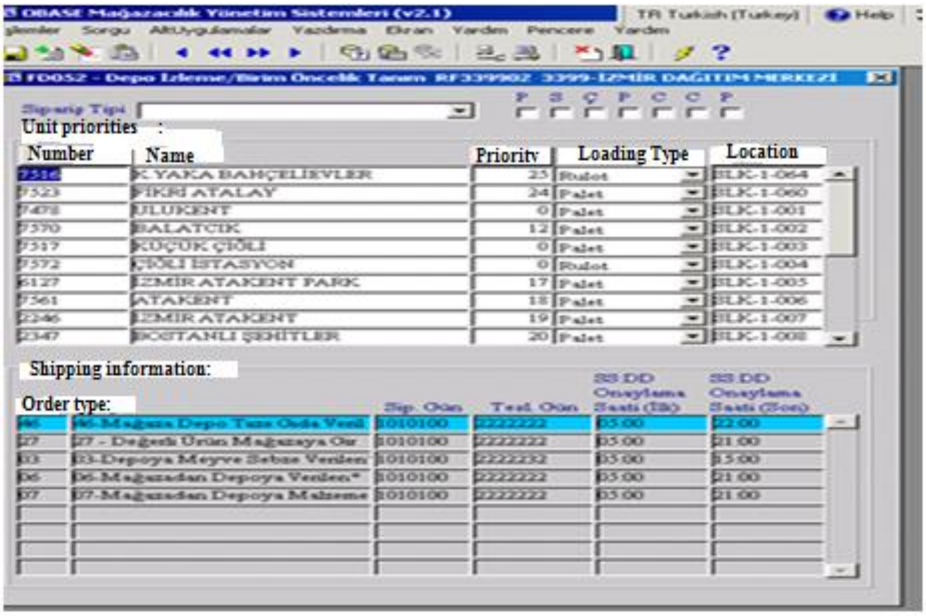

Figure 4.13 Sequencing markets according to priority criterion

Figure 4.14 shows starting to order picking process with hand terminal. Order picker clicks warehouse buton on hand terminal.

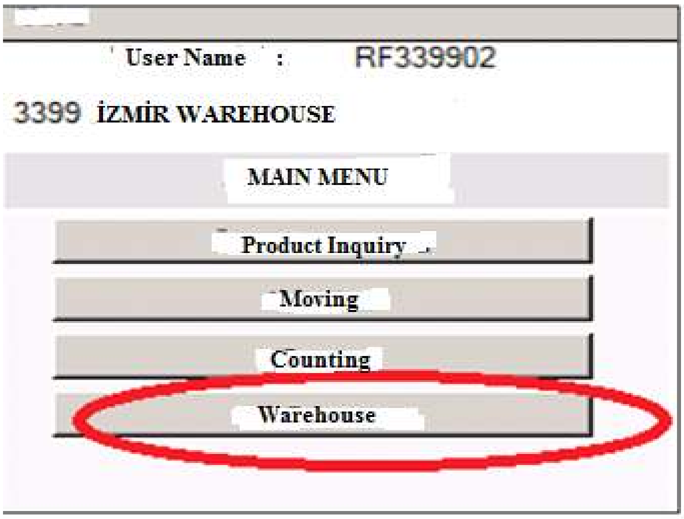

Figure 4.14 Starting order picking screen

Next, the order picker clicks “warehouse picking list” button on the hand terminal and order picking process starts (Figure 4.15).

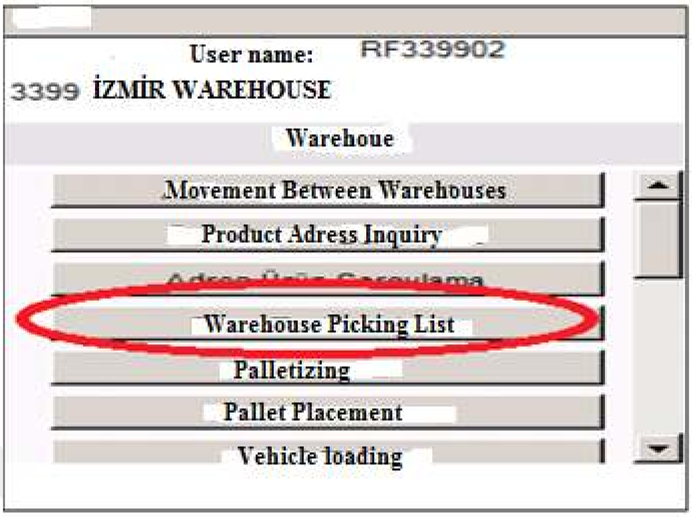

Figure 4.15 Picking list screen

With this menu, order picker chooses his perron and he defines his hand terminal user number the chosen perron. He sees on the screen which category of the orders will be picked. The orders are shown in his screen and picker starts picking orders (Figure 4.16). There is a selected market for picking orders. Picking list number, perron and market name are seen on the screen (Figure 4.17).

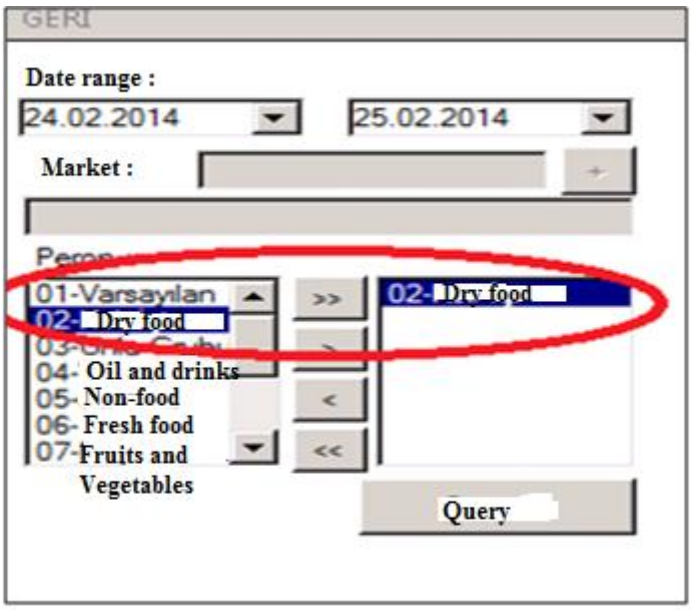

Figure 4.16 Category of orders screen

Figure 4.17 Market selection screen

The market is chosen from the screen that is picked orders. The orders of chosen market are seen on the screen and also locations of each product on the shelves are seen. Products are picked from picking cell considering about the weight of the product boxes. Products are put on pallets according to box weights. The picked products are registered and the picking continues to the last product of this market order. After finishing of one market order picking, the order picker enters the shipping location number of the market. The picked orders are put into vehicle according to this shipping location number. If the products are put in rullot, rullot barcode is attached on the rullot, otherwise pallet barcode is attached. Thus, order picking of this market is completed (Figure 4.18).

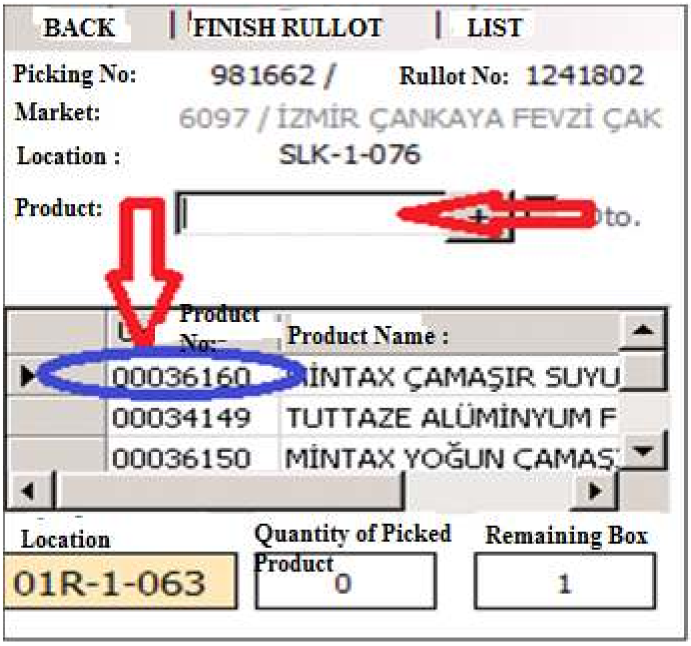

Figure 4.18 Market orders screen

In the shipping location, barcode combining is done by hand terminal. Figure 4.19 shows combining rullot barcodes that come from different perron.

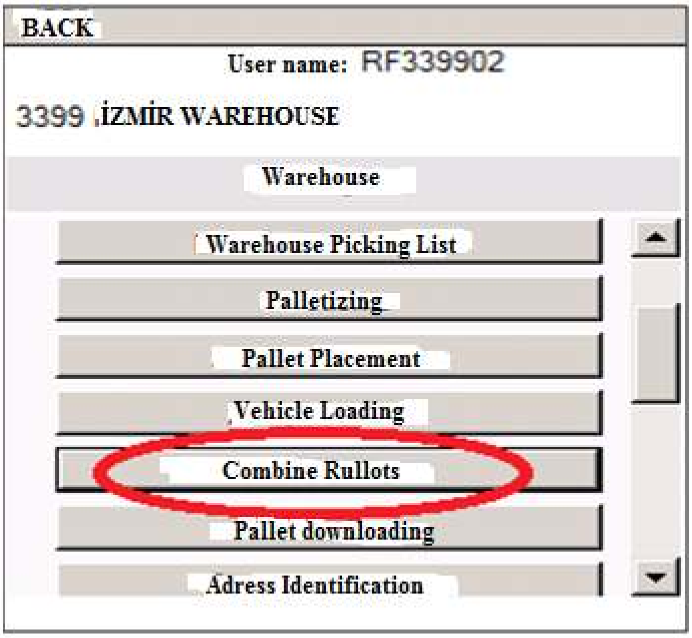

Figure 4.19 Rullots combining screen

Figure 4.20 shows the screen for transferring from source pallet barcode to goal pallet barcode. As it seen below, firstly source pallet barcode secondly goal pallet barcode are read by hand terminal. Thus, source palette from goal palette transfering becomes.

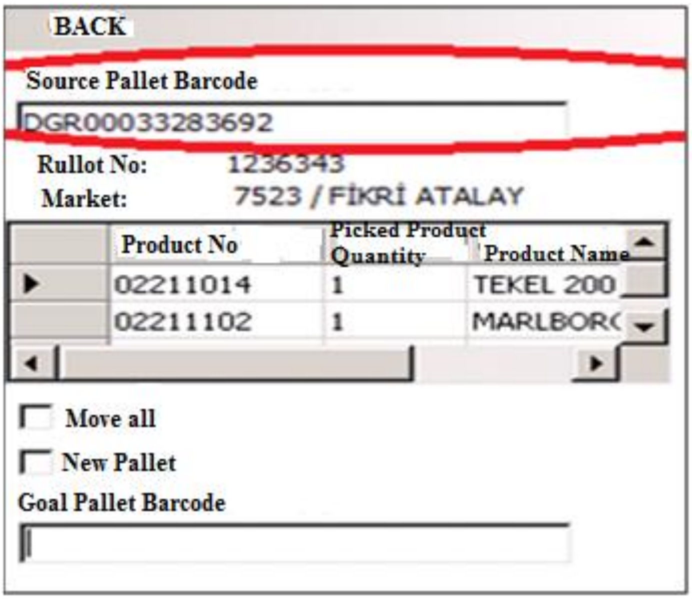

Figure 4.20 Pallets transferring screen

Below menu shows transferring product barcodes from source pallet to goal pallet barcode. Firstly, source pallet barcode is read to hand terminal. Each product barcode in the source pallet is read to hand terminal and transferred to goal pallet barcode. Thus, systematic loading/transfering product barcode from source palette to goal palette is completed. The shipping personnel combine pallets systematically that comes from different perrons. He sequences the pallets according to shipping location number because small shipping location number shows that this pallet will be sent to the nearest market from warehouse (Figure 4.21).

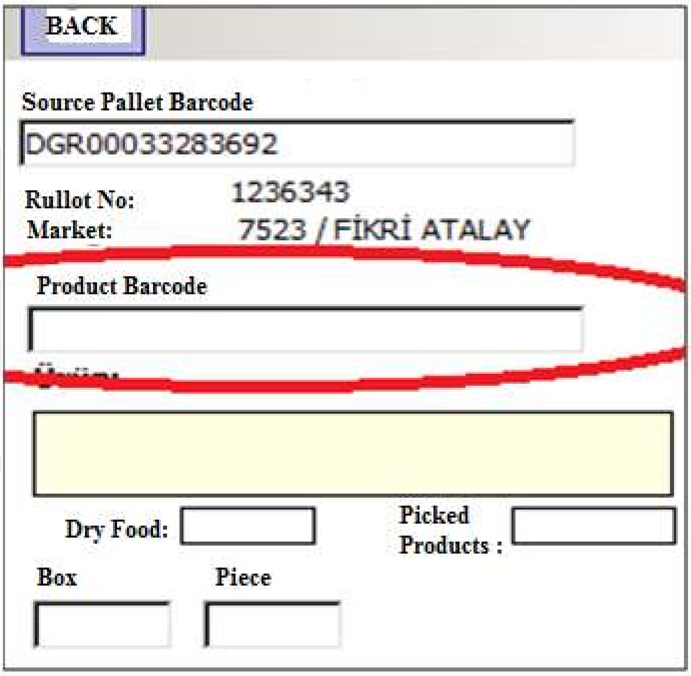

Figure 4.21 Product transferring screen

Figure 4.22 shows identification of the vehicle that will go to route. This screen provides identification of the vehicle. Undefined vehicles on the system aren’t shipped. Anymore, defined barcode is a type of identity card for the vehicle. The pallets wait for being loaded in the shipping area and loading pallets in vehicles is done according markets sequence. Vehicle loading is done in the followings: Vehicle loading is chosen from the hand terminal. The barcode of the vehicle is read to the hand terminal. After reading barcode, route is made for the vehicle. The pallets which will be sent with this vehicle are loaded and loading process is finished. After finishing loading the pallets in the vehicle, waybill of the vehicle is made from this menu by clicking shipping management on the screen (Figure 4.23).

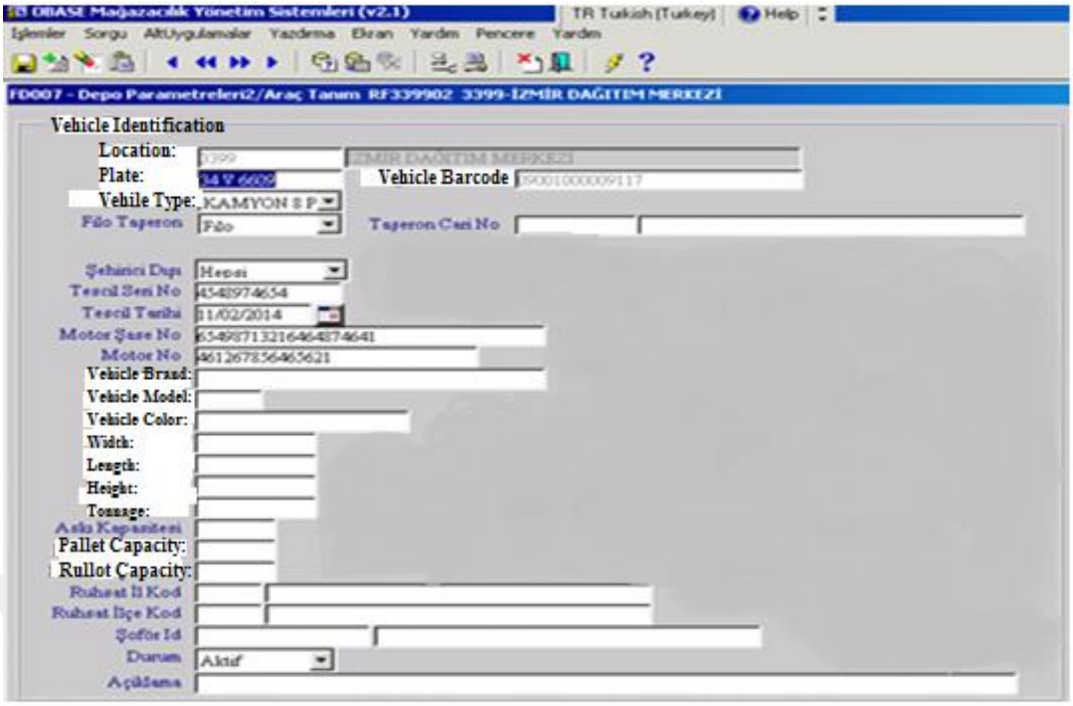

Figure 4.22 Vehicle identification screen

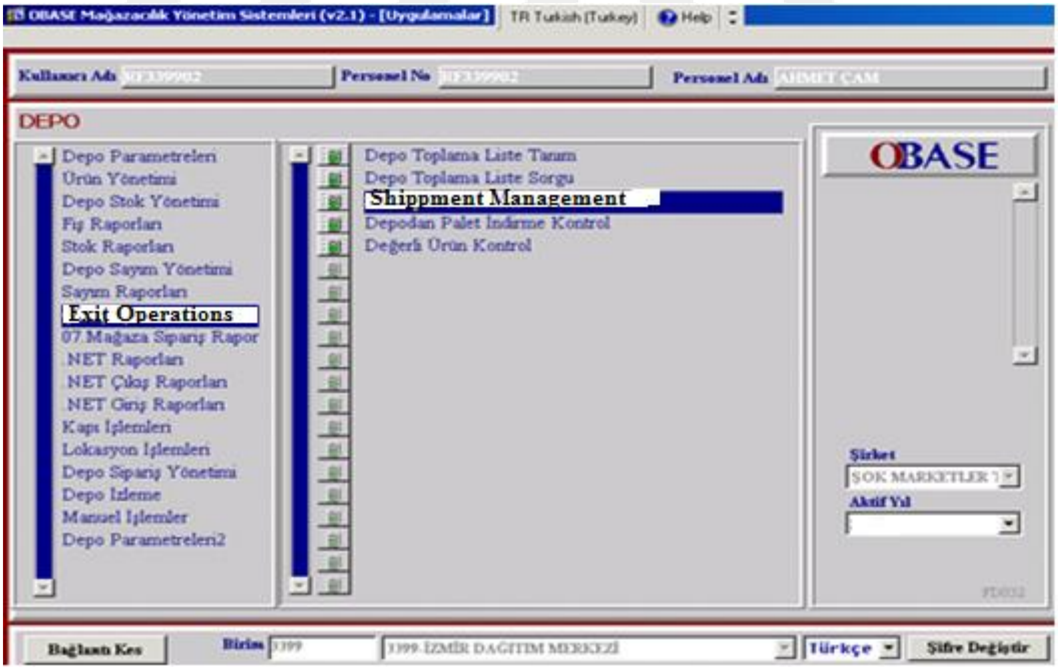

Figure 4.23 Shipping management screen

Figure 4.24 shows the situation of the vehicle. If the vehicle is waiting or it is being loaded, the situation on the screen is updated according to situation. Figure 4.25 shows making necessary documents for each supermarket in the vehicle.

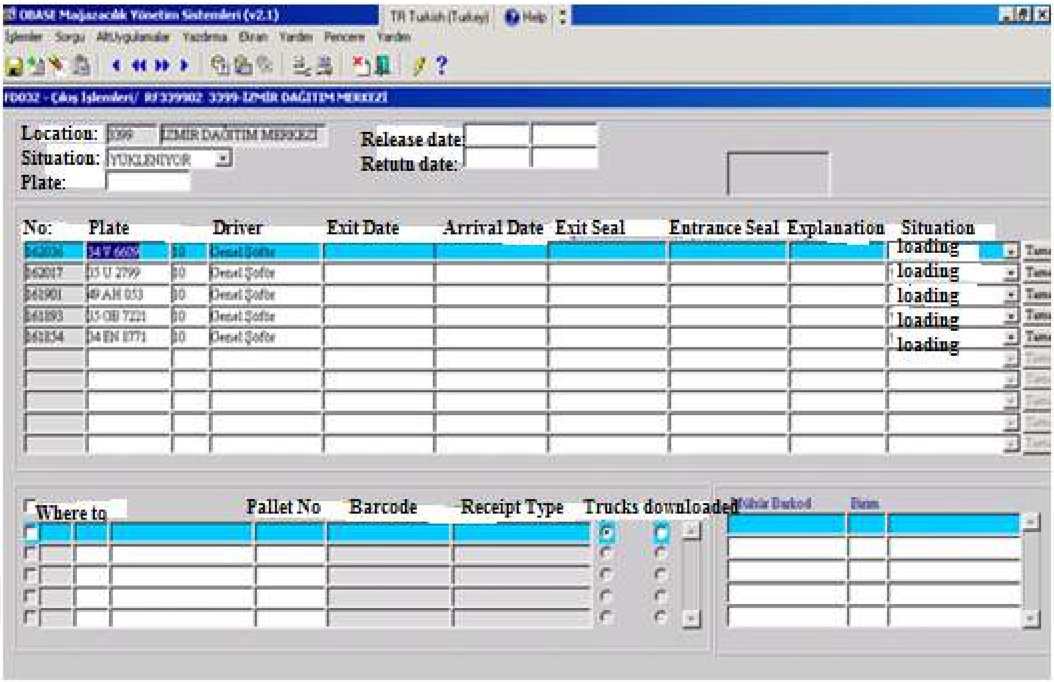

Figure 4.24 Situation of the vehicle

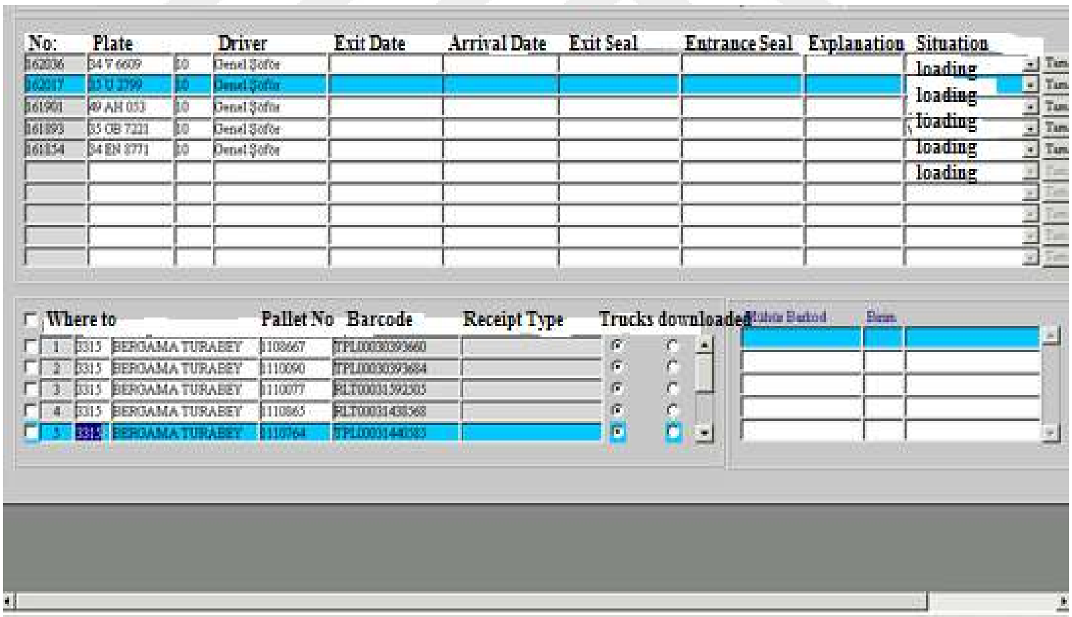

Figure 4.25 Making documents for markets

Vehicle route document is prepared for every market. The name of the markets, quantities of pallets, where the vehicle will go, in town or out of town route, the driver's information are shown in this document. The shipment chief permits the vehicle for shipping, after preparing the waybill of shipping vehicle, vehicle route document and market waybills. The driver of vehicle takes these documents and leaves from the warehouse and the driver starts delivering the products (Figure 4.26). Thus, as explained above, warehouse operations in warehouse management system are completed.

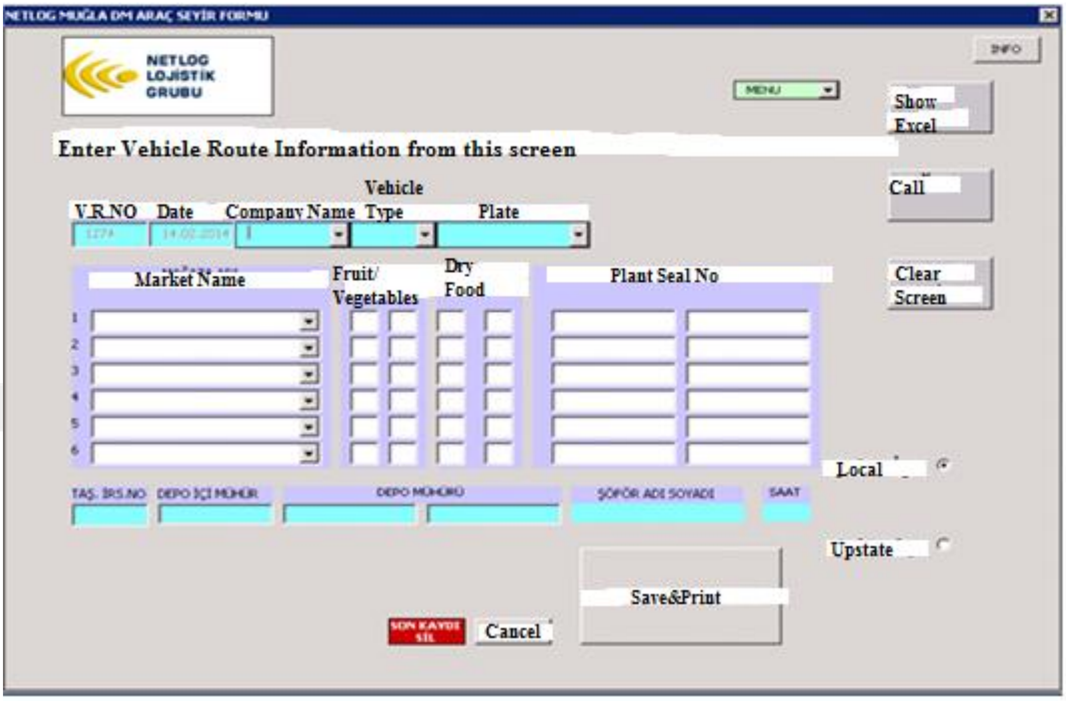

Figure 4.26 Vehicle route document

4.3 Problem Definition in Retail Warehouse

The problem in the case study is a real life problem and it is performed in a retail warehouse. There is a process that is applied in the warehouse. The process is explained in the followings. The suppliers sent to required products to warehouse; the products arrive in the warehouse; the incoming products are controlled according to quantity number, damage and etc.; if there is not any problem about controlling, the each incoming product type is carried and stored in the shelves randomly; later order picking is performed according to orders requested by stores; the products are picked from the shelves according to orders of each store; respectively the products of each store are picked; the picked products are taken to shipping area; the products of the stores in the shipping area are loaded into trucks. This is the process that is applied in the warehouse.

The problem in this retail warehouse is that, there are lots of product types and while allocating products in the shelves there are no criteria and they are allocated randomly. So, this causes some problems for the order pickers. Due to irregular stock allocation, it is difficult to find products while picking orders. So, the order pickers have to travel longer distances and as a result, they waste time for picking. To prevent longer travelling distances, the existing product allocation should be rearranged.

Storage allocation policy affects order picking performance as followings. If a product type is not assigned to a particular/specific location in the shelves, that is, if it is randomly assigned, the order picker will have difficulty finding the product every time. The order picker has to deal with this problem constantly. As a result, storage allocation affects most order picking performance in the warehouse operations. So, the order picking performance will be improved by trying alternative stock allocation models and minimizing travelling distance as order picking performance indicator will be considered in this study.

4.4 Focus of Research

One of the factors that affect the order picking performance is the stock allocation policy in the warehouses. There is high relationship between order picking performance and stock allocation policy. This study generates new storage allocation policies for minimizing travelling distance. We can improve order picking performance by applying accurate and appropriate stock allocation policy. In this study, we want to improve order picking performance by allocating the products in the shelves according to alternative storage allocations.

Since the cost of order picking is very high; to improve order picking process is very important. Another important of order picking process is that besides affecting all the operations in the warehouse and also the order picking affects external warehouse process. For example, order pickers spend most time for picking orders in the warehouse and the products that could not be picked on time are shipped to retail chain supermarket late. The products aren't available in the supermarket when the customer needs them. When a customer goes to the chain supermarket, he can not buy the product he needs or wants, this is very bad position for supermarkets in today's conditions. The supermarket is confronted with an unsatisfied customer.

It can be clearly seen that the order picking performance in a retail warehouse is a very significant issue that needs to be studied and improved. So, the factors that affect order picking performance must be examined in details.

4.5 Flow of Study

There is an overview in this part and the steps of case study are explained. As a first step, we should define the current situation in the warehouse. There are so many product types in the warehouse and similar product types are stored in different distant locations. First of all, we must group the product types as categories. Each category must include similar products. For example, milk category is made from milk types. Water category is made from water types. We group the product types in categories and we get 35 categories. Thus, we have done grouping for product types.

In current situation, the products are assigned on shelves using random storage policy. This used policy causes irregularities in the warehouse and order picking performance is affected badly from this position. So, it is necessary to locate the categories on shelves by using specific storage policies. As it has already mentioned previous, there are different storage allocation policies in literature. We will propose three alternative storage policies. First, we will use clased based storage policy, then family grouping storage policy, and finally we will use combination of family grouping and clased based storage policy. Namely, we located the categories according to three different storage allocation policies. Our aim is to determine the most appropriate storage allocation policy for this warehouse. Therefore, we store the categories by using these policies respectively.

The first proposed method is the classed based storage policy. We make ABC classification namely Pareto analysis. We use annual product data for making ABC classification. We sequence the amount of ordered products from large to small. Other name of ordered products is stock output rate. According to stock output rate, the product types ordered much are classified in A class, later B class is made, finally the product types ordered little are classified in C class. We allocate the categories according to these ABC classes. This allocation is explained in the followings. The products in A class are allocated to the front of the warehouse, the products in B class are allocated to the middle of the warehouse and the products in C class are allocated to other empty locations.

The second proposed method we used is the family grouping storage. We allocate the similar categories close to each other. For example, the water category is a kind of liquid and soda water category is also a kind of liquid. These categories are a kind of drink types. So these two categories are allocated to close to each other for this storage policy. Also, being liquid or solid food is important when storing. It is important when storing a product that it is food or nonfood.

In the last storage policy, we use family grouping and classed based storage policy together. The products with the highest demanded will be at the front of the warehouse, but at the same time similar categories are assigned close to each other. For example, oil is liquid food also milk is liquid food. They are allocated close to each other. However, the stock output rate of milk is higher than the stock output rate of oil. So, milk is allocated to the front of the oil. That is, milk is allocated to the first shelf; the oil is allocated to the second shelf. For this combined storage policy, both the products should be allocated close to each other according to similarities and the allocation should be made considering the storage output rate.

We perform three different stock allocation policies. We don’t know which one is the best. So, we need to do extra works to determine this. Our primary aim in this study is, to create new stock allocation policies for minimizing travel distance when picking orders. We want to pick the products according to the stock allocation policies we have created. We have already determined travelling distance as order picking performance measure.

It is necessary to use some methods to find the travelling distance. There are some routing policies. As routing policy, we use A star and Dijikstra's algorithm for calculating travelling distance. How will the storage policies help us for calculating the travelling distance? For example, we choose the family grouping storage as allocation policy. Later according to these policies, we pick 10 different products. Now, we calculate the travelling distance between these products by using above routing policies. When comparing two routing policies, Dijikstra's algorithm is better than A star algorithm. For that reason, we find the travelling distance between the products by using the Dijikstra's algorithm for the three proposed storage allocation policies. We create a programme with C#.NET to do these calculations. In this programme, we decide on storage allocation policy, later we choose the products we want to pick. When the programme is run, the programme gives us the distance travelled to pick the products.

Respectively, we allocate the products according to three different storage allocation policies described above. Later, we pick the products what we want. At the end of all these processes, we can determine which storage allocation policy minimizes the travelled distance to pick the products. The analysis of each storage allocation policy will be done in the next parts.

We made a flow chart to show steps that is applied in the study. The flow chart of this research can be shown in Figure 4.27.

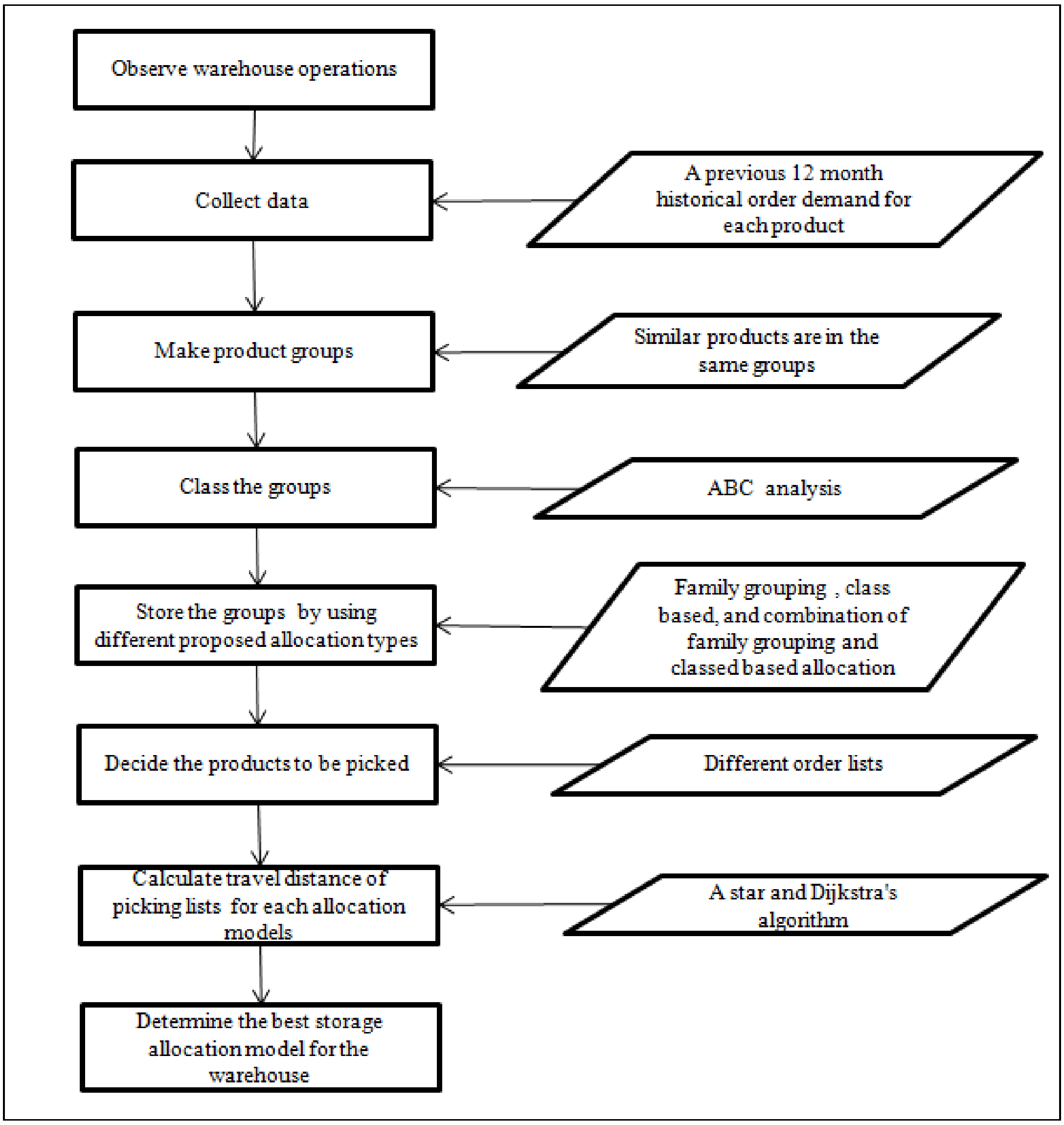

Figure 4.27 Flow chart of the case study

4.6 Assumptions

While getting a solution to this warehouse problem, we use some information about the warehouse. These are;

a) The picking area has 5 aisles and 10 perrons (shelves). Each aisle has same length and width. Entrance is located at the right corner of picking area. Exit is located at the left corner of picking area.

b) The shelves have five floors. First floor of the shelves is named as picking cells. Each picking cell has only one product type, in other words one product type is located in one picking cell.
c) The order pickers pick the products from picking cells. It isn't allowed to pick products from other floors of shelves. Picking cells are only used for picking orders.
d) All storage locations and picking cells are the same size.
e) There are 20 order picking lists. Each order picking list includes 10 product types. The picking list shows product orders of stores.
f) The warehouse employs human as pickers for order picking. In the picking area of the warehouse, an order picker walks along the aisles to pick products, picks the requested products from storage shelves manually and puts them on a pallet. The order picking system is picker-to-parts system and is considered as a low level picking.
g) The Obase warehouse system is used in this warehouse. Because of irregular storage allocation, the sytem can not be used efficiently. After the arrangements are made, the changes will be defined to the Obase warehouse system.

The warehouse in this case study is shown in Figure 4.28. In order to calculate the travel distances for picking orders, some warehouse information is necessary. This information is as follows;

Width of an aisle: 200 cm
Number of cell in a perron: 15 cells
Width of a cell: 120 cm.
Length of a cell: 80 cm.

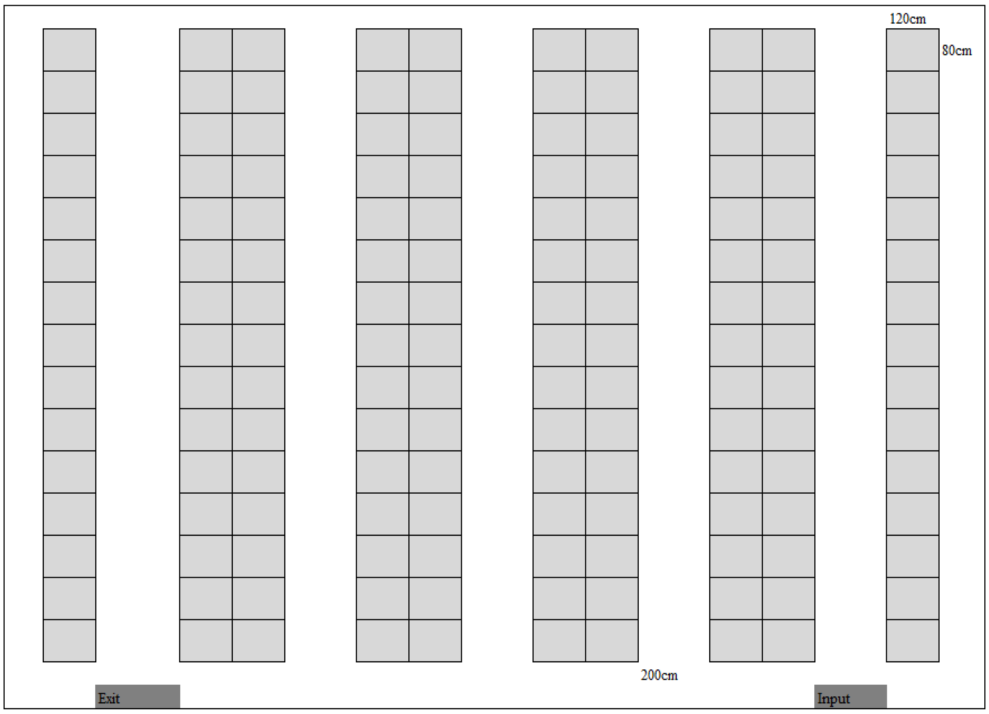

Figure 4.28 Layout of warehouse

In this warehouse, Obase Warehouse System, which has been explained in section 4.2, is used. After the orders are seen in the Obase System, the order pickers are assigned to the perrons. The picker picks the requested products using the list of market. The list includes products that should be sent to the stores. The order pickers can learn the requested orders using their own hand terminals. The hand terminals show the products according to product location address from smaller to larger. Every time the location of the products is changing because of locating the products randomly. When the picker is assigned to perrons, he picks the products and places them on pallet in the perron and later he takes the pallet to shippment area. The products in each perrons are picked one by one. After finishing one store's orders, the other stores' orders are picked sequentially. When all stores' orders are picked, order picking process is completed.

4.7 Research Data

The data for analyzing product types was gathered from Obase warehouse system. We have reviewed the current product types in the warehouse. The products aren't grouped. For example, when the chocolate group is called, this group should have only chocolate types or when a group of oils is called, there must be only oil types in this group. Grouping makes it easy to control and monitor product types. We analyse the products with the following process. First, product types available in warehouse are obtained and examined. There are 710 product types in the warehouse. We need to categorize them to provide control over the product types. Thus, the products in each category will be seen. The product types are grouped by categories. We get 35 categories. As a result of product grouping, we used different colors to represent the product groups in the warehouse layout. The colors of product categories are shown in Table 4.1

Table 4.1 Distinctive color of categories

No	Category	Distinctive color	No	Category	Distinctive color
1	Water		19	Fizzy drink	
2	Milk		20	Coffee	
3	Detergent		21	Fruit juice	
4	Chocolate		22	Sugary snacks	
5	Flour		23	Dish detergents	
6	Napkins		24	Chips	
7	Macaroni		25	Breakfast food	
8	Biscuit		26	Cracker	
9	Canned foods		27	Rice	
10	Oil		28	Personnel care	
11	Sugar		29	Legume	
12	Cakes		30	Hair care	
13	Soda water		31	Soupmix	
14	Wafer		32	Candies	
15	Cleaning agents		33	Spices	
16	Dried fruits		34	Salt	
17	Home equipments		35	Olives	
18	Tea				

4.8 Analysis of Data

We will do analysing on the product types in this part. At first, it is necessary to gather data and we will do the followings for gathering. We can take the data from warehouse system for every 15 days but we need past one year data. So we combine every 15 days of data. For combination, we use vlookup feature of Microsoft Excel and we obtain one year output of each product types. The amount of product output means the stock output rate. This will be used for classifying products according to Pareto analysing. After calculating the output quantity of each product for the past one year, we can calculate the output quantity of the categories. Each category contains a different number of product groups. Grouping simplifies controlling over data.

We make the categories in this way. As we mentioned before in Table 4.1, first we determine category names. Later, we define the product types for each category. That is, under each product category, the product types of that category are specified. We give a number for each category. We collect the product types under the numbered category. For example, the category that is called as 1 defines water category. Water types are defined in category 1. The category that is called as 2 defines milk category. Milk types are defined in category 2. It continues with this way up to 35 categories. Thus, product types have been categorized. The categorization of products for category 1 and category 2 is shown below in Table 4.2 as an example. There are 35 categories like that. We will do same things all 35 categories. Thus, we can see what kind of product types a category contains. All categories are shown in Appendix.

Table 4.2 Creation of categories

Product Type	Sum of annual output of products	Category
CEYSU NATURAL SPRING WATER 5 L	304.473	1
CEYSU NATURAL SPRING WATER 0.5 L	102.003	1
HAYAT WATER 5 L.	97.283	1
CEYSU NATURAL SPRING WATER 1.5 L	85.650	1
HAYAT WATER 0.50 L	66.501	1
HAYAT SU 1.5 LITER	65.329	1
SAKA WATER 10 L.	61.545	1
SAKA WATER MINI SÜNGER BOB 0.33L	7.761	1
MİS UHT SEMI SKINNED MILK 1L	192.159	2
MİS UHT WHOLE MILK 1L	100.000	2
SEK MILK 1 L	30.405	2
PINAR MILK 1 L	27.839	2
ÜLKER İÇİM MILK1 L	13.035	2
SEK CHOCOLATE MILK 200 ML	11.789	2
SEK MILK 200 ML	9.729	2
MİS 200 ML UHT WHOLE MILK	9.491	2
SEK LIGHT MILK 1 L	9.033	2
SEK STRAWBERRY MILK 200 ML	5.798	2
SEK BANANA MILK 200 ML	4.749	2
PINAR MILK 500 ML	4.057	2
İÇİM MILK 200 ML	4.032	2
MİS 500 ML UHT WHOLE MILK	3.009	2
İÇİM HERO BABY CONTINUED MILK 12-36 500 ML	2.538	2
ÜLKER İÇİM BANANA MILK 200 ML	1.561	2
		 35

After creating categories, we arrange the product categories from large to small according to the amount of annual output. We classify the product categories according to Pareto analysis. The product categories with the most output rate is classified in A class, with low output rate is classified in C class. Between A and C class is classified as B class.

Also, the products within the categories also need to be grouped. While we are deciding the number of groups, we consider the number of product types in that category. If the number of product types is higher in a category, the number ofgroups is also higher. For example, water category includes 8 product types and 3 subgroups; milk categoryincludes 15 product types and 4 subgroups. How many products and groups a category contains can be seen in the following Table 4.3.

Table 4.3 Product types and groups

Product Category	Category Names	Product types in the category	Product groups in the category
1	Water	8	3
2	Milk	15	4
3	Soda water	5	2
4	Fruit juice	8	3
5	Fizzy drink	14	3
6	Flour	12	3
7	Sugar	7	2
8	Oil	17	3
9	Macaroni	16	3
10	Rice	7	1
11	Legume	12	3
12	Tea	24	4
13	Coffee	17	3
14	Chocolate	31	7
15	Biscuit	32	7
16	Sugary snacks	21	3
17	Dried fruits	25	3
18	Cracker	12	2
19	Salt	2	1
20	Breakfast food	22	4
21	Detergent	15	4
22	Dish detergents	10	3
23	Cleaning agents	21	4
24	Home equipments	67	12
25	Napkins	17	3
26	Cakes	20	3
27	Spices	25	3
28	Wafer	16	3
29	Candies	14	2
30	Chips	15	2
31	Personnel care	90	17
32	Hair care	13	3
33	Canned foods	57	8
34	Soupmix	17	3
35	Olives	6	1

Defining categories, making groups in each category, calculation of the output amount of each category, calculation of the output amount of each group and calculation of the output amount of each product is very important and essential phase. It is also long process to be analyzed. This phase will be principal data for the stock allocation policies we will develop.

4.8.1 Existing Storage Allocation Policy Used in the Retail Warehouse

All the operations in the warehouse have been examined. We have seen that the most important process affecting all the processes is the order picking process. During the order picking process, we have seen that the current stock allocation policy has a negative effect on the order picking performance. When we improve the existing storage allocation policy, depending on this, order picking performance also improves.

Existing storage allocation is random storage allocation policy for this warehouse. What is needed to improve the stock allocation policy is briefly explained as follows. The stock output rate of each product was examined. It is observed that the products are not classified in detail in this warehouse. For instance, the products that are similiar to each other are stored in different picking cells, which results in a big problem for order pickers because finding the ordered products becomes difficult and the order pickers walk longer distance unnecessarily. For example, in the existing storage allocation, milk1 is located in first perron but milk2 and milk3 are located in fifth perron. All milk groups should be in the same perron to be proper product allocation. For example, if milk1 and milk3 were ordered together by the stores, order picker picks firstly milk1 and later he travels the other perron to pick milk3. If milk 1 and milk3 were close to each other, unnecessary walking wouldn't be. It can be clearly seen that, the current order picking model used in this warehouse needs some improvements. So, we propose new storage allocation models for this warehouse, in next part we will make these new models and also analyse them.

Based on the current situation of the the retail warehouse, the existing storage allocation in the shelves is shown in Figure 4.29. This figure shows first floor of the shelves. Order picking is done only from first floor.

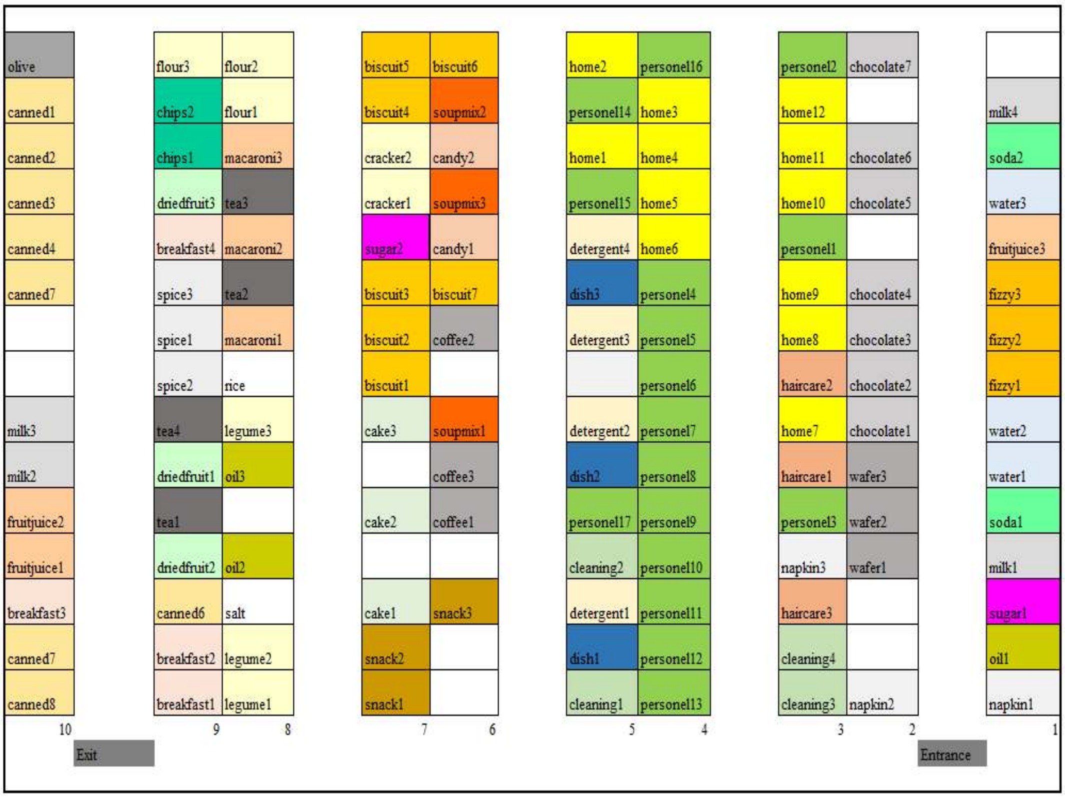

Figure 4.29 Current product locations in the layout of the warehouse

4.9 The Proposed Solution Methodology

The proposed solution methodology consists of two phases. In the first phase, the products in the warehouse are grouped and using these groups ABC classification is done. In the second phase, according to the classifications found in phase 1, alternative stock allocation models are first constructed. Three new stock allocation models are constructed and the products are located on the shelves according to these allocation models. Later, the pickup distances required by the existing and the newly constructed models are calculated using heuristic methodologies. The aim is to decide which storage allocation model is the best for minimizing travel distance for order picking. For existing and our three proposed models, we use A Star and Dijskstra's algorithms as the routing policies.

4.9.1 Phase 1: ABC Analysis in the Warehouse

This part consists of two parts. First, we give brief information about ABC analysis. Second, we apply ABC analysis on the products.

1) Information for ABC analysis:

ABC analysis is studied in the literature widely and it is a highly used method in practically. It is a method that divides products into classes according to stock output rate. The classes of products with higher stock output rate are stored the region closer to the warehouse entrance and these classes are called as A class. The classes of products that are demanded rarely, that is, with low stock output rate are stored to the farthest region from the entrance. This class is called as C class. There is B class between A class and C class. The products belongs to B class are stored in the middle part of the warehouse. Figure 4.30 shows an ABC curve and view of storage region in a warehouse for ABC classed based storage (Hausman & et al., 1976).

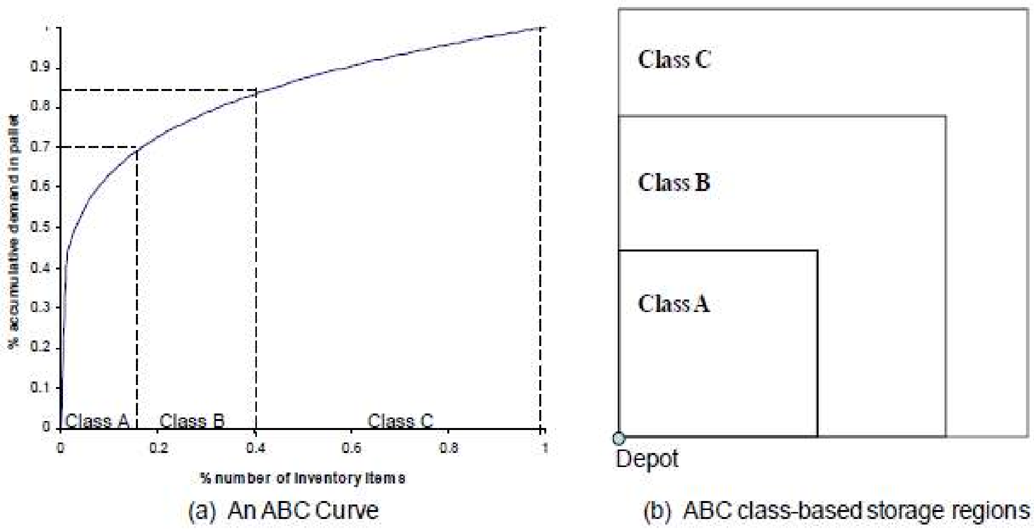

Figure 4.30 ABC curve and regions of ABC classed based storage

2) Performing ABC analysis in the Warehouse:

In this phase, we perform ABC analysis by using annual output of products. The product groups are classified according to ABC analysis. Other name of ABC analysis is Pareto analysis. As we created earlier, there are 35 categories; i.e. water, milk, detergent, chocolate, flour, napkin, macaroni, biscuit,canned food, oil, sugar, cakes, soda water, wafer, cleaning agent, dried fruit, home equipment, tea, fizzy drink, coffee, fruit juice, sugary snack, dish detergent, chips, breakfast food, crackers, rice, personnel care, legume, hair cares, soupmix, candy, spice, salt and olives. ABC analysis is done according to product categories and their annual stock output rate. Annual stock output rate means the amount of products that are shipped from warehouse to stores in one year. After analyzing the products we obtained that;

A total of 5.141.550 boxes were shipped within one year. The products are shipped in boxes. 3.728.265 boxes are classfied in A class, 1.118.576 boxes are classfied in B class, 294.659 boxes are classfied in C class. ABC analysis of the categories is shown in Figure 4.31

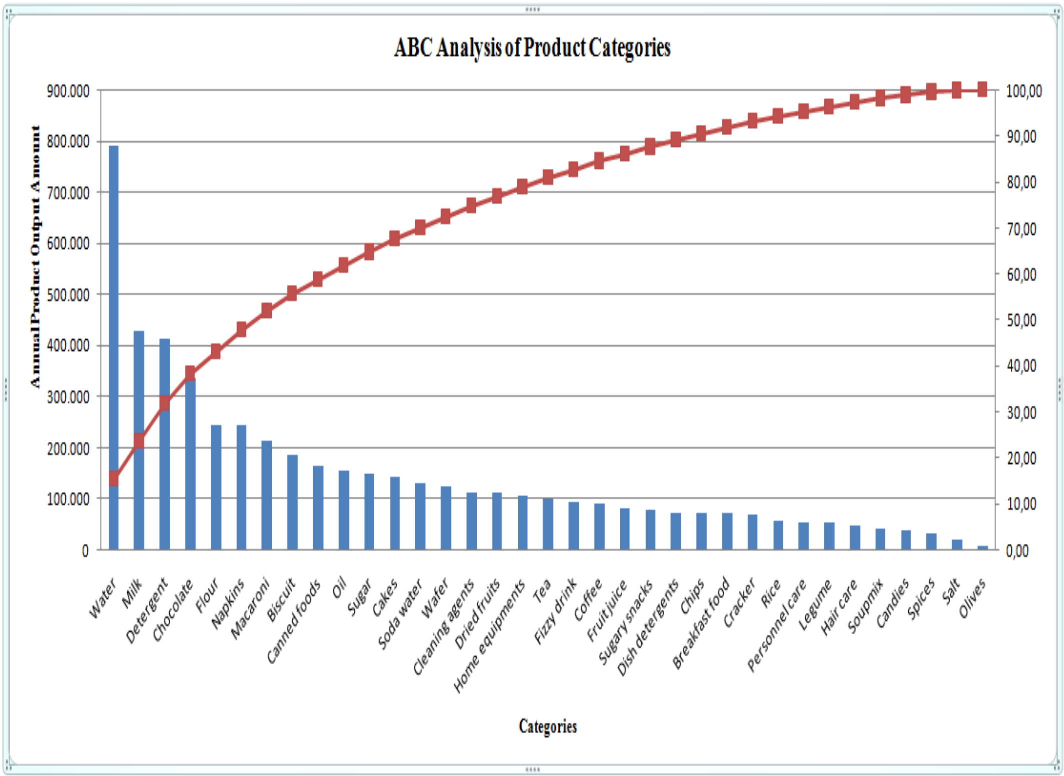

Figure 4.31 ABC analysis of product categories

Later, these categories of products are divided into 135 sub-groups. Water has 3 subgroups, milk has 4 subgroups, detergent has subgroups, chocolate has 7 subgroups, flourhas 3 subgroups, napkin has 3 subgroups, macaroni has 3 subgroups, biscuit has 7subgroups, canned food has 8 subgroups, oil has 3 subgroups, sugar has 2 subgroups, cake has 3 subgroups, soda water has 2 subgroups, wafer has 3 subgroups, cleaning agent has 4 subgroups, dried fruit has 3 subgroups, home equipment has 12 subgroups, tea has 4 subgroups, fizzy drink has 3 subgroups, coffee has 3 subgroups, fruit juice has 3 subgroups, sugary snack has 3 subgroups, dish detergent has 3 subgroups, chips has 2 subgroups, breakfast food has 4 subgroups, cracker has 2 subgroups, rice has 1 group, personnel care has 17 subgroups, legume has 3 subgroups, hair care has 3 subgroups, soupmix has 3 subgroups, candy has 2 subgroups, spice has 3 subgroups, salt has 1 group, olive has 1 group. After grouping, we will use them for new product allocation models to be created. In the next part, we will allocate the products according to above subgroups. We know from the ABC analysis that which subgroup belongs to which class, so this information will be very useful while allocating groups in the shelves. Table 4.4 summarizes the list of product categories and subgroups and their annual stock output rate.

Table 4.4 Stock output rate of each group for one-year

Product category	Number of shipped boxes	Classification of categories	Number of groups in the	Cumulative shipment of boxes	Cumulative %change	Pareto analysis (ABC)
Water	790.543	wat1>wat2>wat3	3	790.543	15%	A
Milk	429.225	milk1>.....>milk4	4	1.219.767	24%	A
Detergent	413.757	de1>.....>de4	4	1.633.524	32%	A
Chocolate	335.689	ch1>.....>ch7	7	1.969.213	38%	A
Flour	245.129	fl1>.....>fl3	3	2.214.343	43%	A
Napkins	244.112	na1>.....>na3	3	2.458.455	48%	A
Macaroni	214.821	ma1>.... ma3	3	2.673.276	52%	A
Biscuit	186.526	bi1>.....>bi7	7	2.859.802	56%	A
Canned foods	163.478	cann1>.....>cann8	8	3.023.280	59%	A
Oil	156.431	oil1>.....>oil3	3	3.179.711	62%	A
Sugar	150.113	sug1>sug2	2	3.329.824	65%	A
Cakes	143.176	cake1>.....>cake3	3	3.473.000	68%	A
Soda water	129.998	soda1>soda2	2	3.602.998	70%	A
Wafer	125.267	waf1>.....>waf3	3	3.728.265	73%	A
Cleaning agents	112.343	cl1>.....>cl4	4	3.840.608	75%	B
Dried fruits	110.873	dried1>.....>dried3	3	3.951.481	77%	B
Home equipments	106.625	home1>.....>home1	12	4.058.106	79%	B
Tea	98.432	tea1>.....>tea4	4	4.156.537	81%	B
Fizzy drink	94.907	fizzy1>.....>fizzy3	3	4.251.444	83%	B
Coffee	91.439	coffee1>.....>coffee3	3	4.342.883	84%	B
Fruit juice	81.169	frui1>.....>frui3	3	4.424.051	86%	B
Sugary snacks	79.611	sna1>.....>sna3	3	4.503.662	88%	B
Dish detergents	72.964	dish1>.....>dish3	3	4.576.626	89%	B
Chips	71.484	chips1>chips2	2	4.648.110	90%	B
Breakfast food	70.977	bre1>.....>bre4	4	4.719.087	92%	B
Cracker	69.637	cr1>cr2	2	4.788.724	93%	B
Rice	58.117	rice1	1	4.846.841	94%	B
Personnel care	54.523	pers1>.....>pers17	3	4.901.364	95%	C
Legume	53.056	legu1>.....>legu3	17	4.954.420	96%	C
Hair care	48.770	hair1>.....>hair3	3	5.003.190	97%	C
Soupmix	41.779	soup1>.....>soup3	3	5.044.970	98%	C
Candies	38.252	candy1>candy2	2	5.083.221	99%	C
Spices	31.536	spi1>.....>spi3	3	5.114.758	99%	C
Salt	18.785	salt1	1	5.133.543	100%	C
Olives	7.957	olive1	1	5.141.500	100%	C

4.9.2 Phase 2: Proposed Storage Allocation Policies

In the existing model, the random storage allocation is used for locating products in the shelves. Random storage allocation causes problems for order picking. Since products are not allocated in this warehouse according to a certain rule, it is difficult to find products when picking orders. However, if the product was allocated according to a certain rule in the warehouse, the order pickers would learn the location of the products over time and would not have to search for the location of the products. One of the biggest disadvantages of the random assignment is that it is difficult to find the location of products in the warehouse and this is resulted with loss of time.In addicted to this, the order picker tires and the performance of order picker decreases. So, this allocation model is not proper for order picking in retail warehouses and some arrangements are necessary while locating products in the shelves. Similar products should be located close to each other. The stock output rate of the products is also important because stock output rate of every product is different. The products with high stock output rate should be located front of warehouse.

Considering these criteria, three different allocation models are created for locating products in the shelves. According to the groupings found in phase 1, three alternative stock allocation models are first constructed. In the first model, product groups are stored in the shelves according to ABC analysis. In the second proposed model, family grouping storage is used, in other words, similar product groups are stored close to each other. In third model, ABC analysis and family grouping storage are used together. The products are organized on the shelves according to these three allocation models.

New storage allocation models are created but we don't know whether these proposed models are good. So these models should be tested. The storage allocation model which minimizes travelling distance for picking orders will be the best one. The question that comes to mind here is how we can decide the best model. Order picking lists will help us in this position. Order picking lists show the products that will be visited and will be picked in the warehouses. Travelling distance of each order picking lists is necessary for each allocation model. Order picking lists indicate the products that are requested by the stores. This means that which products will be picked and to where the picked orders are shipped. There are 20 order lists. There are 10 products in each order list. We need to find the distance the order picker went to pick 10 products. The travelling distance for each order picking list is necessary to do an evaluation for proposed allocation models.

As it mentioned before, same picking lists are used for evaluation of the proposed models. The aim is to decide which storage allocation model is the best for minimizing travel distance for order picking. For this purpose, two heuristics, i.e. A*and Dijskstra's algorithms are used for routing the order pickers while the finding shortest path between product locations. Finally the storage allocation model with the minimum distance is selected as the best solution.

The heuristic algorithms were programmed in C# .NET programming language. While making programme, we defined all product groups and proposed allocation models in programme. In the computer programme that we made, the storage allocation model is chosen and picking list is chosen and the programme is run. For example, an order picking list has 10 products to be picked. When these 10 products are entered the programme, the programme will rank the products from close to far and will calculate minimum travelling distance.

In this study, there are 20 picking lists. Travelling distance of 20 picking lists for the existing model and for other three proposed models are calculated. For example, we want see that how far is the travelling distance for picking products in list1 for the existing model and for other three suggested models. So, the picking list1 has 4 travelling distance value. Totally, 80 results are gotten. After travelling distance of all picking lists are calculated, the best storage allocation model is decided by using statistical methods.

A Star Algorithm:

Hart, Nilsson & Bertram (1968) described A star algorithm. A star algorithm is the most popular algorithm for path finding and graph traversal. The algorithm is used for finding least cost path from starting node to the ending node. In Figure 4.32, all nodes of around starting node are checked to go from pink node to blue node. The second node is selected which has the shortest path from starting node. For choosing third node, same process is applied. This step is repeated until you reach finishing node. Nodes are located in the middle of squares. The shortest path is found by passing in the middle of squares from one node to other node.

A star algorithm is an informed search algoritm and it uses best-first search. The algorithm solves the problems going from one node to target node by searching among all possible nodes for finding least distance travelled. It is formulated in terms of weighted graphs. Starting from one specific node of a graph, it constructs a tree until reach predetermined goal node. At each iteration of its main loop, one node is added to path andthe path expands.

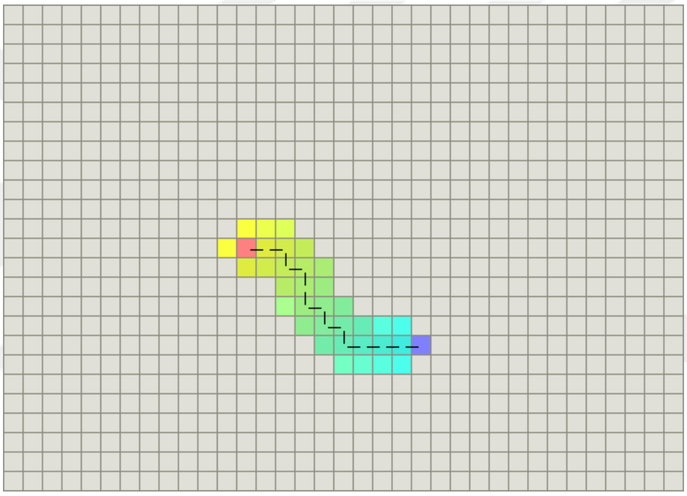

Figure 4.32 Nodes that are visited by A star algoritm

A star algorithm can be classfied as admissable heuristic algorithm. The algorithm uses below function for calculating distance. A star algoritm chooses the path that minimize, $f(n)=g(n)+h(n)$ where n is the last node on the path, $g(n)$ is the cost of the path from the start node to n and $h(n)$ is a heuristic that estimates the cost of the cheapest path from n to the goal.

The steps of A star algorithm is as follows; A star uses priority queue to apply repeated selection of the minimum cost of nodes. This priority queue is known as the *open set.* At each step of the algoritm, the node with lowest $f(n)$ value is removed from the queue. According to destination node, the f and g value of its neighbours are updated accordingly and these neighbors are added to the queue. Algorithm is repeated until a goal node has a lower *f* value or until the queue has no node. The *f* value of the goal is the length of the shortest path since *h* at the goal is zero in admissable heuristic. When searching shortest route on the path, h(n) can be a straight line to the goal node because it is physically the smallest distance between any two points.

Dijkstra's Algorithm:

Dijkstra's algorithm is an algorithm for finding the shortest path between nodes in a graph. It was first introduced by Edsger W. Dijkstra in 1956 and published in 1959 (Dijkstra’s algorithm, n.d.). It is a graph search algorithm that solves shortest path problem for a graph with non negative edges. Dijkstra's algorithm finds minimum shortest path from source node to all other nodes in the graph by producing shortest path tree. This algorithm is often used in routing. For example, the nodes of graph represent cities and edges represent driving distances between pair of cities. Dijkstra's algorithm is used to find the shortest route between one city and all other cities. Starting node is called as initial node. For example, distance of node B will be distance from initial node to B. Dijkstra's algorithm will assign some initial distance values and will try to improve them step by step (Figure 4.33).

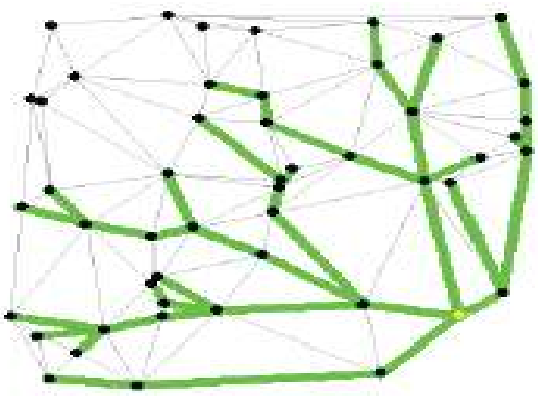

Figure 4.33 Dijkstra’s algorithm

The steps of Dijkstra's algorithm are as follows;

1. Initial node is determined. From source node to other accessible nodes are selected. Tentative distance value is assigned to all nodes. Initial node is zero and other all nodes have infinity.
2. Set the initial node as current. All unvisited nodes are marked. A set of unvisited nodes are created and unvisited nodes are called *unvisited set*.
3. For the current node, all of its unvisited neighbors' *tentative* distances are calculated. Compare the newly calculated *tentative* distance to the current assigned value and assign the smaller one.
4. Current node is marked as visited node and it is removed from *unvisited set.* A visited node won't be checked again.
5. If the all destination node is marked as visited, the algorithm is finished.
6. Otherwise, select the unvisited node that is marked with the smallest tentative distance, set it as the new "current node", and go back to step 3.

Pseudocode of the Dijkstra's algorithm is given below:

```
dist[s] ←o                                  (distance to source vertex is zero)
for  all v ∈ V–{s}
      do  dist[v] ←∞                        (set all other distances to infinity)
S←∅                                         (S, the set of visited vertices is initially empty)
Q←V                                         (Q, the queue initially contains all vertices)
while Q ≠∅                                  (while the queue is not empty)
do   u ← mindistance(Q,dist)                (select the element of Q with the min. distance)
     S←S∪{u}                                (add u to list of visited vertices)
     for all v ∈ neighbors[u]
          do  if   dist[v] > dist[u] + w(u, v)        (if new shortest path found)
                   then     d[v] ←d[u] + w(u, v)      (set new value of shortest path)
                                                      (if desired, add traceback code)
return dist
```

4.9.2.1 Alternative Proposed Storage Allocation Model 1

In the first model, product groups are stored in the shelves according to ABC analysis. We have already classified the products according to ABC analysis and now we can use ABC analysis for allocating the products. The product groups with the highest stock output rate is in A class, the product groups with the medium stock output rate is in B class, the product groups with low stock output rate is in C class.

Stock output rate means most ordered products by the customers and these products are sent mostly to markets. That is, these products are the most picked in all products.

For this proposed model, we allocate A group products in the most accessible zones, for example, in front of shelves, entrance of warehouse or most visited locations. Then, B group products are located in the middle of the warehouse; finally, C group products are located in the remaining places. In our warehouse, entrance and exit are positioned at the front of warehouse. As the first step, A group products are located the shelves on front of the warehouse, later B group products are located, lastly C group products are located the shelves in back of warehouse. This product allocation model is shown in Figure 4.34. After all products are located in the warehouse, the left part in the back is empty.

In literature, each of the product groups in class A can be randomly stored at the front of the warehouse. Also each of the product groups in B class can be stored in the middle part of the warehouse and the groups within the class C can be also randomly stored at the back of the warehouse. After the class of products is determined, the products within the class can be randomly assigned. But, I think that the product groups within the ABC classes should also be allocated according to a certain rule. Therefore, while I am allocating product groups in one class, I also tried to allocate the product groups in A class close to the front of the warehouse with a high output rate. That is, there is an arrangement among product groups within class A, class B, class C.

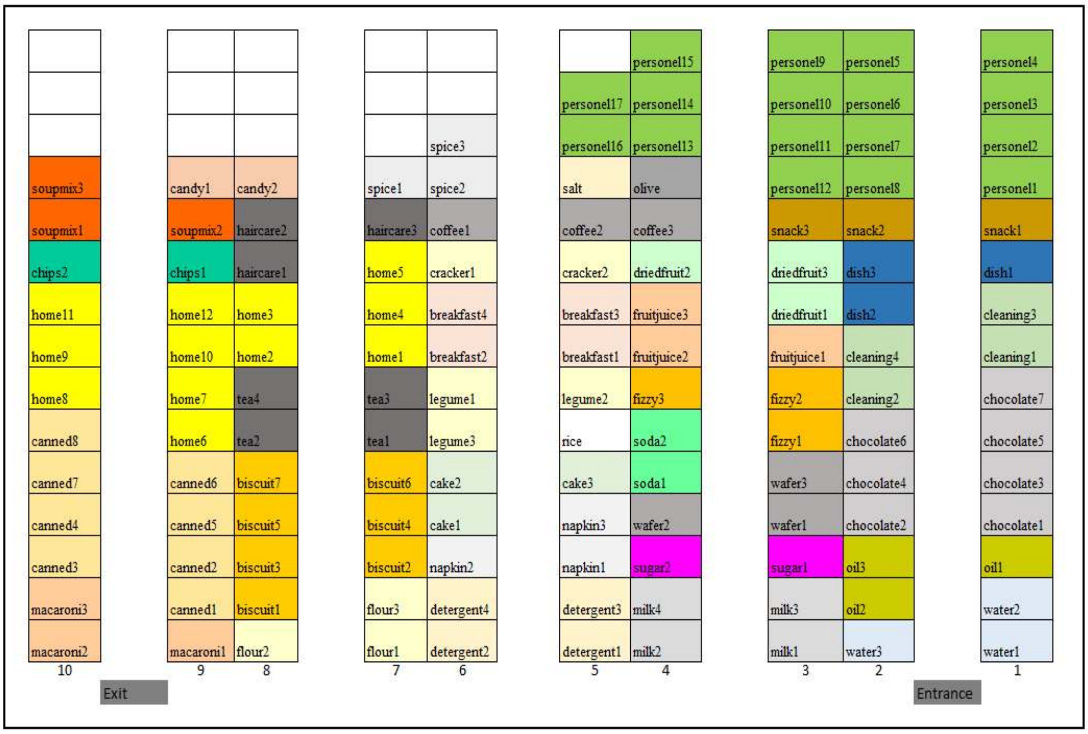

Figure 4.34 The location of products according to model 1

4.9.2.2 Alternative Proposed Stock Allocation Model 2

In the second proposed model, family grouping storage is used in other words; similar product groups are located close to each other. There are two criteria for product allocation. First criterion is, similar product groups are located close to each other. For instance, liquid foods are stored in the first perron and chocolates are stored in another perron and storing continues in that way. This situation can be explained in the following way. For example, milk, water, fruit juice, soda water, fizzy drinks, oil are liquid food. They are stored in the first perron. Flour, macaroni, legume, sugar, rice are the basic food and stored in the second perron. Salt, canned food, brakfast food, olive are stored in third perron. Chocolate, wafer, cake, candies are stored in the forth perron. Biscuit, sugary snack, dried fruit, chip are stored in fifth perron. Tea, coffee, soupmix, spice and crackers are stored in the sixth perron. Napkin and home equipment are stored in the seventh perron. Personnel care products are stored in the eighth perron. Hair care and remaining personnel care products are stored in the ninth perron. Detergent, dish detergents and cleaning agents are stored in the tenth perron. Let's define the perron term that we use here.

There are 10 perrons in this warehouse. First perron is close to entance of the warehouse and tenth perron is close to exit of the warehouse. Second criterion is while locating products in the shelves is the weight of boxes in kg. Product weight of each sub-group is shown in Table 4.5.

Table 4.5 Weight of sub-categories

Sub-categories	Weight of each product(kgs)
water1	20
water2	12
water3	10
milk1	12
milk2	6
milk3	5,4
milk4	5,4
detergent1	18
detergent2	15
detergent3	9
detergent4	7
chocolate1	2,8
chocolate2	2,7
chocolate3	2,6
chocolate4	2,5
chocolate5	2,4
chocolate6	2,3
chocolate7	2,2
flour1	16
flour2	15
flour3	12
napkin1	0,48
napkin2	0,48
napkin3	0,48
macaroni1	10
macaroni2	10
macaroni3	10
biscuit1	5
biscuit2	3,75
biscuit3	2,8
biscuit4	2,5
biscuit5	2,4
biscuit6	2,4
biscuit7	2,1
canned foods1	9
canned foods2	8
canned foods3	6
canned foods4	6
canned foods5	6
canned foods6	4,8
canned foods7	4
canned foods8	3,6
oil1	20
oil2	18
oil3	12
sugar1	20
sugar2	15
cake1	2,4
cake2	1,6
cake3	1,5
soda water1	4,8
soda water2	4,8
wafer1	2,4
wafer2	1,8
wafer3	1,5
cleaning agent1	18
cleaning agent2	16
cleaning agent3	8
cleaning agent4	6
dried fruit1	2,4
dried fruit2	2
dried fruit3	1,8
home equipment1	1,2
home equipment2	1,2
home equipment3	0,75
home equipment4	0,75
home equipment5	0,75
home equipment6	0,75

Sub-categories	Weight of each product(kgs)
home equipment7	0,75
home equipment8	0,72
home equipment9	0,72
home equipment10	0,72
home equipment11	0,6
home equipment12	0,6
tea1	12
tea2	9
tea3	6
tea4	4,8
fizzy1	18
fizzy2	15
fizzy3	12
coffee1	2,5
coffee2	1,5
coffee3	1,2
fruit juice1	12
fruit juice2	6
fruit juice3	5,4
sugary snack1	2,6
sugary snack2	2,4
sugary snack3	2,8
dish detergent1	24
dish detergent2	22
dish detergent3	8
chip1	2,5
chip2	1,98
breakfast food1	5
breakfast food2	4,8
breakfast food3	3,8
breakfast food4	4,8
cracker1	3,6
cracker2	2,5
rice	15
legume1	15
legume2	16
legume3	16
hair care1	2,8
hair care2	2,8
hair care3	2,8
soupmix1	0,9
soupmix2	1,2
soupmix3	0,8
candy1	0,4
candy2	0,6
spice1	1,5
spice2	1,5
spice3	1,5
salt	22,5
olive	6
personnel care1	1,2
personnel care2	0,9
personnel care3	0,9
personnel care4	0,9
personnel care5	0,9
personnel care6	1,2
personnel care7	1,2
personnel care8	1,2
personnel care9	0,75
personnel care10	0,75
personnel care11	0,75
personnel care12	0,75
personnel care13	0,75
personnel care14	0,75
personnel care15	0,75
personnel care16	0,9
personnel care17	0,9

While locating the products in the shelves, first of all similar products are should be stored close each other, because locating the subgroups close the each other is more important than weight criterion. Later the sub-groups that have heavy weight are located before light weight. For example, oil category has 3 sub-groups. Oil1, oil2, oil3 are the sub-groups. In the oil products, oil1 is 20 kgs, oil2 is 18 kgs and oil3 is 12 kgs. While locating the products in the shelves, these three sub-groups should be in the same perron shelves and first oil1, then oil2 and lastly oil3 are located. In other words, heavy product is located in front of light weight. For this model, the products are located in the shelves according to family grouping and also weight criteria are considered.

For this allocation model, the product subgroups are located close to each other in the shelves, in other words, family grouping is applied for locating the products in the shelves. This product allocation model is shown in Figure 4.35, where all sub-groups of a product are located in the same perron. For example, for this model, location of sugar 1 in the first perron and location of sugar 2 in the second perron is not allowed. Sugar1 and sugar2 should be in the same perron. All liquids are located in the same perron. For example, water types, milk types, fruit juice types, soda water types and fizzy drink types are liquid and located side by side in the shelves in first perron. However, all non-foods are located close to each other. For example, the products that are napkin types, home equipment types, personel care types, haircare types, detergent types, dish detergent types and cleaning agent types are non-food. They are located close to each other and tried to locate the distant from food. In the warehouse, food products are allocated in the first, second, third, forth, fifth, sixth and seventh perron. Non-food products are allocated in the eight, ninth and tenth perron. It can be seen from storage allocation model 2.

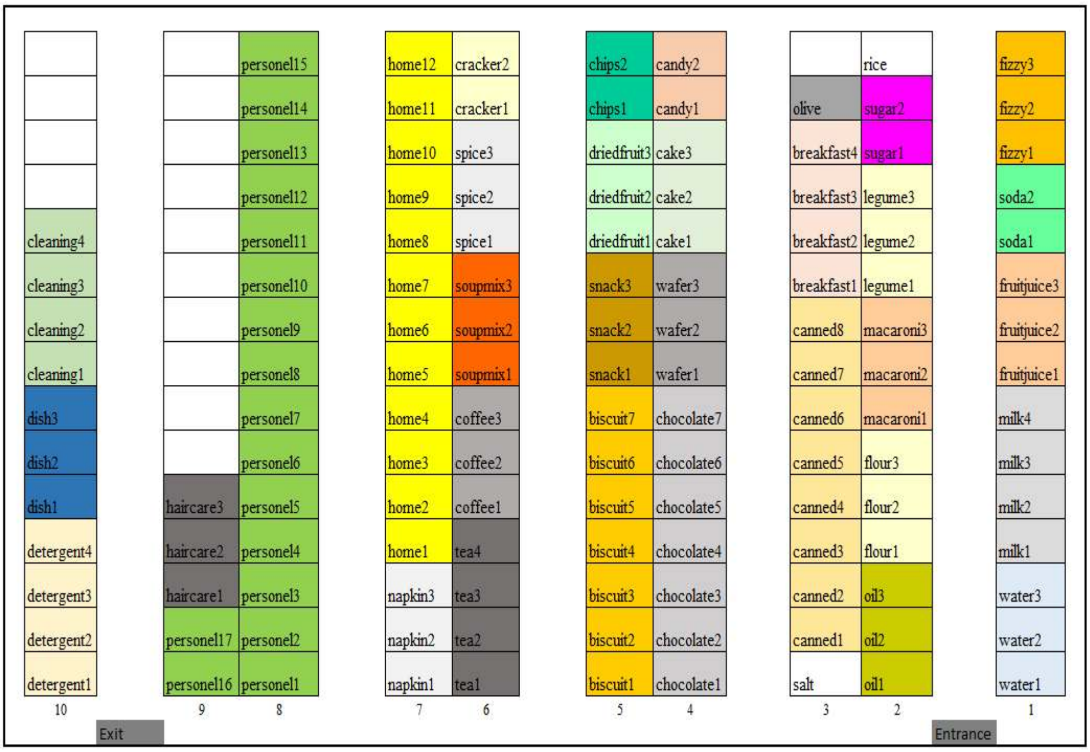

Figure 4.35 The location of products according to model 2

4.9.2.3 Alternative Proposed Stock Allocation Model 3

In third model, ABC analysis and family grouping storage are used together. Two storage allocation policies are combined for the third model. Class based storage and family group storage are used together for allocating products in the shelves. The other name of class based storage is ABC analysis. The most ordered product groups are in A class according to ABC analysis, that is, the products in A class are located front part of the warehouse, later the products in B class are located and finally the products in C class are located in the shelves. Family grouping means allocating similar products close to each other and so similar sub-groups are located to close each other for this model. For example, water, milk, oil, fizzy drinks, soda water, fruit juice are drinks. They are located in the first perron and close to each other. The stock output rates of the products are also important issue. So, for this policy, both similar products located close to each other and the stock output rates are paid attention.

In another example, chocolate, biscuit, cake, wafer, snack, chips crackers, are the junk food. These sub-groups are located in third and forth perron. They are located close to each other and according to ABC classification, that is, the stock output rate. It is shown in Figure 4.36.

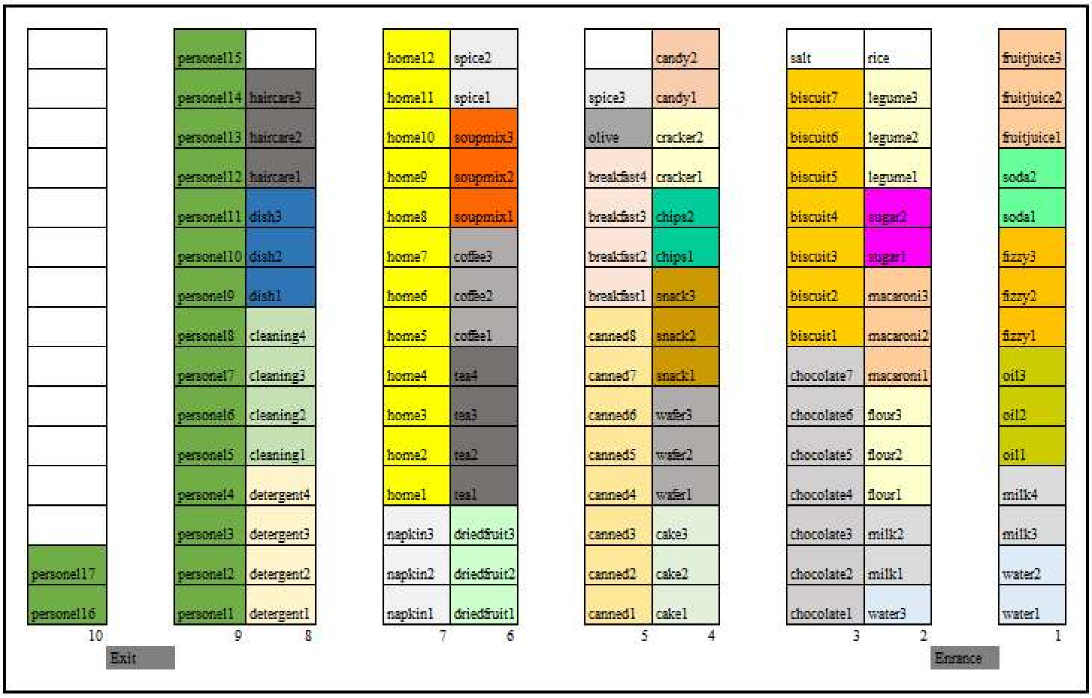

Figure 4.36 The location of products according to model 3

4.10 Sample Picking Lists

New three proposed product allocation models were presented in the preceeding part. According to these models, the product sub-groups are located in the shelves. The existing model and new proposed models are compared in this part. The picking lists are necessary for analysing these models. The picking lists show the ordered products that need to be picked. One order picking list shows product demand of one store. For instance, one picking list includes water1, milk4, oil3, fizzy2, canned1, tea2, coffee3, snack2, cake3, spice3. In other words, order picking lists say us that; visit these product locations and pick them. One store has one picking list. In this study, we are interested in the product orders of 20 stores, so there are 20 different picking lists and each pick lists include 10 product groups. The picking lists are shown in Table 4.6. The comparison of existing and proposed models will be done using order picking lists.

Table 4.6 Picking lists sent from markets

Picking list1	Picking list2	Picking list3	Picking list4	Picking list5	Picking list6	Picking list7	Picking list8	Picking list9	Picking list10
napkin1	water2	soda1	water1	napkin2	water2	cleaning3	water1	water1	milk2
milk1	milk2	chocolate4	napkin2	cleaning1	oil1	personel13	sugar1	milk3	water2
water1	macaroni1	macaroni3	milk1	dish2	sugar1	detergent1	napkin1	fizzy1	flour3
chocolate7	biscuit5	detergent4	personel3	detergent4	dish3	dish2	detergent4	legume3	macaroni1
detergent1	chips2	napkin3	coffee1	coffee2	macaroni1	home1	flour3	detergent3	sugar1
legume2	biscuit2	cleaning1	tea2	fizzy2	haircare2	cake1	chocolate2	flour1	legume2
macaroni3	wafer3	breakfast3	macaroni2	biscuit4	spice1	salt	macaroni2	biscuit3	biscuit4
flour3	chocolate5	oil1	flour2	biscuit1	fruitjuice1	legume3	canned2	macaroni1	chocolate5
oil2	cake3	biscuit1	olive	snack2	canned2	spice2	milk1	canned3	napkin1
dish1	canned1	cake1	breakfast2	breakfast2	olive	breakfast3	soda1	home6	detergent2

Picking list11	Picking list12	Picking list13	Picking list14	Picking list15	Picking list16	Picking list17	Picking list18	Picking list19	Picking list20
detergent1	olive	chocolate1	napkin1	water3	macaroni1	detergent1	chocolate1	flour1	water2
water1	canned4	driedfruit2	milk1	milk4	legume3	dish3	dish3	milk3	oil1
milk4	driedfruit1	wafer1	water3	chocolate3	cracker2	water1	personel2	chocolate6	macaroni3
soupmix3	flour1	cake2	wafer3	cake2	chips1	haircare2	olive	cake1	chocolate2
biscuit5	macaroni2	biscuit7	soda1	napkin1	biscuit1	fizzy2	water3	oil3	milk4
cracker1	legume3	cracker2	chocolate7	detergent3	wafer3	oil3	fizzy3	detergent1	soupmix1
driedfruit2	salt	breakfast2	napkin3	haircare1	cake3	canned7	detergent3	napkin1	breakfast1
oil2	breakfast1	snack2	cleaning4	home1	canned1	breakfast1	flour3	driedfruit1	napkin2
macaroni2	sugar2	water1	legume1	dish2	driedfruit1	salt	macaroni1	chocolate2	detergent1
legume1	milk1	chocolate7	breakfast1	personel17	napkin1	olive	breakfast1	home2	personel1

The product locations in the picking lists are visited and the products are picked from shelves by the order pickers according to chosen storage allocation policy.

4.11 Results of the Routing Policies

After allocating the product groups according to proposed allocation models, these new models must be compared against the exiting storage allocation. In order to compare the models, we use the travelling distance as performance indicator. There is a distance that must be travelled to pick the products on the order list. The travelling distance of each picking lists for the existing storage allocation and for new proposed allocation models can be calculated by the helping the created computer programme.

It can be stated that we have already known existing storage allocation model isn't good. Therefore, alternative models, namely proposed model1, proposed model2 and proposed model3 are constructed. Later, the travelling distance of picking lists according to these three proposed models are calculated by using computer programmes for two heuristics. We use A Star algorithm and Dijkstra's algorithm for calculating travelling distance for four allocation models. The proposed model which one minimizes the travelling distance is the best model for this warehouse. In the following part we can see the travelling distance results of order picking lists for four allocation models according to A Star algorithm and Dijkstra's algorithm.

Results of A Star Algorithm:

We use A star algoritm for the routing of the order pickers in order to finding travelling distance for all allocation models. When we run the programme, we get four results for every picking list. The products are located in the different shelves for existing and proposed models. The picking route of a picking list is different for each model. The results show the sequence in which the products should be picked. When we look at results, for example result1 (also named as simulation1) for existing allocation model in the warehouse, we can see that at first I pick flour3, second I pick macaroni3, third I pick oil2 and forth I pick legume2. We can see the picking route of picking lists for every model in Table 4.7

Table 4.7 A star's route of picking lists for the existing and proposed models

Existing Model	Simulation 1	Simulation 2	Simulation 3	Simulation 4	Simulation 5
Product1	5,2=flour3	3,3=canned1	3,14=breakfast3	3,2=olive	5,15=breakfast2
Product2	7,4=macaroni3	3,11=milk2	7,4=macaroni3	5,15=breakfast2	9,3=biscuit4
Product3	7,13=oil2	5,3=chips2	9,9=biscuit1	7,2=flour2	9,9=biscuit1
Product4	7,15=legume2	7,8=macaroni1	9,14=cake1	7,6=macaroni2	9,15=snack2
Product5	13,14=detergent1	9,2=biscuit5	13,6=detergent4	7,7=tea2	11,8=coffee2
Product6	13,15=dish1	9,8=biscuit2	13,16=cleaning1	11,12=coffee1	13,6=detergent4
Product7	19,2=chocolate7	9,10=cake3	17,13=napkin3	17,12=personel3	13,11=dish2
Product8	21,11=water1	19,5=chocolate5	19,7=chocolate4	19,16=napkin2	13,16=cleaning1
Product9	21,13=milk1	19,11=wafer3	21,12=soda1	21,11=water1	19,16=napkin2
Product10	21,16=napkin1	21,10=water2	21,15=oil1	21,13=milk1	21,8=fizzy2
	Total distance = 59	Total distance = 73	Total distance = 69	Total distance = 78	Total distance = 71

Suggested Model1	Simulation 1	Simulation 2	Simulation 3	Simulation 4	Simulation 5
Product1	3,15=macaroni3	3,7=chips2	3,15=macaroni3	3,16=macaroni2	7,15=biscuit1
Product2	9,15=flour3	5,15=canned1	7,15=biscuit1	7,11=tea2	9,13=biscuit4
Product3	13,10=legume2	5,16=macaroni1	11,13=cake1	7,16=flour2	11,9=breakfast2
Product4	13,14=napkin1	7,13=biscuit5	11,15=detergent4	11,6=coffee1	11,14=napkin2
Product5	13,16=detergent1	9,14=biscuit2	13,8=breakfast3	11,9=breakfast2	11,15=detergent4
Product6	17,16=milk1	13,12=cake3	13,13=napkin3	11,14=napkin2	13,6=coffee2
Product7	19,15=oil2	15,16=milk2	15,12=soda1	15,5=olive	17,10=fizzy2
Product8	21,7=dish1	17,12=wafer3	19,12=chocolate4	17,16=milk1	19,6=snack2
Product9	21,10=chocolate7	21,11=chocolate5	21,9=cleaning1	21,3=personel3	19,8=dish2
Product10	21,16=water1	21,15=water2	21,14=oil1	21,16=water1	21,9=cleaning1
	Total distance = 62	Total distance = 74	Total distance = 67	Total distance = 73	Total distance = 64

Suggested Model2	Simulation 1	Simulation 2	Simulation 3	Simulation 4	Simulation 5
Product1	3,12=dish1	13,2=chips2	3,9=cleaning1	7,14=personel3	3,9=cleaning1
Product2	3,16=detergent1	13,12=biscuit5	3,13=detergent4	9,15=napkin2	3,11=dish2
Product3	9,16=napkin1	13,15=biscuit2	9,14=napkin3	11,12=coffee1	3,13=detergent4
Product4	15,10=chocolate7	15,4=cake3	13,16=biscuit1	11,15=tea2	9,15=napkin2
Product5	19,6=legume2	15,7=wafer3	15,6=cake1	17,3=olive	11,11=coffee2
Product6	19,8=macaroni3	15,12=chocolate5	15,13=chocolate4	17,6=breakfast2	13,8=snack2
Product7	19,11=flour3	17,15=canned1	17,5=breakfast3	19,9=macaroni2	13,13=biscuit4
Product8	19,15=oil2	19,10=macaroni1	19,8=macaroni3	19,12=flour2	13,16=biscuit1
Product9	21,13=milk1	21,12=milk2	19,16=oil1	21,13=milk1	17,6=breakfast2
Product10	21,16=water1	21,15=water2	21,6=soda1	21,16=water1	21,3=fizzy2
	Total distance = 67	Total distance = 51	Total distance = 69	Total distance = 60	Total distance = 67

Suggested Model3	Simulation 1	Simulation 2	Simulation 3	Simulation 4	Simulation 5
Product1	7,8=dish1	13,16=canned1	7,12=cleaning1	5,14=personel3	7,7=dish2
Product2	7,16=detergent1	15,6=chips2	7,13=detergent4	9,15=napkin2	7,12=cleaning1
Product3	9,16=napkin1	15,11=wafer3	9,14=napkin3	11,9=coffee1	7,13=detergent4
Product4	17,10=chocolate7	15,14=cake3	13,6=breakfast3	11,12=tea2	9,15=napkin2
Product5	19,4=legume2	17,5=biscuit5	15,16=cake1	13,4=olive	11,8=coffee2
Product6	19,8=macaroni3	17,8=biscuit2	17,9=biscuit1	13,7=breakfast2	13,7=breakfast2
Product7	19,11=flour3	17,12=chocolate5	17,13=chocolate4	19,9=macaroni2	15,9=snack2
Product8	19,15=milk1	19,10=macaroni1	19,8=macaroni3	19,12=flour2	17,6=biscuit4
Product9	21,11=oil2	19,14=milk2	21,6=soda1	19,15=milk1	17,9=biscuit1
Product10	21,16=water1	21,15=water2	21,12=oil1	21,16=water1	21,8=fizzy2
	Total distance = 65	Total distance = 42	Total distance = 67	Total distance = 62	Total distance = 71

Table 4.7 A star's route of picking lists for the existing and proposed models (Continued)

Existing Model	Simulation 6	Simulation 7	Simulation 8	Simulation 9	Simulation 10
Product1	3,2=olive	3,14=breakfast3	3,4=canned2	3,5=canned3	3,11=milk2
Product2	3,4=canned2	5,9=spice2	5,2=flour3	3,10=milk3	5,2=flour3
Product3	3,13=fruitjuice1	7,10=legume3	7,6=macaroni2	7,3=flour1	7,8=macaroni1
Product4	5,8=spice1	7,14=salt	13,6=detergent4	7,8=macaroni1	7,15=legume2
Product5	7,8=macaroni1	9,14=cake1	19,9=chocolate2	7,10=legume3	9,3=biscuit4
Product6	13,7=dish3	13,4=home1	21,11=water1	9,7=biscuit3	13,10=detergent2
Product7	17,9=haircare2	13,11=dish2	21,12=soda1	13,8=detergent3	19,5=chocolate5
Product8	21,10=water2	13,14=detergent1	21,13=milk1	15,6=home6	21,10=water2
Product9	21,14=sugar1	15,16=personel13	21,14=sugar1	21,9=fizzy1	21,14=sugar1
Product10	21,15=oil1	17,16=cleaning3	21,16=napkin1	21,11=water1	21,16=napkin1
	Total distance = 87	Total distance = 60	Total distance = 66	Total distance = 86	Total distance = 79

Suggested Model1	Simulation 6	Simulation 7	Simulation 8	Simulation 9	Simulation 10
Product1	5,14=canned2	9,9=home1	3,16=macaroni2	3,14=canned3	5,16=macaroni1
Product2	5,16=macaroni1	11,5=spice2	5,14=canned2	5,11=home6	9,13=biscuit4
Product3	7,6=haircare2	11,11=legume3	9,15=flour3	5,16=macaroni1	9,15=flour3
Product4	9,5=spice1	11,13=cake1	11,15=detergent4	7,14=biscuit3	11,16=detergent2
Product5	15,5=olive	13,5=salt	13,14=napkin1	9,16=flour1	13,10=legume2
Product6	17,9=fruitjuice1	13,8=breakfast3	15,12=soda1	11,11=legume3	13,14=napkin1
Product7	17,14=sugar1	13,16=detergent1	17,14=sugar1	13,15=detergent3	15,16=milk2
Product8	19,7=dish3	15,4=personel13	17,16=milk1	17,11=fizzy1	17,14=sugar1
Product9	21,14=oil1	19,8=dish2	19,13=chocolate2	17,15=milk3	21,11=chocolate5
Product10	21,15=water2	21,8=cleaning3	21,16=water1	21,16=water1	21,15=water2
	Total distance = 74	Total distance = 66	Total distance = 52	Total distance = 60	Total distance = 55

Suggested Model2	Simulation 6	Simulation 7	Simulation 8	Simulation 9	Simulation 10
Product1	3,10=dish3	3,7=cleaning3	3,13=detergent4	3,14=detergent3	3,15=detergent2
Product2	5,13=haircare2	3,11=dish2	9,16=napkin1	9,8=home6	9,16=napkin1
Product3	11,6=spice1	3,16=detergent1	15,15=chocolate2	13,14=biscuit3	13,13=biscuit4
Product4	17,3=olive	7,4=personel13	17,14=canned2	17,13=canned3	15,12=chocolate5
Product5	17,14=canned2	9,13=home1	19,4=sugar1	19,5=legume3	19,4=sugar1
Product6	19,4=sugar1	11,5=spice2	19,9=macaroni2	19,10=macaroni1	19,6=legume2
Product7	19,10=macaroni1	15,6=cake1	19,11=flour3	19,13=flour1	19,10=macaroni1
Product8	19,16=oil1	17,5=breakfast3	21,6=soda1	21,4=fizzy1	19,11=flour3
Product9	21,9=fruitjuice1	17,16=salt	21,13=milk1	21,11=milk3	21,12=milk2
Product10	21,15=water2	19,5=legume3	21,16=water1	21,16=water1	21,15=water2
	Total distance = 67	Total distance = 75	Total distance = 63	Total distance = 68	Total distance = 64

Suggested Model3	Simulation 6	Simulation 7	Simulation 8	Simulation 9	Simulation 10
Product1	7,4=haircare2	5,4=personel13	7,13=detergent4	7,14=detergent3	7,15=detergent2
Product2	7,6=dish3	7,7=dish2	9,16=napkin1	9,8=home6	9,16=napkin1
Product3	11,3=spice1	7,10=cleaning3	13,15=canned2	13,14=canned3	17,6=biscuit4
Product4	13,4=olive	7,16=detergent1	17,15=chocolate2	17,7=biscuit3	17,12=chocolate5
Product5	13,15=canned2	9,13=home1	19,7=sugar1	19,3=legume3	19,4=legume2
Product6	19,7=sugar1	11,2=spice2	19,9=macaroni2	19,10=macaroni1	19,7=sugar1
Product7	19,10=macaroni1	13,6=breakfast3	19,11=flour3	19,13=flour1	19,10=macaroni1
Product8	21,4=fruitjuice1	15,16=cake1	19,15=milk1	21,9=fizzy1	19,11=flour3
Product9	21,12=oil1	17,2=salt	21,6=soda1	21,14=milk3	19,14=milk2
Product10	21,15=water2	19,3=legume3	21,16=water1	21,16=water1	21,15=water2
	Total distance = 56	Total distance = 66	Total distance = 51	Total distance = 62	Total distance = 52

Table 4.7 A star's route of picking lists for the existing and proposed models (Continued)

Simulation 11	Simulation 12	Simulation 13	Simulation 14	Simulation 15
5,13=driedfruit2	3,2=olive	5,13=driedfruit2	5,16=breakfast1	9,12=cake2
7,6=macaroni2	3,6=canned4	5,15=breakfast2	7,16=legume1	13,4=home1
7,13=oil2	5,11=driedfruit1	9,4=cracker2	17,13=napkin3	13,8=detergent3
7,16=legume1	5,16=breakfast1	9,12=cake2	17,15=cleaning4	13,11=dish2
9,2=biscuit5	7,3=flour1	9,15=snack2	19,2=chocolate7	13,12=personel17
9,5=cracker1	7,6=macaroni2	11,7=biscuit7	19,11=wafer3	17,11=haircare1
11,5=soupmix3	7,10=legume3	19,2=chocolate7	21,5=water3	19,8=chocolate3
13,14=detergent1	7,14=salt	19,10=chocolate1	21,12=soda1	21,3=milk4
21,3=milk4	9,6=sugar2	19,13=wafer1	21,13=milk1	21,5=water3
21,11=water1	21,13=milk1	21,11=water1	21,16=napkin1	21,16=napkin1
Total distance = 68	Total distance = 64	Total distance = 70	Total distance = 58	Total distance = 65

Simulation 11	Simulation 12	Simulation 13	Simulation 14	Simulation 15
3,5=soupmix3	3,13=canned4	7,12=biscuit7	11,10=legume1	7,7=haircare1
3,16=macaroni2	3,16=macaroni2	11,9=breakfast2	13,9=breakfast1	9,9=home1
7,13=biscuit5	9,16=flour1	11,12=cake2	13,13=napkin3	11,12=cake2
11,7=cracker1	11,11=legume3	13,7=cracker2	13,14=napkin1	13,3=personel17
11,10=legume1	13,5=salt	15,7=driedfruit2	15,12=soda1	13,14=napkin1
13,16=detergent1	13,9=breakfast1	17,13=wafer1	17,12=wafer3	13,15=detergent3
15,7=driedfruit2	15,5=olive	19,6=snack2	17,16=milk1	15,15=milk4
15,15=milk4	15,14=sugar2	21,10=chocolate7	19,9=cleaning4	19,8=dish2
19,15=oil2	17,8=driedfruit1	21,13=chocolate1	19,16=water3	19,16=water3
21,16=water1	17,16=milk1	21,16=water1	21,10=chocolate7	21,12=chocolate3
Total distance = 80	Total distance = 56	Total distance = 68	Total distance = 50	Total distance = 56

Simulation 11	Simulation 12	Simulation 13	Simulation 14	Simulation 15
3,16=detergent1	13,6=driedfruit1	11,2=cracker2	3,6=cleaning4	3,11=dish2
11,3=cracker1	17,3=olive	13,5=driedfruit2	9,14=napkin3	3,14=detergent3
11,7=soupmix3	17,7=breakfast1	13,8=snack2	9,16=napkin1	5,14=haircare1
13,5=driedfruit2	17,12=canned4	13,10=biscuit7	15,7=wafer3	5,15=personel17
13,12=biscuit5	17,16=salt	15,5=cake2	15,10=chocolate7	9,13=home1
19,7=legume1	19,3=sugar2	15,9=wafer1	17,7=breakfast1	9,16=napkin1
19,9=macaroni2	19,5=legume3	15,10=chocolate7	19,7=legume1	15,5=cake2
19,15=oil2	19,9=macaroni2	15,16=chocolate1	21,6=soda1	15,14=chocolate3
21,10=milk4	19,13=flour1	17,6=breakfast2	21,13=milk1	21,10=milk4
21,16=water1	21,13=milk1	21,16=water1	21,14=water3	21,14=water3
Total distance = 63	Total distance = 49	Total distance = 45	Total distance = 75	Total distance = 68

Simulation 11	Simulation 12	Simulation 13	Simulation 14	Simulation 15
7,16=detergent1	11,16=driedfruit1	11,15=driedfruit2	7,9=cleaning4	3,15=personel17
11,4=soupmix3	13,4=olive	13,7=breakfast2	9,14=napkin3	7,5=haircare1
11,15=driedfruit2	13,8=breakfast1	15,4=cracker2	9,16=napkin1	7,7=dish2
15,5=cracker1	13,13=canned4	15,9=snack2	13,8=breakfast1	7,14=detergent3
17,5=biscuit5	17,2=salt	15,13=wafer1	15,11=wafer3	9,13=home1
19,5=legume1	19,3=legume3	15,15=cake2	17,10=chocolate7	9,16=napkin1
19,9=macaroni2	19,6=sugar2	17,3=biscuit7	19,5=legume1	15,15=cake2
21,11=oil2	19,9=macaroni2	17,10=chocolate7	19,15=milk1	17,14=chocolate3
21,13=milk4	19,13=flour1	17,16=chocolate1	19,16=water3	19,16=water3
21,16=water1	19,15=milk1	21,16=water1	21,6=soda1	21,13=milk4
Total distance = 58	Total distance = 42	Total distance = 47	Total distance = 70	Total distance = 61

Table 4.7 A star's route of picking lists for the existing and proposed models (Continued)

Simulation 16	Simulation 17	Simulation 18	Simulation 19	Simulation 20
3,3=canned1	3,2=olive	3,2=olive	3,10=milk3	5,16=breakfast1
5,4=chips1	3,15=canned7	5,2=flour3	5,11=driedfruit1	7,4=macaroni3
5,11=driedfruit1	5,16=breakfast1	5,16=breakfast1	7,3=flour1	11,10=soupmix1
7,8=macaroni1	7,11=oil3	7,8=macaroni1	7,11=oil3	13,14=detergent1
7,10=legume3	7,14=salt	13,7=dish3	9,14=cake1	17,6=personel1
9,4=cracker2	13,7=dish3	13,8=detergent3	13,2=home2	19,9=chocolate2
9,9=biscuit1	13,14=detergent1	17,2=personel2	13,14=detergent1	19,16=napkin2
9,10=cake3	17,9=haircare2	19,10=chocolate1	19,4=chocolate6	21,3=milk4
19,11=wafer3	21,8=fizzy2	21,5=water3	19,9=chocolate2	21,10=water2
21,16=napkin1	21,11=water1	21,7=fizzy3	21,16=napkin1	21,15=oil1
Total distance = 71	Total distance = 89	Total distance = 74	Total distance = 70	Total distance = 73

Simulation 16	Simulation 17	Simulation 18	Simulation 19	Simulation 20
5,7=chips1	3,12=canned7	5,16=macaroni1	7,9=home2	3,6=soupmix1
5,15=canned1	7,6=haircare2	9,15=flour3	9,16=flour1	3,15=macaroni3
5,16=macaroni1	13,5=salt	13,9=breakfast1	11,13=cake1	11,14=napkin2
7,15=biscuit1	13,9=breakfast1	13,15=detergent3	13,14=napkin1	13,9=breakfast1
11,11=legume3	13,16=detergent1	15,5=olive	13,16=detergent1	13,16=detergent1
13,7=cracker2	15,5=olive	15,10=fizzy3	17,8=driedfruit1	15,15=milk4
13,12=cake3	17,10=fizzy2	19,7=dish3	17,15=milk3	19,13=chocolate2
13,14=napkin1	19,7=dish3	19,16=water3	19,11=chocolate6	21,5=personel1
17,8=driedfruit1	19,14=oil3	21,4=personel2	19,13=chocolate2	21,14=oil1
17,12=wafer3	21,16=water1	21,13=chocolate1	19,14=oil3	21,15=water2
Total distance = 64	Total distance = 88	Total distance = 67	Total distance = 61	Total distance = 72

Simulation 16	Simulation 17	Simulation 18	Simulation 19	Simulation 20
9,16=napkin1	3,10=dish3	3,10=dish3	3,16=detergent1	3,16=detergent1
11,2=cracker2	3,16=detergent1	3,14=detergent3	9,12=home2	7,16=personel1
13,3=chips1	5,13=haircare2	7,15=personel2	9,16=napkin1	9,15=napkin2
13,6=driedfruit1	17,3=olive	15,16=chocolate1	13,6=driedfruit1	11,9=soupmix1
13,16=biscuit1	17,7=breakfast1	17,3=olive	15,6=cake1	15,15=chocolate2
15,4=cake3	17,9=canned7	17,7=breakfast1	15,11=chocolate6	17,7=breakfast1
15,7=wafer3	17,16=salt	19,10=macaroni1	15,15=chocolate2	19,8=macaroni3
17,15=canned1	19,14=oil3	19,11=flour3	19,13=flour1	19,16=oil1
19,5=legume3	21,3=fizzy2	21,2=fizzy3	19,14=oil3	21,10=milk4
19,10=macaroni1	21,16=water1	21,14=water3	21,11=milk3	21,15=water2
Total distance = 58	Total distance = 71	Total distance = 67	Total distance = 73	Total distance = 69

Simulation 16	Simulation 17	Simulation 18	Simulation 19	Simulation 20
9,16=napkin1	7,4=haircare2	5,15=personel2	7,16=detergent1	5,16=personel1
11,16=driedfruit1	7,6=dish3	7,6=dish3	9,12=home2	7,16=detergent1
13,16=canned1	7,16=detergent1	7,14=detergent3	9,16=napkin1	9,15=napkin2
15,4=cracker2	13,4=olive	13,4=olive	11,16=driedfruit1	11,6=soupmix1
15,7=chips1	13,8=breakfast1	13,8=breakfast1	15,16=cake1	13,8=breakfast1
15,11=wafer3	13,10=canned7	17,16=chocolate1	17,11=chocolate6	17,15=chocolate2
15,14=cake3	17,2=salt	19,10=macaroni1	17,15=chocolate2	19,8=macaroni3
17,9=biscuit1	21,8=fizzy2	19,11=flour3	19,13=flour1	21,12=oil1
19,3=legume3	21,10=oil3	19,16=water3	21,10=oil3	21,13=milk4
19,10=macaroni1	21,16=water1	21,7=fizzy3	21,14=milk3	21,15=water2
Total distance = 46	Total distance = 66	Total distance = 66	Total distance = 50	Total distance = 57

Results of Dijkstra's Algorithm:

Dijkstra's algoritm is used as routing policy for finding travelling distance for all models. When we run programme, we get four results for every picking lists. The products are located in the different shelves in existing and proposed allocation models. The picking route of a picking list is different for each model. The results show sequence of products for picking. When we look at the results, for example for existing model, we can see that first I pick napkin1, second I pick milk1, third I pick water1, forth I pick chocalate7, fifth I pick detergent1, sixth I pick dish1, seventh I pick legume2, eighth I pick oil2, ninth I pick macaroni3 and lastly I pick flour3 must be picked. Total travelling distance for picking list1 is 58 metres. The order picker starts picking from napkin1 and finishes picking with flour3 for order picking list1.

After the programme is run, the picking route of picking lists for every allocation model are formed (Table 4.8). Minimum travelling distance for every picking list can be calculated with the programme. It can be clearly seen that solutions found by Dijkstra's Algorithm is better than A star algorithm. A star algoritm does not give proper routes and so it is not suitable for calculating minimum distance for this warehouse. For that reason, Dijkstra's Algorithm will be used for evaluating models.

Table 4.8 Dijkstra's route of picking lists for the existing and proposed models

Existing Model	Simulation 1	Simulation 2	Simulation 3	Simulation 4	Simulation 5
Product1	napkin1	wafer3	oil1	napkin2	napkin2
Product2	milk1	water2	soda1	milk1	fizzy2
Product3	water1	chocolate5	chocolate4	water1	detergent4
Product4	chocolate7	biscuit5	napkin3	personel3	coffee2
Product5	detergent1	macaroni1	cleaning1	coffee1	dish2
Product6	dish1	biscuit2	detergent4	flour2	cleaning1
Product7	legume2	cake3	macaroni3	macaroni2	snack2
Product8	oil2	milk2	biscuit1	tea2	biscuit1
Product9	macaroni3	canned1	cake1	breakfast2	biscuit4
Product10	flour3	chips2	breakfast3	olive	breakfast2
	Total distance = 58	Total distance = 53	Total distance = 61	Total distance = 70	Total distance = 67

Suggested Model1	Simulation 1	Simulation 2	Simulation 3	Simulation 4	Simulation 5
Product1	water1	water2	oil1	water1	cleaning1
Product2	oil2	chocolate5	chocolate4	personel3	dish2
Product3	chocolate7	wafer3	cleaning1	olive	snack2
Product4	dish1	milk2	soda1	milk1	fizzy2
Product5	milk1	cake3	detergent4	napkin2	detergent4
Product6	detergent1	biscuit5	cake1	breakfast2	napkin2
Product7	napkin1	biscuit2	napkin3	coffee1	breakfast2
Product8	legume2	macaroni1	breakfast3	tea2	coffee2
Product9	flour3	canned1	biscuit1	flour2	biscuit4
Product10	macaroni3	chips2	macaroni3	macaroni2	biscuit1
	Total distance = 46	Total distance = 49	Total distance = 52	Total distance = 71	Total distance = 54

Suggested Model2	Simulation 1	Simulation 2	Simulation 3	Simulation 4	Simulation 5
Product1	water1	water2	oil1	water1	fizzy2
Product2	oil2	milk2	macaroni3	milk1	breakfast2
Product3	milk1	macaroni1	soda1	flour2	biscuit1
Product4	flour3	cake3	breakfast3	macaroni2	biscuit4
Product5	macaroni3	wafer3	cake1	olive	coffee2
Product6	legume2	chocolate5	chocolate4	breakfast2	snack2
Product7	chocolate7	canned1	biscuit1	tea2	napkin2
Product8	napkin1	biscuit2	napkin3	coffee1	detergent4
Product9	dish1	biscuit5	detergent4	personel3	dish2
Product10	detergent1	chips2	cleaning1	napkin2	cleaning1
	Total distance = 49	Total distance = 46	Total distance = 50	Total distance = 48	Total distance = 50

Suggested Model3	Simulation 1	Simulation 2	Simulation 3	Simulation 4	Simulation 5
Product1	water1	water2	oil1	water1	fizzy2
Product2	milk1	milk2	macaroni3	milk1	biscuit4
Product3	flour3	macaroni1	soda1	flour2	snack2
Product4	oil2	biscuit5	biscuit1	macaroni2	biscuit1
Product5	macaroni3	chips2	chocolate4	olive	coffee2
Product6	legume2	biscuit2	cake1	breakfast2	breakfast2
Product7	chocolate7	wafer3	breakfast3	coffee1	dish2
Product8	detergent1	chocolate5	cleaning1	tea2	cleaning1
Product9	napkin1	cake3	detergent4	napkin2	detergent4
Product10	dish1	canned1	napkin3	personel3	napkin2
	Total distance = 51	Total distance = 34	Total distance = 57	Total distance = 44	Total distance = 54

Table 4.8 Dijkstra's route of picking lists for the existing and proposed models (Continued)

Existing Model	Simulation 6	Simulation 7	Simulation 8	Simulation 9	Simulation 10
Product1	oil1	personel13	napkin1	water1	napkin1
Product2	sugar1	cleaning3	sugar1	fizzy1	sugar1
Product3	water2	home1	milk1	home6	water2
Product4	haircare2	dish2	soda1	detergent3	chocolate5
Product5	dish3	detergent1	water1	flour1	detergent2
Product6	macaroni1	salt	chocolate2	biscuit3	legume2
Product7	fruitjuice1	cake1	detergent4	macaroni1	macaroni1
Product8	spice1	legume3	macaroni2	legume3	biscuit4
Product9	canned2	spice2	flour3	milk3	flour3
Product10	olive	breakfast3	canned2	canned3	milk2
	Total distance = 71	Total distance = 62	Total distance = 42	Total distance = 64	Total distance = 63

Suggested Model1	Simulation 6	Simulation 7	Simulation 8	Simulation 9	Simulation 10
Product1	water2	dish2	water1	water1	water2
Product2	oil1	cleaning3	chocolate2	fizzy1	chocolate5
Product3	dish3	personel13	soda1	milk3	sugar1
Product4	olive	detergent1	sugar1	detergent3	milk2
Product5	fruitjuice1	cake1	milk1	legume3	detergent2
Product6	sugar1	legume3	detergent4	biscuit3	napkin1
Product7	haircare2	breakfast3	napkin1	flour1	legume2
Product8	spice1	spice2	flour3	macaroni1	biscuit4
Product9	canned2	salt	macaroni2	canned3	flour3
Product10	macaroni1	home1	canned2	home6	macaroni1
	Total distance = 68	Total distance = 51	Total distance = 37	Total distance = 42	Total distance = 42

Suggested Model2	Simulation 6	Simulation 7	Simulation 8	Simulation 9	Simulation 10
Product1	oil1	legume3	water1	water1	water2
Product2	water2	breakfast3	milk1	flour1	milk2
Product3	macaroni1	cake1	flour3	milk3	flour3
Product4	fruitjuice1	salt	macaroni2	macaroni1	macaroni1
Product5	sugar1	spice2	soda1	legume3	legume2
Product6	olive	personel13	sugar1	fizzy1	sugar1
Product7	canned2	home1	canned2	canned3	chocolate5
Product8	spice1	detergent1	chocolate2	biscuit3	biscuit4
Product9	dish3	dish2	napkin1	home6	napkin1
Product10	haircare2	cleaning3	detergent4	detergent3	detergent2
	Total distance = 69	Total distance = 71	Total distance = 44	Total distance = 62	Total distance = 50

Suggested Model3	Simulation 6	Simulation 7	Simulation 8	Simulation 9	Simulation 10
Product1	water2	legume3	water1	water1	water2
Product2	oil1	salt	milk1	milk3	milk2
Product3	macaroni1	cake1	flour3	flour1	flour3
Product4	sugar1	breakfast3	macaroni2	macaroni1	macaroni1
Product5	fruitjuice1	spice2	sugar1	fizzy1	sugar1
Product6	spice1	dish2	soda1	legume3	legume2
Product7	olive	cleaning3	chocolate2	biscuit3	biscuit4
Product8	canned2	home1	canned2	canned3	chocolate5
Product9	dish3	detergent1	detergent4	home6	napkin1
Product10	haircare2	personel13	napkin1	detergent3	detergent2
	Total distance = 55	Total distance = 67	Total distance = 40	Total distance = 54	Total distance = 38

Table 4.8 Dijkstra's route of picking lists for the existing and proposed models (Continued)

Existing Model	Simulation 11	Simulation 12	Simulation 13	Simulation 14	Simulation 15
Product1	water1	milk1	wafer1	napkin1	napkin1
Product2	milk4	flour1	water1	milk1	chocolate3
Product3	soupmix3	macaroni2	chocolate1	soda1	water3
Product4	detergent1	sugar2	chocolate7	wafer3	milk4
Product5	legume1	legume3	biscuit7	water3	haircare1
Product6	oil2	salt	snack2	chocolate7	personel17
Product7	macaroni2	breakfast1	cake2	napkin3	dish2
Product8	cracker1	driedfruit1	cracker2	cleaning4	detergent3
Product9	biscuit5	canned4	driedfruit2	legume1	home1
Product10	driedfruit2	olive	breakfast2	breakfast1	cake2
	Total distance = 68	Total distance = 54	Total distance = 65	Total distance = 48	Total distance = 63

Suggested Model1	Simulation 11	Simulation 12	Simulation 13	Simulation 14	Simulation 15
Product1	water1	milk1	water1	water3	water3
Product2	oil2	sugar2	chocolate1	chocolate7	chocolate3
Product3	driedfruit2	driedfruit1	chocolate7	cleaning4	dish2
Product4	milk4	olive	snack2	soda1	milk4
Product5	detergent1	salt	driedfruit2	wafer3	detergent3
Product6	legume1	breakfast1	wafer1	milk1	napkin1
Product7	cracker1	legume3	cake2	napkin1	cake2
Product8	biscuit5	flour1	breakfast2	napkin3	personel17
Product9	macaroni2	canned4	cracker2	legume1	haircare1
Product10	soupmix3	macaroni2	biscuit7	breakfast1	home1
	Total distance = 66	Total distance = 42	Total distance = 56	Total distance = 39	Total distance = 47

Suggested Model2	Simulation 11	Simulation 12	Simulation 13	Simulation 14	Simulation 15
Product1	water1	flour1	water1	water3	water3
Product2	oil2	milk1	cake2	milk1	milk4
Product3	milk4	macaroni2	breakfast2	legume1	cake2
Product4	macaroni2	legume3	wafer1	soda1	chocolate3
Product5	legume1	sugar2	chocolate7	wafer3	napkin1
Product6	cracker1	olive	chocolate1	breakfast1	home1
Product7	driedfruit2	breakfast1	biscuit7	chocolate7	dish2
Product8	soupmix3	canned4	snack2	napkin1	detergent3
Product9	biscuit5	salt	driedfruit2	napkin3	haircare1
Product10	detergent1	driedfruit1	cracker2	cleaning4	personel17
	Total distance = 45	Total distance = 43	Total distance = 47	Total distance = 57	Total distance = 53

Suggested Model3	Simulation 11	Simulation 12	Simulation 13	Simulation 14	Simulation 15
Product1	water1	milk1	water1	water3	water3
Product2	milk4	flour1	biscuit7	milk1	milk4
Product3	oil2	macaroni2	cracker2	soda1	chocolate3
Product4	macaroni2	sugar2	snack2	legume1	cake2
Product5	legume1	legume3	chocolate7	chocolate7	napkin1
Product6	cracker1	salt	wafer1	wafer3	detergent3
Product7	biscuit5	driedfruit1	cake2	breakfast1	home1
Product8	driedfruit2	canned4	chocolate1	cleaning4	dish2
Product9	soupmix3	breakfast1	driedfruit2	napkin3	haircare1
Product10	detergent1	olive	breakfast2	napkin1	personel17
	Total distance = 63	Total distance = 45	Total distance = 47	Total distance = 64	Total distance = 46

Table 4.8 Dijkstra's route of picking lists for the existing and proposed models (Continued)

Existing Model	Simulation 16	Simulation 17	Simulation 18	Simulation 19	Simulation 20
Product1	napkin1	water1	chocolate1	napkin1	napkin2
Product2	wafer3	fizzy2	fizzy3	chocolate2	oil1
Product3	cracker2	haircare2	water3	chocolate6	water2
Product4	macaroni1	detergent1	personel2	home2	chocolate2
Product5	biscuit1	dish3	detergent3	detergent1	milk4
Product6	legume3	oil3	dish3	cake1	personel1
Product7	cake3	salt	macaroni1	oil3	detergent1
Product8	driedfruit1	breakfast1	breakfast1	flour1	soupmix1
Product9	chips1	canned7	olive	milk3	macaroni3
Product10	canned1	olive	flour3	driedfruit1	breakfast1
	Total distance = 58	Total distance = 74	Total distance = 60	Total distance = 62	Total distance = 67

Suggested Model1	Simulation 16	Simulation 17	Simulation 18	Simulation 19	Simulation 20
Product1	wafer3	water1	water3	oil3	water2
Product2	driedfruit1	oil3	chocolate1	chocolate2	oil1
Product3	cracker2	dish3	dish3	chocolate6	chocolate2
Product4	legume3	olive	personel2	driedfruit1	personel1
Product5	cake3	fizzy2	olive	milk3	milk4
Product6	napkin1	detergent1	fizzy3	detergent1	detergent1
Product7	biscuit1	breakfast1	detergent3	napkin1	napkin2
Product8	chips1	salt	breakfast1	cake1	breakfast1
Product9	canned1	haircare2	flour3	home2	soupmix1
Product10	macaroni1	canned7	macaroni1	flour1	macaroni3
	Total distance = 52	Total distance = 68	Total distance = 53	Total distance = 52	Total distance = 62

Suggested Model2	Simulation 16	Simulation 17	Simulation 18	Simulation 19	Simulation 20
Product1	macaroni1	water1	water3	oil3	oil1
Product2	legume3	oil3	flour3	flour1	water2
Product3	cake3	fizzy2	macaroni1	milk3	milk4
Product4	wafer3	olive	fizzy3	cake1	macaroni3
Product5	canned1	breakfast1	olive	chocolate6	breakfast1
Product6	biscuit1	canned7	breakfast1	chocolate2	chocolate2
Product7	driedfruit1	salt	chocolate1	driedfruit1	soupmix1
Product8	chips1	detergent1	personel2	home2	napkin2
Product9	cracker2	haircare2	dish3	napkin1	personel1
Product10	napkin1	dish3	detergent3	detergent1	detergent1
	Total distance = 58	Total distance = 51	Total distance = 51	Total distance = 66	Total distance = 56

Suggested Model3	Simulation 16	Simulation 17	Simulation 18	Simulation 19	Simulation 20
Product1	macaroni1	water1	water3	milk3	water2
Product2	legume3	oil3	flour3	flour1	milk4
Product3	cracker2	fizzy2	macaroni1	oil3	oil1
Product4	chips1	salt	fizzy3	chocolate6	macaroni3
Product5	biscuit1	canned7	chocolate1	chocolate2	chocolate2
Product6	wafer3	breakfast1	breakfast1	cake1	breakfast1
Product7	cake3	olive	olive	driedfruit1	soupmix1
Product8	driedfruit1	haircare2	dish3	home2	napkin2
Product9	canned1	dish3	detergent3	detergent1	detergent1
Product10	napkin1	detergent1	personel2	napkin1	personel1
	Total distance = 34	Total distance = 52	Total distance = 57	Total distance = 40	Total distance = 49

4.12 Evaluation of Storage Allocation Models

The solutions found by Dijkstra's Algorithm give better routing results than A star algorithm, for that reason, routing policy of Dijkstra's Algorithm are used. Due to the random allocation of products, the existing storage allocation policy is seemed to be unsuitable for this retail warehouse. While picking orders, finding the products in the warehouse is difficult in this randomly storage allocation. So, new allocation models are necessary for finding products easily and minimizing travelling distance. Creating new storage allocation models for minimizing travelling distance for order picking is the main aim of this study. After new storage allocation models are created, a programme is made for examining these new models and the existing model. In the the programme, the user selects the storage allocation model and determines the products that want to pick. When the programme is run and it gives the minimum travelling distance for picking orders in the picking list. It gives picking route of the products. A display of the program while it is operating is seen in Figure 4.37.

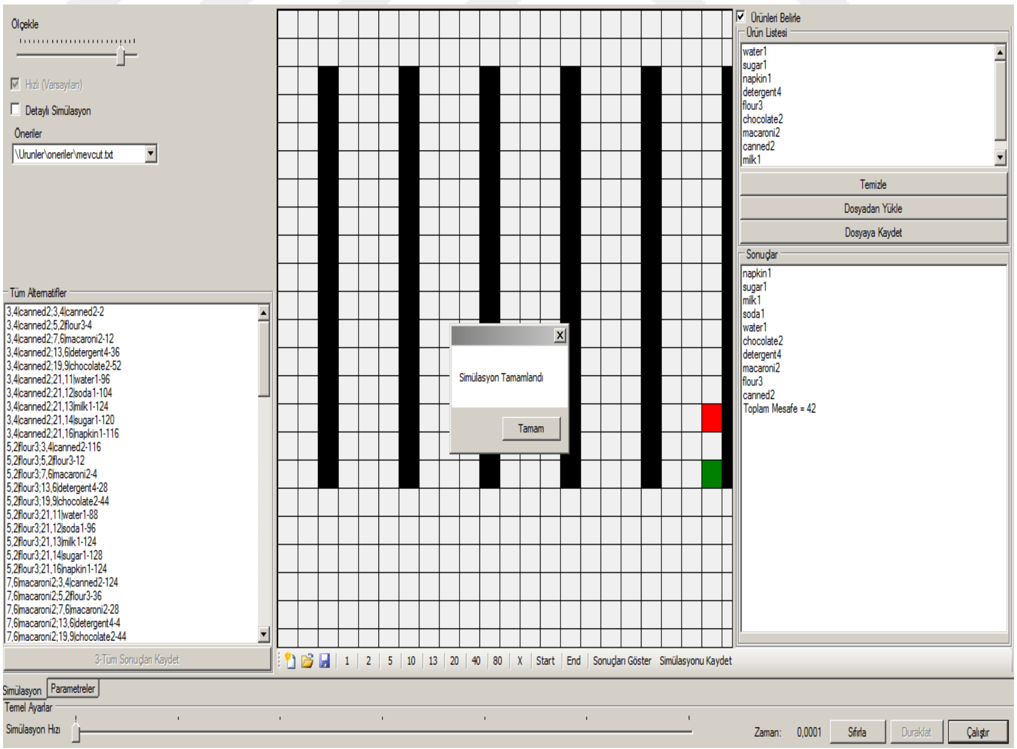

Figure 4.37 Screen of the program

In this study, there are 20 picking lists and there are total 4 storage allocation models, including existing and proposed models. We enter the products in the picking lists that will be picked and we choose storage allocation model in the programme. When we run the program, we see travelling distance to pick orders for selected storage allocation model. So, we have 80 results. Travelling distance of picking lists for each model is in Table 4.9.

Table 4.9 Travelling distance of picking lists for each model

Picking lists	Existing model	Suggested Model1	Suggested Model2	Suggested Model3
Picking list1	58	46	49	51
Picking list2	53	49	46	34
Picking list3	61	52	50	57
Picking list4	70	71	48	44
Picking list5	67	54	50	54
Picking list6	71	68	69	55
Picking list7	62	51	71	67
Picking list8	42	37	44	40
Picking list9	64	42	62	54
Picking list10	63	42	50	38
Picking list11	68	66	45	63
Picking list12	54	42	43	45
Picking list13	65	56	47	47
Picking list14	48	39	57	64
Picking list15	63	47	53	46
Picking list16	58	52	58	34
Picking list17	74	68	51	52
Picking list18	60	53	51	57
Picking list19	62	52	66	40
Picking list20	67	62	56	49

The programme calculates the travelling distance to pick orders for each list and model. And now, we can compare models to see that the proposed allocation models are better or worse than existing model. We use ANOVA test for comparison of these models. We make ANOVA test according to %95 confidence interval. When we analyzed the model results, we find statistical significance as 0.001 in Table 4.10. Significance level is smaller than 0.05. So, we say that proposed storage allocation models are better than the existing allocation model.

Table 4.10 Anova test

ANOVA Distance					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1575.700	3	525.233	6.490	.001
Within Groups	6151.100	76	80.936		
Total	7726.800	79			

Mean, lower and upper bound, standart deviation, minumum and maximum value of each model are seen in Table 4.11. The mean travelling distance of existing model is 61.50 m. The mean travelling distance of proposed model1 is 52.45 m. The mean travelling distance of proposed model2 is 53.30 m. The mean travelling distance of proposed model3 is 49.55 m. We see that the proposed model3 is the best among all storage allocation models.

Table 4.11 Descriptives of results

Descriptives Distance								
					for Mean			
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
Model1	20	52.450	10.1332	2.2659	47.708	57.192	37.0	71.0
Model2	20	53.300	8.2213	1.8383	49.452	57.148	43.0	71.0
Model3	20	49.550	9.6052	2.1478	45.055	54.045	34.0	67.0
Existing	20	61.500	7.8237	1.7494	57.838	65.162	42.0	74.0
Total	80	54.200	9.8898	1.1057	51.999	56.401	34.0	74.0

We compare existing model and other proposed models with Dunnett's Test statistically. Dunnett's test is multiple comparison tests. There is control group and experimental groups. It compares each experimental group only control group instead of comparing all groups in the experiment. For our model, control group is existing storage allocation model and experimental groups are proposed storage allocation models. When we make pairwise comparisons, there is significant difference between existing model and model 3. It is seen in Table 4.12.

Table 4.12 Pairwise comparison of models

Multiple Comparisons					
Dependent Distance Dunnett t (<control)[a]					
(I) Suggested Models		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Upper Bound
Model1	ExistingModel	-9,0500*	2.8449	.003	-3.090
Model2	ExistingModel	-8,2000*	2.8449	.007	-2.240
Model3	ExistingModel	-11,9500*	2.8449	.000	-5.990

The box-plot graphics of the existing and suggested new models are seen in Figure 4.38.

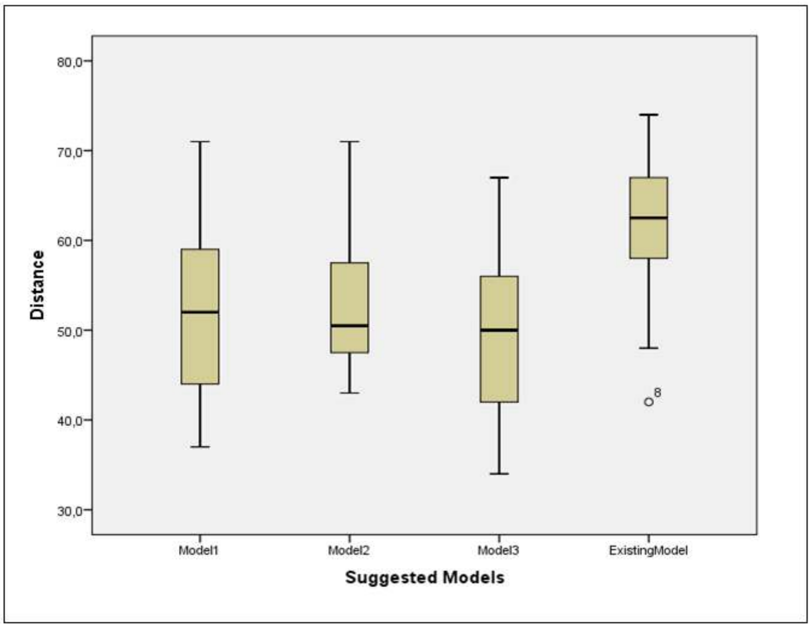

Figure 4.38 Box-plot graphics

As a result, the best storage allocation model is the proposed storage allocation model3. In this model, ABC analysis and family grouping storage allocation policy are used for allocating product groups in the shelves. So, the product groups should be located in the shelves as proposed storage allocation model3 for minimizing travelling distance in this retail warehouse.

CHAPTER FIVE
CONCLUSIONS

In this chapter, the summary of previous chapters and the essential results of case study are given. Additionally, contributions of this study are summarized.

The warehouses are the strategic points where the products are stored and kept until the moment of need. The warehouses play big roles between suppliers and customers and have a significant effect on the costs of the logistic operations. If there is a problem in the processes of warehouse, it is immediately reflected to the customers and this causes with customer dissatisfaction. Also, if this warehouse is a retail warehouse, the sales decrease in big rate. So, the warehouse operations should be examined in detail to provide for delivering higher quality service in a shorter time for increasing customer satisfaction. Below, we summarize the case study and explain conributions of this study for retail warehouse.

5.1 Summary of Study

Especially, retail warehouse operations are complex than other warehouses, since thousands of order pickings are performed every hour and every day. 60% total warehouse cost is order picking cost so success of retail warehouse is related with order picking process. For that reason, the factors that affect order picking process must be examined in detail. Storage allocation policy, batching, zoning, routing are the factors affecting order picking process. But the most important one is the storage allocation policy. Because, when the products arrive in the warehouse, they are received by the warehouse personnel and quality control is done. Later, the product allocation is performed. Performing the product allocation correctly and properly is very important phase. Because batching, zoning, routing are the next steps applied in the warehouses. So, we are interested in storage allocation policy in this study and the storage allocation policy affects the travelling distance while picking orders. We will propose new allocation models to minimize travelling distance.

Performance of order picking is so important. If there is a problem in order picking, next all operations are affected. When inaccurate picking is done, products are sent customers late or wrong and incorrect deliveries occur. Thus, customer dissatisfaction becomes. As it seen, order picking has big cost both inside and outside of warehouse so the performance of order picking should be improved.

In this study, the aim is to minimize travelling distance while picking orders. Current storage location is unsuitable in the warehouse and so new storage allocation models are proposed for minimizing travelling distance. The brief explanation of this study is as follows:

Firstly, we examined past one-year data in the warehouse. To examine the annual data of the products, we got the 15 day data from the system and combined this data with vlookup feature of Ms Excel. Thus, we have found how many boxes are sent for each product types from warehouse to stores within a year. By examining past data, we will have learnt the amount of each product sent from warehouse to store and the amount of product consumption by the customer. So we can see which products are more preferred by the customers.

Secondly, the product types must be divided into categories and groups. As the first step, we categorized the product types as water, milk, detergents, chocolates, flour, napkins, macaroni, biscuits, canned foods, oil, sugar, cakes, soda water, wafers, cleaning agents, dried fruits, home equipments, tea, fizzy drink, coffee, fruit juice, sugary snacks, dish detergents, chips, breakfast food, crackers, rice, personnel cares, legume, hair cares, soupmixes, candies, spice, salt and olives. Thus, we got 35 categories. In the second step, we divided these categories into subgroup and we got 135 subgroups. That is, in the milk category there are milk groups and these groups include milk types. In the water category, there are water groups and they include water types. The purpose of categorizing and grouping is to provide control over product groups and to learn the order quantity of product groups. Categorization and grouping will help us for locating products in the shelves because we will use these groups while allocating products.

Thirdly, we got the stock output rate of each product by examining past one-year data. So, we can calculate the stock output rate of each product groups. Because we have already known the stock output rate of the product types within product groups. Namely, we can see the stock output rate of each product and each group. Above three steps are anaysis of the products. The analysis results are very important and useful for us. Because, we will use analysis results in stock allocation policies. And also we should emphasize that, data collection is a very long and difficult process.

The existing storage allocation policy creates problem in the warehouse. It is seen that the products are randomly allocated in the shelves. In this warehouse, random storage allocation policy is used. This causes more travelling distance for searching products while picking orders. For that reason, existing storage allocation model should be arranged for minimizing travelling distance. We learnt that by observing and analysing the existing storage allocation policy is not proper for this retail warehouse and new allocation policies should be determined. So, we propose three new storage allocation models.

As a result of analyzing data for one-year, we see that preference of each product sub groups is different. The most preferred product subgroup has the highest stock output rate. For the first proposed storage allocation model, we allocated the products in the shelves according to ABC analysis. We used the stock output rate for ABC analysis. We grouped the products according to ABC analysis. The products with high output rate was grouped as A class, the products with medium output rate was grouped as B class, the products with less output rate was grouped as C class. The products in A class are allocated to shelves on front of the warehouse, later the products B class are allocated to shelves in the middle part of the warehouse, lastly the products C class are allocated to shelves in the back of warehouse. In the second proposed model, we allocated the products according to family grouping storage policy. In other words, similar product subgroups are located to close to each other. For example, chocolates and wafers are snack food so we try to locate close to each other in the shelves. Legume and macaroni are main foods that are consumed so we located close to each other. In the third proposed model, products are located by using both ABC analysis and family grouping. For example, chocolate, biscuit, cake, wafer, snack, chips crackers, are the junk food. We located these products close to each other and we allocate the products with higher stock output rate front of the products with lower stock output rate. In the warehouse, we allocated chocolate groups to front region of third perron, latter we allocated the biscuits in the remaining region. As it seen, for this model, we combined classed based and family grouping storage policy.

While allocating the products in the shelves we assumed that; all aisles are equal and their sizes are same. There are 5 aisles and 10 perrons. The system is picker to part system. Manual order picking is done and there is low level picking. The order picking is done only from picking cells. The first floor of the shelves is called as picking cell. It isn't allowed to pick orders from upper floors of the shelves.

The main aim in the study is to minimize travelling distance by improving new storage allocation models. But a programme is necessary for examining these models. This programme should calculate travelling distance while the picking orders. Namely, we can explain in the followings. The stores send orders. The order picker picks the products. He visits various locations to pick orders. The travelling distance of order picker is calculated by the programme that we made. The programme works like this; the user selects the storage allocation policy that is defined in the program later the user enters the product subgroups in other words enters the order picking lists in the programme. When the user enters same products for existing and proposed storage policies, comparison can be made between storage allocation models. The programme that is made calculates travelling distance of each order picking lists and shows routes of picking lists. This programme is made by using C#.NET programming language. Dijkstra's algorithm and A Star algoritm are used for routing but Dijkstra's algorithm gives better results than A Star algoritm. For that reason, while evaluating storage allocation policy, we use Dijkstra's algorithm results. In the programme, 20 picking lists are used for each model. Travelling distance for each picking list and for each model is calculated. After the programme is run, totally 80 travelling distance is gotten. We made statistical analysis for comparing travelling distance resuls of existing model and other proposed models.

As a result, according to evaluation, all proposed storage allocation models are better than the existing storage allocation. The mean travelling distance of existing model is 61.50 m. The mean travelling distance of proposed model1 is 52.45 m. The mean travelling distance of proposed model2 is 53.30 m. The mean travelling distance of proposed model3 is 49.55 m. First proposed model decreases travelling distance 17.25%, second proposed model decreases travelling distance 15.30%, third proposed model decreases travelling distance 24%. The proposed model3 is best model for minimizing travelling distance while picking orders. For this retail warehouse, using classed based and family grouping storage allocation policy must be used for minimizing travelling distance.

5.2 Contributions of the Case Study

The case study shows that storage allocation policy affects travelling distance while picking orders and also travelling distance is minimized by arranging new storage allocation policies. Besides, the case study provides other contributions on different issues.

When random storage allocation is abandoned and the proposed storage allocation policy is adopted, there will be differences as follows. Products will have a specific address and similar products will be allocated close to each other and the products with high stock output rate will be allocated to the front part of the warehouse, the products with between high stock output rate and low stock output rate will be allocated to the middle part of the warehouse, the products with low stock output rate are allocated in remaining empty parts. The products are always allocated to the same places and allocated according to the above criteria, so that the order picker will find products easily in the warehouse and will not waste time searching for the products. The distance travelled to search for products will also decrease. When the order picker travels too far distance to search products in the warehouse, the order picker will get tired and his picking performance will decrease, so the number of boxes picked in one hour will decrease. In terms of order picker this is unwanted and bad situation. When the order picker travels too far and get tired, he will not be able to reach the target order picking amount at the end of the day.

When the order picker can not pick the required target at the end of the day, he has to work overtime. When we take the issue in term of workers, we can think that if they work overtime, they will make a lot of money. But according to my observations, I can definetely say that the workers do not want to work overtime and want to go home on time. The circulation of workers is very high in retail stores. The most important reason is that they work in overtime. Overtime is unwanted situation for workers. As it is seen, when we perform improvements in the warehouse, we also provide contributions for the order pickers because we have made their works easier and they are pleased with their works and order picker satisfaction increases.

This study has also advantages in terms of warehouse cost. There is a target amount that must be picked in the warehouse for every day and must be sent out from the warehouse to stores. If the order pickers can not do it within the working hours, they will work in the overtime. In such a case, the managers have to pay for the overtime. They also have to pay for transporting and dinner because, if workers work overtime, the dinner is served. When overtime is prevented, dinner cost also will not happen. There is also a cost transporting. Transportation service is provided to all staff and workers. At the end of the working hours, the transportation vehicle leaves at the same time. But the workers who work overtime can not use this vehicle because they can not leave the job on time. Later, the workers who are overtime are taken to home with another transportation vehicle. This transportation vehicle is extra cost for warehouse. The warehouse supervisor must telephone the people who are interested in transportation and dinner needs when there is overtime. He speaks with vehicle driver and food company. The warehouse supervisor has to deal with these issues besides his own works and spends unnecessary time. Therefore, when the overtime is prevented, the cost of the transportation service and the cost of the food will also disappear. As a result, this study makes a very important contribution in terms of cost.

There is also another contribution on customers. The processes in the warehouse are interrelated to each other, so if there is a problem in the warehouse, it is reflected to the customer. For example, we can explain it like that; if the storage allocation policy in the warehouse is not proper, first the order picking is affected. Because the order picking is not completed on time, as a result the shipment can not be done on time. That is, the products ordered by the store can not be shipped from the warehouse. Because of not shipping products on time, there aren't the ordered products in the store.

There are no stock areas in the stores, if there are no products in the store; they immediately inform the warehouse. Therefore, according to demands of stores, the products can be shipped to the same store every day. So, the operations in the retail warehouse are very intensive and all operations must be completed on time. For example, if the customers do not find the products in the store at the moment they need it and this situation is repeated a few times, the customers do not want to go to this store again. As a result, it can be said that; if a problem occurs in the stores, the customer is affected by it and customer dissatisfaction becomes.

The case study also has a contribution on inventory. The ABC analysis we conducted in our study has an advantage in terms of inventory count. In the study, we made the ABC analysis according to the stock output rate. The products with high stock output rate need to be controlled frequently so that we can prevent these products from being lost, damaged, or mis-counted. That is, classification improves controlling over the products. And also accurate results are obtained in a shorter time while inventory counting is done.

As it seen above, besides the real purpose of the study we have done, there is also contribution in terms of cost, customer satisfaction and inventory.

5.3 Suggestions for future study

In our study, there are five aisle and ten perrons and there is no cross aisle in the warehouse layout for our case study. We calculated travelled distance for picking orders according to this layout. I wonder this question; if there were cross aisles in the warehouse layout, how did the results we found in our study change? That is, how the warehouse layout affects the order picking travelling distance? A study can be done for learning this.

We provided improvement on travelling distance by performing new storage allocation policies. I think, the study that we did has also saved money in the warehouse but I didn’t evaluate it so I wonder this. In a further study, how much cost savings have been achieved with this study. It can be researched.

We developed alternative storage allocation policies which help minimize travelling distance with this study. For this retail warehouse, the best storage allocation policy is to use the family grouping and the classed based storage allocation together. The integrated model obtained 24 % savings for travelling distance while picking orders. Our recommended model has greatly reduced the distance travelled when picking orders. So, this combined storage allocation policy can be used in warehouse management system. When the product receiving is done by the warehouse, the warehouse management system allacote the products in the shelves according to stock output rate of the products and according to the similarities of the products. So, the warehouse manager can use this storage allocation policy in a warehouse management system. As a result, I would suggest warehouse manager using this system in the warehouse.

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APPENDICES

Table 1a. General data and categorized data used in the study

GENERAL DATA				CATEGORİZED DATA			
No	Product Type	Sum of annual output of products	Category	No	Product Type	Sum of annual output of products	Category
1	CEYSU DOĞAL KAYNAK SUYU 5 L	304.473	1	1	CEYSU DOĞAL KAYNAK SUYU 5 L	304.473	1
2	MİS UHT SÜT YARIM YAĞLI 1LT	192.159	2	2	CEYSU DOĞAL KAYNAK SUYU 0.5 L	102.003	1
3	YILLAR UN 5 KG	154.339	6	3	HAYAT SU 5 L.	97.283	1
4	CEYSU DOĞAL KAYNAK SUYU 0.5 L	102.003	1	4	CEYSU DOĞAL KAYNAK SUYU 1.5 L	85.650	1
5	MİS UHT SÜT YAĞLI 1LT	100.000	2	5	HAYAT SU 0.50 LT.	66.501	1
6	HAYAT SU 5 L.	97.283	1	6	HAYAT SU 1,5 LİTRE	65.329	1
7	CEYSU DOĞAL KAYNAK SUYU 1.5 L	85.650	1	7	SAKA SU 10LT	61.545	1
8	TURSILMATIK 8 KG	78.000	21	8	SAKA SU MINI SÜNGER BOB 0,33L	7.761	1
9	RİNSO KIR BAHÇESİ 5 KG	71.882	21	9	MİS UHT SÜT YARIM YAĞLI 1LT	192.159	2
10	ALOMATİK 5KG KAR ÇİÇEĞİ	68.990	21	10	MİS UHT SÜT YAĞLI 1LT	100.000	2
11	PERSİL GOLD VE GÜLÜN BÜYÜSÜ 8 KG	68.627	21	11	SEK SÜT 1 LT.	30.405	2
12	HAYAT SU 0.50 LT.	66.501	1	12	PINAR SÜT 1 LT.	27.839	2
13	HAYAT SU 1,5 LİTRE	65.329	1	13	ÜLKER İÇİM SÜT 1 LT.	13.035	2
14	YUKA KAĞIT HAVLU 4LÜ	61.678	25	14	SEK KAKAOLU SÜT 200 ML	11.789	2
15	SAKA SU 10LT	61.545	1	15	SEK SÜT 200 ML.	9.729	2
16	ESKİPAZAR MADEN SUYU 6X200ML	59.659	3	16	MİS 200 ML UHT YAĞLI SÜT	9.491	2
17	ORKİDE 4,5 LİTRE PET ŞİŞE	56.652	8	17	SEK LIGHT SÜT 1 LT.	9.033	2
18	ARİEL DAĞ ESİNTİSİ 5 KG	49.544	21	18	SEK ÇİLEKLİ SÜT 200 ML.	5.798	2
19	YUKA TUVALET KAĞIDI 12Lİ	48.322	25	19	SEK MUZLU SÜT 200 ML.	4.749	2
20	KONYAŞEKER ŞEKER TANESİ TOZ ŞEKER 2000GR	45.298	7	20	PINAR SÜT 500 ML.	4.057	2
21	ŞEKER TANESİ TOZ ŞEKER 5 KG	44.546	7	21	İÇİM SÜT 200 ML	4.032	2
22	PİYALE UN 5 KG	38.293	6	22	MİS 500 ML UHT YAĞLI SÜT	3.009	2
23	PRIL SIVI BULASIK DETERJANI LİMON 6 LT	35.249	22	23	İÇİM HERO BABY DEVAM SÜTÜ 12-36 500 ML	2.538	2
24	KARMEN ANTEP FISTIKLI ÇİKOLATA 80GR	32.596	14	24	ÜLKER İÇİM MUZ AROMALI SÜT 200 ML.	1.561	2
25	PİYALE FİYONK 500GR	31.123	9	25	ESKİPAZAR MADEN SUYU 6X200ML	59.659	3
26	SEK SÜT 1 LT.	30.405	2	26	ÜLKER FLORES MADEN SUYU 6X200ML	29.317	3
27	PİYALE BURGU 500GR	30.349	9	27	SARIÇAM LİMON AROMALI MADEN SUYU 6X200ML	19.420	3
28	BEYAZ GÜVERCİN 8Lİ TUVALET KAĞIDI 3 KAT	29.563	25	28	SARIÇAM ELMA AROMALI MADEN SUYU 6X200ML	14.406	3

29	ÜLKER FLORES MADEN SUYU 6X200ML	29.317	3	29	AKMİNA C VITAMINLI LIMON 1 LT	7.196	3
30	PİYALE SPAGETTİ 500GR	28.774	9	30	ULUDAĞ LIMONATA 1 L	17.908	4
31	ÜLKER SÜTLÜ KARE 80 GR.	28.558	14	31	MİS MEYVE NEKTARI ŞEFTALİ 1000ML	14.921	4
32	PINAR SÜT 1 LT.	27.839	2	32	MİS MEYVE NEKTARI KAYISI 1000ML	10.940	4
33	KARMEN SÜTLÜ ÇİKOLATA 80 GR.	27.278	14	33	MİS MEYVE NEKTARI KARIŞIK 1 LT	9.844	4
34	KARMEN BİTTER ÇİKOLATA 80GR	26.321	14	34	CROWN LIMONATA 1 LT	9.773	4
35	RİNSO 10 KG KIR ÇİÇEKLERİ	26.320	21	35	MİS MEYVE NEKTARI VİŞNE 1000ML	6.917	4
36	ALTINKÜP KÜP ŞEKER750 GR	25.426	7	36	MİS MEYVE NEKTARI PORTAKAL 1000ML	6.262	4
37	ÜLKER BİTTER KARE 80 GR.	24.680	14	37	CAPRİ SUN MİX 200 ML.	4.603	4
38	KARMEN FINDIKLI ÇİKOLATA 80GR	23.644	14	38	ÇAMLICA GAZOZ 1.5 LT	13.549	5
39	PİYALE ARPA ŞEHRİYE 500GR	23.030	9	39	CROWN GAZOZ 1,5L	12.347	5
40	KARMEN NUGA BAR 35 GR	21.294	14	40	CROWN COLA 2,5 L	12.038	5
41	OMO 5KG ACTIVE FRESH	20.182	21	41	CROWN PORTAKAL 2,5L	10.972	5
42	PİYALE İNCE UZUN 500GR	20.067	9	42	CROWN MANDALINA 1,5L	8.759	5
43	PİYALE YÜKSÜK 500GR	20.019	9	43	CROWN COLA 1 L	7.818	5
44	PİYALE UN 1KG	19.484	6	44	CROWN COLA LIGHT 1L	7.271	5
45	SARIÇAM LİMON AROMALI MADEN SUYU 6X200ML	19.420	3	45	CROWN COLA 330 ML KUTU	6.399	5
46	YONCA KANOLA 4,5 LT PET	19.413	8	46	CROWN GAZOZ 330 ML KUTU	4.967	5
47	ÜLKER ANTEP FISTIKLI KARE 80 GR.	18.984	14	47	ÇAMLICA GAZOZ 250 ML. CAM ŞİŞE	3.471	5
48	ÜLKER ÇUBUK KRAKER 36 GR.	18.703	18	48	COLA TURKA 500 ML	3.024	5
49	ULUDAĞ LIMONATA 1 L	17.908	4	49	MALTANA ANANAS AROMALI MALT İÇECEĞİ 270 ML	1.666	5
50	PEKİ MOZAİK KEK 200 GR	17.707	26	50	MALTANA ARMUT AROMALI MALT İÇECEĞİ 270 ML	1.551	5
51	NESCAFE 3Ü 1 ARADA 18 GR.	17.209	13	51	MALTANA ŞEFTALİ AROMALI MALT İÇECEĞİ 270ML	1.076	5
52	DOMESTOS DAG ESINTISI 4 KG	16.629	23	52	YILLAR UN 5 KG	154.339	6
53	BİZİM OSMANCIK PİRİNÇ 2,5KG	15.710	10	53	PİYALE UN 5 KG	38.293	6
54	PEKİ KAKAOLU KEK 200GR	15.268	26	54	PİYALE UN 1KG	19.484	6
55	EVİN AYÇİÇEKYAĞI 5LT	15.127	8	55	SÖKE UN 2 KG.	10.371	6
56	MİS MEYVE NEKTARI ŞEFTALİ 1000ML	14.921	4	56	PİYALE PİRİNÇ UNU 250 GR	4.010	6
57	ALTINKÜP TOZ ŞEKER 2 KG	14.863	7	57	PİYALE BUĞDAY NİŞASTA 200GR	4.008	6
58	ÜLKER ÇOKOKREM 500 GR	14.740	20	58	PİYALE GALETA UNU 250GR	3.464	6
59	YUKA PEÇETE 100LÜ	14.669	25	59	PİYALE MISIR UNU 250GR	3.210	6
60	KARMEN HİNDİSTAN CEVİZLİ BAR 25G	14.577	16	60	PİYALE MISIR NİŞASTA 200GR	3.153	6
61	SARIÇAM ELMA AROMALI MADEN SUYU 6X200ML	14.406	3	61	SÖKE TAM BUĞDAY UNU 1 KG	2.518	6
62	PEKİ MEYVELİ KEK 200GR	14.124	26	62	SÖKE KEPEK UNU 1 KG	1.192	6
63	ÜLKER HALLEY 10LU 300 GR.	13.621	15	63	DR.OETKER SADE KEK KARIŞIMI 450 GR.	1.087	6

64	PEKİ KAKAOLU GOFRET 220G	13.587	28
65	ÇAMLICA GAZOZ 1.5 LT	13.549	5
66	ÜLKER ÇİKOLATALI GOFRET 35 GR.	13.514	28
67	AMİGO AYÇEKİRDEĞİ 150 GR	13.484	17
68	VERNELGÜLÜN BÜYÜSÜ 6 LT	13.409	21
69	BİSKREM POŞET 140 GR	13.405	15
70	AMİGO AYÇEKİRDEĞİ 400 GR	13.142	17
71	ÜLKER İÇİM SÜT 1 LT.	13.035	2
72	KARMEN FINDIKLI ÇIKOLATA 40G	12.839	14
73	FALIM DAMLA SAKIZLI ŞEKERSİZ 3LÜ S	12.694	29
74	KOMİLİ ISLAK HAVLU 90 YP	12.509	25
75	CROWN GAZOZ 1,5L	12.347	5
76	AMİGO BOL TUZLU AYÇEKİRDEĞİ 150 GR	12.235	17
77	EVİN AYÇİÇEKYAĞI 1LT	12.071	8
78	CROWN COLA 2,5 L	12.038	5
79	ÜLKER METRO 40 GR.	12.027	14
80	SEK KAKAOLU SÜT 200 ML	11.789	2
81	KARMEN 10LU SÜTLÜ ÇİKOLATALI SANDVİÇ BİSKÜVİ 300G	11.651	15
82	ÜLKER ÇİZİ KRAKER SADE 65 GR.	11.618	18
83	CAFE CROWN LATE 17GR	11.418	13
84	KARMEN ÇİKOLATA GOFRET 38G	11.327	28
85	YEMENELİ TÜRK KAHVESİ 100GR	11.126	13
86	HALK PİLAVLIK BULGUR 1KG	11.108	11
87	YILLAR TUZ 750 GR.	11.090	19
88	KURUKAHVECİ MEHMET EFENDİ 100 GR.	11.030	13
89	CROWN PORTAKAL 2,5L	10.972	5
90	PEKİ KÜP GOFRET 225 GR	10.959	28
91	MİS MEYVE NEKTARI KAYISI 1000ML	10.940	4
92	PİYALE MANTI 500GR	10.939	9
93	KARMEN FINDIKLI GOFRET 32GR	10.898	28
94	PİYALE TEL ŞEHRİYE 500GR	10.866	9
95	ÜLKER SÜTLÜ FINDIKLI KARE 80 GR.	10.795	14
96	DİDO KARE 50G	10.726	14
97	PAPİFRESH ISLAK HAVLU 80Lİ	10.612	25
98	TEMPO PÖTİBÖR BİSKÜVİ 450G	10.569	15
99	DOMESTOS DAĞ ESINTISI 810 GR	10.390	23
100	SÖKE UN 2 KG.	10.371	6
101	SOLO TUVALET KAGIDI 16 LI	10.295	25

64	KONYAŞEKER ŞEKER TANESİ TOZ ŞEKER 2000GR	45.298	7
65	ŞEKER TANESİ TOZ ŞEKER 5 KG	44.546	7
66	ALTINKÜP KÜP ŞEKER750 GR	25.426	7
67	ALTINKÜP TOZ ŞEKER 2 KG	14.863	7
68	BALKÜPÜ ŞEKER 1000GR	8.752	7
69	PİYALE PUDRA ŞEKERİ 250GR	5.743	7
70	BALKÜPÜ TOZ ŞEKER 3 KG	5.485	7
71	ORKİDE 4,5 LİTRE PET ŞİŞE	56.652	8
72	YONCA KANOLA 4,5 LT PET	19.413	8
73	EVİN AYÇİÇEKYAĞI 5LT	15.127	8
74	EVİN AYÇİÇEKYAĞI 1LT	12.071	8
75	EVİN AYÇİÇEKYAĞI 2LT	8.862	8
76	KOMİLİ EGE SIZMA 2,5LT	7.572	8
77	YONCA AYÇİÇEKYAĞI 1 LT.	7.003	8
78	YUDUM AYÇİÇEKYAĞI 5 LT.	6.641	8
79	YONCA AYÇİÇEKYAĞI 2 LT.	5.328	8
80	EVİN MISIR YAĞI 2LT	3.794	8
81	LİO RİVİERA 2LT	2.652	8
82	YUDUM AYÇİÇEKYAĞI 1 LT.	2.459	8
83	KOMİLLİ RİVİERA 2,5LT	2.423	8
84	LİO SIZMA ZEYTİNYAĞI 5LT	1.836	8
85	LİO SIZMA ZEYTİNYAĞI 500ML	1.574	8
86	LİO SIZMA ZEYTİNYAĞI 2LT	1.518	8
87	LIO RİVİERA 1 LT	1.507	8
88	PİYALE FİYONK 500GR	31.123	9
89	PİYALE BURGU 500GR	30.349	9
90	PİYALE SPAGETTİ 500GR	28.774	9
91	PİYALE ARPA ŞEHRİYE 500GR	23.030	9
92	PİYALE İNCE UZUN 500GR	20.067	9
93	PİYALE YÜKSÜK 500GR	20.019	9
94	PİYALE MANTI 500GR	10.939	9
95	PİYALE TEL ŞEHRİYE 500GR	10.866	9
96	FİLİZ SPAGHETTİ MAKARNA 500 GR.	7.265	9
97	FİLİZ BURGU MAKARNA 500 GR.	7.055	9
98	FİLİZ FİYONK MAKARNA 500 GR.	6.227	9
99	FİLİZ KELEBEK MAKARNA 500 GR.	5.603	9
100	FİLİZ ARPA ŞEHRİYE 500 GR.	4.574	9
101	MANTISERİ MANTI 500GR	3.772	9

102	NUTELLA 750 GR	10.236	20
103	ÜLKER ALBENİ 40 GR.	10.228	16
104	TEMPO TUZLU ÇUBUK KRAKER 150GR	10.037	18
105	TEMPO POTİBÖR BİSKÜVİ 1KG	9.904	15
106	ÜLKER PÖTİBÖR BİSKÜVİ 1 KG.	9.873	15
107	PEKİ MOZAİK KEK 40GR	9.852	26
108	MİS MEYVE NEKTARI KARIŞIK 1 LT	9.844	4
109	CROWN LIMONATA 1 LT	9.773	4
110	SEK SÜT 200 ML.	9.729	2
111	MİS 200 ML UHT YAĞLI SÜT	9.491	2
112	HALK BALDO PİRİNÇ 1KG.	9.343	10
113	ÜLKER 9 KAT FINDIKLI GOFRET 50 GR.	9.342	28
114	ÜLKER ÇOKONAT 32 GR.	9.302	28
115	PEKİ KAKAOLU KEK 40 GR	9.235	26
116	KOMİLİ KONFOR TUVALET KAĞIDI 12 Lİ	9.188	25
117	ÜLKER ÇİKOLATALI GOFRET 5Lİ 175 GR.	9.168	28
118	ELIDOR SAMPUAN KOPARAK DOKULMEYE COZUM 700 ML	9.167	32
119	ELIDOR SAMPUAN GUCLU VE PARLAK 700 ML	9.048	32
120	ELIDOR SAMPUAN ONARICI BAKIM 700 ML	9.035	32
121	SEK LIGHT SÜT 1 LT.	9.033	2
122	HALK BALDO PİRİNÇ 2,5KG.	9.014	10
123	HALK KÖFTELİK BULGUR 1KG	9.004	11
124	ALPELLA 3 GEN BEYAZ ÇİKOLATALI GOFRET 32GR	8.980	28
125	RUFFLES ORIGINALS 165GR	8.968	30
126	ÜLKER DANKEK ÇİKOLATALI 40 GR	8.956	26
127	ÇEREZZA POPCORN AİLE BOY 58 GR.	8.943	30
128	HALK PİLAVLIK PİRİNÇ 2,5KG	8.902	10
129	EVİN AYÇİÇEKYAĞI 2LT	8.862	8
130	PEKİ MEYVELİ KEK 40 GR	8.855	26
131	HALK KIRMIZI MERCİMEK 1KG	8.844	11
132	AMİGO KABAK ÇEKİRDEĞİ 200 GR	8.795	17
133	CROWN MANDALINA 1,5L	8.759	5
134	BALKÜPÜ ŞEKER 1000GR	8.752	7
135	ÜLKER NAPOLİTEN 33 GR.	8.735	14
136	BEYBI EKONOMIK ELDIVEN 8-8,5	8.731	24

102	FİLİZ TEL ŞEHRİYE 500 GR.	2.976	9
103	MANTISERİ ERİŞTE 500GR	2.181	9
104	BİZİM OSMANCIK PİRİNÇ 2,5KG	15.710	10
105	HALK BALDO PİRİNÇ 1KG.	9.343	10
106	HALK BALDO PİRİNÇ 2,5KG.	9.014	10
107	HALK PİLAVLIK PİRİNÇ 2,5KG	8.902	10
108	HALK PİLAVLIK PİRİNÇ 1KG	8.355	10
109	BİZİM BALDO PİRİNÇ 2,5KG	3.448	10
110	BİZİM BALDO PİRİNÇ 1KG	3.345	10
111	HALK PİLAVLIK BULGUR 1KG	11.108	11
112	HALK KÖFTELİK BULGUR 1KG	9.004	11
113	HALK KIRMIZI MERCİMEK 1KG	8.844	11
114	HALK KURUFASULYE 1KG	5.272	11
115	PİYALE İRMİK 500 GR	3.966	11
116	HALK NOHUT 1KG	3.429	11
117	HALK YEŞİL MERCİMEK 1KG	3.090	11
118	BİZİM PİLAVLIK BULGUR 1 KG	2.941	11
119	BİZİM PİLAVLIK BULGUR 2.5KG	2.840	11
120	BİZİM DERMASON FASULYE 1 KG	1.722	11
121	BİZİM MUTFAK KIRMIZI MERCİMEK1000GR	1.543	11
122	HALK BARBUNYA 1KG	764	11
123	DEREN DEMLİK 48Lİ POŞET	8.726	12
124	DEREN BARDAK POŞET 25Lİ	8.421	12
125	DEREN ÇAY RİZE 1000GR	8.207	12
126	ÇAYKUR TİRYAKİ ÇAYI 1000 GR.	7.197	12
127	ÇAYKUR RİZE TURİST ÇAY 1000 GR	6.633	12
128	DOĞADAN GELENEKSEL KARADENİZ ÇAY 1000 GR	6.300	12
129	LİPTON YELLOW LABEL ÇAY 1000 GR	6.100	12
130	DEREN ÇAY HARMAN 1000GR	5.822	12
131	DEREN FİLİZ ÇAY 500GR	4.922	12
132	LİPTON YELLOW LABEL BARDAK POŞET ÇAY 25LI	4.654	12
133	LİPTON DOĞU KARADENİZ ÇAYI 1000 GR	3.920	12
134	ÇAYKUR FİLİZ ÇAY 500 GR.	3.862	12
135	DEREN BERGAMOT AROMALI 500GR	3.474	12
136	DOĞUŞ FİLİZ ÇAYI 1000 GR	2.663	12

137	FAIRY BULAŞIK SIVISI 750 ML	8.727	22	137	LIPTON YELLOW LABEL DEMLIK POSET CAY 100LU 320 GR	2.284	12
138	DEREN DEMLİK 48Lİ POŞET	8.726	12	138	ÇAYKUR TOMURCUK ÇAYI 125 GR.	1.997	12
139	ETİ YULAFLI 133 GR.	8.706	15	139	DEREN IHLAMUR 20Lİ POŞET	1.939	12
140	NESCAFE 2Sİ 1 ARADA 14 GR	8.536	13	140	ÇAYKUR ÇAY ÇİÇEĞİ 500 GR.	1.820	12
141	NESTLE ANTEP FIST.DAMAK KARE 80 GR.	8.444	14	141	DEREN YEŞİLÇAY 20Lİ POŞET	1.776	12
142	DEREN BARDAK POŞET 25Lİ	8.421	12	142	ÇAYKUR KAMELYA ÇAY 500 GR.	1.742	12
143	TEMPO FİNGER BISKÜVI 450GR	8.391	15	143	DOĞUŞ BLACK LABEL DEMLIK POŞET ÇAY 100LU	1.656	12
144	HALK PİLAVLIK PİRİNÇ 1KG	8.355	10	144	DEREN YEŞİLÇAY BERGAMOT 20Lİ	1.593	12
145	DR.OETKER INSTANT MAYA 30 GR.	8.284	33	145	DEREN KUŞBURNU 20Lİ POŞET	1.440	12
146	BEYAZ GÜVERCİN PEÇETE 200 YP	8.279	25	146	ÇAYKUR RİZE TURİST ÇAY 100 GR	1.285	12
147	SELPAK HAVLU 8LI	8.241	25	147	NESCAFE 3Ü 1 ARADA 18 GR.	17.209	13
148	SOLO HAVLU 6LI	8.218	25	148	CAFE CROWN LATE 17GR	11.418	13
149	DEREN ÇAY RİZE 1000GR	8.207	12	149	YEMENELİ TÜRK KAHVESİ 100GR	11.126	13
150	DIXI YABAN GÜLÜ 3KG	8.165	23	150	KURUKAHVECİ MEHMET EFENDİ 100 GR.	11.030	13
151	FİLPA PLASTİK BARDAK 10 LU	8.107	24	151	NESCAFE 2Sİ 1 ARADA 14 GR	8.536	13
152	DORİTOS TACO 190GR	7.942	30	152	NESCAFE 3Ü 1 ARADA 18 GR 10 LU	6.197	13
153	CROWN COLA 1 L	7.818	5	153	CAFE CROWN ACTİON 18GR	6.171	13
154	LAYS KLASİK 165 GR	7.770	30	154	NESCAFE CLASSIC 100 GR.EKONOMIK PAKET	3.998	13
155	SAKA SU MINI SÜNGER BOB 0,33L	7.761	1	155	LEZZCAFE 3Ü 1 ARADA 18GR	3.382	13
156	ÜLKER UZUN BATON FISTIKLI 38 GR	7.718	14	156	NESCAFE GOLD 100 GR EKONOMIK PAKET	2.426	13
157	BİLLUR TUZ İYOTLU 750 GR.	7.695	19	157	LEZZCAFE 3Ü1 ARADA FINDIKLI 18GR	2.287	13
158	FAİRY BULAŞIK MAKİNESİ TABLETİ 42Lİ	7.684	22	158	COFFEE MATE 200 GR EKONOMIK PAKET	2.284	13
159	ETİ BURÇAK 140 GR.	7.661	15	159	CAFE CROWN 3Ü 1 FINDIK 8Lİ	1.826	13
160	ÜLKER COCO STAR SÜTLÜ 56 GR.	7.621	14	160	LEZZCAFE CAPPUCCİNO 18GR	1.414	13
161	KOMİLİ EGE SIZMA 2,5LT	7.572	8	161	LEZZCAFE 2Sİ 1 ARADA 12 GR	787	13
162	ÜLKER 9 KAT FINDIKLI CEP BOY	7.509	28	162	LEZZCAFE GOLD 200 GR	714	13
163	SÜPER MARKUS KİREÇ ÇÖZÜCÜ 900 ML	7.329	23	163	LEZZCAFE COFFEE CREAM 200 GR	636	13
164	CROWN COLA LIGHT 1L	7.271	5	164	KARMEN ANTEP FISTIKLI ÇİKOLATA 80GR	32.596	14
165	FİLİZ SPAGHETTİ MAKARNA 500 GR.	7.265	9	165	ÜLKER SÜTLÜ KARE 80 GR.	28.558	14
166	ÜLKER POŞET BEBE 190 GR.	7.226	15	166	KARMEN SÜTLÜ ÇİKOLATA 80 GR.	27.278	14
167	ÇAYKUR TİRYAKİ ÇAYI 1000 GR.	7.197	12	167	KARMEN BİTTER ÇİKOLATA 80GR	26.321	14
168	AKMİNA C VITAMINLI LIMON 1 LT	7.196	3	168	ÜLKER BİTTER KARE 80 GR.	24.680	14
169	ÜLKER 9 KAT MUZLU CEP BOY	7.171	28	169	KARMEN FINDIKLI ÇİKOLATA 80GR	23.644	14
170	DÖKTÜM ÜZÜM SİRKESİ 500ML	7.125	33	170	KARMEN NUGA BAR 35 GR	21.294	14

171	ÜLKER DANKEK ÇILEKLI 40GR	7.059	26		171	ÜLKER ANTEP FISTIKLI KARE 80 GR.	18.984	14
172	FİLİZ BURGU MAKARNA 500 GR.	7.055	9		172	KARMEN FINDIKLI ÇIKOLATA 40G	12.839	14
173	DR.OETKER KREM ŞANTİ 150 GR.	7.042	33		173	ÜLKER METRO 40 GR.	12.027	14
174	YONCA AYÇİÇEKYAĞI 1 LT.	7.003	8		174	ÜLKER SÜTLÜ FINDIKLI KARE 80 GR.	10.795	14
175	ÜLKER PÖTİBÖR 450 GR.	6.962	15		175	DİDO KARE 50G	10.726	14
176	MİS MEYVE NEKTARI VİŞNE 1000ML	6.917	4		176	ÜLKER NAPOLİTEN 33 GR.	8.735	14
177	ÇEREZZA 3 AL 1.99 TL ÖDE 148 GR.	6.784	30		177	NESTLE ANTEP FIST.DAMAK KARE 80 GR.	8.444	14
178	ÜLKER DANKEK MEYVELİ 40 GR.	6.765	26		178	ÜLKER UZUN BATON FISTIKLI 38 GR	7.718	14
179	KOMİLİ KONFOR KAĞIT HAVLU 3 LÜ	6.693	25		179	ÜLKER COCO STAR SÜTLÜ 56 GR.	7.621	14
180	YUDUM AYÇİÇEKYAĞI 5 LT.	6.641	8		180	ÜLKER CARAMİO SÜTLÜ ÇİKOLATA 40 GR.	6.418	14
181	ÇAYKUR RİZE TURİST ÇAY 1000 GR	6.633	12		181	ÜLKER DİDO 38 GR.	5.576	14
182	ETİ ETİMEK 125 GR.	6.615	18		182	KİNDER CHOCOLATE T4 50 GR	5.240	14
183	TEMPO VANİLYA KREMALI BİSKÜVİ 100GR	6.530	15		183	NESTLE BLACK TAM FISTIKLI BITTER ÇİKOLATA 80 GR.	4.811	14
184	ÜLKER CARAMİO SÜTLÜ ÇİKOLATA 40 GR.	6.418	14		184	NESQUİK BEYAZ ÇİKOLATA DOLGULU SÜTLÜ ÇİKOLATA 31GR	4.566	14
185	CROWN COLA 330 ML KUTU	6.399	5		185	ÜLKER UZUN BATON SÜTLÜ 38GR	4.413	14
186	ÜLKER KREMALI SANDVİÇ 85 GR.	6.368	15		186	NESTLE CRUNCH ÇITIR 35 GR.	3.829	14
187	PRIL SIVI BUL.DET.KLASIK (OPAK) 750 GR	6.311	22		187	ÜLKER METRO 5Lİ 200 GR.	3.258	14
188	DOĞADAN GELENEKSEL KARADENİZ ÇAY 1000 GR	6.300	12		188	DİDO STICK 34 GR	2.830	14
189	AMİGO KARIŞIK KURUYEMİŞ 150 GR	6.265	17		189	ÜLKER UZUN BATON FINDIKLI 38GR	2.472	14
190	MİS MEYVE NEKTARI PORTAKAL 1000ML	6.262	4		190	KİNDER MAXİ CHOCOLATE 21 GR.	2.417	14
191	TEMPO SUSAMLI ÇUBUK KRAKER 50G	6.250	18		191	TADIM TADIMCA ANTEP FISTIKLI 30GR	2.224	14
192	FİLİZ FİYONK MAKARNA 500 GR.	6.227	9		192	ÜLKER DAMLA ÇİKOLATA 250 GR	2.145	14
193	VANISH SIVI LEKE ÇIKARICI PEMBE 2+1-3000ML	6.212	23		193	ELİT ŞEMSIYE SÜTLÜ ÇİKOLATA 30GR	2.131	14
194	NESCAFE 3Ü 1 ARADA 18 GR 10 LU	6.197	13		194	KİNDER SURPRİSE 3LÜ 60 GR.	1.100	14
195	CAFE CROWN ACTİON 18GR	6.171	13		195	ÜLKER HALLEY 10LU 300 GR.	13.621	15
196	VIRA TON BALIGI 2X160 GR.	6.171	33		196	BİSKREM POŞET 140 GR	13.405	15
197	LİPTON YELLOW LABEL ÇAY 1000 GR	6.100	12		197	KARMEN 10LU SÜTLÜ ÇİKOLATALI SANDVİÇ BİSKÜVİ 300G	11.651	15
198	MACDİSH BULAŞIK MAKINESI TUZU 1,5 KG	6.095	22		198	TEMPO PÖTİBÖR BİSKÜVİ 450G	10.569	15
199	TEMPO KREMALI KAKAOLU BİSKÜVİ 100 GR	6.060	15		199	TEMPO POTİBÖR BİSKÜVİ 1KG	9.904	15
200	ALBENİ ATIŞTIRMALIK 72 GR	6.008	16		200	ÜLKER PÖTİBÖR BİSKÜVİ 1 KG.	9.873	15
201	DR OETKER KAKAOLU PUDİNG 154 GR.	5.923	33		201	ETİ YULAFLI 133 GR.	8.706	15
202	DEREN ÇAY HARMAN 1000GR	5.822	12		202	TEMPO FİNGER BISKÜVI 450GR	8.391	15

203	SEK ÇİLEKLİ SÜT 200 ML.	5.798	2	203	ETİ BURÇAK 140 GR.	7.661	15
204	PİYALE PUDRA ŞEKERİ 250GR	5.743	7	204	ÜLKER POŞET BEBE 190 GR.	7.226	15
205	KNORR EZOGELİN ÇORBASI 80 GR.	5.663	34	205	ÜLKER PÖTİBÖR 450 GR.	6.962	15
206	AMİGO TUZLU FISTIK 200 GR	5.660	17	206	TEMPO VANİLYA KREMALI BİSKÜVİ 100GR	6.530	15
207	DR.OETKER HAMUR KABARTMA TOZU 5Lİ 50 GR.	5.652	33	207	ÜLKER KREMALI SANDVİÇ 85 GR.	6.368	15
208	ÜLKER ÇIKOLATALI PUDİNG 115G	5.639	33	208	TEMPO KREMALI KAKAOLU BİSKÜVİ 100 GR	6.060	15
209	ETİ TUTKU MOZAİK BİSKÜVİ KAKAO KREMALI 120GR.	5.637	15	209	ETİ TUTKU MOZAİK BİSKÜVİ KAKAO KREMALI 120GR.	5.637	15
210	BREF POWER AKTİV KLOZET BLOĞU	5.633	23	210	KARMEN SÜTLÜ ÇİKOLATALI SANDVİÇ BİSKÜVİ 30G	4.993	15
211	FİLİZ KELEBEK MAKARNA 500 GR.	5.603	9	211	ÜLKER HANIMELLER ASORTİ POŞET 210 GR.	4.821	15
212	ÜLKER DİDO 38 GR.	5.576	14	212	ÜLKER ÇOKOSANDVİÇ 10LU 280 GR.	4.542	15
213	PORCOZ PAS VE KIREC COZUCU 1 LT	5.526	23	213	ETI CANGA 5LI 140 GR	4.062	15
214	BALKÜPÜ TOZ ŞEKER 3 KG	5.485	7	214	ÜLKER HAYLAYF 75 GR.	4.028	15
215	NUTELLA 400 GR.	5.469	20	215	RONDO KLASIK MUZ 75 GR	3.748	15
216	PERWOLL 1,8 LT SIYAH	5.456	23	216	TEMPO LİFLİ KLASİK BİSKÜVİ 155GR	3.363	15
217	DÖKTÜM ELMA SIRKESİ 500ML	5.434	33	217	TEMPO SANDVİÇ BİSKÜVİ 300GR	3.357	15
218	ACE EL VE MATIK ÇAMASIR SUYU 1000 LT	5.415	23	218	ÜLKER MİNİ HALLEY 77 GR.	3.062	15
219	ÜLKER ÇOKOMEL 6 ADET	5.388	16	219	ÜLKER ALTINBAŞAK LIGHT YULAFLI 46 GR.	2.907	15
220	VERNEL 2 LT YUMUŞATICI KARMA	5.384	23	220	ÜLKER ÇOKOSANDVİÇ 28 GR.	2.904	15
221	AMİGO BADEM 150 GR	5.359	17	221	ÜLKER İKRAM BİSKÜVİ ÇİKOLATALI 100 GR.	2.875	15
222	DANKEK MİNİ EVKEK HAVUÇ-TARÇ.40GR	5.351	26	222	ÜLKER BİSKREM RULO 120 GR.	2.565	15
223	YONCA AYÇİÇEKYAĞI 2 LT.	5.328	8	223	ÜLKER İKRAM BİSKÜVİ FINDIK KREMALI 100 GR.	2.382	15
224	ÜLKER 9KAT GOFRET MUZLU 50 GR.	5.309	28	224	MAGIC BAKE KEDİ DİLİ BİSKÜVİ 200GR	2.069	15
225	HALK KURUFASULYE 1KG	5.272	11	225	ÜLKER MAVI YEŞIL KAKAO KRM.KEPEKLİ BİSKÜVİ 90GR	1.370	15
226	KİNDER CHOCOLATE T4 50 GR	5.240	14	226	ÜLKER MAVİ-YEŞİL BİSKÜVİ LİMON LİFLİ 50 GR.	914	15
227	ÜLKER KEKSTRA JÖLEBOL MIX	5.186	26	227	KARMEN HİNDİSTAN CEVİZLİ BAR 25G	14.577	16
228	YUMOŞ EXTRA 720 ML	5.030	23	228	ÜLKER ALBENİ 40 GR.	10.228	16
229	TADIM AY ÇEKİRDEĞİ 1 TL	5.013	17	229	ALBENİ ATIŞTIRMALIK 72 GR	6.008	16
230	KNORR ŞEHRİYELİ TAVUK ÇORBASI 58 GR.	4.997	34	230	ÜLKER ÇOKOMEL 6 ADET	5.388	16
231	KARMEN SÜTLÜ ÇİKOLATALI SANDVİÇ BİSKÜVİ 30G	4.993	15	231	ÜLKER KELLOGS COCO POPS TOPLARI 450 GR.	4.955	16
232	CROWN GAZOZ 330 ML KUTU	4.967	5	232	ALBENİ TANE TANE 50G	4.353	16
233	ÜLKER KELLOGS COCO POPS TOPLARI 450 GR.	4.955	16	233	ALBENİ STICKS 47 GR	4.296	16
234	ETİ BROWNİ GOLD KAKAO SOSLU ÇİK. 9LU 180 GR.	4.945	26	234	ÜLKER ÇOKOPRENS ATIŞTIRMALIK 73 GR.	3.412	16
235	DEREN FİLİZ ÇAY 500GR	4.922	12	235	ETİ CİN LOKMALIK 112 GR	3.256	16

236	BAHARELL YUMUŞATICI 3 LT ÇİÇEK	4.884	23	236	NESQUİK MISIR GEVREĞİ 375 GR.	3.208	16
237	AMİGO FINDIK İÇİ 150 GR	4.873	17	237	YUPO JELLY M.BAHÇESİ 80GR+80GR AYICIK HEDİYE	2.580	16
238	ÜLKER HANIMELLER ASORTİ POŞET 210 GR.	4.821	15	238	YUPO JELLY JUNGLE 80GR+80GR AYICIK HEDİYE	2.518	16
239	NESTLE BLACK TAM FISTIKLI BITTER ÇİKOLATA 80 GR.	4.811	14	239	KENT OLİPS MENTOLLÜ ŞEKER 45 GR.	2.489	16
240	AMİGO ANTEPFISTIK 200 GR	4.770	17	240	KENT TOPİTOP POŞET 8 Lİ	2.231	16
241	SEK MUZLU SÜT 200 ML.	4.749	2	241	YUPO JELLY KOLA 80GR+80GR AYICIK HEDİYE	2.017	16
242	CHEETOS KIVIR KIVIR 54 GR	4.743	30	242	ÜLKER ALBENI-METRO MINI POŞET	1.992	16
243	TURSILMATIK 1KG KIR ÇIÇEĞİ	4.731	21	243	NESTLE POLO ORIGINAL 34 GR.	1.555	16
244	LİPTON YELLOW LABEL BARDAK POŞET ÇAY 25LI	4.654	12	244	NESTLE NESFİT 250 GR.	1.456	16
245	ÜLKER ÇOKOKREM TÜP 40 GR.	4.650	20	245	ÜLKER SPECIAL K KIRM. MEY. VE KARIŞIK MEY. KARMA	1.355	16
246	DANKEK ÇAY SAATI MOZAIK 220 GR	4.628	26	246	KREMİNİ MEY.PASTA ÇİLEK&M.LİMONU 65G	911	16
247	CAPRİ SUN MİX 200 ML.	4.603	4	247	ARI CHOCO KAKAO KAPLI ÇUBUK 170 G	826	16
248	DORITOS NACHO SÜPER BOY	4.579	30	248	AMİGO AYÇEKİRDEĞİ 150 GR	13.484	17
249	FİLİZ ARPA ŞEHRİYE 500 GR.	4.574	9	249	AMİGO AYÇEKİRDEĞİ 400 GR	13.142	17
250	NESQUİK BEYAZ ÇİKOLATA DOLGULU SÜTLÜ ÇİKOLATA 31GR	4.566	14	250	AMİGO BOL TUZLU AYÇEKİRDEĞİ 150 GR	12.235	17
251	ÜLKER ÇOKOSANDVİÇ 10LU 280 GR.	4.542	15	251	AMİGO KABAK ÇEKİRDEĞİ 200 GR	8.795	17
252	DÖKTÜM LIMON SOSU 500 ML	4.511	33	252	AMİGO KARIŞIK KURUYEMİŞ 150 GR	6.265	17
253	LAVAGRİ LAVAŞ 840GR	4.497	33	253	AMİGO TUZLU FISTIK 200 GR	5.660	17
254	CARMEN TEMİZLİK BEZİ 3LÜ	4.466	24	254	AMİGO BADEM 150 GR	5.359	17
255	AMİGO SARI LEBLEBİ 200 GR	4.453	17	255	TADIM AY ÇEKİRDEĞİ 1 TL	5.013	17
256	SERİN BAHÇE SALATA TURŞU 680GR	4.416	33	256	AMİGO FINDIK İÇİ 150 GR	4.873	17
257	ÜLKER UZUN BATON SÜTLÜ 38GR	4.413	14	257	AMİGO ANTEPFISTIK 200 GR	4.770	17
258	KOMİLİ ISLAK MENDİL 15 YP.	4.388	25	258	AMİGO SARI LEBLEBİ 200 GR	4.453	17
259	ALBENİ TANE TANE 50G	4.353	16	259	AMİGO BEYAZ LEBLEBİ 200GR	4.310	17
260	AMİGO BEYAZ LEBLEBİ 200GR	4.310	17	260	AMİGO CEVİZ İÇİ 200 GR	3.660	17
261	ALBENİ STICKS 47 GR	4.296	16	261	AMİGO KIZARMIŞ YERFISTIĞI 150 GR	3.451	17
262	KNORR KREMALI TAVUK ÇORBASI 69 GR.	4.294	34	262	TADIM AYÇEKİRDEK BOL TUZLU 1TL	3.336	17
263	DANKEK ÇAY SAATI MEYVELI 220 GR.	4.284	26	263	AMİGO KAJU CEVİZİ 150 GR	3.032	17
264	DOĞANAY ŞALGAM SUYU ACILI 1000 ML	4.218	33	264	TADIM TUZLU FISTIK 200 GR.	1.695	17
265	HONEYBANA 40GR	4.210	20	265	TADIM KOKTEYL 200 GR.	1.299	17
266	ETİ BROWNI INTENSE 114 GR.	4.147	26	266	TADIM FINDIK İÇİ 200 GR.	1.196	17
267	KNORR MERCİMEK ÇORBASI 76 GR.	4.122	34	267	PEYMAN GÜNKURUSU KAYISI 200 GR.	892	17
268	ETI CANGA 5LI 140 GR	4.062	15	268	PEYMAN BAHÇEDEN ÇİĞ BADEM 180 GR	892	17
269	TAŞKALE TAHİN 300GR	4.061	20	269	PEYMAN KURU KAYISI 200 GR.	871	17

270	PINAR SÜT 500 ML.	4.057	2	270	PEYMAN İÇ CEVİZ 135 GR.	764	17
271	İÇİM SÜT 200 ML	4.032	2	271	PEYMAN BAHÇEDEN KURU ERİK 200GR	725	17
272	ÜLKER HAYLAYF 75 GR.	4.028	15	272	PEYMAN BAHÇEDEN ÇİĞ FINDIK 180 GR	703	17
273	ÜLKER BADEM KRAKER 35 GR	4.024	18	273	ÜLKER ÇUBUK KRAKER 36 GR.	18.703	18
274	TAT KETÇAP 500 GR	4.017	33	274	ÜLKER ÇİZİ KRAKER SADE 65 GR.	11.618	18
275	PİYALE PİRİNÇ UNU 250 GR	4.010	6	275	TEMPO TUZLU ÇUBUK KRAKER 150GR	10.037	18
276	PİYALE BUĞDAY NİŞASTA 200GR	4.008	6	276	ETİ ETİMEK 125 GR.	6.615	18
277	CALGONİT POWERBALL 90LI TABLET	4.003	23	277	TEMPO SUSAMLI ÇUBUK KRAKER 50G	6.250	18
278	NESCAFE CLASSIC 100 GR.EKONOMIK PAKET	3.998	13	278	ÜLKER BADEM KRAKER 35 GR	4.024	18
279	SILVER HAZNELI PARLATICI SÜNGER (NATUREL)	3.991	24	279	ÜLKER GRİSİNİ KEPEKLİ 125 GR.	3.175	18
280	LEZZETİX ÇİĞ KÖFTE SET	3.989	33	280	ÜLKER CİCİ BALIK KRAKER 35 GR.	3.059	18
281	PİYALE İRMİK 500 GR	3.966	11	281	ÜLKER ÇİZİ PEYNİRLİ ÇUBUK KRAKER 50G	2.403	18
282	LİPTON DOĞU KARADENİZ ÇAYI 1000 GR	3.920	12	282	ÜLKER MAVİ-YEŞİL LIGHT MISIR VE PİRİNÇ ÇITIRI 40 G	1.775	18
283	CARMEN BULAŞIK SÜNGERİ 3LÜ OLUKLU	3.886	24	283	ÜLKER MAVİ-YEŞİL LİGHT KEPEKLİ ÇUBUK KRAKER 3LÜ	1.229	18
284	ÇAYKUR FİLİZ ÇAY 500 GR.	3.862	12	284	PEYMAN NUTTZ BARBEKÜ MISIR ÇEREZİ 125 GR	750	18
285	NESTLE CRUNCH ÇITIR 35 GR.	3.829	14	285	YILLAR TUZ 750 GR.	11.090	19
286	EVİN MISIR YAĞI 2LT	3.794	8	286	BİLLUR TUZ İYOTLU 750 GR.	7.695	19
287	KOMİLİ KONFOR PEÇETE 100 LÜ	3.791	25	287	ÜLKER ÇOKOKREM 500 GR	14.740	20
288	MANTISERİ MANTI 500GR	3.772	9	288	NUTELLA 750 GR	10.236	20
289	DANKEK 8 KEK KARMA	3.755	26	289	NUTELLA 400 GR.	5.469	20
290	FASLI BAHARPUL KIRMIZI BİBER 50 GR	3.754	27	290	ÜLKER ÇOKOKREM TÜP 40 GR.	4.650	20
291	RONDO KLASIK MUZ 75 GR	3.748	15	291	HONEYBANA 40GR	4.210	20
292	AMİGO CEVİZ İÇİ 200 GR	3.660	17	292	TAŞKALE TAHİN 300GR	4.061	20
293	CALVE KETÇAP-MAYONEZ SET	3.626	33	293	BOLTANE EKSTRA GELENEKSEL ÇİLEK REÇELİ 385GR	2.936	20
294	ETİ BROWNI INTENSE MİNİ POŞET 144 GR	3.616	26	294	FİSKOBİRLİK SÜTLÜ FINDIK EZME 450GR	2.784	20
295	DR.OETKER BİTTER ÇİKOLATALI PUDİNG 111 GR.	3.605	33	295	ÖZKOVAN SÜZME ÇİÇEK BALI 850GR	2.644	20
296	MR. MUSCLE BANYO-MUTFAK 500 ML KARMA	3.585	23	296	KOSKA SADE HELVA PAKET 500 GR	2.534	20
297	CIF KREM AMONYAKLI 750 ML.	3.564	23	297	BOLTANE EKSTRA GELENEKSEL VİŞNE REÇELİ 385GR	2.339	20
298	HUGGİES ISLAK HAVLU 3LU PAKET	3.553	25	298	TAŞKALE ÜZÜM PEKMEZİ 400GR	2.222	20
299	LAYS BAHARAT SÜPER BOY	3.521	30	299	BOLTANE EKSTRA GELENEKSEL BÖĞÜRTLEN REÇELİ 385GR	1.576	20
300	CHEETOS MİNİ SÜT MISIRI ÇEŞNİL MİNİ BOY 18 GR.	3.509	30	300	BALPARMAK ÇİÇEK BALI 460 GR.	1.536	20
301	DEREN BERGAMOT AROMALI 500GR	3.474	12	301	BOLTANE EKSTRA GELENEKSEL AHUDUDU REÇELİ 385GR	1.464	20
302	ÇAMLICA GAZOZ 250 ML. CAM ŞİŞE	3.471	5	302	FİSKOBİRLİK FINDIK EZMESİ 320 GR	1.427	20

303	PİYALE GALETA UNU 250GR	3.464	6
304	ÜLKER DANKEK MOZAIK 35 GR	3.462	26
305	AMİGO KIZARMIŞ YERFISTIĞI 150 GR	3.451	17
306	BİZİM BALDO PİRİNÇ 2,5KG	3.448	10
307	HALK NOHUT 1KG	3.429	11
308	ÜLKER ÇOKOPRENS ATIŞTIRMALIK 73 GR.	3.412	16
309	HEAD &SHOULDERS KOP.DK.KARŞI400 ML	3.402	32
310	KNORR KREMALI DOMATES ÇORBASI 74 GR.	3.393	34
311	DÖKTÜM KETÇAP 750GR	3.383	33
312	LEZZCAFE 3Ü 1 ARADA 18GR	3.382	13
313	DOVE SAMPUAN 700 MLNEMLENDIRICI VE BES.BAKIM	3.366	32
314	TEMPO LİFLİ KLASİK BİSKÜVİ 155GR	3.363	15
315	YONCA SALÇA 830 GR(28-30BRIX)	3.359	33
316	TEMPO SANDVİÇ BİSKÜVİ 300GR	3.357	15
317	BİZİM BALDO PİRİNÇ 1KG	3.345	10
318	ALBENİ KEK 3 LÜ	3.336	26
319	TADIM AYÇEKİRDEK BOL TUZLU 1TL	3.336	17
320	DR.OETKER ŞEKERLİ VANİLİN 5Lİ 50 GR.	3.334	33
321	COLGATE UCLU ETKI DIS MAC.125 ML//191 GR	3.333	31
322	CARMEN MİKROFİBER BEZ	3.329	24
323	KNORR KREMALI MANTAR ÇORBASI 68 GR.	3.315	34
324	DOVE SAMPUAN TERAPİ 700ML	3.313	32
325	ÜLKER METRO 5Lİ 200 GR.	3.258	14
326	ETİ CİN LOKMALIK 112 GR	3.256	16
327	TUKAŞ DOMATES SALÇASI 700 GR CAM	3.226	33
328	PİYALE MISIR UNU 250GR	3.210	6
329	NESQUİK MISIR GEVREĞİ 375 GR.	3.208	16
330	ÜLKER GRİSİNİ KEPEKLİ 125 GR.	3.175	18
331	SAHİL(30020) ÇAY BARDAK 6 LI	3.156	24
332	PİYALE MISIR NİŞASTA 200GR	3.153	6
333	SUPERFRESH BEZELYE 830 GR	3.142	33
334	RUFFLES PEYNİR SOĞAN SÜPER BOY	3.137	30

303	ÖZKOVAN SÜZME ÇİÇEK BALI 460GR	1.245	20
304	PEHLİVAN CEVİZLİ HELVA 500GR	1.144	20
305	KOSKA TAHİN CAM KAVANOZ 300 GR.	1.070	20
306	ÖZKOVAN ÇAM BALI 460 GR	979	20
307	KOSKA PEKMEZ CAM KAVANOZ 380 GR.	946	20
308	KOSKA KAKAOLU HELVA PAKET 500 GR	768	20
309	TURSILMATIK 8 KG	78.000	21
310	RİNSO KIR BAHÇESİ 5 KG	71.882	21
311	ALOMATİK 5KG KAR ÇİÇEĞİ	68.990	21
312	PERSİL GOLD VE GÜLÜN BÜYÜSÜ 8 KG	68.627	21
313	ARİEL DAĞ ESİNTİSİ 5 KG	49.544	21
314	RİNSO 10 KG KIR ÇİÇEKLERİ	26.320	21
315	OMO 5KG ACTIVE FRESH	20.182	21
316	VERNELGÜLÜN BÜYÜSÜ 6 LT	13.409	21
317	TURSILMATIK 1KG KIR ÇIÇEĞI	4.731	21
318	OMOMATIK COLOR 1.5KG	2.931	21
319	OMOMATIK ACTIVE FRESH 1.5KG	2.647	21
320	CALGON KIREC ONLEYICI 500 GR	2.232	21
321	ARIEL DAG ESINTISI 1.5 KG	1.845	21
322	ARİEL PROFFESİNAL NORMAL 500 ML	1.783	21
323	OMO LIKIT 525 ML ACTIVE	633	21
324	PRIL SIVI BULASIK DETERJANI LİMON 6 LT	35.249	22
325	FAIRY BULAŞIK SIVISI 750 ML	8.727	22
326	FAİRY BULAŞIK MAKİNESİ TABLETİ 42Lİ	7.684	22
327	PRIL SIVI BUL.DET.KLASIK (OPAK) 750 GR	6.311	22
328	MACDİSH BULAŞIK MAKINESI TUZU 1,5 KG	6.095	22
329	MISSFLORA BULAŞIK MAKİNESİ KOKUSU	2.849	22
330	FINISH TUZ 2 KG	2.428	22
331	PRİL JEL BULAŞIK DETERJANI 1.5 LT	1.736	22
332	FİNİSH 28+7 BULAŞIK TABLETİ HEPSİ 1 ARADA	1.525	22
333	FINISH QUANTUM BUL.MAK.TAB. DET.40 + 10	361	22
334	DOMESTOS DAG ESINTISI 4 KG	16.629	23

335	KAV KİBRİT 10LU PAKET	3.100	24	335	DOMESTOS DAĞ ESINTISI 810 GR	10.390	23
336	HALK YEŞİL MERCİMEK 1KG	3.090	11	336	DIXI YABAN GÜLÜ 3KG	8.165	23
337	CAMSİL MATİK 1 LT.	3.063	23	337	SÜPER MARKUS KİREÇ ÇÖZÜCÜ 900 ML	7.329	23
338	ÜLKER MİNİ HALLEY 77 GR.	3.062	15	338	VANISH SIVI LEKE ÇIKARICI PEMBE 2+1-3000ML	6.212	23
339	ÜLKER CİCİ BALIK KRAKER 35 GR.	3.059	18	339	BREF POWER AKTİV KLOZET BLOĞU	5.633	23
340	SÜPER MARKUS LAVABO AÇICI 2*80 GR	3.057	23	340	PORCOZ PAS VE KIREC COZUCU 1 LT	5.526	23
341	HIZIR USTA BARBUNYAPİLAKİ 400	3.034	33	341	PERWOLL 1,8 LT SIYAH	5.456	23
342	AMİGO KAJU CEVİZİ 150 GR	3.032	17	342	ACE EL VE MATIK ÇAMASIR SUYU 1000 LT	5.415	23
343	KEYİFLİ MANGAL KÖMÜRÜ 2,5 KG.	3.025	24	343	VERNEL 2 LT YUMUŞATICI KARMA	5.384	23
344	COLA TURKA 500 ML	3.024	5	344	YUMOŞ EXTRA 720 ML	5.030	23
345	SUPERFRESH GARNITÜR 330 GR	3.011	33	345	BAHARELL YUMUŞATICI 3 LT ÇİÇEK	4.884	23
346	MİS 500 ML UHT YAĞLI SÜT	3.009	2	346	CALGONİT POWERBALL 90LI TABLET	4.003	23
347	FİLİZ TEL ŞEHRİYE 500 GR.	2.976	9	347	MR. MUSCLE BANYO-MUTFAK 500 ML KARMA	3.585	23
348	TAT MAYONEZ 415 GR	2.955	33	348	CIF KREM AMONYAKLI 750 ML.	3.564	23
349	CHEETOS 3LÜ PAKET 3X23 GR.	2.951	30	349	CAMSİL MATİK 1 LT.	3.063	23
350	MİS UHT KREMA 200 ML	2.945	33	350	SÜPER MARKUS LAVABO AÇICI 2*80 GR	3.057	23
351	BİZİM PİLAVLIK BULGUR 1 KG	2.941	11	351	CIF BANYO+MUTFAK JEL SET (%20INDIRIMLI)	2.753	23
352	BEYAZ GÜVERCİN MENDİL 10LU	2.939	25	352	CİF AKTİF KALKAN BANYO SPREY 500 ML	2.230	23
353	BOLTANE EKSTRA GELENEKSEL ÇİLEK REÇELİ 385GR	2.936	20	353	CİF AKTİF KALKAN MUTFAK SPREY 500 ML	2.226	23
354	S&A ODA PARFÜMÜ YEDEK 300 ML	2.934	24	354	MACLAUD KİREÇ ÖNLEYİCİ 500 GR	1.810	23
355	OMOMATIK COLOR 1.5KG	2.931	21	355	BEYBI EKONOMIK ELDIVEN 8-8,5	8.731	24
356	ÜLKER ALTINBAŞAK LIGHT YULAFLI 46 GR.	2.907	15	356	FİLPA PLASTİK BARDAK 10 LU	8.107	24
357	ÜLKER ÇOKOSANDVİÇ 28 GR.	2.904	15	357	CARMEN TEMİZLİK BEZİ 3LÜ	4.466	24
358	ÜLKER İKRAM BİSKÜVİ ÇİKOLATALI 100 GR.	2.875	15	358	SILVER HAZNELI PARLATICI SÜNGER (NATUREL)	3.991	24
359	MISSFLORA BULAŞIK MAKİNESİ KOKUSU	2.849	22	359	CARMEN BULAŞIK SÜNGERİ 3LÜ OLUKLU	3.886	24
360	AIRWICK YEDEK 3LÜ B.ÇİÇEKLERİ	2.847	24	360	CARMEN MİKROFİBER BEZ	3.329	24
361	BİZİM PİLAVLIK BULGUR 2.5KG	2.840	11	361	SAHİL(30020) ÇAY BARDAK 6 LI	3.156	24
362	PİYALE HAM.KABARTMA TOZU 5X10GR	2.839	33	362	KAV KİBRİT 10LU PAKET	3.100	24
363	DİDO STICK 34 GR	2.830	14	363	KEYİFLİ MANGAL KÖMÜRÜ 2,5 KG.	3.025	24
364	FİSKOBİRLİK SÜTLÜ FINDIK EZME 450GR	2.784	20	364	S&A ODA PARFÜMÜ YEDEK 300 ML	2.934	24
365	CIF BANYO+MUTFAK JEL SET (%20INDIRIMLI)	2.753	23	365	AIRWICK YEDEK 3LÜ B.ÇİÇEKLERİ	2.847	24
366	SAROZ BÜZGÜLÜ ÇÖP TORBASI	2.739	24	366	SAROZ BÜZGÜLÜ ÇÖP TORBASI	2.739	24

367	CHEWY YEŞİL NANELİ SAKIZ 21 GR	2.737	29	367	TOKAI KULLAN-AT ÇAKMAK T-M12L	2.531	24
368	TUKAŞ DOMATES SALÇASI 830 GR	2.736	33	368	MAXELL R06 ÇİNKO 4LÜ KALEM PİL	2.332	24
369	LAYS FIRINDAN SÜPER BOY 118 GR	2.701	30	369	S&A ODA VE KUMAŞ PARFÜMÜ SPREY	2.250	24
370	DOĞUŞ FİLİZ ÇAYI 1000 GR	2.663	12	370	FİLPA PLASTİK TABAK 10LU	2.124	24
371	FIRST SENSATIONS KARPUZ AROMALI 27 GR.	2.659	29	371	MİSSFLORA ODA KOUSU	2.108	24
372	LİO RİVİERA 2LT	2.652	8	372	AIRWICK FRESHMATIC KIT +YEDEK	1.990	24
373	OMOMATIK ACTIVE FRESH 1.5KG	2.647	21	373	SILVER CLASSIC KREM BOYA SİYAH	1.794	24
374	ÜLKER DANKEK ISLAK KEK KARMA 40 GR.	2.646	26	374	TUTTAZE BUZDOLABI POŞETİ 100 LÜ 24*38 CM	1.741	24
375	ÖZKOVAN SÜZME ÇİÇEK BALI 850GR	2.644	20	375	P.BAHÇE (52052) 6LI ALANYA SU BARDAK	1.735	24
376	ÇİZMECİ WAFER MASTER 70 GR	2.630	28	376	ANİRAS TUVALET KOKU GİDERİCİ 2*40GR	1.678	24
377	CHEETOS BIFTEKLI AİLE BOYU 54 GR.	2.620	30	377	SAHİL(ASN314)BYK BOY ÇAY BARDAK	1.651	24
378	YUPO JELLY M.BAHÇESİ 80GR+80GR AYICIK HEDİYE	2.580	16	378	FİLPA PLASTİK ÇATAL 10 LU	1.528	24
379	ÜLKER BİSKREM RULO 120 GR.	2.565	15	379	CALDOZA ERKEK ÇORAP GZN	1.509	24
380	İÇİM HERO BABY DEVAM SÜTÜ 12-36 500 ML	2.538	2	380	MAXELL R03 ÇİNKO 2Lİ İNCE KALEM PİL	1.498	24
381	KOSKA SADE HELVA PAKET 500 GR	2.534	20	381	CARMEN OVMA TOPU 2Lİ	1.467	24
382	TOKAI KULLAN-AT ÇAKMAK T-M12L	2.531	24	382	FİLPA PLASTİK KAŞIK 10 LU	1.405	24
383	SÖKE TAM BUĞDAY UNU 1 KG	2.518	6	383	CALDOZA BAYAN PATIK ÇORAP	1.327	24
384	YUPO JELLY JUNGLE 80GR+80GR AYICIK HEDİYE	2.518	16	384	SWEATSHIRT ŞOK MASTER+PERSONEL+BAYAN	1.256	24
385	HEAD&SHOULDERS SAÇ DÖK.KARŞI ŞAMP.400 ML KADIN	2.502	32	385	MAXELL LR03 ALKALİN 2Lİ İNCE KALEM PİL	1.231	24
386	KENT OLİPS MENTOLLÜ ŞEKER 45 GR.	2.489	16	386	SAKURA ALKALİN KALEM PİL 4LÜ LR6	1.226	24
387	ÜLKER UZUN BATON FINDIKLI 38GR	2.472	14	387	SAKURA ALKALİN İNCE PİL 4LÜ LR3	1.205	24
388	MEDİ SAFE KULAK ÇUBUĞU 200LÜ	2.470	31	388	SAKURA 13W. SPİRAL ENERJİ TAS.AMP.-E27	1.174	24
389	YUDUM AYÇİÇEKYAĞI 1 LT.	2.459	8	389	SERA STREÇ FİLM (33 M)	1.132	24
390	DÖKTÜM ACILI KETÇAP 750GR	2.441	33	390	SWEATSHIRT ŞOK MASTER+PERSONEL+BAY	1.088	24
391	CHEWY DAMLA SAKIZLI 21 GR	2.438	29	391	FİLPA KÖRÜKLÜ KAMIŞ 40LI PAKET	1.076	24
392	FINISH TUZ 2 KG	2.428	22	392	MAXELL LR06 ALKALİN 4LÜ KALEM PİL	1.028	24
393	NESCAFE GOLD 100 GR EKONOMIK PAKET	2.426	13	393	CALDOZA DİZALTI SÜPER İNCE ÇORAP 2 Lİ	978	24
394	KOMİLLİ RİVİERA 2,5LT	2.423	8	394	SAKURA ENERJİ TAS.AMPUL 20WATT	923	24
395	KİNDER MAXİ CHOCOLATE 21 GR.	2.417	14	395	SERA BUZDOLABI POŞETİ ORTA 24X38CM	920	24
396	TAT ACILI KETÇAP 500 GR	2.417	33	396	SERA BUZDOLABI POŞETİ KÜÇÜK 20X30CM	850	24
397	ÜLKER ÇİZİ PEYNİRLİ ÇUBUK KRAKER 50G	2.403	18	397	PANTOLON ŞOK PERSONEL BAYAN	772	24

398	ÜLKER İKRAM BİSKÜVİ FINDIK KREMALI 100 GR.	2.382	15
399	BOLTANE EKSTRA GELENEKSEL VİŞNE REÇELİ 385GR	2.339	20
400	MAXELL R06 ÇİNKO 4LÜ KALEM PİL	2.332	24
401	SERİNBAHÇE KARIŞIKTURŞU 670 GR	2.332	33
402	KNORR KÖFTE HARCI 85 GR.	2.296	33
403	LEZZCAFE 3Ü1 ARADA FINDIKLI 18GR	2.287	13
404	COFFEE MATE 200 GR EKONOMIK PAKET	2.284	13
405	LIPTON YELLOW LABEL DEMLIK POSET CAY 100LU 320 GR	2.284	12
406	LİMOJE LİMON KOLONYASI 400 CC	2.279	31
407	KNORR TAVUKSUYU 120 GR %20 İNDİRİMLİ	2.265	34
408	ÇİZMECİ CREPE GOFRET 70 GR	2.259	28
409	S&A ODA VE KUMAŞ PARFÜMÜ SPREY	2.250	24
410	FASLI BAHARKARABİBER TOZ	2.249	27
411	CALGON KIREC ONLEYICI 500 GR	2.232	21
412	KENT TOPİTOP POŞET 8 Lİ	2.231	16
413	CİF AKTİF KALKAN BANYO SPREY 500 ML	2.230	23
414	CİF AKTİF KALKAN MUTFAK SPREY 500 ML	2.226	23
415	TADIM TADIMCA ANTEP FISTIKLI 30GR	2.224	14
416	TAŞKALE ÜZÜM PEKMEZİ 400GR	2.222	20
417	SERİNBAHÇE A. BİBER 330 GR	2.216	27
418	CHEWY KAVANOZ SAKIZ 60 G	2.202	29
419	FIRST YEŞİL NANE AROM. 14LÜ ŞEKERSİZ SAKIZ 27 GR.	2.196	29
420	MANTISERİ ERİŞTE 500GR	2.181	9
421	FİRST DAMLA SAKIZLI 14LÜ ŞEKERSİZ SAKIZ 27 GR.	2.166	29
422	PİYALE ŞEKERLİ VANİLİN 5Lİ 25GR	2.149	33
423	ÜLKER DAMLA ÇİKOLATA 250 GR	2.145	14
424	ELİT ŞEMSIYE SÜTLÜ ÇİKOLATA 30GR	2.131	14
425	FİLPA PLASTİK TABAK 10LU	2.124	24
426	LUX PEACH&CREAM SEFTALI OZLU 100 GR	2.122	31
427	MİSSFLORA ODA KOUSU	2.108	24
428	MEDİ SAFE PAMUK 100 GR	2.079	31

398	SERA BUZDOLABI POŞETİ BÜYÜK 30X45	760	24
399	CALDOZA ÇOCUK ÇORAP	754	24
400	SERA YAĞLI PİŞİRME KAĞIDI	740	24
401	SERA ALÜMİNYUM FOLYO 15 MT	730	24
402	DURACELL PLUS 4LÜ İNCE KALEM PİL	658	24
403	PANTOLON ŞOK PERSONEL BAY	626	24
404	CARMEN CAM BEZİ	618	24
405	FİLPA LATEX ELDİVEN 50Lİ	616	24
406	KOSLA HALI SAMPUANI 900ML ELDE TEMIZLIK	611	24
407	FİLPA PLASTİK BIÇAK 10 LU	597	24
408	CALDOZA SÜPER İNCE KÜLOTLU	524	24
409	SAKURA 13 WATT FULL SPIRAL 2700K (SARI IŞIK) ENER	506	24
410	DURACELL PLUS 2Lİ KALEM PİL	497	24
411	DURACELL PLUS 4LÜ KALEM PİL	484	24
412	MAESTRO 963 12 X 1 KG. (CAM TEMIZLIK)	427	24
413	PANTOLON ŞOK YÖNETİCİ BAY	314	24
414	GÖMLEK ŞOK YÖNETİCİ BAY	290	24
415	SERA FIRIN TORBASI	235	24
416	PANTOLON ŞOK YÖNETİCİ BAYAN	224	24
417	YELEK ŞOK PERSONEL BAY	193	24
418	GÖMLEK ŞOK YÖNETİCİ BAYAN	184	24
419	YELEK ŞOK PERSONEL BAYAN	118	24
420	BİRKLAS KARTON KLASÖR DAR SİYAH (1 LI)	82	24
421	YUKA KAĞIT HAVLU 4LÜ	61.678	25
422	YUKA TUVALET KAĞIDI 12Lİ	48.322	25
423	BEYAZ GÜVERCİN 8Lİ TUVALET KAĞIDI 3 KAT	29.563	25
424	YUKA PEÇETE 100LÜ	14.669	25
425	KOMİLİ ISLAK HAVLU 90 YP	12.509	25
426	PAPİFRESH ISLAK HAVLU 80Lİ	10.612	25
427	SOLO TUVALET KAGIDI 16 LI	10.295	25
428	KOMİLİ KONFOR TUVALET KAĞIDI 12 Lİ	9.188	25

429	MAGIC BAKE KEDİ DİLİ BİSKÜVİ 200GR	2.069	15
430	PİYALE EZOGELİN ÇORBA 70GR	2.056	34
431	FASLI BAHARKİMYON 50GR	2.056	27
432	ÜLKER ÇİKOLATALI GOFRET - ÇOKONAT POŞET	2.044	28
433	YUPO JELLY KOLA 80GR+80GR AYICIK HEDİYE	2.017	16
434	ÇAYKUR TOMURCUK ÇAYI 125 GR.	1.997	12
435	ÜLKER ALBENI-METRO MINI POŞET	1.992	16
436	AIRWICK FRESHMATIC KIT +YEDEK	1.990	24
437	DOĞANAY ŞALGAM SUYU SADE 1000 ML	1.988	33
438	DÖKTÜM MAYONEZ 650GR	1.979	33
439	KÜHNE SALATALIK TURŞUSU (ACILI VE SARIMSAKLI)	1.965	33
440	DEREN IHLAMUR 20Lİ POŞET	1.939	12
441	ONEO SELECT NANE ŞERİT SAKIZ 33 GR	1.937	29
442	FIRST SENSATIONS MEGA MYSTERY 27 GR	1.931	29
443	DR.OETKER ÇİKOLATA SOSU 128 GR.	1.931	33
444	M.BİRLİK KURU SELE 400 GR.	1.908	35
445	PİYALE ANALI KIZLI 91GR	1.907	34
446	ÜLKER HERO BABY KAVANOZ MIX.	1.870	33
447	ÜLKER KAKAO 50GR	1.845	33
448	ARIEL DAG ESINTISI 1.5 KG	1.845	21
449	LİO SIZMA ZEYTİNYAĞI 5LT	1.836	8
450	DALIN SAMPUAN 750 ML	1.830	32
451	CAFE CROWN 3Ü 1 FINDIK 8Lİ	1.826	13
452	ÇAYKUR ÇAY ÇİÇEĞİ 500 GR.	1.820	12
453	DÖKTÜM NAR EKŞİLİ SOSU 350GR	1.815	33
454	MACLAUD KİREÇ ÖNLEYİCİ 500 GR	1.810	23
455	SILVER CLASSIC KREM BOYA SİYAH	1.794	24
456	ARİEL PROFFESİNAL NORMAL 500 ML	1.783	21
457	DEREN YEŞİLÇAY 20Lİ POŞET	1.776	12
458	ÜLKER MAVİ-YEŞİL LIGHT MISIR VE PİRİNÇ ÇITIRI 40 G	1.775	18
459	HIZIR USTA ACI KAH. SOS 320GR	1.769	27
460	ÇAYKUR KAMELYA ÇAY 500 GR.	1.742	12
461	TUTTAZE BUZDOLABI POŞETİ 100 LÜ 24*38 CM	1.741	24

429	BEYAZ GÜVERCİN PEÇETE 200 YP	8.279	25
430	SELPAK HAVLU 8LI	8.241	25
431	SOLO HAVLU 6LI	8.218	25
432	KOMİLİ KONFOR KAĞIT HAVLU 3 LÜ	6.693	25
433	KOMİLİ ISLAK MENDİL 15 YP.	4.388	25
434	KOMİLİ KONFOR PEÇETE 100 LÜ	3.791	25
435	HUGGİES ISLAK HAVLU 3LU PAKET	3.553	25
436	BEYAZ GÜVERCİN MENDİL 10LU	2.939	25
437	KOMİLİ KONFOR MENDİL 10 LU	1.175	25
438	PEKİ MOZAİK KEK 200 GR	17.707	26
439	PEKİ KAKAOLU KEK 200GR	15.268	26
440	PEKİ MEYVELİ KEK 200GR	14.124	26
441	PEKİ MOZAİK KEK 40GR	9.852	26
442	PEKİ KAKAOLU KEK 40 GR	9.235	26
443	ÜLKER DANKEK ÇİKOLATALI 40 GR	8.956	26
444	PEKİ MEYVELİ KEK 40 GR	8.855	26
445	ÜLKER DANKEK ÇILEKLI 40GR	7.059	26
446	ÜLKER DANKEK MEYVELİ 40 GR.	6.765	26
447	DANKEK MİNİ EVKEK HAVUÇ-TARÇ.40GR	5.351	26
448	ÜLKER KEKSTRA JÖLEBOL MIX	5.186	26
449	ETİ BROWNİ GOLD KAKAO SOSLU ÇİK. 9LU 180 GR.	4.945	26
450	DANKEK ÇAY SAATI MOZAIK 220 GR	4.628	26
451	DANKEK ÇAY SAATI MEYVELI 220 GR.	4.284	26
452	ETİ BROWNI INTENSE 114 GR.	4.147	26
453	DANKEK 8 KEK KARMA	3.755	26
454	ETİ BROWNI INTENSE MİNİ POŞET 144 GR	3.616	26
455	ÜLKER DANKEK MOZAIK 35 GR	3.462	26
456	ALBENİ KEK 3 LÜ	3.336	26
457	ÜLKER DANKEK ISLAK KEK KARMA 40 GR.	2.646	26
458	FASLI BAHARPUL KIRMIZI BİBER 50 GR	3.754	27
459	FASLI BAHARKARABİBER TOZ	2.249	27
460	SERİNBAHÇE A. BİBER 330 GR	2.216	27
461	FASLI BAHARKİMYON 50GR	2.056	27

462	PRİL JEL BULAŞIK DETERJANI 1.5 LT	1.736	22
463	P.BAHÇE (52052) 6LI ALANYA SU BARDAK	1.735	24
464	BİZİM DERMASON FASULYE 1 KG	1.722	11
465	HEAD&SHOULDERS KLASIK BAKIM 400 ML SAÇ KREMI	1.699	32
466	TADIM TUZLU FISTIK 200 GR.	1.695	17
467	HOBBY SAÇ JÖLESI PRO-VIT SERT 300 ML	1.689	32
468	ONEO SELECT PORTAKAL AHUDUDU ŞERİT SAKIZ 33 GR	1.686	29
469	ANİRAS TUVALET KOKU GİDERİCİ 2*40GR	1.678	24
470	MALTANA ANANAS AROMALI MALT İÇECEĞİ 270 ML	1.666	5
471	DORITOS FRITOS BARBEKÜ SÜPER BOY	1.658	30
472	ÇEREZZA SİNEMA PEY.VE SOĞ. AROMALI AILE BOY 52GR.	1.658	30
473	FASLI BAHARH.CEVİZİ 40GR	1.658	27
474	DOĞUŞ BLACK LABEL DEMLIK POŞET ÇAY 100LU	1.656	12
475	SAHİL(ASN314)BYK BOY ÇAY BARDAK	1.651	24
476	PİYALE TUTMAÇ ÇORBASI 120 GR	1.649	34
477	ONEO SLİMS YEŞİL NANE 27 GR	1.623	29
478	PİYALE ERİŞTELİ ÇORBA 102 GR	1.610	34
479	PİYALE ET-TAVUK SUYU 80GR	1.598	34
480	DEREN YEŞİLÇAY BERGAMOT 20Lİ	1.593	12
481	KNORR ÇITIR PANE HARCI 90 GR.	1.591	33
482	SERİNBAHÇE BİBERİYE 330 GR	1.585	27
483	ONEO SELECT LİMON KAVUN ŞERİT SAKIZ 33 GR	1.580	29
484	BOLTANE EKSTRA GELENEKSEL BÖĞÜRTLEN REÇELİ 385GR	1.576	20
485	LİO SIZMA ZEYTİNYAĞI 500ML	1.574	8
486	ÜLKER İÇİM MUZ AROMALI SÜT 200 ML.	1.561	2
487	NESTLE POLO ORIGINAL 34 GR.	1.555	16
488	MALTANA ARMUT AROMALI MALT İÇECEĞİ 270 ML	1.551	5
489	FASLI BAHARNANE 20 GR	1.547	27
490	BİZİM MUTFAK KIRMIZI MERCİMEK1000GR	1.543	11
491	BALPARMAK ÇİÇEK BALI 460 GR.	1.536	20
492	URLA ZEYTIN KIRMA 180 GR	1.532	35
493	FİLPA PLASTİK ÇATAL 10 LU	1.528	24
494	FİNİSH 28+7 BULAŞIK TABLETİ HEPSİ 1 ARADA	1.525	22
462	HIZIR USTA ACI KAH. SOS 320GR	1.769	27
463	FASLI BAHARH.CEVİZİ 40GR	1.658	27
464	SERİNBAHÇE BİBERİYE 330 GR	1.585	27
465	FASLI BAHARNANE 20 GR	1.547	27
466	FASLI BAHARKARBONAT 100GR	1.446	27
467	ART TARÇIN ÇUBUK 100GR	1.418	27
468	FASLI BAHAR SUSAM 50 GR	1.327	27
469	FASLI BAHAR KEKİK 20GR	1.255	27
470	FASLI BAHARÇÖREKOTU 50GR	1.028	27
471	FASLI BAHARTARÇIN 40 GR	1.012	27
472	FASLI BAHAR Ç. FISTIĞI 25GR	1.006	27
473	FASLI BAHARKUŞÜZÜMÜ 40 GR	922	27
474	TAT DİJON HARDALI 190 GR.	909	27
475	DUCROS PUL BIBER 35GR	896	27
476	DUCROS H. CEVİZİ 25GR	803	27
477	FASLI BAHARSUMAK 50 GR	792	27
478	DUCROS NANE 12GR	525	27
479	DUCROS KEKİK 12GR	445	27
480	DUCROS KARABİBER 45GR	406	27
481	KNORR ACISSO ACI BIBER SOSU 50 ML	279	27
482	DUCROS DOLMALIK FISTIĞI 23GR	233	27
483	PEKİ KAKAOLU GOFRET 220G	13.587	28
484	ÜLKER ÇİKOLATALI GOFRET 35 GR.	13.514	28
485	KARMEN ÇİKOLATA GOFRET 38G	11.327	28
486	PEKİ KÜP GOFRET 225 GR	10.959	28
487	KARMEN FINDIKLI GOFRET 32GR	10.898	28
488	ÜLKER 9 KAT FINDIKLI GOFRET 50 GR.	9.342	28
489	ÜLKER ÇOKONAT 32 GR.	9.302	28
490	ÜLKER ÇİKOLATALI GOFRET 5Lİ 175 GR.	9.168	28
491	ALPELLA 3 GEN BEYAZ ÇİKOLATALI GOFRET 32GR	8.980	28
492	ÜLKER 9 KAT FINDIKLI CEP BOY	7.509	28
493	ÜLKER 9 KAT MUZLU CEP BOY	7.171	28
494	ÜLKER 9KAT GOFRET MUZLU 50 GR.	5.309	28

495	LİO SIZMA ZEYTİNYAĞI 2LT	1.518	8	495	ÇİZMECİ WAFER MASTER 70 GR	2.630	28
496	CALDOZA ERKEK ÇORAP GZN	1.509	24	496	ÇİZMECİ CREPE GOFRET 70 GR	2.259	28
497	LIO RİVİERA 1 LT	1.507	8	497	ÜLKER ÇİKOLATALI GOFRET - ÇOKONAT POŞET	2.044	28
498	HIZIR USTA YAPRAK SARMA 400GR	1.506	33	498	ÜLKER ÇOKONAT GOFRET 5Lİ 160 GR.	1.268	28
499	MAXELL R03 ÇİNKO 2Lİ İNCE KALEM PİL	1.498	24	499	FALIM DAMLA SAKIZLI ŞEKERSİZ 3LÜ S	12.694	29
500	SUPERFRESH MISIR 3*220 GR	1.483	33	500	CHEWY YEŞİL NANELİ SAKIZ 21 GR	2.737	29
501	CARMEN OVMA TOPU 2Lİ	1.467	24	501	FIRST SENSATIONS KARPUZ AROMALI 27 GR.	2.659	29
502	BOLTANE EKSTRA GELENEKSEL AHUDUDU REÇELİ 385GR	1.464	20	502	CHEWY DAMLA SAKIZLI 21 GR	2.438	29
503	NESTLE NESFİT 250 GR.	1.456	16	503	CHEWY KAVANOZ SAKIZ 60 G	2.202	29
504	FASLI BAHARKARBONAT 100GR	1.446	27	504	FIRST YEŞİL NANE AROM. 14LÜ ŞEKERSİZ SAKIZ 27 GR.	2.196	29
505	DEREN KUŞBURNU 20Lİ POŞET	1.440	12	505	FİRST DAMLA SAKIZLI 14LÜ ŞEKERSİZ SAKIZ 27 GR.	2.166	29
506	FİSKOBİRLİK FINDIK EZMESİ 320 GR	1.427	20	506	ONEO SELECT NANE ŞERİT SAKIZ 33 GR	1.937	29
507	ART TARÇIN ÇUBUK 100GR	1.418	27	507	FIRST SENSATIONS MEGA MYSTERY 27 GR	1.931	29
508	LEZZCAFE CAPPUCCİNO 18GR	1.414	13	508	ONEO SELECT PORTAKAL AHUDUDU ŞERİT SAKIZ 33 GR	1.686	29
509	FİLPA PLASTİK KAŞIK 10 LU	1.405	24	509	ONEO SLİMS YEŞİL NANE 27 GR	1.623	29
510	HIZIR USTA KAHVALTILIK SOS 320GR	1.384	33	510	ONEO SELECT LİMON KAVUN ŞERİT SAKIZ 33 GR	1.580	29
511	ÜLKER MAVI YEŞIL KAKAO KRM.KEPEKLİ BİSKÜVİ 90GR	1.370	15	511	ONEO SLIMS KARPUZ&AHUDUDU 27G	1.322	29
512	ÜLKER SPECIAL K KIRM. MEY. VE KARIŞIK MEY. KARMA	1.355	16	512	ONEO SLIMS DAMLA SAKIZLI ŞEKERSIZ ŞERIT SAKIZ	1.081	29
513	ORKİD ULTRA KANAT. GECE EKO. PK. 14 PED	1.344	31	513	RUFFLES ORIGINALS 165GR	8.968	30
514	TAT TATLI BIBER SALÇASI 550 GR CAM	1.335	33	514	ÇEREZZA POPCORN AİLE BOY 58 GR.	8.943	30
515	M.BİRLİK MİNYON ZEYTİN 500GR.411-460 AD/KG.	1.334	35	515	DORİTOS TACO 190GR	7.942	30
516	CALDOZA BAYAN PATIK ÇORAP	1.327	24	516	LAYS KLASİK 165 GR	7.770	30
517	FASLI BAHAR SUSAM 50 GR	1.327	27	517	ÇEREZZA 3 AL 1.99 TL ÖDE 148 GR.	6.784	30
518	ONEO SLIMS KARPUZ&AHUDUDU 27G	1.322	29	518	CHEETOS KIVIR KIVIR 54 GR	4.743	30
519	KOMİLİ BEBEK ŞAMPUANI NORMAL 500ML	1.305	32	519	DORITOS NACHO SÜPER BOY	4.579	30
520	TADIM KOKTEYL 200 GR.	1.299	17	520	LAYS BAHARAT SÜPER BOY	3.521	30
521	HOBBY SAÇ JÖLESI PRO-VIT ISLAK 300 ML	1.297	32	521	CHEETOS MİNİ SÜT MISIRI ÇEŞNİL MİNİ BOY 18 GR.	3.509	30
522	ÜLKER HERO BABY SÜTLÜ MEYVELİ 8 TAHILLI 500 GR	1.289	33	522	RUFFLES PEYNİR SOĞAN SÜPER BOY	3.137	30
523	TAT DOMATES PÜRESI 200GR	1.288	33	523	CHEETOS 3LÜ PAKET 3X23 GR.	2.951	30
524	BABYSTAR İKİZ PAKET MAXI 40	1.286	31	524	LAYS FIRINDAN SÜPER BOY 118 GR	2.701	30
525	ÇAYKUR RİZE TURİST ÇAY 100 GR	1.285	12	525	CHEETOS BIFTEKLI AİLE BOYU 54 GR.	2.620	30
526	ÜLKER ÇOKONAT GOFRET 5Lİ 160 GR.	1.268	28	526	DORITOS FRITOS BARBEKÜ SÜPER BOY	1.658	30

527	SWEATSHIRT ŞOK MASTER+PERSONEL+BAYAN	1.256	24
528	FASLI BAHAR KEKİK 20GR	1.255	27
529	DR.BEYAZ 1+1 DİŞ FIRÇASI	1.251	31
530	ÖZKOVAN SÜZME ÇİÇEK BALI 460GR	1.245	20
531	KÜHNE ELMA SIRKESİ 500 ML.	1.245	33
532	MAXELL LR03 ALKALİN 2Lİ İNCE KALEM PİL	1.231	24
533	ÜLKER MAVİ-YEŞİL LİGHT KEPEKLİ ÇUBUK KRAKER 3LÜ	1.229	18
534	SAKURA ALKALİN KALEM PİL 4LÜ LR6	1.226	24
535	URLA ZEYTIN KÖY PAÇALI 180 GR	1.225	35
536	PEYMAN KURU ÜZÜM 200 GR.	1.222	33
537	KÜHNE KARIŞIK TURŞU 680GR	1.218	33
538	SAKURA ALKALİN İNCE PİL 4LÜ LR3	1.205	24
539	KNORR YÖRESEL ANALI KIZLI ÇORBASI 92 GR.	1.198	34
540	TADIM FINDIK İÇİ 200 GR.	1.196	17
541	SÖKE KEPEK UNU 1 KG	1.192	6
542	BABY STAR İKİZ PAKET JUNIOR 30	1.185	31
543	KOMİLİ KONFOR MENDİL 10 LU	1.175	25
544	SAKURA 13W. SPİRAL ENERJİ TAS.AMP.-E27	1.174	24
545	AKDEĞİRMEN TUZLU KURU PASTA 500GR	1.162	33
546	PEHLİVAN CEVİZLİ HELVA 500GR	1.144	20
547	SERA STREÇ FİLM (33 M)	1.132	24
548	HEAD&SHOULDERS SAMP.KLASIK BAK 2IN1 400 ML	1.118	32
549	KİNDER SURPRİSE 3LÜ 60 GR.	1.100	14
550	TÜRK HAMAMI KALIP SABUN 4*125 GR	1.096	31
551	SWEATSHIRT ŞOK MASTER+PERSONEL+BAY	1.088	24
552	DR.OETKER SADE KEK KARIŞIMI 450 GR.	1.087	6
553	ONEO SLIMS DAMLA SAKIZLI ŞEKERSIZ ŞERIT SAKIZ	1.081	29
554	FİLPA KÖRÜKLÜ KAMIŞ 40LI PAKET	1.076	24
555	MALTANA ŞEFTALİ AROMALI MALT İÇECEĞİ 270ML	1.076	5
556	KOSKA TAHİN CAM KAVANOZ 300 GR.	1.070	20

527	ÇEREZZA SİNEMA PEY.VE SOĞ. AROMALI AILE BOY 52GR.	1.658	30
528	COLGATE UCLU ETKI DIS MAC.125 ML//191 GR	3.333	31
529	MEDİ SAFE KULAK ÇUBUĞU 200LÜ	2.470	31
530	LİMOJE LİMON KOLONYASI 400 CC	2.279	31
531	LUX PEACH&CREAM SEFTALI OZLU 100 GR	2.122	31
532	MEDİ SAFE PAMUK 100 GR	2.079	31
533	ORKİD ULTRA KANAT. GECE EKO. PK. 14 PED	1.344	31
534	BABYSTAR İKİZ PAKET MAXI 40	1.286	31
535	DR.BEYAZ 1+1 DİŞ FIRÇASI	1.251	31
536	BABY STAR İKİZ PAKET JUNIOR 30	1.185	31
537	TÜRK HAMAMI KALIP SABUN 4*125 GR	1.096	31
538	DR.BEYAZ DİŞ FIRÇASI	1.028	31
539	ARKO KREM (YAĞLI) 20 CC.	955	31
540	SELIN KOLONYA PVC KUTULU 1022 420CC	929	31
541	PLATTE PNC 7-0 BAL	905	31
542	DOVE NEML.SAMPUAN KR.NORMAL 700 ML	822	31
543	MEDİ SAFE DİSK 70Lİ	799	31
544	SELALE ASETON 120 CC	795	31
545	PALETTE PNC 5-0 FINDIK KAHVESİ	776	31
546	PALETTE PNC 4-60 ALTIN KAKAO	774	31
547	PALETTE PNC 6-0 KOYU KUMRAL	755	31
548	SANITABANT STANDART YARABANDI 20LI	752	31
549	HUGGIES MEGA KURU VE RAHAT MAXI 60 PED 7-15KG.	751	31
550	PALETTE PNC 3-0 KOYU KAKAO	708	31
551	HUGGIES MEGA KURU VE RAHAT MAXI PLUS 54 PED 9-20 K	647	31
552	NAZAR ARAP SABUNU TORBA 900 GR.	644	31
553	VASELINE VÜCUT LOSYONU 100 ML ALOE FRESH	630	31
554	DR.BEYAZ ÇOCUK DİŞ FIRÇASI	621	31
555	ORKİD KANATLI NORMAL 12 PED	618	31
556	SENSODYNE DİŞ MACUNU F 50 M	611	31

557	YUVA AKTİF KURU HAMUR MAYASI 100 GR.	1.050	33
558	SANTRAL SIYAH ZEYTİN EZMESİ 175 GR	1.031	35
559	DR.BEYAZ DİŞ FIRÇASI	1.028	31
560	MAXELL LR06 ALKALİN 4LÜ KALEM PİL	1.028	24
561	FASLI BAHARÇÖREKOTU 50GR	1.028	27
562	TAT ACI BIBER SALÇASI 550 GR CAM	1.022	33
563	FASLI BAHARTARÇIN 40 GR	1.012	27
564	FASLI BAHAR Ç. FISTIĞI 25GR	1.006	27
565	KNORR NANELİ VE YOĞURTLU MANTI ÇORBASI 98GR	996	34
566	ÖZKOVAN ÇAM BALI 460 GR	979	20
567	CALDOZA DİZALTI SÜPER İNCE ÇORAP 2 Lİ	978	24
568	ARKO KREM (YAĞLI) 20 CC.	955	31
569	KOSKA PEKMEZ CAM KAVANOZ 380 GR.	946	20
570	KNORR ÇABUK ÇORBA DOMATES 5 AL 4 ÖDE	936	34
571	SELIN KOLONYA PVC KUTULU 1022 420CC	929	31
572	M.BİRLİK YAĞLI SELE 800GR(380-410)	927	35
573	KNORR ET SUYU 120 GR	925	34
574	SAKURA ENERJİ TAS.AMPUL 20WATT	923	24
575	FASLI BAHARKUŞÜZÜMÜ 40 GR	922	27
576	SERA BUZDOLABI POŞETİ ORTA 24X38CM	920	24
577	ÜLKER MAVİ-YEŞİL BİSKÜVİ LİMON LİFLİ 50 GR.	914	15
578	KREMİNİ MEY.PASTA ÇİLEK&M.LİMONU 65G	911	16
579	TAT DİJON HARDALI 190 GR.	909	27
580	PLATTE PNC 7-0 BAL	905	31
581	DUCROS PUL BIBER 35GR	896	27
582	TAT KÖZLENMİŞ PATLICAN 520 GR	896	33
583	PEYMAN GÜNKURUSU KAYISI 200 GR.	892	17
584	PEYMAN BAHÇEDEN ÇİĞ BADEM 180 GR	892	17
585	TAT DOĞRANMIŞ DOMATES 400 GR	882	33
586	PEYMAN KURU KAYISI 200 GR.	871	17

557	ORKİD ULTRA EKO. PLATINUM 18 PED	575	31
558	KOTEX ULTRA HIJ. PED 24 GECE	566	31
559	HUGGIES MEGA KURU VE RAHAT JUNIOR 44 PED 12-25KG	562	31
560	DURU GOURMET VİŞNELİ TURTA SIVI SABUN 300 ML	561	31
561	ARKO TIRAS KOPUGU COOL 200ML	561	31
562	CAN PED 8 PED HASTA ALTI BEZİ BÜYÜK	559	31
563	PİKNİK JAPON TİPİ KÜRDAN 400 LÜ 110-P	549	31
564	KOTEX ULTRA HIJ. PED 36 PED NORMAL	548	31
565	PALETTE PNC 3-68 KIZIL ÇİKOLATA	544	31
566	KOTEX ULTRA HIJ. PED 28 PED UZUN	536	31
567	ORKİD ULTRA KAN. NORMAL EKO. PK. 20 PED	529	31
568	NIVEA SOFT KREM 300 ML.	511	31
569	NIVEA DEO ROLL-ON FOR MEN FRESH 50 ML	495	31
570	ARKO TRAS KREMI COOL 100 GR	487	31
571	PALETTE PNC 1-0 FSİYAH	452	31
572	UNI VAZELIN EXTRA KAVANOZ 170 ML	449	31
573	ARKO NEM NAR-ÜZÜM KREM 75 ML.	444	31
574	DEO 8X4 ROLL-ON MARKANT 50ML	436	31
575	PALETTE PNC 4-86 KIZIL BAHAR	427	31
576	SENSODYNE WHITENING DIS MACUNU 100 ML	420	31
577	NIVEA DEO. WOMEN FRESH 150 ML	391	31
578	NIVEA DEO FORMEN FRESH 150ML	381	31
579	KOLESTON KIT SAÇ BOYASI 6/7 ÇİKOLATA KAHVE	348	31
580	NIVEA DEO ROLL-ON WOMAN FRESH 50 ML.	346	31
581	KOMİLİ ANAD.KAPLIC.BERGAMA S.SAB.750ML	343	31
582	CANPED 10 PED HASTA ALTI BEZİ ORTA	340	31
583	KOTEX GÜNLÜK PED KARMA(ANY-LIGHTDAYS)	339	31
584	PALMOLİVE DUŞ JELİ 250 ML KARMA	331	31
585	PALETTE PNC 1-1 GECE MAVİSİ	325	31
586	LUCKY STRIKE CLICK 1871 BOX	324	31

587	KNORR TUTMAÇ ÇORBASI 123 GR	856	34
588	SERA BUZDOLABI POŞETİ KÜÇÜK 20X30CM	850	24
589	ARI CHOCO KAKAO KAPLI ÇUBUK 170 G	826	16
590	DOVE NEML.SAMPUAN KR.NORMAL 700 ML	822	31
591	DUCROS H. CEVİZİ 25GR	803	27
592	MEDİ SAFE DİSK 70Lİ	799	31
593	SELALE ASETON 120 CC	795	31
594	FASLI BAHARSUMAK 50 GR	792	27
595	LEZZCAFE 2Sİ 1 ARADA 12 GR	787	13
596	PALETTE PNC 5-0 FINDIK KAHVESİ	776	31
597	PALETTE PNC 4-60 ALTIN KAKAO	774	31
598	PANTOLON ŞOK PERSONEL BAYAN	772	24
599	KOSKA KAKAOLU HELVA PAKET 500 GR	768	20
600	HALK BARBUNYA 1KG	764	11
601	PEYMAN İÇ CEVİZ 135 GR.	764	17
602	SERA BUZDOLABI POŞETİ BÜYÜK 30X45	760	24
603	PALETTE PNC 6-0 KOYU KUMRAL	755	31
604	CALDOZA ÇOCUK ÇORAP	754	24
605	SANITABANT STANDART YARABANDI 20LI	752	31
606	HUGGIES MEGA KURU VE RAHAT MAXI 60 PED 7-15KG.	751	31
607	PEYMAN NUTTZ BARBEKÜ MISIR ÇEREZİ 125 GR	750	18
608	SERA YAĞLI PİŞİRME KAĞIDI	740	24
609	SERA ALÜMİNYUM FOLYO 15 MT	730	24
610	PEYMAN BAHÇEDEN KURU ERİK 200GR	725	17
611	LEZZCAFE GOLD 200 GR	714	13
612	PALETTE PNC 3-0 KOYU KAKAO	708	31
613	PEYMAN BAHÇEDEN ÇİĞ FINDIK 180 GR	703	17
614	SUPERFRESH KÖZLENMİŞ BİBER 650 GR.	693	33
615	DURACELL PLUS 4LÜ İNCE KALEM PİL	658	24
616	HUGGIES MEGA KURU VE RAHAT MAXI PLUS 54 PED 9-20 K	647	31
617	NAZAR ARAP SABUNU TORBA 900 GR.	644	31

587	ORKID GUNLUK PED EKO NORMAL 40 LI	322	31
588	PALETTE PNC-8-77 TARÇIN BAKIR	320	31
589	ARKO TIRAS KOPUGU SENSITIVE 200ML	312	31
590	KOMİLİ ANAD.KAPLIC.HAYMA.SI.SAB.750ML	306	31
591	SIGNAL WHITE NOW DIS MACUNU 75ML	289	31
592	DEO 8X4 SPREY DISCOVERY 150 ML	285	31
593	DEO 8X4 HEAVENLY/ HAPPINESS 150 ML	283	31
594	OKEY PREZERVATİF KARMA	279	31
595	DOVE CREAM BAR 100 GR.	278	31
596	ARKO NEM YOGURT-BOGUTLEN KREM 75 ML.	275	31
597	KOLESTON KIT SAÇ BOYASI 8/0 AÇIK KUMRAL	265	31
598	KOLESTON KIT SAÇ BOYASI 7/3 FINDIK KABUĞU	234	31
599	GILLETTE TIRAS BIÇAGI BLUE II PLUS 10LU	233	31
600	NANO BLADE TRAŞ BIÇAĞI 6LI	227	31
601	COLGATE BARBİE-S.MAN ÇOCUK DİŞ MACUNU 50 ML	209	31
602	NANO BLADE BANYO BIÇAĞI 6LI	208	31
603	8X4 ROLL ON HEAVENLY 50ML BAYAN	203	31
604	ARKO TIRAS KOLONYASI COOL 250ML	188	31
605	KOLESTON KIT SAÇ BOYASI 8/74 GİZEMLİ KAHVE	182	31
606	IPANA KOMPLE AGIZ BAKIMI DOGAL DIS MACUNU 50 ML	176	31
607	GILLETTE TIRAS JELI SERIES COOLWAVE HASSAS 200ML	169	31
608	KOMİLİ ANAD.KAPLIC.LADİK SI.SAB.750ML	162	31
609	SESU ILIK AGDA TURUNCU 250 GR.	152	31
610	AXE DEO 150 ML (KARMA)	145	31
611	KOLESTON KIT SAÇ BOYASI 2/0 SİYAH	138	31
612	FİZZ TIRAŞ KÖPÜĞÜ 250 ML	133	31
613	ORAL-B AĞIZ SUYU 500 ML	107	31
614	SESU AGDA BEZI(SPATULALI)	103	31
615	VEET AĞDA BANTI 15+5	101	31
616	ORAL-B EXPERT ANTİBACTERİAL 40M DİŞ FIRÇASI	96	31
617	GILLETTE MACH3 YEDEK BICAK 4LU	35	31

618	LEZZCAFE COFFEE CREAM 200 GR	636	13	618	ELIDOR SAMPUAN KOPARAK DOKULMEYE COZUM 700 ML	9.167	32
619	OMO LIKIT 525 ML ACTIVE	633	21	619	ELIDOR SAMPUAN GUCLU VE PARLAK 700 ML	9.048	32
620	VASELINE VÜCUT LOSYONU 100 ML ALOE FRESH	630	31	620	ELIDOR SAMPUAN ONARICI BAKIM 700 ML	9.035	32
621	PANTOLON ŞOK PERSONEL BAY	626	24	621	HEAD &SHOULDERS KOP.DK.KARŞI400 ML	3.402	32
622	DR.BEYAZ ÇOCUK DİŞ FIRÇASI	621	31	622	DOVE SAMPUAN 700 MLNEMLENDIRICI VE BES.BAKIM	3.366	32
623	CARMEN CAM BEZİ	618	24	623	DOVE SAMPUAN TERAPİ 700ML	3.313	32
624	ORKİD KANATLI NORMAL 12 PED	618	31	624	HEAD&SHOULDERS SAÇ DÖK.KARŞI ŞAMP.400 ML KADIN	2.502	32
625	FİLPA LATEX ELDİVEN 50Lİ	616	24	625	DALIN SAMPUAN 750 ML	1.830	32
626	KOSLA HALI SAMPUANI 900ML ELDE TEMIZLIK	611	24	626	HEAD&SHOULDERS KLASIK BAKIM 400 ML SAÇ KREMI	1.699	32
627	SENSODYNE DİŞ MACUNU F 50 M	611	31	627	HOBBY SAÇ JÖLESI PRO-VIT SERT 300 ML	1.689	32
628	FİLPA PLASTİK BIÇAK 10 LU	597	24	628	KOMİLİ BEBEK ŞAMPUANI NORMAL 500ML	1.305	32
629	ORKİD ULTRA EKO. PLATINUM 18 PED	575	31	629	HOBBY SAÇ JÖLESI PRO-VIT ISLAK 300 ML	1.297	32
630	KOTEX ULTRA HIJ. PED 24 GECE	566	31	630	HEAD&SHOULDERS SAMP.KLASIK BAK 2IN1 400 ML	1.118	32
631	HUGGIES MEGA KURU VE RAHAT JUNIOR 44 PED 12-25KG	562	31	631	DR.OETKER INSTANT MAYA 30 GR.	8.284	33
632	DURU GOURMET VİŞNELİ TURTA SIVI SABUN 300 ML	561	31	632	DÖKTÜM ÜZÜM SİRKESİ 500ML	7.125	33
633	ARKO TIRAS KOPUGU COOL 200ML	561	31	633	DR.OETKER KREM ŞANTİ 150 GR.	7.042	33
634	CAN PED 8 PED HASTA ALTI BEZİ BÜYÜK	559	31	634	VIRA TON BALIGI 2X160 GR.	6.171	33
635	PİKNİK JAPON TİPİ KÜRDAN 400 LÜ 110-P	549	31	635	DR OETKER KAKAOLU PUDİNG 154 GR.	5.923	33
636	KOTEX ULTRA HIJ. PED 36 PED NORMAL	548	31	636	DR.OETKER HAMUR KABARTMA TOZU 5Lİ 50 GR.	5.652	33
637	ÜLKER HERO BABY T.KAŞIK MAMA 500GR	546	33	637	ÜLKER ÇIKOLATALI PUDİNG 115G	5.639	33
638	PALETTE PNC 3-68 KIZIL ÇİKOLATA	544	31	638	DÖKTÜM ELMA SIRKESİ 500ML	5.434	33
639	KOTEX ULTRA HIJ. PED 28 PED UZUN	536	31	639	DÖKTÜM LIMON SOSU 500 ML	4.511	33
640	ORKİD ULTRA KAN. NORMAL EKO. PK. 20 PED	529	31	640	LAVAGRİ LAVAŞ 840GR	4.497	33
641	URLA KAHVALTILIK SOS 180 GR	529	33	641	SERİN BAHÇE SALATA TURŞU 680GR	4.416	33
642	DUCROS NANE 12GR	525	27	642	DOĞANAY ŞALGAM SUYU ACILI 1000 ML	4.218	33
643	CALDOZA SÜPER İNCE KÜLOTLU	524	24	643	TAT KETÇAP 500 GR	4.017	33
644	NIVEA SOFT KREM 300 ML.	511	31	644	LEZZETİX ÇİĞ KÖFTE SET	3.989	33
645	SAKURA 13 WATT FULL SPIRAL 2700K (SARI IŞIK) ENER	506	24	645	CALVE KETÇAP-MAYONEZ SET	3.626	33
646	DURACELL PLUS 2Lİ KALEM PİL	497	24	646	DR.OETKER BİTTER ÇİKOLATALI PUDİNG 111 GR.	3.605	33
647	NIVEA DEO ROLL-ON FOR MEN FRESH 50 ML	495	31	647	DÖKTÜM KETÇAP 750GR	3.383	33
648	ARKO TRAS KREMI COOL 100 GR	487	31	648	YONCA SALÇA 830 GR(28-30BRIX)	3.359	33

649	DURACELL PLUS 4LÜ KALEM PİL	484	24	649	DR.OETKER ŞEKERLİ VANİLİN 5Lİ 50 GR.	3.334	33
650	PALETTE PNC 1-0 FSİYAH	452	31	650	TUKAŞ DOMATES SALÇASI 700 GR CAM	3.226	33
651	UNI VAZELIN EXTRA KAVANOZ 170 ML	449	31	651	SUPERFRESH BEZELYE 830 GR	3.142	33
652	DUCROS KEKİK 12GR	445	27	652	HIZIR USTA BARBUNYAPİLAKİ 400	3.034	33
653	ARKO NEM NAR-ÜZÜM KREM 75 ML.	444	31	653	SUPERFRESH GARNITÜR 330 GR	3.011	33
654	DEO 8X4 ROLL-ON MARKANT 50ML	436	31	654	TAT MAYONEZ 415 GR	2.955	33
655	PALETTE PNC 4-86 KIZIL BAHAR	427	31	655	MİS UHT KREMA 200 ML	2.945	33
656	MAESTRO 963 12 X 1 KG. (CAM TEMIZLIK)	427	24	656	PİYALE HAM.KABARTMA TOZU 5X10GR	2.839	33
657	SENSODYNE WHITENING DIS MACUNU 100 ML	420	31	657	TUKAŞ DOMATES SALÇASI 830 GR	2.736	33
658	DUCROS KARABİBER 45GR	406	27	658	DÖKTÜM ACILI KETÇAP 750GR	2.441	33
659	NIVEA DEO. WOMEN FRESH 150 ML	391	31	659	TAT ACILI KETÇAP 500 GR	2.417	33
660	NIVEA DEO FORMEN FRESH 150ML	381	31	660	SERİNBAHÇE KARIŞIKTURŞU 670 GR	2.332	33
661	FINISH QUANTUM BUL.MAK.TAB. DET.40 + 10	361	22	661	KNORR KÖFTE HARCI 85 GR.	2.296	33
662	KOLESTON KIT SAÇ BOYASI 6/7 ÇİKOLATA KAHVE	348	31	662	PİYALE ŞEKERLİ VANİLİN 5Lİ 25GR	2.149	33
663	NIVEA DEO ROLL-ON WOMAN FRESH 50 ML.	346	31	663	DOĞANAY ŞALGAM SUYU SADE 1000 ML	1.988	33
664	KOMİLİ ANAD.KAPLIC.BERGAMA S.SAB.750ML	343	31	664	DÖKTÜM MAYONEZ 650GR	1.979	33
665	CANPED 10 PED HASTA ALTI BEZİ ORTA	340	31	665	KÜHNE SALATALIK TURŞUSU (ACILI VE SARIMSAKLI)	1.965	33
666	KOTEX GÜNLÜK PED KARMA(ANY-LIGHTDAYS)	339	31	666	DR.OETKER ÇİKOLATA SOSU 128 GR.	1.931	33
667	PALMOLİVE DUŞ JELİ 250 ML KARMA	331	31	667	ÜLKER HERO BABY KAVANOZ MIX.	1.870	33
668	PALETTE PNC 1-1 GECE MAVİSİ	325	31	668	ÜLKER KAKAO 50GR	1.845	33
669	LUCKY STRIKE CLICK 1871 BOX	324	31	669	DÖKTÜM NAR EKŞİLİ SOSU 350GR	1.815	33
670	ORKID GUNLUK PED EKO NORMAL 40 LI	322	31	670	KNORR ÇITIR PANE HARCI 90 GR.	1.591	33
671	PALETTE PNC-8-77 TARÇIN BAKIR	320	31	671	HIZIR USTA YAPRAK SARMA 400GR	1.506	33
672	PANTOLON ŞOK YÖNETİCİ BAY	314	24	672	SUPERFRESH MISIR 3*220 GR	1.483	33
673	ARKO TIRAS KOPUGU SENSITIVE 200ML	312	31	673	HIZIR USTA KAHVALTILIK SOS 320GR	1.384	33
674	KOMİLİ ANAD.KAPLIC.HAYMA.SI.SAB.750ML	306	31	674	TAT TATLI BIBER SALÇASI 550 GR CAM	1.335	33
675	GÖMLEK ŞOK YÖNETİCİ BAY	290	24	675	ÜLKER HERO BABY SÜTLÜ MEYVELİ 8 TAHILLI 500 GR	1.289	33
676	SIGNAL WHITE NOW DIS MACUNU 75ML	289	31	676	TAT DOMATES PÜRESI 200GR	1.288	33
677	DEO 8X4 SPREY DISCOVERY 150 ML	285	31	677	KÜHNE ELMA SIRKESİ 500 ML.	1.245	33
678	DEO 8X4 HEAVENLY/ HAPPINESS 150 ML	283	31	678	PEYMAN KURU ÜZÜM 200 GR.	1.222	33
679	OKEY PREZERVATİF KARMA	279	31	679	KÜHNE KARIŞIK TURŞU 680GR	1.218	33

680	KNORR ACISSO ACI BIBER SOSU 50 ML	279	27
681	DOVE CREAM BAR 100 GR.	278	31
682	ARKO NEM YOGURT-BOGUTLEN KREM 75 ML.	275	31
683	KOLESTON KIT SAÇ BOYASI 8/0 AÇIK KUMRAL	265	31
684	SERA FIRIN TORBASI	235	24
685	KOLESTON KIT SAÇ BOYASI 7/3 FINDIK KABUĞU	234	31
686	DUCROS DOLMALIK FISTIĞI 23GR	233	27
687	GILLETTE TIRAS BIÇAGI BLUE II PLUS 10LU	233	31
688	NANO BLADE TRAŞ BIÇAĞI 6LI	227	31
689	PANTOLON ŞOK YÖNETİCİ BAYAN	224	24
690	COLGATE BARBİE-S.MAN ÇOCUK DİŞ MACUNU 50 ML	209	31
691	NANO BLADE BANYO BIÇAĞI 6LI	208	31
692	8X4 ROLL ON HEAVENLY 50ML BAYAN	203	31
693	YELEK ŞOK PERSONEL BAY	193	24
694	ARKO TIRAS KOLONYASI COOL 250ML	188	31
695	GÖMLEK ŞOK YÖNETİCİ BAYAN	184	24
696	KOLESTON KIT SAÇ BOYASI 8/74 GİZEMLİ KAHVE	182	31
697	IPANA KOMPLE AGIZ BAKIMI DOGAL DIS MACUNU 50 ML	176	31
698	GILLETTE TIRAS JELI SERIES COOLWAVE HASSAS 200ML	169	31
699	KOMİLİ ANAD.KAPLIC.LADİK SI.SAB.750ML	162	31
700	SESU ILIK AGDA TURUNCU 250 GR.	152	31
701	AXE DEO 150 ML (KARMA)	145	31
702	KOLESTON KIT SAÇ BOYASI 2/0 SİYAH	138	31
703	FİZZ TIRAŞ KÖPÜĞÜ 250 ML	133	31
704	YELEK ŞOK PERSONEL BAYAN	118	24
705	ORAL-B AĞIZ SUYU 500 ML	107	31
706	SESU AGDA BEZI(SPATULALI)	103	31
707	VEET AĞDA BANTI 15+5	101	31
708	ORAL-B EXPERT ANTİBACTERİAL 40M DİŞ FIRÇASI	96	31
709	BİRKLAS KARTON KLASÖR DAR SİYAH (1 LI)	82	24
710	GILLETTE MACH3 YEDEK BICAK 4LU	35	31

680	AKDEĞİRMEN TUZLU KURU PASTA 500GR	1.162	33
681	YUVA AKTİF KURU HAMUR MAYASI 100 GR.	1.050	33
682	TAT ACI BIBER SALÇASI 550 GR CAM	1.022	33
683	TAT KÖZLENMİŞ PATLICAN 520 GR	896	33
684	TAT DOĞRANMIŞ DOMATES 400 GR	882	33
685	SUPERFRESH KÖZLENMİŞ BİBER 650 GR.	693	33
686	ÜLKER HERO BABY T.KAŞIK MAMA 500GR	546	33
687	URLA KAHVALTILIK SOS 180 GR	529	33
688	KNORR EZOGELİN ÇORBASI 80 GR.	5.663	34
689	KNORR ŞEHRİYELİ TAVUK ÇORBASI 58 GR.	4.997	34
690	KNORR KREMALI TAVUK ÇORBASI 69 GR.	4.294	34
691	KNORR MERCİMEK ÇORBASI 76 GR.	4.122	34
692	KNORR KREMALI DOMATES ÇORBASI 74 GR.	3.393	34
693	KNORR KREMALI MANTAR ÇORBASI 68 GR.	3.315	34
694	KNORR TAVUKSUYU 120 GR %20 İNDİRİMLİ	2.265	34
695	PİYALE EZOGELİN ÇORBA 70GR	2.056	34
696	PİYALE ANALI KIZLI 91GR	1.907	34
697	PİYALE TUTMAÇ ÇORBASI 120 GR	1.649	34
698	PİYALE ERİŞTELİ ÇORBA 102 GR	1.610	34
699	PİYALE ET-TAVUK SUYU 80GR	1.598	34
700	KNORR YÖRESEL ANALI KIZLI ÇORBASI 92 GR.	1.198	34
701	KNORR NANELİ VE YOĞURTLU MANTI ÇORBASI 98GR	996	34
702	KNORR ÇABUK ÇORBA DOMATES 5 AL 4 ÖDE	936	34
703	KNORR ET SUYU 120 GR	925	34
704	KNORR TUTMAÇ ÇORBASI 123 GR	856	34
705	M.BİRLİK KURU SELE 400 GR.	1.908	35
706	URLA ZEYTIN KIRMA 180 GR	1.532	35
707	M.BİRLİK MİNYON ZEYTİN 500GR.411-460 AD/KG.	1.334	35
708	URLA ZEYTIN KÖY PAÇALI 180 GR	1.225	35
709	SANTRAL SIYAH ZEYTİN EZMESİ 175 GR	1.031	35
710	M.BİRLİK YAĞLI SELE 800GR(380-410)	927	35