

MODELLING CUSTOMER SERVICE QUALITY:  
THE CASE OF BOTTLED WATER DISTRIBUTION

A THESIS SUBMITTED TO  
THE GRADUATE SCHOOL OF SOCIAL SCIENCES  
OF  
IZMIR UNIVERSITY OF ECONOMICS

BY  
İSMAİL KARABAŞ

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE  
DEGREE OF

MASTER OF ARTS


IN  
THE GRADUATE SCHOOL OF SOCIAL SCIENCES

JULY, 2013

Approval of the Graduate School of Social Sciences

  
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**ABSTRACT**

**MODELLING CUSTOMER SERVICE QUALITY: THE CASE OF  
BOTTLED WATER DISTRIBUTION**

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**July 2013, 108 pages**

In this thesis, we focus on customers' perceptions on Logistics Service Quality (LSQ) for bottled water distribution. The delivery process marks the B2C (Business-to-Customer) interaction of the bottled water supply chain, and therefore is very important. Customers' perceptions regarding the product itself, the process, communication and other aspects constitute valuable pointers to evaluate and redesign service strategies. Dimensions of LSQ are determined through an analysis of the industry and review of the literature. Using these dimensions, a survey is designed and implemented in order to assess the significance of each LSQ dimension in the purchasing/repurchasing decisions of customers. Apart from the analysis of the survey and the ANOVA analysis with various demographic segments, the results of the survey are also used as an input for the second phase of the thesis. The second phase aims at constructing a mathematical programming model in order to decide on the optimal allocation of resources to improve LSQ. The mathematical model is run for companies of different characteristics and the results are discussed.

**Keywords:** LSQ, bottled water, survey, mathematical programming

## ÖZET

### MÜŞTERİ HİZMET KALİTESİNİN MODELLENMESİ: ŞİŞELENMİŞ SU DAĞITIMI UYGULAMASI

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**Temmuz 2013, 108 sayfa**

Bu tezde, şişelenmiş su dağıtımında, müşterilerin lojistik hizmet kalite algısına odaklanılmıştır. Şişelenmiş su tedarik zincirinin dağıtım süreci firmadan-müşteriye çalışan pazarların müşteri kısmı ile etkileşimin sağlandığı süreç olduğu için önem taşımaktadır. Bu bağlamda; müşterinin ürüne, sürece, iletişim tekniklerine ve diğer etmenlere karşı oluşan algısı hizmet stratejilerini yeniden tasarlamak için önemli değişkenler olarak görülmektedir. Bu çalışmada, lojistik hizmet kalite algısına dair belirtilen değişkenler, endüstri analizi ve literatüre taraması sonucu belirlenmiştir. Belirlenen değişkenler kullanılarak, bir anket oluşturulmuş ve müşterinin satın alma sürecinde her bir değişkenin önemi sorgulanmıştır. Toplanan veriler, ANOVA analizi ile test edilmiş, sonuçlar tezin ikinci kısmı için girdi olarak kullanılmıştır. Bu çalışmanın ikinci kısmının amacı ise, matematiksel programlama yoluyla kaynakların en iyi şekilde kullanılmasını sağlayarak lojistik hizmet kalite algısını iyileştirmektir. Oluşturulan matematiksel program, farklı özelliklere sahip firmalar için denenmiş ve sonuçlar tartışılmıştır.

**Anahtar kelimeler:** Lojistik Hizmet Kalitesi, şişelenmiş su, anket, matematiksel programlama

## **ACKNOWLEDGEMENT**

I first would like to thank my supervisors, Muhittin Hakan Demir and Bengü Sevil Oflaç, for their incredible support and encouragement. Their valuable guidance and advice has helped me reach my current level of achievement and will continue to serve me during my academic career.

I wish to express my sincere gratitude to the jury who judged this thesis: Işık Özge Yumurtacı and Durmuş Ali Deveci. Both contributed significantly to this thesis and gave ideas for further research. Their comments helped add the final touches to this work.

My colleagues also deserve big thanks for their continuous support and good humor. Not only have they helped me with my thesis, but also throughout my education overall. I would like to mention Cansu Yıldırım and Sinem Tokçaer specifically for their endearing friendship.

An acknowledgement could not be completed without thanking my parents and brother for their unconditional love and support. Through to their unceasing care, they have provided me with the courage to succeed.

Lastly, I am grateful to my girlfriend, Brittany Wood. She has been a vital component of this thesis. Not only has she proofread this thesis more times than I can count, she has also provided endless love and tireless encouragement.

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# CHAPTER I

# INTRODUCTION

The need for consumption by the world's masses has fueled the companies and corporations of the global market economy. These companies and corporations are spurred into production, distribution, selling and branding in order to meet the consumer's needs and demands. At the same time, these companies within the same sectors are competing against one another to gain advantage in the eyes of the customers.

Before the onset of globalization, the number of companies or brands in any given sector was small. Consumers did not have the same variety of options to purchase goods or services as they do today. Presently in the world market, there are many companies running at the same time in any given sector. The high number of firms in a single sector has helped maintain the current competitive market. Due to the existing competitive market place, the need to advertise and establish a unique image in the minds of the consumers has magnified. It is not only important to meet the customers' demand, but also to maintain a positive company image in the eyes of

the consumer. In order to do this, firms and corporations must have effective tools. One of the main tools used to gain competitive advantage is marketing (Tollin & Jones, 2007).

The marketing strategy of a company is fundamental to the company's success. A customer's first impression of a firm can be heavily shaped by the marketing strategies that are employed. Moreover, marketing is not alone in the field of business; conversely, it is a wide concept that interacts with other academic fields. One of the other fields that marketing collaborates with is logistics. Even though logistics can be studied as a unique field in itself, in the real world, logistics works hand in hand with marketing (Alvarado & Kotzab, 2001).

Both marketing and logistics have been very attractive topics of study for researchers of business for many years. Although marketing and logistics are two separate fields, they can be studied in conjunction. Marketing affects logistics and vice versa, logistics affects marketing. There has been a significant amount of research regarding how these two fields intersect and link together (Murphy & Poist, 1992; Ellinger, 2000; Alvarado & Kotzab, 2001; Mentzer & Williams, 2001; Schramm-Klein & Morschett, 2006; Mentzer, Stank, & Esper, 2008; Fugate, Mentzer, & Stank, 2010; Grawe, Daugherty, & Dant, 2012). Due to my practical and theoretical background in Business Administration and Logistics, I am interested in linking these two fields and discovering how and when they intersect.

In the study of logistics, supply chain is a very crucial concept. In fact, supply chain can be seen as a broader concept outside of logistics (Mentzer, et al., 2001; Larson & Halldorsson, 2004). In a supply chain, there are two main flows: goods and services. In this study, we focus on the service supply chain. Emphasis is paid to the

distribution channels of the service sector. Distribution channels render the product directly available for consumption by the consumer and therefore it is vital for companies to manage the distribution effectively. For example, regardless of whether a company produces goods or services, if the company cannot locate their products at the right place in the correct quantity at the precise time, such a company would not be considered as preference by the consumer.

Delivery is a very crucial activity in distribution channels and supply chains. It is one of the key components to gain competitive advantage when doing business. In the literature related to Marketing and Logistics, delivery has received a lot of attention (i.e.: Emerson & Grimm, 1996; Fawcett, Calantone, & Smith, 1997; Zeithaml, Parasuraman, & Malhotra, 2002; Chatterjee, Slotnick, & Sobel, 2002). Even though the physical movements of goods or services are generally seen as a part of logistics, researchers also view it as a component of marketing. This is due to relevance of meeting the demands of the customers who would prefer a delivered product and at the same time, creating a competitive advantage over competitors by utilizing fast and efficient delivery. Delivery service by companies is a great example for examining the intersection of marketing and logistics and their reciprocal relationship.

The main point of interaction between marketing and logistics is seen as the marketing mix. There are four key components (also known as the 4Ps) of the marketing mix: Price, Promotion, Product and Place. According to research on marketing and logistics, the place component of the marketing mix is most directly related to logistics. Although logistics partially affects the other 3Ps as well, the place component is composed of solely logistics activities within companies. Place is explained as locating any and all types of goods or services effectively and

efficiently. Another name for place is physical distribution (Mentzer, Gomes, & Krapfel, 1989).

Both marketing and logistics can be used to generate optimum customer service and customer satisfaction. Much research has paid attention to the many different parts of logistics and marketing in order to maximize the perception of customer service quality. In this thesis the focus is on physical distribution, the place component of the 4Ps as a significant intersection point of logistics and marketing. The main components of physical distribution are studied and their effect on customer service is analyzed.

In the literature related to logistics service quality, there are many studies related to dimensions of service quality, SERVQUAL and Logistics Service Quality (LSQ). The main dimensions related to these concepts are stated by many different researchers (Parasuraman, Zeithaml, & Berry, 1985; Parasuraman, Zeithaml, & Berry, 1988; Emerson & Grimm, 1996; Bienstock, Mentzer, & Bird, 1997; Mentzer, Flint, & Kent, 1999; Mentzer, et al., 2001; Rafele, 2004; Wilding & Juriado, 2004; Aktas & Ulengin, 2005; Rahman, 2006; Bottani & Rizzi, 2006; Banomyong & Supatn, 2011). Although in many of these studies the dimensions are well stated and explained, there is nevertheless a lack of practical examples. In this thesis, these dimensions are not only analyzed, but also applied to the bottled water industry. Dimensions both from the literature and from the practice were utilized in this study.

## **1.1 Motivation of this Study**

A large motivating factor for this study is due to personal experience in the distribution of 19L bottled water. The process of buying and selling bottled water has given me a lot of insight about the distribution channel of the bottled water industry in Turkey. For example, before distributing water to customers, there had to be a decision of when to order the bottles of water, how many bottles of water to buy for meeting the demand and which brands would most fit the need of my customer base. Choosing brands is important because there can be significant price and quality differences among brands. Through selling bottled waters, it was possible to experience both the distribution and delivery process firsthand. Developing close relations with a small proportion of the 19L bottle water customer base also allowed for an acute measurement of the perception on water brands. This experience has helped lead to the choice of service quality dimensions in Turkey's bottled water industry as the research area for this thesis.

A second motivating factor for this study is the fact that the bottled water industry is one of the most dynamic sectors in Turkey, making it an interesting sector to investigate. In countries where the tap water's quality is often questioned in some cities, people prefer to drink and use bottled water. The importance of safe drinking water is greater when people cannot drink or use the city or local tap water. Even though the quality of tap water has been mistrusted by the public for some years, it wasn't until 2008 in Izmir, Turkey that the public's concerns about the tap water's safety were verified by government officials and the damaging scientific results were announced to public. It was clarified that tap water in Izmir was not drinkable. Tap water was found to contain high levels of arsenic. When the health risk was confirmed, a large majority of the Turkish population started consuming bottled

water. Contrary to the tap water, bottled water has an image of being healthy and clean.

In places where there is a health concern regarding the water from the tap, entrepreneurs invest in the bottled water industry. In this study, the main focus is on the bottled water distribution in Turkey and more specifically in city of İzmir. In Turkey, there are several sizes of bottled water; 0,5 liter, 1 liter, 1.5 liter, 5 liter, 10 liter and 19 liter (19L). Since consumers buy this water to use in their homes for drinking and cooking, many prefer the largest size, 19L, delivered to their flats and offices. In this study, the 19L bottle delivery will be examined. The market for this size of water is very dynamic; therefore it is important to understand the most effective distribution strategies and the perception of consumers pertaining to the 19L bottled water industry.

## **1.2 Research Questions**

The research questions for this study are:

- What is the perception of customers on LSQ factors that affect purchasing/repurchasing decisions of bottled water customers?
- How do demographic factors affect the perceptions of customers on the delivery service of bottled water?
- How can main companies and retailers (distributors) optimize their services based on customers' perceptions on LSQ dimensions and factors?
- How should companies with different characteristics differentiate their strategies to improve LSQ?

### **1.3 Structure of the Thesis**

In this paper, the related dimensions of LSQ were found from the related literature. Then, the water distribution process in Izmir, Turkey is analyzed and explained. The chosen dimensions are subsequently applied to the water distribution industry and the results are shown.

The first chapter is an introduction to the thesis subject. The intersection point of Marketing and Logistics areas are explained. A brief reasoning as to why the topic was chosen and why the focus is on the bottled water industry is given. With the purpose and the structure of the thesis, the first chapter is finalized. The second chapter includes the related literature review. Each study in the literature was explained and the relation between the studies of the literature review and this thesis was stated. Then, the bottled water industry was explained given the recent developments. Bottled water industry was analyzed both in and outside of Turkey with statistical data regarding the production and consumption of different countries. Afterwards, the market situation in Turkey and the importance of bottle water industry in Turkey were described. Next, the supply and order processes are shown within the bottled water distribution channel. The chosen dimensions were also given at this point. Lastly, the customer service and customer satisfaction concepts are stated with their connection to this thesis. In the last chapter, the methodology of the thesis is given in details. Both the survey and mathematical modeling methods were explained. All the statistical data applied to the results of the survey are given and then the mathematical model is shown. Finally, the results of the survey and the model are given. In the closing paragraphs, the conclusion is given.



# **CHAPTER II**

## **LITERATURE REVIEW**

In this chapter, we aim to provide a brief overview of the literature related to logistics service quality and customer service introduced earlier. We largely concentrate on the service quality dimensions in the field of logistics. Since a component of this study involves applying the applicable dimensions to the bottle water industry, the relevant literature was assessed accordingly and the possible dimensions to be applied to the bottle water industry in Turkey were identified.

Within the line of research involved in service quality, we review the studies that specifically cover topics related to service quality within the field of logistics. Then, the dimensions of logistics service quality are examined and the link between the dimensions of logistics service quality and customer perception of service quality is assessed. It is important to note that the first researches conducted regarding logistics and service quality termed “service quality” as SERVQUAL (Parasuraman, Zeithaml, & Berry, A Conceptual Model of Service Quality and Its Implications for

Future Research, 1985). Subsequently, the label “physical distribution quality” was added by Bienstock, et al. (1997) in addition to SERVQUAL. The most current term for “service quality” in the field of logistics service is logistics service quality (LSQ) (Mentzer et al. 1999). Throughout this chapter, the terminology used by the researchers in question will be utilized.

In the field of logistics, the service flow has been divided and each part has been termed individually in order to narrow down the main indicators to measure customer service. Furthermore, logistics researchers have conducted studies on each part of the service flow which will be investigated in the literature review. In addition, researchers (Parasuraman, Zeithaml, & Berry, 1985 and 1988; Innis & La Londe, 1994; Emerson & Grimm, 1996; Bienstock, Mentzer, & Bird, 1997; Mentzer, Flint, & Kent, 1999; Rafele, 2004; Wilding & Juriado, 2004; Aktas & Ulengin, 2005; Bottani & Rizzi, 2006;; Rahman, 2006; Banomyong & Supatn, 2011) have divided service quality into different dimensions. While dimensions have changed from research to research, the ultimate aim, to isolate the determinant of customer satisfaction, has stayed the same. In this chapter review, all of the different names and dimensions made in the literature on LSQ, SERVQUAL, and physical distribution quality are examined before going into the following chapter on methodology.

Service quality has long been studied in the logistics and marketing. One of the first authors to focus on service quality was Parasuraman et al. (1985 and 1988). In the mentioned articles, Parasuraman et al. (1985 and 1988) developed a multiple-item scale to measure service quality. The scale included five main dimensions of SERVQUAL:

- tangibles
- reliability
- responsiveness
- assurance
- empathy

Tangibles include physical facilities, materials, and even the appearance of the personnel who provide the service to the customers. Reliability is the ability to perform the promised service dependably and accurately. This dimension also includes deliveries. The third dimension, responsiveness, is the willingness to help customers and provide punctual service. The next dimension, assurance, is the knowledge and courtesy of employees, as well as their ability to inspire trust and confidence in the customers. The last dimension, empathy, concerns the firm's ability to care about its customers and create a customer based service. Empathy is also involved in providing individualized attention to each customer of the company. Yee & Daud (2011) also conducted a study that applied SERVQUAL. In this work, the authors largely focused on the SERVQUAL indicators affecting the customer satisfaction in parcel service delivery (PSD). As a result of their research, tangibility, reliability, and assurance are seen to have direct impact on customer satisfaction. Empathy and responsiveness, according to Yee and Daud (2011), had no significant affect. Another study related to SERVQUAL examined how Chinese consumers assess retail service quality and customer satisfaction (Yo et al, 2013). The conclusions in this paper were that dimensions of SERVQUAL are not effective in every type of consumer segments. One of the managerial findings suggests that global and regional retailers should be aware of their country's specific perceptions because they differ from segment to segment.

The dimensions stated by Parasuraman et al. (1985) were also studied by Landrum et al. (2009). The dimensions of service quality were included in their research about SERVPERF. Moreover, Cronin and Taylor (1992) are one of the first researchers to focus on SERVPERF. In his study, they found that in order to measure the service quality more effectively, a performance based evaluation of the service quality is more cooperative.

The findings about the SERVQUAL term are in contrast with other studies' findings. For instance, Mentzer et al. (2001), one of the first studies on LSQ together with Mentzer's previous study conducted in 1999, was an investigation to see if different customer segments cared about the various aspects and levels of LSQ. As a result, nine dimensions are found to have direct and positive effect on customers' perception of LSQ. The main aim of Mentzer's study (1999) was to impose SERVQUAL domain into the logistics field. The known "Seven Rs" describe the attributes of the company's product/service offering that lead to utility creation through logistics service. For instance, a part of a product's marketing offering is the company's ability to deliver the right amount of the right product at the right place at the right time in the right condition at the right price with the right information. Regarding customer service in the logistics service context, Mentzer, Gomes, and Krapfel (1989) argue that there are two concepts in service delivery: marketing customer service (MCS) and physical distribution service (PDS). They explain the complementary nature of the two elements is to satisfy the customer and propose an integrative framework of customer service. Specifically, findings in this study claim that logisticians need to be concerned with how customers perceive:

- information quality,
- ordering procedures,
- ordering release quantities,
- timeliness,
- order accuracy,
- order quality,
- order condition,
- order discrepancy handling,
- and personnel contact quality.

As a result of these two papers of Mentzer, et al. 1999 and 2001, it is found that LSQ is very crucial for the marketing and logistics strategies of the companies.

Concerning the marketing mix, logistics is specifically associated with the “place” component, while also affecting the other 3 Ps: price, promotion, and product. Bienstock, Mentzer and Bird (1997) was looking for the criteria used to assess physical distribution service quality. According to Bienstock, Mentzer and Bird (1997), the first physical distribution quality dimension is *timeliness*. It is the time located between the customer placing the order and the company receiving the order. Accordingly, this time period should be as short as possible. The delivery of the product to the customer should be fast. After the customer places an order, the time allowed for the order to be received should always be consistent. The time it takes the supplier to put the order together should be constant. Also, there should be little time between the supplier receiving and shipping the order. The second dimension as stated by Bienstock et al. (1997) regarding physical distribution quality is *availability*. The products of ordered by the customers should be available in the

given company's inventory. *Condition* as the third dimension, relates to the state of the product upon delivery to the customer. This dimension entails that each product of every order should be delivered undamaged and in pristine form. Condition also includes the accuracy of orders and the customers need to receive what they ordered correctly. This dimension includes the convenient packaging of the orders as well. One of the findings of this research is that physical distribution service quality influences business profitability through its impact on global quality judgments, which in turn affect purchase intentions. The results of this study also indicate that the criteria of timeliness, availability, and condition significantly influence purchasing managers' perceptions of physical distribution service quality, with timeliness being the most significant of the three dimensions. Therefore, the purchasing managers' judgments of suppliers' physical distribution service quality is influenced by having the ordered products in stock and delivering the specified amount of products un-damaged and on time.

Emerson and Grimm (1996) also discuss the dimensions of service quality while integrating logistics and marketing. The validity of the dimensions proposed by Mentzer et al. in 1989 is examined by Emerson and Grimm (1996). The authors include an additional logistics dimension to Mentzer et al.(1999)' study. The added dimension is communication. Communication refers to the information concerning the available inventory received by the customers when the order is placed. It also includes information given to the customer at the time of order placement about any possible delays or cancellations, as well as expected delivery times. This study by Emerson and Grimm (1996) does not agree with Mentzer, Gomes and Krapfel (1989) on one point; according to the study, the reliability test shows timeliness did not have a significant impact on customer service. There are seven dimensions stated by

Emerson and Grimm (1996); three are related to logistics such as *availability, communication, delivery quality*, while four are related to marketing such as *pricing policy, product support-customer service and product support-sales representative and quality*. The main difference between Emerson and Grimm (1996), and Mentzer, Gomes and Krapfel (1989) was that the timeliness dimension was perceived by Emerson and Grimm (1996) as inclusive as compared to the other logistics related dimensions. Instead, a new dimension, communication was found to have a direct effect on customer service.

Service quality can be found in a variety of research areas. The following studies are not directly related to the field of logistics, but nevertheless the conclusions obtained are important to this study. Saura, et al. 2008 analyzed the quality, satisfaction, and loyalty in the service delivery context, with the aim of considering the role of information and communication technologies (ICT) in this series of effects. In this study, the authors described a framework that can be used to indicate the connection between service quality, customer satisfaction, and loyalty in the supply chain from the perspective of ICT. The study also claims that dimensions such as timeliness and personnel, information and order quality have positive effects on customer satisfaction and loyalty. Another study (Juga et al. 2010) was applied to measure how perceived service quality influences a transporter's satisfaction and loyalty in third-party logistics outsourcing relationships. Findings show that service quality is indeed an essential precursor to customer satisfaction and loyalty. The satisfaction-loyalty model in a logistics outsourcing context confirms that service perceptions inspire loyalty through a shipper's overall satisfaction with the service provider. Continuing with the loyalty related customer service and satisfaction papers, Innis and La Londe (1994) also contributed to the service quality literature.

In their study, they listed three main purposes. First, a purpose of the research was to study the influence of customer service on customer behavior and satisfaction. Second, the authors hoped to study the impact of customer service on market share of a company (as measured by purchase intentions). Third, the research's goal was to argue, based on a review of the literature and the research results, for more integration of the marketing and logistics functions. All in all, there are 32 dimensions stated in their work that effect customer satisfaction, as well as customer loyalty, and market share.

Ellinger, Daugherty and Gustin (1997) questioned how well firms were responding to customer needs and if there is a link between integrated logistics and customer service. Findings showed that there is a strong relation between integrated logistics and customer service. Also, it was noted that the companies with integrated logistics respond to customer needs easier than others. In an article by Willett & Stephenson, (1969), the buyer's response to service times was analyzed. According to the article, the service time of a product/service is directly related to the logistics performance of a company, which in turn provides a better marketing performance opportunity for the company. In addition, shorter delivery times better meet the customer requirements resulting in improved customer service. In an article (Stank, Goldsby, Vickery, & Savitskie, 2003), the main aim was stated as to enlarge the knowledge of logistics service performance and to explore its link to overall business performance in four significant ways: service quality, customer satisfaction, customer loyalty, and market share. The authors also looked to see if there is a connection between service quality, customer satisfaction, customer loyalty and market share. The results showed that the relational performance is positively related to the operational performance and cost. Other results point that relational



performance has a direct effect on satisfaction, but operational and cost performance are found to have no significant relationship with satisfaction. (One theory in the article proves that customer satisfaction is positively influenced by loyalty. The second theory states that market share is positively related to loyalty).

Rafele (2004) studied logistics service measurement. He proposed a hierarchy of the logistics performance measurements which he converted from the PZB model of Parasuraman, Zeithaml and Berry (Parasuraman et al, 1985, 1988) and developed a model with three dimension categories: Tangible components ways of fulfillment and informative actions.

Tangible components have four sub-dimensions. The first sub-dimension concerns assets, that is, the physical instruments and operative means. Assets are also divided into internal (handling and warehousing) and external assets (transport). The second sub-dimension is personnel, the individuals who produce the products and contribute control. Next sub-dimension is availability. This is the existence and readiness of the goods during the delivery process. The final sub-dimension is inventory which is related to the raw materials and the semi-finished supplies that will be transformed into the finished goods. Following tangible components, the second category of dimensions listed by Rafele (2004) is ways of fulfillment. This includes four sub-dimensions as well. The first sub-dimension of the ways of fulfillment is flexibility. Flexibility concerns the ability of a firm to make changes within planned orders to please the customers. The second sub-dimension for this category is service care, which includes the parameters for running a supply service. Next sub-dimension is supply conditions which is the physical movement of the products of the supply service. The last sub-dimension for the category is lead time. Lead time is the length of the act of delivery. The third and final category of the

dimensions used by Rafele (2004) is informative actions. The informative actions dimension is also divided into four sub-dimensions. The first of these sub-dimensions of informative actions is marketing. Marketing is associated with the information on products and the selling circumstances. The second sub-dimension is order management, which involves checking the order flow. The third sub-dimension is after-sales. This relates to the interaction with the customers to solve problems or meet requirements. The last sub-dimension is e-information and it pertains to the method used to direct and control orders by an e-network.

The results from Rafele (2004)'s article are intriguing. One conclusion made is that companies use the same indicators (dimensions) with new interpretations. The most commonly used dimensions are reliability, completeness, correctness, harmfulness, productivity, lead time, delay, regularity, flexibility, availability and scrap level. Another result concluded from this article is that each sector has its own dimensions, in addition to the general dimensions which do not change between sectors. It is not possible to measure all the factors affecting the customer service such as marketing, order managing and after sale activities. Nonetheless, these factors still influence the desired service.

Panayides (2007) focused on the effect of organizational learning on logistics service effectiveness, relationship orientation, and performance of the company. The goal of the study was to determine the influence of organizational learning on inter-firm relationship orientation in the logistics service provider–client context. The results of the study indicate that organizational learning does indeed have a positive effect on relationship orientation and also on the development of logistics service efficiency and overall firm performance.

Some authors linked service quality with customer loyalty (Wong & Sohal, 2003). They did their research to find the effect of service quality dimensions on customer loyalty in C2C and B2C settings. As a result of this article, it was found that service quality and customer loyalty positively affect each other. On the company level, this affect is stronger as compared to the interpersonal level. Whereas tangibles are the most vital dimension for the person to firm level relations, empathy is the most important one for the interpersonal level. Jun, Yang, & Kim (2004) studied the service quality perceptions of the customers on online retailing service quality. The purpose of this study was to find out the key dimensions of service quality that customers perceive in online retailing. Also, the study aimed to determine the most influential online retailing service quality dimensions in attaining an excessive level of overall service quality as perceived by online customers. There are six dimensions used as online retailing service quality dimensions; *reliable/prompt responses, access, ease of use, attentiveness, security and credibility*. Three of these dimensions (*reliable, attentiveness and ease of use*) are seen to have an important impact on both customers' perceived overall service quality and their satisfaction. The *access* dimension had a significant effect on the overall service quality, but not on the satisfaction of the customers.

In order to present a multi-attribute approach for the selection and ranking of the most suitable third-party logistics (3PL) service provider, Bottani and Rizzi (2006) wrote an article. Although Bottani and Rizzi focused on a different topic than what is covered in this thesis, there is nonetheless a relation between the dimensions used in their study and our study. The authors figured that performance, price, physical equipment and information systems, quality, strategic attitude, trust and fairness are the best dimensions to use when judging potential candidates for

outsourcing. These dimensions are from the perspective of a business to business action. There are also other studies related to outsourcing activities with a relation to logistics service (Aktas and Ulengin, 2005; Wilding and Juriado, 2004; Wallenburg, 2009). The dimensions used by Aktaş and Ulengin (2005) are:

- *Reliability of the carrier:* Delivering damage free goods, advance notice of transit delays, shipment security, customization of the products to meet specific needs to handle emergency shipment, length of promised transit times, adhering to the special shipping instructions,
- *Prompt response in the delivery cycle:* On time delivery, fast reaction to complaints to carrier's service, electronic interface for tracing and pickup and billing, carrier's attitude towards problems and complaints.
- *Prestige of the carrier:* Carrier's financial conditions, reputation and cleanliness of the carrier's equipment financial opportunities
- *Flexibility to customer inquiries:* low number of split shipments, ability to handle dangerous materials, willingness to negotiate rates, insurance covariance, assistance from the carrier to handle loss and damage claims reliability and quality of operations
- *Management and delivery cycle:* Provides same day delivery, cash discounts for early payment or prepayment, quality of drivers, accuracy of response to tracing inquires
- *Easiness to collaborate:* A single point of contact with the carrier to resolve operations problems, rate structure simple and easy to understand, accurate billing
- *Accurate order receipt and follow-up:* Carrier's delivery history without loss/damage, bar-coding to facilitate tracing.

The most fascinating result made in this study is that the power of outsourcing activity has been misjudged in Turkey. Businessmen in Turkey tend to do everything by themselves. They tend to only outsource from companies with a nice reputation or who are easy to team up with. Wilding and Juriado (2004) were also concerned with outsourcing. Questions asked by their study were: 1) why to outsource, 2) what to outsource and 3) how to manage satisfaction within third party logistics provider partnerships.

Wilding and Juriado (2004) conducted research based on the following dimensions:

- *Delivery timeliness*: delivery timeliness, delivery punctuality, delivery accuracy, delivery quality, schedule adherence, delivery failures, delivery performance
- *Cost*: costs per unit, full visibility of costs, cost control, financial bonus-penalty system
- *Overall quality*: includes broadly defined measures such as service level, quality of orders, overall quality, fleet quality
- *Inventory management*: stock turnover, shortage claims, throughput, stock accuracy, inventory difference
- *Picking accuracy*: picking accuracy, picking quality
- *Responsiveness and flexibility*: reactivity, response to queries, administration, customer service, flexibility to fluctuations in capacity
- *Error and damage assessment*: percent of damages, error rates
- *Lead-time*: re-supply speed, inbound lead-time

- *Receiving/unloading and dispatch/loading*: dispatch punctuality, unload/load time
- *Documentation*: receipt accuracy
- *Variation in actual and expected performance*: comparison of performance and expectations
- *Other*: product temperature, scanning accuracy, vehicle utilization, staff and customer satisfaction, units per man hour.

Wallenburg (2009) inquired about at what point logistics service providers (LSP) can utilize their proactive improvement to create customer loyalty. They also discussed whether a focus on either cost or performance improvements is preferable. Moreover, Wallenburg studies customer loyalty and how to make it more effective with LSPs. As a result, it was found that proactive cost improvement and proactive performance improvement are both drivers of all core dimensions of loyalty (retention, extension, and referrals).

Another logistics service quality related study examined quality management in logistics (Rahman, 2006). It was a case study applied to Australian companies to see and assess the scope in which quality management practices, tools, and methods are employed. The most exceptional result of this study was identifying quality in logistics as “on-time delivery” for Australian companies. The other dimensions such as integration of quality programs with corporate strategy, development of closer links with suppliers, and consistency in order cycle are critical initiatives which are required for improvement.

Some studies focused on enhancing the service quality in different cases. A study of (Gracia et al, 2013) tests if there is a linkage between the improvement of

human resource activities in specific human resource practices of employees (organizational facilitators) and collective work engagement levels. This study also seeks to find if there would be an increase in the service quality with the improvement in the human resource activities. According to the findings of this article, effectively reinforcing facilitators is indirectly related to service quality. Thus, effectively reinforcing facilitators are directly related to collective work engagement and the unit's perceived relational service competence when helping unit workers overcome barriers of their job. The findings of this study also offer several practical implications for service organizations. It was found that organizational facilitators play a mediating role between organizational facilitators and service quality. Organizational facilitators also are in correlation with collective work engagement and relational service competence. Chang et al (2013) looked into service convenience and service quality for their effect on return intention. Another goal of theirs was to examine customer leaning in order to re-visit as a substitute variable of customer satisfaction and its relationship with service convenience and service quality. According to this article, service convenience and service quality are both influential to consumers' intention to return. In the subject of service quality, Lin (2013) analyzed the most effective way out of 4 models (business flow, cash flow, logistics, and information flow) which were stated as the most important links for online auction. In particular, logistics service has significant importance on online auction business model since it decides whether a physical commodity that has been successfully auctioned by means of electronic commerce can be delivered smoothly to the buyer or not.

Fugate et al. (2010) studied modeling and the logistics performance with the concept of simultaneous pursuit of efficiency, effectiveness, and differentiation in

mind. This paper also contributes to top performing logistics functions and documenting their influence on organizational performance. This paper contributes to a better understanding of logistics performance, the interrelationships among its dimensions and its impact on overall organizational performance for manufacturing firms. Related to logistics customer service, Leuschner, Charvet, & Rogers (2013) created a conceptual model to explain the relationship between logistics customer service (LCS) and the firm performance. The existing research on LCS is examined statistically and the relationship between LCS and firm performance is analyzed by using the Meta Analysis Method. They pointed out that there is a strong relation between LCS and firm performance.

Mwegerano et al. (2012) focused on service quality perception of customers in after sales activities. Service quality in after sales is an important factor affecting competitiveness, it is important that the technical issues raised by authorized service vendors are resolved on time and that corrective actions are of effective quality.

According to Megerano et al. the service quality was divided into ten components such as: *reliability, responsiveness, competence, accessibility, courtesy, communication, credibility, security, tangibles, and understanding the customer*. As a result, it is found that customers form their own perceived quality valuation. A perceived quality is the customer's perception of the overall quality or superiority of a product or services with intended purpose, relative to alternatives. As customers vary in their perceptual abilities, personal judgments and experience level, perceived quality will change accordingly. In this thesis, two of the 14 dimensions were adopted from this study such as responsiveness and understanding the customers. Whereas responsiveness was directly adopted, understanding the customer was also including in this dimension of responsiveness.



## **2.1 Bottled Water Industry**

In this part of my thesis, the bottled water industry is analyzed in detail. In the first section bottled water is discussed in general. The next section looks at the bottled water industry on a global scale by examining the regions other than Turkey and the section following focuses on the bottled water industry in Turkey specifically. Then, Turkey's water import and export will be discussed. The last section analyzes the reasons why the author of this thesis chose business-to-consumer market of bottled water instead of business-to-business market.

## **2.2 Bottled Water**

Bottled water consumption became prevalent in the 1970's. Consumption of water from bottles became prominent due to a variety of reasons. The main reason for the increase in bottle water consumption is the concern for health (Rodwan, 2011). Other reasons include ease of use, perceived low costs, and convenience (SUDER, 2012). The water consumption in the world is around 4,000 cubic kilometers per year on average. The increase in the population and the rise in economic wealth of countries in the world have contributed to the increase in bottled water consumption (Kunaka, 2012).

According to the International Bottled Water Association (Rodwan, 2011), not every type of water can be labeled and sold as bottled water. Spring water is one popular form of bottled water. It is derived from natural springs that flow across the Earth's surface. For water to be labeled as "spring," the water must be collected directly at the spring flow, or through a borehole that reaches the natural underground water deposit. Purified water is another common type of bottle water. Unlike the spring water, purified water does not derive from a natural source.

Purified water is produced by distillation, deionization, reverse osmosis, or other proper processes. Another common name for purified water is distilled water or deionized water based on the process used for its purification. Another form of bottled water is labeled as mineral water. Like spring water, mineral water is naturally produced, yet unlike spring water and purified water, it must contain a minimum of 250 parts per million total dissolved solids. This form of water is unique among others for its constant level of mineral and trace elements. All elements must be natural and occur from the water source; no minerals can be artificially added. Sparkling is yet another type of water that may be bottled. Sparkling may be derived from a natural spring, may contain minerals, or may be purified. What makes sparkling water distinct is the use of carbon dioxide to create a carbonated beverage. Finally, the last form of water that is permissible to be bottled is well water. Well water comes in two forms: artesian water (or artesian well water) and well water. Artesian water comes from a well that taps a confined aquifer. The water in the aquifer must stand at a height above the top of the aquifer. Well water is simply any water derived from a hole that taps an underground aquifer (Rodwan, 2011).

In this thesis, spring water is the focus. Because most of the 19L bottles of water sold in Turkey are spring water. Also, consumers tend to think spring water is the healthiest.

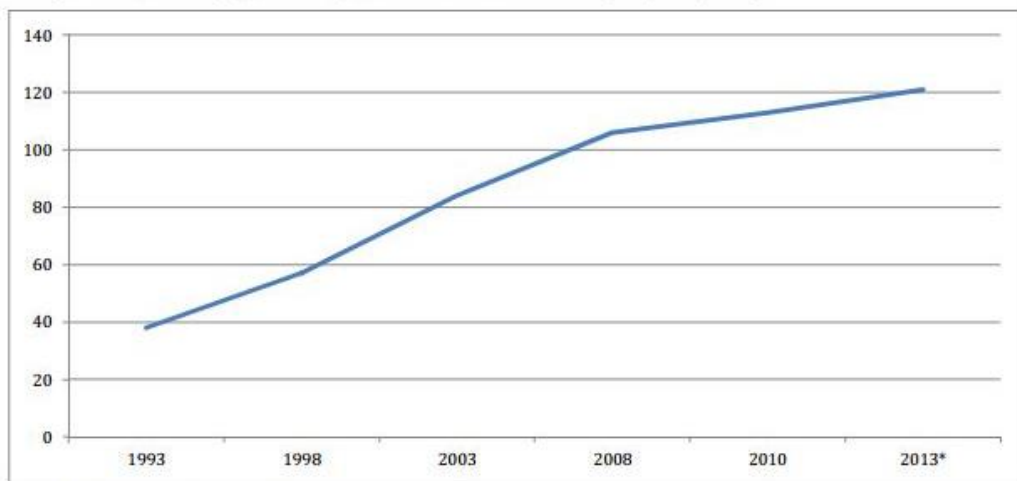
### **2.3 Bottled Water Market Outside of Turkey**

As the U.S. is the largest consumer market for the bottled water industry in the world (Hu, Morton, & Mahler, 2011), it is important to glance over a few quick facts regarding the bottled water industry in the U.S. According to the Beverage Marketing Corporation (BMC), the average wholesale price for a gallon of bottled

water was \$1.21 (\$0.32 per liter) in 2011 in the USA. On average, Americans consume 85 million bottles of water every day, totaling to more 30 billion bottles in a year (Hu, Morton, & Mahler, 2011).

The bottled water industry in the U.S. increased 6.2 percent from 2011 to 2012. The US market isn't the only booming market. By looking at the Figure 1.1, it is clear that there is a steady increase in the bottled water consumption globally since 1993 per person.

**Figure 2.1:** Average Bottled Water Consumption in the World (per person per liter)



Source: Beverage Marketing Corporation (BMC) cited in KUNAKA (2012)

With a 15% increase per year, the bottled water industry is one of the fastest growing industries in the world. According to the report released by BMC BM Global, the total bottled water consumption in the world is about 53 billion gallons (200 billion liters).

IBWA states that consumers in the USA purchase water from these places in 2010:

- 29.7% Mass merchandisers/club stores (where the price per gallon is generally much lower)

- 29.5% Grocery stores
- 5.5% Convenience stores (where the price per gallon is likely to be higher)
- 3.4% Drug stores

In a report released by SUDER, water consumption per person for countries is as shown (Table 2.1):

**Table 2.1:** Water Consumption per Person (in liters) for Countries

Mexico	224
Italy	204
UAC	150
Belgium	148
Germany	132
France	131
Turkey	126
Spain	121
Lubnan	115
Hungary	110
USA	108

Source: SUDER (2010) cited in KUNAKA (2012)

As seen by Table 2.1, Mexico and Italy consume the most water per person in the world. This, however, is misleading when trying to calculate the country with the largest bottled water market. To assess which country consumes the most water from bottles on average, it is important to consider a country's population. You can see the water consumption of the countries in Table 1.2:

**Table 2.1:** Water consumption in Countries (billion liters)

USA	Mexico	China	Brazil	Indonesia	Germany	France	Thailand	Spain
32.8	24.6	19.7	14.3	11	10.8	8.4	6.5	4

Source: SUDER (2010) cited in KUNAKA (2012)

As shown, the U.S. consumes the most water by far. The runner-up (Mexico) to consuming the most water uses nearly 10 billion liters less than the U.S. Europe has four of the largest ten markets: Italy, Germany, France and England. Even though the glass industry is very much developed in Germany and England, in almost every country the plastic packaging is preferred over glass in bottling water (SUDER).

The bottled water industry has a noteworthy impact on the economies of the countries (IBWA). Not only do consumers of bottled water get the perceived added benefits of not drinking from the tap (health, convenience, etc.), these consumers have also helped building up an industry that has become beneficial for the economy of the relevant countries. The bottled water industry has created a wholly new sector with its own capital and flow of goods and money. New jobs created by this industry have reduced the unemployment rate in the given country. According to IBWA, in the United States, the impact of bottled water industry to GDP is about 1 percent.

#### **2.4 Bottled Water Industry in Turkey**

The bottle water industry in Turkey is growing every day. In many cities of Turkey, tap water is not recommended for consumption due to health reasons. Bottled water is a must-buy product for people who live in cities where tap water is

not drinkable. Water, therefore, is a product that humans must consume to survive, but cannot attain for free.

There are several sizes of bottled water in Turkey: 0.5L, 1L, 1.5L, 5L, 10L or 19L. In Turkey, the production of 19L bottles started in 1997. It is stated by KUDAKA (2012) that the main reasons why people prefer this product can be stated as health, being cheap, home delivery option and ease of use.

The 19L bottle is considered the largest water container used in Turkish homes (Ayabakan, et al., 2007). 19L bottled waters are purchased from a variety of companies. In Turkey, there are existing companies that have dominated the market since the introduction of the 19L bottled water to the market. Throughout the years, however, many other companies started conducting business in this sector and therefore the market has become very dynamic. According to SUDER, in last seven years, numbers reveal that 19L bottle water consumption increased by 5%, non-19L bottle retailing market by 34% and non-19L bottle water consumption outside houses by 20% in 2007. By looking at the Table 2.2, it can be seen that in 2012, the total water consumption of a 19L bottle and non-19P bottles is 10.2 billion liters. When 3.75 billion liters is consumed from non-19L bottles, 6.45 billion liters was consumed from 19L bottles.

After looking at the numbers in Table 2.2, it can be seen that bottled water industry's volume is increasing rapidly in Turkey.

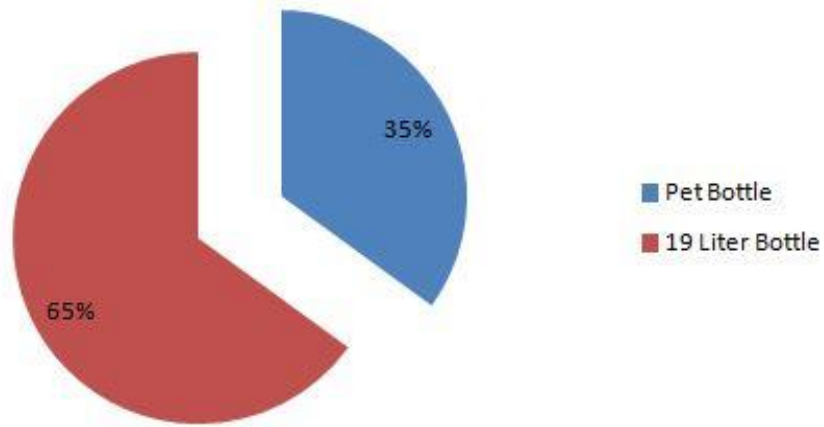
**Table 2.2:** General structure and volume

	2007	2008	2009	2010	2011	2012	2013 (forecast)
<b>Total Consumption (billion L)</b>	8,10	8,70	9,00	9,50	9,90	10,20	10,50
<b>19L bottle (billion L)</b>	6,00	6,30	6,30	6,40	6,50	6,45	6,40
<b>Non-19L bottles production (billion L)</b>	2,10	2,40	2,80	3,10	3,40	3,75	4,10
<b>market volume (billion TL)</b>	2,50	3,00	3,10	3,30	3,50	3,70	4,00
<b>Consumption per person / year</b>	115, 00	122, 00	124, 00	128, 00	133, 00	135, 00	138,00
<b>Growth</b>		7,00 %	3,00 %	6,00 %	4,20 %	3,10 %	3,00%

Source: SUDER (2012)

As it can be seen from the table, In Turkey, the water consumption was 9.3 billion liters and the market volume was 3.4 billion dollars in 2011. The water consumption per person was about 135 liters. 65 % of the total bottled water consumption was the 19L bottles and the 35% was the other non-19L bottles (SUDER, 2010).

**Figure 2.2:** Bottle water sector (%)



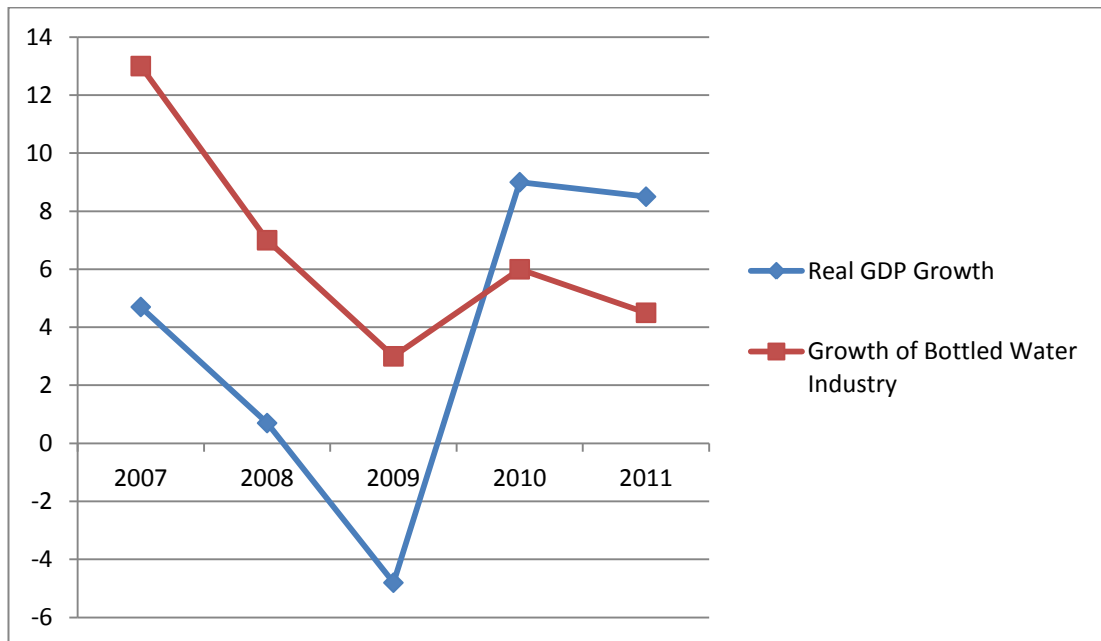
*Source:* SUDER (2010) cited in KUNAKA (2012)

In the non-19L and 19L bottle categories, there are 296 companies and the 10 biggest companies dominate 63 % of the total Turkish market (KUDAKA, 2012)

Despite the economic crisis of 2009, the water industry in Turkey has nevertheless continued to grow. The main reasons for this are due to health concerns regarding the tap water, increase in population, a raise in the general income of people, change in consumer behavior, education level and development of the country. In the Figure 2.2, the growth of the bottled water sector from 2007 until 2011 by can be seen. The blue line shows the real GDP growth of Turkey during the same set of years.



**Figure 2.3:** The position of water industry in Turkey and GDP



Source: TUIK, SUDER; cited in KUDAKA (2012)

Recently in Turkey, the quality of the tap water started being questioned. Due to reasons such as health, ease of use, habit, and trend, bottled water consumers prefer drinking bottled water over tap water. In this study, we examine the logistics service quality (LSQ) perception of the customers with the survey. Then, we provide a mathematical model to maximize the perception of customer service quality using the data from the survey in regards to 19L bottled water. After much research into the bottled water industry and related LSQ literature, the 19L bottled water appears to be the best product that matches with our purpose of measuring the customer perception. Unlike the 19L bottles, all non-19L water bottles are generally bought at the time of purchasing decision and is a matter of impulse buying. Therefore, the level of customer and seller interaction is not very high. Conversely, the 19L bottles are bought for consuming at home or offices in which the process of ordering is seen clearly. The consumer must choose a water brand, then call the company to set up

delivery times and locations. The process then becomes a great opportunity to assess LSQ. After assessing the dimensions of LSQ with the help of the survey, related data was used as inputs to the mathematical model.

As tap water cannot be drunk, water from the tap also is not recommended for other purposes such as cooking, washing foodstuff and so forth. Therefore, it is necessary to have large quantities of drinking water at homes and workplaces. The largest quantity available for domestic use is the 19L bottled water. At the time of a need, consumers are free to decide which brand they want to consume. After they decide, there are several ways of ordering. Face to face interviews show that the most common way of ordering is to call the regional dealer and to give the address where the consumers want their water to be delivered. Each region has its own dealers. They usually hand out brochures or magnets in order to distribute their phone numbers. Another way of ordering is calling the customer service number of the brand and ordering via phone. Once you place your order, they get in contact with the closest dealer and have your water delivered to you. Nowadays, some companies have utilized an online ordering service which occurs in a similar way with phone ordering, but via internet. Regardless of ordering type, the consumers must pay at the door for the purchased water. That is, after the consumer receives the product, he or she must make the payment. During this ordering process, the interaction between the customer and the company can be easily observed. Due to having observable ordering and delivery processes we have selected the 19L bottled water to apply our study.

## 2.5 Turkey's water import and export

A few years ago, Turkey did not have a high amount of spring water export. It was about 30 thousand liters. However, after large corporations joined the water industry, the volume of export increased. In table 2.3, you can see the spring water and soda water exports of Turkey. 98% of the total number is solely spring water export which is the 98 % of 173,610,000 liters in 2011 with a value of 33,000,000 dollars.

**Table 2.3:** Turkey's Beverage, water and sodium carbonate export (Amount: 1,000 liters, Value: 1,000 dollars)

Product Name	2009		2010		2011	
	Amount	Value	Amount	Value	Amount	Value
Beverages	94,557	58,937	114,415	72,653	146,820	98,026
Water and Sodium Carbonate	131,889	23,600	172,081	29,498	173,610	33,040

Source: TUIK, cited in KUDAKA (2012)

The water import of Turkey is significantly low compared to the exports. The small amount of water imported to Turkey is usually marketed towards expats and tourists. In 2011, the amount of spring water and soda water imported was 1,618,000 liters with a value of 1,751,000 dollars.

**Table 2.4:** Turkey’s Beverage, water and sodium carbonate export (Amount: 1,000 liters, Value: 1,000 \$)

Product Name	2009		2010		2011	
	Amount	Value	Amount	Value	Amount	Value
Beverages	20,155	30,157	24,446	32,542	38,238	49,025
Water and Sodium Carbonate	929	825	1,253	1,099	1,618	1,751

Source: TUIK, cited in KUDAKA (2012)

## 2.6 B2B versus B2C Markets

The literature related to logistics service quality (LSQ) is very rich. After analyzing each and every dimension stated by a variety of authors, it is seen that there are dimensions for both business to business (B2B) and business to consumer (B2C) marketing. The supply chain activities and interaction between the parties of this chain is clearly seen in the B2C delivery. In the literature of logistics service quality, there are studies related to different sectors and companies as we stated at the literature review section. However, concerning the customer perception there are not many studies. Furthermore, the research interest of the author of this thesis is also on the customer side of water delivery. Customer perception in the delivery of bottled water industry is the main area that this thesis will focus.

## 2.7 Supply Process of Bottled Water

In this section, the process of water delivery will be explained. We conducted face-to-face interviews with sector experts of different water distribution brands in İzmir, Turkey. Although there are slight variance in the implementation of the water

supply and delivery process, the interviews, nonetheless, provided a generalized insider look into the service flow used by different companies.

Companies of all varieties have unique supply chain players depending on the type of product. Concerning the bottled water industry in Turkey, sizes of the bottles is of more importance than the type of water. This is because the majority of water bottled in 19L form in Turkey is natural spring water. There are numerous sizes of bottled water and each of them has a different distribution channel. A distribution channel is a set of corporate items, institutions or agencies within or external to the manufacturer, which carry out the functions that help marketing of product (Lambert, Stock, & Ellram, 1988). In this thesis, we focused on the distribution channel of the 19L bottled water. At the end of this section, we will state the distribution channel of this product including the activities and the players that take part in the supply chain process.

## **2.8 Production Process**

In Turkey, there are many springs that are being used as sources of water for bottling companies. Spring water changes in taste and ingredients depending on the source. Each of the water selling brands has their own spring rented from the Turkish government. The process of water supply in Turkey was discovered after some face to face interviews with people involved in the industry. The people who were interviewed are from different companies and positions. From Pınar company, the production manager and 2 employees from one of the regional dealers were interviewed. From Özsu company, the manager of the regional dealer and an employee were interviewed. Also, the former operations manager of Kızılıçık company was interviewed. All spring water brands have specific springs and related

distribution processes. There is a facility above the spring where the water is processed. After the water is removed from the spring with the help of pipelines, it goes to a depot where the water is filtered. Afterwards, water continues to the next depot where there is a second filtering activity. The next step is the relaxation period in a pool. After the relaxation process, water is put to the final depot where the bottles are filled. In each step, hygiene of the equipment used is very important.

## **2.9 Cleaning the Bottles and Filling**

After the water is processed, the next step is bottling. The empty bottles are collected from regional dealers and carried to the water distribution facility. The collection and carrying process of the bottles is done depending on the contract of the dealer and the water distribution company. In some cases, the dealer pays for the expenses and in other cases the company provides the needed service.

The bottles arrive to the facility and then are first checked for any damage, bad smell, and so forth. If there is any bottle that cannot be used due to a problem, it is sent to the recycling process. Each 19L bottle can be used up to 50 times, and then they are sent to the recycling even if there is no obvious damage. All the clean and intact bottles are sent to the washing process after passing the first inspection. The empty bottles are washed and decontaminated. After the cleaning process, the bottles are labeled with the brand name.

At times, bottles belonging to different company or labeled by a different brand are incurred by the wrong water-bottle distribution center. For example, if a customer decides to change the brand of their water and calls a new company, the new water-distribution company will then deliver their branded water and pick up the old companies' bottle. These bottles are then sent to their proper company

destination via “commissioners”. Commissioners move between the companies and deliver the empty bottles of each firm by earning commission.

After all the bottles have the sticker of the company and are clean, the fill up process starts. After all bottles are filled, plastic lids are put in place. These lids are then sealed with plastic to ensure the lids are not opened before the end user obtains the product for safety and sanitary reasons. At the end, the bottles are ready for loading on trucks for delivery to the dealer’s warehouses.

## **2.10 From the Facility to End User**

The third part of the water distribution process begins after the trucks arrive to the warehouses of the bottled water dealers. This part of the process is the focus of this study due to the availability of LSQ measurement from the consumer side.

Delivery trucks filled with freshly prepared 19L water bottles are sent from the processing facilities to the warehouses of the dealers. There is one dealer for each region. These regions are defined by the specific companies. The rest of the smaller stores provide their bottled water from these regional distributors. In this case, the contract type matters. Depending on the agreement, either the distributor delivers the bottles to the small stores or small stores pick up the bottles themselves.

After the bottles are located in the depots of the regional dealers’ depots or smaller sellers such as supermarkets or gas sellers, bottles are supplied to the end users. There are a few distribution channels where the end user can provide water. First option is buying directly from the regional dealer. Second option is buying from the stores where they mainly sell propane gas for cooking. Another option is the small supermarkets.

When ordering from these three options, the ordering process for the end user is usually from one of these three ways: calling the regional dealer, calling the customer service (call center) of the company or ordering from internet (online).

It was stated by the interviewees that there are companies which choose to have different types of distribution channels and also some companies choose to be in specific channels. Especially large companies in Turkey tend to own and run everything in their distribution process. Also, they do not want their products to be found anywhere but their chosen regional dealers which is an example of selective type of distribution. There are several purposes in doing this. One aim is to keep the standardized service quality in the highest level as much as possible. Another aim is to eliminate the extra intermediary and the related commission paid to them and to sell directly to the end user. Thus, smaller size companies' products tend to be found in many different locations, such as stores, gas sellers and so forth, whereas larger companies' products are only found at the specified dealers. The aim of the smaller size companies is to sell high in number at a variety of locations and make profit that way.

## **2.11 Different Distribution Channels of Bottled Water Industry in Turkey**

There are three main distribution channels of bottled water delivery in Turkey. Each distribution channel varies based on the sizes and policies of the water distribution company. In all different types of distribution channels, there are two main processes: delivery process of bottles and order process. Firstly we will identify the players of the supply chain. Then the ordering process of each distribution channel will be indicated. Finally the delivery process will be discussed.



Before describing the distribution channels and the processes, a special emphasis should be put on the players of a typical bottled water distribution channel. There are several players, such as water facilities (springs), main distributors, regional dealers, retailers, and end users. Companies either own the spring or they rent it for a number of years from the regional Turkish municipality. Facilities are built on the springs. In some cases, there are main distributors that transport water from spring to the regional dealers. Main distributors therefore work like brokers between the facilities and regional dealers. The regional dealers are then responsible for the rest of the chain until the end user. Main distributors cannot sell to the end user or supermarkets. They can only sell to the regional dealers. Main distributors exist because they generally own a huge warehouse close to city center which makes the distribution process easier. In addition to water facilities and main distributors, there are also regional dealers. Usually, regional dealers receive the bottled water directly from the spring in the distribution chain where main distributors are not present. Regional dealers sell either to the supermarkets, convenience stores or specialty propane tank stores. Regional dealers can also sell directly to the end users. The last two parties of the distribution channel are the retailers and end users. Retailers include supermarkets, convenience stores or specialty propane tank stores. End users are last in each type of distribution chain and are the individuals who will consume the water.

The first figure (Figure 2.4) indicates the distribution channel of the largest water distribution companies in Turkey such as Erikli, Pınar and Nestle. In this type of distribution channel, each and every action within the chain is centralized. Any decision related to a new investment, pricing, promotion activities and so forth, is made by the primary company. As in all the channels there is a water facility

established on the spring, however usually in the cases concerning the larger corporations, the primary company controls the spring. The primary company also assigns dealers for each region. An important policy of such companies is that no third party can be involved in the distribution channel. Therefore, end users are served directly from the regional dealers. On the other hand, according to the information given from the sector experts, in the cases where the location of the regional dealer is far from the households, a retailer can be chosen to deliver to consumers for that region where the regional dealer is located too far away.

**Figure 2.4:** Distribution Channel for Main Companies



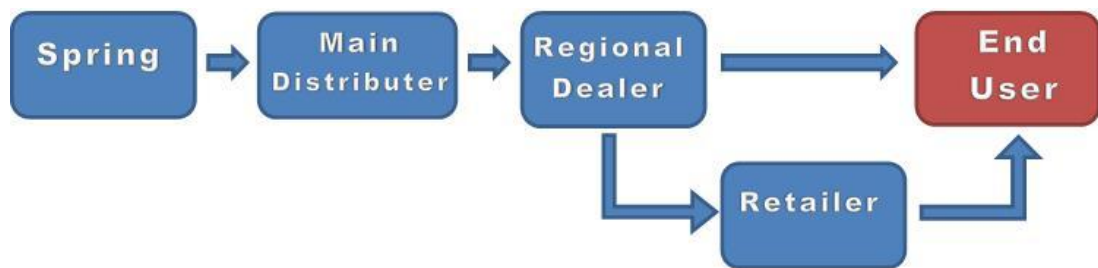
The second type of chain (Figure 2.5) is for middle size brands where each party acts as an independent player. Any type of investment or promotional activities is not being financially supported by the main company. The regional dealers can either sell to the end user or to the retailers.

**Figure 2.5:** Distribution Channel for Retailer



The third distribution channel is unique in that there is a main distributor in the chain (Figure 2.6). In this distribution channel, members are only responsible for themselves as in the second type of distribution channel. Main distributors own a big depot close to the center. They carry the bottled water with their own trucks to their depots. Then, regional dealers travel to the distributor's depot to retrieve the amount of bottle waters they need with their own vehicles. Afterwards, regional dealers sell to the retailers or directly to the end users. Retailers also sell directly to the end users.

**Figure 2.6:** Distribution Channel for Retailer with Main Distributor

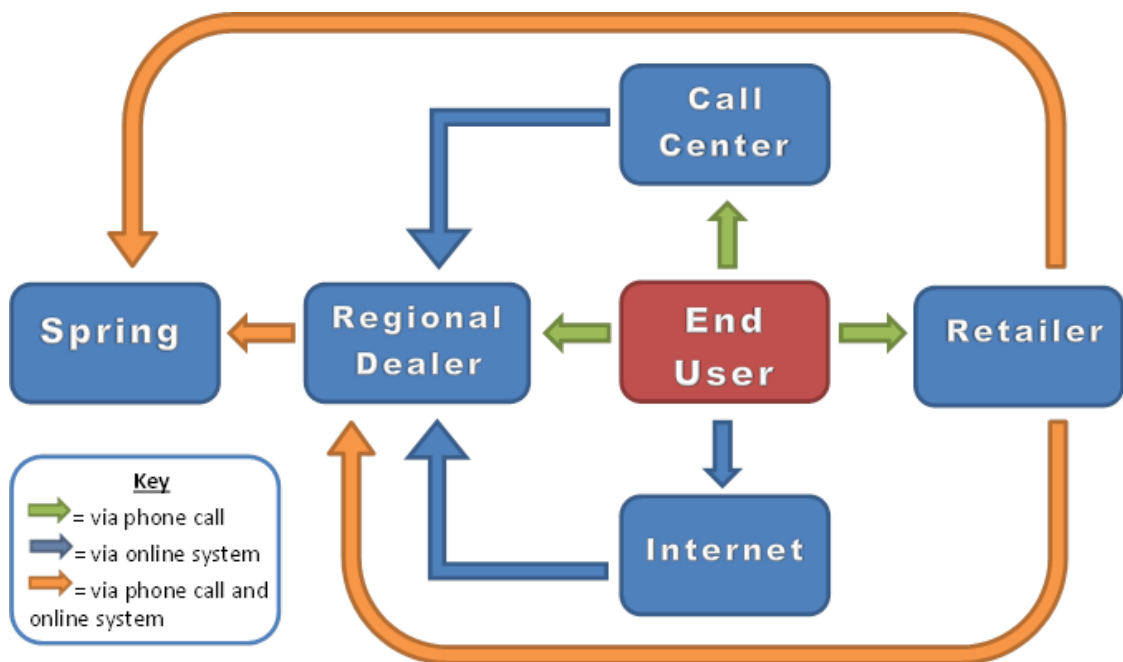


## 2.12 Order Process

In each distribution channel, orders can be placed with the same methods of communication (Figure 2.7). These orders of the end users can be placed via calling the regional dealer, retailer or call center of the respective company. Another way of placing an order is online; however, not all companies offer an online ordering service. Generally, only the largest companies offer an online ordering option. The call center and online orders arrive to the regional dealers and the regional dealers deliver the bottled water to the end user as requested. When end users order from the retailers via phone, retailers then have two ways to carry out the order: using water from the regional dealer or from the water facility. In order to keep stock of bottle waters, usually, retailers order from regional dealers. However, in some cases when

the retailer owns a large truck, they may directly order from the water facility and carry the products back to their store by their own vehicle. Lastly, regional dealers and main distributors can order from the main facility via an online system or phone call.

**Figure 2.7:** Order Process



### 2.13 Customer Service and Customer Satisfaction in the Bottled Water

#### Industry

In this section, it is aimed to demonstrate the link between the bottled water industry and customer service. There are several definitions of customer service. According to Innis and La Londe (1994, p. 3), customer service is:

*“...A process which takes place between the buyer, seller and third party. The process results in a value added to the product or service exchanged. This value*

*added in the exchange process might be short term as in a single transaction or longer term as in a contractual relationship. The value added is also shared, in that each of the parties to the transaction or contracts are better off at the completion of the transaction than it was before the transaction took place. Thus, in a process view: Customer service is a process for providing significant value-added benefits to the supply chain in a cost-effective way.”*

Another definition of customer service was stated by American Marketing Association (2013). Customer service is seen as a customer oriented business philosophy that incorporates and handles all of the components of the customer interface within a predetermined cost-service mix. Customer service includes activities such as ease of checking stock, ordering and post-sale support for the product (Lambert, Stock, & Ellram, 1988; p. 41).

In the end, customer service is one of the best tools that can be used to make the end user most satisfied with the product or service that they receive. This could be the service that occurs in pre-transaction, during transaction and post transaction steps.

Customer service is the key to reach a successful level of doing business. Corporate strategies usually rely on the effectiveness of the customer service applications of the companies. As a result of all the work that firms apply to gain a competitive advantage among other firms, it is very important that customers need to be satisfied. For the companies running in the logistics sector, logistics customer service is the key to customer satisfaction (Leuschner et al., 2013, p. 48).

Customer satisfaction reflects the customer’s general opinion of all the elements of the marketing mix: product, price, promotion and place (Lambert, Stock,

& Ellram, 1988). Customer satisfaction is a measure of how goods and services supplied by a firm meet or exceed customer expectation. Also, the number of customers or percentage of total customers, whose reported experience with a firm, its products, or its services exceeds specified satisfaction goals (Dictionary, 2013).

Before going into details about the customer service and satisfaction in the bottled water industry, it is beneficial to state about some academic work on customer service and satisfaction. Thirumalai and Sinha (2005) investigated the relationship between customer satisfaction and order fulfillment in retail supply chains. The main focus was on implication of product type in electronic business to consumer operations. This research was built to understand if the customer expectations vary across product types through order fulfillment. Innis and La Londe (1994) wrote an article for understanding the importance of customer service when gaining customer satisfaction and loyalty.

The above-mentioned distribution chain of a bottled water company requires a highly customer oriented chain. In this study, the focus is on the 19L bottle distribution. We are aware that the 35% of the market is being hold by non-19L bottle consumption. However, the 19L bottle distribution is the one that is suitable for the scope and interest of this study.

#### **2.14 Dimensions for 19L Water Bottle Distribution Channel**

After an overall review of marketing and logistics literature, more than 90 dimensions are found to be intersecting with this thesis (Parasuraman et al. 1985 and 1988; Mentzer et al. 1999; Emerson and Grimm, 1996; Rafele, 2004; Aktas and Ulengin, 2005; Bottani and Rizzi, 2006; Banomyong and Supatn, 2011; Wilding, Juriado, 2004; Rahman, 2006; Bienstock et al. 1997; Innis and La Londe, 1994).

These 90 or so dimensions in the literature include dimensions for several sectors. They are also different from each other for being either business-to-business or business-to-consumer. After analyzing all the dimensions and receiving some expert opinion from the sector, the best fitting dimensions were picked. From the 90 dimensions which took place in the literature, the ones which fit with the bottled water industry for a business-to-consumer transaction were selected.

**Table 2.5:** Dimensions chosen for the analysis

<b>Information Quality</b> *Accurate Information *Being informed in case of a delay occurs	<b>Mentzer et al., 1999</b>
<b>Ordering Procedure</b> *Fast and easy ordering	
<b>Timeliness</b> *Delivery at the shortest time	
<b>Order Accuracy</b> *Receiving a different brand	
<b>Order Quality</b> *Taste and quality *Minerals *Location of the spring	
<b>Order Condition</b> *Protection around the bottle *Visibility of brand label *Cleanliness of the bottle *If there are scratches on the bottle *Situation of the lid and lock	
<b>Order Discrepancy</b> *Solution during a problem *Effective complaint system	
<b>Personnel Contact Quality</b> *Cleanliness and physical appearance of delivery man *Speech, behaviours and communication of delivery man *Helpfulness of delivery man *Knowledge of delivery man regarding the company and product	
<b>Company's reputation</b> *The prestige of water brand *The brand that people use	<b>Aktaş and Ulengin, 2005</b>
<b>Technology</b> *Use of technological devices *Online ordering service *Call center	<b>Bottani and Rizzi, 2006</b>
<b>Price</b> *Pricing strategy of the company	<b>Banomyong and Supatn, 2011</b>
<b>Error-free transactions</b> *Frequency of having trouble	<b>Rahman, 2006</b>
<b>Responsiveness</b> *Accepting orders on holidays *Accepting orders even a few minutes before the shift ends *Working early in the morning and late at night *Offering a smooth service to cause no problems at the time of payment	<b>Parasuraman et al., 1985</b>  <b>Mvegerano et al., 2012</b>
<b>Promotion</b> *Promotional activities applied	<b>Pi and Huang, 2010</b>



From 90 dimensions, ten were chosen depending on their congruence with the sector. The main concern is that they must be measurable on the consumer side. Afterwards, four other dimensions were added with expert opinion from different companies as stated earlier in this chapter. Those dimensions are price, promotion, technology and error free transactions.

The first dimension is *information quality*. This concerns the information accuracy and availability given by the company to the customers about the product (Mentzer et al. 1999). In the bottled water industry, the accurate information about the water should be provided to consumers. It can be the location of the spring, minerals of the water and so forth. Consumers would also like to be informed about the service process. The information they get during the delivery process is significant. The second dimension is *ordering procedure*. In this industry of bottled water, ordering is one of the main activities of the consumers. This process of ordering needs to be easy and fast (Mentzer et al. 1999). The next dimension is *timeliness*. In today's world, where most of the transactions are happening in less than a second, time gained is of huge importance. For consumers of 19L bottled water, it is highly valuable to receive their order within the shortest time possible (Mentzer et al. 1999). Since tap water is not suggested for drinking, washing and cooking; receiving the bottled water at a shortest time possible is essential. Customers also pay attention to delivery of the goods or service at the time when it is promised.

Another dimension is *order accuracy* (Mentzer et al. 1999). Order accuracy concerns the customer receiving the right items ordered. There can be no replacements and the number of products delivered should match with the number that was asked by the customer. In the bottled water industry, order accuracy

dimension is very applicable. However, there are times when the regional dealers change the brand. Then, the customers of that regional dealer will receive the new brand without being informed. Even though there are consumers who are loyal to the dealer, there are consumers who are also loyal to the brand. When the brand-loyal consumers receive a different brand, it can decrease the level of satisfaction. *Order quality* is related to the attributes of the product (Mentzer et al. 1999). It is about how effective a product works. In the bottled water industry, the taste and ease of drinking water is important for consumers. The minerals that water contains are also significant. In this sector, the location of the company's spring may also refer to the quality of the water in the eyes of the customers.

The next dimension is *order condition*. Due to carriage, handling or transportation of the products, there may be damages. Order condition requires no damages on the box or the product (Mentzer et al, 1999). During the distribution process of the 19L bottles, there may occur some damages. The bottle can be with lots of scratches, it can dusty or dirty or even broken and water may be leaking. For order condition to be maintained there must be a way to protect the outside of the bottle. The brand label of the product should be clearly visible on the bottle. 19L bottles have a lid and a plastic lock surrounding the lid. It is for health reasons proving that the bottle was filled without any external touch and it is not opened after the filling process. Therefore, it is important for customers to receive the 19L water bottle without plastic seal being broken.

Another dimension is *order discrepancy*. If customers are sent a product with damage or of bad quality, the company should be able to replace it (Mentzer et al. 1999). With 19L bottles, this dimension can be seen as if the customers have any kind of problems with the product, they should be able to get assistance easily from

the company. An example can be a customer receiving a damaged or broken bottle. If there is any little crack on the bottle, water will leak. Therefore, the company should offer to change it immediately. For this reason, the main company or the distributor should have an effective complaining system. One of the dimensions stated by Mentzer et al. (1999) and used in this study, is *personnel contact quality*. The employee needs to be knowledgeable about the product and capable of explaining details about the product or brand with customers if needed. When ordering a 19L bottled water, the telephone operator should be professional and friendly. The personnel that make the deliveries also need to be professional and responsive. Being polite, being eager for help and wearing appropriate attire are some examples of the personnel contact quality dimension. According to Aktaş and Ulengin (2005), prestige of the carrier is crucial when deciding on cooperation with a third party logistics company. In this thesis, we adopted this dimension as *company's reputation* for the consumers when they decide on which brand to use.

The next dimension is *technology*. In the literature, this took place as the information technology usage of third party logistics companies (Bottani and Rizzi, 2006). In the bottled water industry, technology is an essential tool. The integration in the distribution channel and effectiveness of the ordering process may highly depend on the technological assets of the company and their effective usage. These assets may play an important role for the image of the company. Using hand-held terminals would lead to a faster order receipt and delivery to the customers. Maintaining an online ordering system and a customer service call center, may lead to better customer service. Banomyong and Supatn (2011) studied on the selection criteria of a third party logistics company. One of the criteria is offering appropriate service discounts. Therefore, *price* becomes important and we adopted this

dimension in our study. The price of 19L bottled water determines the purchase decision of some customers. Rahman (2006) stated that, *error-free transactions* are important when satisfying the customers. In this study, we implement this dimension to the bottled water industry. During the ordering and delivery process, all operations need to be accurate. The number of mistakes should be minimized by the company. Moreover, *responsiveness* is also proper for our study (Parasuraman et al. 1985; Emerson and Grimm, 1996; Rafele, 2004; Banomyong and Supatn, 2011; Wilding and Juriado, 2004). This dimension can show how much the company cares about its customers. A company with a good level of responsiveness would offer the highest level of service. In our study, the ability to order on holidays, early in the morning or late at night and even just a few minutes before closing time are taken into account regarding to this dimension. The last dimension, *promotion*, is not seen often in the literature. However, Pi and Huang (2010) looked at the affect of promotional activities on service quality and customer loyalty. Promotion in this thesis concerns the promotion policy of the water selling company and how it applies it to this sector. Promotion in this thesis can also be worded as a monetary benefit to the customers. It includes activities such as giving free fruit juice, sparkling water and so forth.

# **CHAPTER 3**

## **PROBLEM DEFINITION, METHODOLOGY AND THE MATHEMATICAL MODEL**

In this chapter, we introduce the logistics service quality dimensions that are attributed to the 19L bottle water industry. The survey related with the consumers' perception on these dimensions was constructed. The survey was given to 19L bottled water consumers. The main purpose in doing this was to obtain how the consumers perceive each dimension. In total, 14 dimensions were chosen to be in relation with the scope of this study.

### 3.1 Overview of the Survey Method

The dimensions that form the basis of this study were picked after a thorough analysis of the literature on *service quality* and *logistics service quality*. This research was conducted in two phases. First phase is mainly comprised of the survey and the analysis regarding the survey. The population considered in the survey consisted of various segmentation groups with respect to age, gender, income level, and education level. There are 33 questions in the survey. 32 of those questions refer to the 14 dimensions. The number of questions corresponding to one dimension ranges from one to five. The number of questions varies due to the complexity of assessing the specific dimension within the bottled water industry. One of the 33 questions does not refer to any of the dimensions; it is designed to measure the level of brand loyalty of the respondents. For each question assessing the dimensions, the respondents were asked to rank each sentence depending on their perception during the purchase of a 19-liter bottled water. The ranking was from 1 to 5 (Likerts scale) where 1 stands for “absolutely disagree” and 5 stands for “absolutely agree”.

The first two questions of the survey pertain to the dimension *information quality* (Mentzer, et., 1999). With the first and second questions, respondents were asked whether the accurateness of the information about the product, and being informed regarding delays in the delivery of their order affect their repurchasing decision, respectively. These questions were to gage how important information quality is to overall LSQ. The next dimension is *ordering procedure* (Mentzer, et., 1999). There was one single question asked for measuring this dimension. The question asked if having a fast and easy ordering process does affect the repurchasing decision of the customers. The third dimension is *timeliness* (Mentzer, et., 1999). The

survey enquiry related to this dimension was “Having my order delivered in the shortest amount of time affects my repurchasing decision.” This question measures the level of importance placed by customers on the time between placing the order and receiving it. The fourth dimension is *order accuracy* (Mentzer, et., 1999). For the bottled water case, the dimension seeks to assess incidents of different products being supplied on the repurchasing decision. That is, this dimension questions how customers react in case they receive some brand other than they actually ordered. The related survey statement asked the consumers to state the importance of receiving the same water brand as they exactly ordered on their repurchasing decisions. The next dimension is *order quality* (Mentzer, et., 1999). This dimension is particularly about the quality of the product, drinking water, and three questions were employed to measure this dimension. These questions are related to the taste, minerals and location of the water spring, respectively. A further dimension is *order condition* (Mentzer, et., 1999). This dimension aims to measure on what level product aspects, other than the drinking water itself, affect the repurchasing decision. The related survey inquiries reference the protective safety guards (Question 9), visibility of the brand label (Question 10), cleanliness (Question 11), the amount of scratches (Question 12), the situation of the lid and the lock around the lid on the bottle (Question 13). Another dimension was *order discrepancy* (Mentzer, et., 1999). With this dimension, it is aimed to discover whether the consumers seek for special care and attention in case of a problem with the product or the retailer company. There were two questions on the survey for this dimension. These were related to the extent the company is capable of providing a solution in case of a problem, and the existence of an effective complaining system that is open for consumers use, respectively. *Personnel contact quality* (Mentzer, et., 1999) was the eighth

dimension out of 14 dimensions. It was measured via four statements in the survey. Those question-statements were specifically related with the delivery employed and were associated with the cleanliness, physical appearance (Question 16), speech, behaviors, communication level (Question 17), helpfulness (Question 18), knowledge (Question 19) of the delivery employee. The purpose of this dimension is to appraise how the repurchasing decision of the consumers is effected by the contact point of the customer. The next dimension is *company's reputation* (Aktaş and Ulengin, 2005) which is mainly determined by the water brand. The two survey questions were set to evaluate whether a particular customer's repurchasing decision was affected by what brand people around him/her use, and the image that the brand has on the minds, respectively. *Technology* (Bottani and Rizzi, 2006) is the tenth dimension that we consider in order to evaluate the logistics service quality of the 19L bottled water industry in Turkey. Delivery companies may use technological devices to and in communication and transactions. The survey questions whether such technology that the company in question uses affect the repurchasing intention of the consumers. The three factors considered were: i) use of technology within the ordering process to decrease the delivery lead time, such as hand-held terminals, ii) the existence of an online ordering system for ordering convenience and iii) the possibility of using a call center for customers to place their orders. The one question asked about the *price* (Banomyong and Supatn, 2011) dimension was related to the price perception of the consumers; that is, how important the price of the product to their purchasing decision. The *promotion* dimension is introduced into the survey by Pi and Huang (2010). They focused on the effects of promotional activities on relational quality and customer loyalty. The aim in this thesis is to measure how promotional activities of a brand or dealer affect the consumer's repurchase intention



of a brand. This is incorporated into the survey with a question involving the preceding statement. *Responsiveness* (Parasuraman et al., 1985; Mvegerano et al., 2012) was another dimension surveyed. There were five questions related to this dimension. As the literature suggests this dimension aims to measure how essential it is for the company to build empathy with its customers (Parasuraman, et al. 1985; Mvegerano, et al. 2012). The questions were: being able to place an order during holidays (Question 29), early in the morning and late at night (which may be important for working people) (Question 31), the possibility of placing an order just a few minutes before the closing time (Question 30), the helpfulness of the delivery employee (Question 32), and how the delivery employee reacts in case of problems (e.g. no change money during delivery) (Question 20). The last dimension is *error-free transactions* (Rahman, 2006) and is mainly related with the distributor company. The survey question asked for the importance of the frequency of problems that can be attributed to the distributor company or the product, in the eyes of the consumers. The main motivation behind the survey is the idea that repurchasing decision may be affected by these variables, thus the dimensions that they refer to. The survey provides a means to measure the weight of each dimension when deciding on purchasing and repurchasing of a particular water brand.

In addition to the analysis of the survey regarding customers' results of the survey are also used as an input to the second phase of the thesis. The second phase was built upon a mathematical model. This model uses the information from the survey and company/distributor-specific information in order to decide on an optimal allocation of resources for maximizing customer service level. Details and results of the mathematical programming model will be discussed in sections 3.8 and 3.9.

### **3.2 Survey Sample Selection**

In this section, we describe the methodology used to measure the perceptions of 19L bottled water consumers on logistics service quality dimensions. This first phase of the research was conducted via a survey based method. The dimensions that are selected to define the LSQ perspective of the consumers were represented by a variety of questions. The survey was developed with statements to signify consumer's perspectives when buying or repurchasing 19 liters of water.

222 respondents voluntarily completed the surveys. Due to the advantages of low cost and time saving, convenience sampling was chosen (Malhotra, 2004). Before applying to the factors in the survey, expert opinions were taken. All the elements on the survey were shaped accordingly. The target consumers were mostly families that are at least consuming one 19L bottle a month. The sample also involved university students because they constitute a large consumer-base of the bottled water industry. However, students who live with their families and who are not regular consumers of bottled water are not considered within the target population.

Among the total of 222 respondents who answered the survey, 62.2% (n=138) were female and 37.8% (n=84) were male. While 82.9% (n=184) of the respondents were married, 17.1% (n=38) were single. The distribution of level of education of the respondents is as follows: 0.9% (n=2) elementary school, 1.4% (n=3) primary school, 13% (n=29) high school, 54.5% (n=121) with a Bachelor's degree, 24.8% (n=55) possess a Master's degree and 12.6% (n=28) have a PhD degree.

Concerning the demographics of the survey, respondents were analyzed in five different age groups: (18-25), (26-35), (36-45), (46-60), and (61 and above).

44.1% (n=98) of the respondents were between the ages of 18 and 25, 42.8% (n=95) were between the ages of 26 and 35. 8.6% (n=19) of the respondents were between the ages 36 and 45. 4.1% (n=9) of the respondents were between 46 and 60, while only 0.5% (n=1) of the respondents were 61 and above. In terms of income levels, four intervals were considered. The first group had a monthly income between 0-1500 TL and 33.8% (n=75) of the respondents belong to this division. The percentage of the consumer group who have a monthly income between 1,501 -2,500 TL was 40.5% (n=90) of the total. 18.9% (n=42) belongs to the income level group of 2,501-5,000 TL. The remaining 6.8% (n=15) of the total respondents have an income level of 5001 TL and more per month. (Placeholder1)

**Table 3. 1:** Demographic Characteristics of Sample

		<b>N=222</b>	<b>%</b>
<b>Gender</b>	Female	138	62.2
	Male	84	37.8
<b>Marital Status</b>	Married	184	82.9
	Single	38	17.1
<b>Education</b>	First School	2	0.9
	Primary School	3	1.4
	High School	13	13.0
	Bachelor	121	54.5
	Master	55	24.8
	PhD	28	12.6
<b>Age</b>	18-25	98	44.1
	26-35	95	42.8
	36-45	19	8.6
	46-60	9	4.1
	61 and above	1	0.5
<b>Income (Monthly)</b>	0-1500 TL	75	33.8
	1501-2500 TL	90	40.5
	2501-5000 TL	42	18.9
	5001 TL and above	15	6.8

### 3.3 Results of the Survey

Among the 14 dimensions chosen from among the dimensions introduced in the previous literature on service quality some of them are found to be very

important for consumers. Even though the respondents of the survey agree with the importance of all 14 dimensions (minimum mean value is 3.15 out of 5), the level of importance of each dimension varies. The dimensions stated to be the most important are:

- Ordering Procedure
- Timeliness
- Order Quality
- Order Condition
- Order Discrepancy
- Responsiveness
- Error Free Transactions

Among 222 respondents of the survey, 203 (91%) people agree or absolutely agree with the importance of the ordering procedure to be easy and fast. Similarly, 199 respondents (90%) state that the timing of the delivery service is very important on their decision to purchase the same brand again. In terms of order quality, 210 respondents (95%) assess that taste and quality of the water is crucial. Taste of the water is related to the order quality dimension. Furthermore, 203 consumers (91%) claimed that the condition of the water bottle is significant on their repurchase decision for the same brand. According to the survey results, a critical point is the bottle must be free of dust and dirt upon delivery. 203 of the respondents (91%) say that the situation of the lid and the plastic lock around the lid (order condition) are also essential in terms of repurchasing decision. The next dimension, order discrepancy, is seen to be vital for respondents as well. The company's ability to find a solution to a problem is found mandatory by 200 consumers (90%) for deciding on

a repurchase of the same brand. 196 of the 222 respondents (88%) require an effective complaint management system which plays an important role in their repurchasing decision of the same brand. Responsiveness of the company is also discovered to be significant for the respondents. 193 respondents (87%) favor being able to order on holidays. The statement concerning the ability to order even a few minutes before the end of the shift was agreed by 193 respondents (87%). Another responsiveness related statement was being able to order early in the morning or late at night. 192 of the respondents (86%) state that ordering early in the morning or late at night highly effects their decision of repurchase. The last outstanding dimension is error-free transactions of the company. This dimension refers to the point of contact of the consumers with the company) represented by the distributor) and the product. 199 respondents claim (90%) that the frequency of having problems related to the water or retailer company influenced their decision of repurchase.

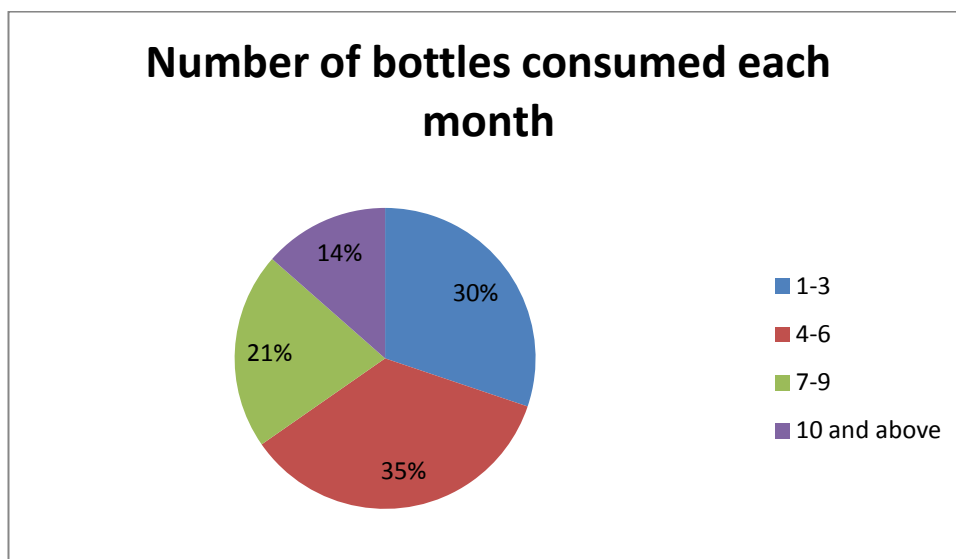
**Table 3. 2:** Mean, Variance, Standard Deviation and Variance of the Variables

<b>Variables</b>	<b>N</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>Variance</b>
1	222	1	5	4,13	1,008	1,016
2	222	1	5	4,18	,883	,779
3	222	1	5	4,46	,810	,657
4	222	1	5	4,41	,860	,740
5	222	1	5	4,11	1,106	1,223
6	222	1	5	4,62	,797	,636
7	222	1	5	4,03	,965	,931
8	222	1	5	3,78	1,025	1,051
9	222	1	5	4,00	1,091	1,190

10	222	1	5	3,83	1,121	1,256
11	222	1	5	4,44	,820	,673
12	222	1	5	3,89	1,112	1,237
13	222	1	5	4,54	,870	,756
14	222	1	5	4,42	,888	,788
15	222	1	5	4,32	,889	,790
16	222	1	5	3,77	1,023	1,047
17	222	1	5	3,92	,979	,958
18	222	1	5	3,32	1,226	1,504
19	222	1	5	3,45	1,095	1,198
20	222	1	5	3,63	1,157	1,339
21	222	1	5	3,16	1,305	1,702
22	222	1	5	3,99	,954	,909
23	222	1	5	3,15	1,171	1,370
24	222	1	5	3,99	,915	,837
25	222	1	5	3,37	1,149	1,320
26	222	1	5	3,96	,899	,808
27	222	1	5	3,65	1,134	1,286
28	222	1	5	3,41	1,129	1,275
29	222	1	5	4,34	,902	,814
30	222	1	5	4,40	,906	,820
31	222	1	5	4,36	,910	,829
32	222	1	5	4,14	,969	,938
33	222	1	5	4,39	,910	,828

Figure 3.1 shows the number of bottles consumed each month. In the survey, there were 4 ranges in terms of consumption: (1-3), (4-6), (7-9), (10 and above). It turned out that 30% of the respondents (67 out of 222) consume 1 to 3 bottles per month. 35% of the respondents (78 out of 222) consume 4 to 6 bottles of water where as 21% (45 out of 222) consume 7 to 9 bottles. The remaining 14% of the respondents (31 out of 222) consume 10 bottles or more each month.

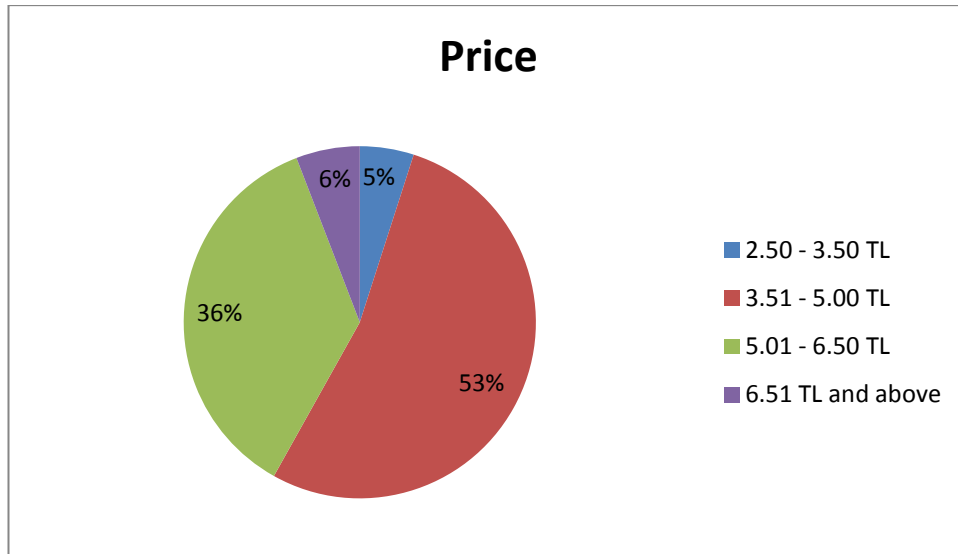
**Figure 3.1:** Number of Bottles Consumed Each Month



As shown on Figure 3.2, there were four price ranges on the survey to evaluate the price that the consumers are willing to pay for a 19L bottled water. From the results of the survey, it can be noted that 53% of the respondents (118 out of 222) are willing to pay between 3.51 TL and 5.00 TL. Where 36% of the respondents (78 out of 222) are willing to pay 5.01 TL to 6.50 TL, only 6% of the respondents (13 out of 222) claimed they are willing to pay 6.51 TL and more. The remaining 5% (11 out of 222) said that they are willing to pay 2.50 TL to 5.00 TL.



**Figure 3. 2:** The Price Range That the Respondents are Willing to Pay



The brand with the highest percentage of customers among respondents is Pınar with 27% (60 out of 222). 23% of the respondents (51 out of 222) use Erikli, whereas 7% (16 out of 222) use Nestle. The other brands and the percentage of customers are given in Figure 3.3. In total, there were customers of more than 25 brands who joined our survey.

**Figure 3.3:** Brands That the Respondents Use

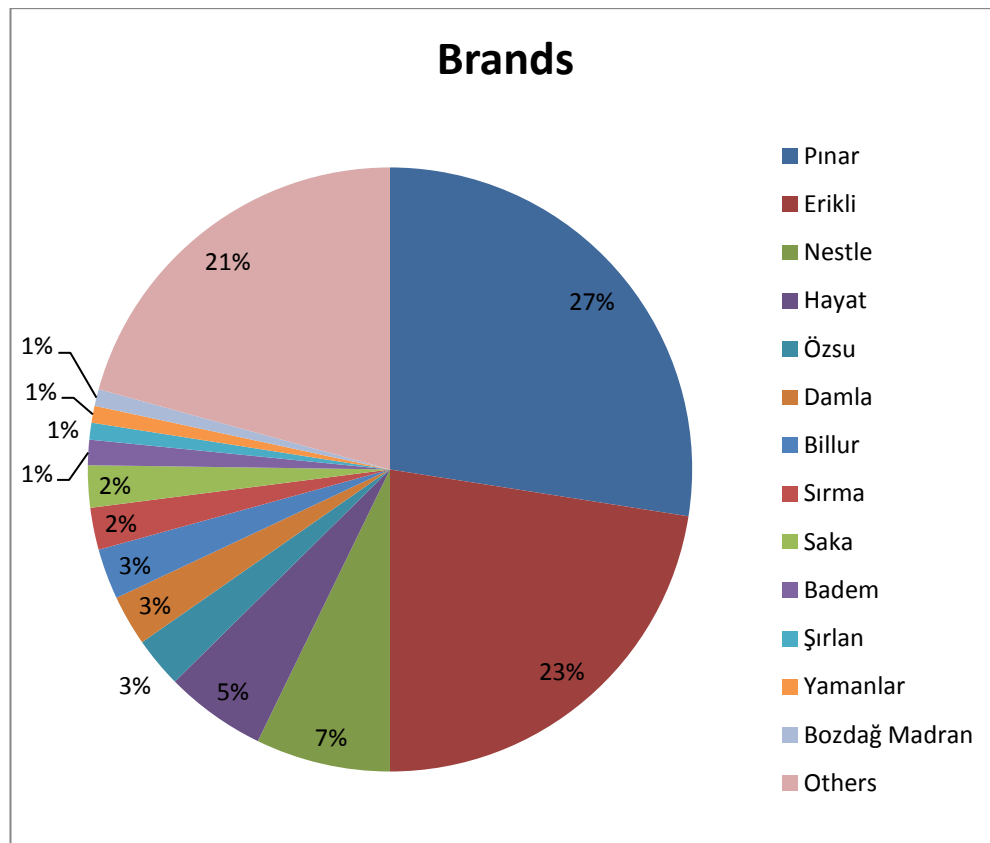
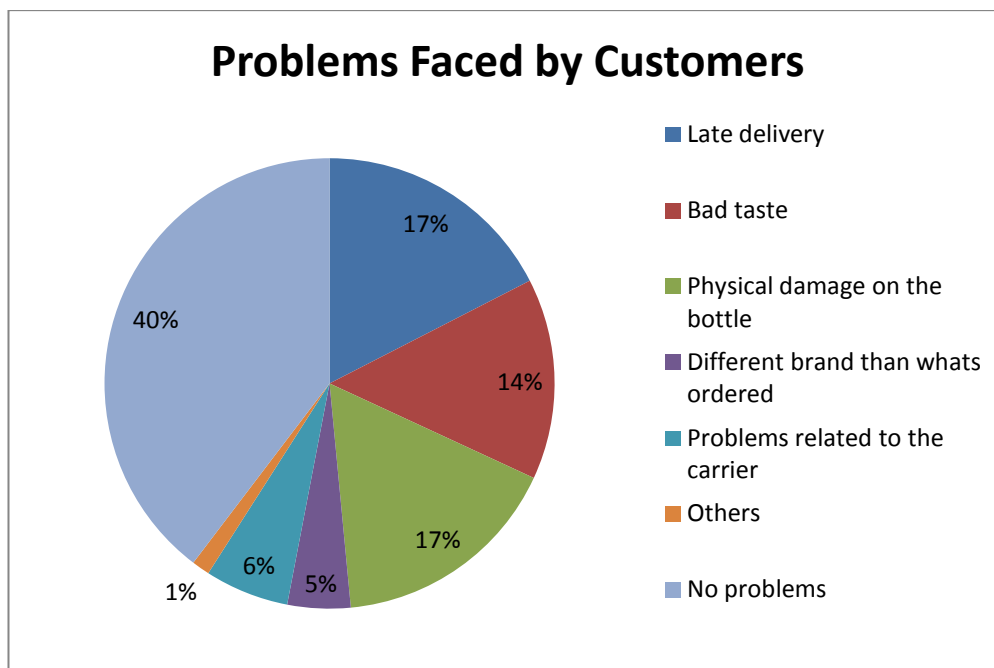


Figure 3.4 demonstrates the problems that the consumers had in the past year. The respondents were allowed to pick more than one problem that they had. 40% of the respondents (89 out of 222) had no problems in the past year. Late delivery and physical damage to the bottle were the most common problems, both with the same percentage of 17%. 14% of the problems listed by the consumers in our survey are related with the water having a bad taste. 6% of the problems were caused by the distributor (carrier) company, whereas 5% of the problems occurred due to receiving a different brand than what was ordered. 1% is due to other type of problems.

**Figure 3.4:** Problems That the Consumers Had In the Past Year



### 3.4 Hypothesis Testing

#### Hypothesis 1

Hypothesis 1 predicted that people with lower income would be more likely to be concerned with the pricing strategy of a bottled water company. To test this hypothesis, one way ANOVA was conducted to compare the effect of income level to the perception of the pricing of a 19L bottled water. According to the results of this test (Table 3.4, Table 3.5, Table 3.6), consumers with high income level are more likely to worry about the prices of a 19L water.

#### Hypothesis 2

This hypothesis is about a water company's use of technology. It is forecasted that the perception on the use of technology for a faster and easier service to the customers is different among gender. Results on Table 3.7; 3.8 and 3.9 indicate that

it is more important for women whether a company uses technological devices than men.

### **Hypothesis 3**

Hypothesis 3 estimated that the effect of income level among the promotional activities of a company would be significantly different. It was expected that consumers with lower income would be more concerned about the promotional activities of bottled water company. Table 3.10; 3.11 and 3.12 shows the results. It is clearly seen that the hypothesis was supported by the results. The perception of consumers among the promotional activities of a company depends on their income level.

### **Hypothesis 4**

This hypothesis estimated that the perception of the used technology of a company would change among the age groups. Younger respondents were expected to be more concerned with the use of technology of a company. Levene's Test for the Homogeneity of Error Variances was conducted and homogeneity was proved ( $p=.542$ ). However, the interaction effect between age groups and technology on repurchase intention was not statistically significant at  $p < .05$  level [ $F(4, 217) = .720, p=.586$ ]. The results show that the perception of the use of technology does not vary among different age groups.

### **Hypothesis 5**

Hypothesis 5 predicted that personnel contact quality perception would change among genders. Women were expected to be more concerned about the physical look, cleanliness and speech of the delivery man than men. The results of one way

ANOVA test shows that there is no significant difference between genders ( $p=.756$ ),  $p < .05$  level [ $F(4, 217) = .720, p=.586$ ].

### **Hypothesis 6**

This hypothesis was set to check if the perception of the pricing strategy var among the number of bottles used each month by the respondents. The respondents who consume more bottled water each month were expected to be concerned about the price more than the other consumers. However, the results indicate that there is no significant difference among the different consumer profiles in terms of the number of bottles consumed each month. Levene's Test for the Homogeneity of Variances shows a significance at  $p=.680$ . Also, there was no significant difference between the dimension and the variable, [ $F(3,218) = 1.131, p = .337$ ].

### **Hypothesis 7**

Hypothesis 7 predicted age groups would have a difference in term of brand loyalty. Consumers of older ages were expected be more loyal to the water brand they use. According to the one-way ANOVA tests,  $p$  level is larger than 0,005, which means there is no significant difference among the age groups for brand loyalty [ $F(4,217) = 0.883, p = 0.475$ ]. Also Levene's Test for the Homogeneity of Variances shows a significance at  $p=.181$ .

### **Hypothesis 8**

This hypothesis estimated that the consumers who consume an expensive brand would be more concerned about the prices of a 19L bottled water. There were about 25 brands stated by the respondents. The results of one-way ANOVA test for brand and perception of price was conducted and Test of Homogeneity of Variances show

the  $p = .008$ , which points to the conclusion that there is no significant difference for price perception among the consumer's of different brands [ $F(13,208) = 1.394$ ,  $p = 0.164$ ].

### **Hypothesis 9**

Hypothesis 9 forecasts consumers using a more expensive brand to be more loyal to their brand than other consumers. Levene's Test of Homogeneity of Variances calculates  $p$  as 0.475. ANOVA test points that there is no statistically significant difference between the brand name and brand loyalty [ $F(13,208) = 1.280$ ,  $p = 0.227$ ]. Among about 25 different brand names, there was no significant difference in terms of brand loyalty.

### **3.5 Reliability Analysis**

Internal consistency is in reference to the uniformity and congruity of the items within a scale. If the items are highly inter-correlated, then the scale is internally reliable. This means all of the items constituting the scale are sharing a common latent variable. Internal consistency is associated with Cronbach's coefficient alpha equivalent to the degree of variance in a scale that is derivable from the real score of the latent variable (Devellis, 2003).

Coefficient alpha is commonly the first measure used to assess the quality of the instrument used to compute reliability. The degree of alpha value denotes the items' capacity to capture the construct (Churchill, 1979). The coefficient's value can be between 0 and 1. A value of 0.6 and less represents insufficient internal consistency reliability (Malhotra, 2004). In this study, coefficient alpha values of the

seven constructs are adequate for seven of those dimensions. The Cronbach's alpha values and number of scale items are displayed below in Table 3.3.

**Table 3.3:** Scale Item Numbers and Scale Reliability

<b>Dimensions</b>	<b>Cronbach's Alpha</b>	<b>Number of Scale Items</b>
Information Quality	0.726	2
Order Quality	0.761	3
Order Condition	0.798	5
Order Discrepancy	0.889	2
Personnel Contact Quality	0.772	4
Technology	0.681	3
Responsiveness	0.802	5

### **3.6 Analysis of Variance**

In order to test the interaction between different segments, ANOVA test was conducted. There are several segments considered in the survey. Information was recorded related to respondents' age, education level, gender, marital status and income level. While few interactions between the dimensions and segments were found, there were some negative interactions between the segment groups which were noteworthy. Next, we state the positive results of ANOVA analysis, as well as the negative results.

The first analysis was applied to see the interaction between income level and its effect on perception of the prices of the 19 liter bottles. Income level was divided into 4 groups (Group 1: 0-1.500TL; Group 2: 1.501 TL-2.500TL; Group 3: 2.501 TL-5.000TL; Group 4: 5.001TL and above). According to the results of the Levene's

Test of Homogeneity of Variance (Table 3.5), variances are significantly different from each other:  $p=0.01$   $F(3, 218) = 3.908$ . Post-hoc comparisons using the Turkey test indicated that the mean score of Group 4 ( $M = 2.87$ ,  $SD = 1.356$ ) was significantly different from Group 1 ( $M = 3.88$ ,  $SD = 0.986$ ) and Group 2 ( $M = 3.68$ ,  $SD = 0.117$ ). Group 3 did not significantly differ from any other groups ( $M = 3.48$ ,  $SD = 1.34$ ).

**Table 3. 4:** Descriptive Statistics for Income Level Effect on Price

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
					0-1500TL	75		
1.501-2.500TL	90	3,68	1,110	,117	3,45	3,91	1	5
2.501-5.000TL	42	3,48	1,234	,190	3,09	3,86	1	5
5.001 TL and above	15	2,87	1,356	,350	2,12	3,62	1	5
Total	222	3,65	1,134	,076	3,50	3,80	1	5

**Table 3. 5:** Test of Homogeneity of Variances

Levene Statistic	df1	df2	Sig.
3,303	3	218	,021



**Table 3. 6:** ANOVA Statistics for Income Level effect on Price

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	14,508	3	4,836	3,908	,010
Within Groups	269,785	218	1,238		
Total	284,293	221			

Another ANOVA test was applied to the segment group of gender and its effect on technology perception of consumers. According to the results of the Levene's Test of Homogeneity of Variance (Table 3.8), variances are significantly different from each other:  $p=.035$   $F(1, 220) = 4.512$ .

**Table 3. 7:** Descriptive Statistics for Gender effect on Technology

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
					Female	138		
Male	84	3,6310	,80829	,08819	3,4555	3,8064	1,33	5,00
Total	222	3,7718	,77671	,05213	3,6690	3,8745	1,33	5,00

**Table 3. 8:** Test of Homogeneity of Variances

Levene Statistic	df1	df2	Sig.
,798	1	220	,373

**Table 3. 9:** ANOVA Statistics for Gender effect on Technology

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2,680	1	2,680	4,512	,035
Within Groups	130,646	220	,594		
Total	133,325	221			

The third test was applied to the income level and its effect on promotion activities of the companies. There has been a significant difference between the pricing perceptions of different income level groups. According to the results of the Levene's Test of Homogeneity of Variance (Table 3.8), variances are significantly different from each other:  $p=.005$   $F(3, 218) =4.352$ . Post-hoc comparisons using the Turkey test indicated that the mean score of Group 4 ( $M = 2.53$ ,  $SD = 1.06$ ) was significantly different from Group 1 ( $M = 3.64$ ,  $SD = 1.074$ ) and Group 2 ( $M = 3.42$ ,  $SD = 1.081$ ). Group 3 did not significantly differ from any other groups ( $M = 3.31$ ,  $SD = 1.22$ ).

**Table 3. 10:** Descriptive Statistics for Income Level effect on Promotion

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval		Minimum	Maximum
					for Mean			
					Lower Bound	Upper Bound		
0-1500TL	75	3,64	1,074	,124	3,39	3,89	2	5
1.501-2.500TL	90	3,42	1,081	,114	3,20	3,65	1	5
2.501-5.000TL	42	3,31	1,220	,188	2,93	3,69	1	5
5.001 TL ve üzeri	15	2,53	1,060	,274	1,95	3,12	1	5
Total	222	3,41	1,129	,076	3,27	3,56	1	5

**Table 3. 11:** Test of Homogeneity of Variances

Levene Statistic	df1	df2	Sig.
,746	3	218	,526

**Table 3. 12:** ANOVA Statistics for Income Level effect on Promotion

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	15,929	3	5,310	4,352	,005
Within Groups	265,945	218	1,220		
Total	281,874	221			

A number of other ANOVA tests were also carried out, however these demonstrated no significant difference between the segments and factor. For instance, between age groups and technology, there was no significant difference. Levene's Test for the Homogeneity of Error Variances was conducted and homogeneity was proved ( $p=.542$ ). However, the interaction effect between age groups and technology on repurchase intention was not statistically significant at  $p < .05$  level [ $F(4, 217) = .720, p=.586$ ]. Another interesting finding was between personnel contact quality and gender. Levene's Test for the Homogeneity of Error Variances was conducted and homogeneity was proved ( $p=.756$ ). One interesting result was found between the numbers of bottles of water consumed each month and the price perception of consumers. There were 4 groups to indicate the numbers of consumption of 19L water bottles such as 1-3, 4-6, 7-9 and 10 and above. Levene's Test for the Homogeneity of Variances shows a significance at  $p=.680$ . Also, there is no significant difference between people with different number of bottled water consuming each month about the perception of pricing strategy of the company; [ $F(3,218) = 1.131, p = .337$ ]. The last remarkable significance test was conducted to age groups and its effect on brand loyalty. Since ANOVA indicates that  $p$  level is larger than 0,005, there has not been an implication [ $F(4,217) = 0.883, p = 0.475$ ]. Also Levene's Test for the Homogeneity of Variances shows a significance at  $p=.181$ . The result shows that there is not a significant difference between different age groups due to brand loyalty.

The last tests were conducted between the brand and its effect on the perception of price. Respondents stated more than 25 brand names of 19L bottled water that they use regularly. ANOVA test for brand and perception of price was conducted and Test of Homogeneity of Variances show the  $p = .008$ , which points to

the conclusion that there is no significant difference between the users of different brands for the perception of price. However, ANOVA test indicates that there is no significant difference between the respondents' perception of pricing strategy of the various 19L bottled water companies, despite being consumers of different brands, [F(13,208) = 1.394, p = 0.164)]. In addition, another analysis was made to see the effect of brand on brand loyalty to see which brand created more of a brand loyalty among the customers. Levene's Test of Homogeneity of Variances calculates p as 0.475. ANOVA test points that there is no statistically significant difference between the brand name and brand loyalty [F(13,208) = 1.280, p = 0.227)].

### **3.7 Development of the Mathematical Model**

The first phase of the methodology used in this thesis was a survey. The purpose of the survey was to measure the customer perception of LSQ dimensions in the bottled water industry. The analyses about the relationship between segments, demographic groups, dimensions and factors were analyzed using the statistical analysis software, SPSS®, and the results were discussed. In this phase, the second half of the methodology will be presented and the results will be discussed in Chapter IV.

The second phase of this thesis relies mainly on the development and implementation of a mathematical model. By using the means and variances of each factor as indicators of their contribution to service quality, the mathematical model is designed to reveal the best allocation of resources to improve service quality. When doing this, the model takes into consideration of the costs and the budget related with factors and resources. As for the implementation of the mathematical model, we consider two different players with specific distribution channels characteristics. The

first player is a corporate, operating through a company channel in which the whole chain is managed centrally. The second implementation focuses on the retailer where the retailer decides most of the operational and tactical actions within part of the supply chain, within its area of activity, such as the delivery process itself, cleanliness of the bottles, and promotional activities. For each variable in the survey, a measure of importance regarding LSQ is reflected into the model by corresponding means and variances. By using this data, the model will decide for the optimum allocation of resources in order to improve existing situation of LSQ. When deciding what exactly to improve, the model depends on the expert opinion (for assessing the impact of investing resources on variables), resources and dimensions, as well as their importance for the consumers.

The implementation considers two different players who were taken as the decision makers: one corporate company and one retailer. Both of these players are assumed to agree on allocating a budget to their own channels with different resources. When deciding for the optimum customer service and customer satisfaction for each player, the model uses company and channel-specific parameters. Each company was set to have a current level of achievement in terms of each variable in the survey. After applying interviews with experts of the sector, the current level of the companies for each variable was estimated. This current level was denoted by a value between 0 and 1, where 1 represents 100% achievement and 0 represents no or negligible achievement. Some of the variables can only take the value 0 or 1. These are called binary variables. The model also considers an upper attainable level and a lower limit acceptable by the customers. For instance, for the case of the corporate company under consideration, the cleanliness of the water bottles was set to be 70% as its current level. Also, the estimation of the upper

attainable level was given as 80%, and the lower acceptable level by customers was set to be 50%. A similar process is also valid for the distribution channel where a retailer was taken as the decision maker. For example the retailer can increase the quality of information given to the customers regarding the water. Retailer's current level for this variable is estimated as 0.5%. When the lowest acceptable level was set as 75%, the upper attainable level was stated as 100%. Using the input data and parameters, the mathematical model decides on how resources to invest for each of the variables.

In order to test the model, it was estimated that the corporate company would be willing to spend at most 2% of its monthly profit for attaining better customer service. It is also assumed that this 2% can be allocated in 3 different types of resources in order to make the necessary improvements. Firstly, there is the one-time spending of money by the company, such as paying for weekly/monthly commercials to increase the company visibility. Secondly, a company may use part of the budget to employees, who will perform the operations designed to realize the improvements. Finally, the company may make long-term investments, such as establishing a customer call center. It is assumed that at most half of the overall budget for the three types may be spent on long-term investment. The rest can be spent on one-time spending or for hiring employees. A similar mind of thinking is also applicable for the case of a retailer. However, we make the reasonable assumption that the retailer would have a much smaller budget than a corporate company. 5% of the 6-month profit was set to be the budget of the retailer. Half of this profit was meant to be for one-time spending and employees, whereas the rest was for long-term investments. Also, the retailer was less flexible in doing the payments due to having a limited

budget. Therefore it is assumed that in practice, most of the long term investments will be made by installments.

Even though there are 33 variables in the survey, not all of them have costs assignable to be improved. That is, some variables can be improved without the use of company money. Therefore, some of the variables were taken out of the list of inputs to the mathematical model. Two examples are quality of water and receiving a different brand than what was ordered. Neither the company nor the retailer has well-defined tools to improve the quality of water beyond what comes out of the source spring. Receiving a different brand can be improved by more cautious handling of the delivery process, thus with no significant costs. After the pre-process of variables, 24 variables remain for the corporate company which could be improved and input to the model. 5 of the 24 were binary variables. On the other hand, for the retailer, 18 variables were identified as having possibility of improvement via investing resources, while 10 were dropped from the list. 5 of the 18 were binary variables.

For the current, lower and upper levels of the variables, the estimates were made by discussions with company representatives and distributors. The estimates were represented in terms of percentages. The unit costs of those improvements are also considered in terms of costs per percentage. For example, in order to improve the information quality, the retailer company can publish and distribute flyers to the consumers. Those flyers are estimated to create a 5% improvement from the current level of information quality. Afterwards, this cost of publishing and distributing flyers was divided into 5, in order to identify the cost of a 1% increase in the current level of the variable. Therefore, the model considers the unit costs of improving the achievement level of each variable by 1% from the current values.



### **3.8 The Model Definition**

Next, the details of the mathematical model will be presented. The following order is used to define the model: the definitions start with an explanation of the parameters, then decision variables, objective function, and constraints are given.

#### Parameters

One of the main inputs of the model is the mean and variance of the dimensions and the variables. These are obtained from the survey. The mean of the responses to each question is taken as the mean value of the significance of the corresponding variable for LSQ. Likewise, the variance of responses to questions is taken as the variance of the improvement that can be achieved by bettering the corresponding variables. For the model to decide on an improvement, the current situation must be defined. The current lower acceptable and upper attainable values are computed as explained earlier and input to the model as parameters. For both the main company and the retailer, unit costs and resource budgets are also input parameters. Other than the mean and variance values, other parameters are the company specifics the model will offer a different type of improvement for both of the players.

#### Decision Variables

The main decision variables are the target levels (or suggested improvement from the current levels) for dimensions and variables. The model also allows for decisions regarding deterioration from current levels of variables and/or dimensions, along with the associated costs. That loss is also defined as decision variables for both dimensions and variables in the model.

### Constraints

There are three main sets of constraints for this model. The first set of constraints ensure that the target values of the variables and dimensions are within the bounds defined by the associated lower and upper bounds. The second set of constraints establishes the target value of the variable (dimension) as the current value plus target improvements minus the level of deterioration. The third set of constraints is to make sure that the amount of resources required to change the levels of the variables (or dimensions) not exceed the predetermined budget for each resource. The budget varies from resource to resource, and from company to company.

### **3.9 The Mathematical Model**

The related notations and the model are given below. As stated earlier, the model is implemented for two different companies: one main company and one retailer.

#### **Sets:**

D = set of dimensions  $d = \{1, 2, \dots, 14\}$

V = set of variables  $v = \{1, 2, \dots, 28\}$

I = set of resources = {money (1), labor (2), investment (3)}

**Parameters:**

$m_d$  = mean weight of dimensions  $d$ ,  $d \in D$

$v_d$  = variance of dimension  $d$ ,  $d \in D$

$n_v$  = mean weight of variable  $v$ ,  $v \in V$

$s_v$  = variance of variable  $v$ ,  $v \in V$

$e_d$  = current level of dimension  $d$ ,  $d \in D$

$b_v$  = current level of variable  $v$ ,  $v \in V$

$l_d, u_d$  = lower, upper bound on value of dimension  $d$ ,  $d \in D$

$a_v, z_v$  = lower, upper bound on value of variable  $v$ ,  $v \in V$

$c_{1v}^i$  = cost of improving level of variable  $v$  by one unit  $v \in V$ ,  $i \in I$

$c_{2v}^i$  = cost of (loss of goodwill etc.) decreasing level of variable  $v$  by one unit  $v \in V$ ,

$i \in I$

$g_1$  = total budget that can be allocated for 2,  $i \in I$

$g_2$  = total acceptable deterioration allowable for 2,  $i \in I$

$j_{dv} = \begin{cases} 1 & \text{if variable } v \text{ explains dimension } d \\ 0 & \text{otherwise} \end{cases} \quad v \in V, d \in D$

$\alpha$  = relative importance of variances with mean values

**Decisions Variables:**

$T_d$  = target level for dimension  $d$  ,  $d \in D$

$F_v$  = target level for variable  $v$  ,  $v \in V$

$W_d$  = improvement (increment) in dimension  $d$  ,  $d \in D$

$H_d$  = deterioration (loss) in dimension  $d$  ,  $d \in D$

$X_v$  = improvement (increment) in variable  $v$  ,  $v \in V$

$Q_v$  = deterioration (loss) in variable  $v$  ,  $v \in V$

**Objective Function:**

Maximize  $\sum_{v \in V} (n_v - \alpha s_v) F_v \rightarrow$  maximize the weighted sum of target values for  
variables

Alternatively, one may have;

Maximize

Maximize  $\sum_{d \in D} (m_d - \alpha r_d) T_d \rightarrow$  maximize the weighted sum of target values  
for variables

### Constraints:

$$T_d = \frac{\sum_{v \in V} j_{dv} * F_v}{\sum_{v \in V} j_{dv}} \quad \rightarrow \text{establish the relationship between dimensions and associated}$$

variables

$$l_d \leq T_d \leq u_d \quad \rightarrow \text{lower acceptable / upper attainable for dimension } d \in D$$

$$a_v \leq F_v \leq z_v \quad \rightarrow \text{lower acceptable / upper attainable for variable } v \in V$$

$$F_v = b_v + X_v - Q_v \quad \rightarrow \text{formulate increment / deterioration for variable } v \in V$$

$$T_d = e_d + W_d - H_d \quad \rightarrow \text{formulate increment / deterioration for dimension } d \in D$$

$$\sum_{v \in V} c_{1v}^i X_v \leq g_{1i} \quad \rightarrow \text{budget of resource } i \text{ for improving variables } i \in I$$

$$\sum_{v \in V} c_{2v}^i Q_v \leq g_{2i} \quad \rightarrow \text{budget of resource } i \text{ for deteriorating ( loss ) variables } i \in I$$

### 0 / 1 ( binary ) variables

In order to incorporate binary variables into this model, we add set  $BV =$  set of dimensions that take on 0 / 1 (binary value) and define the binary counterparts of the parameters, decision variables and constraints. The GAMS formulation of this extended model can be seen in Appendix III.

### 3.10 Results of the Mathematical Model

Once the mathematical programming is run with the input data, the improvements in the variables can now be seen. The results of the mathematical model for the main company case are given in the Table 3.13. The current levels and the suggested improvements are shown both for non-binary and binary variables. For instance, variable 11 corresponds to the survey question inquiring about the chances of repurchase if the bottle is delivered dusty or dirty. The current level for a main company was set as 70%. The mathematical model offers an improvement of 20% for this variable. To give another example, variable number 13 is a binary variable. Variable 13 concerns the lid of the bottle and lock around the lid. It was seen that this could be a binary variable which means a bottle's lid and lock can either be good or unacceptable. The model offers that this variable needs to be improved within the given budget limits.

**Table 3. 13:** Results for Main Company

<b>Variables</b>	11	24	27	28	29	30	31	32	13 (BV)
<b>Current Level</b>	0.7	0.5	0.6	0.8	0.5	0.7	0.7	0.7	0
<b>Increase</b>	0.20	0.171	0.40	0.104	0.50	0.30	0.30	0.30	1
<b>Target Level</b>	0.90	0.671	1.0	0.904	1.0	1.0	1.0	1.0	1

The results for the retailer company are shown in the Table 3.14. The same method was applied to the main company case and the results are given as the current level of a binary and non-binary variable and the improvement of the model is stated.

**Table 3. 14:** Results for Retailer

<b>Variables</b>	1	16	24	30	13 (BV)	20 (BV)
<b>Current Level</b>	0.5	0.6	0.4	0.6	0	0
<b>Increase</b>	0.50	0.40	0.203	0.305	1	1
<b>Target Level</b>	1.0	1.0	0.603	0.905	1	1

The results show that the model provides valuable information to both companies in making decisions on improving customer service.

### **3.11 Findings Regarding the Research Questions**

- The results regarding the first research question about the LSQ variables effecting the purchasing or repurchasing decisions were answered by the survey method. The respondents were asked 33 variables in terms of the influence of each variable in their purchasing or repurchasing decision. The means of the variables indicate that seven of the variables have mean values above 4.40. Those variables are the taste and quality of the water, condition of the water bottle, the situation of the lid and lock of the bottle, order discrepancy, having effective complaint management, being able to order on holidays, a few minutes before the shift ends and early in the morning and late at night.
- The second research question was answered by the ANOVA analysis which was applied to the results of the survey. There were three significant differences found. The first analysis shows that there is a significant difference between the income level groups on the perception of pricing of the water. Respondents with lower income tend to be concerned more about

the price of the 19L bottled water. Another significant difference is seen between genders. Women perceive the use of technology as a more important tool during the ordering process and men. The last significant difference was seen between income level groups for the perception of promotional activities of the company. People with less income level are concerned more about the promotional activities of the water company.

- The next research question was answered by the mathematical programming method. The mean values and variances of each variable was taken and used as inputs to the mathematical programming. Therefore, the mathematical model will provide an optimization of the services of the main companies and retailers.
- The fourth research question was answered by the mathematical model. The companies with different characteristics will also have different resources to use. Due to the differences in the resources of each company, possible investments, employee hiring and cash spending needs to be scheduled accordingly. The mathematical model provides results for two types of companies such as a main company and a retailer.

The mathematical model offers to a main company to make improvements on the cleanliness of the bottle, using technological devices for a better service, pricing, promotion activities, accepting orders during holidays, accepting orders even a few minutes before the end of the shift, accepting orders early in the morning and late at night, increasing the helpfulness of the delivery employee and making sure there is nothing wrong with the lid and lock of the bottle.



For a retailer, the model also suggests to make improvements on the accurateness of the information given to the consumers, the cleanliness and physical appearance of the delivery employee, use of technology for a better ordering process, accepting orders even a few minutes before the shift is over, making sure the lid and lock of the bottle is safe and resolving problems that may occur during the payment at the door.

# CHAPTER IV

# CONCLUSION

In this study, we focus on logistics service quality. We provide definitions of supply chain management, distribution channel, marketing, and logistics interaction; moreover, we identify the classifications of dimensions used for measuring the performance of a company.

We review logistics service quality literature from the perspective of the customer service and customer satisfaction for 19L bottled water. Measuring such concepts is challenging, therefore we give the LSQ literature in detail including the corresponding dimensions. Characteristics of the bottled water industry are also analyzed and LSQ dimensions that apply to this industry are identified and discussed. The variety of distribution channels of 19L bottled water is also explained.

For the first phase of the study, we applied a survey to more than 220 respondents. The main purpose of the survey was to measure the customer perception on logistics service quality in bottled water industry. The survey also provided input for the second phase of the thesis that involves mathematical programming. As a byproduct of the survey, we also had a measurement of the brand loyalty of customers.

The data gathered from the survey was firstly analyzed with ANOVA. The 33 variables of the survey and the segment groups on the survey were checked in case of a significance or non-significance. The first ANOVA analysis was applied to see if there is a significant relation between the respondent's income level and the perception of price. The results show that the perception of the respondents among the price varies depending on their income level. Whereas the respondents who are concerned more about the price belong to the lowest income level, the ones with the highest income level are concerned the least with the price.

The second analysis was applied to see the interaction between the gender and technology perception. The common assumptions would state that males are more into the technology and technological devices than females. However, the results of this analysis indicate that women are more concerned about the technological devices used by the water company than men. Technology perception of this study was set around the technology utilized by the company to offer an easier and faster service to the consumers. It was seen that women pay more attention to such a utilization of the water companies than men. Next analysis was applied to see the relation between the income level and perception of promotion activities. Promotion activities term in the survey was to denote if the promotion activities applied by the water company effects the perception of the consumers. Promotion activities can be like free sparkling water, fruit juice or anything given for free next to a 19L-bottled water. It was seen that there is significance between the two, income level and promotion activities perception. People with lower income tend to mind more about the promotion activities that the water company offers. People with higher income mind less about the promotion activities of the water company.

The statistical analyses summarized above refer to the ones that demonstrate a significant relationship. In addition to those, there were a few more analyses where there were no significance seen even though one would expect beforehand. The first such analysis was the interaction between age groups and technology. Before the survey was applied, it was expected that the youngest respondents would tend to be more interested in the technology utilization of the water companies. However, ANOVA analysis revealed that it was not the case. Another interesting result was seen between the gender segment and the dimension of personnel contact quality. Personnel contact quality is about the physical appearance, speech, communication and similar characteristics of delivery persons. It is a common belief that women care more about these kinds of facts. However, the associated significance was seen to be more than 0,05 which means there is no relationship between the gender segment and personnel contact quality dimension. Furthermore, another analysis was completed between the number of bottles consumed each month and the factor of price perception. It was expected that people who consume more bottles each month would be more concerned about the price. However, the results of ANOVA analysis indicate that this is not statistically justified. As stated earlier, one of the 33 factors was to measure brand loyalty of the consumers. Before the analysis, it was expected that older consumers would be more loyal to the brand they use. The results show that this relationship is not significant either.

The last two analyses were applied to see the relationship between the brand that the consumers use and its effect on price perception and brand loyalty. Respondents stated more than 25 brand names with different consumer images and prices. At first sight, one might expect that people who consume a cheaper brand would perceive the price as an important factor. However the statistical results show

this is not true. The final analysis referred to the expectation that there would be significant relationship between the consumed brand and brand loyalty. The often cited reasoning supported by the off-the-record interviews of consumers who consume relatively expensive brands is being loyal to the brand. However, the results of the statistical analysis reveal that there is no significant relationship between the used brand and brand loyalty. In addition to this (although there is no significant difference between the brand and brand loyalty), the three brands most expensive brands in the market have the lowest mean value for brand loyalty. This can be interpreted as the consumers of the most expensive three brands are more loyal to their brands. This result was not statistically proved but we can see that at least these three brands support the expectations before the analysis.

Results of the survey showed different relations across various segments, dimensions and factors. With a measurement of the customer perception of Logistics Service Quality (LSQ) on hand, the second phase involved the mathematical model. The outcomes of the survey were used as inputs to the mathematical model. The means and the variances of each factor are taken from the analysis on statistical software SPSS. These means and variances are used to construct the weight of each dimension in the mathematical model with an objective of maximizing the perception of customer service quality.

The results belong to all three types of different distribution channels. There are three different distribution channels stated earlier and each of the channels includes different players. The results of the mathematical model belong to two different players. The first player, main company, takes place in the first distribution channel where there are three players (Table 2.4). The retailer can be seen both on the Table 2.5 and 2.6.

Simply stating, results of the mathematical model will indicate which variable to improve and by how much. As stated earlier, the model was implemented for two scenarios; main (corporate) company and retailer (distributor). The results for the main company show that the company should make improvements for the cleanliness of the bottle, using technological devices for a better service, pricing, promotion activities, accepting orders during holidays, accepting orders even a few minutes before the end of the shift, accepting orders early in the morning and late at night, increasing the helpfulness of the delivery employee and making sure there is nothing wrong with the lid and lock of the bottle.

The mathematical model suggests the retailer somewhat different directions to improve the variable. Results of the model state that the retailer should improve the accurateness of the information given to the customers, the cleanliness and physical appearance of the delivery employee, use of technology for a better ordering process, accepting orders even a few minutes before the shift is over, making sure the lid and lock of the bottle is safe and resolving problems with payment at the door.

All of these improvements are related with a cost in terms of resources. Therefore, the mathematical model decides on the improvements with respect to the budget given. However, there are a few variables which were dropped out due to having no attribute cost. Even though these variables were not included in the mathematical model, they are still important for the company. For example, receiving a different brand than what was ordered is one of the variables which were deducted. The company can improve this variable by keeping better track of its customers. In case of a regional dealer change, the company may let its customers know; therefore no customers will face this problem.

#### **4.1 Limitations and Future Research**

This study has a number of limitations. The survey in the thesis was implemented with around 220 respondents. The survey could be applied to more respondents. The sampling method used in the survey is convenience sampling. For more reliable results, random sampling method could be used. The weights input to the mathematical model could be obtained from multiple regressions with the output of the survey or using factor analysis. However, neither of the analysis gave usable results. Regarding the mathematical model, the current values for variables, budgets and costs per improvement were obtained through meetings with experts and company professionals, judgment and estimation. It would be better to incorporate more supporting evidence and data verification onto this process.

As for future research, the mathematical programming model can be extended by taking the positive and negative correlations between variables and dimensions into consideration. Clearly, decisions of one company in the supply chain affects other companies and vice versa. The mathematical programming model could be extended to take such interactions into consideration, with multiple decision makers. The model can also be employed in a sensitivity analysis setting, to observe the effects of change of parameters on the suggested strategies for companies. Based on the output of the mathematical programming model, a follow-up survey can also be implemented in order to see how the suggested improvements would actually affect customer perceptions.

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# **APPENDICES**

# Appendix I

## Survey in English

Dear Respondent,

This survey was prepared by İsmail Karabaş, a Master's student and a Research Assistant in the Department of Logistics Management. The purpose of this survey is to use it for his thesis titled as "Logistics Service Quality Perception of the Consumers in Bottled Water Industry".

**The number of people in your family including you:** .....

**Number of 19-liter bottles of water consumed per month:** ( ) 1-3 ( ) 4-6 ( ) 7-9 ( ) 10 and above

**Which brand do you consume?** .....

Please check your preference in the boxes along the sentences. Please pick one box for each sentence.

1	2	3	4	5
Absolutely Agree	Agree	Neither agree or Disagree	Agree	Absolutely Agree

	1	2	3	4	5
1. The accurateness of the information given by the company regarding the product will affect my repurchasing decision.					
2. Being informed due to a delay in delivery of my order will affect my repurchasing decision.					
3. Having a fast and easy ordering process will affect my repurchasing decision					
4. Having my order delivered in the shortest amount of time will affect my repurchasing decision.					
5. Receiving a different brand that what I ordered will affect my repurchasing					

decision.					
6. The taste and the quality of my water will affect my repurchasing decision.					
7. The minerals in the water will affect my repurchasing decision.					
8. The location of the spring of my water brand will affect my repurchasing decision.					
9. If there is a protection around the water bottle, will affect my repurchasing decision.					
10. The visibility of the brand label on the bottle will affect my repurchasing decision.					
11. If the water bottle is not delivered dusty or dirty, it will affect my repurchasing decision.					
12. If the bottle is without scratches, it will affect my repurchasing decision.					
13. The position of the lid and the lock around the lid will affect my repurchasing decision.					
14. The company coming up with a solution when I have a problem with the product will affect my repurchasing decision.					
15. The company having an effective complaining system when I have a problem with the product will affect my repurchasing decision.					
16. The cleanliness and the physical appearance of the delivery employee will affect my repurchasing decision.					
17. The speech, behaviors and communication level of the delivery employee will affect my repurchasing decision.					
18. The helpfulness of the delivery employee such as carrying the bottle inside the house when needed, opening the lid, putting the pump in place will affect my repurchasing decision.					
19. The knowledge of the delivery employee regarding the company and the product will affect my repurchasing decision.					
20. Having trouble with the payment at the door will affect my repurchasing decision. (Delivery employee not having enough change money etc.)					
21. I can easily change the water brand that I use.					
22. The prestige of the water brand that I use will affect my decision of choosing that brand.					
23. The water brand that people around me use will affect my decision of purchasing that brand.					
24. The company using technological devices to provide a better service to customers such as a easier and faster ordering will affect my repurchasing decision. (handheld etc.)					
25. The company having an online ordering service will affect my decision of choosing that brand.					
26. The company having a customer call center for ordering will affect my repurchasing decision.					
27. Price will affect my decision of choosing a brand.					
28. The company applying promotion activities will affect my repurchasing decision.					
29. Being able to place and order even during holidays will affect my repurchasing decision.					

30. Being able to place and order even a few minutes before the end of the shift will affect my repurchasing decision.					
31. If the ordering is possible early in the morning and late at night, will affect my repurchasing decision.					
32. If I am not at home at the time of delivery of water, the helpfulness of the delivery employee will affect my repurchasing decision. (Calling by phone etc.)					
33. The frequency of having trouble with the product or the company will affect my repurchasing decision.					

**PLEASE STATE THE FOLLOWING:**

The price that I am willing to pay for a 19 liter bottled water:

- 2.50-3.50 TL  3.51-5.00 TL  5.01-6.50 TL  6.51 TL and above

The problem(s) that I had in the past year caused by the water or the distribution company:

- Late delivery  
 Bad taste of the water  
 Physical damage on the bottle (hole, scratches, dustiness etc.)  
 Having a different brand delivered than what was ordered  
 Problems caused by the delivery employee  
 I had not problems.  
 Other (Explain): .....

**Age:**  18-25  26-35  36-45  46-60  61 and above

**Education:**  Elementary School  Primary School  High School  University  Master  
 PhD

**Gender:**  Female  Male

**Marital Status:**  Married  Single

**Income Level:**  0-1,500 TL  1,501-2,500 TL  2,501-5,000 TL  5,001 TL and above



## Appendix II

### Survey in Turkish

Sayın katılımcı,

Bu anket İzmir Ekonomi Üniversitesi Lojistik Yönetimi Bölümü Araştırma Görevlisi ve Yüksek Lisans öğrencisi İsmail Karabaş tarafından ‘Damacana Su Sektöründe Müşterilerin Lojistik Servis Algısı’ konulu tez çalışması çerçevesinde hazırlanmıştır.

**Siz dahil ailenizdeki birey sayısı:** .....

**Evinizde bir ayda tüketilen damacana su sayısı:** ( ) 1-3 ( ) 4-6 ( ) 7-9 ( ) 10 ve üzeri

**Hangi marka damacana su kullanıyorsunuz?** .....

Damacana su ile ilgili aşağıda yer alan sorular için katılım derecelerinizi, ifadelerin sonundaki kutulardan birini işaretleyerek belirtiniz. Her bir ifade için tek bir dereceyi seçiniz.

1	2	3	4	5
Kesinlikle Katılmıyorum	Katılmıyorum	Ne Katılıyorum Ne Katılmıyorum	Katılıyorum	Kesinlikle Katılıyorum

	1	2	3	4	5
1. Ürün ile ilgili, şirket tarafından verilen bilgilerin doğruluğu, o markayı tekrar satın alma kararımı etkiler.					
2. Teslimatta gecikme yaşanması durumunda bilgilendiriliyor olmam, o markayı tekrar satın alma kararımı etkiler.					
3. Sipariş vermenin hızlı ve kolay olması, o markayı tekrar satın alma kararımı etkiler.					
4. Verdiğim siparişin bana en kısa zamanda ulaşması, o markayı tekrar satın alma kararımı etkiler.					
5. Sipariş verdiğim markanın dışında başka bir marka gelmesi, sipariş verdiğim markayı tekrar satın alma kararımı etkiler.					

6. Kullandığım suyun tadı ve içim rahatlığı, o markayı tekrar satın alma kararımı etkiler.					
7. Kullandığım suyun içerdiği mineraller, o markayı tekrar satın alma kararımı etkiler.					
8. Kullandığım suyun kaynağının yeri, o markayı tekrar satın alma kararımı etkiler.					
9. Damacananın dışında koruma olması, o markayı tekrar satın alma kararımı etkiler.					
10. Damacananın marka etiketinin görünür olması, o markayı tekrar satın alma kararımı etkiler.					
11. Damacananın tozlu veya kirli bir şekilde gelmemesi, o markayı tekrar satın alma kararımı etkiler.					
12. Damacananın çiziksiz olması, o markayı tekrar satın alma kararımı etkiler.					
13. Damacananın kapağının ve kapağın etrafındaki kilidinin durumu, o markayı tekrar satın alma kararımı etkiler.					
14. Ürün ile ilgili bir sorun yaşadığımda, firmanın bir çözüm üretmesi, o markayı tekrar satın alma kararımı etkiler.					
15. Ürün ile ilgili bir sorun yaşadığımda, firmanın etkili bir şikayet mekanizmasına sahip olması, o markayı tekrar satın alma kararımı etkiler.					
16. Damacananı evime teslim etmeye gelen dağıtıcının fiziksel görünüşü ve temizliği, o markayı tekrar satın alma kararımı etkiler.					
17. Damacananı evime teslim etmeye gelen dağıtıcının konuşma şekli, tavırları ve iletişim seviyesi o markayı tekrar satın alma kararımı etkiler.					
18. Damacananı evime teslim etmeye gelen dağıtıcının, gerektiğinde damacananı evin içine taşımaya, kapağını açmaya, pompayı takmaya gibi yardım etme eğilimi, o markayı tekrar satın alma kararımı etkiler.					
19. Damacananı evime teslim etmeye gelen dağıtıcının ürün ve firmaya dair bilgi düzeyi, o markayı tekrar satın alma kararımı etkiler.					
20. Kapıda ödeme sırasında sorun yaşamak o markayı tekrar satın alma kararımı etkiler. (Dağıtıcının bozuk parasının olmaması, para üzerini verememesi vb.)					
21. Kullandığım suyun markasını kolayca değiştirebilirim.					
22. Kullandığım su markasının itibarı, marka seçim kararımı etkiler.					
23. Çevremdeki tüketicilerin kullandıkları damacana markaları, satın alma kararımı etkiler.					
24. Firmanın teknoloji yardımıyla tüketicilere daha kolay ve hızlı sipariş süreci sağlaması o markayı tekrar satın alma kararımı etkiler, (el terminalleri vb.).					
25. Firmanın online sipariş ağının olması, marka seçim kararımı etkiler.					
26. Müşterinin sipariş verebileceği ve müşteri hizmetleri numarası olarak kullanılacak bir telefon hattının olması, o markayı tekrar satın alma kararımı etkiler.					
27. Fiyat, marka seçim kararımı etkiler.					
28. Kullandığım markanın promosyon faaliyetleri yapıyor olması, o markayı tekrar satın alma kararımı etkiler.					
29. Tatil günlerinde sipariş verebiliyor olmak, o markayı tekrar satın alma kararımı etkiler.					
30. Dağıtım saatinin bitimine kısa süre kaldığında bile ürünün teslimatının gerçekleştiriliyor olması, o markayı tekrar satın alma kararımı etkiler.					

31. Sipariş verebilme sürem, sabah erken ve akşam geç saatleri de kapsamı, o markayı tekrar satın alma kararımı etkiler.					
32. Siparişin teslimat zamanında evde bulunamadığımda, teslimat için gelen kişinin çözüm araması, o markayı tekrar satın alma kararımı etkiler, (bana telefonla ulaşması vb.).					
33. Su veya dağıtıcı firma ile ilgili yaşadığım sorun sıklığı, o markayı tekrar satın alma kararımı etkiler.					

**LÜTFEN BELİRTİNİZ:**

19 litrelik 1 Damacana su için uygun bulduğum fiyat aralığı:

( ) 2.50-3.50 TL ( ) 3.51-5.00 TL ( ) 5.01-6.50 TL ( ) 6.51 TL ve üzeri.

Son 1 yılda damacana su konusunda/kullandığım markada yaşadığım sıkıntılar:

- ( ) Geç teslimat  
( ) Suyun tadında bozukluk  
( ) Damacana fiziksel tahribat (delik, çok çizik, toz vb.)  
( ) Sipariş verilenin dışında bir markanın getirilmesi  
( ) Damacana'yı evime teslim etmeye gelen dağıtıcı ile ilgili problemler  
( ) Hiç sıkıntı yaşamadım.  
( ) Diğer (Lütfen belirtiniz): .....

**Yaşınız:** ( ) 18-25 ( ) 26-35 ( ) 36-45 ( ) 46-60 ( ) 60 ve üzeri

**Eğitim Durumunuz:** ( ) İlkokul ( ) Ortaokul ( ) Lise ( ) Üniversite ( ) Y.Lisans ( ) Doktora

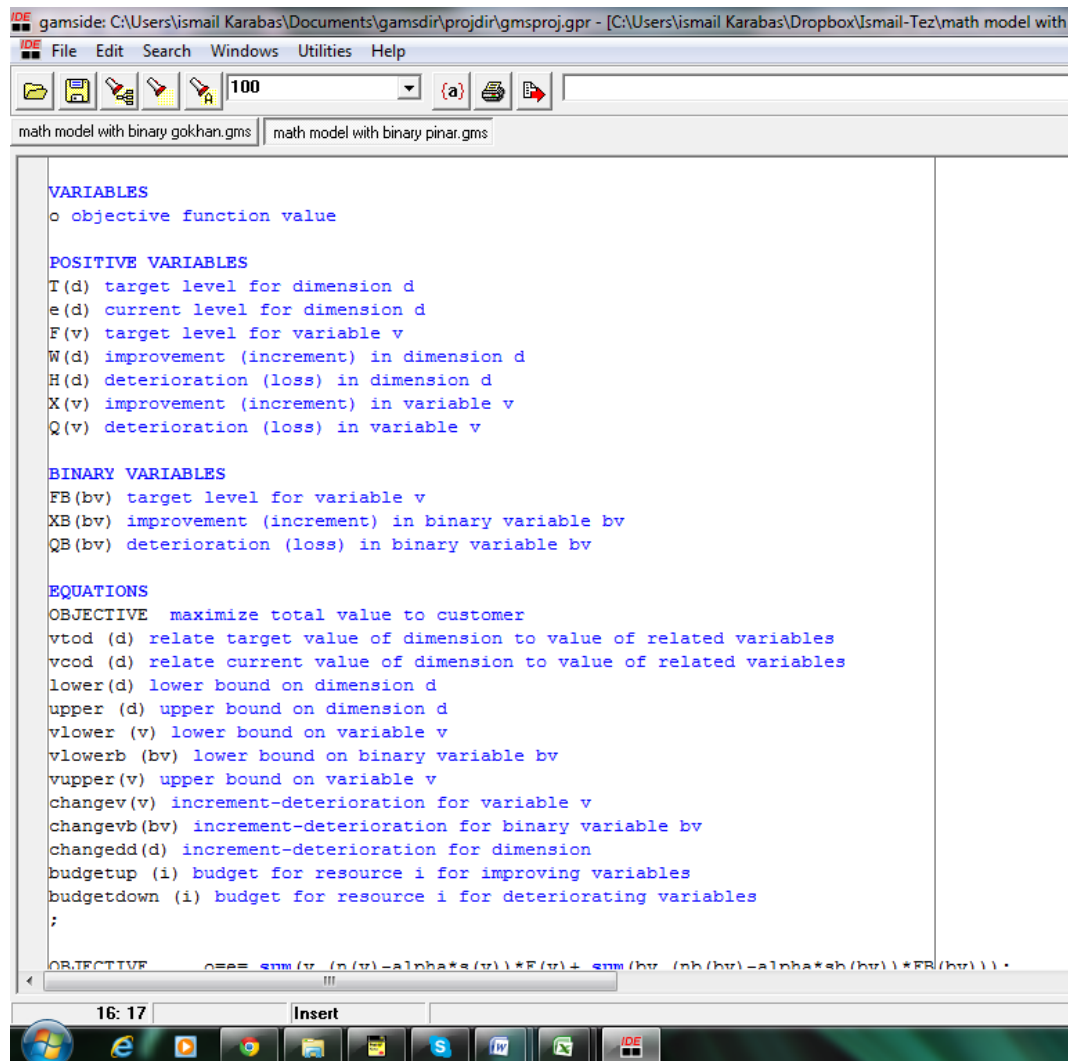
**Cinsiyetiniz:** ( ) Kadın ( ) Erkek  
Bekar

**Medeni Durumunuz:** ( ) Evli ( )

**Gelir Düzeyiniz:** ( ) 0-1.500 TL ( ) 1.501-2.500 TL ( ) 2.501-5.000 TL ( ) 5.001 TL ve üzeri

# Appendix III

## Gams Code for the Mathematical Programming Model



```
IDE gamside: C:\Users\ismail Karabas\Documents\gamsdir\projdir\gmsproj.gpr - [C:\Users\ismail Karabas\Dropbox\ismail-Tez\math model with
IDE File Edit Search Windows Utilities Help
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math model with binary gokhan.gms | math model with binary pinar.gms
VARIABLES
o objective function value

POSITIVE VARIABLES
T(d) target level for dimension d
e(d) current level for dimension d
F(v) target level for variable v
W(d) improvement (increment) in dimension d
H(d) deterioration (loss) in dimension d
X(v) improvement (increment) in variable v
Q(v) deterioration (loss) in variable v

BINARY VARIABLES
FB(bv) target level for variable v
XB(bv) improvement (increment) in binary variable bv
QB(bv) deterioration (loss) in binary variable bv

EQUATIONS
OBJECTIVE maximize total value to customer
vtod (d) relate target value of dimension to value of related variables
vood (d) relate current value of dimension to value of related variables
lower(d) lower bound on dimension d
upper (d) upper bound on dimension d
vlower (v) lower bound on variable v
vlowerb (bv) lower bound on binary variable bv
vupper(v) upper bound on variable v
changev(v) increment-deterioration for variable v
changevb(bv) increment-deterioration for binary variable bv
changedd(d) increment-deterioration for dimension
budgetup (i) budget for resource i for improving variables
budgetdown (i) budget for resource i for deteriorating variables
;

OBJECTIVE o== sum(v, (p(v)-alpha*(z))*F(v)+ sum(bv, (pb(bv)-alpha*sb(bv))*FB(bv)))
```

```

IDE gamside: C:\Users\ismail Karabas\Documents\gamsdir\projdir\gmsproj\gpr - [C:\Users\ismail Karabas\Dropbox\ismail-Tez\math model with binary gokhan.gm
File Edit Search Windows Utilities Help
100
math model with binary gokhan.gms | math model with binary pinar.gms

EQUATIONS
OBJECTIVE maximize total value to customer
vtod (d) relate target value of dimension to value of related variables
vcod (d) relate current value of dimension to value of related variables
lower (d) lower bound on dimension d
upper (d) upper bound on dimension d
vlower (v) lower bound on variable v
vlowerb (bv) lower bound on binary variable bv
vupper (v) upper bound on variable v
changev (v) increment-deterioration for variable v
changevb (bv) increment-deterioration for binary variable bv
changedd (d) increment-deterioration for dimension
budgetup (i) budget for resource i for improving variables
budgetdown (i) budget for resource i for deteriorating variables
;

OBJECTIVE .. o=e= sum (v, (n(v)-alpha*s(v))*F(v)+ sum (bv, (nb(bv)-alpha*sb(bv))*FB(bv)));
vtod (d) .. T(d)* (sum (v,j(v,d))+ sum (bv,jb(bv,d))) =e= sum (v, j(v,d)*F(v))+ sum (bv, jb(bv,d)*FB(bv));
vcod (d) .. e(d)* (sum (v,j(v,d))+ sum (bv,jb(bv,d))) =e= sum (v, j(v,d)*b(v))+ sum (bv, jb(bv,d)*bb(bv));
lower (d) .. l(d) =l= T(d);
upper (d) .. u(d) =g= T(d);
vlower (v) .. a(v) =l= F(v);
vlowerb (bv) .. ab(bv) =l= FB(bv);
vupper (v) .. z(v) =g= F(v);
changev (v) .. F(v) =e= b(v) + X(v) ;
changevb (bv) .. FB(bv) =e= bb(bv) + XB(bv);
changedd (d) .. T(d) =e= e(d) + W(d) - H(d);
budgetup (i) .. sum (v,c1(v,i)*X(v))+ sum (bv,c1b(bv,i)*XB(bv)) =l= g1(i);
budgetdown (i) .. sum (v,c2(v,i)*Q(v))+ sum (bv,c2b(bv,i)*QB(bv)) =l= g2(i);
MODEL crm /ALL/;

option optcr=0;

SOLVE crm USING MIP maximizing o;

```