CUSTOMER SATISFACTION MODELLING FOR MOBILE DATA SERVICES

Case study: T-Mobile

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Abstract

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During the last years, Mobile Network Operators (MNO) have focused more on customer retention and customer loyalty, than on attracting new customers as a strategy to achieve growth in a saturated market that has a high number of competitors. One of the main factors leading to customer retention and customer loyalty is suggested to be customer satisfaction, which in turn is affected by other factors. Therefore, this research evaluates customer satisfaction with mobile data services by studying and analyzing its determining factors. Additionally, the research discusses the relationship between customer satisfaction and the other top determining factors of customer loyalty i.e. service quality and perceived value. As a result, a model is proposed to measure and track customer satisfaction for mobile data services. This proposed model is tested with one of the main mobile data services of T-Mobile: mobile internet. The application of Factor Analysis and Structural Equation Modeling on the relevant customer data allows determining the validity and reliability of the proposed model. Finally, multigroup analysis is applied in order to test the moderator effects that age, gender, income, attitude towards technology and the service provider have on the proposed model. The results obtained show that the relationships between customer satisfaction and customer loyalty are influenced by the characteristics of the customers

Acknowledgments

This thesis work is the final product of my master specialization at the Delft University of Technology. The master programme of Management of Technology allowed me to take a glimpse on the impact, at many levels, that technology has over the market and companies. One of the areas that caught more my *attention was the area of mobile services, which is currently the technology that is changing the world. Therefore, I did my thesis in this area. The development of this thesis was characterized by ups and downs, but I always have the support of my supervisors. I want to thank my first supervisor, Mark de Reuver, for his constant support, his guidance and weekly discussions. All his comments and feedback were essential to finish this thesis. I want to thank my external supervisor, Michael Coulson from T-Mobile, as well, for his support and positive attitude, which was very helpful during difficult times. Finally, I want to thank Prof. Bouwman and my second supervisor, Maarten Kroesen, for their comments and valuable feedback, which helped to enrich this thesis work.*

This thesis also represents the achievement and end *of a dream,* the dream of *doing a specialization abroad. During my time in Delft, I could experience the international and Dutch culture, I knew fascinating people, with different ways to see life; this experience gave me a new vision of the world. However, this dream would not have been possible without the support of my whole family, especially my three older sisters, Patricia, Virginia and Emy Luz, they are an example of life to me. Last but not least, I want to thank my husband, Carlos, for his unconditional support, patient and for showing me the sun even in darkest day. Nothing of this would have been possible without him. He is an inspiration for me and helps me to be a better person. Finally, I said that this was the end of a dream, but, even more important, it is* the start of new dreams.

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Chapter 1 Introduction

Mobile Network Operators (MNO) have increasingly been facing radical changes driven by a combination of market, technological and business forces. On the one hand, during the last years a rapid advance in communication technologies, especially in terms of quality, speed and information richness, has made it possible for these companies to go from delivering only voice-communication to more data-rich services. Furthermore, these new technologies, such as cloud computing, are continually creating new service opportunities. On the other hand, the mobile market is almost saturated, and the access to mobile services has become both affordable and ubiquitous, the result being that around 80% of the population already uses mobile services. Additionally, factors such as the de-regulation of the telecommunications industry and the partial regional standardization are also increasing competition, even with new competitors from sources that did not exist before, and are eroding switching barriers, since users can quite easily change their Mobile Operator, while keeping the previous handset and phone number, with little or no switching costs(Turel & Serenko, 2006).

As a consequence, MNO's are undergoing a transformation in order to remain competitive in a fast changing market. One of the first steps of this transformation is to change the traditional strategies focused on attracting and gaining new customers. These strategies have lost efficacy and efficiency since, as mentioned above, the mobile market is saturated and the cost of attracting new customers is higher than of retaining customers(Liu, Guo, & Lee, 2011). Furthermore, with the increasing number of new competitors, and since loyalty is linked to customer retention and profitability(Turel & Serenko, 2006), MNO's have realized that their best option to achieve a sustainable competitive advantage is through a strategy focused on customer retention. Three different factors, namely service quality, customer satisfaction and perceived value have been identified as leading to customer loyalty and customer retention. Among these factors, it has been found that customer satisfaction has a strong positive and direct effect on loyalty, therefore making it possible to increase customer loyalty by improving customer satisfaction.

It is therefore logical that MNO's have started to become more and more interested in how to create value for their customers by providing them with satisfactory experiences in the use of services. So the provision of a satisfactory experience together with relevant services has become critical for companies. Therefore MNO's are currently looking for customer satisfaction models that provide insights into the experience of customers when using a service or product. By analyzing these insights, companies will be able to implement strategies and mechanisms to improve their customers' experience. A better customer experience will result in more satisfied customers, which in turn will lead to customer loyalty and customer retention, since these three concepts are directly linked(Torsten J. Gerpott, 2001).

To sum up, MNO's are currently switching from strategies focused on attracting new customers to strategies focused on customer loyalty and customer retention, in order to take advantage of the new opportunities, and face the challenges brought by a fast changing market. Therefore, MNO's need to track and measure customer satisfaction of their products and services in order to implement these new strategies Therefore, this thesis aims to research customer satisfaction with mobile services, in order to further understand and increase the knowledge needed by MNO's to enhance customer retention and customer loyalty.

1.1 Related Work

In this section a review on the related work on customer satisfaction, customer loyalty and customer retention is done in order to help to understand the issues involved. Additionally, the concepts and gaps in the existing literature are discussed.

Customer Loyalty (CL) and customer retention (CR) are concepts related to the maintenance of the business relationship established between a manufacturer or service provider and customers. This relationship can be maintained involuntarily when switching barriers or lock-in mechanisms are present on the delivery of the service; or in a voluntarily way when customers show a favorable attitude towards the service provider. When a relationship is maintained in the latter way it is termed as customer loyalty *(Torsten J. Gerpott, 2001)*. These two concepts are strongly interrelated in terms of cause and effect, since CL leads to CR. Furthermore, CL is a success factor, especially for mobile network operators (MNO), since it can lead to long-term financial performance *(Lai, et al., 2008) (Turel & Serenko, 2006)*. Therefore, a lot of attention has been paid to CL by researchers and companies.

As mentioned before, CL is a leading factor for CR, but CL itself is affected by other leading factors. In a number of research studies carried out so far, different factors have been found of which the top factors leading to CL are: service quality, customer satisfaction (CS), and perceived value *(Lai, et al., 2008)*. However, many research studies focus on CS as being the main factor leading to CL, because customers that are satisfied with the experience when using a service are likely to continue using the service provided by the same service provider. Additionally, CS can provide a competitive advantage and has become a key factor for corporate success, since, besides incrementing loyalty, it prevents churn, lowers customers' sensitive to price, and consolidates retention *(Moon-Koo Kima, 2004)*. Therefore, CS has been widely studied. Following the research studies on CS and CL done specifically for mobile services or MNO are discussed.

1.1.1 Mobile Services

Even though CS, CL and CR have been widely studied in the past, the research on these concepts specifically for mobile services has only begun to be done a few years ago, with the first studies in the early 2000s. These research studies analyzed the differences between the mobile service sector and more traditional sectors. It has been found that users of information technology services have some unique patterns of behavior. Moreover, the mobile services present specific characteristics, different from the characteristics when compared with consumer of traditional services *(Lerzan Aksoy, 2013)*. For example, as the result of the contractual relationship between the provider and the consumer, stronger switching barriers are created, thus the customer is 'locked-in' to a specific provider for a long period of time. Therefore, even though customers are dissatisfied and disloyal with the current service provider, they will continue using its services *(Turel & Serenko, 2006)*.

Additionally, these research studies have found that some leading factors are specific to CL and some to CS, while other factors lead to both concepts. Factors such as complaint management, social bonds, and playfulness have an effect on CS *(Don Jyh-Fu Jeng, 2012) (KyoungAe Kim, 2011)*, and factors like switching barriers, structural bonds, legal bonds, and the attractiveness of the alternative solutions have an effect on CL *(Moon-Koo Kima, 2004) (Liu, et al., 2011) (KyoungAe Kim, 2011)*. At the same time, factors such as trust, corporate image, service quality and perceived value, have an effect on both

concepts, CS and CL *(Turel & Serenko, 2006) (Lai, et al., 2008) (Kuo, et al., 2009)*. As it is possible to see, CS and CL are highly interrelated and show a complex relationship *(Don Jyh-Fu Jeng, 2012)*.

However, the research studies done so far have focused on the analysis of CL and CS on voice-based mobile services. Even though voice-based mobile services have been the core service for MNO, this situation has been shifting rapidly in recent years. Currently, the MNO's are focusing more and more on providing high speed data and multimedia services, than voice services, since this kind of services are predicted to generate more revenues than voice in the near future *(Mutaz M. Al-Debei, 2012)*. Therefore, a research on CS and CL focusing on data-based mobile services is an interesting area, in which this thesis aims to make a contribution.

Additionally, during the last few years, because of the advance of communication technologies, MNOs have started using new tools such as social media, sms, polling, etc., which allow permanent and easy contact and communication with their customers. As a result, companies collect large quantities of customer data, which is not very useful unless it is analyzed to extract valuable knowledge from it *(Syed Uzair Ahmed Bahelvi, 2005)*. However, most of the research studies done on CL, CR and CS, collect data by using surveys, and then record the data in a format suitable for statistics analysis, not allowing companies to use and benefit from the consumer data gathered through these new tools. Therefore, the present research aims to investigate if this customer data can be analyzed and give suggestions on how to record data in a useful format.

1.2 Research Framework

In this chapter the different aspects of the research proposal will be discussed. To start, the main concepts related to the research topic are defined, followed by the definition of the research objective, research questions, research approach, and research plan.

1.2.1 Core Concepts

The main concepts of the present research are described as follows, in order to better define the context of the present research proposal.

Customer loyalty can be defined as "a deeply held commitment to re-buy or re-patronize a preferred product/service consistently in the future" *(Liu, et al., 2011)*. Loyalty is the result of the relationship between the manufacturer or service provider that creates a favorable attitude of the customers towards a specific service provider. A 'loyal' customer will be willing to repurchase the same or additional services/products from the same provider, and will show a high tolerance to price increase in the product or service provided.

Customer Retention can be understood as the actual maintenance of the relationship between customers and service providers *(Torsten J. Gerpott, 2001)*. Many times this retention can be achieved involuntarily by preventing a customer to shift providers, for example by implementing switching barriers or lock-in mechanisms.

Research studies carried on customer retention and customer loyalty have showed a strong link between these two concepts and the profitability of companies. However, it has been suggested that loyalty is the key success factor for mobile operators, since retention drives profitability on the long term *(Turel & Serenko, 2006)*.

Customer Satisfaction can be defined as the overall attitude a customer forms based on the experience of using a product or service. Additionally, satisfaction is also influenced by the relationship between the customer and the provider. The satisfaction can be defined using two different perspectives. The first one is the transaction-specific perspective that measures satisfaction based only in the recent purchasing experiences of the customer. Contrarily, in the cumulative perspective the satisfaction is determined based on all the purchasing experiences of all customers. For the purpose of this research, the second perspective is used by tracking and measuring satisfaction based on all the purchasing experiences of the customers *(Kuo, et al., 2009)*.

Mobile Internet can be defined as the access to Internet via handheld devices, such as mobile phones, smart phones or tablet computers. In order to access Internet, the handheld device needs to be connected to a mobile network or other wireless network *(Hoyoung Kim, 2002)*. For the current research, mobile internet is understood to be a service provided by the Mobile Network Operators (MNO). .

1.2.2   Research Objective and Research Questions

From the study of the related work, it is possible to identify two gaps in the existing literature on CS and CL for mobile services. The first one is that research studies are focused on voice-based mobile services, thus there is a lack of research studies for data-based mobile services. The second gap is that most of the research studies done so far, use one time surveys to gather customer data, thus companies are not able to use the customer data gathered through new tools such as social media, sms, etc. in order to track and measure CS and CL. Therefore, this research is focused on data-based mobile services and aims to make use of the companies' customer data gathered through the use of new tools. Additionally, from the conceptual model proposed in the previous section is possible to observe that, among the several factors that lead to CL, CS is one of the main ones. So that, the present research study is focused on how to measure and track customer satisfaction for mobile network operators. Additionally, the research further examines the relationships between customer satisfaction and the other main leading factors of customer loyalty i.e. service quality and perceived value. In this way, the research study aims to help MNO's to analyze and understand CS in order to be able to apply better strategies and mechanisms to increase CL and CR. To reach this goal, a conceptual model for customer satisfaction, specific to mobile services, will be proposed. This conceptual model will show the different factors that lead to customer satisfaction and their corresponding importance in the model. Therefore, the research objective is the following:

> *To help Mobile Network Operators to improve their strategies in order to increase customer loyalty and customer retention, by providing a model that allows MNO's to track, measure, and gain insights on customer satisfaction, with data-based mobile services, using the data sources that an MNO possesses.*

The unit of analysis of the research is customer satisfaction related to a single company; therefore how customer satisfaction can be measured and tracked on an industry level is not studied in this research. Additionally, customer satisfaction is studied from a cumulative perspective i.e. including all the purchasing experiences of the customer *(Kuo, et al., 2009)*. Finally, the proposed model will be tested using only one specific product of MNO's, in this case mobile internet, because of the research's constraints on time and resources. Based on this, the main research question is:

- *How company level factors lead to customer satisfaction for the mobile internet service provided by a mobile network operator?*

The factors that lead to customer satisfaction can be classified on four different levels, namely situational factors, customer's background factors, market factors and company factors *(Michael D. Johnson, 1998)*. Situational factors are related with the surrounding situation of the customer, including political, economical and social factors. Customer's background factors are for example values, income level, personality, etc. Market Factors are mainly related with the competing situation, such as how many competitors are present in the market and how attractive are the alternatives options. Finally, the company factors are all the factors on which the company has a direct effect, like service quality, trust, corporate image, complaint management, marketing, price, etc. However, the present research is focused on company-level factors, since companies have direct control over these kinds of factors *(Torsten J. Gerpott, 2001)*.

In order to answer the research question the following sub-questions are proposed:

1. *What are the company level factors that lead to customer satisfaction, and what is their importance in the overall customer experience?*

2. *How can these factors be operationalized in order to track and measure customer satisfaction for mobile network operators?*

3. *What systems, among the ones currently used by companies to gather customer data, can be used for the proposed customer satisfaction model?*

4. *How can the model's effectiveness be evaluated by using the customer data gathered by the systems defined in question 3?*

5. *What is the link between the proposed model and the existing customer loyalty indexes of companies?*

The proposed sub-questions will help to gain the necessary knowledge to answer the main question of the research. For this purpose, the first question aims to define the main company level factors that play a role in the customer satisfaction. Once defined the company level factors in the previous sub-question, the construct for each factor will be defined in the second sub-question. The systems mentioned in the third question are related to tools like social media, sms, etc, that are currently used by mobile network operators to connect and communicate with their customers. Thus, the answer to the third question will help to define which of those systems can be used to gather customer data for the proposed model. For the fourth question, statistic techniques will be studied and examined in order to determine the most adequate technique that permits the use of the customer data gathered through the systems defined in the previous questions. By applying the selected technique on the customer data gathered, the proposed model will be evaluated. In the final question, it will be investigated how the customer loyalty indexes that MNO's already apply to measure and track customer loyalty, can be improved by integrating them with the outcome of the proposed customer satisfaction model.

1.2.3   Thesis Relevance

During the last decade a fast growth of the mobile telecommunication market has been observed, where the diffusion of mobile services has outperformed the expectations of experts. As a result, the use of mobile services has become an integrated part of everyone's daily life, thus increasing the interest in the study of mobile services. Academics have been discussing how mobile services are different from more traditional services, and how its different characteristics can affect the user's experience when using them.

These research studies have helped to understand how to achieve customer retention and customer loyalty with mobile services. However, in order to provide comprehensive and adequate research on these two concepts, two main trends on the market need to be taken into account. The first one is the rapid growth of data-based mobile services, since customers are using more and more mobile services based on the transmission of data instead of voice. Furthermore, it has been predicted that mobile data-based mobile services will outnumber the use of voice-based mobile services in the next years, increasing the importance of research into this kind of mobile services. The second trend is the large quantity of customer data companies generate, through the use of tools like sms, social media, CRM, etc. This customer data is useful for companies only if valuable information about customers can be obtained from it. Therefore, the present research, that includes both trends, is interesting and useful since will provide knowledge, help to understand data-based mobile services, and will also add value to the customer data generated.

Currently MNO's are focusing more on customer retention than on attracting new customers, mainly because they have to deal with a saturated market and an increasing number of competitors. One of the main strategies to achieve customer retention is to maintain and improve customer loyalty. Thus customer loyalty has become a critical issue for MNO's. This research study aims to provide understanding on customer loyalty by analyzing customers' satisfaction when using mobile services provided by MNO's. Therefore, the research will help companies to implement better strategies to improve customer loyalty.

1.3 Research Approach

This research is aimed to be carried out in two main phases. The first phase consists of the theoretical part, where all the concepts, theories and models on customer satisfaction will be studied and analyzed. As a result, a conceptual model for customer satisfaction for MNO's will be proposed. To continue, an operational model will be built, based on the proposed model, which allows the measurement of CS. In the second phase of the research, the proposed model will be evaluated as a case study with the company T-Mobile. For this purpose, the data about customers of T-Mobile will be analyzed. In the next paragraphs a more detailed description of each phase is done, specifying the research approach for each phase.

To start, the core concepts of the research sub-questions will be inspected by doing a literature review on customer satisfaction, service quality and perceived value. The purpose of this literature review is to become familiar with the context of the project and with the research studies done on this topic. Even though at the beginning the literature review will be carried on in general for customer satisfaction, at the end the review will be narrowed down to literature specific to customer satisfaction in the telecom industry. As a result of this literature review, the different customer satisfaction conceptual models proposed by different authors will be determined. The factors that compose these conceptual models will be applied for the present research by discussing them for the mobile domain. For this purpose in the second part of the first phase, a literature review will be done on customer satisfaction specifically for mobile services. As a result, it will be possible to propose a model to measure and track customer satisfaction with mobile services.

The second phase of the research will consist of the evaluation of the proposed model. For this purpose, a case study will be carried on T-Mobile. T-Mobile Netherlands BV is a mobile network operator, and is a subsidiary of Deutsche Telekom Group, one of the largest global telecommunications companies. T-Mobile is always looking to provide a good experience to its users, thus it is continuously investing in

improving the capacity and reliability of the network. Currently, T-Mobile is starting to be focused on customer satisfaction and loyalty. During this phase the statistical techniques will be applied to the customer data of T-Mobile. This data will be gathered from systems of T-Mobile. The application of statistical techniques will enable the determination of the accuracy, reliability and validity of the proposed model.

1.4 Outline

In chapter 2 the theoretical framework needed for this research is described. In this chapter the main concepts are discussed and the theoretical base for the analysis is established. In chapter 3 a network approach is applied towards the literature review. As a result of this network approach an initial model is proposed for measure and track customer satisfaction with mobile data services. In Chapter 4, the selected methodology for this research is discussed, including the selection of case study, the sample selection and the statistics techniques used to evaluate the proposed model, namely Exploratory Factor Analysis, Confirmatory Factor Analysis and Structural Equation Modeling. In Chapter 5 the results of the application of these techniques over the customer data are discussed, and the validity and reliability of the proposed model is assessed. Finally, in Chapter 6 the main findings, limitations, practical and theoretical relevance, recommendations and limitations of the research are discussed.

Chapter 2   Theoretical Framework

2.1 Description of the main concepts As was stated in the previous section, the objective of this thesis is to propose a model to track and measure one of the main determining factors of customer loyalty (CL): customer satisfaction (CS). Additionally, the model aims to explore the relationship of customer satisfaction with the other main determining factors of CL i.e. service quality (SQ) and perceived value (PV). All of them studied and investigated in the context of mobile services. Therefore, through this chapter these concepts, namely customer loyalty, customer satisfaction, service quality, perceived value and mobile series; are discussed from a theoretical perspective.

2.1.1   Customer Loyalty

Companies have two overall strategies to face a fast changing market namely the offensive and defensive strategies. On one hand, the offensive strategy focuses on attracting new customers, and has as a behavioral objective that customers switch providers. On the other hand, the defensive strategy focuses on the retention of customers and has a behavioral objective the customer satisfaction. The latter strategy presents two forms, one form based on switching barriers and the other one on customer loyalty *(Fornell, 1992)*.

Figure 1: Companies' Strategies
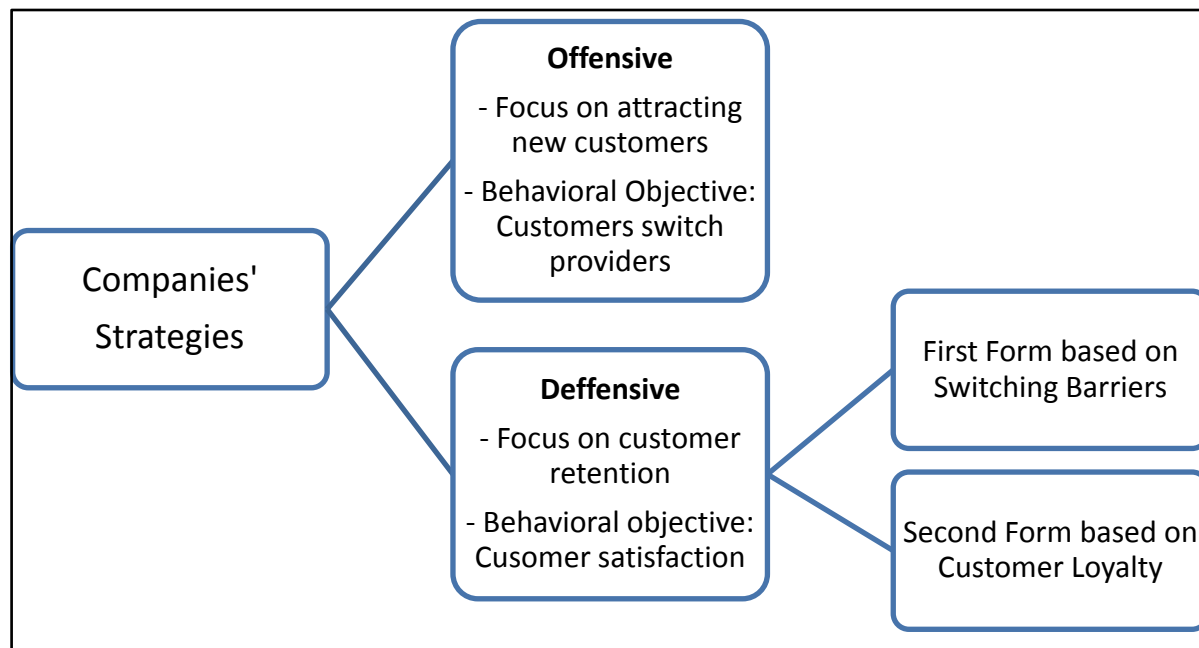
The first form is based on the implementation of switching barriers, such as search costs, transaction costs, learning costs, customer discounts, cognitive effort, etc., in order to retain customers. This first form of customer retention is conceptually specified differently in different research studies, such as pure customer retention *(Torsten J. Gerpott, 2001)* or short-term loyalty *(Jones & Sasser 1995)*. However, on these research studies has been found that this first form of customer retention presents a number of

drawbacks, such as the initial sales can be more difficult if the customers are aware of the switching barriers, and the barriers can be eliminated by external forces *(Fornell, 1992)*.

While customer retention in the first form has as a behavioral objective that customers switch providers, the second form has the customer satisfaction as behavioral objective. This second form, where customers voluntarily continue using the services from the same provider as a result of a positive attitude of the customer towards the provider, is known as customer loyalty *(Torsten J. Gerpott, 2001)*. In the first form, customers are more likely to look for new options and switch providers as soon as the switching barriers are eliminated. Contrary, a loyal customer is less price sensitive and less likely to switch providers when the situation changes, therefore customer loyalty has been associated with companies' profitability and long-term performance, thus becoming one of the main strategic sources of revenues for companies *(Lai, Griffin, & Babin, 2008; Taylor, 2007)*. Therefore, this research focuses on this second form of customer retention, know as customer loyalty.

Customer loyalty (CL) has been widely studied, thus there are many definitions for it in the literature. For this research customer loyalty can be understood as "a deeply held commitment to re-buy or re-patronize a preferred product/service consistently in the future" *(R.L. Oliver, 2009)*. At the beginning, the research studies on CL were carried on just from a behavioral perspective, where loyalty was seeing just as a pattern of repeat purchasing of tangible goods, and it was defined as the number of purchasing allocated to a brand over a period of time. However, those first studies showed an unanalyzable random component in the cycle of repurchasing, thus in the 1970s the research on loyalty started to include different perspectives than just the behavioral looking for an explanation to the purchase pattern sequences *(R.L. Oliver, 2009)*. Currently, research studies done on CL include consumers' beliefs, affect and intention, in order to analysis the true customer loyalty. By including these factors it is possible to explain the reasons and understand why a customer decides to repurchase a product and continue using the services from the same provider *(Dick, 1994)*.

In order to include consumer's beliefs, affect and intention, two additional components have been added to the analysis of CL, namely attitudinal and cognitive components. The cognitive component of customer loyalty is based on the evaluation of the benefits and rewards of the service/product, thus it reflects customers' brand experience and exclusive consideration of one service provider at expense of others *(Taylor, 2007)*. The second component, the attitudinal one, tries to further understand customer loyalty by analyzing not only their behavior but also emotional and psychological factors. In this dimension, the customers will remain loyal not only because situational exigencies, such as price and convenience, but also for a sense of engagement and allegiance with the service provider. For example, even if the customer is not able to select the service provider for her mobile internet, since the service is paid and selected by her employer, she will still recommend the service to other people *(Dick, 1994)*. As it is possible to see, a stronger commitment results from a customer loyalty that includes attitudinal and cognitive components than from a loyalty that includes only a behavioral component. However, the development of this kind of customer loyalty takes a long period of time and more than just a marketing campaign *(Kumar & Shah, 2004)*.

As a consequence, currently most of the research studies on CL show it as a multi-dimensional concept i.e. customer loyalty might include behavioral, attitudinal and cognitive components. However, there is a lack of agreement on how many dimensions it has, since some research studies define CL as a two-dimension concept including only behavioral and attitudinal components, and others like (Bloemer, De

Ruyter, & Wetzels, 1999) define CL as a three-dimension concept including the cognitive component as well (Dick, 1994). However, for the purpose of this thesis, customer loyalty is defined as a two-dimension concept that includes a behavioral loyalty and a combination of attitudinal/cognitive loyalty, since this combination has been showed to accurately identify true customer loyalty with services *(Taylor, 2007)*.

Figure 2: Dimensions of Customer Loyalty
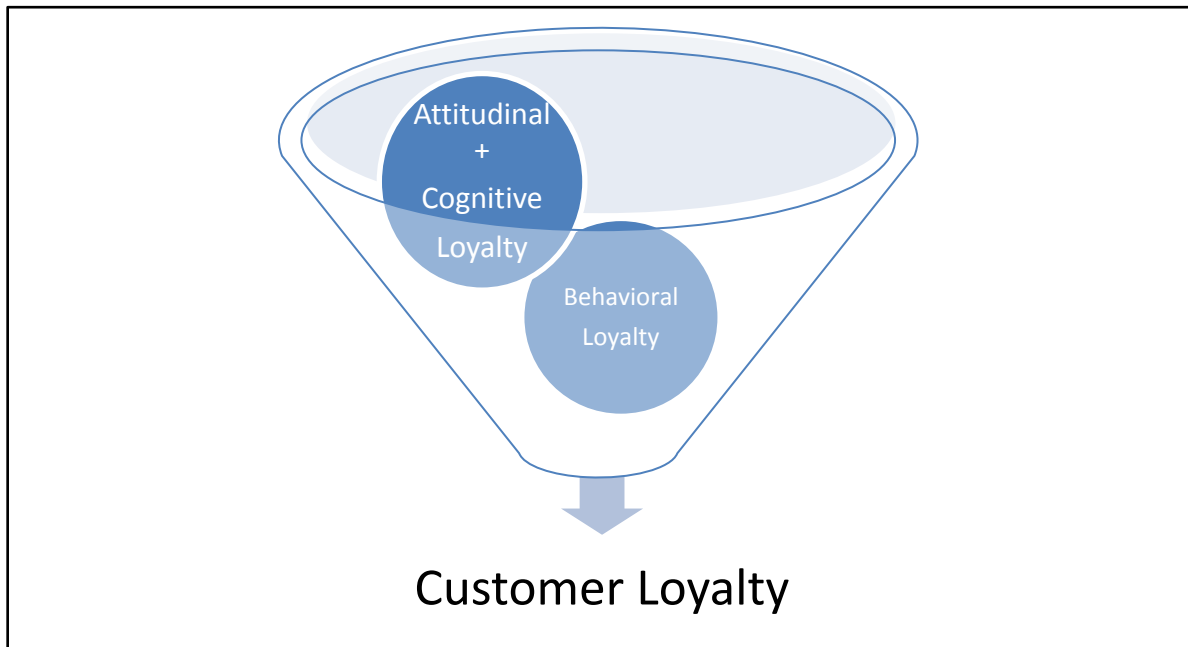
To sum up, CL is part of the second form of the defensive strategy used by companies to retain customers. Even though, customer retention can be achieved by switching barriers as well, CL presents a number of benefits that make it a better option for companies. In order to examine CL, behavioral, attitudinal and cognitive components have been taken into account in the literature. However, an approach that includes the behavioral component and the attitudinal and cognitive components combined into one has been chosen for this thesis, due to its accuracy to identify CL for services.

2.1.1.1 The relationship between Customer Loyalty (CL) and Customer Satisfaction (CS)

In order to measure and track CL two different kinds of factors are possible to find in the literature. On the one hand, there are the consequences of customer loyalty i.e. repurchase intention, price tolerance *(Turel & Serenko, 2006)* and intention to recommend services *(Ali Turkyılmaz, 2007; Lerzan Aksoy, 2013)*. On the other hand, there are the antecedents of CL which are the factors that lead or determine CL. In this group exists a bigger variety since many research studies have been done on this topic, where customer satisfaction, service quality and perceived value *(Kuo, Wu, & Deng, 2009; Lai et al., 2008)*, brand image *(Ali Turkyılmaz, 2007; Lai et al., 2008)* and switching barriers *(Liu et al., 2011; Moon-Koo Kima, 2004)* are most often proposed as antecedents of CL.

Among the antecedent factors, CS shows a very close relationship with CL. This relationship comes from a set of beliefs shared by companies. Customer satisfaction is the result of high quality products and related services that meet customers' needs. A customer satisfied with the service provided becomes a loyal customer, thus satisfaction leads to greatly increase loyalty *(Jones & Sasser 1995)*. Additionally,

according to the offensive/defensive theory mentioned before, CS is the behavior objective in order to achieve customer retention through loyalty. Furthermore, the telecommunication literature has showed that CS has a strong capacity to predict CL for MNO's and can explain close to 100% of loyalty in the service industry *(Eshghi, Haughton, & Topi, 2007)*. Therefore, CS can be considered as one of the most important determining factors for CL, especially for MNO's, and its study and analysis can be very helpful to develop and/or increase customer loyalty with mobile services.

2.1.2   Customer Satisfaction

Customer Satisfaction can be defined as an 'an experience-based assessment made by the customer on how far his own expectations about the individual characteristics or the overall functionality of the services obtained from the provider have been fulfilled' *(Torsten J. Gerpott, 2001)*. During the last years, much attention has been paid by academics to CS because the many benefits that a high customer satisfaction level can generate for companies, such as increment of customer loyalty, decrease of customer churn, improvement of marketing campaign and enhancement of business reputation *(Ali Turkyılmaz, 2007; Moon-Koo Kima, 2004)*. Even though, at the beginning the research on CS was done from a transaction-specific perspective, recent studies follow a more economic psychology-base approach that studies CS from a cumulative perspective *(Johnson, Gustafsson, Andreassen, Lervik, & Cha, 2001)*. The cumulative perspective indicates that the overall evaluation of CS should be done on base of all the customer purchase experiences, disregarding any specific purchase experience *(Kuo et al., 2009)*. Therefore, CS can be understood as post-usage state due to a cumulative consumption experience that reflects how the service has fulfilled its purpose *(Richard L. Oliver, 1999)*. This cumulative perspective is necessary, and it is used in this thesis, since it is more capable to predict loyalty through satisfaction, especially for the mobile environment *(Kuo et al., 2009; Lin & Wang, 2006)*.

Additionally, the research on CS has been carried on different levels. On one hand, some studies have been done on an industry level, where CS has been studied by comparing the results of a number of companies of the same industry. These industry level studies mainly resulted in the elaboration of "customer satisfaction indexes" for different countries, such as the first national customer satisfaction index (CSI) in Sweden developed by (Fornell, 1992), the American Customer Satisfaction Index (ACSI) by (Fornell, Johnson, Anderson, Cha, & Bryant, 1996) and the European Customer Satisfaction Index *(ECSI, 1998) (Ali Turkyılmaz, 2007)*. On the other hand, many of other studies have been carried on a company level by focusing only on one company. In these research studies it is possible to observe that CS presents common as well as specific characteristics according to the sector the company belongs to. For example, according to *(Taylor, 2007)* there is a bigger dependency on the development of interpersonal relationships between the provider and the customer for the service sector than for other sectors that provide tangible goods. Therefore, by focusing only on one company it is possible to do a deeper analysis of the specific characteristics of CS for one sector, like in the case of this thesis the mobile service sector. However, a further discussion on CS specifically for mobile services is done in next sections.

2.1.2.1   Antecedents and consequences of CS

In the same way as CL, CS presents antecedents and consequences. One of the main consequences of CS, as previously mentioned, is CL which in turn leads to customer retention. However, besides CL, it is possible to find other consequences of CS on the literature, namely word-of-mouth and customer complains. Word-of-mouth is related with the predisposition of the customers to recommend the service

to other people and it has a positive relationship with CS, since if the CS increases the word-of-mouth does it as well *(Fornell, 1992)*. The second consequence is customer complain that can be explained by using the exit-voice theory. This theory states that customers when having problems with a product/service have two options: they can stop using the service or they can complain with the provider in order to find a solution to their problem *(Ali Turkyılmaz, 2007)*. Therefore, one of the consequences of CS is customer complains, having a negative relationship between these two concepts, since if CS increases customer complaints decrease.

Table 1: Type of Factors Affecting Customer Satisfaction

Type of Factor	Description
Situational factors	The situational factors are related with the surrounding situation to the customer, including political, economical and social factors.
Customer's background factors	The customer's background factors are for example values, income level, personality, etc.
Market factors	The market factors are mainly related with the competing situation, such as how many competitors are present in the market and how attractive are the alternatives options.
Company factors	The company factors are all the factors on which the company has a direct influence, such as the marketing, price, etc.

On the other side, there are the antecedents of CS. CS overall is determined by the customer's expectations and perceptions on the service provided. Customer's expectations are prior to the perception, and can be defined as what the customer 'predicts' the service will be. Customer's expectations capture the previous information about the company's services gathered via either advertisement and word-to-mouth information, or the experience with the service itself in the past *(Johnson et al., 2001)*. The second antecedent of CS, customer perception, is related with the customer's performance experience when consuming a service. This performance experience provides the customer with a perceived value and perceived quality of the service. Both concepts, value perception and perceived quality, show a positive relationship with customer satisfaction, since as perceived value or perceived quality increases, customer satisfaction increases. In *Table 1* it is possible to classify in four types the factors that influence CS. However, this thesis focuses on company factors

2.2 Service Quality (SQ)

Through the last years, many research studies have been done on service quality (SQ) because of its specific contribution to the business competitiveness. These research studies have found that service quality is a critical factor for companies' performance and long term viability (Bolton & Drew, 1991). Although, these research studies agree on the importance of service quality, they still discuss its role on the achievement of customer satisfaction and customer loyalty. Some authors found service quality as leading directly to CL, while other state that SQ leads to CL through CS. However, for this thesis both approaches will be used, where SQ is a determining factor for CS and for CL. In this case, there is a discussion about if SQ lead to CS, or CS lead to SQ. Some authors state that a satisfied customer will perceived a service as having good quality, while other state that the service quality will lead to a satisfied customer. However, according to *(Lai et al., 2008)* the second approach, that links quality as leading to satisfaction, can explain more variance in CL and has received considerable support and empirical validation. Therefore, for this research is assumed that SQ leads to CS

On the other hand, the measurement of service quality is discusses by scholars as well. Its objectively measurement presents some difficulties, since according to *(Hoyoung Kim, 2002)* services are defined as intangibles, heterogeneous and inseparables, thus there is still discussion on how to operationalize it. A number of different scales have been proposed to measure service quality, being the SERVQUAL one of the most used. The SERVQUAL scale was developed by (Parasuraman, Zeithaml, & Berry, 1988) and it is based on the gap theory that states that the service quality is defined as the difference between customers' expectations and their perceived performance of a service. The scale originally included ten items, but it was later reduced to five, namely tangible, responsiveness, reliability, assurance and empathy.

Even though, the SERVQUAL is one of the scales most y used across cultures and industries to measure service quality and it has widely tested for reliability and validity ((Bolton & Drew, 1991; Carrillat, Jaramillo, & Mulki, 2007; Cronin Jr & Taylor, 1994), many scholars have criticized it and question its validity. For instance, (Cronin Jr & Taylor, 1994) proposed a only-performance index, namely SERVPERF, to measure service quality, which it was suggested it can produces better results of validity, reliability and predictive power than SERVQUAL. A number of authors support the use of SERVPERF (Babakus & Boller, 1992; Richard L Oliver & DeSarbo, 1988), who state that customers' perceptions of the service quality are already composed by the expectations and actual performance of the service. However, the discussion about which method is more adequate continues, and both methods are supported by different scholars (Carrillat et al., 2007).

Additionally, other critics have been raised towards the SERVQUAL. For instance, the generalizabity of this scale has been questioned. The SERVQUAL has been developed in USA and tested in multiple industries with the aim to develop a universal scale. However, in this case the trade-off between generalizability and relevance should be taken into account (Babakus & Boller, 1992). In a research study that tested the SERVQUAL in four different service industries, a limited generalizability of the scale was found and modified scales were recommended in order to apply the SERVQUAL in other study contexts (Carman, 1990). However, in the case of applying a modified SERVQUAL the scale validity can be affected by the impact of item adaptation. Furthermore, the applicability of the SERVQUAL across different cultures has been questioned since it was developed in USA. (Zhao, Bai, & Hui, 2002) reported problems with the negative wording in terms of reliability and practical interpretation in a research conducted in a Chinese retail service.

Nevertheless, for this thesis the SERVQUAL scale is used because it is well-established to measure service quality. Even though, there are some critics to this scale, the SERVQUAL is still one of the most used scales and it has been widely tested in different research studies.

2.3 Perceived Value

According to *(Faber, Haaker, & Bouwman, 2004)*, the perceived value can be defined as "the value seen as the perceived benefits and total costs (or sacrifice) of (obtaining) a product or service". The costs or sacrifice incurred by a customer can be defined using different approaches. One is the monetary approach, where the customer's sacrifice is defined by the money paid for the service. In this case as less money is paid for a high quality product, more positively is the service perceived. Therefore, promotions and discount coupons, as an example, can be used to increase the perceived value of the service. In this approach, only the monetary costs are included into the *sacrifice* done by the customer to get the service.

As a result, this approach neglects other non-monetary costs such as transaction costs, search costs, negotiation costs, and the time incurred during the purchase; factors that, according to *(Kuo et al., 2009)*, should be included in the definition of the perceived value. Therefore, for this research, perceived value is defined as a service evaluation affected by the benefits, the advance sacrifices and ex-post performance perceived by the customers.

2.4 Mobile Services

Mobile data services are involved in people's day-to-day life and play an important role on the generation of revenues for MNO's. The first mobile data was a short message service (SMS) that was originally intended to send emergency alerts and special promotions *(Qi, Li, Li, & Shu, 2009)*. From then till now, the demand and supply of mobile data services (MDS) have increased rapidly thanks to the development of the third-generation mobile technology (3G) and long term evolution (LTE) mobile network (H. Bouwman, Bejar, & Nikou, 2012). Currently, MNOs provide a combination of voice and data mobile services, where customers use voice services mainly for basic communication i.e. phone calls, and mobile data services for social functions such as entertainment, information gathering, business transactions, etc.

Even though, nowadays the use of mobile data services is surpassing the use of mobile voice services (MVS), the experience with the voice service is a precondition for the mobile data service. If the basic communication experience provided by the voice services is not satisfied, customers will perceived the whole experience as non satisfactory even if the experience with the data service is satisfactory *(Qi et al., 2009)*. Following, a classification of mobile services is presented *(H. Bouwman, Reuver, & Koning, 2010)*, where it is possible to observe that some types of services are based only on data, while others are complemented by voice.

Table 2: Classification of Mobile Services

Mobile Service Types	Description
Information services	Are the services that allow gather information in different ways, such as news, weather, transportation timetables, etc
Communication and messaging services	Which are the result of the complementation between MDS and MVS. The most popular example of this kind of services is the SMS
Entertainment services	Mainly based on MDS, some examples are: listen to music, watching television, playing games, and chatting
Transaction services	Services that are done using MDS and are related with mobile payments.

Even though, business services are part of this classification as well, these kind of services are not included since this thesis is focused on mobile services for consumers.

Because Mobile Data Services provide customer access to data anywhere and anytime, they have to really fit the behavior of customers. As a result, two main characteristics, namely the concept of mobility and users' context are important for MDS *(H. Bouwman et al., 2010)*.

The introduction of MDS disrupted the mobile telecommunication value chain established by network operators. New actors started to delivering new mobile data services on top of the network provided by

network operators. Therefore, the value chain became into a value networks, that includes many actors with roles not clearly defined *(H. Bouwman et al., 2010).* This scenario makes more complicated the study of satisfaction with mobile services, since the experience when using a service is affected by factors in control of the other actors besides of the MNO. For example, when a customer is using a chatting service on her smartphone and she has some problems with it, the non-satisfactory experience will be associated not only with the application but with the MNO that provides the network, even though the problem is not in control of the MNO but only under the control of the application developer.

2.5 Moderator Variables

A moderation effect occurs when a third variable changes the relationship between two related variables or constructs. This third variable is known as moderator variable (Jr, Black, Babin, & Anderson, 2010). The study of moderator variables was conducted in this thesis because it has been shown that a model's predictive power may be potentially increased by the inclusion of moderator variables (Serenko, Turel, & Yol, 2006). For this study, five moderator variables, namely gender, age, income, attitude towards technology and service provider's characteristics were selected on base of a literature review related to personal determinants of customer satisfaction and customer loyalty. In the next paragraphs, a short discussion about these variables is done.

A number of research studies have been conducted on the impact of the demographic variables, namely age, income and gender, on the customer satisfaction and customer loyalty in a general context (Homburg & Giering, 2001; Walsh, Evanschitzky, & Wunderlich, 2008), in a mobile services context (Deng, Lu, Wei, & Zhang, 2010; Nysveen, Pedersen, Thorbjørnsen, & Berthon, 2005; Serenko et al., 2006) and in the context of mobile services adoption (Harry Bouwman, Carlsson, Walden, & Molina-Castillo, 2008). These research studies show the moderation effect of age since different ways of behavior and reasoning were found in different age groups. In the case of income, it was shown that it affects the purchasing behavior and the consumptions patterns of customers. For the third variable, gender, it was found that the male and female roles are affected by the socialization, thus men are supposed to be more assertive and women more nurturing (Serenko et al., 2006). Therefore, these three variables were selected because they have shown to affect the proposed relationships between constructs proposed in the management and marketing literature.

In the case of the moderator variable *attitude toward technology,* its moderating effect has been studied before as the attitude towards mobile innovations. For instance, it has been found that young and male groups have a positive attitude towards mobile innovations (Harry Bouwman et al., 2008). Therefore, this thesis studies the effect of the customers' attitude towards technology on the customer satisfaction and customer loyalty.

Finally, a group analysis is conducted based on the MNO that provides the mobile service. For this purpose, groups are formed including customers of different MNO. The analysis of the moderator variable of provider allows determining if the different corporate strategies that MNOs follow have an effect on the proposed model of customer satisfaction and customer loyalty.

Chapter 3   Network approach towards literature review

As it is possible, this thesis is supported by the research studies done in the past. However, when doing the review of the existing literature on this thesis's topic, many studies were found, thus making difficult to make an overview of all the results in this area. Therefore, a network approach toward literature research is used to generate the needed insights for this thesis. The network approach, that combines the strengths of meta-analysis (objective, systematic) with the visual-analytics offered by network methods, was proposed by *(van de Wijngaert, Bouwman, & Contractor, 2012)*.

By applying this approach will be possible to show the concepts and their causal relations across different studies on CS and CL. Additionally, a network approach provides extra information and allows gaining new types of insights on the networks. On the node level it allows defining if a concept is dependant, independent or mediating. On the network level it allows measuring the density of the network, the generalizability of the theoretical framework, characterize changes on the theoretical domain over time and evaluate to what extent the proposed hypotheses are empirically validated(van de Wijngaert et al., 2012). However, because of the constraints of time, only the following metrics are used for the analysis of this thesis:

Table 3: Metrics used in the Network Analysis

Metric Name	Metric Description
Independent nodes	Their causes are outside of the scope of the theoretical model.
Dependant nodes	These nodes are dependant and the explanations of their causes are inside the scope of the theoretical model.
Density of the network	It shows the presence or lack of parsimony on the research studies done on this particular topic

In order to apply a network approach towards a literature review a number of steps are required, namely selection of articles, data gathering, unification and aggregation and analysis of the results. A description of each of these steps for this thesis is done in the following sections.

3.1 Selection of Articles

The selection of articles plays an important role for the application of a network approach toward a literature review, since all the results and the vision obtained at the end depend on this selection. Therefore, the selection must be done carefully and taking into account different aspects. To summarize the selection of articles was done following the following guidelines:

a) The database Scopus was used to look for the articles. This database was used because it allows access to the most important articles in the field, and permits filter them according to the number of times the articles have been cited.

b) In order to search the articles few key concepts related with the research proposal were chosen. According to the research proposal, previously explained, the following concepts were used:
- Customer Satisfaction
- Customer Loyalty

-    Customer retention

Nevertheless, the search using only those concepts results in a big variety of research studies, since customer satisfaction and customer loyalty have been researched since the early 1980's. Therefore, these concepts were combined with the following concepts:

-    Mobile services
-    Mobile network operator

The combination of both sets of concepts helped to narrow down the focus of the articles' search.

One of the first filters applied to the articles was how many times an article had been cited by other articles. This filter gives an insight on what are the research studies that have been used more often as a base for other research studies. However, this filter can showed a bias since articles published many years ago are likely to be more cited. Additionally, articles published many years ago can sometimes show information that is not valid anymore nowadays. In order to avoid these problems, the search for articles was limited to articles that were published up to ten years ago (from 2004 to 2013). Additionally, some new articles were included as well (articles from 2012 and 2013), even though they have not been cited many times.

The next step was to select the final articles from the list of returned articles by the search. The first step was to review the keywords and the abstract of the articles in order to determine how relevant the article was i.e. the content of the article is related with the research proposal. Then a quick revision of each article was performed to select the most relevant ones. Finally, a complete revision was done on the selected articles. As final result, 8 articles were selected to perform the network analysis. The list of the articles is showed in *Appendix A*: . However, it should be noted that the selection of articles was done subjectively, thus some articles that might be relevant could have been excluded from this thesis. Even more, a deeper search might find more relevant articles to conduct the network approach towards the literature review.

3.2 Data Gathering, Unification and Aggregation

Once the articles were selected, the data gathering took place. For this purpose, the selected articles were carefully read and studied. From the selected articles 62 hypotheses were found, with an average of 8 hypotheses per article. Of these hypotheses that were tested empirically, 85% were supported and 15% were rejected. In order to obtain the data from the articles, a spreadsheet that contains the following information was used:

a) Bibliographic information: Title and year of the article
b) Information about the core concepts: Independent and dependant variable
c) Definition of the variables
d) Information about the test's result on the variables
e) Aggregation and Unification of the variables
f) Operationalization of the variables

Other important aspect of the analysis is the unification and aggregation of the data, because similar concepts can overlap in different studies, or same concepts can be studied using different labels. Therefore, in order to simplify the visualization of the network, the concepts of the selected articles

followed a process of unification and aggregation. The table with the complete information can be found in the *Appendix B*: .

3.3 Conceptual Model and Network Analysis

The final result is showed in *Figure 3*. In this network is possible to see the concepts of the hypothesis represented by nodes in the network. The shape of a node, either a circle or square, represents the dependency or independency of the concepts, and the casual relations between the concepts are represented as arrows. The size of the icons represents the number of articles that researched the concept, thus as more articles included the concept on the research, bigger is the icon. Finally, the color of the node represents the in-degree or out-degree of the concept.

One observation to be done is the network does not show high density. This rather low density is mainly because most of the research studies done on CL are based on the /satisfaction/value/quality models according to Cronin (2000). The satisfaction model determines CS as the primary and direct link to CL. In the value model, the perceived value instead of CS is the link to CL. And in the quality, or indirect model, service quality is described as the primary and direct link to CL *(Lai et al., 2008)*. Thus, the selected research studies use almost the same concepts, only introducing a few new concepts such as trust, corporate image or alternative attractiveness, situation that results in a low density of the network. Therefore, it is possible to conclude that perceived value, service quality and customer satisfaction are the considered the main antecedents of CL in the literature

Figure 3: Visualization of the Network
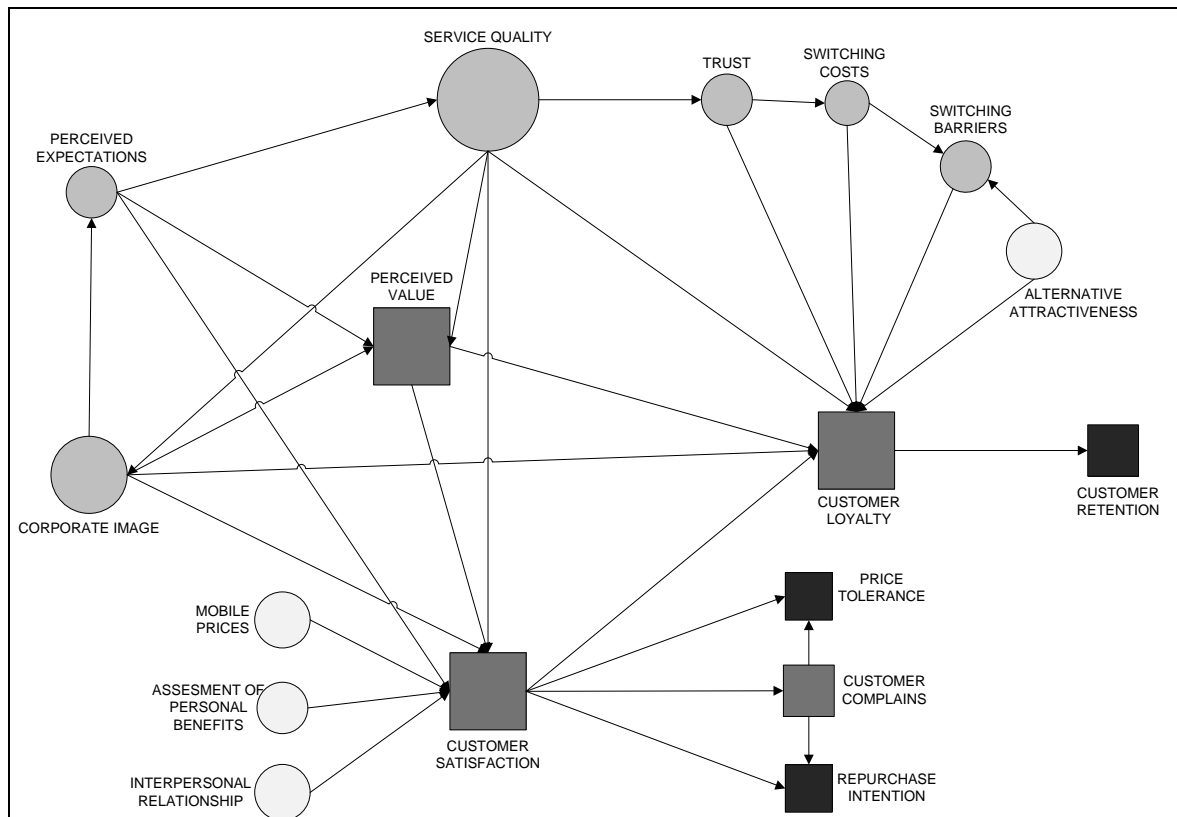
Other observation possible from the network depicted is that that these three concepts, CS, SQ and PV have a complex relationship between them and with CL. It said that a complex relationship is showed, because SQ and PV can affect CL directly, but at the same time through CS. Moreover, SQ has an effect on PV as well. Therefore, it is possible to see that there is a discussion on if SQ and PV affect CL directly or through CS.

Additionally, in the *Figure 4* it is possible to observe how many times a concept has been studied as the cause of other concepts i.e. the number of times a concept is defined as independent; and how many times has been studied as the result of other concepts i.e. the number of times a concept is defined as dependant. In this figure, CS is showed as the concept most often used as the cause or result of other concepts. CS is defined nine times as the cause of other concepts and eighteen times as the result of other concepts. The second concept in the table is service quality that is used seventeen times to explain other concepts and two as the result of other concepts. Following in the list there are perceived value, corporate image, etc. Therefore, the research studies show that SQ and CS have a strong capacity to predict CL.

Figure 4: Descriptive Statistics Regarding the Concepts Used
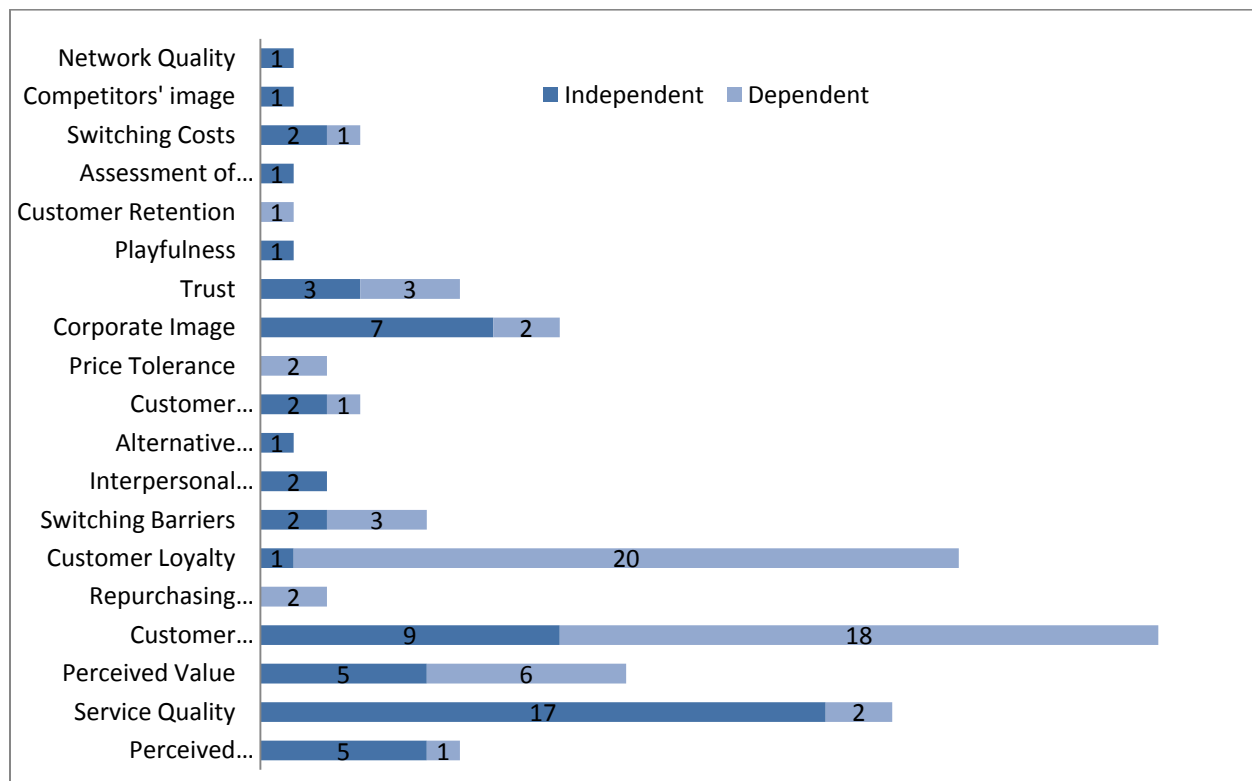
To summarize, it is possible to make the following conclusion based on the network approach toward the literature review:

    a) The network shows a low density, where most of the concepts studied are common to most of the research studies.
    b) The main three antecedent concepts of customer loyalty are Customer Satisfaction, Service Quality and Perceived Value

c) There is a discussion on whether Service Quality and Perceived Value have a direct effect on Customer Loyalty or through Customer Satisfaction

d) Among the three concepts, Service Quality and Customer Satisfaction have showed a stronger capacity to predict CL.

Finally, based on these observations, the conceptual model proposed for this thesis is showed in *Figure 5*. This proposed conceptual model is focused on the research of customer satisfaction as the main antecedent of customer loyalty. Additionally, this thesis will explore the relationship of customer satisfaction with service quality and perceived value. As it can observed, service quality and perceived value can affect customer loyalty in two ways, either as a direct antecedents of customer loyalty or through customer satisfaction. This thesis aims to determine in which way these two concepts have a bigger effect on customer loyalty.

Figure 5: Proposed Conceptual Model
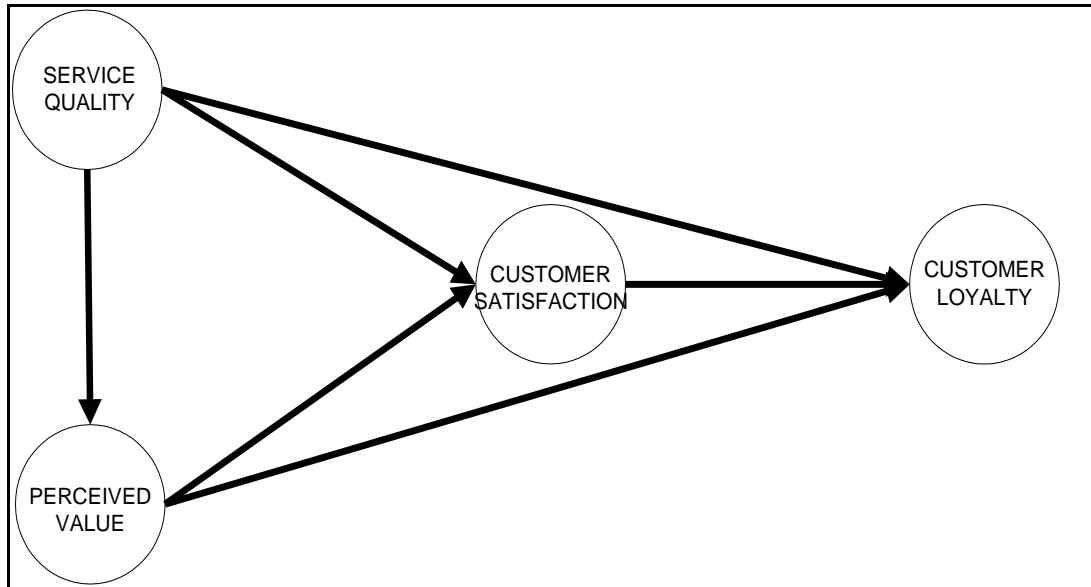
Chapter 4   Methodology

Through the previous chapters a theory framework has been developed that proposes, as a result, a conceptual model that shows the relationships between the concepts that lead to customer satisfaction and customer loyalty. This proposed conceptual model is based on existing theory and previous research studies on the area of mobile services. However, these research studies were conducted in a different context from the present research, since they propose customer satisfaction and customer loyalty models that are evaluated with mobile services in general, without making a distinction between voice and data mobile services. For this reason, the proposed model in this thesis needs to be evaluated with mobile data services, which are the focus of this thesis, in order to assess its fitness in this context. Therefore, through this chapter the methodology applied to determine this fitness, as well as the sampling, data collection and operationalization of the constructs are explained and described.

4.1 Case Study

A number of different research methodologies are available for conducting research studies. When deciding between these research methodologies, diverse issues have to be considered, such as if the research is applied or fundamental, if it follows a quantitative or qualitative approach, the extent of control over events, etc., in order to determine the best methodology for a specific research. Among those different research methodologies, the case study methodology has been recommended for research studies that aim to analyze contemporary phenomena on basis of the qualitative particulars *(Yin, 2009)*. However, it has been stated that special care in issues like the generalizability and replicability when applying case study *(Lee, 1989)*.

For the purpose of this research study, the case study methodology was chosen to be applied. The case study is selected because it allows focusing on contemporary phenomenon in a real-life context, like the study of customer satisfaction with mobile data services for T-Mobile, and it is possible to benefit from previous theoretical prepositions to guide the research and analysis of this phenomenon.

Following, a description of the approach used, based on the work of *(Yin, 2009)*, is presented by discussing the case selection, sources of data collection, and finally the statistical technique used to analyze the data.

4.1.1   Case Selection

One of the first issues to deal with in a case study is the selection of the unit of analysis. In order to select the adequate unit of analysis for this thesis, the first step is to analyze the main research question for this research. The research question for this thesis, as stated in *0* is:

- *How company level factors lead to customer satisfaction for the mobile internet service provided by a mobile network operator?*

By analyzing this research question, it is possible to determine that the unit of analysis most appropriated for this research is the mobile network operator that provides the mobile service for which the customer satisfaction will be tracked.

After defining the unit of analysis, the next step was to select the mobile network operator to work with for this research. The selection of the mobile network operator was done on basis of the following criteria.

First, the mobile network operator (MNO) was among the main mobile network operators of the Netherlands. Second, the MNO is one of the main providers of mobile data services. And finally, the MNO has available historical customer data to be used in the research. As a result, T-Mobile was selected to conduct the research, because it is one of the main providers of mobile data services in the Netherlands and had available customer data for this research. Next, a description of this mobile network operator is presented.

4.1.2 T-Mobile

T-Mobile Netherlands BV is a mobile network operator subsidiary of Deutsche Telekom Group one of the largest telecommunications companies. Currently T-Mobile, with its nearly 5 million customers, is one of the largest telecom providers in the Netherlands's market with a portfolio of mobile telecommunications services for consumers and businesses. The company was among the first companies to introduce smartphones into the Netherlands and is currently leader in providing mobile internet.

T-Mobile is always looking to provide a good experience to its users, thus it is continuously investing in improving the capacity and reliability of the network. The aim of the company is to provide access to its customers to innovative solutions and provide the best possible service, by focusing on a qualitative mobile network and a successful portfolio of services and products.

Currently, T-Mobile 3G mobile network provides coverage to more than 50 percent of Dutch population and is the first of this kind to rolled out in the country. Additionally, T-Mobile has the largest percentage in the postpaid smartphone in the Netherlands, with around the 30 percent of the market share. Furthermore, the company is starting to be focused on customer satisfaction and loyalty *(AG, 2013)*.

As it is possible to see, T-Mobile meets the first and second requirements previously stated, since it is one of the main providers of mobile data services in the Netherlands. The third requirement, related with the availability of data, is assessed in the next section, where the data collection is describes as well as the sources of this data.

4.2 Data Collection

Data collection is important for any research, since it can impact on the reliability, validity and final results of the research *(Sekaran & Bougie, 2010)*. Therefore, advice on issues like the design of the questionnaires, the ability of the interviewer, etc., is usually given for this stage of the research. However, this thesis follows a different approach for the data collection, since it will use historical customer data that is available from the selected MNO, in this case T-Mobile. Even though, this approach allows access to a considerable quantity of customer data of T-Mobile gathered during a long period of time, it must be noted that the data has been gathered by somebody else than the researcher. As a result, control over issues of the data collection was not possible.

The approach used for the data collection, shows special challenges for the research. First, the process to collect the data must be well studied and understood, in order to identify what possible problems, gaps and issues the data might present. For the purpose of obtaining this knowledge about the data collection process, different interviews were conducted with the people responsible for the systems that collect this customer data.

Apart from the interviews, the questionnaires used to gather the data were carefully analyzed, as well as the answer sheets. As a result of this study, it was possible to gain a first idea on how the data collection was done. This first idea was next confirmed or explained by a second interview and via emails with the people responsible for the systems. Finally, as a result of this work and the help of the responsible people, it was possible to obtain a good understanding of the data collection process and assess the problems and issues that could have an impact on the research results. In the next section, a description of the system for the data collection is done followed by the analysis of the sampling procedure.

4.2.1 The TRI*M system

The TRI*M system aims to analyze and measure different aspects of the relationships between T-Mobile and its customers. For this purpose, questionnaires and surveys are used to collect customer data. The TRI*M is a system implemented by Deutsche Telekom to track customer preferences across its subsidiaries in different countries. In the Netherlands, TRI*M gathers information about customers of T-Mobile as well as of competitors companies such as Vodafone, KPN, Telfort, etc. The customer data is gathered continually from mobile users of the Netherlands, with a response rate between 5% and 16%, and reports are generated each three months.

4.2.2 Sample

For the purposes of this thesis, the customer data gathered on 2012 by the TRI*M system was used. The initial dataset had a total number of 10816 respondents. However, as was mentioned before, this dataset contained information of customers of different MNOs of the Netherlands, thus it was needed to apply a number of filters over this dataset before starting with the analysis.

The first filter applied was to select the customers of T-Mobile, and exclude respondents from other providers. The next filter was applied to select only the postpaid customers of T-Mobile. The research was focused on post-paid customers because many of the variables in the dataset were meant for this kind of clients. For example, in the case the questions that aimed to measure the performance of the loyalty program among customers, were applicable only for post-paid customers. The final filter applied was to select the customers that had accessed internet from mobile phone in last 6 months. This filter was applied because, as previously stated, this thesis aims to evaluate the fitness of the proposed model by analyzing the data from customers of mobile internet.

Next, the variables included in the dataset were analyzed. In the initial dataset, 32 variables were found, from which 6 variables were discarded. These variables were discarded because they were specifically measuring issues related only with mobile voice services, such as costs for making calls, costs for calling an international number, etc. Therefore, the purpose of excluding these variables was to keep only the variables that capture the customer experience with mobile data services as well. Finally, after the filters were applied, a final dataset was obtained with 646 respondent and 28 variables.

Once defined the dataset to be used in the research, different statistical techniques were analyzed in order to determine the most appropriated ones for this research.

4.3 Statistics Techniques

A number of different research characteristics play a role in determining the most adequate statistical technique for a research. One of the main characteristics to take into account is the number of variables,

independent and dependent, that are going to be tested in the research, and the scale used to measure these variables *(Sekaran & Bougie, 2010)*. In this research there are three independent variables, namely service quality, perceived value and customer satisfaction and two dependent variables, namely customer satisfaction and customer loyalty.

Additionally, it is important to point out a special characteristic of this proposed conceptual model. The variables included in the model are not purely independent or dependent, since, as it is possible to observe in the model, service quality and perceived value lead to customer satisfaction, and then customer satisfaction leads to customer loyalty. As a result, customer satisfaction is both, a dependent and independent variable at the same time. Therefore, it is important to select an adequate technique that permits to examine this series of dependence relationship simultaneously, since most of the statistical techniques, such as exploratory factor analysis, multiple regression analysis, multiple discriminant, logistic regression, anova, manova, etc., do not allow assessing the measurement properties and examine the key theoretical relationship in one technique *(Jr et al., 2010)*.

Other important aspects to take into account when selecting the methodology are the size of the sampling and the research objective *(Sekaran & Bougie, 2010)*. Even though the sample size is determined by the extent of confidence and precision wanted in the research, some techniques are better handling small sample than others, which require bigger samples. In the case of this research, the sample has a considerable size, what provides freedom to some extent, in the selection of the statistical technique to be applied in this research.

Based on the research characteristics described, Factor Analysis and Structural Equations Modeling (SEM) were selected to be applied in the customer data in order to evaluate the proposed conceptual model. During the first phase of the analysis, Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) are applied. These two statistic techniques will allow determining an appropriate distribution of the variables between the constructs, and test the reliability and validity of the proposed measurement model.

By applying SEM it will be possible to study the structural properties of the proposed conceptual model, since this technique allows combining elements of multiple regressions and factor analysis. As a result of this combination, SEM allows examining the overall relationship between theoretical concepts and measurable variables *(Moon-Koo Kima, 2004)*. Additionally, SEM will permit to examine a series of dependence relationship simultaneously, such as in the case of customer satisfaction that is an independent and dependent variable at the same time *(Jr et al., 2010)*. For these reasons, an approach divided in two parts, the first applying Factor Analysis and the second Structural Equation Modeling, seems to be the most adequate technique for this research.

4.4 Operationalization

The next step on the research is the operationalization of the concepts included in the proposed conceptual model, namely perceived value, service quality, customer satisfaction and customer loyalty. An adequate operationalization will guarantee that the concepts measured are indeed the concepts intended to be measured. The approach used in this research consists on, first, going through the literature to find the existing operationalization of these concepts, to then adapt them to the present context. Even though, the adaptation of scale items in order to capture specific context elements is generally accepted, there is a lack of research about how the item adaptation impacts on the scale validity. Additionally, any

operationalization is very likely to exclude some important dimensions because it fails to recognize them, and some irrelevant dimensions can be mistakenly included as well. Therefore, special attention must be paid when defining the operationalization of the concepts, but always considering that there is not a perfect operationalization *(Carrillat et al., 2007)*.

As previously mentioned, the operationalization of the concepts is first based on previous research studies, and then it is adapted to the available customer data for this thesis. For this purpose, an analysis of the operationalization used in different research studies on mobile services is done. As a result of this analysis, the most adequate dimensions for each one of the concepts are selected. During this selection the fit between the dimensions of the selected operationalization methods and the availability of variables in the dataset are taken into account. In *Table 4* the operationalization method selected for each concept is showed as well as the research source.

Table 4: Proposed Operationalization based on Theory

Article	Author	Concept	Abbreviation	Operational definition
Refinement and reassessment of the SERVQUAL scale	Parasuraman, A., Zeithaml, V.A. and Berry, L.L. (1991)	Service Quality	SQ1	Tangible
			SQ2	Reliability
			SQ3	Responsiveness
			SQ4	Assurance
			SQ5	Empathy
Customer retention, loyalty, and satisfaction in the German mobile cellular telecommunications market	Torsten J. Gerpott, Wolfgang Rams, Andreas Schindler	Customer Loyalty	CL1	Willingness to recommend
			CL2	Repurchase Likelihood
		Customer Satisfaction	CS1	Overall Satisfaction
Development of a customer satisfaction index model	Ali Türkyılmaz; Coskun Ozkan	Perceived Value	PV1	Ratio Performance/Price
			PV2	Competitive Advantage

The dimensions selected to measure each construct have been selected based on previous research studies. Following a definition of each one of these dimension is provided.

Service Quality

a) Tangible: Physical facilities, equipment, and appearance of personnel
b) Reliability: Ability to perform the promised service dependably and accurately
c) Responsiveness: Willingness to help customers and provide prompt service
d) Assurance: Knowledge and courtesy of employees and their ability to inspire trust and confidence
e) Empathy: Caring, individualized attention the firm provides its customers.

Customer Loyalty

a) Willingness to recommend: This dimension reflects how likely is that the customer will recommend the services of the MNO to other persons.

b) Repurchase Likelihood: This dimensions shows how likely is that the customer will choose the same provider for a new mobile phone.

Customer Satisfaction

a) Overall Satisfaction: This dimensions shows how satisfied is the customer in general with the whole service provided.

Perceived Value

a) Ratio Performance/Price: This dimension shows the perceived level of product quality relative to the price paid by customers.
b) Competitive Advantage: The benefit a customer gets when using the services of the current provider instead of the services of the competitors.

Finally, in *Figure 5* an updated conceptual model is show including all dimensions for each construct.

Figure 5: Proposed Conceptual Model showing Dimensions
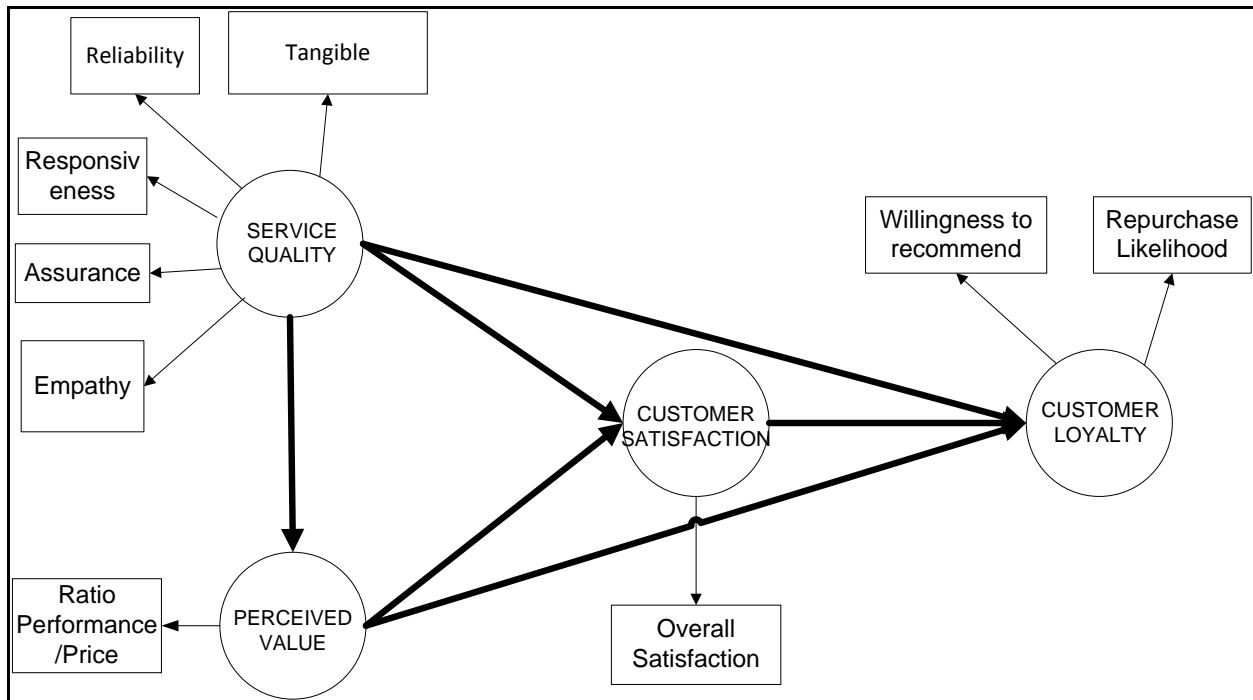
After selecting the operationalization to be used, the measurement variables were assigned to each dimension. The variables included in the *Table* 5 were measured using a five point likert Scale designed to evaluate how strongly subjects agree o disagree with the statement of a five-point scale. The complete set of questions and the scale used for each variable can be found in the *Appendix C:* . Finally, after obtaining the final dataset and finishing the operationalization of the variables, the analysis was applied through the selected statistic techniques.

Table 5: Measurement Variables for Each Dimension

#	Data Base	Variables	Construct
1	TRI*M	Recommendation	CL1
2	TRI*M	Further Usage	CL2
3	TRI*M	Overall experience	CS1
4	TRI*M	Positively surprised	CS1
5	TRI*M	Feel at Home	CS1
6	TRI*M	Feel Appreciated As a Customer	CS1
7	TR*M	Value for Money	PV1
8	TR*M	Tariffs Overall	PV1
9	TRI*M	Prices Overall	PV1
10	TRI*M	Competitive Advantage	PV2
11	TR*M	Handset Internet Overall	SQ1
12	TRI*M	Handset upgrade	SQ1
13	TR*M	Handset Overall	SQ1
14	TRI*M	Speed of Handset Internet Connection	SQ1
15	TRI*M	Network coverage overall	SQ2
16	TRI*M	Performance	SQ2
17	TR*M	Handset Internet Overall	SQ2
18	TR*M	Stability of the connection	SQ2
19	TRI*M	Customer service overall	SQ3
20	TRI*M	Customer centric approach	SQ3
21	TRI*M	Performance of existing products	SQ3
22	TRI*M	Offer of new products	SQ3
23	TRI*M	Customer information overall	SQ4
24	TRI*M	Performance of support	SQ4
25	TRI*M	Transparent tariff structure	SQ4
26	TRI*M	Company rewards loyal customers	SQ5
27	TRI*M	Loyal programs overall	SQ5

Chapter 5 Results

In the previous chapter an analysis of the statistical technique to be applied in this research was done. As a result of this analysis, three statistical techniques were defined as the most appropriate to determine the fitness of the proposed model to track and measure customer satisfaction and customer loyalty with mobile data services.

First, an exploratory factor analysis (EFA) will be applied in order to determine the best distribution of the available variables to represent the proposed constructs i.e. Customer Loyalty, Customer Satisfaction, Perceived Value and Service Quality. As a result of this exploratory factor analysis, a modification of the initial model will be proposed. The new model, that includes the modifications, is used as input for the next step. Second, a confirmatory factor analysis (CFA) will be conducted in order to assess the fitness of the proposed model. In this stage only the measurement model i.e. a model that specifies the rules of correspondence between variables and constructs are analyzed *(Jr et al., 2010)*. As a result, the extent to what the variables selected explained the associated construct, i.e. the validity of the model, will be assessed. Finally, structural equation modeling (SEM) will be applied to determine the fitness of the overall model, including the measurement model and the structural model i.e. the dependence relationship among independent and dependent constructs *(Jr et al., 2010)*.

Through this fourth chapter the results of the application of these three statistic techniques are described and analyzed. The application of each statistical technique is described in detail, explaining the results and what decisions were taken base on these results. During this description a short version of the results are showed in

Table 6. The description of the statistical techniques follows the same order as when they were applied, first exploratory factory analysis, then confirmatory factory analysis, to finish with structural equation modeling. The section starts with a description and analysis of the assessment of the general requirements for any dataset to be analyzed by using statistical techniques, such as normality and outliers.

5.1 Descriptive Statistics

The initial examination is a necessary step to assure the data meets the basic requirements to apply any multivariate statistic techniques. Additionally, this first examination will allow gaining a better understanding about the data that is going to be used for the research. The examination starts with a table with the general descriptive characteristics of the data, to continue with the assessment of the normality, outliers, to finally determine missing values and how to handle them.

As it is possible to observe in the *Table 6,* 27 variables were included in the analysis. From these variables, the standard deviation of most of the data fall within 1, with few cases over 1, and even in those cases the standard deviation is not much higher than 1. These standard deviations suggest that the data are concentrated around the mean. Additionally, since the variables were measured using a *likert scale*, an overview of the minimum and maximum values can provide a first assessment that the data do not present outliers. Additionally, it is possible to determine that the sample shows a approximately normal distribution. For the results of normality see *Appendix D*.

Table 6: Descriptive statistics

Variables	N	Min.	Max.	Mean	Standard Deviation
Performance	646	1	5	3.22	.893
Recommendation	638	1	5	3.64	1.089
Further usage	641	1	5	3.91	1.006
Competitive advantage	604	1	5	2.86	.909
Network Coverage overall	644	1	5	3.06	1.005
Value for money	643	1	5	3.06	.823
Prices overall	630	1	5	2.88	.798
Performance of Existing products	645	1	5	3.12	.692
Stability of the connection	643	1	5	3.09	.882
Performance of the Handset internet service overall	631	1	5	2.88	.856
Speed of handset internet connection	267	1	5	2.68	.837
Tariffs overall	607	1	5	2.83	.736
Transparent tariff structure	605	1	5	2.92	.810
Performance of Handset overall	643	1	5	3.56	1.058
Performance of the Handset upgrade	635	1	5	3.62	.961
Offer of new products	609	1	5	2.84	.828
Customer information overall	614	1	5	2.69	.915
Company rewards loyal customers	628	1	5	2.39	1.011
Customer service overall	414	1	5	3.03	.852
Loyalty Program overall	260	1	5	3.03	.858
Satisfaction	614	1	5	4.00	.741
Positively surprised	611	1	5	3.29	.866
Feel at home	611	1	5	3.57	.784
Feel appreciated as a customer	612	1	5	3.39	.850
Customer centric approach	358	1	5	2.90	.803
Performance of support	436	1.	5	3.124	.749
Effort to get support	614	1.0	5	2.348	.949
Valid N (listwise)	0				

Finally,

Table 6 allows determining the variables that present a percentage of missing values higher than 5%, by considering the total number of observations (646). Before applying any statistic technique, it is important to determine the randomness of these missing values, especially in order to determine the most appropriate remedy for the missing values. The first step was to determine what variables present missing values because of the research design. On the basis of this explanation, many variables that showed missing values were discarded for further analysis of randomness. For example, many customers that answer "no" to the question "Did you visit the webpage" did not answer the question "How would you rate the performance of the webpage" as well. After making this distinction, five variables were found that presented important levels of missing values i.e. more than 5% of missing values.

To continue with the analysis of missing values, separate variance *t-Tests* and *cross tabulations* were used in order to determine if the missing values showed any correlation with other variables or were completely random (MCAR) missing values. Even though, the results of these two tests showed some weak correlations between some variables, they were not enough to determine the missing values were not random. Thus, the Little's MCAR test was applied in order to determine the randomness of the missing values, The Little's MCAR result was significant at the 0.05 level, thus it was possible to accept the null hypothesis: "the values are missing completely at random".

Table 7: Results of Little's MCAR test for Missing Values

Performance of support	Speed of handset internet connection	Customer service overall	Loyalty Program overall	Customer centric approach
3.1246	2.68	3.04	2.99	2.90

In *Table 7* the results of the test of missing values are showed. Since the missing values were MCAR, any imputation method was appropriated for the missing values. In this case, according the advice provided by *(Jr et al., 2010)*, the missing values were processed before applying the statistical techniques. For this purpose, the *Multiple Imputation (MI) Method* provided by the software AMOS IBM Spss was applied in order to solve the missing values. The IM method is an extension of the Expectation Maximization method that uses stochastic multivariate methods with the difference that extends the process to 5-1o times. For this thesis the MI generated 5 different datasets, which then were combined into a single data set by using averaging formulas following the advice provided by (Olinsky, Chen, & Harlow, 2003). The use of MI provides the advantage of reducing nonresponse bias because "MI can incorporate information about nonresponse by modeling either the known reasons for nonresponse or the uncertainty about the reasons for nonresponse" (Montalto & Sung, 1996).

Finally, after the assessment of these basic requirements, it was possible to continue with the application of the multivariate techniques selected for this research.

5.2 Exploratory Factor Analysis (EFA)

The main objective of the application of Exploratory Factor Analysis (EFA) in this thesis was to derive the underlying structure among the variables in the available dataset. The first decision, in order to apply this statistic technique, is about what variables include and what variables exclude from the analysis. The selection of variables is an important step in the process of applying EFA, since these variables will implicitly specify the potential structure to be identified, thus EFA is always on risk of suffering of the

phenomenon of "garbage in, garbage out". In order to avoid this phenomenon, the selection of variables was done based on existing theory and other research studies on the topic of Customer Satisfaction and Customer Loyalty. The selection process of these variables can be reviewed in the *Theoretical Framework* (*Chapter 2*). This selection process allowed proposing an initial model for Customer Satisfaction and Customer Loyalty with mobile data services, which can be seen in *Table 8*. This proposed model was used as the initial model for the application of EFA.

Table 8: Proposed model for Customer Satisfaction

Concepts	Constructs		Variables
Customer Loyalty	CL1	Willingness to Recommend	Willingness to Recommend
	CL2	Repurchase Likelihood	Further Usage
Customer Satisfaction	CS1	Overall Satisfaction	Satisfaction
			Positively Surprised
			Feel at home
			Feel appreciated as customer
Perceived Value	PV1	Value added/Price	Value for Money
			Prices overall
			Tariffs Overall
	PV2	Advantage compared with other offers	Competitive advantage
Service Quality	SQ1	Tangible	Handset internet service overall
			Speed of handset internet connection
			Performance: Handset upgrade
			Performance: Handset Overall
	SQ2	Reliability	Performance
			Network coverage overall
			Handset Internet Overall
			Stability of the connection
	SQ3	Responsiveness	Customer Centric Approach
			Performance of existing products
			Offer of new products
			Customer service overall
	SQ4	Assurance	Customer information overall
			Performance of support
			Transparent Tariff Structure
	SQ5	Empathy	Company rewards loyal customers
			Loyalty program overall

After defining the variables to be used, the general requirements for the application of EFA were assessed. The first requirement is about the sample size. The sample should be at least 100 or larger, and,

as a general rule, the minimum size should have at least five as the number of variables to be included in the analysis. Since the sample size was around 600 observations for 27 initial variables, this first requirement was accomplished. Additionally, general assumptions, i.e. normality, outliers and missing values, were already studied in the previous section of descriptive statistics.

Once the general requirements for EFA were met, the next step was to ensure that the selected variables showed a sufficient intercorrelation. It is needed to test the intercorrelation between the variables order to assure that these variables can produce representative factors or constructs. This intercorrelation can be tested from the overall perspective as well as from the individual variable perspective. For this thesis the intercorrelation was tested from both perspectives.

To start, the correlation matrix was generated in order to study the correlation loadings for the variables. This matrix showed an adequate basis to continue with the analysis since 31% of the correlations were significant at the .01 level. This situation was confirmed by the *Bartlett's Test of Sphericity* that gave a significant result at the .001 level. Next, the measure sampling adequacy (MSA) was studied. The MSA should be at least higher than .50 and ideally higher than .70 in order to assure the factorability of the set of variables. The overall MSA for the model was .653, value that is considered as acceptable.

The next step was to review the *measure of sampling adequacy* MSA for each variable. The rule of MSA is that the MSA for each variable should be higher than .5. The variables that fall in the unacceptable range must be excluded from the analysis (Jr et al., 2010). Therefore, the variables that showed a value lower than .5 were deleted one by one starting with the variable with the lowest value, and then re-calculate the factor analysis after deleting it. This process is repeated until all the variables reach acceptable values. As a result of this analysis the variables *Loyalty Program overall, Handset Internet Overall, Handset upgrade* and *Speed of handset internet connection,* that showed values lower than .05, were excluded from the analysis..

At this point the analysis was split into independent and dependent variables. Even though, when using the exploratory factor analysis the variables are not divided into independent and dependent, this technique can be used to factor analyze independent and dependent variables separately (Hair, Celsi, Money, Samouel, & Page, 2011; Shipps & Milwaukee, 2007). Therefore, it was decided to split the analysis into dependent and independent variables following the advice provided by (Jr et al., 2010) that states that "mixing dependent and independent variables in a single factor analysis and then using the derived factors to support dependency relationship is inappropriate".

The next step was to determine the number of factors to be retained. The number of factor was determined by a combination of the number of factors proposed in the initial model, thus supported by theory; and result of the application of latent root criterion method. The *latent root of retaining factors* determines that *eigenvalues* that show a value greater than 1.0 should be kept. According to this method, 4 factors, which showed an eigenvalue greater than 1.0, should be kept for the independent variables and 4 factors for the dependent variables. However, according to the proposed model 7 factors were needed for the independent variables and 6 for the dependent variables. In order to solve this problem with the number of factors, a visual revision was done of the *screen plot of eigenvalues.* This revision allowed determining that 5 factors were appropriated for the independent variables and 5 for the dependent variables, by identifying the elbow in the eigenvalues. So finally, 5 factors were kept for independent variables and 5 for the dependent, in order to continue the exploratory factor analysis.

Finally, after meeting the requirements and determining the number of factors, the next step was to generate and examine the *Unrotated Factor Matrix of Loadings*. This matrix contains the factor loadings for each variable on each derived factor. The analysis and interpretation of each one of these factor loadings allow identifying the underlying structure of the variables. The first decision to be taken in order to generate this matrix is which extraction method to use. The method most used is the Principal Component, but since this model is supported by theory, the Maximum Likelihood method was more appropriated.

Once generated the *Unrotated Factor Matrix of Loadings,* the factor loadings were studied to determine the degree of association between each variable and each factor. The rule to interpret this matrix is by selecting the factor loadings greater than 0.40. During this phase of the analysis the communalities i.e. square sum of factor loadings, should be assessed as well. The communalities show how much of the variable variance is explained by the factors. In this case, communalities higher than .50 are searched in this thesis and variables with communality lower than .50 should be considered for deletion. In the next section the description of the variables distribution among the factors is done.

5.2.1   Analysis of Dependent Variables

The analysis started with the study of the dependent variables. In the analysis of the communalities it was possible to observe that 5 variables showed values lower than .50. Even though, according to (Osborne & University, 2005) communality above .4 can be accepted when analyzing real data, two variables showed communalities even lower than .4 namely *Positively Surprised and Feel Appreciated as a Customer*. Additionally, these two variables showed the lowest loading on the factors (.496 and .513). Therefore, these variables were excluded from the analysis. Finally, In *Table 9* the factor loadings together with the communalities are shown.

Table 9: Factor Matrix for Dependent Variables

	Factor		
	Satisfaction	**Loyalty**	**Communalities**
Q02 Recommendation	.199	**.656**	.470
Q03 Further usage	.015	**.811**	.658
Feel At Home	**.602**	.256	.428
Satisfaction	**.612**	.212	.419

5.2.2   Analysis of Independent Variables

In the analysis for independent variables, it was possible to see that the communalities *of Competitive advantage, Handset Overall, Customer Centric Approach and Customer service overall* showed a communality lower than .4 and they did not load significantly on any factor. If a variable has no significant loadings and has a unacceptable communality, it may be eliminated and the factor model respecified (Jr et al., 2010). Therefore, they were excluded from the analysis. The *Factor Matrix of Loadings* was generated once more, this time giving as a result all the communalities higher than .40.

By examining the unrotated factor matrix it is possible to observe that, as expected, the factor solution showed a distribution of the variables according the order of importance of the factors, with the first factor accounting for the most of the variance. Seven of the eleven variables show the highest factor

loading on the first factor. Additionally, some variables show high loadings in two factors, thus making difficult the interpretation of the variable distribution. Therefore, the use of a rotated solution was necessary.

In order to obtain a rotated solution, first the VARIMAX rotation was applied. However, the rotated Factor Matrix still showed a distribution of the variables not totally clear, so as a second option the QUARTIMAX rotation was applied. With this second rotation the final matrix of factor loadings was obtained, which was used to distribute the variables through the factors. The results of this rotation can be observed in *Table 10*

Table 10: Rotated Factor Matrix

	Factors			
	Reliability	**Perceived Value**	**Responsiveness**	**Tangible**
Performance	**.481**	.306	.246	.254
Network Coverage overall	**.703**	.376	.053	.015
Value for money	.282	**.890**	.114	.222
Prices overall	.225	**.467**	.258	.345
Existing products	.398	.338	.202	**.434**
Stability of the connection	**.556**	.168	.116	.246
Handset internet service overall	.381	.209	.250	**.403**
Tariffs overall	.122	.230	.134	**.563**
Transparent tariff structure	.241	.198	.307	**.454**
Offer of new products	.160	.102	**.555**	.252
Customer information overall	.022	.112	**.728**	.099
Performance of Support	.317	.201	**.453**	.294

Conclusions

To conclude, the proposed model was modified including the selected variables through the exploratory factor analysis, and distributing them according to the results of this analysis. In *Table 11* it is possible to observe this final distribution, which is used as the input for the confirmatory factor analysis. This table shows that one variable was deleted from Customer Satisfaction and one from Perceived Value.

In the case of Service Quality, only three dimensions of the five initially proposed were kept, namely Reliability, Responsiveness and Tangible. The exclusion of two of the dimensions proposes a considerable modification to the initial model. However, the use of only three of the five proposed dimensions in this model can be explained for the lack of adequate questions on the surveys to measure these dimensions. This necessity to modify a model based on theory is a natural consequence when using data not gathered specifically for the research.

Therefore, it is possible to conclude that by making use of the exploratory factor analysis was possible to obtain a variable distribution that, even though is still based on theory, is also determined on the correlations found in the data. The combination of the subjective perspective, based on theory, and the objective perspective, based on the statistical technique, produced a modified model that is more adequate to represent the underlying theory on customer satisfaction and customer loyalty and the customer data available for the research.

Table 11: Modified model for Customer Satisfaction

Construct	Dimensions		Variables
Customer Loyalty	CL1	Willingness to Recommend	Willingness to Recommend
	CL2	Repurchase Likelihood	Further Usage
Customer Satisfaction	CS1	Overall Satisfaction	Satisfaction
			Feel at home
Perceived Value	PV1	Price/Sacrifice and efforts	Value for Money
			Prices overall
Service Quality	SQ1	Reliability	Network coverage overall
			Performance
			Stability of the connection
	SQ2	Responsiveness	Offer of new products
			Customer information overall
			Performance of Support
	SQ3	Tangible	Handset internet service overall
			Existing Products
			Tariffs overall
			Transparent tariff structure

5.3 Confirmatory Factor Analysis

After completing the *exploratory factor analysis,* which resulted in a modified model to track and measure consumer satisfaction with mobile data services, the analysis continued by applying *confirmatory factor analysis (CFA)*. Confirmatory factor analysis allows evaluating how well the measured variables represent the associated construct. However, in this point some confusion can arise because of the similarity of the confirmatory with the explanatory factor analysis. Even though, in general terms both techniques test the relationship between the variables and the constructs, they apply a different approach to test this relationship. While in confirmatory factor analysis the results are strongly guided by theory, in the exploratory factor analysis the results are more determined for the data used for the test. However, a more detailed explanation of the differences between these two factor analyses can be found in *Methodology (Chapter 3)*. In order to apply CFA, it is needed not only to define the variables that represent the constructs, but also the constructs or factors these variables are associated with. Therefore,

the first input for this analysis was a model that specifies the variables and the associated factors, an approach different from EFA, where only the variables were specified as input, and the factors were defined as a result of the analysis. The software used for the CFA was IBM SPSS Amos, which uses visual diagrams called *path diagrams* to represent the models. Therefore, in Figure 6**¡Error! No se encuentra el origen de la referencia.** the model used for the CFA is showed as a *path diagram.*

Figure 6: Measurement Model for Customer Satisfaction
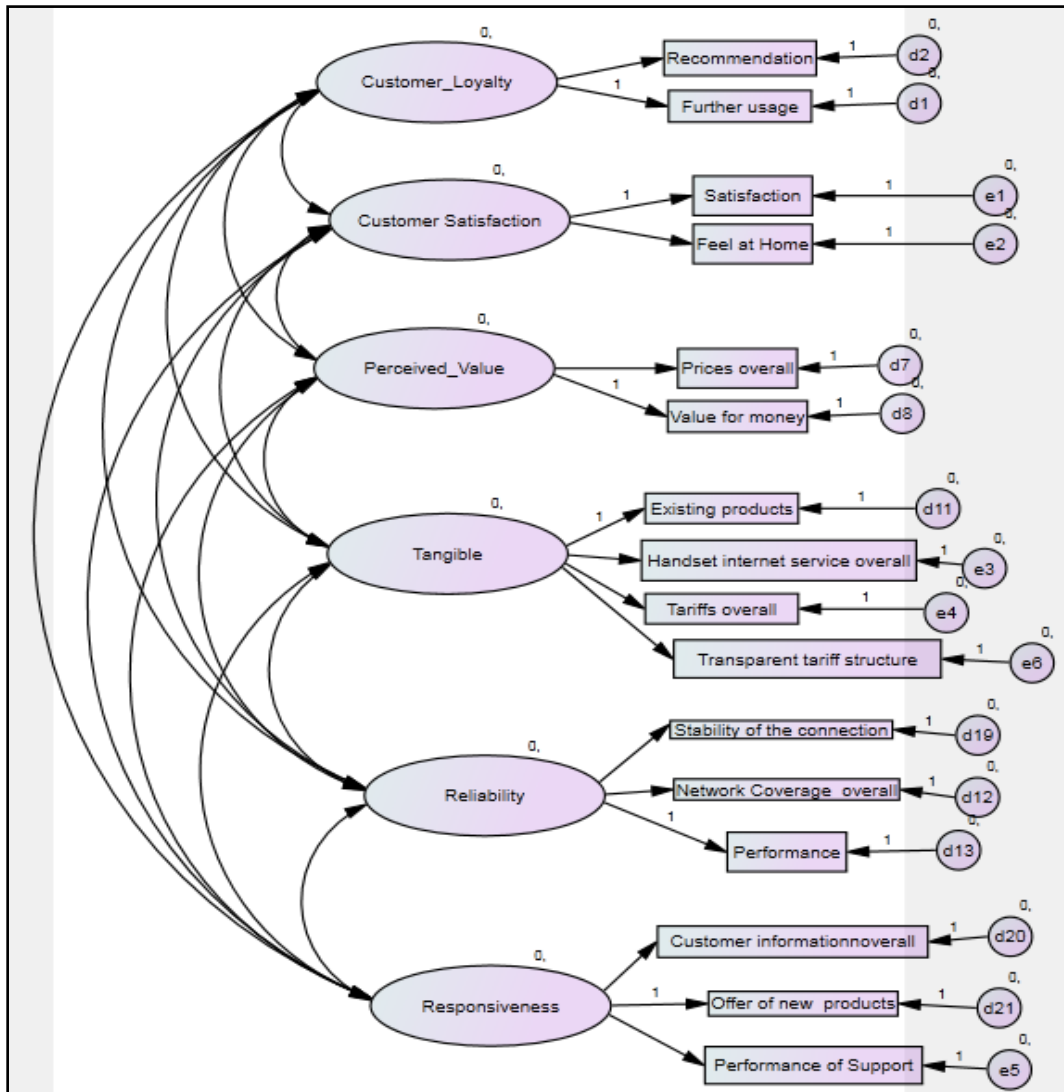
In the path diagram are depicted the constructs and the variables associated to them. However, it is possible observe that only the relationships between the variables are represented, and not the relationships between constructs. This type of model is known as the *measurement model,* where there are no structural relationships i.e. relationships of dependence between the constructs. In the confirmatory analysis all the constructs are considered as exogenous i.e. equivalent to independent constructs, and that they only show correlation between them *(Jr et al., 2010).* Therefore, during the CFA only the measurement model will be analyzed, thus leaving the analysis of the structural model for the last phase of this research when structural equation modeling (SEM) is applied.

5.3.1 General Requirements

Before actually applying the CFA, a revision of the general requirements for this analysis is needed. The first requirement is the *unidimensionality* of the variables i.e. each variable is related to only one construct. However, in this research the unidimensionality was assessed by the application of the EFA. According to the result of this analysis, the variables were assigned to a construct when they showed a high correlation with only one construct. Another requirement is related with the number of variables per construct. Good practices advice that a construct should be represented at least by 3 variables, and ideally by 4 in order to assure reliability and construct validity. Even though, confirmatory factor analysis can still work with two variables per construct, this situation can complicate obtaining the results. A construct represented by less than 3 variables can produce an *unidentified model* i.e. a unique solution cannot be found for the model, that represents a problem since the goal when applying CFA is to produce an *overidentified model* where a unique solution is found for the model *(Byrne, 2013)*.

As it possible to observe in the path diagram showed in Figure 6, the model meets this requirement with most of the factors, since they are represented at least by three variables. However, some factors are represented only by two variables. However, there are some special cases where a construct can have only two variables if the two variables are sufficient if they represent well the construct and since this model was based on theory, the analysis will continue including this construct. Following a resume is showed with the information discussed so far:

- The CFA will analyze only the measurement model and not the structural model.
- For this analysis all the constructs are considered as exogenous
- For this analysis all the constructs are considered to have correlation relationships between them
- Unidimensionality of the variables is supported by the previous application of the exploratory factor analysis.

After assessing the general requirements, the confirmatory factor analysis was applied. Once was verified that the model was correctly specified, the CFA results were reviewed in order to determine how well the measurement model based on theory fits the data.

5.3.2 Model Validity

5.3.2.1 Overall Goodness of fitness (GOF)

In order to continue with the analysis the validity of the proposed measurement model was assessed. The first step is to examine the overall fit of the model. For this purpose different fit indices provided by the output of CFA are analyzed. In this case the focus is on the key GOF values in order to determine the overall fit. In *Table 12* the fit indices to be analyzed are shown.

The first index of fitness to be analyzed is the overall X^2 that shows a value of 90.370 with 50 grades of freedom. The p-value is significant with a value of .003, thus the X^2 does not indicate a good fitness for the proposed model. However, since the effective size of the sample is around 600, other fit indices should be examined as well. In this case, the rule according to *(Jr et al., 2010)* is to look for at least one absolute fit index and one incremental fit index, that show a good fitness. The next index to be analyzed is the (RMSEA) which has a value of .034 lower than .07, thus it meets the rule for a model with 16 variables. The interval for the RMSEA is between 0.020 and 0.047, showing that even the upper bound

meets the rule. Next, the normed chi-square is examined, which shows a value of 1.81, which is lower than 2.00 thus it can be considered good. Therefore, RMSEA and Normed chi-square, as absolute fit measures, provide support for the model fit.

Table 12: Overall Goodness of Fit Indices

Chi-square ($X^{2)}$
Chi-square = 90.370 (p = .003)
Degrees of freedom = 50
Absolute Fit of Measure
Root Mean Square Error of Approximation (RMSEA) = .034
90 percent confidence interval for RMSEA = (0.020;0.047)
Normed chi-square = 1.81
Incremental Fir Indices
Incremental fit Index (IFI) = .937
Comparative Fit Index (CFI) = .933

In the case of the incremental fit indices, the CFI was examined, since this index is the most used. The CFI shows a value of .937 higher than .90, thus meeting the rule for this index. Additionally, the Incremental Fit Index (IFI) shows a value of .933, higher than .90, supporting the model as well. After the analysis applied, the results for the goodness of fit are shown in *Table 13*.

- Chi-Square is significant, thus is does not provide support for the goodness of fit
- The RMSEA and the normed chi-square, absolute fit measures, meet the rule, thus providing support for the model fit
- The CFI and IFI an incremental fit measure, meet the rule thus providing support for the model fit

As it is possible to see, there is at least one absolute fit index and on incremental fit index that support the model fit. However, the most fundamental fit index, the chi-square, does not provide support for the model. In this case it should be considered the size of the sample, since a big sample can make complicate for the chi-square to achieve a non-significance level. Therefore, so far, it can be conclude that the model shows an acceptable goodness of fit. However, the reliability and validity of the model must be assessed as well.

5.3.2.2 Convergent Validity

Factor Loadings

The first step was to review the path estimates between each variable and the associated construct. In the case of IBM SPSS Amos, the software used, the information about the path estimates is showed as the *regression weights*. In this case the rule to follow is the same used for EFA, regression weights should be at least higher than 0.5 and ideally higher than 0.7. During the analysis of the regression weights, it is important to assess that they are statistical significant.

In *Table 13* it is possible to see that the *standardized regression weights* or *factor loadings* were used to assess the path estimates instead of the *regression weights*. The use of the standardized version removes the effects due to the scale of measures, and the output is much easier to interpret in relation with the rules *(Jr et al., 2010)*. A first look to the table shows that all the estimates are statistical significant[1]. Then the estimates for each variable are studied. The *Table 13* shows that most of the variables show a regression weight higher than .50, and some even higher than .70. The significance and estimates obtained provide an initial evidence of convergent validity.

Table 13: Standardized Factor Loadings
*** means that the p-value is smaller than .0001

Variables		Constructs	Estimate	P
Customer Information Overall	←	Responsiveness	0.628	***
Offer of new products	←	Responsiveness	0.6	***
Support of Performance	←	Responsiveness	0.38	***
Network Coverage Overall	←	Reliability	0.735	***
Performance	←	Reliability	0.723	***
Stability of the Connection	←	Reliability	0.621	***
Performance of Existing Products	←	Tangible	0.74	***
Performance Handset Internet	←	Tangible	0.568	***
Tariffs Overall	←	Tangible	0.41	***
Transparent tariff structure	←	Tangible	0.442	***
Prices Overall	←	Perceived_Value	0.721	***
Value for Money	←	Perceived_Value	0.854	***
Further Usage	←	Customer_Loyalty	0.809	***
Recommendation	←	Customer_Loyalty	0.657	***
Satisfaction	←	Customer_Satisfaction	0.949	***
Feel at Home	←	Customer_Satisfaction	0.533	***

However, it is possible to observe that three variables, namely *Transparent Tariff Structure, Support_Performance and Tariffs Overall* show values lower than .5, thus becoming in prime candidates for deletion. The decision to exclude these variables depends on the results of other tests.

However, when the analysis was conducted over the model including these variables, it was found that the Average Variance Extracted (AVE) for the constructs Tangible and Responsiveness showed variables lower than the accepted threshold of .5. The AVE for Tangible was 0.3 and for Responsiveness was 0.34. Therefore, in order to improve these values, these three variables, *Transparent Tariff Structure,*

Support_Performance and Tariffs Overall, were excluded from the model. As a result, the model showed an improvement and met the requirements. Following, the new matrix of factor loadings is showed.

Table 14: Modified Matrix of Standardized Factor Loadings Weights

Variables		Constructs	Estimate	P
Customer Information Overall	←	Responsiveness	0.654	***
Offer of New Products	←	Responsiveness	0.698	***
Network Coverage Overall	←	Reliability	0.748	***
Performance	←	Reliability	0.755	***
Stability of the Connection	←	Reliability	0.675	***
Handset Internet Overall	←	Tangible	0.625	***
Existing Products	←	Tangible	0.743	***
Prices Overall	←	Perceived_Value	0.801	***
Value for Money	←	Perceived_Value	0.631	***
Further Usage	←	Customer_Loyalty	0.843	***
Recommendation	←	Customer_Loyalty	0.675	***
Satisfaction	←	Customer_Satisfaction	0.963	***
Feel at Home	←	Customer_Satisfaction	0.530	***

In *Table 14* it is possible to observe that all the variables met the requirement of having a factor loading higher than 0.5. This table shows the final variables that were used for the analysis, since, as it is shown in the next section; they meet the requirements of CFA. It should be noted as well, that the values of overall fit of the model, reported at the beginning of this section, were also the values obtained by using these variables. Next, the reliability, construct validity and discriminant validity for these variables is assessed.

Reliability

The first step to assess reliability was to obtain the AVE values for all the constructs. As previously mentioned, the AVE should be around 5 to be at least acceptable. In this case, the constructs showed an AVE in a range from 0.47 to 0.63, with two constructs, namely Responsiveness and Tangible, showing AVE's lower than 0.5. However, since these values were slightly lower than .5 the minimum accepted, it was decided to continue with the analysis.

Table 15: Construct Reliability Results

Construct	Responsiveness	Reliability	Perceived Value	Customer Loyalty	Customer Satisfaction	Tangible
Construct Reliability	0.90	0.94	0.94	0.92	0.82	0.95

The second step was to determine the reliability of the model as another indicator of convergent validity. In this case, the *construct reliability* is applied, which uses the factor loadings, and the error variances terms in order to determine the reliability of the variable and the associated constructs

In *Table 15* the results of the construct reliability test are shown. The rule used is that values higher than .7 show good reliability and higher than 6 show acceptable reliability. As it is possible to observe in the table, all the constructs show a good reliability, what indicates that the measures consistently represent the same construct, thus the model shows internal consistency.

As a consequence of the results obtained from the analysis of the factor loadings and the construct reliability of the proposed model, it is possible to conclude that the model show convergent validity. The next step is to determine the Discriminant validity

5.3.2.3 Discriminant Validity

The discriminant validity allows determining the extent to which a construct is truly distinct from other constructs. In this way, by assessing the discriminant validity of the model it will be possible to determine that the proposed constructs capture a measurement of the variables that the other construct do not. In order to determine the discriminant validity the average variance-extracted values for any two constructs will be compared with the square of the correlation estimate between these two constructs.

The comparison of the square correlations and the average variance is showed in *Table 16*. From the analysis of this table is possible to observe that most of the pairs of constructs show an Average Variance higher than the correlation. However, there are some cases were the correlation is higher than the average variance. An analysis of these cases show that the construct Tangible of service quality tend to have a high correlations with other constructs. A first idea could be that more variables representing this construct could reduce these high correlations. However, when the initial analysis was conducted with the construct Tangible with four variables, the correlations were equal or showed a minimal difference. Even more, with the reduction of the variables the discriminant validity of the construct was improved. Therefore, since just few cases show this problem and the difference between the average variance and the correlation is not considerable, the analysis was continued with this model.

Table 16: Discriminant Validity

Factors	AVE	Perceived Value	Respons.	Reliability	Tangible	Customer Satisfaction	Customer Loyalty
Perceived Value	0.520		0.23	0.41	0.50	0.14	0.22
Responsiveness	0.46	0.23		0.26	0.35	0.059	0.15
Reliability	0.528	0.41	0.26		0.64	0.12	0.51
Tangible	0.471	0.60	0.35	0.64		0.096	0.4
Customer Satisfaction	0.604	0.14	0.059	0.12	0.096		0.103
Customer Loyalty	0.583	0.22	0.15	0.51	0.4	0.103	

5.3.3   Standardized Residuals and Modification Indices

After determining the goodness of fit of the model and the path estimates for each variable, the next step is to analyze standardized residuals and modification indices. These additional indices provide information about other specific problems model might present.

The rule to be applied in order to examine the standardized residuals is that their values should be, ideally, less than 2, and at least less than 4. Standardized residuals between 2 and 4 should be carefully studied and values higher than 4 might suggest potentially problems because they can indicate that an unacceptable degree of error might be present in the model. However, in the model there were not standardized residuals higher than 2.5.

Table 17: Modification Indices higher than 4.0

Variables	←	Constructs	M.I.	Par Change
Value for Money	←	Performance	5.470	.076
Prices Overall	←	Stability of the Connection	4.993	.070

The last values to be examined are the modification indices associating the loadings of each indicator. Modification indices higher than 4 suggest that some changes might improve the model fit. As it is possible to see in *Table 17*, 2 correlations are suggested that might improve the model fitness. From the four involved variables, three have a loading estimate higher than .7, what indicates a strong correlation with their respective constructs. Therefore, no action is needed over these variables. The remaining variable, namely Stability of the Connection has a loading estimate slightly higher than 0.6, what added to the high modification index, it can indicate a lack of unidimensionality. However, making changes on the model only based on modification indices is not recommended *(Jr et al., 2010)* and, since these two variables have not showed any other non acceptable value during the analysis, the model not will be modified.

Conclusions

To conclude, the model provides acceptable indices for the overall fit of the model, except for the case of the chi-square. However, this value can be explained by the influence that big samples i.e. samples with more than 400 cases, have over this index. Therefore, it is possible to state that the model has an acceptable overall goodness of fit and it is accepted.

Second, the measurement model i.e. the variables that represent each factor, shows some indices that might suggest some problems with the model. However, since no variable shows a persistent problem over different test, and most of them show at least an acceptable loading estimate the measurement model will be kept will the same variables.

Finally, in *Figure 7* the final measurement model is shown, model that is used as the input for the application of the Structural Equation Modeling (SEM) in order to test the structural model.

Figure 7: Modified Measurement Model
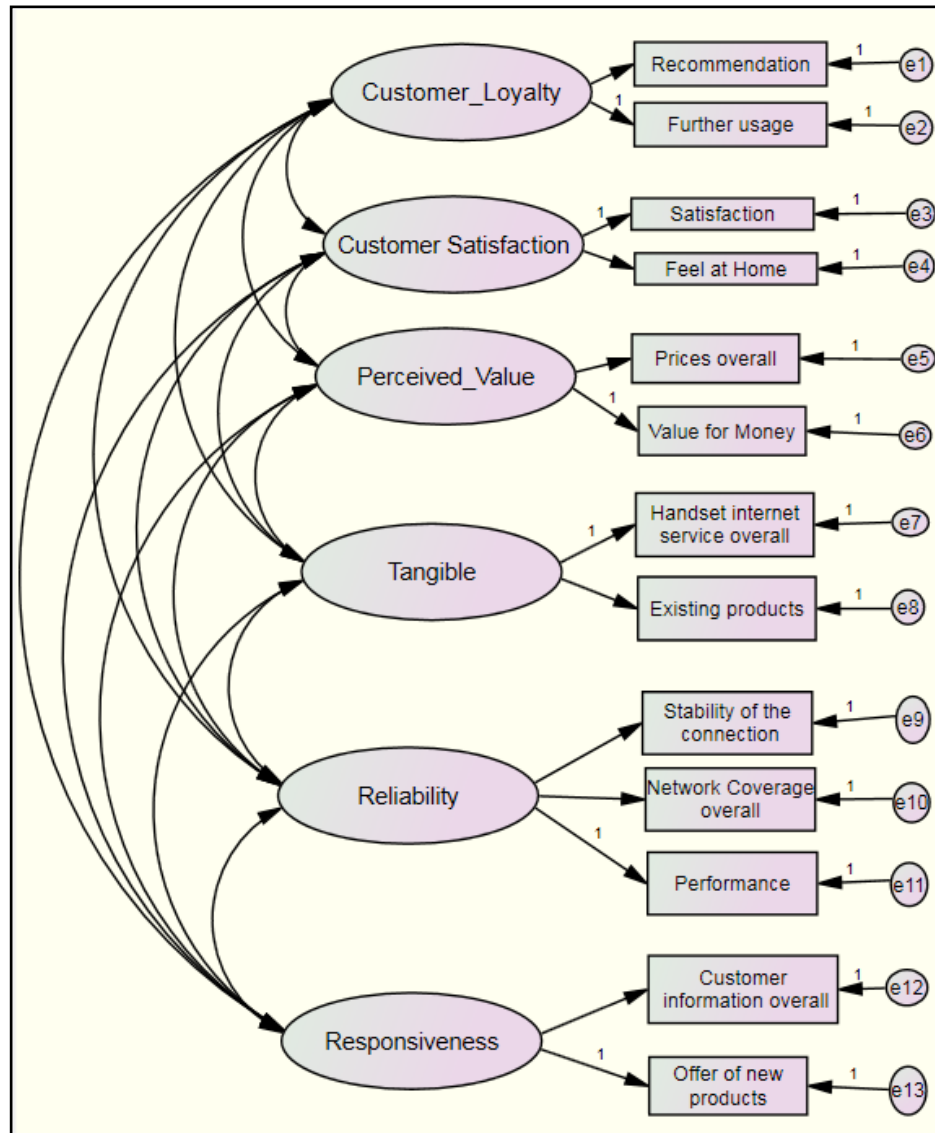
5.4 Structural Equation Modeling

Once the measurement model was tested and analyzed, and a final modified model was obtained, the analysis continued with the structural model. As previously mentioned, a structural model tests the dependency relationships of the factors show in a model. The relationships that are proposed are based on the existing theory on customer satisfaction and customer loyalty. The proposed structural model is shown in *Figure 8.*

As it is possible to observe, the structural model is based on the proposed measurement model. In the structural model the covariances between the constructs were replaced with the structure proposed in the initial model. This structure is based on theory and its analysis, which will determine if the model is

accepted or rejected, is of main interest in this research. For this purpose, the structural model was analyzed again, and the results are shown next.

Figure 8: Structural Model
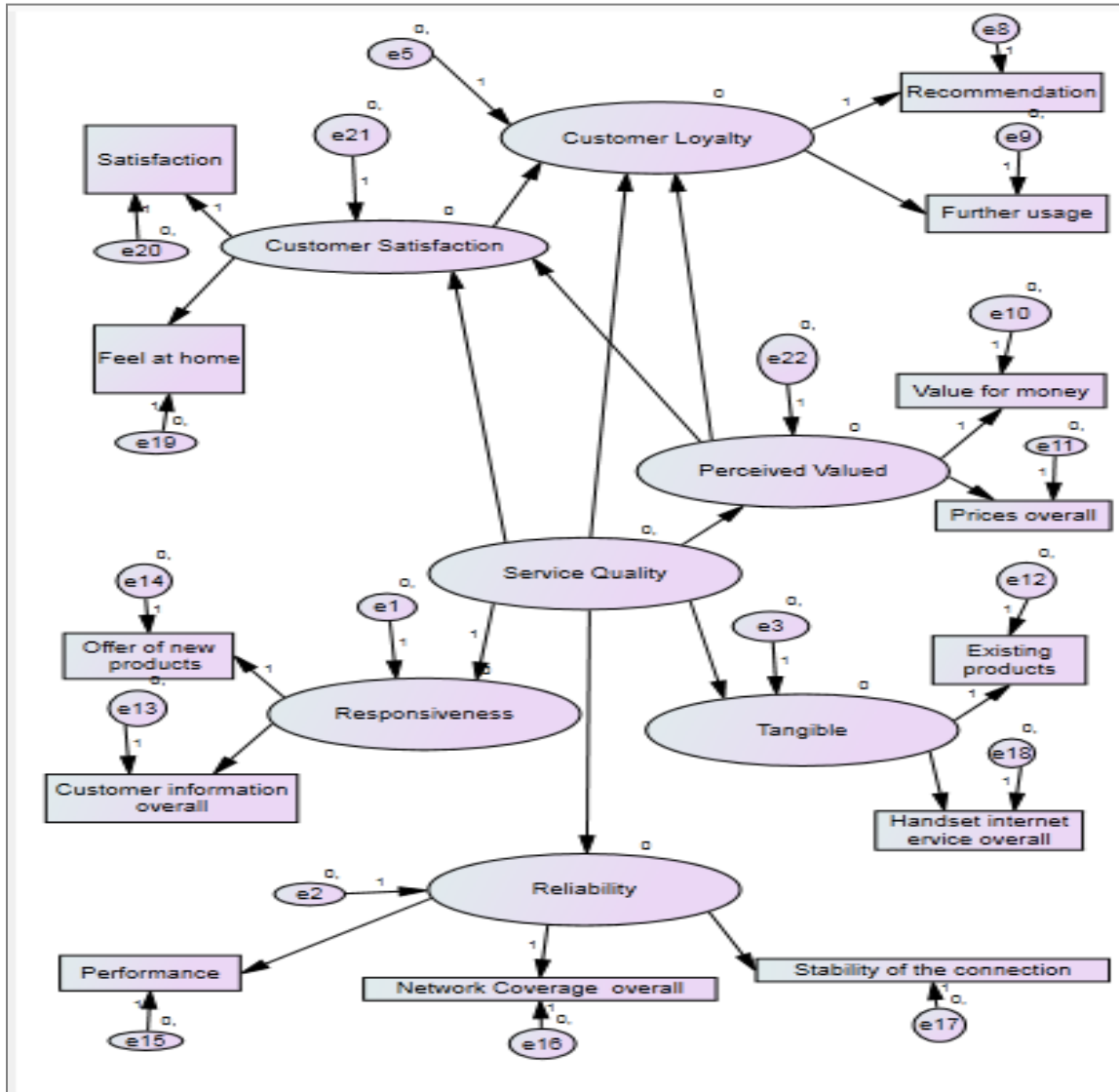
5.4.1   Model Validity

5.4.1.1 Overall Goodness of fitness

The first step is to determine the overall fit of the model. For the analysis of the goodness of fit indices shown in *Table 18* the same cut-off values used in the previous section will be applied. The first index of fitness, the overall X^2, shows a value of 100.257 with 56 grades of freedom. The p-value is significant with a value of .000, thus the X^2 does not indicate a good fitness for the proposed model. The root mean of square error of approximation (RMSEA) has a value of .038 lower than .07, thus it meets the rule. The interval for the RMSEA is between 0.026 and 0.050, showing that even the upper bound meets the rule. Next, the normed chi-square is examined, which shows a value 1.79, that is lower than 2.00, thus it can be

considered good. Therefore, RMSEA and normed chi-square, as absolute fit measures, provide support for the model fit.

Table 18: Overall Goodness of Fit Indices

Chi-square ($X^{2)}$)
Chi-square = 100.257 (p = .000)
Degrees of freedom = 56
Absolute Fit of Measure
Root Mean Square Error of Approximation (RMSEA) = .038
90 percent confidence interval for RMSEA = (0.026;0.050)
Normed chi-square = 1.79
Incremental Fir Indices
Incremental Fit Index (IFI) = .908
Comparative Fit Index (CFI) = .903

In the case of the incremental fit indices, the CFI shows a value of .903 higher than .90, thus meeting the rule for this index. Additionally, the Incremental Fit Index (IFI) shows a value of .908, higher than .90, supporting the model as well.

As it is possible to see, there is at least one absolute fit index and on incremental fit index that support the model fit. However, the most fundamental fit index, the chi-square, does not provide support for the model. In this case it should be considered the size of the sample, since a big sample can make complicate for the chi-square to achieve a non-significance level. Therefore, so far, it can be conclude that the model shows an acceptable goodness of fit.

5.4.1.2 Factor Loadings

After the overall goodness of fit of the model was assessed in the previous section, the goodness of fit of the factors is analyzed in this section.

The first assessment to test the structural equation is that the factor loadings should not vary substantially from the factors loadings obtained in the CFA. In *Table 19* it is possible to see that only small fluctuations are present (less than .05) which are considered acceptable. Additionally, all the factors show path loadings higher than .3 and significance at p<0.05, thus the path loadings can be accepted.

Table 19: Factor Loadings for the Structural Model

Constructs			Estimate	P
Perceived_Valued	←	Service_Quality	0.784	***
Customer_Satisfaction	←	Service_Quality	0.160	***
Customer_Loyalty	←	Service_Quality	0.833	***
Responsiveness	←	Service_Quality	0.554	***
Tangible	←	Service_Quality	0.973	***
Reliability	←	Service_Quality	0.926	***
Customer_Loyalty	←	Perceived_Valued	0.178	0.002
Customer_Satisfaction	←	Perceived_Valued	0.230	0.049
Prices Overall	←	Perceived_Valued	0.793	***
Value for Money	←	Perceived_Valued	0.583	***
Offer of New Products	←	Responsiveness	0.691	***
Customer Information Overall	←	Responsiveness	0.648	***
Network Coverage Overall	←	Reliability	0.752	***
Performance	←	Reliability	0.748	***
Stability of the connection	←	Reliability	0.671	***
Existing Products	←	Tangible	0.715	***
Handset Internet Overall	←	Tangible	0.580	***
Further Usage	←	Customer_Loyalty	0.837	***
Recommendation	←	Customer_Loyalty	0.647	***
Feel at Home	←	Customer_Satisfaction	0.526	***
Satisfaction	←	Customer_Satisfaction	0.977	***
Customer_Loyalty	←	Customer_Satisfaction	0.196	0.027

The analysis of standardized residuals did not show values higher than 2.5, so no actions were needed. In the case of the modification indices, just one value higher was higher than 4 as shown in *Table 20*. However, since the introduction of this modification was not supported by theory and the improvement of the model was just of .079 no action are taken.

Table 20: Modification Indices for the Structural Model

Variables			M.I.	Par Change
Existing Products	←	Value for Money	4.687	.060

So far, the results of the analysis applied showed that the model can be accepted. However, the last step in order to determine if the model is accepted or rejected is to compare it with other models. According to theory, there must be at least another model that fits as well as the proposed model. Even more, with complex model, as the one proposed in this research, the probability of finding other models increases. In order to carry on this comparison, the proposed model was compared with the measurement model. In the next section, this comparison is discussed and the results are shown.
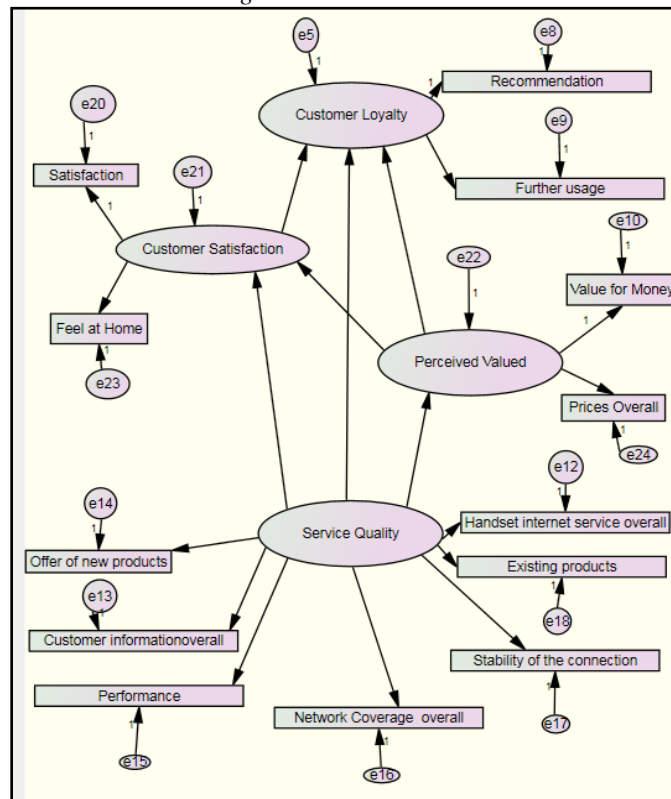
5.4.2   Model Comparison

The objective of comparing the proposed model with another model is determine if the proposed model not only has an acceptable fit, but performs better than the alternative model as well. In order to compare the two models the $X^2 difference\ test$ was applied. This test allows to decide whether a proposed model fits better or not than a competing model. The only assumption needed to apply this test is that the models are nested i.e. one of the models can be obtained simply by fixing/eliminating parameters from the other model (Werner & Schermelleh-Engel, 2010). The comparison of models can be achieved by assessing the differences of values that each model shows in X^2 values.

The first comparison was made with the measurement model. The chi square for the structural model is 100.257 (D$f(56)$) and the chi square for the measurement model is 90.370 (D$f(56)$), thus the chi square difference (ΔX^2) is 9.887 and $\Delta df\ is\ 6$. According to these results, the ΔX^2 is insignificant at the 0.5 level, thus meaning that constraining the measurement model in order to obtain the structural model does not worsen the fit of the model. Therefore, the comparison of the measurement model with the structural model by using the $X^2 difference\ test,$ provides supporting evidence for the proposed model in this research based on theory.

Figure 9: Nested Model

For the second model comparison a nested model was formed on base of the proposed structural model. For this purpose the different dimensions of service quality were removed, leaving that the variables load directly on service quality. This B model can be observed in *Figure 9*. The results for the model B are chi square of 149.029 with 59 degree of freedom, thus the chi square difference (ΔX^2) is 48.77 and the $\Delta df\ is\ 3.$ According to these results, the ΔX^2 is significant at the 0.5 level, thus meaning that less constrained

model B significantly worsen the fit of the model. Therefore, it is possible to conclude that the structural model provides a better fit.

Conclusions

To conclude, it is possible to observe that the initial model was improved by the application of the exploratory factor analysis. Next, the proposed model was analyzed in two parts. First, the measurement model was assessed through the application of Confirmatory Factor Analysis, and then the structural model was tested through the application of Structural Equation Modelling. As a result of the analysis and the comparison of models, it is possible to accept the proposed model as a good model to track and measure customer satisfaction with mobile data services.

5.4.3 Results Analysis

As it is possible to observe in *Figure 10*, the relationships between service quality, perceived value, customer satisfaction and customer loyalty were positive and significant, thus supporting the proposed hypotheses for this thesis. Following the initial proposed model is shown including the results of the tests applied.

Figure 10: Proposed Model including tests results
* p<0.05;***p<0.001
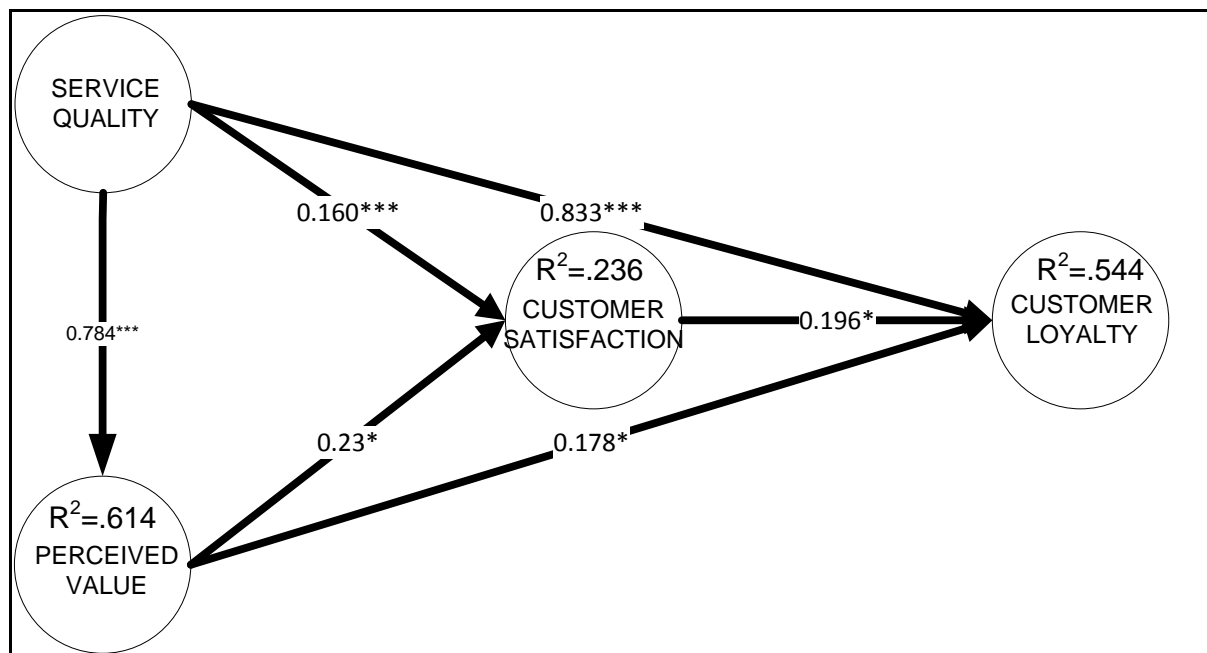
As was initially proposed, customer satisfaction is positively influenced by service quality (0.160) and perceived value (0.23), thus showing that improving the service quality and value of the mobile data services will lead to customer satisfaction. At the same time, it was confirmed that customer loyalty is positively influenced by customer satisfaction (0.196), service quality (0.833) and perceived value (0.178). These results confirm the findings of other research studies *(Kuo et al., 2009; Lai et al., 2008; Turel & Serenko, 2006)*. Among these results, the service quality showed to have a stronger direct effect

on customer loyalty than perceived value and customer satisfaction, and a stronger effect on customer satisfaction than perceived value. The results of indirect and direct effects are shown in *Table 21*

Table 21: Indirect & Direct Effects

	Direct	Indirect	Total
Perceived Value	0.178	0.22	0.40
Service Quality	0.833	1.04	1.87
Customer Satisfaction	0.196	0	0.20

5.5 MultiGroup Analysis

Once the analysis of the proposed model was finished and support for the main effects were found, the research continues by applying multigroup analysis over the model. For this purpose, a number of moderator variables were selected in order to gain further insights. The selection of the moderator variables is based on moderator variables used in previous research studies. The moderator variables used for the multigroup analysis are age, gender, income, technology orientation, use of mobile internet and the MNO that provides the service. The frequency values for each variable can be seen in *Appendix E*. A more complete description of the selected moderator variables can be seen in *Theoretical Framework (Chapter 2)*

The multigroup analysis starts with the assessment of the model goodness of fitness for all the proposed groups. The result showed that all the groups showed an acceptable fitness, the results can be seen in *Appendix F*: . To continue with the analysis, the configural invariance and the metric invariance of the measurement model were assessed for each group. According to (Jr et al., 2010) at least partial invariance is needed in order to assure that the differences seen in the structural model truly represent a differing structural relationship and are not due to a group idiosyncrasy. The configural invariance was assessed by using the same model for all the groups, thus confirming that all groups have the same number of constructs and items associated with each construct.

In order to determine the metric invariance the difference between a *Totally Free Group Model (TF)* was compared against a constrained group. The groups formed by all the moderator variables showed full metric invariance, except the KPN group. However, as was mentioned before, if full invariance is not achieved, the partial variance is sufficient. The partial invariance for the groups formed by KPN and T-Mobile customers, was achieved by removing the constraint on the factor *Reliability*. The results of the invariance analysis can be seen in *Appendix F:*

Once the requirements of configural and metric invariance were met, the multigroup analysis continued by analyzing the structural group differences. For this purpose, the chi square difference (ΔX^2) for each moderator variable was calculated over the structural model. The assessment of the ΔX^2 allows testing the null hypothesis that the moderator variable does not have any effect on the structural model. In order to assess the chi square difference a constrained model is compared with a model that is free to vary (Jr et al., 2010). The multigroup analysis for the first four moderator variables namely age, gender, income and attitude towards technology was conducted over the sample composed only by the customers of T-Mobile. The sample of KPN customers was used only for the analysis of the last moderator variable.

In *Table 22* the results for the chi square differences of the structural model for the groups formed by each one of the moderator variables are shown. As it is possible to see, the null hypothesis was rejected for all the moderator variables, since the comparison of all the groups formed by the moderator variables showed significant differences at the 0.05 level.

Table 22: Moderator Variables Results
* Chi square is significant at the 0.05 level

Moderator Variable	ΔX^2 (ΔDf =15)
Gender	37.02*
Age	40.18*
Income	44.66*
Attitude Towards Technology	41.19*
MNO	123.295*

Once it was proven that each moderator variables has a significant effect on the model, an analysis was done over the effect of the moderator variables on each of the relationships in the model.

5.5.1 Gender

The group differences between male and females were found significant (ΔX^2 (Df =15) =37.02*).

Table 23: Results of MultiGroup Analysis for Gender

Path	Female	Male	Chi-Square Difference (ΔDf =1)
CS->CL	.109	.123	ΔX^2 = 2.24
PV->CL	.252	.163	ΔX^2 = 4.25*
PV->CS	.205	.229	ΔX^2 = 0.04
SQ->CL	.849	.800	ΔX^2 = 7.29*
SQ->CS	.105	.138	ΔX^2 = 0.317
SQ->PV	.605	.785	ΔX^2 = 0.036

From the analysis of each relationship in the model, it was found that two relationships are different at a significant level. In *Table 23* it possible to see that the effects of perceived value and service quality on customer loyalty are higher for female than males.

5.5.2 Age

In order to assess the moderator effect of age, the customers were split into two groups, namely old and younger. The *young* group includes customers from 18 to 34 years old and the group *old* includes the customers that are equal or more than 35 years old. The split is based on the work done by (Hanzaee & Andervazh, 2012). Additionally, the group differences between old and young were found significant (ΔX^2 (Df =15) =40.18*).

In *Table 24* it is possible observe that the relationship of service quality on perceived value shows a significant difference when comparing groups based on the customer age. The service quality has a higher effect on the perceived value for customer in the group *old* than for customers in the group *young*.

Table 24: Results of MultiGroup Analysis for Age

Path	Young	Old	Chi-Square Difference ($\Delta Df = 1$)
CS->CL	.161	.199	$\Delta X^2 = 0.274$
PV->CL	.242	.099	$\Delta X^2 = 0.4$
PV->CS	.174	.263	$\Delta X^2 = 1.152$
SQ->CL	.816	.876	$\Delta X^2 = 0.067$
SQ->CS	.229	.154	$\Delta X^2 = 0.932$
SQ->PV	.694	.829	$\Delta X^2 = 9.6*$

5.5.3 Income

The next moderator variable to be analyzed is the income of the customers. Two groups were created for this purpose, customer with a higher income i.e. average household disposable income higher than Euro 36000, and low income i.e. average household disposable income equal or lower than Euro 36000. The split of income was done on the base of the average household income for the Netherlands (OECD) The group differences between high and low income were found significantt ($\Delta X^2 (Df = 15) = 44.66*$).

Table 25: Results of MultiGroup Analysis for Income

Path	Low-Medium	High	Chi-Square Difference ($\Delta Df = 1$)
CS->CL	.178	.170	$\Delta X^2 = 2.44$
PV->CL	.195	.165	$\Delta X^2 = 0.119$
PV->CS	.337	.335	$\Delta X^2 = 0.042$
SQ->CL	.697	.842	$\Delta X^2 = 6.46*$
SQ->CS	.030	.058	$\Delta X^2 = 1.26$
SQ->PV	.707	.844	$\Delta X^2 = 5.18*$

From the analysis of the differences for each relationship in the model, it is possible to observe that the effect of service quality on customer loyalty and on perceived value shows a significant difference for groups. For customers with high income the service quality has a greater effect on the achievement of customer loyalty and perceived value than for customer with low income.

5.5.4 Attitude towards technology

The customers' attitude towards technology was split into two groups. The first group includes all the customers that are prone or like to use new technology, and the second group includes all the customers that use proven technology. The group differences were found significant ($\Delta X^2 (Df = 15) = 41.19*$).

Path	New Technology	Proven Technology	Chi-Square Difference ($\Delta Df =1$)
CS->CL	.144	.138	$\Delta X^2 = 1.28$
PV->CL	.038	.046	$\Delta X^2 = 0.45$
PV->CS	.371	.312	$\Delta X^2 = 4.08$ *
SQ->CL	.790	.702	$\Delta X^2 = 28.7$ *
SQ->CS	.297	.200	$\Delta X^2 = 2.8$ *
SQ->PV	.828	.709	$\Delta X^2 = 0.75$

As it is possible to see in *Table 26*, significant differences were found for perceived value over customer satisfaction, and service quality over customer loyalty and customer satisfaction. The perceived value and service quality shows a higher effect on customer satisfaction and customer loyalty for customers prone to use new technology than for customer that use proven technology.

5.5.5 Mobile Network Operator

The KPN group was formed by applying the same filters to the data, namely post paid customers that have used mobile internet in the past 6 months. However, in this case the selected observations correspond to customer of the MNO KPN. In *Table 27* the results of the multigroup analysis for T-Mobile and KPN are shown.

Table 27: Results of MultiGroup Analysis for KPN and T-Mobile

Path	T-Mobile	KPN	Chi-Square Difference ($\Delta Df =1$)
CS -> CL	.180	.128	$\Delta X^2 = 7.88$*
PV -> CL	.190	.255	$\Delta X^2 = 1.436$
PV -> CS	.022	.081	$\Delta X^2 = 2.173$
SQ -> CL	.821	.453	$\Delta X^2 = 1.065$
SQ -> CS	.340	.522	$\Delta X^2 = 5.249$*
SQ -> PV	.730	.169	$\Delta X^2 = 2.165$

As it is possible to see, the groups formed by the customer of KPN and T-Mobile show a significant difference. The difference of relationship of customer satisfaction on customer loyalty was found significant, showing a higher effect for T-Mobile than for KPN. In the case of the relationship of service quality on customer satisfaction, the other relationship with a significant difference in the model, it was found that for KPN this relationship has a higher effect than for T-Mobile.

Chapter 6   Conclusions and Recommendations

In previous chapters of this thesis, an analysis on customer data of T-Mobile has been developed. As a result, a model to track and measure customer satisfaction and customer loyalty with mobile data services has been proposed. Through this final chapter, the main findings, limitations and opportunities for future research discovered during this analysis are discussed. The chapter starts describing the main findings and comparing them with the existing literature on customer satisfaction with mobile services. Then, the research questions are used to describe the limitations and recommendations of the analysis. Finally, the chapter concludes by discussing the practical and theoretical relevance of the research, and presenting a reflection over the work done.

6.1 Main Findings

As a result of the conducted research, this thesis proposes a model to track and measure customer satisfaction with mobile data services. The proposed model has been examined through the application of three statistic techniques, namely Exploratory Factor Analysis, Confirmatory Factor Analysis and Structural Equation Modeling. The statistical analysis was conducted in two phases. In the first phase, the application of Exploratory Factor Analysis and Confirmatory Factor Analysis allowed the definition and evaluation of the measurement model, while in the second phase, Structural Equation modeling was applied in order to evaluate the structural model. The final result of the analysis provides evidence that the proposed model shows adequate reliability and validity.

The application of these three statistical techniques confirms the proposed relationships between the four factors in the model, namely service quality, perceived value, customer satisfaction and customer loyalty. Additionally, the application of Factor Analysis enabled to re-define the model according to the available customer data of T-Mobile. As a result, the initial five dimensions of Service Quality were reduced to three, namely responsiveness, reliability and tangible. These main findings are discussed through the next section.

6.1.1   The role of customer satisfaction

As previously mentioned, the application of the three statistical techniques over the customer data of T-Mobile, confirms the initial proposed relationships between the factors in the model. It is shown that service quality and perceived value have positive influence on customer satisfaction, and, at the same time, customer satisfaction has a positive influence on customer loyalty. These findings corroborate the results of other research studies on customer satisfaction and customer loyalty with mobile services(Kuo et al., 2009; Torsten J. Gerpott, 2001).The confirmation of these relationships is an indication that, as the same as with customers of mobile services in general, customers of mobile data services that perceive greater service quality and value on their mobile data services, are more satisfied customers; and MNOs that have more satisfied customers have more loyal customer as well

6.1.2   Service Quality vs. Perceived Value

A comparison between the total effects of the factors in the model shows that service quality (1.87) has the greatest effect on customer loyalty, followed by perceived value (0.40) and customer satisfaction (0.2). The great effect of service quality on customer loyalty is an interesting finding of this research, since research studies on mobile services in general state that perceived value plays a more important role

on customer loyalty than service quality(Kuo et al., 2009; Lai et al., 2008). Therefore, this finding proposes a difference in the measurement model for mobile data services from the model for mobile services in general.

The greater effect of service quality on customer loyalty can be explained by two reasons. On the one hand, it can be explained by the increasing expectations of mobile service consumers on service quality. According to (Don Jyh-Fu Jeng, 2012) consumers increase the use of intensive mobile data solution in the same extent they increase their knowledge and expertise. Therefore, in developed mobile market such the one in the Netherlands, it is expected a high use of intensive mobile data solutions. As a result, consumers increase their expectations on mobile service quality, since this service quality is needed to support the use of these intensive mobile data solutions.

On the other hand, the greater effect of service quality can be explained by a weaker effect of perceived value on customer loyalty. This weaker effect can be explained by the difficulty for MNOs to achieve differentiation in developed mobile markets. Additionally, according to (De Reuver, Bouwman, Prieto, & Visser, 2011), mobile services depend on several generic services provided by different actors, thus the perceived value by customers when using mobile servicers is attributed not only to the MNO, but to all the providers. Therefore, it is difficult for MNOs to create loyalty through perceived value.

6.1.3   The role of Service Quality

These findings are related with the dimensions that measure service quality. As a result of the analysis applied through this research, three dimensions, from the five initially proposed on base of the SERVQUAL scale, are determined as appropriated to represent service quality with mobile data services. The two dimensions not included are *Empathy and Assurance,* two dimensions related with the personal relationship between the MNO and the customers. When determining the causes for this elimination, it should be taken into account to what extent the limitations of the research, as well as the characteristics of the mobile data services had an effect on the elimination of these two dimensions. However, in a discussion on the possible causes for these eliminations is done further on.

The analysis of the remaining three dimensions of service quality allows determining the different levels of effect that each dimension has on customer loyalty. It is possible to define a two-tier structure for the dimensions of service quality, where each tier shows the relative importance of the dimension on the overall service quality. In the first tier there are the dimensions of *Tangible and Reliability* that have higher effect on the service quality, and on the second tier is *Responsiveness* that shows a lower effect.

Among the dimensions of service quality, Reliability has the highest effect on the overall service quality, followed by Tangible, and last is Responsiveness that shows the lowest effect. This rank of the effects of these three dimensions on service quality can be explained by analyzing the main characteristics of mobile services. The dimension *Reliability* includes the variables *Performance, Network Coverage and Connection Stability*, which play a critical role when providing customers access to data. In the same way, once obtained a good network quality, the next important aspects in order to obtain access to data are the *Tangibles* characteristics of the mobile device. Therefore, it can be understood that *Reliability* and *Tangible* have a higher effect on the service quality, since providing customers access to data anywhere and anytime is one of the main characteristics of mobile services (H. Bouwman et al., 2010).

6.1.4 MultiGroup Analysis

The final main findings are related with the application of multigroup analysis. As a result of the analysis conducted over five moderator variables it was possible to determine different effects on the model caused by the customer personal characteristics. The results of this thesis, which show that the proposed demographic variables namely age, gender and income, have a moderator effect, are supported by other research studies in different contexts (Serenko et al., 2006) (Harry Bouwman et al., 2008; Deng et al., 2010; Homburg & Giering, 2001; Nysveen et al., 2005).

For the first moderator variable namely age, it has been found that service quality has a greater effect on perceived value for the group of old people than for the group of young people. This shows that older people consider the service quality in greater extent when forming perceptions on the value obtained from the mobile service. This can be explained by the fact that young customers tend to make a more intense research about the service or product, thus including other issues than service quality in the definition of the perceived value (Moscovitch, 1982). Furthermore, their perception of the value may rely over the opinion of reference groups, such as friends or the sales personal, more than on the service quality of the mobile service itself (Serenko et al., 2006). Therefore, service quality has a lesser effect on the perceived value for young customers, and this finding suggests that improvement in service quality has better results on old people.

For the second moderator variable, gender, it has been found that perceived value and service quality have a greater effect on customer loyalty for women than for men. This result can be explained by two characteristics of women. Women tend to be more innovative, but, at the same time it takes longer for them to get used to new possibilities (Harry Bouwman et al., 2008). Therefore, when women are using new technologies, such as mobile internet, the effect of service quality and the perceived value have a higher effect on the achievement of their loyalty with the MNO.

In the case of the third moderator variable, income, it has been found that the effect of service quality on customer loyalty and perceived value has a higher effect for customers with high income than for customers with low income. This result can be explained by the fact that customers with high income tend to have a higher education level, thus having a greater capacity of information processing (Homburg & Giering, 2001). As a result, customers with higher income have higher expectations and are more rigorous when evaluation the service quality of a mobile data service. Additionally, the switching costs are less significant for them, thus in order to remain loyal with a MNO, the service quality plays a more important role for them than for customers with lower income.

For the fourth variable, attitude towards technology, it has been found that the effect of service quality on customer satisfaction and customer loyalty, and the effect of perceived value on customer satisfaction are higher for customers prone to use new technology than for customers that prefer to use proven technology. The results for the perceived value on customer satisfaction, it can be explained for the fact that customers prone to use new technologies take the risk of using new technology that has not been proven yet because of the benefits or value they can obtain from this new technology. Thus, the value these customers perceive in a mobile service has a higher effect on their satisfaction. On the other hand, the effect of service quality on customer satisfaction and customer loyalty can be seen as being lower for customers that use proven technology. Customers that use proven technology usually have an aversion to change, thus they tend to remain with the same MNO, independently of the service quality provided.

The final moderator variable included was the provider of the mobile data service, namely mobile internet. The comparison between customers of KPN and T-Mobile showed that the effect of customer satisfaction on customer loyalty was greater for T-Mobile than for KPN, and the effect of service quality on customer satisfaction is greater for KPN than for T-Mobile. The explanation for the differences between these two MNO requires a deep analysis for KPN, which is out of the scope of this thesis. However, by doing a general review of the strategies of both MNO, it is possible to suggest some causes. On one hand, KPN follows a differentiation strategy in order to increase its penetration in the business market (Gerritz, 2009), thus it aims to provide premium services to its customers. Therefore, KPN customers have higher expectations about the quality of the services provided by KPN. On the other hand, the lower effect of service quality on customer satisfaction for T-Mobile customers might be explained by the fact that one of the biggest customer segments of T-Mobile uses smartphones from the brand iPhone. The iPhone users show a strong loyalty towards Apple and iPphone, thus the user-experience is more related with the handset than with the MNO, in this case T-Mobile.

6.2 Recommendations and Limitations

Once the main findings were stated, the Conclusions Chapter follows by answering the initial research

- *What are the company level factors that lead to customer satisfaction, and what is their importance in the overall customer experience?*

As it is possible to observe, the analysis results help MNOs to improve the understanding of the factors that lead to customer satisfaction and customer loyalty. Part of the results reinforces the results found by other research studies, while others are new for this area. The main findings of the thesis show that customer satisfaction is important in order to obtain the loyalty of customers. Additionally, it is shown that service quality and perceived value play an important role to achieve customer loyalty either directly or indirectly through customer satisfaction. Among the both factors, service quality showed a higher effect. Therefore, MNOs should focus on improving service quality and perceived value as a strategy to achieve customer satisfaction and customer loyalty.

Therefore, MNOs should focus on the improvement of customer satisfaction as an adequate strategy to achieve customer loyalty. The results of the thesis show that satisfied customer are very likely to become loyal customers, and good service quality on the mobile services leads to satisfied customers. Additionally, it is shown that among the service quality dimensions, *Reliability* has the highest effect on the overall service quality, therefore, MNOs should focus their efforts to provide reliable network coverage and stable connections.

However, when analyzing the results of this thesis, it is important to consider its limitations as well. This thesis focuses on the analysis of company level factors in order to measure and track customer satisfaction, thus excluding market. Therefore, it will be interesting to see future research studies on customer satisfaction for mobile data services including market factors, such as attractiveness of the competitors' offers..

- *How can these factors be operationalized in order to track and measure customer satisfaction for mobile network operators?*

The result of this thesis shows a proposed model that operationalizes the factors that lead to customer satisfaction. The operationalization was done on basis of the existing theory and previous research studies on this topic and, at the same time, was determined by the available customer data. Customer satisfaction was measured as the overall satisfaction of customer towards the MNO; customer loyalty was measured through the willingness to recommend the MNO, and further use of the services; service quality uses the SERVQUAL measurement scale; and perceived value was measured by the value customers obtain for the money.

In final operationalization of the factor *service quality*, from the initial five dimensions only three were kept. The elimination of these two dimensions can be due to two reasons. On the one hand, the SERVQUAL scale is mostly relevant for the four services included in the original study, thus it might need some adjustment for other kind of services, as noted by (Parasuraman et al., 1988). Therefore, an appropriate adaptation of the SERVQUAL scale, as the one proposed in this thesis, might be needed in order to measure service quality for mobile data services.

On the other hand, the elimination of these two dimensions was due to a limitation of this research. As it was previously mentioned, the customer data used for this research comes from a secondary source. Even though, the use of secondary data has the advantage of providing a relative big sample size, it has the drawback of not meeting the specific needs of this research and the control over how this data is collected is lost. Therefore, when determining the reasons of the elimination of the two dimensions, and during the whole analysis, this limitation should be considered.

- *What systems, among the ones currently used by companies to gather customer data, can be used for the proposed customer satisfaction model?*

The initial goal of this thesis was the use of customer data gathered by different systems of T-Mobile for the evaluation of the proposed model. To achieve this goal, two systems were studied and analyzed in order to determine an appropriate method to integrate the data. These two systems were selected because each of them gathers different data about T-Mobile. The first system was the ResponseTek that collects information about the customer experience each time a customer contacts T-Mobile in order to obtain information, support or complain about a problem. The second system was the TRI*M system that, as described in *Chapter 4 Methodology*, send questionnaires to randomly chosen customers in order to assess their overall experience with T-Mobile services.

Even though, many different approaches were tested in an effort to integrate the data from the two systems, the matches of customers between systems were too few, thus it was not possible to conduct the analysis with the resulting sample. Therefore, it was determined that the solution, in order to continue with the research, was to use only on system. In order to decide which system to use, the two systems were analyzed to determine the most adequate to conduct the analysis. During this analysis, the ResponseTek system showed to have limited customer data that, without being combined with data from the TRI*M system, was not sufficient to conduct the analysis. Therefore, the TRI*M system was selected to evaluate the proposed customer satisfaction model.

Although the integration of customer data was not possible, following a recommendation is provided on how this integration can be achieved.

As it was previously mentioned, the TRI*M system send questionnaires to randomly chosen customers. However, in order to make possible the integration of these two systems, the TRI*M should collect data about customer experience not only randomly but also including some of the customers that have had contact with the support system. In this way, it will be possible to achieve a data integration with the ResponsTek system, that will enable the analysis of the effect that the complaint management has on customer loyalty.

- *How can the model's effectiveness be evaluated by using the customer data gathered?*

The effectiveness of the proposed model was evaluated by the application of statistics techniques. To start, the application of *factor analysis* enabled the extraction of the most representative items for each factor from the available variables. This selection was achieved by combining the existing measurement models in the literature with the available customer data of T-Mobile. In a first phase, the application of exploratory factor analysis, allowed determining how the available variables were correlated and which were more appropriated for the research. In the next phases, the application of confirmatory factor analysis and structural equation modeling allowed assessing the validity and reliability of the measurement and structural proposed model.

At this point, it should be noted that in this thesis a cross-section study was conducted, thus it is not possible to determine cause and effect of the proposed variables. In order to determine the causality a longitudinal study is required.

- *What is the link between the proposed model and the existing customer loyalty indexes of companies?*

The proposed model and the customer loyalty index of T-Mobile present a first link, since the model was developed by using the customer data gathered through this customer index. However, the model proposed, as well as the result of this thesis show that some improvements are possible for the customer loyalty index. Besides of the measurement of customer loyalty, some changes in the process of gathering customer data can allow the use of information generated by different systems of T-Mobile in the customer loyalty index, as explained previously. Additionally, the proposed analysis shows that the customer loyalty index can be used discover specific characteristics of the model of customer satisfaction and customer loyalty for customers of T-Mobile.

6.3 Theoretical Relevance

This thesis makes a contribution to the existing literature on customer satisfaction and customer loyalty because these two concepts are specifically studied in the context of mobile data services. Research on customer satisfaction and customer loyalty has been widely conducted since many years ago. These research studies were first conducted over tangible products, then on intangible services, to continue the study of these two concepts on specific industries and contexts. One of the contexts that got the attention lately is the one of mobile services because of its rapid growth in recent years. However, in order to provide comprehensive and adequate research on this context, the increasing use of mobile data services over mobile voice services should be taken into account.

Even though, a number of research studies on customer satisfaction and customer loyalty with mobile services have been conducted, this thesis is one of the first attempts to study customer satisfaction and customer loyalty on the context of mobile data services. In this way, this thesis provides insights on the

factors that lead to customer satisfaction and customer loyalty with mobile data services, their importance in the achievement of these two concepts and the differences from a mobile voice service context. Contrary to the findings of a number of research studies on customer satisfaction and customer loyalty with mobile voice services (Kuo et al., 2009; Lai et al., 2008; Liu et al., 2011) the results of this thesis show that the effect of service quality on customer loyalty is not only indirect through customer satisfaction but also direct in the context of mobile data services, in this case represented by mobile internet.

Additionally, this research includes the analysis of the customer individual characteristics, namely age, gender, income and attitude towards technology, in order to determine their moderator effect on the customer satisfaction model. In this way, this thesis provides answer to calls raised by (Kuo et al., 2009; Moon-Koo Kima, 2004; Torsten J. Gerpott, 2001) to include moderator variables in the study of customer satisfaction with mobile services. Through the application of multigroup analysis, it was possible to determine significant differences in the customer satisfaction model for each of the moderator variables. These results show that the customer satisfaction and the customer loyalty are not only affected by psychological or behavioral factors, such as perceived value and service quality, but also by personal characteristics of the customers. The results of this thesis showed that the groups formed by women, old people, customers with high income and customer prone to use new technology show higher effects on the relationships proposed in the model. Therefore, this thesis shows that future studies should consider customer satisfaction and customer loyalty as a complex concept.

Finally, this thesis makes a contribution to theory by testing the moderator effect that the MNO that provides the mobile service has on the customer satisfaction model. The results obtained show that significant differences are present between the two MNOs selected for the study, namely T-Mobile and KPN, thus providing support for the assertion that the company strategy might have an effect on the proposed relationships in the model. Even though, this conclusion confirms the results of research studies on customer satisfaction in other industries (Miles), it is the first in the context of mobile services. Therefore, it provides a baseline for future research on the effect that image and expectations created by the MNO's strategy have on customer loyalty and customer satisfaction.

To conclude, this thesis makes a contribution to theory, since it exposes the relevance of conducting research studies focused on mobile data service. It is shown that future research on the customer satisfaction and customer loyalty with mobile data services is worthwhile. The future research could include the study of market factors in the model, such as the alternative attractiveness, switching costs, trust and image. Additionally, future research could include the study of other moderator variables proposed in the literature such as contract duration, type of handset used and education level (Eshghi et al., 2007; Kim & Yoon, 2004; Torsten J. Gerpott, 2001)

6.4 Practical Relevance

Prior to this research study, there was little knowledge about the differences between how to obtain customer satisfaction with mobile voice services and with mobile data services. This situation mainly because, most of the research studies conducted for mobile services do not make a difference between the customer experience with voice-calling and with mobile data services. Even more, in many of these research studies, the customer experience with voice-calling plays a more important role than the experience when using mobile internet or other kind of mobile data service. Therefore, the knowledge and

understanding about how to achieve customer satisfaction is more applicable for the experience with voice-calling than for the experience with mobile internet.

On the other hand, in developed and saturated mobile markets, as the market of the Netherlands, where MNOs are focusing on customer loyalty and mobile data services are increasing their importance rapidly, the measurement and track of customer satisfaction with mobile data services is becoming critical. However, as a consequence of this lack of research studies on mobile data services, MNOs base their strategies on the research studies of customer satisfaction on mobile services in general, thus assuming that what is adequate for mobile voice services is adequate for mobile data services.

Nevertheless, the result of this thesis shows that some differences exist between the achievement of satisfaction with a customer that uses the voice-calling service and a customer that uses mobile internet. Therefore, it is possible to give some practical advice to MNOs. Firstly, MNO should pay more attention to the question of which type of mobile services are core for its business, and according to this decision implement adequate strategies. If the mobile data services, like mobile internet, are more important, as in the case of T-Mobile, the MNOs should focus their strategies on improving the service quality. It is advisable to focus on service quality because, as it is shown by this thesis, service quality not only has an effect on customer loyalty through customer satisfaction, but also has a strong direct effect on customer loyalty.

Secondly, according to the results of this thesis, the most important dimension of the service quality is the reliability of the service. Therefore, MNOs should focus on providing a *reliable* service by providing adequate network coverage and stable connection that helps to improve the performance of the mobile internet service. Next, MNOs should focus on improving the tangible characteristics of the products and the responsiveness toward their customers.

Thirdly, MNOs should take care of the value their customers perceive on the mobile service. In this case, the results of this thesis show that the variable value for money has a higher effect than the performance of mobile prices on the customer perceived value. Therefore, MNOs should consider that providing value-added for their customers leads to more satisfied customers than only providing lower mobile prices.

Finally, the main advice for MNOs is that they should consider that some of the characteristics and behaviors of mobile voice services might not be the same for mobile data services. Therefore, the strategies implemented in order to achieve customer satisfaction and customer loyalty with mobile data services should reflect these differences. This thesis provides an initial step to determine these differences, however further research needs to be done in order to extend the knowledge and understanding of this type of mobile services.

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Appendices

Appendix A: *List of Articles used for the Network Approach.*

In the following table the bibliographic information of the articles used for the network approach towards literature review are listed

#	Authors	Article Title	Year
1	Turel, O., & Serenko, A	Satisfaction with mobile services in Canada: An empirical investigation	2006
2	Kuo, Y.-F., Wu, C.-M., & Deng, W.-J.	The relationships among service quality, perceived value, customer satisfaction, and post-purchase intention in mobile value-added services.	2009
3	Lai, F., Griffin, M., & Babin, B. J	How quality, value, image, and satisfaction create loyalty at a Chinese telecom	2008
4	Liu, C.-T., Guo, Y. M., & Lee, C.-H	The effects of relationship quality and switching barriers on customer loyalty	2011
5	Moon-Koo Kima, M.-C. P, Dong-Heon Jeong	The effects of customer satisfaction and switching barrier on customer loyalty in Korean mobile telecommunication services	2012
6	Torsten J. Gerpott, W. R., Andreas Schindler	Customer retention, loyalty, and satisfaction in the German mobile cellular telecommunications market	2001
7	Ali Turkyılmaz, C. O.	Development of a customer satisfaction index model	2007
8	Aydin, S., & Özer, G	The analysis of antecedents of customer loyalty in the Turkish mobile telecommunication market	2005

Appendix B: *Information about variables used in Network Approach*

In the following tables the information about the variables used for the Network Approach towards literature review is provided. The information is for each article used, and the tables show if the variable was defined as independent (I) or dependent (D) and the operationalization of the variable. Additionally, information is provided about if the variable was aggregated and on which other variable.

1) *Turel, O., & Serenko, A. (2006). Satisfaction with mobile services in Canada: An empirical investigation*

Variable	Definition	I	D	Aggreg.	Operationalization
Perceived Quality	It is the served market evaluation of recent service usage experience	X	X	Service Quality	Overall evaluation of quality experience. Evaluation of how well the product fit the customer's personal requirements. Evaluation of reliability experience.
Perceived Expectations (PE)	The PE construct represents both previous service experience and forward-looking beliefs regarding a provider's ability to offer the desired quality	X			Overall expectations of the quality of mobile services. Expectations on how these mobile services would meet customers' personal requirements. Expectations on the reliability of the mobile services.
Perceived Value	It addresses the perception of quality for money	X	X		Rating of quality given price. Rating of price given quality.
Customer Satisfaction	It is the subscribers' reaction to their judgment of the state of fulfillment	X	X		Overall satisfaction. Expectancy disconfirmation (performance that falls short of or exceeds expectations). Performance versus the customer's ideal product or service in the category.
Price Tolerance	It is the probability of staying with the current provider if it increases its prices, or if competitors decrease their prices.		X		Range of how much lower the competitors' prices have to be in order to customers switch providers. Range of how much higher the provider's prices have to be in order to customer switch providers.
Repurchasing Likelihood	It is the probability of choosing the same service provider when a person acquires a new mobile phone service		X		How likely is that the customer will choose the same provider for a new mobile phone
Customer Complains (CC)	It refers a customer who voices its complaint to the firm in an effort to receive restitution	X	X		Has the customer complained either formally or informally about the product or service?

2) *Kuo, Y.-F., Wu, C.-M., & Deng, W.-J. (2009). The relationships among service quality, perceived value, customer satisfaction, and post-purchase intention in mobile value-added services.*

Variable	Definition	I	D	Aggreg.	Operationalization
Service Quality	It is the difference between customers' expectation and their perceived performance of a service	X			Content Quality. Navigation and visual design. Management and customer service. System reliability and connection quality.
Perceived Value	In this study, perceived value is the evaluation of the benefits of a product or a service by customers based on their advance sacrifices and ex-post perceived performance when they use mobile value-added service	X	X		I feel I am getting good mobile value-added services for a reasonable price. Using the value-added services provided by this telecom company is worth for me to sacrifice some time and efforts. Compared with other telecom companies, it is wise to choose this telecom company.
Customer Satisfaction	It is defined as the total consumption perception of consumers when using mobile value-added services	X	X		I am satisfied with the value-added services provided by this telecom company. I think this telecom company has successfully provided value-added services. This value-added service is better than expected
Post-Purchase Intention (PPI)	Post-purchase intention is the tendency that consumers will purchase the goods or services at the same shop and deliver their use experiences to friends and relatives		X	Customer Loyalty	In the future, I will use the value-added services provided by this telecom company again. In the future, I will recommend the value-added services provided by this telecom company to my relatives and friends. In the future, I will continue to use the value-added services provided by this telecom company.

3) *Lai, F., Griffin, M., & Babin, B. J. (2008). How quality, value, image, and satisfaction create loyalty at a Chinese telecom*

Variable	Definition	I	D	Aggreg.	Operationalization
Service Quality		X			SERVQUAL (tangible, responsiveness, reliability, assurance and empathy)
Customer Satisfaction		X	X		Satisfaction with the service and Satisfaction with the company
Perceived Value	It is a consumer's perception of the subjective worth of some activity or object considering all net benefits and costs of consumption	X	X		Service Value and Service Quality
Corporate Image	It is a perception of an organization held in consumer memory and works as filter which influences the perception of the operation of the company	X	X		Company's overall Reputation, Prestige, Brand Reputation and Reputation compared with competitors
Loyalty			X	Customer Loyalty	Intention to repurchase and willingness to recommend to others

4) *Liu, C.-T., Guo, Y. M., & Lee, C.-H. (2011). The effects of relationship quality and switching barriers on customer loyalty*

Variable	Definition	I	D	Aggreg.	Operationalization
Satisfaction	It is an overall attitude formed based on the experience after customers purchase a product or use a ser-vice	X	X	Customer Satisfaction	Satisfaction with the Service Provider. S Satisfaction with the relationship with the Service Provider. Overall satisfaction with the Service Provider
Loyalty	It is a deeply held commitment to rebuy or repatronize a preferred product/service consistently in the future		X	Customer Loyalty	Intention to stay with the carrier. Intention to recommend the carrier to others
Trust	It is that a party has confidence in the honesty and reliability of his partner	X	X		Service Provider reliability. Trustworthiness. Confidence
Switching barriers	Switching barriers are factors that make it difficult for a customer to change service providers	X			Economic loss associated with switching carriers. Psychological burden associated with switching carriers
Playfulness	Playfulness is a state that an individual experiences	X			Perceptions about enjoyment
Service Quality	Service quality is also defined as the difference between customer expectation and the perception of service quality	X			Interaction Quality. Outcome Quality
Intimacy	Intimacy is the perceived psychological closeness a customer has with the service provider	X		Interpersonal Relationship	Trust toward carrier. Intimacy felt toward carrier

5) *Moon-Koo Kima, M.-C. P., Dong-Heon Jeong. (2004). The effects of customer satisfaction and switching barrier on customer loyalty in Korean mobile telecommunication services*

Variable	Definition	I	D	Aggreg.	Operationalization
Service Quality	Service Quality is the customers' satisfaction or dissatisfaction formed by their experience of purchase and use of the service	X			Call quality, Pricing and price schedule, Mobile device functionality and design, Type and convenience of value-added services, Subscription and change procedures, Customer support system and complaint processing
Customer Satisfaction	Customer satisfaction is the customer reaction to the state of fulfillment, and customer judgment of the fulfilled state	X	X		Overall satisfaction with the carrier Overall satisfaction with the service

Switching costs	It means the cost incurred when switching, including time, money and psychological cost	X		Switching Barriers	Perception of loss in social status and performance associated with the churn of service from an existing carrier, Perception of cost of adaptation, associated with switching to a new carrier, Perception of economic cost involved in switching to a new carrier
Switching barriers	It refers to the difficulty of switching to another provider that is encountered by a customer who is dissatisfied with the existing service, or to the financial, social and psychological burden felt by a customer when switching to a new carrier	X	X		Economic and psychological difficulty perceived by customer, when switching carriers
Alternative attractiveness	It means the reputation, image and service quality of the replacing carrier, which are expected to be superior or more suitable than those of the existing carrier	X			Alternative carrier's reputation, image and service quality, according to the customer's perception
Interpersonal relationship	Interpersonal relationship means a psychological and social relationship that manifests itself as care, trust, intimacy and communication	X			Customer's perception of social and psychological rapport with carrier
Customer Loyalty	The concept of customer loyalty is understood as a combination of customers' favorable attitude and the behavior of repurchase		X		Intention to stay with the carrier Intention to recommend the carrier to others

6) *Torsten J. Gerpott, W. R., Andreas Schindler. (2001). Customer retention, loyalty, and satisfaction in the German mobile cellular telecommunications market*

Variable	Definition	I	D	Aggreg.	Operationalization
Customer Retention	It is concerned with maintaining the business relationship established between a supplier and a customer		X		Customers' intentions to terminate the contract as soon as possible
Customer Loyalty	The customer loyalty term is used when a customer may carry out subsequent transactions because she has a favorable attitude towards the provider and the services he supplies, and because he therefore wants to keep the business relationship going to their mutual benefit.	X	X		Intention to repurchase. Willingness to recommend a product to others
Customer Satisfaction	It is an experience-based assessment made by the customer of how far his own expectations about the individual characteristics or the overall functionality of the services obtained from the provider have been fulfilled	X	X		Satisfaction with mobile communication network.

Competitors Image	A customer's perception of the network operator's competitors	X		Alternative Attractiveness	Customer orientation, reliability and modernity
Network Quality	It is reflected in excellent indoor and outdoor coverage and in the clarity of voice reproduction without any connection break-downs	X		Service Quality	Overall experience of network quality. Call quality when using the network
Mobile prices	It refers to the price paid for obtaining access to and using the network;	X			Price and tariffs to get access to the network
Assessment of personal benefit	It refers to the personal benefit a customer obtains from mobile communications services	X			Personal benefits of the network for the customer

7) *Ali Turkyılmaz, C. O. (2007). Development of a customer satisfaction index model*

Variable	Definition	I	D	Aggreg.	Operationalization
Image	The image construct evaluates the underlying image of the company. Image refers to the brand name and the kind of associations customers get from the product/company	X		Corporate Image	Being reliable. being professional. social contributions to society. customer relations. innovative and forward looking. adding value to user (prestige)
Customer Expectations	Expectations are the results of prior experience with the company's products. This construct evaluates customer expectations for overall quality, for product and service quality, and for fulfillment of personal needs	X	X	Perceived Expectations (PE)	expectations for fulfillment of personal need. expectations for overall quality. expectations for product quality. expectations for service quality
Perceived Quality	PQ is the served market's evaluation of recent consumption experience	X	X		overall quality. product quality (technical). service quality. customer services. appropriateness to intent of use
Perceived Value	PV is the perceived level of product quality relative to the price paid by customers	X	X		price/performance. performance/price
Customer Satisfaction	The index indicates how much customers are satisfied, and how well their expectations are met.	X	X		overall satisfaction. fulfillment of expectations. compare with ideal
Customer Loyalty	Loyalty has been defined as a long-term commitment to repurchase involving both repeated patronage and a favorable attitude		X		repurchase intention. recommendation to others. price tolerance

8) Aydin, S., & Özer, G. (2005). The analysis of antecedents of customer loyalty in the Turkish mobile telecommunication market

Variable	Definition	I	D	Aggreg.	Operationalization
Service Quality	It is the consumer's judgment about the overall excellence or superiority of a service				Evaluation of the main services (Quality of calling area, value-added services, customer support services, the suppliers' services of the operator, and services in campaigns)
Trust	Trust occurs when one party believes that the other party's actions would result in positive outcomes for itself				reliability. ethics. service quality. and cumulative process.
Corporate Image	Corporate image is described as the overall impression made on the minds of the public about a firm				Company's stability. company's innovativeness. company's contribution to society. company's leading role. company's positive image
Switching costs	It is defined as one-time costs facing the buyer when switching from one supplier's product to another's			Switching Barriers	Perceived monetary costs. perceived uncertainty costs. perceived evaluation costs. perceived learning costs. and perceived set-up costs.
Customer Loyalty	It is defined as a deeply held commitment to rebuy or repatronize a preferred product/service consistently in the future,				Repurchase intention (next-use). Resistance to switching and willingness to recommend.

Appendix C: *Dataset of questions*

The answers were measured by using a five-point likert scale, going from negative to positive assessments.

- *Definitely not, probably not, ...Definitely.*
- *Very dissatisfied, dissatisfied,....Very Satisfied*
- *Totally disagree, Disagree,....Totally agree*
- *No advantage at all, Only slight advantage......A very big advantage*
- *Poor, Fair,...Excellent*

In the following list, the questions used in order to gather the customer data are shown. The list only shows the questions of the variables that were used for this research.

1) Willingness to Recommend: *Would you advise friends or acquaintances of yours to become a customer of T-Mobile?*
2) Repurchase Likelihood: *How likely is it that you will continue to use products and services of T-Mobile?*
3) Performance: *Looking back on your experience with T-Mobile, how would you rate T-Mobile's performance overall?*
4) Competitive Advantage: *How big is the advantage for you to use products and services of T-Mobile rather than another provider*?
5) Satisfaction: And how satisfied are you with T-Mobile overall?
6) *How much effort did you personally have to put forth to handle your requests?*
7) *To what extent do you agree with the following statements?*
    a. *I feel appreciated by T-Mobile*
    b. *I feel at home at T-Mobile*
    c. *I'm positively surprised by T-Mobile*
    d. *Company Rewards Loyal Customers*
8) *How would you rate T-Mobile's performance regarding:*
    a. *Value for Money*
    b. *Prices Overall*
    c. *Tariffs Overall*
    d. *Handset Internet Overall*
    e. *Handset Upgrade*
    f. *Handset Overall*
    g. *Transparent Tariff Structure*
    h. *Performance of Existing Products*
    i. *Customer service Overall*
    j. *Customer information overall*
    k. *Performance of support channels*
    l. *Loyalty program overall*
    m. *Customer Centric Approach*
    n. *Offer of new Products*
    o. *Network Coverage Overall*
9) *How would you rate the mobile internet service regarding [aspect]?*
    a. *Speed of mobile internet connection*
    b. *Stability of the connection*

Appendix D: *Normality Tests*

One of the assumptions in order to apply the Factor Analysis and SEM techniques is the data has a multivariate normal distribution. In order to tests the normal distribution of the data, the first step was to assess the univariate normality of each variable. An analysis of the skewness and kurtosis of the variables shows that all the variables have a significant level at .5. Therefore, the data has a no-normal distribution. The next step is to determine the level of the no-normality present in the variables. For this purpose, the values of skewness and kurtosis, and the median, mode and mean for each variable are examined.

Test of Normality	Skewness	Kurtosis	Mean	Median	Mode
Performance	0.226	0.389	3.25	3.00	3
Recommendation	-0.599	0.017	3.77	4.00	4
Further usage	-0.959	0.935	4.01	4.00	4
Competitive advantage	-0.025	0.403	2.92	3.00	3
Network Coverage overall	0.134	0.231	3.03	3.00	3
Value for money	0.424	1.398	3.00	3.00	3
Prices overall	0.177	1.453	2.85	3.00	3
Existing products	0.468	1.818	3.09	3.00	3
Stability of the connection	0.336	1.15	3.05	3.00	3
Handset internet service overall	0.131	1.085	2.90	3.00	3
Speed of handset internet connection	0.302	-0.69	2.58	3.00	3
Tariffs overall	-0.401	1.492	2.87	3.00	3
Transparent tariff structure	0.107	1.211	2.92	3.00	3
Handset overall	-0.169	-0.412	3.50	3.00	3
Handset upgrade	0.136	-1.496	2.76	3.00	1
Renewal offer for handset	-0.154	-1.341	3.25	3.00	5
Offer of new products	-0.142	1.024	2.88	3.00	3
Customer information overall	-0.093	0.326	2.79	3.00	3
Customer service overall	-0.076	-0.643	3.05	3.00	3
Loyalty Program overall	-0.17	-0.975	3.22	3.00	3
Satisfaction	-0.93	0.156	3.68	4.00	4
Positively surprised	0.017	-0.962	2.71	3.00	3
Feel at home	-0.533	-0.47	3.44	4.00	4
Feel appreciated as a customer	-0.209	-0.499	3.19	3.00	3
Effort Mean for Call Center, Shop and Website	0.252	0.446	3.48	3.00	2.
Company Rewards Loyal Customers	0.123	-0.236	2.43	3.00	3.

In order to determine the level of no-normality present in the variables, the cutoffs proposed by (Muthén & Kaplan, 1985) were used that states that "if most variables have univariate skewnesses and kurtoses in the range −1.0 to +1.0, not much distortion is to be expected". Even though, most of the variables in this research have skewness and kurtosis in this range, ten variables show a kurtosis slightly higher than ±1.0. In this case the transformation of the variables can be considered as possible solution. However, when the no-normality of the variables is slight or moderate, the transformation only has a minor effect (Gao, Mokhtarian, & Johnston, 2008).

However, even a slight no normal distribution of the individual variables has a negative effect on the multivariate normal distribution. Therefore, a no multivariate normal distribution is expected. The next step was to determine the level of the no multivariate normal distribution. The test of Mardia's multivariate kurtosis is used to measure the multivariate distribution of the dataset. According to Mardia's test a "sample can be considered multivariate normally distributed at the .05 level of significance when the critical ratio is less than 1.96, indicating that the coefficient of multivariate kurtosis is not significantly different from zero"(Mardia, 1970).

The results of the first Mardia's test applied over the data showed a critical ratio of 11.56 higher than the expected 1.96. Therefore, a solution is needed in order to achieve the multivariate distribution of the sample. However, since the transformations do not provide a valid solution, the deletion of outliers was selected as solution to be applied. When deleting outliers it must be considered the tradeoff between the achievement of a multivariate distribution and the loss of observations in the sample, thus loss of information power.

 In order to determine the outliers that should be deleted, the Mahalanobis distance was used. The Mahalanobi test analysis the distance of an observation, in standardized units, of the sample means for all the variables. By using the Mahalanobis test it was possible to determine the outliers that showed the highest distance from the rest of observations. The deletion of the outliers was done constantly controlling the critical value of the Mardia's test, in order to delete just the needed number of observations.

Since the initial critical ratio is not too high, and the variables show a slightly univariate distribution, it was needed to delete only 28 observations. The final critical ratio for the Mardia's test is of 1.95 and the sample was reduced in less than 5%, thus not losing a considerable information power.

Appendix E: *Frequencies tables of moderator variables*

Gender		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	289	51.8	51.8	51.8
	Female	269	48.2	48.2	100.0
	Total	558	100.0	100.0	

Age		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Young	252	45.2	45.2	45.2
	Old	306	54.8	54.8	100.0
	Total	558	100.0	100.0	

Income		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	417	74.7	74.7	74.7
	2	141	25.3	25.3	100.0
	Total	558	100.0	100.0	

Attitude towards Technology		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	New Technology	290	52.0	52.0	52.0
	Proven Technology	268	48.0	48.0	100.0
	Total	558	100.0	100.0	

Appendix F: *Results of Invariance Analysis*

Model Tested	Model Fit Measures				Model Differences	
	X^2	Df	RMSEA	CFI	ΔX^2	ΔDf
AGE						
Young	49.89	50	0.008	0.99		
Old	108.86	50	0.063	0.952		
Configural invariance	158.75	100	0.033	0.97		
Metric invariance	168.017	107	0.033	0.969	9.27	7
Gender						
Male	74.55	50	0.043	0.946		
Female	71.81	50	0.042	0.976		
Configural invariance	146.36	100	0.03	0.976		
Metric invariance	152.83	107	0.029	0.976	6.47	7
Income						
High	85.54	50	0.071	0.938		
Low	78.157	50	0.038	980		
Configural invariance	163.902	100	0.034	0.968		
Metric invariance	175.929	107	0.035	0.965	12.03	7
Attitude towards technology						
New Technology	101.12	50	0.061	0.954		
Proven Technology	82.68	50	0.051	0.964		
Configural invariance	183.81	100	0.04	0.959		
Metric invariance	190.84	107	0.038	0.959	7.03	7
MNO						
KPN	176.341	50	0.076	0.941		
T-Mobile	90.37	50	0.034	0.933		
Configural invariance	266.711	100	0.054	0.936		
Metric invariance	279.8	107	0.054	0.936	13.09	7