

ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL

**A DECISION MODELING STUDY WITH FUZZY COGNITIVE
MAPPING METHOD ON CUSTOMERS' BRAND PREFERENCES
CRITERIA IN TELECOMMUNICATIONS INDUSTRY**



M.Sc. THESIS

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Department of Management Engineering

Management Engineering Programme

JUNE 2022

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İSTANBUL TEKNİK ÜNİVERSİTESİ ★ LİSANSÜSTÜ EĞİTİM ENSTİTÜSÜ

**TELEKOMÜNİKASYON SEKTÖRÜNDE MÜŞTERİLERİN MARKA TERCİH
KRİTERLERİ ÜZERİNE BULANIK BİLİŞSEL HARİTALAMA YÖNTEMİ İLE
BİR KARAR MODELLEME ÇALIŞMASI**

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To my family and friends,



FOREWORD

First of all, I would like to thank my esteemed advisor Prof. Dr. Hatice Camgöz Akdağ, who provided me with all kinds of support in writing this thesis, spared her time and changed my point of view towards academic studies. In addition, I would like to thank my managers and colleagues who supported and helped me get my master's degree in work life. Finally, I would like to express my gratitude to my family and friends who have always stood by me and supported me throughout my work.

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TABLE OF CONTENTS

	<u>Page</u>
FOREWORD	ix
TABLE OF CONTENTS	xi
ABBREVIATIONS	xiii
SYMBOLS	xv
LIST OF TABLES	xvii
LIST OF FIGURES	xix
SUMMARY	xxi
ÖZET	xxv
1. INTRODUCTION	1
2. LITERATURE REVIEW	5
2.1 Brand as a Term	5
2.1.1 What is brand?	5
2.1.2 Importance of brand for businesses	6
2.1.3 Brand preferences of customers	7
2.1.4 The factors that affect the brand preference	8
2.1.4.1 Socio-cultural factors	8
2.1.4.2 Personal factors	9
2.1.4.3 Psychological factors	10
2.2 Telecommunications Industry	10
2.2.1 Brand preferences and expectations of customers for telecom companies	12
2.3 Fuzzy Cognitive Mapping	16
2.3.1 Cognitive maps	16
2.3.2 Fuzzy cognitive maps	17
3. METHODOLOGY	19
4. APPLICATION	27
4.1 Determining the Criteria	27
4.2 Data Collection	29
4.3 Structuring the Relationships' (Cognitive) Map	30
4.3.1 Opinions of experts	31
4.3.2 Adjacency / weights' matrix	39
4.4 Analysis	40
4.4.1 Calculations	40
4.4.2 Results and analysis	41
4.4.2.1 Outdegree, indegree and centrality values	41
4.4.2.2 Iteration result	44
4.4.3 Scenario analysis	44
4.4.3.1 Scenario 1: Change in price (C1)	45
4.4.3.2 Scenario 2: Change in coverage area (C2)	45
4.4.3.3 Scenario 3: Change in network quality / speed (C3)	45
4.4.3.4 Scenario 4: Change in service quality (C4)	46
4.4.3.5 Scenario 5: Change in variety of services (C5)	46
4.4.3.6 Scenario 6: Change in use/suggestion by family and friends (C6)	47

4.4.3.7 Scenario 7: Change image / emotional bond (C7)	47
4.4.3.8 Scenario 8: Change in advertisement / communication (C8).....	48
4.4.3.9 Scenario 9: Change in trust (C9)	48
4.5 Summary of Analysis	49
5. CONCLUSION	53
5.1 Further Implications	55
REFERENCES	57
APPENDICES	63
APPENDIX A	64
CURRICULUM VITAE	65



ABBREVIATIONS

FCM	: Fuzzy Cognitive Mapping
NAvg	: Negative Average
NE	: No Effect
NL	: Negative Less
NM	: Negative Much
NVL	: Negative Very Less
NVM	: Negative Very Much
PAvg	: Positive Average
PL	: Positive Less
PM	: Positive Much
PVL	: Positive Very Less
PVM	: Positive Very Much



SYMBOLS

$A_i^{(k+1)}$: Value of influenced i concept's Activation Matrix at k+1. step

A_i, A_j : Value of influencer concepts

W_{ji} : Weighted values for [ji] cell, $W_{ji} \in [-1,1]$





LIST OF TABLES

	<u>Page</u>
Table 4.1 : An example of an adjacency / weights' matrix of a cognitive map..	17
Table 4.2 : Some examples for application fields of FCM.....	17
Table 4.3 : An example of an adjacency / weights' matrix of a fuzzy cognitive map.....	22
Table 4.1 : Some examples for application fields of FCM.....	27
Table 4.2 : Votes of Expert 1.....	31
Table 4.3 : Votes of Expert 2.....	31
Table 4.4 : Votes of Expert 3.....	32
Table 4.5 : Votes of Expert 4.....	32
Table 4.6 : Votes of Expert 5.....	33
Table 4.7 : Votes of Expert 6.....	33
Table 4.8 : Votes of Expert 7.....	34
Table 4.9 : Votes of Expert 8.....	34
Table 4.10 : Votes of Expert 9.....	35
Table 4.11 : Average of all experts' opinions.....	35
Table 4.12 : Reduced average of all experts' opinions.....	37
Table 4.13 : Reduced average of all experts' opinions after ignored relationships.	38
Table 4.14 : Number of votes.	38
Table 4.15 : Final table of relationships.	39
Table 4.16 : Adjacency / Weights' matrix.....	39
Table 4.17 : Indegree, outdegree, centrality values with receiver, transmitter and ordinary information for each concept.....	43
Table 4.18 : Concepts and their reference ranks.	44
Table 4.19 : Influences of change in price on other concepts.....	45
Table 4.20 : Influences of change in coverage area on other concepts.....	45
Table 4.21 : Influences of change in network quality / speed on other concepts.	45
Table 4.22 : Influences of change in service quality on other concepts.....	46
Table 4.23 : Influences of change in variety of services on other concepts.....	46
Table 4.24 : Influences of change in use/suggestion by family and friends on other concepts.....	47
Table 4.25 : Influences of change in image / emotional bond on other concepts.	47
Table 4.26 : Influences of change in advertisement / communication on other concepts.....	48
Table 4.27 : Influences of change in trust on other concepts.	48
Table 4.28 : Reference ranks from largest to smallest.....	49
Table 4.29 : Outdegree values from largest to smallest.....	50
Table 4.30 : Indegree values from largest to smallest.....	50
Table 4.31 : Centrality values from largest to smallest.	50



LIST OF FIGURES

	<u>Page</u>
Figure 2.1 : An example of a cognitive map.	16
Figure 3.1 : Visualisation of linguistic variants.	20
Figure 3.2 : An example of a fuzzy cognitive map.	22
Figure 4.1 : Relationship map between criteria.	36
Figure 4.2 : Sigmoid function.....	40
Figure 4.3 : Outdegree graph.....	42
Figure 4.4 : Indegree graph.....	42
Figure 4.5 : Centrality graph.	43
Figure A.1 : Survey sheet.	64



A DECISION MODELING STUDY WITH FUZZY COGNITIVE MAPPING METHOD ON CUSTOMERS' BRAND PREFERENCES CRITERIA IN TELECOMMUNICATIONS INDUSTRY

SUMMARY

Today, businesses need to consider many factors in order to survive in a competitive environment and to stand out from the competition. While some of these are factors such as cost advantage, way of doing business, organizational structure and culture, adaptation to the environment, etc., one of the most important points is the customer. Many customer-related factors are critical to the survival of businesses. Areas such as customer acquisition, promotion, satisfaction, meeting their needs and new sales opportunities are some of the issues that companies focus on.

The perspectives and strategies that businesses develop towards customers can change in terms of their sectors. For example, the customer perspective of a business in the FMCG sector and the perspective of a business in the banking industry towards the customer will differ in many respects. On the other hand, the telecom sector stands out as a sector with its own dynamics in terms of both being very dynamic and competitive and progressing with a system based on subscription in general.

The needs and expectations of consumers are changing and their demands from companies differ day by day. Both increasing population and technological developments affect the behavior patterns of consumers. This pushes companies to better analyze customer expectations, to be intertwined with customers, and to offer them the most appropriate products and services. The aim of this study is to determine which areas the companies operating in the telecommunications sector should focus on according to customer expectations and criteria for brand preference by using the Fuzzy Cognitive Mapping (FCM) method.

In addition to the strategies of the enterprises, the expectations of each customer from the enterprises may differ, and it may be necessary to find special solutions for each customer group. From this point of view, in addition to customer acquisition/retention strategies, it has become inevitable for businesses to keep the pulse of the customer very well, analyze their expectations very well and offer solutions. Expectations of consumers from companies can be affected by demographic reasons such as age, gender, education level, as well as by psychological or socio-cultural reasons. As a result of this, each consumer buys products or services by evaluating companies with their specific needs and expectations.

In addition, each consumer pays attention to features of the product or service they need while purchasing. For example, a customer who wants to buy a television decides on the television she/he will buy by evaluating many points such as screen size, brightness, warranty period, price, etc. This situation is the same for the telecom industry. At this point, businesses operating in the telecom industry are making decisions about the future of the brand and trying to offer solutions suitable for customer needs by doing research on customer preferences. Data is collected from

many sources by methods such as measuring general customer feelings and expectations with the support of research companies, identifying needs by collecting feedback from dealer channels, identifying experienced or potential problems through analyzes made from conversations in call centers. Customer experience is tried to be improved by doing action plans according to these results.

Generating meaningful and useful results from such a large pool of information and turning it into action is one of the biggest problems encountered for businesses. Although it makes it easier for businesses to manage this process in a similar way with years of experience and knowledge and to make inferences based on the results of previous actions, efficient and focused methods are always sought for businesses to make more accurate decisions and find solutions in a more cost-effective way. The FCM method is one of the most effective methods in terms of both creating a meaningful relationship map according to the results of the researches and helping businesses to make decisions more cost-effectively. For this reason, it was decided to use FCM method to solve the problem in this study.

From this point of view, it has been researched which areas the customers in the telecommunications sector care and which dynamics these areas affect in the business in this study. As a result of this research, it is aimed to determine which areas the enterprises operating in the telecommunications sector should focus on and to facilitate their decision making by using FCM modeling. Firstly, a detailed literature review was made the issues that customers pay the most attention to the choice of telecom operator were determined as follows.

1. Price
2. Coverage Area
3. Network quality / Speed
4. Service quality
5. Variety of services
6. Use/suggestion by family and friends
7. Image / Emotional bond
8. Advertising / Communication
9. Trust

The criteria determined in the literature studies were evaluated by experts who are experienced and have strong knowledge in the sector in order to map the relationship between them and analyze with the FCM method. Iteration steps of the FCM method were applied with the help of the relationship map and weighted matrix obtained by the questionnaire applied to these experts.

FCMappers application was used in the application of the FCM method in terms of providing both time and an easy excel format. After the weighted matrix values are entered into the FCMappers application, the results are listed.

As a result of the iteration steps, the most critical criteria for the system were found as follows, respectively.

1. Image / Emotional bond
2. Trust

3. Use/suggestion by family and friends
4. Advertising / Communication
5. Variety of services
6. Service quality
7. Coverage Area
8. Network quality / Speed
9. Price

Considering the result, the criteria of 'Image / Emotional bond', 'Trust' and 'Use/suggestion by family and friends' came to the fore as the most important criteria.

In the light of these results, the following recommendations are presented for companies operating in the telecom sector.

- Companies should establish an emotional bond with their customers and should not be a brand that only serves them.
- Firms should pay attention to their image in front of their customers and present an image that is compatible with the demographic, psychological and sociological structure of the society.
- Companies should give confidence to their customers, keep their promises and fulfill their commitments. They should avoid actions that may surprise customers.
- Companies should pay close attention to their customers' relationships with family and friends. They should develop special actions for people's relatives according to their own strategies.
- Companies should carry out their communication activities in line with their own strategies in order to create a brand image and establish a bond with customers and to make their voices heard.
- Companies should also care about infrastructure developments in order to respond to the final requests of customers. Although it is very important to touch, connect and stay in touch with customers, companies should also focus on infrastructure investments as it affects the product used by customers and therefore many factors that the customer cares about.



TELEKOMÜNİKASYON SEKTÖRÜNDE MÜŞTERİLERİN MARKA TERCİH KRİTERLERİ ÜZERİNE BULANIK BİLİŞSEL HARİTALAMA YÖNTEMİ İLE BİR KARAR MODELLEME ÇALIŞMASI

ÖZET

Günümüzde bir işletmenin rekabetçi ortamda hayatta kalabilmesi ve rekabette öne çıkabilmesi için birçok faktörü göz önünde bulundurması gerekmektedir. Bunlardan bazıları maliyet avantajı, iş yapış şekli, organizasyonel yapı ve kültür, bulunulan çevreye uyum vb. gibi konular olurken en önemli noktalardan biri de müşteridir. Müşteri ile ilgili birçok faktör işletmelerin hayatta kalabilmesi için kritiktir. Müşterinin kazanımı, tutundurulması, memnuniyeti, ihtiyaçlarının karşılanması, yeni satış fırsatları gibi alanlar firmaların temelde odaklandığı konulardan bazılarıdır.

İşletmelerin sektörleri itibarıyla müşterilere karşı geliştirdikleri bakış açıları ve stratejileri değişebilmektedir. Örneğin FMCG sektöründeki bir işletmenin müşteriye bakış açısı ile bankacılık sektöründeki bir işletmenin müşteriye bakış açısı birçok noktada farklılık gösterecektir. Telekom sektörü ise hem çok dinamik ve rekabetçi olması hem de genelde abonelik üzerine kurulu bir sistem ile ilerlemesi açısından kendine has dinamikleri olan bir sektör olarak göze çarpmaktadır.

Gün geçtikçe tüketicilerin ihtiyaçları ve beklentileri değişmekte, firmalardan talepleri farklılaşmaktadır. Hem artan nüfus hem de teknolojik gelişmeler tüketicilerin davranış modellerini etkilemektedir. Bu da firmaları müşteri beklentilerini daha iyi analiz etmeye, müşteriler ile iç içe olmaya ve onlara en uygun ürün ve hizmeti sunmaya itmektedir. Bu tezin amacı da müşteri beklentilerini bulanık bilişsel haritalama (BBH) metodu ile analiz ederek firmalara odaklanmaları gereken alanlar hakkında fikir sunabilmektir.

İşletmelerin stratejilerine ek olarak her müşterinin işletmelerden beklentileri farklılık gösterebilmekte, her müşteri kitlesine özel çözümler bulunması gerekebilmektedir. Bu açıdan bakıldığında işletmelerin müşteri kazanımı/tutundurulması stratejilerine ek olarak müşterinin nabzını çok iyi tutması, beklentilerini çok iyi analiz etmesi ve çözüm sunması kaçınılmaz hale gelmiştir. Tüketicilerin firmalardan beklentileri yaş, cinsiyet, eğitim seviyesi gibi demografik nedenlerden etkilenebileceği gibi psikolojik ya da sosyo-kültürel nedenlerden de etkilenebilir. Bunun neticesinde her bir tüketici kendine özel ihtiyaç ve beklentiler ile firmaları değerlendirerek ürün veya hizmet satın alır.

Bunun yanı sıra her bir tüketici ihtiyacı olan ürün veya hizmeti satın alırken onun özelliklerine de dikkat eder. Örneğin, televizyon almak isteyen bir müşteri ekran boyutu, parlaklık, garanti süresi, fiyat vb. gibi birçok noktada değerlendirme yaparak alacağı televizyona karar verir. Telekom sektörü için de bu geçerlidir. Bu noktada telekomünikasyon sektöründe faaliyet gösteren işletmeler müşteri tercihleri üzerine birçok çalışma yaparak hem marka geleceği ile ilgili kararlar almakta hem de müşteri ihtiyaçlarına uygun çözümleri sunmaya çalışmaktadır. Burada araştırma şirketlerinden destek alarak genel müşteri hissiyatını ve beklentilerini ölçme, bayi kanallarından geribildirimler toplanarak ihtiyaçları belirleme, çağrı merkezlerindeki konuşmalardan

yapılan analizler ile yaşanan veya olası problemleri belirleme vb gibi yöntemler ile birçok noktadan bilgi toplanmaktadır. Buralardan çıkan sonuçlar ile aksiyon planları çıkarılarak müşteri deneyimleri iyileştirilmeye çalışılmaktadır.

Buradaki karşılaşılan en büyük problemlerden biri işletmelerin bu kadar büyük bir bilgi havuzundan anlamlı ve yararlı sonuçlar ortaya çıkarabilmesi ve bunu aksiyona dönüştürebilmesidir. İşletmelerin yıllardan beri süregelen tecrübe ve bilgi birikimi ile bu süreci benzer şekilde yönetmeleri, farklı müşteri segmentlerine hitap etmeleri, daha önce yapılan aksiyonların sonuçlarına göre çıkarım yaparak ilerlemeleri işlerini kolaylaştırır da işletmelerin hem daha isabetli karar vermesi hem de daha maliyetsiz yoldan çözüm bulması açısından her zaman daha verimli ve odaklı yöntemler aranmaktadır. BBH yöntemi bu anlamda hem araştırmaların sonucuna göre anlamlı bir ilişki haritası çıkarması, hem de bunun sonucunda işletmelerin daha maliyetsiz bir şekilde karar vermelerine yardımcı olması açısından en etkili yöntemlerden biridir. Bu sebeple bu çalışmadaki problemin çözümünde BBH modellemesi kullanılmaya karar verilmiştir.

Bu noktadan hareketle bu çalışmada telekomünikasyon sektöründeki müşterilerin hangi alanlara önem verdikleri, bu alanların işletmede hangi dinamikleri etkilediği araştırılmıştır. Bu araştırmanın neticesinde telekomünikasyon sektöründe faaliyet gösteren işletmelerin bu çıktılar doğrultusunda FCM modellemesini kullanarak hangi alanlara yönelmeleri ve odaklanmaları gerektiğinin belirlenmesi ve temelde karar vermelerinin kolaylaştırılması hedeflenmiştir. Bu kapsamda ilk olarak detaylı bir literatür taraması yapılmış ve sonucunda müşterilerin telekom operatörü tercihi konusundan en çok dikkat ettiği hususlar aşağıdaki şekilde tespit edilmiştir.

1. Fiyat
2. Kapsama alanı
3. Şebeke kalitesi / Hız
4. Servis kalitesi
5. Servis çeşitliliği
6. Aile ve arkadaşların kullanımı / önermesi
7. İmaj / Duygusal bağ
8. Reklam / İletişim
9. Güven

Literatür çalışmalarında tespit edilen kriterler, aralarındaki ilişki haritasının çıkarılması ve BBH metoduyla analiz edilmesi amacıyla sektörde tecrübeli ve bilgi sahibi uzmanlar tarafından değerlendirilmiştir. Dokuz farklı uzmana uygulanan anket ile çıkarılan ilişki haritası ve ağırlıklı matris yardımıyla BBH metodunun iterasyon adımları uygulanmıştır.

BBH metodunun uygulanmasında hem zaman hem de kolay bir excel formatı sunması açısından FCMappers uygulamasından faydalanılmıştır. Ağırlıklı matris değerleri FCMappers uygulamasına girildikten sonra sonuçlar listelenmiştir.

İterasyon adımları sonucunda sistem için en kritik öneme sahip olan kriterler sırasıyla aşağıdaki gibi bulunmuştur.

1. İmaj / Duygusal bağ

2. Güven
3. Aile ve arkadaşların kullanımı / önermesi
4. Reklam / İletişim
5. Servis çeşitliliği
6. Servis kalitesi
7. Kapsama alanı
8. Şebeke kalitesi / Hız
9. Fiyat

Sonuca baktığımızda ‘İmaj / Duygusal bağ’, ‘Güven’ ve ‘Aile ve arkadaşların kullanımı / önermesi’ kriterleri en önemli kriterler olarak ön plana çıkmıştır.

Bu sonuçlar ışığında telekom sektöründe faaliyet gösteren firmalar için aşağıdaki öneriler sunulmuştur.

- İşletmeler, müşterileri ile duygusal bağ kurmalı, sadece onlara ürün ve hizmet sunan bir kurum olmamalıdır.
- İşletmeler toplumun demografik, psikolojik ve sosyo-kültürel değerlerine uygun olarak bir imaj yaratmalı ve müşterilerine hissettirmelidir.
- İşletmeler müşterilerine güven aşılamalı ve kendilerini güvende hissettirmelidir. Verdiği sözleri tutmalı, müşterilerini mağdur etmemeli ve müşterileri şaşırtabilecek aşırı davranışlardan kaçınmalıdır.
- İşletmeler müşterilerin aile ve arkadaşlarına da yüksek önem vermelidir. Müşterilerin yakın çevrelerine özel kurgu ve stratejiler geliştirerek onlarla bağını güçlendirmelidir.
- İşletmeler yaptığı kampanyalar, sosyal sorumluluk projeleri vb gibi aldığı aksiyonlar ile ilgili müşterilerine sesini duyurmalı ve iletişim yapmalıdır. Hem marka imajı hem de müşteriler ile bağ kurulması açısından doğru iletişim kanallarından doğru müşterilere ulaşılmalıdır.
- İşletmelerin sunduğu ürünlerin birçoğu altyapıya bağlıdır. Her ne kadar müşterilere dokunmak, bağ kurmak, iletişimde kalmak çok önemli olsa da müşterilerin kullandığı ürünü ve dolayısıyla müşterinin önem verdiği birçok faktörü etkilediğinden firmaların altyapı yatırımlarına da ağırlık vermeleri gerekmektedir.



1. INTRODUCTION

Throughout the history, technology is developing every day to meet the people's demand. But today, needs of people change every day and this change occurs rapidly. Same way, technology development is becoming faster and trends change very fast. We can see that very clear with the pandemic. It happened suddenly and people had to live with hard conditions and new rules. For example, working at home was not easy for most of the people and companies, but they had to stay at home with the new era. Or individuals performed 171 percent more purchasing behavior online instead of physically shopping at grocery stores (Kara & Karanfiloğlu, 2020).

While the success of a good and service manufacturer was measured by the ability to produce a single product at the lowest cost in the past, today it has been measured by flexibility, versatility, the ability to manage continuous improvement and change, to feel the change in customer needs and the market in advance, that is, agility (Soylu & İleri, 2010). Companies need to keep up with changes to stay alive.

Agility, speed, flexibility, ability to respond to innovations and high quality, personalized products, adapt to change in culture, mobilization of basic functions, and the best use of resources and the best application of flexible products and services to the customer (Sherehiy et al., 2007).

Agility and interoperability are essential requirements to adapt to rapidly changing environmental conditions. Interoperability means great communication between business segments, while agility is the flexibility to adapt and cope with unexpected environmental environments (Kim et al., 2006).

Today one of the most important things for companies is to survive, but this is getting harder day after day. The factors are previous paragraphs are not the only reasons for companies to survive. As well as competition is a very important factor to face for the companies also. Especially in the last decade, every company paid more attention to innovation and improvement compared to previous years. This situation causes more competition, and it makes surviving harder.

In addition to this every day a new firm can join to the game and become a very serious competitor to the other companies in any sector, as Because they can be more flexible, innovative, fast etc. There can be lots of reason to this. After covid-19 disease, digitalization became faster which also accelerated the competition for most of the sectors.

Most of the companies need customers to gain revenue and sustain their operations. But companies have to compete to acquire customers in this very competitive world as this is the hardest part as mentioned above.

Today, a company needs to consider many factors in order to survive in a competitive environment and to stand out from the competition. While some of these are issues such as cost advantage, way of doing business, organizational structure and culture, adaptation to the environment, etc., one of the most important points is the customer. Many customer-related factors are critical to the survival of businesses. Areas such as customer acquisition, promotion, satisfaction, meeting their needs, and new sales opportunities are some of the issues that companies focus on.

Companies use many different channels to acquire new customers. For example, customer acquisition can be done through dealers, as well as through digital channels. In addition to these, many channels such as call centers, collaborations, private sales representatives etc. can be given as examples. Each channel has its own advantages and disadvantages. For example, while dealers play a more effective role in convincing people, they are high-cost channels. On the contrary, digital channels stand out as channels where the proactive behavior of the customer can be expected from time to time, although the cost is lower. At this stage, customers' brand preferences may differ according to the channel. For example, customers who are not convinced in digital channels can be convinced by the influence of sales representatives in dealers.

Same way, another aim is to try to keep the existing customers as the customers of the company by touching them through different channels. Channels such as dealers, digital channels, call centers etc. play important roles in customer retention with their unique dynamics. To summarize, businesses aim to increase their customer base with many different strategies, channels and setups for both new customers and existing customers.

As mentioned above, at every stage, in every channel, differences play a critical role. However, in addition to the strategies of the enterprises, regardless of new or existing customer the expectations of each customer from the enterprises may differ, and it may be necessary to find special solutions for each customer group. From this point of view, in addition to customer acquisition/retention strategies, it has become inevitable for businesses to keep the pulse of the customer very well, analyze their expectations very well and offer solutions.

The perspectives and strategies that businesses develop towards customers may change in terms of their sectors. For example, the customer perspective of a business in the FMCG sector and the perspective of a business in the banking industry towards the customer will differ in many respects. The telecom sector, on the other hand, stands out as a sector with its own dynamics in terms of not only being very dynamic and competitive but also working with a system based on subscription in general. New customer acquisition and retention is the basis of the revenue model of the businesses. People always demand different things. All customers have different behavior, there are so many segments (corporate, individual, young, affluent etc), companies have to offer different options to different kind of customers.

In addition to this, in Turkey, telecommunication is a regulated sector that official institutions have some rules. These rules can change rapidly and companies need to cope up with these rules also very fast by thinking customer centered.

At this point, businesses operating in the telecommunications sector are making many studies on customer preferences, making decisions about the future of the brand and trying to offer solutions suitable for customer needs. Here, information is collected from many points by methods such as measuring general customer sentiment and expectations with the support of research companies, identifying needs by collecting feedback from dealer channels, identifying experienced or potential problems through analyzes made from conversations in call centers. Action plans are drawn up with the results obtained from these, and customer experiences are tried to be improved.

Generating meaningful and useful results from such a large pool of information and taking action is one of the biggest problems encountered here for companies. Although it makes it easier for businesses to manage this process in a similar way with years of experience and knowledge, to appeal to different customer segments, and to make

inferences based on the results of previous actions, it is always easier for businesses to make more accurate decisions and find solutions in a more cost-effective way. Efficient and focused methods are sought. In this sense, the FCM method is one of the most effective methods in terms of both creating a meaningful relationship map according to the results of the researches and as a result helping businesses to make decisions more cost-effectively. For this reason, it was decided to use FCM modeling to solve the problem in this study.

The aim of this study is to determine which areas the companies operating in the telecommunications sector should focus on according to customer expectations and criteria for brand preference by using the Fuzzy Cognitive Mapping (FCM) method.



2. LITERATURE REVIEW

2.1 Brand as a Term

2.1.1 What is brand?

Before explaining customer preferences for companies, we can focus on what a brand is and why companies need brands and what they do with it. Throughout the history many cultures use brands for different needs and purposes. In old times term of brand is used for three purposes (Briciu & Briciu, 2016). First of these purposes is to determine where a product is produced. Second is for explaining the basic functions of it. And the last is to show the quality of the product. People use brand as a sign or symbol on a product to show its attributes.

From point of views of Bruce and Harvey (trans. 2010), brand is anything that distinguishes a product, service, or organization from others and is an entity that creates loyalty, adds value, is the main factor of growth and forces the company to innovate.

According to American Marketing Association, the brand is a name, term, sign, symbol, or a combination of all these that distinguishes the goods and services of a business from the goods and services of its competitors (Kotler, 2000, p. 404).

A brand is a phenomenon that is consciously designed and has symbolic meanings (Doğru & Çakır, 2016). Brand is a comprehensive term, and many features that determine the product fall within the scope of the brand (Mucuk, 1998, p. 150).

According to Aktuğlu (2004, p. 16), the brand is; “It is the name, symbol, or combination of these that determines the identity of the goods or services, enables the product to be distinguished from its competitors, facilitates communication with consumers as the focal point of marketing management and advertising management practices, provides legal advantages to producers and consumers, in short, differentiates the product”.

According to Turk Patent, any sign, symbol, or name is a brand if they distinguish the goods or services of an enterprise from goods or services of another enterprise (Türk Patent ve Marka Kurumu, n.d.).

From these definitions it can be said that brand is a concept for businesses to differentiate their goods or services from similar businesses. It is also a concept in the mind of customers. Because of this, every step a business take can be considered as a part of the business. Once a brand is created, future of the business can be affected by the past and the present of a business. As a result, it can be said that brand is like a dress of the businesses.

2.1.2 Importance of brand for businesses

The meaning of brand is defined above, now it is time to explain the importance of it for the businesses.

Brands help businesses to effectively serve their customers, minimize their costs, and help their defense and promotion strategies in an intensely competitive environment (Moon & Millison, trans. 2003, p. 45).

Businesses always prefer to continue their activities in the market with their own identity. Its purpose is to differentiate its product or service from other brands. In this case, it will provide the opportunity to add original value to the product or service. It will have the opportunity to determine a strategy against other products or services. The only way to achieve this is to create a brand (Tozoğlu et al., 2011).

Since the brand is the product of the enterprise, it has a significant value in terms of both risk and profit and competitive advantage. In this respect, it has an important place in the decision area of the enterprise for the following reasons (Satici, 2012):

- Trademark, imitation, copy etc. It protects the business against unfair competition.
- Because consumers give strong brands a second chance, the mistakes of strong brands in the market are easily forgiven.
- The brand has more impressive power in increasing demands than the name of the business. As a strong brand will increase customer loyalty, its consumers become permanent customers.

- The brand distinguishes the product or service from the competing brand (İzgören, 2000, p. 138-147).

Creating brand is a costly investment but it can help the business in the long term. Brand creates loyalty, loyalty creates high revenue, high revenue creates more investment and profit, this situation lowers the costs. It also has advantages for advertising. If the brand is known among customers, it is getting easier to advertise in terms of not only on TV, internet or another platform, but also the way of word of mouth (Durmaz, 2016).

To conclude, brand is crucial for companies to sustain their business and increase revenue and growth. It is a long-term investment and covers everything of the company.

2.1.3 Brand preferences of customers

Brand and importance of it have been briefly explained above. It is time to mention about the customer preferences on brands. It was mentioned that the competition between companies is at the top level today. There are so many different companies or brands for almost every sector. For example, if a customer goes to a market to buy a chocolate, the customer would face with at least ten or fifteen different chocolate brands to buy for just one type of chocolate even if it is very small market. If it is also considered that there are similar types of products, this number will increase extraordinarily. Because other products or brands are also a competitor for each other. At this point, the customer must decide which brand he / she is going to buy. This is the decision time, and the brand shows itself here.

Another example for explaining how hard the competition is that let's say a customer wants to watch a movie. Normally we would expect her / him to go to cinema and pick a movie to watch. But today there is a new player for this industry which is Netflix. Same way, Airbnb which has zero hotel is the one of the biggest competitors of Hilton Hotels which have 6500 facilities all around the world. World is changing very fast, especially with the acceleration of digitalization competition is getting harder for the companies and brands.

The brand preference formation process includes: first, exposure to many brands, followed by a complex purchase decision process. (Aktuğlu, 2004, p. 16).

Many factors like the nature of the consumer's needs, the perception of the characteristics of the brand by the consumers, the corporate image and marketing strategies of the companies that produce the brand etc. determine the brand preference. In the most general terms, brand preference is expressed as the determination of a particular brand in the purchasing decision process as a result of the evaluation of the brand with the influence of consumer needs and the consumer's beliefs and attitudes towards the brand. In other words, brand preference is the behavior of consumers to choose a brand among competing brands depending on their habits or past experiences (Aktuğlu & Temel, 2006).

Activities such as evaluating, searching, purchasing, using and disposing of products and services that individuals think they can meet their own needs and/or the needs of others, and decision-making processes that affect these activities can be defined as consumer behavior (Yağcı & İlarslan, 2010). The term consumer behavior and brand preference have the same meaning in this manner.

After understanding the term of brand preference of customers, businesses should understand and focus on the factors that affect the brand preference.

2.1.4 The factors that affect the brand preference

Different customers prefer different products or brands as we defined it as brand preference or consumer behavior above. There can be a lot of reason for this, it cannot be explained with just one factor. The brand preference of consumers is affected by socio-cultural, personal and psychological factors. As socio-cultural factors, culture and social class are important factors in purchasing behavior. On the other hand, consumer behavior is also influenced by advisory groups, family, role and status. Consumer's age, life period, occupation, economic power, lifestyle and personality constitute personal factors. Psychological factors are motivation, perception, learning, beliefs and attitudes (Kotler, 2003, p. 183-195).

2.1.4.1 Socio-cultural factors

Social factors can be classified as culture, roles, friends, family, social class and reference groups, media and advertisements. Social class and roles are important factors. For example, individuals who have important roles among the society or have impact on other members of society prefer premium brands generally. Changes that

the person undergoes throughout her life (such as role transitions) cause changes in purchasing behavior (Aktuğlu & Temel, 2006).

Same way, for consumers, brands have a symbolic meaning to take place in social groups. The indication of conforming to the group and belonging to that group is generally evaluated with the preferred brands (Hogg Margaret Bruce & Hill, 1998).

Culture and family are also another important factors for socialization of a person. The brands that other family members prefer can be decisive for the selection of products or brands. Friends have similar impacts also.

Media and advertisements are another factors of purchasing behavior of consumers. Brands generally use advertisements to take a place in the mind of consumers and this situation can affect the consumer behavior. Especially in the last decade social media platforms and influencers are becoming more effective.

2.1.4.2 Personal factors

Personal factors can be anything about the person her/himself. The ones that come to mind the most are demographic characteristics such as age, gender, marital status, education level, occupation and income level.

First, age of consumers has a significant effect on what kind of goods, which models and styles she / he will turn to. Same way marital status of a consumer affects the preference directly. Whether a person is married or single, if married, whether they have children, gender, income status, education level, professional status and lifestyle are the personal factors that affect purchasing decisions generally. (Deniz, 2012)

When these factors are considered separately, they are not determinative on consumption and purchasing behaviors alone. For example, two different consumers with same marital status, income level but different ages prefer different types of products or brands. Let's assume that a start-up founder and an artisan with the same income level but different ages want to buy shoes. Probably the start-up founder will prefer a sportier style while the artisan will prefer the more classic models. Demographic or any other personal factors that are specific to a person affect the prefers directly.

2.1.4.3 Psychological factors

Although the factors mentioned above are personal or socio-cultural, they affect people's lives as they shape. They can affect not only their buying behavior but also their perspective, perception and the way of thinking about any condition or situation. For example, while one of the two people working in the same workplace under the same conditions complains about the conditions, the other person may find the same conditions very comfortable and convenient. Although it is the same situation, the ways of perceiving and interpreting the situation are different. Different reactions to different situations in this or similar way may appear as psychological factors.

Motivation, perception, learning and attitudes and beliefs can be classified as psychological factors. Motivation can be defined as the behaviors that aim to determine the needs of the consumers selected as the target and to mobilize the consumer in order to meet these needs while learning can be defined as the changes that occur in the behavior of people as a result of the effect of different elements in the environment they live in. Attitude refers to the consumer's positive or negative feelings about an idea, object or symbol. Belief includes information, opinions, and judgments based on personal experience or external sources. Last of all perception is called recognizing and interpreting different stimuli in the environment with sense organs. (Tozoğlu et al., 2011)

All the above factors come together and have a great influence on a person's decision making and choosing a brand. These are the key elements in a consumer's decision-making in general. No single factor can be the main factor, but when considered as a whole, it can be seen that these are the factors underlying each consumer's making different choices or making different decisions.

However, specific expectations, needs and preferences of consumers differ for each industry or product. For this reason, every business should analyze what the consumers need, what they expect and what they demand for their own products or services, based on these factors, and act accordingly.

2.2 Telecommunications Industry

Telecommunication is the transmission, broadcast or reception of news, text, pictures, symbols or any kind of information with electromagnetic systems such as wire, radio,

optics, etc. (Türk Dil Kurumu, n.d.). It can be said that from this definition, telecommunication allows people to communicate from far.

The telecommunication industry is an industry that provides solutions for people and businesses to communicate with each other and meet their communication needs. As mentioned in the definition above, many technological infrastructures are included in its scope. A wide range of products and services, from satellite to mobile technologies, from fiber infrastructure to cable telephones are offered to consumers within the scope of the telecommunication industry.

Apart from the services offered for businesses, the products and services that are on the agenda for individual users are generally mobile and fixed infrastructures. Telecom companies generally offer individual customers mobile lines for voice, sms and internet needs, and fixed internet offers for home internet.

Needs such as the use of social media, online banking, e-commerce, etc. are increasing with digitalization. This increases the need for internet day by day. It is up to companies operating in the telecom industry to meet the need for the internet and to offer products and services suitable for people. For this reason, the importance of telecom companies is increasing.

Especially during the pandemic period, people's usage habits have changed, and people have started to meet most of their needs from online platforms. The fact that many companies switched to remote work during the Covid-19 process and the training continued in the virtual environment brought along the need for strong infrastructure and uninterrupted service. This situation was reflected as an extraordinary demand for telecom companies. In parallel with the isolation and quarantine practices throughout the world, serious increases of up to 75 percent were observed in data traffic in the first place (KPMG, 2020).

This situation has caused companies to increase the importance given to digitalization and to act faster to meet customer needs. At this point, telecom companies have acted as a bridge between people and businesses that offer products and services to people. Therefore, people's expectations have changed suddenly, and the telecom industry has tried to cope up with these changing needs quickly.

If we look at the situation in Turkey, the number of broadband subscribers reached 87.5 million in the third quarter of 2021 and the number of fixed broadband subscribers

is 17.7 million in the same period. While there are 4.6 million fiber subscribers, there are 11.3 million xDSL technology users and 1.4 million cable internet users. In mobile broadband, the prevalence rate by population corresponds to 83.4%, with 69.7 million users as of the third quarter of 2021. Compared to the OECD average of 118.3% mobile broadband prevalence, it can be said that Turkey's growth potential in this area continues (Türk Telekom, 2021).

2.2.1 Brand preferences and expectations of customers for telecom companies

Until this point, the concept of the brand, the importance of the brand, the relations of the consumers with the brands were explained, and then the telecommunication sector was mentioned. In this section, what consumers expect from telecommunication brands and their preference criteria will be discussed.

As mentioned above, socio-cultural, personal and psychological factors are effective in consumers' brand preferences. However, consumers also have specific demands and needs that vary depending on the sector and product. At this point, the specific expectations and needs of individual mobile customers from telecommunication companies will be examined in more detail.

Şahin & Topal (2020) examined the factors affecting the GSM operator preference of mobile phone users in their research. The factors that emerged as a result of factor analysis can be expressed as follows:

1. Attitude and service quality of service center employees
2. The physical atmosphere of the service centers and the interest of the employees
3. Content of advertisements
4. Communication quality
5. Speed in service delivery
6. Tariff and price
7. Suggestion by family and friends
8. The effectiveness and adequacy of advertisements
9. Honesty

Barutçu (2007) also examined the factors affecting operator selection in his Customer Loyalty research in the GSM Sector and concluded that customers care about the following factors:

1. Price
2. Being the operator used by family and friends
3. Coverage Area
4. Advantages offered to students
5. Variety of services offered
6. Advantages that other GSM operators do not offer
7. Reward programs for frequent users
8. Friend recommendations
9. Advertisement

Şengün ve Menteş (2018) GSM operatör markalarının tüketici açısından değerlendiren bir çalışma yapmış ve çalışmada tercih faktörleri aşağıdaki gibi olmuştur:

1. Quality
2. Price
3. Image
4. Promotions
5. Family and friends

Dündar and Ecer (2008) researched the reasons for operator preference in their study named Determining the GSM Operator Preference of Students with the Analytical Hierarchy Process Method and reached the following results:

1. Price
2. Coverage Area
3. Family's GSM operator subscription
4. Service quality

In the study of Doğru and Koçer (2016) on the Brand Loyalty of GSM Operator Users, the following factors came to the fore in the operator preference criteria of customers:

1. Network power
2. Price
3. Social responsibility projects
4. Service quality

Followings are found in the study of Alamro and Rowley (2011) about antecedents of consumer brand preference in telecommunication industry:

1. Brand awareness
2. Brand Image
3. Consumer attribute

Qayyum et al. (2016) found the followings in their research about antecedents of customer loyalty in the mobile phone industry:

1. Customer satisfaction
2. Perceived service quality
3. Perceived value
4. Perceived switching costs
5. Trust
6. Corporate image

The following factors are the criteria of the study of Chakraborty et al. (2013) in which the determinants of customer satisfactions are researched:

1. Generic requirements
 - a. Connectivity
 - b. Voice quality
 - c. Other customer needs
2. Functional quality
 - a. Customer service etc
3. Price
 - a. Flexibility

b. Promotion offers

4. Latest services for customer needs

Olatokun and Nwonne (2012) investigated the determinants of customers choice of mobile operator and found followings as criteria:

1. Price
2. Service quality
3. Service availability
4. Promotion
5. Brand image

The following factors are found in the study of Shafei et al. (2016) in which the factors affecting customer loyalty are investigated:

1. Call quality
2. Pricing structure
3. Value added services
4. Customer support

As it is seen, many different criteria have been observed in the above studies and these criteria have been revealed in many different studies. As customers change, needs change as well and customers demand different kinds of things from companies. One of the biggest problems for businesses is generating meaningful and useful results from these criteria and turn it into action. Although it makes it easier for businesses to manage this process with years of experience and knowledge, or to make inferences based on the results of previous actions, more efficient and focused methods are always sought to make more accurate decisions and find solutions in a more cost-effective way. The FCM method is one of the most effective methods in terms of creating a meaningful relationship map in complex models and helping businesses to make decisions more cost-effectively. For this reason, it is decided to use FCM modeling to solve the problem in this study.

2.3 Fuzzy Cognitive Mapping

2.3.1 Cognitive maps

The cognitive map concept was proposed by Edward Tolman in 1948. Tolman (1948) gave a food reward after each successful run through a maze in an experiment he conducted with a group of rats. As a result of this experiment, he observed that the running speed of the mice and the number of mistakes they made decreased. The same procedures were applied to a second group without any food reward, and no increase in running speed or decrease in the number of errors was observed. At this point, although it is concluded that learning took place in the first group and not in the second group, this would be a false inference. Because when the mice in the second group were given food reward, it was observed that the mice in this group had a rapid improvement in the running speed and the number of errors. The rats learned the maze but did not find any motivation to demonstrate that they learned. As a result, Tolman stated that rats learned spatial relationships and even developed a cognitive map of the maze.

Cognitive maps see the environment as a cause-effect relationship (Srinivas & Shekar, 1997). Casual maps are a type of cognitive maps and they are networks that consist of items and directional (cause and effect) between these items (Langfield-Smith, 2007). Items can affect each other positively or negatively.

A positive arrow from item A to item B means A increases B. A negative arrow from A to B means A decreases B casually Axelrod (1976).

An example of a cognitive map is given below.

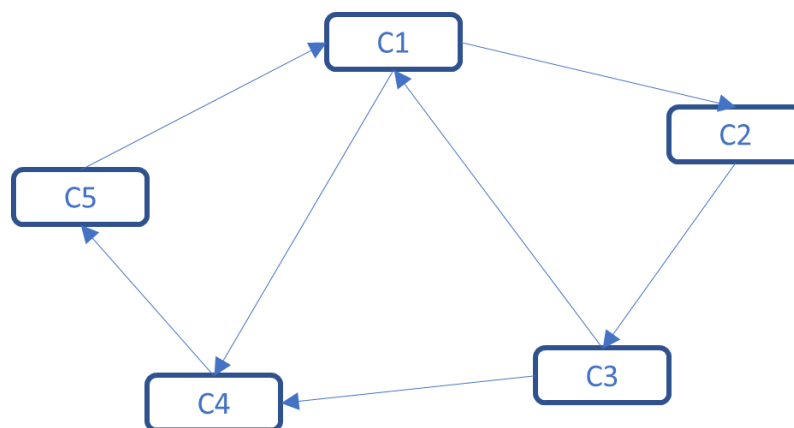


Figure 2.1 : An example of a cognitive map.

This map can be shown as matrix called adjacency / weights' matrix.

Table 4.1 : An example of an adjacency / weights' matrix of a cognitive map.

$$\begin{pmatrix} 0 & W_{12} & 0 & W_{14} & 0 \\ 0 & 0 & W_{23} & 0 & 0 \\ W_{31} & 0 & 0 & W_{34} & 0 \\ 0 & 0 & 0 & 0 & W_{45} \\ W_{51} & 0 & 0 & 0 & 0 \end{pmatrix}$$

Adjacency/Weights' Matrix of Concepts shows the level of relationships between concepts. If the value is high, there is a strong connection between two concepts. Same way, if there is a lower value, then that connection is weaker.

2.3.2 Fuzzy cognitive maps

Cognitive maps show the relationship between concepts, but one of the shortcomings is that they only deal with whether the relationship is positive or negative. But from time to time, the strength or size of this relationship may need to be known. Fuzzy cognitive maps can be used for such situations. In summary, the strength of the causality between concepts do not have to be equal to -1, 0 or 1, it can be between -1 and 1. It can be said that fuzzy cognitive maps (FCMs) is a type of cognitive maps that are using Fuzzy Logic.

Fuzzy cognitive maps are used in many fields and researches to find an optimal solution. There are some examples in the table below.

Table 4.2 : Some examples for application fields of FCM

Author(s)	Fields
Stylios et al. (2008)	Medicine
Amirkhani et al. (2017)	
Hobbs et al. (2002)	Environment
Özesmi and Özesmi (2004)	
Xirogiannis and Glykas (2004)	Business
Riberio et al. (2017)	
Lee et al. (2011)	
Jetter and Schweinfart (2011)	Energy
Papageorgiou et al. (2009)	Agriculture
Cole and Persichitte (1999)	Education
Repiso et al. (2007)	IT
Chen and Chiu (2016)	Engineering
Peter et al. (2015)	Production

As can be seen in the table above, FCM is used in many areas. FCM can be very useful in situations where it is often complex and difficult to model.

In this research, FCM method is used for the targeted output. The factors affecting customer preferences will be determined from the literature. Afterwards, the relationship and degree of these preference criteria will be determined by interviewing people who are experts in the sector and have strong knowledge in this field. The results of combining these two inputs will be analyzed with the FCM methodology and the most important preference criteria will be determined. As the FCM methodology can be used in many different fields and purposes as mentioned above, it can also be used very effectively in deciding which areas businesses should focus on in line with customer preferences and expectations in telecom industry.

3. METHODOLOGY

Brand is one of the most important parts of businesses and many elements are brought together to create a brand. In order for customers to prefer brands, businesses need to consider both customer general and specific expectations, focus on the right points and offer the most appropriate solution to customers because customers consider many factors when making their brand choices. The aim of this study is to determine which areas the companies operating in the telecommunications sector should focus on according to customer expectations and criteria for brand preference by using the Fuzzy Cognitive Mapping (FCM) method.

FCM method is chosen because the system is very dynamic and complex. Each criterion may be related to or affect each other directly or indirectly. The FCM method can be very useful when there are many criteria and it is difficult to develop a model to find the most suitable criteria.

First, the expectations of customers from telecom companies are investigated by looking at the past research on the telecom industry in the literature. Many different criteria have been observed from many sources. Although many of the studies reach similar results, there are points where they differ or express the same result with different words. The criteria obtained in different studies were brought together and a list of criteria was created for this study. For the criteria list, the major criteria found in each study were taken, and the criteria expressed with different words were combined under a single title. The criteria list created as a result of this has formed the basic inputs of the FCM method.

After the criteria list was created, the FCM method was started to be applied. Experts are asked about the relationships between the criteria and strength of the relationships if there is. The strengths of the relationships are between 1 and 5, with 1 being the least and 5 the most. There is no specific rule about the number of experts whose advice will be taken. In the literature, a different number of experts are consulted for the relationship map. For example, in the study of Uygun et al. (2017) the opinions of 3 experts are included, while in the study of Stylios &

Groumpos, (2004), the opinions of 4 experts are used. In this study, 9 different experts are asked about the relationships between concepts in order to reach more accurate outputs.

A fuzzy cognitive map and weights' matrix is shown in the image below. The nodes here indicate the concepts in the system, and the arrows indicate the direction and strength of causality.

FCM is a method that is capable of solving such models with its linguistic variables structure which makes it more understandable for the experts or decision makers. The definition of inter-conceptual relations with fuzzy sets instead of numerical expressions creates a qualitative model and enables experts to transfer the knowledge in their field of expertise to the system with simple linguistic expressions, avoiding sensitive numerical expressions. Linguistic variables can take values using membership functions in the range $[-1,1]$ (Uygun et al., 2017).

For example, an expert can think that Concept 1 affects Concept 2 much positively (it means 0,8 out of 1) It can be scaled according to the researcher.

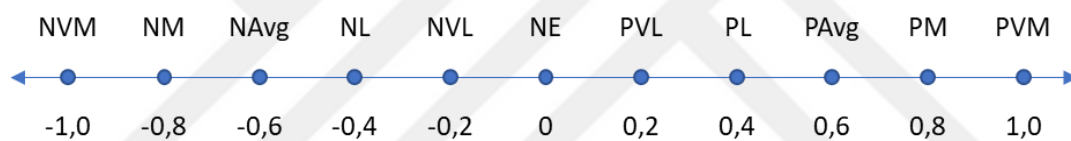


Figure 3.1 : Visualisation of linguistic variants.

The image above can be an example for scaling of linguistic variants. Means of the abbreviations are below:

PVM: Positive Very Much

PM: Positive Much

PAv: Positive Average

PL: Positive Less

PVL: Positive Very Less

NE: No Effect

NVM: Negative Very Much

NM: Negative Much

NAvg: Negative Average

NL: Negative Less

NVL: Negative Very Less

Fuzzy cognitive maps are dynamic systems and it works step by step. In every iteration, calculations are made until the result is got. Because of its dynamic nature, any concept can be added to or removed from the system.

The way the system and iterations work is as follows.

First of all, concepts that affect each other or not and their weights should be determined by experts.

If the concept of C_j affects the concept of C_i , this effect will also have a weight W_{ji} in the range $[-1,1]$ (Groumpos, 2015).

- If W_{ji} is greater than zero, the relationship between C_j and C_i is positive. For example, an increase in the value of C_j will cause an increase in the value of C_i .
- If W_{ji} is less than zero, the relationship between C_j and C_i is negative. For example, an increase in the value of C_j will cause an decrease in the value of C_i .
- If W_{ji} is equal to zero, there is no relationship between C_j and C_i

The farther W_{ji} is from zero, in other words, the greater its absolute value, the greater the effect.

The arithmetic average of the strengths of all relationships is taken after receiving the opinions of all experts. In order to include zero values in the mean and calculation, the arithmetic mean was taken instead of the geometric mean. A relationship map is drawn up according to this table to visualize the relationships between criteria.

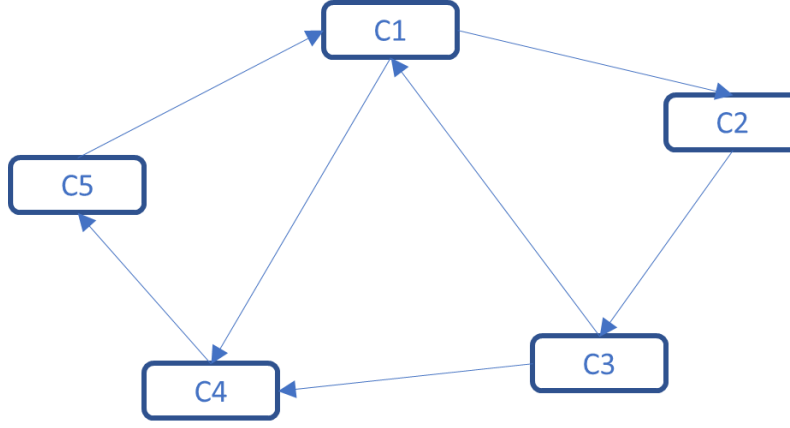


Figure 3.2 : An example of a fuzzy cognitive map.

To create the weights' matrix, the values of the final relationship table are reduced between [0,1]. Experts voted the strength of relationships between [1,5], because of this reducing is done by dividing the values by 5. Very low-impact relationships and relationships that were voted on by only a small percentage of experts are excluded to reduce complexity of the model. Because the purpose of the model is to find the most effective criteria, the excluded relationships do not serve this purpose and also make it difficult to reach the result. If a relationship rate is below or equal to 0,2, it means its strength is below 1 out of 5, because 0,2 corresponds to 1 in terms of opinions of experts, this relationship is ignored. Besides, relationships that are voted by 3 or less experts ignored also to avoid confusion. Because it is not possible for a relationship that few people say, even with maximum severity, to have a large enough impact to affect the system, but it creates complexity.

The weights' matrix is created after obtaining the final relationship table by eliminating the relationships that has minor effect. Weights' matrix of concepts shows the level of relationships between concepts. If the value is high, there is a strong connection between two concepts. Same way, if there is a lower value, then that connection is weaker.

Table 4.3 : An example of an adjacency / weights' matrix of a fuzzy cognitive map.

$$\begin{pmatrix} 0 & W_{12} & 0 & W_{14} & 0 \\ 0 & 0 & W_{23} & 0 & 0 \\ W_{31} & 0 & 0 & W_{34} & 0 \\ 0 & 0 & 0 & 0 & W_{45} \\ W_{51} & 0 & 0 & 0 & 0 \end{pmatrix}$$

In this study, iteration method will be used to get and interpret the results. In this method, activation matrix will be used to provide interconnection between concepts that are in relationship between each other. It is said that above, FCM is a dynamic system and works step by step. The values of each concept are affected by other concepts by applying the equation below (Kyriakarakos et al., 2017).

$$A_i^{(k+1)} = f \left([A_i(k)] + \sum_{j=1, j \neq i}^n [A_j(k) \times W_{ji}] \right) \quad (3.1)$$

In this formula, j. concepts influence i. concepts where:

A_i = Initial value of influenced i concept's Activation Matrix at k. step

$A_i^{(k+1)}$ = Value of influenced i concept's Activation Matrix at k+1. step

A_j = Value of influencer j concept

W_{ji} = Weighted values for [ji] cell, $W_{ji} \in [-1,1]$

$A_i, A_j \in [0,1]$

$i, j = 1, 2, \dots, N$ where N is the total number of nodes

This value gets a new value at each step. Conversion formulas are used to keep this value within a certain range, which is usually between 0 and 1. 4 of the most used formulas are shown below. Since negative values will be meaningless in the model output, the sigmoid function is used in this research. (Akıncı & Yeşil, 2013)

- bivalent

$$f(x) = \begin{cases} 0, & x \leq 0 \\ 1, & x > 0 \end{cases} \quad (3.2)$$

- trivalent

$$f(x) = \begin{cases} -1, & x \leq -0,5 \\ 0, & -0,5 < x \leq 0,5 \\ 1, & x > 0,5 \end{cases} \quad (3.3)$$

- logistic (sigmoid)

$$f(x) = \frac{1}{1 + e^{-x}} \quad (3.4)$$

- hyperbolic tangent

$$f(x) = \tan(\lambda x) = \frac{e^x - e^{-x}}{e^x + e^{-x}} \quad (3.5)$$

Last of all, the steps for iterations will be as below (Papageorgiou et al., 2011):

1. The initial vector $A(k)$ is defined according to the experts' opinion.
2. The initial vector A and the W matrix determined by the experts are multiplied by using Eq. (3.1)
3. The result is kept between zero and one using the Eq. (3.4).
4. The new $A(k+1)$ is defined as the initial vector of next step
5. Step 2, 3 and 4 are repeated until the difference between vectors is less than 0,001.

FCM Mappers application is used for these calculations. Because it not only offers a convenient excel format for calculations, but also allows to reach the result in a shorter time due to time constraints.

Indegree, outdegree and centrality values of each concept can be found in this tool. Indegree value means the total absolute amount of column of each concept while outdegree value states total absolute amount of row of each concept. Centrality is sum of indegree and outdegree values of each concept. It can be said that level of impact of a concept can be seen by looking at the centrality of it. Centrality shows the how strong the total impact of a concept. Indegree or outdegree values says the type of concept that if it is transmitter, receiver or ordinary. Transmitter concepts have positive outdegree with zero indegree values, on the other hand receiver concepts have positive indegree with zero outdegree. In other words, transmitters only affect other concepts and receivers are affected by other concepts. (Byung Sung Yoon & Jetter, 2016) Ordinary concepts can have both outdegree and indegree values. So they affect and are affected by others.

- Outdegree

$$\sum_{k=1}^N |W_{ik}| \quad (3.6)$$

- Indegree

$$\sum_{k=1}^N |W_{ki}| \quad (3.7)$$

- Centrality

$$\sum_{k=1}^N |W_{ik}| + \sum_{k=1}^N |W_{ki}| \quad (3.8)$$

After the iterations are made, each criterion has a reference value. This value shows the importance of each criterion for the system. Scenario analysis is performed for each criterion by increasing or decreasing these reference values. Scenario analyzes are an effective way to see how one criterion affects other criteria and how much it changes reference values.

According to the outputs of the application, the results are interpreted and suggestions are made.





4. APPLICATION

In this study, it will be investigated that which criteria the businesses sector should focus on by using FCM modeling in line with customer preferences/expectations.

4.1 Determining the Criteria

First, the expectations of customers from telecom companies are investigated by looking at the past researches on the telecom sector in the literature. Many different criteria have been observed from many sources. These criteria can be listed as follows.

Table 4.1 : Some examples for application fields of FCM

Author(s)	Criteria
Şahin and Topal (2020)	Attitude and service quality of service center employees, The physical atmosphere of the service centers and the interest of the employees, Content of advertisements, Communication quality, Speed in service delivery, Tariff and price, Suggestion by family and friends, The effectiveness and adequacy of advertisements, Honesty
Barutçu (2007)	Price, Being the operator used by family and friends, Coverage Area, Advantages offered to students, Variety of services offered, Advantages that other GSM operators do not offer, Reward programs for frequent users, Friend recommendations, Advertisement
Şengün ve Menteş (2018)	Quality, Price, Image, Promotions, Family and friends
Dündar and Ecer (2008)	Price, Coverage area, Family's GSM operator subscription, Service quality
Doğru and Koçer (2016)	Network power, Price, Social responsibility projects, service quality
Alamro and Rowley (2011)	Brand awareness, brand image, Consumer attribute
Qayyum et al. (2016)	Customer satisfaction Perceived service quality, Perceived value, Perceived switching costs, Trust, Corporate image
Chakraborty et al. (2013)	Generic requirements, Functional quality, Price, Flexibility
Olatokun and Nwonne (2012)	Price, Service quality, Service availability, Promotion, Brand image
Shafei et al. (2016)	Call quality, Pricing structure, Value added services, Customer support

Although the criteria may seem different at first glance, in fact the same criteria are written with different words. For example, price from Olatokun and Nwonne (2012) and pricing structure from Shafei et al. (2016) refer to the same criterion. Same way, friend recommendations from Barutçu (2007), family and friends from Şengün and Menteş (2018) or family's GSM operator subscription from Dünder and Ecer (2008) refer to same criterion which is combined under 'family and friends use / suggest' in this research.

Therefore, by combining the above criteria, the following criteria have been formed as a summary under certain headings.

1. Price

This is the price of any product or service for customers buy from an operator.

2. Coverage Area

Coverage area is the ability that the operators can provide uninterrupted service in the region they serve.

3. Network quality / speed

Network quality is the strength and continuity of service to customers. In addition, the internet speed of the customers who are offered mobile internet service can also be related to the network quality.

4. Service quality

Service quality is the quality of presenting the products and services offered to customers. For example, the shorter the waiting time of a customer calling the call center, the higher the quality.

5. Variety of services

Service diversity is the differentiation of products and services offered to customers and finding solutions to different needs of customers. An example of diversity is that an operator providing mobile services offers customers not only a voice or data line, but also a platform where they can listen to music.

6. Use/suggestion by family and friends

People around the customers recommend the operators they use. It could be because of price, quality or anything else.

7. Image / Emotional bond

Brands try to create an image in the society through advertisements, social responsibility activities or different methods. With the effect of this image or a different effect, people can establish an emotional bond with brands.

8. Advertisement / Communication

It is the brands' placing advertisements on television, newspapers, internet or other media and communicating with their consumers through this means.

9. Trust

Trust is the confidence of the customers on companies if companies fulfill the promises or not. For example, encountering surprise prices on month-end invoices undermines trust.

The concepts and abbreviations to be used in the study can be listed as follows:

- Concept 1 (C1): Price .
- Concept 2 (C2): Coverage Area
- Concept 3 (C3): Network quality / speed
- Concept 4 (C4): Service quality
- Concept 5 (C5): Variety of services
- Concept 6 (C6): Use/suggestion by family and friends
- Concept 7 (C7): Image / Emotional bond
- Concept 8 (C8): Advertisement / Communication
- Concept 9 (C9): Trust

4.2 Data Collection

In fuzzy cognitive mapping, all concepts may have a relationship between them. To clarify that, a survey is conducted to the experts from telecommunication sector. This

survey helped the study to detect positive or negative relationships between concepts.

Experts:

- Work in one of three biggest telecom operators in Turkey
- Work as a product manager, marketing manager or similar fields that are related to campaigns
- Have strong knowledge about telecom industry
- Have at least three years of experience

To get data from experts, questions are asked them from survey sheet that is shown in appendices as Appendix A via e-mail or online meeting. The survey is conducted separately so that answers of the experts do not affect the answers of others. Experts are asked to tell +,- or 0 to detect relationships between concepts. If there is a relationship, they are asked to tell the level of relationship (1, 2, 3, 4, 5) of actors. This survey helped to structure the pairwise comparison between concepts and building illustrative map, and creating Adjacency/Weights' matrix.

These numbers represents the rates as below:

- Level 1: %20 effective
- Level 2: %40 effective
- Level 3: %60 effective
- Level 4: %80 effective
- Level 5: %100 effective

4.3 Structuring the Relationships' (Cognitive) Map

Before doing pairwise comparison, it can be useful to give some information about table. The table shows the positive or negative correlation between concepts. If there is a (+) sign in a little cell, it means that the concept in the row affect the concept in the column positively. Same way, if there is a (-) sign in a little cell, it means that the concept in the row affect the concept in the column negatively. If there is a (0) sign in a little cell, it means that the concept in the row and the concept in the column are not correlated directly.

4.3.1 Opinions of experts

9 different experts are asked about the relationships between the concepts. The opinions expressed by all experts are given in the tables below. The first yellowish row and column in the table indicate the criteria. The blue cells indicate whether there is a relationship, while the green cells just to the right of the blue cells indicate the magnitude of the relationship if there is a relationship between concepts.

Expert 1

Table 4.2 : Votes of Expert 1.

Criteria	C1		C2		C3		C4		C5		C6		C7		C8		C9	
C1											-	-5	+	2	+	2		
C2	-	-2					+	2	+	1	+	1	+	2	+	1	+	3
C3	-	-5					+	5	+	2	+	4	+	5	+	4	+	4
C4	-	-5							+	1	+	4	+	4	+	3	+	4
C5							+	2			+	3	+	3	+	4		
C6													+	4			+	4
C7	-	-3									+	4					+	4
C8																	+	2
C9											+	3	+	5				

According to Expert 1, there are 35 relationships. C2 and C3 affect the others the most and C6 and C7 are most affected by the others in terms of the number of relationships.

Expert 2

Table 4.3 : Votes of Expert 2.

Criteria	C1		C2		C3		C4		C5		C6		C7		C8		C9	
C1																		
C2	-	-5			+	4					+	5	+	4			+	4
C3	-	-5									+	5	+	4			+	4
C4	-	-5									+	4	+	3			+	3
C5	-	-1															+	2
C6													+	2			+	4
C7											+	4					+	4
C8													+	3				
C9	-	-3									+	4	+	4				

According to opinion of Expert 2, there are 23 relationships. C2 is the one that affects the others the most and C7 is the one that is most affected by the others in terms of the number of relationships.

Expert 3

Table 4.4 : Votes of Expert 3.

Criteria	C1		C2		C3		C4		C5		C6		C7		C8		C9	
C1									+	2	-	-5	-	-2			-	-2
C2	-	-3			+	5	+	3	+	3	+	5	+	3	+	4	+	4
C3	-	-3	+	5			+	3	+	3	+	5	+	3	+	4	+	4
C4	-	-2							+	4	+	5	+	4	+	4	+	4
C5							+	4			+	4	+	3	+	3	+	3
C6													+	5	+	5	+	5
C7											+	5			+	5	+	5
C8											+	5	+	5			+	5
C9											+	5	+	5				

According to opinion of Expert 3, there are 42 relationships. C2 and C3 are the criteria that affect the others the most and C6, C7 and C9 are the criteria that are most affected by the others in terms of the number of relationships.

Expert 4

Table 4.5 : Votes of Expert 4.

Criteria	C1		C2		C3		C4		C5		C6		C7		C8		C9	
C1			+	4	+	4	+	5	+	5	-	-2	+	3	+	5	+	4
C2	-	-4					+	4	+	4	+	5	+	4	+	4	+	4
C3	-	-4									+	5	+	4	+	4	+	5
C4	-	-4							+	4	+	5	+	5	+	4	+	5
C5	-	-4					+	3			+	4	+	5	+	5	+	5
C6	-	-4			-	-3	-	-3	+	4			+	5	+	4	+	4
C7	-	-4									+	5			+	5	+	4
C8	-	-4									+	5	+	5			+	5
C9											+	4	+	5				

According to opinion of Expert 4, there are 49 relationships. C2 is the one that affects the others the most and C6, C7 and C9 are the criteria that are most affected by the others in terms of the number of relationships.

Expert 5

Table 4.6 : Votes of Expert 5.

Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1						-3	2		
C2	-4			3		2	4	1	3
C3	-4			3		4	4	4	4
C4	-4				2	4	4	3	4
C5				3		4	5	4	
C6							2		4
C7	-3								
C8							5		
C9							5		

According to opinion of Expert 5, there are 29 relationships. C2 and C3 are the criteria that affect the others the most and C7 is the one that is most affected by the others in terms of the number of relationships.

Expert 6

Table 4.7 : Votes of Expert 6.

Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1		-2	-4	-4		-3	5	1	
C2	-1			2		1			3
C3	-4			3	3	4	5		5
C4	-4				3	4	3		4
C5				2					
C6									4
C7	-3					4			4
C8									2
C9						3	5		

According to opinion of Expert 6, there are 29 relationships. C1 and C3 are the criteria that affect the others the most and C6 and C9 are the criteria that are most affected by the others in terms of the number of relationships.

Expert 7

Table 4.8 : Votes of Expert 7.

Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1							+ 1	+ 4	
C2	- -3		+ 2	+ 4		+ 2	+ 2		+ 4
C3	- -5	+ 2		+ 5		+ 5	+ 5		+ 5
C4	- -4				+ 3	+ 5	+ 5		+ 5
C5	- 2			+ 1		+ 5	+ 5	+ 4	+ 3
C6							+ 2		+ 5
C7	- -5							+ 5	+ 4
C8							+ 3		+ 2
C9							+ 5		

According to opinion of Expert 7, there are 33 relationships. C2 and C3 are the criteria that affect the others the most and C7 is the one that is most affected by the others in terms of the number of relationships.

Expert 8

Table 4.9 : Votes of Expert 8.

Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1						- -2	+ 3	+ 4	+ 3
C2	- -1			+ 1	+ 2	+ 3		+ 1	+ 1
C3	- -4			+ 4	+ 2	+ 3	+ 5	+ 4	+ 5
C4	- -3				+ 2	+ 3	+ 5	+ 4	+ 2
C5	- -3					+ 3	+ 4	+ 4	+ 3
C6							+ 3		+ 5
C7	- -3							+ 2	+ 5
C8	- -3						+ 5		+ 2
C9						+ 3	+ 5	+ 3	

According to opinion of Expert 8, there are 39 relationships. C3 is the one that affects the others the most and C9 is the one that is most affected by the others in terms of the number of relationships.

Expert 9

Table 4.10 : Votes of Expert 9.

Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1						-3	4		
C2	-1		-3	3	3	2	1	2	5
C3	-4	-2		5	4	5	5	3	5
C4	-4	-2			2	5	4	5	5
C5				4		5	4	5	
C6				-2	1				4
C7	-4					5		2	5
C8							4		4
C9						4	5		

According to opinion of Expert 9, there are 40 relationships. C2 and C3 are the criteria that affect the others the most and C6 and C7 are the criteria that are most affected by the others in terms of the number of relationships.

Average of all experts' opinions

Table 4.11 : Average of all experts' opinions.

Average	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1	-	+ 0,22	0,00	+ 0,11	+ 0,78	- 2,56	+ 2,00	+ 1,78	+ 0,56
C2	- 2,67	-	+ 0,89	+ 2,44	+ 1,44	+ 2,89	+ 2,22	+ 1,44	+ 3,44
C3	- 4,22	+ 0,56	-	+ 3,11	+ 1,56	+ 4,44	+ 4,44	+ 2,56	+ 4,56
C4	- 3,89	- 0,22	-	-	+ 2,33	+ 4,33	+ 4,11	+ 2,56	+ 4,00
C5	- 0,67	-	-	+ 2,11	-	+ 3,11	+ 3,22	+ 3,22	+ 1,78
C6	- 0,44	-	- 0,33	- 0,56	+ 0,56	-	+ 2,56	+ 1,00	+ 4,33
C7	- 2,78	-	-	-	-	+ 3,00	-	+ 2,11	+ 3,89
C8	- 0,78	-	-	-	-	+ 1,11	+ 3,33	-	+ 2,44
C9	- 0,33	-	-	-	-	+ 2,89	+ 4,89	+ 0,33	-

According to opinion of all experts, there are 56 relationships (one is the with average of 1). C1, C2 and C3 are the criteria that affect the others the most and C1, C6, C7, C8

and C9 are the criteria that are most affected by the others in terms of the number of relationships.

A cognitive map is drawn in order to visualize the relationships and make it more clear to understand (the relationship between $C1 \rightarrow C3$ is not drawn because it's average effect is zero).

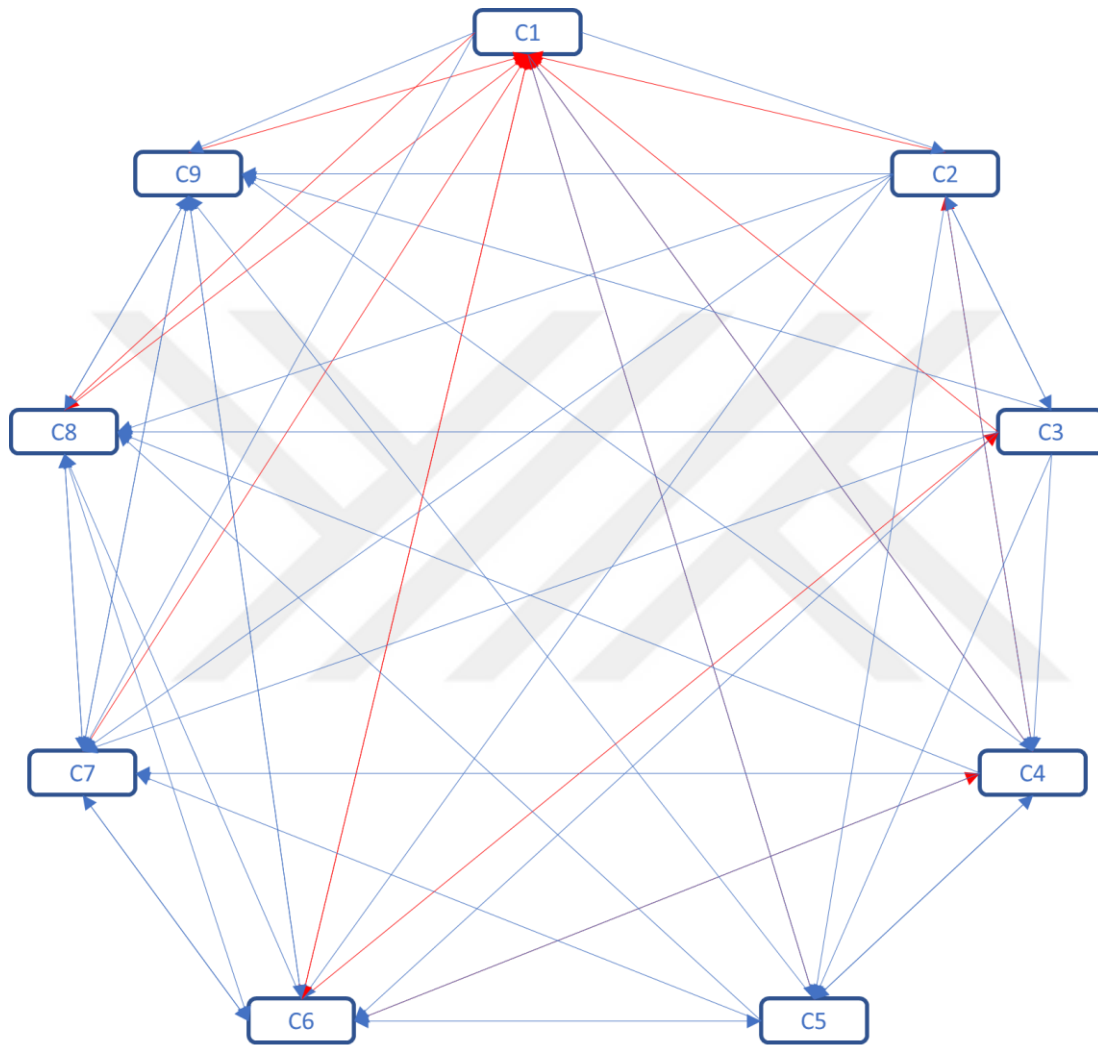


Figure 4.1 : Relationship map between criteria.

From C1 to C9 in the boxes are the criteria that are defined before. The arrows between the criteria show the relationship between them. Blue arrows indicate a positive relationship, while red ones indicate a negative relationship.

It can be seen that the problem has a complex structure on the relationships' map. Ratio of number of arrows to number of concepts is 6,1 (55 arrows, 9 concepts). This result show how complex this problem is. This image shows us the direct relationships. For example, service quality (C4) affects image / emotional bond (C7) directly and

positively or network quality (C3) affects price (C1) directly and negatively. It means that if service quality increases, image / emotional bond increases also. Or a positive change in network quality cause a negative change in price. It increases price but price increase is a negative thing.

First of all, the values in the table are the values that the experts voted between 1 and 5. Therefore, the values in the averages table are also between 1 and 5. However, these values need to be reduced between 0 and 1 in order to be used in FCM calculations. For this, all the values in the table can be divided by 5 and a reduced average table can be obtained.

The table is shown below.

Table 4.12 : Reduced average of all experts' opinions.

Average [0,1]	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1	-	0,04	0,00	0,02	0,16	- 0,51	+ 0,40	+ 0,36	0,11
C2	- 0,53	-	0,18	+ 0,49	+ 0,29	+ 0,58	+ 0,44	+ 0,29	+ 0,69
C3	- 0,84	0,11	-	+ 0,62	+ 0,31	+ 0,89	+ 0,89	+ 0,51	+ 0,91
C4	- 0,78	- 0,04	-	-	+ 0,47	+ 0,87	+ 0,82	+ 0,51	+ 0,80
C5	- 0,13	-	-	+ 0,42	-	+ 0,62	+ 0,64	+ 0,64	+ 0,36
C6	- 0,09	-	-0,07	- 0,11	0,11	-	+ 0,51	0,20	+ 0,87
C7	- 0,56	-	-	-	-	+ 0,60	-	+ 0,42	+ 0,78
C8	- 0,16	-	-	-	-	+ 0,22	+ 0,67	-	+ 0,49
C9	- 0,07	-	-	-	-	+ 0,58	+ 0,98	0,07	-

It is said that above the complexity of the system is very high. To reduce this complexity two more criteria are examined.

1. The rates below or equal to 0,2 are ignored. Because if it is below 0,2, it means that the strength of the relationship is below 1 out of 5 (0,2 corresponds to 1 in terms of opinions of experts.) and average of all experts say that there is no relationship or the importance of the relationship is very low
2. Relationships that are voted by minority of experts but are not voted by most of them are ignored in order not to mislead the results and to avoid erroneous results. If number of votes for a relationship is less then or equal to 3, that relationship is ignored for this reason.

According to these criteria, two new tables are shown below

Table 4.13 : Reduced average of all experts' opinions after ignored relationships.

Average	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1	-	0,04	0,00	0,02	0,16	- 0,51	+ 0,40	+ 0,36	0,11
C2	- 0,53	-	0,18	+ 0,49	+ 0,29	+ 0,58	+ 0,44	+ 0,29	+ 0,69
C3	- 0,84	0,11	-	+ 0,62	+ 0,31	+ 0,89	+ 0,89	+ 0,51	+ 0,91
C4	- 0,78	- 0,04	-	-	+ 0,47	+ 0,87	+ 0,82	+ 0,51	+ 0,80
C5	- 0,13	-	-	+ 0,42	-	+ 0,62	+ 0,64	+ 0,64	+ 0,36
C6	- 0,09	-	- 0,07	- 0,11	0,11	-	+ 0,51	0,20	+ 0,87
C7	- 0,56	-	-	-	-	+ 0,60	-	+ 0,42	+ 0,78
C8	- 0,16	-	-	-	-	+ 0,22	+ 0,67	-	+ 0,49
C9	- 0,07	-	-	-	-	+ 0,58	+ 0,98	0,07	-

This table is reorganized according to criteria 1 and the cells are filled with red are ignored because they are below or equal to 0,2

Table 4.14 : Number of votes.

# of Votes	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1	-	2	2	2	2	7	8	5	3
C2	+ 9	-	+ 4	+ 8	+ 5	+ 9	+ 7	+ 6	+ 9
C3	+ 9	3	-	+ 7	+ 5	+ 9	+ 9	+ 6	+ 9
C4	+ 9	1	-	-	+ 8	+ 9	+ 9	+ 6	+ 9
C5	+ 4	-	-	+ 7	-	+ 7	+ 7	+ 7	+ 5
C6	1	-	1	2	2	-	+ 7	2	+ 9
C7	+ 7	-	-	-	-	+ 6	-	+ 5	+ 8
C8	2	-	-	-	-	2	+ 7	-	+ 7
C9	1	-	-	-	-	+ 7	+ 9	1	-

This table shows the number of votes from experts for each relationship. The blue cells indicate whether there are votes, and the green cells to the right of the blue cells indicate how many votes, if any. The cells are filled with red are ignored because they are below or equal to 3.

It is seen that the eliminated criteria are mostly common. The differing points are:

- C5 → C1 Even if it gets four votes from experts, the average effect is less than or equal to 0,2.

- C2 → C3 Even if it gets four votes from experts, the average effect is less than or equal to 0,2.
- C8 → C6 Even if the average effect is more than 0,2, it gets two votes from experts.

According to these results, the final table is created below.

Table 4.15 : Final table of relationships.

Final	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1	-	-	-	-	-	- 0,51	+ 0,40	+ 0,36	-
C2	- - 0,53	-	-	+ 0,49	+ 0,29	+ 0,58	+ 0,44	+ 0,29	+ 0,69
C3	- - 0,84	-	-	+ 0,62	+ 0,31	+ 0,89	+ 0,89	+ 0,51	+ 0,91
C4	- - 0,78	-	-	-	+ 0,47	+ 0,87	+ 0,82	+ 0,51	+ 0,80
C5	-	-	-	+ 0,42	-	+ 0,62	+ 0,64	+ 0,64	+ 0,36
C6	-	-	-	-	-	-	+ 0,51	-	+ 0,87
C7	- - 0,56	-	-	-	-	+ 0,60	-	+ 0,42	+ 0,78
C8	-	-	-	-	-	-	+ 0,67	-	+ 0,49
C9	-	-	-	-	-	+ 0,58	+ 0,98	-	-

This table shows the final situation. There are 38 relationships with 9 criteria. Its complexity is 4,2. Adjacency / weights' matrix will be drawn according Table 4.15.

4.3.2 Adjacency / weights' matrix

Adjacency / weights' matrix shows the relationships between concepts. According to the final table, the matrix will be as following.

Table 4.16 : Adjacency / Weights' matrix.

0	0	0	0	0	-0,51	0,40	0,36	0
-0,53	0	0	0,49	0,29	0,58	0,44	0,29	0,69
-0,84	0	0	0,62	0,31	0,89	0,89	0,51	0,91
-0,78	0	0	0	0,47	0,87	0,82	0,51	0,80
0	0	0	0,42	0	0,62	0,64	0,64	0,36
0	0	0	0	0	0	0,51	0	0,87
-0,56	0	0	0	0	0,60	0	0,42	0,78
0	0	0	0	0	0	0,67	0	0,49
0	0	0	0	0	0,58	0,98	0	0

4.4 Analysis

4.4.1 Calculations

Weights' matrix of concepts shows the level of relationships between concepts. If the value is high, there is a strong connection between two concepts. Same way, if there is a lower value, then that connection is weaker. In this study, iteration method will be used to get and interpret the results. In this method, activation matrix will be used to provide interconnection between concepts that are in relationship between each other. Weighted values are between 0 and 1 for activation matrix.

Besides, the Sigmoid function will be used in activation matrix to do iterations as mentioned above. It is very helpful to do iteration to keep the values between 0 and 1 for the next iterations.

$$A_i^{(k+1)} = f \left([A_i(k)] + \sum_{j=1, j \neq i}^n [A_j(k) \times W_{ji}] \right) \quad (3.1)$$

In this formula, j. concepts influence i. concepts where:

A_i = Initial value of influenced i concept's Activation Matrix at k. step

$A_i^{(k+1)}$ = Value of influenced i concept's Activation Matrix at k+1. step

A_j = Value of influencer j concept

W_{ji} = Weighted values for [ji] cell, $W_{ji} \in [-1,1]$

$A_i, A_j \in [0,1]$

$i, j = 1, 2, \dots, N$ where N is the total number of nodes

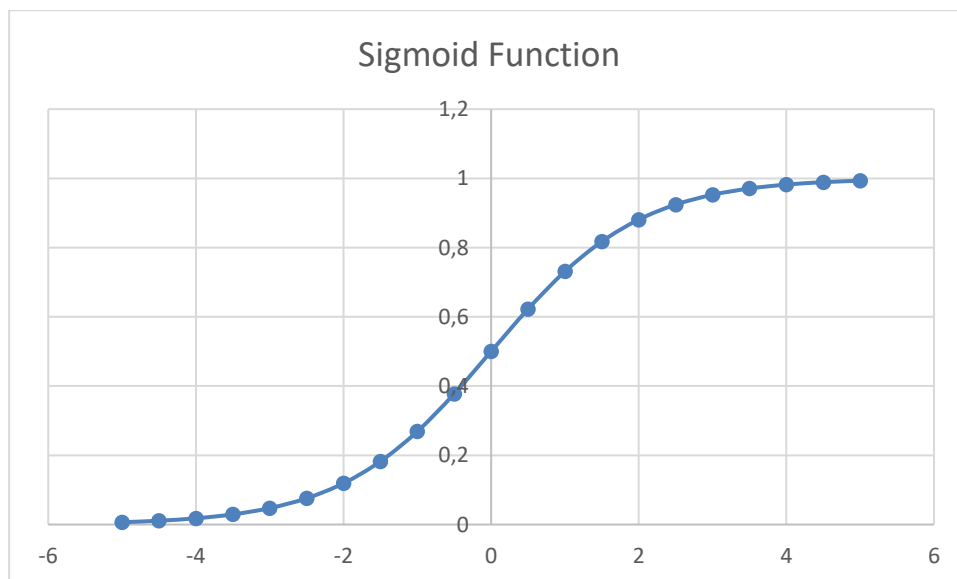


Figure 4.2 : Sigmoid function.

$$f(x) = \frac{1}{1 + e^{-x}} \quad (3.4)$$

FCMappers tool will be used to do computations. Because it provides an excel application to analyzing adjacency matrix and iterations. Indegree, outdegree and centrality values of each concept can be found in this tool. Indegree value means the total absolute amount of column of each concept while outdegree value states total absolute amount of row of each concept. Centrality is sum of indegree and outdegree values of each concept. It can be said that level of impact of a concept can be seen by looking at the centrality of it. Centrality shows the how strong the total impact of a concept. Indegree or outdegree values says the type of concept that if it is transmitter, receiver or ordinary. Transmitter concepts have positive outdegree with zero indegree values, on the other hand receiver concepts have positive indegree with zero outdegree. In other words, transmitters only affect other concepts and receivers are affected by other concepts. (Byung Sung Yoon & Jetter, 2016) Ordinary concepts can have both outdegree and indegree values. So they affect and are affected by others.

- Outdegree

$$\sum_{k=1}^N |W_{ik}| \quad (3.6)$$

- Indegree

$$\sum_{k=1}^N |W_{ki}| \quad (3.7)$$

- Centrality

$$\sum_{k=1}^N |W_{ik}| + \sum_{k=1}^N |W_{ki}| \quad (3.8)$$

4.4.2 Results and analysis

4.4.2.1 Outdegree, indegree and centrality values

First of all, it is better to start with the indegree, outdegree and centrality values of each concept.

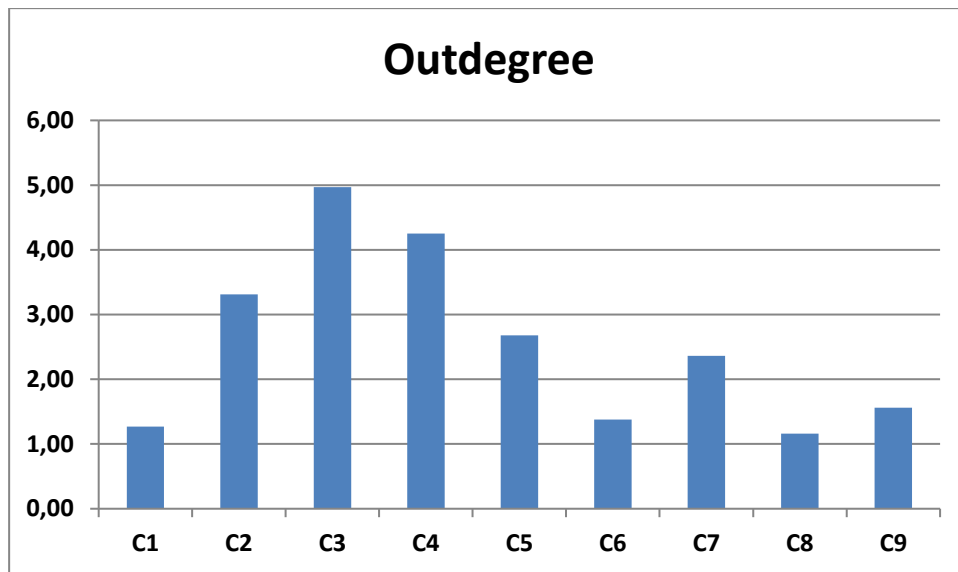


Figure 4.3 : Outdegree graph.

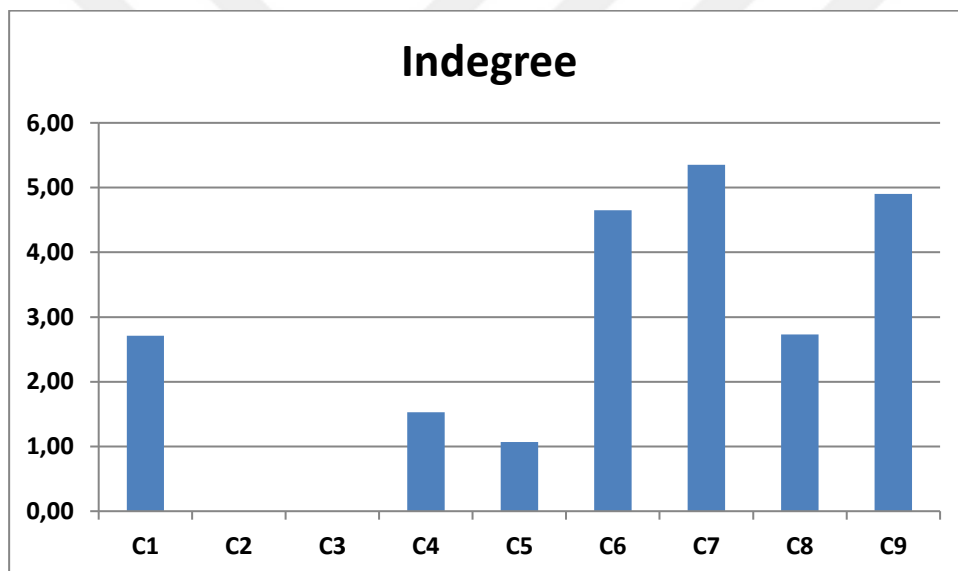


Figure 4.4 : Indegree graph.

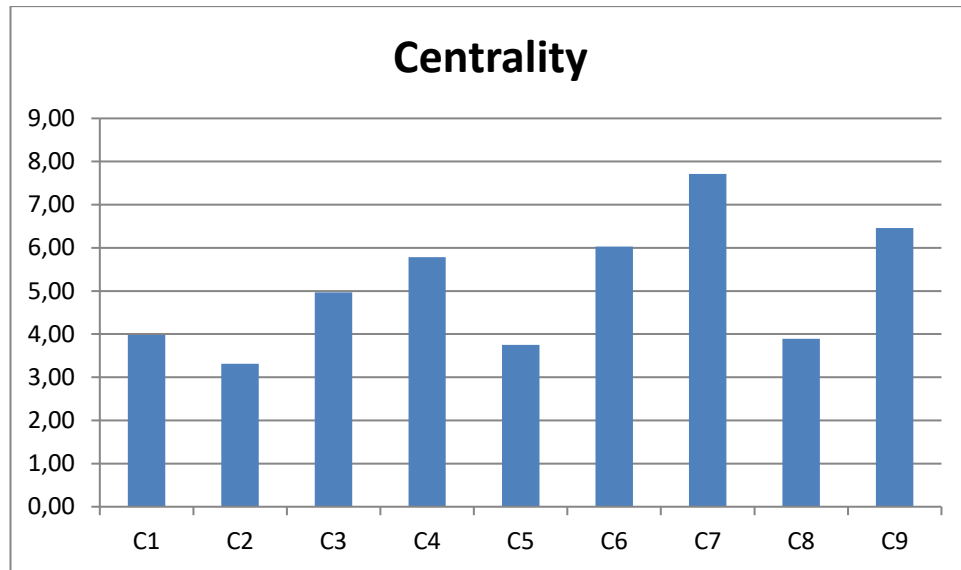


Figure 4.5 : Centrality graph.

Table 4.17 : Indegree, outdegree, centrality values with receiver, transmitter and ordinary information for each concept.

Concepts	Outdegree	Indegree	Centrality	Transmitter	Receiver	Ordinary
C1	1,27	2,71	3,98			+
C2	3,31	0	3,31	+		
C3	4,97	0	4,97	+		
C4	4,25	1,53	5,78			+
C5	2,68	1,07	3,75			+
C6	1,38	4,65	6,03			+
C7	2,36	5,35	7,71			+
C8	1,16	2,73	3,89			+
C9	1,56	4,9	6,46			+

It can be seen that in the table above;

- There are two transmitter concepts which are C2 and C3 and rest are ordinary concepts. There is no receiver concept.
- The highest centrality value belongs to C7 with 7,71 while the lowest one belongs to C2 with 3,31.
- The highest indegree value belongs to C7 with 5,35 while the lowest one belongs to C2 and C3 with 0.
- The highest outdegree value belongs to C3 with 4,97 while the lowest one belongs to C8 with 1,16.

4.4.2.2 Iteration result

Before doing scenario analysis and sensitivity, it can be better to show the reference ranks of each concept.

Table 4.18 : Concepts and their reference ranks.

Concepts	Reference
C1	0,116
C2	0,659
C3	0,659
C4	0,877
C5	0,838
C6	0,987
C7	0,995
C8	0,949
C9	0,994

Concepts and their reference ranks have given in Table 4. It can be seen that C6, C7, C8 and C9 are the most important criteria for brand preference compared to other criteria while C1 is the least important one. Next chapter scenario analysis will be done to see changes how an increase or decrease of each concept affect other concepts.

4.4.3 Scenario analysis

Scenario analyzes are made for each criterion in order to understand whether or how effective the criteria are on other criteria. In these analyzes, the reference ranks above will be decreased in the first scenario and increased in the second scenario. In this way, the effects of increases and decreases in the specified criteria on other criteria will be seen separately.

The first row and column in the tables indicate headings as usual. The criterion in the row filled in blue is the criterion for which the scenario analysis is made. Cells filled with red indicate that the criterion in that row decreased for that particular scenario, while cells filled with green indicate that it increased. If a cell is not filled with any color, it means that the criterion that the analysis is made for does not have any impact on the concept that corresponds to the cell.

4.4.3.1 Scenario 1: Change in price (C1)

Table 4.19 : Influences of change in price on other concepts.

Concepts	Reference	Decrease	Increase	% Change of Decrease	% Change of Increase
C1	0,116	0,000	1,000	-100,00%	759,46%
C2	0,659	0,659	0,659	0,00%	0,00%
C3	0,659	0,659	0,659	0,00%	0,00%
C4	0,877	0,877	0,877	0,00%	0,00%
C5	0,838	0,838	0,838	0,00%	0,00%
C6	0,987	0,988	0,980	0,07%	-0,73%
C7	0,995	0,995	0,996	-0,02%	0,15%
C8	0,949	0,947	0,963	-0,23%	1,47%
C9	0,994	0,994	0,994	0,00%	0,00%

It is seen that changes in price do not affect the other concepts too much.

4.4.3.2 Scenario 2: Change in coverage area (C2)

Table 4.20 : Influences of change in coverage area on other concepts.

Concepts	Reference	Decrease	Increase	% Change of Decrease	% Change of Increase
C1	0,116	0,170	0,096	46,10%	-17,62%
C2	0,659	0,000	1,000	-100,00%	51,73%
C3	0,659	0,659	0,659	0,00%	0,00%
C4	0,877	0,828	0,896	-5,51%	2,22%
C5	0,838	0,801	0,854	-4,40%	1,92%
C6	0,987	0,980	0,990	-0,79%	0,27%
C7	0,995	0,993	0,996	-0,21%	0,08%
C8	0,949	0,936	0,954	-1,33%	0,57%
C9	0,994	0,990	0,996	-0,40%	0,13%

From the table above, it can be said that coverage area affects the price most. It affects most of the criteria but the effect is not high. It has no impact on network quality/speed.

4.4.3.3 Scenario 3: Change in network quality / speed (C3)

Table 4.21 : Influences of change in network quality / speed on other concepts.

Concepts	Reference	Decrease	Increase	% Change of Decrease	% Change of Increase
C1	0,116	0,209	0,086	79,93%	-26,10%
C2	0,659	0,659	0,659	0,00%	0,00%
C3	0,659	0,000	1,000	-100,00%	51,73%
C4	0,877	0,813	0,901	-7,22%	2,73%

Table 4.21 (continued): Influences of change in network quality / speed on other concepts.

C5	0,838	0,798	0,856	-4,87%	2,07%
C6	0,987	0,974	0,991	-1,36%	0,38%
C7	0,995	0,990	0,996	-0,47%	0,14%
C8	0,949	0,926	0,958	-2,35%	0,92%
C9	0,994	0,989	0,996	-0,58%	0,17%

From the table above, it can be said that network quality / speed affects the price most and service quality second. It also affects almost every other criterion but the effect is not too much. It has no effect on coverage area.

4.4.3.4 Scenario 4: Change in service quality (C4)

Table 4.22 : Influences of change in service quality on other concepts.

Concepts	Reference	Decrease	Increase	% Change of Decrease	% Change of Increase
C1	0,116	0,226	0,106	94,27%	-9,09%
C2	0,659	0,659	0,659	0,00%	0,00%
C3	0,659	0,659	0,659	0,00%	0,00%
C4	0,877	0,000	1,000	-100,00%	14,08%
C5	0,838	0,761	0,847	-9,27%	1,06%
C6	0,987	0,970	0,989	-1,80%	0,14%
C7	0,995	0,989	0,995	-0,58%	0,05%
C8	0,949	0,919	0,952	-3,13%	0,34%
C9	0,994	0,988	0,995	-0,66%	0,06%

From the table above, it can be said that service quality affects the price most and variety of services second. It also affects almost every other criterion but the effect is not too much. It has no effect on coverage area and network quality / speed.

4.4.3.5 Scenario 5: Change in variety of services (C5)

Table 4.23 : Influences of change in variety of services on other concepts.

Concepts	Reference	Decrease	Increase	% Change of Decrease	% Change of Increase
C1	0,116	0,121	0,116	4,20%	-0,64%
C2	0,659	0,659	0,659	0,00%	0,00%
C3	0,659	0,659	0,659	0,00%	0,00%
C4	0,877	0,826	0,885	-5,77%	0,91%
C5	0,838	0,000	1,000	-100,00%	19,29%
C6	0,987	0,978	0,989	-0,99%	0,13%
C7	0,995	0,991	0,996	-0,42%	0,05%

Table 4.23 (continued): Influences of change in variety of services on other concepts.

C8	0,949	0,910	0,954	-4,05%	0,55%
C9	0,994	0,992	0,995	-0,26%	0,04%

From the table above, it can be said that variety of services do not have too much effect on other criteria but it affects price most also. It has no effect on coverage area and network quality / speed.

4.4.3.6 Scenario 6: Change in use/suggestion by family and friends (C6)

Table 4.24 : Influences of change in use/suggestion by family and friends on other concepts.

Concepts	Reference	Decrease	Increase	% Change of Decrease	% Change of Increase
C1	0,116	0,117	0,116	0,19%	0,00%
C2	0,659	0,659	0,659	0,00%	0,00%
C3	0,659	0,659	0,659	0,00%	0,00%
C4	0,877	0,877	0,877	0,00%	0,00%
C5	0,838	0,838	0,838	0,00%	0,00%
C6	0,987	0,000	1,000	-100,00%	1,29%
C7	0,995	0,992	0,995	-0,34%	0,00%
C8	0,949	0,949	0,949	-0,01%	0,00%
C9	0,994	0,986	0,994	-0,79%	0,01%

From the above, it is seen that family and friends use have low impact on other criteria.

4.4.3.7 Scenario 7: Change image / emotional bond (C7)

Table 4.25 : Influences of change in image / emotional bond on other concepts.

Concepts	Reference	Decrease	Increase	% Change of Decrease	% Change of Increase
C1	0,116	0,200	0,116	71,84%	-0,28%
C2	0,659	0,659	0,659	0,00%	0,00%
C3	0,659	0,659	0,659	0,00%	0,00%
C4	0,877	0,877	0,877	0,00%	0,00%
C5	0,838	0,838	0,838	0,00%	0,00%
C6	0,987	0,976	0,987	-1,16%	0,00%
C7	0,995	0,000	1,000	-100,00%	0,51%
C8	0,949	0,925	0,949	-2,54%	0,01%
C9	0,994	0,987	0,994	-0,71%	0,00%

From the table above, it can be said that image / emotional bond do not have too much effect on other criteria.

4.4.3.8 Scenario 8: Change in advertisement / communication (C8)

Table 4.26 : Influences of change in advertisement / communication on other concepts.

Concepts	Reference	Decrease	Increase	% Change of Decrease	% Change of Increase
C1	0,116	0,117	0,116	0,25%	-0,01%
C2	0,659	0,659	0,659	0,00%	0,00%
C3	0,659	0,659	0,659	0,00%	0,00%
C4	0,877	0,877	0,877	0,00%	0,00%
C5	0,838	0,838	0,838	0,00%	0,00%
C6	0,987	0,987	0,987	-0,01%	0,00%
C7	0,995	0,990	0,995	-0,45%	0,02%
C8	0,949	0,000	1,000	-100,00%	5,40%
C9	0,994	0,991	0,994	-0,35%	0,01%

From the table above, it can be said that advertisement / communication does not have too much effect on other criteria.

4.4.3.9 Scenario 9: Change in trust (C9)

Table 4.27 : Influences of change in trust on other concepts.

Concepts	Reference	Decrease	Increase	% Change of Decrease	% Change of Increase
C1	0,116	0,117	0,116	0,46%	0,00%
C2	0,659	0,659	0,659	0,00%	0,00%
C3	0,659	0,659	0,659	0,00%	0,00%
C4	0,877	0,877	0,877	0,00%	0,00%
C5	0,838	0,838	0,838	0,00%	0,00%
C6	0,987	0,977	0,987	-1,02%	0,00%
C7	0,995	0,987	0,995	-0,84%	0,00%
C8	0,949	0,949	0,949	-0,02%	0,00%
C9	0,994	0,000	1,000	-100,00%	0,58%

From the table above, it can be said that advertisement / communication does not have too much effect on other criteria.

4.5 Summary of Analysis

First of all, in order to determine the concepts that are important, it is necessary to look at the result of the iteration values of each concept. As said before, these values indicate the effect of the concept on the system.

Therefore, concepts with high values can be said to be the most important concepts for the system. Looking at Table 6.17, the importance levels of all concepts are seen. Of course, every concept is important for the study, but as a result of this study, the concepts with the greatest impact were determined. The following table lists the concepts in order of importance.

Table 4.28 : Reference ranks from largest to smallest.

Concepts	Reference
C7	0,995
C9	0,994
C6	0,987
C8	0,949
C5	0,838
C4	0,877
C2	0,659
C3	0,659
C1	0,116

From table 4.28, it can be said that network quality / speed, service quality and coverage area are criteria that are most effective and important concepts for brand preference.

On the other hand, indegree, outdegree and centrality values are also important resources in determining important concepts. Because these values shows the effect of one concept on other concepts, the effect of other concepts on a particular concept, or the overall level of influence of a concept. Outdegree and indegree values means different things but centrality indicates the sum of total effect of a concept. Although it is not as precise as the iteration results, it is normal for centrality to be parallel to the iteration results. In this context, the indegree, outdegree and centrality values are also listed separately from the largest to the smallest.

Table 4.29 : Outdegree values from largest to smallest.

Concepts	Outdegree
C3	4,97
C4	4,25
C2	3,31
C5	2,68
C7	2,36
C9	1,56
C6	1,38
C1	1,27
C8	1,16

From table 4.29, it can be said that image / emotional bond, trust and use/suggestion by family and friends are the criteria most influenced by the others.

Table 4.30 : Indegree values from largest to smallest.

Concepts	Indegree
C7	5,35
C9	4,9
C6	4,65
C8	2,73
C1	2,71
C4	1,53
C5	1,07
C3	0
C2	0

From table 4.30, it can be said that image / emotional bond, trust and use/suggestion by family and friends are the criteria most influenced by the others.

Table 4.31 : Centrality values from largest to smallest.

Concepts	Centrality
C7	7,71
C9	6,46
C6	6,03
C4	5,78
C3	4,97
C1	3,98
C8	3,89
C5	3,75
C2	3,31

From table 4.31, it can be said that image / emotional bond, trust and use/suggestion by family and friends are the criteria that are most effective and crucial for the system. These results are parallel to the iteration results as expected.





5. CONCLUSION

The aim of this thesis is to determine which areas the companies operating in the telecom sector should focus on based on customer expectations and criteria for brand preference by using FCM method. First of all, the concept of brand and the importance of the brand for customers and companies are mentioned. Afterwards, customer expectations from brands and specifically from telecom companies were analyzed and suggestions were presented to telecom companies.

Brand is a very important tool for consumers to distinguish products and to choose a business among many alternatives. Businesses have been trying to create and develop a brand from the moment they were born, and to offer their products and services to consumers under that brand.

Consumers choose the brand that they prefer to buy a product or service from among these brands according to the criteria they have determined. At this point, businesses are in a great race to become the brand preferred by consumers. This race is getting hotter and new players are joining the race every day. In this context, businesses should communicate with their customers correctly, improve the customer experience and listen to the voices of their consumers.

The dynamics of each industry is different and the products and services demanded by customers change accordingly. Apart from the standard setups that the businesses will make in order to be the brand preferred by the consumers, there are also steps that must be taken specific to the sector they are in and their own products and services. In this study, these steps have been analyzed in detail and conclusions have been reached regarding a sector such as the telecom where customer preferences are very variable.

Telecom companies analyze customer expectations with their experience and research over the years and take action accordingly. In addition, customer feedback also guides companies' development processes and investments. Every customer has different expectations from companies. Even if the customers clearly state their expectations from the companies, since many different needs arise from many customers,

companies focus on many different areas at the same time and try to meet most of the customer expectations. This situation forces the companies, so they focus on the point that they consider most important. This leads to the diversification of the market, the formation of customer segmentations and the preference of different companies by customers from different groups. For example, while one telecom operator focuses on improving the customer experience by giving importance to quality with a strong infrastructure, another operator may prefer the strategy of providing services to customers at affordable prices by placing less importance on infrastructure.

Although customer expectations differ, many of these expectations affect each other and expectations are intertwined. For example, infrastructure is also important for a customer whose expectation from the company is trust. Because a strong infrastructure fosters a sense of trust, so a company that wants its customers to trust itself should focus on infrastructure investments. This and many other examples can be given. This study was carried out to analyze customer expectations in this direction and to determine the criteria that most affect the system among the criteria.

Companies that are operating in the telecom industry should focus on different points specific to their own sector and products, in addition to the classic brand preference elements. Within the scope of the results achieved in this study, 9 criteria that consumers attach most importance to were determined. These criteria were obtained by combining many different studies as a result of literature review. After the interaction of these criteria with each other, the most critical criteria were determined by the FCM method.

According to this result, the three most important criteria were listed as follows.

- C7: Image / Emotional bond
- C9: Trust
- C6: Use/suggestion by family and friends
- C8: Advertisement / Communication
- C5: Variety of services
- C4: Service quality
- C2: Coverage area

- C3: Network quality / speed
- C1: Price

As a result, 'Image / Emotional bond', 'Trust' and 'Use/suggestion by family and friends' were determined as the most influencing factors of customer preferences.

One of the biggest difficulties experienced during the study was the simplification and combination of the criteria obtained from various studies. Many studies have been researched about the criteria affecting customer preferences in the telecom industry and many conclusions have been reached. Bringing them together and gathering them under certain headings has been challenging.

Another difficulty is to reveal the interaction and degree of the determined criteria with each other. For this, experts experienced in the sector were consulted and a map was created. It took a long time to find, persuade and interview experienced experts from the industry.

5.1 Further Implications

The factors that most affect customer preferences for companies operating in the telecom industry have been determined. In the light of the above, companies should focus on these criteria according to their own strategies but should also consider others. Because the criteria are dependent on each other and a positive or negative change in one of them affects the others.

The following recommendations are made for companies operating in the telecom industry:

- Companies should establish an emotional bond with their customers and should not be a brand that only serves them.
- Firms should pay attention to their image in front of their customers and present an image that is compatible with the demographic, psychological and sociological structure of the society. For example, the activities carried out by companies in the field of social responsibility in Turkey find a response in the eyes of the society. Companies should analyze this well and create a suitable image for the society.

- Companies should give confidence to their customers, keep their promises and fulfill their commitments. They should avoid actions that may surprise customers. For example, a firm that implements a low-price strategy should not surprise its customers by increasing prices rapidly. Likewise, a company with a strong infrastructure and high-quality service strategy should not cause any interruptions in its services and should offer the promised quality to its customers uninterruptedly.
- Firms should pay close attention to their customers' relationships with family and friends. A happy customer also recommends the product and service to his/her environment, and also considers the products and services offered to him/her. For example, a special recipe for family members can make a person feel special and recommend it to his family and close friends. Companies should develop special actions for people's relatives according to their own strategies.
- Companies should carry out their communication activities in line with their own strategies in order to create a brand image and establish a bond with customers and to make their voices heard. For example, the shooting of an emotional commercial film in order to make the activities performed in the field of social responsibility known to the customers, can positively affect both the bonding with the customers and the brand image.
- Companies should also care about infrastructure developments in order to respond to the final requests of customers. Although it is very important to touch, connect and stay in touch with customers, companies should also focus on infrastructure investments as it affects the product used by customers and therefore many factors that the customer cares about. For example, it is necessary to have a strong infrastructure to provide an uninterrupted service without damaging the trust of the customers.

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APPENDICES

APPENDIX A: Survey sheet



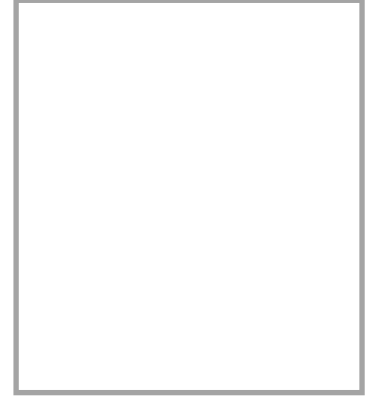
APPENDIX A

Mobile Operator Preference	C1	C2	C3	C4	C5	C6	C7	C8	C9
Price (C1)									
Coverage area (C2)									
Network quality / speed (C3)									
Service quality (C4)									
Variety of services (C5)									
Family and friends use / suggest (C6)									
Image / Emotional bond (C7)									
Advertisement / Communication (C8)									
Trust (C9)									
Please fill in the blue cells with (+) sign if the concept in the row affects the concept in the column positively and fill in the green cell just right of the blue cell with a number between 1 and 5 according to level of impact with 1 being the least and 5 the most.									
Please fill in the blue cells with (-) sign if the concept in the row affects the concept in the column negatively and fill in the green cell just right of the blue cell with a number between 1 and 5 according to level of impact with 1 being the least and 5 the most.									
Please fill in the blue and green cells with (0) if there is a no casual relationship between the concepts in the row and in the column.									

Figure A.1 : Survey sheet.

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