DETERMINING OPTIMUM PRICING STRATEGY FOR A TELECOMMUNICATIONS SERVICE BY USING FUZZY EXTENDED AHP

(BULANIKLAŞTIRILMIŞ AHP KULLANILARAK BİR TELEKOMÜNİKASYON HİZMETİNİN FİYATLANDIRMA STRATEJİSİNİN BELİRLENMESİ)

by

Duygu EKİCİ

Thesis

Submitted in Partial Fulfillment

of the Requirements

for the Degree of

MASTER OF SCIENCE

in

INDUSTRIAL ENGINEERING

in the

INSTITUTE OF SCIENCE AND ENGINEERING

of

GALATASARAY UNIVERSITY

Supervisor: Prof. Dr. H. Ziya ULUKAN

August 2007

DETERMINING OPTIMUM PRICING STRATEGY FOR A TELECOMMUNICATIONS SERVICE BY USING FUZZY EXTENDED AHP

(BULANIKLAŞTIRILMIŞ AHP KULLANILARAK BİR TELEKOMÜNİKASYON HİZMETİNİN FİYATLANDIRMA STRATEJİSİNİN BELİRLENMESİ)

by

Duygu EKİCİ

Thesis

Submitted in Partial Fulfillment

of the Requirements

for the Degree of

MASTER OF SCIENCE

Date of Submission : August 31, 2007

Date of Defense Examination: September 25, 2007

Supervisor : Prof. Dr. H. Ziya ULUKAN

Committee Members : Assistant. Prof. Dr. Esra ALBAYRAK

Associate Prof. Dr. Tufan Vehbi KOÇ

ACKNOWLEDGMENTS

In this study the optimum pricing strategy for a telecommunication service/product is studied in a multi criteria manner and the most important criteria effecting final decision is also determined.

I would like to thank the operator and all its workers, which I carried out my study and work in, for the superior helps on my project.

I would like to thank Prof. Dr. Ziya ULUKAN for leading me on my project and sharing his knowledge and experiences with me. I would like to thank him for his understanding and patience.

And finally, I would like to thank my family for their great encouragement and support.

Duygu EKİCİ

August, 2007

Table of Contents

List of Symbols v
List of Figures vi
List of Tables vii
Abstract ix
Résumé xi
Özet xiii
1. Introduction 1
2. Telecommunication Business 3
2.1. The Telecommunications Revolution 3
2.2. Telecommunications Services 4
2.3. Developments in Turkish Telecommunications Marketplace 6
3. Pricing of Telecommunications Services 8
3.1. General Product Pricing Considerations and Approaches 8
3.1.1. Factors Affecting Pricing Decisions 9
3.1.1.1. Internal Factors 9
3.1.1.2. External Factors 9
3.1.2. General Pricing Strategies 13
3.2. Product Pricing Approaches for Telecommunications Services 14
3.2.1. Definitions of Charge, Price and Tariff 14
3.2.2. Importance of Telecommunication Pricing 15
3.2.3. Common Telecommunication Pricing Formulations 16
3.3. Fuzzy Sets and Product Pricing 18
3.3.1. Fuzzy Set Theory 19
3.3.2. Fuzzy Sets and Triangular Fuzzy Numbers 20
3.3.3. Multi-Attribute Evaluation Under Fuzziness: Fuzzy AHP 23
3.3.4. Extended Fuzzy AHP 25
4. Application 34

4.1. Application Company 34
4.2. Application of FEAHP in Deciding Optimum Pricing Strategy 35
4.2.1. Identification of Main and Sub Pricing Strategy Criteria 36
4.2.2. Construction of AHP Structure 42
4.2.3. Construction of Matrices and Risk Evaluation 43
4.2.4. Research Results 51
5. Conclusion 54
References 56
Appendices 60
Appendix A 60
Appendix B 79
Biographical Sketch 91

List of Symbols

$\tilde{M}$: A triangular fuzzy number.

$\mu_{\tilde{M}}(x)$: Membership function of a triangular fuzzy number M.

(l, m, u) : Smallest, most promising and largest possible values of a triangular fuzzy number.

$M^{l(y)}$: Left side representation of a fuzzy number.

$M^{r(y)}$: Right side representation of a fuzzy number.

a_{ij} : Fuzzy representation of pair wise comparison.

a_{ij}^{-1} : Reciprocal of a_{ij}.

M_{crisp} : Defuzzified triangular fuzzy number.

CI : Consistency index.

CR : Consistency ratio.

λ_{max} : Largest eigen value of the comparison matrix.

RI : Random index.

A : Defuzzified pair wise comparison matrix.

$\bar{R}$: A fuzzy positive reciprocal comparison matrix.

S_i : Synthetic extent value with respect to the ith object.

D : Highest intersection point between μ_{M_1} and μ_{M_2}.

$d'(A_i)$: Degree of possibility of i^{th} synthetic extent value to be greater than the others.

W' : Weight vector.

W : Normalized weight vector, which gives the priority weights of one alternative over another.

List of Figures

Figure 3.1	: Inelastic Demand	11
Figure 3.2	: Elastic Demand	12
Figure 3.3	: A triangular fuzzy number	22
Figure 3.4	: A three level hierarchy	26
Figure 3.5	: The intersection between M_1 and M_2	32
Figure 4.1	: A Simple presentation of product family.	35
Figure 4.2	: Four leveled AHP structure	42
Figure 4.3	: Relationship between Price Economic Value & Pricing Strategy	43
Figure 4.4	: Weighting values of main pricing strategy criteria	48
Figure 4.5	: Priority weights of each pricing strategy with respect to the sub criteria	52
Figure 4.6	: Priority weights of each risk level with respect to the risk factors	53

List of Tables

Table 3.1	: The comparison of different fuzzy AHP methods	24
Table 3.2	: Average random consistency index (RI)	29
Table 4.1	: Triangular fuzzy conversion scale	44
Table 4.2	: The The fuzzy evaluation matrix of the main pricing criteria with respect to the goals	44
Table 4.3	: Evaluation of the sub-pricing strategy criterion with respect to Stakeholder Criteria	48
Table 4.4	: Evaluation of the sub-pricing strategy criterion with respect to Market Criteria	48
Table 4.5	: Evaluation of the sub-pricing strategy criterion with respect to Demand Criteria	49
Table 4.6	: Evaluation of the sub-pricing strategy criterion with respect to Cost/Supply Criteria	49
Table 4.7	: Evaluation of the sub-pricing strategy criterion with respect to Regulation Criteria	49
Table 4.8	: Summary of combinations of priority weights	50
Table 4.9	: Weights of pricing strategies and overall score	51
Table AI	: Questionnaire forms used to aid comparisons of main pricing strategy criteria	61
Table AII	: Questionnaire forms used to aid comparisons of sub pricing strategy criteria	61
Table AII	: Questionnaire forms used to aid comparisons of pricing strategies	65
Table B.1	: Pair wise comparisons of main pricing strategy criteria	79
Table B.2	: Pair wise comparisons of Stakeholder Criterion’s sub-pricing strategy criteria.	79
Table B.3	: Pair wise comparisons of Market Criterion’s sub-pricing strategy criteria.	80

Table B.4 : Pair wise comparisons of Demand Criterion's sub-pricing strategy criteria. 81
Table B.5 : Pair wise comparisons of Cost/Supply Criterion's sub-pricing strategy criteria. 81
Table B.6 : Pair wise comparisons of Regulation Criterion's sub-pricing strategy criteria. 82
Table B.7 : Pair wise comparison of pricing strategy alternatives with respect to the sub-pricing criteria of stakeholder criterion 82
Table B.8 : Pair wise comparison of pricing strategy alternatives with respect to the sub-pricing criteria of market criterion 84
Table B.9 : Pair wise comparison of pricing strategy alternatives with respect to the sub-pricing criteria of demand criterion 86
Table B.10 : Pair wise comparison of pricing strategy alternatives with respect to the sub-pricing criteria of cost/supply criterion 87
Table B.7 : Pair wise comparison of pricing strategy alternatives with respect to the sub-pricing criteria of regulation criterion 89

ABSTRACT

Modern telecommunications technology is now widely seen as a critical driver in economic development. Telecommunications is the convergence of voice, data (WAN), LAN, video, image, and wireless communications technologies to facilitate communications between people or to deliver entertainment, information, and other services to people.

Both technology and economics play a major role in the new telecommunications environment. The success an operator is not guaranteed by advanced technology and creative services.

Recent advances in technology with the deregulation of the telecommunication market and the proliferation of the Internet, have created a highly competitive environment for communication service providers.

There is no simple recipe for pricing telecommunications services in all contexts. Pricing is a complex subject, which depends on parameters of market, customer demand, regulation, costs and at last parameters of stakeholders. As an initial step of rational pricing, establishing optimum pricing strategy, that is market positioning of the telecommunications operator, plays a critical role for its success. Through accurate focus, the optimum pricing strategy for operator can be figured out by incorporating all the necessary criteria into account.

This research is carried out in an alternative telecommunications operator. The operator is working on a triple play service, and during the feasibility studies, the need for determining the optimum pricing strategy has come into account. The aim of this study is to identify the optimum pricing strategy, and give an important input for the feasibility study.

Pricing decisions are multidimensional and include imprecise data. Due to the nature of environment, benefiting from the multi-attribute evaluation methods is more reliable. The AHP is one of the most widely used multi-criteria decision making tool. However, it does not take into account the uncertainty and imprecise data. In order to overcome this handicap, in this study Fuzzy Extended Analytical Hierarchy Process (FEAHP) approach is proposed to determine the risk level of the project.

The result of the study shows that the optimum pricing strategy for the operator for the studied product is “Market Penetration” strategy. The most important drivers of this strategy were also determined, which might help operator to manage its market positioning strategically.

RESUME

La technologie de télécommunications moderne est maintenant largement vue comme conducteur critique dans le développement économique. Les télécommunications est la convergence de la voix, des données (WAN), du LAN, de la vidéo, de l'image, et des technologies de communications sans fil pour faciliter des communications entre les personnes ou pour fournir le divertissement, l'information, et d'autres services aux gens.

La technologie et les sciences économiques jouent un rôle important dans le nouvel environnement de télécommunications. Le succès un opérateur n'est pas garanti par technologie de pointe et services créateurs.

Les avances récentes en technologie avec la déréglementation du marché de télécommunication et la prolifération de l'Internet, ont créé une condition de concurrence fortement pour des fournisseurs de service de communication.

Il n'y a aucune recette simple pour des services de télécommunications d'évaluation dans tous les contextes. L'évaluation est un sujet complexe, qui dépend des paramètres de marché, demande de client, règlement, coûts et enfin des paramètres des dépositaires. Comme mesure initiale de l'évaluation raisonnable, l'établissement de la stratégie de prix d'optimum, celle est positionnement du marché de l'opérateur de télécommunications, joue un rôle critique pour son succès. Par le foyer précis, la stratégie de prix d'optimum pour l'opérateur peut être figurée dehors en incorporant tous les critères nécessaires en considération.

Cette recherche est effectuée dans un opérateur alternatif de télécommunications. L'opérateur travaille sur un service triple de jeu, et pendant les études de faisabilité de faisabilité, le besoin de déterminer la stratégie de prix d'optimum a hérité le compte. Le

but de cette étude est d'identifier la stratégie de prix d'optimum, et donne une entrée importante pour l’étude de faisabilité de faisabilité.

En évaluant des décisions soyez multidimensionnel et incluez les données imprécises. En raison de la nature de l'environnement, tirant bénéfice du multi-attribuez les méthodes d'évaluation est plus fiable. L'AHP est un de l'outil le plus largement répandu de prise de décision de multicritère. Cependant, il ne tient pas compte de l'incertitude et des données imprécises. Afin de surmonter ce handicap, dans cette approche analytique prolongée brouillée du processus de hiérarchie d'étude (FEAHP) est proposé de déterminer le niveau de risque du projet.

Le résultat de l'étude prouve que la stratégie de prix d'optimum pour l'opérateur pour le produit étudié est stratégie "de pénétration du marché". Les conducteurs les plus importants de cette stratégie ont été également déterminés, qui pourraient aider l'opérateur à contrôler son marché plaçant stratégiquement.

ÖZET

Modern telekomünikasyon teknolojileri gününüzde genellikle ekonomik gelişmenin en kritik itici güçlerinden biri olarak kabul edilmektedir. Telekomünikasyon, insanlar arasındaki iletişimi kolaylaştırmak, insanlara bilgi eğlence ne diğer servisleri sunmak için, ses, veri, LAN, video, resim ve kablosuz iletişim teknolojilerindeki yakınsamayı ifade etmektedir.

Yeni telekomünikasyon sektöründe, hem teknoloji hem de ekonomi kritik bir rol oynamaktadır. Bir operatörün başarısı sadece ileri teknoloji ve yaratıcı ürünlerle garanti edilememektedir.

Takın geçmişte sektörün özelleştirilmesi ve regülasyonla teknolojide yaşanan gelişmeler, yaygınlaşan İnternet, Telekom operatörleri için oldukça rekabetçi bir çevre yaratmıştır.

Tüm telekomünikasyon servislerine uygulanabilecek standart bir fiyatlandırma modeli bulunmamaktadır. Fiyatlandırma; pazar koşulları, talep, maliyet/arz, regülasyon ve şirket ortaklarının kriterlerinden etkilenen oldukça karmaşık bir kavramdır. Akılcı fiyatlandırmanın ilk adımı olarak, optimum fiyatlandırma stratejisini, Pazar konumlanmasını, belirlemek kritik bir rol oynamaktadır. Doğru bir yaklaşım ile optimum fiyatlandırma stratejisi tüm gerekli kriterleri de dikkate alarak belirlenebilir.

Çalışma alternatif bir Telekom operatöründe yürütülmüştür. Operatör üçlü paket olarak sunacağı bir servisin çalışmalarını ve fizibilitesini yapmaya devam etmektedir. Fizibilite çalışmaları sırasında optimum fiyatlandırma stratejisini belirleme gereksinimi belirmiştir. Bu çalışmanın amacı söz konusu ürün için optimum fiyatlandırma stratejisini belirleyerek, fizibiliteye gerekli girdiyi sağlamaktır.

Fiyatlandırma stratejisi çok boyutlu bir kavram olarak ele alınmalıdır. Fiyatlandırma stratejisinin kriterleri doğaları gereği bir belirsizlik içermektedirler. Dolayısıyla fiyatlandırma stratejisinin belirlenmesi süreçlerinde çok ölçütlü değerlendirme metotlarının kullanımı daha etkin ve doğru sonuçlara ulaşılmasını sağlayacaktır. Analitik Hiyerarşi Prosesi (AHP) oldukça sık kullanılan etkin birçok ölçütlü karar verme tekniğidir. Ancak AHP belirsizliği ve kesin olmayan durumları göz önünde bulundurmamaktadır. Çalışmada AHP' nin bu eksikliğini ortadan kaldırabilecek bir yöntem olan Bulanık Analitik Hiyerarşi Prosesi (FEAHP) kullanılmıştır.

Çalışmanın sonuçlarına göre ele alınan üçlü ürün için en uygun fiyatlandırma stratejisinin "Pazar Penetrasyonu" olduğu belirlenmiştir. Operatöre strateji geliştirme süresinde destek olması için, optimum fiyatlandırma stratejisiyle birlikte, bu strateji üzerinde en önemli etkiye sahip değişkenler de belirlenmiştir.

1. INTRODUCTION

With the liberalization of telecommunications markets around the world and the development of new communications technologies, new telecommunication services are being offered to potential customers at an increasing rate.

Traditionally, the telecommunication services were used to describe telephony (voice) services. By the help of development in communication technologies and the Internet, today, the industry uses telecommunications to describe the transmission of voice, video, image, and data across related telecommunications infrastructure. Modern telecommunications technology is now widely seen as a critical driver in economic development.

In the age of telecommunications due to the challenging competition conditions and highly complex structure of telecommunication business, it becomes really an important issue for telecommunication operators to be able to develop methodical and intelligent pricing strategies.

Pricing is not a single concept, but a multidimensional issue. There are various criteria, which should be considered together in order to be able to achieve an effective pricing strategy. Pricing strategy is of great importance because it affects both revenue and buyer behavior. The whole pricing environment is therefore should be considered analytically, both from the point of view of the company and its strategies and then from the aspect of the consumer and market, end even from the point of view of government and legislation.

This study mainly focuses on the determining the optimum pricing strategy for a telecommunications company. The related criteria and their characteristics that may affect shaping the appropriate pricing strategy are identified.

Pricing is a multidimensional concept; it should be evaluated with respect to more than one criterion to get more reliable results. The Analytic Hierarchy Process (AHP) is one of the most widely used multiple criteria decision-making tools. Once the structuring is completed, the AHP is surprisingly simple to apply and it can effectively handle both qualitative and quantitative data.

The factors that effect pricing decisions are essentially uncertainty. Because of their nature, they include imprecise and vague data. AHP uses crisp data and does not take into account the uncertainty. Fuzzy set theory is especially powerful when there is an unavailability of precise or complete information. Thus, fuzzy set theory can be a valid supporting tool to overcome the handicaps of AHP in fuzzy environment.

In this research fuzzy extended Analytic Hierarchy Process (FEAHP) method is proposed for determining the optimum pricing strategy of a telecommunication product. Finally an illustrative real life application is presented for the utilization of FEAHP in establishing optimum pricing strategy.

2. TELECOMMUNICATIONS BUSINESS

Telecommunications is the science of communicating over a long distance using telephone or radio technology [1]. This involves using microelectronic (small semiconductor chip), computer, and PC technologies to transmit, receive, and switch voice, data, and video communications over different transmission media, including copper, fiber, and electromagnetic transmissions. This definition implies that telecommunications is doing more than just voice communications. Further, it does not imply using analog transmission exclusively. Many forms of analog and digital transmission are employed in telecommunications today. Analog communication is like a dimmer switch for light because it has an almost unlimited number of brightness settings. In contrast, digital communication works like a simple light switch that has only on or off.

2.1. The Telecommunications Revolution

21st century is the era of telecommunications services. Recent developments in fiber optics and other network technology, along with the flexible and creative software World Wide Web have given network users a technology platform that supports many useful and appealing services. This is one of the main drivers, which encourages the drive towards worldwide network connectivity and today's Internet evolution. This is a revolution, which is changing the way people engage in social life and business.

The Internet has created a new and different economy, in which the goods and services have no weight, and are not tied to place [2]. Telecommunications and other related information services are provided and regulated by related authorities. The electronic-economy, based on evolutions in telecommunications sector that provide businesses with new ways to access their customers, is destined to be much more than a simple sector of economy.

When people use the word “telecommunications,” most think of the classical analog telephone. That is telephony. Telephony is focused on voice communications. Telecommunications has evolved into much more. The telephone network was originally designed to carry human voice and not digital information such as data, music, or video. It supported telephony (voice communications), but not telecommunications (data, image, and video). Today, telephony (voice communications), WAN, LAN, wireless communications, and PC technologies merge to become telecommunications in the next millennium.

2.2. Telecommunications Services

For many years telecommunications market has been supplied by a large regulated and protected monopolies. These monopolies have provided users with the benefits of economy of scale, provision of universal service, consistency and compatibility of technology, stable service provision and guaranteed availability. Services have developed slowly; demand has been predictable and network s has been relatively easy to dimension [3].

In comparison, the market for modern telecommunication services is very competitive. New generation telecommunication operators continuously develop new attractive services and offer those services to their customers in a very competitive environment.

The services provided by operators are based on IP technology. Three main service group of today’s telecommunication operators are;

- Internet (Data) services,
- Voice Services
- Video Services.

All these services base on the developments in IP technologies. As through the speed of internet service that a customer can have increases, the additional services like voice

and video have been added to operators' offers.

Today, the industry uses telecommunications to describe the transmission of voice, video, image, and data across today's telephone infrastructure.

Telecommunications is the merging of voice, data (WAN), LAN, video, image, and wireless communications technologies with PC and microelectronic technologies to facilitate communications between people or to deliver entertainment, information, and other services to people. Microelectronics is the technology of constructing electronic circuits and devices in very small packages such as computer chips [1]. Telecommunications represents a convergence of these technologies into networks and systems that serve people planet-wide.

Traditional data communications, or WAN communications, were the transmission of data (at that time text and numbers) between sites. They encompassed all the necessary computer hardware, electronics, optical equipment, and signaling techniques required to send encoded information. Television required delivery of video information to distribution points (TV stations). Images were sent by facsimile (fax) transmission because the images could not be easily encoded as data. Wireless transmission evolved from early two-way radio systems (walkie-talkies) that permitted instant intercom-like communications between people, regardless of their physical location.

The Internet provides a focal point of standardization (TCP/ IP and HTML), and a platform for developing and delivering new services to consumers [3]. The master of these technologies and the Internet will dominate the way of communications and also social life.

Convergence occurs because data, voice, video, and other information is encoded as a stream of 1's and 0's, making them digital communications. Since everything is sent digitally, these types of transmissions can be combined and sent over the same high-speed transmission channels or pipes. That has been done for years in the telephone network.

What is changing today is that the delivery of these diverse types of data is via one composite (or combined) digital stream on a single physical network to the business or residential site instead of delivering voice, video, and data communications via different digital streams on different physical networks.

2.3. Developments in Turkish Telecommunications Marketplace

The telecommunications industry in Turkey has gone through a number of significant changes in the last few years. The monopoly of the incumbent operator over fixed line infrastructure and voice services has been terminated as of the end of 2003. An independent regulatory authority has been established in 2000 with extensive authority to issue secondary legislation. The incumbent operator is up for privatization in 2005

The Turkish telecommunications industry is regulated by the Turkish Telecom Authority, which regulates the market and issues licenses for telecommunication services. The Telecom Authority also approves telecommunications equipment to be imported into the country. The Government of Turkey has committed having enacted into law (with liberalization regulations being promulgated and put into effect in January 2004) the framework to secure a private sector telecom market.[4]

Infrastructure and Technology: Turk Telekom, as the incumbent fixed line operator, has over 19 million subscribers. It has a high digitalization rate (digitalization is 96 percent of its transmission lines). The fixed line density is approximately 29 percent. Turk Telekom has the only Internet backbone structure of Turkey named as TTnet. More than 50 private Internet service providers are using this backbone. Turk Telecom also owns three satellites and satellite earth stations. Major cities are connected with fiber optic networks and international connections are provided via submarine cables and satellite communication. [5]

Future Prospects/Opportunities: The liberalization of the Turkish telecommunications market in 2004 may force the market for the establishment of several other fiber optic networks as an alternative to Turk Telekom's network to

provide traffic to the private sector. Best prospects will be voice and data transmission services through fiber optic networks and VoIP. High-speed data and leased line services have a promising future in Turkey. Over 40 private sector companies have already obtained a license [6]. Additional opportunities also exist for the Turkish market in international traffic either originating or terminating in the country. Due to the widely dispersed Turkish population around the world, there is considerable amount of international calls being placed, primarily from Western Europe and the United States to Turkey.

3. PRICING OF TELECOMMUNICATIONS SERVICES

An important part of any business plan for selling telecommunications services is pricing and competition issues. Traditionally, those services have been developed with out addressing pricing issues. This is because telecommunications services have been provided by large monopolies, with guaranteed incomes. The bundling and pricing aspects of services have been secondary. However, services are now sold in competitive markets and an important part of service definition how it should be priced.

Of course a price must be charged for something if service providers are to recover their costs and remain in business. But this is only one of the main important reasons for product pricing. Even before the actual pricing of product takes place, firms should decide on their overall pricing strategy and market positioning. In addition this is not only depending a single criteria, i.e cost, but rather a set of criteria those should be considered all together for strategic decision making.

3.1. General Product Pricing Considerations and Approaches

All profit organizations and many nonprofit must set prices on their products or services. Price is the amount of money charged for a product or service, or the sum of the values what consumers exchange for the benefits of having or using product or service [7]. Something of value is exchanged for satisfaction and utility, includes tangible (functional) and intangible (prestige) factors.

Buyers must determine if the utility gained from the exchange is worth the buying power that must be sacrificed. Price represents the value of a good among potential purchases and for ensuring competition among sellers in an open market economy.

3.1.1. Factors Affecting Pricing Decisions

A company's pricing decisions are affected both by internal company factors and external environmental factors.

3.1.1.1 Internal Factors Affecting Pricing Decisions

- **Marketing Objectives:** The company should select its target market positioning carefully. Pricing decisions is largely determined by decisions on market positioning like; Survival, Current Profit Maximization, Market-Share Leadership, Product Quality Leadership

- **Marketing Mix Strategy:** Pricing decision is only one part of the general marketing strategy. Price decisions must be coordinated with product design, distribution, and promotion decisions to form a consistent and effective marketing program.

- **Costs**: Costs set the floor for the price that the company can charge for its product [8]. The company wants to charge a price that both cover all its costs for producing, distributing, and selling the product and a delivers a fair rate of return for its effort and risk. A company's costs take two forms:

    - **Fixed Costs**: Costs that do not vary with production or sales level*; Executive Salaries, Rent*
    - **Variable Costs:** Costs that vary directly with the level of production; Commissions, Raw materials

3.1.1.2. External Factors Affecting Pricing Decisions

External factors include the nature of the market and demand, competition and other environmental elements.

The Market and Demand: The market and demand set the upper limit for price. When "types of market" considered:

- **Pure Competition:** Market consists of many buyers and sellers trading on a uniform commodity such as wheat, copper etc. No single seller or buyer has much effect on going price.

- **Monopolistic Competition:** Market consists of many buyers and sellers who trade over a range of prices. Sellers can differentiate their offers to buyers. Marketing strategy is important but less affected from competitors strategies.

- **Oligopolistic Competition**: A market in which there are a few sellers who are sensitive to each other's pricing/ marketing strategies. It's hard to enter market for new firms.

- **Pure Monopoly:** A market in which there is a single seller. Even a non-regulated company is free to price at what market will bear, it does not always charge full price:

    - Not to attract competition
    - To penetrate market with low price
    - Fear of government etc..

One of the most important external factors which effects pricing decisions is the *"Price-Demand Relationship*" [9]. Each price the company will charge will lead a different level of demand. The relation between the price charged and the resulting demand can be shown by a Demand Curve. A demand curve is a curve that shows the number of units the market will buy in a given time period at different prices that might be charged. In normal case demand and price are inversely related: demand increases as prices decrease.

"*Price elasticity*" is another key factor that affects pricing decisions [10]. Price Elasticity refers to how responsive demand will be to a change in price. If demand hardly changes with a small change in price, the demand is called Inelastic Demand (Figure 3.1). It occurs when products have many substitutes and consumption is discretionary. On the other hand if demand changes greatly with a small change in price, it is called Elastic

$$\text{Price elasticity} = \frac{\%\_change\_in\_quantity\_demanded}{\%\_change\_in\_price} \tag{3.1}$$

Inelastic Demand (Figure 3.1.): It occurs when products have few if any substitutes and consumption is necessary.

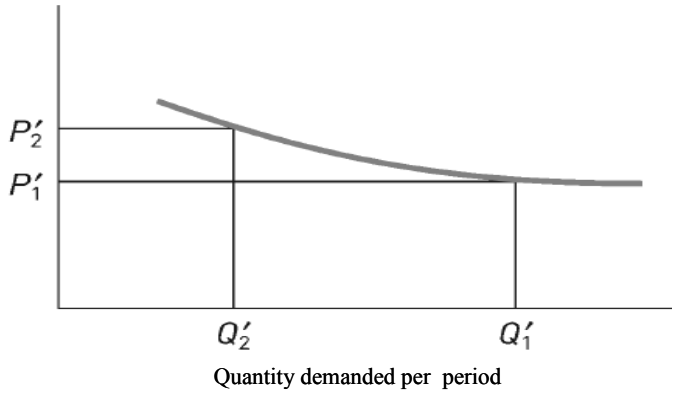


Figure 3.1. Inelastic Demand

If demand is inelastic, raising prices to earn more profits can be main pricing strategy. If demand is elastic, sellers will consider lowering their prices to get more total revenue (Figure 3.2.).

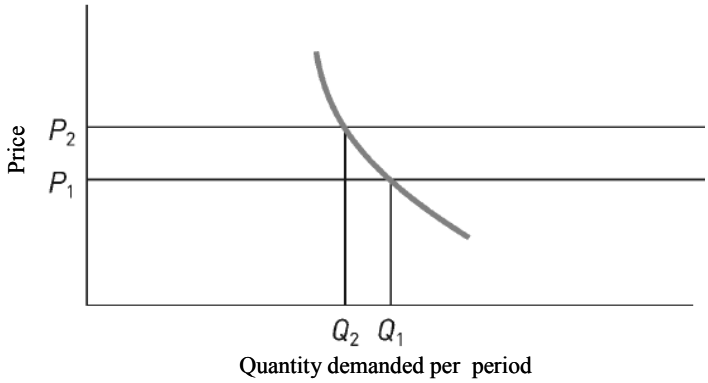


Figure 3.2. Elastic Demand

- **Competitors' Prices and Offerings:** The results of the pricing strategy will not only depend on consumer response, but also on the reaction of competitors. Competitive behavior varies considerably with market structure, intensity of competition, and the existence and nature of significant competitive advantages. Besides market structure, the distribution of market shares, the marketing goals and strategies of competitors affect the likelihood and nature of competitive reactions. Competitive retaliation may attenuate pricing effects, and sometimes provoke real price wars (prices are continually reduced, even to unprofitable levels). The analysis of competitive behavior is therefore a prerequisite for effective pricing. Competitors respond to actions of other market players by using those marketing variables that are their "best weapons", such that price as well as non-price reactions should be monitored.

  Substantial deviations from competitors' price levels are only feasible through significant competitive advantages. The most important competitive advantages for pricing relate to costs and unique product values. Cost advantages exist when the product can be produced and/or distributed at a lower unit cost than competitors; they result from superior skills or resources.

  Unique product value results from (tangible or intangible) product characteristics that are valued by consumers and differentiate the product from its substitutes.

Unique product value reduces the price sensitivity of consumers, thereby enabling the firm to set prices above the competitors' level without experiencing a considerable decrease in demand.

- **Other External Factors:** The other external factors that should affect pricing decisions are; economic conditions, government, social concerns.

3.1.2. General Pricing Strategies

A company that plans to develop a "New Product" should decide where to position the product versus competing products in term of quality and price. There exist 3 possible pricing strategies [1].

- **Market-Skimming Pricing:** Charging the highest price possible that buyers will pay is called as "Market-Skimming Pricing". This strategy will attract market segment more interested in quality, status, uniqueness etc. Company makes fewer, but more profitable sales. Companies should choose this strategy when:

    - Product's quality and image must support its higher price.
    - Costs of smaller volume cannot be so high they cancel the advantage of charging more.
    - Competition can be minimized by other means, ie, brand loyalty, patent, high barriers to entry etc.
    - Competitors should not be able to enter market easily and undercut the high price.

- **Market-Penetration Pricing:** The setting of "market penetration strategy" is carried out by companies whose prime objective is to capture a large market share in the quickest time period possible.

The conditions, which usually prevail for penetrating pricing to be effective, include:

- A low price will tend to discourage competitors from entering the market
- Market must be highly price sensitive so a low price produces more market growth.
- Potential economies of scale and/or significant experience curve effects. Production and distribution costs must fall as sales volume increases.

- **Going-Rate Pricing:** Firm bases its price largely on competitors' prices, with less attention paid to its own costs or to demand. Price changes would also be nearly same with competitors. When demand elasticity is hard to measure firms feel quite secure with this strategy.

3.2. Product Pricing Approaches for Telecommunications Services

Telecommunication services are valuable economic commodities. The prices for which they can be sold depend on factors of demand, supply, and how the market operates. The key players in the market for telecommunications services are suppliers (operators), consumers and regulators [11].

The nature of competition among suppliers, how they interact with customers, and how the market is regulated all have effects on the pricing strategy that will be chosen.

3.2.1. Definitions of Charge, Price and Tariff

For telecommunications industry there are there terms which is in the scope of pricing strategy. The *charge* is the amount that is billed for a service. *Price* is the amount of money associated with a unit of service, and this is used to compute the charge. *Tariff* refers to the general structure of prices and charges.

3.2.2. Importance of Telecommunication Pricing

For telecommunications industry, the following items are main reasons that make developing a pricing strategy a must for the operators [11].

- Pricing affects the way services are used and how resources are consumed. The value that customers obtain from services depends on congestion and on the way services are priced.

- Telecommunication service contracts provided for substantial flexibility. Pricing plays an important role as an incentive mechanism to control performance and increase stability.

- Modern networking technology provides new possibilities for producers and the consumers to exchange economic signals on fast time scales. This allows for the creation of new flexible services that consumer can control and by which they can better express their needs. Previously the services were statically defined and the network operator was in total control.

- There is no unique way to price. "Flat" versus "usage-based" charging has important effects on short-term and long-term operation and operators' competitive positions. For a "flat rate tariff" the consumer pays the predetermined fee, and uses the service proposed as much as s/he wishes. On the other side, for usage-based charging the consumer pays for what s/he actually consumes.

- Competition can be greatly influenced by architecture of a network and ability of few players to control bottleneck resources in parts of the network, such as access. Competition and regulation issues are important in today's telecommunication market.

- Telecommunication services are economic goods and must be priced accordingly.

There are generic service models that capture aspects such as quality and performance.

3.2.3. Common Telecommunication Pricing Formulations

The prices for which telecommunication services can be sold mainly depend on factors of demand, supply and how the market operates.

The demand for a service is determined by the value users place upon it and the price they are willing to pay to obtain it. The quantity of the service that is supplied in the market depends on how much suppliers, operators, can expect to charge for it and on their costs. Operators' costs depend upon the efficiency of their network operations, sales and after-sales operations and license costs if there exists.

The consumer's problem is to maximize the customer's net benefit, which is called consumer surplus [11]. Consumer surplus is calculated as;

$$CS_t = \max_x \left[u_t(x) - p^T x \right] \tag{3.2}$$

Where u_t (x) is the utility to customer t of vector quantities of services x. p^T is the transpose price vector of services.

From the supplier (operator) side of view, suppose an operator produces quantities of k different services, denoted by "*y*". Producer surplus is the difference between revenue that is obtained from selling these services, r(y), and the cost of services provided, c(y).

$$\prod = \max_{y \in Y} \left[r(y) - c(y) \right] \tag{3.3}$$

For regulators, the problem is to maximize total welfare, W, which is defined as

$$W = \alpha_c CS + \alpha_p \prod \tag{3.4}$$

where α_c and α_p are the assigned relative weights.

According to the studies of economists "Ramsey Pricing" and "Pareto Efficiency Framework" are the best approaches for regulated telecommunications industry [12].

A solution to the mentioned problem was provided by Ramsey [13] which subsequently was called Ramsey pricing:

$$(p_{it} - M_{it} / p_{it})\varepsilon_{it} = k \tag{3.5}$$

where

$$\varepsilon = -\frac{dx_{it}}{dp_{it}} \frac{p_{it}}{y_{it}} \tag{3.6}$$

And "p_{it}" is the price of product i to customer type t, "M_{it}" is the marginal cost of product i to customer type t, "k" is the Ramsey constant, "ε_{it}" is the elasticity of demand product i to customer type t.

The other accepted solution concept is Pareto Efficiency. A solution point is Pareto Efficient if there is no other point for which all participants are at least as well off and at least one participant is strictly better off, for same total amount of goods.

K. Brown and R. NorGaard [13] have developed a weighted sum linear goal programming (WSLGP) to improve decision making in telecommunications pricing. The objective function of their model is minimization of a penalty function comprising a vector of goals and constraints.

In WSLGP the objective function is the form:

$$Min(Z) = \sum_{N} \sum_{M} \lambda_n y_m \qquad (3.7)$$

where "λ" are the penalty weights assigned by regulators to N components. "y_j" are the auxiliary variables, which specify the possible direction of the allowed deviations from the goals and the flexibility of constraints. The Ramsey equation, the optimal efficiency goal is:

$$(p_{it} - M_{it} / p_{it})\varepsilon_{it} = k$$

The company profit equation is

$$0 \le p_i x_i - C(X) - \prod$$

The individual product or service goal that each service should cover its own variable cost is

$$p_{it} x_{it} \ge c_{it} x_{it}$$

Although there are various studies and models developed on telecommunications pricing, according to the author's knowledge there is no study on multi-criteria decision modeling for telecommunications pricing strategy.

3.3. Fuzzy Sets and Product Pricing

Establishment of the sales price of a product is one of the fundamental management decisions. Pricing decisions are of crucial importance and unless taken seriously, they can cause a major threat to the sustainability of the company.

Conventional pricing models depend on criteria like demand forecasts or demand projections that include uncertainty. The uncertainty in those models is based on the

concept of randomness and on probability theory. In real life, there are situations that the probability distribution of demand or any other criteria that effect pricing strategy may not obtainable due to lack of historical data. The introduction of a new product is a typical example. In these kinds of situations decision maker faces a fuzzy environment. The fuzzy set theory provides a possible solution approach for that kind of vague model.

In literature several researchers developed pricing models for fuzzy demand. Yao and Wu [14] studied consumer surplus and producer surplus for fuzzy demand and fuzzy supply. Chang (2002) studied optimal fuzzy revenue for fuzzy demand quantity. Yao and Shih [15] investigated fuzzy revenue for fuzzy demand quantity based on interval-valued fuzzy sets.

3.3.1. Fuzzy Set Theory

Human understanding of most real life situations and physical processes is based largely on imprecise human reasoning. The leading theory in quantifying uncertainty in scientific models had been probability theory which depends on classical set theory and binary logic. Classical binary logic only admits the opposites of “true” and “false”, which does not admit degrees of truth in between these two extremes. An element either belongs or does not belong to the set; the boundary of the set is crisp.
An important evolution of the expression of uncertainty was the introduction of fuzzy sets by Lotfi Zadeh in 1965 [16] and development of possibility theory. Possibility theory was introduced by Lotfi Zadeh in 1978 [17]. D. Dubois and H. Prade further contributed to its development [18].

The fuzzy set theory is a mathematical theory designed to model the vagueness or imprecision of human cognitive processes that was pioneered by Zadeh [16]. This theory is basically a theory of classes with unsharp boundaries. What is important to recognize is that any crisp theory can be fuzzified by generalizing the concept of a set within that theory to the concept of a fuzzy set. Fuzzy set theory and fuzzy logic have been applied in a great variety of applications, which are reviewed by several authors. Fuzzy set theory is an important branch of Operations Research, providing tools to

quantify imprecise verbal statements and to classify outcomes of decision-analytical experiments.

Fuzzy set theory has been criticized for being probability theory in disguise; it is easy to understand now that the two theories are concerned with two distinct phenomena: with observations that can be classified in vaguely described (imprecise) categories only, and with experiments such that the outcomes can be classified into well-defined (crisp) categories. In essence, fuzzy set theory is concerned with our probability to categorize things and to label the categories via natural language [19].

The key idea of fuzzy set theory is that an element has a degree of membership in a fuzzy set. The membership function represents the grade of membership of an element in a set. The membership values of an element vary between 1 and 0. Elements can belong to a set in a certain degree and elements can also belong to multiple set. Fuzzy set allows the partial membership of elements. Transition between membership and non membership is gradually. Membership function maps the variation of value of linguistic variables into different linguistic classes. The adaptation of membership function for a given linguistic variable under a given situation is done in three ways [20]:

(a) Experts previous knowledge about the linguistic variable;
(b) Using simple geometric forms having slopes (triangular, trapezoidal or *s*-functions) as per the nature of the variable; and
(c) By trial and error learning process.

3.3.2. Fuzzy Sets and Triangular Fuzzy Numbers

To deal with vagueness of human thought, Zadeh [16] first introduced the fuzzy set theory that was oriented to the rationality of uncertainty due to imprecision or vagueness. A major contribution of fuzzy set theory is its capability of representing vague data. The theory also allows mathematical operators and programming to apply to the fuzzy domain.

A fuzzy set is a class of objects with a continuum of grades of membership. Such a set is characterized by a membership (characteristic) function, which assigns to each object a grade of member ship ranging between 0 and 1. In this set the general terms such as "large", "medium", and "small" each will be used to capture a range of numerical values. A tilde "□ " will be placed above a symbol if the symbol represents a fuzzy set.

A *fuzzy number* "A" is a fuzzy set of the real line with a normal, (fuzzy) convex and continuous membership function of bounded support. Fuzzy number is a special fuzzy set, such that $\mu = \{(x, \mu_{\tilde{M}}(x), x \in R)\}$ where the value of x lies on the real line R_1 i.e. $-\infty<x<\infty$ and $\mu_{\tilde{M}}(x)$ is a continuous mapping from R_1 to the close interval [0, 1]. If l, m and u, respectively, represent the smallest possible value, the most promising value and the largest possible value that describe a fuzzy event then the triangular fuzzy number (TFN) can be denoted as a triplet *(l, m, u)* where, $l \le m \le u$. When $l = m = u$, it is a non-fuzzy number by convention. The membership function can be defined as:

$$\mu_{\tilde{M}}(x)=\begin{cases}(x-l)/(m-l), & l \le x \le m \\ (u-x)/(u-m), & m \le x \le u \\ 0, & \text{otherwise}\end{cases} \tag{3.8}$$

A TFN is shown in Figure 3.3.

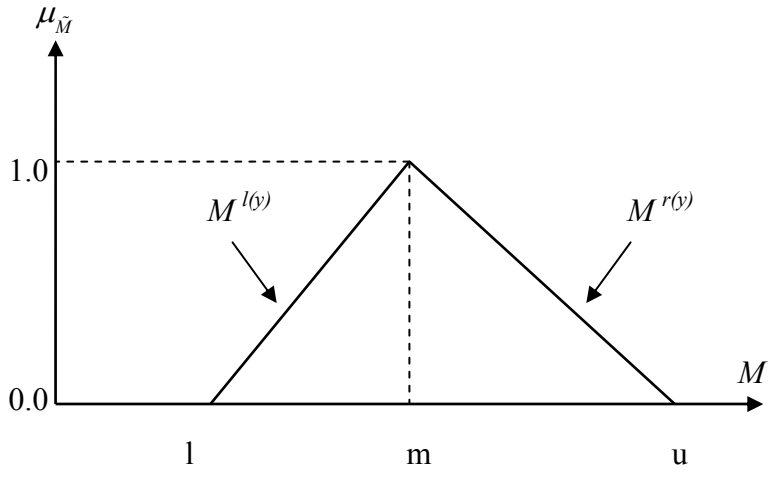


Figure 3.3. A triangular fuzzy number.

A fuzzy number can be given by its corresponding left and right representation of each degree of membership:

$$\begin{aligned} M&=\left(M^{l(y)},M^{r(y)} \right) \\ &=\left(l+(m-l)y,u+(m-u)y \right),y\in [0,1] \end{aligned} \tag{3.9}$$

l(y) and *r(y)* denote the left side and the right side representation of a fuzzy number, respectively.

Consider two triangular fuzzy numbers M_1 and M_2, $M_1=(l_1,m_1,u_1)$ and $M_2=(l_2,m_2,u_2)$. The operational laws of triangular fuzzy numbers are as follows [37]:

1. $(l_1,m_1,u_1)\oplus(l_2,m_2,u_2)$

$$=(l_1+l_2,\ m_1+m_2,\ u_1+u_2)\,. \tag{3.10}$$

2. $(l_1,m_1,u_1)\otimes(l_2,m_2,u_2)$

$$\cong(l_1l_2,\ m_1m_2,\ u_1u_2)\,. \tag{3.11}$$

3. $(\lambda,\lambda,\lambda)\otimes(l_2,m_2,u_2)$

$$\cong(\lambda l_1,\lambda m_1,\lambda u_1),\ \ \lambda\rangle 0,\ \lambda\in R\,. \tag{3.12}$$

4. $$(l_1,m_1,u_1)^{-1}\cong(1/u_1,1/m_1,1/l_1) \tag{3.13}$$

3.3.3. Multi-Attribute Evaluation Under Fuzziness: Fuzzy AHP

There are many fuzzy AHP methods proposed by various authors. These methods are systematic approaches to the alternative selection and justification problem by using the concepts of fuzzy set theory and hierarchical structure analysis. Decision makers usually find that it is more certain to give interval judgments than fixed value judgments. This is because usually he/she is unable to be explicit about his/her preferences due to the fuzzy nature of the comparison process.

The first studies of fuzzy AHP is presented by Van Laarhoven and Pedrycz [22] which compared fuzzy ratios described by triangular membership functions. Buckley [23] determines fuzzy priorities of comparison ratios whose membership functions are trapezoidal. Chang [24] introduces a new approach for handling fuzzy AHP, with the use of triangular fuzzy numbers for pair wise comparison scale of fuzzy AHP, and the use of the extent analysis method for the synthetic extent values of the pair wise comparisons.

In their research, Tüysüz and Kahraman [25] reviewed numbers of fuzzy AHP approaches.

Table 3.1 gives a comparison of the fuzzy AHP methods in the literature that have important differences in their theoretical structures. The comparison includes the advantages and disadvantages of each method.

Kahraman et al. [26-27], Buyukozkan et al. [28], Chan and Kumar [29], and Ayağ and Özdemir [20] used Chang's [24] fuzzy AHP for various decision-making problems in their researches.

Because of the advantages of Chang's [24] extent analysis on fuzzy AHP are relatively superior to the others due to the reasons mentioned in Table 3.1, this method will be used in establishing optimum pricing strategy. In the literature, there is no publication dealing with optimum pricing strategy using fuzzy AHP. Saaty and Vargas [30]

introduced the primary work of using AHP in new product pricing strategy. They apply AHP in establishing strategies for the pricing of new products.

Table 3.1 The comparison of different fuzzy AHP methods [42].

Sources	Main Characteristics	Advantages(A)/Disadvantages(D)
Van Laarhoven &Pedrycz (1983)	Direct extension of Saaty's AHP method with triangular fuzzy numbers.	(A)The opinions of multiple decision-makers can be modeled in the reciprocal matrix.
	Lootsma's logarithmic least square method is used to derive fuzzy weights and fuzzy performance scores.	(D)There is not always a solution to the linear equations.
		(D)The computational requirement is tremendous, even for a small problem.
		(D)It allows only triangular fuzzy numbers to be used.
Buckley (1985)	Direct extension of Saaty's AHP method with trapezoidal fuzzy numbers.	(A) It is easy to extend the fuzzy case.
	Uses the geometric mean to derive fuzzy weights and performance scores.	(A)It guarantees a unique solution to the reciprocal comparison matrix.
		(D)The computational requirement is tremendous.
Boender et al. (1989)	Modifies Van Laarhoven and Pedrycz's method.	(A)The opinions of multiple decision-makers can be modeled.
	Present a more robust approach to the normalization of the local priorities.	(D)The computational requirement is tremendous.
Chang (1996)	Synthetical degree values.	(A)The computational requirement is relatively low.
	Layer simple sequencing.	(A)It follows the steps of crisp AHP. It does not involve additional operations.
	Composite total sequencing.	(D)It allows only triangular fuzzy numbers to be used.
Cheng (1996)	Builds fuzzy standards.	(A)The computational requirement is not tremendous.
	Represents performance scores by membership functions.	(D)Entropy is used when probability distribution is known. The method is based on both probability and possibility measures.
	Uses entropy concepts to calculate aggregate weights.	

3.3.4. Extended Fuzzy AHP

In fuzzy extended AHP which was proposed by Chang [24] the steps of Saaty's [31] crisp AHP can be followed. The basic steps of this type of AHP, can be summarized as follows:

1st Step: State the problem.

2nd Step: Identify overall goal of the problem stated in step 1. Determine the objectives of the problem.

3rd Step: Identify the criteria that must be satisfied in order to achieve the determined goal. In other words, identify the criteria influence the decision.

4th Step: Structure the problem in a hierarchy of different levels constituting goal, criteria, sub-criteria and alternatives.

The simplest form used to structure a decision problem is a hierarchy consisting of three levels: the goal of the decision at the top level, followed by a second level consisting of the criteria by which the alternatives located in the third level, will be evaluated (see Fig.3.4).

Hierarchical decomposition of complex systems appears to be a basic device used by the human mind to cope with diversity. One organizes the factors affecting the decision in gradual steps from the general, in the upper levels of hierarchy, to the particular, in the lower levels. The purpose of the structure is to make it possible to judge the importance of the elements in a given level with respect to some of all of the elements in the adjacent level above [30].

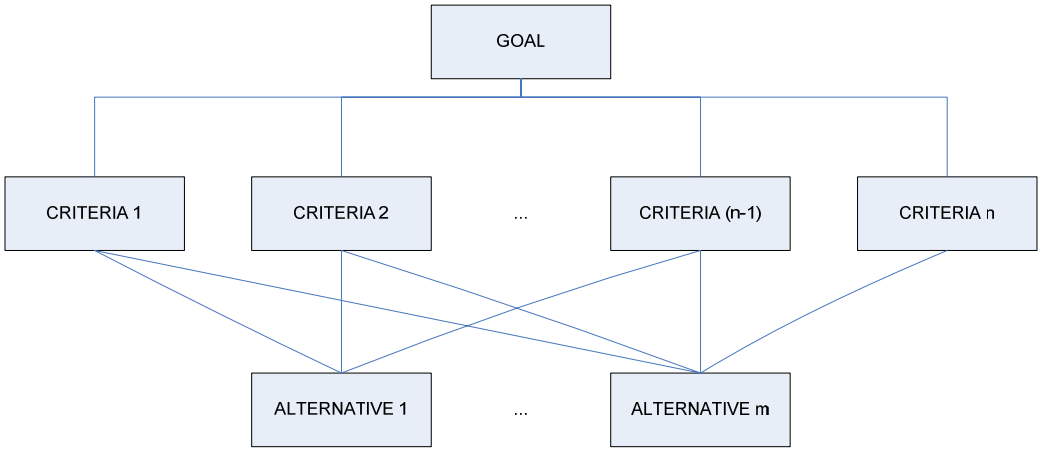


Figure 3.4. A three level hierarchy.

5th Step: Compare each element in the corresponding level and calibrate them on the numerical scale. This requires n (n-1)/2 comparisons, where n is the number of elements with the considerations that diagonal elements are equal or (1, 1, 1) in fuzzy AHP and the other elements will simply be the reciprocals of the earlier comparisons.

If strong importance of element i over element j hold, then the pair wise comparison scale can be represented by the fuzzy number $a_{ij}=(l,m,u)$ and its reciprocal will be $a_{ij}^{-1}=(1/u,1/m,1/l)$. A 3x3 pair wise comparison matrix can be represented as follows:

$$\begin{pmatrix} a_{11}=(1,1,1) & a_{12}=(l_{12},m_{12},u_{12}) & a_{13}=(l_{13},m_{13},u_{13}) \\ a_{21}=(1/u_{12},1/m_{12},1/l_{12}) & a_{22}=(1,1,1) & a_{23}=(l_{23},m_{23},u_{23}) \\ a_{31}=(1/u_{13},1/m_{13},1/l_{13}) & a_{32}=(1/u_{23},1/m_{23},1/l_{23}) & a_{33}=(1,1,1) \end{pmatrix}$$

6th Step: Perform calculations to check consistency. The consistency in fuzzy AHP is another important subject that needs to be examined. There are a few methods for checking consistency in literature.

i. The AHP methodology of Saaty [31] provides a consistency index to measure any inconsistency within the judgments in each comparison matrix as well as for the entire hierarchy. The index can be used to indicate whether or not the targets can be arranged in an appropriate order of ranking and how consistent are the pair wise comparison matrices. In fuzzy AHP for consistency checking, the defuzzification method of triangular fuzzy numbers was employed to convert the fuzzy comparison matrices into crisp matrices, which thereafter are used for the investigation of the consistency similarly in crisp AHP.

A triangular fuzzy number, represented as $M=(l,m,u)$, can be defuzzified to a crisp number as follows [32]:

$$M_{crisp}=(4m+l+u)/6 \tag{3.15}$$

The consistency index, CI, and the consistency ratio, CR, for a comparison matrix can be computed with the use of following equations:

$$CI=\frac{(\lambda_{max}-n)}{(n-1)} \tag{3.16}$$

$$CR=\frac{CI}{RI(n)} \tag{3.17}$$

Where λ_{max} is the largest eigen value of the comparison matrix, n is the dimension of the matrix, and RI (n) is a random index, that depends on n, as shown in Table 3.2.

If the CI value is found to be sufficiently small, the decision-maker's judgment may be consistent enough to give useful weighting estimates for various decision making criteria. If CI/RI $\leq$ 0.10, the degree of consistency is satisfactory. If CI/RI > 0.10, there are inconsistencies. In this case, the AHP may not yield meaningful results unless one re-examines the judgments and changes them as necessary to reduce the inconsistency below 0.10 [30].

λ_{max} can be calculated by the following steps [48]:

- Assume that A is the defuzzified pair wise comparison matrix for m objectives.

$$A = \begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{n1} & \cdots & a_{nn} \end{bmatrix}$$

- Divide each entry in column j of A by the sum of the entries in column j. New matrix is Aw, in which the sum of the entries in each column will be 1. This operation is normalization.

$$Aw = \begin{bmatrix} \frac{a_{11}}{\sum a_{i1}} & \frac{a_{12}}{\sum a_{i2}} & \cdots & \frac{a_{1n}}{\sum a_{in}} \\ \cdots & \cdots & \cdots & \cdots \\ \cdots & \cdots & \cdots & \cdots \\ \frac{a_{n1}}{\sum a_{i1}} & \frac{a_{n2}}{\sum a_{i2}} & \cdots & \frac{a_{nn}}{\sum a_{in}} \end{bmatrix} \tag{3.18}$$

- Compute c_i as the average of the entries in row i of Aw to yield the column vector C. Where c_i represents the relative degree of importance of the ith objective.

$$C = \begin{bmatrix} c_1 \\ c_2 \\ \dots \\ c_n \end{bmatrix} = \begin{bmatrix} \frac{a_{11}}{\sum a_{i1}} + \frac{a_{12}}{\sum a_{i2}} + \dots + \frac{a_{1n}}{\sum a_{in}} \\ \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \\ \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \\ \frac{a_{n1}}{\sum a_{i1}} + \frac{a_{n2}}{\sum a_{i2}} + \dots + \frac{a_{nn}}{\sum a_{in}} \end{bmatrix} \quad (3.19)$$

- Compute A.C.

$$A.C = \begin{bmatrix} a_{11} & \dots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{n1} & \cdots & a_{nn} \end{bmatrix} \times \begin{bmatrix} c_1 \\ \dots \\ c_n \end{bmatrix} = \begin{bmatrix} x_1 \\ \dots \\ x_n \end{bmatrix} \quad (3.20)$$

- Calculate $\lambda_{max.}$(maximum eigen value of the comparison matrix) by using the A.C and C matrices.

$$\lambda_{\max} = \frac{1}{n}\sum_{i=1}^{n} \frac{\text{ith entry in A.C}}{\text{ith entry in C}} = \frac{1}{n}\sum_{i=1}^{n} \frac{x_i}{c_i} \quad (3.21)$$

Table 3.2 Average random consistency index (RI) [33].

N	1	2	3	4	5	6	7	8	9	10
Random Consistency Index(R.I)	0	0	.52	.89	1.11	1.25	1.35	1.40	1.45	1.49

ii. Buckley [23] gives the following definition of consistency in terms of fuzzy numbers:

A fuzzy positive reciprocal comparison matrix $\overline{R} = \left[\overline{r}_{ij}\right]$ is consistent if and only if

the following indifference relationships hold:

$$\bar{r}_{ik} \otimes \bar{r}_{kj} \approx \bar{r}_{ij} \quad i,j,k \in 1,\ldots, n \tag{3.22}$$

where $\otimes$ is a fuzzy multiplication symbol. Relationship (3.22) means that the fuzzy indifference relationship has a maximum membership value of 1.

iii. Leung and Cao [34] extended Buckley's approach. Fuzzy relationships are transformed into equivalent auxiliary crisp relationships in the forms of feasible region of relative weights.

A fuzzy comparison matrix is defined to be consistent within tolerance deviation δ, if the α-level cut feasible region S'_α is not empty.

$$S'_\alpha = \left\{ w: (1-\delta) L_{ij\alpha} \le \frac{w_i}{w_j} \le (1+\delta) U_{ij\alpha}, \quad i \ne j=1,...,n, w_j \ge 0, \sum_{j=1,...,n} w_j = 1 \right\} \tag{3.23}$$

where w_i and w_j are the weights of the i^{th} and j^{th} elements, respectively. Here δ represents deviations from the upper bound $U_{ij\alpha}$ and the lower bound $L_{ij\alpha}$.

A practical way to test the fuzzy comparison consistency within tolerance deviation δ is to solve the following auxiliary linear program:

$$\begin{aligned} &\min \beta = \beta_1 + \beta_2 \\ &\text{s.t.} \ln(1-\delta) L_{ij1} \le \ln(w_i) - \ln(w_j) + \beta_{1ij} - \beta_{2ij} \le \ln(1+\delta) U_{ij1}, \qquad i \ne j, 1, ..., n \\ &\beta_1 \ge \beta_{1ij}, \beta_2 \ge \beta_{2ij}, \beta_{1ij}, \beta_{2ij} \ge 0 \end{aligned} \tag{3.24}$$

where $\ln(w_i)$, β_{1ij}, β_{2ij}, β_1, β_2 are decision variables.

If $\beta=0$, the fuzzy comparison matrix is consistent within tolerance deviation δ. If $\beta>0$, this means that there are no feasible weights, that the fuzzy comparison matrix is not consistent within δ. In this case, the decision maker would make the judgments again.

7th Step: Compute the value of fuzzy synthetic extent.

Let $X=\{x_1, x_2, ..., x_n\}$ be an object set, and $U=\{u_1,u_2,..., u_m\}$ be a goal set. According to the method of Chang's extent analysis, each object is taken and extent analysis for each goal, g_i, is performed, respectively. Therefore, m extent analysis values for each object can be obtained, with the following signs Chang [24]:

$$M_{g_i}^{1},M_{g_i}^{2},...,M_{g_i}^{m}, \quad i=1,2,...,n \tag{3.25}$$

where all the $M_{g_i}^{j}$ $(j=1,2,...,m)$ are triangular fuzzy numbers (TFNs).

The value of fuzzy synthetic extent with respect to the i th object is defined as

$$S_i=\sum_{j=1}^{m} M_{g_i}^{j} \otimes \left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{g_i}^{j}\right]^{-1} \tag{3.26}$$

8th Step: Calculate the priority vectors of the fuzzy AHP.

Step 8.1. The degree of possibility of $M_1 \geq M_2$ is defined as

$$V(M_1 \geq M_2)=\sup_{x\geq y}\left[\min\left(\mu_{M_1}(x),\mu_{M_2}(y)\right)\right] \tag{3.27}$$

When a pair (x,y) exists such that $x \geq y$ and $\mu_{M_1}(x)=\mu_{M_2}(y)=1$, then we have

$V(M_1 \geq M_2)=1$. Since M_1 and M_2 are convex fuzzy numbers;

$$V(M_1 \geq M_2)=1 \quad \text{iff } m_1 \geq m_2,$$
$$V(M_2 \geq M_1)=\text{hgt}(M_1 \cap M_2)=\mu_{M_1}(d), \tag{3.28}$$

where d is the ordinate of the highest intersection point D between μ_{M_1} and μ_{M_2} (see Figure 3.5).

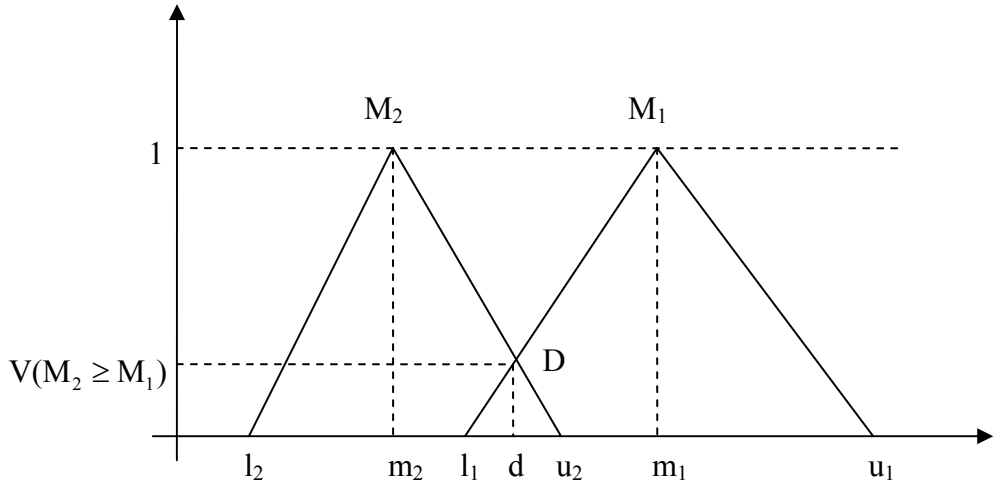


Figure 3.5 The intersection between M_1 and M_2.

When $M_1 = (l_1,m_1,u_1)$ and $M_2 = (l_2,m_2,u_2)$, the ordinate of D is given by:

$$V(M_2 \geq M_1)=\text{hgt}(M_1 \cap M_2)$$

$$= \begin{cases} 1, & \text{if } m_2 \geq m_1 \\ 0, & \text{if } l_1 \geq u_2 \\ \dfrac{(l_1-u_2)}{[(m_2-u_2)-(m_1-l_1)]}, & \text{otherwise} \end{cases} \tag{3.29}$$

To compare M_1 and M_2, we need both the values of $V(M_1 \geq M_2)$ and $V(M_2 \geq M_1)$.

Step 8.2. The degree possibility for a convex fuzzy number to be greater than k convex fuzzy numbers $M_i\,(i=1,2,...,k)$ can be defined by

$$V(M \geq M_1, M_2, ..., M_k) = V\left[(M \geq M_1) \text{ and } (M \geq M_2) \text{ and } ... \text{ and } (M \geq M_k)\right]$$
$$= \min V(M \geq M_i), \quad i=1,2,...,k . \tag{3.30}$$

Assume that;

$$d'(A_i) = \min V(S_i \geq S_k), \tag{3.31}$$

For k=1,2,...,n; $k \neq i$. Then the weight vector is given by

$$W' = (d'(A_1), d'(A_2), ..., d'(A_n))^T \tag{3.32}$$

Where $A_i\,(i=1,2,...,n)$ are n elements.

Step 8.3**:** Via normalization, the normalized weight vectors are

$$W = (d(A_1), d(A_2), ..., d(A_n))^T \tag{3.33}$$

where W is a non fuzzy number.

4. APPLICATION

4.1. Application Company

The application company is an alternative telecom operator, which been incorporated in June 2004 by a GSM operator. In January of the same year, liberalization of fixed telephony services in Turkey commenced, bringing forth a competitive environment in voice services.

Having obtained a “Type A” LDTS license in September 2004 for long distance calls, the company had the authorization to provide its clients with voice services, without them having to dial a prefix or use a dialer.

In December 2004, the company started providing wholesale voice carrying services, becoming a transition point for calls between different countries, in addition to its origination-termination services between Turkey and foreign countries.

The operator received its ISP (Internet Service Provider) license in February 2005, as the first step toward "Data Communication" services provision alongside voice services in line with its strategy of providing "complete telecommunication services".

After this important step, the company launched its ADSL and ADSL Double services in March, 2007. ADSL Double allowed voice and data service together in line with broadband trends developing in the globe, which enabled clients to use the Internet and make voice calls over broadband.

The company's network infrastructure comprises a system designed and implemented with redundancy for voice and data transmission. New generation voice services are reinforced with high capacity switchboards that are backed up on location basis. Voice and data transmission in 12 different locations in Turkey, as well as voice and data

transmission for international connections, are provided over redundant fixed lines.

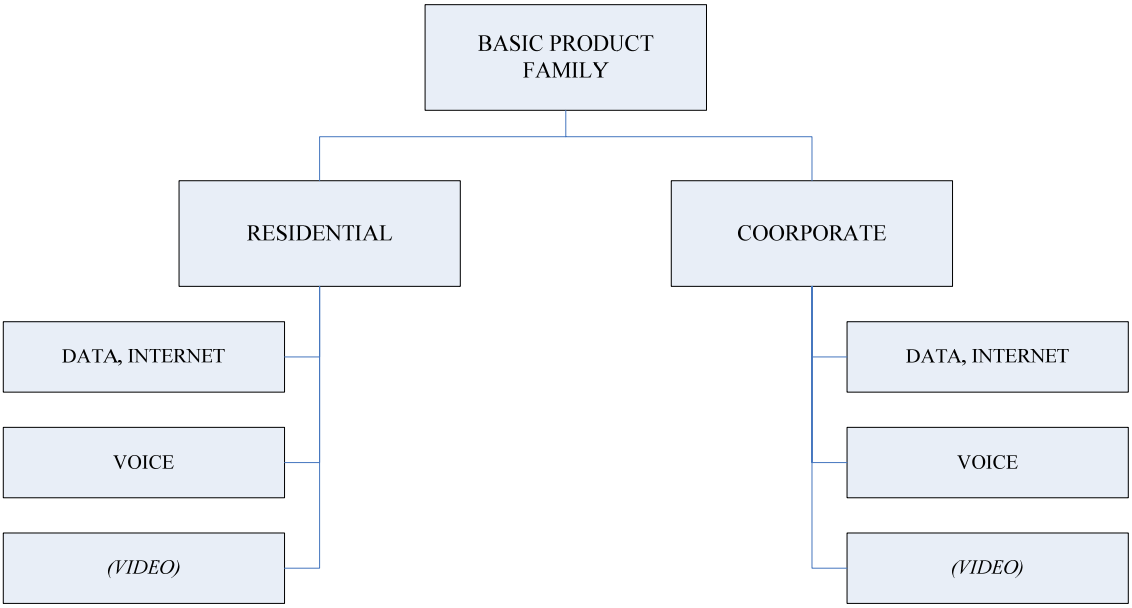


Figure 4.1 A Simple presentation of product family.

In the research the application company decides to find out the most appropriate pricing strategy for its planned triple play packages, including data, voice and video services bundled together. This service was at the investigating and feasibility stage for time being the research has made. Launch decision will be at further stages for the mentioned product.

4.2. Application of FEAHP in Deciding Optimum Pricing Strategy

Pricing strategy of a product/service is multidimensional; so when deciding the optimum pricing strategy, it should be evaluated with respect to more than one criterion to get results that are more reliable. The Analytic Hierarchy Process (AHP) is one of the most widely used multiple criteria decision-making tools. The AHP can effectively handle both qualitative and quantitative data.

The relevant criteria that needed to be considered for successful implementation of pricing strategy are essentially uncertain and include imprecise and vague data. AHP uses crisp data and does not take uncertainty into account. Fuzzy set theory is a mathematical theory designed to model the vagueness or impression of human judgment. It is especially powerful when there is an unavailability of precise or complete information. Fuzzy set theory can be a valid supporting tool to overcome the handicaps of AHP in fuzzy environment.

Because of multidimensional and imprecise nature of "Deciding Optimum Pricing Strategy" problem, in this research FEAHP method is proposed in order to determine the optimum pricing strategy for the operator.

4.2.1. Identification of Main and Sub Pricing Strategy Criteria

In this section, for the identification phase of the study, pricing strategy criteria were composed from early studies and experiences of 3 executives, namely pricing executive, product development executive and finance executive of the company. According to these studies pricing strategy criteria is classified in 5 main groups:

I. Stakeholder Criteria (StCr):

- **Internal Rate of Return (IRR):** The discount rate often used in capital budgeting that makes the net present value of all cash flows from a particular project equal to zero [35]. Generally speaking, the higher a pricing strategy's internal rate of return, the more desirable it is to undertake that strategy. As such, IRR can be used to rank several pricing strategy alternatives, a firm is considering. Assuming all other factors are equal among the various alternatives, the project with the highest IRR would probably be considered the best and undertaken first.

  To find the internal rate of return, find the IRR that satisfies the following equation:

$$Initial\_Investment = \sum_{t=1}^{N} \frac{C_t}{(1+IRR)^t} \tag{4.1}$$

where, C_t is the cash flow of the year *t*, and N is the last year of the lifetime of the project.

- **Return on Investment (ROI):** The term means that decision makers evaluate the investment by comparing the magnitude and timing of expected gains to the investment costs [35]. It is the performance measure used to evaluate the efficiency of an investment or to compare the efficiency of a number of different investments. To calculate ROI, the benefit (return) of an investment is divided by the cost of the investment; the result is expressed as a percentage or a ratio.

$$ROI = \frac{Gain\_From\_Investment - Cost\_of\_Investment}{Cost\_of\_Investment} \tag{4.2}$$

- **Cash Flow (CF):** A revenue or expense stream that changes a cash account over a given period. Cash in-flows usually arise from one of three activities - financing, operations or investing. The statement of cash flows - that shows the amount of cash generated and used by a company in a given period, calculated by adding non-cash charges (such as depreciation) to net income after taxes.

  Cash flow can be attributed to a specific project, i.e. product pricing strategy, or to a business as a whole cash flow (outflow for investment phase and inflow after a successful product launch) is one of the critical items when deciding the pricing strategy.

- **Peak Cash Funding (PCF):** From product design phase to the end of the product the maximum cash need for a point in time, is another important criterion for pricing strategy decision.

II. Market Criteria (MCr):

- **Product Awareness (PdAws):** Product awareness is used to describe the full-fit information that potential consumers have about the offered telecommunication product. Since the services and products in the sector are developing so fast, often it would be a need for companies to make potential customers understand and realize their needs for the company's product or service. As the product awareness increase more flexible, the operator will be for pricing its product.

- **Price Sensitivity (PrSen):** It is a measure to quantify the relative (or percent) change in quantity demanded to the relative change in price. Mostly a price drop results in an increase in the quantity demanded by consumers. The demand for a good is relatively inelastic when the quantity demanded does not change much with the price change. Inelastic demand figures low price sensitivity whereas elastic demand figures higher price sensitivity.

- **Customer Life Time (CLT):** Since Telecommunication products and/or services are the ones that are not purchased once but consumes for a time period, it has a direct effect on the entire stream of purchases that the customer would make over a lifetime of patronage. Therefore, the longer customer lifetime value is more desirable for telecommunication operators.

- **Market Penetration Ratio (MPen):** The ratio of customers of the proposed product over the total market gives the market penetration ratio. It signifies the potential customers that are not currently using a similar product, acquisition opportunity, in addition with the potential churn from the competitors substitute products. Measuring market penetration accurately is essential to defining a market and discovering new opportunities.

- **Potential Market (PoM):** Projections on potential market gives a strong insight on the possible sales volume and has direct effect on deciding possible pricing strategy of the product.

- **Market Growth Rate (MGR):** The rate, usually expressed as a percentage per annum, at which a market is increasing in size. Knowledge of market growth is essential to the pricing strategy. If the company sales growth is greater than or equal to market growth, the firm is comparatively healthy. If, however, the company's growth in sales is less than market growth, it is very likely the firm is in competitive trouble, especially if this is not your strategy. On the other hand when skimming strategy is selected this would be the situation that the company wants to face.

III. Demand Criteria (DCr):

- **Customer Return on Investment (CROI):** the customers benefit for choosing the alternative operators service is an important identifier of the potential demand for the service. As long as the operator provides higher return, which is the customer is better of choosing the service instead of any other competitive one the demand would be expected to be higher for that service. However, for "Market Skimming Strategy" for the targeted customer segment perception of the service will be more important than the economic benefit of having that service.

- **Quality Perception (QPer):** As the quality of the service/product increases, the product/service becomes more suitable for premium customer, which brings the concept of the skimming strategy. Since the perception of the product and/or brand is more important for premium customer, quality perception is one of the main drivers for market skimming strategy.

- **Brand Value (BVal):** Brand value is also an important criterion for market positioning of the firm. It is based on the extent to which it has high brand loyalty, brand name awareness, and general perception. As long as the operator has a strong value it has a greater chance to differentiate from its competitors, i.e. choosing other strategies than on-going market strategy.

- **Product Differentiation (PdDif):** Differentiating the company's offer and product will give customers more value than competitor's do. This can be achieves both by lower prices or providing more benefits that justify higher prices, according to the pricing strategy selected by the company.

- **Reference Price:** Reference price is the price that customers carry in their minds and they refer to when looking at a given product. The reference price might be formed by noting current prices, remembering past prices or assessing the buying situation. Higher reference price gives the company more flexibility to price product higher, skimming strategy. But, although the reference price is high the operator may choose to keep prices lower and penetrate the market.

IV. Cost/Supply Criteria (CSCr):

- **Operational Expense (OPEX):** Operating expenditures are the on-going costs for running the product. Since it exits as long as the product is in the market, the price for the product should be set that the OPEX is covered by sale of it. Therefore, higher OPEX indicates high product price. If the operator wants to position the product for penetration strategy, then it should be able to lower its operational expenses.

- **Capital Expense (CAPEX):** Capital Expenditures (CAPEX), refers to the cost of developing or providing non-consumable parts for the product. For a determined time period of market, the sale of product with the selected pricing strategy should cover the capital expense that has been spent in order to be able to launch that service.

- **Subscriber Acquisition Cost (SAC):** Subscriber acquisition cost (SAC) is the average cost of signing up a new customer. It is most frequently used by telecoms companies. Since it is a per customer cost, for the customer life time period, the revenue from each customer should cover subscriber acquisition cost. So if the operator has high subscriber acquisition cost, then it should choose market

skimming strategy to cover that cost, or it should be able to lengthen the customer life time if it will obey penetration strategy despite high subscriber acquisition cost.

- **Capacity (CAP):** The capacity that the operator carry out, have direct effect on its supply to the market. If the operator has limited capacity, it cannot position itself for market penetration strategy, which needs higher sales volume.

V. Regulation Criteria (RCR):

- **Local Regulation Licenses (LRL):** Telecommunication is a regulated industry and the operators have to have related licenses in order to be able to provide related telecommunication services. When deciding pricing strategy operators should take this in to account.

- **Price Limits (PrLim):** as being a regulated industry, the operator may have direct limitations on price, in a way that it could not be higher or lower than a certain price. In that case, price limits have direct effect on chosen pricing strategy.

- **On Market Time (OMT):** On market time has direct effect on pricing strategy, by means that if the company is late to be on market, which could be due to the regulation, and penetration strategy may be out of the scope. This would be the case if the first operator in the market would have a fast rollout and high market penetration in a short time.

- **Global Organizations Strategy (GOS):** The opinions of global organizations for the product positioning may have direct effect on pricing strategy. For example if the offered product is accepted to be a utility than penetration, strategy would be the main alternative for the product.

4.2.2. Construction of AHP Structure

In this study a four-leveled hierarchy is proposed in order to classify the pricing criteria. The objective, which takes place at the top level, is to decide the optimum pricing strategy. The second level consists of 5 main pricing criteria. The third level consists of 23 sub-pricing criteria. And finally 3 pricing strategy, market skimming, market penetration and on-going price strategies are located in the fourth level as alternatives. Figure 4.2 shows the AHP structure.

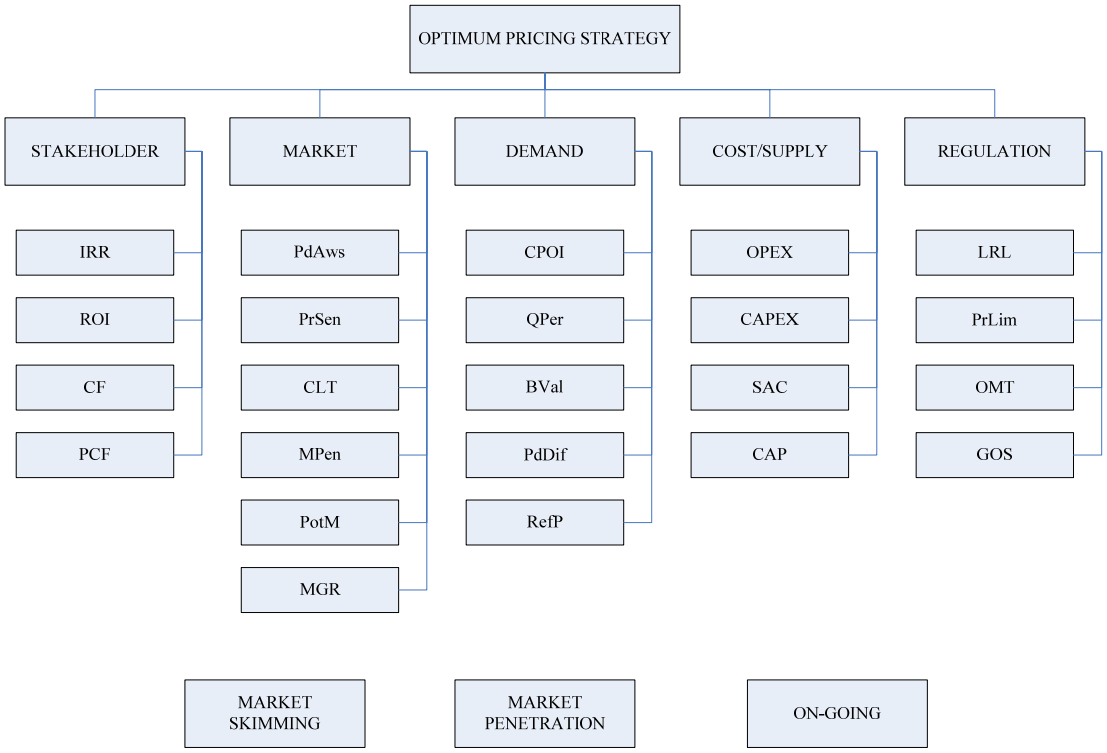


Figure 4.2 Four leveled AHP structure.

4.2.3. Pricing Strategy Identification

Before setting a price, the operator must identify the role that the price will play in the product's overall marketing strategy. The operator may choose a strategy that will serve to restrict the firm's market to an executive segment or that will serve as the main tool for attracting buyers, or again it will serve as a neutral function, secondary to other

aspects of marketing. These are all strategic decisions, which will directly effect the firm's market positioning and therefore should be taken precedence.

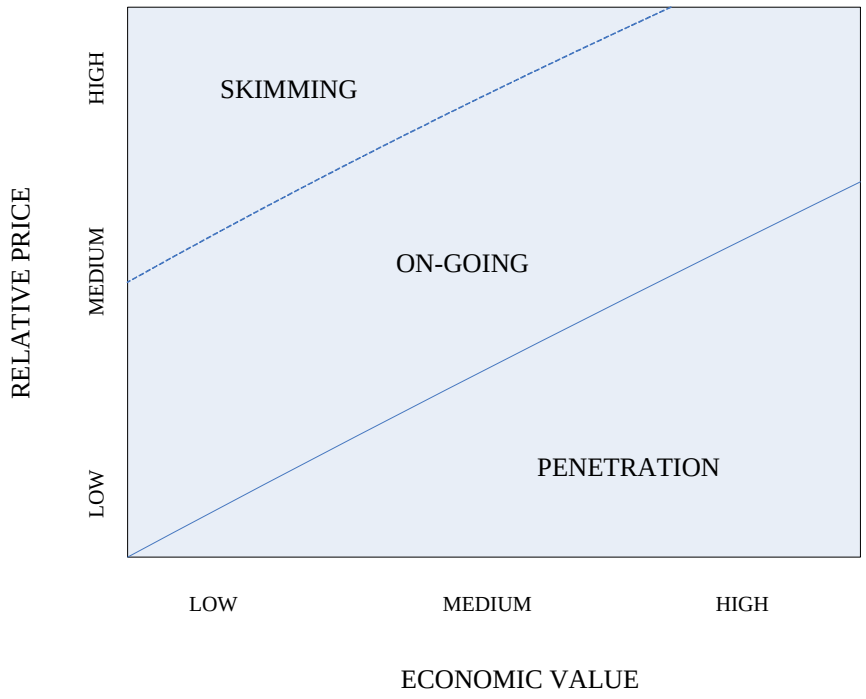


Figure 4.3. Relationship between Price, Economic Value and Pricing Strategy

Skimming Strategy is designed to capture high margins at the expense of high sales volume. It involves setting price high relative to the economic value of the most potential customers in order to benefit from the relative price insensitivity of a small segment [8].

Penetration Strategy involves setting a price far enough below economic value to attract and hold a large base of customers.

4.2.4. Construction of Matrices and Risk Evaluation

In FEAHP, after developing the hierarchy the second step is comparative judgment. A pricing (marketing) executive, a product development executive and a finance executive of the firm had been asked to made their comparisons by using the triangular fuzzy

scale, which is given in Table 4.1.

In order to take the imprecision of human qualitative assessments into consideration defined fuzzy numbers are used. Sample questionnaire forms to receive the experts' assessments are given in Appendix A.

Table 4.1. Triangular fuzzy conversion scale.

Linguistic scale	Fuzzy scale			Fuzzy reciprocal scale		
Just Equal	1,00	1,00	1,00	1,00	1,00	1,00
Weakly More Important	0,50	1,00	1,50	0,67	1,00	2,00
Moderately More Important	1,00	1,50	2,00	0,50	0,67	1,00
Strongly More Important	1,50	2,00	2,50	0,40	0,50	0,67
Very Strongly More Important	2,00	2,50	3,00	0,33	0,40	0,50
Absolutely More Important	2,50	3,00	3,50	0,29	0,33	0,40

The elements on the second level main pricing criteria are arranged into a matrix and the experts make the judgments about the relative importance of the elements. As mentioned in the previous sections the pair wise comparison will be performed in terms of which of the elements will dominate the other. Comparisons are made by linguistic judgments. These judgments will then be expressed as triangular fuzzy numbers. The pair wise comparison matrix for main pricing criteria is shown in Table 4.2. The values of the matrix are the mean values of the decision makers' preferences. Detailed fuzzy evaluation matrices of each expert are given in Appendix B.

Table 4.2 The fuzzy evaluation matrix of the main pricing criteria with respect to the goal.

	StCr			MCr			DCr			CSCr			RCr		
StCr	1,00	1,00	1,00	0,47	0,61	0,89	0,33	0,40	0,50	0,50	0,69	1,17	0,67	1,17	1,67
MCr	1,17	1,67	2,17	1,00	1,00	1,00	0,56	1,00	1,67	0,61	1,00	1,83	1,17	1,67	2,17
DCr	2,00	2,50	3,00	0,61	1,00	1,83	1,00	1,00	1,00	0,61	1,00	1,83	2,17	2,67	3,17
CSCr	1,17	1,67	2,17	0,56	1,00	1,67	0,56	1,00	1,67	1,00	1,00	1,00	1,17	1,67	2,17
RCr	0,61	0,89	1,67	0,47	0,61	0,89	0,32	0,39	0,49	0,47	0,61	0,89	1,00	1,00	1,00

Before performing the related FEAHP calculations consistency of the pair wise comparison matrices were examined. First triangular fuzzy numbers were converted to

crisp numbers by using Equation (3.15). Then by using Equations (3.16) and (3.17), consistency ratio CR is calculated. It is found that the degree of consistency is satisfactory for all of the comparison matrices.

By using the consistent fuzzy comparison matrix which is given in Table 4.2 the value of fuzzy synthetic extent with respect to the overall goal is calculated by using Equation (3.26). Calculations are made by Microsoft Excel. Fuzzy synthetic values are obtained as follows:

$$S_{StCr} = (2.97,3.87,5.22) \otimes (0.03,0.04,0.05)$$

$$= (0.08,0.14,0.25)$$

$$S_{MCr} = (4.50,6.33,8.33) \otimes (0.03,0.04,0.05)$$

$$= (0.12,0.22,0.42)$$

$$S_{DCr} = (6.39,8.17,10.83) \otimes (0.03,0.04,0.05)$$

$$= (0.17,0.29,0.51)$$

$$S_{CSCr} = (4.44,6.33,8.67) \otimes (0.03,0.04,0.05)$$

$$= (0.12,0.22,0.41)$$

$$S_{RCr} = (2.87,3.50,4.93) \otimes (0.03,0.04,0.05)$$

$$= (0.07,0.12,0.23)$$

And by using these synthetic values degree of possibility values are obtained from Equation (3.29).

$V(S_{StCr}>S_{MCr}) = 0,60$
$V(S_{StCr}>S_{DCr}) = 0,35$
$V(S_{StCr}>S_{CSCr}) = 0,60$
$V(S_{StCr}>S_{RCr}) = 1,00$

$V(S_{MCr}>S_{StCr}) = 1,00$
$V(S_{MCr}>S_{DCr}) = 0,79$
$V(S_{MCr}>S_{CSCr}) = 0,17$
$V(S_{MCr}>S_{RCr}) = 1,00$

$V(S_{DCr}>S_{StCr}) = 1,00$
$V(S_{DCr}>S_{MCr}) = 1,00$
$V(S_{DCr}>S_{CSCr}) = 1,00$
$V(S_{DCr}>S_{RCr}) = 1,00$

$V(S_{CSCr}>S_{StCr}) = 1,00$
$V(S_{CSCr}>S_{MCr}) = 1,00$
$V(S_{CSCr}>S_{DCr}) = 0,79$
$V(S_{CSCr}>S_{RCr}) = 1,00$

$V(S_{RCr}>S_{StCr}) = 0,92$
$V(S_{RCr}>S_{MCr}) = 0,54$
$V(S_{RCr}>S_{DCr}) = 0,29$
$V(S_{RCr}>S_{CSCr}) = 0,54$

By applying Equation 3.31, d′ values are obtained:

$$d'(StCr) = V(S_{StCr} \geq S_{MCr}, S_{DCr}, S_{CSCr}, S_{RCr})$$

$$= \min(0.60,0.35,0.60,1.00) = 0.35$$

$$d'(MCr) = V(S_{MCr} \geq S_{StCr}, S_{DCr}, S_{CSCr}, S_{RCr})$$

$$= \min(1.00,0.79,0.17,1.00) = 0.17$$

$$d^{'}(DCr) = V(S_{DCr} \geq S_{StCr}, S_{MCr}, S_{CSCr}, S_{RCr})$$

$$= \min(1.00,1.00,1.00,1.00) = 1.00$$

$$d^{'}(CSCr) = V(S_{CSCr} \geq S_{StCr}, S_{MCr}, S_{DCr}, S_{RCr})$$

$$= \min(1.00,1.00,0.79,1.00) = 0.79$$

$$d^{'}(RCr) = V(S_{RCr} \geq S_{StCr}, S_{MCr}, S_{DCr}, S_{CSCr},)$$

$$= \min(0.92,0.54,0.29,0.54) = 0.29$$

Therefore, according to Equation (3.32) the weight vector is given by the minimum d' values of each pricing strategy criterion:

$$W^{'} = (0.35,0.17,1.00,0.79,0.29)^{T}$$

Via normalization, the normalized weight vector with respect to overall goal W_G is obtained as:

$$W = (0.13,0.07,0.39,0.30,0.11)^{T}.$$

Figure 4.4 exhibits the weighting values for main pricing criteria.

After the pair wise comparisons and evaluation of weight vector with respect to the goal the same steps are repeated in order to find the weight vectors of each sub-pricing criterion. Thus five comparison matrices are composed and weight vectors are evaluated as shown in Table 4.3 - 4.7.

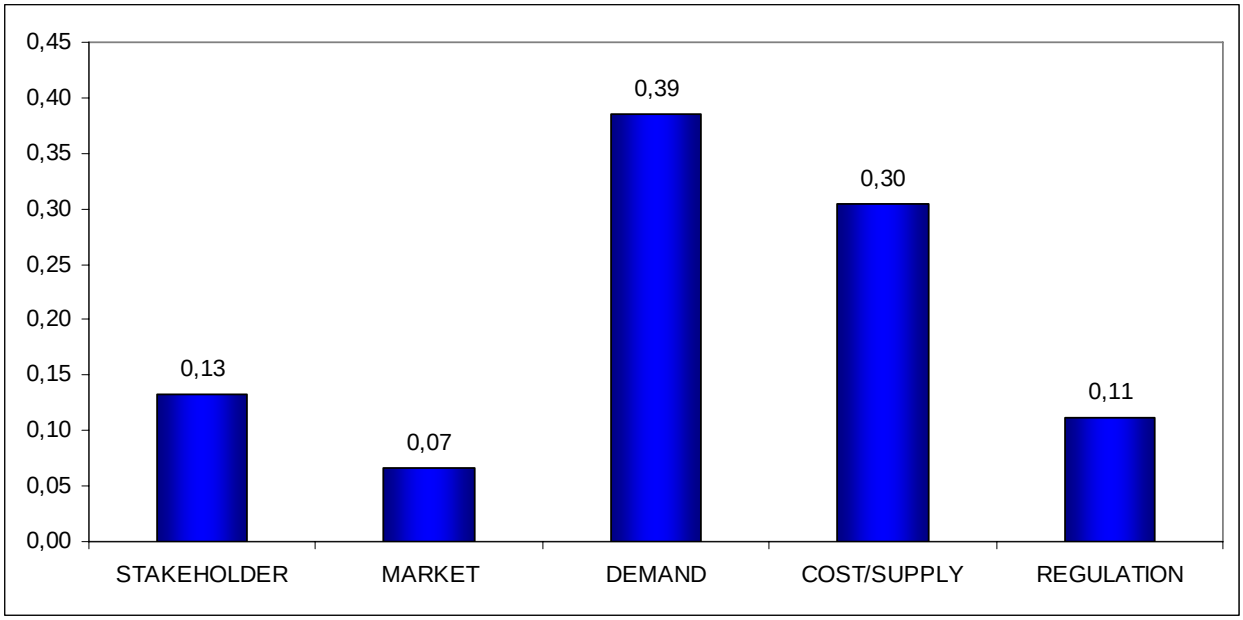


Figure 4.4 Weighting values of main pricing strategy criteria.

Table 4.3. Evaluation of the sub-pricing strategy criterion with respect to Stakeholder Criteria .

	IRR			ROI			CF			PCF			WStCr
IRR	1,00	1,00	1,00	0,61	1,00	1,83	0,52	0,72	1,22	0,47	0,61	0,89	0,09
ROI	0,56	1,00	1,67	1,00	1,00	1,00	0,50	0,67	1,00	0,61	0,89	1,67	0,09
CF	1,00	1,50	2,00	1,00	1,50	2,00	1,00	1,00	1,00	0,61	1,00	1,83	0,49
PCF	1,17	1,67	2,17	0,67	1,17	1,67	0,56	1,00	1,67	1,00	1,00	1,00	0,31

Table 4.4. Evaluation of the sub-pricing strategy criterion with respect to Market Criteria

	PdAw			PrSen			CLT			Mpen			PoM			MGR			WMCr
PdAw	1,00	1,00	1,00	0,56	0,89	1,50	1,17	1,67	2,17	0,80	1,17	1,56	1,22	1,67	2,33	0,50	0,67	1,00	0,21
PrSen	0,72	1,17	1,83	1,00	1,00	1,00	1,50	2,00	2,50	0,89	1,33	2,00	1,33	1,83	2,33	0,67	1,00	2,00	0,04
CLT	0,49	0,67	1,11	0,40	0,50	0,67	1,00	1,00	1,00	0,56	0,80	1,50	0,61	1,00	1,83	0,36	0,43	0,56	0,12
Mpen	0,83	1,11	1,50	0,50	0,78	1,17	1,00	1,50	2,00	1,00	1,00	1,00	1,17	1,67	2,17	0,41	0,63	0,89	0,20
PoM	0,43	0,67	0,94	0,43	0,56	0,78	0,56	1,00	1,67	0,47	0,61	0,89	1,00	1,00	1,00	0,39	0,49	0,67	0,09
MGR	1,00	1,50	2,00	0,50	1,00	1,50	1,83	2,33	2,83	1,39	2,00	2,67	1,67	2,17	2,67	1,00	1,00	1,00	0,30

Table 4.5. of the sub-pricing strategy criterion with respect to Demand Criteria

	CROI			Qper			Bval			PdDif			RefP			WDCr
CROI	1,00	1,00	1,00	0,83	1,33	1,83	1,22	1,67	2,33	1,67	2,17	2,67	0,72	1,00	1,50	0,33
Qper	0,58	0,83	1,56	1,00	1,00	1,00	1,17	1,56	2,00	1,33	1,83	2,33	0,47	0,72	1,06	0,03
Bval	0,43	0,67	0,94	0,61	0,86	1,17	1,00	1,00	1,00	0,89	1,33	2,00	0,44	0,58	0,83	0,18
PdDif	0,39	0,49	0,67	0,43	0,56	0,78	0,52	0,83	1,39	1,00	1,00	1,00	0,38	0,47	0,61	0,10
RefP	0,72	1,00	1,50	1,06	1,50	2,17	1,33	1,83	2,33	1,67	2,17	2,67	1,00	1,00	1,00	0,34

Table 4.6. Evaluation of the sub-pricing strategy criterion with respect to Cost/Supply Criteria.

	OPEX			CAPEX			SAC			CAP			WCS
OPEX	1,00	1,00	1,00	1,17	1,67	2,17	0,47	0,61	0,89	1,00	1,39	1,83	0,23
CAPEX	0,50	0,69	1,17	1,00	1,00	1,00	0,36	0,43	0,56	0,63	0,89	1,22	0,04
SAC	1,17	1,67	2,17	1,83	2,33	2,83	1,00	1,00	1,00	1,50	2,00	2,50	0,41
CAP	0,63	0,89	1,22	1,00	1,39	1,83	0,41	0,52	0,72	1,00	1,00	1,00	0,14

Table 4.7. Evaluation of the sub-pricing strategy criterion with respect to Regulation Criteria

	LRL			PrLim			OMT			GOS			WR
LRL	1,00	1,00	1,00	0,41	0,52	0,72	0,38	0,47	0,61	0,72	1,17	1,83	0,23
PrLim	1,50	2,00	2,50	1,00	1,00	1,00	0,67	1,06	1,50	1,83	2,33	2,83	0,04
OMT	1,67	2,17	2,67	0,72	1,06	1,67	1,00	1,00	1,00	1,83	2,33	2,83	0,41
GOS	0,56	0,89	1,50	0,36	0,44	0,58	0,36	0,43	0,56	1,00	1,00	1,00	0,14

In this section, as the first step of the evaluations, firstly the relative weights of the main pricing strategy criterion with respect to the goal and then relative weights of the sub-pricing strategy criterion with respect to the related main pricing criteria are evaluated.

Finally, the experts assessed the importance level of sub-pricing strategy criterion by again making pair wise comparisons between market penetration strategy (MP), market skimming strategy (MS), and on-going pricing strategy (OG) and performed similar calculations. Table 4.8 gives the summary of combinations of priority weights of sub-pricing strategy criterion.

The weights of pricing strategies with respect to the each main pricing criterion are given by adding the weights per pricing strategy multiplied by weights of the

corresponding sub-pricing criteria.

Finally the weights of each pricing strategy can be calculated by weights per pricing strategy multiplied by weights of the corresponding main pricing criteria. Table 4.9 shows the weights of pricing strategies with respect to the each main pricing criteria and overall score of each risk level.

Table 4.8. Summary of combinations of priority weights.

	Sub-risk criterion of Stakeholder Criteria						
	IRR	**ROI**	**CF**	**PCF**			**Pricing Alternative's Weight**
Weight	0,09	0,09	0,49	0,31			
Market Penetration	0,00	0,00	0,70	0,30			**0,25**
Market Skimming	0,77	0,84	0,16	0,48			**0,57**
On-Going Pricing	0,23	0,16	0,14	0,21			**0,18**

	Sub-risk criterion of Market Criteria						
	PdAw	**PrSen**	**CLT**	**Mpen**	**PoM**	**MGR**	**Pricing Alternative's Weight**
Weight	0,21	0,04	0,12	0,20	0,09	0,30	
Market Penetration	0,58	0,72	0,60	0,89	0,90	0,72	**0,74**
Market Skimming	0,35	0,09	0,18	0,00	0,00	0,09	**0,12**
On-Going Pricing	0,07	0,19	0,22	0,11	0,10	0,19	**0,15**

	Sub-risk criterion of Demand Criteria						
	CROI	**Qper**	**Bval**	**PdDif**	**RefP**		**Pricing Alternative's Weight**
Weight	0,33	0,03	0,18	0,10	0,34		
Market Penetration	0,90	0,00	0,00	0,10	0,63		**0,32**
Market Skimming	0,00	0,69	0,75	0,57	0,00		**0,40**
On-Going Pricing	0,10	0,31	0,25	0,33	0,37		**0,27**

Table 4.8. Summary of combinations of priority weights (continued).

	Sub-risk criterion of Cost/Supply Criteria						
	OPEX	**CAPEX**	**SAC**	**CAP**			**Pricing Alternative's Weight**
Weight	0,23	0,04	0,41	0,14			
Market Penetration	0,13	0,46	0,00	0,03			**0,16**
On-Going Pricing	0,31	0,36	0,38	0,30			**0,34**

	Sub-risk criterion of Regulations Criteria						
	LRL	**PrLim**	**OMT**	**GOS**			**Pricing Alternative's Weight**
Weight	0,23	0,04	0,41	0,14			
Market Penetration	0,07	0,72	0,72	0,72			**0,56**
Market Skimming	0,57	0,09	0,09	0,09			**0,21**
On-Going Pricing	0,36	0,19	0,19	0,19			**0,23**

Table 4.9. Weights of pricing strategies and overall score.

	Pricing Alternative's Weight
Market Penetration	0,32
Market Skimming	**0,42**
On-Going Pricing	0,27

4.2.5. Research Results

By using fuzzy extended AHP, firstly, the relative importance of main pricing strategy criteria with respect to the goal and the relative importance of sub- pricing strategy criteria with respect to the related main pricing strategy were calculated. As shown in Figure 4.3 demand criteria “DCr” carries the highest priority of 39% and it is followed by with 30% cost/supply criteria “CSCr”, 13% stakeholder criteria “StCr”, 11% regulation criteria “RCr”, and 7% market criteria “MCr”.

Cash flow criteria “CF” is identified as the most important attribute under the stakeholder criteria. Under the market criterion, market growth rate “MGR” carries the

highest priority weight. Reference price criteria “RP” is the most important attribute under the pricing demand criterion. For Cost/supply criterion, subscriber acquisition cost “SAC”, and for regulations criterion on market time “OMT” sub criteria carry the highest priority weights.

After the evaluation of priority weights of pricing strategies with respect to the each sub-pricing criterion, Figure 4.5 and Figure 4.6 are obtained as a summary.

Figure 4.5 Priority weights of each pricing strategy with respect to the sub-pricing criteria

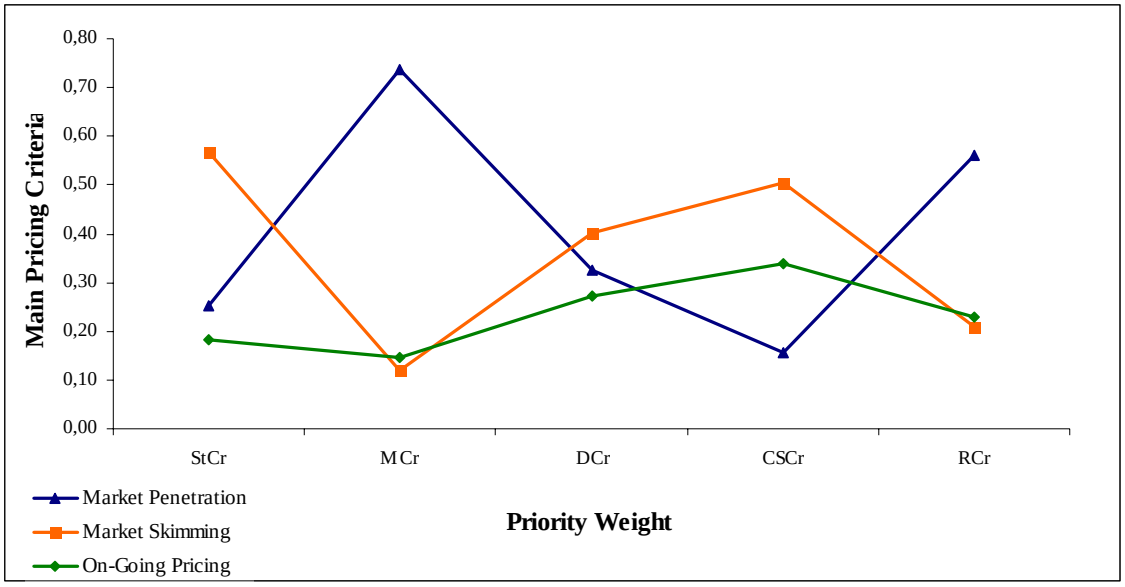
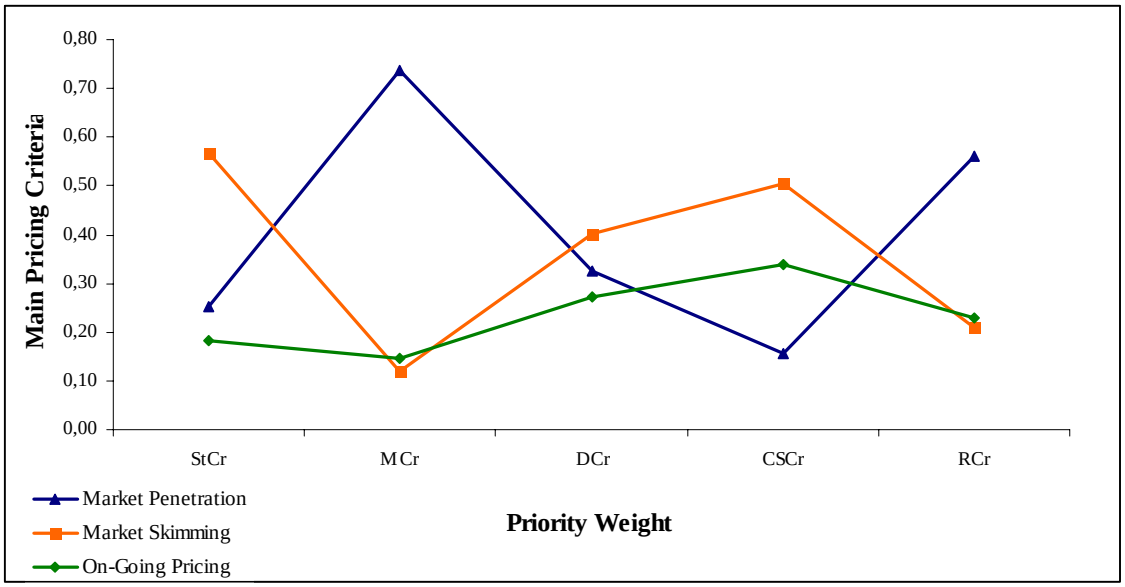
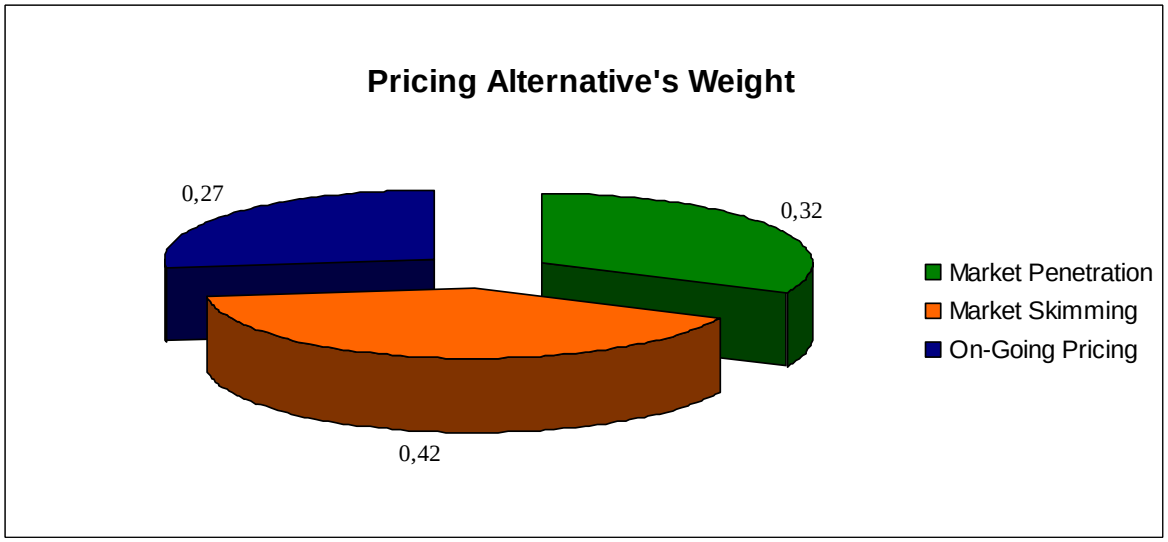


Figure 4.6 Priority weights of each risk level with respect to the risk factors.



After the calculations, which were recommended in the previous sections the scores for each pricing strategy, is obtained. Figure 4.7 represents the score for each pricing alternative for the product. The score of each pricing strategy is as follows; with 32% market penetration, 42 % market skimming and 27% on-going pricing strategy.

Figure 4.7 Final priority weights of risk levels.



5. CONCLUSION

In this research Fuzzy Extended Analytic Hierarchy Process approach has been presented to determine the optimum pricing strategy for a telecommunications product. In the approach triangular fuzzy numbers were used. The aim of this study is to identify all the main criteria that should have impact on pricing decision and furthermore estimate the suitable pricing strategy of an example telecommunications service/product.

Pricing is one of the essential concepts in telecommunications industry. Because, there are heavy competition conditions along with regulatory issues which should be both taken into account during pricing decisions. Positioning of the operator and its product, that is selected pricing strategy - market skimming, market penetration and on-going price strategy – is the key process before determining the final price or tariff of the product.

Determining optimum pricing strategy should be performed by using one of the multi-attribute evaluation methods. Because of the multidimensional nature of pricing benefiting from the multi-attribute evaluation methods is more reliable. And also developing appropriate pricing strategy is including essentially uncertainty and includes imprecise and vague data. This requires a method that allows the use of decision makers' vague judgments in the pair wise comparison of attributes. The fuzzy AHP method meets this requirement. There are many fuzzy AHP methods developed in the literature. In this study, Chang's [24] extent analysis method on fuzzy AHP is selected and applied to the risk evaluation of an ERP implementation project.

The FEAHP model discussed in this paper is proved to be straightforward, less time taking and having less computational expense as compared to other existing decision making systems. The use of FEAHP does not involve burdensome mathematical

operation and so making it of general use for solving practical multi attribute decision making problems. The FEAHP has the ability to capture the vagueness of human thinking style and effectively solve multi-attribute decision making problems.

The result of the study shows that the optimum pricing strategy for the studied product/service is market penetration strategy. To deploy the market penetration strategy effectively, the company should analyze its competitors and the market deeply and announce a price/tariff relatively low to its competitors.

In this study FAHP method is selected and applied instead of conventional crisp AHP the evaluations can also be made by using AHP. Although, the AHP is one of the most widely used multi-criteria decision making tool but application of AHP in determining pricing strategy will have some limitations.

The AHP does not take into account the uncertainty. It is mainly used in nearly crisp decision applications. But pricing environment is uncertain, so it is not useful using AHP in establishing pricing strategy. The results obtained from AHP will not be accurate as the results obtained from FAHP.

Furthermore, it is also recognized that human assessment on qualitative attributes is always subjective and thus imprecise. Therefore, conventional AHP seems inadequate to capture decision-maker's requirements explicitly. In order to model this kind of uncertainty in human preference, fuzzy sets could be incorporated with the pair wise comparison as an extension of AHP. The fuzzy AHP approach allows a more accurate description of the decision making process.

REFERENCES

[1] Moulton, P., Moulton, J., "*Telecommunications survival guide: Telecommunications Evolution and Future*", Prentice Hall, 2001

[2] Cohill, A. M., "*Telecommunications as Essential Public Infrastructure*", Michigan Telecommunications Conference, (2002).

[3] Fransman, M., "*Evolution of the Telecommunications Industry into the Internet Age*", Communications and Strategy 43, (2001)

[4] http://strategis.ic.gc.ca/epic/site/imr-ri.nsf/en/gr120962e.html.

[5] Burnham , James B., "*Telecommunications Policy In Turkey: Restructuring For Economic Growth*", European Union Center of Excellence European Studies Center, University of Pittsburgh, Policy Paper No. 11 (2006)

[6] http://ec.europa.eu/egov, eGovernment Factsheets – Turkey

[7] Kotler, P., Armstrong, G., "*Principles of Marketing*", Prentice Hall International Editions (2000).

[8] Nagle, T.T., Holden R. K., "*The Strategy and Tactics of Pricing*", Prentice Hall (1995)

[9] Phillips, R., "*Pricing and Revenue Optimization*", Stanford University Pres, (2005)

[10] Pashigian, B.P., "Price *Theory and Applications*", Mc Graw Hill (1995)

[11] Courcoubetis, C., Weber, R., "*Pricing Communications Networks: Economics, Technology and Modelling*", Wiley, (2003).

[12] Crew, M.A., Kleindorfer, P.R., "*The Economics of Public Utility Regulation*", Cambridge, MA: MIT Press, (1986)

[13] Brown, K., Norgaard, R., "*Modelling the Telecommunication Pricing Decision*", Decision Science, (May/June), 673-686, (1992).

[14] J.S. Yao, K. Wu, "*Consumer Surplus and Producer Surplus for Fuzzy Demand and Fuzzy Supply*", *Fuzzy Sets and Systems 103 (1999).*

[15] J.S. Yao, T.S. Shih, *"Fuzzy Revenue for Fuzzy Demand Quantity Based on Interval-Valued Fuzzy Sets"*, Computers & Operation Research 29 *(2002).*

[16] L.A.Zadeh, "*Fuzzy Sets*", Information and Control, 8(1965) 338-353. sayfa 35

[17] *L.A.Zadeh* , "*Fuzzy Sets as the Basis for a Theory of Possibility*", *Fuzzy Sets and Systems* 1:3-28, 1978. (Reprinted in *Fuzzy Sets and Systems* 100 (Supplement): 9-34, 1999).

[18] Dubois, D., and Prade, H., "*Possibility Theory, Probability Theory and Multiple-valued Logics: A Clarification*", *Annals of Mathematics and Artificial Intelligence* 32:35-66, 2001

[19] Lootsma, F.A., "*Fuzzy Logic for Planning and Decision Making"*, Kluwer Academic Publishers, London, (1997).

[20] Ayağ, Z., Özdemir, R.G., "*A Fuzzy AHP Approach to Evaluating Machine Tool Alternatives*", Journal of Intelligent Manufacturing, 17, 179-190, (2006)

[21] Ross, T.J., "*Fuzzy Logic with Engineering Applications*", John Wiley & Sons Ltd., *(2004)*

[22] VanLaarhoven, P.J.M., Pedrycz, W., "*A Fuzzy Extension of Saaty's Priority Theory*", Fuzzy Sets and Systems, 11, 229-241, (1983).

[23] Buckley, J.J., "*Fuzzy Hierarchical Analysis*", Fuzzy Sets and Systems, 17, 233–247, (1985)

[24] Chang, D.Y., "*Applications of the Extent Analysis Method on Fuzzy AHP*", European Journal of Operational Research, 95, pp.649-655, (1996)

[25] Tüysüz, F., Kahraman, C., "*Project Risk Evaluation Using a Fuzzy Analytic Hierarchy Process: An Application to Information Technology Projects*", International Journal of Intelligent Systems, 21, 559-584, (2006).

[26] Kahraman, C., Cebeci, U., Ulukan, Z., "*Multi-criteria Supplier Selection Using Fuzzy AHP*", Logistics Information Management, 16, 382–394, (2003).

[27] Kahraman, C., Cebeci, U., Ruan, D., "*Multi-Attribute Comparison of Catering Service Companies Using Fuzzy AHP: The Case of Turkey*", International Journal of Production Economics, 87, 171–184, (2004).

[28] Büyüközkan, G., Kahraman, C., Ruan, D., "*A Fuzzy Multi-Criteria Decision Approach for Software Development Strategy Selection*", *International Journal of General Systems, 33, 259–280, (2004).*

[29] Chan, F.T.S., Kumar, N., "*Global Supplier Development Considering Risk Factors Using Fuzzy Extended AHP-Based Approach*", The International Journal of Management Science, 35(4), 417-431, (2007).

[30] Saaty, T., Vargas, L. G. , *"Models, Methods & Applications of the Analytic Hierarchy Process"*, Kluwer's International Series, London, (2001).

[31] Saaty, T.L., "*The Analytic Hierarchy Process"*, Mc Graw-Hill, New York, (1980).

[32] Kwong, C.K., Bai, H., "*Determining the Importance Weights for the Customer Requirements in QFD Using a Fuzzy AHP with an Extent Analysis Approach*", IIE Transactions, 35, 619-626, (2003)

[33] Winston, W. L., "*Operations Research Applications and Algorithms*", Duxbury, California, (2001).

[34] Leung, L.C., Cao, D., "*On Consistency Ranking of Alternatives in Fuzzy AHP*", European Journal of Operational Research, 124, 102-113, (2000).

[35] Park, C. S., Gunter, P. S., "*Advanced Engineering Economics*", John Wiley & Sons Inc., New York, (1990).

APPENDICES

APPENDIX A: QUESTIONNAIRE

Read the following questions and put check marks on the pair wise comparison matrices. If an attribute on the left is more important than the one matching on the right, put your check mark to the left of the importance "*Equally*" under the importance level you prefer. If an attribute on the left is less important than the one matching on the right, put your check mark to the right of the importance "*Equally"* under the importance level you prefer.

QUESTIONS

With respect to the overall goal "Optimum Pricing Strategy" of a triple play product,

1. How important is stakeholder effect when it is compared with market effect?
2. How important is stakeholder effect when it is compared with demand effect?
3. How important is stakeholder effect when it is compared with decision cost/supply effect?
4. How important is stakeholder effect when it is compared with regulation effect?
5. How important is market effect when it is compared with demand effect?
6. How important is market effect risk when it is compared with cost/supply effect?
7. How important is market effect when it is compared with regulation effect?
8. How important is demand effect when it is compared with cost/supply effect??
9. How important is demand effect risk when it is compared with regulation effect?
10. How important is cost/supply effect risk when it is compared with regulation effect?

Table AI. Questionnaire forms used to aid comparisons of main pricing criteria

		Importance of one main criteria over another											
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
1	StCr												MCr
2	StCr												DCr
3	StCr												CSCr
4	StCr												RCr
5	MCr												DCr
6	MCr												CSCr
7	MCr												RCr
8	DCr												CSCr
9	DCr												RCr
10	CSCr												RCr

With respect to the sub-pricing criteria 'Stakeholder Criteria (StCr)'

11. How important is IRR when it is compared with ROI?
12. How important is IRR when it is compared with cash flow?
13. How important is IRR when it is compared with peak cash funding?
14. How important is ROI when it is compared with cash flow?
15. How important is ROI when it is compared with peak cash funding?
16. How important is cash flow when it is compared with peak cash funding?

Table AII. Questionnaire forms used to aid comparisons of sub-pricing criteria

		Importance of one sub criteria over another											
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
11	IRR												ROI
12	IRR												CF
13	IRR												PCF
14	ROI												CF
15	ROI												PCF
16	CF												PCF

With respect to the sub-pricing criteria 'Market (MCr)'

17. How important is product awareness when it is compared with price sensitivity?
18. How important is product awareness when it is compared with customer life time?
19. How important is product awareness when it is compared with market penetration?
20. How important is product awareness when it is compared with potential market?
21. How important is product awareness when it is compared with market growth rate?
22. How important is price sensitivity when it is compared with customer life time?
23. How important is price sensitivity when it is compared with market penetration?
24. How important is price sensitivity when it is compared with potential market?
25. How important is price sensitivity when it is compared with market growth rate?
26. How important is customer life time when it is compared with market penetration?
27. How important is customer life time when it is compared with potential market?
28. How important is customer life time when it is compared with market growth rate?
29. How important is market penetration when it is compared with potential market?
30. How important is market penetration when it is compared market growth rate?
31. How important is potential market when it is compared with market growth rate?

Table AII. Continued.

		Importance of one sub-criteria over another											
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	Attributes
17	PdAws												PrSen
18	PdAws												CLT
19	PdAws												Mpen
20	PdAws												PotM
21	PdAws												MGR
22	PrSen												CLT
23	PrSen												Mpen
24	PrSen												PotM
25	PrSen												MGR
26	CLT												Mpen
27	CLT												PotM
28	CLT												MGR
29	MPen												PotM
30	MPen												MGR
31	PotM												MGR

With respect to the sub-pricing criteria 'Demand (DCr)'

32. How important is customer ROI when it is compared with quality perception?
33. How important is customer ROI when it is compared with brand value?
34. How important is customer ROI when it is compared with product differentiation?
35. How important is customer ROI when it is compared with reference price?
36. How important is quality perception when it is compared with brand value?
37. How important is quality perception when it is compared with product differentiation?
38. How important is quality perception when it is compared with reference price?
39. How important is brand value when it is compared with reference price?
40. How important is brand value when it is compared with product differentiation?
41. How important is product differentiation when it is compared with reference price?

Table AII. Continued.

		Importance of one sub-criteria over another											
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
32	CROI												Qper
33	CROI												Bval
34	CROI												Pdif
35	CROI												RefP
36	QPer												Bval
37	QPer												Pdif
38	QPer												RefP
39	Bval												Pdif
40	BVal												RefP
41	Pdif												RefP

With respect to the sub-pricing criteria 'Cost/Supply (CSCr)'

42. How important is OPEX when it is compared with CAPEX?
43. How important is OPEX when it is compared with SAC?
44. How important is OPEX expertise when it is compared CAP?

45. How important is CAPEX when it is compared with SAC?
46. How important is CAPEX when it is compared with CAP?
47. How important is SAC when it is compared with CAP?

Table AII. Continued.

Importance of one sub criteria over another													
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
42	OPEX												CAPEX
43	OPEX												SAC
44	OPEX												CAP
45	CAPEX												SAC
46	CAPEX												CAP
47	SAC												CAP

With respect to the sub-pricing criteria 'Regulations (RCr)'

48. How important is local regulation licenses when it is compared with price limitation?
49. How important is local regulation license when it is compared with on market time?
50. How important is local regulation license when it is compared with global organizations strategies?
51. How important is price limitation when it is compared with on market time?
52. How important is price limitation when it is compared with global organizations strategies?
53. How important is local regulation license when it is compared with global organizations strategies?

Table AII. Continued.

Importance of one sub criteria over another													
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
48	LRL												PrLim
49	LRL												OMT
50	LRL												GOS
51	PrLim												OMT
52	PrLim												GOS
53	OMT												GOS

With respect to the sub-attribute 'IRR'

54. What degree do you assign when market penetration strategy is compared with market skimming strategy?
55. What degree do you assign when market penetration strategy is compared with on-going price strategy?
56. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Questionnaire forms used to aid comparisons of pricing strategies.

Importance of one sub criteria over another													
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
54	MP												MS
55	MP												OG
56	MS												OG

With respect to the sub-attribute 'ROI'

57. What degree do you assign when market penetration strategy is compared with market skimming strategy?
58. What degree do you assign when market penetration strategy is compared with on-going price strategy?
59. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

Importance of one sub criteria over another													
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
57	MP												MS
58	MP												OG
59	MS												OG

With respect to the sub-attribute 'Cash Flow (CF)'

60. What degree do you assign when market penetration strategy is compared with market skimming strategy?
61. What degree do you assign when market penetration strategy is compared with on-going price strategy?
62. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

Importance of one sub criteria over another													
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
60	MP												MS
61	MP												OG
62	MS												OG

With respect to the sub-attribute 'Peak Cash Funding (PCF)'

63. What degree do you assign when market penetration strategy is compared with market skimming strategy?
64. What degree do you assign when market penetration strategy is compared with on-going price strategy?
65. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

Importance of one sub criteria over another													
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
63	MP												MS
64	MP												OG
65	MS												OG

With respect to the sub-attribute 'Product Awareness (PrAw)'

66. What degree do you assign when market penetration strategy is compared with market skimming strategy?

67. What degree do you assign when market penetration strategy is compared with on-going price strategy?
68. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

		Importance of one sub criteria over another											
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
66	MP												MS
67	MP												OG
68	MS												OG

With respect to the sub-attribute 'Price Sensitivity (PrSen)'

69. What degree do you assign when market penetration strategy is compared with market skimming strategy?
70. What degree do you assign when market penetration strategy is compared with on-going price strategy?
71. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

		Importance of one sub criteria over another											
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
69	MP												MS
70	MP												OG
71	MS												OG

With respect to the sub-attribute 'Customer Life Time (CLT)'

72. What degree do you assign when market penetration strategy is compared with market skimming strategy?
73. What degree do you assign when market penetration strategy is compared with on-going price strategy?
74. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

Importance of one sub criteria over another													
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
72	MP												MS
73	MP												OG
74	MS												OG

With respect to the sub-attribute 'Market Penetration (MPen)'

75. What degree do you assign when market penetration strategy is compared with market skimming strategy?
76. What degree do you assign when market penetration strategy is compared with on-going price strategy?
77. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

Importance of one sub criteria over another													
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatedly More	Weakly More	Just Equal	Weakly More	Moderatedly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
75	MP												MS
76	MP												OG
77	MS												OG

With respect to the sub-attribute 'Potential Market (PotM)'

78. What degree do you assign when market penetration strategy is compared with market skimming strategy?
79. What degree do you assign when market penetration strategy is compared with on-going price strategy?
80. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

Importance of one sub criteria over another													
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatedly More	Weakly More	Just Equal	Weakly More	Moderatedly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
78	MP												MS
79	MP												OG
80	MS												OG

With respect to the sub-attribute 'Market Growth Rate (MGR)'

81. What degree do you assign when market penetration strategy is compared with market skimming strategy?

82. What degree do you assign when market penetration strategy is compared with on-going price strategy?
83. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

Importance of one sub criteria over another													
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
81	MP												MS
82	MP												OG
83	MS												OG

With respect to the sub-attribute 'Customer RPI (CROI)'

84. What degree do you assign when market penetration strategy is compared with market skimming strategy?
85. What degree do you assign when market penetration strategy is compared with on-going price strategy?
86. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

Importance of one sub criteria over another													
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
84	MP												MS
85	MP												OG
86	MS												OG

With respect to the sub-attribute ‘Quality Perception (QPer)’

87. What degree do you assign when market penetration strategy is compared with market skimming strategy?
88. What degree do you assign when market penetration strategy is compared with on-going price strategy?
89. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

		Importance of one sub criteria over another											
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
87	MP												MS
88	MP												OG
89	MS												OG

With respect to the sub-attribute ‘Brand Value (BVal)’

90. What degree do you assign when market penetration strategy is compared with market skimming strategy?
91. What degree do you assign when market penetration strategy is compared with on-going price strategy?
92. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

Importance of one sub criteria over another													
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatedly More	Weakly More	Just Equal	Weakly More	Moderatedly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
90	MP												MS
91	MP												OG
92	MS												OG

With respect to the sub-attribute 'Product differentiation (PdDif)'

93. What degree do you assign when market penetration strategy is compared with market skimming strategy?
94. What degree do you assign when market penetration strategy is compared with on-going price strategy?
95. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

Importance of one sub criteria over another													
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatedly More	Weakly More	Just Equal	Weakly More	Moderatedly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
93	MP												MS
94	MP												OG
95	MS												OG

With respect to the sub-attribute 'Reference Price (RefP)'

96. What degree do you assign when market penetration strategy is compared with market skimming strategy?

97. What degree do you assign when market penetration strategy is compared with on-going price strategy?
98. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

Importance of one sub criteria over another													
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
96	MP												MS
97	MP												OG
98	MS												OG

With respect to the sub-attribute 'OPEX'

99. What degree do you assign when market penetration strategy is compared with market skimming strategy?
100. What degree do you assign when market penetration strategy is compared with on-going price strategy?
101. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

Importance of one sub criteria over another													
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
99	MP												MS
100	MP												OG
101	MS												OG

With respect to the sub-attribute ‘CAPEX’

102. What degree do you assign when market penetration strategy is compared with market skimming strategy?
103. What degree do you assign when market penetration strategy is compared with on-going price strategy?
104. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

		Importance of one sub criteria over another											
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderately More	Weakly More	Just Equal	Weakly More	Moderately More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
102	MP												MS
103	MP												OG
104	MS												OG

With respect to the sub-attribute ‘SAC’

105. What degree do you assign when market penetration strategy is compared with market skimming strategy?
106. What degree do you assign when market penetration strategy is compared with on-going price strategy?
107. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

Importance of one sub criteria over another													
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
105	MP												MS
106	MP												OG
107	MS												OG

With respect to the sub-attribute 'Capacity (CAP)'

108. What degree do you assign when market penetration strategy is compared with market skimming strategy?

109. What degree do you assign when market penetration strategy is compared with on-going price strategy?

110. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

Importance of one sub criteria over another													
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
108	MP												MS
109	MP												OG
110	MS												OG

With respect to the sub-attribute 'Local Regulation Licenses (LRL)'

111. What degree do you assign when market penetration strategy is compared with market skimming strategy?

112. What degree do you assign when market penetration strategy is compared with on-going price strategy?

113. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

Importance of one sub criteria over another													
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
111	MP												MS
112	MP												OG
113	MS												OG

With respect to the sub-attribute 'Price Limits (PrLim)'

114. What degree do you assign when market penetration strategy is compared with market skimming strategy?

115. What degree do you assign when market penetration strategy is compared with on-going price strategy?

116. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

Importance of one sub criteria over another													
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
114	MP												MS
115	MP												OG
116	MS												OG

With respect to the sub-attribute 'On Market Time (OMT)'

117. What degree do you assign when market penetration strategy is compared with market skimming strategy?
118. What degree do you assign when market penetration strategy is compared with on-going price strategy?
119. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

		Importance of one sub criteria over another											
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
117	MP												MS
118	MP												OG
119	MS												OG

With respect to the sub-attribute 'Global Organizations Strategy (GOS)'

120. What degree do you assign when market penetration strategy is compared with market skimming strategy?
121. What degree do you assign when market penetration strategy is compared with on-going price strategy?
122. What degree do you assign when market skimming strategy is compared with on-going price strategy?

Table AIII. Continued.

Importance of one sub criteria over another													
Questions	**Attributes**	Absolutely More	Very Strongly More	Strongly More	Moderatetly More	Weakly More	Just Equal	Weakly More	Moderatetly More	Strongly More	Very Strongly More	Absolutely More	**Attributes**
120	MP												MS
121	MP												OG
122	MS												OG

APPENDIX B

Expert evaluations.

Table B.1 Pair wise comparisons of main pricing strategy criteria.

	StCr			**MCr**			**DCr**			**CSCr**			**RCr**		
StCr	1,00	1,00	1,00	0,50	0,67	1,00	0,33	0,40	0,50	0,50	0,67	1,00	0,50	1,00	1,50
MCr	1,00	1,50	2,00	1,00	1,00	1,00	0,67	1,00	2,00	0,50	1,00	1,50	1,00	1,50	2,00
DCr	2,00	2,50	3,00	0,50	1,00	1,50	1,00	1,00	1,00	0,50	1,00	1,50	2,50	3,00	3,50
CSCr	1,00	1,50	2,00	0,67	1,00	2,00	0,67	1,00	2,00	1,00	1,00	1,00	1,00	1,50	2,00
RCr	0,67	1,00	2,00	0,50	0,67	1,00	0,29	0,33	0,40	0,50	0,67	1,00	1,00	1,00	1,00

StCr	1,00	1,00	1,00	0,50	0,67	1,00	0,33	0,40	0,50	0,33	0,40	0,50	0,50	1,00	1,50
MCr	1,00	1,50	2,00	1,00	1,00	1,00	0,50	1,00	1,50	0,67	1,00	2,00	1,00	1,50	2,00
DCr	2,00	2,50	3,00	0,67	1,00	2,00	1,00	1,00	1,00	0,67	1,00	2,00	1,50	2,00	2,50
CSCr	2,00	2,50	3,00	0,50	1,00	1,50	0,50	1,00	1,50	1,00	1,00	1,00	1,00	1,50	2,00
RCr	0,67	1,00	2,00	0,50	0,67	1,00	0,40	0,50	0,67	0,50	0,67	1,00	1,00	1,00	1,00

StCr	1,00	1,00	1,00	0,40	0,50	0,67	0,33	0,40	0,50	0,67	1,00	2,00	1,00	1,50	2,00
MCr	1,50	2,00	2,50	1,00	1,00	1,00	0,50	1,00	1,50	0,67	1,00	2,00	1,50	2,00	2,50
DCr	2,00	2,50	3,00	0,67	1,00	2,00	1,00	1,00	1,00	0,67	1,00	2,00	2,50	3,00	3,50
CSCr	0,50	1,00	1,50	0,50	1,00	1,50	0,50	1,00	1,50	1,00	1,00	1,00	1,50	2,00	2,50
RCr	0,50	0,67	1,00	0,40	0,50	0,67	0,29	0,33	0,40	0,40	0,50	0,67	1,00	1,00	1,00

StCr	1,00	1,00	1,00	0,47	0,61	0,89	0,33	0,40	0,50	0,50	0,69	1,17	0,67	1,17	1,67
MCr	1,17	1,67	2,17	1,00	1,00	1,00	0,56	1,00	1,67	0,61	1,00	1,83	1,17	1,67	2,17
DCr	2,00	2,50	3,00	0,61	1,00	1,83	1,00	1,00	1,00	0,61	1,00	1,83	2,17	2,67	3,17
CSCr	1,17	1,67	2,17	0,56	1,00	1,67	0,56	1,00	1,67	1,00	1,00	1,00	1,17	1,67	2,17
RCr	0,61	0,89	1,67	0,47	0,61	0,89	0,32	0,39	0,49	0,47	0,61	0,89	1,00	1,00	1,00
CR	**0,05**														

Table B.2 Pair wise comparisons of Stakeholder Criterion's sub-pricing strategy criteria.

	IRR			**ROI**			**CF**			**PCF**		
IRR	1,00	1,00	1,00	0,50	1,00	1,50	0,67	1,00	2,00	0,40	0,50	0,67
ROI	0,67	1,00	2,00	1,00	1,00	1,00	0,50	0,67	1,00	0,67	1,00	2,00
CF	0,50	1,00	1,50	1,00	1,50	2,00	1,00	1,00	1,00	0,67	1,00	2,00
PCF	1,50	2,00	2,50	0,50	1,00	1,50	0,50	1,00	1,50	1,00	1,00	1,00

IRR	1,00	1,00	1,00	0,67	1,00	2,00	0,50	0,67	1,00	0,50	0,67	1,00
ROI	0,50	1,00	1,50	1,00	1,00	1,00	0,50	0,67	1,00	0,67	1,00	2,00
CF	1,00	1,50	2,00	1,00	1,50	2,00	1,00	1,00	1,00	0,67	1,00	2,00
PCF	1,00	1,50	2,00	0,50	1,00	1,50	0,50	1,00	1,50	1,00	1,00	1,00

IRR	1,00	1,00	1,00	0,67	1,00	2,00	0,40	0,50	0,67	0,50	0,67	1,00
ROI	0,50	1,00	1,50	1,00	1,00	1,00	0,50	0,67	1,00	0,50	0,67	1,00
CF	1,50	2,00	2,50	1,00	1,50	2,00	1,00	1,00	1,00	0,50	1,00	1,50
PCF	1,00	1,50	2,00	1,00	1,50	2,00	0,67	1,00	2,00	1,00	1,00	1,00

IRR	1,00	1,00	1,00	0,61	1,00	1,83	0,52	0,72	1,22	0,47	0,61	0,89
ROI	0,56	1,00	1,67	1,00	1,00	1,00	0,50	0,67	1,00	0,61	0,89	1,67
CF	1,00	1,50	2,00	1,00	1,50	2,00	1,00	1,00	1,00	0,61	1,00	1,83
PCF	1,17	1,67	2,17	0,67	1,17	1,67	0,56	1,00	1,67	1,00	1,00	1,00
CR	**0,062**											

Table B.3 Pair wise comparisons of Market Criterion's sub-pricing strategy criteria.

	PdAws			**PrSen**			**CLT**			**Mpen**			**PotM**			**MGR**		
PdAws	1,00	1,00	1,00	0,50	0,67	1,00	0,50	1,00	1,50	0,40	0,50	0,67	0,67	1,00	2,00	0,50	0,67	1,00
PrSen	1,00	1,50	2,00	1,00	1,00	1,00	1,50	2,00	2,50	0,67	1,00	2,00	1,00	1,50	2,00	0,67	1,00	2,00
CLT	0,67	1,00	2,00	0,40	0,50	0,67	1,00	1,00	1,00	0,33	0,40	0,50	0,67	1,00	2,00	0,33	0,40	0,50
Mpen	1,50	2,00	2,50	0,50	1,00	1,50	2,00	2,50	3,00	1,00	1,00	1,00	1,50	2,00	2,50	0,50	1,00	1,50
PotM	0,50	1,00	1,50	0,50	0,67	1,00	0,50	1,00	1,50	0,40	0,50	0,67	1,00	1,00	1,00	0,50	0,67	1,00
MGR	1,00	1,50	2,00	0,50	1,00	1,50	2,00	2,50	3,00	0,67	1,00	2,00	1,00	1,50	2,00	1,00	1,00	1,00

PdAws	1,00	1,00	1,00	0,67	1,00	2,00	1,50	2,00	2,50	1,00	1,50	2,00	1,50	2,00	2,50	0,50	0,67	1,00
PrSen	0,50	1,00	1,50	1,00	1,00	1,00	1,50	2,00	2,50	1,00	1,50	2,00	1,50	2,00	2,50	0,67	1,00	2,00
CLT	0,40	0,50	0,67	0,40	0,50	0,67	1,00	1,00	1,00	0,67	1,00	2,00	0,67	1,00	2,00	0,33	0,40	0,50
Mpen	0,50	0,67	1,00	0,50	0,67	1,00	0,50	1,00	1,50	1,00	1,00	1,00	1,00	1,50	2,00	0,40	0,50	0,67
PotM	0,40	0,50	0,67	0,40	0,50	0,67	0,50	1,00	1,50	0,50	0,67	1,00	1,00	1,00	1,00	0,33	0,40	0,50
MGR	1,00	1,50	2,00	0,50	1,00	1,50	2,00	2,50	3,00	1,50	2,00	2,50	2,00	2,50	3,00	1,00	1,00	1,00

PdAws	1,00	1,00	1,00	0,50	1,00	1,50	1,50	2,00	2,50	1,00	1,50	2,00	1,50	2,00	2,50	0,50	0,67	1,00
PrSen	0,67	1,00	2,00	1,00	1,00	1,00	1,50	2,00	2,50	1,00	1,50	2,00	1,50	2,00	2,50	0,67	1,00	2,00
CLT	0,40	0,50	0,67	0,40	0,50	0,67	1,00	1,00	1,00	0,67	1,00	2,00	0,50	1,00	1,50	0,40	0,50	0,67
Mpen	0,50	0,67	1,00	0,50	0,67	1,00	0,50	1,00	1,50	1,00	1,00	1,00	1,00	1,50	2,00	0,33	0,40	0,50
PotM	0,40	0,50	0,67	0,40	0,50	0,67	0,67	1,00	2,00	0,50	0,67	1,00	1,00	1,00	1,00	0,33	0,40	0,50
MGR	1,00	1,50	2,00	0,50	1,00	1,50	1,50	2,00	2,50	2,00	3,00	3,50	2,00	2,50	3,00	1,00	1,00	1,00

PdAws	1,00	1,00	1,00	0,56	0,89	1,50	1,17	1,67	2,17	0,80	1,17	1,56	1,22	1,67	2,33	0,50	0,67	1,00
PrSen	0,72	1,17	1,83	1,00	1,00	1,00	1,50	2,00	2,50	0,89	1,33	2,00	1,33	1,83	2,33	0,67	1,00	2,00
CLT	0,49	0,67	1,11	0,40	0,50	0,67	1,00	1,00	1,00	0,56	0,80	1,50	0,61	1,00	1,83	0,36	0,43	0,56
Mpen	0,83	1,11	1,50	0,50	0,78	1,17	1,00	1,50	2,00	1,00	1,00	1,00	1,17	1,67	2,17	0,41	0,63	0,89
PotM	0,43	0,67	0,94	0,43	0,56	0,78	0,56	1,00	1,67	0,47	0,61	0,89	1,00	1,00	1,00	0,39	0,49	0,67
MGR	1,00	1,50	2,00	0,50	1,00	1,50	1,83	2,33	2,83	1,39	2,00	2,67	1,67	2,17	2,67	1,00	1,00	1,00
CR	**0,05**																	

Table B.4 Pair wise comparisons of Demand Criterion's sub-pricing strategy criteria.

	CROI			**QPer**			**BVal**			**PdDif**			**RefP**		
CROI	1,00	1,00	1,00	0,50	1,00	1,50	1,50	2,00	2,50	2,00	2,50	3,00	0,50	1,00	1,50
QPer	0,67	1,00	2,00	1,00	1,00	1,00	1,00	1,50	2,00	1,50	2,00	2,50	0,50	1,00	1,50
BVal	0,40	0,50	0,67	0,50	0,67	1,00	1,00	1,00	1,00	0,50	1,00	1,50	0,50	0,67	1,00
PdDif	0,33	0,40	0,50	0,40	0,50	0,67	0,67	1,00	2,00	1,00	1,00	1,00	0,40	0,50	0,67
RefP	0,67	1,00	2,00	0,67	1,00	2,00	1,00	1,50	2,00	1,50	2,00	2,50	1,00	1,00	1,00

CROI	1,00	1,00	1,00	0,50	1,00	1,50	1,50	2,00	2,50	1,00	1,50	2,00	1,00	1,00	1,00
QPer	0,67	1,00	2,00	1,00	1,00	1,00	2,00	2,50	3,00	1,50	2,00	2,50	0,50	0,67	1,00
BVal	0,40	0,50	0,67	0,33	0,40	0,50	1,00	1,00	1,00	0,67	1,00	2,00	0,33	0,40	0,50
PdDif	0,50	0,67	1,00	0,40	0,50	0,67	0,50	1,00	1,50	1,00	1,00	1,00	0,40	0,50	0,67
RefP	1,00	1,00	1,00	1,00	1,50	2,00	2,00	2,50	3,00	1,50	2,00	2,50	1,00	1,00	1,00

CROI	1,00	1,00	1,00	1,50	2,00	2,50	0,67	1,00	2,00	2,00	2,50	3,00	0,67	1,00	2,00
QPer	0,40	0,50	0,67	1,00	1,00	1,00	0,50	0,67	1,00	1,00	1,50	2,00	0,40	0,50	0,67
BVal	0,50	1,00	1,50	1,00	1,50	2,00	1,00	1,00	1,00	1,50	2,00	2,50	0,50	0,67	1,00
PdDif	0,33	0,40	0,50	0,50	0,67	1,00	0,40	0,50	0,67	1,00	1,00	1,00	0,33	0,40	0,50
RefP	0,50	1,00	1,50	1,50	2,00	2,50	1,00	1,50	2,00	2,00	2,50	3,00	1,00	1,00	1,00

CROI	1,00	1,00	1,00	0,83	1,33	1,83	1,22	1,67	2,33	1,67	2,17	2,67	0,72	1,00	1,50
QPer	0,58	0,83	1,56	1,00	1,00	1,00	1,17	1,56	2,00	1,33	1,83	2,33	0,47	0,72	1,06
BVal	0,43	0,67	0,94	0,61	0,86	1,17	1,00	1,00	1,00	0,89	1,33	2,00	0,44	0,58	0,83
PdDif	0,39	0,49	0,67	0,43	0,56	0,78	0,52	0,83	1,39	1,00	1,00	1,00	0,38	0,47	0,61
RefP	0,72	1,00	1,50	1,06	1,50	2,17	1,33	1,83	2,33	1,67	2,17	2,67	1,00	1,00	1,00
CR	**0,06**														

Table B.5 Pair wise comparisons of Cost/Supply Criterion's sub-pricing criteria.

	OPEX			CAPEX			SAC			CAP		
OPEX	1,00	1,00	1,00	1,00	1,50	2,00	0,50	0,67	1,00	1,50	2,00	2,50
CAPEX	0,50	0,67	1,00	1,00	1,00	1,00	0,40	0,50	0,67	1,00	1,50	2,00
SAC	1,00	1,50	2,00	1,50	2,00	2,50	1,00	1,00	1,00	2,00	2,50	3,00
CAP	0,40	0,50	0,67	0,50	0,67	1,00	0,33	0,40	0,50	1,00	1,00	1,00
OPEX	1,00	1,00	1,00	2,00	2,50	3,00	0,50	0,67	1,00	1,00	1,50	2,00
CAPEX	0,33	0,40	0,50	1,00	1,00	1,00	0,33	0,40	0,50	0,50	0,67	1,00
SAC	1,00	1,50	2,00	2,00	2,50	3,00	1,00	1,00	1,00	1,50	2,00	2,50
CAP	0,50	0,67	1,00	1,00	1,50	2,00	0,40	0,50	0,67	1,00	1,00	1,00
OPEX	1,00	1,00	1,00	0,50	1,00	1,50	0,40	0,50	0,67	0,50	0,67	1,00
CAPEX	0,67	1,00	2,00	1,00	1,00	1,00	0,33	0,40	0,50	0,40	0,50	0,67
SAC	1,50	2,00	2,50	2,00	2,50	3,00	1,00	1,00	1,00	1,00	1,50	2,00
CAP	1,00	1,50	2,00	1,50	2,00	2,50	0,50	0,67	1,00	1,00	1,00	1,00
OPEX	1,00	1,00	1,00	1,17	1,67	2,17	0,47	0,61	0,89	1,00	1,39	1,83
CAPEX	0,50	0,69	1,17	1,00	1,00	1,00	0,36	0,43	0,56	0,63	0,89	1,22
SAC	1,17	1,67	2,17	1,83	2,33	2,83	1,00	1,00	1,00	1,50	2,00	2,50
CAP	0,63	0,89	1,22	1,00	1,39	1,83	0,41	0,52	0,72	1,00	1,00	1,00
CR	**0,082**											

Table B.6 Pair wise comparisons of Regulation Criterion's sub-pricing criteria.

	LRL			PrLim			OMT			GOS		
LRL	1,00	1,00	1,00	0,40	0,50	0,67	0,40	0,50	0,67	1,00	1,50	2,00
PrLim	1,50	2,00	2,50	1,00	1,00	1,00	1,00	1,50	2,00	2,50	3,00	3,50
OMT	1,50	2,00	2,50	0,50	0,67	1,00	1,00	1,00	1,00	2,00	2,50	3,00
GOS	0,50	0,67	1,00	0,29	0,33	0,40	0,33	0,40	0,50	1,00	1,00	1,00
LRL	1,00	1,00	1,00	0,50	0,67	1,00	0,40	0,50	0,67	0,50	1,00	1,50
PrLim	1,00	1,50	2,00	1,00	1,00	1,00	0,50	0,67	1,00	1,50	2,00	2,50
OMT	1,50	2,00	2,50	1,00	1,50	2,00	1,00	1,00	1,00	2,00	2,50	3,00
GOS	0,67	1,00	2,00	0,40	0,50	0,67	0,33	0,40	0,50	1,00	1,00	1,00
LRL	1,00	1,00	1,00	0,33	0,40	0,50	0,33	0,40	0,50	0,67	1,00	2,00
PrLim	2,00	2,50	3,00	1,00	1,00	1,00	0,50	1,00	1,50	1,50	2,00	2,50
OMT	2,00	2,50	3,00	0,67	1,00	2,00	1,00	1,00	1,00	1,50	2,00	2,50
GOS	0,50	1,00	1,50	0,40	0,50	0,67	0,40	0,50	0,67	1,00	1,00	1,00
LRL	1,00	1,00	1,00	0,41	0,52	0,72	0,38	0,47	0,61	0,72	1,17	1,83
PrLim	1,50	2,00	2,50	1,00	1,00	1,00	0,67	1,06	1,50	1,83	2,33	2,83
OMT	1,67	2,17	2,67	0,72	1,06	1,67	1,00	1,00	1,00	1,83	2,33	2,83
GOS	0,56	0,89	1,50	0,36	0,44	0,58	0,36	0,43	0,56	1,00	1,00	1,00
CR	0,045											

Table B.7 Pair wise comparison of pricing strategy alternatives with respect to the sub-pricing criteria of stakeholder criterion.

IRR

MP	1,00	1,00	1,00	0,33	0,40	0,50	0,40	0,50	0,67
MS	2,00	2,50	3,00	1,00	1,00	1,00	1,50	2,00	2,50
OG	1,50	2,00	2,50	0,40	0,50	0,67	1,00	1,00	1,00

Expert Averages

MP	1,00	1,00	1,00	0,29	0,33	0,40	0,40	0,50	0,67
MS	2,50	3,00	3,50	1,00	1,00	1,00	1,50	2,00	2,50
OG	2,00	2,50	3,00	0,33	0,40	0,50	1,00	1,00	1,00

MP	**1,00**	**1,00**	**1,00**	**0,30**	**0,36**	**0,43**	**0,40**	**0,50**	**0,67**
MS	**2,33**	**2,83**	**3,33**	**1,00**	**1,00**	**1,00**	**1,50**	**2,00**	**2,50**
OG	**1,67**	**2,17**	**2,67**	**0,38**	**0,47**	**0,61**	**1,00**	**1,00**	**1,00**

MP	1,00	1,00	1,00	0,29	0,33	0,40	0,40	0,50	0,67
MS	2,50	3,00	3,50	1,00	1,00	1,00	1,50	2,00	2,50
OG	1,50	2,00	2,50	0,40	0,50	0,67	1,00	1,00	1,00

CR ***0,04***

ROI

MP	1,00	1,00	1,00	0,29	0,33	0,40	0,40	0,50	0,67
MS	2,50	3,00	3,50	1,00	1,00	1,00	1,50	2,00	2,50
OG	1,50	2,00	2,50	0,40	0,50	0,67	1,00	1,00	1,00

Expert Averages

MP	1,00	1,00	1,00	0,29	0,33	0,40	0,33	0,40	0,50
MS	2,50	3,00	3,50	1,00	1,00	1,00	2,00	2,50	3,00
OG	2,00	2,50	3,00	0,33	0,40	0,50	1,00	1,00	1,00

MP	**1,00**	**1,00**	**1,00**	**0,30**	**0,36**	**0,43**	**0,41**	**0,52**	**0,72**
MS	**2,33**	**2,83**	**3,33**	**1,00**	**1,00**	**1,00**	**1,67**	**2,17**	**2,67**
OG	**1,50**	**2,00**	**2,50**	**0,38**	**0,47**	**0,61**	**1,00**	**1,00**	**1,00**

MP	1,00	1,00	1,00	0,33	0,40	0,50	0,50	0,67	1,00
MS	2,00	2,50	3,00	1,00	1,00	1,00	1,50	2,00	2,50
OG	1,00	1,50	2,00	0,40	0,50	0,67	1,00	1,00	1,00

CR ***0,06***

CF

MP	1,00	1,00	1,00	1,50	2,00	2,50	1,00	1,50	2,00
MS	0,40	0,50	0,67	1,00	1,00	1,00	0,67	1,00	2,00
OG	0,50	0,67	1,00	0,50	1,00	1,50	1,00	1,00	1,00

Expert Averages

MP	1,00	1,00	1,00	2,00	2,50	3,00	1,50	2,00	2,50
MS	0,33	0,40	0,50	1,00	1,00	1,00	0,67	1,00	2,00
OG	0,40	0,50	0,67	0,50	1,00	1,50	1,00	1,00	1,00

MP	**1,00**	**1,00**	**1,00**	**1,83**	**2,33**	**2,83**	**1,17**	**1,67**	**2,17**
MS	**0,36**	**0,43**	**0,56**	**1,00**	**1,00**	**1,00**	**0,67**	**1,00**	**2,00**
OG	**0,47**	**0,61**	**0,89**	**0,50**	**1,00**	**1,50**	**1,00**	**1,00**	**1,00**

MP	1,00	1,00	1,00	2,00	2,50	3,00	1,00	1,50	2,00
MS	0,33	0,40	0,50	1,00	1,00	1,00	0,67	1,00	2,00
OG	0,50	0,67	1,00	0,50	1,00	1,50	1,00	1,00	1,00

CR ***0,08***

PCF									
MP	1,00	1,00	1,00	0,50	0,67	1,00	0,50	1,00	1,50
MS	1,00	1,50	2,00	1,00	1,00	1,00	1,50	2,00	2,50
OG	0,67	1,00	2,00	0,40	0,50	0,67	1,00	1,00	1,00

MP	1,00	1,00	1,00	0,50	0,67	1,00	1,00	1,50	2,00
MS	1,00	1,50	2,00	1,00	1,00	1,00	1,50	2,00	2,50
OG	0,50	0,67	1,00	0,40	0,50	0,67	1,00	1,00	1,00

Expert Averages

MP	**1,00**	**1,00**	**1,00**	**0,56**	**0,78**	**1,33**	**0,67**	**1,17**	**1,67**
MS	**0,83**	**1,33**	**1,83**	**1,00**	**1,00**	**1,00**	**1,33**	**1,83**	**2,33**
OG	**0,61**	**0,89**	**1,67**	**0,43**	**0,56**	**0,78**	**1,00**	**1,00**	**1,00**

MP	1,00	1,00	1,00	0,67	1,00	2,00	0,50	1,00	1,50
MS	0,50	1,00	1,50	1,00	1,00	1,00	1,00	1,50	2,00
OG	0,67	1,00	2,00	0,50	0,67	1,00	1,00	1,00	1,00

CR ***0,10***

Table B.8 Pair wise comparison of pricing strategy alternatives with respect to the sub-pricing criteria of market criterion.

PdAws									
MP	1,00	1,00	1,00	0,50	1,00	1,50	1,50	2,00	2,50
MS	0,67	1,00	2,00	1,00	1,00	1,00	1,00	1,50	2,00
OG	0,40	0,50	0,67	0,50	0,67	1,00	1,00	1,00	1,00

MP	1,00	1,00	1,00	1,00	1,50	2,00	2,00	2,50	3,00
MS	0,50	0,67	1,00	1,00	1,00	1,00	1,00	1,50	2,00
OG	0,33	0,40	0,50	0,50	0,67	1,00	1,00	1,00	1,00

Expert Averages

MP	**1,00**	**1,00**	**1,00**	**0,83**	**1,33**	**1,83**	**1,67**	**2,17**	**2,67**
MS	**0,56**	**0,78**	**1,33**	**1,00**	**1,00**	**1,00**	**0,89**	**1,33**	**2,00**
OG	**0,38**	**0,47**	**0,61**	**0,50**	**0,78**	**1,17**	**1,00**	**1,00**	**1,00**

MP	1,00	1,00	1,00	1,00	1,50	2,00	1,50	2,00	2,50
MS	0,50	0,67	1,00	1,00	1,00	1,00	0,67	1,00	2,00
OG	0,40	0,50	0,67	0,50	1,00	1,50	1,00	1,00	1,00

CR ***0,08***

PrSen									
MP	1,00	1,00	1,00	2,00	2,50	3,00	1,50	2,00	2,50
MS	0,33	0,40	0,50	1,00	1,00	1,00	0,67	1,00	2,00
OG	0,40	0,50	0,67	0,50	1,00	1,50	1,00	1,00	1,00

MP	1,00	1,00	1,00	1,50	2,00	2,50	1,00	1,50	2,00
MS	0,40	0,50	0,67	1,00	1,00	1,00	0,67	1,00	2,00
OG	0,50	0,67	1,00	0,50	1,00	1,50	1,00	1,00	1,00

Expert Averages

MP	**1,00**	**1,00**	**1,00**	**1,83**	**2,33**	**2,83**	**1,17**	**1,67**	**2,17**
MS	**0,36**	**0,43**	**0,56**	**1,00**	**1,00**	**1,00**	**0,61**	**0,89**	**1,67**
OG	**0,47**	**0,61**	**0,89**	**0,67**	**1,17**	**1,67**	**1,00**	**1,00**	**1,00**

MP	1,00	1,00	1,00	2,00	2,50	3,00	1,00	1,50	2,00
MS	0,33	0,40	0,50	1,00	1,00	1,00	0,50	0,67	1,00
OG	0,50	0,67	1,00	1,00	1,50	2,00	1,00	1,00	1,00

CR ***0,08***

CLT

MP	1,00	1,00	1,00	1,50	2,00	2,50	2,00	2,50	3,00
MS	0,40	0,50	0,67	1,00	1,00	1,00	0,50	1,00	1,50
OG	0,33	0,40	0,50	0,67	1,00	2,00	1,00	1,00	1,00

MP	1,00	1,00	1,00	1,00	1,50	2,00	1,00	1,50	2,00
MS	0,50	0,67	1,00	1,00	1,00	1,00	0,50	1,00	1,50
OG	0,50	0,67	1,00	0,67	1,00	2,00	1,00	1,00	1,00

Expert Averages

MP	**1,00**	**1,00**	**1,00**	**1,17**	**1,67**	**2,17**	**1,50**	**2,00**	**2,50**
MS	**0,47**	**0,61**	**0,89**	**1,00**	**1,00**	**1,00**	**0,50**	**1,00**	**1,50**
OG	**0,41**	**0,52**	**0,72**	**0,67**	**1,00**	**2,00**	**1,00**	**1,00**	**1,00**

MP	1,00	1,00	1,00	1,00	1,50	2,00	1,50	2,00	2,50
MS	0,50	0,67	1,00	1,00	1,00	1,00	0,50	1,00	1,50
OG	0,40	0,50	0,67	0,67	1,00	2,00	1,00	1,00	1,00

CR ***0,08***

MPen

MP	1,00	1,00	1,00	2,50	3,00	3,50	2,00	2,50	3,00
MS	0,29	0,33	0,40	1,00	1,00	1,00	0,40	0,50	0,67
OG	0,33	0,40	0,50	1,50	2,00	2,50	1,00	1,00	1,00

MP	1,00	1,00	1,00	2,00	2,50	3,00	1,50	2,00	2,50
MS	0,33	0,40	0,50	1,00	1,00	1,00	0,40	0,50	0,67
OG	0,40	0,50	0,67	1,50	2,00	2,50	1,00	1,00	1,00

Expert Averages

MP	**1,00**	**1,00**	**1,00**	**2,33**	**2,83**	**3,33**	**1,67**	**2,17**	**2,67**
MS	**0,30**	**0,36**	**0,43**	**1,00**	**1,00**	**1,00**	**0,43**	**0,56**	**0,78**
OG	**0,38**	**0,47**	**0,61**	**1,33**	**1,83**	**2,33**	**1,00**	**1,00**	**1,00**

MP	1,00	1,00	1,00	2,50	3,00	3,50	1,50	2,00	2,50
MS	0,29	0,33	0,40	1,00	1,00	1,00	0,50	0,67	1,00
OG	0,40	0,50	0,67	1,00	1,50	2,00	1,00	1,00	1,00

CR ***0,04***

PotM

MP	1,00	1,00	1,00	1,50	2,00	2,50	1,00	1,50	2,00
MS	0,40	0,50	0,67	1,00	1,00	1,00	0,67	1,00	2,00
OG	0,50	0,67	1,00	0,50	1,00	1,50	1,00	1,00	1,00

MP	1,00	1,00	1,00	2,00	2,50	3,00	1,50	2,00	2,50
MS	0,33	0,40	0,50	1,00	1,00	1,00	0,50	0,67	1,00
OG	0,40	0,50	0,67	1,00	1,50	2,00	1,00	1,00	1,00

Expert Averages

MP	**1,00**	**1,00**	**1,00**	**2,00**	**2,50**	**3,00**	**1,50**	**2,00**	**2,50**
MS	**0,34**	**0,41**	**0,52**	**1,00**	**1,00**	**1,00**	**0,56**	**0,78**	**1,33**
OG	**0,41**	**0,52**	**0,72**	**0,83**	**1,33**	**1,83**	**1,00**	**1,00**	**1,00**

MP	1,00	1,00	1,00	2,50	3,00	3,50	2,00	2,50	3,00
MS	0,29	0,33	0,40	1,00	1,00	1,00	0,50	0,67	1,00
OG	0,33	0,40	0,50	1,00	1,50	2,00	1,00	1,00	1,00

CR ***0,07***

MGR									
MP	1,00	1,00	1,00	2,00	2,50	3,00	1,50	2,00	2,50
MS	0,33	0,40	0,50	1,00	1,00	1,00	0,50	0,67	1,00
OG	0,40	0,50	0,67	1,00	1,50	2,00	1,00	1,00	1,00

Expert Averages

MP	1,00	1,00	1,00	2,00	2,50	3,00	1,00	1,50	2,00
MS	0,33	0,40	0,50	1,00	1,00	1,00	0,67	1,00	2,00
OG	0,50	0,67	1,00	0,50	1,00	1,50	1,00	1,00	1,00

MP	**1,00**	**1,00**	**1,00**	**1,83**	**2,33**	**2,83**	**1,17**	**1,67**	**2,17**
MS	**0,36**	**0,43**	**0,56**	**1,00**	**1,00**	**1,00**	**0,61**	**0,89**	**1,67**
OG	**0,47**	**0,61**	**0,89**	**0,67**	**1,17**	**1,67**	**1,00**	**1,00**	**1,00**

MP	1,00	1,00	1,00	1,50	2,00	2,50	1,00	1,50	2,00
MS	0,40	0,50	0,67	1,00	1,00	1,00	0,67	1,00	2,00
OG	0,50	0,67	1,00	0,50	1,00	1,50	1,00	1,00	1,00

CR ***0,08***

Table B.9 Pair wise comparison of pricing strategy alternatives with respect to the sub-pricing criteria of demand criterion

CROI									
MP	1,00	1,00	1,00	1,50	2,00	2,50	1,00	1,50	2,00
MS	0,40	0,50	0,67	1,00	1,00	1,00	0,67	1,00	2,00
OG	0,50	0,67	1,00	0,50	1,00	1,50	1,00	1,00	1,00

Expert Averages

MP	1,00	1,00	1,00	2,00	2,50	3,00	1,50	2,00	2,50
MS	0,33	0,40	0,50	1,00	1,00	1,00	0,50	0,67	1,00
OG	0,40	0,50	0,67	1,00	1,50	2,00	1,00	1,00	1,00

MP	**1,00**	**1,00**	**1,00**	**2,00**	**2,50**	**3,00**	**1,50**	**2,00**	**2,50**
MS	**0,34**	**0,41**	**0,52**	**1,00**	**1,00**	**1,00**	**0,56**	**0,78**	**1,33**
OG	**0,41**	**0,52**	**0,72**	**0,83**	**1,33**	**1,83**	**1,00**	**1,00**	**1,00**

MP	1,00	1,00	1,00	2,50	3,00	3,50	2,00	2,50	3,00
MS	0,29	0,33	0,40	1,00	1,00	1,00	0,50	0,67	1,00
OG	0,33	0,40	0,50	1,00	1,50	2,00	1,00	1,00	1,00

CR ***0,07***

Qper									
MP	1,00	1,00	1,00	0,33	0,40	0,50	0,40	0,50	0,67
MS	2,00	2,50	3,00	1,00	1,00	1,00	1,50	2,00	2,50
OG	1,50	2,00	2,50	0,40	0,50	0,67	1,00	1,00	1,00

Expert Averages

MP	1,00	1,00	1,00	0,29	0,33	0,40	0,33	0,40	0,50
MS	2,50	3,00	3,50	1,00	1,00	1,00	1,50	2,00	2,50
OG	2,00	2,50	3,00	0,40	0,50	0,67	1,00	1,00	1,00

MP	**1,00**	**1,00**	**1,00**	**0,32**	**0,38**	**0,47**	**0,38**	**0,47**	**0,61**
MS	**2,17**	**2,67**	**3,17**	**1,00**	**1,00**	**1,00**	**1,33**	**1,83**	**2,33**
OG	**1,67**	**2,17**	**2,67**	**0,43**	**0,56**	**0,78**	**1,00**	**1,00**	**1,00**

MP	1,00	1,00	1,00	0,33	0,40	0,50	0,40	0,50	0,67
MS	2,00	2,50	3,00	1,00	1,00	1,00	1,00	1,50	2,00
OG	1,50	2,00	2,50	0,50	0,67	1,00	1,00	1,00	1,00

CR ***0,05***

BVal

MP	1,00 1,00 1,00	0,29 0,33 0,40	0,40 0,50 0,67
MS	2,50 3,00 3,50	1,00 1,00 1,00	1,00 1,50 2,00
OG	1,50 2,00 2,50	0,50 0,67 1,00	1,00 1,00 1,00

MP	1,00 1,00 1,00	0,33 0,40 0,50	0,67 1,00 2,00
MS	2,00 2,50 3,00	1,00 1,00 1,00	1,00 1,50 2,00
OG	0,50 1,00 1,50	0,50 0,67 1,00	1,00 1,00 1,00

Expert Averages

1,00	**1,00**	**1,00**	**0,30**	**0,36**	**0,43**	**0,49**	**0,67**	**1,11**
2,33	**2,83**	**3,33**	**1,00**	**1,00**	**1,00**	**1,17**	**1,67**	**2,17**
1,33	**1,83**	**2,33**	**0,44**	**0,58**	**0,83**	**1,00**	**1,00**	**1,00**

MP	1,00 1,00 1,00	0,29 0,33 0,40	0,40 0,50 0,67
MS	2,50 3,00 3,50	1,00 1,00 1,00	1,50 2,00 2,50
OG	2,00 2,50 3,00	0,33 0,40 0,50	1,00 1,00 1,00

CR ***0,10***

PdDif

MP	1,00 1,00 1,00	0,33 0,40 0,50	0,50 0,67 1,00
MS	2,00 2,50 3,00	1,00 1,00 1,00	1,00 1,50 2,00
OG	1,00 1,50 2,00	0,50 0,67 1,00	1,00 1,00 1,00

MP	1,00 1,00 1,00	0,40 0,50 0,67	0,50 0,67 1,00
MS	1,50 2,00 2,50	1,00 1,00 1,00	1,00 1,50 2,00
OG	1,00 1,50 2,00	0,50 0,67 1,00	1,00 1,00 1,00

Expert Averages

1,00	**1,00**	**1,00**	**0,38**	**0,47**	**0,61**	**0,56**	**0,78**	**1,33**
1,67	**2,17**	**2,67**	**1,00**	**1,00**	**1,00**	**0,83**	**1,33**	**1,83**
0,83	**1,33**	**1,83**	**0,56**	**0,78**	**1,33**	**1,00**	**1,00**	**1,00**

MP	1,00 1,00 1,00	0,40 0,50 0,67	0,67 1,00 2,00
MS	1,50 2,00 2,50	1,00 1,00 1,00	0,50 1,00 1,50
OG	0,50 1,00 1,50	0,67 1,00 2,00	1,00 1,00 1,00

CR ***0,09***

RefP

MP	1,00 1,00 1,00	2,50 3,00 3,50	1,00 1,50 2,00
MS	0,29 0,33 0,40	1,00 1,00 1,00	0,50 0,67 1,00
OG	0,50 0,67 1,00	1,00 1,50 2,00	1,00 1,00 1,00

MP	1,00 1,00 1,00	1,50 2,00 2,50	0,50 1,00 1,50
MS	0,40 0,50 0,67	1,00 1,00 1,00	0,50 0,67 1,00
OG	0,67 1,00 2,00	1,00 1,50 2,00	1,00 1,00 1,00

Expert Averages

1,00	**1,00**	**1,00**	**2,00**	**2,50**	**3,00**	**0,83**	**1,33**	**1,83**
0,34	**0,41**	**0,52**	**1,00**	**1,00**	**1,00**	**0,47**	**0,61**	**0,89**
0,56	**0,78**	**1,33**	**1,17**	**1,67**	**2,17**	**1,00**	**1,00**	**1,00**

MP	1,00 1,00 1,00	2,00 2,50 3,00	1,00 1,50 2,00
MS	0,33 0,40 0,50	1,00 1,00 1,00	0,40 0,50 0,67
OG	0,50 0,67 1,00	1,50 2,00 2,50	1,00 1,00 1,00

CR ***0,07***

Table B.10 Pair wise comparison of pricing strategy alternatives with respect to the sub-pricing

criteria of cost/supply criterion

OPEX

MP	1,00	1,00	1,00	0,33	0,40	0,50	0,67	1,00	2,00
MS	2,00	2,50	3,00	1,00	1,00	1,00	1,00	1,50	2,00
OG	0,50	1,00	1,50	0,50	0,67	1,00	1,00	1,00	1,00

Expert Averages

MP	1,00	1,00	1,00	0,40	0,50	0,67	0,50	1,00	1,50
MS	1,50	2,00	2,50	1,00	1,00	1,00	1,00	1,50	2,00
OG	0,67	1,00	2,00	0,50	0,67	1,00	1,00	1,00	1,00

MP	**1,00**	**1,00**	**1,00**	**0,38**	**0,47**	**0,61**	**0,56**	**0,89**	**1,50**
MS	**1,67**	**2,17**	**2,67**	**1,00**	**1,00**	**1,00**	**0,83**	**1,33**	**1,83**
OG	**0,72**	**1,17**	**1,83**	**0,56**	**0,78**	**1,33**	**1,00**	**1,00**	**1,00**

MP	1,00	1,00	1,00	0,40	0,50	0,67	0,50	0,67	1,00
MS	1,50	2,00	2,50	1,00	1,00	1,00	0,50	1,00	1,50
OG	1,00	1,50	2,00	0,67	1,00	2,00	1,00	1,00	1,00

CR ***0,10***

CAPEX

MP	1,00	1,00	1,00	1,50	2,00	2,50	0,50	1,00	1,50
MS	0,40	0,50	0,67	1,00	1,00	1,00	0,50	0,67	1,00
OG	0,67	1,00	2,00	1,00	1,50	2,00	1,00	1,00	1,00

Expert Averages

MP	1,00	1,00	1,00	1,50	2,00	2,50	1,00	1,50	2,00
MS	0,40	0,50	0,67	1,00	1,00	1,00	0,67	1,00	2,00
OG	0,50	0,67	1,00	0,50	1,00	1,50	1,00	1,00	1,00

MP	**1,00**	**1,00**	**1,00**	**1,33**	**1,83**	**2,33**	**0,67**	**1,17**	**1,67**
MS	**0,43**	**0,56**	**0,78**	**1,00**	**1,00**	**1,00**	**0,56**	**0,78**	**1,33**
OG	**0,61**	**0,89**	**1,67**	**0,83**	**1,33**	**1,83**	**1,00**	**1,00**	**1,00**

MP	1,00	1,00	1,00	1,00	1,50	2,00	0,50	1,00	1,50
MS	0,50	0,67	1,00	1,00	1,00	1,00	0,50	0,67	1,00
OG	0,67	1,00	2,00	1,00	1,50	2,00	1,00	1,00	1,00

CR ***0,10***

SAC

MP	1,00	1,00	1,00	0,40	0,50	0,67	0,50	0,67	1,00
MS	1,50	2,00	2,50	1,00	1,00	1,00	0,50	1,00	1,50
OG	1,00	1,50	2,00	0,67	1,00	2,00	1,00	1,00	1,00

Expert Averages

MP	1,00	1,00	1,00	0,40	0,50	0,67	0,50	0,67	1,00
MS	1,50	2,00	2,50	1,00	1,00	1,00	1,00	1,50	2,00
OG	1,00	1,50	2,00	0,50	0,67	1,00	1,00	1,00	1,00

MP	**1,00**	**1,00**	**1,00**	**0,36**	**0,44**	**0,58**	**0,44**	**0,58**	**0,83**
MS	**1,83**	**2,33**	**2,83**	**1,00**	**1,00**	**1,00**	**1,00**	**1,50**	**2,00**
OG	**1,33**	**1,83**	**2,33**	**0,52**	**0,72**	**1,22**	**1,00**	**1,00**	**1,00**

MP	1,00	1,00	1,00	0,29	0,33	0,40	0,33	0,40	0,50
MS	2,50	3,00	3,50	1,00	1,00	1,00	1,50	2,00	2,50
OG	2,00	2,50	3,00	0,40	0,50	0,67	1,00	1,00	1,00

CR ***0,10***

CAP									
MP	1,00	1,00	1,00	0,33	0,40	0,50	0,50	0,67	1,00
MS	2,00	2,50	3,00	1,00	1,00	1,00	1,00	1,50	2,00
OG	1,00	1,50	2,00	0,50	0,67	1,00	1,00	1,00	1,00

Expert Averages

MP	1,00	1,00	1,00	0,40	0,50	0,67	0,50	0,67	1,00
MS	1,50	2,00	2,50	1,00	1,00	1,00	0,50	1,00	1,50
OG	1,00	1,50	2,00	0,67	1,00	2,00	1,00	1,00	1,00

MP	**1,00**	**1,00**	**1,00**	**0,36**	**0,43**	**0,56**	**0,56**	**0,78**	**1,33**
MS	**1,83**	**2,33**	**2,83**	**1,00**	**1,00**	**1,00**	**1,00**	**1,50**	**2,00**
OG	**0,83**	**1,33**	**1,83**	**0,52**	**0,72**	**1,22**	**1,00**	**1,00**	**1,00**

MP	1,00	1,00	1,00	0,33	0,40	0,50	0,67	1,00	2,00
MS	2,00	2,50	3,00	1,00	1,00	1,00	1,50	2,00	2,50
OG	0,50	1,00	1,50	0,40	0,50	0,67	1,00	1,00	1,00

CR ***0,10***

Table B.11 Pair wise comparison of pricing strategy alternatives with respect to the sub-pricing criteria of regulation criterion

LRL									
MP	1,00	1,00	1,00	0,40	0,50	0,67	0,50	0,67	1,00
MS	1,50	2,00	2,50	1,00	1,00	1,00	0,50	1,00	1,50
OG	1,00	1,50	2,00	0,67	1,00	2,00	1,00	1,00	1,00

Expert Averages

MP	1,00	1,00	1,00	0,40	0,50	0,67	0,67	1,00	2,00
MS	1,50	2,00	2,50	1,00	1,00	1,00	1,00	1,50	2,00
OG	0,50	1,00	1,50	0,50	0,67	1,00	1,00	1,00	1,00

MP	**1,00**	**1,00**	**1,00**	**0,38**	**0,47**	**0,61**	**0,52**	**0,72**	**1,22**
MS	**1,67**	**2,17**	**2,67**	**1,00**	**1,00**	**1,00**	**0,83**	**1,33**	**1,83**
OG	**1,00**	**1,50**	**2,00**	**0,56**	**0,78**	**1,33**	**1,00**	**1,00**	**1,00**

MP	1,00	1,00	1,00	0,33	0,40	0,50	0,40	0,50	0,67
MS	2,00	2,50	3,00	1,00	1,00	1,00	1,00	1,50	2,00
OG	1,50	2,00	2,50	0,50	0,67	1,00	1,00	1,00	1,00

CR ***0,09***

PrLim									
MP	1,00	1,00	1,00	1,50	2,00	2,50	1,00	1,50	2,00
MS	0,40	0,50	0,67	1,00	1,00	1,00	0,67	1,00	2,00
OG	0,50	0,67	1,00	0,50	1,00	1,50	1,00	1,00	1,00

Expert Averages

MP	1,00	1,00	1,00	1,00	1,50	2,00	0,50	1,00	1,50
MS	0,50	0,67	1,00	1,00	1,00	1,00	0,67	1,00	2,00
OG	0,67	1,00	2,00	0,50	1,00	1,50	1,00	1,00	1,00

MP	**1,00**	**1,00**	**1,00**	**1,83**	**2,33**	**2,83**	**1,17**	**1,67**	**2,17**
MS	**0,36**	**0,43**	**0,56**	**1,00**	**1,00**	**1,00**	**0,61**	**0,89**	**1,67**
OG	**0,47**	**0,61**	**0,89**	**0,67**	**1,17**	**1,67**	**1,00**	**1,00**	**1,00**

MP	1,00	1,00	1,00	1,50	2,00	2,50	0,50	1,00	1,50
MS	0,40	0,50	0,67	1,00	1,00	1,00	0,67	1,00	2,00
OG	0,67	1,00	2,00	0,50	1,00	1,50	1,00	1,00	1,00

CR ***0,08***

OMT

MP	1,00	1,00	1,00	0,67	1,00	2,00	0,40	0,50	0,67
MS	0,50	1,00	1,50	1,00	1,00	1,00	0,50	0,67	1,00
OG	1,50	2,00	2,50	1,00	1,50	2,00	1,00	1,00	1,00

Expert Averages

MP	1,00	1,00	1,00	0,67	1,00	2,00	0,33	0,40	0,50
MS	0,50	1,00	1,50	1,00	1,00	1,00	0,67	1,00	2,00
OG	2,00	2,50	3,00	0,50	1,00	1,50	1,00	1,00	1,00

MP	**1,00**	**1,00**	**1,00**	**1,83**	**2,33**	**2,83**	**1,17**	**1,67**	**2,17**
MS	**0,36**	**0,43**	**0,56**	**1,00**	**1,00**	**1,00**	**0,61**	**0,89**	**1,67**
OG	**0,47**	**0,61**	**0,89**	**0,67**	**1,17**	**1,67**	**1,00**	**1,00**	**1,00**

MP	1,00	1,00	1,00	0,50	0,67	1,00	0,40	0,50	0,67
MS	1,00	1,50	2,00	1,00	1,00	1,00	0,67	1,00	2,00
OG	1,50	2,00	2,50	0,50	1,00	1,50	1,00	1,00	1,00

CR ***0,08***

GAS

MP	1,00	1,00	1,00	1,00	1,50	2,00	0,50	1,00	1,50
MS	0,50	0,67	1,00	1,00	1,00	1,00	0,67	1,00	2,00
OG	0,67	1,00	2,00	0,50	1,00	1,50	1,00	1,00	1,00

Expert Averages

MP	1,00	1,00	1,00	1,50	2,00	2,50	0,50	1,00	1,50
MS	0,40	0,50	0,67	1,00	1,00	1,00	0,67	1,00	2,00
OG	0,67	1,00	2,00	0,50	1,00	1,50	1,00	1,00	1,00

MP	**1,00**	**1,00**	**1,00**	**1,83**	**2,33**	**2,83**	**1,17**	**1,67**	**2,17**
MS	**0,36**	**0,43**	**0,56**	**1,00**	**1,00**	**1,00**	**0,61**	**0,89**	**1,67**
OG	**0,47**	**0,61**	**0,89**	**0,67**	**1,17**	**1,67**	**1,00**	**1,00**	**1,00**

MP	1,00	1,00	1,00	2,00	2,50	3,00	1,00	1,50	2,00
MS	0,33	0,40	0,50	1,00	1,00	1,00	0,67	1,00	2,00
OG	0,50	0,67	1,00	0,50	1,00	1,50	1,00	1,00	1,00

CR ***0,08***

BIOGRAPHICAL SKETCH

Duygu Ekici was born in 1980 in İstanbul. She was graduated from Antalya High School in 1998. She was graduated from Marmara University Engineering Faculty, Industrial Engineering Department as an industrial engineer in 2003. In 2004 she has been started her graduate program in Galatasaray University, Industrial Engineering Master of Science Program. She had started her professional life as a SAP- APO consultant and worked on various Supply Planning and Demand Planning projects. Subsequently, she passed to telecommunication sector and she is still working at the same sector as Service and Product Development Specialist.