EVALUATING PRICING STRATEGIES WITH FUZZY LINEAR PROGRAMMING APPROACHES

(FİYATLANDIRMA STRATEJİLERİNİN BULANIK DOĞRUSAL PROGRAMLAMA YAKLAŞIMLARIYLA DEĞERLENDİRİLMESİ)

by

Elif ALAYBEYOĞLU, B.S.

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

June, 2013

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Date of Submission : May 24, 2013

Date of Defense Examination : June 19, 2013

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ACKNOWLEDGEMENTS

No one walks alone on the journey of life. First and foremost I would like to thank to my mother Gönül YILMAZ for her encouragement about my decisions in the life and to my advisor Assoc. Prof. Y. Esra ALBAYRAK for her valuable support and guidance. It is very precious to know that these two women will always walk beside me.

I would like to express my gratitude to my dear professors, Assoc. Prof. Temel ÖNCAN and Assist. Prof. Tuncay GÜRBÜZ, who were there for me anytime I needed with their endless patience and knowledge.

Finally, my dear friends Pınar Uluer, İlke Bereketli and Seli Sharef, thank you very much for your help and support.

This thesis is dedicated to Gönül Yılmaz, as all the other achievements of mine.

Elif Alaybeyoğlu

June, 2013

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LIST OF SYMBOLS

4P	:	Product – Price – Place – Promotion
DM	:	Decision Maker
FLP	:	Fuzzy Linear Programming
FPIS	:	Fuzzy Positive Ideal Solution
FNIS	:	Fuzzy Negative Ideal Solution
IF	:	Intuitionistic Fuzzy
IFPIS	:	Intuitionistic Fuzzy Positive Ideal Solution
IFS	:	Intuitionistic Fuzzy Set
IMC	:	Integrated Marketing Communications
LINMAP	:	Linear Programming Model for Multidimensional Analysis of Preferences
MADM	:	Multi-Attribute Decision Making
MAGDM	:	Multi-Attribute Group Decision Making
MBI	:	Management by Instructions
MBO	:	Management by Objectives
MBV	:	Management by Values
NIS	:	Negative Ideal Solution
NPD	:	New Product Development

PIS	:	Positive Ideal Solution
PLC	:	Product Life Cycle
PR	:	Public Relations
R&D	:	Research and Development
TFN	:	Triangular Fuzzy Number
TOPSIS	:	Technique for Order Preference by Similarity to Ideal Solution

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ABSTRACT

Nowadays, marketing approach is customer-focused and products are directly oriented to meet customer needs. Production guided by the needs and tastes of customers prevents inefficient use of sources and accumulation of waste products. Products gain value in order to find market. Otherwise, the production does not make sense and does not contribute to the economical strengthening. Marketing aims an efficient production process. Hence it establishes a communication network between producers and consumers. Producer's success is directly proportionate to significance of consumer's desires.

Marketing, which is a long process, needs organization and management. Therefore the term "marketing strategy" is widely used. At the most macro level, marketing strategy focuses on manipulations of marketing mix variables (4P) – product, price, place and promotion. Strategic marketing planning becomes more and more important in today's competitive conditions.

One of the marketing mix variables is the price of the product and decisions surrounding the overall pricing strategies of company. Pricing is the process of determining what a company will receive in exchange for its products. Price, is basically about the charging of the product however, pricing is not that simple. Price should be considered with the segmentation and the positioning of the product because price naturally brings a classification to the product. For a company, decisions concerning price determination depend on determinants in the market as well as the consumer portfolio or the target market of the company, the financial and organizational structure of the company itself and the characteristics of the product. Therefore, it is a multi-attribute decision making problem.

Main focus of this thesis is to evaluate pricing strategies and select the best pricing strategy solution while considering internal and external factors influencing the

company's pricing decisions associated with new product development. The fuzzy linear programming technique for multiple attribute group decision making problems is investigated in marketing decisions with preference information on pricing strategies alternatives. In this study, to reflect the decision maker's subjective preference information and to determine the weight vector of factors (attributes), the fuzzy linear programming technique for multidimensional analysis of preference (LINMAP) and the LINMAP under intuitionistic fuzzy (IF) environments are used.

At the beginning, the base concepts of marketing strategy are reviewed. Then two methodologies with different fuzzification methods are used for analyzing individual and multidimensional preferences with linear programming approach under fuzzy environments and these systematic methodologies are proposed to select the best pricing strategy. First, the fuzzy LINMAP is applied, which is a multi attribute group decision making technique, where decision makers give their preferences on alternatives in a fuzzy relation. This method is a fuzzy prioritization method based on an optimization problem with linear constraints, considering the imprecise judgments of decision-makers which model the uncertainty with fuzzy numbers and uses paired comparison judgments directly to derive crisp priorities. In the second part, the LINMAP under Atanassov's IF environment is applied. IF sets are used to capture the fuzziness in decision information and describe the decision makers preferences given through pair-wise comparisons with hesitancy degrees. In both of the applications, Borda's social choice function is used to determine the ranking orders of alternatives.

The usefulness of the models was observed by their effect on the decision-making process in selecting an appropriate alternative and the case studies show that the fuzzy LINMAP method and the LINMAP method under IF environment are applicable as an evaluation technique for marketing strategies alternatives. The current fuzzy linear programming model offers the decision maker some flexibility to incorporate his/her own priority in the model. Consequently, managers can use such approaches in making their strategic decisions in case of incomplete information and vagueness. The models provide a useful conceptual framework for evaluating pricing strategies alternatives and marketing managers can use such approaches in making their strategic decisions.

RESUME

Aujourd'hui, l'approche marketing est axée sur la clientèle et les produits sont directement orientés vers les besoins du client. Production guidée par les besoins et les goûts des clients empêche l'utilisation inefficace des sources et de l'accumulation de déchets. Les produits gagnent de la valeur afin de trouver des marchés. Sinon, la production n'a pas de sens et ne contribue pas au renforcement économique. Trouver des marchés pour les produits et pour les services est une mission de marketing. Marketing vise un processus de production efficace. Par conséquent, il établit un réseau de communication entre les producteurs et les consommateurs. Le succès du producteur est directement lié à la signification des désirs des consommateurs.

Le Marketing, qui est un processus long, a besoin de l'organisation et de la gestion. Par conséquent, le terme «stratégie de marketing» est largement utilisé. Au niveau le plus macro, la stratégie de marketing axée sur des manipulations des variables du marketing mix (4P) - produit, prix, place et promotion. La planification stratégique de marketing devient de plus en plus importante dans les conditions de concurrence d'aujourd'hui.

L'une des variables du marketing mix est le prix du produit et les décisions entourant les stratégies générales de prix de la société. Le prix contient le processus de détermination de ce que l'entreprise recevra en échange de ses produits. Le prix est essentiellement sur la charge du produit mais, le prix n'est pas si simple. Le prix devrait être considéré avec la segmentation et le positionnement du produit parce que le prix apporte naturellement une classification du produit. Pour une entreprise, les décisions concernant la détermination du prix dépendent des facteurs déterminants sur le marché ainsi que le portefeuille des consommateurs ou du marché cible de l'entreprise, la structure financière et organisationnelle de l'entreprise elle-même et les caractéristiques du produit. Par conséquent, il s'agit d'un problème de prise de décision multi-attributs.

L’objectif principal de cette thèse est d'évaluer les stratégies de prix et de choisir la meilleure solution de la stratégie de prix tout en tenant compte des facteurs internes et externes qui influencent les décisions de prix de la société associée à développement de nouveaux produits. La technique de programmation linéaire floue pour les problèmes de décision du groupe multi-attributs est étudiée dans les décisions de marketing avec des informations de préférence sur les alternatives des stratégies de prix. Dans cette étude, afin de refléter les informations de préférence subjective de l’expert et de déterminer le vecteur de poids de facteurs (attributs), la technique de programmation linéaire floue pour l'analyse multidimensionnelle de préférence (LINMAP) et le LINMAP sous les environnements floue intuitionniste (IF) sont utilisés.

D’emblée, les concepts de base de la stratégie marketing sont expliqués en détail. Puis deux méthodologies avec les méthodes de fuzzification différentes sont utilisées pour analyser les préférences individuelles et multidimensionnelles à l'approche de programmation linéaire dans des environnements flous et ces méthodes systématiques sont proposées pour choisir la meilleure stratégie de prix. Tout d'abord, le LINMAP floue est appliquée, ce qui est une technique de décision du groupe multi-attributs, où les experts donnent leurs préférences sur les alternatives à une relation floue. Cette méthode est une méthode de priorisation floue basée sur un problème d'optimisation avec des contraintes linéaires. Dans la deuxième partie, le LINMAP sous les environnements flous intuitionnistes d’Atanassov est appliquée. Les ensembles IF sont utilisés pour capturer le flou dans l'information de décision et de décrire les préférences des décideurs par les comparaisons binaires avec des degrés d'hésitations. Dans les deux applications, fonction de choix social de Borda est utilisé pour déterminer l'ordre de classement des alternatives.

L'utilité des modèles a été observé selon leurs effets sur le processus de prise de décision de l’alternative appropriée en cas des études montrent que la méthode de LINMAP floue et la méthode LINMAP sous l'environnement IF sont applicables pour l’évaluation des alternatives des stratégies de marketing. Le modèle actuel de programmation linéaire floue offre à l’expert une certaine flexibilité pour intégrer sa propre priorité dans le modèle. Par conséquent, les gestionnaires peuvent utiliser ces approches dans leurs décisions stratégiques en cas d'information incomplète et vague.

ÖZET

Günümüzde pazarlama anlayışı müşteri odaklı hale gelmekte ve ürünler doğrudan müşteri ihtiyaçlarını karşılayabilmek üzere üretilmektedir. Tüketicilerin ihtiyaç ve beğenisine göre yapılan üretim, kaynakların verimsiz kullanımını ve atık madde birikimini engellemektedir. Ürünler pazar buldukları zaman değer kazanır, aksi takdirde üretim yapmak anlamsızlaşır ve ekonomik güçlenmeye katkıda bulunmaz. Pazarlamanın amacı verimli bir üretim süreci elde etmektir. Dolayısıyla pazarlama, üretici ve tüketici arasında bir iletişim bağı kurmakta ve şirketlerin başarısı tüketici ihtiyaçlarının doğru tahmin edilmesi ile artmaktadır.

Pazarlama sürecinin uzunluğu bu sürecin iyi planlanmasını ve yönetilmesini gerektirmektedir. Bu sebeple "Pazarlama Stratejisi" kavramı, pazarlama karması elemanlarının oluşturulması ve kontrol edilmesi fikri üzerinden ortaya çıkmaktadır. Pazarlama karması elemanları ürün, fiyat, tanıtım ve dağıtımdır. Pazarlama karmasının doğru oluşturulması ürünün başarısında önemli bir rol oynamakta ve bu sebeple stratejik pazarlama yönetimi kavramı günümüzün rekabet şartlarında giderek daha önemli hale gelmektedir.

Pazarlama karmasının elemanlarından biri olan fiyat, şirketin fiyatlandırma stratejisi konusunda verdiği tüm kararları kapsamaktadır. Fiyat aslında şirketin ürünü karşılığında ne kadar ücret istediğidir, ancak fiyatlandırma kararı fiyatın tanımını aşan bir pazarlama stratejisidir. Fiyatlandırma yapılırken ürünün konumlandırılması ve hedef pazarı da hesaba katılmalıdır, çünkü bir ürünün fiyatı aslında o ürünü müşteri gözünde sınıflandırmaktadır. Şirket fiyatlandırma yaparken pazar değişkenleri, müşteri portföyü, hedef pazar, finansal yapı, yönetim yapısı, rekabet şartları, ürün özellikleri gibi birçok faktörü değerlendirmelidir. Dolayısıyla fiyatlandırma, çok ölçütlü bir karar verme problemidir.

Bu tezin amacı, yeni ürün geliştirme sırasında fiyatlandırma stratejisi kararının belirlenmesinde etkili olan iç ve dış faktörleri göz önünde bulundurarak şirket için en iyi fiyatlandırma stratejisini seçmektir. Çok ölçütlü grup karar verme problemlerinde bulanık doğrusal programlama yöntemleri, karar verici tercihleri değerlendirilerek fiyatlandırma stratejileri seçimi için incelenmiştir. Karar vericilerin bireysel tercihlerini yansıtmak ve faktörleri ağırlıklandırmak için bulanık LINMAP ve sezgisel bulanık ortamda LINMAP yöntemleri kullanılmıştır.

Öncelikle pazarlama stratejisinin temel kavramları ele alınmış ve detaylı olarak açıklanmıştır. Çalışmanın devamında en iyi fiyatlandırma stratejisinin bulunması için iki farklı bulanık ortamda doğrusal programlama yöntemi kullanılmıştır. Bunlardan biri bulanık ortam diğeri ise sezgisel bulanık ortamdır. Uygulamanın ilk bölümünde karar vericilerin tercihlerini bulanık ortamda değerlendirmek için çok ölçütlü grup karar verme tekniği olan bulanık LINMAP kullanılmıştır. Bu yöntem karar vericilerin önceliklerini belirlendiği, kararlardaki belirsizliklerin hesaba katıldığı, ikili karşılaştırmaların değerlendirildiği, doğrusal kısıtları olan bir optimizasyon yöntemidir. Uygulamanın ikinci bölümünde ise karar vericilerin tereddütlerini hesaba katmak amacıyla Atanassov'un sezgisel bulanık ortamında doğrusal programlama yapılmıştır. İki uygulamada da alternatiflerin sıralanması için Borda fonksiyonu kullanılmıştır.

Modellerin kullanışlılığı uygulama bölümünde yapılan vaka analizlerinde görülmektedir. İki model de vakalardaki şirket için uygun sonuçlar elde etmekte ve pazarlama stratejilerinin değerlendirilmesi için kullanılabilmektedir. Bulanık doğrusal programlama modeli karar vericilere önceliklerini belirtmeleri için esneklik sağlamaktadır. Sezgisel bulanık programlama modeli ise karar vericilerin tereddütlerini hesaba katmaktadır. Bu iki model yöneticilere eksik bilgi ve belirsizlik durumlarında bu yaklaşımları kullanabilme fırsatı sunmaktadır. Sonuç olarak, bu modeller fiyatlandırma alternatiflerinin değerlendirilmesinde ve stratejik pazarlama kararlarının verilmesinde faydalı olabilecek bir kavramsal çerçeve sunmaktadır.

1. INTRODUCTION

Marketing is a vital factor in accelerating economic activities between producers and consumers. Finding needed goods and services at desired location with readily available amounts is very important for consumers. Thereby consumers can easily benefit from goods and services in the extent of their purchasing power.

Effectively for the success of a company, the invented core product is crucial in the first place and a good product is more likely to bond market. However, the development of technology and the supply which exceeds demand create difficult conditions in the market and competition. For reasons such as defend or increase the market share, be superior to the opponents, have an innovative and leader company image in the market and reduce risks by increasing the range of products; companies always need new products. The general expectation of the customer and the demand is always toward the new and improved products. New products should be launched at the same speed or faster than competitors. The company must exceed its old product before its competitors, with its own new product. For this reason, the continuity of the company's success is proportional to the activity of new product development. When the new product development is observed as a process, it is found that the majority of the process consists of the marketing strategy decisions that begin at the inception of the concept of the product (Kotler & Armstrong, 2012). As a result, the concepts that add value to the product such as marketing and branding become much more important. These processes begin now, since the invention of the product because which give or add value to a product are the customer and the point of view of the customer. Thus it is necessary to properly introduce and explain the product to the customer and gain their trust.

Nowadays, marketing approach is customer-focused and products are directly oriented to meet customer needs. According to actual definition of Kotler, marketing is managing profitable customer relationships (Kotler & Armstrong, 2012). Production

guided by the needs and tastes of customers prevents inefficient use of sources and accumulation of waste products. Products gain value in order to find market. Otherwise, the production does not make sense and does not contribute to the economical strengthening. Finding markets for produced goods and services is a mission of marketing. Marketing aims an efficient production process. Hence it establishes a communication network between producers and consumers. Due to the communication channel it determines the needs and wants of consumers and it offers this information to producers. Producer's success is directly proportionate to significance of consumer's desires.

The availability of products is also included in marketing activities. Companies with sizable capacities producing large amounts need distribution channels to reach numerous customers. Organization of distribution channels with efficient planning and execution of marketing activities facilitates the flow of products to the end-users. Briefly marketing starts with customers and ends up with customers.

Marketing, which is a long process, needs organization and management. Therefore the term "marketing strategy" is widely used. At the most macro level, marketing strategy focuses on manipulations of marketing mix variables (4P) – product, price, place and promotion (Schnaars, 1991). Another definition of strategy in marketing with a broader perspective of strategy claims that strategic market planning is a four-step process: defining the business, setting a mission, selecting functional plans for marketing, production, and other areas, and budgeting for those plans (Abell & Hammond, 1979). Thus the strategic marketing planning becomes more and more important in today's competitive conditions.

One of the marketing mix variables is the price of the product and decisions surrounding the overall pricing strategies of company. Pricing is the process of determining what a company will receive in exchange for its products. Price, is basically about the charging of the product however, pricing is not that simple. Price should be considered with the segmentation and the positioning of the product because price naturally brings a classification to the product. Besides, pricing strategy proceeds with the product's life cycle. List price, discounts, allowances, payment periods, credit terms etc. should be considered throughout the process. For a company, decisions

concerning price determination depend on determinants in the market as well as the consumer portfolio or the target market of the company, the financial and organizational structure of the company itself and the characteristics of the product. Therefore, it is a multi-attribute decision making (MADM) problem.

Main focus of this thesis is to evaluate pricing strategies and select the best pricing strategy solution while considering internal and external factors influencing the company's pricing decisions associated with new product development (NPD). The fuzzy linear programming (FLP) technique for multiple attribute group decision making (MAGDM) problems is investigated in marketing decisions with preference information on pricing strategies alternatives. In this study, to reflect the decision maker's subjective preference information and to determine the weight vector of factors (attributes), the fuzzy linear programming technique for multidimensional analysis of preference (fuzzy LINMAP) and the LINMAP under intuitionistic fuzzy (IF) environments are used.

In multiple attribute decision-making (MADM) problems, a decision maker (DM) is often faced with the problem of selecting, evaluation or ranking alternatives that are characterized by multiple, usually conflicting, attributes (Hwang, Chen, & Hwang, 1992). LINMAP is a MADM method and is based on pair-wise comparisons of alternatives given by decision makers and generates the best compromise alternative as the solution that has the shortest distance to the positive ideal solution (PIS) (Srinivasan & Shocker, 1973). Since most of the MADM problems include both quantitative and qualitative attributes that use imprecise data and human judgments, crisp values are insufficient (Hwang et al., 1992; Su, 2011). In MADM problems, fuzzy set theory is well suited to deal with such decision problems (Ross, 2004; Van Laarhoven & Pedrycz, 1983; Y. M. Wang & Parkan, 2005; L. Zadeh, 1965). The fuzzy LINMAP method (Albayrak, 2008; Albayrak & Erensal, 2006, 2009; Bereketli, Genevois, Albayrak, & Ozyol, 2011; D. F. Li, 2008; D. F. Li, Chen, & Huang, 2010; D. F. Li & Sun, 2007; D. F. Li & Yang, 2004) is a linear programming model based consistency and inconsistency indices of the preferences given by decision maker. According to the concept of fuzzy and technique for order preference by similarity to ideal solution (TOPSIS), the fuzzy positive ideal solution (FPIS) and the fuzzy negative ideal solution

(FNIS) are defined (C. T. Chen, 2000). By solving the linear programming problem, FPIS, the weights of attributes and the distance of each alternative from the FPIS are calculated. According to the increasing order of these distances, the best alternative is obtained and the ranking order of all alternatives is determined.

Additionally, this thesis offers an alternative instrument to fuzzy LINMAP for solving MADM problems which can be applicable to many real-life decision making problems such as strategic marketing decisions. In MADM problems, there exists an alternative set A which consists of m efficient alternatives from which the best alternative has to be selected and which are assessed on n attributes. In evaluation process of alternatives there are quantitative and qualitative attributes and in this thesis, the alternatives are evaluated on qualitative attributes through using intuitionistic fuzzy sets (IFS) (Atanassov, 1986, 1999). As IF set is an appropriate tool to capture the fuzziness in information, the LINMAP under IFSs is used to describe the DM's preferences given through pair-wise comparisons with hesitancy degrees (D. F. Li, 2008). The pair-wise comparison matrices are constructed by using preference relations on alternatives given by the decision makers. The linear programming model with the group consistency and inconsistency indices is used to estimate IF positive ideal solution (IFPIS) and weights of attributes (D. F. Li, 2008; D. F. Li et al., 2010). The distances of alternatives to the IFPIS are calculated to determine their ranking orders for the decision makers (Szmidt & Kacprzyk, 2001). The ranking order of alternatives for the group is generated using the Borda's social choice function (Hwang & Lin, 1987).

During the last years, in the literature there are several studies about strategic marketing planning; by Van Bruggen & Wierenga, questioning the claim that marketing models are routinely used by many companies and advocating the development of integrated marketing management support systems (van Bruggen & Wierenga, 2000), by Li, establishing a web-enabled hybrid approach to strategic marketing planning to support some key stages of the strategic marketing planning process (S. Li, 2005), by Rekik et al., proposing a multi-criteria decision making support system to aid the marketing strategy selection in e-commerce (Denguir-Rekik, Montmain, & Mauris, 2009), by Lin et al., implementing fuzzy analytic network process for the selection of the best marketing strategy as a multiple criteria decision making problem (Lin, Lee, & Wu,

2009), by Wu et al., modeling the marketing strategy decision-making problem as a multi-criteria decision-making problem, implementing of the integration of the analytic network process and TOPSIS to determine the appropriate marketing strategy (Wu, Lin, & Lee, 2010), by Li & Li, investigating the use of multi-agent based hybrid intelligent systems in support of international marketing planning (S. L. Li & Li, 2010), by Wierenga, formulating interesting and relevant research questions about marketing decision making (Wierenga, 2011), by Tsai et al., proposing an integrated model for evaluating airlines' websites effectiveness which is based on the perspectives of ''marketing mix 4Ps'' and ''website quality'' for the web-based marketing using the analytic network process (Tsai, Chou, & Leu, 2011), by Liao, proposing a method that will guide the product development team to select the best marketing strategy by taking into account the price level and product/market segmentation (Liao, 2011), and by Wang, providing a reference for planning brand marketing with a hybrid multi-criteria decision making model combining the decision making trial and evaluation laboratory with analytic network process and VIKOR methods (Y. L. Wang & Tzeng, 2012).

This thesis is organized as follows: The next chapter reviews base concepts of marketing strategy. Chapter 3 presents the basic definitions of multi attribute group decision making (MAGDM) problems with ratings of alternatives on attributes. The fuzzy numbers and linguistic variables, the fuzzy distance formula, the normalization method, consistency and inconsistency indices between preferences of alternatives are defined. The fuzzy LINMAP model and fuzzy linear programming model with Atanassov's intuitionistic fuzzy set (IFS) are constructed to estimate fuzzy positive ideal solution (FPIS) and weights of attributes. In Chapter 4, the proposed model is constructed and strategic marketing criteria are described as the attributes of the model. In Chapter 5, two applications with different fuzzification methods are used to generate the ranking order of pricing strategies and to find the best pricing strategy solution. The study is concluded in Chapter 6.

2. BASIC CONCEPTS OF MARKETING STRATEGY

2.1 Market, Marketing and Customer

Market, the origin of the word “marketing”, is a set of products that are considered substitutes for usage situations and a set of consumers for whom these uses are relevant (Dubois & Jolibert, 1998). Basically, market’s components are producers and consumers, in other words, enterprises/firms and their customers.

Regarding the definition of marketing, from different times and different point of views,

- Marketing is a transaction – an exchange- intended to satisfy human needs and wants (Stanton, 1981).
- Marketing is all processes implemented by an organization (or other "social entity") to understand and influence, in the direction of its objectives, the conditions of exchange between other entities, individuals, groups or organizations (Dubois & Jolibert, 1998).
- Marketing is the art of finding and keeping customers (Kotler, 1999).
- Marketing is the planning, coordination and control of all business activities conducted on the current and potential markets where company can achieve its goals only by consistently meeting the needs of the customer (Meffert, 2000).
- Marketing is a business function which parallels other functions as production, research, management, human resources, and accounting (Ferrell & Hartline, 2011).
- Marketing is the process of planning and executing the conception, pricing, promotion, and distribution of ideas, goods, and services to create exchanges that satisfy individual and organizational objectives (A.M.A., 2005).
- Marketing is an organizational function and a set of processes for creating, communicating, and delivering value to customers and for managing customer

relationships in ways that benefit the organization and its stakeholders (A.M.A., 2012).

- The process by which companies create value for customers and build strong customer relationships in order to capture value from customers in return (Kotler & Armstrong, 2012).

The definitions of marketing change in time, by focalizing on customer. The last two definitions of Kotler and American Marketing Association comprise the two key factors of marketing today: value and customer relationships. The development of technology leans upon marketing to be more customized. Marketing should be all around, directly and personally. Smart phones, mobile devices, social networks etc. enhances the availability of customer. The marketers use all intermediary paths for gathering information of customer and making promotion, even they could send push notifications on cell phones. Marketers attempt to be a part of customer's life and enrich the brand experience for this customer because today, marketing is not only selling and advertising but also satisfying customer needs to provide superior customer value.

2.2 New Product Development

Nowadays the development of technology and the supply which exceeds demand create difficult conditions in the market and competition. The companies that aim to provide competitive advantage tend towards new products and new markets to satisfy customer needs because a company without satisfied customers has not a chance for success in long term. Even if a company's current products are successful, clients are satisfied with the products and services and the profits are high, the company will always be subject to the risk because the opponents, trying to grab a market share, will continuously launch new products. The general expectation of the customer is always having new and improved products. Therefore, the success of the firm is proportional to the activity of new product development (NPD). New products should be launched at the same speed or faster than the competitors. The company should exceed its old product before its competitors, with its own new product. The NPD process becomes more and more important.

Companies can obtain new products in two different ways; the first is to buy it. The company may acquire new products by buying an entire other business, a patent or license production of another company. The second option is to establish its own research and development (R&D) department to support the work of NPD (Kotler & Armstrong, 2012).

NPD is not only producing a new product but also having new target markets/segments and new positioning with an existing product. The concept of NPD is applied in different ways in each sector, each company and for each product. For example, the electronics industry is based on technological superiority. For packaged foods or household items, small-scale changes in existing products may be sufficient. The matrix developed by Igor Ansoff (Ansoff, 1957) for determining appropriate strategies in the field of strategic management, classifies the concept of product development depending on market as shown in Table 2.1.

Table 2.1 Ansoff Matrix

		PRODUCT	
		Present	New
MARKET	Present	Market Penetration	Product Development
	New	Market Development	Diversification

Actually NPD depends on the point of view of both the company and its customers. If this matrix is explained in detail, there are six options related to the newness of the products (Ferrell & Hartline, 2011);

- ***New-to-the-World Products (Discontinuous Innovations):*** These products involve a pioneering effort by a firm that eventually leads to the creation of an entirely new market. New-to-the-world products are typically the result of radical thinking by individual inventors or entrepreneurs.

- ***New Product Lines:*** These products represent new offerings by the firm, but the firm introduces them into established markets. New product lines are not as risky as true innovation, and they allow the firm to diversify into closely related product categories.
- ***Product Line Extensions:*** These products supplement an existing product line with new styles, models, features, or flavors. Product line extensions allow the firm to keep its products fresh and exciting with minimal development costs and risk of market failure.
- ***Improvements or Revisions of Existing Products:*** These products offer customers improved performance or greater perceived value. The common ‘‘new and improved’’ strategy used in packaged goods and the yearly design changes in the automobile industry are good examples.
- ***Repositioning:*** This strategy involves targeting existing products at new markets or segments. Repositioning can involve real or perceived changes to a product.
- ***Cost Reductions***, This strategy involves modifying products to offer performance similar to that of competing products, but at a lower price. Similarly, a firm may be able to lower a product’s price due to improved manufacturing efficiency or a drop in the price of raw materials. For example, many computer manufacturers offer lower-priced products that use standard or slightly dated technology.

NPD process consists of customer needs analysis, idea generation, screening and evaluation, business analysis, product and marketing strategy development, testing and commercialization steps (Cravens, 2000) as shown in Figure 2.1.

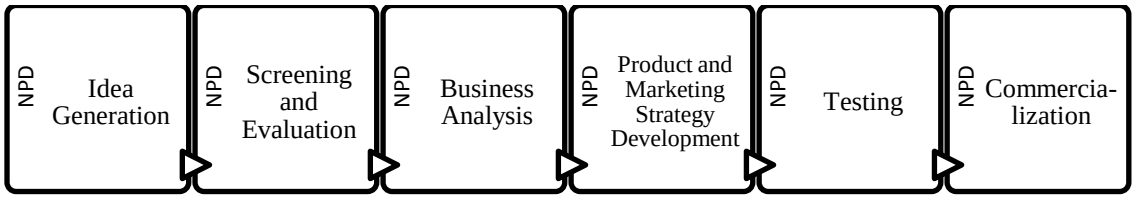

Figure 2.1 NPD Process

Marketing is the process of planning and executing the conception, pricing, promotion, and distribution of ideas, goods, and services to create exchanges that satisfy individual

and organizational goals and consequently marketing strategy is a critical component of NPD (H. H. Chen, H.I. Lee, & Tong, 2006; Liao, 2011). Marketing strategy and NPD should be integrated starting from the creation of a product.

2.3 Strategic Marketing Management

In order to propose a marketing strategy selection model, marketing and marketing strategy should be defined. The essence of marketing is a transaction – an exchange – intended to satisfy human needs and wants (Stanton, 1981). Marketing is not just an activity of a department in a company; it is a management requiring process. Marketing focuses not only on the tasks of its own department but also is responsible to arrange and plan all the company's activities. Marketing is neither static, nor seasonal hence the compatibility and the efficiency of the marketing plan is significant.

When conceived as a process, the content of marketing includes strategic and tactical planning, research and analysis, creation of goals and objectives, development of long-term relationships with customers, decisions for competitive advantage compared to other companies, implementation of marketing activities, control, social responsibility and ethics. If these factors are put in order, it is noticed that marketing consists of five main steps; (1) research, (2) segmentation, market targeting, positioning, (3) marketing mix constitution, (4) implementation of the strategy and (5) control as shown in **Figure 2.2** (Kotler, 1999).

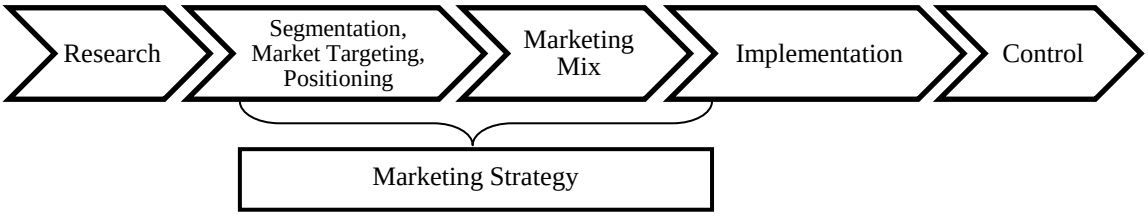

Figure 2.2 Marketing Process

The company first executes a research and collects the market data. Market research, customer surveys and analysis of the collected data are fulfilled. This step not only provides the company financial forecasts, but also gives ideas about customer needs, perceptions and preferences.

The second and the third steps form the marketing strategy. Marketing strategy involves two key questions: Which customers will the company serve? How to create a value for these customers (Kotler & Armstrong, 2012)? Thus, segmentation, targeting and positioning are three of the pillars of modern and customer-driven marketing strategy approach which will be discussed in detail in the next section.

Once all the strategic marketing decisions are made, the company produces the product, set a price, distributes and implements promotional activities on the market. For the implementation step, all departments of the company should perform effectively with collaboration: R&D, production, marketing / sales, human resources, logistics, finance and accounting.

Marketing should not be limited only to these four steps, the last step is equally important as the previous. The company must follow market responses and customer feed-backs, evaluate the results and take corrective actions to improve the performance. If the business fails, the fault must be sought in the strategic steps. The company should assess the validity of the marketing strategies constantly by monitoring the new data and change these strategies in the right direction, if necessary.

2.3.1 Segmentation

Marketing strategy starts with segmentation. Since it is the first step, it has a strong impact on marketing strategy formulation and on the success of the marketing efforts. Segmentation is to find customer groups which are homogeneous between them and heterogeneous compared to other groups (Freter & Baumgarth, 2004). In segmentation it is crucial to find customers who respond in a similar way to the offered marketing efforts. Different segments with different needs entail different marketing mixes. Major segmentation variables for consumer markets are geographic (world region or country, country region, city or metro size, density, climate), demographic (age, gender, family size, family life cycle, income, occupation, education, education, religion, race, generation, nationality), psychographic (social class, lifestyle, personality) and behavioral variables (occasions, benefits, user status, user rates, loyalty status, readiness stage, attitude toward product) (Kotler & Armstrong, 2012). Segmentation aims to find the distinctive qualities of current markets, divide markets into segments according to

these qualities, determine the size and the growth of these segments and observe the competitors.

Many segmentation approaches are traditional in the sense that firms have used them successfully for decades. In fact, many of today's most successful firms use these tried-and-true approaches. Some organizations actually use more than one type of segmentation, depending on the brand, product, or market in question. The traditional segmentation strategies are (Ferrell & Hartline, 2011):

Mass Marketing: It seems odd to call mass marketing a segmentation approach, as it involves no segmentation whatsoever. Companies aim mass marketing campaigns at the total (whole) market for a particular product. Companies that adopt mass marketing take an undifferentiated approach that assumes that all customers in the market have similar needs and wants that can be reasonably satisfied with a single marketing program. This marketing program typically consists of a single product or brand (or, in the case of retailers, a homogeneous set of products), one price, one promotional program, and one distribution system as shown in **Figure 2.3**.

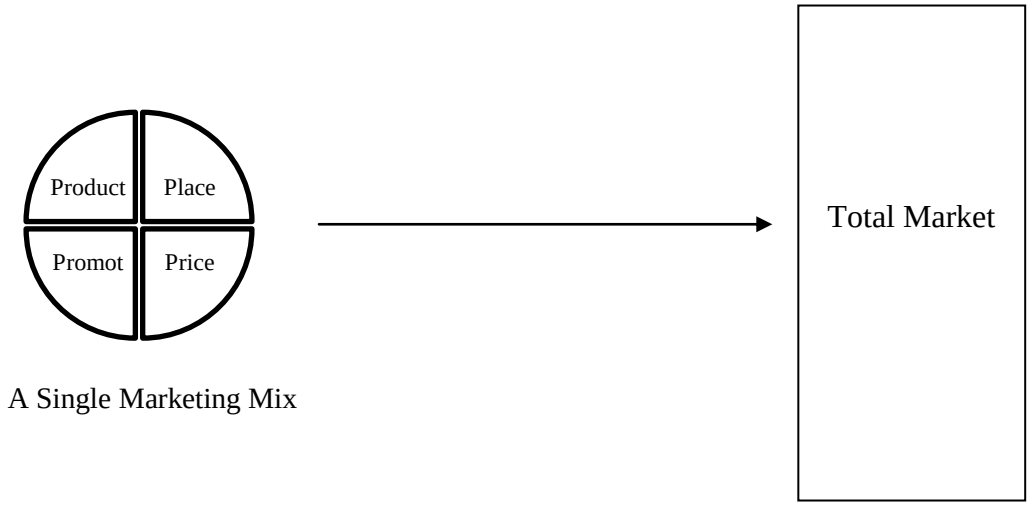

Figure 2.3 Mass marketing

Mass marketing works best when the needs of an entire market are relatively homogeneous. Good examples include commodities like oil and agricultural products. In reality, very few products or markets are ideal for mass marketing, if for no other

reason than companies, wanting to reach new customers, often modify their product lines.

Although mass marketing is advantageous in terms of production efficiency and lower marketing costs, it is inherently risky. By offering a standard product to all customers, the organization becomes vulnerable to competitors that offer specialized products that better match customers' needs. In industries where barriers to entry are low, mass marketing runs the risk of being seen as too generic. This situation is very inviting for competitors who use more targeted approaches. Mass marketing is also very risky in global markets, where even global brands like Coca-Cola must be adapted to match local tastes and customs.

Differentiated marketing: Most firms use some form of market segmentation by (1) dividing the total market into groups of customers having relatively common or homogeneous needs, and (2) attempting to develop a marketing program that appeals to one or more of these groups. This approach may be necessary when customer needs are similar within a single group, but their needs differ across groups. Through well designed and carefully conducted research, firms can identify the particular needs of each market segment to create marketing programs that best match those needs and expectations. Within the differentiated approach there are two options: the *multisegment approach* and the *market concentration approach*.

Firms using the *multisegment approach* seek to attract buyers in more than one market segment by offering a variety of products that appeal to different needs as shown in **Figure 2.4**. Firms using this option can increase their share of the market by responding to the heterogeneous needs of different segments. If the segments have enough buying potential, and the product is successful, the resulting sales increases can more than offset the increased costs of offering multiple products and marketing programs. The multisegment approach is the most widely used segmentation strategy in medium- to large-sized firms. It is extremely common in packaged goods and grocery products.

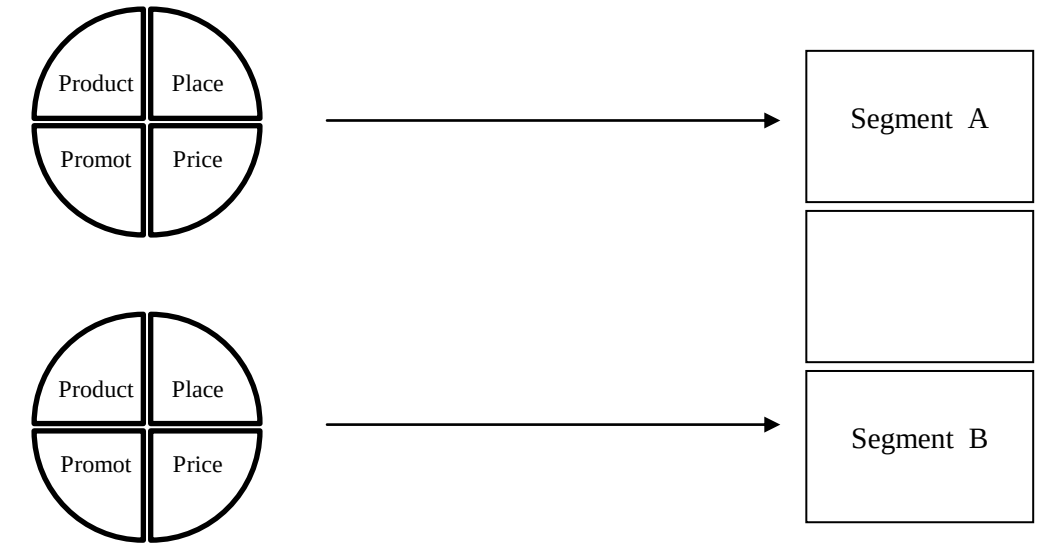

Figure 2.4 Differentiated Marketing – Multisegment Approach

Firms using the *market concentration approach* focus on a single market segment as shown in **Figure 2.5**. These firms often find it most efficient to seek a maximum share in one segment of the market. The main advantage of market concentration is specialization, as it allows the firm to focus all of its resources toward understanding and serving a single segment. Specialization is also the major disadvantage of this approach. By ‘‘putting all of its eggs in one basket,’’ the firm can be vulnerable to changes in its market segment, such as economic downturns and demographic shifts. Still, the market concentration approach can be highly successful. In the arts, where market concentration is almost universal, musical groups hone their talents and plan their performances to satisfy the tastes of one market segment, divided by genres of music such as country, rock, or jazz.

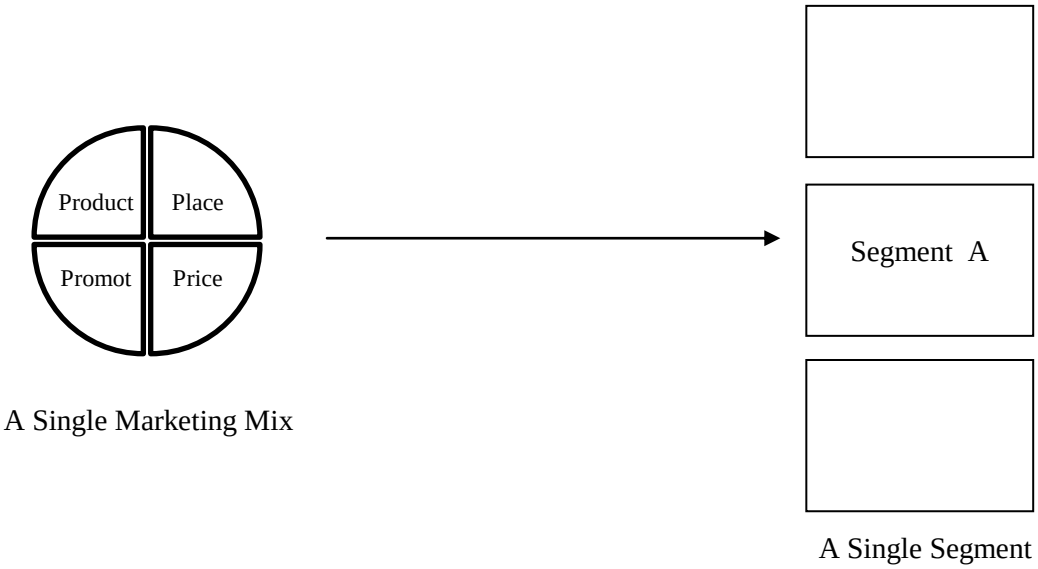

Figure 2.5 Differentiated Marketing – Market Concentration Approach

Niche Marketing: Some companies narrow the market concentration approach even more and focus their marketing efforts on one small, well-defined market segment or niche that has a unique, specific set of needs as shown in **Figure 2.6**. Customers in niche markets will typically pay higher prices for products that match their specialized needs. The key to successful niche marketing is to understand and meet the needs of target customers so completely that, despite the small size of the niche, the firm's substantial share makes the segment highly profitable. An attractive market niche is one that has growth and profit potential, but is not so appealing that it attracts competitors. The firm should also possess a specialization or provide a unique offering that customers find highly desirable.

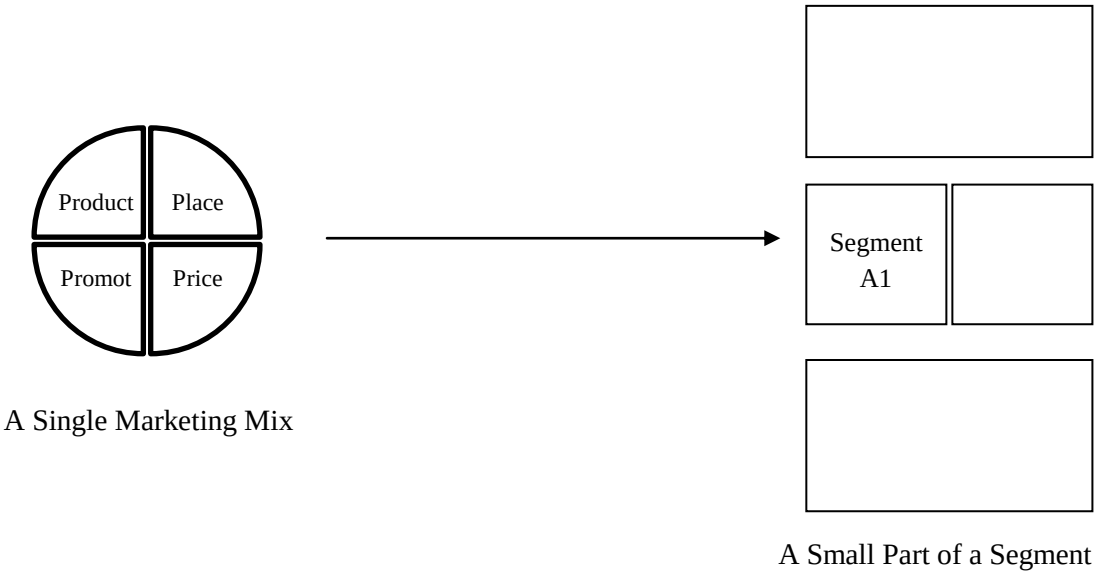

Figure 2.6 Niche Marketing

Effective segmentation is achieved when customers sharing similar patterns of demand are grouped together and where each group or segment differs in the pattern of demand from other segments in the market. Theoretically, the base(s) used for segmentation should lead to segments that are (Whalley, 2010):

1. Measurable/Identifiable: Here the base(s) used should preferably lead to ease of identification in terms of who is in each segment. It should also be capable of measurement in terms of the potential customers in each segment.
2. Accessible: Here the base(s) used should ideally lead to the company being able to reach selected market targets with their individual marketing efforts.
3. Meaningful: The base(s) used must lead to segments which have different preferences or needs and show clear variations in market behavior and response to individually designed marketing mixes.
4. Substantial: The base(s) used should lead to segments which are sufficiently large to be economically and practically worthwhile serving as discrete market targets with a distinctive marketing mix.

2.3.2 Market Targeting

After a company has defined its market segments, it can choose one or many of these segments. Basically the target market is the segment served. Market targeting involves evaluating each market segment's attractiveness and selecting one or more segments to enter. A company should target segments in which it can profitably generate the greatest customer value and sustain it over time. A company with limited resources might decide to serve only one or a few special segments or market niches. Such nichers specialize in serving customer segments that major competitors overlook or ignore. Alternatively, a company might choose to serve several related segments—perhaps those with different kinds of customers but with the same basic wants. Most companies enter a new market by serving a single segment, and, if this proves successful, they add more segments (Kotler & Armstrong, 2012).

The target market must be clearly identifiable to simplify the marketing communications and large enough to achieve required profit. A company might consider five basic strategies for target market selection: (1) single segment targeting, (2) selective targeting, (3) mass market targeting, (4) product specialization, and (5) market specialization as shown in **Figure 2.7** (Ferrell & Hartline, 2011).

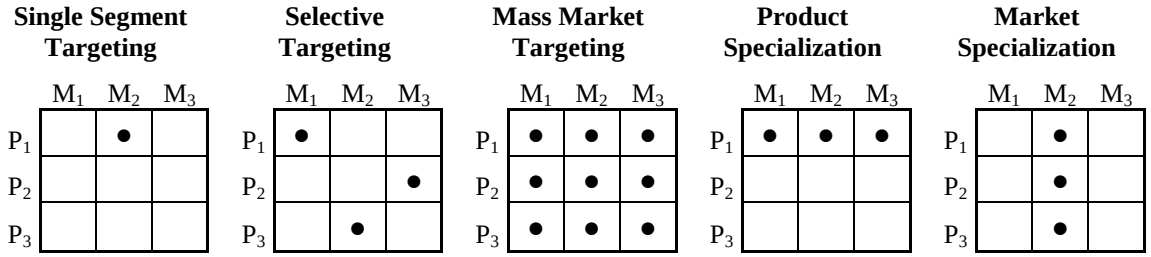

Figure 2.7 Basic Strategies for Target Market Selection

Single Segment Targeting: Firms use single segment targeting when their capabilities are intrinsically tied to the needs of a specific market segment. Many consider the firms using this targeting strategy to be true specialists in a particular product category. The firms using single segment targeting are successful because they fully understand their customers' needs, preferences, and lifestyles. These firms also constantly strive to

improve quality and customer satisfaction by continuously refining their products to meet changing customer preferences.

Selective Targeting: Firms that have multiple capabilities in many different product categories use selective targeting successfully. This strategy has several advantages, including diversification of the firm's risk and the ability to cherry pick only the most attractive market segment opportunities. The firms using this strategy do not try to be all things to all customers and carefully select product/market combinations where its capabilities match customers' needs.

Mass Market Targeting: Only the largest firms have the capability to execute mass market targeting, which involves the development of multiple marketing programs to serve all customer segments simultaneously.

Product Specialization: Firms engage in product specialization when their expertise in a product category can be leveraged across many different market segments. These firms can adapt product specifications to match the different needs of individual customer groups.

Market Specialization: Firms engage in market specialization when their intimate knowledge and expertise in one market allows them to offer customized marketing programs that not only deliver needed products but also provide needed solutions to customers' problems.

Consequently, the company must consider many factors to select the target market because it is a leading step in order to construct the appropriate marketing mix.

2.3.3 Positioning

Once the target market is defined, the company must consider creating a value for the customers. This step is called positioning. A position is a complex set of perceptions, impressions and feelings and it is important to note that customers position the company's value offering with or without its help (Bradley, 2003). Positioning is arranging for a product to occupy a clear, distinctive, and desirable place relative to competing products in the minds of target consumers, accordingly marketers plan positions that distinguish their products from competing brands and give them the

greatest advantage in their target markets (Kotler & Armstrong, 2012). Consumers make positioning of products according to their opinions of these products to accelerate, simplify and optimize their shopping. In addition, positioning for a company can be interpreted as differentiation of a product from its competitors. Hence proposing a value, a difference from other products is the major concern of positioning. A product with a favorable position in target customers' minds creates competitive advantage for company. Positioning step is more important for the new products because once a product is positioned for the customer, it is nearly impossible to change.

Firms can design their marketing programs to position and enhance the image of a product offering in the minds of target customers. To create a positive image for a product, a firm can choose from among several positioning strategies, including strengthening the current position, repositioning, or attempting to reposition the competition (Ferrell & Hartline, 2011).

Strengthen the Current Position: The key to strengthening a product's current position is to monitor constantly what target customers want and the extent to which customers perceive the product as satisfying those wants. Any complacency in today's dynamic marketplace is likely to result in lost customers and sales. This strategy is especially true for firms that pursue competitive advantage based on customer intimacy. Strengthening a current position is all about continually raising the bar of customer expectations.

Repositioning: At times, declining sales or market share may signal that customers have lost faith in a product's ability to satisfy their needs. In such cases, a new position may be the best response, as strengthening the current position may well accelerate the downturn in performance. Repositioning may involve a fundamental change in any of the marketing mix elements, or perhaps even all of them.

Reposition the Competition: In many cases, it is better to attempt to reposition the competition rather than change your own position. A direct attack on a competitor's strength may put its products in a less favorable light or even force the competitor to change its positioning strategy.

Positioning is therefore the process of designing an image and value so that customers within the target segment understand what the company or brand stands for in relation to its competitors. It should be apparent that positioning is a fundamental element of the marketing planning process, since any decision on positioning has direct and immediate implications for the whole of the marketing mix. In essence, therefore, the marketing mix can be seen as the tactical details of the organization's positioning strategy. Where, for example, the organization pursuing a high-quality position needs to be reflected not just in the quality of the product that is to be sold, but in every element of the mix, including price, the pattern of distribution, the style of advertising and the after-sales service. Without this consistency, the believability of the positioning strategy reduces dramatically (Wilson & Gilligan, 2005).

2.4 Marketing Mix

Last step of the marketing strategy is creating the marketing mix. Marketing mix elements, also known as 4P's, are product, price, promotion and place (McCarthy, 1960). Each P represents different strategies for marketing and is vital for the success. It is a framework which helps to structure the approach to each market. The mix is a bundle of variables which are offered to the customer. The marketing variables under each P are shown in **Figure 2.8** (Kotler & Keller, 2012).

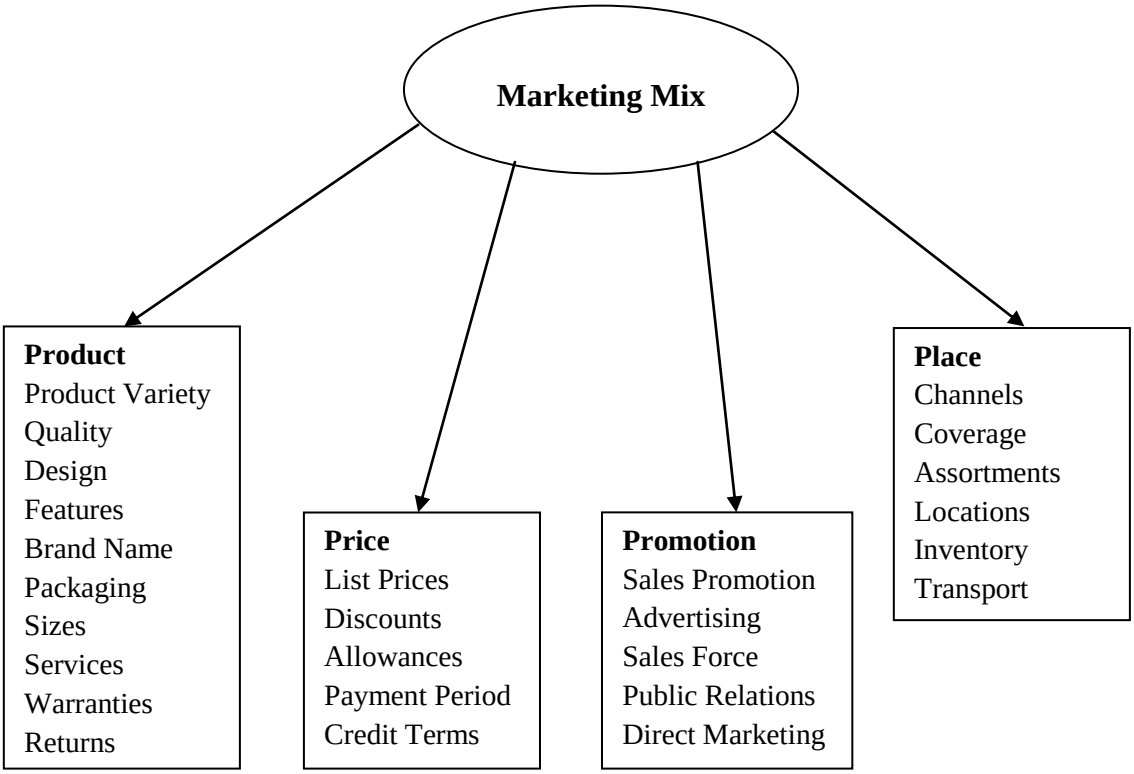

Figure 2.8 Four P Components of the Marketing Mix

Product, perhaps the most important of the 4P's, is acquired by the customers via exchange to satisfy a need. Product consists of quality, variety, characteristics, options, style, brand, package, product service and all the other elements that reach the customer with the product. Price, is basically about the charging of the product however, pricing is not that simple. Price should be considered with the segmentation and the positioning of the product because price always brings a classification to the product. Besides, pricing strategy proceeds with the product's life cycle. List price, discounts, allowances, payment periods, credit terms etc. should be considered throughout the process. Promotion is the most ubiquitous element of a company's marketing strategy because promotional activities are necessary to communicate the features and benefits of a product to the company's intended target markets (Ferrell & Hartline, 2011). Advertising, sales promotion, personal selling, public relations are included in promotion. Place, actually distribution, is about the availability of the product. Channels, coverage, locations, inventory, transportation, logistics, supply chain,

retailers, supplier relations, vertical integration are distribution factors and are taken into account in place strategy.

An effective marketing program blends each marketing mix element into an integrated marketing program designed to achieve the company's marketing objectives by delivering value to consumers. The marketing mix constitutes the company's tactical tool kit for establishing strong positioning in target markets (Kotler & Armstrong, 2012). In other words, each of these elements has special concerns and difficulties. Building a marketing mix is complicated and effortful for a company.

2.4.1 Product

The most concrete part of the marketing mix is the product. Product is defined as anything that can be offered to a market for attention, acquisition, use or consumption that might satisfy a want or need (Kotler & Armstrong, 2012). It also includes ideas, organizations, services, persons, places, and a mixture of these. In today's marketing point of view, products are more customized. Producers that tend to create value for their customers differentiate their market offerings and sell experiences with their products and brands. Product planners need to think about products and services on three levels as shown in **Figure 2.9** (Kotler & Armstrong, 2012).

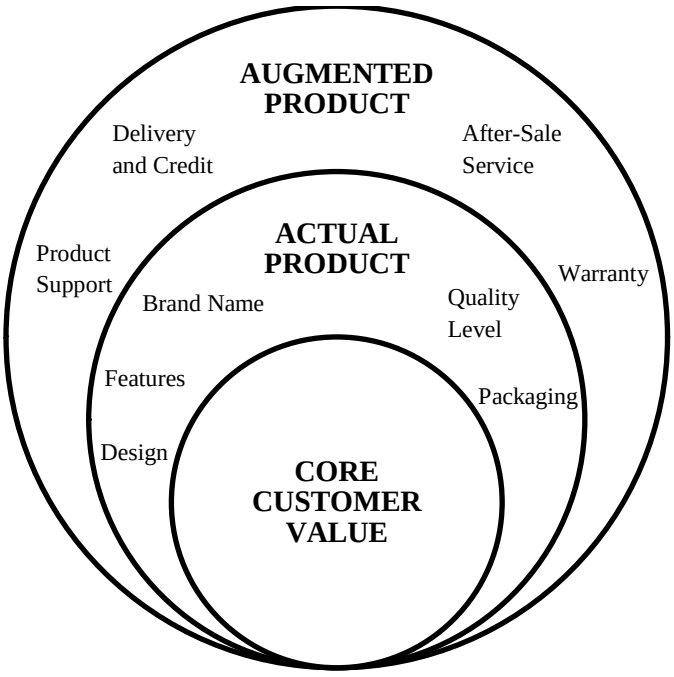

Figure 2.9 Three Levels of Product

Each level adds more customer value. The most basic level is the core customer value, which addresses the question "What is the buyer really buying?" When designing products, marketers must first define the core, problem-solving benefits or services that consumers seek. At the second level product planners must turn the core benefit into an actual product. They need to develop product and service features, design, a quality level, a brand name, and packaging. Finally, product planners must build an augmented product around the core benefit and actual product by offering additional consumer services and benefits. Consumers see products as complex bundles of benefits that satisfy their needs. When developing products, marketers first must identify the core customer value that consumers seek from the product. They must then design the actual product and find ways to augment it to create this customer value and the most satisfying customer experience (Kotler & Armstrong, 2012).

Similarly as living things, products have a life cycle. Product Life Cycle (PLC) is widely known and most respected among marketing planning tools. The PLC refers to product categories or product classes and not to individual brands. It traces the evolution of a product's development (birth, growth, maturity, decline and death) over five stages (Ferrell & Hartline, 2011):

- Development: A time of no sales revenue, negative cash flow, and high risk.
- Introduction: A time of rising customer awareness, extensive marketing expenditures, and rapidly increasing sales revenue.
- Growth: A time of rapidly increasing sales revenue, rising profits, market expansion, and increasing number of competitors.
- Maturity: A time of sales and profit plateaus, a shift from customer acquisition to customer retention, and strategies aimed at holding or stealing market share.
- Decline: A time of persistent sales and profit decreases, attempts to postpone the decline, or strategies aimed at harvesting or divesting the product.

Classification/Type of the product influence a product's pricing, distribution and promotion too. Products for personal use and enjoyment are called *consumer products* (Ferrell & Hartline, 2011). Consumer products and services are classified further based on how consumers go about buying them. Consumer products include *convenience products*, *shopping products*, *specialty products*, and *unsought products*. These

products differ in the ways consumers buy them and, therefore, in how they are marketed as shown in **Table 2.2** (Kotler & Armstrong, 2012).

Table 2.2 Marketing Considerations for Consumer Products

Marketing Considerations	**Type of Consumer Product**			
	Convenience	**Shopping**	**Specialty**	**Unsought**
Customer Buying Behavior	Frequent purchase; little planning, little comparison or shopping effort; low customer involvement	Less frequent purchase; much planning and shopping effort; comparison of brands on price, quality and style	Strong brand preference and loyalty; special purchase effort; little comparison of brands; low price sensitivity	Little product awareness; knowledge (or, if aware, little or even negative interest)
Price	Low price	Higher price	High price	Varies
Distribution	Widespread distribution; convenient locations	Selective distribution in fewer outlets	Exclusive distribution in only one or a few outlets per market area	Varies
Promotion	Mass promotion by the producer	Advertising and personal selling by both the producer and resellers	More carefully targeted promotion by both the producer and resellers	Aggressive advertising and personal selling by the producer and resellers
Examples	Toothpaste, magazines and laundry detergent	Major appliances, televisions, furniture and clothing	Luxury goods, such as Rolex watches or fine crystal	Life insurance and blood donations

Companies generally do not sell just one product. They produce a variety of products to respond different needs. The variety of a company's products is called the product portfolio of this company. Managing a product portfolio includes two major activities: (1) evaluating the performance of the products in the portfolio, and (2) managing and, when necessary, altering product strategies (Cravens, 2000).

A company's product portfolio is described with respect to *product lines* and *product mixes*. A broad group of products intended for essentially similar uses and possessing reasonably similar physical characteristics, constitutes a *product line* and the product mix is the full list of all products offered for sale by a company. The structure of the product mix has dimensions of both breadth (width/variety) and depth (assortment). The breadth is measured by the number of product lines carried and its depth, by the

assortment of sizes, colors, and models offered within each product line (Stanton, 1981).

Although offering a wide variety and deep assortment of products can make the coordination of marketing activities more challenging and expensive; it also creates a number of important benefits (Ferrell & Hartline, 2011):

- **Economies of Scale:** Offering many different product lines can create economies of scale in production, bulk buying, and promotion. Many firms advertise using an umbrella theme for all products in the line. The single theme covering the entire product line saves considerably on promotional expenses too.
- **Package Uniformity:** When all packages in a product line have the same look and feel, customers can locate the firm's products more quickly. It also becomes easier for the firm to coordinate and integrate promotion and distribution.
- **Standardization:** Product lines often use the same component parts which greatly reduce manufacturing and inventory handling costs.
- **Sales and Distribution Efficiency:** When a firm offers many different product lines, sales personnel can offer a full range of choices and options to customers. For the same reason, channel intermediaries are more accepting of a product line than they are of individual products.
- **Equivalent Quality Beliefs:** Customers typically expect and believe that all products in a product line are about equal in terms of quality and performance. This is a major advantage for a firm that offers a well known and respected line of products.

A firm's product portfolio must be carefully managed to reflect changes in customers' preferences and the introduction of competitive products. Product offerings may be modified to change one or more characteristics that enhance quality and/or style, or lower the product's price. Firms may introduce product line extensions that allow it to compete more broadly in an industry (Ferrell & Hartline, 2011).

A broad product offering signals substance, acceptance, leadership, and often the convenience of one-stop shopping. Breadth also works well as a dimension for the firms but expanding the product offering involves risks too. The firm may venture into

business areas in which it lacks skills and competencies, the brand might be eroded, and resources needed elsewhere may be absorbed (Aaker & McLoughlin, 2010).

2.4.2 Price

In the narrowest sense, price is the amount of money charged for a product or a service. More broadly, price is the sum of all the values that customers give up to gain the benefits of having or using a product or service (Kotler & Armstrong, 2012). Many internal and external factors influence pricing decisions, including the nature of the market, economic conditions, the company's overall marketing strategy, objectives, and marketing mix, as well as organizational considerations. Price is only one element of the company's broader marketing strategy. If the company has selected its target market and positioning carefully, then its marketing mix strategy, including price, will be fairly straightforward (Kotler & Armstrong, 2012). The price also creates a positioning in customers' minds, therefore setting an initial price for a new product is vital for the success of this product. In its role as an allocator of scarce resources, price determines what will be produced (supply) and who will get how much of these goods and services (demand) (Stanton, 1981).

Pricing is often a major source of confrontation between sellers and buyers. The sellers, by their nature, have a tendency to inflate prices because they want to receive as much as possible in an exchange with a buyer. From the sellers' perspective, four key issues become important in pricing strategy: (1) cost, (2) demand, (3) customer value, and (4) competitors' prices. From the buyers' perspective, two key issues determine pricing strategy for most firms: (1) perceived value, and (2) price sensitivity (Ferrell & Hartline, 2011).

Pricing decisions are one of the most complicated decisions to be made for a company because pricing consists of many determinants with uncertainty about customers, competitors and partners. In order to set the initial price, all the major determinants of pricing must be considered. These major determinants are company's pricing objectives, supply and demand, company's cost structure, competition and industry structure, stage of the PLC, price elasticity of the demand and

laws/regulations/directives (Bradley, 2003; Ferrell & Hartline, 2011; Kotler & Armstrong, 2012).

Company's Pricing Objectives

Setting specific pricing objectives, which are realistic, measurable, and attainable, is an important part of pricing strategy. There are a number of pricing objectives that firms may pursue as shown in **Table 2.3** (Ferrell & Hartline, 2011).

Table 2.3 Description of Common Pricing Objectives

Profit-Oriented	Designed to maximize price relative to competitors' prices, the product's perceived value, the firm's cost structure, and production efficiency. Profit objectives are typically based on a target return, rather than simple profit maximization.
Volume-Oriented	Sets prices in order to maximize dollar or unit sales volume. This objective sacrifices profit margin in favor of high product turnover.
Market Demand	Sets prices in accordance with customer expectations and specific buying situations. This objective is often known as ''charging what the market will bear.''
Market Share	Designed to increase or maintain market share regardless of fluctuations in industry sales. Market share objectives are often used in the maturity stage of the PLC.
Cash Flow	Designed to maximize the recovery of cash as quickly as possible. This objective is useful when a firm has a cash emergency or when the PLC is expected to be quite short.
Competitive Matching	Designed to match or beat competitors' prices. The goal is to maintain the perception of good value relative to the competition.
Prestige	Sets high prices that are consistent with a prestige or high status product. Prices are set with little regard for the firm's cost structure or the competition.
Status Quo	Maintains current prices in an effort to sustain a position relative to the competition.

Supply and Demand

The basic laws of supply and demand have an obvious influence on pricing strategy (Ferrell & Hartline, 2011). Usually, there is an inverse relationship between supply and demand however there will always be exceptions due to the market, the product and the consumer behavior.

Company's Cost Structure

A company's costs take two forms: fixed and variable. Fixed costs (also known as overhead) are costs that do not vary with production or sales level. Variable costs vary directly with the level of production. Total costs are the sum of the fixed and variable costs for any given level of production (Kotler & Armstrong, 2012). Since the break-even point analysis is vital for most of the companies, cost structure of a company is a major determinant of pricing strategy. The proportion of fixed costs and variable costs in total costs creates advantages and disadvantages for the companies.

Competition and Industry Structure

The competitive market structure of the industry in which a firm operates affects its flexibility in raising or lowering prices. Industry structure also affects how competitors will respond to changes in price. There are four basic competitive market structures (Ferrell & Hartline, 2011):

- ***Perfect Competition:*** A market containing an unlimited number of sellers and buyers who exchange for homogeneous products. Market entry is easy and no single participant can influence price or supply significantly. For the most part, perfect competition does not exist, although some agricultural and commodity markets come reasonably close.
- ***Monopolistic Competition:*** A market containing many sellers and buyers who exchange for relatively heterogeneous products. Marketing strategy involves product differentiation and/or niche marketing to overcome the threats imposed by the wide availability of substitute products. The heterogeneous nature of the products gives firms some control over prices. Most markets fall into this category.

- ***Oligopoly:*** A market containing relatively few sellers who control the supply of a dominant portion of the industry's product. However, no one seller controls the market. One firm's prices affect the sales of competing firms, and all firms typically match the price changes of competitors. These firms often turn to non-price strategies to differentiate their product offerings. Examples of oligopolies include the automobile, tobacco, oil, steel, aerospace, and music recording industries.
- ***Monopoly:*** A market dominated by a single seller who sells a product with no close substitutes. The single seller is the sole source of supply.

Stage of the Product Life Cycle

Marketing strategy shifts as a product moves through the stages of its life cycle. Pricing changes, like changes in the other elements of the marketing program, occur as demand, competition, customer expectations, and the product itself change over time. **Table 2.4** illustrates how pricing changes might occur over the PLC (Ferrell & Hartline, 2011).

Table 2.4 Pricing Strategy over the Product Life Cycle

Introduction	The price sensitivity of the market determines the initial pricing strategy. When the market is relatively insensitive to price, prices are set high to recoup investment and generate high profits to fuel growth (a price skimming strategy). If the market is sensitive to price, prices are set at, or lower than, the competition to gain a foothold in the market (a price penetration strategy).
Growth	A gradual lowering of prices occurs due to increasing competition and growing economies of scale that reduce production and marketing costs. The product also begins to appeal to a broader base of customers, many of whom are quite price sensitive.
Maturity	Prices continue to decrease as competition intensifies and ineffective firms are eliminated from the market. Most firms focus heavily on cost savings; economies of scale; or synergies in production, promotion, and distribution to maintain profit margins. Specific pricing tactics encourage brand switching in an attempt to steal business away from the competition.
Decline	Prices continue to fall until only one or a few firms remain. At that point, prices begin to stabilize or even increase somewhat as firms squeeze the last bit of profit from a product. Some products can experience sharp increases in price if their popularity and unique appeal remain high.

Price Elasticity of the Demand

Price elasticity of the demand is defined as the percentage change in quantity demanded in response to a one percent change in price, the responsiveness, or elasticity, of the quantity demanded of a good or service to a change in its price (Marshall, 1997). Price elasticity differs in markets, for different products. Price elasticity increases with availability of product substitutes, higher total expenditure, noticeable differences and easy price comparisons, on the other hand it decreases with lack of substitutes, real or perceived necessities, complementary products, perceived product benefits, situational influences and product differentiation (Ferrell & Hartline, 2011).

Base Pricing Strategies

Although prices for individual products are made on case-by-case basis, most firms have developed a general and consistent approach – or general pricing strategy – to be used in establishing prices. A firm's base pricing strategy establishes the initial price and sets the range of possible price movements throughout the product's life cycle. There are five base strategies commonly used by the companies (Ferrell & Hartline, 2011).

- ***Price Skimming:*** The idea behind price skimming is to intentionally set a high price relative to the competition, thereby skimming the profits off the top of the market. Price skimming is designed to recover the high R&D and marketing expenses associated with developing a new product. It may also be used to initially segment the market based on price, or to control the initial demand for the product. For price skimming to work, the product must be perceived as having unique advantages over competing products. When the high price brings unique or new benefits, customers do not mind paying for the product. Virtually all new high-tech products, new computer technology, and new prescription drugs use a price-skimming approach.
- ***Prestige Pricing:*** Firms using prestige pricing set their prices at the top end of all competing products in a category. This is done to promote an image of exclusivity and superior quality. The company competes only on service and the value of the unique, high-quality experience that they deliver to customers.

Prestige pricing is a viable approach in situations where it is hard to objectively judge the true value of a product. In these instances, a higher price may indicate a higher quality product.

- ***Value-Based Pricing:*** Firms that use a value-based pricing approach set reasonably low prices but still offer high-quality products and adequate customer services. Many different types of firms use value-based pricing; however, retailing has widely embraced this approach, where it is known as everyday low pricing or EDLP. The goal of value-based pricing is to set a reasonable price for the level of quality offered. Prices are not the highest in the market, nor are they the lowest. Instead, value-based pricing sets prices so they are consistent with the benefits and costs associated with acquiring the product. The firms using this strategy exhibit the two major characteristics of the value-based pricing approach. First, these firms have the capacity to offer reasonable prices because they have engineered themselves to be a low-cost provider in their industry. Value-based pricing requires that the firm be highly efficient in operations and marketing in order to keep costs, and prices, low. Second, firms adopting value-based pricing maintain consistent prices over time; they use sales, discounts, and other pricing tactics infrequently. Value-based pricing naturally draws customers because they have confidence in the value of the products they buy. Customers also like the approach because it requires less effort to find good prices on the products they want and need.
- ***Competitive Matching:*** In many industries, particularly oligopolies, pricing strategy focuses on matching competitors' prices and price changes. Although some firms may charge slightly more or slightly less, these firms set prices at what most consider to be the ''going rate'' for the industry. Two competitive factors largely drive this strategy. First, firms that offer commodity-type products (e.g., airlines, oil, steel) have a very difficult time finding any real or perceived basis for product differentiation. So, when customers see all products as being about the same, the prices have to be about the same as well. Second, some industries are so highly competitive that competitive price matching becomes a means of survival. The automobile industry and its long-running zero-percent financing and generous rebate offers are a good example.

- ***Penetration Pricing:*** The goal of penetration pricing is to maximize sales, gain widespread market acceptance, and capture a large market share quickly by setting a relatively low initial price. This approach works best when customers are price sensitive for the product or product category; when research and development and marketing expenses are relatively low; or when new competitors will quickly enter the market. Because of its flexibility, penetration pricing can be used to launch a new product or to introduce new product lines to an established product portfolio. The benefits of penetration pricing (rapid market acceptance and maximum sales) also have the benefit of discouraging competition from entering the market. This is a powerful advantage that makes a penetration approach quite appealing. However, the strategy is not for all firms. To use penetration pricing successfully, the firm must have a cost structure and scale economies that can withstand narrow profit margins. Some firms adopt a penetration pricing strategy by selling their products at a loss, hoping to make up the lost revenue via the sale of accessories, add-ons, or subscription services. Although price penetration does not necessarily mean low profit per unit sold, it does require a higher volume of sales to achieve the same total profit that would be achieved using a price-skimming approach. For these reasons, price penetration occurs primarily in situations where the firm has a reasonable expectation of achieving the necessary sales volume to make the product financially viable.

2.4.3 Promotion

A company's total promotion—also called its marketing communications mix—consists of the specific blend of advertising, public relations, personal selling, sales promotion, and direct-marketing tools that the company uses to persuasively communicate customer value and build customer relationships. The five major promotion tools are defined as follows (Cravens, 2000; Kotler & Armstrong, 2012):

• ***Advertising:*** Any paid form of non-personal presentation and promotion of ideas, goods, or services by an identified sponsor.

• ***Sales promotion:*** Short-term incentives to encourage the purchase or sale of a product or service.

• ***Personal selling:*** Personal presentation by the firm's sales force for the purpose of making sales and building customer relationships.

• ***Public relations:*** Building good relations with the company's various publics by obtaining favorable publicity, building up a good corporate image, and handling or heading off unfavorable rumors, stories, and events.

• ***Direct marketing:*** Direct connections with carefully targeted individual consumers to both obtain an immediate response and cultivate lasting customer relationships.

Each category involves specific promotional tools used to communicate with customers. For example, advertising includes broadcast, print, Internet, outdoor, and other forms. Sales promotion includes discounts, coupons, displays, and demonstrations. Personal selling includes sales presentations, trade shows, and incentive programs. Public relations (PR) include press releases, sponsorships, special events, and Web pages. Lastly direct marketing includes catalogs, telephone marketing, kiosks, the Internet, mobile marketing, and more.

At the same time, marketing communication goes beyond these specific promotion tools. The product's design, its price, the shape and color of its package, and the stores that sell it all communicate something to buyers. Thus, although the promotion mix is the company's primary communications activity, the entire marketing mix—promotion and product, price, and place—must be coordinated for greatest impact (Kotler & Armstrong, 2012).

Today, more companies are adopting the concept of integrated marketing communications (IMC). Under this concept, as illustrated in **Figure 2.10**, the company carefully integrates its many communications channels to deliver a clear, consistent, and compelling message about the organization and its brands (Kotler & Armstrong, 2012).

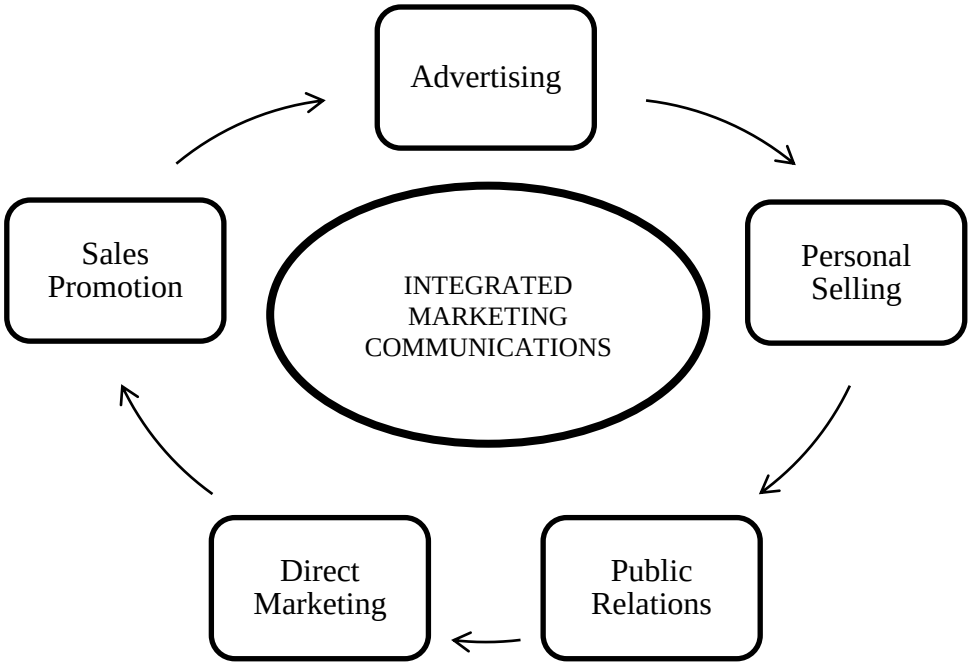

Figure 2.10 Integrated Marketing Communications

Integrated marketing communications calls for recognizing all touch-points where the customer may encounter the company and its brands. Each brand contact will deliver a message—whether good, bad, or indifferent. The company's goal should be to deliver a consistent and positive message to each contact. IMC leads to a total marketing communications strategy aimed at building strong customer relationships by showing how the company and its products can help customers solve their problems.

Integrated marketing communications ties together all of the company's messages and images. Its television and print ads have the same message, look, and feel as its e-mail and personal selling communications. And its PR materials project the same image as its Web site or social network presence. Often, different media play unique roles in attracting, informing, and persuading consumers; these roles must be carefully coordinated under the overall marketing communications plan (Kotler & Armstrong, 2012).

Since the promotion strategy of the marketing mix is heavily influenced by technological development, the control and monitoring, analyzing the feed-backs is significant. The role of promotional elements varies depending on the nature of the

product and the consumer behavior. This variability also occurs across stages in a product's life cycle as shown in **Table 2.5** (Ferrell & Hartline, 2011).

Table 2.5 Promotional Strategy over the Product Life Cycle

Introduction	Promotion depends on heavy advertising and public relations to build brand awareness and educate customers on the product's benefits. Personal selling ensures distribution coverage and supply chain cooperation. Consumer sales promotion stimulates product trial, while trade sales promotion facilitates or expedites distribution activities, especially in obtaining favorable shelf space or product display.
Growth	To sustain growth, firms spend heavily on advertising and public relations to build and maintain brand loyalty. Personal selling maintains distribution and supply chain cooperation. Sales promotion activities decline in importance.
Maturity	A firm's use of advertising shifts to emphasize reminding customers of the firm's products. Sales promotion efforts strongly encourage brand switching for both consumers and the trade. Personal selling remains important to ensure supply chain support and distribution coverage.
Decline	Firms begin to drastically reduce their advertising and public relations efforts in an attempt to reduce expenses. Sales promotion and personal selling drop to levels that are just sufficient enough to maintain product support.

Coordinating promotional elements within the context of the entire marketing program requires a complete understanding of the role, function, and benefits of each element. The advantages and disadvantages of each element must be carefully balanced against the promotional budget and the firm's IMC goals and objectives. To ensure a constant and synergistic message to targeted customers, the firm must ultimately decide how to weigh each promotional element in the overall IMC strategy (Ferrell & Hartline, 2011).

2.4.4 Place

The last P of the marketing mix, place, consists of distribution and supply chain management. Although these were the forgotten elements of marketing strategy throughout most of the twentieth century now they are among the most important strategic decisions for many companies. Distribution has remained essentially invisible to customers because the processes occur behind the scenes but now it ranks at the top

of the list in achieving a sustainable advantage and true differentiation in the marketplace. An appropriate distribution strategy can overcome some weaknesses in pricing, products, and promotion. However, a poor distribution strategy will kill a firm's efforts to market a product. Setting a distribution strategy is expensive; therefore, it must balance the needs of customers with the needs of the firm. "Place" of the marketing mix, consists of two interrelated components (Ferrell & Hartline, 2011):

- ***Marketing Channels:*** An organized system of marketing institutions through which products, resources, information, funds, and/or product ownership flow from the point of production to the final user. Some channel members or intermediaries physically take possession or title of products (e.g., wholesalers, distributors, retailers), whereas others simply facilitate the process (e.g., agents, brokers, financial institutions).
- ***Physical Distribution:*** Coordinating the flow of information and products among members of the channel to ensure the availability of products in the right places, in the right quantities, at the right times, and in a cost-efficient manner. Physical distribution (or logistics) includes activities such as customer service/order entry, administration, transportation, warehousing (storage and materials handling), inventory carrying, and the systems and equipment necessary for these activities.

The term *supply chain* expresses the connection and integration of all members of the marketing channel as shown in **Figure 2.11** (Poirier & Reiter, 1996).

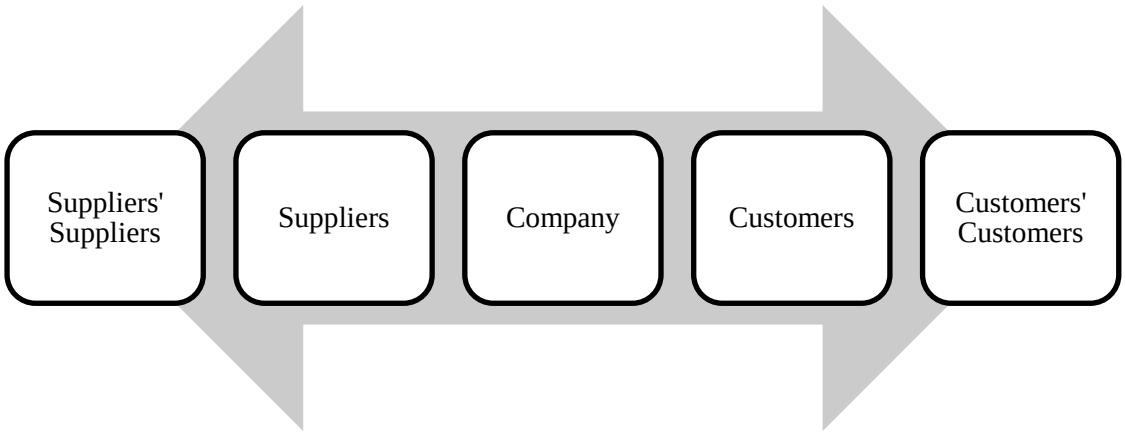

Figure 2.11 Graphical Depiction of a Supply Chain

A good distribution network creates a strong competitive advantage for an organization (Cravens, 2000). Like the other elements of the marketing mix, distribution strategy differs with PLC as shown in **Table 2.6**.

Table 2.6 Distribution Strategy over the Product Life Cycle

Introduction	Gradually roll out product to expand availability; get channel intermediaries on board
Growth	Intensify efforts to expand product reach and availability
Maturity	Extensive product availability; retain shelf space; phase out unprofitable outlets or channels
Decline	Maintain a level necessary to keep brand loyal customers; continue phasing out unprofitable channels

A concern for marketing channels of distribution refers to the institutional and logistical arrangements for delivering value to the customer. More precisely, marketing channels deal with the issue of the arrangements the organization makes to physically deliver its products to the customer. Marketing channels perform the function of accumulating products into assortments required by customers and ensuring that this assortment is delivered to the location desired at the time required and in the quantities demanded. Wholesalers and retailers play a key role in this process (Bradley, 2003).

3. METHODOLOGY

3.1 Basic Concepts

3.1.1 Linguistic and Fuzzy Notion

The classical MADM solution methods assume all values are crisp numbers. However, in reality, crisp data are insufficient to model real life-decision problems. The attributes could be quantitative and qualitative. The MADM problem contains a mixture of crisp, fuzzy and/or linguistic data. A linguistic variable is a variable whose values are linguistic terms (L. A. Zadeh, 1975). The concept of linguistic variable is very useful when dealing with situations which are too complex and/or not well defined to be reasonably described in conventional quantitative expressions (Zimmermann, 1991). In this methodology, linguistic variables are used to model human judgments, and these linguistic variables can be described by triangular fuzzy numbers, $\tilde{d} = (a_{ij}, b_{ij}, c_{ij})$ (Van Laarhoven & Pedrycz, 1983; L. Zadeh, 1965).

3.1.2 Basic Theory of Triangular Fuzzy Number

Fuzzy Number

A fuzzy number is a convex fuzzy set, characterized by a given interval of real numbers, each with a grade of membership between 0 and 1. There are several possible ways to represent fuzzy numbers. One special class of fuzzy numbers is triangular fuzzy number, which is relatively easy to model and works well with most applications. Triangular fuzzy numbers (TFN), are a special class of fuzzy number *M* on *R*, expressed as (a, b, c) and its membership function $\mu_M(x): R \rightarrow [0,1]$ is equal to

$$\mu_M(x) = \begin{cases} \frac{x-a}{b-a} & for\ x \in [a,b] \\ \frac{c-x}{c-b} & for\ x \in [b,c] \\ 0, & for\ x < a\ and\ x > c \end{cases} \quad (3.1)$$

where $a \leq b \leq c$, a and c are the lower and upper value of the support of M respectively, and b is the modal value which are often used to illustrate the fuzziness of the data evaluated.

Distance between two triangular fuzzy numbers

Let $\tilde{m} = (m_1, m_2, m_3)$ and $\tilde{n} = (n_1, n_2, n_3)$ be two triangular fuzzy numbers, then the vertex method is defined to calculate the distance between them as (Y. M. Wang & Parkan, 2005)

$$d(\tilde{m}, \tilde{n}) = \sqrt{\frac{1}{3}[(m_1 - n_1)^2 + (m_2 - n_2)^2 + (m_3 - n_3)^2]} \quad (3.2)$$

If both $\tilde{m}$ and $\tilde{n}$ are real numbers, then the distance measurement $d(\tilde{m}, \tilde{n})$ is identical to the Euclidean distance (Ross, 2004). Suppose that both $\tilde{m} = (m_1, m_2, m_3)$ and $\tilde{n} = (n_1, n_2, n_3)$ are two real numbers, then let $m_1 = m_2 = m_3 = m$ and $n_1 = n_2 = n_3 = n$. The distance measurement $d(\tilde{m}, \tilde{n})$ can be calculated as:

$$d(\tilde{m}, \tilde{n}) = \sqrt{\frac{1}{3}[(m_1 - n_1)^2 + (m_2 - n_2)^2 + (m_3 - n_3)^2]}$$

$$d(\tilde{m}, \tilde{n}) = \sqrt{\frac{1}{3}[(m - n)^2 + (m - n)^2 + (m - n)^2]}$$

$$d(\tilde{m}, \tilde{n}) = \sqrt{(m - n)}$$

$$d(\tilde{m}, \tilde{n}) = |m - n| \quad (3.3)$$

3.1.3 Multiple Attribute Group Decision Making (MAGDM) Problem Definition

In MADM problems, the decision maker's preference information is used to rank alternatives. In this study, a fuzzy linear programming technique (FLP) is proposed for multiple attribute group decision making (MAGDM) problems where the decision

maker (DM) gives his/her preference on alternatives in a fuzzy relation. The weights are estimated using the fuzzy linear programming model based on group consistency and inconsistency indices.

Consider a MADM problem with n alternatives A_i , $i = 1, 2, \dots, n$ and m decision attributes C_j , $j = 1, 2, \dots, m$. d_{ij}, component of a decision matrix denoted by $D = (d_{ij})_{n\times m}$, is the rating of alternative A_i with respect to attribute C_j. A MADM problem can be expressed as the following decision matrix:

$$D = \begin{array}{c} \\ A_1 \\ A_2 \\ \vdots \\ A_n \end{array} \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \cdots & C_m \end{array} \\ \begin{bmatrix} d_{11} & d_{12} & \cdots & d_{1m} \\ d_{21} & d_{22} & \cdots & d_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ d_{n1} & d_{n2} & \cdots & d_{nm} \end{bmatrix} \end{array}$$

Let $w = (w_1, w_2, \dots, w_m)^T$ be the vector of weights, where $\sum_{j=1}^{m} w_j = 1$, $w_j \geq 0$, $j = 1, 2, \dots, m$ and w_j denotes the weight of attribute C_j (Hwang et al., 1992).

Normalization

Suppose the rating of alternative $A_i (i = 1,2, \dots, n)$on attribute $C_j (j = 1,2, \dots, m)$ given by DM $P_p (p = 1,2, \dots, P)$ is $\tilde{d}_{ij}^p = (a_{ij}^p, b_{ij}^p, c_{ij}^p)$. A fuzzy multi-attribute group decision making problem can be expressed in matrix format as follows:

$$\widetilde{D}^p = (\tilde{d}_{ij}^p)_{n\times m} = \begin{array}{c} \\ A_1 \\ A_2 \\ \vdots \\ A_n \end{array} \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \cdots & C_m \end{array} \\ \begin{bmatrix} \tilde{d}_{11}^p & \tilde{d}_{12}^p & \cdots & \tilde{d}_{1m}^p \\ \tilde{d}_{21}^p & \tilde{d}_{22}^p & \cdots & \tilde{d}_{2m}^p \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{d}_{n1}^p & \tilde{d}_{n2}^p & \cdots & \tilde{d}_{nm}^p \end{bmatrix} \end{array} \quad p = 1,2, \dots, P \tag{3.4}$$

$\widetilde{D}^p$ is decision matrix for DM p.

$$a_j^{max} = max\{a_{ij}^p;\ a_{ij}^p \in \tilde{d}_{ij}^p = (a_{ij}^p, b_{ij}^p, c_{ij}^p), i = 1,2, \dots, n; p = 1,2, \dots, P\}$$
$$a_j^{min} = min\{a_{ij}^p;\ a_{ij}^p \in \tilde{d}_{ij}^p = (a_{ij}^p, b_{ij}^p, c_{ij}^p), i = 1,2, \dots, n; p = 1,2, \dots, P\} \tag{3.5}$$

$b_j^{max}, b_j^{min}, c_j^{max}, c_j^{min}$ have also same meaning. In MADM problems, there are benefit (B) and cost (C) attributes. Using the scale transformation, the various attributes scales are transformed into a comparable scale.

$$\tilde{y}_{ij}^p = \left\{\frac{a_{ij}^p}{c_j^{max}}, \frac{b_{ij}^p}{b_j^{max}}, \frac{c_{ij}^p}{a_j^{max}} \wedge 1\right\} \text{ for } j \in B \text{ and } \tilde{y}_{ij}^p = \left\{\frac{a_j^{min}}{c_{ij}^p}, \frac{b_j^{min}}{b_{ij}^p}, \frac{c_j^{min}}{a_{ij}^p} \wedge 1\right\} \text{ for } j \in C \quad (3.6)$$

The normalized fuzzy decision matrix denoted by $\tilde{Y}^p$ is obtained.

$$\tilde{Y}^p = (\tilde{y}_{ij}^p)_{n\times m} = \begin{array}{c} \\ A_1 \\ A_2 \\ \vdots \\ A_n \end{array} \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \cdots & C_m \end{array} \\ \begin{bmatrix} \tilde{y}_{11}^p & \tilde{y}_{12}^p & \cdots & \tilde{y}_{1m}^p \\ y_{21}^p & \tilde{y}_{22}^p & & \tilde{y}_{2m}^p \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{y}_{n1}^p & \tilde{y}_{n2}^p & \cdots & \tilde{y}_{nm}^p \end{bmatrix} \end{array} \quad p = 1,2,\dots,P \quad (3.7)$$

where $y_{ij}^p = (y_{ijL}^p, y_{ijM}^p, y_{ijR}^p)$ are normalized triangular fuzzy numbers and denote the location of the i^{th} alternative in the *m*-dimensional space (attributes).

3.2 Fuzzy Group LINMAP Model

The main focus of this study is to provide a linear programming model for multidimensional analysis of preferences (LINMAP). This study uses fuzzy LINMAP to model the problem of selecting, evaluating, or ranking alternatives that are characterized by multiple, usually conflicting, attributes. This study offers a methodology for analyzing individual and multidimensional preferences with linear programming approach in multi attribute group decision making under fuzzy environments (Hwang et al., 1992; Xia, Li, Zhou, & Wang, 2006). The LINMAP method is based on pairwise comparisons of alternatives given by decision makers and generates the best compromise alternative as the solution that has the shortest distance to the positive ideal solution (Srinivasan & Shocker, 1973).

3.2.1 Consistency and Inconsistency Indices

Let $\tilde{X}^* = (\tilde{x}_1^*, \tilde{x}_2^*, \dots, \tilde{x}_m^*)$ is the fuzzy positive ideal point, i.e., the alternative location most preferred by the individual, the square of the weighted Euclidean distance between $\tilde{Y}_i^p$ and $\tilde{X}^*$, where $\tilde{x}_j^* = (x_{jL}^*, x_{jM}^*, x_{jR}^*)$ are triangular fuzzy numbers, can be calculated as

$$d_i(\tilde{y}_{ij}^p, \tilde{x}_j^*) = \left[\frac{1}{3}\left[(y_{ijL}^p - x_{jL}^*)^2 + (y_{ijM}^p - x_{jM}^*)^2 + (y_{ijR}^p - x_{jR}^*)^2\right]\right]^{1/2} \text{ for } i \in A \qquad (3.8)$$

The squared distance $s_i = d_i^2$ is given by

$$S_i^p = \sum_{j=1}^m w_j\left[d(\tilde{y}_{ij}^p, \tilde{x}_j^*)\right]^2 \qquad (3.9)$$

S_i^p can be rewritten using triangular fuzzy numbers $\tilde{x}_j^*$ as (Fan, Hu, & Xiao, 2004; D. F. Li & Yang, 2004; Xia et al., 2006)

$$S_i^p = \frac{1}{3}\sum_{j=1}^m w_j\left[(y_{ijL}^p - x_{jL}^*)^2 + (y_{ijM}^p - x_{jM}^*)^2 + (y_{ijR}^p - x_{jR}^*)^2\right] \qquad (3.10)$$

Suppose that the DM $P_p (p = 1,2, \dots, P)$ gives the preference relations between alternatives by $\Omega^p = \{(k,l);\ A_k \rho_p A_l;\ k,l = 1,2, \dots, n\}$ where ρ_p is a preference relation given by the DM P_p.

$$S_k^p = \sum_{j=1}^m w_j\left[d(\tilde{y}_{kj}^p, \tilde{x}_j^*)\right]^2 \quad \text{and} \qquad (3.11)$$

$$S_l^p = \sum_{j=1}^m w_j\left[d(\tilde{y}_{lj}^p, \tilde{x}_j^*)\right]^2 \qquad (3.12)$$

are squared weighted Euclidean distances between each pair of alternative (k,l) and the fuzzy positive ideal solution ($\tilde{x}^*$). They are called group consistency and inconsistency measurements (Xia et al., 2006). For every ordered pair $(k,l) \in \Omega^p$, the solution would be consistent with the weighted distance model if $S_l^p \geq S_k^p$ and there is no error attributable to the solution (Srinivasan & Shocker, 1973). If $S_l^p < S_k^p$, $(S_k^p - S_l^p)$ gives

error. An index $(S_l^p - S_k^p)^-$ is defined to measure inconsistency between the ranking of alternatives and preferences, i.e., to denote the error of the pair (k, l);

$$(S_l^p - S_k^p)^- = 0 \quad \text{if} \quad S_l^p \geq S_k^p \quad \text{and} \quad (S_l^p - S_k^p)^- = S_k^p - S_l^p \quad \text{if} \quad S_l^p < S_k^p \tag{3.13}$$

Then the inconsistency index can be rewritten as,

$$(S_l^p - S_k^p)^- = max\{0, S_k^p - S_l^p\} \tag{3.14}$$

For all the pairs in Ω^p, the total inconsistency is

$$B^p = \sum_{(k,l)\in\Omega^p}(S_l^p - S_k^p)^- \tag{3.15}$$

and the total poorness of fit for the group is

$$B = \sum_{p=1}^{P} B^p = \sum_{p=1}^{P}\sum_{(k,l)\in\Omega^p}(S_l^p - S_k^p)^- \tag{3.16}$$

Our objective is to minimize the sum of errors for all pairs in Ω^p. Similarly, the total goodness of fit (G) for the group is

$$G = \sum_{p=1}^{P} G^p = \sum_{p=1}^{P}\sum_{(k,l)\in\Omega^p}(S_l^p - S_k^p)^+ \tag{3.17}$$

By definition of $(S_l^p - S_k^p)^+$ and$(S_l^p - S_k^p)^-$,

$$(S_l^p - S_k^p) = (S_l^p - S_k^p)^+ - (S_l^p - S_k^p)^- \tag{3.18}$$

Substituting for B and G from (16) and (17) in Eq. (19);

$$\sum_{(k,l)\in\Omega^p}\left(S_l^p - S_k^p\right)^+ - \sum_{(k,l)\in\Omega^p}\left(S_l^p - S_k^p\right)^-$$
$$= \sum_{(k,l)\in\Omega^p}(S_l^p - S_k^p) = G - B = h \tag{3.19}$$

h is an arbitrary positive number. The constraint imposes the condition that the goodness of fit *G* should be greater than the poorness of fit *B*.

3.2.2 Fuzzy LINMAP Model

The problem of finding the best solution $(w, \tilde{x}^*)$ reduces to finding the solution (w, v) (Crainic, Ricciardi, & Storchi, 2009) which maximizes Eq. (20) subject to the constraints (D. F. Li & Yang, 2004)
The following mathematical programming is constructed;

$$\text{Maximize } \left\{\sum_{p=1}^{P}\sum_{(k,l)\in\Omega^p} Z_{kl}^p\right\} \tag{3.20}$$

$$\text{s.t. } \begin{cases} G - B \geq h \\ S_k^p - S_l^p + Z_{kl}^p \geq 0,\ (k,l) \in \Omega^p,\ p = 1,2,\dots,P \\ \sum_{j=1}^{m} w_j = 1 \\ w_j \geq 0,\ j = 1,2,\dots,m \end{cases}$$

where h is strictly positive and $Z_{kl}^p = max\{0, (S_l^p - S_k^p)\}$ for each $(k,l) \in \Omega^p$ and with $Z_{kl}^p \geq 0$. Using equations (9), (10), (16) and (17), Eq. (20) can be rewritten as

$$\text{Maximize } \left\{\sum_{p=1}^{P}\sum_{(k,l)\in\Omega^p} Z_{kl}^p\right\}$$

subject to:

$$\frac{1}{3}\sum_{j=1}^{m} w_j \sum_{p=1}^{P}\sum_{(k,l)\in\Omega^p}\left[\left(y_{ljL}^{p^2} - y_{kjL}^{p^2}\right) + \left(y_{ljM}^{p^2} - y_{kjM}^{p^2}\right) + \left(y_{ljR}^{p^2} - y_{kjR}^{p^2}\right)\right]$$

$$-\frac{2}{3}\sum_{p=1}^{P}\left[\sum_{j=1}^{m} v_{jL}\sum_{(k,l)\in\Omega^p}(y_{ljL}^p - y_{kjL}^p) + \sum_{j=1}^{m} v_{jM}\sum_{(k,l)\in\Omega^p}(y_{ljM}^p - y_{kjM}^p)\right.$$

$$\left.+\sum_{j=1}^{m} v_{jR}\sum_{(k,l)\in\Omega^p}(y_{ljR}^p - y_{kjR}^p)\right] \geq h$$

$$\frac{1}{3}\sum_{j=1}^{m} w_j \left[\left(y_{kjL}^{p^2} - y_{ljL}^{p^2}\right) + \left(y_{kjM}^{p^2} - y_{ljM}^{p^2}\right) + \left(y_{kjR}^{p^2} - y_{ljR}^{p^2}\right)\right]$$

$$-\frac{2}{3}\sum_{p=1}^{P}\left[\sum_{j=1}^{m} v_{jL}\,(y_{kjL}^{p} - y_{ljL}^{p}) + \sum_{j=1}^{m} v_{jM}\,(y_{kjM}^{p} - y_{ljM}^{p}) + \sum_{j=1}^{m} v_{jR}\,(y_{kjR}^{p} - y_{ljR}^{p})\right] + Z_{kl}^{p} \geq 0, \quad (k,l) \in \Omega^{p}, \qquad p = 1,2,\dots,P$$

$$Z_{kl}^{p} \geq 0, \qquad (k,l) \in \Omega^{p}, \qquad p = 1,2,\dots,P$$

$$v_{jL}, v_{jM}, v_{jR} \geq 0, \quad j = 1,2,\dots,m$$

$$\sum_{j=1}^{m} w_j = 1$$

$$w_j \geq \varepsilon, \qquad j = 1,2,\dots,m$$

Using $= \{v_j\} = (w_j \tilde{x}_j^*)$, it is written as

$$v_{jL} = w_j \tilde{x}_{jL}^*, \qquad v_{jM} = w_j \tilde{x}_{jM}^* \text{ and } \qquad v_{jR} = w_j \tilde{x}_{jR}^* \tag{3.21}$$

By solving this linear programming problem in Eq. (20) using Simplex method, $w_j, v_{jL}, v_{jM}, v_{jR}$ can be obtained. The best values of $\tilde{x}_j^*$ are computed using Eq. (21)

3.3 Linear Programming Model for Multi-Attribute Group Decision Making (MAGDM) Using Intuitionistic Fuzzy Sets (IFSs)

3.3.1 Definition of Intuitionistic Fuzzy Sets (IFSs)

IFSs were first introduced by Krassimir T. Atanassov in 1986 and were developed in 1999 (Atanassov, 1986, 1999). The concept of an intuitionistic fuzzy set (IFS) can be viewed as an alternative approach to define a fuzzy set in cases where available information is not sufficient for the definition of an imprecise concept by means of a conventional fuzzy set (D. F. Li, 2005).

Let $X = \{x_1, x_2, \dots, x_n\}$ be a finite universal set. An IF set A in X is defined as: $A = \{\langle x_l, \mu_A(x_l), \upsilon_A(x_l)\rangle | x_l \in X\}$ with the functions;

$\mu_A : X \to [0,1]$

$x_l \in X \to \mu_A(x_l) \in [0,1]$

and

$\upsilon_A : X \to [0,1]$
$x_l \in X \to v_A(x_l) \in [0,1]$

define the degree of membership ($\mu_A(x_l)$) and the degree of non-membership ($\upsilon_A(x_l)$) of the element $x_l \in X$ to the set $A \subseteq X$ and for every $x_l \in X$, $0 \leq \mu_A(x_l) + \upsilon_A(x_l) \leq 1$.

$\pi_A(x_l) = 1 - \mu_A(x_l) - \upsilon_A(x_l)$ is Atanassov's intuitionistic fuzzy index, the degree of indeterminacy membership, of the element x_l in the set A and for every $x_j \in X$, $0 \leq \pi_A(x_l) \leq 1$.

3.3.2 Distance between IFSs

Distance between intuitionistic fuzzy sets was first introduced by Atanassov (Atanassov, 1999).

Let $A = \{\langle x_l, \mu_A(x_l), \upsilon_A(x_l)\rangle | x_l \in X\}$ and $B = \{\langle x_l, \mu_B(x_l), \upsilon_B(x_l)\rangle | x_l \in X\}$ be two IF sets in the set X. $\pi_A(x_l) = 1 - \mu_A(x_l) - \upsilon_A(x_l)$ and $\pi_B(x_l) = 1 - \mu_B(x_l) - \upsilon_B(x_l)$ are their IF indexes respectively.

An Euclidean distance between IF sets A and B is (Atanassov, 1999; Szmidt & Kacprzyk, 2001),

$$d(A,B) = \sqrt{\frac{1}{2}\sum_{l=1}^{n}[(\mu_A(x_l) - \mu_B(x_l))^2 + (\upsilon_A(x_l) - \upsilon_B(x_l))^2 + (\pi_A(x_l) - \pi_B(x_l))^2]} \quad (3.22)$$

3.3.3 MAGDM problems using IFSs

Atanassov's IF sets are used in MADM problems by (D. F. Li, 2008; D. F. Li et al., 2010) Assume that there is a group consisting of P decision makers who have to rank n alternatives A_i based on m attributes x_j. Let that $A = \{A_1, A_2, \dots, A_n\}$ is an alternative set comprised of n alternatives and $C = \{C_1, C_2, \dots, C_m\}$ be the set of m attributes. Suppose that μ_{ij} and υ_{ij} are the degree of membership and non-membership of the alternative $A_i \in A$ with respect to the attribute $C_j \in C$. The evaluation of the alternative $A_i \in A$ with respect to the attribute $C_j \in C$ is an IFS. The intuitionistic indices $\pi_{ij} = 1 - \mu_{ij} - \upsilon_{ij}$ are the hesitation quantity of the decision maker where $0 \leq \mu_{ij} + \upsilon_{ij} \leq 1$, $\mu_{ij} \in [0,1]$ and $\upsilon_{ij} \in [0,1]$ are the degree of satisfaction and the degree of non-satisfaction, respectively.

Let $D_i = (D_{i1}, D_{i2}, \dots, D_{im}) = (\langle \mu_{i1}, \upsilon_{i1} \rangle, \langle \mu_{i2}, \upsilon_{i2} \rangle, \dots, \langle \mu_{im}, \upsilon_{im} \rangle)$ be the vector of Atanassov's IFSs of all m attributes for alternative $A_i \in A$. Then the MAGDM problem is defined in the matrix format;

$$D^p = \left(\langle \mu_{ij}^p, \upsilon_{ij}^p \rangle\right)_{n \times m} = \begin{matrix} \\ A_1 \\ A_2 \\ \vdots \\ A_n \end{matrix} \begin{matrix} \begin{matrix} C_1 & C_2 & \dots & C_m \end{matrix} \\ \begin{pmatrix} \langle \mu_{11}^p, \upsilon_{11}^p \rangle & \langle \mu_{12}^p, \upsilon_{12}^p \rangle & \dots & \langle \mu_{1m}^p, \upsilon_{1m}^p \rangle \\ \langle \mu_{21}^p, \upsilon_{21}^p \rangle & \langle \mu_{22}^p, \upsilon_{22}^p \rangle & \cdots & \langle \mu_{2m}^p, \upsilon_{2m}^p \rangle \\ \vdots & \vdots & \vdots & \vdots \\ \langle \mu_{n1}^p, \upsilon_{n1}^p \rangle & \langle \mu_{n2}^p, \upsilon_{n2}^p \rangle & \cdots & \langle \mu_{nm}^p, \upsilon_{nm}^p \rangle \end{pmatrix} \end{matrix}$$

D^p is an Atanassov's IF decision matrix for decision maker p and is used to represent the MAGDM problem under Atanassov's IF environment (D. F. Li, 2008; D. F. Li et al., 2010). If ω_j is the weight of each attribute $C_j \in C$, where $0 \leq \omega_j \leq 1$ and $\sum_{j=1}^{m} \omega_j = 1$, the vector of weights $\omega = (\omega_1, \omega_2, \dots, \omega_m)^T$ is unknown a priori and needs to be determined (D. F. Li, 2008).

3.3.4. Consistency and Inconsistency Measurements

Let $D_i = (D_{i1}, D_{i2}, \dots, D_{im}) = (\langle \mu_{i1}, \upsilon_{i1} \rangle, \langle \mu_{i2}, \upsilon_{i2} \rangle, \dots, \langle \mu_{im}, \upsilon_{im} \rangle)$ be the vector of Atanassov's IFSs of all m attributes for alternative $A_i \in A$ $(i = 1,2, \dots, n)$ where $D_{ij} = \langle \mu_{ij}, \upsilon_{ij} \rangle$ $(i = 1,2, \dots, n\ ;\ j = 1,2, \dots, m)$ is an Atanassov's IFS. Let A^+ be an

Atanassov's IF positive ideal solution (IFPIS) represented by an IF set $A^+ = (\langle \mu_1^+, \upsilon_1^+ \rangle, \langle \mu_2^+, \upsilon_2^+ \rangle, \ , \langle \mu_m^+, \upsilon_m^+ \rangle)$. It is unknown a priori and needs to be determined, where $A_j^+ = \{\langle \mu_j^+, \upsilon_j^+ \rangle\} = \{\langle x_j, \mu_j^+, \upsilon_j^+ \rangle\}$ $(j = 1,2, \dots, m)$ is an Atanassov's IF set on attribute C_j.

Using Eq.(22), the square of the weighted Euclidean distance between the alternative A_i and the IFPIS A^+ can be calculated as

$$S_i^p = \sum_{j=1}^{m} \omega_j \left[d\left(D_{ij}^p, A_j^+\right) \right]^2 = \frac{1}{2} \sum_{j=1}^{m} \omega_j \left[\left(\mu_{ij}^p - \mu_j^+\right)^2 + \left(\upsilon_{ij}^p - \upsilon_j^+\right)^2 + \left(\pi_{ij}^p - \pi_j^+\right)^2 \right] \tag{3.23}$$

where $\omega = (\omega_1, \omega_2, \dots, \omega_m)^T$ is the weight vector which is unknown a priori and

$$\pi_{ij}^p = 1 - \mu_{ij}^p - \upsilon_{ij}^p, \ \ \pi_j^+ = 1 - \mu_j^+ - \upsilon_j^+ \tag{3.24}$$

Assume that the decision maker gives her/his preferences between alternatives by $\Omega = \{(k,l) | A_k P A_l, (k,l = 1,2, \dots, n)\}$ from his/her knowledge and experience, where the symbol "ρ" is a preference relation given by the decision maker.

If the weight vector $\omega = (\omega_1, \omega_2, \dots, \omega_m)^T$ and the Atanassov's IFPIS $A^+ = (\langle \mu_1^+, \upsilon_1^+ \rangle, \langle \mu_2^+, \upsilon_2^+ \rangle, \ , \langle \mu_m^+, \upsilon_m^+ \rangle)$ are chosen by the decision maker, using Eq.(25) the decision maker can calculate the squares of the weighted Euclidean distance between each pair of alternative $(k,l) \in \Omega$ and the Atanassov's IFPIS as follows (D. F. Li, 2008)

$$S_k^p = \sum_{j=1}^{m} \omega_j \left[d\left(D_{kj}^p, A_j^+\right) \right]^2 \text{ and } \ S_l^p = \sum_{j=1}^{m} \omega_j \left[d\left(D_{lj}^p, A_j^+\right) \right]^2$$

The alternative A_k is closer to the Atanassov's IFPIS than the alternative A_l if $S_l^p \geq S_k^p$. So the ranking order of alternatives A_k and A_l is determined by S_l^p and S_k^p based on

(ω, A^+) which must be consistent with the preference given by the decision maker. (ω, A^+) should be properly chosen for consistency of the ranking order of alternatives A_k and A_l determined by S_l^p and S_k^p, and the preference provided by the decision maker (D. F. Li, 2008).

To measure inconsistency between the ranking order of alternatives A_k and A_l, an index $\left(S_l^p - S_k^p\right)^-$ is defined as follows (D. F. Li, 2008)

$$\left(S_l^p - S_k^p\right)^- = \begin{cases} S_k^p - S_l^p & (S_l^p < S_k^p) \\ 0 & (S_l^p \geq S_k^p) \end{cases} = \max\left(0, S_k^p - S_l^p\right) \tag{3.25}$$

The ranking order of alternatives A_k and A_l is consistent with the preference given by the decision maker if $S_l^p \geq S_k^p$. Hence, $\left(S_l^p - S_k^p\right)^-$is defined to be 0. On the other hand, the ranking order of alternatives A_k and A_l is inconsistent with the preferences given by the decision maker if $S_l^p < S_k^p$. (D. F. Li, 2008).

A total inconsistency index of the decision maker p is defined as

$$B^p = \sum_{(k,l)\in\Omega^p}\left(S_l^p - S_k^p\right)^- = \sum_{(k,l)\in\Omega^p} \max\left(0, S_k^p - S_l^p\right) \tag{3.26}$$

An index $\left(S_l^p - S_k^p\right)^+$ to measure consistency between the ranking order alternatives A_k and A_l is consistent with the preferences given by the decision maker preferring A_k to A_l can be defined as follows (D. F. Li, 2008)

$$\left(S_l^p - S_k^p\right)^+ = \begin{cases} S_l^p - S_k^p & (S_l^p \geq S_k^p) \\ 0 & (S_l^p < S_k^p) \end{cases} = \max\left(0, S_l^p - S_k^p\right) \tag{3.27}$$

Hence, a total consistency index of the decision maker p is defined as

$$G^p = \sum_{(k,l)\in\Omega^p}\left(S_l^p - S_k^p\right)^+ = \sum_{(k,l)\in\Omega^p} \max\left(0, S_l^p - S_k^p\right) \tag{3.28}$$

The total inconsistency and consistency indices *B* and *G* are all IFSs. The DM's gives their preferences through pair-wise comparisons of alternatives with hesitancy degrees. Whereas, the inconsistency and consistency indices defined in the classical LINMAP (Srinivasan & Shocker, 1973), fuzzy LINMAP (D. F. Li & Sun, 2007; D. F. Li & Yang, 2004; Xia et al., 2006), and LINMAP under IF environments (D. F. Li, 2008; D. F. Li et al., 2010) are real numbers.

3.3.5 LINMAP Model for MAGDM Using IFSs

Maximize $\left\{\sum_{p=1}^{P}\sum_{(k,l)\in\Omega^p} Z_{kl}^{p}\right\}$ (3.29)

subject to:

$$\sum_{j=1}^{m}\omega_j\sum_{p=1}^{P}\sum_{(k,l)\in\Omega^p}\left[\left(\mu_{lj}^{p^2}-\mu_{kj}^{p^2}\right)+\left(v_{lj}^{p^2}-v_{kj}^{p^2}\right)+\left(\pi_{lj}^{p^2}-\pi_{kj}^{p^2}\right)+2\left(\mu_{lj}^{p}-\mu_{kj}^{p}\right)\right.$$

$$\left.+2\left(v_{lj}^{p}-v_{kj}^{p}\right)\right]-\sum_{j=1}^{m}u_j\sum_{p=1}^{P}\sum_{(k,l)\in\Omega^p}\left[4\left(\mu_{lj}^{p}-\mu_{kj}^{p}\right)+2\left(v_{lj}^{p}-v_{kj}^{p}\right)\right]$$

$$-\sum_{j=1}^{m}v_j\sum_{p=1}^{P}\sum_{(k,l)\in\Omega^p}\left[2\left(\mu_{lj}^{p}-\mu_{kj}^{p}\right)+4\left(v_{lj}^{p}-v_{kj}^{p}\right)\right]\geq 2h$$

$$\sum_{j=1}^{m}\omega_j\left[\left(\mu_{kj}^{p^2}-\mu_{lj}^{p^2}\right)+\left(v_{kj}^{p^2}-v_{lj}^{p^2}\right)+\left(\pi_{kj}^{p^2}-\pi_{lj}^{p^2}\right)+2\left(\mu_{kj}^{p}-\mu_{lj}^{p}\right)+2\left(v_{kj}^{p}-v_{lj}^{p}\right)\right]$$

$$-\sum_{j=1}^{m}u_j\left[4\left(\mu_{kj}^{p}-\mu_{lj}^{p}\right)+2\left(v_{kj}^{p}-v_{lj}^{p}\right)\right]$$

$$-\sum_{j=1}^{m}v_j\left[2\left(\mu_{kj}^{p}-\mu_{lj}^{p}\right)+4\left(v_{kj}^{p}-v_{lj}^{p}\right)\right]+2\,Z_{kl}^{p}\geq 0\ (k,l)\in\Omega^p;p$$

$$=1,2,\dots,P$$

$Z_{kl}^{p}\geq 0,\ (k,l)\in\Omega^p;p=1,2,\dots,P$

$u_j\geq 0, v_j\geq 0,\quad j=1,2,\dots,m$

$u_j+\ v_j\leq\omega_j,\quad j=1,2,\dots,m$

$\sum_{j=1}^{m}\omega_j=1$

$\omega_j\geq\varepsilon,\quad j=1,2,\dots,m$

where $\begin{cases}u_j=\omega_j\mu_j^*\\ v_j=\omega_j v_j^*\end{cases}$ (3.30)

When the problem is solved, the best values of $\langle\mu_j^*,v_j^*\rangle$ are calculated using Eq. (30)

4. PROPOSED MODEL

The aim of the model is to evaluate pricing strategies and select the best pricing strategy solution while considering internal and external factors influencing the company's pricing decisions associated with new product development.

4.1 Alternatives of the Model

Many internal and external factors influence pricing decisions, including the nature of the market, economic conditions, the company's overall marketing strategy, objectives, and marketing mix, as well as organizational considerations. Price is only one element of the company's broader marketing strategy. If the company has selected its target market and positioning carefully, then its marketing mix strategy, including price, will be fairly straightforward (Kotler & Armstrong, 2012). The price creates a positioning in customers' minds. Setting an initial price for a new product is vital for the success of this product. Therefore, the purpose of the model proposed in this study is to select the best pricing strategy for the company in NPD process.

Therefore the alternatives of the model are the base pricing strategies classified by Ferrell & Hartline (Ferrell & Hartline, 2011) as broadly defined in section **2.4.2**:

- ***Price Skimming:*** Setting a high price relative to the competition, thereby skimming the profits off the top of the market.
- ***Prestige Pricing:*** Set the prices at the top end of all competing products in a category to indicate a higher quality.
- ***Value-Based Pricing:*** Setting reasonably low prices but still offer high-quality products and adequate customer services.
- ***Competitive Matching:*** Setting the prices by focusing on matching competitors' prices and price changes.

- ***Penetration Pricing:*** Setting relatively low prices to maximize sales, gain widespread market acceptance, and capture a large market share quickly.

4.2 Attributes of the Model

The attributes of the model are the strategic marketing criteria influencing the pricing strategy selection process. Since the model aims to find the best pricing strategy, the criteria must be defined with a marketing perspective.

The criteria that affect marketing strategy are classified under six main headings: ***Innovation, Manufacturing / Operations, Management, Market, Consumer*** and ***Product*** as shown in **Figure 4.1**.

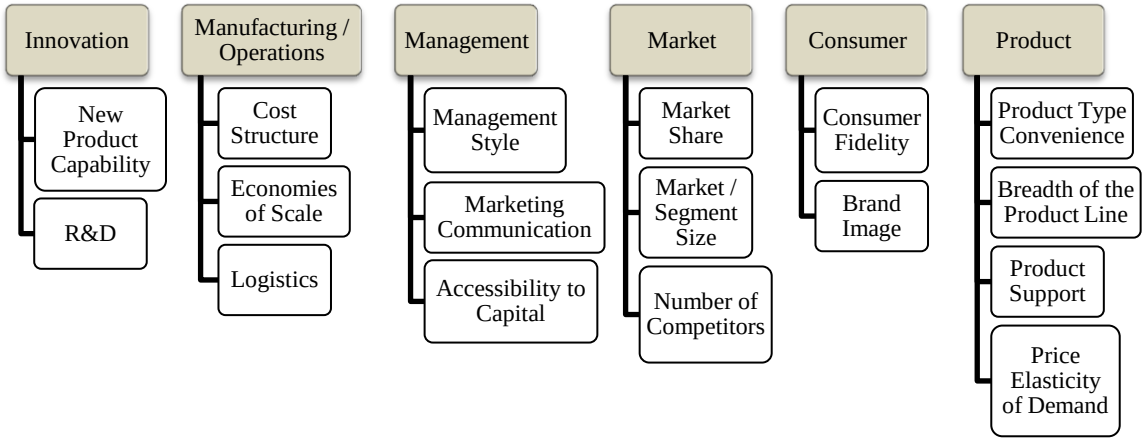

Figure 4.1 Strategic Marketing Criteria

Innovation is the first criterion. The word innovation is derived from the Latin word "innovare", which means to renew or change. Nowadays it represents the new product development (NPD) process and Research and Development (R&D) operations for the companies. One of the strengths of a company is its ability to develop innovative products that have distinct technological advantage. The percentage spent on R&D, the outputs of the process in terms of product characteristics/differentiation and performance capabilities (technologies), new products, product modifications, and patents provide more definitive measures of the company's ability to innovate (Aaker & McLoughlin, 2010). Technology through the activities in the value-added chain has the

goal of developing final products to consumers (Khalil, 2000). NPD is the result of innovation (Feldman, 1994). Successful NPDs need an innovative environment and are critical to the success of a firm (H. H. Chen et al., 2006). According to these definitions, ***New Product Capability*** and ***R&D*** criteria will represent the innovation criterion in the model.

Second criterion, Manufacturing / Operations, consists of the production processes and other operations (logistics, outsourcing etc.) of the company except managerial activities. Capacity, flexibility, efficiency, effectiveness of the operations and cost structure are included in this criterion. Offering many different product lines can create economies of scale in production, bulk buying, and promotion (Ferrell & Hartline, 2011). A company's costs take two forms; fixed costs that do not vary with production or sales level, and variable costs that vary directly with the level of production. Total costs are the sum of fixed and variable costs for any given production level (Kotler & Armstrong, 2012). Since the marketing of a product should start with the production of this product, Manufacturing / Operations criterion is important for the marketing strategy. Marketing and manufacturing integration in each stage of product development is respectively associated with greater product competitive advantage, which in turn is associated with higher project return on investment (Swink & Song, 2007). Marketing and manufacturing harmony matters significantly to business outcomes directly and indirectly (Hausman, Montgomery, & Roth, 2002). ***Cost Structure, Economies of Scale*** and ***Logistics*** criteria will represent this criterion in the model. These criteria are defined in **Table 4.1**.

Management criterion consists of quality of top and middle management, knowledge of business, culture, strategic goals and plans, entrepreneurial thrust, planning / operation system, loyalty / turnover, quality of strategic decision making (Aaker & McLoughlin, 2010). Communication with the consumers and financial resources are also included in management criterion. There are three management methods in the literature: Management by Instructions (MBI), Management by Objectives (MBO) and Management by Values (MBV) (Ji & Zhou, 2004). MBI is based on the hierarchically arranged control of the employees (Taylor, 1911). MBO is based on two principles: one is the division of the company in semi-autonomous centers of management (divisions,

departments, services, offices, groups), the other is the determination of the objectives to be reached (Drucker, 1954). MBV is to direct an organization by using its capital axiology (the total of all the intangible values accumulated by the company throughout time) the most effectively possible. In today's conditions, MBO and MBI management styles give inadequate results; on the other hand MBV is emerging as a strategic leadership tool of tremendous potential for practical development. (Dolan & Garcia, 2002). Consequently the management criterion will be represented by ***Management Style, Marketing Communications*** and ***Accessibility to Capital*** criteria in the model.

Market criterion is related to the market that the company serves. Markets are rarely simple; they are complex consisting of a variety of buyers with disparate motives, backgrounds all leading to different needs and wants. Markets also have disparate macro-environment factors affecting them; different levels and types of competition and several other factors also mean that markets are rarely homogenous (Whalley, 2010). Therefore companies make segmentation of the market and choose one or more of these segments to serve. The size and other specifications of the segment served play an important role for the marketing strategy. The market structure is equally significant. The interrelated issue of the number of sellers and their relative market shares has long been the focus of analysis by economists, who have typically categorized an industry in terms of five types: **An absolute monopoly**, in which, because of patents, licenses, scale economics or some other factor, only one firm provides the product or service, **a differentiated oligopoly**, where a few firms produce products that are partially differentiated, **a pure oligopoly**, in which a few firms produce broadly the same commodity, **monopolistic competition**, in which the industry has many firms offering a differentiated product or service and **pure competition**, in which numerous firms offer broadly the same product or service (Wilson & Gilligan, 2005). Hence the ***Market Share, Market / Segment Size*** and ***Number of Competitors*** criteria will represent the market criterion in the model.

Consumer criterion represents the company's potential customers who compose the company's target market/segment. Creating a strong, tight connection to customers is the dream of any marketer and often the key to long-term marketing success (Kotler & Keller, 2012). Loyal consumers of a product procure a successful mature stage in this

product's life cycle. Therefore, marketing strategists need to understand what criteria consumers use to evaluate their products and services and how consumers create a brand image. If it is discovered that a product or service does not meet with consumer's expectations then the marketer can change the product so that it fits with consumer expectations, change people's beliefs about the product or service or move the consumer's perception of what comprises an ideal product more in the direction of the existing brand's profile of attributes (Proctor, 2000). Accordingly, consumer criterion will be represented by ***Consumer Fidelity*** and ***Brand Image*** criteria in the model.

Product criterion, one of the 4P's, is already defined in section **2.4.1** and will be represented in the model by ***Product Type Convenience, Breadth of the Product Line, Product Support*** and ***Price Elasticity of the Demand*** criteria which are defined in **Table 4.1**.

Table 4.1 Definitions of Strategic Marketing Criteria

Criterion	*Definition*	*Reference*
New Product Capability	The company's ability to develop innovative products	(Aaker & McLoughlin, 2010)
R&D	The company's technological advantage, patents and technical capabilities	(Aaker & McLoughlin, 2010)
Cost Structure	The proportion of fixed costs in the total costs for any given level of production for the company	(Kotler & Armstrong, 2012)
Economies of Scale	The cost advantages that an enterprise obtains due to expansion	(Stigler, 1958)
Logistics	The company's strength of planning, implementing, and controlling the physical flow of materials, final goods, and related information from points of origin to points of consumption to meet customer requirements at a profit	(Kotler & Armstrong, 2012)
Management Style	The suitability of the company's management method to MBV	(Dolan & Garcia, 2002)
Marketing Communication	The promotions that the company uses to persuasively communicate customer value and build customer relationships	(Kotler & Armstrong, 2012)
Accessibility to Capital	The company's financial resources and the quickness to find the capital	(Aaker & McLoughlin, 2010)
Market Share	Market share is the percentage of a market (defined in terms of either units or revenue) accounted for by a specific entity	(Davies & Geroski, 1997)
Market / Segment Size	The number of consumers in the company's target market	(Ferrell & Hartline, 2011)
Number of Competitors	The number of sellers, their relative market shares, and the degree of differentiation that exists between the competing companies and products for a market	(Wilson & Gilligan, 2005)
Consumer Fidelity	Loyalty of consumers to the products of a company in a long period of time	(Kotler & Keller, 2012)
Brand Image	The beliefs about products that the consumers develop with respect to their various attributes	(Proctor, 2000)
Product Type Convenience	The convenience of the product type (mass or special) to the market structure (low or high differentiation) and to the company's financial resources (low or high)	(Kotler & Armstrong, 2012)
Breadth of the Product Line	Systems capability, the diversity of the product line of a company	(Aaker & McLoughlin, 2010)
Product Support	A part of the augmented product, support service for the use of the product, an important part of the consumers' overall brand experience	(Kotler & Armstrong, 2012)
Price Elasticity of Demand	The percentage change in quantity demanded in response to a one percent change in price, the responsiveness, or elasticity, of the quantity demanded of a good or service to a change in its price	(Marshall, 1997)

5. APPLICATION

5.1 General Information

In order to evaluate the first application of the model, a technological device manufacturer company has been chosen. This company produces personal computers (PC's), laptops, tablet PC's, smart phones, portable media players and all accessorizes of these products with a wide range and has an important market share around the world. Therefore company has an edge on the financial resources and is able to spare an elevated budget for the R&D expenses. These conditions provide high capability of new products and effective new product development processes for the company. Since its foundation, this company uses the Blue Ocean Strategy as its general marketing strategy and has a sufficient marketing communication with the customers. Blue Ocean Strategy suggests that an organization should create new demand in an uncontested market space, or a "Blue Ocean", rather than compete head-to-head with other suppliers in an existing industry (Kim & Mauborgne, 2005). As a result, the size of the target market is not mountant but since the fidelity of customers is extraordinary because of the reliable brand image and the competitors are eliminated using blue ocean strategy, the demand of the products of this company is considerably high. The company is advantageous about the economies of scale, fixed costs are minimized and logistics network is well-supported.

Launching of a new laptop of this company is selected for the application. With a marketing insight, this is a specialty product; which is unique, one-of-a-kind product that consumers will spend considerable time, effort, and money to acquire (Ferrell & Hartline, 2011). The product's type is convenient with the target market and the product line of this product has a broad range. This is not a new-to-the-world laptop however it has a faster micro-processor than the other laptops which belong to the same product line. Product support of this new laptop is absolutely sufficient because the

company provides an attentive product support for all the products. Lastly, the price elasticity of demand for this product is very low because the brand matters for customers.

The attributes of the model are the strategic marketing criteria which are already explained in Chapter 4. Three decision makers, chosen by the company from the marketing department, will evaluate the alternatives for these attributes and will give their preference relations. Since this company is one of the market leaders, the last two pricing strategies are eliminated by the decision makers. Pricing strategy must be appropriate to the company's overall marketing strategy. Penetration pricing and competitive matching strategies cannot be used in blue ocean strategy. Hence, in this application, the model has three alternatives: Value-Based Pricing, Price Skimming, and Prestige Pricing. Briefly in the application, the model has 17 attributes and 3 alternatives, as shown in **Figure 5.1**, which will be evaluated by 3 decision makers.

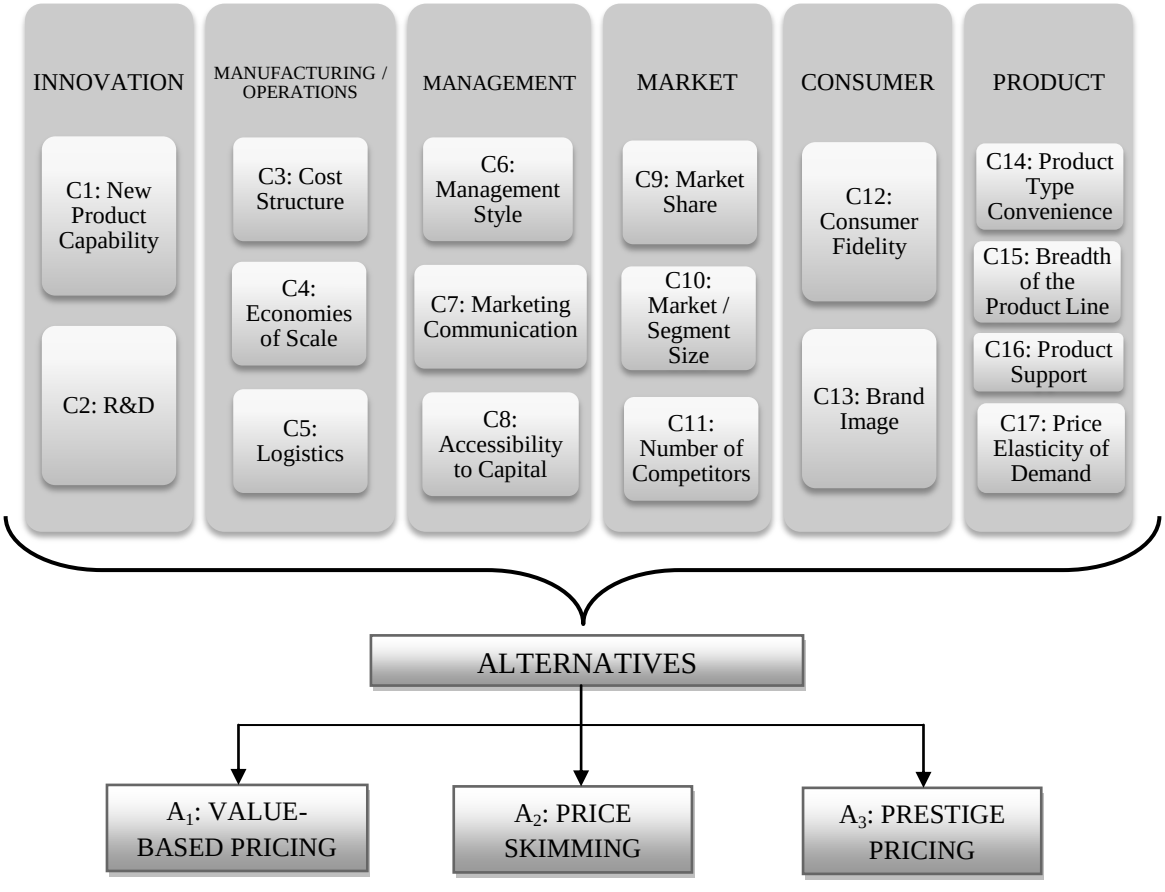

Figure 5.1 The Attributes and the Alternatives of the Model

5.2 Step by Step Procedure Using Fuzzy LINMAP

The main focus of this part is to provide a fuzzy LINMAP application. The proposed method is currently applied to evaluate marketing strategies and select the best pricing strategy while considering the preferences of several decision makers. The computational procedure is summarized as follows:

Step1: The experts, the company's marketing department managers, identify the evaluation attributes.

Step2: The experts, $P_p(p = 1,2,3)$ give their preference judgments between alternatives with paired comparisons as $\Omega_1 = \{(2,1),(1,3)\}$, $\Omega_2 = \{(2,3),(1,3)\}$, $\Omega_3 = \{(2,1)\}$. Here (2,1) stands for 2 is preferred to 1 and (1,3) denotes 1 is preferred to 3.

Step 3: The experts use the linguistic variables (shown in **Table 5.1**) to evaluate the rating of alternatives with respect to each attribute.

Table 5.1 Ratings for the Linguistic Variables

Very Poor (VP)	(0, 0.1, 0.3)
Poor (P)	(0.2, 0.3, 0,4)
Fair (F)	(0.4, 0.5, 0.6)
Good (G)	(0.6, 0.7, 0.8)
Very Good (VG)	(0.8, 0.9, 1.0)

Step 4: Obtain the data and ratings of all alternatives $A_i(i = 1,2,3)$ on every attribute $C_j(j = 1,2,\dots,17)$ given by three experts $P_p(p = 1,2,3)$ as in **Table 5.2**.

Table 5.2 Decision Information and Ratings of the Three Alternatives

Heading	Criterion	Alternatives	Decision Makers		
			P_1	P_2	P_3
Innovation	C_1: New Product Development	A_1	VG	VG	G
		A_2	G	F	G
		A_3	G	G	F
	C_2: R&D	A_1	VG	VG	VG
		A_2	F	P	F
		A_3	G	F	G
Manufacturing / Operations	C_3: Cost Structure	A_1	G	G	VG
		A_2	G	F	G
		A_3	VP	P	P
	C_4: Economies of Scale	A_1	F	P	F
		A_2	F	F	G
		A_3	VG	G	VG
	C_5: Logistics	A_1	P	VP	VP
		A_2	F	F	F
		A_3	G	VG	G
Management	C_6: Management Style	A_1	G	VG	G
		A_2	VG	VG	VG
		A_3	F	G	G
	C_7: Marketing Communication	A_1	G	G	G
		A_2	G	F	F
		A_3	G	VG	G
	C_8: Accessibility to Capital	A_1	VG	G	VG
		A_2	G	VG	G
		A_3	F	F	G
Market	C_9: Market Share	A_1	VG	VG	VG
		A_2	P	F	P
		A_3	G	F	F
	C_{10}: Market / Segment Size	A_1	G	F	G
		A_2	P	P	F
		A_3	G	VG	VG
	C_{11}: Number of Competitors	A_1	VP	VP	VP
		A_2	F	P	F
		A_3	G	VG	G
Consumer	C_{12}: Consumer Fidelity	A_1	VG	VG	VG
		A_2	G	VG	VG
		A_3	G	G	G
	C_{13}: Brand Image	A_1	VG	G	VG
		A_2	VG	VG	VG
		A_3	G	F	G
Product	C_{14}: Product Type Convenience	A_1	F	P	P
		A_2	G	F	F
		A_3	VG	G	VG
	C_{15}: Breadth of the Product Line	A_1	VP	VP	P
		A_2	P	VP	P
		A_3	G	G	VG
	C_{16}: Product Support	A_1	G	G	F
		A_2	VG	G	VG
		A_3	P	P	VP
	C_{17}: Price Elasticity of Demand	A_1	VP	VP	VP
		A_2	P	VP	P
		A_3	F	G	F

Step 5: Construct the fuzzy decision matrices (**Table 5.3**) and normalized fuzzy decision matrices (**Table 5.4**) for each expert. **Table 5.3** and **Table 5.4** are for the expert P_1. In the same vein, construct the matrices $\widetilde{D}^P$ and $\tilde{Y}^P$ for the experts P_2 and P_3. These matrices are given in APPENDIX A.

Table 5.3 Fuzzy Decision Matrix for Expert P_1 ($\widetilde{D}^1$)

	X1			X2			X3			X4			X5			X6		
A1	0.8	0.9	1	0.8	0.9	1	0.6	0.7	0.8	0.4	0.5	0.6	0.2	0.3	0.4	0.6	0.7	0.8
A2	0.6	0.7	0.8	0.4	0.5	0.6	0.6	0.7	0.8	0.4	0.5	0.6	0.4	0.5	0.6	0.8	0.9	1
A3	0.6	0.7	0.8	0.6	0.7	0.8	0	0.1	0.3	0.8	0.9	1	0.6	0.7	0.8	0.4	0.5	0.6

	X7			X8			X9			X10			X11			X12		
A1	0.6	0.7	0.8	0.8	0.9	1	0.8	0.9	1	0.6	0.7	0.8	0	0.1	0.3	0.8	0.9	1
A2	0.6	0.7	0.8	0.6	0.7	0.8	0.2	0.3	0.4	0.2	0.3	0.4	0.4	0.5	0.6	0.6	0.7	0.8
A3	0.6	0.7	0.8	0.4	0.5	0.6	0.6	0.7	0.8	0.6	0.7	0.8	0.6	0.7	0.8	0.6	0.7	0.8

	X13			X14			X15			X16			X17		
A1	0.8	0.9	1	0.4	0.5	0.6	0	0.1	0.3	0.6	0.7	0.8	0	0.1	0.3
A2	0.8	0.9	1	0.6	0.7	0.8	0.2	0.3	0.4	0.8	0.9	1	0.2	0.3	0.4
A3	0.6	0.7	0.8	0.8	0.9	1	0.6	0.7	0.8	0.2	0.3	0.4	0.4	0.5	0.6

Table 5.4 Normalized Fuzzy Decision Matrix for Expert P_1 ($\widetilde{Y}^1$)

	X1			X2			X3			X4			X5			X6		
A1	0.8	1	1	0.8	1	1	0.8	1	1	0.4	0.6	0.8	0.3	0.4	0.7	0.6	0.8	1
A2	0.6	0.8	1	0.4	0.6	0.8	0.8	1	1	0.4	0.6	0.8	0.5	0.7	1	0.8	1	1
A3	0.6	0.8	1	0.6	0.8	1	0	0.1	0.5	0.8	1	1	0.8	1	1	0.4	0.6	0.8

	X7			X8			X9			X10			X11			X12		
A1	0.8	1	1	0.8	1	1	0.8	1	1	0.8	1	1	0	0.1	0.5	0.8	1	1
A2	0.8	1	1	0.6	0.8	1	0.2	0.3	0.5	0.3	0.4	1	0.5	0.7	1	0.6	0.8	1
A3	0.8	1	1	0.4	0.6	0.8	0.6	0.8	1	0.8	1	1	0.8	1	1	0.6	0.8	1

	X13			X14			X15			X16			X17		
A1	0.8	1	1	0.4	0.6	0.8	0	0.1	0.5	0.6	0.8	1	0	0.2	0.8
A2	0.8	1	1	0.6	0.8	1	0.3	0.4	0.7	0.8	1	1	0.3	0.6	1
A3	0.6	0.8	1	0.8	1	1	0.8	1	1	0.2	0.3	0.5	0.7	1	1

Step 6: Construct the linear programming model in Eq. (20)

Maximize $z_{21}^{1} + z_{13}^{1} + z_{23}^{2} + z_{13}^{2} + z_{21}^{3}$

subject to

-0.09w1 - 0.52w2 + 1.51w3 + 1.12w4 + 1.14w5 + 1.21w6 - 1.03w7 + 0.93w8 - 0.74w9 -2.03w10 - 1.35w11 +0.45w12 + 1.07w13 - 0.90w14 - 2.15w15 - 2.53w16 - 1.57w17 - 0.01v1L + 0.00v1M + 0.17v1R + 0.27v2L + 0.30v2M + 0.33v2R - 0.87v3L - 0.99v3M - 0.77v3R + 0.63v4L + 0.72v4M + 0.22v4R + 0.63v5L + 0.70v5M + 0.25v5R - 0.67v6L - 0.73v6M - 0.17v6R + 0.57v7L + 0.63v7M + 0.17v7R - 0.40v8L - 0.44v8M - 0.50v8R + 0.40v9L + 0.45v9M + 0.50v9R + 1.13v10L + 1.27v10M + 0.67v10R + 0.77v11L + 0.85v11M + 0.42v11R - 0.27v12L - 0.29v12M + 0.00v12R - 0.53v13L - 0.59v13M - 0.33v13R + 0.50v14L + 0.57v14M + 0.05v14R + 1.33v15L + 1.53v15M + 0.89v15R - 1.33v16L - 1.50v16M - 0.94v16R + 1.01v17L + 1.15v17M + 0.50v17R $\leq$ - 1

0.22w1 + 0.53w2 + 0.00w3 + 0.00w4 - 0.35w5 - 0.22w6 + 0.00w7 + 0.22w8 + 0.75w9 + 0.44w10 - 0.49w11 + 0.22w12 + 0.00w13 - 0.31w14 - 0.14w15 - 0.22w16 - 0.29w17 - 0.13v1L - 0.15v1M + 0.00v1R - 0.27v2L - 0.29v2M - 0.17v2R + 0.00v3L + 0.00v3M + 0.00v3R + 0.00v4L + 0.00v4M + 0.00v4R + 0.17v5L + 0.19v5M + 0.22v5R + 0.13v6L + 0.15v6M + 0.00v6R + 0.00v7L + 0.00v7M + 0.00v7R - 0.13v8L - 0.15v8M + 0.00v8R - 0.40v9L - 0.45v9M - 0.33v9R - 0.33v10L - 0.38v10M + 0.00v10R + 0.33v11L + 0.38v11M + 0.33v11R - 0.13v12L - 0.15v12M + 0.00v12R + 0.00v13L + 0.00v13M + 0.00v13R + 0.13v14L + 0.15v14M + 0.17v14R + 0.17v15L + 0.19v15M + 0.11v15R + 0.13v16L + 0.15v16M + 0.00v16R + 0.22v17L + 0.27v17M + 0.17v17R + $z_{21}^{1} \leq 0$

- 0.22w1 - 0.22w2 - 0.76w3 + 0.53w4 + 0.62w5 - 0.31w6 + 0.00w7 - 0.53w8 - 0.22w9 + 0.00w10 + 0.76w11 - 0.22w12 - 0.22w13 + 0.53w14 + 0.76w15 - 0.52w16 + 0.62w17 + 0.13v1L + 0.15v1M + 0.00v1R + 0.13v2L + 0.15v2M + 0.00v2R + 0.50v3L + 0.57v3M + 0.33v3R - 0.27v4L - 0.29v4M - 0.17v4R - 0.33v5L - 0.38v5M - 0.22v5R + 0.13v6L + 0.15v6M + 0.17v6R + 0.00v7L + 0.00v7M + 0.00v7R + 0.27v8L + 0.29v8M + 0.17v8R + 0.13v9L + 0.15v9M + 0.00v9R + 0.00v10L + 0.00v10M + 0.00v10R - 0.50v11L - 0.57v11M - 0.33v11R + 0.13v12L + 0.15v12M + 0.00v12R + 0.13v13L + 0.15v13M + 0.00v13R - 0.27v14L - 0.29v14M - 0.17v14R - 0.50v15L - 0.57v15M - 0.33v15R + 0.27v16L + 0.30v16M + 0.33v16R - 0.45v17L - 0.53v17M - 0.17v17R + $z_{13}^{1} \leq 0$

0.31w1 + 0.21w2 - 0.35w3 + 0.27w4 + 0.53w5 - 0.22w6 + 0.53w7 - 0.53w8 + 0.00w9 + 0.75w10 + 0.75w11 - 0.22w12 - 0.53w13 + 0.27w14 + 0.76w15 - 0.62w16 + 0.76w17 - 0.13v1L - 0.15v1M - 0.17v1R - 0.13v2L - 0.15v2M - 0.17v2R + 0.17v3L + 0.19v3M + 0.22v3R - 0.17v4L - 0.19v4M + 0.00v4R - 0.27v5L - 0.29v5M - 0.17v5R + 0.13v6L + 0.15v6M + 0.00v6R - 0.27v7L - 0.29v7M - 0.17v7R + 0.27v8L + 0.29v8M + 0.17v8R + 0.00v9L + 0.00v9M + 0.00v9R - 0.40v10L - 0.45v10M - 0.33v10R - 0.40v11L - 0.45v11M - 0.33v11R + 0.13v12L + 0.15v12M + 0.00v12R + 0.27v13L + 0.29v13M + 0.17v13R - 0.17v14L - 0.19v14M + 0.00v14R - 0.50v15L - 0.57v15M - 0.33v15R + 0.33v16L + 0.38v16M + 0.22v16R - 0.50v17L - 0.57v17M - 0.33v17R + $z_{23}^{2} \leq 0$

-0.22w1 - 0.53w2 - 0.62w3 + 0.62w4 + 0.83w5 - 0.22w6 + 0.22w7 - 0.31w8 - 0.53w9 + 0.53w10 + 0.83w11 - 0.22w12 - 0.31w13 + 0.62w14 + 0.76w15 - 0.62w16 + 0.76w17 + 0.13v1L + 0.15v1M + 0.00v1R + 0.27v2L + 0.29v2M + 0.17v2R + 0.33v3L + 0.38v3M + 0.22v3R - 0.33v4L - 0.38v4M - 0.22v4R - 0.53v5L - 0.59v5M - 0.42v5R + 0.13v6L + 0.15v6M + 0.00v6R - 0.13v7L - 0.15v7M + 0.00v7R + 0.13v8L + 0.15v8M + 0.17v8R + 0.27v9L + 0.29v9M + 0.17v9R - 0.27v10L - 0.29v10M - 0.17v10R - 0.53v11L - 0.59v11M - 0.42v11R + 0.13v12L + 0.15v12M + 0.00v12R + 0.13v13L + 0.15v13M + 0.17v13R - 0.33v14L - 0.38v14M - 0.22v14R - 0.50v15L - 0.57v15M - 0.33v15R + 0.33v16L + 0.38v16M + 0.22v16R - 0.50v17L - 0.57v17M - 0.33v17R + $z_{13}^{2} \leq 0$

0.00w1 + 0.53w2 + 0.22w3 - 0.31w4 - 0.49w5 - 0.22w6 + 0.27w7 + 0.22w8 + 0.75w9 + 0.31w10 - 0.49w11 + 0.00w12 + 0.00w13 - 0.21w14 + 0.00w15 - 0.53w16 - 0.29w17 + 0.00v1L + 0.00v1M + 0.00v1R - 0.27v2L - 0.29v2M - 0.17v2R - 0.13v3L - 0.15v3M + 0.00v3R + 0.13v4L + 0.15v4M + 0.17v4R + 0.33v5L + 0.38v5M + 0.33v5R + 0.13v6L + 0.15v6M + 0.00v6R - 0.17v7L - 0.19v7M + 0.00v7R - 0.13v8L - 0.15v8M + 0.00v8R - 0.40v9L - 0.45v9M - 0.33v9R - 0.13v10L - 0.15v10M - 0.17v10R + 0.33v11L + 0.38v11M + 0.33v11R + 0.00v12L + 0.00v12M + 0.00v12R + 0.00v13L + 0.00v13M + 0.00v13R + 0.13v14L + 0.15v14M + 0.17v14R + 0.00v15L + 0.00v15M + 0.00v15R + 0.27v16L + 0.29v16M + 0.17v16R + 0.22v17L + 0.27v17M + 0.17v17R + $z_{21}^{3} \leq 0$

$\sum_{i=1}^{17} w_i = 1$

$w_i \geq 0.01$ $(i = 1,2, \ldots,17)$

$z_{21}^{1} \geq 0,\ z_{13}^{1} \geq 0,\ z_{23}^{2} \geq 0,\ z_{13}^{2} \geq 0,\ z_{21}^{3} \geq 0$

Step 7: Solve linear programming problem: To obtain the best weights and the fuzzy positive ideal point, taking $h = 1.0$ and using $\tilde{Y}^p$ and Ω^p, solve Eq. (20).

By solving linear programming problem, using MATLAB R11 on a Pentium IV PC with a 3 GHz CPU and 4 GB RAM, the results are obtained:

$$\omega = (\omega_1, \omega_2, \dots, \omega_{17}) = (0.04, 0.04, 0.04, 0.06, 0.06, 0.03, 0.06, 0.02, 0.04, 0.16,$$
$$0.07, 0.03, 0.02, 0.05, 0.13, 0.05, 0.09)$$

and

$$\tilde{v} = (\tilde{v}_1, \tilde{v}_2, \dots \tilde{v}_{17}) = \big((0.38, 0.38, 0.38), (0.40, 0.39, 0.41), \dots (0.33, 0.31, 0.33)\big)$$

Using ω and $\tilde{v}$ values with Eq. (21), the positive ideal solutions set is calculated

$$\tilde{x}^* = (\tilde{x}_1^*, \tilde{x}_2^*, \dots \tilde{x}_{17}^*) = \big((8.60, 8.48, 8.58), (8.92, 8.76, 9.14), \dots (3.46, 3.35, 3.60)\big)$$

$\tilde{v}$ and $\tilde{x}^*$ is given in APPENDIX B.

Step 8: Calculate the square of the weighted Euclidean distance (S_i) between each pair of alternative, $\tilde{Y}_i^p$, and the fuzzy positive ideal solution, $\tilde{x}^*$. The results are obtained using Eq. (9) and shown in the **Table 5.5**.

Table 5.5 Weighted Euclidian Distances

	P_1	P_2	P_3
A_1	87.5635	87.7063	86.7797
A_2	86.6957	87.4637	87.3664
A_3	86.5961	87.5059	87.3420

According to these distances, the ranking orders of the three alternatives for the three experts are as follows:

For P_1: $A_3 \rho A_2 \rho A_1$ (Symbolizing "the expert P_1 prefers A_3 to A_2" by $A_3 \rho A_2$)

For P_2: $A_2 \rho A_3 \rho A_1$

For P_3: $A_1 \rho A_3 \rho A_2$

Step 9: The group ranking order of all alternatives can be obtained using social choice functions such as Borda's function (Hwang & Lin, 1987). Borda's function ranks the alternatives in the order of the value of $f_b(x)$, Borda scores are shown in **Table 5.6**.

Table 5.6 Borda's Scores

	P_1	P_2	P_3	Borda's Score
A_1	0	0	2	2
A_2	1	2	0	3
A_3	2	1	1	4

The ranking order of the three alternatives is A_3, A_2 and A_1 according to the Borda's scores; in other words, the best alternative is A_3. The best alternative is Prestige Pricing, the second alternative is Price Skimming and the last alternative is Value-Based Pricing.

5.3 Step by Step Procedure Using LINMAP Under IF Environment

The aim of this part is to provide a LINMAP application extended with Atanassov's IF sets. The most important difference which exists between the first part and the second part of the application is the second part considers the hesitations of the decision makers. The degree of indeterminacy membership (π) represents the hesitations mathematically. Hence the linguistic variables for the ratings differ from the first part and Atanassov's IF sets are used to express the linguistic variables with terms using subjective judgments. The proposed method is currently applied to evaluate marketing strategies and select the best pricing strategy as in the first part but while considering in addition the hesitations in the preferences of the decision makers. The computational procedure is summarized as follows:

Step1: The experts, the company's marketing department managers, identify the evaluation attributes.

Step2: The experts, $P_p(p = 1,2,3)$ give their preference judgments between alternatives with paired comparisons as $\Omega_1 = \{(2,1),(1,3)\}$, $\Omega_2 = \{(2,3),(1,3)\}$, $\Omega_3 = \{(2,1)\}$, exactly the same as in the first part.

Step 3: The experts use IF sets corresponding the linguistic variables (shown in **Table 5.7**) to evaluate the rating of alternatives with respect to each attribute (D. F. Li et al., 2010).

Table 5.7 Linguistic Variables and Corresponding IF Sets

Very Poor (VP)	$\langle 0.95, 0.05 \rangle$
Poor (P)	$\langle 0.7, 0.25 \rangle$
Fair (F)	$\langle 0.5, 0.4 \rangle$
Good (G)	$\langle 0.25, 0.7 \rangle$
Very Good (VG)	$\langle 0.05, 0.95 \rangle$

Step 4: Obtain the data and ratings of all alternatives $A_i(i = 1,2,3)$ on every attribute $C_j(j = 1,2, \dots ,17)$ given by three experts $P_p(p = 1,2,3)$ as in Table 3.

Step 5: Construct the decision matrices D^p using IF sets for each expert. **Table 5.8** is for the expert P_1. In the same vein, construct the matrices D^2 and D^3 for the experts P_2 and P_3. These matrices are given in APPENDIX C. The columns are $\mu_{ij}, \nu_{ij}, \pi_{ij}$ values respectively of the alternative i for the attribute j.

Table 5.8 IF Sets Decision Matrix for Expert P_1 (D^1)

	X1			X2			X3			X4			X5			X6		
A1	0,95	0,05	0	0,95	0,05	0	0,7	0,25	0,05	0,5	0,4	0,1	0,25	0,7	0,05	0,7	0,25	0,05
A2	0,7	0,25	0,05	0,5	0,4	0,1	0,7	0,25	0,05	0,5	0,4	0,1	0,5	0,4	0,1	0,95	0,05	0
A3	0,7	0,25	0,05	0,7	0,25	0,05	0,05	0,95	0	0,95	0,05	0	0,7	0,25	0,05	0,5	0,4	0,1

	X7			X8			X9			X10			X11			X12		
A1	0,7	0,25	0,05	0,95	0,05	0	0,95	0,05	0	0,7	0,25	0,05	0,05	0,95	0	0,95	0,05	0
A2	0,7	0,25	0,05	0,7	0,25	0,05	0,25	0,7	0,05	0,25	0,7	0,05	0,5	0,4	0,1	0,7	0,25	0,05
A3	0,7	0,25	0,05	0,5	0,4	0,1	0,7	0,25	0,05	0,7	0,25	0,05	0,7	0,25	0,05	0,7	0,25	0,05

	X13			X14			X15			X16			X17		
A1	0,95	0,05	0	0,5	0,4	0,1	0,05	0,95	0	0,7	0,25	0,05	0,05	0,95	0
A2	0,95	0,05	0	0,7	0,25	0,05	0,25	0,7	0,05	0,95	0,05	0	0,25	0,7	0,05
A3	0,7	0,25	0,05	0,95	0,05	0	0,7	0,25	0,05	0,25	0,7	0,05	0,5	0,4	0,1

Step 6: Construct the linear programming model in Eq. (29)

Maximize $z_{21}^{1} + z_{13}^{1} + z_{23}^{2} + z_{13}^{2} + z_{21}^{3}$

subject to

0,11w1 + 0,00w2 - 0,57w3 - 0,34w4 - 0,80w5 + 1,02w6 - 0,69w7 + 0,35w8 + 0,12w9 - 0,69w10 - 0,69w11 + 0,45w12 + 0,68w13 - 0,46w14 + 0,45w15 + 0,57w16 + 0,34w17 - 0,05u1 + 0,45u2 - 0,95u3 + 1,00u4 + 1,35u5 - 1,45u6 + 1,10u7 - 0,75u8 + 0,65u9 + 2,00u10 + 1,55u11 - 0,60u12 - 1,10u13 + 0,80u14 + 1,65u15 - 2,20u16 + 1,25u17 + 0,05π1 - 0,45π2 + 1,40π3 - 0,70π4 - 0,60π5 + 0,70π6 - 0,50π7 + 0,30π8 - 0,80π9 - 1,40v10 - 0,95v11 + 0,30v12 + 0,50v13 - 0,35v14 - 1,95v15 + 1,75v16 - 1,55v17 ≤ -1

0,45w1 + 0,69w2 + 0,00w3 + 0,00w4 + 0,24w5 - 0,45w6 + 0,00w7 + 0,45w8 + 0,45w9 + 0,00w10 + 0,69w11 + 0,45w12 + 0,00w13 - 0,24w14 + 0,45w15 - 0,45w16 + 0,45w17 - 0,60u1 - 1,10u2 + 0,00u3 + 0,00u4 + 0,40u5 + 0,60u6 + 0,00u7 - 0,60u8 - 1,50u9 - 0,90u10 + 0,70u11 - 0,60u12 + 0,00u13 + 0,50u14 + 0,30u15 + 0,60u16 + 0,30u17 + 0,30v1 + 0,50v2 + 0,00v3 + 0,00v4 - 0,70v5 - 0,30v6 + 0,00v7 + 0,30v8 + 1,20v9 + 0,90v10 - 1,30v11 + 0,30v12 + 0,00v13 - 0,20v14 - 0,60v15 - 0,30v16 - 0,60v17 $-2\ z_{21}^{1} \leq 0$

-0,45w1+-0,45w2+0,45w3 + 0,69w4 + 0,00w5 - 0,24w6 + 0,00w7 - 0,69w8 - 0,45w9 + 0,00w10 - 0,45w11 - 0,45w12 - 0,45w13 + 0,69w14 - 0,45w15 + 0,00w16 - 0,69w17 + 0,60u1 + 0,60u2 + 1,20u3 - 1,10u4 - 0,90u5 + 0,50u6 + 0,00u7 + 1,10u8 + 0,60u9 + 0,00u10 - 1,20u11 + 0,60u12 + 0,60u13 - 1,10u14 - 1,20u15 + 0,90u16 - 0,70u17 - 0,30v1 - 0,30v2 - 1,50v3 + 0,50v4 + 0,90v5 - 0,20v6 + 0,00v7 - 0,50v8 - 0,30v9 + 0,00v10 + 1,50v11 - 0,30v12 - 0,30v13 + 0,50v14 + 1,50v15 - 0,90v16 + 1,30v17 $-2\ z_{13}^{1} \leq 0$

0,24w1 - 0,24w2 + 0,24w3 + 0,24w4 + 0,69w5 - 0,45w6 + 0,69w7 - 0,69w8 + 0,00w9 + 0,45w10 + 0,45w11 - 0,45w12 - 0,69w13 + 0,24w14 - 0,45w15 + 0,00w16 - 0,45w17 - 0,50u1 - 0,40u2 + 0,40u3 - 0,50u4 - 1,10u5 + 0,60u6 - 1,10u7 + 1,10u8 + 0,00u9 - 1,50u10 - 1,50u11 + 0,60u12 + 1,10u13 - 0,50u14 - 1,20u15 + 0,90u16 - 1,20u17 + 0,20v1 + 0,70v2 - 0,70v3 + 0,20v4 + 0,50v5 - 0,30v6 + 0,50v7 - 0,50v8 + 0,00v9 + 1,20v10 + 1,20v11 - 0,30v12 - 0,50v13 + 0,20v14 + 1,50v15 - 0,90v16 + 1,50v17 $-2\ z_{23}^{2} \leq 0$

-0,45w1 - 0,69w2 + 0,00w3 + 0,00w4 + 0,00w5 - 0,45w6 + 0,45w7 - 0,24w8 - 0,69w9 + 0,69w10 + 0,00w11 - 0,45w12 - 0,24w13 + 0,00w14 - 0,45w15 + 0,00w16 - 0,45w17 + 0,60u1 + 1,10u2 + 0,90u3 - 0,90u4 - 1,80u5 + 0,60u6 - 0,60u7 + 0,50u8 + 1,10u9 - 1,10u10 - 1,80u11 + 0,60u12 + 0,50u13 - 0,90u14 - 1,20u15 + 0,90u16 - 1,20u17 - 0,30v1 - 0,50v2 - 0,90v3 + 0,90v4 + 1,80v5 - 0,30v6 + 0,30v7 - 0,20v8 - 0,50v9 + 0,50v10 + 1,80v11 - 0,30v12 - 0,20v13 + 0,90v14 + 1,50v15 - 0,90v16 + 1,50v17 $-2\ z_{13}^{2} \leq 0$

0,00w1 + 0,69w2 + 0,45w3 - 0,24w4 + 0,69w5 - 0,45w6 + 0,24w7 + 0,45w8 + 0,45w9 + 0,24w10 + 0,69w11 + 0,00w12 + 0,00w13 + 0,24w14 + 0,00w15 - 0,69w16 + 0,45w17 + 0,00u1 - 1,10u2 - 0,60u3 + 0,50u4 + 0,70u5 + 0,60u6 - 0,50u7 - 0,60u8 - 1,50u9 - 0,50u10 + 0,70u11 + 0,00u12 + 0,00u13 + 0,40u14 + 0,00u15 + 1,10u16 + 0,30u17 + 0,00v1 + 0,50v2 + 0,30v3 - 0,20v4 - 1,30v5 - 0,30v6 + 0,20v7 + 0,30v8 + 1,20v9 + 0,20v10 - 1,30v11 + 0,00v12 + 0,00v13 - 0,70v14 + 0,00v15 - 0,50v16 - 0,60v17 $-2\ z_{21}^{3} \leq 0$

$-\omega_i + u_i + v_i \leq 0$

$\sum_{i=1}^{17} \omega_i = 1$

$\omega_i \geq 0.01\ (i = 1,2,\ldots,17)$

$z_{21}^{1} \geq 0,\ z_{13}^{1} \geq 0,\ z_{23}^{2} \geq 0,\ z_{13}^{2} \geq 0,\ z_{21}^{3} \geq 0$

Step 7: Solve linear programming problem: To obtain the best weights and the IF positive ideal solution (IFPIS), taking $h = 1.0$ and using D^p and Ω^p, solve Eq. (29).
By solving linear programming problem, using MATLAB R11 on a Pentium IV PC with a 3 GHz CPU and 4 GB RAM, these results are obtained:

$$\omega = (\omega_1, \omega_2, \dots, \omega_{17})$$
$$= (0.032, 0.038, 0.074, 0.050, 0.081, 0.035, 0.061, 0.034, 0.047, 0.120, 0.089, 0.029, 0.033, 0.046, 0.079, 0.091, 0.060)$$

$$u = (u_1, u_2, \dots, u_{17})$$
$$= (0.012, 0.005, 0.059, 0.002, 0.003, 0.030, 0.003, 0.024, 0.004, 0.002, 0.001, 0.019, 0.027, 0.005, 0.002, 0.085, 0.002)$$

$$v = (v_1, v_2, \dots, v_{17})$$
$$= (0.010, 0.025, 0.001, 0.038, 0.055, 0.003, 0.043, 0.004, 0.034, 0.103, 0.070, 0.004, 0.002, 0.028, 0.074, 0.003, 0.054)$$

Using w, u and v values with Eq. (30), the IFPIS set is calculated (APPENDIX D).

$$A^+ = \{\langle \mu_j^+, v_j^+ \rangle \ (j = 1,2, \dots,17)\} = \{\langle 0.37,0.33 \rangle, \langle 0.16,0.66 \rangle, \dots, \langle 0.03,0.91 \rangle\}$$

Step 8: Calculate the square of the weighted Euclidean distance S_i^p between each pair of alternative, D_i^p , and the fuzzy positive ideal solution, A^+. The results are obtained using Eq. (23) and shown in the **Table 5.9**.

Table 5.9 Weighted Euclidian Distances with IFPIS

	P_1	P_2	P_3
A_1	0.1635	0.1302	0.1702
A_2	0.3654	0.4356	0.4380
A_3	0.0977	0.0730	0.1122

According to these distances, the ranking orders of the three alternatives for the three experts are as follows:
For P_1: $A_3 \rho A_1 \rho A_2$ (Symbolizing "the expert P_1 prefers A_3 to A_1" by $A_3 \rho A_1$)
For P_2: $A_3 \rho A_1 \rho A_2$
For P_3: $A_3 \rho A_1 \rho A_2$

Step 9: The group ranking order of all alternatives can be obtained using social choice functions such as Borda's function (Hwang & Lin, 1987). Borda's function ranks the alternatives in the order of the value of $f_b(x)$, Borda scores are shown in **Table 5.10**.

Table 5.10 Borda's Scores

	P_1	P_2	P_3	Borda's Score
A_1	1	1	1	3
A_2	0	0	0	0
A_3	2	2	2	6

The ranking order of the three alternatives is A_3, A_1 and A_2 according to the Borda's scores; in other words, the best alternative is A_3. The best alternative is Prestige Pricing, the second alternative is Value-Based Pricing and the last alternative is Price Skimming.

5.4 Concluding Remarks

In this study, in both of the applications of fuzzy LINMAP tool and LINMAP extended with IF sets tool, the best solution is determined as Prestige Pricing strategy. This result is significant for a company whose products do not differ from the competitors' in terms of functionality and who stays distant from the highly competitive area, positions its products in an uncontested market neutralized of the competition.

In the applications of fuzzy LINMAP and LINMAP extended with IF sets, the second and third alternatives are determined as, "A_2, A_1" and "A_1, A_2", respectively. In the second part, Value-Based Pricing (A_1) strategy takes the second place and this situation can be interpreted as meaningful if the subjective criteria which bring hesitation as lack of information, risk attitude of decision makers etc. are taken into consideration.

In the application, "Market/Segment Size" criterion is determined as the most important criteria by both of the tools. Indeed, the company presents the products to a narrow target market and provides competitive advantage with superior design features.

In the first and second part of the application, the second important criterion is determined as "Breadth of the Product Line" and "Product Support", respectively. This is significant for a company who adopts Blue Ocean positioning strategy, bringing the product criterion into the forefront because the company responds the customers' demand with a short but deep product line as well as multiplies and expands the core product with an improved product support service.

6. CONCLUSION

Nowadays, marketing approach customer-focused and products are directly oriented to meet customer needs. Since marketing is a long process which needs organization and management, strategic marketing planning becomes a key factor of success for the companies in today's competitive market conditions. Marketing strategy, which focuses on manipulations of marketing mix variables (product, price, place and promotion), is vital in the new product development and influenced by many factors.

The aim of this thesis is to evaluate strategic marketing factors and select the best pricing strategy solution while considering the preferences of several decision makers. This study searches the answers of questions why strategic marketing is required to be implementing to enterprises, and what the most suitable solutions for pricing are.

Therefore first the base concepts of marketing strategy are reviewed. Then two methodologies with different fuzzification methods are used for analyzing individual and multidimensional preferences with linear programming approach under fuzzy environments and these systematic methodologies are proposed to select the best pricing strategy. First, the fuzzy LINMAP is applied, which is a multi attribute group decision making technique, where decision makers give their preferences on alternatives in a fuzzy relation. This method is a fuzzy prioritization method based on an optimization problem with linear constraints, considering the imprecise judgments of decision-makers which model the uncertainty with fuzzy numbers and uses paired comparison judgments directly to derive crisp priorities. In the second part, the LINMAP under Atanassov's IF environment is applied. IF sets are used to capture the fuzziness in decision information and describe the decision makers preferences given through pair-wise comparisons with hesitancy degrees. In both of the applications, Borda's social choice function is used to determine the ranking orders of alternatives.

In this thesis, the use of FLP to strategic marketing development has been discussed and this approach to marketing problems has not yet been appeared in the literature. Three pricing strategies alternatives are determined in the study: (A_1) Value-Based Pricing, (A_2) Price Skimming, and (A_3) Prestige Pricing. 17 attributes; 2 innovation attributes, 3 manufacturing/operations attributes, 3 management attributes, 3 market attributes, 2 consumer attributes and 4 product attributes based on these alternatives are also stated. To reflect the DM's subjective preference information and to determine the weight vector of attributes, the fuzzy LINMAP model and the LINMAP model under IF environment are constructed. The weights of the alternatives are obtained then ranked by using a social choice function.

At the end of this study, both the two methods set "Market / Segment Size" (C10) as the key attribute and "Prestige Pricing" as the best pricing strategy solution.

The usefulness of the models was observed by their effect on the decision-making process in selecting an appropriate alternative and the case studies show that the fuzzy LINMAP method and the LINMAP method under IF environment are applicable as an evaluation technique for marketing strategies alternatives. The current fuzzy linear programming model offers the decision maker some flexibility to incorporate his/her own priority in the model. Consequently, managers can use such approaches in making their strategic decisions in case of incomplete information and vagueness. The models provide a useful conceptual framework for evaluating pricing strategies alternatives and marketing managers can use such approaches in making their strategic decisions.

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APPENDIX A

Table A.1 Fuzzy Decision Matrix for Expert P_2

	X1			X2			X3			X4			X5			X6		
A1	0.8	0.9	1	0.8	0.9	1	0.6	0.7	0.8	0.2	0.3	0.4	0	0.1	0.3	0.8	0.9	1
A2	0.4	0.5	0.6	0.2	0.3	0.4	0.4	0.5	0.6	0.4	0.5	0.6	0.4	0.5	0.6	0.8	0.9	1
A3	0.6	0.7	0.8	0.4	0.5	0.6	0.2	0.3	0.4	0.6	0.7	0.8	0.8	0.9	1	0.6	0.7	0.8

	X7			X8			X9			X10			X11			X12		
A1	0.6	0.7	0.8	0.6	0.7	0.8	0.8	0.9	1	0.4	0.5	0.6	0	0.1	0.3	0.8	0.9	1
A2	0.4	0.5	0.6	0.8	0.9	1	0.4	0.5	0.6	0.2	0.3	0.4	0.2	0.3	0.4	0.8	0.9	1
A3	0.8	0.9	1	0.4	0.5	0.6	0.4	0.5	0.6	0.8	0.9	1	0.8	0.9	1	0.6	0.7	0.8

	X13			X14			X15			X16			X17		
A1	0.6	0.7	0.8	0.2	0.3	0.4	0	0.1	0.3	0.6	0.7	0.8	0	0.1	0.3
A2	0.8	0.9	1	0.4	0.5	0.6	0	0.1	0.3	0.6	0.7	0.8	0	0.1	0.3
A3	0.4	0.5	0.6	0.6	0.7	0.8	0.6	0.7	0.8	0.2	0.3	0.4	0.6	0.7	0.8

Table A.2 Fuzzy Decision Matrix for Expert P_3

	X1			X2			X3			X4			X5			X6		
A1	0.6	0.7	0.8	0.8	0.9	1	0.8	0.9	1	0.4	0.5	0.6	0	0.1	0.3	0.6	0.7	0.8
A2	0.6	0.7	0.8	0.4	0.5	0.6	0.6	0.7	0.8	0.6	0.7	0.8	0.4	0.5	0.6	0.8	0.9	1
A3	0.4	0.5	0.6	0.6	0.7	0.8	0.2	0.3	0.4	0.8	0.9	1	0.6	0.7	0.8	0.6	0.7	0.8

	X7			X8			X9			X10			X11			X12		
A1	0.6	0.7	0.8	0.8	0.9	1	0.8	0.9	1	0.6	0.7	0.8	0	0.1	0.3	0.8	0.9	1
A2	0.4	0.5	0.6	0.6	0.7	0.8	0.2	0.3	0.4	0.4	0.5	0.6	0.4	0.5	0.6	0.8	0.9	1
A3	0.6	0.7	0.8	0.6	0.7	0.8	0.4	0.5	0.6	0.8	0.9	1	0.6	0.7	0.8	0.6	0.7	0.8

	X13			X14			X15			X16			X17		
A1	0.8	0.9	1	0.2	0.3	0.4	0.2	0.3	0.4	0.4	0.5	0.6	0	0.1	0.3
A2	0.8	0.9	1	0.4	0.5	0.6	0.2	0.3	0.4	0.8	0.9	1	0.2	0.3	0.4
A3	0.6	0.7	0.8	0.8	0.9	1	0.8	0.9	1	0	0.1	0.3	0.4	0.5	0.6

Table A.3 Normalized Fuzzy Decision Matrix for Expert P_2

	X1			X2			X3			X4			X5			X6		
A1	0.8	1	1	0.8	1	1	0.8	1	1	0.3	0.4	0.7	0	0.1	0.4	0.8	1	1
A2	0.4	0.6	0.8	0.2	0.3	0.5	0.5	0.7	1	0.5	0.7	1	0.4	0.6	0.8	0.8	1	1
A3	0.6	0.8	1	0.4	0.6	0.8	0.3	0.4	0.7	0.8	1	1	0.8	1	1	0.6	0.8	1

	X7			X8			X9			X10			X11			X12		
A1	0.6	0.8	1	0.6	0.8	1	0.8	1	1	0.4	0.6	0.8	0	0.1	0.4	0.8	1	1
A2	0.4	0.6	0.8	0.8	1	1	0.4	0.6	0.8	0.2	0.3	0.5	0.2	0.3	0.5	0.8	1	1
A3	0.8	1	1	0.4	0.6	0.8	0.4	0.6	0.8	0.8	1	1	0.8	1	1	0.6	0.8	1

	X13			X14			X15			X16			X17		
A1	0.6	0.8	1	0.3	0.4	0.7	0	0.1	0.5	0.8	1	1	0	0.1	0.5
A2	0.8	1	1	0.5	0.7	1	0	0.1	0.5	0.8	1	1	0	0.1	0.5
A3	0.4	0.6	0.8	0.8	1	1	0.8	1	1	0.3	0.4	0.7	0.8	1	1

Table A.4 Normalized Fuzzy Decision Matrix for Expert P_3

	X1			X2			X3			X4			X5			X6		
A1	0.8	1	1	0.8	1	1	0.8	1	1	0.4	0.6	0.8	0	0.1	0.5	0.6	0.8	1
A2	0.8	1	1	0.4	0.6	0.8	0.6	0.8	1	0.6	0.8	1	0.5	0.7	1	0.8	1	1
A3	0.5	0.7	1	0.6	0.8	1	0.2	0.3	0.5	0.8	1	1	0.8	1	1	0.6	0.8	1

	X7			X8			X9			X10			X11			X12		
A1	0.8	1	1	0.8	1	1	0.8	1	1	0.6	0.8	1	0	0.1	0.5	0.8	1	1
A2	0.5	0.7	1	0.6	0.8	1	0.2	0.3	0.5	0.4	0.6	0.8	0.5	0.7	1	0.8	1	1
A3	0.8	1	1	0.6	0.8	1	0.4	0.6	0.8	0.8	1	1	0.8	1	1	0.6	0.8	1

	X13			X14			X15			X16			X17		
A1	0.8	1	1	0.2	0.3	0.5	0.2	0.3	0.5	0.4	0.6	0.8	0	0.2	0.8
A2	0.8	1	1	0.4	0.6	0.8	0.2	0.3	0.5	0.8	1	1	0.3	0.6	1
A3	0.6	0.8	1	0.8	1	1	0.8	1	1	0	0.1	0.4	0.7	1	1

APPENDIX B

Table B.1 $\tilde{v}$ Values

v	1 L	0.3828	v	7 L	0.3489	v	13 L	0.6367
v	1 M	0.3774	v	7 M	0.3421	v	13 M	0.6435
v	1 R	0.3819	v	7 R	0.3819	v	13 R	0.6428
v	2 L	0.3962	v	8 L	0.598	v	14 L	0.3935
v	2 M	0.3889	v	8 M	0.603	v	14 M	0.3826
v	2 R	0.4058	v	8 R	0.6091	v	14 R	0.5041
v	3 L	0.6026	v	9 L	0.424	v	15 L	0.3225
v	3 M	0.6095	v	9 M	0.4187	v	15 M	0.3093
v	3 R	0.6131	v	9 R	0.4323	v	15 R	0.3572
v	4 L	0.3726	v	10 L	0.275	v	16 L	0.6759
v	4 M	0.3615	v	10 M	0.2625	v	16 M	0.6884
v	4 R	0.4356	v	10 R	0.3293	v	16 R	0.6141
v	5 L	0.3422	v	11 L	0.3544	v	17 L	0.321
v	5 M	0.3353	v	11 M	0.3486	v	17 M	0.3111
v	5 R	0.396	v	11 R	0.3634	v	17 R	0.3342
v	6 L	0.6172	v	12 L	0.5687			
v	6 M	0.6233	v	12 M	0.5722			
v	6 R	0.48	v	12 R	0			

Table B.2 $\tilde{x}^*$ Values

x*	1	L	8.602247	x*	7	L	6.046794	x*	12	R	0				
x*	1	M	8.480899	x*	7	M	5.928943	x*	13	L	31.05854				
x*	1	R	8.582022	x*	7	R	6.618718	x*	13	M	31.39024				
x*	2	L	8.923423	x*	8	L	25.23207	x*	13	R	31.3561				
x*	2	M	8.759009	x*	8	M	25.44304	x*	14	L	8.610503				
x*	2	R	9.13964	x*	8	R	25.70042	x*	14	M	8.371991				
x*	3	L	15.10276	x*	9	L	9.614512	x*	14	R	11.03063				
x*	3	M	15.27569	x*	9	M	9.494331	x*	15	L	2.567675				
x*	3	R	15.36591	x*	9	R	9.802721	x*	15	M	2.46258				
x*	4	L	6.629893	x*	10	L	1.728473	x*	15	R	2.843949				
x*	4	M	6.432384	x*	10	M	1.649906	x*	16	L	14.50429				
x*	4	R	7.75089	x*	10	R	2.069767	x*	16	M	14.77253				
x*	5	L	5.555195	x*	11	L	4.782726	x*	16	R	13.17811				
x*	5	M	5.443182	x*	11	M	4.704453	x*	17	L	3.455328				
x*	5	R	6.428571	x*	11	R	4.904184	x*	17	M	3.348762				
x*	6	L	19.1677	x*	12	L	18.16933	x*	17	R	3.597417				
x*	6	M	19.35714	x*	12	M	18.28115								
x*	6	R	14.90683												

APPENDIX C

Table C.1 IF Sets Decision Matrix for Expert P_2

	X1			X2			X3			X4		
A1	0.95	0.05	0	0.95	0.05	0	0.7	0.25	0.05	0.25	0.7	0.05
A2	0.5	0.4	0.1	0.25	0.7	0.05	0.5	0.4	0.1	0.5	0.4	0.1
A3	0.7	0.25	0.05	0.5	0.4	0.1	0.25	0.7	0.05	0.7	0.25	0.05
	X5			X6			X7			X8		
A1	0.05	0.95	0	0.95	0.05	0	0.7	0.25	0.05	0.7	0.25	0.05
A2	0.5	0.4	0.1	0.95	0.05	0	0.5	0.4	0.1	0.95	0.05	0
A3	0.95	0.05	0	0.7	0.25	0.05	0.95	0.05	0	0.5	0.4	0.1
	X9			X10			X11			X12		
A1	0.95	0.05	0	0.5	0.4	0.1	0.05	0.95	0	0.95	0.05	0
A2	0.5	0.4	0.1	0.25	0.7	0.05	0.25	0.7	0.05	0.95	0.05	0
A3	0.5	0.4	0.1	0.95	0.05	0	0.95	0.05	0	0.7	0.25	0.05
	X13			X14			X15			X16		
A1	0.7	0.25	0.05	0.25	0.7	0.05	0.05	0.95	0	0.7	0.25	0.05
A2	0.95	0.05	0	0.5	0.4	0.1	0.05	0.95	0	0.7	0.25	0.05
A3	0.5	0.4	0.1	0.7	0.25	0.05	0.7	0.25	0.05	0.25	0.7	0.05
	X17											
A1	0.05	0.95	0									
A2	0.05	0.95	0									
A3	0.7	0.25	0.05									

Table C.2 IF Sets Decision Matrix for Expert P_3

	X1			X2			X3			X4		
A1	0.7	0.25	0.05	0.95	0.05	0	0.95	0.05	0	0.5	0.4	0.1
A2	0.7	0.25	0.05	0.5	0.4	0.1	0.7	0.25	0.05	0.7	0.25	0.05
A3	0.5	0.4	0.1	0.7	0.25	0.05	0.25	0.7	0.05	0.95	0.05	0
	X5			X6			X7			X8		
A1	0.05	0.95	0	0.7	0.25	0.05	0.7	0.25	0.05	0.95	0.05	0
A2	0.5	0.4	0.1	0.95	0.05	0	0.5	0.4	0.1	0.7	0.25	0.05
A3	0.7	0.25	0.05	0.7	0.25	0.05	0.7	0.25	0.05	0.7	0.25	0.05
	X9			X10			X11			X12		
A1	0.95	0.05	0	0.7	0.25	0.05	0.05	0.95	0	0.95	0.05	0
A2	0.25	0.7	0.05	0.5	0.4	0.1	0.5	0.4	0.1	0.95	0.05	0
A3	0.5	0.4	0.1	0.95	0.05	0	0.7	0.25	0.05	0.7	0.25	0.05
	X13			X14			X15			X16		
A1	0.95	0.05	0	0.25	0.7	0.05	0.25	0.7	0.05	0.5	0.4	0.1
A2	0.95	0.05	0	0.5	0.4	0.1	0.25	0.7	0.05	0.95	0.05	0
A3	0.7	0.25	0.05	0.95	0.05	0	0.95	0.05	0	0.05	0.95	0
	X17											
A1	0.05	0.95	0									
A2	0.25	0.7	0.05									
A3	0.5	0.4	0.1									

APPENDIX D

Table D.1 The IFPIS Set

A+	1	0.37134	0.32784
A+	2	0.13558	0.66025
A+	3	0.79673	0.01781
A+	4	0.04559	0.74363
A+	5	0.03345	0.67586
A+	6	0.8612	0.08834
A+	7	0.05623	0.70922
A+	8	0.71672	0.10886
A+	9	0.07941	0.73321
A+	10	0.01411	0.86117
A+	11	0.00598	0.78669
A+	12	0.65529	0.13498
A+	13	0.82077	0.0718
A+	14	0.09694	0.60857
A+	15	0.03079	0.92799
A+	16	0.93421	0.02925
A+	17	0.03358	0.90656

BIOGRAPHICAL SKETCH

Elif Alaybeyoğlu was born in Adana on February 13, 1988. She studied at Galatasaray High School where she was graduated in 2007. She started her undergraduate studies in the Industrial Engineering Department of Galatasaray University in the same year. In 2011, she obtained the B.S. degree in Industrial Engineering. She started her graduate studies in Industrial Engineering at the Institute of Science of Galatasaray University in 2011. Since October 2011, she has been working as a research assistant in Industrial Engineering Department of Galatasaray University. Currently, she is working towards master's degree under the supervision of Assoc. Prof. Dr. Y. Esra Albayrak.

She is the co-author of the journal article entitled "Criteria Weighing and 4P's Planning in Marketing Using a Fuzzy Metric Distance and AHP Hybrid Method" which has been selected for publication in International Journal of Computational Intelligence Systems in the Special Issue devoted to Computational Intelligence in Decision Making. She received the "Best Paper Award" with the paper entitled "Criteria Weighting and 4P's Planning in Marketing Using Analytic Network Process" which was presented at the Proceedings of the 2012 IAENG International Conference on Industrial Engineering.

Her research interest and focus are in the areas of multiple attribute decision making, fuzzy logic and strategic marketing management.