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EGE UNIVERSITY
Graduate School of Applied and Natural Science



AN APPLICATION FOR THE DETERMINATION AND VALUATION OF QUALITATIVE FACTORS AFFECTING THE VALUE OF PATENTS IN THE CHEMICAL INDUSTRY

MSc Thesis

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Department of Chemical Engineering

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Department of Chemical Engineering

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2023

Habibe Ezelsu ÇELİK tarafından Yüksek Lisans tezi olarak sunulan “AN APPLICATION FOR THE DETERMINATION AND VALUATION OF QUALITATIVE FACTORS AFFECTING THE VALUE OF PATENTS IN THE CHEMICAL INDUSTRY” başlıklı bu çalışma EÜ Lisansüstü Eğitim ve Öğretim Yönetmeliği ile EÜ Fen Bilimleri Enstitüsü Eğitim ve Öğretim Yönergesi’nin ilgili hükümleri uyarınca tarafımızdan değerlendirilerek savunmaya değer bulunmuş ve 27.01.2023 tarihinde yapılan tez savunma sınavında aday oybirliği ile başarılı bulunmuştur.

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EGE ÜNİVERSİTESİ FEN BİLİMLERİ ENSTİTÜSÜ
ETİK KURALLARA UYGUNLUK BEYANI EÜ

Lisansüstü Eğitim ve Öğretim Yönetmeliğinin ilgili hükümleri uyarınca Yüksek Lisans Tezi olarak sunduğum “Kimya Sektöründeki Patentlerin Değerini Etkileyen Nitel Faktörlerin Belirlenmesi ve Değerlemesine Yönelik Bir Uygulama” başlıklı bu tezin kendi çalışmam olduğunu, sunduğum tüm sonuç, doküman, bilgi ve belgeleri bizzat ve bu tez çalışması kapsamında elde ettiğimi, bu tez çalışmasıyla elde edilmeyen bütün bilgi ve yorumlara atıf yaptığımı ve bunları kaynaklar listesinde usulüne uygun olarak verdiğimi, tez çalışması ve yazımı sırasında patent ve telif haklarını ihlal edici bir davranışımın olmadığını, bu tezin herhangi bir bölümünü bu üniversite veya diğer bir üniversitede başka bir tez çalışması içinde sunmadığımı, bu tezin planlanmasından yazımına kadar bütün safhalarda bilimsel etik kurallarına uygun olarak davrandığımı ve aksinin ortaya çıkması durumunda her türlü yasal sonucu kabul edeceğimi beyan ederim.

27/01/2023

Habibe Ezelsu ÇELİK



ÖZET**KİMYA SEKTÖRÜNDEKİ PATENTLERİN DEĞERİNİ ETKİLEYEN
NİTEL FAKTÖRLERİN BELİRLENMESİ VE DEĞERLEMESİNE
YÖNELİK BİR UYGULAMA**

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Bu çalışmada bir patentin değerini etkileyen nitel kriterlerin saptanması ve önem sırasına konması, bununla birlikte Çok Kriterli Karar Verme (ÇKKV) yöntemlerinden TOPSIS, VIKOR, ARAS ve BORDA Sayım metotları kullanılarak 2015-2020 yılları arasında yapılan C12P ve C12Q IPC kodlu patent başvurularının saptanan kriterlere göre sıralaması yapılması amaçlanmıştır.

Bu çalışmanın ilk kısmında; literatür taraması, akademisyen ve uzman görüşleri ile belirlenen ve patent değerini etkileyen kriterler belirlenmiştir. Üzerinde uygulama yapılması için belirlenen bu kriterlerin önem sıralarını bulmak amacıyla Entropi yöntemi uygulanarak kriter ağırlıkları bulunmuştur. Daha sonra patentlerin (alternatiflerin) bu kriterler baz alınarak kalitelerine göre sıralanması için sırasıyla TOPSIS, VIKOR ve ARAS metotları uygulanmıştır. Bu metotlarla elde edilen sıralamaların ortalamasını bulmak ve tek bir sıralamaya indirgemek amacıyla ise BORDA Sayım metodu uygulanarak nihai sıralamaya ulaşılmıştır.

Bu çalışmanın sonraki kısmında elde edilen sıralamadaki en iyi ve en kötü 15 patent incelenmiştir. Bu patentlerin her bir kriter değeri, bu değerlerin incelenmesi ve literatürle uyumlu olup olmadığı araştırılmıştır. Elde edilen sonuçlar ile patentin kalitesini etkileyen nitel değerlerin önemi vurgulanmış; firmaların gelişimi için nicel değerlerin yanı sıra nitel değerlere de önem verilmesi gerektiği, özellikle çalışma sonucunda öne çıkan kriterlere yoğunlaşılması gerektiği önerilmiştir.

Anahtar sözcükler: Patent değerlendirme, nitel özellikler, TOPSIS, VIKOR, ARAS, BORDA Sayım,



ABSTRACT**AN APPLICATION FOR THE DETERMINATION AND VALUATION OF
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Supervisor: Assoc. Prof. Serdal TEMEL

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In this study, patent applications with C12P and C12Q IPC codes made between 2015-2020 were used. In this study, Multi-Criteria Decision-Making methods are used to determine the qualitative criteria that affect the value of a patent and to put them in order of importance are aimed.

In the first part of this study; the criteria that affecting patent value were determined by the literature research, the opinions of academicians and experts. The weights of the criterion were identified using the Entropy method in order to determine the order of significance of these criteria. The patents (alternatives) were then ranked using the TOPSIS, VIKOR, and ARAS methodologies, which rated each patent's quality in relation to these criteria. In order to find the average of the rankings obtained by these methods and reduce them to a single ranking, the method of BORDA Count was applied to reach the eventual ranking.

In the next part of this study, the best and worst 15 patents in the obtained ranking were examined. By examining these values and whether they were compatible with the literature, each criterion value of these patents was investigated. With the results obtained, the importance of qualitative values affecting the quality of the patent was emphasized, it has been suggested that for the development of companies, attention should be paid to qualitative values as well as quantitative values, and that the criteria that stand out as a result of the study should be focused on.

Keywords: Patent valuation, qualitative features, TOPSIS, VIKOR, ARAS, BORDA Count



ÖNSÖZ

Patent değ erleme konusunda literat rde  alıřmalar yapılmıř olsa da, kimya sekt r nde ve patenti etkileyen nitel değ erler  zerine yapılmıř fazla  alıřma bulunmamaktadır. Patent değ erleme zor ve karmařık olabilir, bu konuda pratik ve basit tek bir y ntem elde etmek řu an i in m mk n sayılmamaktadır.

Bu tez  alıřması 4 ana kısımdan oluřmaktadır. Giriř ve literat r kısmında fikri m lkiyet hakları, patent, patent değ erleme, kimya sekt r nde patentin yeri gibi alt bařlıklar hakkında bilgi vermektedir. İkinci kısımda  alıřmada uygulanan metotlar ve uygulama adımları anlatılmaktadır.    nc  kısımda daha  nce anlatılan metot ve adımların uygulanıřı g sterilmektedir. Son kısımda ise yapılan uygulama sonu ları g sterilmekte ve tartıřılmaktadır.

Bu tez  alıřmasının belirlenmesinde, planlanmasında, arařtırılmasında ve y r t lmesinde motivasyonunu ve desteęini eksik etmeyen, yoęun bilgi birikimi ve tecr belerinden yararlandığımı, y nlendirme ve bilgilendirmeleriyle  alıřmamı řekillendiren sayın hocam Do . Dr. Serdal Temel'e, aynı  zveriyle yardımlarını ve teknik bilgi bakımından desteęini esirgemeyen Mustafa  akır'a teřekk rlerimi bor  bilirim.

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Habibe Ezelsu  ELİK

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NOMENCLATUREAbbreviations

AHP	Analytical Hierarchy process
ARAS	Additive Ratio Assessment
CPC	Cooperative Patent Classification
DMU	Decision-Making Units
EPC	European Patent Convention
EPO	European Patent Office
EU	European Union
IP	Intellectual Property
IPC	International Patent Classification
IPR	Intellectual Property Rights
MCDM	Multi-Criteria Decision-Making
PCT	Patent Cooperation Treaty
SME	Small, Medium Enterprises
TOPSIS	Technique for Order Preference by Similarity to Ideal Solution

NOMENCLATURE (continued)

TPI	Turkish Patent Institute
USA	United States of America
USPTO	The United States Patent and Trademark Office
VIKOR	Vlsekriterijumska Optimizacija I Kompromisno Resenje
WIPO	World Intellectual Property Organization

1. INTRODUCTION

1.1 Introduction of Intellectual Property Rights and Patent

All kinds of intellectual knowledge of people may have a value in the market. Although it cannot be touched or seen, we can think of this intellectual information as a product called "intellectual property" (IP). IP is defined as a formation of the mind, such as inventions, literary and artistic works, names, symbols, designs, and pictures used in commercial activity and produced by an individual's imagination (Drahos, 1999).

The word "property" is a generic term that probably started to be used frequently in the twentieth century. (Drahos, 1999). This generic term describes a collection of legal frameworks, each of which gives ownership rights over a particular subject matter to varying degrees. Early IP law dealt with inventions, literary and artistic works, designs, and trademarks. Notwithstanding its early historical associations with the concept of monopoly and prerogative, one notable aspect of intellectual property is that its context is constantly growing. The twentieth century has witnessed the addition of new or existing topics to current intellectual property systems (such as the copyright protection for software on computers and the patentability of microorganisms as part of patent law) as well as the development of new systems to preserve new or existing subject matter (for instance plant variety protection). There is no sign that the strongly expanding character of intellectual property system will change. On a global scale, the World Intellectual Property Organization's work program still includes specific legal protection for data bases (WIPO) (Drahos, 1999).

IP can be defined as a set of property rights that protects products of mind, and these rights are considered especially important to the business sector as they provide useful business tools that can not only be used to protect products of the human mind, but also **commercially**.

Traditionally, business life has been built and designed on tangible assets such as buildings, land, machinery, and equipment. Recently, however, intellectual

property has become more important than these assets. The information and communication technology revolution, which affects most industries and enterprises, has fundamentally changed the way in which people previously thought about business. This is especially true now that the internet and e-commerce have grown and spread. This emerging new situation highlights the importance of knowledge management of intangible digital content consisting of information, data, information, or intellectual assets more than ever in the evolving industry and business history around the world (Drahoš, 1999).

The primary objective of intellectual property law is to encourage the creation of a variety of intellectually generated products and services. To this purpose, the law offers individuals and entities property rights, typically for a limited period of time, over the knowledge and intellectual property they produce. This provides an economic incentive for their development by enabling individuals to profit from the knowledge and intellectual products they produce and by enabling them to safeguard their ideas and prevent copying (Goldstein & Reese, 2008). The main type of intellectual property are copyright, trademarks, patents and trade secret.

Copyright is the legal protection that an intellectual right provides to its creator for a commercial benefit, ensuring that no one other than the owner of the idea is allowed to use it. Books, music, movies, artwork (including sculptures and paintings), and technological works are all covered by copyright protection (such as software, computer programs and electronic databases). In relation to literary and artistic creations, the term "copyright" describes the act of copying an original work, which may only be done by the author or with the author's consent (WIPO, 2016). A trademark can be any term, phrase, symbol, design, or combination of these that defines products or services from those of others (USPTO, 2015). It is how consumers identify these goods or services on the market and distinguish them from opponents. A trademark serves to identify the source of goods or services, offers legal protection for the brand, and aids in preventing fraud and counterfeiting (USPTO, 2015).

Trade secrets are private information with IP rights that can be licensed or sold. Information must meet certain criteria to be considered as a trade secret, including being confidential, known only to a limited number of people, being subject to reasonable measures taken by the rightful owner of the information to keep it unknown and including the use of confidentiality agreements for employees and commercial partners (WIPO, 2022).

An exclusive right to protect an innovation is known as a patent. Against disclosing of the all know-how within the invention, patent system offers its inventors and owners the sole authority to get benefit from that invention and preventing others to use this invention for any commercial purpose for a limited period of time. As a result, the patent holder (patentee) generally has the right to prevent others from producing, selling, or importing it without the permission of the patent owners. This exclusive privilege, which lasts for 20 years from the filing date as long as annual maintenance fees are paid, is only valid inside the nation where the patent was awarded (WIPO, 2003).

There are different reasons for filing a patent application (WIPO, 2018):

- Strong market position and competitive advantage
- Recovering R&D costs and obtaining higher returns on investments
- Licensing or transfer/sale
- Access to technology through cross-licensing
- Diminished risks of infringement
- Access to new markets
- Attracting investors: In business, it is incredibly important for start-ups and also investments in settled companies
- Prestige/reputation/image: Demonstrating a high level of proficiency, technological capability and specialized knowledge, beneficial in generating funds, finding commercial partners, increasing brand recognition and market value.

Although, it may not be wise and feasible to patent all inventions, there are certain criteria for patenting of any invention.

- 1) Innovation Step: The existing product should have a different feature than the previous one, and the new product should be an innovation, and it should be clearly displayed.
- 2) Invention Step: The product to be patented must have an inventive step after the innovation step. Invention should not be apparent to the person who is in the business. Therefore, the invention is not obvious any person even for whom in the business.
- 3) Industrial Applicability: It means that the invention, by its nature, can be acquired in industry or used as a work tool. The subject of the invention must be suitable for the enterprise.

For a patent application, the patent should contain innovation step, not a known technology. It must be applicable; the applicant must demonstrate in detail in the application form that the invention is viable. Patents need to be analyzed in detail; applications should be examined by technically competent experts, and the current state of the technique should be analyzed in detail.

It takes some times for the applications to be examined and concluded by the national patent offices. Patents are protected for 20 years from the day and time of application, with the protection period beginning on that day. Additionally, it is exceedingly expensive to file for patents and maintain them. The cost of patent application starting from drafting, filling and yearly fees payment in different countries may require big financial resources. Despite this amount of investment, many patents cannot generate any revenue or cannot provide expected advantages to the inventors.

Thus, it is important to understand why there are many patent applications from different sectors, regions, and countries. The main expectation is to get benefit out of those patents either directly (revenue generation) or indirectly (protection of the field). However, not all patents can provide benefits to its inventors due to many reasons such as the novelty level of the invention, potential needs for that product,

future expectation, its market, potential competition etc. Therefore, it is important to have strong and valuable patents in order to get expected benefits. However, the value of the patent is not straightforward, there is no consensus in the literature on how to calculate it, and there is no concrete agreement about the factors that can take a part in defining the value of the patents.

Therefore, the purpose of this thesis is to define the factors that can be used to define the value of the patents and rank of those patents according to their value by using those defined factors with the help of qualitative approaches. For the study we will focus only on the patents belong to the C12Q and C12P classes and years between 2015 and 2020.

1.1.1 Protection of an Invention in Turkey and Patent Application Process

The patent application process is defined internationally, and almost similar procedure is applicable for the most countries. However, each step of the procedure is very critical and should be handled with care and good management. Otherwise, a valuable invention may not be protected properly, and this negatively affects its inventors.

Registration: A national patent application for Turkey can be made directly to Turkish Patent and Trademark Office (TÜRKPATENT). As an alternative, Turkey can be identified and an international application made through the Patent Cooperation Treaty (PCT) or the European Patent Office. Since Turkey is the part of PCT, the first application in Turkey can be considered as the beginning of international application and in 12 months, the inventors can apply PCT so that their application have opportunity to be protected in other countries. The application must include a search request for cutting-edge technology, often known as previous technology research, or submit it within a year of the filing date or priority date. If this is not done, the application will be considered as withdrawn. It is important for the inventors to conduct novelty search before filing. This novelty search will help the inventor to understand if there is any similar patent available. If there is a similar patent, it cannot be patented and therefore this creates a loss both in money and time

for the inventors. Therefore, novelty search before registration is advised to be conducted by the inventors (IPO, 2017).

Patent examination procedure: After receiving confirmation from TÜRKPATENT that the research report or a previous research report is accepted, there is a period of 3 months for the institution to request an investigation. If it is determined that the invention is not patentable in all three analyses (*invention step, innovation step and industrial implication*), the application will be rejected. In this case, there is no option to appeal to the TÜRKPATENT Re-examination and Evaluation Department. However, before the rejection, TURKPATENT ask for explanation, clarification, and supplementary materials in order to understand the invention. After analyzing of all information which supported by the inventor, TURKPATENT (same for all national Patent Institute) makes decision. Therefore, filing patent is a very critical step. Inventors should provide all necessary information in a logical frame.

Opposition: After the publication of the patent grant decision, a period of 6 months is given to third parties to appeal against the granted patent. TÜRKPATENT Re-examination and Evaluation Department will evaluate these objections, and it is possible to invalidate the patent in cases where there are no patentability criteria. Opposition is a risk for almost all patents. After patents are accepted, the competitors can sue the inventors for infringing their patents. Thus, inventors need to take necessary precautions before patent filing and need to collaborate with a patent attorney.

Annual Patent Fee: To maintain the application in active, an annual fee must be paid each year from the third year of the application or date of international filing. This payment should be made until the end of life of the patent. The fee can vary the number of countries.

Cancellation: The court declares a registered patent invalid if:

- a) In case it is proven that the patent does not meet the required criteria,
- b) Proving that the right actually belongs to another individual (s),

c) The declaration of invalidity may be claimed either during the protection period or within five years after the protection's termination (IPO, 2017).

1.2 Overview of Patents in Turkey

Turkish intellectual property rules and regulations date back to the 1870s, during the Ottoman Empire Period (Denk et al., 2021). The first regulations on intellectual property in our country are in the "ahi-order institution", which dates back to the 13th and 14th centuries. Ahi system was based on invention unlike the guild system in the west and encouraging innovation. According to the Ahi system, it was necessary to develop a new product or introduce an innovation in technology for the union of tradesmen (Ozcelik&Ozcelik, 2012).

According to a definition from 1871, the "Patent Law," which was enacted in 1879, together with the "Regulations on Trademarks for Goods Commerce" form the cornerstone of legal protection for both patents and trademarks. Afterwards, in 1925, Turkey joined the International Union for the Protection of Industrial Property, in 1965, it enacted Trademark Law, and in 1976, it joined the World Intellectual Property Organization (WIPO). Turkey established her own national patent office in 1994 (Denk et al., 2021).

Industrial property rights experienced a major shift in 1994 with the establishment of the Turkish Patent Institute (TPI), which is governed by the Ministry of Industry and Trade but has administrative and financial autonomy. The "Law No. 5000 on the Establishment and Duties of the Turkish Patent Institute" was passed in 2003 in order to implement it and adapt it to the current environment.

In 2016, the organization's name was transformed to "Turkish Patent and Trademark Office," and its abbreviation was modified to "TÜRKPATENT". TURKPATENT offers services to increase the number of patent applications in Turkey. It is because the patent applications number is one of the key metrics of R&D and innovation intensity in the countries. Since patents are the main source of radical technologies, countries are allocating their resources to develop more patents and convert them into new technologies. Therefore, patents without

commercial capacity mainly create cost but not revenue for companies and countries. In his way, the quality (commercial value) of the patent is more significant than its quantity.

With the help of TURKPATENT and other organizations, Turkey is also focusing on increasing the number of patents. Between the year 2010 and 2020, the increase can be seen that as the table 1.1.

According to the data of the TURKPATENT between the years 2010 and 2021, it is seen that the patent applications number has been increase. While there were 3250 patent applications in total with PCT and European Patent Convention (EPC) applications in 2010, as can be seen that this number increased to 8439 in 2021. In foreign applications, EPC is more preponderant than TURKPATENT and PCT, and at the same period, more applications are made than local applications. Although there was a decrease in the general increase rate local and foreign applications in 2018, it has been observed that patent applications have been increasing in general within 10 years.

Table 1.1. Distribution of Patent Applications According to Last 10 Years

Year	Local					Foreign					Grand Total	Total Increase Rate
	TÜRK PATENT	PCT	EPC	Total	Increase Rate	TÜRK PATENT	PCT	EPC	Total	Increase Rate		
2010	3120	60	70	3250	25,58%	77	100	4916	5093	9,46%	8343	15,22%
2011	3962	43	82	4087	25,75%	120	100	5934	6154	20,83%	10241	22,75%
2012	4360	74	109	4543	11,16%	78	154	6824	7056	14,66%	11599	13,26%
2013	4345	54	129	4528	-0,33%	95	175	7257	7527	6,68%	12055	3,93%
2014	4654	112	95	4861	7,35%	149	183	7182	7514	-0,17%	12375	2,65%
2015	5302	50	160	5512	13,39%	251	238	7957	8446	12,40%	13958	12,79%
2016	6153	88	204	6445	16,93%	407	211	9715	10333	22,34%	16778	20,20%
2017	7994	181	450	8625	33,82%	202	178	10278	10658	3,15%	19283	14,93%
2018	7114	42	193	7349	-14,79%	137	173	10845	11155	4,66%	18504	-4,04%
2019	7751	120	255	8126	10,57%	63	154	11573	11790	5,69%	19916	7,63%
2020	7803	117	280	8200	0,91%	90	148	10267	10505	-10,90%	18705	-6,08%
2021	8071	163	205	8439	2,91%	85	157	8885	9127	-13,12%	17566	-6,09%

Source: (TÜRKPATENT, 2022)

Table 1.2. Registered Patent Document Statistics

Year	Local					Foreign					Grand Total	Total Increase Rate
	TÜRK PATENT	PCT	EPC	Total	Increase Rate	TÜRK PATENT	PCT	EPC	Total	Increase Rate		
2010	507	66	69	642	40,79%	83	110	4675	4868	-5,55%	5510	-1,78%
2011	714	59	74	847	31,93%	56	67	5569	5692	16,93%	6539	18,68%
2012	879	44	102	1025	21,02%	28	53	6710	6791	19,31%	7816	19,53%
2013	1068	33	143	1244	21,37%	43	68	7570	7681	13,11%	8925	14,19%
2014	1141	34	76	1251	0,56%	40	66	7173	7279	-5,23%	8530	-4,43%
2015	1471	96	163	1730	38,29%	33	123	8214	8370	14,99%	10100	18,41%
2016	1563	48	183	1794	3,70%	64	91	9125	9280	10,87%	11074	9,64%
2017	1713	44	207	1964	9,48%	47	96	10317	10460	12,72%	12424	12,19%
2018	2558	39	208	2805	42,82%	197	88	10792	11077	5,90%	13882	11,74%
2019	1740	16	247	2003	-28,59%	151	34	11532	11717	5,78%	13720	-1,17%
2020	1903	26	285	2214	10,53%	71	63	10669	10803	-7,80%	13017	-5,12%
2021	3063	62	217	3342	50,95%	82	180	8962	9224	-14,62%	12566	-3,46%

Source: (TÜRKPATENT, 2022)

Similarly, the number of registered patents also has been increased between the year 2010 and 2021. While there were 642 registered patent documents in total with PCT and EPC in 2010, it is seen that this number increased to 3342 in 2021. Furthermore, the local application also has been increased 6 times in the same period. It is seen that, both application and the registration of patent have been increased in Turkey. It is also seen that the number of foreign registered patent increased between the analyzed period. This shows that foreign companies see Turkey as an important market and therefore they prefer to protect their invention in Turkey.

In addition to local application, comparison with other developed countries also provide information about the patenting performance of Turkey. For the same period, it is seen that the US is the leading country and Turkey definitely needs to her patenting performance.

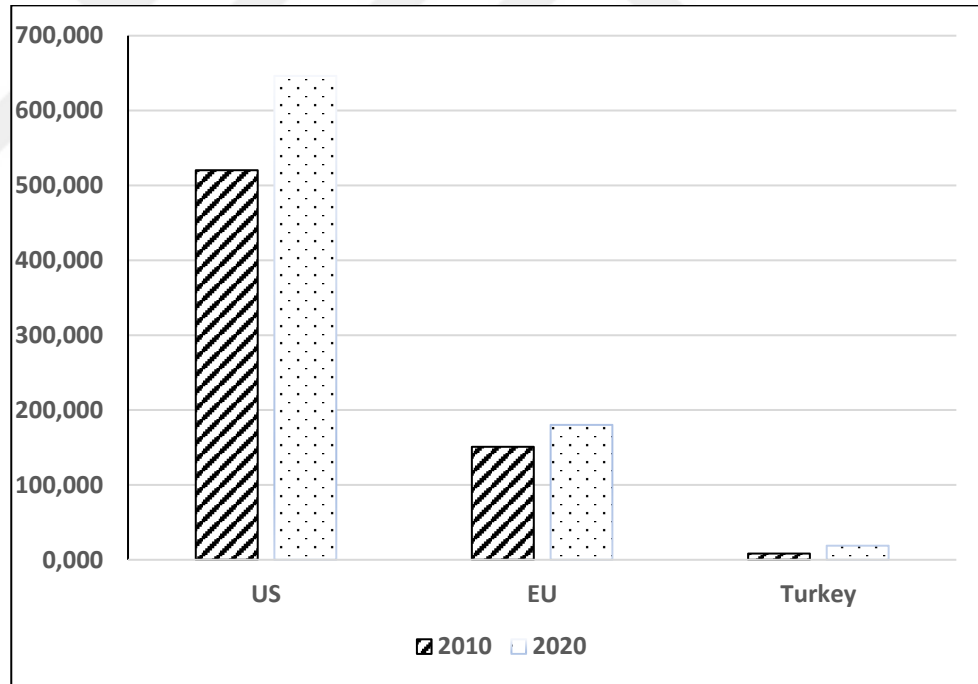


Figure 1.1 Comparison of Total Number of Patent Applications in 2010 and 2020 according to USA, EU and Turkey

Source: USPTO, 2021; EPO 2011; EPO, 2021; TÜRKPATENT, 2022

1.3 Types of Patent Valuation

The main reason of patent application is to get benefit and for that reason, having an idea about patent value is critical for the further steps. However, since there are many unknown parameters in the patent process such as market size, competitors, requested investments, future regulations, potential customers behaviors etc., it is not very easy to estimate patent value. However, there are methodologies for valuation of patents.

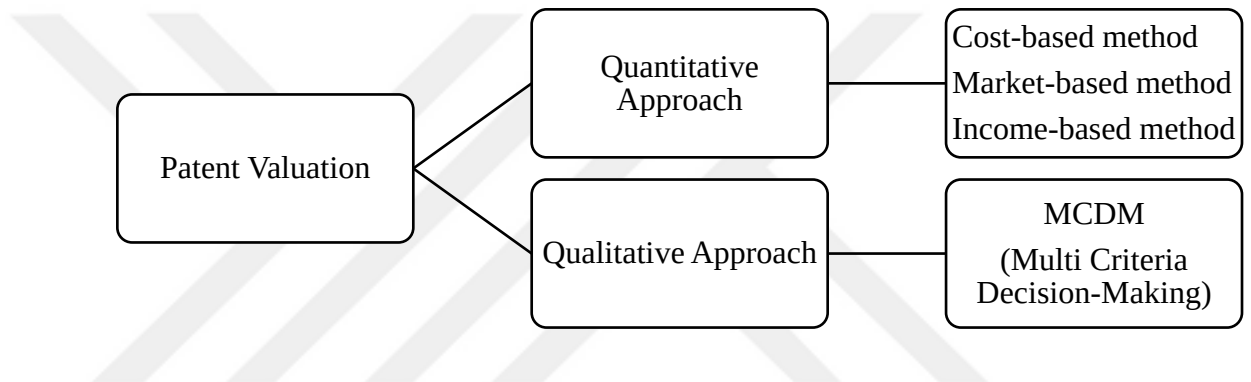


Figure 1.2. Types of Patent Valuation Scheme

Source: By the author from all sources

Patent valuation is divided into two as quantitative and qualitative approaches. The quantitative approach includes cost-based, market-based, and income-based methods (Kalip et al., 2022). There are no definite methods determined for the qualitative approach; usually an evaluation is made based on qualitative criteria. For both approaches, brief definitions, when they can be applied, advantages and disadvantages are given in the table 1.3.

Table 1.3. Quantitative and Qualitative Approach of Patent Valuation

	Quantitative Approach			Qualitative Approach
Name of the method	Cost-Based	Market-Based	Income Based	
Definition	The value of the patent is identified by the company's internal and external costs during manufacturing.	The patent's value is assessed by comparing it to current prices achieved by businesses with similar operations.	The estimated income from the patent is calculated.	Sets a reference value using various scoring and evaluation criteria.
Using	When the company obtains such internal and external information.	When a market exists to which it can be compared.	When it is possible to access financial statements.	When to classify the patent's value.
Advantages	• Visible in the company's accounting statements. • Raise awareness on the existence of the patent.	• Relatively simple. • Useful to validate other methodologies. • Potential to be used for future because of changes in the company's strategy.	• Relatively simple if the assets have already been produced. • Cash flows can be determined and predicted. • It is simple to separate financial from physical assets.	• Relatively simple. • Complex methods are not required. • Public access to the information. • Risks and opportunities can be considered.

Source: (Gómez et al., 2019)

Table 1.3. Quantitative and Qualitative Approach of Patent Valuation (continued)

Disadvantages	• No direct correlation between the development costs and future/potential income. • Historical costs are not reliable because of the fast advance of technology.	• Reference prices are not publicly disclosed sometimes. • Same royalty rates. • The valuation could be based on the costs and not the patent.	• The resulting value may be not clear as it is based on a hypothesis. • Determining the proper rate to pay royalties becomes difficult. • Separating assets from intangible advantages is not easy.	• Dependent on valuers' expertise. • The quality depends on the information given. • Low market acceptance.
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In the literature, several studies have been completed on valuation of patents. The subject of patent valuation is seen as an important issue that has been studied by different experts and researchers, especially since the last decade. Although there are many studies in the literature that used quantitative methods to value patents, it is clear that there are very few qualitative studies.

In the cost-based approach, the patent value is calculated in accordance with the internal and external expenditure of company during production period and appears in the accounting records. Although it creates awareness about the existence of patents, historical costs are not dependable due to the rapid progress of technology.

In the market-based approach, when there is a market for comparison, patent value is determined by comparing prices recently reached with similar businesses. Because of simplicity, strategic changes, future utilization is useful for validating potential and other methods, but valuation may be based on cost, not patent.

In the income-based method, when financial data is accessible, it is possible to estimate the potential patent revenue. It is relatively simple and cash flow can be determined but it is difficult to distinguish assets from intangible advantage.

In the qualitative approach, when the patent value is classified, a reference value is determined with the difference scoring and evaluation factors. It is simple, complex methods are not required, data is easy to access for public and can assess risks and opportunities. Quality depends on the information provided and the expertise of the individual that do valuation.



2. LITERATURE

2.1 Importance of Patent Valuation

As knowledge has become a basic economic asset in the knowledge economy, its use, control and protection is also critical for business and economic management (Taş, 2006).

With the rapid growth of communication and information technology, the globalization process has given rise to the idea of "knowledge economy" (Güvel & Parlakyıldız, 2015).

There are technologically intensive products and R&D investments as a result of creative ideas generated by the knowledge economy. In order to achieve economic growth, countries today put a greater focus on technological innovations and R&D investments. For these reasons, the importance placed on IPR is the foundation of technological progress by preserving creative ideas in the information economy. (Guvel & Parlakyıldız, 2015). IPR is currently can be recognized as one of the cornerstones of the knowledge economy worldwide, as it is crucial to innovation, development, and entrepreneurship. Innovations and patents are in an indispensable position for the development of companies, as well as making significant contributions to economic growth. Patents are very important for companies for many reasons such as protecting the technology and techniques owned, providing protection against rival companies etc. Valuation of these patents is also required as a guide for the success and income of a product, but there are no practical methods for valuation of patents, so it is very difficult to decide on an accepted common patent valuation approach. Even if the result of all studies is decided on a common and single method, it is not possible to rely on this method.

In their study, Yavuz and Baki (2019) calculated the values of patents owned by a corporation working in the automotive sector using the TOPSIS and VIKOR methodologies, and the findings of both methods were compared. Spearman correlation analysis was used to see whether there was a relationship between these results, and it was determined that there was a high degree of positive correlation between the ranks (Yavuz & Baki, 2019).

Subaşı (2011) addressed the problem of choosing an external audit firm of a financial institution and used TOPSIS and analytical hierarchy process (AHP) methods to define patent value solve it. Subaşı compared the results obtained in this study by using those two methods and mentioned the reasons for the differences. (Subaşı, 2011)

Garcia et al. (2018) emphasized the significance of developing a model based on the real option technique to assist decision-makers in valuing challenging projects. In this regard, the purpose is to create a tool that is simple to use and that decision makers can use intuitively to evaluate patent-protected technological innovation initiatives. As a consequence of the study, it has been decided that standard valuation methodologies are insufficient for projects with high risk, uncertainty, and flexibility, and that models based on the real option method are the most appropriate way for the valuation of these projects and should be used (García et al., 2018).

Ildır (2017) determined that the cash flow method is the most suitable method to use in a valuation to be conducted in this context in his study dealing with patent valuation methods in the context of corporate tax law exemption in Turkey (Ildır, 2017).

Ishii (2017) also highlighted the importance of patent value, advantages, and disadvantages of patent valuation methods in detail and the calculations of patent valuation methods were supported by numerical examples and tables in his study conducted with the Japanese Patent Office.

Furthermore, Grimaldi et al. (2015) created a systematic and repeatable strategy for increasing patents value and obtaining all possible critical information from the patent portfolio in the study. This structure for evaluating patent portfolios is innovative because it combines technological-bibliometric data with economic-strategic concerns. The framework that was created was used by two businesses in the aerospace and defense industries. The framework's application findings

revealed that it may be utilized for strategic planning and sustainable technology management.

In their research Han and Sohn (2015), used survival analysis to analyze the major variables connected to patent value as measured during the patent life. Furthermore, the Euclidean distance between forward and backward citation patents was determined using text mining to obtain patent claim singular value decompositions (SVDs). The Euclidean distance is a calculation that helps in the finding of similarly cited patents. According to the results of the study of Han and Sohn (2015), Euclidean distance has the ability to find patents easily with similar citations and that improved approaches are required because it cannot distinguish the difference in meaning in words.

Ersoy and Akbaba (2014) conducted research in which they discussed the subject of patent valuation from an accounting perspective. It is explained with examples how the patent will be valued, redeemed, and accounted for in accordance with the Ministry of Finance's Uniform Chart of Accounts, International/Turkish Accounting Standards, and Capital Markets Board regulations. The study also includes the definition of a patent and its historical development, the stages of obtaining a patent and explanations of patent valuation approaches (Ersoy & Akbaba, 2014).

Kopczewska and Kopyt (2014) present a new nonlinear correction approach in the patent value market that takes into account factors such as patent life cycle expiration time, copy risk, and momentum. Furthermore, the method is said to have a quality that increases the accuracy and reliability of existing patent value methods. (Kopczewska & Kopyt, 2014)

In their work, Gupeng and Xiangdong (2012) developed a patent valuation model based on patent renewal fees and applied it to Chinese patent resources to analyze patent values in China. The findings of patent study on expired and unexpired patents revealed that records should be considered for patent value analyses. (Gupeng & Xiangdong, 2012)

Tonisson and Maicher (2012) reviewed the literature and described three traditional valuation methodologies (cost, market, and income-based approaches) by analyzing their positive and negative characteristics. As a consequence of their study, they highlighted that there is no universally accepted valuation approach, and that each enterprise will choose its own value method for intangible assets (Tonisson&Maicher, 2012).

Furthermore, Wirtz (2012) offered thorough descriptions of the three classic valuation approaches, cost, market, and revenue-based approaches, and the applicability of the methods was critically assessed. He highlighted that, among these approaches, income-based approaches are the best fit for many valuation scenarios. Moreover, it is suggested in intellectual property valuation to utilize more than one approach to verify valuation results with alternative methods (Wirtz, 2012).

In their work, Agliardi and Agliardi (2011) used the real option model with fuzzy numbers to produce a method to measure the value of the skate, which contains many concepts that cannot be measured, such as patent lawsuits. Uncertainties such as the patent owner's potential income, the patent's validity and scope, and litigation costs are represented by fuzzy figures (Agliardi&Agliardi, 2011).

Ercan (2011) created a dynamic valuation model with artificial neural networks in his study by examining registered and rejected patents in the white goods sector. Support Vector Machines were used for this purpose (SVM). SVM and Backpropagation Algorithm (BPA), the most used artificial neural network technique, were compared in the study. The model prepared as a result of the study allowed to predict in advance about the patent registration decision (Ercan, 2011).

Ernst, Legler, and Lichtenthaler (2010) developed a theoretical model of the real option technique in patent valuation that accounts for the uncertainty of future patent value in their study. Furthermore, Monte Carlo simulations were employed in the model to calculate the patent value. In the simulation analysis, the R&D project was compared with and without patent protection. The analysis showed that

a project with patent protection would have greater investment costs and net cash flows than a project without a patent (Ernst et al., 2010).

In his study, Sözer (2008) touched on some fundamental ideas such as variables influencing patent value, value indicators and patent valuation methodologies were extensively explained. In addition, the study also analyzed the subject of patent value in Turkey and around the world, and it was discovered that patent awareness has not been fully formed in Turkey, and that patent valuation techniques and application areas have not developed yet in Turkey (Sözer, 2008).

Chiu and Chen (2007) suggested a system by scoring for determining the importance of IP valuation criteria from the viewpoint of the licensor. The system AHP for determining the importance of patent valuation criteria was developed from the viewpoint of the licensor. Moreover, the method is a multi-criteria decision analysis method that considers both quantitative and qualitative considerations. They also provided a case study on a company's patent in their study to analyze the findings in the perspective of the licensor. (Chiu & Chen, 2007)

Wu and Tseng (2006) investigated patent value both theoretically from the perspective of the real option method and empirically using panel data. The study includes a sensitivity analysis that shows the relationships between patent value and generated assets, period till expiry, volatility, and risk-free rate. Statistics of 101 Taiwanese electronics companies were analyzed using cross-sectional and time series analysis between 1993 and 2002 in this study. The generated asset, expiry, and interest rate on risk-free assets were found to increase in conjunction with the patent value. (Wu & Tseng, 2006)

Chaplinsky (2002) stated in his study that each valuation technique has strong and weak points and there is no one correct valuation strategy on the income approach, market approach, and cost approaches, which are among the valuation methods of intellectual property assets. Following a single valuation approach in intellectual property valuations produces issues such as not being able to manage human errors, not being able to regulate the consistency of the valuation result and not being able to provide multiple perspectives. For these reasons, it has been stated

that using a single patent valuation method is not appropriate and the necessity and significance of using multiple methods in the valuations to be made has been highlighted. (Chaplinsky, 2002)

Literature review shows that patent valuation is an important issue and there is no single agreed methodology for measuring the value of the patent. Furthermore, it is suggested that in addition to quantitative approaches, qualitative approaches are needed to define the patent value.

Hirschey and Richardson (2001) investigated how high-tech corporations in Japan and the US valued their patent portfolios and discovered that scientific metrics of patent quality may be able to inform managers about the quality of their creative output and the value of their R&D investment. (Hirschey&Richardson, 2001)

Pitkehly (1997) investigated traditional patent valuation approaches (income-based, market-based, and cost-based) as well as accounting methods, renewal, and econometric methods based on stock market data in his study, which states that patent valuations should be constantly renewed, and the patent value kept up to date. He also stated that valuation methods based on option pricing theory can be used in patent valuation. He also discussed that further research in this field is a need to define alternative ways for patent valuation. (Pitkehly, 1997)

2.2 Patents in Chemical Industry

The oldest "high-tech" industry and one of the largest manufacturing sectors is the chemical sector. In addition, it is one of the few remaining industries where licensing is crucial and where patents have historically been essential and useful (Arora, 2002). As a result, the industry's history offers valuable insights that may also apply to other sectors of the economy. The development of the chemical industry demonstrates the obvious inadequacy of the traditional conceptualization of patents, which centers on the trade-off between the short-term monopolistic restraints and the long-term benefits of increased innovation. Patents are frequently utilized in conjunction with other tools, such as trade secrets, in the chemical

business. Furthermore, patents are frequently used by businesses to wall off specific technological fields rather than being connected to discrete advances. The underlying knowledge base may influence the efficiency and application of patents. The usefulness of patents was constrained and trade secrets regarding the manufacturing process were promoted due to our incomplete understanding of the chemistry underpinning the manufacture and usage of organic dyestuffs. The development of chemical engineering, on the other hand, expanded the use of process patents and encouraged the patenting of processes. The development of patent law has changed in reaction to adjustments in the structure of the industry, as demonstrated by the history of the chemical industry, and its use goes far beyond merely excluding competitors (Arora, 2002).

To get a general idea of today's chemistry patent environment, a study was conducted to determine, rank, and compare patent quality criteria taken into account most recent and publicly traded chemical companies (LexisNexis, 2022). In this study, publicly traded chemical companies were ranked by combining specific classes of Cooperative Patent Classification (CPC) and IPC to obtain a large chemistry patent database research that was conducted. In this research 20 patent companies were evaluated and graphed according to the factors of patent portfolio, patent quality and competitive impact (Figure 2.1).

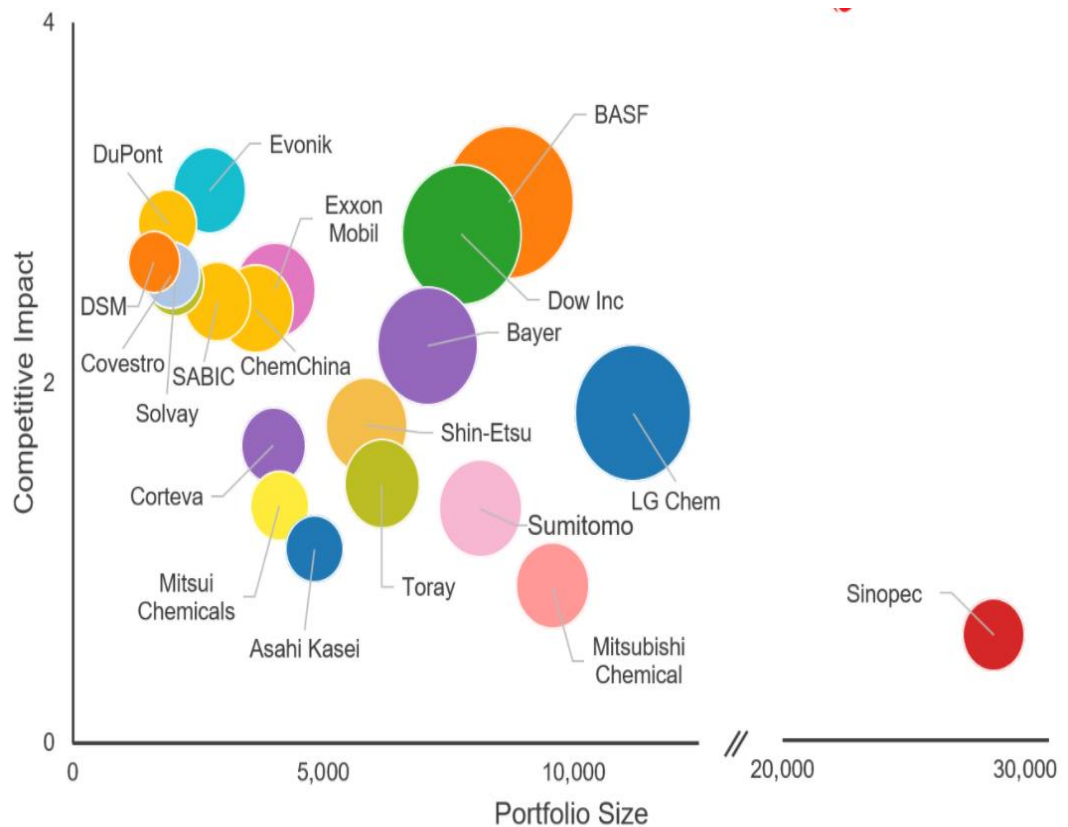


Figure 2.1. The active portfolios of the top 20 chemical companies as of 17th June 2021

Source: LexisNexis, 2022

Larger patent portfolios typically have lower-quality patents, contrary to the conventional norm for portfolio strength. Companies that have powerful patent portfolios (BASF, Dow, LG Chem, and Sinopec) deviate from this general pattern, including BASF and Dow (Figure 2.2). In addition, despite its small portfolio size, BASF has the powerful patent portfolio and it is one of the top 20 chemical companies based on average patent quality (LexisNexis, 2022). Sinopec is the last company on the size-impact graph, and it has the greatest portfolio of patents. Sinopec ranks fourth in terms of power of the portfolio among the 20 firms, which is slightly offset by the portfolio size. Theoretically, for Sinopec to equal the portfolio strength of distant BASF, it would need to expand its portfolio.

The gap between portfolio size and portfolio strength is more clearly illustrated in the figure below, which compares the top five chemical companies' patent portfolio sizes and strengths directly.

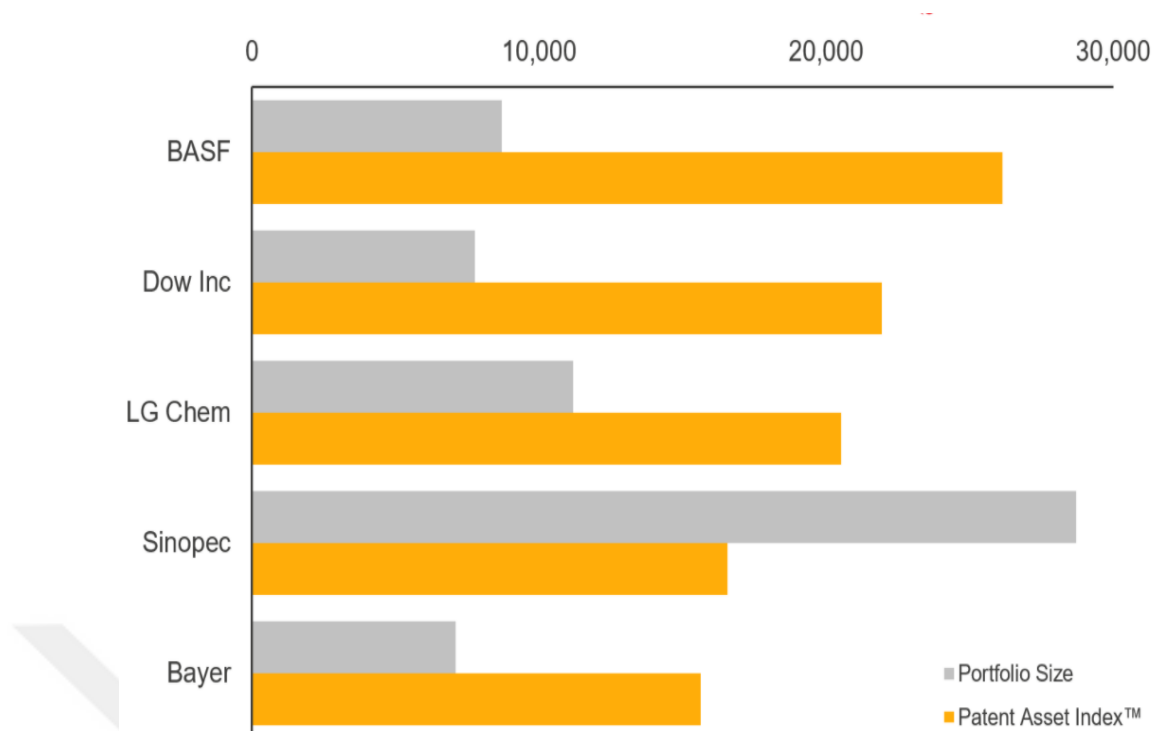


Figure 2.2. The portfolio size and and portfolio strength of the top five chemical companies as of 17th June 2021

Source: LexisNexis, 2022

When the CPC main groups of companies are considered, it is seen that they have very different products / productions from each other, but at the same time, it is a proof that chemicals and the chemical industry seems that it has potential to be in other goods and sectors.

When the chemical-related and chemistry-related startups analyzed, it is seen that there is an extraordinary growth in funding over the past decade. While there were only startups for commodity chemicals in 2011, in recent years biotechnology, Ai/ML-R&D, 3D-printing and batteries have been in the first place with the developing technology. This replacement also directly changes the market; biotechnology startup investments entered with approximately 2 billion dollars in 2015 and this figure increased to approximately 6.5 billion dollars in 2020 as an example (Accenture, 2021).

2.3. IPC (International Patent Classification)

The term "International Patent Classification" (IPC) refers to a hierarchical classification system that is primarily used to categorize and search patent documents (such as utility models, granted patent specifications, and patent applications) in accordance with the technical fields to which they are relevant (WIPO, 2022). It acts as a tool for the systematic arrangement of patent documents, a foundation for the selective dissemination of knowledge, and a method for assessing the state of the art in certain technological fields.

The IPC is used by patent offices to categorize patent applications and conduct examination-related searches. The IPC can be used to search for patents or patent-related material by anybody engaged in technological development, invention, or application. It is particularly helpful for innovators, researchers, lecturers, students, lawyers, multinational corporations, SMEs, and start-ups. There are several nations that use the IPC when publishing their patent documents; there are more than 100 patent offices worldwide that use the IPC. In a way, the IPC serves as the book's index (WIPO, 2022). IPC helps users to find the right technology among many others in a very easy and short time. IPC also help companies and countries to classify their own technology intensity. For instance, some countries are giving prioritize some of the IPC category for incentivizing. Companies are also using IPC when they are analyzing their collaborator or competitors. There are eight different IPC category where all technologies are classified per sector.

- A: Human Necessities
- B: Performing Operations; Transporting
- C: Chemistry; Metallurgy
- D: Textiles; Paper
- E: Fixed Constructions
- F: Mechanical Engineering; Lighting; Heating; Weapons; Blasting
- G: Physics
- H: Electricity

The local and foreign number of patent application per IPC provided in the Table 4 between the year 2011 and 2021. The first three IPC categories are human necessity, performing operations & transporting and chemistry & metallurgy respectively.



Table 2.1. Distribution of Patent Applications by IPC Classes

Classes	2011		2012		2013		2014		2015	
	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign
A	601	1608	1022	1700	1141	1000	1349	1021	1623	2046
B	509	1397	572	1448	688	806	863	769	1033	1446
C	107	1250	121	1588	204	915	235	607	283	1565
D	117	264	110	356	164	155	161	105	215	257
E	160	239	225	281	241	155	295	160	286	339
F	378	515	526	583	513	317	749	310	821	664
G	260	326	344	430	456	287	580	200	700	400
H	169	457	227	579	288	308	432	250	552	601

Source: TÜRKPATENT, 2021

Table 2.1. Distribution of Patent Applications by IPC Classes (Continue)

Classes	2016		2017		2018		2019		2020		2021	
	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign
A	1719	3701	1300	2723	1684	2828	1535	2889	1965	2468	2162	2154
B	1162	2650	815	1999	941	2077	1042	2134	1012	2073	1294	1826
C	345	2793	218	2309	290	2395	308	2484	329	2148	506	1847
D	262	534	300	314	256	337	259	431	233	325	283	344
E	306	578	219	560	236	541	219	524	228	475	287	392
F	937	1407	874	1078	711	1183	791	1321	613	1096	716	949
G	1037	869	963	589	1034	703	1070	815	1197	743	1562	630
H	794	1092	783	1044	629	1059	598	1176	680	1154	701	990

Source: TÜRKPATENT, 2021

3. METHODS

3.1 Multiple-Criteria Decision-Making

The decision making is not an easy process especially if there is no reliable data and right tools (Li, 2007). Therefore, especially for complex decision problems it is necessary to know and to use the right methods that help decision makers for the best decision. Multiple Criteria Decision Making (MCDM) is one of those qualitative decision-making methods which is changing rapidly and continuously today. It is important for rational decision making as it considers criteria that are often in conflict with each other. For this reason, efforts to develop methods that produce more effective and better results in the academic field continue (Paksoy, 2017).

In the selection processes of alternatives, decision-making methods that allow for the simultaneous evaluation of a large number of qualitative and well-structured criteria in order to make complex and demanding decisions in the selection processes of the alternatives and to make a joint decision by involving many people in the decision-making process, ensure that the decisions to be taken offer the most sensitive and the closest solution (Ömürbek and Şimşek, 2014). MCDM methods are analytical methods that provide the opportunity to evaluate measurable and unmeasurable strategic and operational factors at the same time, and that can involve a large number of people in the decision-making process (Görener, 2009) and it MCDM methods began to be developed in the 1960s to help solve complex decision problems.

MCDM is a method that makes it possible to select the best option out of many simultaneously applied criteria. They are the approaches that provide understanding into determining the most appropriate strategy given the issue and pertinent circumstances, taking into account how many independent components are useful (Hamurcu & Eren, 2017). In addition, they are approaches that may be evaluated by presenting inferences in a common language when the criteria disagree or when a numerical value cannot adequately convey the criterion.

MCDM methods are used in selection processes in many areas such as performance evaluation, warehouse and establishment location selection, supplier selection, supply chain management, financial investment decisions, evaluation of health care wastes, banking performance, employee performance. MCDM methods, which are highly effective in solving complex problems encountered in businesses and organizations, contribute significantly to the performance of businesses by offering better solutions (Lakshmive et.al., 2013).

As of today MCDM methods are famous in many areas such as a social, financial, cultural, and political fields and in many different institutions. MCDM provides different options to the decision makers especially for the conflicting criteria. Steps followed in the MCDM method can be listed as:

- The subject's criteria and potential solutions are identified.
- The criteria's relative importance is defined.
- The options are rated once each alternative has been assessed based on all criteria.

The elements that must be included in the MCDM models used to choose between at least two alternatives are briefly as follows:

- Purpose: It is the desired outcome of the decision process activities by guiding the criteria in accordance with the decision-makers' preferences.
- Decision maker: Refers to the person or group that uses the decision-making authority to choose from alternatives for a specific purpose.
- Criteria: It can be defined as the main features or efficiency parameters used in the evaluation of alternatives. It is used to make selection and sorting in the solution of the decision problem.
- Criterion weights: It can be defined as the criteria's level of importance used in the solution of decision-making problems. Each of the criteria to be used

in the evaluation of alternatives may not be equally important. Therefore, each criterion significance level needs to be determined.

- **Alternatives:** The objective of the application is to describe multiple options with various qualities. The decision-maker is then required to rank or select from these options. The aim is to choose one of the possible alternatives.
- **Decision matrix:** It is the matrix structure in which the main elements such as alternatives, criteria, criterion weights of the problem defined in the decision-making are displayed together. In the columns of the matrix, there are the criteria to be used in solution of the decision-making problem, and the alternatives to be selected in the rows. By using the matrix structure, complex problems become understandable, and the decision problem can be easily solved by evaluating many data related to alternatives and criteria at the same time.

3.2 Entropy Method

The idea of entropy is especially evident since it is used in physics, knowledge theory, math, and several other fields of engineering and science. Entropy, first described by Rudolph Clausius in 1865, to measure unavailability of a system's energy to as well as a measure of disorder. Claude E. Shannon pioneered the term of information entropy. Entropy is a measure of the uncertainties due to the randomness variable in information theory. Under certain conditions, Shannon's entropy implies an absolute limit on the highest expected lossless compression of any communication: Shannon's source coding theorem states that, in the limit, the average length of the shortest possible form to encode the messages in a given alphabet is their entropy divided by the logarithm of the number of symbols in the targeted alphabet (Zhang, 2011).

The Shannon entropy in information theory can be applied to determine the level of disorder and its applicability to information systems. Degree of disorder of the system decreases as the entropy value decreases. One of the objective fixed

weight approaches is the entropy weight method, which bases the index weight on the amount of information (Li, 2011).

Shannon first presented the notion of information entropy in his 1948 publication *A Mathematical Theory of Communication*. Ever since, it has been extensively used in many different industries, including engineering, management, and other professions. According to the concept of information entropy, the information's quantity or quality acquired from the decision-making context is one of the aspects determining the correctness and reliability of a decision-making problem. Entropy is consequently a very important scale when it comes to applying it to various examination or evaluation scenarios in different decision-making processes. In a similar manner, entropy can also be used to estimate the amount of useful information that data itself provides (Wu, 2011).

Entropy theory states that decision-making units (DMUs) can be assessed. Assuming there are m numbers of alternatives and n numbers of evaluation criteria, the decision-making matrix can be described as follows (Wu, 2011):

The steps applying in the entropy method for calculating entropy-based weights are shown as follows (Yavuz&Baki, 2019; Perçin&Sonmez, 2018):

Step 1: Creating the Initial Decision Matrix

For a multi-criteria decision problem with m decision alternatives and n evaluation criteria, the initial decision matrix is formed as follows.

$$X_{m \times n} = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1j} \\ x_{21} & x_{22} & \dots & x_{2j} \\ \vdots & \vdots & \ddots & \vdots \\ x_{i1} & x_{i2} & \dots & x_{ij} \end{bmatrix} \quad (i=1, \dots, m; j=1, \dots, n) \quad (1)$$

Step 2: Normalizing the Initial Decision Matrix

In this step, the normalization process is applied in different ways according to the benefit (2) or cost (3) oriented criteria.

$$P_{ij} = \frac{x_{ij} - x_j^{\min}}{x_j^{\max} - x_j^{\min}} \quad (i = 1, \dots, m; j = 1, \dots, n) \quad (2)$$

$$P_{ij} = \frac{x_j^{\max} - x_{ij}}{x_j^{\max} - x_j^{\min}} \quad (i = 1, \dots, m; j = 1, \dots, n) \quad (3)$$

The obtained values after normalization calculations are shown in the matrix:

$$R = [r_{ij}]_{m \times n} \quad (4)$$

Step 3: Calculating Entropy Values

The entropy value (E_j) of each criterion is calculated by the following equation:

$$E_j = -k \sum_{i=1}^m f_{ij} \ln(f_{ij}) \quad (i=1, \dots, m; j=1, \dots, n) \quad (5)$$

The f_{ij} and k values in the formula are calculated as follows:

$$f_{ij} = \frac{r_{ij}}{\sum_{i=1}^m r_{ij}} \quad (i=1, \dots, m; j=1, \dots, n) \quad (6)$$

$$k = (\ln(m))^{-1} \quad (m: \text{number of alternatives}) \quad (7)$$

In some cases, all f_{ij} values being the same means that the Entropy value for the criteria reaches the highest level ($E_j=1$).

Step 3: Calculating Degree of Differentiation

The degree of variation of the entropy value (d_j) is calculated by the following equation:

$$d_j = 1 - E_j \quad (j=1, \dots, n) \quad (8)$$

Step 4: Calculating Entropy Weights of Criteria

$$W_j = \frac{d_j}{\sum_{j=1}^n d_j} \quad (j=1, \dots, n) \quad (9)$$

Since the entropy weight indicates the degree of useful information, the criterion with a higher result of the calculation is considered to be more important in terms of decision making/evaluation.

3.3 TOPSIS Method

The chosen alternative must be the closest to the positive ideal solution and the furthest from the negative ideal solution, according to the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methodology developed in 1981 by Hwang and Yoon. (Li et al., 2011). The positive ideal solution in this characteristic includes of the best results from the criteria, and the negative ideal solution includes the worst results.

TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) Method ranks the alternatives by determining which ideal solutions are most likely to be positive by maximizing utility and least likely to be negative by reducing cost. The TOPSIS method is used in the evaluation and comparison of the performances of enterprises in an intensely competitive environment, and in the solution of multi-criteria decision-making problems by considering multiple financial ratios (Perçin&Sonmez, 2018).

The basic concept is defining the ideal and negative result for decision-making problem, find a feasible result and rank the alternatives according to the closeness between the feasible and ideal solution respectively (Li, 2011). The steps are as follows (Yavuz&Baki, 2019; Li, 2011; Perçin&Sönmez, 2018):

Step 1: Creating the Initial Decision Matrix

For a multi-criteria decision problem with m decision alternatives and n evaluation criteria, the initial decision matrix is formed as follows.

$$X_{m \times n} = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1j} \\ x_{21} & x_{22} & \dots & x_{2j} \\ x_{i1} & x_{i2} & \dots & x_{ij} \end{bmatrix} \quad (i=1, \dots, m; j=1, \dots, n) \quad (1)$$

Step 2: Normalizing the Initial Decision Matrix

The original matrix must be normalized to guarantee that all of the characteristics are equal and have the same format in order to eliminate the impact of the index dimension and its variation range on evaluation outcomes. The normalized decision matrix is $R=[r_{ij}]_{m \times n}$, and it may be derived as follows:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{j=1}^m x_{ij}^2}} \quad (i = 1, \dots, m; j = 1, \dots, n) \quad (10)$$

Step 3: Determination of the Weighted Normalized Decision Matrix

Weighted normalized decision matrix (V_{ij}) is generated by multiplying the normalized decision matrix by the weights of the criterion (W_j).

$$V_{ij} = r_{ij} \times W_j \quad (i=1, \dots, m; j=1, \dots, n) \quad (11)$$

Step 4: Calculation of Positive and Negative Ideal Reference Points

The greatest weighted evaluation criterion in the V matrix is chosen to establish a positive ideal reference point. The negative ideal reference point is created by taking into account the smallest of the weighted evaluation criteria in the V matrix. Following equations are used to calculate these reference points for benefit and cost criteria.

$$V^+ = (V_1^+, V_2^+, \dots, V_m^+) \quad (12)$$

$$V^- = (V_1^-, V_2^-, \dots, V_m^-) \quad (13)$$

$$V_j^+ = \begin{cases} \max v_{ij}, \text{the benefit indexes} \\ \min v_{ij}, \text{the cost indexes} \end{cases}$$

$$V_j^- = \begin{cases} \max v_{ij}, \text{the cost indexes} \\ \min v_{ij}, \text{the benefit indexes} \end{cases}$$

Step 5: Calculation of Distances to Positive Ideal and Negative Ideal Solutions

The following equations can be used to determine how far the alternatives are from the positive ideal (Si+) and negative ideal (Si-) solutions.

$$S_i^+ = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^+)^2}, (i = 1, \dots, m; j = 1, \dots, n) \quad (14)$$

$$S_i^- = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^-)^2}, (i = 1, \dots, m; j = 1, \dots, n) \quad (15)$$

Step 6: Calculating Proximity to Ideal Reference Point

Following factor determine the relative degree of approximation:

$$C_i = S_i^- / (S_i^+ + S_i^-), (0 \leq C_i \leq 1; i = 1, 2, \dots, m) \quad (16)$$

The alternatives are ranked from largest to smallest and their relevance levels are established based on the values acquired in the previous step. The option with the highest C_i rating is considered as the best option.

3.4 VIKOR Method

With the work done by Opricovic and Tzeng in 2004, the VIKOR technique, which was first proposed by Serafim Opricovic, started to be used to the resolution of multi-criteria decision-making problems. After this time, it can be noticed that a limited number of studies in many fields have employed the method by academic perspectives. The method is called VIKOR which is an abbreviation of the initials of the Slavic phrase VlseKriterijumska Optimizacija I Kompromisno Resenje. The phrase translates to "multi-criteria optimization and compromise solution" (Görener, 2011).

The VIKOR approach makes it possible to sort and choose among alternatives when there are conflicting criteria, while also focusing on providing the best result. With this approach, it is unclear how the outcome will be affected by the maximum group benefit and the minimum regret from competing perspectives (Görener, 2011).

The application steps of this method are as follows:

Step 1: Creating the Initial Decision Matrix

For a multi-criteria decision problem with m decision alternatives and n evaluation criteria, the initial decision matrix is formed as follows:

$$X_{m \times n} = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1j} \\ x_{21} & x_{22} & \dots & x_{2j} \\ x_{i1} & x_{i2} & \dots & x_{ij} \end{bmatrix} \quad (i=1, \dots, m; j=1, \dots, n) \quad (1)$$

Step 2: Determination of the Best (f_i^+) and Worst (f_i^-) Values in the Initial Matrix

The values of f_i^+ and f_i^- varies depending on whether the criterion is cost or benefit type.

$$f_i^+ = \max_j f_{ij}; \quad f_i^- = \min_j f_{ij}; \quad i = 1, 2, \dots, n \quad (\text{Benefit type}) \quad (17)$$

$$f_i^+ = \min_j f_{ij}; \quad f_i^- = \max_j f_{ij}; \quad (i = 1, 2, \dots, n \quad (\text{Cost type}) \quad (18)$$

Step 3: Calculation of Normalized Matrix

After generating the matrix values, the normalization process was applied to purify the unit values and make them comparable.

$$r_{ij} = \frac{f_i^* - x_{ij}}{f_i^* - f_j^-} \quad (19)$$

Step 4: Calculation of Weighted Normalized Matrix

With the help of Equation 18, “Normalization Matrix” and “w” weights are multiplied.

$$V_{ij} = r_{ij}xW_{ij} \quad (20)$$

Step 5: Calculation of Sj and Rj Values

Sj values and Rj values are calculated with the help of equations 19 and 20:

$$S_j = \sum_{k=1}^n \frac{(f_i^+ - f_{ij})W_i}{f_i^+ - f_i^-} \quad (21)$$

$$R_j = \max_j \left(w_j \cdot \frac{f_j^* - x_{ij}}{f_j^* - f_j^-} \right) \quad (22)$$

Step 6: Calculation of Qj Values

The Qj values for each alternative are calculated with the help of the following equation.

$$Q_i = \frac{v.(S_j - S^*)}{(S^-) - (S^*)} + \frac{(1-v).(R^- - R^*)}{(R^-) - (R^*)} \quad (23)$$

The parameters used in the step of calculating the Qi (S+, S- R+, R- and v) are given respectively:

$$S^* = \min_i (S_i) \quad (24)$$

$$S^- = \max_i (S_i) \quad (25)$$

$$R^* = \min_i (R_i) \quad (26)$$

$$R^- = \max_i (R_i) \quad (27)$$

$$v = 0,5 \text{ (constant)} \quad (28)$$

The value of “v” indicates the largest group benefit value, while the value of (1-v) specify the minimum regret weight of the opposing decision makers. In the “VIKOR” method, $v > 0.5$ determines the majority vote (consensus), $v = 0.5$ consensus (consensus), $v < 0.5$ determines the veto, and the “v” value is determined by the group decision by the decision makers.

Step 7: Ranking Qj, Sj, Rj Values

These values are ordered from smallest to largest and the alternative with the minimum Qj value is determined as the best option.

Step 8: Testing the Validity of the Result Obtained

At this phase, two requirements must be satisfied for the option with the minimum Qj value to be suggested as a compromise solution:

- Condition 1-Acceptable advantage: To proof that the two best solutions are significantly different from each other. In the inequality below, A' stands for the best option with the minimum Q value, and A'' for the second-best alternative. The D(Q) value is calculated using the number of alternatives (j).

$$Q_{A'} - Q_{A''} \geq D(Q) \quad (27)$$

$$D(Q) = 1/(j - 1) \quad (28)$$

- Condition 2–Acceptable stability: To show that the resulting compromise solution is stable, the option with the lowest Q value ought to have the lowest score in at least one of the S and R values.

If either of the above two conditions is not met, the proposed set of compromise solutions are given below:

- If the 2nd condition is not met, A' and A'' alternatives,
- If the 1st condition is not met, a compromise solution set consisting of A', A'',..., AM alternatives is suggested. The AM alternative in the proposed solution set is determined as the largest M value satisfying the $Q_{AM} - Q_{A'} < D(Q)$ inequality. Then, ranking is done regarding to the Q values in the compromise solution set. The best alternative is one of the alternatives with the lowest Q value.

3.5 ARAS Method

Additive Ratio Assessment (ARAS) method was developed by Z. Turskis and E. K. Zavadskas as a novel way for resolving MCDM issues. The classic approach to decision analysis, called Multi-Criteria Decision Making (MCDM), emphasizes subjective classification (sequencing). Existing MCDM procedures compare the efficiency constants of existing solutions to the value of the ideal positive alternative solution or take into account the distances between the ideal positive and ideal negative solutions. The efficiency constants of the research-related alternatives and the best alternative the researcher has added to the decision problem are compared using the ARAS methodology (Yıldırım, 2015).

Step 1: Creating the Initial Decision Matrix

The initial decision matrix for a multi-criteria decision problem with m decision alternatives and n evaluation criteria is constructed as follows. The matrix has the following values: m for the number of alternatives, n for the number of criteria, x_{ij} for the performance value of the i alternative according to the j criterion, and x_{0j} for the j criterion's ideal value. Formula (30) is used if the value of the optimal j criterion is uncertain (Ecer, 2016):

$$X = \begin{bmatrix} x_{01} & x_{02} & \dots & x_{0n} \\ x_{11} & x_{12} & \dots & x_{1n} \\ \vdots & \vdots & \dots & \vdots \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix}; i = 0, 1, \dots, m; j = 1, 2, \dots, n \quad (29)$$

$$\begin{cases} \text{If } \max_i x_{ij}, & x_{0j} = \max_i x_{ij} \\ \text{If } \min_i x_{ij}^*, & x_{0j} = \min_i x_{ij}^* \end{cases} \quad (30)$$

Step 2: Normalization Matrix

The purpose of this step is to standardize the criteria with different dimensions by performing the normalization process. In normalization, Formula (32) is used for the criteria that are desired to be maximum, and Formula (33) is used for criteria that are desired to be minimum.

$$\bar{x}_{ij} = \frac{x_{ij}}{\sum_{i=0}^m x_{ij}} \quad (31)$$

$$\bar{x}_{ij} = \frac{1/x_{ij}}{\sum_{i=0}^m 1/x_{ij}} \quad (32)$$

Step 3: Creating the Weighted Normalized Decision Matrix

The weighted normalized matrix is generated by multiplying the normalized matrix by the criterion weights.

$$S_i = \sum_{j=1}^n x_{ij} \quad i = 0, 1, \dots, m \quad (33)$$

Step 5: Calculating the Benefit Rating and Obtaining the Rank

By comparing an alternative's optimality function value to the optimality function value of the best alternative, the degree of utility can determine. The calculation is carried out by applying the formula numbered, even though S_0 is the best optimality function value.

$$K_i = \frac{S_i}{S_0}; \quad i = 0, 1, \dots, m \quad (34)$$

3.6 BORDA Count Method

Jean-Charles de Borda proposed the BORDA COUNT technique in 1784 as one of the voting methods under the social election concept. Method of BORDA Count rates the alternatives based on the decision-makers' collective individual preferences. Moreover, this method is one of the data aggregation techniques that can be applied to reduce two or more ranking forms to a single rational ranking. The method classifier, which is easy to implement, does not require prior knowledge of performance (Omürbek & Akçakaya, 2018).

In BORDA Counting method, BORDA values are obtained by assigning zero points to the least preferred alternative by the decision maker, 1 point to the next, and $n-1$ points (n : total number of alternatives) to the most preferred alternative. Alternative BORDA score is formed by summing each BORDA value of the alternative. Alternatives are ranked based on their BORDA scores. The best alternative is that which has the highest BORDA score (Ludwin, 1978). BORDA Count method steps are as follows:

Step 1: Ranking the Alternatives

Alternatives are ordered from least preferred to most preferred by the decision maker.

Step 2: Obtaining BORDA Values

The ranked alternatives (starting with the least preferred) are given points starting from 0. These scores form the BORD value of the alternatives

Step 3: Obtaining the BORDA Score

BORDA score is obtained by summing all BORDA values of each alternative.

Step 4: Ranking BORDA Scores

The obtained BORDA scores are ordered from high to low. The alternative with the highest BORDA score is determined as the best alternative.



4. APPLICATION

4.1 Identifying the Problem

The objective of the thesis study is to identify the qualitative factor that affect the value of the high value-added IPC classes in the chemical sector and to rank these patents in accordance with their values.

4.2 Determination of Criteria

There are many quantitative and qualitative factors that affect a patent, but for the purpose of the thesis, qualitative criteria that are effective have been taken into account. Eight criteria were chosen for the study after taking into account studies in the literature, expert legal counsel, and academics' views on patents. The table below lists these requirements along with their definitions:

Table 4.1. Criteria Used in the Study and Their Explanations

Criteria	Definition	Cost/Benefit
Number of Claims	The number of elements that the invention is desired to protect.	Benefit
Remaining Term of the Patent	The remaining time until the protection of the applied patent expires.	Benefit
Number of Protected Countries	The number of countries that have patent protection.	Benefit
Number of Inventors	The number of inventors of the patented product.	Benefit
Patent Agent/Attorney Presence	Presence of a patent agency/attorney involved in the patenting process	Benefit
Number of Patents of the Applicant	The number of applicant of the patented product.	Benefit
Backward Citations	The reference of the related patent to previous patents in quotation marks.	Cost
Forward Citations	The number of citations a patent has received by subsequent patents.	Benefit

In line with these data, the criteria were determined as follows:

- ✓ C1: Number of Claims
- ✓ C2: Remaining Term of the Patent
- ✓ C3: Number of Protected Countries
- ✓ C4: Number of Inventors
- ✓ C5: Patent Agent/Attorney Presence
- ✓ C6: Number of Patents of the Applicant
- ✓ C7: Backward Citations
- ✓ C8: Forward Citations

4.3 Determination of Alternatives

For the study, each of the patents with IPC codes determined in the chemical industry between 2015-2020 were carefully examined. Total of 107 alternatives were evaluated and shown as A1, A2, A3..., A107. Name of these alternatives (patents) can be seen in the appendix.

4.4 Obtaining Data

All the criteria of the alternatives examined in the study were found through the patent attorney and with the help of various patent sites and are shown in the table given below:

Table 4.2. Data Used in the Study

Alternatives	Criteria							
	C1	C2	C3	C4	C5	C6	C7	C8
A1	4	19	1	1	1	8	0	0
A2	1	19	1	3	1	4	0	0
A3	23	19	1	3	1	1319	0	0
A4	13	19	1	5	1	5	0	0
A5	14	19	1	1	1	1	0	0
A6	9	19	1	4	1	23	0	0
A7	19	19	1	1	1	1	0	0

Table 4.2. Data Used in the Study (continued)

A8	5	18	1	4	1	5	0	0
A9	3	18	1	2	1	1	0	0
A10	1	18	1	2	0	4	0	0
A11	1	18	1	2	0	1	0	0
A12	4	18	1	1	1	56	0	0
A13	1	18	1	2	1	48	0	0
A14	13	18	1	2	0	64	0	0
A15	20	18	1	2	1	75	0	0
A16	6	18	1	2	1	4	0	0
A17	8	18	1	2	1	1	0	0
A18	6	18	1	2	1	10	0	0
A19	3	18	1	4	1	10	0	0
A20	8	18	1	5	1	2	0	0
A21	4	17	1	1	0	1	0	0
A22	1	17	1	5	1	36	2	0
A23	17	17	1	2	1	10	0	0
A24	16	17	1	5	1	21	0	0
A25	3	17	1	1	0	8	0	0
A26	6	17	1	5	1	4	0	0
A27	3	17	1	1	0	8	1	0
A28	18	17	1	3	1	30	4	0
A29	7	17	1	1	1	48	0	0
A30	2	17	1	2	1	2	0	0
A31	5	17	1	2	1	1	0	0
A32	10	17	1	1	1	1	2	0
A33	18	17	1	2	1	1	0	0
A34	17	17	1	3	1	5	7	0
A35	6	17	1	3	1	261	0	0
A36	7	17	1	3	0	223	15	0
A37	4	17	1	2	1	261	0	0
A38	5	17	1	2	1	1	1	0
A39	3	17	1	3	1	10	3	0
A40	17	17	1	4	1	16	4	0
A41	11	17	1	1	1	9	0	0

Table 4.2. Data Used in the Study (continued)

A42	11	17	1	2	1	30	2	0
A43	12	17	1	2	0	223	7	0
A44	6	17	1	2	1	16	0	0
A45	4	17	1	4	1	38	1	0
A46	15	17	1	2	1	30	5	0
A47	9	17	2	2	1	19	2	0
A48	7	17	1	3	1	1	0	0
A49	5	17	1	1	0	15	0	0
A50	9	17	1	4	1	15	0	0
A51	15	16	1	1	0	11	0	0
A52	26	16	3	7	0	93	7	0
A53	4	16	1	1	1	2	5	0
A54	13	16	1	3	1	11	3	0
A55	28	16	2	5	1	93	9	0
A56	7	16	1	3	1	261	0	0
A57	22	16	2	4	1	43	1	0
A58	3	16	1	1	1	11	2	0
A59	11	16	1	2	1	261	0	0
A60	8	16	1	2	1	261	0	0
A61	12	16	1	3	0	223	4	0
A62	1	16	1	1	1	1	0	0
A63	15	16	1	6	1	21	4	0
A64	2	16	1	6	1	261	0	0
A65	2	15	1	2	1	1	0	0
A66	15	15	1	1	1	21	0	0
A67	8	15	1	4	0	1	0	0
A68	6	15	1	3	1	1	0	0
A69	1	15	1	2	1	1	2	0
A70	6	15	2	6	0	223	16	0
A71	4	15	1	4	1	1	0	0
A72	2	15	1	1	1	1	0	0
A73	13	15	1	1	1	1	0	0
A74	1	15	1	4	1	1	0	0
A75	10	15	1	4	1	261	1	0

Table 4.2. Data Used in the Study (continued)

A76	1	15	1	4	1	72	6	1
A77	1	15	1	4	1	72	7	0
A78	4	15	1	1	1	2	0	0
A79	6	15	1	8	1	261	0	0
A80	18	15	1	2	1	2	0	0
A81	1	15	1	3	1	1	0	0
A82	7	15	1	2	1	2	0	0
A83	15	14	1	4	1	6	0	0
A84	3	14	1	2	1	1	0	0
A85	23	14	1	1	1	5	0	0
A86	23	14	4	3	1	93	21	13
A87	14	14	1	1	0	2	0	0
A88	15	14	6	1	0	2	7	1
A89	5	14	1	5	1	10	0	0
A90	14	13	7	2	1	1	14	1
A91	1	18	1	1	1	48	0	0
A92	10	18	1	1	1	6	0	0
A93	1	18	1	1	0	10	0	0
A94	9	18	1	1	1	4	0	0
A95	10	18	1	2	0	1	0	0
A96	13	18	1	5	1	75	0	0
A97	1	18	1	3	1	10	0	0
A98	5	18	1	5	1	2	0	0
A99	2	18	1	3	1	10	0	0
A100	19	18	1	2	0	1	0	0
A101	7	18	1	4	1	5	0	0
A102	10	16	1	1	0	1	0	0
A103	8	16	1	2	1	48	0	0
A104	9	14	1	1	1	1	0	0
A105	9	15	1	7	1	261	0	0
A106	35	15	1	2	1	261	0	0
A107	2	14	1	1	1	2	0	0

4.5 Analysis and Findings

The results of the alternative rankings using the TOPSIS, VIKOR, ARAS, and BORDA Count techniques are shown below, along with the criteria weights determined by using the entropy method.

4.5.1 Determining the Weights of Criteria Affecting Patent Value by Entropy Method

The weight results calculated by the Entropy method, all application steps of which are given in appendix are provided in the table given below:

Table 4.3. Weights of Criteria Calculated by Entropy Method

Order	Number of Criteria	Name of Criteria	Weight	Percent (%)
1	C8	Forward Citations	0,377	37,743
2	C3	Number of Protected Countries	0,270	27,008
3	C1	Number of Claims	0,143	14,309
4	C6	Number of Patents of the Applicant	0,132	13,155
5	C4	Number of Inventors	0,047	4,693
6	C5	Patent Agent/Attorney Presence	0,020	1,960
7	C2	Remaining Term of the Patent	0,009	0,897
8	C7	Backward Citations	0,002	0,234

Considering the results of the entropy-based criteria weighting calculations, the forward citation criterion (C8) is seen as the first and the most important criterion with 37.74%. Number of protected countries criterion (C3) is determined as the second most important criterion with approximately 27.01%, followed by number of claims criterion (C1) with 14.31%. The last and the first criterion with

the lowest weight is backward citation criterion (C7) with 0.23%, followed by the remaining term of the patent criterion (C2) with 0.89% and patent agent/attorney presence criterion (C5) with 1.96%, respectively. These calculated criteria weights are used where necessary for other ranking methods.

4.5.2 Ranking of Alternatives with Using TOPSIS Method

The TOPSIS methodology was applied by using the weights obtained in the entropy method. The TOPSIS method was used to rank the alternatives after the weights was determined. All application steps are given in appendix. The results of the ranking methods and the value of alternatives, namely patents, are ranked. According to the results of the TOPSIS method, the proximity degrees and rankings of the alternatives according to the ideal solution are shown in the table below.

Table 4.4. Degrees of Proximity and Ranking of Alternatives to the Ideal Solution

Alternatives	Degrees of Proximity to the Ideal Solution (C*)	Rank
A1	0,011	86
A2	0,009	92
A3	0,219	3
A4	0,038	42
A5	0,038	41
A6	0,027	52
A7	0,052	23
A8	0,017	70
A9	0,009	94
A10	0,005	105
A11	0,005	106
A12	0,015	76
A13	0,012	83
A14	0,037	44
A15	0,057	16
A16	0,016	75
A17	0,022	60
A18	0,016	74
A19	0,014	80

Table 4.4. Degrees of Proximity and Ranking of Alternatives to the Ideal Solution (continued)

A20	0,026	55
A21	0,009	90
A22	0,017	71
A23	0,047	32
A24	0,046	34
A25	0,007	99
A26	0,021	62
A27	0,007	101
A28	0,050	26
A29	0,021	63
A30	0,008	97
A31	0,014	78
A32	0,027	50
A33	0,049	28
A34	0,047	31
A35	0,052	22
A36	0,046	33
A37	0,051	25
A38	0,014	79
A39	0,011	84
A40	0,048	30
A41	0,030	48
A42	0,031	47
A43	0,053	20
A44	0,017	73
A45	0,017	72
A46	0,042	37
A47	0,049	29
A48	0,020	64
A49	0,013	81
A50	0,027	54
A51	0,041	39
A52	0,110	5

Table 4.4. Degrees of Proximity and Ranking of Alternatives to the Ideal Solution (continued)

A53	0,011	88
A54	0,036	45
A55	0,089	7
A56	0,053	19
A57	0,074	8
A58	0,009	96
A59	0,057	13
A60	0,054	17
A61	0,053	18
A62	0,006	104
A63	0,045	35
A64	0,053	21
A65	0,008	98
A66	0,041	38
A67	0,023	59
A68	0,017	69
A69	0,007	100
A70	0,064	10
A71	0,015	77
A72	0,007	102
A73	0,035	46
A74	0,012	82
A75	0,057	15
A76	0,073	9
A77	0,018	68
A78	0,011	87
A79	0,057	14
A80	0,049	27
A81	0,009	93
A82	0,019	67
A83	0,042	36
A84	0,009	95
A85	0,063	11

Table 4.4. Degrees of Proximity and Ranking of Alternatives to the Ideal Solution (continued)

A86	0,770	1
A87	0,038	43
A88	0,209	4
A89	0,019	65
A90	0,238	2
A91	0,011	85
A92	0,027	49
A93	0,004	107
A94	0,024	56
A95	0,027	51
A96	0,041	40
A97	0,009	91
A98	0,019	66
A99	0,010	89
A100	0,052	24
A101	0,021	61
A102	0,027	53
A103	0,024	58
A104	0,024	57
A105	0,058	12
A106	0,105	6
A107	0,007	103

According to the TOPSIS method results, the first and highest value alternative was determined as the A86 alternative. The following alternatives are A90, A3, A88 and A52 respectively. The last and lowest value alternative was determined as the A93 alternative.

4.5.3 Ranking of Alternatives with Using VIKOR Method

VIKOR technique was applied by using weights obtained in the entropy method. All application steps are given in appendix. S_j , R_j , Q_j values and their ranking calculated after the application are shown in table below.

Table 4.5. S_j , R_j and Q_j Values

Alternatives	S	R	Q
A1	0,956	0,377	0,974
A2	0,955	0,377	0,973
A3	0,732	0,377	0,798
A4	0,891	0,377	0,923
A5	0,914	0,377	0,941
A6	0,913	0,377	0,940
A7	0,893	0,377	0,925
A8	0,933	0,377	0,956
A9	0,955	0,377	0,973
A10	0,983	0,377	0,995
A11	0,983	0,377	0,995
A12	0,952	0,377	0,971
A13	0,959	0,377	0,976
A14	0,927	0,377	0,951
A15	0,877	0,377	0,912
A16	0,943	0,377	0,963
A17	0,934	0,377	0,957
A18	0,942	0,377	0,963
A19	0,941	0,377	0,962
A20	0,914	0,377	0,941
A21	0,979	0,377	0,992
A22	0,942	0,377	0,963
A23	0,897	0,377	0,928
A24	0,880	0,377	0,914
A25	0,983	0,377	0,995
A26	0,924	0,377	0,949
A27	0,983	0,377	0,995
A28	0,885	0,377	0,918
A29	0,942	0,377	0,963

Table 4.5. S_j, R_j and Q_j Values (continued)

A30	0,961	0,377	0,978
A31	0,949	0,377	0,968
A32	0,934	0,377	0,957
A33	0,894	0,377	0,925
A34	0,892	0,377	0,924
A35	0,912	0,377	0,939
A36	0,933	0,377	0,956
A37	0,927	0,377	0,951
A38	0,949	0,377	0,968
A39	0,950	0,377	0,969
A40	0,884	0,377	0,917
A41	0,929	0,377	0,953
A42	0,921	0,377	0,946
A43	0,917	0,377	0,944
A44	0,943	0,377	0,964
A45	0,936	0,377	0,958
A46	0,904	0,377	0,933
A47	0,885	0,377	0,918
A48	0,933	0,377	0,956
A49	0,973	0,377	0,988
A50	0,917	0,377	0,943
A51	0,933	0,377	0,956
A52	0,749	0,377	0,812
A53	0,961	0,377	0,978
A54	0,909	0,377	0,937
A55	0,780	0,377	0,836
A56	0,909	0,377	0,937
A57	0,816	0,377	0,864
A58	0,964	0,377	0,980
A59	0,899	0,377	0,929
A60	0,911	0,377	0,939
A61	0,912	0,377	0,939
A62	0,974	0,377	0,988
A63	0,880	0,377	0,914

Table 4.5. S_j, R_j and Q_j Values (continued)

A64	0,910	0,377	0,938
A65	0,964	0,377	0,980
A66	0,914	0,377	0,941
A67	0,945	0,377	0,965
A68	0,941	0,377	0,962
A69	0,969	0,377	0,984
A70	0,875	0,377	0,910
A71	0,942	0,377	0,963
A72	0,971	0,377	0,986
A73	0,925	0,377	0,949
A74	0,955	0,377	0,973
A75	0,891	0,377	0,923
A76	0,920	0,348	0,885
A77	0,949	0,377	0,968
A78	0,962	0,377	0,979
A79	0,881	0,377	0,915
A80	0,897	0,377	0,927
A81	0,962	0,377	0,978
A82	0,943	0,377	0,964
A83	0,897	0,377	0,928
A84	0,961	0,377	0,978
A85	0,884	0,377	0,917
A86	0,351	0,135	0,000
A87	0,941	0,377	0,962
A88	0,684	0,348	0,701
A89	0,932	0,377	0,955
A90	0,619	0,348	0,650
A91	0,966	0,377	0,982
A92	0,932	0,377	0,955
A93	0,989	0,377	1,000
A94	0,937	0,377	0,959
A95	0,946	0,377	0,966
A96	0,886	0,377	0,919
A97	0,956	0,377	0,974

Table 4.5. S_j, R_j and Q_j Values (continued)

A98	0,927	0,377	0,951
A99	0,952	0,377	0,971
A100	0,908	0,377	0,936
A101	0,925	0,377	0,949
A102	0,955	0,377	0,973
A103	0,933	0,377	0,956
A104	0,943	0,377	0,964
A105	0,875	0,377	0,911
A106	0,799	0,377	0,851
A107	0,972	0,377	0,987

As mentioned earlier in section 3.4, the alternative compromise solution with the smallest Q_j value is recommended and should be tested when applying the VIKOR method. Acceptable advantage and acceptable stability conditions were tested, and the validity of the results is shown in Table 4.6. (Tested conditions are shown for the first and last 10 patents in the alternative order).

Table 4.6. Ranking of Q_{A'} - Q_{A''}, S, R and Q Values

Q Value	Ranking	Q_{A'} - Q_{A''} Value	S_{Rank}	R_{Rank}	Q_{Rank}
0,000	A86	0,650	1	1	1
0,650	A90	0,051	2	2	2
0,701	A88	0,097	3	2	3
0,798	A3	0,014	4	5	4
0,812	A52	0,024	5	5	5
0,836	A55	0,015	6	5	6
0,851	A106	0,013	7	5	7
0,864	A57	0,021	8	5	8
0,885	A76	0,025	43	2	9
0,910	A70	0,000	9	5	10
0,986	A72	0,001	98	5	98
0,987	A107	0,001	99	5	99
0,988	A49	0,000	100	5	100

Table 4.6. Ranking of QA' - QA'', S, R and Q Values

0,988	A62	0,004	101	5	101
0,992	A21	0,003	102	5	102
0,995	A25	0,000	103	5	103
0,995	A27	0,000	104	5	104
0,995	A10	0,000	105	5	105
0,995	A11	0,005	106	5	106
1,000	A93		107	5	107

In order to meet the first condition, the acceptable advantage condition, the difference between the two best options ($QA' - QA''$) must be at least DQ value (0.009). Considering the results in Table 4.6 it is seen that almost all of the first 10 patents meet this condition.

The alternative with the lowest Q value must also have the lowest score in minimum one of the S and R values in order to satisfy the second criterion, known as the acceptable stability condition. As seen in the table, the first-ranked A86 alternative has the same lowest score in all three values. In addition, it is seen that almost all of the first 10 patents also meet this condition.

4.5.4 Ranking of Alternatives with Using ARAS Method

The ARAS method was applied by using the weights obtained in the entropy method. All application steps are given in appendix. Si values (optimality function), Ki values (utility degree) and the ranking of the alternatives based on these values are given in the table 4.7.

Table 4.7. Ranking of S_i and K_i Values

Alternatives	S_i	$K_i (S_i/S_0)$	Ranking
Optimum	0,213	1,000	-
A1	0,003	0,015	86
A2	0,003	0,014	95
A3	0,029	0,136	3
A4	0,005	0,024	40
A5	0,005	0,021	47
A6	0,005	0,022	44
A7	0,005	0,025	37
A8	0,004	0,018	71
A9	0,003	0,015	91
A10	0,003	0,012	105
A11	0,003	0,012	106
A12	0,004	0,019	60
A13	0,004	0,017	76
A14	0,005	0,025	31
A15	0,007	0,032	23
A16	0,004	0,017	78
A17	0,004	0,018	68
A18	0,004	0,017	73
A19	0,004	0,017	79
A20	0,004	0,020	53
A21	0,003	0,013	100
A22	0,004	0,019	62
A23	0,005	0,025	34
A24	0,006	0,027	29
A25	0,003	0,013	101
A26	0,004	0,019	57
A27	0,003	0,014	94
A28	0,006	0,028	26
A29	0,004	0,020	52
A30	0,003	0,014	96
A31	0,003	0,016	83
A32	0,004	0,019	58

Table 4.7. Ranking of Si and Ki Values (continued)

A33	0,005	0,025	36
A34	0,005	0,025	32
A35	0,008	0,038	18
A36	0,007	0,035	22
A37	0,008	0,036	21
A38	0,004	0,017	77
A39	0,003	0,016	81
A40	0,006	0,027	30
A41	0,004	0,020	55
A42	0,005	0,023	43
A43	0,008	0,038	20
A44	0,004	0,018	70
A45	0,004	0,021	49
A46	0,005	0,025	33
A47	0,006	0,030	24
A48	0,004	0,018	67
A49	0,003	0,015	85
A50	0,005	0,021	48
A51	0,005	0,022	46
A52	0,013	0,059	6
A53	0,003	0,015	88
A54	0,005	0,023	42
A55	0,011	0,051	8
A56	0,008	0,039	15
A57	0,009	0,043	11
A58	0,003	0,015	87
A59	0,009	0,041	14
A60	0,008	0,039	16
A61	0,008	0,039	17
A62	0,003	0,012	104
A63	0,006	0,028	28
A64	0,008	0,038	19
A65	0,003	0,014	98
A66	0,005	0,024	41

Table 4.7. Ranking of Si and Ki Values (continued)

A67	0,004	0,018	63
A68	0,004	0,017	75
A69	0,003	0,014	99
A70	0,010	0,046	9
A71	0,004	0,017	80
A72	0,003	0,013	103
A73	0,004	0,021	50
A74	0,003	0,015	90
A75	0,009	0,043	12
A76	0,017	0,082	5
A77	0,004	0,021	51
A78	0,003	0,015	92
A79	0,009	0,042	13
A80	0,005	0,025	35
A81	0,003	0,014	97
A82	0,004	0,017	74
A83	0,005	0,025	38
A84	0,003	0,014	93
A85	0,006	0,028	27
A86	0,183	0,860	1
A87	0,004	0,020	54
A88	0,028	0,130	4
A89	0,004	0,019	61
A90	0,030	0,140	2
A91	0,003	0,016	82
A92	0,004	0,019	59
A93	0,003	0,012	107
A94	0,004	0,018	66
A95	0,004	0,018	64
A96	0,006	0,030	25
A97	0,003	0,015	89
A98	0,004	0,018	65
A99	0,003	0,015	84
A100	0,005	0,024	39
A101	0,004	0,019	56

Table 4.7. Ranking of Si and Ki Values (continued)

A102	0,004	0,017	72
A103	0,005	0,022	45
A104	0,004	0,018	69
A105	0,009	0,043	10
A106	0,012	0,057	7
A107	0,003	0,013	102

A86 alternative is determined as the first alternative which has highest value according to the ranking of alternatives with the ARAS method, followed by A90, A3, A88 and A76 alternatives, respectively. The last and lowest value alternative was determined as the A93 alternative.

4.5.5 Ranking of Alternatives with Using BORDA Count Method

BORDA Count method was applied to reduce the rankings of alternatives with TOPSIS, VIKOR and ARAS methods to a single rational ranking. All steps with ranking and BORDA values of each method are shown in the appendix. The table below shows the score of each alternative and the ranking of the alternatives based on these scores.

Table 4.8. Ranking of Alternatives According to BORDA Score

Alternative	BORDA Score	Order
A86	318	1
A90	315	2
A3	311	3
A88	310	4
A52	305	5
A106	301	6
A55	300	7
A76	298	8
A57	294	9
A70	292	10
A105	288	11
A79	279	12
A75	273	13

Table 4.8. Ranking of Alternatives According to BORDA Score (continued)

A15	270	14
A85	267	15
A59	265	16
A56	255	17
A60	253	18
A28	251	19
A47	249	20
A61	249	20
A64	247	22
A35	245	23
A63	245	23
A24	244	25
A40	244	25
A43	238	27
A7	237	28
A96	236	29
A34	235	30
A80	233	31
A33	232	32
A23	227	33
A100	227	33
A37	226	35
A46	221	36
A83	220	37
A4	217	38
A36	212	39
A66	203	40
A54	201	41
A14	198	42
A5	192	43
A6	187	44
A42	187	44
A51	179	46
A73	179	46
A50	177	48

Table 4.8. Ranking of Alternatives According to BORDA Score (continued)

A20	173	49
A41	167	50
A103	163	51
A92	160	52
A87	159	53
A26	157	54
A101	157	54
A32	153	56
A89	143	57
A98	140	58
A45	139	59
A29	138	60
A94	137	61
A17	134	62
A48	132	63
A95	131	64
A67	125	65
A77	125	65
A8	124	67
A104	123	68
A22	121	69
A68	114	70
A102	113	71
A18	108	72
A44	107	73
A82	107	73
A12	104	75
A16	98	76
A19	98	76
A71	95	78
A38	87	79
A31	84	80
A39	77	81
A13	74	82
A99	68	83

Table 4.8. Ranking of Alternatives According to BORDA Score (continued)

A74	67	84
A1	63	85
A91	58	86
A49	55	87
A53	55	87
A97	54	89
A9	51	90
A2	50	91
A78	49	92
A58	43	93
A84	42	94
A30	39	95
A81	39	95
A65	31	97
A21	29	98
A69	25	99
A27	22	100
A25	18	101
A72	18	101
A107	17	103
A62	12	104
A10	6	105
A11	3	106
A93	0	107

With the BORDA Count method applied at the end, the first and best alternative was determined as the A86 alternative, while the A93 alternative was determined as the last and worst alternative.

All results are compatible with each other and these rankings have been combined and evaluated in the results and evaluation section.

5. RESULTS AND DISCUSSION

Patent valuation plays an important role in determining many strategic decisions of companies and therefore increasing their income and profits. In this respect, when the literature is examined, it is remarkable that there are few studies on patent valuation and that very few of these studies use MCDM techniques. In addition, there has not been much work on patent valuation or these studies are not accessible, except for material selection and a few chemical engineering applications within the scope of the chemical industry. This is very significant because there have been very few fields, inventions and patents that the chemical industry has not been involved in recent years. Although the qualitative features of the patent used as criteria in this study are used in other studies, and this is the first study which analyzed 107 patent application in chemical sector so far. These reasons make this study unique in terms of contributing to the literature. To determine the importance of these criteria and their superiority to each other, criteria weights were calculated using the Entropy method.

Considering the results of the criteria weights calculated by the entropy method, the forward citation criterion (C8) was determined as the first and most important criterion with 37.74%. This is followed by the criterion for the number of protected countries (C3) with 27.01% and the criterion for the number of claims (C1) with 14.31%. The criterion in the last place with the lowest weight was the backward citation criterion (C7) with 0.23%. These calculated criteria weights were used for other ranking methods.

The alternatives whose criterion weights were calculated were ranked from the best alternative to the worst alternative with TOPSIS, VIKOR, ARAS methods, respectively. Although the results were similar, a single ranking was determined by taking the averages of the other methods with the BORDA Count method. The option with the biggest patent value consider as best alternative. The A86 alternative was found to be best alternative and the A93 alternative to be worst alternative as a result of each methodology. In addition, in Table 4.9 below, the best and worst 15 alternatives in the rankings of all methods are shown side by side. It seems clear that alternative rankings yielded very similar results. This has also tested the reliability of the application.

Since there are too many alternatives to give information about all of them individually, the best and worst 15 alternatives are specified. The data of criteria for best and worst alternatives shown in table 4.10.

Table 4.9. Best and Worst Alternatives for Each Method

	TOPSIS	VIKOR	ARAS	BORDA
Order	Best 15 Alternatives			
1	A86	A86	A86	A86
2	A90	A90	A90	A90
3	A3	A88	A3	A3
4	A88	A3	A88	A88
5	A52	A52	A76	A52
6	A106	A55	A52	A55
7	A55	A106	A106	A106
8	A57	A57	A55	A57
9	A76	A76	A70	A76
10	A70	A70	A105	A70
11	A85	A105	A57	A105
12	A105	A15	A75	A85
13	A59	A63	A79	A15
14	A79	A24	A59	A79
15	A75	A79	A56	A75
Order	Worst 15 Alternatives			
93	A81	A78	A84	A81
94	A9	A65	A27	A30
95	A84	A58	A2	A84
96	A58	A91	A30	A58
97	A30	A69	A81	A21
98	A65	A72	A65	A65
99	A25	A107	A69	A69
100	A69	A49	A21	A72
101	A27	A62	A25	A25
102	A72	A21	A107	A107
103	A107	A25	A72	A27
104	A62	A27	A62	A62
105	A10	A10	A10	A10
106	A11	A11	A11	A11
107	A93	A93	A93	A93

Table 4.10. Data of Criteria for Best and Worst Alternatives

	Criteria							
Alternatives	C8	C3	C1	C6	C4	C5	C2	C7
A86	13	4	23	93	3	1	14	21
A90	1	7	14	1	2	1	13	14
A3	0	1	23	1319	3	1	19	0
A88	1	6	15	2	1	0	14	7
A52	0	3	26	93	7	0	16	7
A55	0	2	28	93	5	1	16	9
A106	0	1	35	261	2	1	15	0
A57	0	2	22	43	4	1	16	1
A76	1	1	1	72	4	1	15	6
A70	0	2	6	223	6	0	15	16
A105	0	1	9	261	7	1	15	0
A85	0	1	23	5	1	1	14	0
A15	0	1	20	75	2	1	18	0
A79	0	1	6	261	8	1	15	0
A75	0	1	10	261	4	1	15	1
A81	0	1	1	1	3	1	15	0
A30	0	1	2	2	2	1	17	0
A84	0	1	3	1	2	1	14	0
A58	0	1	3	11	1	1	16	2
A21	0	1	4	1	1	0	17	0
A65	0	1	2	1	2	1	15	0
A69	0	1	1	1	2	1	15	2
A72	0	1	2	1	1	1	15	0
A25	0	1	3	8	1	0	17	0
A107	0	1	2	2	1	1	14	0
A27	0	1	3	8	1	0	17	1
A62	0	1	1	1	1	1	16	0
A10	0	1	1	4	2	0	18	0
A11	0	1	1	1	2	0	18	0
A93	0	1	1	10	1	0	18	0

In the table, it is seen that all criteria values of the first 15 patents, except for the C2 criterion, are much higher than the last 15 patents. The C2 criterion, the remaining term of patent criterion, had almost the same value for each alternative as it was studied with patents over a 5-year period (2015-2020). For this reason, criterion C2 was expected to be less important. As a proof of this expectation, it can be shown that it is in the second place from the last as a result of the criterion weight calculation.

Looking at the remaining criteria, the ranking of the criteria weights and the criteria values of the alternatives overlap. Considering the criteria one by one;

C8 (Forward Citation): Number of forward citation is the number of citations received by a patent by subsequent patents. While this number can go up to 13 in the best alternatives, it has only zero value in the worst alternatives. The higher the number of forward citations, the higher the value of the patent. This result is compatible with the literature.

C3 (Protected Countries): The best alternatives are generally protected in more than one country, while the worst alternatives are protected in only one country. The fact that it is protected in more than one country indicates that the patent has developed internationally, thus increasing its added value. At the same time, it indicates that the patented product carries an important idea that is worth protecting in more than one country, which is an element that increases the value of the patent. This result is also compatible with the literature.

C1 (Number of Claims): The number of patent claims shows the scope of the patent's protection. The range of patent protection for the underlying patent right is anticipated to be wider if a patent has more claims. While the values of the best alternatives in this criterion ranged from 1 to 35, the average was determined as 17.4. The values of the worst alternatives in this criterion vary between 1 and 4, while the average is 2. These results show that the best alternatives have more value than the worst alternatives, proving that they agree with the literature.

C6 (Number of Patents of the Applicant): It is seen that the applicants have much more patents with a big difference in the best alternatives. If a company, school or person has more than one or more patent, it can be attributed to the fact that that institution/person is knowledgeable and reliable about the patent.

It also means they have more experience with the value of a patent. In this context, the result obtained is in agreement with the literature.

C4 (Number of Inventors): The high number of inventors means that there is more than one point of view on the basis of the innovative idea, which is the essence of the patent, and on the examination/evaluation of the idea. Participation by several inventors in a research project increases the importance of the relevant technology to the patent holder, and this factor can improve the quality of a patent in terms of the technology it covers. Thus, a big difference can be made in the development of the invention and the patent even before the patent is obtained.

Although there is no extreme difference between the best alternative and the worst alternatives for the values in the C4 criterion, the number of inventors can reach up to 8 in the best alternatives. The results obtained according to the data are in agreement with the literature.

C5 (Patent Agent/Attorney Presence): Values for this criterion are evaluated as 1 or 0, that is, whether there is a patent attorney or not. Patent agency/attorney are institutions/persons who have a scientific degree, educated and qualified in the law related to patent and intellectual property rights. It provides advice on the procedures in the preparation and process of the patent application. Thus, the presence of a patent agency or attorney is crucial to the process of preparing a patent. According to the data, there is no big difference between the values of alternatives of best and the worst, only a negligible difference of 0.2 is obtained when their average is taken. It has a less important place among the evaluated criteria, and the calculated criterion weight proves this.

In the literature on patent valuation, Yavuz and Baki (2019) applied the ordering of patent values in the automotive sector with multi-criteria decision

making methods. When the results of the related study are compared with the results of this study, it is noteworthy that there are some similarities and differences. While the automotive sector is discussed in the related study, the chemical sector is discussed in this study. Similarly, in the related study, the number of claims and the number of protected countries were among the most important criteria affecting the patent value, while other criteria were not included in this study. Criteria such as the number of competitor companies and objection status are included in the relevant study.

These criteria were intended to be included in this study, but the specific and short time (5 years), too many alternatives (107 alternatives), and certain IPC codes (C12P and C12Q) made this impossible. In addition, while the most important factor affecting the patent in the related study was the number of claims, the number of prominent citations in this study was determined as the most important factor.

Additionally, Yüce (2018) conducted a study to rate Turkey's livable provinces using the MCDM methods TOPSIS, VIKOR, and ARAS. While statistics and livable provinces were the subject of this study, patents with high added value in the chemical industry were examined in this study. As a result of the related study, it has been observed that the most important criterion is health, and the least important criterion is civic participation. Although TOPSIS, VIKOR and ARAS methods were used in common with the aforementioned study, BORDA Count method was also applied to obtain a single result by taking the average of the method results in this study.

6. CONCLUSION

In this study; in the chemical industry, the value of patents C12P and C12Q, which are high value-added IPC classes, were analyzed. Patent applications between 2015 and 2020 were used for this research, and they were ranked using TOPSIS, VIKOR and ARAS methods, which are multi-criteria decision-making techniques, and the BORDA Count method was applied to reduce and organize the results into a single ranking.

The criteria to be worked on with the literature review and the opinions of academics and experts were determined as follows; number of claims, remaining term of the patent, number of protected countries, number of inventors, patent agent/attorney presence, number of patents of the applicant, backward citations, forward citations. The Entropy method was used to calculate the weights of these requirements. While the most important factors affecting the value of the patent were determined as the number of forward citations with 37.74%, the number of protected countries with 27.01% and the number of claims with 14.31%, the least significant factor was determined as the number of backward citations with 0.23%. Alternatives (patents) were ranked by TOPSIS, VIKOR, ARAS and finally BORDA Count methods, and the best and worst 15 results are given in the table 4.9 in the results and discussion section. While the best alternative was determined as A86, the worst alternative was determined as A93. The criteria data of these alternatives are also shown in the table 4.10 and it is proven to be compatible with the literature.

There are, of course, some limitations in this study; accessing patent information and patent applications made within a certain time period, difficulty in reaching every criterion for each alternative, etc. In particular, working with a much larger number of alternatives than the number of alternatives used in literature studies and evaluating this with more than one criterion and method has been the biggest difficulty of this study.

Although numbers and profit, that is, quantitative values, are very important for companies, qualitative values will become much more important today and in the future, especially in terms of developing technology, innovation and R&D. It becomes mandatory for companies not to ignore this situation. In order for companies to develop, grow and earn more profits, they need to give more importance to patenting and especially to patent valuation. As a result of the studies carried out to increase the patent portfolio and its quality, it is recommended to focus on important qualitative criteria (number of forward citations, number of claims, number of protected countries) that affect the patent value in question.



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TEŞEKKÜR

Bu çalışmanın gerçekleştirilmesinde, yüksek bilgi birikimi ve mesleki deneyiminin yanı sıra, yüksek lisans eğitimine başlamama öncü olan, yüksek lisans eğitimim boyunca da vermiş olduğu destekler ve teşvikler ile motive olmamda çok büyük emeği geçen, samimiyetiyle her zaman yanımda ve bana destek olan kıymetli hocam Doç. Dr. Serdal TEMEL'e çok teşekkür ediyorum.

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Habibe Ezelsu ELİK

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▪ August-September 2019 :	Intern Chemical Engineer	TUPRAŞ Izmir Refinery / Izmir
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APPENDICES

APPENDIX 1. Name and number of the Patents (Alternatives) Used in the Study

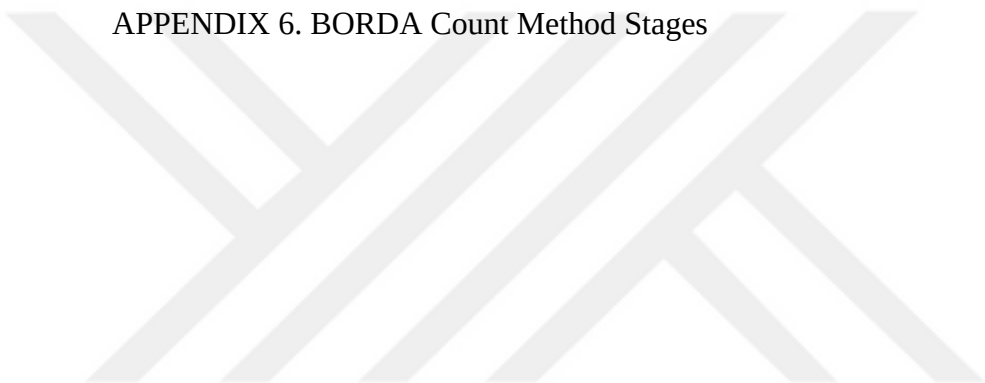
APPENDIX 2. Entropy Method Stages

APPENDIX 3. TOPSIS Method Stages

APPENDIX 4. VIKOR Method Stages

APPENDIX 5. ARAS Method Stages

APPENDIX 6. BORDA Count Method Stages



APPENDIX 1

Name and number of the Patents (Alternatives) Used in the Study

PATENT ORDER	NAME	PATENT NUMBER
1	[MT] Microbial EKZOPOLISAKKARITLERIN (EPS) CHIPS YUEZEYLERİNDE YOENTEMI OF USE	TR202021314 A2
2	[MT] Diagnostic YOENTEMI AKCIGER cancer	TR202020648 A2
3	[MT] KONUM BAZLI YOĞUNLUK VE SALGIN HASTALIK BULAŞ RİSKİ TESPİT SİSTEMİ	TR202019866 A2
4	[MT] The SARS-COV IN-2 ICIN OEZELLESMIS FAST SCANNING KIT	TR202018428 A2
5	GERÇEK ZAMANLI PCR CİHAZININ TLR7 RESEPTÖRÜNÜ KODLAYAN GENİN NORMAL VE NADİR GÖRÜLEN VARYANTLARININ TESPİTİ AMACIYLA KULLANIMI VE KULLANIM YÖNTEMİ, TLR7 GENİNİN NORMAL VE NADİR GÖRÜLEN VARYANTLARININ GERÇEK ZAMANLI PCR CİHAZINDA TESPİTİ AMAÇLI KULLANILMAK ÜZERE GELİŞTİRİLEN TANI KİTİ	TR202020743 A2
6	[MT] Fast AND MODUELER A PCR DEVICE	TR202015580 A2
7	[MT] Faced COVID-19 HASTALIGINA HIPERIMMUN SERUM	TR202013842 A2
8	[MT] DNA, RNA CAN BE ENCODED AS PEPTID MOLEKUEL-BASED, in particular TRACEABILITY AND FOLLOW SPEED YUEKSEK BARCODE/ISARETCI UERETIM YOENTEMI	TR202010864 A2
9	[MT] The elastic YOENTEMI NECESSARILY CONCENTRATION WITH THE POLYMER	TR202008937 A2
10	[MT] Sets the primary AND THE PROBE KULLANILDIGI SEMI-MULTIPLEX KORONAVIRUES USLE GERCEK TIME polymerase chain reaction MOUNTING KIT	TR202006162 A2
11	[MT] Sets the primary AND THE PROBE KULLANILDIGI MULTIPLEX KORONAVIRUES QRT-PCR TEST KIT	TR202004448 A2
12	[EN] A DISEASE ESTIMATION SYSTEM AND METHOD ACCORDING TO GENE EXPRESSION VALUES	WO21080540 A1
13	[EN] KIT FOR DETECTION OF BIG SIX ENTEROHEMORRHAGIC <i>ESCHERICHIA COLI</i> SEROTYPES WITH RT-PCR	WO21080545 A1
14	[EN] CELL CULTURE MEDIUM FOR REDUCING FUCOSYLATION AND BASIC VARIANTS IN THE PRODUCTION OF ANTIBODIES	WO21066772 A1
15	[EN] BIOLOGICAL IMPROVEMENT METHOD OF SAND SOILS USING VIRIDIBACILLUS ARENOSI K64 BACTERIA	WO21050028 A1
16	[EN] A SYSTEM FOR USE IN ELECTROCHEMICAL ANALYSIS PROCESSES	WO21034291 A2
17	KİŞİSELLEŞTİRİLMİŞ DNA TEKNOLOJİLERİ VE GENETİK TESTLER VE BU TESTLER İÇİN YÖNTEM	TR201912216 A2
18	[EN] METHOD OF OBTAINING POWDER MONO,-DI GLYCERIDE COATED WITH DRIED MILK AND WHEY PROTEIN FROM BONE WASTE OIL OBTAINED FROM A RENDERING (ANIMAL BY-PRODUCTS) FACILITY	WO21025650 A2
19	[EN] METHOD OF AUTISM RISK DETERMINATION	WO21025648 A2
20	INFLUENZA A ENFEKSİYONU TANISI İÇİN (M2E) PEPTİDİNE SPESİFİK İGY ANTİKORUNA DAYALI BİR HIZLI TANI KİTİ	TR201911593 A2
21	EXPERTUS- ÜZERİNDE BULUNAN TEK MEKANİZMAYLA KOLLARIN 180 DERECE HAREKETİNİ MÜMKÜN KILAN VE 30 FARKLI VÜCUT HAREKETİNİN YAPILMASINI SAĞLAYAN VÜCUT ÇALIŞMA İSTASYONU	TR201907110 A2

22	[EN] ANTI-EGFR MONOCLONAL ANTIBODY SPECIFIC TO THE DIMERIZATION REGION OF THE EPIDERMAL GROWTH FACTOR RECEPTOR	WO20226576 A1
23	[EN] A METHOD AND BIOSENSOR FOR DETERMINATION AND MEASUREMENT OF DELTAMETHRIN	WO21054917 A2
24	NEKROZ YOLAĞINI AKTİVE EDEREK SİTOTOKSİK ETKİ GÖSTEREN VE BİR SAPOGENOL TÜREVİ OLAN AG-08 MOLEKÜLÜ VE BUNUN SENTEZLENMESİ YÖNTEMİ	WO20222717 A1
25	YUTULABİLEN, KENDİLİĞİNDEN ŞİŞEN, VÜCUT DIŞINDAN SÖNDÜRÜLEBİLEN VE SİNDİRİM KANALINDAN ATILAN MİDE BALONU	TR201906272 A2
26	Nükleik asit tetkikinde kullanılmak için bir cihaz.	TR201905558 A2
27	[EN] INTERVENTION WITH DISORDERS OF AGING	WO19135727 A2
28	TETRAHYMENA THERMOPHILA YAPAY KROMOZOMU 2 (TtAC2) VE REKOMBİNANT PROTEİN ÜRETİMİNDE KULLANIMI	WO20197518 A1
29	[MT] Intended to treat LOESEMİ UEZERE A COMPOSITION OF VEGETABLE OEZLUE	TR201902582 A2
30	[EN] DIRECT CARBAPENEMASES TRIPLE (KPC-2, OXA-48, NDM-1) PCR DIAGNOSTIC KIT	WO20167272 A2
31	[MT] - The MICROBIAL RESOURCES HIYALUERONİK UERETİMİ INHIBİTOERLER USED DURING THE ACID AND widespread outcry against the MENTIONED INHIBİTOERUEN ASSURED FROM A PROCEDURAL	TR201901809 A2
32	[EN] A METHOD FOR A FAST AND HIGH-QUALITY GENOMIC OR CELL-FREE DNA ISOLATION IN A SINGLE TUBE AND A KIT THEREFORE	WO20159461 A2
33	[MT] Some of the treatment of cancer TREATMENT GOEREN DETERMINING THE DEGREE OF RESPONSE YOENTEM A.	TR201900163 A2
34	[EN] STRESS-REGULATED MIRNAS AS NOVEL CANCER BIOMARKERS	WO20142017 A2
35	SU, GIDA ve YÜZEYLER İÇİN HİJYEN ve KALİTE ÖLÇÜM CİHAZI	TR201820857 A2
36	[EN] FAST AND PORTABLE MICROFLUIDIC DETECTION SYSTEM AS AN ALTERNATIVE TO SALMONELLA'S CLASSICAL CULTURE METHOD	WO20136595 A1
37	[MT] CLAVIBACTER MICHIGANENSIS SUBS. To BE USED FOR MALFUNCTIONS SEPEDONICUS İZOTERMAL COGALTIM YOENTEMINE BASED ON THE DNA KIT	TR201819039 A2
38	[EN] GLUCOSE BIOSENSOR BASED ON POLYPHOSPHONOUNDECYL ACRYLATE-CO-POLYVINYLMIDAZOLE-CO-POLYVINYLFERROCENE-CO-POLYGLYCIDYL METHACRYLATE TETRA BLOCK COPOLYMER	WO20117170 A1

39	[EN] MINIMAL BIOMARKERS AND RELATED NEXT-GENERATION SEQUENCING KIT FOR DIAGNOSING ALZHEIMER'S DISEASE FROM INTESTINAL MICROBIOME	WO20117164 A1
40	[EN] EPOXIDIZED SOYBEAN OIL MIXTURES WITH REDUCED SOLIDIFICATION TEMPERATURE	WO20117162 A1
41	[EN] A METHOD FOR ANTIMICROBIAL HYPERTHERMIA DETECTING THE APPROPRIATE TEMPERATURE VALUE AT WHICH THE MICROORGANISM IS INHIBITED	WO20112040 A1
42	[EN] RECOMBINANT TETRAHYMENA THERMOPHILA GLUTATHIONE S TRANSFERASE MU34 ENZYME (TTGSTM34-8XHIS) AND USES THEREOF	WO20096550 A1
43	[EN] DETECTION METHOD FOR HALAL FOOD AND HALAL FOOD ADDITIVES	WO20089756 A1
44	[MT] NAR ASH GUENES YANIKLIGINA DURABLE AND SENSITIVE INDIVIDUALS ARE DISTINGUISHING MOLEKUELER MARKOERLER.	TR201815742 A2
45	[EN] WATER-SOLUBLE, NON-AGGREGATED SILICON PHTALGECYANINE COMPOUND HAVING IN VITRO ANTICANCER EFFECT AGAINST CANCER TYPES OF LUNG, LIVER, BREST AND MELANOMA	WO20068015 A1
46	[EN] TETRAHYMENA THERMOPHILA ARTIFICIAL CHROMOSOME 1 (TTAC1) AND ITS USE FOR THE PRODUCTION OF RECOMBINANT PROTEINS	WO20068014 A2
47	[EN] MODIFIED AOX1 PROMOTER VARIANTS	WO20068018 A1
48	[MT] At MALLOCHII PENICILLIUM FUNGAL KOEKENLI PIGMENT UERETIM YOENTEMI	TR201812095 A2
49	[MT] AURA SEATS AND TRACKING YAPILANMASI	TR201810464 A2
50	[MT] A TEST CUBUGU	TR201810361 A2
51	[EN] IN VIVO POST-TRANSLATIONAL PROCESSING OF TARGET PROTEINS BY FURIN IN PLANTS: ENGINEERING, EXPRESSION AND PRODUCTION OF FUNCTIONAL ACTIVE HUMAN FURIN IN N. BENTHAMIANA PLANTS	WO20013774 A1
52	[EN] PROCESS FOR PROVIDING A CULTURE OF MICROORGANISMS TO AN ELONGATED ELEMENT	US2019376017 AA
53	[EN] ANALYSIS OF URINE TEST STRIPS WITH MOBILE CAMERA ANALYSYS AND PROVIDING RECOMMENDATION BY CUSTOMISING DATA	WO19221676 A1
54	[EN] DETERMINATION OF REGULATORY DNA REGIONS OF ALCOHOL DEHYDROGENASE 3 (ADH3) PROMOTER AND DESIGN OF SYNTHETIC PROMOTERS FOR RECOMBINANT PROTEIN PRODUCTION	WO19203769 A1

55	[EN] PROCESS FOR PREPARING A DYED BIOPOLYMER AND PRODUCTS THEREOF	US2019309335 AA
56	[MT] For the assignment of the enzyme MIYOFOSFORILAZ EKSIKLIGININ MOLEKUELER DIAGNOSTIC TEST	TR201802456 A2
57	[EN] EXOSOME ISOLATION METHOD BY TWO PHASE FLUID SYSTEM	US2021101093 AA
58	[EN] A NOVEL MEDIUM FOR GROWTH AND ANTIBIOTIC SUSCEPTIBILITY TEST OF MYCOBACTERIA	WO19132836 A2
59	[MT] Acetic acid KUETLESEL IONIC LIQUID PHASE AND THE SEPARATION OF THE MEMBRANE YOENTEMI	TR201721494 A2
60	[MT] BRUCELLA FIELD SUSLARI AND ASI SUSLARININ IDENTIFIKASYONU DIRECT CLINICAL OERNEKLERDEN	TR201716632 A2
61	[EN] AN ANALYSIS METHOD USED FOR FOREIGN TISSUE DETECTION AND A PRIMER-PROBE SET USED IN THE ANALYSIS METHOD	EP3476947 A1
62	[MT] FENILKETONUERI TEST KIT FOR babies	TR201716047 A2
63	[EN] PRODUCTION METHOD OF TELOMERASE ACTIVATORS AND TELOMERASE ACTIVATORS OBTAINED BY THIS METHOD	WO19070219 A2
64	[MT] IMPLANT YERLESIMLI BIYOSENSÖR AND ANTI-BACTERIAL AGENT İÇERİKLİ NANOKAPSÜL APP.	TR201712532 A2
65	[MT] KAGIT TO BE USED WITH THE MEDICAL FIELD-BASED GLUCOSE DIAGNOSTIC KIT.	TR201709599 A2
66	[MT] For the DETERMINATION OF THE blood is considered the KREATININ SYSTEM AND YOENTEM	TR201707158 A2
67	[MT] Food MENSEİ MOUNTING DEVICE.	TR201707026 A2
68	[MT] Coming UP WITH THE ALTERNATIVE POLİADENİLASYON İZOFORMLARI TYPES OF CANCER Expenditures	TR201706659 A2
69	[EN] PAPER-BASED ANALYTICAL MICROFLUIDIC CHIP AND DEVICE, HAVING EMBOSSED AND DEBOSSSED PROCESSING CHANNEL, FOR NUCLEIC ACID DIAGNOSIS	WO18226193 A2
70	[EN] METHOD FOR RAPID IDENTIFICATION OF MICROORGANISMS PRODUCING NUCLEASE ENZYMES	US2020017898 AA
71	[MT] A DNA ISOLATION YOENTEMI AND KIT	TR201702069 A2
72	[MT] TAQ DNA POLYMERASE ENZYME YOENTEMI ÜRETİM	TR201700177 A2
73	[MT] The MOUNTING YOENTEMI MUSHROOM POISONING	TR201620290 A2
74	[MT] Romanian FUNGUSLARI RECEIVED MICROBIOLOGICAL COCKTAIL (ANOP) BİYOMETAN - MAKROALGİLERDEN ÜRETİMİN YOENELİK YOENTEM ECONOMICALLY ARTTIRILMASINA YİLED	TR201620350 A1
75	[EN] EARLY DIAGNOSIS METHOD AND KIT FOR BREAST CANCER	US2019345564 AA
76	[EN] A METHOD FOR IMPROVING THE BIOGAS POTENTIAL OF ANAEROBIC DIGESTIONS WITH RUMEN FUNGI	WO18124984 A1

77	[EN] A METHOD FOR IMPROVEMENT OF METHANE PRODUCTION FROM MICROALGAE	WO18124988 A1
78	[MT] Agile BREADS OBTAINED XANTHAN RANGE UERETIM YOENTEMI	TR201619593 A1
79	[MT] BRCA1 AND BRCA2 NEGATIFLIGINI ALGORITMASI SET	TR201619284 A2
80	[MT] The NEW GENERATION OF NUKLEIK ACIDS AND A SINGLE POINT OF AN APPOINTMENT COULD MUTATE YOENELİK EMPEDIMETRIK YOENTEM	TR201617696 A1
81	[MT] IDRARDAN PCA3 BIYOBELIRTEC THE YOENTEMI	TR201617170 A2
82	[MT] ET UERUENLERİNİN NATURAL NITRATE KUERLEME YOENTEMI - NATURAL RESOURCES	TR201616013 A1
83	[MT] Is the BREAD MAYASI COMPOSITION AND UERETIM YOENTEMI	TR201609816 A2
84	[MT] Bacterial DIAGNOSTIC TOOL	TR201608981 A1
85	Bir Kolajen Hidrolizat Ürünü ve Bunun Üretim Metodu	TR201608957 A2
86	[EN] COMPOSITE FABRIC COMPRISING A BACTERIAL BIOPOLYMER LAYER	US2017314190 AA
87	[MT] Cylindrical HUECRE KUeltuERUE SISELERİNDE LENTIVIRAL GEN TREATMENT VEKTOER UERETIM YOENTEMI	TR201603933 A2
88	[EN] PRODUCTION OF IN VIVO N-DEGLYCOSYLATED RECOMBINANT PROTEINS BY CO-EXPRESSION WITH ENDO H	US2018327764 AA
89	[MT] Carbon-BASED ELECTRODE AND ITS UERETIM YOENTEMI	TR201512161 A1
90	[EN] USE OF A CELLULOSE HYDROLYSATE FOR BIOGAS PRODUCTION	US2018155750 AA
91	[MT] Sentetik DNA ile Kimliklendirme	TR202007204 A2
92	KİMYASAL HARP MADDELERİ (KHM) VE ZEHİRLİ ENDÜSTRİYEL MALZEMELERİ (ZEM) ALGILAMAYA YÖNELİK METAL OKSİT TABANLI BİR SENSÖR DİZİSİ	TR202007094 A2
93	BAHARATLARDA VE YAĞLI TOHURLARDA AFLATOKSİN GİDERİMİ AMACIYLA ATIMLI (VURGULU) ELEKTRİK ALAN YÖNTEMİNİN KULLANIMI	TR202004250 A2
94	REAKTİF KARTUŞU TAŞIMA SİSTEMİ	TR201923083 A2
95	L-glutamik asit kaynaklı gıda katkı maddesi üretimi ve üretimde verim artışı	TR201922987 A2
96	REKOMBİNANT PROTEİN ÜRETİMİ İÇİN BİR YÖNTEM	TR201920838 A2
97	HÜCRE SİZ FETAL DNA TAYİNİNE YÖNELİK GENOSENSÖR	TR201920699 A2
98	DALLI DARI ZİRAİ ATIĞINDAN SELÜLAZ ENZİMİ ELDE ETME YÖNTEMİ	TR201920570 A2
99	SERUMDA FERRİK DEMİRİN TAYİNİ İÇİN YENİ BİR BİYOSENSÖR	TR201919913 A2
100	Anaerob Bakteriye Klinik Numunelerden Cins Düzeyinde Aynı Anda Tanımlayabilen Multiplex PCR Kiti	TR201914447 A2

101	OVARYUM KANSER TEŞHİS KİTİ	TR201913321 A2
102	TAVUK YUMURTASINDA VE DİĞER KANATLI HAYVANLARDA KULUÇKA ÖNCESİ CİNSİYET TESPİT APARAT VE YÖNTEMİ	TR201809728 A2
103	BİYOGAZ ÜRETİMİ İÇİN BİR YÖNTEM	TR201711941 A2
104	LDL KOLESTROL DİREK TAYİN METODU	TR201606231 A2
105	HİV NEGATİF KAPOİ SARKOMU İÇİN BİYOMARKER OLABİLECEK YENİ miRNA MOLEKÜLLERİ	TR201618800 A2
106	21 GONOSOMAL INDEL LOKUSLU MULTİPLEKS KİMLİKLENDİRME PANELİ	TR201707157 A2
107	Evsel ve Endüstriyel Atık Suların İçindeki Pestisitlerin Tayini İçin Güneş Hücresinden Biyosensör	TR201606746 A2



APPENDIX 2

Entropy Method Stages

Initial Decision Matrix

Alternatives	C1	C2	C3	C4	C5	C6	C7	C8
A1	4	19	1	1	1	8	0	0
A2	1	19	1	3	1	4	0	0
A3	23	19	1	3	1	1319	0	0
A4	13	19	1	5	1	5	0	0
A5	14	19	1	1	1	1	0	0
A6	9	19	1	4	1	23	0	0
A7	19	19	1	1	1	1	0	0
A8	5	18	1	4	1	5	0	0
A9	3	18	1	2	1	1	0	0
A10	1	18	1	2	0	4	0	0
A11	1	18	1	2	0	1	0	0
A12	4	18	1	1	1	56	0	0
A13	1	18	1	2	1	48	0	0
A14	13	18	1	2	0	64	0	0
A15	20	18	1	2	1	75	0	0
A16	6	18	1	2	1	4	0	0
A17	8	18	1	2	1	1	0	0
A18	6	18	1	2	1	10	0	0
A19	3	18	1	4	1	10	0	0
A20	8	18	1	5	1	2	0	0
A21	4	17	1	1	0	1	0	0
A22	1	17	1	5	1	36	2	0
A23	17	17	1	2	1	10	0	0
A24	16	17	1	5	1	21	0	0
A25	3	17	1	1	0	8	0	0
A26	6	17	1	5	1	4	0	0
A27	3	17	1	1	0	8	1	0
A28	18	17	1	3	1	30	4	0
A29	7	17	1	1	1	48	0	0
A30	2	17	1	2	1	2	0	0
A31	5	17	1	2	1	1	0	0
A32	10	17	1	1	1	1	2	0
A33	18	17	1	2	1	1	0	0
A34	17	17	1	3	1	5	7	0
A35	6	17	1	3	1	261	0	0
A36	7	17	1	3	0	223	15	0
A37	4	17	1	2	1	261	0	0

A38	5	17	1	2	1	1	1	0
A39	3	17	1	3	1	10	3	0
A40	17	17	1	4	1	16	4	0
A41	11	17	1	1	1	9	0	0
A42	11	17	1	2	1	30	2	0
A43	12	17	1	2	0	223	7	0
A44	6	17	1	2	1	16	0	0
A45	4	17	1	4	1	38	1	0
A46	15	17	1	2	1	30	5	0
A47	9	17	2	2	1	19	2	0
A48	7	17	1	3	1	1	0	0
A49	5	17	1	1	0	15	0	0
A50	9	17	1	4	1	15	0	0
A51	15	16	1	1	0	11	0	0
A52	26	16	3	7	0	93	7	0
A53	4	16	1	1	1	2	5	0
A54	13	16	1	3	1	11	3	0
A55	28	16	2	5	1	93	9	0
A56	7	16	1	3	1	261	0	0
A57	22	16	2	4	1	43	1	0
A58	3	16	1	1	1	11	2	0
A59	11	16	1	2	1	261	0	0
A60	8	16	1	2	1	261	0	0
A61	12	16	1	3	0	223	4	0
A62	1	16	1	1	1	1	0	0
A63	15	16	1	6	1	21	4	0
A64	2	16	1	6	1	261	0	0
A65	2	15	1	2	1	1	0	0
A66	15	15	1	1	1	21	0	0
A67	8	15	1	4	0	1	0	0
A68	6	15	1	3	1	1	0	0
A69	1	15	1	2	1	1	2	0
A70	6	15	2	6	0	223	16	0
A71	4	15	1	4	1	1	0	0
A72	2	15	1	1	1	1	0	0
A73	13	15	1	1	1	1	0	0
A74	1	15	1	4	1	1	0	0
A75	10	15	1	4	1	261	1	0
A76	1	15	1	4	1	72	6	1
A77	1	15	1	4	1	72	7	0
A78	4	15	1	1	1	2	0	0
A79	6	15	1	8	1	261	0	0
A80	18	15	1	2	1	2	0	0

A81	1	15	1	3	1	1	0	0
A82	7	15	1	2	1	2	0	0
A83	15	14	1	4	1	6	0	0
A84	3	14	1	2	1	1	0	0
A85	23	14	1	1	1	5	0	0
A86	23	14	4	3	1	93	21	13
A87	14	14	1	1	0	2	0	0
A88	15	14	6	1	0	2	7	1
A89	5	14	1	5	1	10	0	0
A90	14	13	7	2	1	1	14	1
A91	1	18	1	1	1	48	0	0
A92	10	18	1	1	1	6	0	0
A93	1	18	1	1	0	10	0	0
A94	9	18	1	1	1	4	0	0
A95	10	18	1	2	0	1	0	0
A96	13	18	1	5	1	75	0	0
A97	1	18	1	3	1	10	0	0
A98	5	18	1	5	1	2	0	0
A99	2	18	1	3	1	10	0	0
A100	19	18	1	2	0	1	0	0
A101	7	18	1	4	1	5	0	0
A102	10	16	1	1	0	1	0	0
A103	8	16	1	2	1	48	0	0
A104	9	14	1	1	1	1	0	0
A105	9	15	1	7	1	261	0	0
A106	35	15	1	2	1	261	0	0
A107	2	14	1	1	1	2	0	0
Max	35	19	7	8	1	1319	21	13
Min	1	13	1	1	0	1	0	0

Normalized Decision Matrix

Alternatives	K1	K2	K3	K4	K6	K7	K8	K9
A1	0,088	1,000	0,000	0,000	1,000	0,005	1,000	0,000
A2	0,000	1,000	0,000	0,286	1,000	0,002	1,000	0,000
A3	0,647	1,000	0,000	0,286	1,000	1,000	1,000	0,000
A4	0,353	1,000	0,000	0,571	1,000	0,003	1,000	0,000
A5	0,382	1,000	0,000	0,000	1,000	0,000	1,000	0,000
A6	0,235	1,000	0,000	0,429	1,000	0,017	1,000	0,000
A7	0,529	1,000	0,000	0,000	1,000	0,000	1,000	0,000
A8	0,118	0,833	0,000	0,429	1,000	0,003	1,000	0,000
A9	0,059	0,833	0,000	0,143	1,000	0,000	1,000	0,000
A10	0,000	0,833	0,000	0,143	0,000	0,002	1,000	0,000
A11	0,000	0,833	0,000	0,143	0,000	0,000	1,000	0,000
A12	0,088	0,833	0,000	0,000	1,000	0,042	1,000	0,000
A13	0,000	0,833	0,000	0,143	1,000	0,036	1,000	0,000
A14	0,353	0,833	0,000	0,143	0,000	0,048	1,000	0,000
A15	0,559	0,833	0,000	0,143	1,000	0,056	1,000	0,000
A16	0,147	0,833	0,000	0,143	1,000	0,002	1,000	0,000
A17	0,206	0,833	0,000	0,143	1,000	0,000	1,000	0,000
A18	0,147	0,833	0,000	0,143	1,000	0,007	1,000	0,000
A19	0,059	0,833	0,000	0,429	1,000	0,007	1,000	0,000
A20	0,206	0,833	0,000	0,571	1,000	0,001	1,000	0,000
A21	0,088	0,667	0,000	0,000	0,000	0,000	1,000	0,000
A22	0,000	0,667	0,000	0,571	1,000	0,027	0,905	0,000
A23	0,471	0,667	0,000	0,143	1,000	0,007	1,000	0,000
A24	0,441	0,667	0,000	0,571	1,000	0,015	1,000	0,000
A25	0,059	0,667	0,000	0,000	0,000	0,005	1,000	0,000
A26	0,147	0,667	0,000	0,571	1,000	0,002	1,000	0,000
A27	0,059	0,667	0,000	0,000	0,000	0,005	0,952	0,000
A28	0,500	0,667	0,000	0,286	1,000	0,022	0,810	0,000
A29	0,176	0,667	0,000	0,000	1,000	0,036	1,000	0,000
A30	0,029	0,667	0,000	0,143	1,000	0,001	1,000	0,000
A31	0,118	0,667	0,000	0,143	1,000	0,000	1,000	0,000
A32	0,265	0,667	0,000	0,000	1,000	0,000	0,905	0,000
A33	0,500	0,667	0,000	0,143	1,000	0,000	1,000	0,000
A34	0,471	0,667	0,000	0,286	1,000	0,003	0,667	0,000
A35	0,147	0,667	0,000	0,286	1,000	0,197	1,000	0,000
A36	0,176	0,667	0,000	0,286	0,000	0,168	0,286	0,000
A37	0,088	0,667	0,000	0,143	1,000	0,197	1,000	0,000
A38	0,118	0,667	0,000	0,143	1,000	0,000	0,952	0,000
A39	0,059	0,667	0,000	0,286	1,000	0,007	0,857	0,000
A40	0,471	0,667	0,000	0,429	1,000	0,011	0,810	0,000
A41	0,294	0,667	0,000	0,000	1,000	0,006	1,000	0,000

A42	0,294	0,667	0,000	0,143	1,000	0,022	0,905	0,000
A43	0,324	0,667	0,000	0,143	0,000	0,168	0,667	0,000
A44	0,147	0,667	0,000	0,143	1,000	0,011	1,000	0,000
A45	0,088	0,667	0,000	0,429	1,000	0,028	0,952	0,000
A46	0,412	0,667	0,000	0,143	1,000	0,022	0,762	0,000
A47	0,235	0,667	0,167	0,143	1,000	0,014	0,905	0,000
A48	0,176	0,667	0,000	0,286	1,000	0,000	1,000	0,000
A49	0,118	0,667	0,000	0,000	0,000	0,011	1,000	0,000
A50	0,235	0,667	0,000	0,429	1,000	0,011	1,000	0,000
A51	0,412	0,500	0,000	0,000	0,000	0,008	1,000	0,000
A52	0,735	0,500	0,333	0,857	0,000	0,070	0,667	0,000
A53	0,088	0,500	0,000	0,000	1,000	0,001	0,762	0,000
A54	0,353	0,500	0,000	0,286	1,000	0,008	0,857	0,000
A55	0,794	0,500	0,167	0,571	1,000	0,070	0,571	0,000
A56	0,176	0,500	0,000	0,286	1,000	0,197	1,000	0,000
A57	0,618	0,500	0,167	0,429	1,000	0,032	0,952	0,000
A58	0,059	0,500	0,000	0,000	1,000	0,008	0,905	0,000
A59	0,294	0,500	0,000	0,143	1,000	0,197	1,000	0,000
A60	0,206	0,500	0,000	0,143	1,000	0,197	1,000	0,000
A61	0,324	0,500	0,000	0,286	0,000	0,168	0,810	0,000
A62	0,000	0,500	0,000	0,000	1,000	0,000	1,000	0,000
A63	0,412	0,500	0,000	0,714	1,000	0,015	0,810	0,000
A64	0,029	0,500	0,000	0,714	1,000	0,197	1,000	0,000
A65	0,029	0,333	0,000	0,143	1,000	0,000	1,000	0,000
A66	0,412	0,333	0,000	0,000	1,000	0,015	1,000	0,000
A67	0,206	0,333	0,000	0,429	0,000	0,000	1,000	0,000
A68	0,147	0,333	0,000	0,286	1,000	0,000	1,000	0,000
A69	0,000	0,333	0,000	0,143	1,000	0,000	0,905	0,000
A70	0,147	0,333	0,167	0,714	0,000	0,168	0,238	0,000
A71	0,088	0,333	0,000	0,429	1,000	0,000	1,000	0,000
A72	0,029	0,333	0,000	0,000	1,000	0,000	1,000	0,000
A73	0,353	0,333	0,000	0,000	1,000	0,000	1,000	0,000
A74	0,000	0,333	0,000	0,429	1,000	0,000	1,000	0,000
A75	0,265	0,333	0,000	0,429	1,000	0,197	0,952	0,000
A76	0,000	0,333	0,000	0,429	1,000	0,054	0,714	0,077
A77	0,000	0,333	0,000	0,429	1,000	0,054	0,667	0,000
A78	0,088	0,333	0,000	0,000	1,000	0,001	1,000	0,000
A79	0,147	0,333	0,000	1,000	1,000	0,197	1,000	0,000
A80	0,500	0,333	0,000	0,143	1,000	0,001	1,000	0,000
A81	0,000	0,333	0,000	0,286	1,000	0,000	1,000	0,000
A82	0,176	0,333	0,000	0,143	1,000	0,001	1,000	0,000
A83	0,412	0,167	0,000	0,429	1,000	0,004	1,000	0,000
A84	0,059	0,167	0,000	0,143	1,000	0,000	1,000	0,000

A85	0,647	0,167	0,000	0,000	1,000	0,003	1,000	0,000
A86	0,647	0,167	0,500	0,286	1,000	0,070	0,000	1,000
A87	0,382	0,167	0,000	0,000	0,000	0,001	1,000	0,000
A88	0,412	0,167	0,833	0,000	0,000	0,001	0,667	0,077
A89	0,118	0,167	0,000	0,571	1,000	0,007	1,000	0,000
A90	0,382	0,000	1,000	0,143	1,000	0,000	0,333	0,077
A91	0,000	0,833	0,000	0,000	1,000	0,036	1,000	0,000
A92	0,265	0,833	0,000	0,000	1,000	0,004	1,000	0,000
A93	0,000	0,833	0,000	0,000	0,000	0,007	1,000	0,000
A94	0,235	0,833	0,000	0,000	1,000	0,002	1,000	0,000
A95	0,265	0,833	0,000	0,143	0,000	0,000	1,000	0,000
A96	0,353	0,833	0,000	0,571	1,000	0,056	1,000	0,000
A97	0,000	0,833	0,000	0,286	1,000	0,007	1,000	0,000
A98	0,118	0,833	0,000	0,571	1,000	0,001	1,000	0,000
A99	0,029	0,833	0,000	0,286	1,000	0,007	1,000	0,000
A100	0,529	0,833	0,000	0,143	0,000	0,000	1,000	0,000
A101	0,176	0,833	0,000	0,429	1,000	0,003	1,000	0,000
A102	0,265	0,500	0,000	0,000	0,000	0,000	1,000	0,000
A103	0,206	0,500	0,000	0,143	1,000	0,036	1,000	0,000
A104	0,235	0,167	0,000	0,000	1,000	0,000	1,000	0,000
A105	0,235	0,333	0,000	0,857	1,000	0,197	1,000	0,000
A106	1,000	0,333	0,000	0,143	1,000	0,197	1,000	0,000
A107	0,029	0,167	0,000	0,000	1,000	0,001	1,000	0,000

Rij	C1	C2	C3	C4	C5	C6	C7	C8
A1	0,004	0,016	0,000	0,000	0,011	0,001	0,010	0,000
A2	0,000	0,016	0,000	0,011	0,011	0,000	0,010	0,000
A3	0,026	0,016	0,000	0,011	0,011	0,212	0,010	0,000
A4	0,014	0,016	0,000	0,022	0,011	0,001	0,010	0,000
A5	0,015	0,016	0,000	0,000	0,011	0,000	0,010	0,000
A6	0,009	0,016	0,000	0,017	0,011	0,004	0,010	0,000
A7	0,021	0,016	0,000	0,000	0,011	0,000	0,010	0,000
A8	0,005	0,013	0,000	0,017	0,011	0,001	0,010	0,000
A9	0,002	0,013	0,000	0,006	0,011	0,000	0,010	0,000
A10	0,000	0,013	0,000	0,006	0,000	0,000	0,010	0,000
A11	0,000	0,013	0,000	0,006	0,000	0,000	0,010	0,000
A12	0,004	0,013	0,000	0,000	0,011	0,009	0,010	0,000
A13	0,000	0,013	0,000	0,006	0,011	0,008	0,010	0,000
A14	0,014	0,013	0,000	0,006	0,000	0,010	0,010	0,000
A15	0,022	0,013	0,000	0,006	0,011	0,012	0,010	0,000
A16	0,006	0,013	0,000	0,006	0,011	0,000	0,010	0,000
A17	0,008	0,013	0,000	0,006	0,011	0,000	0,010	0,000
A18	0,006	0,013	0,000	0,006	0,011	0,001	0,010	0,000

A19	0,002	0,013	0,000	0,017	0,011	0,001	0,010	0,000
A20	0,008	0,013	0,000	0,022	0,011	0,000	0,010	0,000
A21	0,004	0,011	0,000	0,000	0,000	0,000	0,010	0,000
A22	0,000	0,011	0,000	0,022	0,011	0,006	0,009	0,000
A23	0,019	0,011	0,000	0,006	0,011	0,001	0,010	0,000
A24	0,018	0,011	0,000	0,022	0,011	0,003	0,010	0,000
A25	0,002	0,011	0,000	0,000	0,000	0,001	0,010	0,000
A26	0,006	0,011	0,000	0,022	0,011	0,000	0,010	0,000
A27	0,002	0,011	0,000	0,000	0,000	0,001	0,010	0,000
A28	0,020	0,011	0,000	0,011	0,011	0,005	0,008	0,000
A29	0,007	0,011	0,000	0,000	0,011	0,008	0,010	0,000
A30	0,001	0,011	0,000	0,006	0,011	0,000	0,010	0,000
A31	0,005	0,011	0,000	0,006	0,011	0,000	0,010	0,000
A32	0,011	0,011	0,000	0,000	0,011	0,000	0,009	0,000
A33	0,020	0,011	0,000	0,006	0,011	0,000	0,010	0,000
A34	0,019	0,011	0,000	0,011	0,011	0,001	0,007	0,000
A35	0,006	0,011	0,000	0,011	0,011	0,042	0,010	0,000
A36	0,007	0,011	0,000	0,011	0,000	0,036	0,003	0,000
A37	0,004	0,011	0,000	0,006	0,011	0,042	0,010	0,000
A38	0,005	0,011	0,000	0,006	0,011	0,000	0,010	0,000
A39	0,002	0,011	0,000	0,011	0,011	0,001	0,009	0,000
A40	0,019	0,011	0,000	0,017	0,011	0,002	0,008	0,000
A41	0,012	0,011	0,000	0,000	0,011	0,001	0,010	0,000
A42	0,012	0,011	0,000	0,006	0,011	0,005	0,009	0,000
A43	0,013	0,011	0,000	0,006	0,000	0,036	0,007	0,000
A44	0,006	0,011	0,000	0,006	0,011	0,002	0,010	0,000
A45	0,004	0,011	0,000	0,017	0,011	0,006	0,010	0,000
A46	0,016	0,011	0,000	0,006	0,011	0,005	0,008	0,000
A47	0,009	0,011	0,050	0,006	0,011	0,003	0,009	0,000
A48	0,007	0,011	0,000	0,011	0,011	0,000	0,010	0,000
A49	0,005	0,011	0,000	0,000	0,000	0,002	0,010	0,000
A50	0,009	0,011	0,000	0,017	0,011	0,002	0,010	0,000
A51	0,016	0,008	0,000	0,000	0,000	0,002	0,010	0,000
A52	0,029	0,008	0,100	0,034	0,000	0,015	0,007	0,000
A53	0,004	0,008	0,000	0,000	0,011	0,000	0,008	0,000
A54	0,014	0,008	0,000	0,011	0,011	0,002	0,009	0,000
A55	0,032	0,008	0,050	0,022	0,011	0,015	0,006	0,000
A56	0,007	0,008	0,000	0,011	0,011	0,042	0,010	0,000
A57	0,025	0,008	0,050	0,017	0,011	0,007	0,010	0,000
A58	0,002	0,008	0,000	0,000	0,011	0,002	0,009	0,000
A59	0,012	0,008	0,000	0,006	0,011	0,042	0,010	0,000
A60	0,008	0,008	0,000	0,006	0,011	0,042	0,010	0,000
A61	0,013	0,008	0,000	0,011	0,000	0,036	0,008	0,000

A62	0,000	0,008	0,000	0,000	0,011	0,000	0,010	0,000
A63	0,016	0,008	0,000	0,028	0,011	0,003	0,008	0,000
A64	0,001	0,008	0,000	0,028	0,011	0,042	0,010	0,000
A65	0,001	0,005	0,000	0,006	0,011	0,000	0,010	0,000
A66	0,016	0,005	0,000	0,000	0,011	0,003	0,010	0,000
A67	0,008	0,005	0,000	0,017	0,000	0,000	0,010	0,000
A68	0,006	0,005	0,000	0,011	0,011	0,000	0,010	0,000
A69	0,000	0,005	0,000	0,006	0,011	0,000	0,009	0,000
A70	0,006	0,005	0,050	0,028	0,000	0,036	0,002	0,000
A71	0,004	0,005	0,000	0,017	0,011	0,000	0,010	0,000
A72	0,001	0,005	0,000	0,000	0,011	0,000	0,010	0,000
A73	0,014	0,005	0,000	0,000	0,011	0,000	0,010	0,000
A74	0,000	0,005	0,000	0,017	0,011	0,000	0,010	0,000
A75	0,011	0,005	0,000	0,017	0,011	0,042	0,010	0,000
A76	0,000	0,005	0,000	0,017	0,011	0,011	0,007	0,063
A77	0,000	0,005	0,000	0,017	0,011	0,011	0,007	0,000
A78	0,004	0,005	0,000	0,000	0,011	0,000	0,010	0,000
A79	0,006	0,005	0,000	0,039	0,011	0,042	0,010	0,000
A80	0,020	0,005	0,000	0,006	0,011	0,000	0,010	0,000
A81	0,000	0,005	0,000	0,011	0,011	0,000	0,010	0,000
A82	0,007	0,005	0,000	0,006	0,011	0,000	0,010	0,000
A83	0,016	0,003	0,000	0,017	0,011	0,001	0,010	0,000
A84	0,002	0,003	0,000	0,006	0,011	0,000	0,010	0,000
A85	0,026	0,003	0,000	0,000	0,011	0,001	0,010	0,000
A86	0,026	0,003	0,150	0,011	0,011	0,015	0,000	0,813
A87	0,015	0,003	0,000	0,000	0,000	0,000	0,010	0,000
A88	0,016	0,003	0,250	0,000	0,000	0,000	0,007	0,063
A89	0,005	0,003	0,000	0,022	0,011	0,001	0,010	0,000
A90	0,015	0,000	0,300	0,006	0,011	0,000	0,003	0,063
A91	0,000	0,013	0,000	0,000	0,011	0,008	0,010	0,000
A92	0,011	0,013	0,000	0,000	0,011	0,001	0,010	0,000
A93	0,000	0,013	0,000	0,000	0,000	0,001	0,010	0,000
A94	0,009	0,013	0,000	0,000	0,011	0,000	0,010	0,000
A95	0,011	0,013	0,000	0,006	0,000	0,000	0,010	0,000
A96	0,014	0,013	0,000	0,022	0,011	0,012	0,010	0,000
A97	0,000	0,013	0,000	0,011	0,011	0,001	0,010	0,000
A98	0,005	0,013	0,000	0,022	0,011	0,000	0,010	0,000
A99	0,001	0,013	0,000	0,011	0,011	0,001	0,010	0,000
A100	0,021	0,013	0,000	0,006	0,000	0,000	0,010	0,000
A101	0,007	0,013	0,000	0,017	0,011	0,001	0,010	0,000
A102	0,011	0,008	0,000	0,000	0,000	0,000	0,010	0,000
A103	0,008	0,008	0,000	0,006	0,011	0,008	0,010	0,000
A104	0,009	0,003	0,000	0,000	0,011	0,000	0,010	0,000

A105	0,009	0,005	0,000	0,034	0,011	0,042	0,010	0,000
A106	0,040	0,005	0,000	0,006	0,011	0,042	0,010	0,000
A107	0,001	0,003	0,000	0,000	0,011	0,000	0,010	0,000

Calculation of Entropy Values

Alternative	C1	C2	C3	C4	C5	C6	C7	C8
A1	-0,020	-0,066	0,000	0,000	-0,051	-0,008	-0,046	0,000
A2	0,000	-0,066	0,000	-0,050	-0,051	-0,004	-0,046	0,000
A3	-0,095	-0,066	0,000	-0,050	-0,051	-0,329	-0,046	0,000
A4	-0,060	-0,066	0,000	-0,085	-0,051	-0,005	-0,046	0,000
A5	-0,064	-0,066	0,000	0,000	-0,051	0,000	-0,046	0,000
A6	-0,044	-0,066	0,000	-0,069	-0,051	-0,020	-0,046	0,000
A7	-0,082	-0,066	0,000	0,000	-0,051	0,000	-0,046	0,000
A8	-0,025	-0,057	0,000	-0,069	-0,051	-0,005	-0,046	0,000
A9	-0,014	-0,057	0,000	-0,029	-0,051	0,000	-0,046	0,000
A10	0,000	-0,057	0,000	-0,029	0,000	-0,004	-0,046	0,000
A11	0,000	-0,057	0,000	-0,029	0,000	0,000	-0,046	0,000
A12	-0,020	-0,057	0,000	0,000	-0,051	-0,042	-0,046	0,000
A13	0,000	-0,057	0,000	-0,029	-0,051	-0,037	-0,046	0,000
A14	-0,060	-0,057	0,000	-0,029	0,000	-0,046	-0,046	0,000
A15	-0,085	-0,057	0,000	-0,029	-0,051	-0,053	-0,046	0,000
A16	-0,030	-0,057	0,000	-0,029	-0,051	-0,004	-0,046	0,000
A17	-0,040	-0,057	0,000	-0,029	-0,051	0,000	-0,046	0,000
A18	-0,030	-0,057	0,000	-0,029	-0,051	-0,009	-0,046	0,000
A19	-0,014	-0,057	0,000	-0,069	-0,051	-0,009	-0,046	0,000
A20	0,000	-0,057	0,000	-0,085	-0,051	-0,001	-0,046	0,000
A21	0,000	-0,048	0,000	0,000	0,000	0,000	-0,046	0,000
A22	0,000	-0,048	0,000	-0,085	-0,051	-0,029	-0,043	0,000
A23	-0,075	-0,048	0,000	-0,029	-0,051	-0,009	-0,046	0,000
A24	-0,071	-0,048	0,000	-0,085	-0,051	-0,018	-0,046	0,000
A25	0,000	-0,048	0,000	0,000	0,000	-0,008	-0,046	0,000
A26	-0,030	-0,048	0,000	-0,085	-0,051	-0,004	-0,046	0,000
A27	-0,014	-0,048	0,000	0,000	0,000	-0,008	-0,045	0,000
A28	-0,078	-0,048	0,000	-0,050	-0,051	-0,025	-0,039	0,000
A29	0,000	-0,048	0,000	0,000	-0,051	-0,037	-0,046	0,000
A30	-0,008	-0,048	0,000	-0,029	-0,051	-0,001	-0,046	0,000
A31	0,000	-0,048	0,000	-0,029	-0,051	0,000	-0,046	0,000
A32	-0,048	-0,048	0,000	0,000	-0,051	0,000	-0,043	0,000
A33	-0,078	-0,048	0,000	-0,029	-0,051	0,000	-0,046	0,000
A34	-0,075	-0,048	0,000	-0,050	-0,051	-0,005	-0,034	0,000
A35	0,000	-0,048	0,000	-0,050	-0,051	-0,133	-0,046	0,000
A36	-0,035	-0,048	0,000	-0,050	0,000	-0,119	-0,017	0,000
A37	0,000	-0,048	0,000	-0,029	-0,051	-0,133	-0,046	0,000

A38	-0,025	-0,048	0,000	-0,029	-0,051	0,000	-0,045	0,000
A39	-0,014	-0,048	0,000	-0,050	-0,051	-0,009	-0,041	0,000
A40	-0,075	-0,048	0,000	-0,069	-0,051	-0,015	-0,039	0,000
A41	-0,052	-0,048	0,000	0,000	-0,051	-0,009	-0,046	0,000
A42	-0,052	-0,048	0,000	-0,029	-0,051	-0,025	-0,043	0,000
A43	-0,056	-0,048	0,000	-0,029	0,000	-0,119	-0,034	0,000
A44	0,000	-0,048	0,000	-0,029	-0,051	-0,015	-0,046	0,000
A45	-0,020	-0,048	0,000	-0,069	-0,051	-0,030	-0,045	0,000
A46	-0,068	-0,048	0,000	-0,029	-0,051	-0,025	-0,037	0,000
A47	-0,044	-0,048	-0,150	-0,029	-0,051	-0,017	-0,043	0,000
A48	0,000	-0,048	0,000	-0,050	-0,051	0,000	-0,046	0,000
A49	0,000	-0,048	0,000	0,000	0,000	-0,014	-0,046	0,000
A50	0,000	-0,048	0,000	-0,069	-0,051	-0,014	-0,046	0,000
A51	-0,068	-0,038	0,000	0,000	0,000	-0,010	-0,046	0,000
A52	-0,104	-0,038	-0,230	-0,114	0,000	-0,062	-0,034	0,000
A53	-0,020	-0,038	0,000	0,000	-0,051	-0,001	-0,037	0,000
A54	-0,060	-0,038	0,000	-0,050	-0,051	-0,010	-0,041	0,000
A55	-0,110	-0,038	-0,150	-0,085	-0,051	-0,062	-0,030	0,000
A56	0,000	-0,038	0,000	-0,050	-0,051	-0,133	-0,046	0,000
A57	-0,092	-0,038	-0,150	-0,069	-0,051	-0,034	-0,045	0,000
A58	-0,014	-0,038	0,000	0,000	-0,051	-0,010	-0,043	0,000
A59	0,000	-0,038	0,000	-0,029	-0,051	-0,133	-0,046	0,000
A60	0,000	-0,038	0,000	-0,029	-0,051	-0,133	-0,046	0,000
A61	-0,056	-0,038	0,000	-0,050	0,000	-0,119	-0,039	0,000
A62	0,000	-0,038	0,000	0,000	-0,051	0,000	-0,046	0,000
A63	-0,068	-0,038	0,000	-0,100	-0,051	-0,018	-0,039	0,000
A64	0,000	-0,038	0,000	-0,100	-0,051	-0,133	-0,046	0,000
A65	0,000	-0,028	0,000	-0,029	-0,051	0,000	-0,046	0,000
A66	0,000	-0,028	0,000	0,000	-0,051	-0,018	-0,046	0,000
A67	0,000	-0,028	0,000	-0,069	0,000	0,000	-0,046	0,000
A68	0,000	-0,028	0,000	-0,050	-0,051	0,000	-0,046	0,000
A69	0,000	-0,028	0,000	-0,029	-0,051	0,000	-0,043	0,000
A70	-0,030	-0,028	-0,150	-0,100	0,000	-0,119	-0,014	0,000
A71	0,000	-0,028	0,000	-0,069	-0,051	0,000	-0,046	0,000
A72	0,000	-0,028	0,000	0,000	-0,051	0,000	-0,046	0,000
A73	0,000	-0,028	0,000	0,000	-0,051	0,000	-0,046	0,000
A74	0,000	-0,028	0,000	-0,069	-0,051	0,000	-0,046	0,000
A75	-0,048	-0,028	0,000	-0,069	-0,051	-0,133	-0,045	0,000
A76	0,000	-0,028	0,000	-0,069	-0,051	-0,051	-0,036	-0,173
A77	0,000	-0,028	0,000	-0,069	-0,051	-0,051	-0,034	0,000
A78	0,000	-0,028	0,000	0,000	-0,051	-0,001	-0,046	0,000
A79	0,000	-0,028	0,000	-0,127	-0,051	-0,133	-0,046	0,000
A80	0,000	-0,028	0,000	-0,029	-0,051	-0,001	-0,046	0,000

A81	0,000	-0,028	0,000	-0,050	-0,051	0,000	-0,046	0,000
A82	0,000	-0,028	0,000	-0,029	-0,051	-0,001	-0,046	0,000
A83	0,000	-0,016	0,000	-0,069	-0,051	-0,006	-0,046	0,000
A84	0,000	-0,016	0,000	-0,029	-0,051	0,000	-0,046	0,000
A85	0,000	-0,016	0,000	0,000	-0,051	-0,005	-0,046	0,000
A86	-0,095	-0,016	-0,285	-0,050	-0,051	-0,062	0,000	-0,169
A87	0,000	-0,016	0,000	0,000	0,000	-0,001	-0,046	0,000
A88	-0,068	-0,016	-0,347	0,000	0,000	-0,001	-0,034	-0,173
A89	0,000	-0,016	0,000	-0,085	-0,051	-0,009	-0,046	0,000
A90	-0,064	0,000	-0,361	-0,029	-0,051	0,000	-0,019	-0,173
A91	0,000	-0,057	0,000	0,000	-0,051	-0,037	-0,046	0,000
A92	-0,048	-0,057	0,000	0,000	-0,051	-0,006	-0,046	0,000
A93	0,000	-0,057	0,000	0,000	0,000	-0,009	-0,046	0,000
A94	-0,044	-0,057	0,000	0,000	-0,051	-0,004	-0,046	0,000
A95	-0,048	-0,057	0,000	-0,029	0,000	0,000	-0,046	0,000
A96	-0,060	-0,057	0,000	-0,085	-0,051	-0,053	-0,046	0,000
A97	0,000	-0,057	0,000	-0,050	-0,051	-0,009	-0,046	0,000
A98	-0,025	-0,057	0,000	-0,085	-0,051	-0,001	-0,046	0,000
A99	-0,008	-0,057	0,000	-0,050	-0,051	-0,009	-0,046	0,000
A100	-0,082	-0,057	0,000	-0,029	0,000	0,000	-0,046	0,000
A101	-0,035	-0,057	0,000	-0,069	-0,051	-0,005	-0,046	0,000
A102	-0,048	-0,038	0,000	0,000	0,000	0,000	-0,046	0,000
A103	-0,040	-0,038	0,000	-0,029	-0,051	-0,037	-0,046	0,000
A104	-0,044	-0,016	0,000	0,000	-0,051	0,000	-0,046	0,000
A105	-0,044	-0,028	0,000	-0,114	-0,051	-0,133	-0,046	0,000
A106	-0,129	-0,028	0,000	-0,029	-0,051	-0,133	-0,046	0,000
A107	-0,008	-0,016	0,000	0,000	-0,051	-0,001	-0,046	0,000
Total	-3,162	-4,578	-1,822	-4,177	-4,466	-3,284	-4,648	-0,689
E_j	0,677	0,980	0,390	0,894	0,956	0,703	0,995	0,147
d_j (1-E_j)	0,323	0,020	0,610	0,106	0,044	0,297	0,005	0,853
W_j	0,143	0,009	0,270	0,047	0,020	0,132	0,002	0,377
Percent (%)	14,31	0,90	27,01	4,69	1,96	13,16	0,23	37,74

APPENDIX 3

TOPSIS Method Stages

Weighted Normalized Decision Matrix

Alternatives	C1	C2	C3	C4	C5	C6	C7	C8
A1	0,005	0,001	0,018	0,001	0,002	0,001	0,000	0,000
A2	0,001	0,001	0,018	0,004	0,002	0,000	0,000	0,000
A3	0,028	0,001	0,018	0,004	0,002	0,106	0,000	0,000
A4	0,016	0,001	0,018	0,007	0,002	0,000	0,000	0,000
A5	0,017	0,001	0,018	0,001	0,002	0,000	0,000	0,000
A6	0,011	0,001	0,018	0,006	0,002	0,002	0,000	0,000
A7	0,023	0,001	0,018	0,001	0,002	0,000	0,000	0,000
A8	0,006	0,001	0,018	0,006	0,002	0,000	0,000	0,000
A9	0,004	0,001	0,018	0,003	0,002	0,000	0,000	0,000
A10	0,001	0,001	0,018	0,003	0,000	0,000	0,000	0,000
A11	0,001	0,001	0,018	0,003	0,000	0,000	0,000	0,000
A12	0,005	0,001	0,018	0,001	0,002	0,004	0,000	0,000
A13	0,001	0,001	0,018	0,003	0,002	0,004	0,000	0,000
A14	0,016	0,001	0,018	0,003	0,000	0,005	0,000	0,000
A15	0,024	0,001	0,018	0,003	0,002	0,006	0,000	0,000
A16	0,007	0,001	0,018	0,003	0,002	0,000	0,000	0,000
A17	0,010	0,001	0,018	0,003	0,002	0,000	0,000	0,000
A18	0,007	0,001	0,018	0,003	0,002	0,001	0,000	0,000
A19	0,004	0,001	0,018	0,006	0,002	0,001	0,000	0,000
A20	0,010	0,001	0,018	0,007	0,002	0,000	0,000	0,000
A21	0,005	0,001	0,018	0,001	0,000	0,000	0,000	0,000
A22	0,001	0,001	0,018	0,007	0,002	0,003	0,000	0,000
A23	0,021	0,001	0,018	0,003	0,002	0,001	0,000	0,000
A24	0,020	0,001	0,018	0,007	0,002	0,002	0,000	0,000
A25	0,004	0,001	0,018	0,001	0,000	0,001	0,000	0,000
A26	0,007	0,001	0,018	0,007	0,002	0,000	0,000	0,000
A27	0,004	0,001	0,018	0,001	0,000	0,001	0,000	0,000
A28	0,022	0,001	0,018	0,004	0,002	0,002	0,000	0,000
A29	0,009	0,001	0,018	0,001	0,002	0,004	0,000	0,000
A30	0,002	0,001	0,018	0,003	0,002	0,000	0,000	0,000
A31	0,006	0,001	0,018	0,003	0,002	0,000	0,000	0,000
A32	0,012	0,001	0,018	0,001	0,002	0,000	0,000	0,000
A33	0,022	0,001	0,018	0,003	0,002	0,000	0,000	0,000
A34	0,021	0,001	0,018	0,004	0,002	0,000	0,000	0,000
A35	0,007	0,001	0,018	0,004	0,002	0,021	0,000	0,000
A36	0,009	0,001	0,018	0,004	0,000	0,018	0,001	0,000
A37	0,005	0,001	0,018	0,003	0,002	0,021	0,000	0,000

A38	0,006	0,001	0,018	0,003	0,002	0,000	0,000	0,000
A39	0,004	0,001	0,018	0,004	0,002	0,001	0,000	0,000
A40	0,021	0,001	0,018	0,006	0,002	0,001	0,000	0,000
A41	0,013	0,001	0,018	0,001	0,002	0,001	0,000	0,000
A42	0,013	0,001	0,018	0,003	0,002	0,002	0,000	0,000
A43	0,015	0,001	0,018	0,003	0,000	0,018	0,000	0,000
A44	0,007	0,001	0,018	0,003	0,002	0,001	0,000	0,000
A45	0,005	0,001	0,018	0,006	0,002	0,003	0,000	0,000
A46	0,018	0,001	0,018	0,003	0,002	0,002	0,000	0,000
A47	0,011	0,001	0,036	0,003	0,002	0,002	0,000	0,000
A48	0,009	0,001	0,018	0,004	0,002	0,000	0,000	0,000
A49	0,006	0,001	0,018	0,001	0,000	0,001	0,000	0,000
A50	0,011	0,001	0,018	0,006	0,002	0,001	0,000	0,000
A51	0,018	0,001	0,018	0,001	0,000	0,001	0,000	0,000
A52	0,032	0,001	0,054	0,010	0,000	0,007	0,000	0,000
A53	0,005	0,001	0,018	0,001	0,002	0,000	0,000	0,000
A54	0,016	0,001	0,018	0,004	0,002	0,001	0,000	0,000
A55	0,034	0,001	0,036	0,007	0,002	0,007	0,001	0,000
A56	0,009	0,001	0,018	0,004	0,002	0,021	0,000	0,000
A57	0,027	0,001	0,036	0,006	0,002	0,003	0,000	0,000
A58	0,004	0,001	0,018	0,001	0,002	0,001	0,000	0,000
A59	0,013	0,001	0,018	0,003	0,002	0,021	0,000	0,000
A60	0,010	0,001	0,018	0,003	0,002	0,021	0,000	0,000
A61	0,015	0,001	0,018	0,004	0,000	0,018	0,000	0,000
A62	0,001	0,001	0,018	0,001	0,002	0,000	0,000	0,000
A63	0,018	0,001	0,018	0,009	0,002	0,002	0,000	0,000
A64	0,002	0,001	0,018	0,009	0,002	0,021	0,000	0,000
A65	0,002	0,001	0,018	0,003	0,002	0,000	0,000	0,000
A66	0,018	0,001	0,018	0,001	0,002	0,002	0,000	0,000
A67	0,010	0,001	0,018	0,006	0,000	0,000	0,000	0,000
A68	0,007	0,001	0,018	0,004	0,002	0,000	0,000	0,000
A69	0,001	0,001	0,018	0,003	0,002	0,000	0,000	0,000
A70	0,007	0,001	0,036	0,009	0,000	0,018	0,001	0,000
A71	0,005	0,001	0,018	0,006	0,002	0,000	0,000	0,000
A72	0,002	0,001	0,018	0,001	0,002	0,000	0,000	0,000
A73	0,016	0,001	0,018	0,001	0,002	0,000	0,000	0,000
A74	0,001	0,001	0,018	0,006	0,002	0,000	0,000	0,000
A75	0,012	0,001	0,018	0,006	0,002	0,021	0,000	0,000
A76	0,001	0,001	0,018	0,006	0,002	0,006	0,000	0,029
A77	0,001	0,001	0,018	0,006	0,002	0,006	0,000	0,000
A78	0,005	0,001	0,018	0,001	0,002	0,000	0,000	0,000
A79	0,007	0,001	0,018	0,012	0,002	0,021	0,000	0,000
A80	0,022	0,001	0,018	0,003	0,002	0,000	0,000	0,000

A81	0,001	0,001	0,018	0,004	0,002	0,000	0,000	0,000
A82	0,009	0,001	0,018	0,003	0,002	0,000	0,000	0,000
A83	0,018	0,001	0,018	0,006	0,002	0,000	0,000	0,000
A84	0,004	0,001	0,018	0,003	0,002	0,000	0,000	0,000
A85	0,028	0,001	0,018	0,001	0,002	0,000	0,000	0,000
A86	0,028	0,001	0,072	0,004	0,002	0,007	0,001	0,374
A87	0,017	0,001	0,018	0,001	0,000	0,000	0,000	0,000
A88	0,018	0,001	0,108	0,001	0,000	0,000	0,000	0,029
A89	0,006	0,001	0,018	0,007	0,002	0,001	0,000	0,000
A90	0,017	0,001	0,126	0,003	0,002	0,000	0,001	0,029
A91	0,001	0,001	0,018	0,001	0,002	0,004	0,000	0,000
A92	0,012	0,001	0,018	0,001	0,002	0,000	0,000	0,000
A93	0,001	0,001	0,018	0,001	0,000	0,001	0,000	0,000
A94	0,011	0,001	0,018	0,001	0,002	0,000	0,000	0,000
A95	0,012	0,001	0,018	0,003	0,000	0,000	0,000	0,000
A96	0,016	0,001	0,018	0,007	0,002	0,006	0,000	0,000
A97	0,001	0,001	0,018	0,004	0,002	0,001	0,000	0,000
A98	0,006	0,001	0,018	0,007	0,002	0,000	0,000	0,000
A99	0,002	0,001	0,018	0,004	0,002	0,001	0,000	0,000
A100	0,023	0,001	0,018	0,003	0,000	0,000	0,000	0,000
A101	0,009	0,001	0,018	0,006	0,002	0,000	0,000	0,000
A102	0,012	0,001	0,018	0,001	0,000	0,000	0,000	0,000
A103	0,010	0,001	0,018	0,003	0,002	0,004	0,000	0,000
A104	0,011	0,001	0,018	0,001	0,002	0,000	0,000	0,000
A105	0,011	0,001	0,018	0,010	0,002	0,021	0,000	0,000
A106	0,043	0,001	0,018	0,003	0,002	0,021	0,000	0,000
A107	0,002	0,001	0,018	0,001	0,002	0,000	0,000	0,000
Positive	0,043	0,001	0,126	0,012	0,002	0,106	0,000	0,374
Negative	0,001	0,001	0,018	0,001	0,000	0,000	0,001	0,000

Calculation of Distances to Positive Ideal and Negative Ideal Solutions

Alternatives	S_j^+	S_j^-	C^*
A1	0,405	0,004	0,011
A2	0,406	0,004	0,009
A3	0,390	0,109	0,219
A4	0,404	0,016	0,038
A5	0,404	0,016	0,038
A6	0,404	0,011	0,027
A7	0,404	0,022	0,052
A8	0,405	0,007	0,017
A9	0,405	0,004	0,009
A10	0,406	0,002	0,005
A11	0,406	0,002	0,005

A12	0,404	0,006	0,015
A13	0,405	0,005	0,012
A14	0,403	0,016	0,037
A15	0,402	0,024	0,057
A16	0,405	0,007	0,016
A17	0,405	0,009	0,022
A18	0,405	0,007	0,016
A19	0,405	0,006	0,014
A20	0,405	0,011	0,026
A21	0,405	0,004	0,009
A22	0,405	0,007	0,017
A23	0,404	0,020	0,047
A24	0,404	0,019	0,046
A25	0,405	0,003	0,007
A26	0,405	0,009	0,021
A27	0,405	0,003	0,007
A28	0,403	0,021	0,050
A29	0,404	0,009	0,021
A30	0,406	0,003	0,008
A31	0,405	0,006	0,014
A32	0,405	0,011	0,027
A33	0,404	0,021	0,049
A34	0,404	0,020	0,047
A35	0,400	0,022	0,052
A36	0,401	0,019	0,046
A37	0,400	0,021	0,051
A38	0,405	0,006	0,014
A39	0,405	0,005	0,011
A40	0,404	0,020	0,048
A41	0,405	0,012	0,030
A42	0,404	0,013	0,031
A43	0,400	0,022	0,053
A44	0,405	0,007	0,017
A45	0,405	0,007	0,017
A46	0,404	0,018	0,042
A47	0,400	0,021	0,049
A48	0,405	0,008	0,020
A49	0,405	0,005	0,013
A50	0,404	0,011	0,027
A51	0,404	0,017	0,041
A52	0,394	0,049	0,110
A53	0,405	0,004	0,011
A54	0,404	0,015	0,036

A55	0,397	0,039	0,089
A56	0,400	0,022	0,053
A57	0,399	0,032	0,074
A58	0,405	0,004	0,009
A59	0,400	0,024	0,057
A60	0,400	0,023	0,054
A61	0,400	0,023	0,053
A62	0,406	0,002	0,006
A63	0,404	0,019	0,045
A64	0,401	0,022	0,053
A65	0,406	0,003	0,008
A66	0,404	0,017	0,041
A67	0,405	0,010	0,023
A68	0,405	0,007	0,017
A69	0,406	0,003	0,007
A70	0,396	0,027	0,064
A71	0,405	0,006	0,015
A72	0,406	0,003	0,007
A73	0,404	0,015	0,035
A74	0,406	0,005	0,012
A75	0,400	0,024	0,057
A76	0,378	0,030	0,073
A77	0,404	0,008	0,018
A78	0,405	0,004	0,011
A79	0,400	0,024	0,057
A80	0,404	0,021	0,049
A81	0,406	0,004	0,009
A82	0,405	0,008	0,019
A83	0,404	0,018	0,042
A84	0,405	0,004	0,009
A85	0,404	0,027	0,063
A86	0,113	0,379	0,770
A87	0,404	0,016	0,038
A88	0,363	0,096	0,209
A89	0,405	0,008	0,019
A90	0,362	0,113	0,238
A91	0,405	0,004	0,011
A92	0,405	0,011	0,027
A93	0,406	0,001	0,004
A94	0,405	0,010	0,024
A95	0,405	0,011	0,027
A96	0,403	0,017	0,041
A97	0,405	0,004	0,009

A98	0,405	0,008	0,019
A99	0,405	0,004	0,010
A100	0,404	0,022	0,052
A101	0,405	0,009	0,021
A102	0,405	0,011	0,027
A103	0,404	0,010	0,024
A104	0,405	0,010	0,024
A105	0,400	0,025	0,058
A106	0,399	0,047	0,105
A107	0,406	0,003	0,007



APPENDIX 4

-VIKOR Method Stages

Determination of the Best (f_i^+) and Worst (f_i^-) Values in the Initial Matrix

	C1	C2	C3	C4	C5	C6	C7	C8
F+	35	19	7	8	1	1319	0	13
F-	1	13	1	1	0	1	21	0

Weighted Normalized Matrix

	C1	C2	C3	C4	C5	C6	C7	C8
A1	0,130	0,000	0,270	0,047	0,000	0,131	0,000	0,377
A2	0,143	0,000	0,270	0,034	0,000	0,131	0,000	0,377
A3	0,051	0,000	0,270	0,034	0,000	0,000	0,000	0,377
A4	0,093	0,000	0,270	0,020	0,000	0,131	0,000	0,377
A5	0,088	0,000	0,270	0,047	0,000	0,132	0,000	0,377
A6	0,109	0,000	0,270	0,027	0,000	0,129	0,000	0,377
A7	0,067	0,000	0,270	0,047	0,000	0,132	0,000	0,377
A8	0,126	0,001	0,270	0,027	0,000	0,131	0,000	0,377
A9	0,135	0,001	0,270	0,040	0,000	0,132	0,000	0,377
A10	0,143	0,001	0,270	0,040	0,020	0,131	0,000	0,377
A11	0,143	0,001	0,270	0,040	0,020	0,132	0,000	0,377
A12	0,130	0,001	0,270	0,047	0,000	0,126	0,000	0,377
A13	0,143	0,001	0,270	0,040	0,000	0,127	0,000	0,377
A14	0,093	0,001	0,270	0,040	0,020	0,125	0,000	0,377
A15	0,063	0,001	0,270	0,040	0,000	0,124	0,000	0,377
A16	0,122	0,001	0,270	0,040	0,000	0,131	0,000	0,377
A17	0,114	0,001	0,270	0,040	0,000	0,132	0,000	0,377
A18	0,122	0,001	0,270	0,040	0,000	0,131	0,000	0,377
A19	0,135	0,001	0,270	0,027	0,000	0,131	0,000	0,377
A20	0,114	0,001	0,270	0,020	0,000	0,131	0,000	0,377
A21	0,130	0,003	0,270	0,047	0,020	0,132	0,000	0,377
A22	0,143	0,003	0,270	0,020	0,000	0,128	0,000	0,377
A23	0,076	0,003	0,270	0,040	0,000	0,131	0,000	0,377
A24	0,080	0,003	0,270	0,020	0,000	0,130	0,000	0,377
A25	0,135	0,003	0,270	0,047	0,020	0,131	0,000	0,377
A26	0,122	0,003	0,270	0,020	0,000	0,131	0,000	0,377
A27	0,135	0,003	0,270	0,047	0,020	0,131	0,000	0,377
A28	0,072	0,003	0,270	0,034	0,000	0,129	0,000	0,377
A29	0,118	0,003	0,270	0,047	0,000	0,127	0,000	0,377
A30	0,139	0,003	0,270	0,040	0,000	0,131	0,000	0,377
A31	0,126	0,003	0,270	0,040	0,000	0,132	0,000	0,377
A32	0,105	0,003	0,270	0,047	0,000	0,132	0,000	0,377

A33	0,072	0,003	0,270	0,040	0,000	0,132	0,000	0,377
A34	0,076	0,003	0,270	0,034	0,000	0,131	0,001	0,377
A35	0,122	0,003	0,270	0,034	0,000	0,106	0,000	0,377
A36	0,118	0,003	0,270	0,034	0,020	0,109	0,002	0,377
A37	0,130	0,003	0,270	0,040	0,000	0,106	0,000	0,377
A38	0,126	0,003	0,270	0,040	0,000	0,132	0,000	0,377
A39	0,135	0,003	0,270	0,034	0,000	0,131	0,000	0,377
A40	0,076	0,003	0,270	0,027	0,000	0,130	0,000	0,377
A41	0,101	0,003	0,270	0,047	0,000	0,131	0,000	0,377
A42	0,101	0,003	0,270	0,040	0,000	0,129	0,000	0,377
A43	0,097	0,003	0,270	0,040	0,020	0,109	0,001	0,377
A44	0,122	0,003	0,270	0,040	0,000	0,130	0,000	0,377
A45	0,130	0,003	0,270	0,027	0,000	0,128	0,000	0,377
A46	0,084	0,003	0,270	0,040	0,000	0,129	0,001	0,377
A47	0,109	0,003	0,225	0,040	0,000	0,130	0,000	0,377
A48	0,118	0,003	0,270	0,034	0,000	0,132	0,000	0,377
A49	0,126	0,003	0,270	0,047	0,020	0,130	0,000	0,377
A50	0,109	0,003	0,270	0,027	0,000	0,130	0,000	0,377
A51	0,084	0,004	0,270	0,047	0,020	0,131	0,000	0,377
A52	0,038	0,004	0,180	0,007	0,020	0,122	0,001	0,377
A53	0,130	0,004	0,270	0,047	0,000	0,131	0,001	0,377
A54	0,093	0,004	0,270	0,034	0,000	0,131	0,000	0,377
A55	0,029	0,004	0,225	0,020	0,000	0,122	0,001	0,377
A56	0,118	0,004	0,270	0,034	0,000	0,106	0,000	0,377
A57	0,055	0,004	0,225	0,027	0,000	0,127	0,000	0,377
A58	0,135	0,004	0,270	0,047	0,000	0,131	0,000	0,377
A59	0,101	0,004	0,270	0,040	0,000	0,106	0,000	0,377
A60	0,114	0,004	0,270	0,040	0,000	0,106	0,000	0,377
A61	0,097	0,004	0,270	0,034	0,020	0,109	0,000	0,377
A62	0,143	0,004	0,270	0,047	0,000	0,132	0,000	0,377
A63	0,084	0,004	0,270	0,013	0,000	0,130	0,000	0,377
A64	0,139	0,004	0,270	0,013	0,000	0,106	0,000	0,377
A65	0,139	0,006	0,270	0,040	0,000	0,132	0,000	0,377
A66	0,084	0,006	0,270	0,047	0,000	0,130	0,000	0,377
A67	0,114	0,006	0,270	0,027	0,020	0,132	0,000	0,377
A68	0,122	0,006	0,270	0,034	0,000	0,132	0,000	0,377
A69	0,143	0,006	0,270	0,040	0,000	0,132	0,000	0,377
A70	0,122	0,006	0,225	0,013	0,020	0,109	0,002	0,377
A71	0,130	0,006	0,270	0,027	0,000	0,132	0,000	0,377
A72	0,139	0,006	0,270	0,047	0,000	0,132	0,000	0,377
A73	0,093	0,006	0,270	0,047	0,000	0,132	0,000	0,377
A74	0,143	0,006	0,270	0,027	0,000	0,132	0,000	0,377
A75	0,105	0,006	0,270	0,027	0,000	0,106	0,000	0,377

A76	0,143	0,006	0,270	0,027	0,000	0,124	0,001	0,348
A77	0,143	0,006	0,270	0,027	0,000	0,124	0,001	0,377
A78	0,130	0,006	0,270	0,047	0,000	0,131	0,000	0,377
A79	0,122	0,006	0,270	0,000	0,000	0,106	0,000	0,377
A80	0,072	0,006	0,270	0,040	0,000	0,131	0,000	0,377
A81	0,143	0,006	0,270	0,034	0,000	0,132	0,000	0,377
A82	0,118	0,006	0,270	0,040	0,000	0,131	0,000	0,377
A83	0,084	0,007	0,270	0,027	0,000	0,131	0,000	0,377
A84	0,135	0,007	0,270	0,040	0,000	0,132	0,000	0,377
A85	0,051	0,007	0,270	0,047	0,000	0,131	0,000	0,377
A86	0,051	0,007	0,135	0,034	0,000	0,122	0,002	0,000
A87	0,088	0,007	0,270	0,047	0,020	0,131	0,000	0,377
A88	0,084	0,007	0,045	0,047	0,020	0,131	0,001	0,348
A89	0,126	0,007	0,270	0,020	0,000	0,131	0,000	0,377
A90	0,088	0,009	0,000	0,040	0,000	0,132	0,002	0,348
A91	0,143	0,001	0,270	0,047	0,000	0,127	0,000	0,377
A92	0,105	0,001	0,270	0,047	0,000	0,131	0,000	0,377
A93	0,143	0,001	0,270	0,047	0,020	0,131	0,000	0,377
A94	0,109	0,001	0,270	0,047	0,000	0,131	0,000	0,377
A95	0,105	0,001	0,270	0,040	0,020	0,132	0,000	0,377
A96	0,093	0,001	0,270	0,020	0,000	0,124	0,000	0,377
A97	0,143	0,001	0,270	0,034	0,000	0,131	0,000	0,377
A98	0,126	0,001	0,270	0,020	0,000	0,131	0,000	0,377
A99	0,139	0,001	0,270	0,034	0,000	0,131	0,000	0,377
A100	0,067	0,001	0,270	0,040	0,020	0,132	0,000	0,377
A101	0,118	0,001	0,270	0,027	0,000	0,131	0,000	0,377
A102	0,105	0,004	0,270	0,047	0,020	0,132	0,000	0,377
A103	0,114	0,004	0,270	0,040	0,000	0,127	0,000	0,377
A104	0,109	0,007	0,270	0,047	0,000	0,132	0,000	0,377
A105	0,109	0,006	0,270	0,007	0,000	0,106	0,000	0,377
A106	0,000	0,006	0,270	0,040	0,000	0,106	0,000	0,377
A107	0,139	0,007	0,270	0,047	0,000	0,131	0,000	0,377

Sj, Rj and Qj Values of Alternatives

Alternatives	S _j	R _j	Q _j
A1	0,956	0,377	0,974
A2	0,955	0,377	0,973
A3	0,732	0,377	0,798
A4	0,891	0,377	0,923
A5	0,914	0,377	0,941
A6	0,913	0,377	0,940
A7	0,893	0,377	0,925
A8	0,933	0,377	0,956

A9	0,955	0,377	0,973
A10	0,983	0,377	0,995
A11	0,983	0,377	0,995
A12	0,952	0,377	0,971
A13	0,959	0,377	0,976
A14	0,927	0,377	0,951
A15	0,877	0,377	0,912
A16	0,943	0,377	0,963
A17	0,934	0,377	0,957
A18	0,942	0,377	0,963
A19	0,941	0,377	0,962
A20	0,914	0,377	0,941
A21	0,979	0,377	0,992
A22	0,942	0,377	0,963
A23	0,897	0,377	0,928
A24	0,880	0,377	0,914
A25	0,983	0,377	0,995
A26	0,924	0,377	0,949
A27	0,983	0,377	0,995
A28	0,885	0,377	0,918
A29	0,942	0,377	0,963
A30	0,961	0,377	0,978
A31	0,949	0,377	0,968
A32	0,934	0,377	0,957
A33	0,894	0,377	0,925
A34	0,892	0,377	0,924
A35	0,912	0,377	0,939
A36	0,933	0,377	0,956
A37	0,927	0,377	0,951
A38	0,949	0,377	0,968
A39	0,950	0,377	0,969
A40	0,884	0,377	0,917
A41	0,929	0,377	0,953
A42	0,921	0,377	0,946
A43	0,917	0,377	0,944
A44	0,943	0,377	0,964
A45	0,936	0,377	0,958
A46	0,904	0,377	0,933
A47	0,885	0,377	0,918
A48	0,933	0,377	0,956
A49	0,973	0,377	0,988
A50	0,917	0,377	0,943
A51	0,933	0,377	0,956

A52	0,749	0,377	0,812
A53	0,961	0,377	0,978
A54	0,909	0,377	0,937
A55	0,780	0,377	0,836
A56	0,909	0,377	0,937
A57	0,816	0,377	0,864
A58	0,964	0,377	0,980
A59	0,899	0,377	0,929
A60	0,911	0,377	0,939
A61	0,912	0,377	0,939
A62	0,974	0,377	0,988
A63	0,880	0,377	0,914
A64	0,910	0,377	0,938
A65	0,964	0,377	0,980
A66	0,914	0,377	0,941
A67	0,945	0,377	0,965
A68	0,941	0,377	0,962
A69	0,969	0,377	0,984
A70	0,875	0,377	0,910
A71	0,942	0,377	0,963
A72	0,971	0,377	0,986
A73	0,925	0,377	0,949
A74	0,955	0,377	0,973
A75	0,891	0,377	0,923
A76	0,920	0,348	0,885
A77	0,949	0,377	0,968
A78	0,962	0,377	0,979
A79	0,881	0,377	0,915
A80	0,897	0,377	0,927
A81	0,962	0,377	0,978
A82	0,943	0,377	0,964
A83	0,897	0,377	0,928
A84	0,961	0,377	0,978
A85	0,884	0,377	0,917
A86	0,351	0,135	0,000
A87	0,941	0,377	0,962
A88	0,684	0,348	0,701
A89	0,932	0,377	0,955
A90	0,619	0,348	0,650
A91	0,966	0,377	0,982
A92	0,932	0,377	0,955
A93	0,989	0,377	1,000
A94	0,937	0,377	0,959

A95	0,946	0,377	0,966
A96	0,886	0,377	0,919
A97	0,956	0,377	0,974
A98	0,927	0,377	0,951
A99	0,952	0,377	0,971
A100	0,908	0,377	0,936
A101	0,925	0,377	0,949
A102	0,955	0,377	0,973
A103	0,933	0,377	0,956
A104	0,943	0,377	0,964
A105	0,875	0,377	0,911
A106	0,799	0,377	0,851
A107	0,972	0,377	0,987

APPENDIX 5

ARAS Method Stages

Normalized Decision Matrix

c	C1	C2	C3	C4	C5	C6	C7	C8
Optimum	0,035	0,011	0,052	0,027	0,011	0,172	0,000	0,448
A1	0,004	0,011	0,007	0,003	0,011	0,001	0,000	0,000
A2	0,001	0,011	0,007	0,010	0,011	0,001	0,000	0,000
A3	0,023	0,011	0,007	0,010	0,011	0,172	0,000	0,000
A4	0,013	0,011	0,007	0,017	0,011	0,001	0,000	0,000
A5	0,014	0,011	0,007	0,003	0,011	0,000	0,000	0,000
A6	0,009	0,011	0,007	0,014	0,011	0,003	0,000	0,000
A7	0,019	0,011	0,007	0,003	0,011	0,000	0,000	0,000
A8	0,005	0,010	0,007	0,014	0,011	0,001	0,000	0,000
A9	0,003	0,010	0,007	0,007	0,011	0,000	0,000	0,000
A10	0,001	0,010	0,007	0,007	0,000	0,001	0,000	0,000
A11	0,001	0,010	0,007	0,007	0,000	0,000	0,000	0,000
A12	0,004	0,010	0,007	0,003	0,011	0,007	0,000	0,000
A13	0,001	0,010	0,007	0,007	0,011	0,006	0,000	0,000
A14	0,013	0,010	0,007	0,007	0,000	0,008	0,000	0,000
A15	0,020	0,010	0,007	0,007	0,011	0,010	0,000	0,000
A16	0,006	0,010	0,007	0,007	0,011	0,001	0,000	0,000
A17	0,008	0,010	0,007	0,007	0,011	0,000	0,000	0,000
A18	0,006	0,010	0,007	0,007	0,011	0,001	0,000	0,000
A19	0,003	0,010	0,007	0,014	0,011	0,001	0,000	0,000
A20	0,008	0,010	0,007	0,017	0,011	0,000	0,000	0,000
A21	0,004	0,010	0,007	0,003	0,000	0,000	0,000	0,000
A22	0,001	0,010	0,007	0,017	0,011	0,005	0,044	0,000
A23	0,017	0,010	0,007	0,007	0,011	0,001	0,000	0,000
A24	0,016	0,010	0,007	0,017	0,011	0,003	0,000	0,000
A25	0,003	0,010	0,007	0,003	0,000	0,001	0,000	0,000
A26	0,006	0,010	0,007	0,017	0,011	0,001	0,000	0,000
A27	0,003	0,010	0,007	0,003	0,000	0,001	0,088	0,000
A28	0,018	0,010	0,007	0,010	0,011	0,004	0,022	0,000
A29	0,007	0,010	0,007	0,003	0,011	0,006	0,000	0,000
A30	0,002	0,010	0,007	0,007	0,011	0,000	0,000	0,000
A31	0,005	0,010	0,007	0,007	0,011	0,000	0,000	0,000

A32	0,010	0,010	0,007	0,003	0,011	0,000	0,044	0,000
A33	0,018	0,010	0,007	0,007	0,011	0,000	0,000	0,000
A34	0,017	0,010	0,007	0,010	0,011	0,001	0,013	0,000
A35	0,006	0,010	0,007	0,010	0,011	0,034	0,000	0,000
A36	0,007	0,010	0,007	0,010	0,000	0,029	0,006	0,000
A37	0,004	0,010	0,007	0,007	0,011	0,034	0,000	0,000
A38	0,005	0,010	0,007	0,007	0,011	0,000	0,088	0,000
A39	0,003	0,010	0,007	0,010	0,011	0,001	0,029	0,000
A40	0,017	0,010	0,007	0,014	0,011	0,002	0,022	0,000
A41	0,011	0,010	0,007	0,003	0,011	0,001	0,000	0,000
A42	0,011	0,010	0,007	0,007	0,011	0,004	0,044	0,000
A43	0,012	0,010	0,007	0,007	0,000	0,029	0,013	0,000
A44	0,006	0,010	0,007	0,007	0,011	0,002	0,000	0,000
A45	0,004	0,010	0,007	0,014	0,011	0,005	0,088	0,000
A46	0,015	0,010	0,007	0,007	0,011	0,004	0,018	0,000
A47	0,009	0,010	0,015	0,007	0,011	0,002	0,044	0,000
A48	0,007	0,010	0,007	0,010	0,011	0,000	0,000	0,000
A49	0,005	0,010	0,007	0,003	0,000	0,002	0,000	0,000
A50	0,009	0,010	0,007	0,014	0,011	0,002	0,000	0,000
A51	0,015	0,009	0,007	0,003	0,000	0,001	0,000	0,000
A52	0,026	0,009	0,022	0,024	0,000	0,012	0,013	0,000
A53	0,004	0,009	0,007	0,003	0,011	0,000	0,018	0,000
A54	0,013	0,009	0,007	0,010	0,011	0,001	0,029	0,000
A55	0,028	0,009	0,015	0,017	0,011	0,012	0,010	0,000
A56	0,007	0,009	0,007	0,010	0,011	0,034	0,000	0,000
A57	0,022	0,009	0,015	0,014	0,011	0,006	0,088	0,000
A58	0,003	0,009	0,007	0,003	0,011	0,001	0,044	0,000
A59	0,011	0,009	0,007	0,007	0,011	0,034	0,000	0,000
A60	0,008	0,009	0,007	0,007	0,011	0,034	0,000	0,000
A61	0,012	0,009	0,007	0,010	0,000	0,029	0,022	0,000
A62	0,001	0,009	0,007	0,003	0,011	0,000	0,000	0,000
A63	0,015	0,009	0,007	0,020	0,011	0,003	0,022	0,000
A64	0,002	0,009	0,007	0,020	0,011	0,034	0,000	0,000
A65	0,002	0,008	0,007	0,007	0,011	0,000	0,000	0,000
A66	0,015	0,008	0,007	0,003	0,011	0,003	0,000	0,000
A67	0,008	0,008	0,007	0,014	0,000	0,000	0,000	0,000
A68	0,006	0,008	0,007	0,010	0,011	0,000	0,000	0,000
A69	0,001	0,008	0,007	0,007	0,011	0,000	0,044	0,000
A70	0,006	0,008	0,015	0,020	0,000	0,029	0,006	0,000
A71	0,004	0,008	0,007	0,014	0,011	0,000	0,000	0,000
A72	0,002	0,008	0,007	0,003	0,011	0,000	0,000	0,000
A73	0,013	0,008	0,007	0,003	0,011	0,000	0,000	0,000
A74	0,001	0,008	0,007	0,014	0,011	0,000	0,000	0,000
A75	0,010	0,008	0,007	0,014	0,011	0,034	0,088	0,000
A76	0,001	0,008	0,007	0,014	0,011	0,009	0,015	0,034
A77	0,001	0,008	0,007	0,014	0,011	0,009	0,013	0,000
A78	0,004	0,008	0,007	0,003	0,011	0,000	0,000	0,000
A79	0,006	0,008	0,007	0,027	0,011	0,034	0,000	0,000
A80	0,018	0,008	0,007	0,007	0,011	0,000	0,000	0,000
A81	0,001	0,008	0,007	0,010	0,011	0,000	0,000	0,000
A82	0,007	0,008	0,007	0,007	0,011	0,000	0,000	0,000
A83	0,015	0,008	0,007	0,014	0,011	0,001	0,000	0,000
A84	0,003	0,008	0,007	0,007	0,011	0,000	0,000	0,000
A85	0,023	0,008	0,007	0,003	0,011	0,001	0,000	0,000
A86	0,023	0,008	0,030	0,010	0,011	0,012	0,004	0,448
A87	0,014	0,008	0,007	0,003	0,000	0,000	0,000	0,000
A88	0,015	0,008	0,045	0,003	0,000	0,000	0,013	0,034
A89	0,005	0,008	0,007	0,017	0,011	0,001	0,000	0,000
A90	0,014	0,007	0,052	0,007	0,011	0,000	0,006	0,034

A26	0,001	0,000	0,002	0,001	0,000	0,000	0,000	0,000	0,004	0,019
A27	0,000	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,003	0,014
A28	0,003	0,000	0,002	0,000	0,000	0,001	0,000	0,000	0,006	0,028
A29	0,001	0,000	0,002	0,000	0,000	0,001	0,000	0,000	0,004	0,020
A30	0,000	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,003	0,014
A31	0,001	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,003	0,016
A32	0,001	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,004	0,019
A33	0,003	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,005	0,025
A34	0,002	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,005	0,025
A35	0,001	0,000	0,002	0,000	0,000	0,004	0,000	0,000	0,008	0,038
A36	0,001	0,000	0,002	0,000	0,000	0,004	0,000	0,000	0,007	0,035
A37	0,001	0,000	0,002	0,000	0,000	0,004	0,000	0,000	0,008	0,036
A38	0,001	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,004	0,017
A39	0,000	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,003	0,016
A40	0,002	0,000	0,002	0,001	0,000	0,000	0,000	0,000	0,006	0,027
A41	0,002	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,004	0,020
A42	0,002	0,000	0,002	0,000	0,000	0,001	0,000	0,000	0,005	0,023
A43	0,002	0,000	0,002	0,000	0,000	0,004	0,000	0,000	0,008	0,038
A44	0,001	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,004	0,018
A45	0,001	0,000	0,002	0,001	0,000	0,001	0,000	0,000	0,004	0,021
A46	0,002	0,000	0,002	0,000	0,000	0,001	0,000	0,000	0,005	0,025
A47	0,001	0,000	0,004	0,000	0,000	0,000	0,000	0,000	0,006	0,030
A48	0,001	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,004	0,018
A49	0,001	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,003	0,015
A50	0,001	0,000	0,002	0,001	0,000	0,000	0,000	0,000	0,005	0,021
A51	0,002	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,005	0,022
A52	0,004	0,000	0,006	0,001	0,000	0,002	0,000	0,000	0,013	0,059
A53	0,001	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,003	0,015
A54	0,002	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,005	0,023
A55	0,004	0,000	0,004	0,001	0,000	0,002	0,000	0,000	0,011	0,051
A56	0,001	0,000	0,002	0,000	0,000	0,004	0,000	0,000	0,008	0,039
A57	0,003	0,000	0,004	0,001	0,000	0,001	0,000	0,000	0,009	0,043
A58	0,000	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,003	0,015
A59	0,002	0,000	0,002	0,000	0,000	0,004	0,000	0,000	0,009	0,041
A60	0,001	0,000	0,002	0,000	0,000	0,004	0,000	0,000	0,008	0,039
A61	0,002	0,000	0,002	0,000	0,000	0,004	0,000	0,000	0,008	0,039
A62	0,000	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,003	0,012
A63	0,002	0,000	0,002	0,001	0,000	0,000	0,000	0,000	0,006	0,028
A64	0,000	0,000	0,002	0,001	0,000	0,004	0,000	0,000	0,008	0,038
A65	0,000	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,003	0,014
A66	0,002	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,005	0,024
A67	0,001	0,000	0,002	0,001	0,000	0,000	0,000	0,000	0,004	0,018
A68	0,001	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,004	0,017

A69	0,000	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,003	0,014
A70	0,001	0,000	0,004	0,001	0,000	0,004	0,000	0,000	0,010	0,046
A71	0,001	0,000	0,002	0,001	0,000	0,000	0,000	0,000	0,004	0,017
A72	0,000	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,003	0,013
A73	0,002	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,004	0,021
A74	0,000	0,000	0,002	0,001	0,000	0,000	0,000	0,000	0,003	0,015
A75	0,001	0,000	0,002	0,001	0,000	0,004	0,000	0,000	0,009	0,043
A76	0,000	0,000	0,002	0,001	0,000	0,001	0,000	0,013	0,017	0,082
A77	0,000	0,000	0,002	0,001	0,000	0,001	0,000	0,000	0,004	0,021
A78	0,001	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,003	0,015
A79	0,001	0,000	0,002	0,001	0,000	0,004	0,000	0,000	0,009	0,042
A80	0,003	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,005	0,025
A81	0,000	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,003	0,014
A82	0,001	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,004	0,017
A83	0,002	0,000	0,002	0,001	0,000	0,000	0,000	0,000	0,005	0,025
A84	0,000	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,003	0,014
A85	0,003	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,006	0,028
A86	0,003	0,000	0,008	0,000	0,000	0,002	0,000	0,169	0,183	0,860
A87	0,002	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,004	0,020
A88	0,002	0,000	0,012	0,000	0,000	0,000	0,000	0,013	0,028	0,130
A89	0,001	0,000	0,002	0,001	0,000	0,000	0,000	0,000	0,004	0,019
A90	0,002	0,000	0,014	0,000	0,000	0,000	0,000	0,013	0,030	0,140
A91	0,000	0,000	0,002	0,000	0,000	0,001	0,000	0,000	0,003	0,016
A92	0,001	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,004	0,019
A93	0,000	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,003	0,012
A94	0,001	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,004	0,018
A95	0,001	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,004	0,018
A96	0,002	0,000	0,002	0,001	0,000	0,001	0,000	0,000	0,006	0,030
A97	0,000	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,003	0,015
A98	0,001	0,000	0,002	0,001	0,000	0,000	0,000	0,000	0,004	0,018
A99	0,000	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,003	0,015
A100	0,003	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,005	0,024
A101	0,001	0,000	0,002	0,001	0,000	0,000	0,000	0,000	0,004	0,019
A102	0,001	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,004	0,017
A103	0,001	0,000	0,002	0,000	0,000	0,001	0,000	0,000	0,005	0,022
A104	0,001	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,004	0,018
A105	0,001	0,000	0,002	0,001	0,000	0,004	0,000	0,000	0,009	0,043
A106	0,005	0,000	0,002	0,000	0,000	0,004	0,000	0,000	0,012	0,057
A107	0,000	0,000	0,002	0,000	0,000	0,000	0,000	0,000	0,003	0,013

APPENDIX 6

BORDA Count Method Stages

Orders, BORDA Values and BORDA Scores of Alternatives for Each Method

Alternatives	TOPSIS		VIKOR		ARAS		BORDA	
	Order	BORDA Value	Order	BORDA Value	Order	BORDA Value	BORDA Score	BORDA Count
A1	86	21	86	21	86	21	63	85
A2	92	15	84	23	95	12	50	91
A3	3	104	4	103	3	104	311	3
A4	42	65	22	85	40	67	217	38
A5	41	66	41	66	47	60	192	43
A6	52	55	38	69	44	63	187	44
A7	23	84	24	83	37	70	237	28
A8	70	37	56	51	71	36	124	67
A9	94	13	85	22	91	16	51	90
A10	105	2	105	2	105	2	6	105
A11	106	1	106	1	106	1	3	106
A12	76	31	81	26	60	47	104	75
A13	83	24	88	19	76	31	74	82
A14	44	63	48	59	31	76	198	42
A15	16	91	12	95	23	84	270	14
A16	75	32	70	37	78	29	98	76
A17	60	47	59	48	68	39	134	62
A18	74	33	66	41	73	34	108	72
A19	80	27	64	43	79	28	98	76
A20	55	52	40	67	53	54	173	49
A21	90	17	102	5	100	7	29	98
A22	71	36	67	40	62	45	121	69
A23	32	75	28	79	34	73	227	33
A24	34	73	14	93	29	78	244	25
A25	99	8	103	4	101	6	18	101
A26	62	45	45	62	57	50	157	54
A27	101	6	104	3	94	13	22	100
A28	26	81	18	89	26	81	251	19
A29	63	44	68	39	52	55	138	60
A30	97	10	89	18	96	11	39	95
A31	78	29	76	31	83	24	84	80
A32	50	57	60	47	58	49	153	56
A33	28	79	25	82	36	71	232	32
A34	31	76	23	84	32	75	235	30

A35	22	85	36	71	18	89	245	23
A36	33	74	54	53	22	85	212	39
A37	25	82	49	58	21	86	226	35
A38	79	28	78	29	77	30	87	79
A39	84	23	79	28	81	26	77	81
A40	30	77	17	90	30	77	244	25
A41	48	59	51	56	55	52	167	50
A42	47	60	44	63	43	64	187	44
A43	20	87	43	64	20	87	238	27
A44	73	34	71	36	70	37	107	73
A45	72	35	61	46	49	58	139	59
A46	37	70	30	77	33	74	221	36
A47	29	78	19	88	24	83	249	20
A48	64	43	58	49	67	40	132	63
A49	81	26	100	7	85	22	55	87
A50	54	53	42	65	48	59	177	48
A51	39	68	57	50	46	61	179	46
A52	5	102	5	102	6	101	305	5
A53	88	19	90	17	88	19	55	87
A54	45	62	33	74	42	65	201	41
A55	7	100	6	101	8	99	300	7
A56	19	88	32	75	15	92	255	17
A57	8	99	8	99	11	96	294	9
A58	96	11	95	12	87	20	43	93
A59	13	94	29	78	14	93	265	16
A60	17	90	35	72	16	91	253	18
A61	18	89	37	70	17	90	249	20
A62	104	3	101	6	104	3	12	104
A63	35	72	13	94	28	79	245	23
A64	21	86	34	73	19	88	247	22
A65	98	9	94	13	98	9	31	97
A66	38	69	39	68	41	66	203	40
A67	59	48	74	33	63	44	125	65
A68	69	38	63	44	75	32	114	70
A69	100	7	97	10	99	8	25	99
A70	10	97	10	97	9	98	292	10
A71	77	30	69	38	80	27	95	78
A72	102	5	98	9	103	4	18	101
A73	46	61	46	61	50	57	179	46
A74	82	25	82	25	90	17	67	84
A75	15	92	21	86	12	95	273	13
A76	9	98	9	98	5	102	298	8
A77	68	39	77	30	51	56	125	65

A78	87	20	93	14	92	15	49	92
A79	14	93	15	92	13	94	279	12
A80	27	80	26	81	35	72	233	31
A81	93	14	92	15	97	10	39	95
A82	67	40	73	34	74	33	107	73
A83	36	71	27	80	38	69	220	37
A84	95	12	91	16	93	14	42	94
A85	11	96	16	91	27	80	267	15
A86	1	106	1	106	1	106	318	1
A87	43	64	65	42	54	53	159	53
A88	4	103	3	104	4	103	310	4
A89	65	42	52	55	61	46	143	57
A90	2	105	2	105	2	105	315	2
A91	85	22	96	11	82	25	58	86
A92	49	58	53	54	59	48	160	52
A93	107	0	107	0	107	0	0	107
A94	56	51	62	45	66	41	137	61
A95	51	56	75	32	64	43	131	64
A96	40	67	20	87	25	82	236	29
A97	91	16	87	20	89	18	54	89
A98	66	41	50	57	65	42	140	58
A99	89	18	80	27	84	23	68	83
A100	24	83	31	76	39	68	227	33
A101	61	46	47	60	56	51	157	54
A102	53	54	83	24	72	35	113	71
A103	58	49	55	52	45	62	163	51
A104	57	50	72	35	69	38	123	68
A105	12	95	11	96	10	97	288	11
A106	6	101	7	100	7	100	301	6
A107	103	4	99	8	102	5	17	103