GLOBAL & DOMESTIC SUPPLIER SELECTION FOR TECH-ENABLED PROPERTY MANAGEMENT AND HOSPITALITY INDUSTRY USING FUZZY AHP

by

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ABSTRACT

GLOBAL & DOMESTIC SUPPLIER SELECTION FOR TECH-ENABLED PROPERTY MANAGEMENT AND HOSPITALITY INDUSTRY USING FUZZY AHP

Supplier selection is an important phenomenon for the success of supply chain management in organizations. To survive within a competitive business environment, supply chain departments should be very careful in the matter of supplier selection. Especially evaluating global suppliers together with domestic suppliers is a very complex and risk prone activity. As companies become highly dependent on their suppliers, the consequences might be more critical in case of a poor decision making. This study investigates the supplier selection process for an emerging sector referred as tech-enabled property management and hospitality industry. The companies operating in this industry provide premium fully-furnished serviced apartments to business travelers and expats with mid to long-term duration of stays, after renting the apartments from landlords, building managements or developers in the real estate industry. The aim of this study is to present appropriate selection criteria and propose an efficient technique in selecting the best global and domestic suppliers for the respective industry. In this regard, it focuses on the identification of the selection criteria and its sub-criteria, determination of the importance weights of these decision variables, calculation of the priority weights to rank the suppliers and finally selecting the best supplier with the highest priority weight among the alternatives using Fuzzy Analytic Hierarch Process (FAHP). The data is collected through a questionnaire applied on the experienced professionals in a company operating in this emerging market.

ÖZET

BULANIK AHP KULLANARAK TEKNOLOJİ ERİŞİMLİ MÜLK YÖNETİMİ VE KONAKLAMA SEKTÖRÜ İÇİN YABANCI VE YERLİ TEDARİKÇİ SEÇİMİ

Tedarikçi seçimi, şirketler için tedarik zinciri yönetiminin başarısı açısından önemli bir kavramdır. Bu rekabetçi iş ortamında şirketlerin varlıklarını sürdürebilmeleri için tedarik zinciri departmanlarının tedarikçi seçimi konusunda çok dikkatli olmaları gerekir. Özellikle yabancı tedarikçileri yerli tedarikçilerle birlikte değerlendirmek çok karmaşık ve risk eğilimli bir faaliyettir. Şirketler tedarikçilerine büyük ölçüde bağımlı hale geldikçe, kararlarının zayıf olması durumunda sonuçlar çok kritik olabilir. Bu çalışmada, teknoloji erişimli mülk yönetimi ve konaklama endüstrisi olarak adlandırılan ve gelişmekte olan bir sektör için tedarikçi seçim süreci araştırılıyor. Bu sektörde faaliyet gösteren şirketler mülkleri mülk sahiplerinden, emlak sektöründeki bina yönetimlerinden veya geliştiricilerden kiraladıktan sonra, iş için seyahat edenlere veya yabancı çalışanlara birinci sınıf tam donanımlı hizmetli daireler olarak sunarak orta ve uzun süreli konaklama hizmeti sağlarlar. Bu çalışmanın amacı, ilgili sektör için uygun tedarikçi seçim kriterlerini sunmak ve en iyi yerli ve yabancı tedarikçileri seçmek için etkili bir teknik önermektir. Bu bağlamda, seçim kriterlerinin ve alt kriterlerinin tanımlanması, bu karar değişkenlerinin Bulanık Analitik Hiyerarşik İşlemi (FAHP) kullanarak önem ağırlıklarının belirlenmesi, tedarikçileri sıralamak için öncelik ağırlıklarının hesaplanması ve son olarak da en yüksek öncelik ağırlığına sahip tedarikçinin seçilmesi üzerinde duruluyor. Veriler, bu gelişmekte olan pazarda faaliyet gösteren bir şirkette deneyimli profesyonellere uygulanan bir anket aracılığıyla toplanmaktadır.

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LIST OF SYMBOLS

Σ	Summation
μ	Membership Function
$\sim$	Fuzzy Set
$\otimes$	Multiplication
$\cap$	Intersection

LIST OF ACRONYMS/ABBREVIATIONS

AHP	Analytic Hierarch Process
AHP-QFD	Analytic Hierarchy Process and Quality Function Deployment
ANP	Analytic Network Process
BIST	Istanbul Stock Exchange
CEO	Chief Executive Officer
COI	Chain of Interaction
CPI	Consumer Price Index
DANP	DEMATEL based Analytic Network Process
DEMATEL	Decision-making Trial and Evaluation Laboratory
EFA	Exploratory Factor Analysis
EU	European Union
FAHP	Fuzzy Analytic Hierarchy Process
FDM	Fuzzy Delphi Method
FEAHP	Fuzzy Extended Analytic Hierarchy Process
FMCG	Fast-moving Consumer Goods
FMOLP	Fuzzy Multi-objective Linear Programming
FSC	The Forest Stewardship Council
GYODER	The Association of Real Estate and Real Estate Investment Companies of Turkey
ISM	Interactive Selection Model
ISO	International Organization of Standardization
JIT	Just-in-time
MEA	Middle East & Africa
NY	New York
PFI	Private Finance Initiative
PGP	Preemptive Goal Programming
RAK	Ras Al-Khaimah
RICS	Royal Institution of Chartered Surveyors
SEM	Structural Equation Modeling

SME	Small and Medium-sized Enterprises
TFN	Triangular Fuzzy Number
TL	Turkish Lira
TOBB	The Union of Chambers and Commodity Exchanges of Turkey
TOPSIS	Technique for order preference by similarity to ideal solution
TUIK	Turkish Statistical Institute
TURKSTAT	Turkish Statistical Institute
UAE	United Arab Emirates
UK	United Kingdom
US	United States
USA	United States of America
VAT	Value-added tax
WGP	Weighted Goal Programming

1. INTRODUCTION

Supplier selection is one of the most important decisions made in the tech-enabled property management and hospitality industry. This study develops a decision-making support system that guides the top management of tech-enabled property management and hospitality companies in selecting the best supplier. The companies operating in this industry basically rent properties in several different locations in cities from landlords, building managements or real estate developers, furnish the apartments from couch to bed, home textile to kitchenware and sublet them to travelers and expats with mid- to long-term duration of stays. In order to collect data for the research, the proposed model implemented on a real company o perating in this industry. A company in the respective industry buys furniture and necessary equipment including electronics, small appliances and other amenities in bulk from several other countries around the world. In this regard, supplier selection is a very important concept for these kinds of companies. In order for the companies operating in this industry to be successful, they should be very careful in their decision-making in selecting the best suppliers because the greatest part of their capital expenditures is composed of rental payments and furniture procurement. In this regard, a model is proposed to select the best global and domestic supplier in favor of the companies' objectives.

1.1. Background of The Research

For the last twenty years, an expansion in Turkey's construction sector in parallel with the economic growth has been observed. Nowadays, the term 'construction' is not considered solely as the construction activities but as a term that contains all activities that are associated with the maintenance and operation of the industry such as real estate sector. In other words, real estate sector is regarded as a subset of the construction industry. Likewise, the development of the real estate sector is also dependent on the economic growth.

Turkish real estate industry has been suffering from high mortgage interest rates lately and therefore the housing sales are displaying a downward trend. According to GYODER's Real Estate Sector 2018 report, as of December 2018, the monthly interest rate on mortgages became 2.04% and the annual compound interest rate was calculated to be 27.39% as seen in Figure 1.1. Therefore, people have become less likely to borrow to own a house recently. Under poor economic conditions, the risk of failure is very high for the people who plan to get a loan for buying a property. The economy needs to be robust and stable in order to make people spend to save.



Figure 1.1. Mortgage Loan Interest Rate (%) (GYODER, 2018).

In 2018, housing sales decreased by 2.41% compared to the previous year and became 1,375,398 units as shown in Table 1.1. There were many other factors that affected the housing sales other than increased mortgage loan rates. During this period, the increased construction costs along with an increase in house prices contributed to the slowdown in housing sales. In 2018, there was a decrease of 1.23% and 3.44% in the first-hand and second-hand house sales compared to the previous year, respectively (GYODER, 2018). In 2018, there was a 41.49% contraction in the number of mortgaged sales compared to the previous year. The share of mortgaged sales in total house sales also decreased and became 20.13% compared to 33.57% last year (GYODER, 2018). This indicated that the increase in mortgage rates during the year directly affected the amount of mortgaged sales. The inflationary pressure limited economic activity due to the devaluation caused by the rapid depreciation of TL, the tightening of financial conditions and the sharp increase in interest rates according to GYODER's Turkey Real Estate Sector 2018 report. Even though there were some strong incentives given such

as VAT reductions, the new legislation that eases real estate acquisition by foreigners in Turkey and the extension of some campaigns provided to the end consumer, 2018 was a year with a contraction of demand in housing (GYODER, 2018).

Table 1.1. Housing Sales on Quarterly Basis (number) (GYODER, 2018).

	First Sale	**Second Hand Sale**	**Total Sales**	**Mortgaged Sales**
Q1'16	139.860	163.604	303.464	95.861
Q2'16	152.305	175.030	327.335	105.223
Q3'16	142.585	162.427	305.012	102.297
Q4'16	196.936	208.706	405.642	146.127
2016 Total	631.686	709.767	1.341.453	449.508
Q1'17	145.826	179.954	325,780	125,093
Q2'17	150.397	178.186	328,583	120,282
Q3'17	180.466	195.899	376,365	117,852
Q4'17	183.009	195.577	378,586	109,872
2017 Total	659.698	749.616	1.409.314	473,099
Q1'18	138.777	165.100	303.877	89.380
Q2'18	160.100	182.055	342.155	112.425
Q3'18	167.198	189.161	356.359	54.478
Q4'18	185.497	187.510	373.007	20.537
2018 Total	651.572	723.826	1.375.398	276.820

In the last quarter of 2018, the real estate developers offered buyers their own long-term interest-free payment models in order to compensate for the negative affect of the high mortgage rates on sales. Thus, the sales with promissory notes by developers were recorded as 48.2% of all the sales; whereas, the bank loan utilization rate was calculated around 10% of housing sales in the same period (GYODER, 2018).

Turkey's average real estate purchasing power index decreased by 21.05% compared to the previous quarter which is a 33.23% decrease compared to the same quarter of the previous year as shown in Figure 1.2. It is an important economic indicator which shows whether a family with an average income can own a house using a 120-month loan or not (GYODER, 2018). While the index values of 100 and above indicate that this is possible, values below 100 mean prove the opposite.



Figure 1.2. Real Estate Purchasing Power Index (120-month Term Loan) (GYODER, 2018).

1.2. Liter

When the increase of the house prices as well as return performances of the financial investment instruments in the fourth quarter of 2018 are examined, a loss of 3.81% in BIST-100 index is observed (GYODER, 2018). Other than that, significant losses were experienced in the US Dollar, Euro and gold in the same quarter. The deposit rate, which provided a more regular return for its investors, yielded higher than inflation (CPI was recorded 0.78% in the fourth quarter of 2018). Housing investments, which are known as the traditional investment instrument of Turkish investors, had always been a better alternative compared to other financial instruments especially in the long run (GYODER, 2018). However, in the fourth quarter of 2018, the return on investment in both new and second-hand houses remained below inflation.

There were several solutions proposed in the GYODER'S Turkey Real Estate Sector 2019 First Quarter report such as the immediate launch of alternative financing tools both for contractors and consumers, extension of the tax exemptions for Real Estate Investment Funds and Real Estate Investment Trusts, executing tax deductions on construction materials like concrete and steel, forming the necessary regulations related to long term financing, etc. to revive the sales in the residential market. In this regard, the new industry investigated under this study can also help increase the demand in houses because the potential buyers will realize that they will have a constant income if they lease their properties to the companies in tech-enabled property

management and hospitality industry. Thus, they will be encouraged to invest in houses since they will be able to pay their debts with the constant rental income and make profit from their investments in the long run. Because tech-enabled property management and hospitality companies transform the space and provide an added-value to the real estate, they are able to attract more rental income compared to an empty house without furniture and appliances. With the help of this added-value, the property is occupied right away with a higher rent, the company earns money, the landlord receives more rental income and the real estate developers and investors can sell more to the confident buyers and, as a result, construct more buildings. This flow is illustrated in Figure 1.3 below. Therefore, it's going to provide mutual benefit for landlords, real estate developers, investors and also tech-enabled property management and hospitality companies.

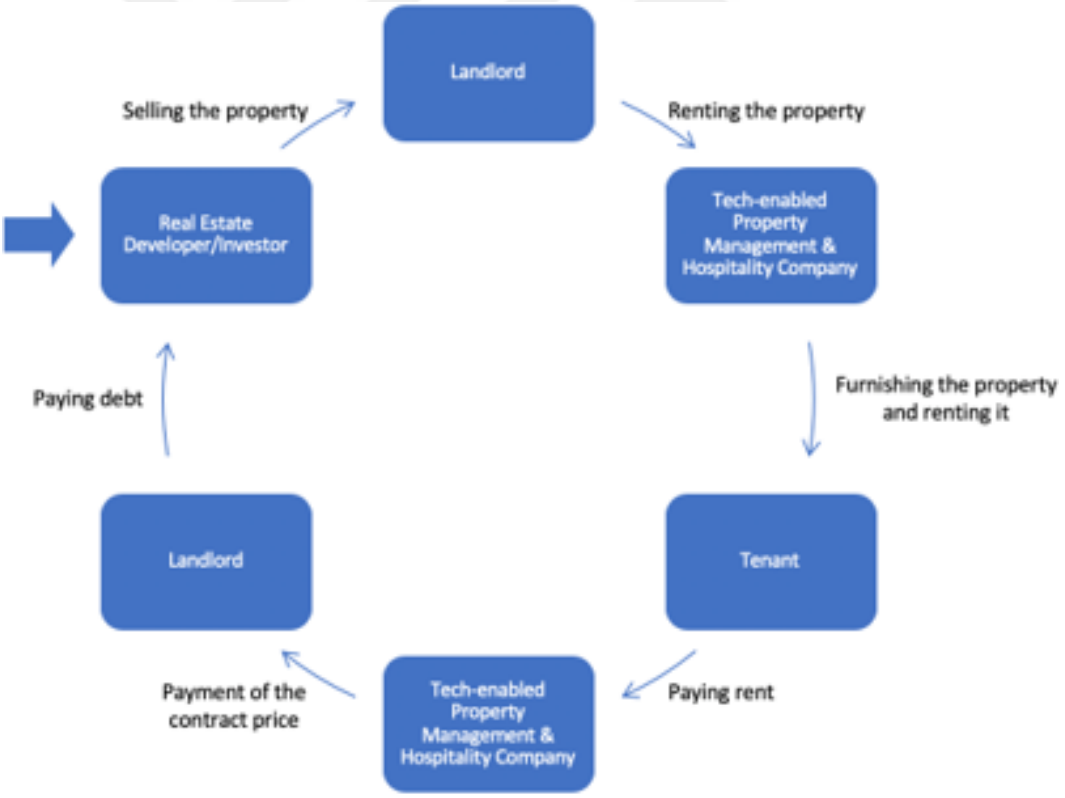

Figure 1.3. Flow of Business.

1.3. Related Studies

There are many studies in the literature that cover supplier selection problem but not many of them go into the depths of the hospitality industry. Yet, the industry investigated under this research is an emerging market. Moreover, the industry examined in this study is not only the hospitality industry but it is a combination of property management, hospitality and tech-enabled industries. Therefore, none of the research projects have addressed or covered this issue purely, yet. The detailed explanation of the industry the company operates in will be provided in the following sections.

14 different studies are selected from the literature which are related to supplier selection problem focusing on various industries. The studies that mainly focus on supplier selection problem are Kahraman et al. (2003), Kilic (2013), Chen et al. (2016), Chan (2003), Guneri and Kuzu (2009), Zhang et al. (2015), Chan et al. (2008), Kilincci and Onal (2011), Shaw et al. (2012), Lima Junior et al. (2014), Nazari-Shirkouhi et al. (2013), Hsu et al. (2014), Onder and Kabadayi (2015) and Scott et al. (2015).

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Kahraman *et al.* (2003) is one of the papers that is related to supplier selection problem where Fuzzy AHP is proposed as the supplier selection technique. A questionnaire is conducted on the purchasing managers of a white goods manufacturer in Turkey. Chan (2003) is one of the fourteen papers examined under this study that focuses purely on the supplier selection problem. The paper argues that supplier selection problem is intervened by subjective and qualitative human judgment so much that several different methodologies are used together to overcome its effect. In this regard, a method called Chain of Interaction (COI) is proposed as a part of Interactive

Selection Model (ISM) (Chan, 2003). Then, Analytic Hierarchy Process is utilized. A numerical example is done for the manufacturing firms from developed countries for illustration purposes.

Guneri and Kuzu (2009) used the Just-in-time approach and fuzzy suitability index to solve the supplier selection problem. These approaches are then applied to a medium-sized manufacturer of plaster and cement-based products and eight suppliers are evaluated with respect to the selection criteria. In Chan *et al.* (2008), the Fuzzy Analytic Hierarchy Process is implemented to a manufacturing firm in the real world in order to deal with the global supplier selection problem. Kilincci and Onal (2011) undertakes a fuzzy AHP based approach to select the best supplier firm providing the highest customer satisfaction for the criteria determined for a washing machine company. Shaw *et al.* (2012) presents an integrated approach for selecting the most appropriate supplier using Fuzzy AHP and Fuzzy Multi-objective Linear Programming. The study investigates a clothing manufacturer operating in India that does export to the USA and Europe. Kilic (2013) is another research that refers to supplier selection problem and proposes an integrated methodology combining fuzzy TOPSIS with mixed integer linear programming model. The proposed methodologies are then applied to the air filter sector.

Nazari-Shirkouhi *et al.* (2013) refers to supplier selection and order allocation problem together using a two-phase Fuzzy Multi-objective Linear Programming Model. The model is applied to a numerical example where a buyer plans to purchase five products from four suppliers which can provide multiple items. Chen *et al.* (2016) focuses on the effectiveness of supplier selection strategy in eliminating the risks and the uncertainties of global supply chain processes. In this paper, two different methods are introduced called Weighted Goal Programming (WGP) and Preemptive Goal Programming (PGP). The proposed methodologies are then applied to a company in the automotive industry. Lima Junior *et al.* (2014) conducts a comparative analysis between the two methods, Fuzzy AHP and Fuzzy TOPSIS. Both methods were applied on a manufacturing company operating in the automotive industry and found suitable for the supplier selection problem. In Zhang *et al.* (2015) an integrated methodology

based on Fuzzy Set Theory and Analytic Network Process is developed to solve the global supplier selection problem. A case study describing the implementation of this model to a real-world supplier selection scenario in a manufacturing firm is introduced. Scott *et al.* (2015) proposes an integrated method when dealing with supplier selection problem and combines Analytic Hierarchy Process and Quality Function Deployment (AHP-QFD). The proposed methodology is tested on four suppliers in the bioenergy industry.

Onder and Kabadayi (2015) deals with supplier selection problem in the hospitality industry using Analytical Network Process (ANP). The seven main criteria which are reliability, quality, price-cost, communications and relations, sustainability, service quality and technology are decomposed into 37 sub-criteria to deal with the problem in depth. The proposed methodology is applied to a hotel in Istanbul, Turkey. In Hsu *et al.* (2014), a model is proposed to select the best supplier with low carbon and high energy management performance by using a combination of different methods such as Fuzzy Delphi Method, DEMATEL-based ANP, and VIKOR. The integrated methodology is then applied to a hotel to demonstrate the procedure.

1.4. Aim and Objectives of The Study

The aim of this study is to provide appropriate evaluation criteria and propose an efficient technique in selecting the global and domestic suppliers for an emerging sector referred as tech-enabled property management and hospitality industry.

The ultimate goal of supply chain is to optimize the supplier selection process by balancing the different aspects of it, e.g., increasing the overall value gained from the supplier by reducing the downsides and enhancing the customer satisfaction performance. With this in mind, the research aims to meet the following objectives:

- to find selection criteria suitable for the emerging industry investigated under this research,

- to derive interrelations among the criteria and attributes determined for the supplier selection regarding the specific industry,
- to calculate the weights for each criterion with respect to the overall goal of the study and the weights of each attribute with respect to each criterion,
- to provide a ranking for the suppliers investigated under this research based on the weights calculated for supplier alternatives,
- to select the best supplier among the alternatives under each category and the best supplier overall that satisfies the main goal.

1.5. Methodology

In this section, a summary of each phase of the research is given and the research technique is briefly explained. In order to solve the global and domestic supplier selection problem, Fuzzy Analytic Hierarchy Process is used in this research. In the analytic hierarchy part of the process, pairwise comparison matrices are constructed with the predetermined decision criteria which are classified into sub-attributes. The data was collected through a questionnaire survey composed of those pairwise comparison matrices which is conducted on the experts in the field of study. In the fuzzy part of the process, the relative importance of the variables over another are determined using the fuzzy numbers assigned by the experts through linguistic variables. Thus, the uncertain and qualitative aspect of the human judgment is reflected and turned into a tangible factor for decision-making.

1.6. Scope and Limitations

The scope of the study is to develop a decision-making support system that guides the top management of tech-enabled property management and hospitality companies in selecting the best supplier. Since a tech-enabled property management and hospitality company rents apartments in several different locations from landlords, building managements or real estate developers and furnishes them, companies need many different furniture and equipment such as couch, bed, home textile, kitchenware, etc. Therefore, the suppliers of a company in the respective industry are furniture, textile,

electronics, and many other household goods manufacturers and wholesalers around the world. This study focuses only the selection of furniture suppliers. Even though several researches were conducted for various areas of supply chain management in the hospitality industry, none of them tackled the supplier selection problem adequately except a few. Furthermore, the field of operation investigated under this research is not only hospitality sector. Property management is considered as another branch of the activity of the proposed industry. Third component of this industry is technology. Companies operating in this emerging market utilizes technology highly in their operations in order to compete with the serviced apartments and hotels. Since it is an emerging market as a combination of three, the few research projects performed for effective supplier selection in the hospitality industry are not sufficient to address the issue here. Therefore, this study aims to fill this gap in the literature.

As it resembles the hospitality industry in many ways, it differs from it in multiple ways, too. Therefore, the importance and priority weights for these two industries are expected to be different from each other. Also, it is observed that the related studies in the literature either focus on the selection of domestic or global suppliers. In this regard, it also differentiates from other studies.

One of the limitations of this study is the number of experts. Since it's a quite new industry and all the competitors are based abroad, only 8 professionals working in a tech-enabled property management and Hospitality Company's product & supply chain function are surveyed. In other words, the number of respondents in this study are quite low. Those eight experts are a supply chain manager performing demand planning, order allocation, warehouse management and shipment scheduling along with one supply chain analyst, one foreign trade manager in charge of import & export operations, strategic sourcing and locating global suppliers, two procurement managers finding both domestic and global suppliers, negotiating payment terms and unit price, placing orders, and lastly three design managers designing and developing furniture.

The global sourcing requires maintaining a long-term relationship along with a significant volume commitment to the suppliers. The companies operating in this

emerging market are opening up in new locations every month and supplying a huge amount of furniture constantly from all around the world. Therefore, even if one part of this emerging market lies in the hospitality industry, this study might be irrelevant for the hotel businesses because they are not considered as continuous furniture buyers. On the contrary, they work project-based with the global suppliers. However, for big retailers or wholesalers, this study might make sense to some extent as they place monthly, quarterly or yearly orders and thus need to sustain long term partnerships with global suppliers. So, the limitation of this study is that it addresses to companies sourcing globally as well as domestically and carrying out long term business partnerships while buying significant amounts in bulk in certain periods.

Another limitation of the study is that when more than five suppliers are evaluated using Fuzzy AHP, the questionnaire becomes too long to fill in. In Fuzzy AHP, all suppliers are evaluated according to each sub-attribute. As the number of sub-attributes increases, the number of pairwise comparison matrices also increases. This may result in a very long survey and inaccuracy in the results as the respondents might lose their attention during the process.

1.7. Organization of Thesis

The content in this thesis is structured as follows:

In Chapter 2, literature review about the supplier selection problem is provided. Within the framework of supplier selection, various methodologies, their implementations in different industries and decision variables specific to these industries are examined. The gap in the literature and the research question are identified at the end of this section.

In Chapter 3, research methodology is identified. The advantages and disadvantages of the two methodologies are discussed. The reason for combining the two methodologies are explained. The questionnaire is prepared with respect to the method.

In Chapter 4, the results of the analysis are shared regarding the tech-enabled property management and hospitality company using the proposed approach. The best supplier is identified through the weights and priorities calculated for the decision variables.

In chapter 5, the decision variables selected for the new industry are explained in detail. The results of the proposed model implemented on a real company in the sector are summarized and explained in chapter 4.

In chapter 6, the conclusion of the research is stated explicitly. The contributions of this study to the literature are emphasized. The limitations of the study are mentioned and recommendations for the area subject to future research are provided.

2. LITERATURE REVIEW

2.1. Introduction

In this section, first the industry investigated under this research is introduced in detail. Then, the previous studies conducted on the supplier selection processes are examined and various methods available in the literature are mentioned. Among many alternative methodologies, the previous studies mostly concentrate on the Fuzzy Theory. However, it is observed that in order to overcome some limitations of this theory, it is combined with various other methods depending on the research questions.

In the literature, there are many studies performed to select the best supplier under multi-criteria. Even if they focus on different industries and therefore utilize different methodologies and decision variables or so-called selection criteria to evaluate suppliers, the main objective behind all of them is to find the right supplier to allocate the companies' limited resources effectively and efficiently.

2.2. Tech-Enabled Property Management and Hospitality Industry

This study focuses on an emerging industry which does not own a unique title yet to describe itself. Many startups rising in this line of business, most of which began operating almost 5 years ago, define themselves as tech-enabled property management and hospitality companies. These companies are basically providing fully-equipped furnished serviced apartments to business travelers and expats with mid to long-term duration of stays, i.e. over 1 month, after renting the apartments from landlords, building managements or developers in the real estate industry. They also support the clients in issues of maintenance regarding the property. Some of them offer short term rentals as well but the actual orientation is observed towards longer stays in this market. As a result, being associated with multiple industries at the same time, it is a niche market focused on a specific product.

One part of this specific industry is referred as property management because these companies rent the apartments from landlords or building managements as mentioned, furnish them from couch to bed, home textile to kitchenware, and sublease them to people seeking various types of accommodation, either corporate or vacation. To emphasize, properties are not bought but rented instead since it is not feasible to buy all those properties from a cash flow point of view.

According to an official definition published by RICS (Royal Institution of Chartered Surveyors), property management is where;

"a property manager operates a real estate property for a fee often on behalf of a landlord. The property manager will commonly assist with services which include: meeting an owner's investment objectives, maintaining detailed tenancy records, ensuring lease terms are complied with, including rent and operating expenses collection, service charges annual rendering, tenant liaison on a day-to-day basis, meeting statutory obligations, maintaining a proper building condition and operating property on a sustainable basis" (RICS, 2011).

Apart from receiving a fee from the landlord, companies operating in this new industry provide all the services mentioned above in the official definition. As one part of this sector lies in the property management industry by means of the features listed above, the other part is considered as a subset of the hospitality industry, providing lodging solutions for business travelers and expats. The hospitality industry is defined by Wikipedia as:

"...a broad category of fields within the service industry that includes lodging, food and drink service, event planning, theme parks, transportation, cruise line, traveling and additional fields within the tourism industry‟" (Wikipedia, no date).

The third component of this emerging industry is to be tech-enabled. According to NY Times, "start-ups that delivered real-world services with the aid of some clever technology - those so-called on demand or sharing economy companies" are called tech-

enabled companies (Kerstetter, 2015). In other words, tech-enabled businesses do not create new technology. Instead, they use existing tools to either make a company more efficient and smarter or to provide a new service. Rather, they use tech companies' innovations like hardware and software to create something new.

The companies in the sector are trying to reinvent the $570 billion hotel industry (Statista, 2019) or reshape the 12$ billion corporate housing industry, leasing unfurnished homes and converting them into convenient, fully-furnished serviced apartments for travelers with purposes of extended stay.

There is a considerably high demand in furnished serviced apartments by corporations as they look for lodging options for their employees who either relocate or stay in a different city for an extended period of time for an assignment or project. There are also people who are obliged to move out of their homes due to unforeseeable events, disasters, or divorces and seek an instant alternative to move in. Furthermore, there is a bunch of people who are undergoing a medical treatment and usually in need for a comfy place to stay in a city away from their home.

Also, there has been a shift observed globally in the trend of owning homes to renting homes for the past decade. People would like to have more flexibility and ease of move-in and move-out because they would like to work from wherever and whenever they want. They would not like to be bound by leasing terms, buy furniture for a rental and be restricted by its immobility, deal with a cable company or maintenance issues, pay utilities and bills, etc. They are given the flexibility to sign a lease less than 12 months. These are all covered by corporate rental providers in this unique industry, providing their clients a living experience without a hassle who are just expected to pay their rent and not care about the rest. Furthermore, the additional services only increase the rent by 25% on average for the same apartment listed unfurnished before which is still a lot more affordable than hotels, extended stay hotels, or traditional corporate housing.

The companies also aim to attract the modern business traveler often in their late 20s to early 40s who are working in a variety of industries and are known to look for quality and experience rich accommodation solutions with respect to their high income. In that sense, this fresh concept of serviced apartments addresses a gap between the typical hotels and private accommodations such as short-term rentals. They also aim to reach more mainstream audiences with affordable solutions in the future as the industry grows.

Furthermore, the customization has gained more prominence with millennials. Therefore, the so-called serviced apartments that provides out of stationary properties and services have received considerable attention. As this brand-new serviced apartment concept attaches importance to customization while keeping away from the standardization, it differentiates itself from regular serviced apartments and hotels.

In this study, tech-enabled property management and hospitality companies are linked to serviced apartments in order to relate the sector to the audience. They are essentially serviced apartment businesses that are licensed to run as a hotel, and they use marketplaces like their own websites or famous online listing platforms to market their properties. Therefore, the industry is referred either as serviced apartment or corporate housing industry in this study. It is also found useful in order to figure out the size of this niche market which targets to replace the former ways of long-term corporate rentals and occupy a huge market share. As tech-enabled property management and hospitality companies have many characteristics in common with the abovementioned industries, they certainly differ in many significant ways, too.

In 2017, a survey was conducted in the serviced apartment sector in the Americas, Europe and the Middle East to measure the level of confidence of the serviced apartment operators about the economy in their region, their prospects for the sector and for their own businesses (George Sell, 2017).

As a result of the survey, 64% of the respondents from Europe were found to be more optimistic in their prospects for their own businesses compared to Middle East

& Africa (MEA) with 60% and the Americas with 50%. The survey showed that 63% of the operators in Europe had onboarded new units in the past 12 months and 79% were planning to onboard more units in the upcoming 12 months. Whereas, in the Americas (US & Canada), almost 60% of the operators had onboarded new units over the course of 12 months and 66% were planning to onboard more units in the next 12 months. In MEA, over 70% of the operators had onboarded more units in spite of concerns of oversupply in some of the regions and 90% are planning to onboard more in the upcoming year. This shows there are strong growth plans in the sector.

In the survey, the respondents were also asked about their forecast on the markets that will achieve the greatest growth over the next year. In Europe, Amsterdam, Germany and Dublin were selected to be the top cities for growth according to the respondents' projections. In the MEA region, Dubai, RAK, Kenya and Uganda are predicted to be the cities with the greatest growth according to the respondents' projections.

The survey also showed that 44% of European operators have introduced new product or changed the existing one to be more attractive to millennials and younger travelers. A further 23% was planning to do the same. In the MEA area, more than 60% introduced new product or changed the existing one to appeal to the same audience. Other than that, 47% of European operators expect that people will travel more for leisure business over the next year. The same situation was expected for the MEA region. These figures all indicate a potential for growth in this emerging market.

There are many startups operating in the tech-enabled property management and hospitality industry. Differences of a corporate rental from a hotel is that the units are not concentrated in one location or one building like in a typical hotel but rather they are spread over the entire city. This is advantageous in terms of providing location- and price-wise flexibility to clients. However, it is disadvantageous at the same time from operational aspect when managing cleaning and maintenance services for the properties. It is very different from the traditional hotel or property management companies in other aspects, too. While providing these services, companies make use

of technology like smart apps to receive and address the requests of the clients when they are locked out of their apartment or need a light bulb.

As mentioned before, there is a movement away from traditional hospitality concept to a new definition of hospitality. Startups have already started to take advantage of this opportunity, seeing the demand in the authentic and unique stay experience which is lacked in the traditional hotel model as well as the rising trend of shared economy. As it is seen from the trend that people are seeking local experiences such as renting an apartment instead of staying at a hotel, there is definitely a growth opportunity in this area. This demand is also proven by the rise of a well-known online booking and mediator platform. These companies aim to provide convenient rentals that provide people with a home-away-home feeling as well as the consistency and quality of a hotel.

Since each market has a special regulation that the corporate housing companies should comply with, in some cities these companies are regulated under hotels, in some others they are regulated under vacation rental units. The reason is that the market is again fairly new, and it cannot be classified under a specific field of business and regulated accordingly.

One of the startups operating in this industry has more than 20 offices around the world. The company have received more than $100 million of funding up until now. Adding rentals to its inventory every month in the North America and Europe, its revenue is expected to hit $400 million in 2019 which is four times their revenue in 2018 with an average daily rate of 200$. Another tech-enabled serviced apartment startup has a $45 million revenue run rate from renting out 900 homes in 23 cities which means 5 times growth with respect to last year. There are other startups that are performing a hyper growth, too which have received significant funding investment from venture capitals, private equities, angel investors and companies operating in the relative field. All the investments made can be considered an indicator of the future growth of this unique industry.

Since corporate housing and serviced apartment market including aparthotels, extended stay hotels, branded residences, etc. exist for years and there are many well-known hotel companies around the world which occupy a whole building and lease them after furnishing and equipping them, it might not be seen as a new industry. However, these startups are using technology to create a system that streamlines many processes involved in the traditional hospitality business. From mobile keys to smart locks, housekeeping to many other services, lots of processes are managed by apps or by other means of technology in contrast to the hotel industry. These companies rely on technology to onboard and manage the real estate, design and furnish the apartments, manage their supply chain and other daily operations, restore data related to properties, manage third party service providers such as cleaning companies, logistics companies, suppliers, etc. and lastly, to manage guest experience.

Technology, with all these benefits, help the companies scale much faster by increasing the number of units rapidly, generating significant amount of revenue, easing operations, increasing customer satisfaction, etc. Technology also enables management of inventory levels for furniture, kitchenware and appliances, place orders in the right amounts and eliminate the stock-out risk. The companies are also managing all of their imports and exports processes, shipping containers full of furniture and equipment with the help of technology.

2.3. Other Industries Related to Tech-enabled Property Management and Hospitality Industry

This section summarizes the background of the industries that support the niche product and the sector mentioned in this study. In this regard, the conditions of furniture industry and furniture manufacturers in Turkey are examined, global and domestic furniture import and export figures are presented. Lastly, a glimpse of current conditions and forecasts of global serviced apartment and corporate housing industry is given to understand the environment in which this specific industry aims to transform and dominate.

The Turkish furniture industry has a predominantly small-scale type of ateliers, most of which are operated by traditional methods. On the other hand, especially for the last 15-20 years, the number of large and medium-sized enterprises have started to increase (İhracat Genel Müdürlüğü, 2018). According to TUIK General Census of Industry and Business Establishments data, the sector employs 133,000 people. The number of enterprises operating in this area is over 34,000. The manufacturing companies providing high level of employment are usually large firms.

The furniture sector in Turkey concentrated in certain regions where the forest products are mainly harvested. Important furniture production regions according to their share in total production are listed in the decreasing order as Istanbul, Ankara, Bursa (Inegol), Kayseri, Izmir and Adana. In the furniture market, Istanbul comes first in the employment ranking as well, followed by Ankara, Bursa, Kayseri and Izmir, respectively (İhracat Genel Müdürlüğü, 2018) .

Istanbul, with an average of 3.7 persons per company in the furniture sector, has an employment level above the average of Turkey which is 3.2 persons per company (İhracat Genel Müdürlüğü, 2018). Ankara also has always played an important role in the furniture production. According to TURKSTAT's data, Ankara is the second city with its employment level and number of enterprises. However, these enterprises are labor intensive and the number of firms engaged in large scale production is not much. Bursa comes after Ankara with regards to employment level in the furniture sector (İhracat Genel Müdürlüğü, 2018). Especially Bursa-Inegol region has had a rapid development in the wood industry thanks to its great forest area. Moreover, for the exports made in the sector, it is ranked third after Kayseri and Istanbul.

Kayseri has become an important furniture center thanks to the technological advances, new investments, and furniture manufacturing in various branches. According to TOBB's data and TURKSTAT's exports figures (İhracat Genel Müdürlüğü, 2018), Kayseri hosts the largest ones of the sector which are capable of mass production and experienced in exports. In 2012, with $355M, Kayseri accounted for 18.7% of Turkey's furniture exports alone (İhracat Genel Müdürlüğü, 2018). According to TURKSTAT's

data, with employment level of 11.5 persons per company, Kayseri is a region where large-scale firms are gathered. Izmir comes fifth in the ranking according to the employment level after Kayseri (İhracat Genel Müdürlüğü, 2018). Even though, the port in Izmir provides ease of transportation and enables exports, there are mostly small firms in Izmir and the sector is not developed as much.

Furniture is a consumption good with high demand elasticity. The demand for furniture depends on the new residential construction and income growth. Therefore, it is very much affected by economic conditions. Because of the inadequacy of demand, the sector does not work at full capacity. The most important factor in inability to increase the capacity utilization rates in Turkey is the shrinkage of demand in the domestic market. Then, comes the lack of foreign demand. The problems related to financing, employees, local and imported raw materials are also considered as major factors that affect the capacity utilization rates in the sector.

Since 2001, the Turkish furniture industry has begun to do more exports than imports and has been running trade surplus continuously (İhracat Genel Müdürlüğü, 2018). After the economic crisis in 2001, the domestic demand decreased significantly. As a result, the firms tended towards exports in order to compensate for the financial losses that the lack of domestic demand brought and the exports has become the major force behind development. It is expected that the sector will maintain its tradition of foreign trade balance and keep up its contribution to the country's economy, and thus the developments achieved in exports since 2001 will continue.

The furniture industry possesses the potential for greater improvement in more robust macroeconomic conditions and with the experience acquired in the foreign markets and the exports. However, one third of the exports done by the sector is for the EU and more than half of the imports are from the EU (İhracat Genel Müdürlüğü, 2018). For the long-term growth objectives of the sector, it is necessary to improve the transaction volumes with other markets such as the US.

The development of the furniture industry depends on the development of furniture exports. Even if the furniture industry is known as a leading sector in Turkey thanks to the number of establishments and the employment it creates, it has a limited market share within Turkey's exports volume. The market share of the furniture exports in total exports volume of Turkey was calculated to be 1.5% with $2.36B in 2017. Whereas, in 2001, it was $192M (İhracat Genel Müdürlüğü, 2018).

While some of the firms in the sector export directly, most of them export their products through other firms such as contractors engaged in construction projects abroad. However, in recent years, there has been a significant increase in the number of Turkish companies that started exporting directly and selling in the foreign markets through their own distribution channels. Turkey mostly exports furniture to Iraq for the last ten years and the latest export volume to this country was reported to be $427M in 2017 (İhracat Genel Müdürlüğü, 2018). Other major markets that Turkey exports furniture are Germany, Saudi Arabia, France, USA, United Kingdom, United Arab Emirates, Romania, Israel and Azerbaijan.

The main obstacles in front of the furniture exports are the lack of modern and design-oriented production of Turkish manufacturers as well as the political problems in the surrounding countries. Financial issues, the lack of knowledge of medium and small sized firms in foreign markets and exports were the other problems affected the actual volume of exports. However, the technology utilized in furniture production in Turkey has been improving with increasing number of export channels and exporting firms. Realizing the importance of product design and brand awareness, finances allocated to these areas are increased by furniture manufacturers. Moreover, demonstration of interest in bringing up furniture designers and creating more employment opportunities for them are of great influence for the future of the sector. In addition, intensive commercial transactions with the EU facilitate compliance with high furniture quality and health standards. All of these factors contribute to the development of the furniture sector in Turkey.

Although Turkey imported furniture mainly from EU countries, China left them behind in 2006 and become the first country of import (İhracat Genel Müdürlüğü, 2018). Using its cost advantage, China accounted for one third of total imports of Turkey in 2015. In 2016, China lost 12% of market share in imported goods. In this respect, the country with the highest import volume became Germany with $84M million dollars in 2017, followed by Italy with $76M of furniture imports (İhracat Genel Müdürlüğü, 2018). Other countries that are in the forefront of furniture import after China are Poland, France, Bulgaria and Romania. Main product groups that Turkey imports are wooden furniture, metal furniture, upholstered furniture with metal structure, and upholstered furniture with wooden structure.

In 2002, furniture exports in the world was $63.9B (İhracat Genel Müdürlüğü, 2018). In 2008, it reached to $132.3B but then decreased to $108.2B in 2009 due to the global economic crisis (İhracat Genel Müdürlüğü, 2018). However, in 2017, the furniture exports reached $181.5B with a significant increase of 7.6% compared to the previous year as shown in Table 1.1. The furniture exports market is largely dominated by EU countries because furniture manufacturing is their fundamental industry. The two of its largest production groups are kitchen furniture and upholstery. Germany and Italy are the largest manufacturers and exporters among the EU countries. Poland, France, Denmark, Belgium, Sweden, Austria, the UK and the Netherlands are important furniture exporters, too.

In 2017, Germany was ranked second in the world with an export of $12.9B as shown in Table 1.1. Poland, with exports of $11.6B, made 6.4% of the world's furniture export and was ranked second among EU countries and third in the world in 2017 (İhracat Genel Müdürlüğü, 2018). Italy, on the other hand, was ranked 4th in the world with a share of 6.2% the same year. In the meantime, China has grown rapidly in furniture exports and left Germany and Italy behind. China's exports in 2017 exceeded $59B and accounted for 32.7% of global furniture exports as shown in Table 1.1. Other countries and their shares in furniture exports in 2017 are as follows; Germany 7.1%, Poland 6.4%, Italy 6.2%, Vietnam 4.8% and USA 4.5%. The share of Turkey's exports in 2016 was 1.1% (İhracat Genel Müdürlüğü, 2018). According to

the 2017 data, the world's first 20 furniture export countries account for %86.4 of the market. In 2017, the country that increased its furniture exports the most with respect to the previous year was Vietnam with 56.6% increase, followed by the Netherlands and United Kingdom with an increase of 49.2% and 13.8% in exports, respectively (İhracat Genel Müdürlüğü, 2018).

Table 2.1. World Furniture Exports by Countries (In Million Dollars) (İhracat Genel Müdürlüğü, 2018).

Countries		**2016**	**2017**	**2017**
		(Thousand $)	**(Thousand$)**	**(% share)**
	Worldwide	168.721.291	181.461.563	100.0
1	China	56.112.618	59.295.789	32.7
2	Germany	12.341.326	12.897.202	7-Jan
3	Poland	10.646.131	11.552.801	6-Apr
4	Italy	10.680.879	11.240.160	6-Feb
5	Vietnam	5.571.827	8.728.284	4-Aug
6	USA	8.516.314	8.425.974	4-May
7	Mexico	8.021.859	8.214.535	2-Jun
8	Canada	4.678.485	4.713.167	2-May
9	Czech Republic	4.123.760	4.562.836	1-Jul
10	United Kingdom	2.760.260	3.141.152	1-Jul
11	Netherlands	2.082.110	3.106.085	1-Jun
12	France	2.751.614	2.931.080	1-Mar
13	Spain	2.331.746	2.444.126	1-Mar
14	Malaysia	2.377.863	2.432.676	1-Mar
15	Denmark	2.302.690	2.431.238	1-Mar
16	Romania	2.358.371	2.421.299	1-Mar
17	Turkey	2.233.794	2.361.300	1-Jan
18	Swedish	1.996.824	2.086.123	1-Jan
19	Portugal	1.863.508	2.001.583	1.0
20	Lithuanian	1.628.245	1.846.636	1.0
Top 20 Countries Total		145.380.224	156.834.046	86.4

Global furniture import has been displaying an upwards trend for years and in 2017 imported furniture increased by 8.5% and reached $179.4B as shown in Table 2.1

(İhracat Genel Müdürlüğü, 2018). Even though the European Union countries have the greatest share of imports worldwide in all fields as in the exports, the USA has the biggest market share specifically in furniture import. In 2017, the USA with a $55B volume of furniture import constituted the one third of the volume worldwide (İhracat Genel Müdürlüğü, 2018). Following the USA, Germany is the second greatest furniture importer in the world with $15.3B corresponding to an 8.5% of market share as shown in Table 2.1 (İhracat Genel Müdürlüğü, 2018). The United Kingdom, France, Japan, Holland and Spain are the other leading furniture importers in the world.

Table 2.2. World Furniture Imports by Countries (In Million Dollars) (İhracat Genel Müdürlüğü, 2018).

Countries		**2016**	**2017**	**2017**
		(Thousand $)	**(Thousand$)**	**(% share)**
	Worldwide	165.334.520	179.413.376	100.0
1	USA	51.451.305	55.026.329	30.7
2	Germany	14.697.422	15.257.692	8.5
3	United Kingdom	8.701.637	9.235.445	5.1
4	France	8.059.704	8.660.662	4.8
5	Canada	6.874.359	7.292.871	4.1
6	Japan	6.521.859	6.730.875	3.8
7	Netherlands	3.100.791	5.250.311	2.9
8	Spain	3.215.652	3.397.117	1.9
9	Switzerland	3.344.339	3.381.968	1.9
10	Australia	3.275.925	3.375.026	1.9
11	China	2.683.494	3.130.753	1.7
12	Czech Republic	2.563.267	3.008.950	1.7
13	Mexico	2.853.382	2.894.040	1.6
14	Belgium	2.805.892	2.883.511	1.6
15	Italy	2.543.895	2.688.613	1.5
16	Austria	2.489.234	2.629.537	1.5
17	South Korea	2.287.279	2.477.727	1.8
18	Poland	1.925.548	2.379.028	1.3
19	Swedish	2.182.935	2.372.899	1.3
20	Norway	1.811.721	1.982.413	1.1
Top 20 Countries Total		133.389.640	144.055.767	80.3

The last sector that is related to the tech-enabled property management and hospitality industry is the serviced apartment & corporate housing market. According to the Apartment Service's 2018-2019 report (The Apartment Service Worldwide, 2018), there are 1,022,984 serviced apartments worldwide including 73,563 corporate housing units in 13,164 locations. Two years ago, there were 826,759 apartments including 70,300 corporate housing units in 10,777 locations (The Apartment Service Worldwide, 2018). So, these figures represent an increase of 23.7% in the inventory of the serviced apartments and an increase of 4.6% in the corporate housing units in two years. In the previous two-year interval, the increase in the inventory of the serviced apartments was 10.5% (The Apartment Service Worldwide, 2018). So, the growth rate of the serviced apartment supply increased more than double in this time period. Despite this high growth rate, the report argues that there are still shortages in many popular destinations and the supply still holds the opportunity to grow.

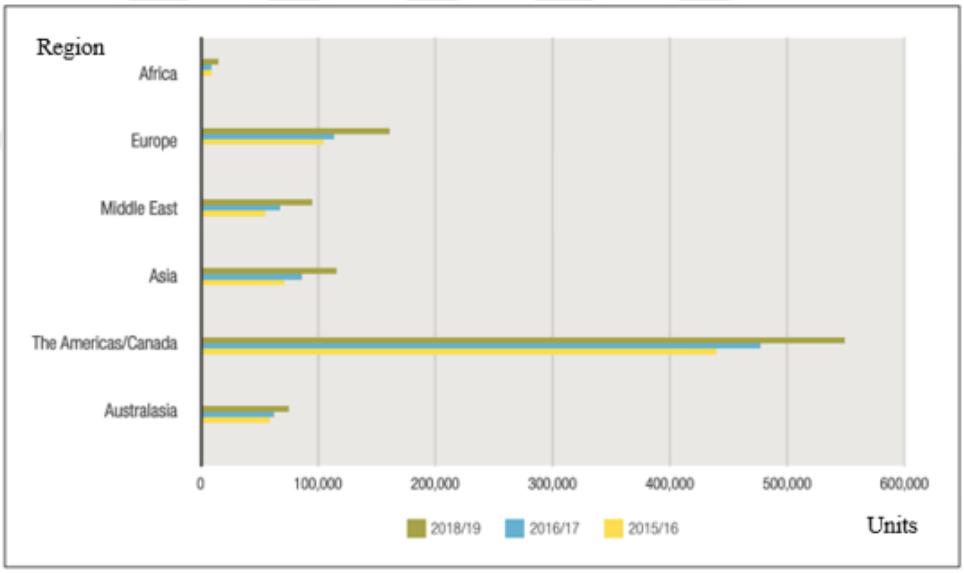

Figure 2.1. Serviced Apartment Supply by Region (Units) (The Apartment Service Worldwide, 2018).

As seen in Figure 2.1, the North America holds the greatest supply of serviced apartments with approximately 560,000 units in 2018/19 (The Apartment Service Worldwide, 2018). It corresponds to 54.5% market share, a decrease of 4.1% on 2016/17. Europe is again the second largest region of serviced apartments globally with 15.9% in 2018/19 after 2016/17 in spite of an increase of 2.1% in the overall mar-

ket share. Asia is the third region with 11.4% market share (The Apartment Service Worldwide, 2018).

The factors that make serviced apartments an attractive alternative compared to hotels are guest experience, location, cost, quality, length of stay, convenience (ease of booking), amenities, etc. (The Apartment Service Worldwide, 2018). This is important for the fact that demand for serviced apartments will keep the upward trend. Corporates or expats that prefer staying at serviced apartments are looking for lodging mostly for business travel, an assignment/project or relocation as shown in Figure 2.2.

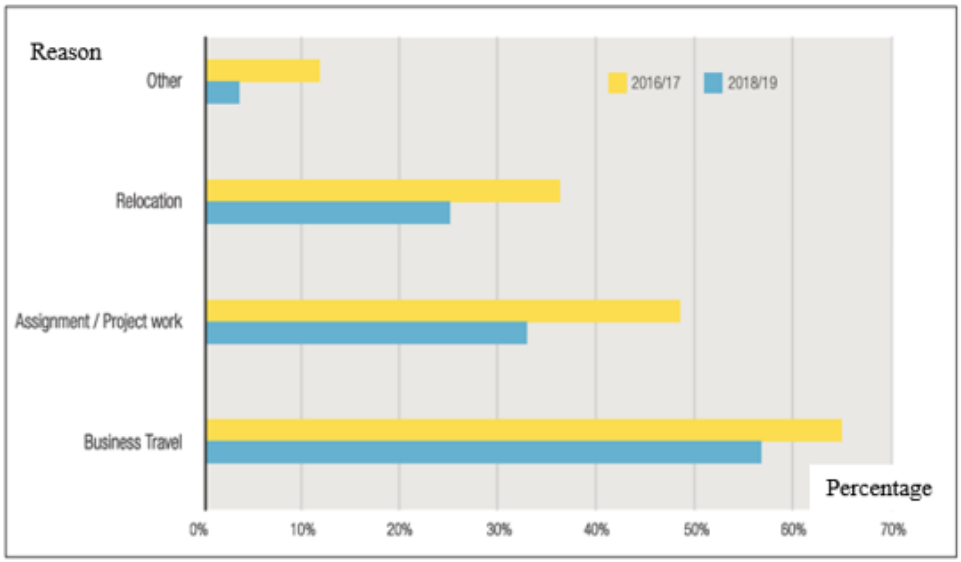

Figure 2.2. Corporate Use of Serviced Apartments (The Apartment Service Worldwide, 2018).

Asia's serviced apartment inventory increased by 63% in four years and reached to 116,603 units in 889 locations across (The Apartment Service Worldwide, 2018). Whereas, Africa's serviced apartment inventory increased by 57.7% in four years and reached to 13,883 units in 216 locations across Africa (The Apartment Service Worldwide, 2018). Australasia serviced apartment inventory increased by 27.64% in four years and reached 75,524 units in 1,147 locations across Australasia (The Apartment Service Worldwide, 2018). In Europe, 41% of openings in 2019 are in the United Kingdom, with Germany accounting for 32% (The Apartment Service Worldwide, 2018). Other serviced apartment developments in the pipeline across Europe are in France,

Ireland and Spain other than the UK and Germany. According to The Apartment Service Worldwide (2018), over 10,000 serviced apartments will be built in Europe between 2017 and 2020.

In the Middle East, hospitality sector is growing fast with the projects in the pipeline from local and international developers and operators. According to The Apartment Service Worldwide (2018), the inventory of serviced apartments, branded residences, and other type of extended stays are increasing rapidly. Over 10,000 additional serviced apartment units are needed to meet the projected demand in Saudi Arabia, the UAE and Qatar. In these markets, Dubai and Riyadh hold the highest number of keys with approximately 30,000 and 600 properties, respectively (The Apartment Service Worldwide, 2018). Whereas, North America has the largest inventory for extended-stay products with more than 500,000 units. The serviced apartment inventory across the US and Canada has increased by 25% in 4 years and reached to 557,435 units in 7,173 locations (The Apartment Service Worldwide, 2018).

2.4. Previous Studies on Supplier Selection

Kahraman *et al.* (2003) emphasizes the strategic importance of the supplier selection decisions to the organizations. According to the paper, being a multi-criterion problem, supplier selection process is usually very complex and solved in an unstructured way. In this paper, Fuzzy AHP is proposed as the selection technique and a questionnaire is conducted on the purchasing managers of a white goods manufacturer in Turkey. In the questionnaire, the evaluation criteria taken into account are basically supplier performance, product performance and service performance. Under supplier performance, three main components of suppliers' operations are included: financials, management and quality systems. Whereas, in product performance, four main attributes are mentioned: handling, use in manufacturing, other business considerations and end use. Lastly, regarding service performance criteria, four major elements are discussed which are customer support, customer satisfiers, follow-up and professionalism.

Under supplier performance, "financials" is one of the attributes. According to the paper, companies should entail a robust financial status for their suppliers because it is considered an indicator of their long-term stability, proof of a reliable performance and ability to maintain their products and services. Management is another attribute of supplier performance discussed in this paper. According to Kahraman *et al.* (2003), managerial skills acquired by suppliers are essential as they bring good supplier-buyer relationships and indicate that the demand will be fulfilled while compatible price, quality and service are provided. The last attribute of supplier performance is quality systems. According to the paper, firms should look into suppliers who practice quality assurance and control procedures, employ internal rating and reporting systems, handle feedback from customers in order to maintain and improve the quality of its products and services. Because suppliers with quality systems and processes are generally able to address customer needs and benefit customer satisfaction more than the others, it is a significant supplier selection criterion for companies.

Product performance is the third and the last main criteria evaluated in Kahraman *et al.* (2003) . In this criteria, end use of the products being purchased is taken into consideration. Functionality, quality, reliability, durability, compatibility are some major facts related to the end use of the products. Another attribute under product performance criteria is handling. Handling includes packaging, shelf-life and storage requirements which are quite important for a white goods manufacturer. Another attribute under product performance is the use of products in manufacturing. According to the paper, the products should be tested and manufactured with ease. This attribute also considers quality, compatibility and end-use performance. The last attribute of product performance is "other business considerations". With the help of this attribute, the suppliers who produce environment-friendly products, use recycled product content, and pay attention to ergonomics are differentiated.

The last supplier selection criteria discussed in Kahraman *et al.* (2003) is service performance. According to the paper, a company should always take into account service as a selection criterion because during or after any product purchase, companies definitely receive services such as order processing, delivery, support and so on. One

of the attributes of service performance mentioned is customer support. When evaluating the eligibility of customer support, a company should examine concepts such as accessibility, timeliness, responsiveness and dependability of the supplier. Another aspect to be considered is follow-up, i.e., how the supplier keeps the company informed on the production status or change in delivery dates and verifies satisfaction. Companies should also consider knowledge, accuracy, attitude and reliability of their suppliers which are grouped under the attribute, professionalism.

Finally, using the Fuzzy AHP method, the priority weights of the aforementioned supplier selection criteria are determined. As a result, the best supplier for the predetermined criteria is identified. According to the paper, the reason the two methods, Fuzzy Set Theory and Analytic Hierarchy Process, are combined is the inability of the crisp AHP to capture the uncertainty in the judgment of human beings while assigning the evaluation scores.

Chan (2003) discusses that the supplier selection process should be based on tangible factors. However, it is considerably affected by human judgment which is subjective and qualitative. In order to solve this problem, several different methodologies are used together. A method called Chain of Interaction (COI) is proposed as a part of Interactive Selection Model (ISM). Then, Analytic Hierarchy Process is utilized. A numerical example is shown to apply ISM to the real situation in most of the manufacturing firms from developed countries.

In Chan (2003), various supplier selection models are created for different buyer-supplier relationships. Before implementing AHP, an Interactive Selection Model (ISM) is used to determine the selection criteria and the buyer-supplier relationships. Since the process of AHP is considered quantitative, ISM deals with the subjective and qualitative parts at the earlier stages of the analysis and converts them to measurable factors using COI. COI basically assesses the interactions between the criteria with the help of experts who have the knowledge and experience to decide their relative importance. Then, the data collected from the ISM is inserted into AHP to calculate the final results.

The evaluation criteria taken into account in Chan (2003) are cost, quality, design capability, manufacturing capability, technical capability, technological capability, performance history, management capability, degree of cooperation, financial performance, and degree of closeness.

Cost and quality, being the most common criteria in the related studies in the literature, are the most straightforward factors for the supplier selection problem. Other than the cost and quality, there are other selection criteria central to many manufacturing firms from developed countries. For example, design capability means the ability of a supplier to control design-related issues such as change in design, robustness of design, etc. Manufacturing capability refers to ability of a supplier to control issues such as production, operational sequences, tools, etc. Technical capability means supplier's ability to control field-related skills such as maintenance. Technological capability refers to ability of a supplier to conduct research. Performance history means the track record of supplier's business data. Management capability means ability of a supplier to control its human resources. Degree of cooperation refers to willingness of a supplier to work on a request by the company. Financial performance means the track record of supplier's financial data. Degree of closeness means willingness of a supplier to share information. In the literature, this attribute is usually covered under relationship criteria.

Guneri and Kuzu (2009) worked on imprecise data to generate decisions using fuzzy logic. With the help of fuzzy logic, the human reasoning process is reflected effectively in this research. Basically, a fuzzy suitability index for supplier alternatives are calculated and the suppliers are ranked according to those fuzzy indices to select the best supplier among the alternatives.

As in Kahraman *et al.* (2003), the strategic importance of supplier selection decision to organizations is emphasized in Guneri and Kuzu (2009) but in contrast to the method used in Kahraman *et al.* (2003), Just-in-time (JIT) approach is used in Guneri and Kuzu (2009). This approach aims to improve quality, flexibility and levels of service received from suppliers by eliminating any type of waste and developing a

buyer-supplier long-term relationship based on mutual trust.

The proposed methodology is applied to a medium-sized manufacturer of plaster and cement-based products and eight suppliers are evaluated with respect to the selection criteria. There are four stages to finding the appropriate supplier using fuzzy suitability index. First, the evaluation criteria are identified. Second, the relative importance of each attribute is determined with respect to the overall objectives. Third, the impact of each supplier on the attributes are determined. Lastly, the suppliers are ranked according to their fuzzy suitability index.

In Guneri and Kuzu (2009), the selection criteria are determined in line with the JIT approach and based on the literature. The evaluation criteria taken into account in this paper were quality, technological capabilities, total cost, buyer-supplier partnership, geographic location, flexibility, production performance, just-in-time delivery. Quality is one of the most important criteria in the JIT approach. The suppliers should have quality certifications and should be bound by severe penalties in contracts in case of quality failures. In order to make sure that the quality assessment systems are in place, companies can arrange visits to check the supplier's production facilities. This will also help prevent waste of time due to goods going back and forth between the buyer and the supplier not matching the quality standards.

Technological capability of a supplier is another important selection attribute because it affects the manufacturing capacity significantly. It enables product development with the supplier and makes them open to improvement. Technology also helps the improvement of the quality of materials and decreases the production time. Total cost is another important criterion in JIT approach. Rather than including just a material cost, all the other costs such as transportation, packaging, carrying inventory, and possibility of price reduction are considered in total cost. Even though a supplier has the lowest material cost, the rest can make its total cost exceed the others because low material costs brings out other costs due to waste.

Buyer-supplier relationships are important in JIT approach. A close buyer-supplier relationship enables flexibility management, contract negotiation, and less time spent on the orders. Instead, it allows companies to focus on and improve other aspects of procurement process such as packaging and transportation. Geographical location is very important because it affects the duration of contracts, total cost due to increased transportation and logistics cost, and on-time delivery. For example, when a supplier is located far away, they look for long lasting business partnerships and commitment. Therefore, this should definitely be included in the supplier selection criteria according to the paper.

According to the JIT approach, flexibility is another critical factor because it affects the payments, discounts, minimum order quantities, capacity and willingness to address the companies' requests such as increase in order volume, new product development or change in the design. Another key factor in the JIT approach is the production performance of the suppliers. Production performance includes production ability and history, financial status, reputation in the industry, past business practices, etc. This data allows companies to make predictions of supplier's progress in the future. Just-in-time (JIT) delivery is the last selection criteria which has become important with the increasing global sourcing. Delays that occur in transport or lead times that extend disrupt global supply chain processes significantly.

Chan *et al.* (2008) discusses the Fuzzy Analytic Hierarchy Process in order to deal with the global supplier selection problem. An effective decision-making model is created using the proposed method and implemented to a manufacturing firm in the real world. In order to execute the method, first the decision criteria significant to the global business environment are determined. Next, pairwise comparison matrices are constructed which is the part taken from the AHP model. Then, the importance of one criterion over another is determined using the fuzzy theory. The linguistic variables corresponding to triangular fuzzy numbers are used to state the preferences by the experts. Thus, a qualitative concept is transformed into a quantitative factor representing the human reasoning. Finally, the priority weights of each supplier are computed and the best global supplier is selected among the alternatives.

In the global business environment, the political-economic situation, geographical location, infrastructure, financial background, performance history and risk factors are very important evaluation factors according to this study. Therefore, the evaluation criteria taken into account in Chan *et al.* (2008) are cost of ownership, quality, service, background and risk factors.

In a competitive global environment, companies would like to purchase the most cost-effective items to increase profitability Chan *et al.* (2008). There are three main sub-attributes considered under the cost of ownership criterion in Chan *et al.* (2008). Product cost is the primary cost factor under this criterion. The companies tend to prefer the supplier with the lowest product cost, also known as manufacturing cost, which covers the order processing cost, maintenance cost, warranty cost, etc.

For the global supplier selection problem, logistics cost is another significant cost factor. Logistics cost include lengthy distribution channel cost, transport expenses, inventory cost, handling and packaging cost, damages in the way and insurance cost. These cost items are usually inevitable in foreign trade and might be very high depending on the circumstances.

According to Chan *et al.* (2008), the companies should also look into tariff and taxes that vary from country to country. A company should pay attention to this cost factor very carefully because countries may impose high tariff and taxes for some imported goods in order to protect the local manufacturers. Therefore, these costs should be estimated item by item very carefully before selecting the international suppliers because they can increase the cost of goods substantially.

Another criterion discussed in Chan *et al.* (2008) is the quality of the products. Quality at the source is a very common application among international suppliers following the lean manufacturing principles. Quality at the source is identified as maintaining the quality of goods at every single stage from production to delivery. There are 4 major quality measures that affect this criterion. First is the supplier's capability to conform to the specifications provided by the company. A percentage of

products that are not in line with the specifications is a key indicator of the supplier's service quality. In addition, a supplier should be reliable in two ways. First, the products that it delivers should last a considerable period of time. In other words, its products should be durable. Second, it should deliver in the committed time frame because the businesses rely on the lead times promised by the suppliers. If a supplier fails to deliver reliable and durable products, this brings increased costs to the company in return. The companies should make sure that the quality assessment processes are in place at the supplier and they have the necessary certifications. Also, they should be bound by penalties or contracts to encourage them to maintain the quality. The last attribute of the quality criteria is the process capability which is basically the supplier's ability to produce quality products.

Another criterion crucial to the global supplier selection is the service performance of a supplier. A good service provided by the supplier help improve many other aspects significant to global sourcing. For example, delivery reliability is a critical factor because delay in transports can cause exponential increases in lead time affecting the other functions of a company which relies an important part of its business to global sourcing. Information sharing is another component of the service performance affecting the ease of communication and negotiability. For a successful global business partnership, long term commercial relations should be built and maintained. Differences in languages, business manners, ethics, communication tools can all create obstacles for an effective information sharing and a good service performance. Both parties should ensure effective communication to understand each other's requests and expectations well in order to prevent any failures which are nonreversible due to far distances. Flexibility and responsiveness are other elements that help address the companies' urgent inquiries such as last-minute design changes or purchase order revisions. Having this flexibility at the supplier enhances the performance of the company. Customer response is the last attribute under service performance criteria. It is actually the business references of a supplier. If a supplier has worked with many well-known customers, then it proves customer satisfaction in the areas such as service performance, quality, price, etc.

Supplier's background needs to be checked because it reveals different characteristics such as technological capability, financial status, facility and infrastructure, and market reputation about the supplier. In a global environment, utilization of technology plays a crucial role in the competition among the suppliers. Also, quality, flexibility, conformance to specifications, good service performance, delivery reliability, ease of communication and new product development are all related to technological capability. Financial status is very important factor to build a long-term partnership with the supplier. Also, a robust financial structure proves delivery reliability as well. The company makes sure that the supplier will deliver the order amount on time. "Facility and infrastructure" attribute should be compared among the suppliers because it tells about the production capacity of the supplier and the likelihood of the supplier to deliver high quality products and ability to address the inquiries from the company. Market reputation is again very much related to other attributes analyzed in this paper. Moreover, if a supplier has a remarkably good performance history in quality and service, that means the supplier has outstanding clients and is very well known in the market.

Risk factors are included as an evaluation criterion especially in the case of global sourcing because there are many unknown and unfamiliar external conditions likely to disrupt the sourcing operations. Global sourcing has the risk component compared to domestic procurement. Risk, being a qualitative concept, should be quantified and incorporated to the evaluation process. The attributes related to risk criteria analyzed in this paper are geographical location, political stability and foreign policies, exchange rates and economic position, terrorism and crime rate. The companies need to evaluate the risks involved with any supplier and locate alternative suppliers as a backup plan. Risk is an external factor such that even if the company has the capability to handle many other aspects of supplier selection internally, there is nothing that can be done to fix external factors under some circumstances. For example, geographical location of a supplier is important in terms of the plant's location, increasing the likelihood of delays, and the possibility of natural calamities. Since a long-term relation is trying

to be built, these risks will create obstacles. The political status and the business policies of the country in which the supplier operates are important to maintain long term relationships with the suppliers. Therefore, stabilized governments are preferred because unsteady leaderships cause change in policies such as new tax implications or regulatory obstacles. Besides, different countries have different currencies which are subject to exchange rate fluctuations depending on the economic position of the country. These changes can highly affect the costs so that they should be factored into the equation. Terrorism and crime rate are also considered for global supplier selection as the delivery schedule might be affected or the delivery might not be done at all in areas with high risk of terrorist activities and crime rate.

Kilincci and Onal (2011) undertake a fuzzy AHP based approach to select the best supplier firm providing the highest customer satisfaction for the criteria determined for a washing machine company. Supplier selection is a critical decision-making problem including both qualitative and quantitative elements as mentioned in the other examples of the literature. For instance, to identify the right suppliers that have the capacity and capability to consistently meet a firm's needs while making sense cost-wise and quality-wise is not trivial. In this paper, supplier selection problem of a well-known washing machine company in Turkey is investigated and Fuzzy Analytic Hierarchy Process is used to select the best supplier firm. Three main criteria are identified with fourteen sub-attributes to evaluate three potential suppliers. The main attributes or criteria are supplier, product performance, service performance. Whereas, the sub-attributes are financial status, management approach, technical ability, quality systems and process, geographical location, production facility and capacity, working with Kanban approach, product price, handling, product quality, follow-up, technical support, lead time and professionalism.

Under supplier criteria, financial status, management approach, technical ability, quality systems and processes, geographical location, production facilities and capacity, working with Kanban approach attributes are measured. A robust financial status of the supplier is required for long term commitments. A strategic management approach of the supplier helps companies build good relationships with suppliers. Technical

ability of a supplier enables adjustment of the supplier according to the companies' needs and requests. It also indicates that the supplier has the capability to improve its operations and production.

Quality systems and processes should be available at the supplier in order to deliver high quality products. Geographical location is effective in the delivery time, transportation cost and ease of accessibility in the means of technical support. Supplier's production facility and capacity should be able to fulfill company's further demands such as order volume increases and new product development. Working with Kanban approach is very helpful in decreasing the logistics cost because the supplier keeps the stock of the products instead of the company and the company pays only for the product it uses.

Product performance criteria includes three main attributes: product price, handling, and product quality. Product price constitutes a great portion of the cost of the goods. Therefore, it is important the keep the product price low. Handling includes four different operations in it: transportation, storage, receiving, and packaging. Packaging keeps the products from any damage during transportation or storage. Storage and receiving operations keep track of the stockout situations. Transportation is related to the rapid delivery time. Product quality is another important attribute of the product performance. Supplier's quality performance is measured with the number of products returned to the supplier due to some quality issues which is called the rejection rate. Service performance is another main criterion in selecting the best supplier. It is an indicator of the benefits provided by the suppliers. Regardless of the purchase, a service is definitely provided by the supplier such as delivery and support. Therefore, it needs to be taken into consideration. Sub-attributes like follow-up, technical support, lead time and professionalism are assessed under service performance. Information about the production stages, planned delivery date, delay in the shipment and transportation arrangements should be provided by the supplier. This sub-attribute is called follow-up. Technical support should be given by the supplier in case the company faces a problem during utilization. Lead time is the time needed to manufacture a product beginning from the order date and ending on the delivery date. The lead time

may or may not include the time required to obtain the raw materials necessary for manufacturing. It is very important in the service performance of a supplier because it directly affects the delivery time which is promised to the customer. Professionalism, another attribute of service performance mentioned in the study, can be considered as the experience, knowledge, attitude and the reliability of the supplier.

After the main criteria and sub-attributes are defined to design the hierarchical structure, the priorities of criteria, sub-attributes or alternatives over another are determined with the help of a questionnaire which is composed of pairwise comparison questions. The preference or importance of one factor over another is defined by the experts responding the pairwise comparison questions with linguistic variables. First, the experts compared the criteria with respect to the main goal which is to select the best supplier. Then, they compared the sub-attributes with respect to the criteria. Then, the experts compared the suppliers, also known as alternatives, with respect to each sub-attribute. The consistency of each pairwise comparison matrices is checked calculating the consistency ratios, a procedure of crisp AHP to measure the rationality of the answers. Later, the linguistic variables are converted to triangular fuzzy numbers to calculate the weights for criteria and sub-attributes along with the weights for alternatives. The supplier with the highest priority weight is selected as the best supplier.

Shaw *et al.* (2012) presents an integrated approach for selecting the appropriate supplier using fuzzy-AHP and fuzzy multi-objective linear programming. The study investigates a clothing manufacturer operating in India that does export to the USA and Europe. The raw material, which is the fabric in this case, should be sustainable as the customers of the manufacturer are interested in the environment friendly products. Therefore, the company incorporates environmental criteria into their suppliers' evaluation process while keeping in mind the other important decision variables including cost, quality, lead time and demand in addition to greenhouse gas emission (carbon footprint). While improving the environmental efficiency, cost effectiveness becomes an issue because they are affected from each other. Also, the management of the company decides that a long-term commitment should made with the suppliers

in order to achieve desired carbon emission levels because then the suppliers would be willing to share the information about the realistic carbon footprints of the products manufactured. The company's management brought together a group of people from various divisions such as purchasing, production, marketing, quality control, research and development with the objective to define the criteria to help select the best supplier among the alternatives. First, they decided on the criteria such as cost, quality rejection, late delivery percentage, greenhouse gas emission, etc., then they decided on four potential suppliers to evaluate under these criteria. Upon the decision of this group, the priorities of the selection criteria are determined only by the purchasing and operations managers with the help of a pairwise comparison survey. A nine-point scale is used in the survey and the consistency of each expert's answer is measured. In case of inconsistency, the survey is repeated until the consistency is maintained. Depending on the result of the survey, the relative weights of the supplier selection criteria are determined using Fuzzy AHP method. In fuzzy linear programming model, objective functions are formulated for each criterion which are cost, late delivery, quality rejection and carbon footprint minimizations. Then, these objective functions are solved and lower and upper bound of the objectives are calculated. Then, the relative importance/preference weights are multiplied with each membership function of fuzzy linear programming to formulate the crisp equation using weight additive model (Tiwari *et al.*, 1987). Lastly, the crisp formulation is solved and the best supplier is found.

Kilic (2013) proposed an integrated methodology for the supplier selection problem and combined fuzzy TOPSIS with mixed integer linear programming model. The proposed methodologies are applied to the air filter sector. The selection criteria are determined interviewing with the managers of companies operating in the respective field in Turkey. As a result of the interview, it is concluded that the air filters produced by a specific supplier differ in quality, delivery time and cost. Also, in selecting the best supplier, the geographical location and the references of the suppliers should be taken into consideration, too. Since there are more than one product type produced by different suppliers with limited capacities, the importance values have to be determined for each supplier per product type with respect to the evaluation criteria. The evaluation criteria taken into account in Kilic (2013) are quality, cost, delivery time,

geographical location, and references.

First of all, using the Fuzzy TOPSIS method, the importance values of the suppliers are obtained with respect to each product. Then, inserting these importance values into the mixed integer linear programming model, the best suppliers and the order quantities to be assigned to each supplier are computed. The difference of this study from the existing studies in literature is that it calculates the quantity to be provided by each supplier in addition to selecting the best supplier.

Nazari-Shirkouhi *et al.* (2013) refers to the supplier selection and order allocation problem together using a two-phase fuzzy multi-objective linear programming model. The proposed model attempts to minimize total purchasing and ordering costs, number of defects, and late deliveries from the suppliers simultaneously. The paper deals with a supplier selection and order allocation problem under various prices and product options. The model is applied to a numerical example where a buyer plans to purchase five products from four suppliers which can provide around four items.

There are two main purposes of Nazari-Shirkouhi *et al.* (2013). First is to create a mixed integer linear programming model to address suppliers with various price levels and buyers with several objectives in conflict such as minimization of total costs, number of rejected items and number of late delivered items. However, suppliers face constraints such as demand, capacity, flexibility and prices to achieve these objectives. In order to solve this conflict of optimizing these objectives at the same time, an interactive two-phase fuzzy multi-objective linear programming model is proposed. The evaluation criteria taken into account are basically cost (total purchasing and ordering costs), quality (number of rejected items), delivery (number of late delivered items) and demand.

Chen *et al.* (2016) illustrates how an effective supplier selection strategy can eliminate the risks and diminish the effects of the unpredictable events in global supply chain processes. In this paper, two different methods called Weighted Goal Programming (WGP) and Preemptive Goal Programming (PGP) are introduced. The proposed

methodologies are applied to a company operating in the automotive industry with suppliers from all around the world. In accordance with that, the evaluation criteria are determined with respect to the global performance measurements.

The evaluation criteria taken into account in Chen *et al.* (2016) are mainly safety, quality, delivery, cost, people, environment, cash flow, and risk. In order to reflect the global performance measurements better, these main criteria are broken down into sub-attributes. For quality criteria, warranty cost and repairs per 1000 vehicles are calculated and compared. For delivery, production schedule achievement in percentages is measured. Under cost criteria, maintenance and logistics costs are included. Under people criteria, employee satisfaction index and individual development are evaluated. Under environment criteria, energy usage (KWH/unit) is taken into account. For cash flow criteria, profit and investment are assessed. For risk criteria, World Risk Index in percentages is used.

The first methodology, WGP allows dealing with several supplier selection objectives at the same time. The objectives refer to the selection criteria which are safety, quality, delivery, cost, people, environment, cash flow, and risk. First, a numeric goal is established for each objective. Then, penalty weights are assigned to the objectives by the senior management as the decision-makers to figure out the relative effects in case the numeric goals can't be achieved. So, there is a chance for objectives to deviate from their goals. The ultimate goal is to minimize the weighted sum of these deviations. Based on WGP model, quality, profit and risk are found to be the objectives that are most likely to deviate from their goals.

In the second part of the methodology, PGP prioritizes several goals of quality, profit and risk to find the optimal supplier. In contrast to WGP model, PGP focuses on one goal at a time. The process of minimizing the deviation and determining the priority of each goal continues until all of the goals are considered. Then, the prioritization of the objectives is completed.

As a result of the analyses, safety is found to be the most crucial factor for the supplier selection in an automotive company. Risk is identified to be one of the critical selection criteria as well. Chen *et al.* (2016) argues that through a resilient supplier selection strategy, disruptions in global supply chain processes due to unexpected disasters can be mitigated. According to the paper, for example, there are valuable lessons learned by the supply chain sector after the Great East Japan Earthquake in March 2011 and the severe floods in Thailand in May 2012. Last of all, environmental awareness proves important for the company which has to address global concerns of today's world, supplying from the global resources.

Lima Junior *et al.* (2014) conducts a comparative analysis between the two methods, Fuzzy-AHP and Fuzzy TOPSIS. Both methods were applied on a manufacturing company operating in the automotive industry and found suitable for the supplier selection problem. The Fuzzy TOPSIS should be preferred over Fuzzy-AHP thanks to its convenience in changing alternatives or criteria, flexibility and supportiveness in group decision making process, less computational complexity, and better modeling of uncertainty. The evaluation criteria taken into account in Lima Junior *et al.* (2014) were quality, price, delivery, supplier profile, and supplier relationship. Quality includes conformance quality, quality management and after sales service quality. Price is the purchasing cost of the product. Delivery is related to delivery time and reliability. Supplier profile is related to market reputation and financial status. Supplier relationship refers to the degree of cooperation and relationship based on trust between the buyer and the supplier. In the paper, some advantages and disadvantages of Fuzzy AHP and Fuzzy TOPSIS methods are compared. Fuzzy TOPSIS does not restrict the number of criteria evaluated as opposed to Fuzzy AHP. However, it does not enable breakdown of the criteria into sub-attributes, either. It is suggested in (Thomas.L.Saaty, 1980) that the number of criteria or alternatives evaluated using AHP are limited to nine which is a valid situation for Fuzzy AHP method, too. Even though the limitation of the number of criteria can be unriddled by breaking down the criteria into sub-criteria as in the Fuzzy AHP hierarchy structure, still the number of alternatives creates a limitation.

This is not a desirable situation in the supplier selection problem. Fuzzy AHP is not very useful in case of adding an alternative or a criterion because an inversion of the order occurs when an additional criteria or alternative is included. This is called ranking reversal and it is not a desirable outcome too. On the contrary, Fuzzy TOPSIS always produces a consistent importance order. When there are a few criteria and suppliers, Fuzzy AHP is more useful than Fuzzy TOPSIS. However, as the number of criteria and alternatives increase, then the number of judgments required for Fuzzy AHP is greater than that of Fuzzy TOPSIS. In addition, it still takes less time to conduct the operations for Fuzzy AHP than Fuzzy TOPSIS. Both methods support group decision making. However, increasing the number of decision makers will increase the time complexity of Fuzzy AHP more than Fuzzy TOPSIS because the amount of data required by Fuzzy AHP is significantly greater than the Fuzzy TOPSIS. Since both methods are based on the fuzzy set theory, they both deal with uncertainty with similar precision but in case a supplier is replaced, Fuzzy AHP is more appropriate with fewer judgment and less time complexity compared to Fuzzy TOPSIS.

Even though several researches were was conducted for various areas of supply chain management in the hospitality industry, none of them tackled the supplier selection problem adequately except a few. In Sánchez-Rodríguez *et al.* (2006), it is claimed that a process for supplier selection and purchasing procedures needs to be implemented by hospitality corporations in order to make their sourcing process more effective, seeing that hotels lack proper sourcing strategies.

According to Zhang *et al.* (2009), existing studies of supply chain management in the tourism industry can be divided into three categories according to the areas they focus on. First is the investigation of the relationships between suppliers (hotels, attractions, airlines, etc.) and travel agencies/tour operators. The past studies in this field usually treated the tourism companies and business travelers as the customers and hotel as the suppliers. Therefore, supplier selection problem in the hospitality industry in literature are generally from a different perspective compared to the supplier selection problem this study investigates. Second is the examination of the relationships between wholesale and retail travel agencies and third is the identification of supplier selection

problems. However, supplier selection problem is not discussed in detail in the literature except a few.

Fantazy *et al.* (2010) focuses on the supply chain management in the Canadian hospitality industry. The data collected from 105 hotels in Canada through questionnaires reveals the impact of strategic purchasing on supply chain and on hotels' performance using Structural Equation Modeling (SEM) approach. The questionnaire is applied on the experts who are the owner, general manager, purchasing manager, and supply chain managers of the hotels. The results of the study show that strategic purchasing depends on attributes such as relationship with the supplier, communication, service quality, financial performance and customer satisfaction. In order to calculate the weights of each decision variable or so-called selection criteria mentioned above, Exploratory Factor Analysis (EFA) is used. In Fantazy *et al.* (2010), alternative suppliers are not compared. Only the priority weights are determined for the attributes. So, again the supplier selection problem is not solved completely in this paper.

Christodoulidou *et al.* (2012) suggests that hotels need to establish a sourcing strategy which they currently lack in order to achieve their long-term goals. The analysis shows that in today's tough business and economic environment, the hospitality industry is facing many challenges, especially in procurement where the decision-making process differs significantly from other industries. In order to overcome these challenges related to quality, delivery, and cost issues, the study suggests the use of sophisticated sourcing methods. In this paper, supplier selection is only investigated as a component of strategic sourcing. Again, it is not specifically addressing how to solve the supplier selection problem.

Another study of supply chain management in the hospitality industry conducted by Xu and Gursoy (2015) mentions that hospitality supply chain is not only limited to the supply chain of products but also includes the supply of the services. Suppliers in the hospitality supply chain include local farms, food and beverage manufacturers, equipment and furniture manufacturers, product manufacturers, craft producers, water and energy suppliers, educational institutions, and waste recycling and disposal service

providers.

There are two research projectse that focused on the supplier selection problem in the hospitality industry similar to this study except the fact that they investigated the hotels as a case study. In Onder and Kabadayi (2015), supplier selection problem is solved with another multi-criteria decision making method called Analytical Network Process (ANP). First, the decision problem is identified. Then, the dependencies among clusters, known as outer dependence, and the dependencies among elements of the clusters, known as inner dependence, are determined. After pairwise comparisons of the elements and clusters are obtained, the super matrix and weighted super matrix are created. The weighted super matrix is raised to its power to obtain the limit super matrix and the best supplier is selected.

Like Fuzzy AHP, ANP also deals with tangible and intangible criteria to select the right supplier under multiple objectives. The proposed methodology of supplier selection is applied to a five-star business hotel in Istanbul for three candidate suppliers. The main evaluation criteria identified according to the company's priority objectives with the help of literature and the purchasing managers of the hotel are listed as reliability, quality, price-cost, communications and relations, sustainability, service quality and technology. These main criteria are decomposed into several sub-criteria.

For example, the criteria "reliability of a supplier" depends on the number of working years in the sector, positive recommendations about the supplier, ability to meet delivery quantities, ability to meet delivery due dates, compliance with packaging requirements, supplier's reputation in the industry and financial stability and staying power. Quality criteria depends on the ISO certification, process control capability, corrective and preventive action system, past quality experience with supplier and compliance with delivery standards. Price-cost criteria includes ordering cost, transportation cost, net price of the final product, maintenance and repair cost and flexible payment terms.

Under communication and relations criteria lies the sales force product knowledge, ability to solve the quality problems, flexible contract conditions, communication capability, order receiving system of the supplier and past and current relationship with supplier. Sustainability criteria includes environmental policy of the supplier, ISO 14001 certification, recycling policy of the supplier, education status of the employee, workplace safety and employee training and social responsibility. Service quality criteria includes customer satisfaction, product line diversity, ability to respond to unexpected demand, after sales service and technical support availability for the products. Lastly, technology criterion includes information systems, storage systems, and transportation systems.

The results of the ANP shows that compliance with delivery standards, past quality experience with supplier, ability to meet delivery due dates are the most important criteria in the supplier selection process of the hotel. On the other hand, the sustainability criteria are found to be the least important supplier selection criteria by the purchasing department of the hotel.

In Hsu *et al.* (2014), a model is proposed to select the best supplier in terms of carbon and energy management performance by using a multiple-criteria decision-making method. An illustrative example of a hotel company was presented to demonstrate the selection process of a low carbon supplier. By conducting a literature review and gathering expert opinions, 10 criteria on carbon and energy performance were identified to evaluate low carbon suppliers using the Fuzzy Delphi Method (FDM) along with several other methods. The criteria taken into consideration in Hsu *et al.* (2014) are energy efficiency of products, eco-labeling of products, carbon accounting and inventory, energy reduction of food processing, carbon governance, carbon policy, carbon reduction targets, carbon and energy management systems, transport efficiency, collaboration of suppliers, measures of carbon reduction and energy conservation, and food mile management.

First, the Fuzzy Delphi Method is used to identify the consistency of the selection criteria through expert opinions. In this regard, a threshold was set and the criteria

below that the threshold is eliminated. Second, the Decision-making Trial and Evaluation Laboratory (DEMATEL) based Analytic Network Process (DANP) is used to acquire the weights of the ten criteria to reflect the influential relationship between them. Finally, VIKOR method is used to rank the supplier alternatives.

As a result of the analysis, the criteria "carbon reduction targets", carbon policy, and "measures of carbon reduction and energy conservation" are found to be the most significant evaluation criteria according to the obtained weights of criteria for evaluating carbon performance of suppliers.

In Zhang *et al.* (2015) an integrated methodology based on Fuzzy Set Theory and Analytic Network Process is developed to solve the global supplier selection problem. The proposed model deals with the uncertain information and the interrelationships between the attributes effectively.

As in the Fuzzy AHP model, the selection criteria and sub-attributes are determined first. Then, the pairwise comparison matrices are constructed for fuzzy evaluation of the criteria and sub-attributes and filled with triangular fuzzy numbers. In order to reflect the dependencies between the sub-attributes, a pairwise comparison matrix is formed per sub-attribute and the interdependency weights of the sub-attributes under a particular criterion are calculated. A super matrix is formed with all the interdependency weights calculated. All the weights calculated from fuzzy comparison matrices and interdependency matrices are multiplied to find the desirability index per supplier. Finally, the best supplier is selected based on the ranking according to the desirability indices.

The evaluation criteria taken into account in Zhang *et al.* (2015) are basically cost, quality, service performance, supplier's profile and risk factor as in most of the studies in the literature. Since the paper focuses on the global supplier selection, the criteria breakdown indicates the global performance measures too. For example, cost criterion includes tariff and custom duties in addition to product price and freight cost. Quality criteria includes increased lead time in addition to evaluation criteria such as

rejection rate of the product, quality assessment and remedy for quality problems. Risk factor is included in the study in order to take into account the risks involved in the global sourcing. Risk factor criteria includes geographical location, political stability, economy and terrorism as its sub-attributes. Service performance criteria includes delivery schedule, ease of communication and response to changes in addition to technological and R&D support. Lastly, supplier's profile includes financial status, customer base and performance history in addition to production facility and capacity in order to get insight on the company and its businesses more.

Scott *et al.* (2015) proposes an integrated method when dealing with supplier selection problem and combines Analytic Hierarchy Process and Quality Function Deployment (AHP-QFD). It was developed by Ho *et al.* (2011) for supplier selection and applied in Ho *et al.* (2012), Scott *et al.* (2013), and Scott *et al.* (2015). This integrated method utilizes chance constrained optimization algorithm approach and Monte-Carlo simulation.

First, the decision stakeholders are identified in order to include their requirements in the supplier selection process. Then, the prioritization is made between those requirements using AHP-QFD method. After identifying the stakeholders or decision-makers along with their requirements, the orders are allocated according to the stakeholders' decision criteria. In the first stage of the proposed method, AHP-QFD is used to compute the importance weights of the potential suppliers based on different stakeholder groups and their requirements or so-called selection criteria. In the second stage, orders are allocated using chance constrained optimization algorithm which takes into account the selection criteria, constraints on the final product or quality of goods, stochastic quality measures of materials, capacity of each supplier and the supplier importance score or weight from the first stage. The importance weights calculated with AHP-QFD method are factored into chance constrained model to optimize the order allocation to satisfy the stakeholders. The higher the supplier score or the weight, the greater the stakeholder satisfaction. In the third stage, results are validated using Monte-Carlo simulation. The outcome of the simulation proves that the criteria outlined in the optimization stage are right. The proposed methodology

is tested on four suppliers in the bioenergy industry which has a very dynamic supplier market. This industry makes a good example of multi-stakeholder, multi-criteria, multi-supplier and stochastic supply characteristics problem with the variation of natural materials, the uncertainty in supply quality and composition in the long term, and the complex stakeholder requirements. Also, the chemical properties, availability and price vary significantly from one supplier to another.

The evaluation criteria taken into account in Scott *et al.* (2015) are summarized as long term contracts, take or pay clauses, track record, personal relationship, contract with PFI back-up, fixed price, traceable (chain of custody), base cost of material (d/MWh), clear definition of fuel, visibility, quality control mechanisms in place, Guarantee of fuel quality available, supplier stability, distance from buyer, CO2/MWh, land use change, FSC accreditation, alternative end use, diversion of material from landfill, environmental regulatory in the environment the supplier operates, performance against sustainability assurance certificate indicators, credit strength, size of balance sheet, financially robust or credible counterparty, rural jobs created or safeguarded, dependency on imports, SME employment created, and biodiversity change.

2.5. Research Question

With this study, contribution is provided to the literature by presenting a global and domestic supplier selection strategy for an emerging industry. The industry investigated under this study is a new sector that consists of tech-enabled property management and hospitality companies of ten well-known brands whose names are not given in this study.

Within this industry, procurement process is closer to the concept of hospitality supply chain. However, having a deeper look at the literature, none of the research projectses specifically concentrated on the problem of selecting the best global or domestic supplier among the alternatives to procure food, equipment, furniture, amenities and other services in the hospitality industry. Even if the importance of the supplier selection is emphasized in these studies, none of them go into detail to discuss the ways of

selecting the best global or domestic supplier taking into account the objectives of a hotel or serviced apartment in the hospitality industry.

This study aims to deal with the complex nature of decision-making process in the supplier selection of a company with a fairly different business model than the traditional entities in the hospitality industry. The companies operating in this industry are basically renting studio, one-bedroom or two-bedroom apartments in several locations within a city either from landlords or building managements, furnishing them from couch to bed, home textile to kitchenware, and subleasing them to mainly business travelers and expats with a certain markup. This process of onboarding a property and furnishing it should take place in maximum three days to keep the business feasible. In order to perform such fast operations, companies have to place bulk orders for furniture and equipment monthly or quarterly from all around the world, ship them to destinations where they are present and keep stock in local warehouses. The operations described above requires a significant effort in supply chain management. In this regard, supplier selection is one of the major components of the supply chain management. Therefore, the companies should implement a proper sourcing strategy to select the best potential supplier in line with their overall objectives.

Dealing with domestic and global suppliers and evaluating them simultaneously are also tricky processes. To select the best supplier among the alternatives is the most important objective to keep the company profitable and operating. As a result, the effective and efficient supply chain forms the core of this business.

Even if this market seems to resemble an already existing one because there is a very similar way of operations in the serviced apartment or corporate housing industry, there are many ways this business model differentiates itself from the available industries. For example, this emerging market aims to utilize technology very well in order to attract new generations, streamline its processes and overcome its traditional competitors in the hotel and serviced apartment industry.

After several years of staying at the hotels or trying various options of extended stays, many corporates are tired of the same elegant design, same location, a front desk and hotel restaurants. Serviced apartments which are intended to provide more flexibility with an apartment-like layout with a separate kitchen and a living room still have a clean-cut design, the lengthy process of check-in & check-out, and gathered in a single building are found to be very restrictive and overwhelming by the customers. Other than the use of technology, the supply chain management of this new market happens to be very different than the conventional hotel supply chain in terms of

- monthly and continuous procurement of furniture and equipment,
- demand planning with respect to the growth projections of each city,
- warehouse management,
- logistics management,
- imports & exports,
- legal and contractual issues with the landlords and the clients changing according to the regulations of different countries and cities,
- financial obstacles like attracting investment and completing funding rounds.

These are the conditions that make this industry completely different than the existing short-term rental or extended stay markets. In this regard, this study aims to provide suitable evaluation criteria for the respective new industry and introduce a useful technique for the best global and domestic supplier selection.

3. RESEARCH METHODOLOGY

3.1. Introduction

In order to solve the global and domestic supplier selection problem, Fuzzy Analytic Hierarchy Process is used in this research following the steps outlined in Figure 3.1. In the literature review part under this section, the method of selecting the related papers and the decision-making criteria are explained. Then, the selection of the methodology to solve the supplier selection problem and the preparation of the questionnaire are explained. Lastly, the collection of data through the questionnaire and the analysis of data through the research method are detailed.



Figure 3.1. Outline of the Approach.

Among many related studies, the papers in the literature review section are selected considering that they tackle the supplier selection problem in various industries as much as hospitality industry. Since the tech-enabled property management and hospitality industry is an emerging market, there weren't any studies conducted in this field and the studies performed in the hospitality industry were not adequate to cover the subject completely. The papers used in this study are selected considering the fact that they will provide the best guidance for this research in terms of selection crite-

ria and the process. It was observed that there are multiple methods to perform the supplier selection analysis. Each and every method has a different feature to generate valid outcomes for the respective industry. Among many alternative methodologies, the previous studies mostly concentrate on the Fuzzy Theory as shown in Table 3.1. However, it was observed in the literature that in order to overcome some limitations of this theory, it was combined with various other methods depending on the research question and the industry investigated. Table 3.1 summarizes the literature examined under this study and the methodologies used in these research projects to conduct the supplier selection analysis. In this study, Fuzzy AHP method is used to solve the global and domestic supplier selection problem. Supplier selection is a complicated decision-making problem as it involves both tangible and intangible factors together. Therefore, both methods are combined in this study because fuzzy sets have the ability to resemble the uncertain and imprecise decision making nature of human beings and AHP has the ability to model the real world with the hierarchical structure, decomposing the criteria into their sub-factors and examining the problem in depth. Furthermore, even though ANP (Analytic Network Process) is a very common methodology in supplier selection problems, AHP is used instead of ANP in this research because ANP considers the interrelations between the decision variables in the same cluster and makes comparisons with respect to another internal decision variable regardless of the hierarchy. However, criteria in the same cluster are independent of each other in this research. When any conflict is found between the internal elements of a cluster in this study, they are either removed or merged. Therefore, AHP is used of ANP in this research.

Table 3.1. Supplier Selection Approaches and Industries Investigated in Selected Studies

Author(s)	**Methodology**	**Industry**
Kahraman *et al.* (2003)	Fuzzy Analytic Hierarchy Process (Fuzzy AHP)	Manufacturing Industry (White goods)
Chan (2003)	Interactive Selection Model (ISM) with AHP	Manufacturing Industry
Guneri and Kuzu (2009)	JIT approach and Fuzzy Suitability Index	Construction Materials Industry
Chan *et al.* (2008)	Fuzzy Analytic Hierarchy Process (Fuzzy AHP)	Manufacturing Industry
Kilincci and Onal (2011)	Fuzzy Analytic Hierarchy Process (Fuzzy AHP)	Manufacturing Industry (White goods)
Shaw *et al.* (2012)	Fuzzy AHP and Fuzzy Multi-Objective Linear Programming	Textile Industry
Nazari-Shirkouhi *et al.* (2013)	Fuzzy Multi-Objective Linear Programming (FMOLP)	Manufacturing Industry
Kilic (2013)	Fuzzy TOPSIS and Mixed Integer Linear Programming	Manufacturing Industry (Air filter)
Lima Junior et al. (2014)	Fuzzy AHP and Fuzzy TOPSIS	Automotive Industry
Chen *et al.* (2016)	Weighted Goal Programming (WGP) and Preemptive Goal Programming (PGP)	Automotive Industry
Zhang *et al.* (2015)	Fuzzy Extended Analytic Network Process (FEANP)	Manufacturing Industry
Scott *et al.* (2015)	Analytic Hierarchy Process-Quality Function Deployment (AHP-QFD)	Bioenergy Industry
Hsu *et al.* (2014)	Fuzzy Delphi Method (FDM), DEMATEL, DANP & VIKOR	Hospitality Industry
Onder and Kabadayi (2015)	Analytic Network Process (ANP)	Hospitality Industry

While selecting the 14 papers listed above, the keywords that were taken into account were supplier selection, manufacturing industry, decision-making/process, multicriteria decision-making, supply strategy, supply chain management, supplier evaluation, hospitality, decision support system, purchasing strategy, tourism supply chain, global supplier selection and domestic supplier selection. The other related studies found were eliminated because they were not solving the supplier selection problem until the end. Instead, they mentioned the importance of the effective supply chain management for the corperations and supplier selection strategy in this regard. Also, it was important in the paper selection process that all these 14 different studies from the literature which were related to supplier selection problem focused on various industries. The research in the literature has investigated the supplier selection problem and focused on both similar and different criteria depending on their relevant industry since 1960s. However, this study takes into account more recent research projects done since 2003 in order to determine the supplier selection criteria. From the pattern driven from Table 3.2, it is concluded that the most important criteria are quality, cost, delivery time and financials.

The Table 3.2 presents a summary of literature on supplier selection reviewed under this research. Among the studies listed, the rest of the criteria that are most frequently encountered are geographical location, service, manufacturing capability, technological capability, relationship, management capability, flexibility, supply facility & infrastructure and risk factors. Table 3.2 shows only the most common selection criteria among these studies. There are other selection criteria used in these research projects that differentiate them from the existing studies in the literature. In addition, the attributes named slightly different in each study are grouped under the same criteria in the table if they refer to the same factor. As seen from below, every industry focuses on different decision criteria according to their own requirements and concerns. The selection criteria that this paper focuses on and how they shaped into a hierarchy table are further discussed in the next

Table 3.2. Supplier Selection Approaches and Industries Investigated in Selected Studies

Selection Criteria	**Literature**														
	Kahraman *et al.* (2003)	Chan (2003)	Gumeri and Kuzu (2009)	Chan *et al.* (2008)	Kilincci and Onal (2011)	Shaw *et al.* (2012)	Kilic (2013)	Nazari-Shirkouhi *et al.* (2013)	Chen *et al.* (2016)	Lima Junior *et al.* (2014)	Hsu *et al.* (2014)	Onder and Kabadayi (2015)	Zhang *et al.* (2015)	Scott *et al.* (2015)	Frequency
Quality	x	x	x	x	x	x	x	x	x	x		x	x	x	93%
Cost		x	x	x	x	x	x	x	x	x		x	x	x	86%
Delivery Time			x	x	x	x	x	x	x	x			x		64%
Financial Status	x	x		x	x				x			x	x	x	57%
Geographical Location			x	x	x		x							x	36%
Service				x	x			x				x	x		36%
Manufacturing Capability		x	x		x			x					x		36%
Technological Capability		x	x	x								x	x		36%
Relationship			x							x		x		x	29%
Management Capability	x	x			x										21%
Flexibility			x	x				x					x		29%
Supply Facility and Infrastructure				x									x		14%
Risk Factors				x					x				x		21%
Environmental Awareness						x			x		x	x		x	36%

3.2. Analytic Hierarchy Process (AHP)

Human beings are not able to handle all the factors and their effects simultaneously in their judgment when dealing with complex decisions (Saaty, 1988). Furthermore, they usually follow an unstructured path in their decision-making process which is not very ideal for complicated situations. The solution should be organized in order to deal with complex problems. AHP is a structured technique for organizing and analyzing complex decisions, which was developed by Saaty in the 1970s . Its hierarchical basis helps form this structured path for the solution of the decision making problem (Saaty, 1988).

One of the many advantages of AHP is that it enables identifying the interrelationships that exist between the decision factors (Saaty, 1988). AHP is beneficial when subjective, abstract or qualitative criteria are involved in the decision making because it enables decision makers to assign numerical values to vague concepts and draw a conclusion from these values (Saaty, 1988). AHP differs from conventional ways of decision-making methods thanks to its numerical approach to priorities. In AHP, priorities are derived for criteria, sub-attributes and for the performance of the alternatives on each sub-attribute using pairwise comparison judgements. The individual and overall weights calculated show how much they contribute to the goal (Saaty, 2001).

AHP is a method that enables decision making under multi-criteria. The application of AHP to a decision problem involves four main steps (Zahedi, 1986). First step is to create a hierarchical model. In order to do that, the problem or the goal of the study should be identified, and the decision variables known as the criteria and sub-criteria should be determined. A hierarchical model goes from general criteria down to more specific sub-criteria. General criteria is usually considered uncertain or hard to evaluate since it refers to a broader concept; whereas, sub-criteria is considered certain and much easier to evaluate as it refers to more specific concepts (Chan *et al.*, 2008)

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Saaty (1977) defines decomposing a hierarchy into clusters as such:

(i) Decide on the elements that serve for a similar function or have properties in common to group together in each cluster.
(ii) Perform comparisons on the clusters and the sub-clusters.
(iii) Recompose the clusters to get the overall priorities.
(iv) Results should be the same as if there were no decomposition.

Through a detailed literature review of 14 selected studies in the respective field as shown in Table 3.2, all probable selection criteria are listed first. The initial hierarchy table constructed had 28 attributes under 6 major selection criteria. The selection criteria which have similar meanings or attributes which are recurrent under different criteria are merged to prepare the final simplified form of the hierarchy table as suggested in Saaty (1977). While eliminating the irrelevant and recurrent selection criteria, the opinions of the respondents of the survey who are experienced professionals in a company in the respective industry and the opinion of the thesis advisor are taken into consideration along with the guidance of the literature review. The formation of the clusters is also done the same way, considering the insights of an academician, the

experienced professionals and the relevant studies in the past. In the former version of the hierarchy table shown in Table 3.1, in addition to the attributes "conformance to specifications/design" and "product reliability/durability" under quality criteria, there was "quality control mechanisms" attribute as well. It was later decided that the quality control mechanisms did not need to be a separate attribute under the quality criteria because if a product is found to be in line with the specifications as well as durable, the quality control mechanisms of the respective supplier are assumed to be in place. Having such an extra attribute with a similar meaning is likely to create confusion for the respondents and thus cause conflict in their responses. Therefore, it is removed from the attribute list with respect to the expert opinions.

Table 3.3. Former Version of the Hierarchy Table.

A. Goal		Global and Domestic Supplier Evaluation/Selection
B. Criteria		**C. Sub-criteria**
1	Cost	Unit price
		Transportation cost - plant location
		Logistics cost
		Insurance cost
		Tariff and taxes
2	Quality	Conformance to specifications/design
		Quality control mechanisms
		Product reliability/durability
3	Capacity	Production facility & infrastructure
		Technological capability
		Demand fulfillment/Monthly production capacity
4	Service	Product range
		Communication/negotiability
		Lead time
		On time delivery
		Delivers the right order amount
		Flexibility and responsiveness
		Consumer Safety Compatibility
		Client references
		Export experience
		Contract alignment
5	Financials	Payment term
		Financial risk report (reliability/credibility)
		Payment type
6	Risk Factors	Political stability
		Exchange rates
		Economic conditions
		Cultural differences

In the former hierarchy table, there was also a main criterion named “capacity”. The attributes under this criterion were either merged with other attributes under different criteria or transferred to another criteria with respect to expert opinions. This is how the 6 main criteria came down to 5 in the first place. For instance, the attribute “production facility & infrastructure” was removed from the list thinking that it was covered under “demand fulfillment/monthly production capacity” attribute. It was assumed that if a company fulfills the demand and has a sufficient monthly production capacity, it should have a decent production facility and infrastructure, too. The attribute “technological capability” was removed from the attribute list for the same reason. Moreover, it was assumed that it was covered in the attributes “communication/negotiability” and “flexibility and responsiveness”, too. Lastly, the attribute “demand fulfillment/monthly production capacity” was moved under service criteria and the capacity criteria was discarded from the list of main criteria.

Under service criteria, the attribute “product range” which represented the variety of products that can be produced per supplier was removed after it was found irrelevant. With respect to the experts’ opinion, it was decided that product range was not taken into consideration at all while evaluating the suppliers. The attribute “lead time” was also removed thinking that it was covered under “on time delivery” attribute. Theoretically, companies start to work with suppliers knowing their lead time in advance and schedule the shipment and order placement dates accordingly. Then, if a supplier delivers on time, lead time should not have any effect on the supplier’s evaluation and therefore, it was removed from the attributes list upon consensus of the experts.

Under service criteria, “delivering the right amount” was another attribute that was removed from the hierarchy table thinking that if a supplier fulfills the demand and has a sufficient monthly production capacity, it should deliver the right order amount. Another attribute under service criteria which was “consumer safety compatibility” was later found irrelevant because companies directly rule a supplier out at the beginning if they are not able to produce products that are compatible with consumer safety standards that the companies are looking for.

In addition to consumer safety compatibility, “contract alignment” attribute was found to be irrelevant. Therefore, it was removed from the list of attributes. When a contract is signed between a customer and a supplier, both parties should meet the requirements expected on their end. Since divergence from a contract may result in a court case, it is assumed that all parties will have an alignment on the contract and likewise none of the parties will be willing to sign anything that is against their own benefit in the first place.

Under the “financials & economics” criteria, the attribute payment type is removed because it was found irrelevant. Regardless of the payment method, whether it is done by cheque or wire transfer, the attribute that matters is decided to be the payment term. Payment term is a critical factor that will be effective on the cash flow of the company. For example, the global suppliers ask for higher downpayments in order to guarantee themselves and they would like to receive the rest of the payment at delivery of the goods which is the delivery to the port in imports case. This situation might change after building trust with the global suppliers. However, at the beginning, the domestic suppliers are more advantageous with the long payment terms they provide. The main reason for that is being in the same country and competing with the other domestic suppliers that have strong financials.

The last main criteria in the former hierarchy table was “risk factors”. Consulting the experts, i.e. the respondents of the survey, political stability was found to have a very little effect and was decided to be neglected. Furthermore, “cultural differences” is removed from the attributes list thinking that it was already considered under “communication/negotiability” attribute under service criteria. According to the experts, it would be confusing for the respondents because they would be rating it both in the “communication/negotiability” attribute and the “cultural differences” under risk factors. This might lead to error in the results. So, removing the “political stability” and “cultural differences” attributes from under risk factors and moving the “exchange rates” and “economic conditions” under financials criteria, the name of the main criteria is changed into financials & economics. As a result, a total of 17 attributes under 4 major selection criteria are obtained as shown in the Figure 3.1 below. Figure 3.1 is

the hierarchical structure of the problem where goal is at the first level, criteria is at the second level, attributes are at the third level, and decision alternatives are at the fourth level.

To sum up, after identifying the main criteria, sub-attributes and alternatives, the hierarchy of the supplier selection problem is structured. The Figure 3.2 shows the structuring of the supplier selection problem hierarchy with four levels. The top level of the hierarchy represents the ultimate goal of the problem which is selection of the best global or domestic supplier firm. The second level of the hierarchy is grouped under four categories, which are cost, quality, service and financials & economics. At the third level, these main attributes are decomposed into various sub-attributes that either serve for a similar function or have properties in common. Finally, the bottom level of the hierarchy presents the alternative suppliers among which satisfies the main goal the most will be selected.

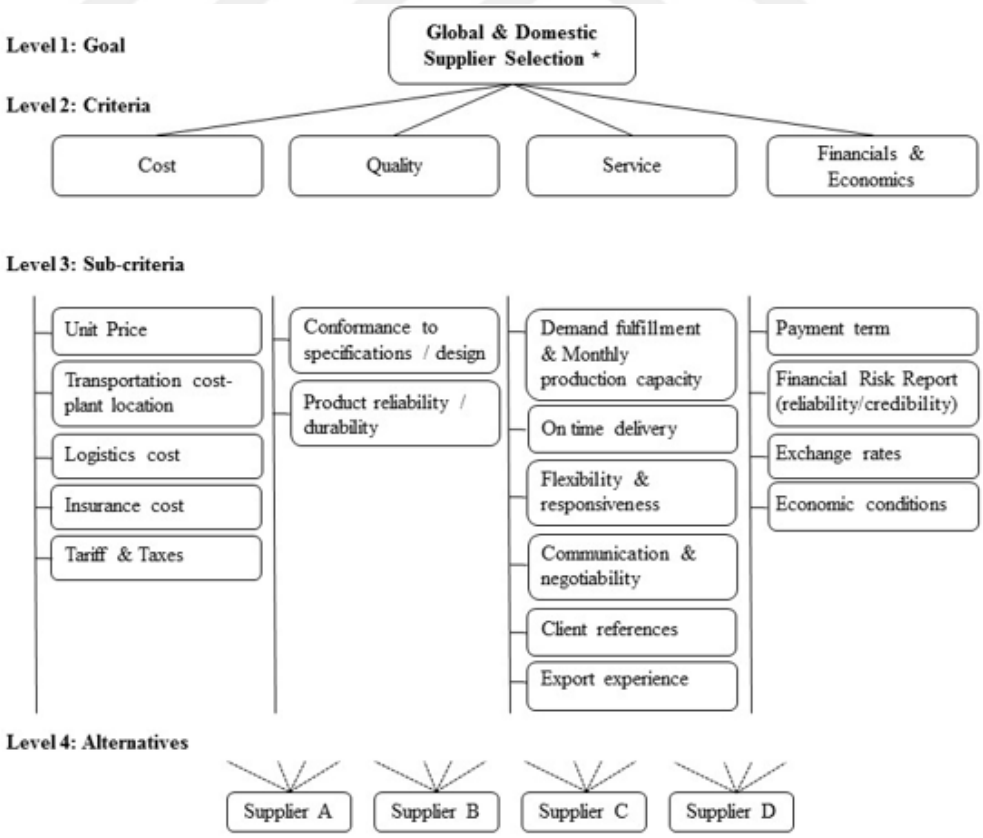

Figure 3.2. Hierarchy Table.

After creating a hierarchy table, a pairwise comparison analysis is performed separately among the criteria and among the sub-attributes of the respective criteria. The judgment matrices in the pairwise comparison are usually formed using a nine-point scale in the traditional AHP but in this study a five-point scale is utilized as shown in Table 3.4. The numbers actually indicate the strength of preference for one over the other. From 1 to 5, these exact numbers signify equal importance/preference, weak importance / preference, strong importance/preference, very strong importance / preference, or extremely strong importance/preference over one another.

Table 3.4. The Scale and Its Description.

Code	**Linguistic Variables**
1	Equal importance/preference
2	Weak importance/preference
3	Strong importance/preference
4	Very strong importance/preference
5	Extremely strong importance/preference

After filling out the judgment matrices, first the consistency ratios are computed in order to justify that the comparisons made subjectively by each expert are legitimate within themselves. In case the ratio is greater than 0.1, human judgments are not considered in the acceptable inconsistency limit and the analysis should be performed until the consistency is obtained. Therefore, the weights of the sub-criteria can be calculated from the judgment matrices if the consistency ratios are less than 0.1.

Consistency is essential in human thinking because it enables to order the world according to dominance (Saaty, 2006). However, it is stated in Saaty (1977) that improving consistency does not mean that the answer gets closer to reality. It only shows that the ratios in the matrix make sense and the data is not chosen randomly. It is mentioned in the study that it is an essential characteristic but not enough to determine how good the data set is. In other words, even if the consistency is within the defined limit, the judgements might be poor in being close to reality (Saaty, 1977).

The consistency ratio calculated for each pairwise comparison is expected to be maximum 10%. If it were greater than that, then it would disrupt the rationality of the measurement (Saaty, 2006).

After the consistency is maintained, local weights are computed for each criterion and sub-attribute. As the last step, local weights are aggregated to obtain final weights of alternatives. The final weights represent the rating of the alternatives and the solution of the multi-criterion decision making problem.

Even though it is a simple and systematic approach, it cannot reflect the uncertainty of human preference using discrete numbers and represent its impact precisely in the results. In other words, this method has inability to represent human judgement adequately due to the uncertainties and imprecisions involved in the making. Theoretically, the AHP is a very useful approach to determine the importance of decision variables with respect to each other which are subjective and qualitative in nature as mentioned in Saaty (1988). However, in reality, the vagueness involved in the human preference causes decision-makers to straddle in assigning exact numbers between the two ends of the comparison judgments. Fuzzy set theory has the capability to fill this gap by representing uncertainty mathematically which will be further discussed in the next section.

3.3. Fuzzy Set Theory

Fuzzy set theory has the capability to resemble human judgment. It was designed to mathematically represent vague situations and provide a systematic tool for dealing with the multi-criterion decision problems (Chan *et al.*, 2008). The fuzzy sets, introduced by Zadeh (1965), enable to generate decisions within all the vagueness, uncertainty and imprecision in the human decision making process. The most common method in the Fuzzy AHP applications is the extent analysis method proposed by Chang in 1992 (Kilincci and Onal, 2011).

A fuzzy set is defined by a membership function, which assigns to each attribute a continuum grade of membership ranging between 0 and 1 (Zadeh, 1965). A triangular fuzzy number (TFN) is denoted by (l, m, u) and illustrated in Figure 3.2. The letters symbolize the smallest possible value, the most promising value and the largest possible value in a fuzzy event, respectively (Kahraman *et al.*, 2004). A tilde "∼" over the letter is used to specify a fuzzy set.

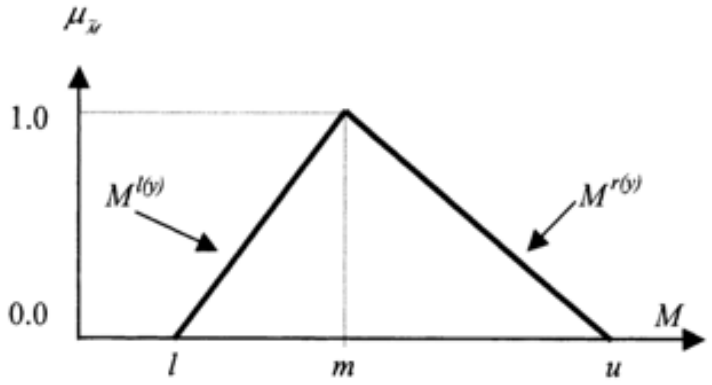

Figure 3.3. A Triangular Fuzzy Number (Kahraman *et al.*, 2004).

A membership function of a fuzzy set is defined by the below equation (Kahraman *et al.*, 2004).

$$\mu_{\tilde{M}} = \left\{ \begin{array}{c} 0, x < l, \\ (x-l) \setminus / \setminus \setminus (m-l), l \leq x \leq m, \\ (u-x) \setminus / \setminus \setminus (u-m), m \leq x \leq u, \\ 0, x > u. \end{array} \right\} \tag{3.1}$$

A fuzzy number can always be given by its corresponding left and right representation of each degree of membership (Kahraman *et al.*, 2004):

$\tilde{M} = (M^{l(y)}, M^{r(y)} = (l + (m-l)\, y, u + (m-u)\, y), y \in [0,1]$, where $l(y)$ denotes the left side representation and r(y) denotes the right side representation of a fuzzy

number.

According to the extent analysis method proposed by Chang in 1992, each object is taken and extent analysis for each goal, g_i, is performed respectively. Therefore, m extent analysis values for each object can be obtained with the following signs:

$M_{g_i}^1, M_{g_i}^2, \ldots, M_{g_i}^m i = 1, 2, ..., n$ where all the $M_{g_i}^j, j = 1, 2, ..., m$ triangular fuzzy numbers.

The steps of Chang's extent analysis can be found below (Kahraman *et al.*, 2004).

Step 1: The value of fuzzy synthetic extent with respect to ith object is defined as

$$S_i = \sum_{j=1}^{m} M_{g_i}^j \otimes \left[\sum_{i=1}^{n} \sum_{j=1}^{m} M_{g_i}^j \right]^{-1} \tag{3.2}$$

$\sum_{j=1}^{m} M_{g_i}^j$ is obtained by performing the fuzzy addition operation of m extent analysis values for a particular matrix such that

$$\sum_{j=1}^{m} M_{g_i}^j = \left(\sum_{j=1}^{m} l_j, \sum_{j=1}^{m} m_j, \sum_{j=1}^{m} u_j \right) \tag{3.3}$$

To obtain $[\sum_{(i=1)}^{n} \sum_{(j=1)}^{m} M_{(g_i)}^j \Sigma]^{(-1)}$, the fuzzy addition operation of $M_{g_i}^j j = 1, 2, \ldots, m$ values is performed such that

$$\sum_{i=1}^{n} \sum_{j=1}^{m} M_{g_i}^j = \left(\sum_{i=1}^{n} l_i, \sum_{i=1}^{n} m_i, \sum_{i=1}^{n} u_i \right) \tag{3.4}$$

and then the inverse of the vector in above equation is computed such that

$$\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{g_i}^{j}\right]^{-1} = \left(\frac{1}{\sum_{i=1}^{n} u_i}, \frac{1}{\sum_{i=1}^{n} m_i}, \frac{1}{\sum_{i=1}^{n} l_i}\right) \tag{3.5}$$

Step 2: The degree of possibility of $M_2 = (l_2, m_2, u_2) \geq M_1 = (l_1, m_1, u_1)$ is defined as:

$$V\left(M_2 \geq M_1\right) = \frac{sup}{y \geq x} \left\lfloor min(\mu_{M_1}\left(x\right), \mu_{M_2}\left(y\right)) \right\rfloor \tag{3.6}$$

The above equation can also be expressed as:

$$V\left(M_2 \geq M_1\right) = hgt\left(M_1 \cap^{M_2}\right) = \mu_{M_2}\left(d\right) \tag{3.7}$$

$$= \left\{ \begin{array}{l} 1, if m_2 \geq m_1, \\ 0, if l_1 \geq u_2, \\ \frac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)}, otherwise, \end{array} \right\} \tag{3.8}$$

where d is the ordinate of the highest intersection point D between

μ_{M_1} and μ_{M_2} we need both the values of $V\left(M_1 \geq M_2\right)$ and $V\left(M_2 \geq M_1\right)$

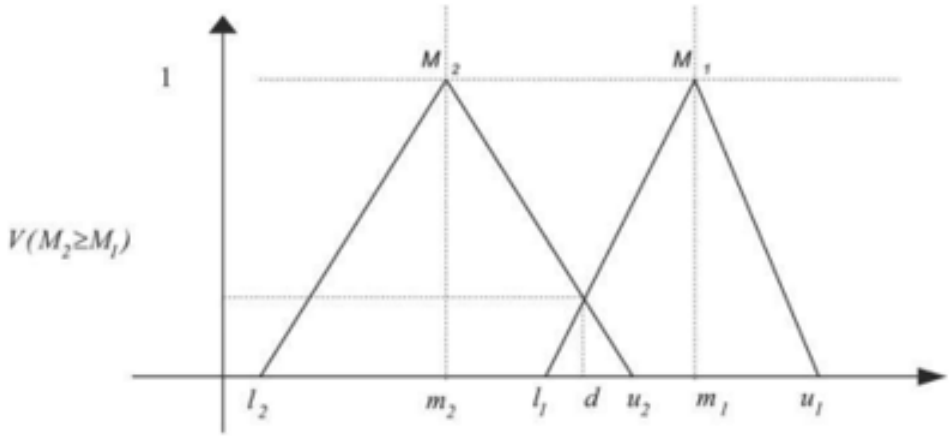

Figure 3.4. The Intersection Between M_1 and M_2 (Kahraman *et al.*, 2003).

Step 3: The degree of possibility for a convex fuzzy number to be greater than k convex fuzzy numbers $M_i\,(i = 1, 2, \ldots, k)$ can be defined by

$$\begin{aligned} & V\left(M \geq M_1, M_2, \ldots, M_k\right) \\ & = V\left[\left(M \geq M_1\right) and \left(M \geq M_2\right) and \ldots and \left(M \geq M_k\right)\right. \\ & = \min V\left(M \geq M_i\right), i = 1, 2, 3, \ldots, k. \end{aligned} \tag{3.9}$$

Assume that

$$\begin{aligned} & d'\left(A_i\right) = minV\left(S_i \geq S_k\right) \\ & For k = 1, 2, \ldots, n; k \neq i \; Then \; the \; weight \; vector \; is \; given \; by \\ & W' = \left(d'\left(A_1\right), d'\left(A_2\right), \ldots, d'\left(A_n\right)\right)^T where A_i (i = 1, 2, \ldots, n) \end{aligned} \tag{3.10}$$

Step 4: The weight vectors are normalized and represented as:

$W = \left(d\left(A_1\right), d\left(A_2\right), \ldots, d\left(A_n\right)\right)^T$ where W is a non-fuzzy number. This gives the priority weights of one alternative over another.

3.4. Combining Fuzzy Set Theory and AHP For Supplier Selection Analysis

AHP is a widely used method to solve multi-criterion decision making problems. However, its use of a scale composed of discrete numbers usually from 1 to 9 prevents comparison of attributes subject to uncertainty. In supplier selection analyses, a decision maker needs more than a discrete nine-point scale can achieve to address uncertain conditions. Therefore, fuzzy logic is incorporated in the decision-making processes where qualitative and quantitative attributes exist together.

This limitation of AHP is eliminated by the use of linguistic variables and triangular fuzzy numbers (TFN). These two concepts help convert an exact number into a range where one point in the scale is represented with three different values called triangular fuzzy numbers. These numbers help determine the priorities of one decision variable over another more realistically, giving an interval rather than an exact number.

This process is known as the extent analysis method where extent refers to the interval of an attribute to be satisfied for the goal (Kilincci and Onal, 2011). The method proposed by Chang in 1992 is used for the solution of Fuzzy AHP. So, the difference between the Fuzzy AHP and the traditional AHP is the use of fuzzy numbers in the solution.

Fuzzy Analytic Hierarchy Process (FAHP) is utilized to guide the decision makers in their preferences of one criteria, attribute or supplier over another. Supplier selection process plays a crucial role in the success of an organization within today's fast changing and competitive business world. Therefore, it should be held strategically. In selecting the criteria and the attributes, their strategic importance to this specific industry is considered.

Earliest work in Fuzzy AHP approach appeared in van Laarhoven and Pedrycz (1983). Many other research projectses have also used Fuzzy AHP for various type of problems. For example, Fuzzy AHP is used for selecting the best domestic supplier with three main criteria and eleven sub-attributes in Kahraman *et al.* (2003).

The steps for computing the priority or importance weights of different decision variables at each level of the hierarchy table and deciding the best supplier using the Fuzzy AHP method is summarized as follows in Chan *et al.* (2008):

(i) Comparison matrix of the main criteria with respect to the goal is constructed with the help of the data from the questionnaire.
(ii) The fuzzy synthetic extent values are determined with respect to each criterion using the extent analysis method.
(iii) The degree of possibility of the superiority of each fuzzy synthetic extent value is determined with respect to each other.
(iv) The minimum degree of possibility of the superiority of each criterion over another is determined.
(v) The weight vectors of the criteria are computed according to the minimum degree of possibility of superiority of each criterion.

(vi) The weight vectors are normalized and the final weights of the decision criteria are determined with respect to the goal.

(vii) Comparison matrices of sub-attributes with respect to each criterion are constructed with the help of the data from the questionnaire.

(viii) Steps 2-6 are repeated and the final weights of all the sub-attributes are determined with respect to their specific criterion.

(ix) Comparison matrices of alternatives with respect to each sub-attribute are constructed with the help of the data from the questionnaire.

(x) Steps 2-6 are repeated and the priority weights of the alternatives are determined with respect to each sub-attribute.

(xi) Priority weights of alternatives are multiplied by the importance weights of sub-attributes and thus the priorities of the alternatives are determined with respect to criteria.

(xii) Priority weights of the alternatives are multiplied by the importance weights of the criteria and the final priorities of the alternatives are determined with respect to the goal.

(xiii) The supplier (alternative) with the greatest priority weight is selected.

4. RESULTS

Table 4.1 shows the final version of the hierarchy table after some of the criteria and sub-attributes are merged and removed. The final version of hierarchy table is left with 4 main selection criteria and a total of 17 sub-attributes as shown below.

Table 4.1. Final Version of the Hierarchy Table.

1. Goal		Global and Domestic Supplier Selection
2. Criteria		**3. Sub-criteria**
1	Cost	Unit price
		Transportation cost - plant location
		Logistics cost
		Insurance cost
		Tariff and taxes
2	Quality	Conformance to specifications/design
		Product reliability/durability
3	Service	Demand fulfillment/Monthly production capacity
		On time delivery
		Flexibility and responsiveness
		Communication/negotiability
		Client references
		Export experience
4	Financials & Economics	Payment term
		Financial risk report (reliability/credibility)
		Exchange rates
		Economic conditions

4.1. Priority Weights for the Criteria

Table 4.2. Priorities with respect to Global & Domestic Supplier Selection.

Rank	**Name**	**Weight**
1	Cost	0.267
2	Quality	0.256
3	Service	0.242
4	Financials & Economics	0.234

As shown in Table 4.2, according to the Global & Domestic Supplier Selection, cost is the first priority. Next priorities are assigned to quality, service and financials & economics according to the obtained weights.

4.2. Priority Weights for the Sub-Attributes

Table 4.3. Priorities with respect to Cost.

Rank	**Name**	**Weight**
1	Unit Price	0.264
3	Transportation cost	0.208
2	Logistics cost	0.209
5	Insurance cost	0.112
4	Tariff and Taxes	0.207

As shown in Table 4.3, according to the cost, unit price is the first priority. Next priorities are assigned to logistics cost, transportation cost - plant location, tariff and taxes and insurance cost, respectively.

Table 4.4. Priorities with respect to Quality.

Rank	**Name**	**Weight**
2	Conformance to specifications/design	0.485
1	Product reliability/durability	0.515

As shown in Table 4.4, according to the quality, product reliability/durability is the first priority. Next priority is assigned to conformance to specifications/design according to the obtained weights.

Table 4.5. Priorities with respect to Service.

Rank	**Name**	**Weight**
1	Demand fulfillment/Monthly production capacity	0.237
2	On time delivery	0.213
6	Flexibility & responsiveness	0.102
5	Communication & negotiability	0.121
4	Client references	0.137
3	Export experience	0.191

As shown in Table 4.5, according to the service, demand fulfillment/monthly production capacity is the first priority. Next priorities are assigned to on time delivery, export experience, client references, communication & negotiability and flexibility & responsiveness according to the obtained weights.

Table 4.6. Priorities with respect to Financials & Economics.

Rank	**Name**	**Weight**
1	Payment term	0.328
2	Financial risk report (reliability/credibility)	0.257
3	Exchange rates	0.226
4	Economic conditions	0.189

As shown in Table 4.6, according to the financials & economics, payment term is the first priority. Next priorities are assigned to Financial risk report (reliability/credibility), exchange rates and economic conditions according to the obtained weights.

4.3. Summary of the Priority Weights for the Alternatives and Ranking of the Suppliers

Table 4.7 presents the importance weights of sub-attributes which are derived by multiplying the importance weights of each criterion by the importance weights of the corresponding sub-criteria. As shown in the last row of the table, the weights add up to 1.

Table 4.7. Overall Importance Weights of Sub-attributes.

Sub-attributes	**Overall Weights**
Unit price	0.071
Transportation cost	0.056
Logistics cost	0.056
Insurance cost	0.03
Tariffs & Taxes	0.055
Conformance to specifications/design	0.124
Product reliability/durability	0.132
Demand fulfillment/Monthly production capacity	0.057
On time delivery	0.052
Flexibility and responsiveness	0.025
Communication/negotiability	0.029
Client references	0.033
Export experience	0.046
Payment term	0.077
Financial Risk Report (reliability/credibility)	0.06
Exchange rates	0.053
Economic conditions	0.044
Total	**1.000**

5. IMPLEMENTATION OF THE PROPOSED MODEL TO A TECH-ENABLED PROPERTY MANAGEMENT AND HOSPITALITY COMPANY

5.1. Introduction

This study investigates a tech-enabled property management startup operating in the hospitality and real estate industry, providing premium fully-furnished serviced apartments to business travelers and expats with mid to long-term duration of stays, i.e. over 1 month.

Founded in Europe in 2013, the idea originated when the founder and CEO of the company who worked abroad as an expat had many experiences staying in hotels or at poor quality furnished properties longer than a desired time period. In other words, while a decent hotel was great for couple of days or an average furnished apartment is fine for a few months, they were not enough to ensure the life standard and comfort an expat is seeking during a longer accommodation. Thus, it became obvious to the founder over time that there was a huge need in the market for serving such purpose. So, this necessity stimulated to establish the business venture abovementioned.

Furthermore, a market research was conducted to justify this point of view. In the market research, it was found out that the size of the corporate housing market was about US$ 12 billion and not many competitors existed in the exact same field. Although there were more than one million serviced apartments operated by well-known hotel companies (Apartment Service report 2018-2019), the business is unique and differentiates from the hotels in many ways.

The company basically rents high quality properties in prime locations either from landlords or building managements, furnishes them from couch to bed, home textile to kitchenware, and sublease them to mainly business travelers and expats with

a certain markup. The company manages to keep the prices at such a level that they always come out cheaper than a month-long hotel stay. It also supports its clients in issues of maintenance regarding the property using technology which is included in the rental price. Currently, the company operates in 9 different markets which are New York City, San Francisco, Los Angeles, Chicago, Boston, Washington D.C., Dubai, Athens and Istanbul with more than 2000 apartments available globally and planning expansions to different cities around the world.

The business model possesses a great growth potential with three major aspects. First of all, it differentiates from the conventional hotel business while making use of the existing supply of properties in the residential market. This situation provides a financial advantage over the hotel business because it skips the long and capital-intensive construction processes. In addition to that, it does not bind itself to a single building but spreads over the entire city and provides a wide range of options to clients in terms of apartment size and location. Thus, it helps the company make its expansion smooth, steady and fast.

Secondly, the company utilizes the technology as it enables online booking through its website. Also, through the app, the clients can arrange cleanings and maintenance as well as submit property-related requests, pay rents, reach the contractual terms and their lease status online, view apartments, check availabilities, extend their stays, sign a new lease, etc. The technology used by the company also helps employees coordinate effectively internally or with third parties integrated to its system and store a huge real estate and company data. The most important of all, the company provides smart home features such as smart bulbs, smart locks and other systems integrated with Google Home. Thus, the use of technology creates operational efficiency, enhances customer satisfaction and helps build a steady and fast growth, too.

Lastly, in spite of being located in the best buildings of the most convenient neighborhoods, the company has 25-30% price advantage over the hotels and other long-term accommodation options available in the market such as serviced apartments. It also competes with other stand-alone furnished properties with its high quality and

stylish furniture and gets ahead with the after sales services it provides. Therefore, the price advantage is expected to affect the company's rapid expansion as well.

Within the company's capital and operating expenditures, the rent payments and the furniture procurement constitute the greatest portion. Up until now, all the furniture and equipment placed in the properties have been supplied from Turkey. The aim was to achieve a significant cost advantage in order to compete with the daily rates of hotels. However, after a while, the sources have started to become short in terms of product range and supplier diversity within Turkey. In addition to that, the urge for cutting down the costs has started to count more from the growth perspective. Therefore, the company decided not to restrict its procurement to Turkey but rather expand its sourcing points to several destinations around the world.

In this regard, the supply chain function has found it vital to add a supplier evaluation and selection process to their scope in order to make fair comparisons among the alternatives. Also, a startup should always be very careful spending the cash flowing in from the investors. With this in mind, supplier selection is very important in terms of allocating the limited financial resources of the company in a very effective and efficient way.

Being a startup, the company receives financing from many different channels such as venture capitals, private equities and angel investors. After completing four rounds of investment, the total funding raised by the company have reached to $28M. While seeking further investment, the company targets to surpass 7,500 apartments and $1bn in valuation by the end of 2021. Furthermore, by 2023, it plans to be present in more than 50 cities around the world with a portfolio over 50,000 properties. So, considering its targets, the company will almost double the inventory of corporate housing in 4 years with an addition of approximately 50,000 units. The company has over 2,000 properties available in nine cities across the world. In order to achieve these aggressive targets in such a short period of time, supplier selection is a very important element of the process as the huge part of the investment is allocated to the supply chain functions.

The company manages its supply chain processes from Turkey locating Istanbul as its supply chain hub while importing from China, India and Vietnam, and exporting to the United States, Greece, and United Arab Emirates. Until quite recently, the company was supplying all the furniture and equipment from Turkey and shipping them to the markets it exists. Due to the company's rapid growth rate and the rising competition in the industry, the company had started looking into different countries to supply its needs. As the competition has increased within the industry, especially the quality and design have started to gain importance. Before, the company's only priority was decreasing the costs in supplying all the furniture from Turkey to compete with the other fast-growing rivals. However, the furniture has started to fall apart after some period of time upon usage and become more costly for the company as it required revamp. Therefore, the durability, i.e., quality has gained importance. The design also gained importance as the company positioned itself to provide a high-end product and aimed to attract more customers. Therefore, the objective shifted towards other aspects of the furniture such as quality, durability, design, capacity, etc.

Even though the company contributes to Turkey's furniture export volume (e.g. TL 4m in 2017), the company has become aware of the fact that furniture industry in Turkey was limited in terms of high-end furniture manufacturers and production capacities. The company was sourcing almost all of its wooden furniture from Bursa-Inegol and Denizli; whereas, its upholstered furniture group mainly from Istanbul and Ankara, which are known with their leading furniture suppliers in Turkey according to the furniture sector report issued in 2018 by Turkish Ministry of Trade mentioned in the background of the literature review section. Finding the resources insufficient considering its growth and expansion plans in Europe, Asia and North America, the company has decided to add more suppliers to its supply chain in Asia. The product categories the company is looking for are wooden furniture like dining tables, coffee tables, tv stands, bed frames, dressers, wardrobes, upholstered furniture like sofas, armchairs, dining chairs, home textile like bed sheets, comforters, rugs, kitchenware, lighting, etc.

As a result, the company has started considering Asia to widen its supplier range as suppliers in Turkey especially in the furniture sector remained short in addressing the evolving requests of the company both in terms of quantity and production capacity. Performing imports and exports, company's decision-making processes are affected by a wide range of factors which are discussed further in the discussion section.

5.2. Data Collection

In order to collect the data, a questionnaire survey is conducted on 8 employees of the company investigated under this research. These experienced professionals are asked about their preferences on the selection criteria and the alternatives through pairwise comparison technique and the comparison matrices are filled with codes corresponding to linguistic variables which are represented by triangular fuzzy numbers. The company had 350 employees among which the product & supply chain team consists of 8.

One supply chain manager, who has an experience of 9 years in the supply chain sector and worked for a world famous FMCG company before, performs demand planning, order allocation, warehouse management and shipment scheduling along with one supply chain analyst who has been in the sector for more than a year. One foreign trade manager, who has an experience of 11 years in the foreign trade and global sourcing sector and worked for several well-known furniture and clothing retailers in Turkey is in charge of import & export operations, strategic sourcing and locating global suppliers. Two procurement managers, who have an experience of 7 and 9 years in the sector and worked at several well-known furniture retailers in Turkey supplying furniture from manufacturers both in Turkey and abroad, find both domestic and global suppliers, negotiate payment terms and unit price, and place orders. Lastly, three design managers, who has an average of 5 years of experience in the sector and had worked for the company's supply chain function before as the company being a startup, now design and develop furniture for the company only.

The questionnaire is designed in the form of pairwise comparisons as the Fuzzy AHP methodology requires in its application. The question asked for the judgment matrix below is in the form of "How important is cost when it is compared to quality?" The rest of the questions that are asked for filling in each pairwise comparison table are found in Appendix A. First of all, pairwise comparison matrix of criteria with respect to goal is constructed as in Table 5.1. In Table 5.2, Table 5.3, Table 5.4 and Table 5.5, the pairwise comparison matrices of sub-attributes with respect to criteria are shown.

Table 5.1. Pairwise Comparison Matrix with respect to Global & Domestic Supplier Selection.

	Cost	Quality	Service	Financials & Economics
Cost				
Quality				
Service				
Financials & Economics				

Table 5.2. Pairwise Comparison with respect to Cost

	Unit price	Transportation cost	Logistics cost	Insurance cost	Tariff & Taxes
Unit price					
Transportation cost					
Logistics cost					
Insurance cost					
Tariff & Taxes					

Table 5.3. Pairwise Comparison with respect to Quality.

	Conformance to specifications/design	Product reliability/durability
Conformance to specifications/design		
Product reliability/durability		

Table 5.4. Pairwise Comparison with respect to Service.

	Demand fulfillment/ Monthly production capacity	On time delivery	Flexibility and responsiveness	Communication / negotiability	Client references	Export experience
Demand fulfillment/ Monthly production capacity						
On time delivery						
Flexibility and responsiveness						
Communication/ negotiability Client references Export experience						

Table 5.5. Pairwise Comparison with respect to Financials & Economics.

	Payment term Payment term	Financial Risk Report (Reliability/Credibility)	Exchange rates Exchange rates	Economic conditions Economic conditions
Payment term				
Financial Risk Report (Reliability/Credibility)				
Exchange rates				
Economic conditions				

Table 5.6 shows pairwise comparison matrix for comparing decision alternatives with respect to sub-attributes. Normally, there are 17 of these judgment matrices in the appendix since there are 17 sub-attributes. Since the matrix is the same for all the other pairwise comparisons for alternatives, only one is included for illustrative purposes. The question asked for this particular type of judgment matrix is such "How important/preferable is supplier A compared to B in terms of unit price?"

Table 5.6. Alternative Pairwise Comparisons with respect to Sub-Attributes.

	Supplier A	Supplier B	Supplier C	Supplier D
Supplier A				
Supplier B				
Supplier C				
Supplier D				

All the questions above are repeated for the suppliers such that supplier A is compared to suppliers B, C and D, supplier B is compared to suppliers C and D, and

supplier C is compared to supplier D. Even with four suppliers and seventeen sub-attributes, the survey was considered to be a long one by the respondents. This was the only feedback received from the respondents regarding the questionnaire. Only the white cells in the pairwise comparison matrices provided in Table 5.1 through Table 5.6 are filled out using a five-point numerical scale given in the Table 5.7 below.

If X and Y are the elements to compare, either an attribute or an alternative, the code "1" defines that X and Y are equal importance or preference; whereas, the code "5" defines that X is extremely strong importance or preference than Y. When filling out the matrices, the respondents can use both negative and positive numbers. If the code assigned is positive, it means that the criterion, attribute or alternative on the left column is more important/preferable than the criterion, attribute or alternative in the top row. If the code assigned is negative, then the top row is more important/preferable than the left column. The below table shows the fuzzy numbers corresponding to each code or linguistic variable. Filling out the pairwise comparison matrices, respondents are provided with the below scale including only the codes and the linguistic variables.

Table 5.7. The Linguistic Variables and Their Corresponding Fuzzy Numbers.

Code	**Linguistic Variables**	**L**	**M**	**U**
1	Equal importance/preference	1	1	1
2	Weak importance/preference	1	1.5	2
3	Strong importance/preference	1.5	2	2.5
4	Very strong importance/preference	2	2.5	3
5	Extremely strong importance/preference	2.5	3	3.5

5.3. Results

Table 5.8 shows the priority weights of the suppliers with respect to each sub-attribute as described in Step 9 in research methodology section. Table 5.9 shows the priority weights of the suppliers with respect to the main criteria as explained in Step 11 under research methodology section. Lastly, overall priorities of the suppliers with respect to the goal of the research are given in Table 5.10 as detailed in Step 12 in the

research methodology section.

Table 5.8. Priority Weights of the Alternatives (Suppliers) with respect to Each Sub-Attribute.

	Priority Weights			
Sub-attributes	**Supplier A**	**Supplier B**	**Supplier C**	**Supplier D**
Unit price	0.316	0.348	0.164	0.171
Transportation cost	0.234	0.226	0.233	0.307
Logistics cost	0.238	0.219	0.235	0.308
Insurance cost	0.231	0.204	0.255	0.311
Tariff & Taxes	0.280	0.268	0.200	0.252
Conformance to specifications/design	0.303	0.287	0.216	0.194
Product reliability/durability	0.406	0.339	0.194	0.060
Demand fulfillment/Monthly production capacity	0.343	0.322	0.155	0.180
On time delivery	0.279	0.311	0.304	0.107
Flexibility and responsiveness	0.276	0.294	0.202	0.228
Communication/negotiability	0.252	0.266	0.253	0.229
Client references	0.345	0.312	0.229	0.114
Export experience	0.343	0.352	0.259	0.045
Payment term	0.255	0.249	0.260	0.236
Financial Risk Report (reliability/credibility)	0.363	0.353	0.242	0.042
Exchange rates	0.209	0.222	0.220	0.349
Economic conditions	0.270	0.270	0.213	0.248

Table 5.9. Priority Weights of the Alternatives (Suppliers) with respect to Each Criterion.

	Priority Weights			
Criteria	**Supplier A**	**Supplier B**	**Supplier C**	**Supplier D**
Cost	0.266	0.263	0.210	0.260
Quality	0.356	0.314	0.205	0.125
Service	0.311	0.314	0.234	0.142
Financials & Economics	0.275	0.274	0.237	0.214

Table 5.10. Priority Weights and Ranking of the Suppliers.

	Name	**Priority**
1	Supplier A	0.302
2	Supplier B	0.291
3	Supplier C	0.223
4	Supplier D	0.186

6. DISCUSSION

The tech-enabled property management and hospitality industry is very important for the real estate and the construction sector because it will increase the housing sales and speed up the depletion of the existing residential supply in the market. The new industry will help increase the demand in houses because the potential buyers will realize that they have a constant income if they lease their properties to these companies. Therefore, they will be encouraged to invest in houses since the constant rental income they receive will make them pay their debts and make profit from their investments in the long run. Furthermore, the tech-enabled property management and hospitality companies transform the space and provide an added-value to the real estate. Therefore, they are able to generate more rental income compared to an empty house without furniture and appliances. With the help of this added-value, the property is occupied right away with a higher rent, the company earns money, the landlord receives more rental income and the real estate developers and investors can sell more to the confident buyers and, as a result, construct more buildings. However, for this emerging industry to succeed, there are two crucialhuge cost items involved in their feasibility. First is the rental payments and second is the furniture and equipment expenditures. If these companies can improve their supply chain management, they will make more profit and grow. Therefore, the model proposed in this study for effective and efficient supplier selection is intended to realize the improvement in the supply chain of tech-enabled property management and hospitality companies.

The aim of this study is to provide appropriate selection criteria and propose an efficient technique in selecting the best global and domestic supplier for an emerging industry where tech-enabled property management and hospitality companies operate. In this regard, this study focuses on the identification of the selection criteria, determination of interrelationships between the criteria and its sub-attributes, calculation of priority weights to rank the suppliers and finally selecting the best supplier with the highest priority weight among the alternatives.

The criteria associated with the supplier selection for a tech-enabled property management and hospitality company are provided in this study. This study goes beyond the general categorization or clustering of the decision variables for supplier selection in the literature after merging some attributes and criteria with each other. Also, it involves criteria related to global sourcing together with the domestic sourcing. In addition to the traditional criteria such as unit price, quality and delivery, some other criteria required for global measurements such as economic conditions, exchange rates, export experience, logistics cost, insurance cost, payment term, tariff & taxes attributes are added to the evaluation process. The decomposition and the clustering of the decision variables different than the studies in the literature aims to provide guidelines for the decision makers in this specific industry to decide their suppliers, whether they are global or domestic, with greater efficiency and optimization.

Decision variables or so-called selection criteria differ according to the companies' needs, preferences, strategies and objectives. Decision variables are selected based on the knowledge of the group of experts and information obtained from the past research projectses. The aim of the whole process is to find the supplier with the highest possibility of meeting the requirements defined for an industry. The challenge exists in converting the predefined criteria expressed qualitatively into a data that can be assessed quantitatively. In order to address this conversion problem, Fuzzy Analytic Hierarchy Process is performed. Linguistic variables representing triangular fuzzy numbers are used in the pairwise comparisons and helped the preferences qualitative and subjective in nature turn into quantifiable objects.

Selection criteria should be analyzed in great depth and precision because even if a certain supplier offers a higher price compared to its alternatives, other aspects of the supplier such as good quality production and robust financial status can compensate for its costliness and make them get selected. Furthermore, the availability of a significant export experience might not be sufficient to overcome the high unit prices or excessive tariffs & taxes. These all depend on the companies' preferences. As mentioned before, because of the complex nature of the decision making when sourcing overseas, the companies need to make use of a proper technique for comparison. Effective supplier

selection can help achieve considerable efficiency in the entire supply chain process and can increase the profitability of the company.

First of all, this study contributes to the literature by presenting the probable selection criteria for a new industry in which tech-enabled property management and hospitality companies operate. This study also presents practical contributions to purchasing or supply chain managers in this specific industry in choosing the best supplier and sourcing strategically. Furthermore, it provides a balanced tradeoff between all the criteria central to the objective of the company instead of favoring one and neglecting the other completely.

In addition to presenting selection criteria for global and domestic supplier selection, the research aims to identify the relative importance of those criteria based on the preferences of the professionals through pairwise comparison technique and determine the ranking of the suppliers with respect to each other. The professionals mentioned in this study are actually the employees of a company in the respective industry who are working either in product or supply chain functions. Their roles are supply chain manager, supply chain analyst, purchasing manager, design manager and foreign trade manager. The questionnaire is completed through in person interviews with these experienced professionals. There were 8 professionals who were interviewed and all of them responded to all of the questions which means a response rate of 100%. The respondents evaluated the selection criteria and the suppliers with respect to the attributes under the selection criteria with a five-point scale provided in the research methodology section.

The results show that the most important selection criteria in this specific industry is the cost which is followed by quality, service, and financials & economics, respectively as shown in Figure 6.1. In 12 out of 14 studies investigated under this research, cost is taken into consideration as a criterion. Only Kahraman *et al.* (2003) and Hsu *et al.* (2014) did not focus on the cost. In Kilincci and Onal (2011), the cost criterion is covered in product price under product performance category and is found to be less important than the product quality attribute. In Chan (2003), cost

criterion, decomposed into product cost, total logistics management cost and tariff and taxes, has the highest importance weight among other criteria including quality, service, background and risk factors. In Kilic (2013), cost is found to be the most important criterion along with quality. In Guneri and Kuzu (2009), cost became the second after quality according to the decision-makers. In Zhang *et al.* (2015), cost is found to be the most important criterion among other criteria such as quality, service performance, supplier's profile and risk factor. In Lima Junior *et al.* (2014) , being slightly greater than quality, the cost has found to be criterion with the highest importance weight.

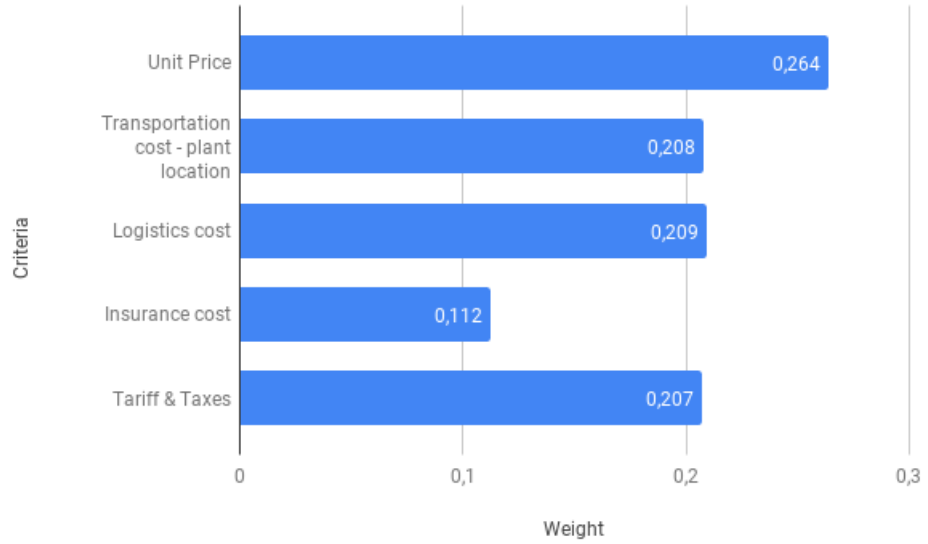

Figure 6.1. Priorities with respect to Global & Domestic Supplier Selection.

When the attributes are considered within each category, unit price is the most important attribute under cost criteria as shown in Figure 6.2 which is followed by logistics cost, transportation cost, tariff & taxes and insurance cost, respectively. Unit price attribute is come across as product price in Kilincci and Onal (2011) and as net price of the final product in Onder and Kabadayi (2015). In Kilincci and Onal (2011), product price is considered as a sub-attribute of product performance criteria. In Onder and Kabadayi (2015), cost is referred as price-cost criteria which includes ordering cost, transportation cost, maintenance and repair cost, and flexible payment terms in addition to net price of the final product. Likewise, in Guneri and Kuzu (2009), rather than including just a material cost, all the other costs such as transportation,

packaging, carrying inventory, and possibility of price reduction are considered under total cost.

Weights for logistics cost, transportation cost and tariff & taxes are found to be very close to each other. This shows how hard it is to differentiate in between the suppliers while making a decision. Without any proper tool or methodology, human judgment might be deceiving in terms of the selection of the best supplier due to its inability to handle complex situations simultaneously (Saaty, 1988). Logistics cost only refers to storage cost under this research as the transportation cost is treated separately. Usually past studies include the transportation cost within the logistics cost. Realizing their significant individual importance in this specific industry, they are considered separately in this study. For example, logistics cost discussed in Chan *et al.* (2008) includes transport expenses as well as inventory cost, handling and packaging cost, damages in the way and insurance cost. In Chan *et al.* (2008), the importance of tariff and taxes are mentioned such that countries may impose high tariff and taxes for some imported goods in order to protect the local manufacturers. The rates usually change from country to country and are applied on item or material basis. Therefore, these costs should be estimated very carefully before selecting the international suppliers as they can increase the cost of goods substantially. Zhang *et al.* (2015) also focuses on the global supplier selection and includes tariff and custom duties under cost criteria in addition to product price and freight cost. Insurance cost has the least importance among the other attributes under cost criteria. It is also treated as a separate attribute in this study but in literature it is considered within logistics cost as in Chan *et al.* (2008).

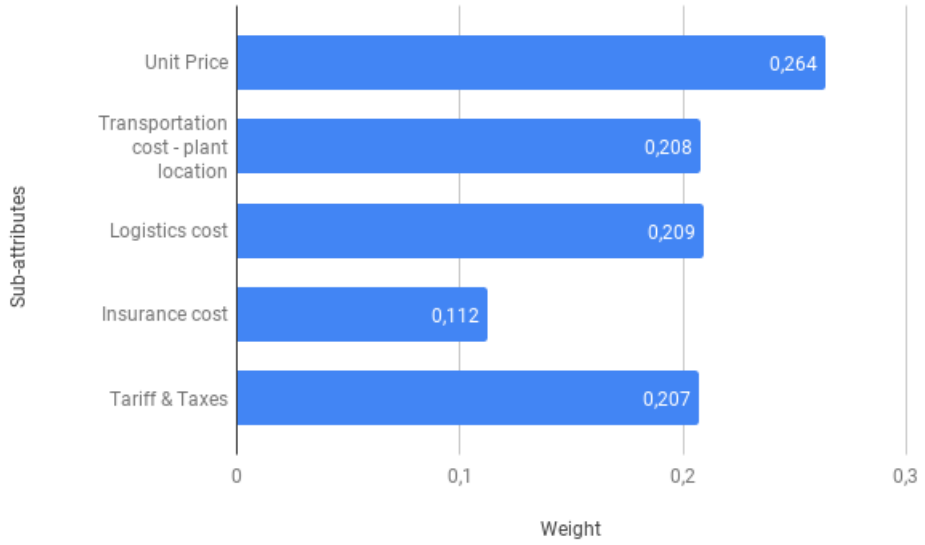

Figure 6.2. Priorities with respect to Cost.

Under quality criteria, product reliability/durability is found more important than conformance to specifications/design by the decision makers as shown in Figure 6.3. Considering the business model discussed under this research, the product durability should be more important than the product design because even if the design is not very good or not very satisfying yet during a new product development, products should have at least the strength to stand for long years. They should not require revamp very often as it would be very costly to change or repair if any issues rise that threaten a product's service life. With this in mind, design can be given much more tolerance than the durability of a product in case the requirements are not met. In the literature, Chan *et al.* (2008) deals with conformance to specifications under quality criteria as in this paper which is found to be the most important attribute among the other attributes such as product reliability, quality assessment technique and process capability under the main criteria "quality".

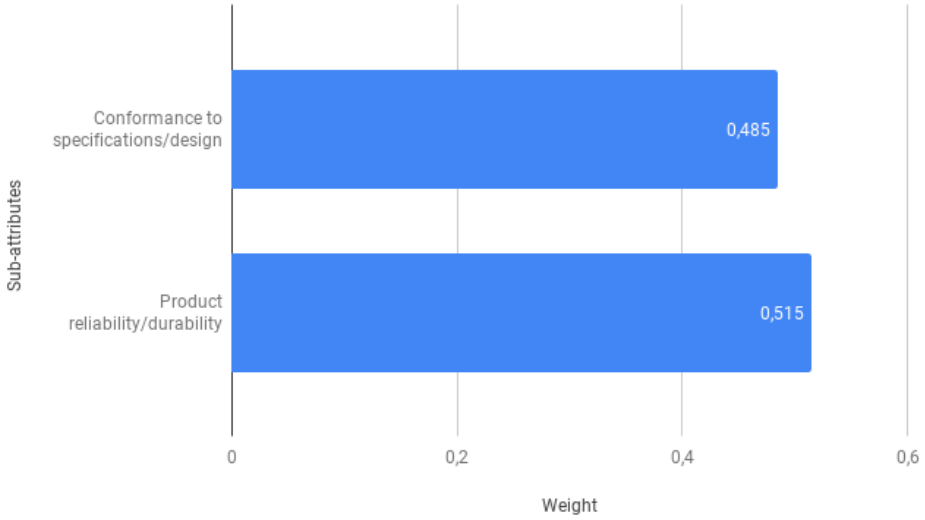

Figure 6.3. Priorities with respect to Quality.

Under service criteria, demand fulfillment/monthly production capacity is found to be the most important attribute by the professionals as shown in Figure 6.4. As mentioned before, one of the objectives of the company is to expand to new cities in Europe and Asia and reach 50,000 properties by 2023. With its very aggressive growth plans, the company needs suppliers that are eligible to fulfill its demands in terms of quantity. Therefore, while assessing the suppliers, monthly production capacity is a great indicator of a supplier's ability to address this need. Also, as mentioned before, this is a continuous supply process in contrast to hotels and serviced apartments. In other words, this is not going to be a one-off order but a repetitive one with a quantity likely to increase. Demand fulfillment/monthly production capacity is not discussed in the literature as detailed as it is here. In Chan *et al.* (2008), production capacity is taken into account in facility and infrastructure attribute under supplier's background criteria. However, the attribute in this study is adjusted as demand fulfillment/monthly production capacity to comply to the objectives of the company. In Guneri and Kuzu (2009), manufacturing capacity of a supplier is evaluated under the attribute called technological capability as technological advances increase the production volume and reduces the production time and labor force. In Kilincci and Onal (2011), it is taken into account as production facility and capacity under supplier criteria. In Zhang *et al.* (2015), it is considered as production facility and capacity under supplier's profile.

Since company's objective is to stock only a month worth of products to keep the inventory levels under control, it is important to know the monthly capacity of the supplier. Therefore, production capacities discussed within other related studies are quite different than in this study.

On time delivery is the second important attribute in service category. Since all the furniture and equipment are supplied by Turkey, where the supply chain hub is located, to the cities where the company is present, the shipments scheduled with respect to the growth projections of those cities cannot be changed due to long travel periods. Therefore, every order should arrive on time and there should not be any delays in delivery of goods. Every late delivery will result in higher transportation cost on item basis because the containers will not be sent fully loaded. This will also result in increased furnishing costs as the markets need to recoup the missing items from the containers with locally purchased expensive ones. Delivery is a very common attribute in the literature. It is found in 10 out of 14 studies investigated under this research. Every research has a different way of examining the effects of delivery depending on the respective industry. Delivery time is evaluated specifically in couple of studies. For example, in Onder and Kabadayi (2015), supplier's ability to meet delivery due dates are evaluated under the criteria "reliability of a supplier". In Kilincci and Onal (2011), delivery time is associated with the criteria "geographical location" along with the transportation cost and ease of accessibility. However, in Kilic (2013), delivery time is considered as a separate criteria from geographical location. In Lima Junior *et al.* (2014), delivery time is found related to delivery along with the reliability.

Export experience have become the third important attribute in the service category. A supplier experienced in exports could be helpful in packaging and handling processes. From the manufacturer to the apartment, items are moving five times on average. First, they move out of the factory and are loaded into a truck to be delivered to the port. Then, they are loaded to a container in the port and shipped to a city. During ocean freight or road transport, the goods are exposed to movement for weeks. Before they arrive to the final mile, the goods move once again from the arrival port to the local warehouse where they will be distributed to the apartments as the last

part of the move. Therefore, it's important for the supplier to be familiar with the export processes in order to provide good packaging and handling services as well as necessary documents on time as requested. Having done exports to many countries is very advantageous for the supplier from company's point of view because it means they are familiar with the standards and regulations of those countries regarding the consumer side. This attribute is not found in the literature so that it is a contribution of this study to the literature.

Following export experience, client references is the fourth attribute in the order of importance. Good client references indicate long term partnership and satisfaction with the products and services of the supplier. Especially for global suppliers, it is a very good indicator in terms of design, quality, credibility and financials before starting to work with them. In Chan *et al.* (2008), the same concept is referred as customer response; whereas, in Zhang *et al.* (2015) it is referred as customer base under supplier's profile criteria along with financial status and performance history. In two papers in the hospitality industry, Fantazy *et al.* (2010) and Onder and Kabadayi (2015), it is referred as customer satisfaction and supplier's reputation in the industry under the criteria "reliability of supplier", respectively. As a result, related studies are examining this concept from different perspectives.

Communication/negotiability is the fifth attribute under service criteria. First of all, communication is important for product development and design side because suppliers should understand the expectation of the client very well. Especially in the preparation of the product samples, misunderstandings often cause significant waste of time and delays in order placement. Negotiability is important from procurement's point of view since the supplier should be willing to come to an acceptable price point for the client. Suppliers should also be willing to negotiate on the payment terms, clauses in the contract and minimum order quantities as well. In Onder and Kabadayi (2015), it is evaluated under communications and relations criteria which includes attributes such as ability to solve the quality problems, flexible contract conditions, communication capability, order receiving system of the supplier and past and current relationship with supplier. In Chan *et al.* (2008), communication is taken into account in information

sharing attribute under service performance criteria. In Zhang *et al.* (2015), it is taken into consideration as ease of communication under service performance criteria.

Flexibility and responsiveness of a supplier has the least importance in the service category. This attribute is needed in order to measure the ability of a supplier to address in case an increase in the order quantities last minute or change in the design that is late for the manufacturing. Guneri and Kuzu (2009) also mentions the benefits of flexibility such as payment terms, discounts, minimum order quantities, capacity and willingness to address the companies' requests such as increase in order volume, new product development or change in the design.

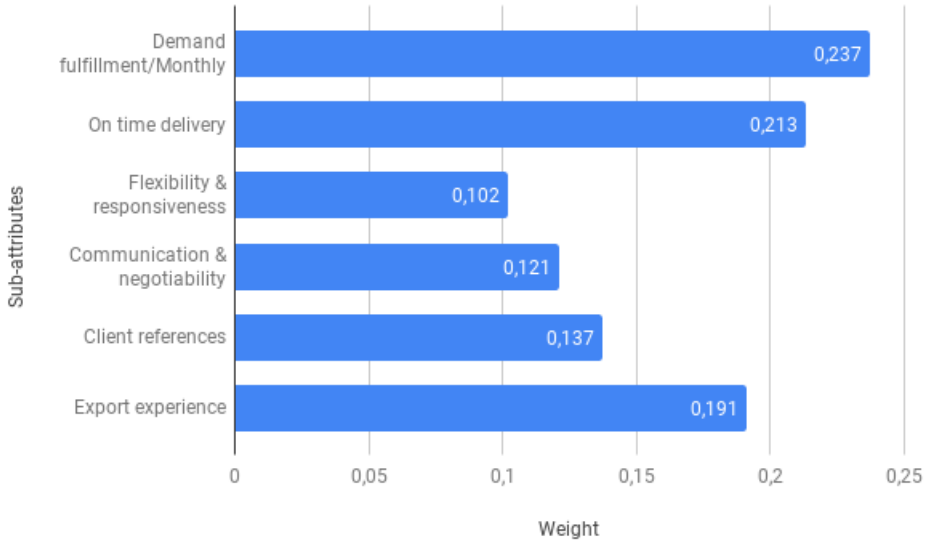

Figure 6.4. Priorities with respect to Service.

Under financials and economics criteria, payment term is selected to be the most important attribute for global and domestic supplier selection in tech-enabled property management and hospitality industry as shown in Figure 6.5. Companies operating in this industry are fairly new and most of them are startups. Their limited funds come from investments from venture capitals, private equities and angel investors. Therefore, the funds should be allocated very carefully. In this regard, payment term is a very important tool in order to improve cash flows and have more robust financials. Companies operating in this market have significant capital expenditures such as rental

payments and furniture procurement. These expenses need to be deferred in the cash flow statements since there is a payback period for the return on investment. Other studies that consider payment term as a relevant attribute for supplier selection are Onder and Kabadayi (2015) which evaluated payment term under price-cost criteria and Guneri and Kuzu (2009) which evaluates payment indirectly as an element affected by flexibility of a supplier.

Financial risk report (reliability/credibility) is the second important attribute under financials & economics criteria. In Turkey, suppliers are asked for their "Findeks" report which is an indicator of a supplier's financials. There is always a risk whether a supplier will be able to deliver the goods in return for the payment received. This risk is even higher with global suppliers as they are more unknown to the client. In the past, there were suppliers who agreed upon long payment terms but later failed to achieve the terms and deliver the products. This is definitely an undesirable outcome. Financial risk reports of suppliers aim to diminish this risk by eliminating those suppliers from their financial look. Financial risk reports were not considered as an evaluation criterion in the literature before. Therefore, this is one of the other contributions of this study to the literature.

"Exchange rates" attribute is the third important attribute under financials & economics criterion. Even if there aren't any global suppliers among the alternatives, it is important to take the "exchange rates" attribute into consideration because the raw materials might be subject to exchange rate fluctuations in domestic suppliers, too. For example, a domestic home textile manufacturer used to sell in Turkish Liras had to switch to dollars due to cotton prices in dollars because of significant rises in exchange rates. Therefore, the prices get affected and a domestic supplier can go down from being a leading supplier to a disadvantageous one. Furthermore, in case of global sourcing, the parties agree on the prices at the time of procurement. However, after the procurement is done and the down-payment is made, there are couple of months until the delivery of goods to transfer the rest of the payment. This is risky because if the exchange rates increase significantly, then the price might not be valid as it used to be for the client, considering the currency in which they plan to pay.

The last attribute under financials & economics criteria is the “economic conditions”. This attribute has the least importance among the others because it refers to the economic conditions of the country where the supplier is located. If a country does not have a strong economy, the trade is prone to the risk of being disrupted. This might affect the exports as well, but the risk is considered too low. The client might remain uncovered if there is no cover up stock or plan B in place. This might result in stock-outs and increase in furnishing costs due to local one-off purchases.

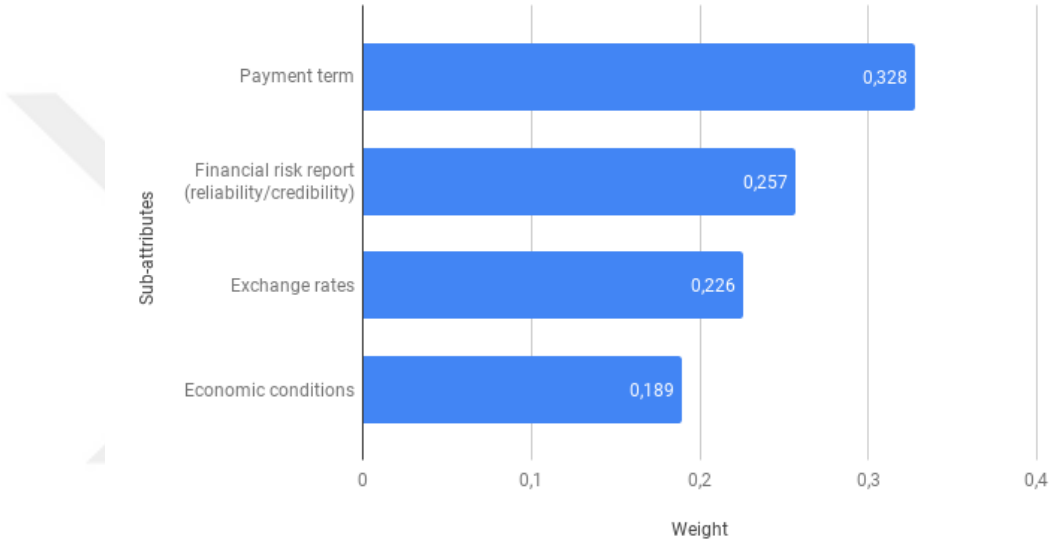

Figure 6.5. Priorities with respect to Financials & Economics.

Supplier A and Supplier B are manufacturers located in China, Supplier C is an importer in Turkey and Supplier D is a manufacturer in Turkey of the same furniture category. Supplier A and B have very competitive prices compared to Supplier C and D, so it is reasonable that Supplier A and B are most preferable ones and their weights are very close to each other. Supplier C is the least preferable one in terms of cost because it imports the same products and add a margin on top of the prices to sell them to the company.

Since Supplier A and B are located in China and Supplier C imports from the far east, their plant locations are very far away. Therefore, the transportation takes longer and costs more. The least preferable one in terms of transportation cost is Supplier B.

Supplier A and Supplier C are more preferable than Supplier B because they minimize their transportation cost by loading a full truck instead of doing a partial shipment. The most preferable one in terms of transportation cost is Supplier D, being in Turkey and having a small atelier with a storage at the center of Istanbul. The company has two warehouses in Istanbul, one serving for Turkey operations and the other for export operations. The goods are received at the warehouse located in Istanbul and then distributed to the other cities around the world with containers. Therefore, the transportation cost of the Supplier D is low compared to the others, being in the same city with the company's warehouses.

For the logistics cost, the most preferable one is Supplier D, being located in Turkey. Also, the logistics cost is low with this supplier because they can store in their own storage and make deliveries when need be. Therefore, they happen to carry the inventory cost for the company. Supplier C is also in Turkey but does not provide the same advantage of storing inventory on behalf of the company. They deliver in two weeks from the date of order. Since Supplier C is a big retailer in Turkey with more than 50 stores which it fosters as well as selling in bulk, they import in huge amount and they store in their warehouse until the stock is depleted. Since Supplier C is an importer and bears the storage cost of the items for months as they bring in bulk, they include the logistics cost on their end in their prices. Therefore, Supplier C received a score less than Supplier D despite being located in Turkey. Supplier B is the least preferable one because they have a minimum order quantity and the order placed for this supplier corresponds to three-month worth of demand. Therefore, the company has to carry the storage cost for months until the goods are depleted and this makes it less preferable.

Regarding the insurance cost criteria, Supplier D is the most preferable one, being a manufacturer in Turkey. For imports, there is an insurance cost involved in the price to ensure that the cost of goods is reimbursed in case they can't be delivered to the final mile safe and sound. The insurance cost is also valid for the shipments from Turkey to the other cities. However, since the insurance cost is covered by the supplier in imports case, they tend to charge more on the item basis with respect to the insurance cost

covered by the company in exports case. Therefore, the global suppliers are found to be the least preferable ones under this attribute.

For tariff and taxes category, Supplier A is the most preferable one and Supplier C is the least preferable one. Even though Supplier D has the VAT incentive from the Turkish government, it is not as effective as the other taxes implied. (Because Supplier C is a manufacturer in Turkey, it has been given a right from the government not to charge VAT for the goods it manufactures if they are going to be exported. This is done by the government to encourage businesses that perform exports of the goods made in Turkey and to support the domestic producers. The restriction is that the goods should be exported within four months of the invoice date. If the goods are not exported, the government has a right to collect the VAT (Gelir Idaresi Baskanligi, 2017). Because the other suppliers are either global manufacturers or importers, they are not subject to this law and cannot make use of this advantage. However, they might not be subject to other tariff & taxes as the products with Turkish origin do so. The tariff & taxes category is a complicated attribute because the company ships these goods to Greece, United Arab Emirates and the United States from Turkey. Sometimes, some of them are directly shipped from China to the aforementioned countries. Turkey market also receives imported goods to use in its apartments in Istanbul. Imported goods are usually subject to different tariff & taxes in different countries and they also change from time to time depending on the political relations and economic situations of countries. Therefore, it is really hard for the respondents to assess the suppliers under this criterion effectively and the results are expected to be prone to error.

In conformance to specifications/design, Supplier A is the most preferable one because most of the time the goods delivered are exactly the same with the witness samples and production samples confirmed. Also, this means that they have the capability to produce according to the design and technical details provided by the customer. This is what Supplier C lacks which orders its own selection without asking the customer and the customers can only select from the selection made by the supplier. Therefore, it has a low preference for this attribute compared to suppliers A and B. Supplier D is the least preferable one because its products usually come out different

than the first sample confirmed by the customer in terms of aesthetics and quality. The quality here refers to packaging, material and finishing standards. If any of them is missing, the scores of the suppliers for this criterion go down.

In the product reliability/durability category, Supplier D receives the lowest score. It is because the products are often coming out of the packages broken. So, the product's durability is a concern for customers as it is revealed in the priority weights. The most preferable supplier in this category became Supplier A obtaining the highest weight with the use of high-quality raw material and finishes.

In demand fulfillment/monthly production capacity category, Supplier A is the most preferable one according to the experts followed by Supplier B. The manufacturers in China has larger production facilities and infrastructure compared to the Supplier D producing in a small atelier. Being an importer, Supplier C is the least preferable one among the alternatives because it is not a manufacturer and its supply is limited with the volume of its imports.

For the attribute "on time delivery", it is observed from the weights that Supplier B is the most preferable one even though it's a global supplier. The prediction at the beginning with global suppliers was that they would always be late in delivery. However, it turns out that the domestic supplier is the least preferable one compared to the rest of the alternatives. The weight for the least preferable supplier is too low that it hardly delivered on time. In this case, global suppliers are taking advantage of their production capacities and export experience to deliver on time.

In the flexibility and responsiveness attribute, global suppliers are found to be the most preferable ones. Since the products purchased from Supplier C are already imported, there is no flexibility to change the design or the order quantity for the items that are liked or needed more. However, its responsiveness is high in addressing other requests from the customer such as packaging and handling but according to the weights it does not compensate for the flexibility in the aforementioned areas.

For communication/negotiability category, all the weights are quite close to each other. Supplier B is the most preferable one with a priority weight of 0.266 followed by Supplier C and B with priority weights of 0.253 and 0.252, respectively. Two of these suppliers is a global supplier and the other one is a domestic supplier. At the beginning, it was thought that working with global suppliers would be a bit hard in regard to communication. However, the results show that it depends on the supplier's attitude, not on its country of origin. Even if Supplier D is a domestic supplier, it received the minimum score.

In terms of client references, Supplier A is the most preferable one as a global supplier. It is known as the manufacturer of well-known brands around the world. Supplier D is the least preferable one being a domestic supplier and not having as strong references as global suppliers. In export experience category, supplier D is found to be the least preferable one. Since Supplier D only does exports through its customers, a result close to zero is possible. The most preferable one is Supplier B as expected, being a global supplier located in China and selling its products across the world.

In terms of payment term, Supplier C is found to be the most preferable one. Global suppliers require down-payments, therefore, their scores are slightly less than Supplier C. Supplier D is the least preferable one even though it is expected to be the exact opposite. Normally, it is easier to build mutual trust with domestic suppliers and obtain longer payment terms but since they are actually a small manufacturer with an unstable financial situation, they are not able to provide that. Similarly, in financial risk report (reliability/credibility) category, the least preferable one is found to be Supplier D. Even though Supplier A is the most preferable one in terms of financial reliability/credibility, it is not the best supplier in payment term criterion due to trust issues with global suppliers.

In exchange rates and economic conditions categories, Supplier A and Supplier B have very close weights. Both located in China, they are subject to the same exchange rate and the same economic conditions. Since they sell in US Dollars and their currency

get affected by the exchange rates, the domestic supplier is found to be less risky. Supplier D is selected to be the most preferable one for the exchange rates category because they sell in Turkish Liras and do not get affected by the exchange rates. Since Supplier C is an importer, the weight is found to be closer to Supplier A and Supplier B rather than Supplier D which is a domestic supplier, too.

For the "economic conditions" category, Supplier A and Supplier B are found to be the most preferable ones. Since Supplier C is an importer and they import from several countries, they are found riskier compared to the other alternatives and selected to be the least preferable one under the uncertainty.

When ranking the suppliers with respect to the main criteria, Supplier A is found to be the most preferable one for the cost category followed by Supplier B, D and C, respectively. For quality category, Supplier A is found to be the most preferable one; whereas, Supplier D is found to be the least preferable one. For service criteria, Supplier B is found to be slightly preferable than Supplier A but highly preferable than the others. Supplier D is found to be the least preferable one in service criterion. Under financials & economics criteria, weights of Supplier A and Supplier B are found very close to each other. For the same criteria, the least preferable one is found to be Supplier D. These weights are accumulation of all the weights calculated for each supplier with respect to sub-attributes. This part is where Saaty (1977) refers as the step of recomposing the clusters to get the overall priorities in AHP. As a result, the best supplier is selected to be Supplier A, followed by Supplier B, C and D, respectively.

Even though several research projects existes were conducted for supply chain management in the hospitality industry, none of them handled the supplier selection problem adequately. Christodoulidou *et al.* (2012) mentions the importance of the supplier selection problem in the hospitality industry but do not go into depth to propose a selection method. In Fantazy *et al.* (2010) only the priority weights are determined for the decision variables. Alternative suppliers are not compared. Only Onder and Kabadayi (2015) and Hsu *et al.* (2014) deal with the supplier selection problem in the hospitality industry properly. However, Hsu *et al.* (2014) concentrates on the low car-

bon supplier selection and only includes criteria related to carbon reduction. Moreover, the field of operation of the companies operating in the respective industry is not only the hospitality sector. The industry here is a combination of property management, hospitality and tech-enabled sectors. Since it is an emerging market as a combination of three, the few researches performed for effective supplier selection in the hospitality industry are not sufficient to address the issue here. Therefore, this study aims to fill this gap in the literature.

7. CONCLUSION

For the success of supply chain management in an organization, the supplier selection is an important phenomenon in numerous ways. It needs to be addressed in detail and in an organized way as many companies rely their businesses on procurement to great extent (Liu and Hai, 2005). Especially incorporating global suppliers to supplier selection processes along with domestic suppliers is a very complex and risk prone activity because the company has to build long term business partnerships with unfamiliar international suppliers. As companies become highly dependent on their suppliers whether it is domestic or global, the consequences might be more critical in case of a poor decision making. Moreover, it is not feasible to change suppliers frequently since it takes quite a lot of time to get to the procurement stage due to the long design and product development processes. Besides, the business has to continue. Therefore, supplier selection requires great attention at the beginning.

To survive within a competitive environment, supply chain departments should be very careful in the matter of supplier selection (Pearson and Ellram, 1995). Before starting to work with any supplier, they should evaluate several options depending on the criteria affecting the company's business. For example, considering the industry examined under this research, the criteria should address the following principles: the cost of goods, the target profit margins, the cash flow of the company, the stock-out risk and its outcomes financially and operationally, the optimum inventory levels, the logistics issues likely to arise, customer satisfaction, etc. These principles formed the background of this research and are handled in different criteria.

However, all of these factors that have an influence on the longevity and the profitability of the business are not always quantitative. There are some qualitative factors as well, which are hard to assess especially when copped with the quantitative ones. In order to mitigate the complexities in multi-criterion decision making, a strategy should be developed taking into account the requirements to fulfill related to the overall objective of the company (Chen *et al.*, 2016).

Those requirements are actually called the evaluation criteria in Fuzzy Analytic Hierarchy Process used to carry out this research. The very first step of the strategy is to identify the evaluation criteria understanding the firm's needs (Kahraman *et al.*, 2003). To do that, the goal of the company should be acknowledged. After identifying the evaluation criteria depending on the specific objective of the company, a questionnaire is performed on the employees familiar with those objectives to understand each criterion's relation with or significance over another. Following that, the suppliers are ranked with respect to the weights computed for each attribute and the best supplier is selected.

Furthermore, this performance analysis is not a one-off task. It should be carried out periodically (Bevilacqua and Petroni, 2003) because the requirements of a business might change in time or the performance of the suppliers might improve or deteriorate. In such cases, the criteria and the sub-attributes need to be revised and the ranking of the suppliers might be affected after re-running the model. Therefore, a decision-making support system like this is very useful for the companies.

There are several contributions of this study to the literature. First of all, it presents a global and domestic supplier selection strategy for a newly developing market referred as tech-enabled property management and hospitality industry by the operating companies and in the media. For that purpose, this study lists the selection criteria for the emerging industry. The four main criteria taken into consideration in this study are cost, quality, service and financial & economics. These main criteria are decomposed into 17 sub-attributes to evaluate the supplier alternatives in depth. These sub-attributes are unit price, transportation cost, logistics cost, insurance cost and tariff & taxes under cost criteria, conformance to specifications/design and product reliability/durability under quality criteria, demand fulfillment/monthly production capacity, on time delivery, flexibility & responsiveness, communication/negotiability, client references and export experience under service criteria, payment term, financial risk report (reliability/credibility), exchange rates and economic conditions under financials & economics criteria. Among these 17 sub-attributes, demand fulfillment/monthly production capacity, export experience, financial risk report (reliability/credibility) and

exchange rates are 4 new attributes that are specific to this industry and are introduced to the literature in this study.

This study also presents a practical approach to purchasing and supply chain managers in selecting the best supplier and sourcing strategically in this specific industry. The common mistake made by the decision makers is that while paying attention to one criterion, they tend to neglect the others which are central to the objectives of the company. This is due to the inability of human decision-making process to handle more than one factor at the same time. Therefore, it is necessary to use a proper tool to evaluate both qualitative and quantitative criteria simultaneously.

In addition to its contributions, this study has some limitations that might lead to further research. First of all, the Fuzzy AHP method is not very efficient after a certain number of alternatives. In case more than five suppliers are evaluated, the questionnaire becomes too long to fill in for the respondents. Since suppliers are compared with respect to the sub-attributes and there are 17 sub-attributes in this research, the questionnaire survey is already quite long. Since the number of sub-attributes cannot go lower than a certain level considering the company's objectives, the number of suppliers should be kept at a certain level, too. However, there might be some cases with more than 5 supplier alternatives for a specific product category in the future and this might create a problem in terms of the response rates. Therefore, further research can be done to improve this limitation of number of sub-attributes and alternatives.

Another limitation is with the number of experts in the field. Since it's a quite new industry and all the competitors are based abroad, only 8 professionals working in the company's product & supply chain function located in Istanbul are surveyed. In other words, the number of respondents in this study are quite low. For future research, the sample size can be bigger in order to obtain a more general conclusion for the industry. Also, more case studies might be conducted to measure the validity of the proposed model and the criteria for the global and domestic supplier selection problem.

Another limitation of this study is the specific sector it refers to. The sector is a combination of hospitality, property management and tech-enabled industries. Even if one part of this emerging market is associated with the hospitality industry, this study might be irrelevant for the hotels and serviced apartments. First of all, even though the procurement process looks the same, many items including most of the furniture remain out of scope in hotels and serviced apartments. They have a standardized furniture throughout their whole complex. However, the companies in the specific industry buy a variety of furniture in terms of design and functionality. Since there are a lot of different types of furniture and almost every product has an alternative, in case of replacement or stock out, the supplier selection process does not necessarily have to be the same as in the hotels and serviced apartments case. This specific industry provides flexibility to go for hundreds of suppliers as long as the objectives are satisfied.

Also, hotels and serviced apartments are not considered as continuous furniture buyers. Rather, they work project-based with the global and domestic suppliers. On the contrary, global sourcing requires a long-term partnership along with a significant volume commitment to the suppliers. The companies operating in this emerging market are expanding to new destinations every month and supplying a considerable amount of furniture constantly from the suppliers all around the world. Therefore, even though it is not entirely related to hotel and serviced apartment businesses, this study might make sense for big retailers or wholesalers as they place monthly, quarterly or yearly orders as long as they create their own selection criteria based on the objectives of their sector. So, the limitation of this study is that it addresses to companies sourcing globally as well as domestically and maintaining long term business partnerships while buying huge amounts in bulk in certain periods.

Because of the complex nature of the decision making when sourcing overseas, the companies should make use of a proper technique for supplier comparison. Effective supplier selection can help achieve considerable efficiency in the entire supply chain process and allocation of the company's resources in a right way. As a result, the tech-enabled property management and hospitality companies will be able to make more profit and the related industry will grow steadily. Furthermore, the real estate and the

construction sector will benefit from this growth because it will affect the housing sales and the occupancy of the existing residential supply in the market in a positive way.

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APPENDIX A: THE QUESTIONS THAT ARE ASKED

The questions that are asked for filling in the pairwise comparison with respect to global & domestic supplier selection are given below.

1. How important is cost when it is compared to quality?
2. How important is cost when it is compared to service?
3. How important is cost when it is compared to financials & economics?
4. How important is quality when it is compared to service?
5. How important is quality when it is compared to financials & economics?
6. How important is service when it is compared to financials & economics?

The questions that are asked for filling in the pairwise comparison table with respect to cost are found below.

1. How important is unit price when it is compared to transportation cost?
2. How important is unit price when it is compared to logistics cost?
3. How important is unit price when it is compared to insurance cost?
4. How important is unit price when it is compared to tariff and taxes?
5. How important is transportation cost when it is compared to logistics cost?
6. How important is transportation cost when it is compared to insurance cost?
7. How important is transportation cost when it is compared to tariff and taxes?
8. How important is logistics cost when it is compared to insurance cost?
9. How important is logistics cost when it is compared to tariff and taxes?
10. How important is insurance cost when it is compared to tariff and taxes?

Figure A.1. The questions that are asked 1.

The question that is asked for filling in the pairwise comparison table with respect to quality is:

1. How important is conformance to specifications/design when it is compared to product reliability/durability?

The questions that are asked for filling in the pairwise comparison table with respect to service is:

1. How important is demand fulfilment/monthly production capacity when it is compared to on time delivery?
2. How important is demand fulfilment/monthly production capacity when it is compared to flexibility and responsiveness?
3. How important is demand fulfilment/monthly production capacity when it is compared to communication/negotiability?
4. How important is demand fulfilment/monthly production capacity when it is compared to client references?
5. How important is demand fulfilment/monthly production capacity when it is compared to export experience?
6. How important is on time delivery when it is compared to flexibility and responsiveness?
7. How important is on time delivery when it is compared to communication/negotiability?
8. How important is on time delivery when it is compared to client references?
9. How important is on time delivery when it is compared to export experience?
10. How important is flexibility and responsiveness when it is compared to communication/negotiability?
11. How important is flexibility and responsiveness when it is compared to client references?
12. How important is flexibility and responsiveness when it is compared to export experience?

Figure A.2. The questions that are asked 2.

13. How important is communication/negotiability when it is compared to client references?
14. How important is communication/negotiability when it is compared to export experience?
15. How important is client reference when it is compared to export experience?

The questions that are asked for filling in the pairwise comparison table with respect to financials & economics are found below.

1. How important is payment term when it is compared to financial risk report (reliability/credibility)?
2. How important is payment term when it is compared to exchange rates?
3. How important is payment term when it is compared to economic conditions?
4. How important is financial risk report (reliability/credibility) when it is compared to exchange rates?
5. How important is financial risk report (reliability/credibility) when it is compared to economic conditions?
6. How important is exchange rates when it is compared to economic conditions?

The questions that are asked to fill in the pairwise comparison table for Alternative Pairwise Comparisons with respect to Sub-Attributes

1. How important/preferable is supplier A compared to B in terms of unit price?
2. How important/preferable is supplier A compared to B in terms of transportation cost?
3. How important/preferable is supplier A compared to B in terms of logistics cost?

Figure A.3. The questions that are asked 3.

4. How important/preferable is supplier A compared to B in terms of insurance cost?
5. How important/preferable is supplier A compared to B in terms of tariffs & taxes?
6. How important/preferable is supplier A compared to B in terms of conformance to specifications/design?
7. How important/preferable is supplier A compared to B in terms of product reliability/durability?
8. How important/preferable is supplier A compared to B in terms of demand fulfillment/monthly production capacity?
9. How important/preferable is supplier A compared to B in terms of on time delivery?
10. How important/preferable is supplier A compared to B in terms of flexibility and responsiveness?
11. How important/preferable is supplier A compared to B in terms of communication/negotiability?
12. How important/preferable is supplier A compared to B in terms of client references?
13. How important/preferable is supplier A compared to B in terms of export experience?
14. How important/preferable is supplier A compared to B in terms of payment term?
15. How important/preferable is supplier A compared to B in terms of financial risk report (reliability/credibility)?
16. How important/preferable is supplier A compared to B in terms of exchange rates?
17. How important/preferable is supplier A compared to B in terms of economic conditions?

Figure A.4. The questions that are asked 4.

APPENDIX B: MEAN OF EIGHT EXPERTS

Mean of Eight Experts

Pairwise comparison with respect to Global & Domestic Supplier Selection*

G	C1	C2	C3	C4
C1	(1.000,1.000,1.000)	(0.400,1.000,3.500)	(0.500,1.489,3.500)	(1.000,1.517,3.500)
C2	(0.286,1.000,2.500)	(1.000,1.000,1.000)	(0.400,1.190,2.500)	(0.400,1.147,3.500)
C3	(0.286,0.672,2.000)	(0.400,0.840,2.500)	(1.000,1.000,1.000)	(0.400,1.147,2.500)
C4	(0.286,0.659,1.000)	(0.286,0.872,2.500)	(0.400,0.872,2.500)	(1.000,1.000,1.000)

Pairwise comparison with respect to Cost

C1	S1	S2	S3	S4	S5
S1	(1.000,1.000,1.000)	(1.000,2.022,3.000)	(1.000,1.719,3.000)	(1.500,2.532,3.500)	(1.000,2.018,3.500)
S2	(0.333,0.495,1.000)	(1.000,1.000,1.000)	(0.500,0.986,2.500)	(1.000,1.846,3.000)	(0.400,1.098,3.000)
S3	(0.333,0.582,1.000)	(0.400,1.014,2.000)	(1.000,1.000,1.000)	(1.000,2.096,3.000)	(0.333,0.978,3.000)
S4	(0.286,0.395,0.667)	(0.333,0.542,1.000)	(0.333,0.477,1.000)	(1.000,1.000,1.000)	(0.333,0.539,1.000)
S5	(0.286,0.496,1.000)	(0.333,0.911,2.500)	(0.333,1.022,3.003)	(1.000,1.855,3.003)	(1.000,1.000,1.000)

Pairwise comparison with respect to Quality

C2	S6	S7
S6	(1.000,1.000,1.000)	(0.333,0.849,3.000)
S7	(0.333,1.178,3.003)	(1.000,1.000,1.000)

Figure B.1. Mean of Eight Experts 1.

Pairwise comparison with respect to Service

C3	S8	S9	S10	S11	S12	S13
S8	(1.000,1.000,1.000)	(1.000,1.731,2.500)	(1.500,2.487,3.500)	(1.500,2.460,3.500)	(1.500,2.602,3.500)	(1.000,1.863,2.500)
S9	(0.400,0.578,1.000)	(1.000,1.000,1.000)	(1.500,2.298,3.000)	(1.000,2.087,3.500)	(1.000,2.207,3.500)	(1.000,1.780,3.000)
S10	(0.286,0.402,0.667)	(0.333,0.435,0.667)	(1.000,1.000,1.000)	(0.400,0.884,3.000)	(0.400,0.586,1.000)	(0.333,0.423,0.667)
S11	(0.286,0.407,0.667)	(0.286,0.479,1.000)	(0.333,1.131,2.500)	(1.000,1.000,1.000)	(0.400,0.707,2.000)	(0.286,0.452,1.000)
S12	(0.286,0.384,0.667)	(0.286,0.453,1.000)	(1.000,1.706,2.500)	(0.500,1.414,2.500)	(1.000,1.000,1.000)	(0.333,0.546,1.000)
S13	(0.400,0.537,1.000)	(0.333,0.562,1.000)	(1.499,2.364,3.003)	(1.000,2.212,3.497)	(1.000,1.832,3.003)	(1.000,1.000,1.000)

Pairwise comparison with respect to Financials & Economics

C4	S14	S15	S16	S17
S14	(1.000,1.000,1.000)	(1.000,1.916,3.000)	(1.500,2.058,3.000)	(1.000,2.219,3.500)
S15	(0.333,0.522,1.000)	(1.000,1.000,1.000)	(0.500,1.510,2.500)	(1.000,1.634,3.000)
S16	(0.333,0.486,0.667)	(0.400,0.662,2.000)	(1.000,1.000,1.000)	(0.400,1.464,3.000)
S17	(0.286,0.451,1.000)	(0.333,0.612,1.000)	(0.333,0.683,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Unit Price

S1	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,0.639,2.000)	(1.500,2.485,3.500)	(1.500,2.276,3.500)
A2	(0.500,1.565,2.500)	(1.000,1.000,1.000)	(1.500,2.592,3.500)	(1.500,2.486,3.500)
A3	(0.286,0.402,0.667)	(0.286,0.386,0.667)	(1.000,1.000,1.000)	(0.400,0.842,2.500)
A4	(0.286,0.439,0.667)	(0.286,0.402,0.667)	(0.400,1.188,2.500)	(1.000,1.000,1.000)

Figure B.2. Mean of Eight Experts 2.

Alternative pairwise comparisons with respect to Transportation cost - plant location

S2	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.500,1.165,2.000)	(0.400,1.052,2.500)	(0.400,0.578,1.000)
A2	(0.500,0.858,2.000)	(1.000,1.000,1.000)	(0.400,1.052,2.500)	(0.400,0.538,1.000)
A3	(0.400,0.951,2.500)	(0.400,0.951,2.500)	(1.000,1.000,1.000)	(0.400,0.608,1.000)
A4	(1.000,1.730,2.500)	(1.000,1.859,2.500)	(1.000,1.645,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Logistics cost

S3	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.107,2.000)	(0.400,1.107,2.500)	(0.333,0.581,1.000)
A2	(0.500,0.903,1.000)	(1.000,1.000,1.000)	(0.400,1.107,2.500)	(0.333,0.581,1.000)
A3	(0.400,0.903,2.500)	(0.400,0.903,2.500)	(1.000,1.000,1.000)	(0.400,0.639,1.000)
A4	(1.000,1.721,3.003)	(1.000,1.721,3.003)	(1.000,1.565,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Insurance cost

S4	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.207,2.500)	(0.286,0.829,2.500)	(0.286,0.497,1.000)
A2	(0.400,0.829,1.000)	(1.000,1.000,1.000)	(0.286,0.829,2.500)	(0.286,0.498,1.000)
A3	(0.400,1.206,3.497)	(0.400,1.206,3.497)	(1.000,1.000,1.000)	(0.333,0.575,1.000)
A4	(1.000,2.012,3.497)	(1.000,2.008,3.497)	(1.000,1.739,3.003)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Tariff & Taxes

S5	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,1.121,3.000)	(1.000,1.987,3.000)	(0.500,1.336,2.500)
A2	(0.333,0.892,2.500)	(1.000,1.000,1.000)	(1.000,1.969,3.000)	(0.500,1.000,2.000)
A3	(0.333,0.503,1.000)	(0.333,0.508,1.000)	(1.000,1.000,1.000)	(0.400,0.686,2.000)
A4	(0.400,0.749,2.000)	(0.500,1.000,2.000)	(0.500,1.458,2.500)	(1.000,1.000,1.000)

Figure B.3. Mean of Eight Experts 3.

Alternative pairwise comparisons with respect to Conformance to specifications/design

S6	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,1.317,2.500)	(1.000,2.146,3.500)	(1.000,2.355,3.500)
A2	(0.400,0.759,2.500)	(1.000,1.000,1.000)	(1.000,1.897,3.000)	(1.000,2.302,3.500)
A3	(0.286,0.466,1.000)	(0.333,0.527,1.000)	(1.000,1.000,1.000)	(0.400,1.403,3.000)
A4	(0.286,0.425,1.000)	(0.286,0.434,1.000)	(0.333,0.713,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Product reliability/durability

S7	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.781,3.000)	(1.000,2.208,3.500)	(2.000,2.865,3.500)
A2	(0.333,0.561,1.000)	(1.000,1.000,1.000)	(1.500,2.059,3.000)	(1.500,2.530,3.500)
A3	(0.286,0.453,1.000)	(0.333,0.486,0.667)	(1.000,1.000,1.000)	(1.000,1.734,2.500)
A4	(0.286,0.349,0.500)	(0.286,0.395,0.667)	(0.400,0.577,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Demand fulfillment/Monthly production capacity

S8	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,1.251,2.500)	(2.000,2.676,3.500)	(1.500,2.650,3.500)
A2	(0.400,0.799,2.500)	(1.000,1.000,1.000)	(1.500,2.530,3.500)	(1.000,2.397,3.500)
A3	(0.286,0.374,0.500)	(0.286,0.395,0.667)	(1.000,1.000,1.000)	(0.400,0.760,2.500)
A4	(0.286,0.377,0.667)	(0.286,0.417,1.000)	(0.400,1.316,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to On time delivery

S9	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.500,0.777,1.000)	(0.400,0.760,2.000)	(1.500,2.226,3.500)
A2	(1.000,1.287,2.000)	(1.000,1.000,1.000)	(0.500,1.075,2.500)	(1.500,2.344,3.500)
A3	(0.500,1.316,2.500)	(0.400,0.930,2.000)	(1.000,1.000,1.000)	(1.500,2.226,3.500)
A4	(0.286,0.449,0.667)	(0.286,0.427,0.667)	(0.286,0.449,0.667)	(1.000,1.000,1.000)

Figure B.4. Mean of Eight Experts 4.

Alternative pairwise comparisons with respect to Flexibility & responsiveness

S10	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,0.812,2.000)	(1.000,1.929,3.500)	(0.400,1.830,3.000)
A2	(0.500,1.232,2.500)	(1.000,1.000,1.000)	(1.000,2.207,3.500)	(1.000,2.098,3.500)
A3	(0.286,0.518,1.000)	(0.286,0.453,1.000)	(1.000,1.000,1.000)	(0.286,1.015,2.500)
A4	(0.333,0.546,2.500)	(0.286,0.477,1.000)	(0.400,0.985,3.497)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Communication & negotiability

S11	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,0.872,2.000)	(0.500,0.964,3.000)	(0.400,1.436,3.500)
A2	(0.500,1.147,2.500)	(1.000,1.000,1.000)	(0.500,1.216,3.500)	(0.500,1.805,3.500)
A3	(0.333,1.037,2.000)	(0.286,0.822,2.000)	(1.000,1.000,1.000)	(0.400,1.595,3.000)
A4	(0.286,0.696,2.500)	(0.286,0.554,2.000)	(0.333,0.627,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Client references

S12	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.500,1.416,2.500)	(1.000,2.219,3.000)	(1.500,2.787,3.500)
A2	(0.400,0.706,2.000)	(1.000,1.000,1.000)	(1.000,1.970,3.000)	(1.500,2.475,3.500)
A3	(0.333,0.451,1.000)	(0.333,0.508,1.000)	(1.000,1.000,1.000)	(1.000,2.043,3.000)
A4	(0.286,0.359,0.667)	(0.286,0.404,0.667)	(0.333,0.489,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Export experience

S13	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,0.931,2.000)	(1.000,1.655,3.000)	(2.000,2.932,3.500)
A2	(0.500,1.074,2.500)	(1.000,1.000,1.000)	(1.000,1.857,3.000)	(2.000,2.863,3.500)
A3	(0.333,0.604,1.000)	(0.333,0.539,1.000)	(1.000,1.000,1.000)	(1.500,2.421,3.500)
A4	(0.286,0.341,0.500)	(0.286,0.349,0.500)	(0.286,0.413,0.667)	(1.000,1.000,1.000)

Figure B.5. Mean of Eight Experts 5.

Alternative pairwise comparisons with respect to Payment term

S14	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,1.208,2.500)	(0.333,0.879,2.500)	(0.400,1.392,3.000)
A2	(0.400,0.828,2.500)	(1.000,1.000,1.000)	(0.333,0.841,3.000)	(0.400,1.336,3.500)
A3	(0.400,1.138,3.003)	(0.333,1.189,3.003)	(1.000,1.000,1.000)	(0.400,1.455,3.000)
A4	(0.333,0.718,2.500)	(0.286,0.749,2.500)	(0.333,0.687,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Financial risk report (reliability/credibility)

S15	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,1.124,2.000)	(1.500,2.059,3.000)	(2.000,2.801,3.500)
A2	(0.500,0.890,2.500)	(1.000,1.000,1.000)	(1.000,2.040,3.000)	(1.500,2.726,3.500)
A3	(0.333,0.486,0.667)	(0.333,0.490,1.000)	(1.000,1.000,1.000)	(1.500,2.290,3.500)
A4	(0.286,0.357,0.500)	(0.286,0.367,0.667)	(0.286,0.437,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Exchange rates

S16	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,1.165,2.000)	(0.333,0.508,1.000)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,1.208,2.500)	(0.333,0.523,1.000)
A3	(0.500,0.858,2.000)	(0.400,0.828,2.000)	(1.000,1.000,1.000)	(0.286,0.500,1.000)
A4	(1.000,1.969,3.003)	(1.000,1.912,3.003)	(1.000,2.000,3.497)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Economic conditions

S17	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.480,2.500)	(0.400,1.226,2.500)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.480,2.500)	(0.400,1.226,2.500)
A3	(0.400,0.676,1.000)	(0.400,0.676,1.000)	(1.000,1.000,1.000)	(0.333,0.925,2.000)
A4	(0.400,0.816,2.500)	(0.400,0.816,2.500)	(0.500,1.081,3.003)	(1.000,1.000,1.000)

Figure B.6. Mean of Eight Experts 6.

Expert 1

Pairwise comparison with respect to Global & Domestic Supplier Selection*

G	C1	C2	C3	C4
C1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
C2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.000,1.500,2.000)
C3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
C4	(0.333,0.400,0.500)	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Pairwise comparison with respect to Cost

C1	S1	S2	S3	S4	S5
S1	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(1.000,1.500,2.000)	(2.500,3.000,3.500)	(2.500,3.000,3.500)
S2	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)
S3	(0.500,0.667,1.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(2.000,2.500,3.000)
S4	(0.286,0.333,0.400)	(0.500,0.667,1.000)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
S5	(0.286,0.333,0.400)	(0.500,0.667,1.000)	(0.333,0.400,0.500)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Pairwise comparison with respect to Quality

C2	S6	S7
S6	(1.000,1.000,1.000)	(0.333,0.400,0.500)
S7	(2.000,2.500,3.000)	(1.000,1.000,1.000)

Figure B.7. Expert 1-1.

Pairwise comparison with respect to Service

C3	S8	S9	S10	S11	S12	S13
S8	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.500,3.000,3.500)	(2.000,2.500,3.000)	(2.000,2.500,3.000)	(1.500,2.000,2.500)
S9	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)	(2.000,2.500,3.000)
S10	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
S11	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)
S12	(0.333,0.400,0.500)	(0.286,0.333,0.400)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
S13	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Pairwise comparison with respect to Financials & Economics

C4	S14	S15	S16	S17
S14	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
S15	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.000,1.500,2.000)
S16	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
S17	(0.333,0.400,0.500)	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Unit Price

S1	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A2	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A3	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Figure B.8. Expert 1-2.

Alternative pairwise comparisons with respect to Transportation cost - plant location

S2	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(0.400,0.500,0.667)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(0.400,0.500,0.667)
A3	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(1.000,1.000,1.000)
A4	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Logistics cost

S3	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(0.333,0.400,0.500)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(0.333,0.400,0.500)
A3	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(1.000,1.000,1.000)
A4	(2.000,2.500,3.000)	(2.000,2.500,3.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Insurance cost

S4	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.286,0.333,0.400)	(0.286,0.333,0.400)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.286,0.333,0.400)	(0.286,0.333,0.400)
A3	(2.500,3.000,3.500)	(2.500,3.000,3.500)	(1.000,1.000,1.000)	(1.000,1.000,1.000)
A4	(2.500,3.000,3.500)	(2.500,3.000,3.500)	(1.000,1.000,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Tariff & Taxes

S5	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(1.500,2.000,2.500)	(1.000,1.000,1.000)
A2	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.500,0.667,1.000)
A3	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Figure B.9. Expert 1-3.

Alternative pairwise comparisons with respect to Conformance to specifications/design

S6	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.500,3.000,3.500)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Product reliability/durability

S7	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Demand fulfillment/Monthly production capacity

S8	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A3	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to On time delivery

S9	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.500,2.000,2.500)
A2	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)
A3	(1.000,1.500,2.000)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Figure B.10. Expert 1-4.

Alternative pairwise comparisons with respect to Flexibility & responsiveness

S10	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)
A3	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Communication & negotiability

S11	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)
A2	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A3	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Client references

S12	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A2	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A3	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Export experience

S13	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A3	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Figure B.11. Expert 1-5.

Alternative pairwise comparisons with respect to Payment term

S14	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(0.500,0.667,1.000)	(1.500,2.000,2.500)
A2	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(1.000,1.500,2.000)
A3	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Financial risk report (reliability/credibility)

S15	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Exchange rates

S16	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A3	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Economic conditions

S17	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)
A4	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)

Figure B.12. Expert 1-6.

Expert 2

Pairwise comparison with respect to Global & Domestic Supplier Selection*

G	C1	C2	C3	C4
C1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
C2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)
C3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
C4	(0.333,0.400,0.500)	(0.286,0.333,0.400)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Pairwise comparison with respect to Cost

C1	S1	S2	S3	S4	S5
S1	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.000,1.500,2.000)	(2.500,3.000,3.500)	(2.500,3.000,3.500)
S2	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)
S3	(0.500,0.667,1.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
S4	(0.286,0.333,0.400)	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.000,1.000)
S5	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(1.000,1.000,1.000)

Pairwise comparison with respect to Quality

C2	S6	S7
S6	(1.000,1.000,1.000)	(0.400,0.500,0.667)
S7	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Figure B.13. Expert 2-1.

Pairwise comparison with respect to Service

C3	S8	S9	S10	S11	S12	S13
S8	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(2.500,3.000,3.500)	(2.500,3.000,3.500)	(1.500,2.000,2.500)
S9	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(2.000,2.500,3.000)	(1.500,2.000,2.500)	(1.000,1.500,2.000)
S10	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(0.400,0.500,0.667)	(0.333,0.400,0.500)
S11	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(0.333,0.400,0.500)
S12	(0.286,0.333,0.400)	(0.400,0.500,0.667)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(0.333,0.400,0.500)
S13	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(2.000,2.500,3.000)	(2.000,2.500,3.000)	(2.000,2.500,3.000)	(1.000,1.000,1.000)

Pairwise comparison with respect to Financials & Economics

C4	S14	S15	S16	S17
S14	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
S15	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)
S16	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)
S17	(0.333,0.400,0.500)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Unit Price

S1	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(1.500,2.000,2.500)	(1.500,2.000,2.500)
A2	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A3	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(0.400,0.500,0.667)	(0.286,0.333,0.400)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Figure B.14. Expert 2-2.

Alternative pairwise comparisons with respect to Transportation cost - plant location

S2	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A3	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Logistics cost

S3	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.500,0.667,1.000)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.500,0.667,1.000)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Insurance cost

S4	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.400,0.500,0.667)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.500,0.667,1.000)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(1.500,2.000,2.500)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Tariff & Taxes

S5	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(0.500,0.667,1.000)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(0.500,0.667,1.000)
A3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Figure B.15. Expert 2-3.

Alternative pairwise comparisons with respect to Conformance to specifications/design

S6	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(2.000,2.500,3.000)
A2	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)
A3	(0.333,0.400,0.500)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Product reliability/durability

S7	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A2	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)
A3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Demand fulfillment/Monthly production capacity

S8	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A2	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A3	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to On time delivery

S9	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(1.500,2.000,2.500)
A2	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.500,2.000,2.500)
A3	(1.500,2.000,2.500)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Figure B.16. Expert 2-4.

Alternative pairwise comparisons with respect to Flexibility & responsiveness

S10	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)
A2	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A3	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Communication & negotiability

S11	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)
A2	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A3	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Client references

S12	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A2	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A3	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Export experience

S13	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)
A3	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)
A4	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(1.000,1.000,1.000)

Figure B.17. Expert 2-5.

Alternative pairwise comparisons with respect to Payment term

S14	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.500,0.667,1.000)	(1.000,1.500,2.000)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(1.000,1.500,2.000)
A3	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Financial risk report (reliability/credibility)

S15	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)
A3	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)
A4	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Exchange rates

S16	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A3	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Economic conditions

S17	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)
A4	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)

Figure B.18. Expert 2-6.

Expert 3

Pairwise comparison with respect to Global & Domestic Supplier Selection*

G	C1	C2	C3	C4
C1	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)
C2	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)
C3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
C4	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Pairwise comparison with respect to Cost

C1	S1	S2	S3	S4	S5
S1	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(1.000,1.500,2.000)	(2.500,3.000,3.500)	(2.500,3.000,3.500)
S2	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.500,2.000,2.500)	(1.000,1.500,2.000)
S3	(0.500,0.667,1.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(1.500,2.000,2.500)
S4	(0.286,0.333,0.400)	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
S5	(0.286,0.333,0.400)	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Pairwise comparison with respect to Quality

C2	S6	S7
S6	(1.000,1.000,1.000)	(0.400,0.500,0.667)
S7	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Figure B.19. Expert 3-1.

Pairwise comparison with respect to Service

C3	S8	S9	S10	S11	S12	S13
S8	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)	(1.500,2.000,2.500)
S9	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.000,1.500,2.000)	(2.000,2.500,3.000)	(1.500,2.000,2.500)
S10	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.333,0.400,0.500)
S11	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.333,0.400,0.500)
S12	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
S13	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(2.000,2.500,3.000)	(2.000,2.500,3.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Pairwise comparison with respect to Financials & Economics

C4	S14	S15	S16	S17
S14	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
S15	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
S16	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
S17	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Unit Price

S1	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A3	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Figure B.20. Expert 3-2.

Alternative pairwise comparisons with respect to Transportation cost - plant location

S2	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(0.400,0.500,0.667)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.400,0.500,0.667)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Logistics cost

S3	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.500,0.667,1.000)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.500,0.667,1.000)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Insurance cost

S4	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.500,0.667,1.000)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.500,0.667,1.000)
A3	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Tariff & Taxes

S5	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(1.000,1.500,2.000)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.000,1.500,2.000)
A3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Figure B.21. Expert 3-3.

Alternative pairwise comparisons with respect to Conformance to specifications/design

S6	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)
A3	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Product reliability/durability

S7	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A2	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)
A3	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Demand fulfillment/Monthly production capacity

S8	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.500,3.000,3.500)	(2.500,3.000,3.500)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(2.000,2.500,3.000)
A3	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to On time delivery

S9	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.500,2.000,2.500)
A2	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.500,2.000,2.500)
A3	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)
A4	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.000,1.000,1.000)

Figure B.22. Expert 3-4.

Alternative pairwise comparisons with respect to Flexibility & responsiveness

S10	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(1.000,1.500,2.000)	(1.500,2.000,2.500)
A2	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A3	(0.500,0.667,1.000)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(0.400,0.500,0.667)	(0.286,0.333,0.400)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Communication & negotiability

S11	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.000,1.500,2.000)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.500,2.000,2.500)
A3	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)
A4	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Client references

S12	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A2	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A3	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Export experience

S13	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)
A2	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A3	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Figure B.23. Expert 3-5.

Alternative pairwise comparisons with respect to Payment term

S14	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A2	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A3	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.333,0.400,0.500)	(0.286,0.333,0.400)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Financial risk report (reliability/credibility)

S15	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A2	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A3	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.333,0.400,0.500)	(0.286,0.333,0.400)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Exchange rates

S16	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.400,0.500,0.667)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.400,0.500,0.667)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Economic conditions

S17	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.400,0.500,0.667)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.400,0.500,0.667)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.333,0.400,0.500)
A4	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(1.000,1.000,1.000)

Figure B.24. Expert 3-6.

Expert 4

Pairwise comparison with respect to Global & Domestic Supplier Selection*

G	C1	C2	C3	C4
C1	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.500,2.000,2.500)	(1.000,1.000,1.000)
C2	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(0.500,0.667,1.000)
C3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
C4	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Pairwise comparison with respect to Cost

C1	S1	S2	S3	S4	S5
S1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.500,2.000)
S2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.000,1.500,2.000)	(0.400,0.500,0.667)
S3	(0.400,0.500,0.667)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(0.400,0.500,0.667)
S4	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.333,0.400,0.500)
S5	(0.500,0.667,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(1.000,1.000,1.000)

Pairwise comparison with respect to Quality

C2	S6	S7
S6	(1.000,1.000,1.000)	(0.500,0.667,1.000)
S7	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Figure B.25. Expert 4-1.

Pairwise comparison with respect to Service

C3	S8	S9	S10	S11	S12	S13
S8	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(1.500,2.000,2.500)
S9	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(1.000,1.500,2.000)
S10	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(0.333,0.400,0.500)
S11	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.500,0.667,1.000)
S12	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(1.500,2.000,2.500)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
S13	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(2.000,2.500,3.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Pairwise comparison with respect to Financials & Economics

C4	S14	S15	S16	S17
S14	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)
S15	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)
S16	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
S17	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Unit Price

S1	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(2.000,2.500,3.000)	(1.500,2.000,2.500)
A2	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(2.500,3.000,3.500)	(2.000,2.500,3.000)
A3	(0.333,0.400,0.500)	(0.286,0.333,0.400)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Figure B.26. Expert 4-2.

Alternative pairwise comparisons with respect to Transportation cost - plant location

S2	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(0.400,0.500,0.667)
A2	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)
A3	(1.500,2.000,2.500)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Logistics cost

S3	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(0.500,0.667,1.000)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.500,0.667,1.000)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)
A4	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Insurance cost

S4	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.400,0.500,0.667)	(0.500,0.667,1.000)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(0.400,0.500,0.667)
A3	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Tariff & Taxes

S5	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(2.000,2.500,3.000)	(1.000,1.500,2.000)
A2	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(1.000,1.500,2.000)
A3	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Figure B.27. Expert 4-3.

Alternative pairwise comparisons with respect to Conformance to specifications/design

S6	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A2	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A3	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(0.333,0.400,0.500)	(0.286,0.333,0.400)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Product reliability/durability

S7	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Demand fulfillment/Monthly production capacity

S8	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)	(2.500,3.000,3.500)
A2	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(2.000,2.500,3.000)
A3	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to On time delivery

S9	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(1.500,2.000,2.500)
A2	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)
A3	(1.500,2.000,2.500)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)
A4	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(1.000,1.000,1.000)

Figure B.28. Expert 4-4.

Alternative pairwise comparisons with respect to Flexibility & responsiveness

S10	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Communication & negotiability

S11	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)
A3	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(2.000,2.500,3.000)
A4	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Client references

S12	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A2	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A3	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(2.000,2.500,3.000)
A4	(0.333,0.400,0.500)	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Export experience

S13	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(2.000,2.500,3.000)
A2	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A3	(1.000,1.000,1.000)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(2.000,2.500,3.000)
A4	(0.333,0.400,0.500)	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(1.000,1.000,1.000)

Figure B.29. Expert 4-5.

Alternative pairwise comparisons with respect to Payment term

S14	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Financial risk report (reliability/credibility)

S15	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)
A3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Exchange rates

S16	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A3	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Economic conditions

S17	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Figure B.30. Expert 4-6.

Expert 5

Pairwise comparison with respect to Global & Domestic Supplier Selection*

G	C1	C2	C3	C4
C1	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.000,1.500,2.000)	(1.000,1.000,1.000)
C2	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(0.400,0.500,0.667)
C3	(0.500,0.667,1.000)	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
C4	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Pairwise comparison with respect to Cost

C1	S1	S2	S3	S4	S5
S1	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.000,1.500,2.000)	(2.000,2.500,3.000)	(1.000,1.500,2.000)
S2	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(0.400,0.500,0.667)
S3	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.333,0.400,0.500)
S4	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.333,0.400,0.500)
S5	(0.500,0.667,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(2.000,2.500,3.000)	(1.000,1.000,1.000)

Pairwise comparison with respect to Quality

C2	S6	S7
S6	(1.000,1.000,1.000)	(0.333,0.400,0.500)
S7	(2.000,2.500,3.000)	(1.000,1.000,1.000)

Figure B.31. Expert 5-1.

Pairwise comparison with respect to Service

C3	S8	S9	S10	S11	S12	S13
S8	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(1.000,1.500,2.000)
S9	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(1.500,2.000,2.500)
S10	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(0.400,0.500,0.667)
S11	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.400,0.500,0.667)
S12	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(1.000,1.500,2.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.333,0.400,0.500)
S13	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(1.000,1.000,1.000)

Pairwise comparison with respect to Financials & Economics

C4	S14	S15	S16	S17
S14	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)
S15	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)
S16	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
S17	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Unit Price

S1	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(2.500,3.000,3.500)	(2.000,2.500,3.000)
A2	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(1.500,2.000,2.500)
A3	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Figure B.32. Expert 5-2.

Alternative pairwise comparisons with respect to Transportation cost - plant location

S2	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(0.400,0.500,0.667)
A3	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Logistics cost

S3	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)
A3	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Insurance cost

S4	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)
A3	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Tariff & Taxes

S5	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)
A2	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Figure B.33. Expert 5-3.

Alternative pairwise comparisons with respect to Conformance to specifications/design

S6	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A2	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Product reliability/durability

S7	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A3	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Demand fulfillment/Monthly production capacity

S8	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A2	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.000,1.500,2.000)
A3	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(0.286,0.333,0.400)	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to On time delivery

S9	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Figure B.34. Expert 5-4.

Alternative pairwise comparisons with respect to Flexibility & responsiveness

S10	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Communication & negotiability

S11	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.500,0.667,1.000)	(0.500,0.667,1.000)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.500,0.667,1.000)
A3	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Client references

S12	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A3	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Export experience

S13	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)
A3	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(2.000,2.500,3.000)
A4	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(1.000,1.000,1.000)

Figure B.35. Expert 5-5.

Alternative pairwise comparisons with respect to Payment term

S14	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.000,1.500,2.000)	(2.000,2.500,3.000)
A2	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Financial risk report (reliability/credibility)

S15	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)
A3	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(2.000,2.500,3.000)
A4	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Exchange rates

S16	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)
A3	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Economic conditions

S17	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)
A3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.000,1.000)
A4	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.000,1.000)

Figure B.36. Expert 5-6.

Expert 6

Pairwise comparison with respect to Global & Domestic Supplier Selection*

G	C1	C2	C3	C4
C1	(1.000,1.000,1.000)	(2.500,3.000,3.500)	(2.500,3.000,3.500)	(2.500,3.000,3.500)
C2	(0.286,0.333,0.400)	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(0.500,0.667,1.000)
C3	(0.286,0.333,0.400)	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
C4	(0.286,0.333,0.400)	(1.000,1.500,2.000)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Pairwise comparison with respect to Cost

C1	S1	S2	S3	S4	S5
S1	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(2.000,2.500,3.000)	(2.000,2.500,3.000)	(1.500,2.000,2.500)
S2	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(1.000,1.500,2.000)
S3	(0.333,0.400,0.500)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(0.500,0.667,1.000)
S4	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
S5	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Pairwise comparison with respect to Quality

C2	S6	S7
S6	(1.000,1.000,1.000)	(1.500,2.000,2.500)
S7	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Figure B.37. Expert 6-1.

Pairwise comparison with respect to Service

C3	S8	S9	S10	S11	S12	S13
S8	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(2.000,2.500,3.000)	(2.000,2.500,3.000)	(1.500,2.000,2.500)
S9	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.500,2.000)
S10	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(0.333,0.400,0.500)
S11	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(0.400,0.500,0.667)
S12	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
S13	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(2.000,2.500,3.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Pairwise comparison with respect to Financials & Economics

C4	S14	S15	S16	S17
S14	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
S15	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)
S16	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)
S17	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Unit Price

S1	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(2.000,2.500,3.000)	(1.500,2.000,2.500)
A2	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(2.500,3.000,3.500)	(2.000,2.500,3.000)
A3	(0.333,0.400,0.500)	(0.286,0.333,0.400)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Figure B.38. Expert 6-2.

Alternative pairwise comparisons with respect to Transportation cost - plant location

S2	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(0.500,0.667,1.000)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(0.400,0.500,0.667)
A3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Logistics cost

S3	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.500,0.667,1.000)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(0.500,0.667,1.000)
A3	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Insurance cost

S4	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(0.400,0.500,0.667)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(0.400,0.500,0.667)
A3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.333,0.400,0.500)
A4	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Tariff & Taxes

S5	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(0.500,0.667,1.000)
A3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(0.400,0.500,0.667)	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Figure B.39. Expert 6-3.

Alternative pairwise comparisons with respect to Conformance to specifications/design

S6	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(2.500,3.000,3.500)
A2	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)
A3	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)
A4	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Product reliability/durability

S7	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)	(2.500,3.000,3.500)
A2	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A3	(0.286,0.333,0.400)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Demand fulfillment/Monthly production capacity

S8	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(2.000,2.500,3.000)	(1.500,2.000,2.500)
A2	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(2.500,3.000,3.500)	(2.000,2.500,3.000)
A3	(0.333,0.400,0.500)	(0.286,0.333,0.400)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to On time delivery

S9	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)
A2	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)
A3	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.333,0.400,0.500)	(0.286,0.333,0.400)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Figure B.40. Expert 6-4.

Alternative pairwise comparisons with respect to Flexibility & responsiveness

S10	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(2.500,3.000,3.500)	(1.500,2.000,2.500)
A2	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(2.500,3.000,3.500)	(2.000,2.500,3.000)
A3	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Communication & negotiability

S11	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(0.400,0.500,0.667)
A2	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(2.500,3.000,3.500)	(1.000,1.500,2.000)
A3	(1.000,1.500,2.000)	(0.286,0.333,0.400)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(1.500,2.000,2.500)	(0.500,0.667,1.000)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Client references

S12	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A2	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)
A3	(0.333,0.400,0.500)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)
A4	(0.286,0.333,0.400)	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Export experience

S13	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(1.000,1.500,2.000)	(2.500,3.000,3.500)
A2	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A3	(0.500,0.667,1.000)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(2.000,2.500,3.000)
A4	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(1.000,1.000,1.000)

Figure B.41. Expert 6-5.

Alternative pairwise comparisons with respect to Payment term

S14	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.333,0.400,0.500)	(1.000,1.500,2.000)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.333,0.400,0.500)	(1.000,1.500,2.000)
A3	(2.000,2.500,3.000)	(2.000,2.500,3.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)
A4	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(0.333,0.400,0.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Financial risk report (reliability/credibility)

S15	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A2	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A3	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.333,0.400,0.500)	(0.286,0.333,0.400)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Exchange rates

S16	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.333,0.400,0.500)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(0.400,0.500,0.667)
A3	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.286,0.333,0.400)
A4	(2.000,2.500,3.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Economic conditions

S17	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.400,0.500,0.667)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.400,0.500,0.667)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.333,0.400,0.500)
A4	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(1.000,1.000,1.000)

Figure B.42. Expert 6-6.

Expert 7

Pairwise comparison with respect to Global & Domestic Supplier Selection*

G	C1	C2	C3	C4
C1	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(1.000,1.000,1.000)
C2	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)
C3	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
C4	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Pairwise comparison with respect to Cost

C1	S1	S2	S3	S4	S5
S1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(1.000,1.500,2.000)
S2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)	(1.000,1.500,2.000)
S3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.000,1.000,1.000)
S4	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
S5	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Pairwise comparison with respect to Quality

C2	S6	S7
S6	(1.000,1.000,1.000)	(1.500,2.000,2.500)
S7	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Figure B.43. Expert 7-1.

Pairwise comparison with respect to Service

C3	S8	S9	S10	S11	S12	S13
S8	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)	(2.500,3.000,3.500)	(1.500,2.000,2.500)
S9	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.500,2.000,2.500)
S10	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(0.333,0.400,0.500)
S11	(0.286,0.333,0.400)	(0.400,0.500,0.667)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(0.333,0.400,0.500)
S12	(0.286,0.333,0.400)	(0.400,0.500,0.667)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
S13	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(2.000,2.500,3.000)	(2.000,2.500,3.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Pairwise comparison with respect to Financials & Economics

C4	S14	S15	S16	S17
S14	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
S15	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.000,1.500,2.000)
S16	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
S17	(0.286,0.333,0.400)	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Unit Price

S1	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(2.000,2.500,3.000)	(1.500,2.000,2.500)
A2	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(2.500,3.000,3.500)	(2.000,2.500,3.000)
A3	(0.333,0.400,0.500)	(0.286,0.333,0.400)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Figure B.44. Expert 7-2.

Alternative pairwise comparisons with respect to Transportation cost - plant location

S2	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.500,0.667,1.000)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.500,0.667,1.000)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Logistics cost

S3	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(0.500,0.667,1.000)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.500,0.667,1.000)
A3	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Insurance cost

S4	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.400,0.500,0.667)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.400,0.500,0.667)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Tariff & Taxes

S5	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.500,2.000)
A2	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(0.500,0.667,1.000)
A3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(0.500,0.667,1.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Figure B.45. Expert 7-3.

Alternative pairwise comparisons with respect to Conformance to specifications/design

S6	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.000,1.500,2.000)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.000,1.500,2.000)
A3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Product reliability/durability

S7	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)
A3	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Demand fulfillment/Monthly production capacity

S8	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(2.500,3.000,3.500)	(2.000,2.500,3.000)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(2.500,3.000,3.500)	(2.000,2.500,3.000)
A3	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to On time delivery

S9	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(2.000,2.500,3.000)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(2.000,2.500,3.000)
A3	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Figure B.46. Expert 7-4.

Alternative pairwise comparisons with respect to Flexibility & responsiveness

S10	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(1.500,2.000,2.500)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(1.500,2.000,2.500)
A3	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Communication & negotiability

S11	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.000,1.500,2.000)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.000,1.500,2.000)
A3	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Client references

S12	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
A3	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Export experience

S13	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(2.500,3.000,3.500)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(2.500,3.000,3.500)
A3	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(2.500,3.000,3.500)
A4	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(1.000,1.000,1.000)

Figure B.47. Expert 7-5.

Alternative pairwise comparisons with respect to Payment term

S14	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)
A3	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Financial risk report (reliability/credibility)

S15	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)
A3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(2.500,3.000,3.500)
A4	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Exchange rates

S16	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.400,0.500,0.667)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.400,0.500,0.667)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.333,0.400,0.500)
A4	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Economic conditions

S17	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A3	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Figure B.48. Expert 7-6.

Expert 8

Pairwise comparison with respect to Global & Domestic Supplier Selection*

G	C1	C2	C3	C4
C1	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(1.000,1.500,2.000)
C2	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)
C3	(1.000,1.500,2.000)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
C4	(0.500,0.667,1.000)	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Pairwise comparison with respect to Cost

C1	S1	S2	S3	S4	S5
S1	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(1.000,1.500,2.000)
S2	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(0.500,0.667,1.000)
S3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(0.400,0.500,0.667)
S4	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(0.333,0.400,0.500)
S5	(0.500,0.667,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(1.000,1.000,1.000)

Pairwise comparison with respect to Quality

C2	S6	S7
S6	(1.000,1.000,1.000)	(2.000,2.500,3.000)
S7	(0.333,0.400,0.500)	(1.000,1.000,1.000)

Figure B.49. Expert 8-1.

Pairwise comparison with respect to Service

C3	S8	S9	S10	S11	S12	S13
S8	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(2.500,3.000,3.500)	(1.500,2.000,2.500)	(1.000,1.500,2.000)
S9	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)	(1.000,1.500,2.000)	(1.000,1.500,2.000)
S10	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(0.400,0.500,0.667)	(0.333,0.400,0.500)
S11	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(0.286,0.333,0.400)
S12	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
S13	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(2.000,2.500,3.000)	(2.500,3.000,3.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Pairwise comparison with respect to Financials & Economics

C4	S14	S15	S16	S17
S14	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(2.000,2.500,3.000)
S15	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.500,2.000,2.500)
S16	(0.400,0.500,0.667)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)
S17	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Unit Price

S1	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(2.000,2.500,3.000)	(1.500,2.000,2.500)
A2	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(2.500,3.000,3.500)	(2.000,2.500,3.000)
A3	(0.333,0.400,0.500)	(0.286,0.333,0.400)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Transportation cost - plant location

S2	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(0.500,0.667,1.000)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(0.400,0.500,0.667)
A3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.400,0.500,0.667)

Figure B.50. Expert 8-2.

A4	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Logistics cost

S3	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)
A3	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Insurance cost

S4	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(0.500,0.667,1.000)	(0.333,0.400,0.500)
A2	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.333,0.400,0.500)
A3	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(0.333,0.400,0.500)
A4	(2.000,2.500,3.000)	(2.000,2.500,3.000)	(2.000,2.500,3.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Tariff & Taxes

S5	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(1.500,2.000,2.500)	(1.000,1.500,2.000)
A2	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(1.000,1.500,2.000)
A3	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Figure B.51. Expert 8-3.

Alternative pairwise comparisons with respect to Conformance to specifications/design

S6	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.500,3.000,3.500)	(1.000,1.500,2.000)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(1.000,1.500,2.000)
A3	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Product reliability/durability

S7	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.000,2.500,3.000)	(2.500,3.000,3.500)
A2	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)
A3	(0.333,0.400,0.500)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Demand fulfillment/Monthly production capacity

S8	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(2.000,2.500,3.000)	(1.500,2.000,2.500)
A2	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(2.500,3.000,3.500)	(2.000,2.500,3.000)
A3	(0.333,0.400,0.500)	(0.286,0.333,0.400)	(1.000,1.000,1.000)	(0.400,0.500,0.667)
A4	(0.400,0.500,0.667)	(0.333,0.400,0.500)	(1.500,2.000,2.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to On time delivery

S9	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(2.500,3.000,3.500)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(2.500,3.000,3.500)
A3	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(2.500,3.000,3.500)
A4	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(1.000,1.000,1.000)

Figure B.52. Expert 8-4.

Alternative pairwise comparisons with respect to Flexibility & responsiveness

S10	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(0.400,0.500,0.667)	(2.000,2.500,3.000)	(0.400,0.500,0.667)
A2	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(2.000,2.500,3.000)	(1.000,1.000,1.000)
A3	(0.333,0.400,0.500)	(0.333,0.400,0.500)	(1.000,1.000,1.000)	(0.286,0.333,0.400)
A4	(1.500,2.000,2.500)	(1.000,1.000,1.000)	(2.500,3.000,3.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Communication & negotiability

S11	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.500,2.000,2.500)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(1.500,2.000,2.500)
A3	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)
A4	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Client references

S12	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Export experience

S13	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.500,3.000,3.500)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(2.500,3.000,3.500)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(2.000,2.500,3.000)
A4	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(1.000,1.000,1.000)

Figure B.53. Expert 8-5.

Alternative pairwise comparisons with respect to Payment term

S14	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)	(0.400,0.500,0.667)
A3	(1.000,1.500,2.000)	(1.000,1.500,2.000)	(1.000,1.000,1.000)	(0.500,0.667,1.000)
A4	(1.500,2.000,2.500)	(1.500,2.000,2.500)	(1.000,1.500,2.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Financial risk report (reliability/credibility)

S15	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)
A2	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.500,2.000,2.500)	(2.500,3.000,3.500)
A3	(0.400,0.500,0.667)	(0.400,0.500,0.667)	(1.000,1.000,1.000)	(2.000,2.500,3.000)
A4	(0.286,0.333,0.400)	(0.286,0.333,0.400)	(0.333,0.400,0.500)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Exchange rates

S16	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.333,0.400,0.500)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(0.333,0.400,0.500)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(0.333,0.400,0.500)
A4	(2.000,2.500,3.000)	(2.000,2.500,3.000)	(2.000,2.500,3.000)	(1.000,1.000,1.000)

Alternative pairwise comparisons with respect to Economic conditions

S17	A1	A2	A3	A4
A1	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)
A2	(1.000,1.000,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)	(1.000,1.500,2.000)
A3	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)	(1.000,1.500,2.000)
A4	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(0.500,0.667,1.000)	(1.000,1.000,1.000)

Figure B.54. Expert 8-6.