DECISION MAKING MODEL FOR DETERMINING PROCUREMENT METHOD WITHIN PUBLIC-PRIVATE PARTNERSHIP FRAMEWORK FOR AIRPORT PROJECTS

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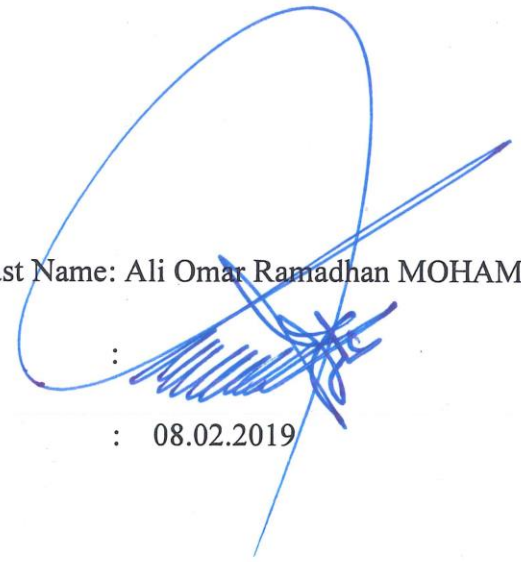

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ABSTRACT

DECISION MAKING MODEL FOR DETERMINING PROCUREMENT METHOD WITHIN PUBLIC-PRIVATE PARTNERSHIP FRAMEWORK FOR AIRPORT PROJECTS

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Public-private partnership (PPP) is the most important strategy mechanisms of project development. Adoption of PPP procurement as a strategy for infrastructure projects, such as airports, highways, bridges, water supplies, and telecommunication, has been implemented in developed and developing countries. PPP is expected to achieve added value for money through transparent procurement and the best quality of service. Although, PPPs are very complex and expensive, the success of these projects ensures significant outcomes for governmental organizations and practitioners. A comprehensive review of the literature on the critical success factors, risk factors and the decision-making tools of PPP projects not only aims to reveal the importance of these factors, it also shows the lack of a comprehensive decision-making model for determining an appropriate PPP procurement method. Airport projects in Turkey, in particular, constitute of some of the most capital demanding infrastructures and the level of key performance indicators (KPIs) to which these investments are subjected to is a great significance. On this basis, KPIs of PPP projects in developing countries (Turkey) and the selection of appropriate PPP procurement method for infrastructure projects, particularly for airport projects are critical issues that need to be analysed and investigated. Data for this study have been collected through a questionnaire with working in states and private PPP experts in Turkey. 20 CSFs and 46 risk factors of PPP projects have been clarified from an extensive systematic literature review. The questionnaire survey conducted on 167

experts of which 67 of them responded to PPP projects of airports from both public and the private sector in Turkey.

This study presents a methodology approach for a Decision-Making Model (DMM) to determine the best PPP procurement method considering KPIs for PPP airports projects for developing countries based on a case study. The model is expected to be used for infrastructure projects, mostly for airports. The DMM is structured on the Multi-Criteria Decision Making (MCDM) methods, basically AHP and PROMETHEE approach, which starts with the AHP method to prioritize and determine weights of the criteria for a specific case study (New Antalya airport - Turkey). PROMETHEE method is used to obtain final ranking for the alternatives. The AHP results revealed that the most important criteria for PPP airport projects in Turkey based on the case study are; finance risks; stability; operation risks; project and process quality; legal framework and regulatory risks; construction risks; project planning and strategy; transparent managements; and environmental and force majeure risks. Furthermore, the best PPP procurement method for new Antalya airport projects are obtained and ranked based on importance and listed as; build-operate-transfer (BOT); build-own-operate model (BOO); build-own-operate-transfer (BOOT); long-term-rent (LTR); and concession model. The validation of this methodology and the DMM by the experts from both sectors show that, they are an effective way for PPP procurement selection and they can be applied for the developing countries. They are an applicable, universal and testable which can be adopted as a tool and contribute to decision-makers to select the best fit PPP procurement method for airports projects in order to enhance projects successfully.

Keywords: Public-Private Partnership. Decision-making model, Airport, Critical Success Factors (CSFs), Risk factors, Key Performance Indicators.

ÖZ

KAMU-ÖZEL ORTAKLIĞI ÇERÇEVESİNDE HAVAALANİ PROJELERİNİN TEDARİK YÖNTEMİNİN BELİRLENMESİ İÇİN KARAR VERME MODELİ

Ali Omar Ramadhan MOHAMMED

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Şubat 2019

Kamu-özel ortaklığı (PPP), proje geliştirmenin en önemli strateji mekanizmalarından biridir. Gelişmiş ve gelişmekte olan ülkelerde havaalanları, otoyollar, köprüler, su kaynakları ve telekomünikasyon gibi altyapı projeleri için bir strateji olarak PPP alımının kabul edilmesi. PPP'nin şeffaf tedarik ve en iyi hizmet kalitesi ile paranın karşılığını alması beklenmektedir. Her ne kadar PPP çok karmaşık ve pahalı olsa da, bu projelerin başarısı kamu kuruluşları ve uygulayıcılar için önemli sonuçlar sağlamaktadır. Kamu-özel ortaklıkları projelerinin kritik başarı faktörleri, risk faktörleri ve karar alma araçları hakkındaki literatürün kapsamlı bir incelemesi, bu faktörlerin önemini ortaya çıkarmayı değil, aynı zamanda kapsamlı bir kararın olmadığını da gösterir. uygun bir PPP tedarikinin belirlenmesi için yapım modeli. Özellikle Türkiye'deki havaalanı projeleri, en çok talepkar altyapıların ve bu performansların uygulandığı temel performans düzeyinin, göstergelerin (KPI) bir bölümünü teşkil ediyor. Bu temelde, kamu-özel sektör Kİİ'leri, gelişmekte olan ülkelerdeki ortaklık projeleri (Türkiye) ve uygun PPP modellerinin seçimi, analiz edilmesi ve araştırılması gereken kritik konulardır. Bunun için veriler, eyaletlerde çalışarak ve Türkiye'deki özel PPP uzmanlarıyla anket yoluyla toplanmıştır. Kapsamlı bir sistematik literatür taramasından, 20 CSF ve 46 PPP projesi risk faktörü açıklığa kavuşturulmuştur.

Anket anketi, 67'si yanıt veren 167 uzmanla, hem kamudan hem de Türkiye'deki özel sektörden havaalanlarının PPP projelerine cevap verdi. Bu çalışma, Karar Verme Modeli (DMM) için, gelişmekte olan ülkeler için havalimanları projeleri için PPP'ler için KPI'ları göz önünde bulundurarak en iyi PPP tedarikini belirlemek için bir metodoloji yaklaşımı sunmaktadır. Modelin altyapı projelerinde, çoğunlukla havaalanlarında kullanılması bekleniyor. DMM, AHP yöntemiyle başlayan, temelde AHP ve PROMETHEE yaklaşımına dayanan Çok Kriterli Karar Verme (MCDM) yöntemleri, AHP yöntemiyle başlayan ve belirli bir vaka incelemesi için kriterlerin ağırlıklarını belirleyen (New Antalya havalimanı) üzerine yapılandırılmıştır. - Türkiye). PROMETHEE yöntemi alternatifler için nihai sıralama elde etmek için kullanılır. AHP sonuçları, Türkiye'deki PPP havaalanı projeleri için en önemli kriterlerin vaka çalışmasına dayandığını; finans riskleri; istikrar; operasyon riskleri; proje ve süreç kalitesi; yasal çerçeve ve düzenleyici riskler; inşaat riskleri; proje planlama ve strateji; şeffaf yönetimler; ve çevresel ve mücbir sebep riskleri. Ayrıca, yeni Antalya havalimanı projeleri için en iyi PPP alımları elde edilmiş ve önem sırasına göre; yap-işlet-devret (YİD); yap-işlet-işletme modeli (BOO); yap-işlet-işlet-devret (BOOT); uzun vadeli kiralama (LTR); ve imtiyaz modeli. Bu metodolojinin ve DMM'nin her iki sektörden uzmanlar tarafından onaylanması, PPP tedarik seçiminde etkili bir yol olduğunu ve gelişmekte olan ülkeler için uygulanabileceğini göstermektedir. Önerilen araştırma metodolojisi ve DMM, bir araç olarak benimsenebilecek uygulanabilir, evrensel ve test edilebilir olup, karar vericilere, projeleri başarıyla geliştirmek için havaalanları için en uygun PPP tedarik sistemini seçmelerine katkıda bulunur.

Anahtar Kelimeler: Kamu-Özel Ortaklığı, Karar verme modeli, Havaalanı, Kritik Başarı Faktörleri (BOS), Risk faktörleri, Anahtar Performans Göstergeleri.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

AHP:	Analytical Hierarchy Process
BOT:	Build Operate Transfer
BOO:	Build Own Operate
BOOT:	Build Own Operate Transfer
BLOT:	Build Lease Operate Transfer
CSF:	Critical Success Factor
DBO:	Design Build Operate
DBFO:	Design Build Finance Operate
DMM:	Decision Making Model
ELECTRE:	Elimination and Choice Translating Reality
OM:	Operation Maintenance
KPI:	Key Performance Indicators
LTR:	Long Term Rent
MCDM:	Multi Criteria Decision Making
PPP:	Public Private Partnership
PROMETHEE:	Preference Ranking Organization Method for Enrichment Evaluations
RF:	Risk Factor
PFI:	Private Finance Initiative
PPI:	Private Participation in Infrastructure

CHAPTER I

INTRODUCTION

1.1 Overview

This chapter presents a short explanation of the background to the research problem and an overview of the research topic. Research questions and objectives are also presented in this chapter in addition to the main research contributions and thesis organization, which provides a brief explanation of each chapter of the dissertation.

1.2 Research Background

The most important procurement strategies of project development actually are the Public Private Partnership (PPP) which is increasingly being used to implement infrastructure projects worldwide to support government funds and experience [1]. In order to deliver successful infrastructure projects, developed countries have implemented this PPP strategy in a variety of sectors, including, telecommunications, water projects, power, airports, sanitation, health and education [2]. PPP has been recognized as an efficient method of delivering value for money for public infrastructure and services [3]. For that, many authors in the literature have highlighted the need to manage and allocate risk in PPP projects [2, 4-9]. Successful completion of PPP projects depends very much on the quality of risk assessment [10]. Grimsey and Lewis [11] state that optimal risk allocation aims to reduce both the possibilities of project risks materializing and the consequences if they do. Optimal risk allocation has two elements: (1) optimal risk management and the motivation to achieve it; and (2) value for money.

Furthermore, many researchers and academics have sought to establish the critical factors affecting the success of PPP projects implementation, that may affect the effectiveness and efficiency of PPP procurement in developed and developing countries [12-15]. PPP has been practiced in many developed and a number of developing countries to deliver construction and building projects. Although the

adaptation of PPP in these places have many advantages that have been well documented, not all of these projects have been successfully implemented. For countries that are new at adopting PPP, it is even more important for them to identify the Critical Success Factors (CSFs) and the success criteria in order to implement these kinds of projects effectively and to reduce the risks for all parties [16]. Furthermore, effective management and proper risk allocation are the main factors for successful project implementation, especially during the entire project lifecycle.[17].

Osei-Kyei & Chan (2015) , in their review study, indicate that there have been five most reported CSFs for PPPs over the past 23 years, namely risk allocation and sharing, strong private consortia, political support, community/public support and transparent procurement. Osei-Kyei Robert, Albert P. C. Chan [18] demonstrate in their newest study about CSFs for PPP projects that every success criterion is critical. However, they emphasize seven critical criteria which affect the success of PPP projects: risk management effectiveness, output specifications achievement, good quality service operations, adherence to time, public services satisfaction, long-term relationships and partnerships, and profitability. The most attractive factors for the private sector to invest in public-private partnerships in developing countries include political support and acceptability for PPPs, a positive attitude on the part of a government towards private sector investments and political stability [19].

In contrast with developed countries, recent research shows variations in PPP implementation such that developing countries encounter many problems, such as instability of financial resources, lack of political will, public sector inadequacies, corruption in the contractual environment, and administrative bottlenecks [17, 20, 21]. These problems have created challenges in the formulation of full contractual agreements to cover all emergencies and reach value for money in public-private partnership projects [17, 22]. Moreover, the adoption of a PPP regulatory framework could be affected by the different economies legal systems. [23]. With regard to PPP decision-making, economic viability and value-for-money valuations are the main approaches of selecting and defining the scope of Public-Private Partnership projects. This choice does not consider the public attitudes and expectations of other stakeholders. However, it has been reported that the main reason for the failure of PPP projects in some cases is public opposition [17].

The Analytic Hierarchy Process (AHP) was first introduced by T. Saaty (1980). Many of AHP applications can be seen in various sectors such as business, management, government. The strength of AHP also lies in its simple mathematical calculations to perform decision making processes [24]. The AHP method has a specialty, which is its flexibility to be integrated with many techniques, including Linear Programming, Quality Function Deployment, Goal Programming, Data Envelopment Analysis and a number of other MCDMs, such as the PROMETHEE method. This advantage allows the user to benefit from all the combined methods, thereby better and more easily achieving desired goals [25, 26].

1.3 Statement of the Problem

PPPs have, in recent years, emerged as one of the major approaches to deliver infrastructure projects [27]. PPP procurements success is the eventual target of public and private sectors. Taking this into consideration, the last decade has seen valuable research and studies into the CSFs for PPP projects [18]. Furthermore, the identification and evaluation of risk factors and proper risk allocation are the two main themes in PPP risk management [6, 28], especially in large projects such as airport projects. In contrast with the recent research of developed countries showing variations in PPP implementation, developing countries face many problems, including the instability of financial resources, lack of political will, public sector inadequacies, corruption of the contractual environment and administrative bottlenecks [17, 20, 21]. For a long time, risk management in PPPs has attracted considerable attention from both scholars and practitioners. However, the lack of systematic risk assessment and a paucity of management frameworks have been two of the critical reasons for the failures of PPP projects [29, 30]. With regard to the decision process in PPPs, the value of availability, economic instability and contract efficiency have become the main methods involved in the selection and scoping of PPP projects. [17]. Because PPPs are a complex and usually have a long period contract, selecting the appropriate PPP model for a specific public service is not a simple process [31].

Based on the popularity of PPP projects the evaluation and selection of projects procurement method can be regarded as a MCDM problem, this study begins with an extensive systematic review of the relevant materials from journal articles,

conference papers, research reports and books to gather the background knowledge about PPP procurement methods and Key Performance Indicators (KPIs) for PPP projects. The objective of the literature review was to develop an overall research framework for the research. An in-depth study was conducted to define the most effective CSFs and risk factors (RFs) for PPP projects in PPP publications from 2000 to 2018. A multidisciplinary review of the literature on the public-private partnerships projects and their critical success factors, Risk factors and different MCDM methods used in this area of study are not only the aims to reveal the important the Key Performance Indicators (KPIs), it also shows the lack of a comprehensive Decision-Making Model (DMM) for the selection of an appropriate PPP procurement method. On this basis, KPIs of PPP projects, particularly airport projects in developing countries and the determination of appropriate PPP procurements method, are critical issues that need to be investigated.

1.4 Aims and Research Objectives

The aim of this study is to obtain a deep understanding of what PPP is and its application in developing countries and to develop a methodology approach for the DMM to determine a best-fit PPP procurement by considering KPIs for infrastructure projects, mostly for airports. The decision-making model is structured on the MCDM methods (AHP and PROMETHEE approach). The objectives of this research are, therefore, to:

1. Determine the most common CSFs and RFs in Public-Private Partnership projects found in international publications;
2. Identify and rank the most important CSFs and RFs for PPP projects in terms of KPIs, particularly for airport projects in developing countries (Turkey).
3. Develop a research methodology approach and a decision making model to determine a best-fit PPP procurement method considering KPIs for developing countries for infrastructure projects, mostly for airports;

1.5 Research Questions

To achieve the research objectives and to address the stated research problem, a number of Research Questions have been created as shown in figure 1.1 to provide a

focus for the research study: the main research questions in this study which guides this research is as follows:

RQ. How should a decision-making model be designed to determine a best PPP procurement method for infrastructure project, particularly for airports projects?

Four sub-research questions are developed to answer the main research question;

Q1. What are the most common CSFs, risk factors and KPIs of PPP projects particularly for airport projects?

Q2. How can we define and priorities the criteria for PPP airport projects?

Q3. What is the best-fit PPP procurement method for airport projects?

Q4. Are the proposed methodology and the DMM for determining the best PPP procurement for airport project being effective, applicable and valid?

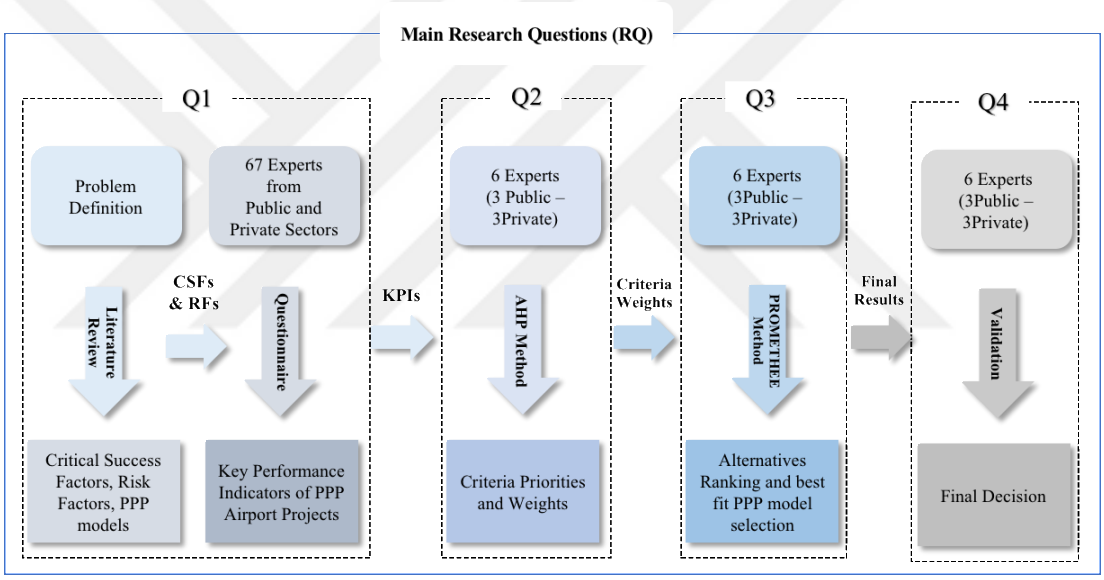


Figure 1.1. Research Questions Framework

1.6 Research Contributions

This research offers an innovative analytical and methodological approach to how to select a PPP procurement method for developing countries, particularly for airport projects. Furthermore, this study will assist public and private parties in PPP procurement to make correct and appropriate decisions regarding the selection and adoption of PPP procurements for airport projects by identifying the KPIs for these projects. The proposed model in this research will help to guide future researches and provide clear guidance to the public and private sector with regard to the significant KPIs that affect the selection of a best fit PPP procurement method. In addition, this

DMM offers steps of analysis and deep investigation of the factors that affect choosing a PPP procurement method.

1.7 Research Motivations and significance of the study

This section discusses the motivations for the work undertaken in this research. Although there are several studies in the field of PPP in developed countries and a few in developing countries based on the comprehensive literature study for the previous studies, there are limited studies that address the development of a methodology approach for a DMM to determine the best fit PPP procurement for infrastructure projects. Furthermore, this methodology can be used as a guide for developing a new regulation, standards and as a checklist for new PPP procurement method selection. It is believed that the proposed decision-making model and it is methodology will be helpful both for public and private sectors to make correct decisions for PPP procurement method selection. Moreover, the suitability and strength of AHP and PROMETHEE approach is another motivation for using these techniques.

1.8 Organization of the thesis

In this part, a brief description of the main chapters of the thesis. Six chapters are reported by their entire contents in this thesis and described as shown below.

Chapter 1: Introduction. This chapter explain briefly a background of the research problem and the research objectives. In addition, it also lists the main research question and sub questions and research contributions. This chapter also includes the organization of the thesis outline.

Chapter 2: Literature Review. Comprehensive literature review for the past studies about Public Private Partnership projects and its CSFs, RFs have been presented by detail in this chapter. Also, this chapter present the state-of-art of research in PPP and it is characteristic such as the CSFs and RFs of these projects. Furthermore, this review study discusses the different techniques of the MCDM methods that used in PPP topics.

Chapter 3: Research Methodology. This chapter illustrates the stages of the research methodology that was applied in this thesis to answer the research problem that

addressed in this thesis. In addition to a detail explanation to the DMM steps. The research methodology is divided into 5 stages; first aims to define the research problem, exploration, then evaluation the criteria, after that selection the alternatives stage, finally validation stage.

Chapter 4: Implementation with case study: This chapter outline the implementation of the DMM in addition to the questionnaire survey results followed by descriptive analysis of the questionnaire survey respondent's by using SPSS v25 software. Implementation of AHP-PROMETHEE approach. The application and the results of the AHP survey with experts have been illustrated by detail in this chapter and the result of PROMETHEE method for final decision based on the case study, in addition to a brief explanation to the research overall results.

Chapter 5: Discussion. In this chapter outcomes of the research are discussed by detail considering the case study.

Chapter 6: Conclusion. This chapter provides a conclusion of the research study and the major finding in addition to the research recommendation.

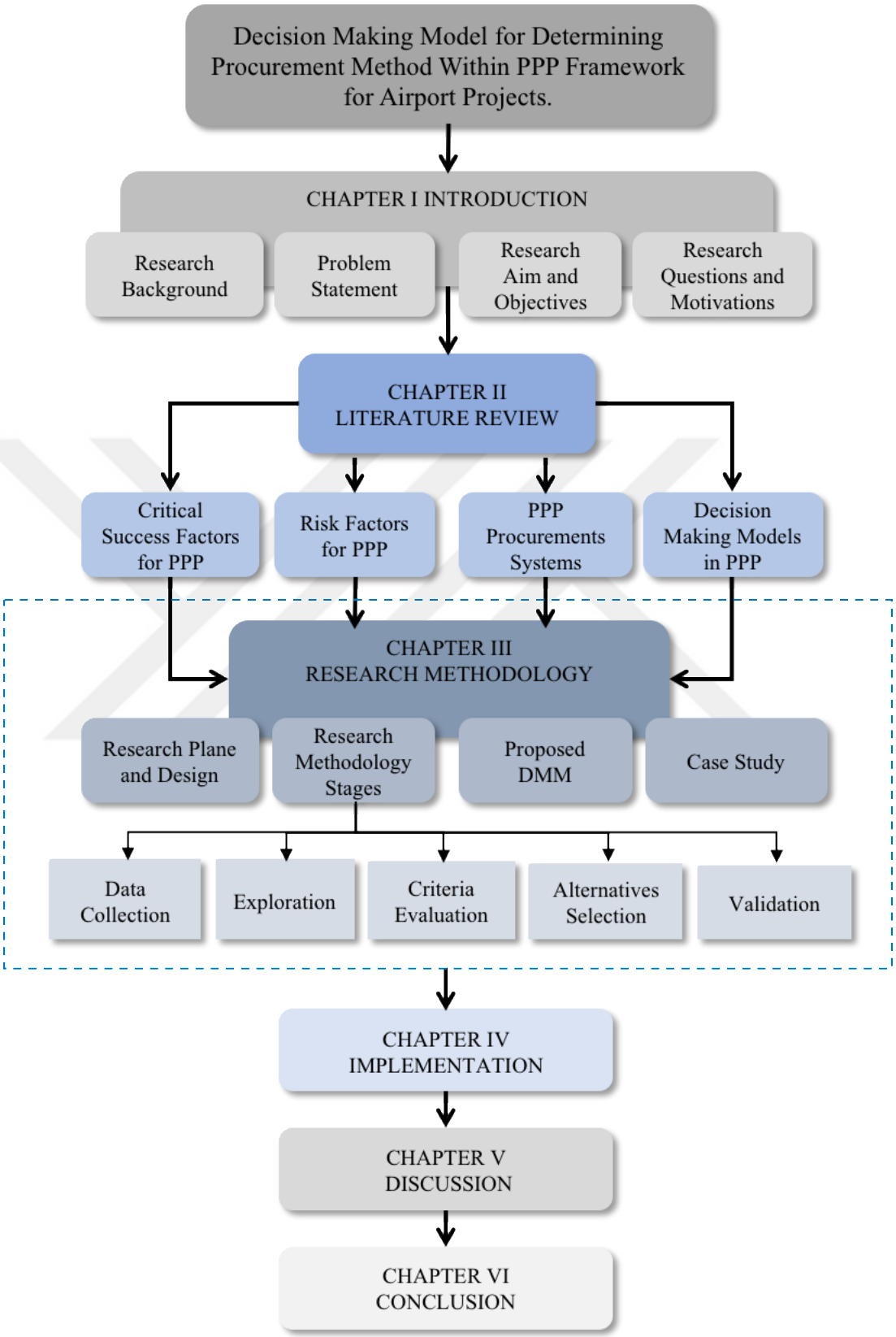


Figure 1.2. Organization of the thesis

CHAPTER II

LITERATURE REVIEW

2.1 Introduction to PPP

PPP has been adopted more and more widely for the past two decades[32], where it has been used in several industries and sectors including transport, water projects, technology, healthcare, rehabilitation and correction facilities, and urban regeneration [33]. Risks associated with the PPP projects are important factors to consider during the procurement of the projects due to their difficulty to control and analyze. Therefore, in order to achieve the project objectives for the public and privates stakeholders, it is imperative to implement risk management practices in the PPP projects for balanced risk and rewards for both parties [7, 34]. Due to the increasing demand for more and bigger infrastructure, governments started looking for new financing models for their projects, especially with the monetary fund constraints that are imposed by the struggling economies. A solution was found through involving the financial and technical capabilities of the private sector by building a Public-Private Partnership (PPP) [35]. The model is considered one of the most significant mechanisms for procurement for bigger development [2]. The recent financial crisis in 2007 to 2008 increased the interest in adopting the PPP model in developed and developing countries in order to provide the needed development by the governments [15]. Through a comprehensive literature review, Li, Akintoye [36] provided a summary of the positive and negative implications of using the PPP model, in addition to identifying the relative importance of each implication through the perception of the PPP stakeholders in the United Kingdom. Li et al., [37] mentioned four categories of positive factors that are related to enhancing the

technological and economic factors of the projects, providing more benefits to the public, eliminating the constraints imposed by the regulations and financial circumstances, and providing opportunity for the public entity to save transaction costs. Furthermore, three negative implication categories were mentioned, which are the lack of experience from the public and private stakeholders, the result of over-commercializing the projects, and the increase of time and cost for the stakeholders as a result of the adopted model. There are several developed and developing countries that put the PPP model into practice as a tool to develop infrastructure projects in many sectors, including electrical power, water services, telecommunication, healthcare, education, transportation, sanitation facilities, correction facilities, and many other projects that are aimed to service the public.

Although there are plenty of positive experience on the international level with the PPP model, its implementation is limited in the developing countries for the transportation, power infrastructure and telecommunication projects [2]. The PPP model is generally executed through a long-term concession contracts utilized for mega projects and infrastructures. The supplier in the PPP model is responsible for the building and after construction phases with a duration that may reach thirty years. Furthermore, this type of contracts is used extensively in the U.S., Canada, European countries and many developing countries in projects of different sectors including transportation, energy generation and transmission, water networks, Information Technology, correction facilities, waste management plants, educational and healthcare projects, and other sectors that target the service of the public [38]. There are factors that need to be included in order for the PPP model to function properly:

- The project should serve the mutual objectives and interests of all stakeholders; public and private, in order to provide the required services with benefits for both of them.
- The roles and responsibilities must be clearly defined for each stakeholder to form an understanding of the costs and risks associated with the project.
- An economic feasibility shall be studied for the project and reviewed periodically in order to create a “win-win” situation that benefits the public and the private sector.

- Implementing the PPP model requires a detailed planning during the development and the implementation phases, which is well-defined and monitored.

A successful PPP model prioritizes the benefits of both parties involved in the development and overlook the short-term self-interests of the individual party. Therefore, it should be viewed as a partnership that aims to benefit the public and private sector, rather than a grant or an opportunity to maximize winning on the account of the other side [39]. The popularity of the PPP model merges from its utilization in the infrastructure developments, which require very high investment financially that might not be available within the reach of the developing countries' governments [28]. Prior proceeding with an effective research about the PPP model, it is important to choose the most proper research methodology and the PPP types that are commonly used in the market. Through studying the construction management literature sources, there are four method that are used to study the PPP model; literature review, interviews, questionnaires and case studies. For studying CSFs for PPP projects, the popular research methodology have been used is case study method [15].

2.2 Definitions of Public-Private Partnership (PPP)

Although there is no specific and widely accepted definition for the PPP model, it can be described as a mechanism utilized by the government in order to procure strategic and infrastructure projects for the public through using the private sector's resources and expertise. It is important to perform a detailed long-term analysis to ensure that objective and risks are balanced for a rewarding PPP implementation. It is necessary for the legal and institutional entities to reinforce the implementation of the PPP model as an effective mechanism for project execution and operation, especially in developing countries [40]. Nonetheless, practically, adopting the PPP model imposes a variety of arrangements, which cannot be always defined uniformly [41]. There are several definitions for the PPP model, which were previously used in the literature:

- A description of the various possible relationships between the public and private sectors in providing infrastructure and public services projects [42].

- PPP is a long-term agreement between a government entity and a private entity to provide an asset or a service, where the private entity bears the main risk and take on responsibility of management, and the compensation is tied to the performance of the private entity, as per the definition of the PPP Knowledge Lab [40].
- The Canadian Council for Public–Private Partnerships (2004) defines PPP as a cooperation between public and private sector through the proven expertise of the stakeholders in order to satisfy a public need and distribute the resources and the risks, as well as the financial rewards, between the public and the private entities.
- An agreement between two or more entities to cooperate to achieve public needs and objectives, where finances and risks are shared, in addition to benefits.

For a full understanding of the PPP model, it is imperative to separate it for the conventional procurement models, as the boundaries between them are ambiguous. Nevertheless, the main distinguishing characteristic emerges for the risk management strategy; in conventional procurement the risk is borne by the public entity, while the PPP model allows the distribution of risk between the private and the public sector [43].

2.2.1 Differences between the PPP Model and Conventional Procurement

Conventional infrastructure procurement is performed through an acquisition mechanism that enable the government to reward the construction and management of the project to one or more private entity. Generally, the quantities and the qualities of the different project aspects are defined by the government entity responsible for the type of infrastructure, while the execution is awarded through a tender process. On the completion of the construction, the project is transferred to the government entity for operation and management [44]. Furthermore, the conventional procurement requires the government entity to manage the design of the project in order to hand it to the contractor, while the PPP model the government entity needs to define the service quality and capacity needed by the public, while the private sector take on designing, constructing and managing the project for the specified contract period [39]. The detailed differences between PPP and conventional procurement are shown in Table 2.1.

Table 2.1. Distinguishing points between the PPP and conventional procurement.

Conventional	PPP
• Public entity purchases an asset for infrastructure	• Public entity purchases the services of the infrastructure
• Short-term contract for design and construction ranging between two to four years	• Full long-term agreement including the design, construction, management and maintenance of the facility
• Specifications based on input	• Specifications based on output
• Bid winner satisfies the minimum requirements provided by the client with respect to quality through scoring the highest marks in the commercial and technical according to the specified weights	• Bid winner satisfies the mandatory requirements set by the client to deliver the required service, the design quality and the terms of construction and operation with the best value
• Whole-of-life asset risk is borne by the public entity	• Whole-of-life asset risk borne by the private entity
• The payment profile spikes at the start of the contract with the down payment with lower periodical costs	• Payment profile starts after the commissioning of the asset with even payments based on the service level provisioned over the long-term contract
• Construction time and cost overruns are the liability of the public entity	• Construction time and cost overruns are the liability of the private entity
• Facility operation is by the public entity	• Based on the contract terms, the public entity may or may not operate the facility
• The public entity needs to establish several contracts through the lifecycle of the facility	• The public entity establishes and manages one long-term contract over the lifecycle of the facility
• Often, no criteria are defined for ongoing performance	• Performance criteria are defined, and payments are determined based on it
• Low definition of handover quality	• High definition of End-of-term handover quality

The main advantage of PPPs is that both construction and operation tasks are the responsibility of a sole private entity; however, with conventional procurement, these

tasks are assigned to two separate contractors [11]. Hoppe et al., 2013 [45] conducted an empirical research that included a comparison of the PPP model and conventional procurement in the laboratory in terms of performance. The conclusion of the study shows that in contrast to conventional procurement, public–private partnership have very strong encouragement for cost reductions investment, while there are weak desirable and undesirable investment incentives.

2.2.2 PPP Model Types

For different project objectives and requirements, there are different types of PPP procurement method partnerships that have emerged, which vary based on the involvement extent of the private entity [40]. The types of the PPP methods have several defining terms, including; Design-Build-Transfer (DBT), Operation – Maintenance (OM), Design-Build-Operate (DBO), Build-Lease-Operate-Transfer (BLOT) , Build-Own-Operate-Transfer (BOOT) , Design-Build-Transfer-Operate (DBTO), Design-Build-Finance-Operate (DBFO) , Build-Own-Operate (BOO) etc. [46].

Table 2.2. Main types of Public-Private Partnership [27]

PPP Approaches	Definition
Operation – Maintenance (OM)	• The responsibility for all operation and maintenance aspects lies with the private entity • The private entity manages the capital investment, where the determination of the investment usage is also determined by both partners, despite the fact if financing is from the private or the public sectors
Design-Build-Operate (DBO)	• The design, construction, operation, and maintenance of the project is the undertaken by the private entity before handing it over to the public entity for the specified contract period
Design-Build-Finance-Operate (DBFO)	• The financing, design, construction, operation, and maintenance of the project is the responsibility of the private entity, while the full ownership is maintained with the public entity
Build-Operate-Transfer (BOT)	• The financing, design, construction, operation, and maintenance of the project is the responsibility of the private entity for the contract period, while ownership is transferred to the public entity at the end with no cost
Build-Own-Operate (BOO)	• The project is fully owned by the private entity in perpetuity, while the public entity purchases the services of the project for a specified contractual time

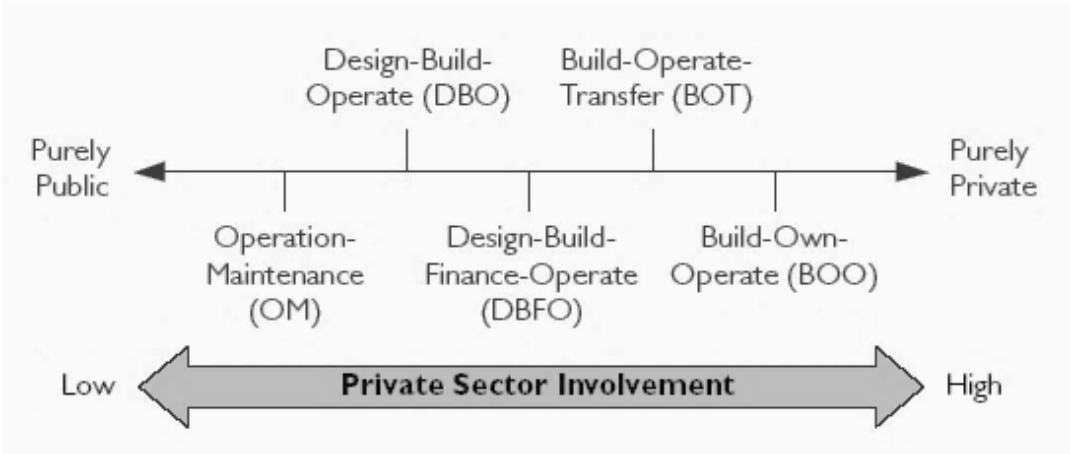


Figure 2.1 Continuum of Types of PPP [27].

2.2.3 PPP's Advantages and Disadvantages

There are many advantages of the PPP model as it allows the utilization of the privates sector's finances, technical and managerial experience, and innovation. Moreover, the model facilitates less lifecycle cost, distributed risk, enhanced service and perfromance quality, and improved public management [47]. Another advantage of the approach is its ability to utilize resources efficiently, where the public entity focuses on its core competencies and transfer the unfamiliarity with the project risk to the private entity [48]. Furthermore, utilizing the skills, experience, available technology and innovation of the private sector allows a satisfactory project delivery with shared risks along the different stages of the project [49]. In spite of the many benefits emerging from adopting the PPP model, there are several challenges that arise in its planning, execution, monitoring and control that differs based on the project and country conditions [50].

Several benefits can result from adopting the PPP model, if it was appropriately structured, executed and managed. Kwak and Ibbs [27], [51] concluded several important benefits for PPP procurement, including but not limited to:

1. Increasing the "value for money" with infrastructure projects through lower and efficient costs with dependable service quality.
2. Helping to maintain the budget of the public sector budgets, especially in the presence of budget deficiencies.

3. Allows the avoidance of early capital and administrative costs for the public sector.
4. Reduction of the project's life-cycle costs and delivery time.
5. Quality enhancement and increase of infrastructure services' efficiency.
6. Allowing innovative solutions in the development of infrastructure services.
7. The transference of construction, financial and operational risks from the public sector to the private sector.
8. Simulating the growth of the local economy through increasing employment rate and providing further opportunities.

In spite of the several benefits and their role in increasing the development of infrastructure services, the PPP projects faced several critics from specialists, which includes the following arguments:

1. The model is considered as a new concept that its knowledge is not well-spead in some countries.
2. The knowledge and skills required by the model are often unavailable with both the public and private sectors, or one of them.
3. The competitive nature of the conventional procurement is absent in the PPP model, which emerges from its high financial burden.
4. Delays are imposed on the planning and implementation of the PPP model because of the political disagreements, opposition by the public, or the complexity of contract negotiations.
5. Increase of costs is expected through the PPP model as the borrowing interest rates are higher for the private entities, in comparison with governmental entities.
6. Reduction in accountability as a result of the information treated as "commercial-in-confidence".
7. The PPP model results into a monopoly situation, which imposes higher fees on the public who are using the infrastructure services [27, 52].

2.2.4 PPP Project Phases

The PPP project goes through several phases during its development, which can be defined through five main phases, which can start and finish in an consecutive or parallel manners [39].

1. Initiation phase: the feasibility of using the PPP model is determined in this stage of preliminary investigations through evaluating the public current and future needs, studying the alternative models and assessing the risks associated with the model adoption.
2. Design phase: The project is announced, private entities are prequalified, and the procurement process is initiated. The PPP contract is signed upon award to the most lucrative tender. In order to ensure the decision feasibility, the financial and the technical capabilities are audited.
3. Building phase: The design of the facility is planned, detailed and constructed, while operation and service plans are finalized.
4. Operation phase: The operation of the facility is commenced, services are provided to the public and maintenance activities become effective, as per the signed contract.
5. Transference phase: After the completion of the contract period, the facility operation and service responsibilities are transferred to the public entity, if the contract is not extended. The measurements and the processes of transference depend on the PPP model that is applied in the contact.

It is recommended that the public entity intensifies its involvement during the initiation phase in order to ensure awarding a contract that will yield the desirable outcomes. Nonethless, the PPP model requires a hands-on involvement by the public entity during all the phases to follow up the contract execution. Figure 2.2 shows the PPP model processes during the described phases.

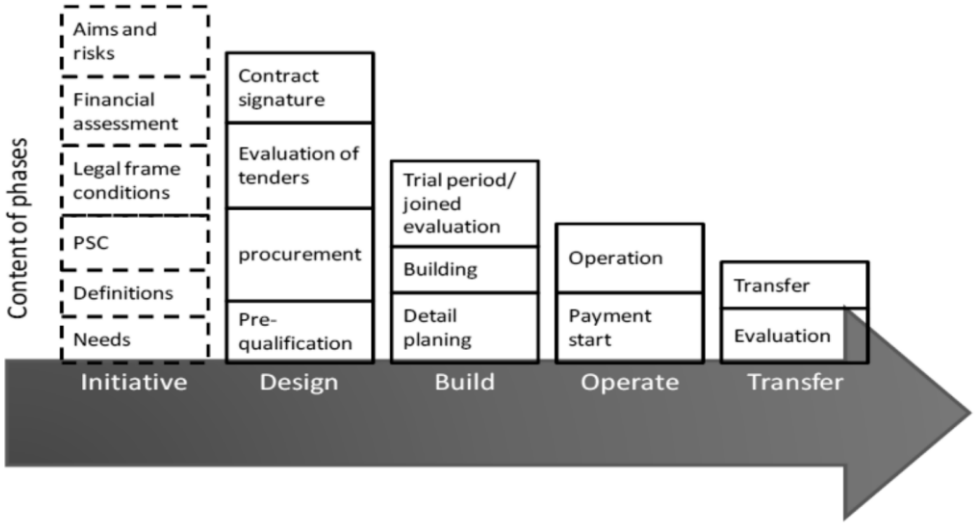


Figure 2.2. The sequence of PPP process[39].

2.2.5 PPP Model Forms

Based on the degree of the private entity's structure, participation, resources, risks and awards, the model of implementing the public-private partnership is implemented. The balance of the partnership is determined according to the domination in it between the private and the public entity. The World Bank has provided a broader classification of the infrastructure sector's contracts, where PPP transactions are classified into the following categories [53]; management and operation contract (M&O); concession; greenfield projects and divestiture (full private ownership)

Organization and Operation Contract (M&O): These types of contracts are structured for management or lease-operate long-term contracts. The M&O contract allows the public project to be negotiated and executed with a specialized private entity, where it takes on the responsibilities of management and operations. Furthermore, the public entity remains the owner of the facility under this contract and is responsible of the capital and operation finances.

Greenfield Projects: There several types of the PPP model that can be used with this type of contracts, including BLO (Build Lease Own), BOO (Build Owen Operate) and BOT (Build Operate Transfer). This contract is executed through forming a joint venture between the private and public entities, or solely a joint venture of private entities, that build and operate the facility through a specified contract period. At the end of the concession period, the facility is returned to the public entity as the owner and the operator, while capital and operation expenditure are distributed between the different stakeholders.

Divestiture: Several cases apply to this form, where either a full contract is signed and the private entity receives 100% transference of the equity from the government entity, or a partial contract is signed where part of the equity is transferred. Moreover, the PPP projects are classified according to the contract type by the Asian Development bank into six categories; Service contracts, Management contracts, Afterimage (franchise) or lease contracts, build–operate–transfer (BOT) and similar arrangements, Concessions, and Joint ventures. Table 2.3 shows a summary of the characteristics of the different PPP contracts [54, 55].

Table 2.3. The key characteristics of the different PPP contracts [56]

Branch	Service contracts	Management contracts	Lease contracts	Concessions	BOT
Scope	Several contract forms dedicated for different services	The full operation and/ or major components are managed	Operations, management and special renewals are within the main scope	Financial and operational responsibility under the private entity.	One or more major components are managed for investment and operations
Asset Ownership	Government entity	Government entity	Government entity	Shared public and private ownership	Shared public and private ownership
Duration	1 to 3 years	2 to 5 years	10 to 15 years	25 to 30 years	Variable
O&M Responsibility	Government entity	Private entity	Private entity	Private entity	Private entity
Capital Investment	Government entity	Government entity	Government entity	Private entity	Private entity
Commercial Risk	Minimal	Government entity	Distributed	Private entity	Private entity
Overall Level of Risk Assumed by Private Sector	Based on Unit prices	Minimal to moderate risk	Moderate risks	High risks	High risks
Compensation Terms	Concentrated and continuing	Fixed budget, incentives for performance may exist	Fixed amount or percentage of revenues	Full or partial revenues	Fixed fees with variation based on production
Competition	Productive and incentivizes efficient production in the public entity	Single reward with no renewals	Main contract awarded, while subsidiary contracts are negotiated separately	Main contract awarded, while subsidiary contracts are negotiated separately	A main contract negotiated with a capable private entity, eliminating competition
Special Features	Simulates development of the private sector in the domestic market	Intermediate solution as a demonstration for more private sector involvement	Enhances the efficiency of operations and finances; Skills and career development for local professionals	Enhances the efficiency of operations and finances; Incentivize investment; Skills and career development for local professionals	Incentivize investment; Skills and career development for local professionals
Problems and Challenges	Demands special administration skills and expertise of several contracts and controls	Lack of sufficient control over significant project elements, including budget, resources and human resources	Possibility of conflicts between the public and private entities over investment and finances	Investment compensation tools and implementation, as well as after construction maintenance control over a long period of time reaching to 10 years	No positive influence on operations efficiency; guarantees may be required

As shown in Table 2.3, there are variety of contracts and forms that used for the PPP model, where the risks can be borne completely by the private entity, the public entity or be distributed between them with different proportions depending on the

adopted mechanism. Based on the above comparison, the following observations are noted:

- The applied PPP model is minimally influenced by the facility ownership, as concession or PFI model can be utilized regardless of the contract type.
- Through studying several sources, there is no unified terminology used for the different contract types; however, the researcher used the most common terms to in the description.
- Table 2.4 is provided to show the most significant models used, while variations in the contract's structure may occur to suite the special requirements of the project. Moreover, the provided classification may vary even based on the applied country due to domestic market variations, e.g. note water supply and waste-water utilities.
- The dependency of the public sector on in-house capabilities, resources and expertise is exiting in many countries, which shows opportunities for more PPP model implementation.
- Infrastructure facilities owned by the public entity, while managed by a private entity, is a common model observed in countries like France: Through Affermage contracts water infrastructure facilities are managed by the private sector with long-term management contracts reaching to 12 years.
- In several countries, including Turkey and China, the PFI model is utilized to transfer risks and finances to the public entity, while payments are taken from the public entity rather than the end-users. The model is implemented through BOT/BTO contracts in developing of water-services.
- Concessions, which is considered the most common PPP form in the developing counties, allows the private entity to collect regulated tariff payments from the end-users. Nonetheless, the private sector takes on risks regarding the demand volume of the facility, while meeting service quality and availability requirements, which are factors borne by the public entity at the end of the concession period.
- Privatization, or the BOO form of PPP, can be found in several developed and developing counties where private entities were given the ownership of the assets of the public services, e.g. Water services in England and Chile, while the government role turned into regulating the services between the provider

and the end-user through monitoring, control and laws. The intervention of the public entity includes minimum cost and rate of return investigation and control.

Therefore, it can be observed through the utilization of the model that the effectiveness of implementing the PPP mechanism can vary based on the infrastructure type. For instance, infrastructures such as roads cannot be privatized. Therefore, the concession or the PFI model becomes the most sensible options as PPP implementation mechanisms to utilize the private sector financial capabilities. Furthermore, the PPP forms used for other types of infrastructure projects, e.g. water services, have been found contrasting based on the risks and rewards between privatization and other PPP models. In other examples, such as telecommunication infrastructures, licensing is the most common form of business conduct, rather than using any of the PPP model forms in order to maintain competitiveness and prevent monopolies. The limitation of the private sector involvement in any public infrastructure or activity is provided by the government, where the example of the defense services can be given as a model. The public authority controls the military; however, services, accommodation and equipment can be provided by a private entity.

Table 2.4. Infrastructure provisions for public and private entities [54, 55]

	Public project ◄					► **Private project**
			◄ **Public–Private Partnership** ►			
Contract Type	**Public-sector procurement**	**Franchise (*Affermage*)**	**Design-Build Finance-Operate (DBFO)***	**Build-Transfer-Operate (BTO)****	**Build-Operate-Transfer (BOT)*****	**Build-Own-Operate (BOO)**
Construction	Public sector(2)	Public sector(2)	Private sector	Private sector	Private sector	Private sector
Operation	Public sector(3)	Private sector	Private sector	Private sector	Private sector	Private sector
Ownership(1)	Public sector(4)	Public sector	Public sector	Private sector during construction, then public sector	Private sector during Contract, then public sector	Private sector
Who pays?	Public sector	Users	Public sector or users	Public sector or users	Public sector or users	Private-sector offtaker public sector(5), or users
Who is paid?	n/a	Private sector	Private sector	Private sector	Private sector	Private sector

* Also known as Design-Construct-Manage-Finance (DCMF) or Design-Build-Finance-Maintain (DBFM)
** Also known as Build-Transfer-Lease (BTL), Build-Lease-Operate-Transfer (BLOT) or Build-Lease-Transfer (BLT)
*** Also known as Build-Own-Operate-Transfer (BOOT)
(1) In all cases, ownership may be in the form of a joint venture between the public and private sectors (*cf.* §17.5).
(2) Public sector normally designs the Facility and engages private-sector contractors to carry out construction on its behalf (design-bid-build).
(3) Public sector may enter into service (outsourcing) contracts (for operation and maintenance) with private-sector contractors.
(4) Ownership may be through an independent publicly-owned Project Company, *i.e.* a 'Public-Public Partnership' (*cf.* §17.2.2).
(5) The BOO Contract form applies to PPPs in the minority of cases where ownership of the Facility does not revert to the Public Authority at the end of the PPP Contract (*cf.* §15.11).

2.3 PPP in Developing Countries

More than 120 developing countries had private sector involvement in infrastructure project during the 1990s, where the income in 41% of these countries is classified as low, 39% had low middle, and 20% had upper middle income [57]. Infrastructure projects, including transport, power, telecommunication and utilities, with the value of 2,653 billion USD were financed by the private sector in the developing countries between 1990 and 2012, as per the data base of the World Bank. These projects form 46% of the total worldwide projects, as shown in Table 2.4 and Figure 2.3.

Table 2.5. Infrastructure Investment for developing countries - the number of projects (1990-2012)[53].

Region	No. of projects	Investment in Million
Latin America and the Caribbean	1,707	769,444
East Asia and Pacific	1,666	358,547
South Asia	972	358,259
Europe and Central Asia	819	312,989
Sub-Saharan Africa	471	133,917
The Middle East and North Africa	148	93,101
Total	**5,781**	**2,026,257**

In terms of class, the private investment takes on the form of divestiture (23.91%), Greenfield (57.52%), M&O (0.35%), and the Concession procurement model (18.22%), as shown in Figure 2.4.

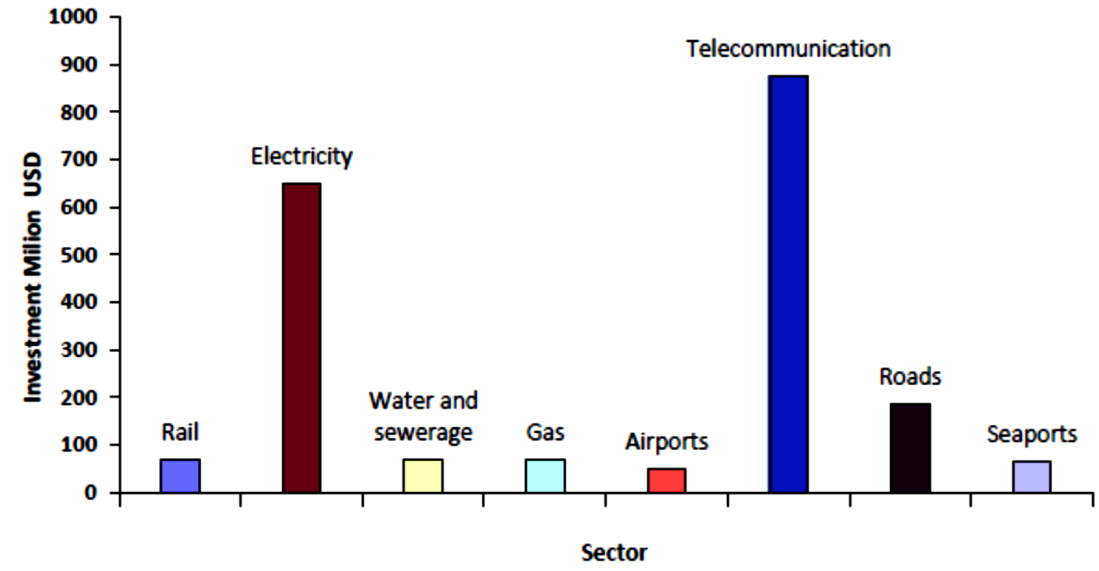


Figure 2.3. Private infrastructure projects investment of developing countries (1990-2012) in Millions of USD[53].

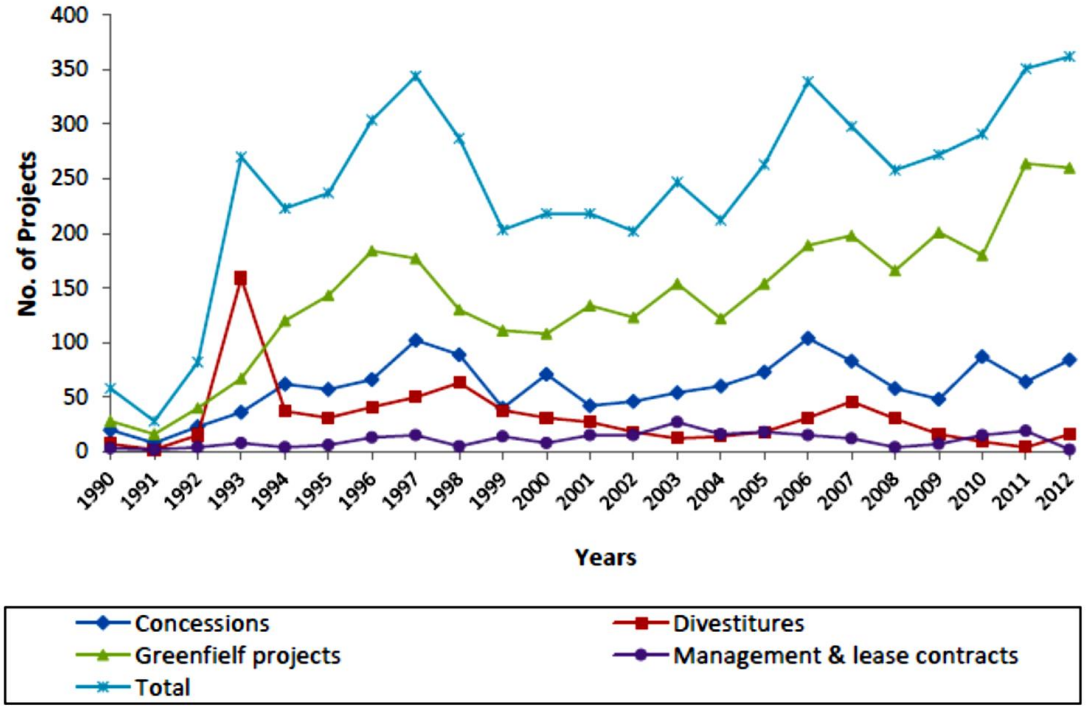


Figure 2.4. Infrastructure projects numbers participation with private in developing countries by type of project, 1990–2012 [53].

Total investment of the telecommunications and electricity sectors are representing respectively about 43.16% and 31.93%, (See Figure 2.5).

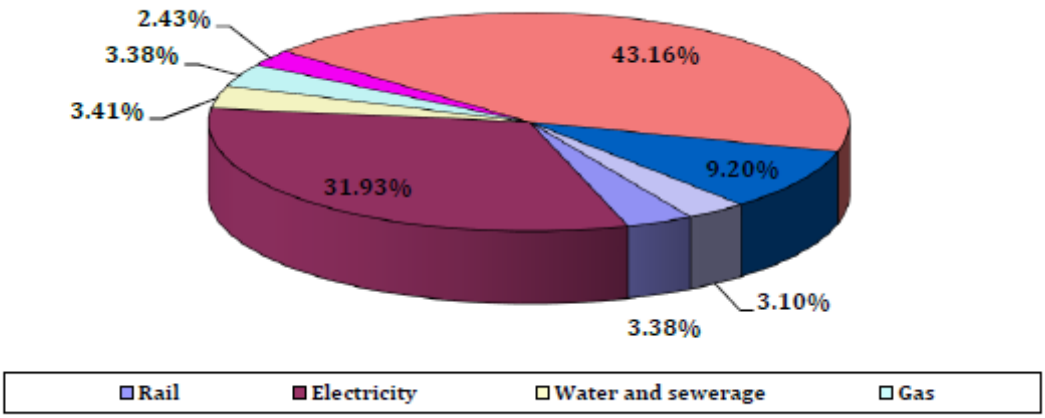


Figure 2.5. Investment in infrastructure projects by private sector in developing countries (1990-2012) [53].

Energy (Electricity and Gas), telecommunications and transport are the top three sectors which received most investment commitment with private participation (See Figure 2.6).

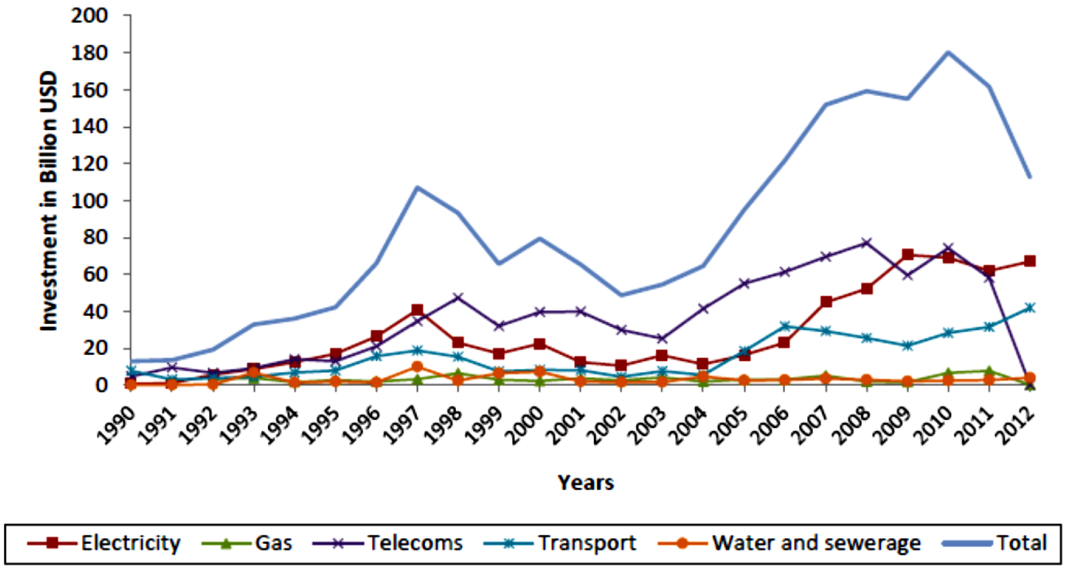


Figure 2.6. Infrastructure Investment in projects in different sectors with private participation in developing countries, 1990–2012 [53].

Transportation sectors, in particular airports formed $2 billion for three projects, making it the second highest investment. In Turkey, the highest PPP project value was attributed to Dalaman, with the value exceeding $1.1 billion for the domestic terminal through a 25-year concession contract. The other two projects were the Mactan-Cebu International Airport Project in the Philippines and the second one is the Ernesto Cortissoz International Airport in Colombia.

Turkey in 2015 capture the highest investment in Private Participation in Infrastructure (PPI) transport sector, especially in airports projects followed by respectively, Colombia, Peru, India, and the Russian Federation. In 2018 as indicated at private participation in infrastructure (PPI) world bank database, that summarized the private sector activity across infrastructure projects and the number of projects at developed and developing regions. As shown in figure 2.8 Top 10 countries around the world are listed based on the amount of the investment, as well as Turkey have ranked in the fourth place [58].

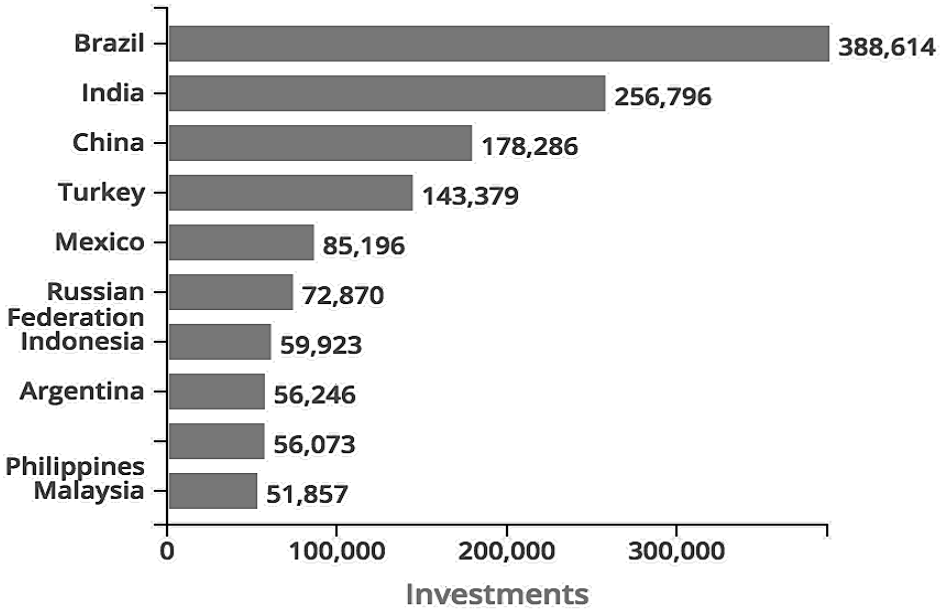


Figure 2.7. Top 10 countries by investment (US $ million) (1990-2018) [58].

Furthermore, (PPI) world bank database also present the top 10 countries by the number of projects. This ranked based on the countries activity for developing the infrastructure projects, Turkey as an active country for adopting a huge number of these projects by 224 projects it ranks in the 7th place [58].

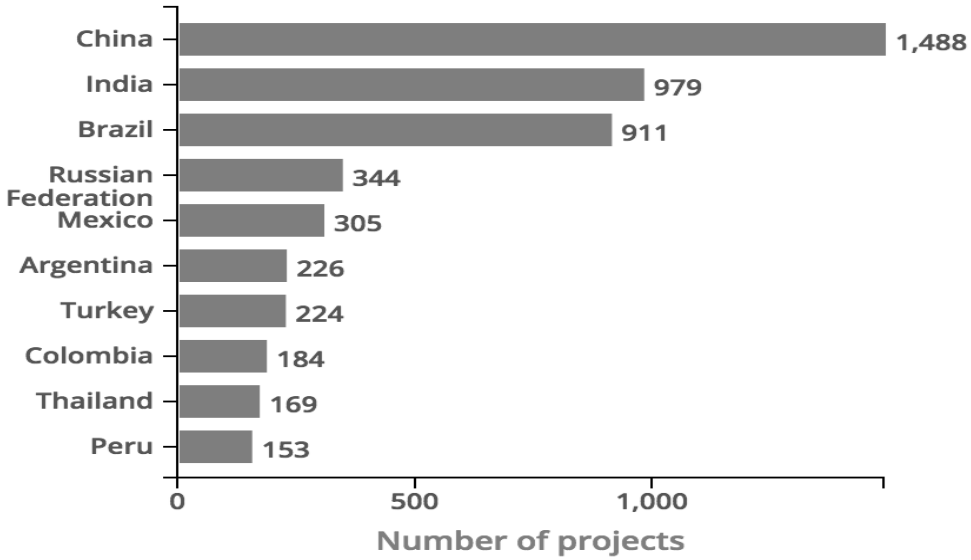


Figure 2.8. Top 10 countries by number of Projects (1990-2018) [58].

2.3.1 PPP in Turkey

Turkey like other developing countries need of varied public services to achieve the demand of new infrastructure construction and renewal of the existing. For this reason, funding is one of the important keys to meet this increasing demand. Most of the time government funding is insufficient, which requires financing from other resources, allow the private sector to invest in public projects, and recover shortfalls in government budget. The World Bank data of 2011 shows that Russia and Turkey investment volume form the concentration of investments in Europe and Central Asia [59]. In the Eurasia region and within the past few years, Turkey has used the model in plenty of infrastructure projects through utilizing the PPP model actively. Moreover, the country built an ambitious PPP portfolio, which awaits realization in the upcoming years [60]. The PPP procurement method is in use in developed and developing Eurasia countries (ECA), as the World Bank's data records 1,263 delivered projects with a value exceeding $95 billion between 2008 and 2013.With 124 PPP projects with the value of $43 billion within the same period, Turkey had accounted for more than 45% both project numbers and values.

Such numbers put Turkey in the top of the ECA list of the most active user of PPP contracts and the third among 98 developing counties on the global level following India and Brazil. The capacity of the public and private sector in Turkey allows

them to adopt the PPP model confidently, which is demonstrated through the number of projects in several sectors, which are planned, under execution or completed. Table 2.4 breaks down the PPP projects according to their sector and type.

It is evident that in the Turkish case study the number of delivered PPP projects is an indicator of the success of the model, which resulted into development and expansion in service quality and public services. Nevertheless, the aging assets in the country still requires additional investment in order to enhance their quality. As shown by the ambitious Turkish PPP portfolio and through the proven experience, the developing countries have a clear case of success in utilizing the model in country development, while it is necessary to understand the implications of the approach [60]. The use of an aggressive PPP approach had set an example for the developing countries in order to restructure development and growth, in spite of the huge value that need to be invested. For example, IGA Airport in Istanbul, a 25-year BOT project is Turkey's third International airport, located in the European side of Istanbul.

Table 2.6. Investment values of PPP projects in Turkey (1990-2013) [60].

Sectors	Sub-types					
	BOO	**BOT**	**BRT**	**Concessions**	**TOOR**	**Total**
Electricity	3677 (5)	3250 (25)			13 017 (46)	19 943 (76)
Airports		40 587 (13)			9645 (6)	50 232 (19)
Roads		10 306 (22)				10 306 (22)
Seaports		309 (16)			1659 (17)	1968 (33)
Hospitals			3826 (5)			3826 (5)
Telecom				13 208 (4)		13 208 (4)
Border gates		335 (13)				335 (13)
Water and sewerage		865 (2)				865 (2)
Total	**3677 (5)**	**55 651 (91)**	**3826 (5)**	**13 208 (4)**	**24 322 (69)**	**100 684 (174)**

Note: Values in brackets depict the number of projects, while others indicate the value of projects. The data includes only the contracts of the central government. The investment values refer to a number of physical assets in the greenfield projects i.e. BOT, BOO, and BLT and payment commitments to the government in TOOR and concession projects [63].

Based on World Bank information [61], about 215 PPP projects with total investment 136 billion dollar from 1990 – 2017 have been constructed. From figure 2.10. It is clear that the huge investment was in 2015 with the 3rd airport project in Istanbul by and the maximum number of the projects was in 2011. In addition, the highest investment was in electricity and airports sectors which emphasize that the airport sector is an important subject that need more investigation figure 2.9

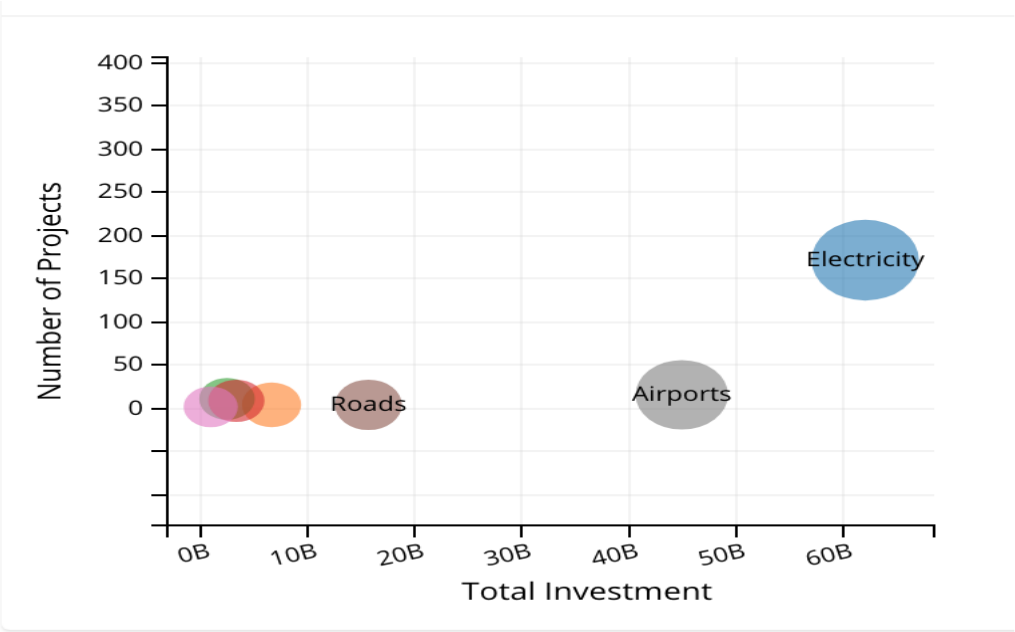


Figure 2.9. Sectors with highest investment in Turkey 1990 - 2017

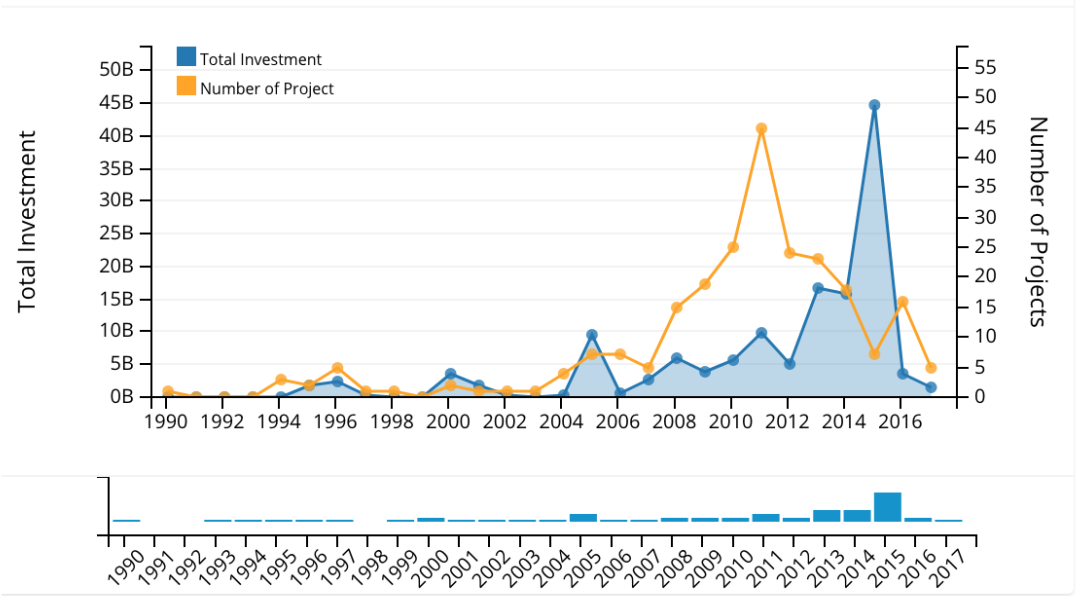


Figure 2.10. Number of projects in Turkey 1990 – 2017

In 2018, world bank PPI database reported the investment and the number of the reaching financial closure in Turkey by sectors. As illustrated in figure 2.11 the number of reaching financial closure projects are 224 projects in many sectors. For instance, 175 electricity projects, followed by 15 airports airport projects.

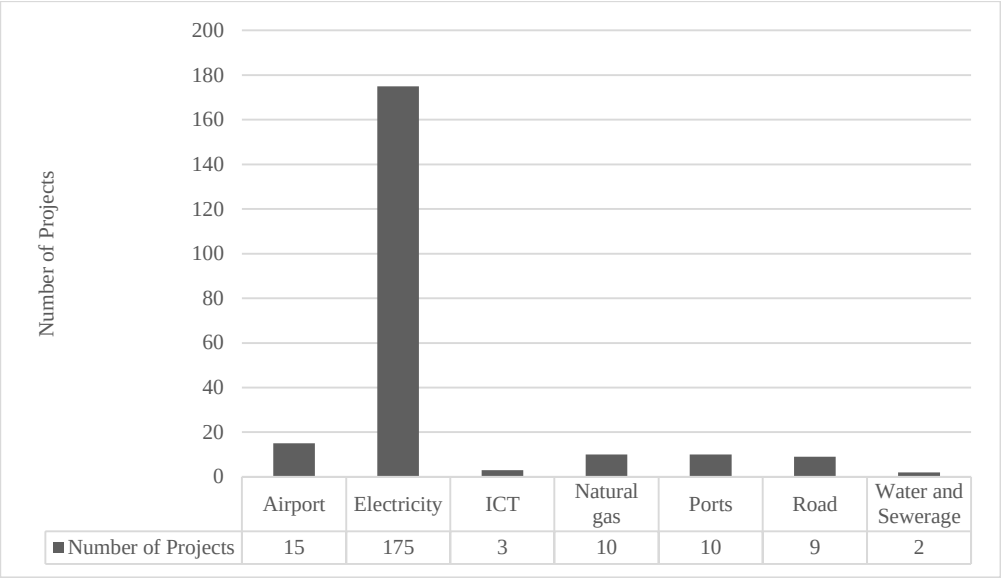


Figure 2.11. Projects reaching financial closure by sector in Turkey(1990-2018) [58].

Moreover, the total investment from the Turkish government in these projects for the infrastructure about 143 (US $ million). It is clear from figure 2.12. Electricity sector gain the largest investment with 62,499 (US $ million), followed by airport sector by 44.934 (US $ million).

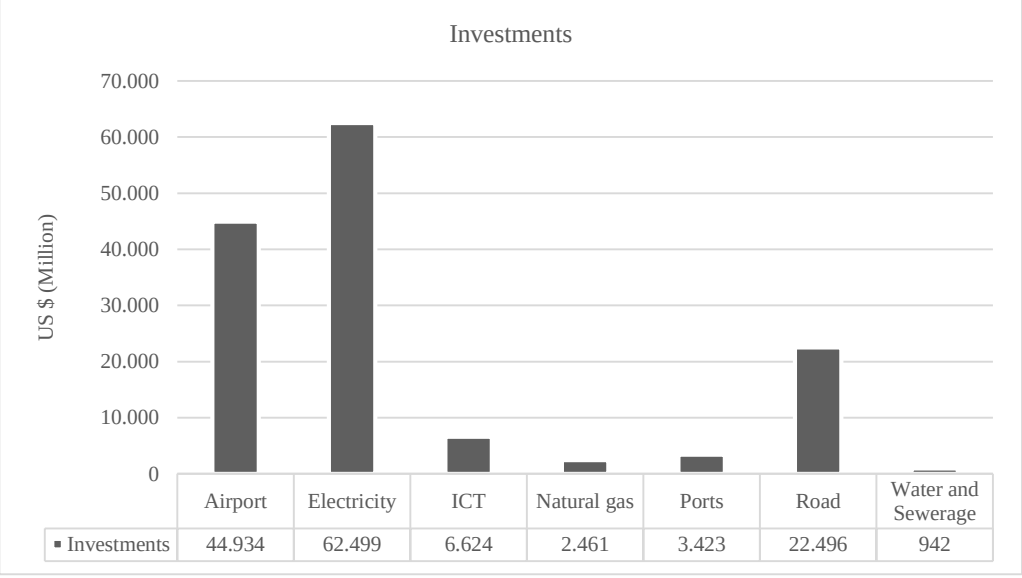


Figure 2.12. Investment in projects by sectors in Turkey (1990-2018) [58].

2.3.2 PPP in airports sector

The international airport forms the access of the country to the rest of the world, where the service provided, and the user experience can impact the city's and country's economics through its reputation. For a successful airport project using the PPP model, the public entity needs to form a strong team containing its best experts, in addition to legal, financial and technical professionals. The tasks that are assigned to the PPP team include creating the project structure in terms of transactions, bidding documents and contract terms, of which the financial and legal aspects form the foundation to the project outcomes. The significance of airport projects emerges from being the front of the country, as citizens' first experience of home and tourists' first impression of the city they are visiting [62]. In many developing countries, the international airport is the point of access to the rest of the world. The reputation is broken or broken based on the perceived airport experience. Innovators need to create multidisciplinary teams Public sector experts and public-private partnership agencies (if any), as well as financial, technical and legal advisors for the best successful airport project architecture. The team will structure the transaction, create bid documents, and draft PPP contract. The legal and financial aspects of purchasing power parities are the basis for something much greater. Airports are not just buildings, but a source of national identity and pride: It is the first taste of the guest returning home and the first scene of the businessman and tourist on the wealth of the city.

Three decades ago, majority of the main airports were public entities and they were considered to be a critical part of countries infrastructure without any reason for sharing or transferring the ownership or management to private sector. For the time being airports became commercialized and depreciated from public filed using different modes of airport ownerships and management with private sector participation [63]. The investment in airport project is very important to countries economic development and value of money, job foundation, attracting foreign companies and offering new commercial opportunities for the local economy. Traditionally, public sector was managed, operated and owned the airports, however, there has been around the world trend towards private sector involvement with varying degrees of private ownership and management, including the use of many

PPP procurement methods. For that, air transport investment belongs to infrastructure business having its specialty and need a certain arrangement. [63].

Particularly, airports shape some of the most capital-demanding infrastructures and the level of risks to which these investments are subject to is very important, severely decreasing the ability of governments and/or private investors to engage with such endeavors [64]. However, in an airport PPP, it is urgent that a monitoring system is put in place to guarantee the concessionaire carries out the agreed-upon reforms, upgrades, and tasks [65]. The participation investment of private models in airports projects vary from greatest involvement of the private sector like full privatization to more traditional way through a concession model. Full privatization models imply the full transfer of shares and ownership of the project. while in a concession models which typically ranging between 15 to 35 years the private sector is engaged in developing and upgrading the airport infrastructure. Also, in this model the private sector responsible for operating and transferring the project back to the government at the end of the concession period. In addition to these models, management contract models that need a short duration implies less private sector participations and control [66].

Turkey as a developing country has successfully developed and operated a variety of airport projects as PPPs. Furthermore, there is an extra number of upcoming airport PPP projects, such as Istanbul's third airport that is expected to be opened within 2018. The governmental plans for the 2023 vision increases the number of domestic airports from 55 to 63, with eight new airports in Bayburt-Gümüşhane (Salyazı), Çukurova, İzmir-Çeşme-Alaçatı, Karaman, Niğde-Aksaray, Rize- Artvin, Yozgat, and western Antalya. The third Istanbul airport, which became partially operational in 2018, illustrates an important Capital Project & Infrastructure (CP&I) project for the Turkish aviation sector. The fully completed airport has a planned capacity of 150 milliom passengers annually and expected to replace Ataturk airport.

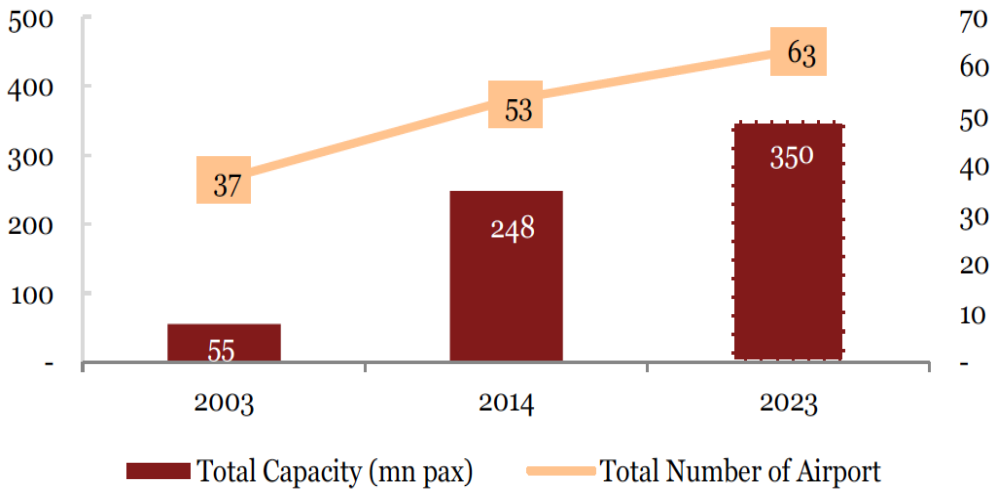


Figure 2.13. Turkey total number of airports and capacity [67].

A total of $143.4 Billion PPP project investment has been achieved in Turkey through using different models [58], including BO, BOT, TOR, and many other, which is attributed to the favorable PPP investment legislation in the country. This trend has picked up in recent years with a bright prospect. Turkey has set ambitious targets to upgrade its infrastructure by 2023. Turkey has significantly improved and upgraded its airport infrastructure and continues to invest in airports as shown in figure 2.13. and the new airports location are indicated in figure 2.14.

Figure 2.14. Location of proposed new airports projects in Turkey [68]

Due to the long period and complex stakeholder relation- ships involved in PPP contracts, risk management in PPPs has attracted considerable attention from both scholars and practitioners. However, the lack of systematic risk assessment and management frameworks has been one of the critical reasons for the failures of PPP projects [29, 30]. The reality shows that there are several examples of failed PPP experiences. Some failure cases are very well-known, such as the Costa Rican Juan Santamaría International Airport (SJO). SJO, in San José, became famous for the collapse of the PPP model implemented, where the private consortium running the airport ended up being forced by major capital lenders, due to allegations of mismanagement [64]. For this reason, choosing the suitable PPP model is an essential step for successful PPP implementation.

2.4 Procedures for the application of PPP in the airport sector

Starting a PPP Program is a serious step forward in how economic and financial politics is made. Despite policy issues may be quite critical, many times the incorporation speed of these issues in the policy agenda does not reflect that urgency, therefore moments of opportunity for policy discussion shall be found. Figure 2.15 show and explain the steps of PPP policy agenda.

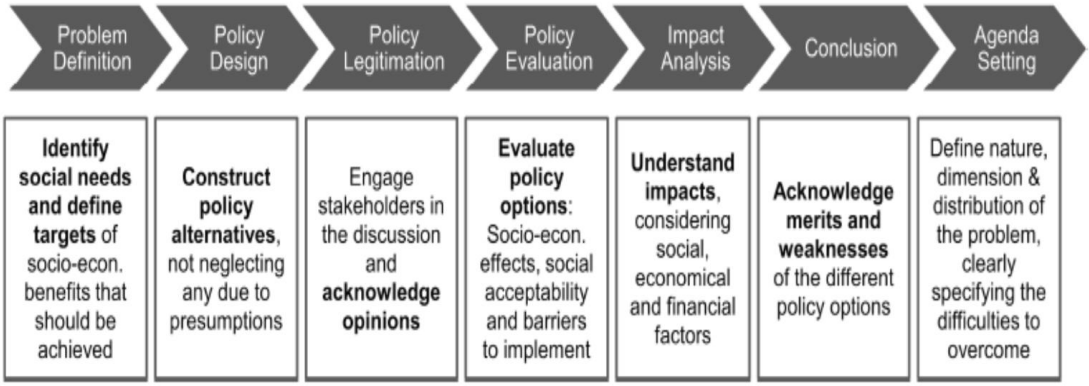


Figure 2.15. Bringing PPP into policy agenda, adapted from [69]

For PPP implementation, is crucial to find the most suitable PPP, according to the profile of the project. With this purpose, two additional tools are proposed [70]. PPP Family Indicator: Preliminary assessment of which PPP model should be adopted, and PPP Mode Validation Tool.

2.5 Basic PPP models in Turkey

Turkey as a developing country for the new countries developing plans need diverse infrastructure services to meet the demand of new infrastructure construction and repair and strengthening of the existing. PPP procurement methods are used for projects in sectors. The numbers and distribution of these projects according to their sector as of the end of 2018 are showed in the previous sections. Lack of the diversity of procurements methods of PPP and the inconsistent and disorganized state of regulations governing PPP methods specially for airport projects are also challenging factors that affect the success of projects during implementation that indicate more researches and investigation in this issue are critical.

2.5.1 Build Operate Transfer (BOT)

The BOT is a PPP model that requires the establishment of a long-term project company from several participating private entities for a concession period in order to finance, design, execute and manage a public facility that is transferred to the public entity at the end of the contract. The sponsors of the project provide the needed investment to initiate and finance the project by using financial tools, such as loans and equity contribution. The unique feature of BOT financing is its unlimited feature, where the project company does not own the required capital [71]. The Turkish Prime Minister Turgut Özal was the first person to use the acronym BOT in the 1980s [72]. According to Irem Dikmen, Ozdoganm [73], the government utilizes the BOT model for urgent infrastructure project that does not have available budget, where such an investment may become a financial burden on the public entity and affect its borrowing capacity. However, the lessons learned from the Turkish experience shows that the BOT model is only feasible in the presence of a regulative framework and a strong legal basis, in addition to a risk-sharing strategy between the project company and the public entity [73].

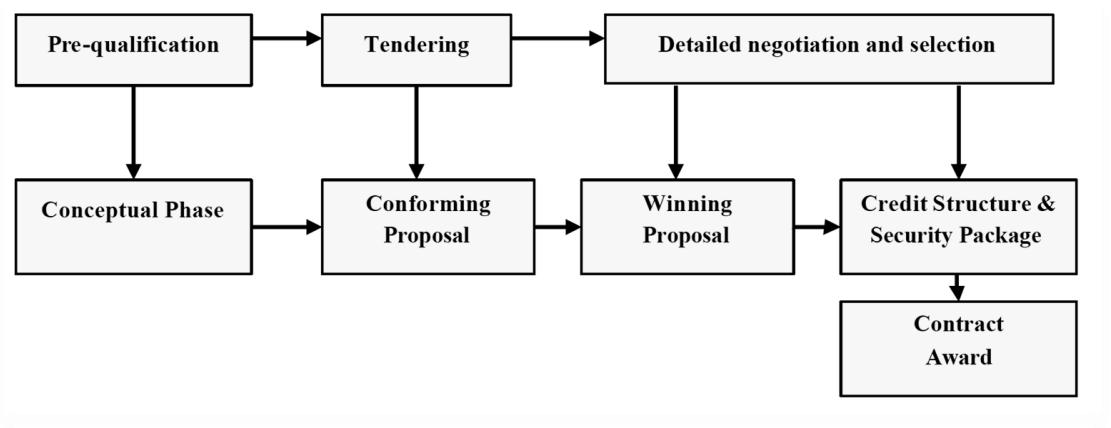


Figure 2.16. Phases of a Typical BOT project

To achieve success, companies that are performing projects with the BOT model should detect and manage the project risks from the perspective of both public and private shareholders in the most effective way. In the mega transportation projects, such as highways, bridges, and airports, there are many risks associated with the property and the large amount of investment, existence of so many stakeholders, long concession period and, last but not least, uncertainties in determining the selling price of the goods or services together with collecting the desired revenue [74].

2.5.2 Build Own Operate Transfer (BOOT)

In the BOOT procurement model, the owner of the utility with the concessionaires until the end of the contract period, at which point both ownership and operating rights are transferred to the public sector [75]. The responsibilities of the consortium include executing the project, operating the facility and collect running revenues to repay the borrowed investment until the expiration of the concession period [71]. The government announces the BOOT project through advertising or requests for proposals from prequalified private entities. Thereafter, the government receives the bids based on the BOOT model, which uses the well-established project financing approach [75]. Figure 2.17 present the typical structure of BOOT model

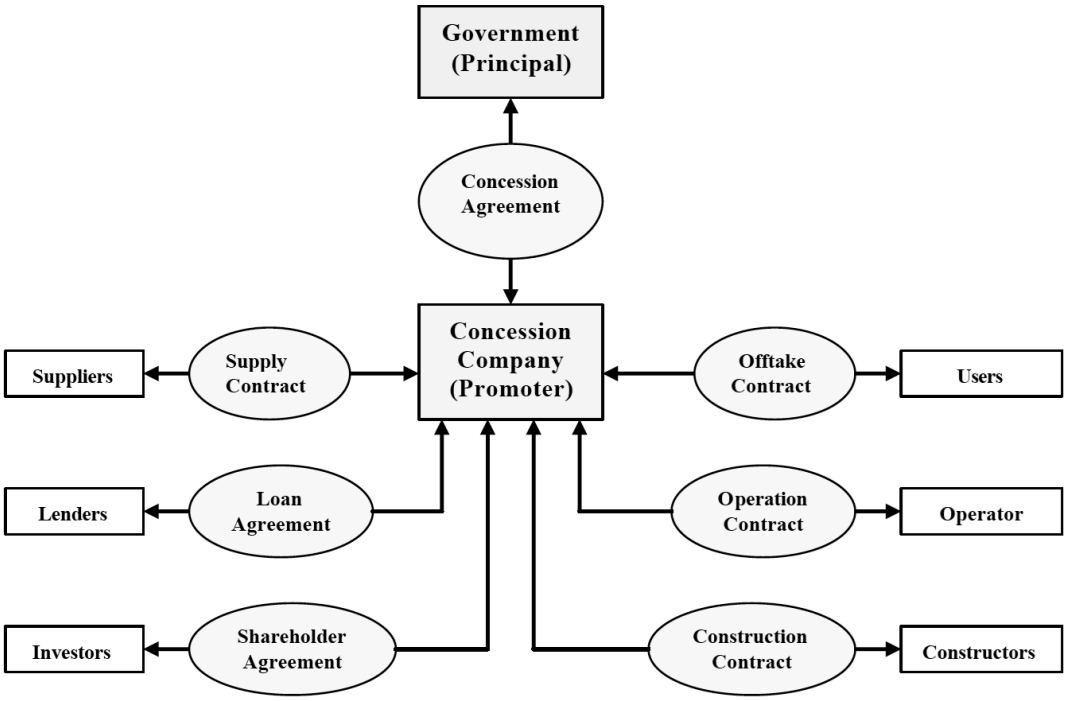


Figure 2.17. Typical Structure of BOOT project

2.5.3 Build Own Operate (BOO)

The design, construction, operation and maintenance of the facility is the responsibility of the contractor, as per the build-own-operate (BOO) model, which is similar to the BOOT model in terms of the transfer of the asset from the private entity to the public entity after finishing the contract period. The distinguishing feature of the BOO model when compared to the BOOT, BOT, DBFO and DBOM models is sustaining the ownership by the private entity in BOO. Subsequently, the revenue risks and surpluses during operation are given to the contractor, which is an incentive to the private sector investment [76].

The concessions of BOO and BOOT have several similarities. The ownership of the facility is not given back to the public entity at the termination of the BOO concession period. The structure of a BOO can be the same as the one shown in Figure 2.19 above. The BOO model gives the private sector the opportunity to own the facility after designing, constructing and financing it, while the commitment for operation and maintenance remains during the concession period [71].

2.5.4 Concession Model

The Law on Concessions Regarding the Provision of Public Services sets forth the legal framework of the concession model, which is defined as the establishment and operation of new facilities, or the operation of already established facilities, through which public services are provided by a private party pursuant to a long-term agreement signed with the administration [66]. The concession contract under the design-build-finance-operate (DBFO) model allows direct investment from the private entity as a primary PPP opportunity. Therefore, the private entity trades off collecting revenues during the concession period with investing in the project, building it and manage its operations for the same period. The model can be used for constructing new facilities, as well as upgrade, modernization and expansion works for existing facilities.

Through a competitive bid, a period that can exceed 30 years can be awarded to the private entity as a concession, where the ownership of the facility is sustained by the public entity. The private entity uses the facility as per the signed contract and they need to ensure its adequate utilization and maintenance before and at the handover time. The award criteria of concession generally include having the capacity for implementation and financing, in addition to the price offered to the public entity [77].

2.5.5 Long Term Rent (LTR)

Long Term Rent (LTR) was introduced by Turkish government Law no. 5335, and 4046. Law no. 4046 allows the application of PPP Models in correlation with privatization implementations. Law no. 5335 leads to transferring operation rights of airports authorized by state to the private sector [78].

2.6 Critical Success Factors (CSFs) in PPP projects

Due to their effectiveness, CSFs are increasingly recognized globally based on their potential influence and significance. [79] shows that delicate and constant management is required by CSFs in order to achieve the performance goals of the organization. Therefore, through the implementation of the PPP model, researchers and practitioners have focused on identifying, studying and applying the CSFs that

increase the probabilities of the project success [80]. The strategic goals of any project are strongly related to its CSFs since they focus on the aims and what is to be done [81]. Many researchers have been written about the Critical Success Factors in PPPs projects such Zhang, X. Q. (2005), Tang and Shen, Q. (2013) and Abdul-Aziz, Jahn Kassim, P.S. (2011). Osei-Kyei and Chan [15], summarized in their review study of 27 publication in the CSFs for PPP projects for over the past 23 years. The study found out that, U.K., China, Hong Kong and Australia have conducted the most research studies on CSFs of the PPP projects. 5 most reported CSFs from 1990-2013 are Risk sharing, Strong private consortium, Political support, public support and transparent procurement. In addition, the number of publication and publications by country focus are presented in figures 2.18 and 2.19 respectively. Furthermore, Babatunda and Perera, [80] conducted a comparison study of PPP in transport infrastructure development in Nigeria, that revealed the most important CSFs for three different case studies projects for infrastructure projects, showing a total of 13 CSFs that are unique to the success and delivery of PPP transport infrastructure projects in Nigeria. CSFs differed slightly within three PPP case studies. Four CSFs at the Airport Privilege were the most effective. And eight CSFs in Port Privilege. The main results of this study were that political support, involvement by providing guarantees, and economic feasibility of the project are the base for successful implementation of PPP transport infrastructure projects in developing countries [80]. It is clear from the literature that, proper risk management for PPP projects will lead to a successful result and wealth value of money for both public and private parties.

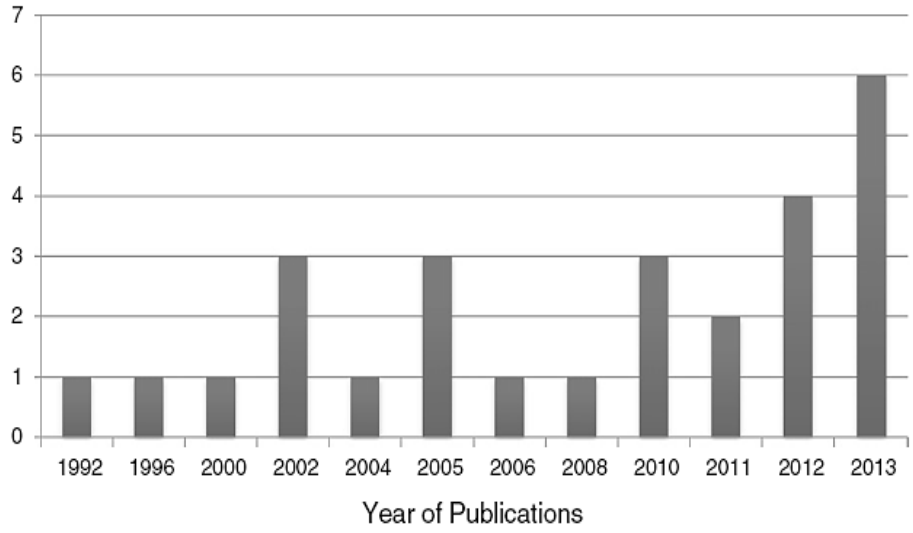


Figure 2.18. The annual number of publications on PPP CSFs from 1990 to 2013.

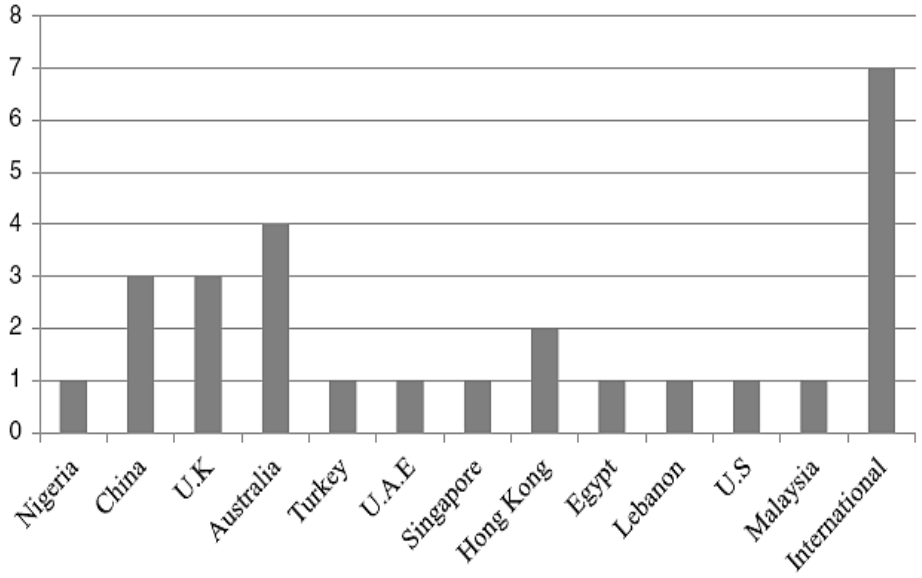


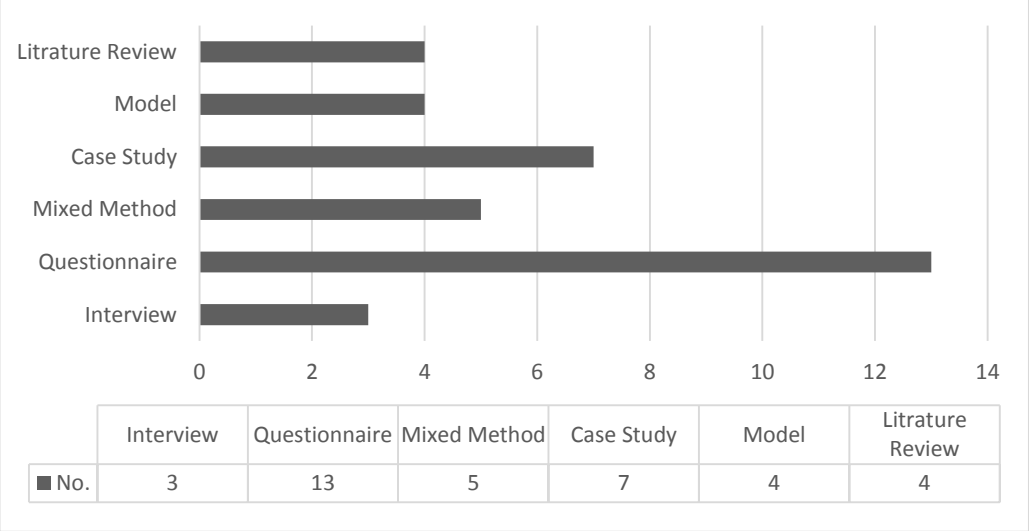
Figure 2.19. PPP CSFs publications by country focus.[15]

5 critical success factor groups (CSFGs) are indicated by Ameyaw and Chan [82] to ensure a successful project implementation of PPP water supply project. These factors namely; partners commitment, consortium from both partners, asset quality and social support, political environment, and national PPP unit. Osei-Kyei Robert, Albert P. C. Chan [18], conducted a survey analysis that examined fifteen PPP model success criteria through a literature survey and a reliable sample of international PPP experts. The results demonstrate the impact of all success criteria. Nevertheless, profitability, long-term partnership and relationship, public service satisfaction, adherence to time, good quality service operations, meeting output specifications and active risk management were the seven most critical CSFs for PPP projects.

2.7 Effective CSFs for PPP Projects (Review Study 2000-2018)

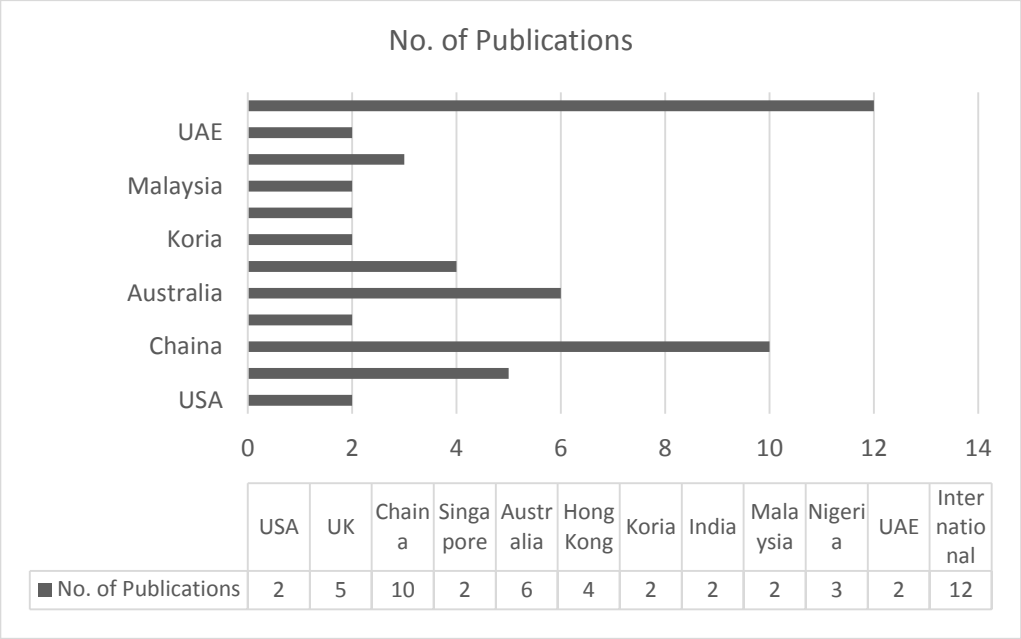
In this research study, a review for the CSFs in PPP projects has been done for 38 publications from different journals to specify the most common criteria have been found by researchers. Table 2.6 show the review process, and the result of this review show that, there are seven important popular criteria. These include: Risk allocation and sharing; Strong private consortium; Transparent procurement; Available financial market; Commitment made by partners; Favorable legal framework; and Political support. From the literature review to the publication about

CSFs for PPP projects from 2000 to 2018 which I have done in this research by using systematic review, there is no study about the specific important criteria affecting choosing PPP model in developing countries and the lack of decision-making model for choosing appropriate PPP model for transportation project need to be investigated. The initial search result shows that there are many publications on CSFs in the area of PPP between 2000 and 2018. The most important publication was found on the Scopus search engine, which covers many publication databases in various areas of research [83]. As shown in Figure 2.21, it is clear that the increase in the number of publications in this area of study during 2016, during which time 11 research studies were published, implying obviously that there is great interest in studying this area to the participations for more successful implementations of PPP projects. Moreover, China is country that has studied the CSFs of the PPP the most subject during the 2000-to-2018 period, as shown in Figure 2.22. Australia, UK, Hong Kong and Nigeria, ranked 6th, 5th, 4th and 3rd in terms of the number of publications, respectively. Moreover, from Figure 2.23, a clear revival of studying the CSFs for PPP projects can be observed in some developing countries such as Nigeria, Ghana and the UAE. It is obvious from the number of publications in the last years that there is more interest in focusing on the success factors or success criteria of PPP projects for more successful implementation and the reduction of the failure of these projects in the future. Questionnaire and case study methods were the most common and most powerful methods to study and explore the CSFs for PPP projects. Different methods which have been adopted to study this area are presented in Figure 2.20.



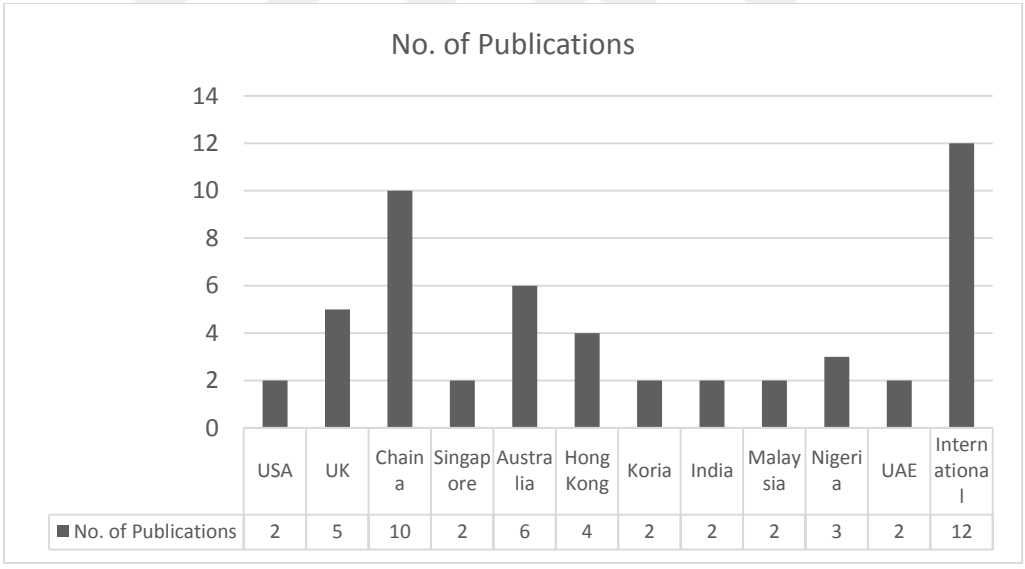
	Interview	Questionnaire	Mixed Method	Case Study	Model	Litrature Review
No.	3	13	5	7	4	4

Figure 2.20. Research Methods used for PPP CSFs studies (produced by the author



	USA	UK	Chaina	Singapore	Australia	Hong Kong	Koria	India	Malaysia	Nigeria	UAE	International
No. of Publications	2	5	10	2	6	4	2	2	2	3	2	12

Figure 2.21. Public Private Partnership CSFs publications (produced by the author)



	USA	UK	Chaina	Singapore	Australia	Hong Kong	Koria	India	Malaysia	Nigeria	UAE	International
No. of Publications	2	5	10	2	6	4	2	2	2	3	2	12

Figure 2.22. Annual Publications on PPP CSFs from 2000 to 2018(produced by the author)

All the publication, which have been collected from the target, search engines and used in this review are presented. 33 critical success factors collected and ranked by its repetition at the publications which have been summarized from 33 article papers and 5 conference papers. All selected publications are presented in the Table 2.7.

The most effective and important seven critical success factors which have been chosen as the top seven CSFs for PPP project from international point view in this study are risk allocations and sharing, strong private consortium, available financial market, commitment made by partners, transparent procurement, political support and favorable legal framework. From the increase concerning in studying this area these years, it is clear that these factors are very important for successful PPP projects implementations.

2.7.1 Risk allocations and sharing

Although, the complexity of the PPP arrangement is the main source of the risks in terms of terms of documentation, financing, taxation, technical details, sub-agreements, and market conditions[50]. Optimal risk allocation is considered the key factor in the success of a PPP project [8, 84]. For that, it is not strange 18 publications in this review study was taken risk allocation and sharing as the most important factor for PPP success. Moreover, the risks in PPP projects should allocate to the party who's able to manage it [85]. For instance, Ke et al., [6] were described a good way of allocating the risks in PPP projects according to an empirical study, There are major risks in the systematic risk category that were preferred to be accepted by the public entities including legal, political and social risks. Moreover, the risks that were preferred to be accepted by the private entities were mainly project specific risks including relationship, operation and construction risks. In the systematic risks, the private entities were ready to accept economic risks, while some risks were accepted to be shared between the two stakeholders, e.g. environmental risks.

2.7.2 Strong private consortium

Well-structured and organized private sector company is very important for PPP success [15]. 14 publications were identified strong private consortium as a critical factor for PPP success, which mean this factor is important for successful PPP implementation especially in the developing countries. For that reason, this result is relevant to the developing countries and it is essential for a successful business project [86]. Strong technical, financial operational, and managerial capacity for the partnership are the most significant success factors in competitive tendering for a

PPP project [87]. Besides, governments at the developing countries must support weak companies to be able to enter the competition with the international ones to handle PPP project successfully.

2.7.3 Available financial market

The available financial market as a CSFs for PPP projects was recognized in 14 publications, which indicate that it is a critical factor for successful PPP implementation in both developed and developing countries. Moreover, flexible and attractive financial instruments is considered important to enable the private sector to finance the PPP project[88, 89]. It was obvious that developing countries seriously need effective financial market with the benefits of low financing costs and a diversified range of financial products to encourage the private sector for adopting PPP projects [89].

2.7.4 Commitment made by partners

The commitment made by partners was also ranked importantly CSF in PPP projects by some researchers in some previous publications such as [88, 90]. This factor was identified by 13 studies as an important factor for PPP successful implementation. Parties should commit their best resources to the partnership project [37] Mostly, commitment refers to dedication and interest of key performers in a project, especially, the client, project team, project sponsor and project company. For successful PPP project implementation, committed to time, quality and budget are critical issues. This indicates that all project stakeholders should be willing to commit their best financial and human resources to the project throughout its lifecycle [37, 90].

2.7.5 Transparent procurement

The fifth-ranked CSF for PPP project in this review in transparent procurement process which have been identified by 11 publications, similarly to the last review paper by Chan & Osei-Kyei [15] which identified it the fifth among the top five important CSFs. This means that, this factor still important for PPP success. Transparent procurement process is essential to reduce the transaction costs and reducing the time in negotiation and completing the deal in a good shape [91]. In

addition, consulting between public and private for any clarification in the project at any stage is essential, and the government should be clarifying any obstacles to ensure a successful implementation of the projects.

2.7.6 Political support

Although this factor ranked in third and fourth place in some publications respectively [15, 92], It identified in 9 publications and ranked in sixth among seven top CSFs in this study. Therefore, it is clear that the political support factor is identified as an important to PPP project development and project success. This factor seems to be the most critical factor in the developing countries because of unstable political in some of these countries. So, it is necessary for the private sector to get a continuity political support and guarantees from governments to ensure the success of PPP projects implementing.

2.7.7 Favorable legal framework

The favorable legal framework was selected the last important success factor among the top seven factors in this study. It was identified in 9 publication which indicates it is important for PPP success as well as the previous factors. Legal framework availability should assure the effectiveness of laws related to PPPs to deal with any legal issues arising in the process. In addition, this framework will offer necessary legal systems within which the PPP procurement process can take place [89].

2.8 Risk Management in PPP Projects

The number of publications relating to risk management in PPP projects is increasing because risks have been considered crucial and are of interest to both scholars and practitioners. Management of risk in PPPs procurement processes and procedures is an integral part. The impact of risks in implementing a PPP project is usually important, so the risk management is very important in PPP projects[93]. The objectives that define the PPP concept are avoiding cost overruns, minimizing disputes in the future, and providing the best value for the client through suitable and strong risk management and distribution of responsibilities. In principle, the PPP

model is based on minimizing, sharing, transferring and managing risks between the public and private entities [94].

CSF / Ref. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	Sum
1. Risk allocation and sharing		*	*	*	*		*	*		*		*			*			*		*				*	*				*	*		*				*	*	18
2. Strong private consortium		*	*	*	*	*			*	*			*	*				*	*							*		*							*			14
3. Available financial market				*		*	*			*	*	*			*			*			*			*	*	*	*							*				14
4. Commitment made by partners			*	*	*			*									*		*		*				*		*	*	*						*		*	13
5. Transparent procurement	*	*	*			*	*				*		*				*						*	*										*				11
6. Political support		*					*	*	*		*				*							*										*	*					9
7. Favorable legal framework	*		*				*					*										*		*	*		*								*		9
8. Community / Public support	*	*	*					*										*										*										5
9. Favorable economic condition			*								*							*																				3
10. Government guarantee							*				*						*									*												4
11.Alignment with government's strategic objective						*														*																		2
12. Revenue sustainability			*											*																			*					3
13. Cost effectiveness	*			*			*																												*				4
14. Clearly defined responsibilities and roles			*	*				*					*																						*		*		6
15. Appropriate project identification	*														*					*						*												4
16. Selection of suitable subcontractors															*																								1
17. Effective supervision mechanism	*											*								*													*					4
18. Technical feasibility of the project				*		*																	*															4
19. Stable macroeconomic environment																	*	*					*		*	*	*						*					7
20. Stable political and social environments																	*		*				*									*				*			5
21. National PPP unit																			*												*					*			3
22. Asset quality and social support																			*	*																*			3
23. Adequate public advisory bodies									*													*		*				*											4
24. Effective management control																*				*			*					*								*			5
25. Good governance																				*			*				*												3
26. Openness and constant communication										*																		*	*	*									4
27. Competitive tendering																				*															*				2
28. Corruption eradication																					*																		1
29. Profitability																													*	*									2
30. Adherence to time																														*			*						2
31. Meeting output specification																														*	*								2
32. Project feedback																																	*						1
33. Reliable and quality service operation																														*	*								2

Table 2.7. CSFs for PPP projects which collected from literature survey from 2000 to 2018 (Produced by the author).

It is not expected to remove all project risks through using risk management strategies; however, the implementation of risk management assures that each risk items are identified and managed for the minimized impact. Therefore, risk management is an essential practice during the lifecycle of the PPP project, as risks are always present and arising [95]. The primary purposes of performing an evaluation of risk factors in PPP projects are to identify the critical risk factors and analyze the extent to which risks may negatively impact the success of the projects or the objectives of the stakeholders. Probability and severity are the two most important attributes to measure risk factors and have been widely used [30]. In addition, the objectives of risk management strategies implemented for the PPP projects are [96, 97]:

- Maximize the value for money for the PPP stakeholders.
- Establish a decision-making system through an informed analysis.
- Alleviate the risk impacts.
- Identify the major risks and the subsequent risks associated with the PPP project.
- Achieve an efficient risk allocation for the PPP model.
- Form the most effective PPP structure financially and contractually.
- Establish risk management practices and processes during the PPP phases throughout the concession period.
- Understanding the project in a better manner through risks identification and response.

Due to uncertainty of the PPP project outcomes, the model is deemed risky in different aspects. The financial feasibility and service provisions are considered the main sources of risks in the PPP project. PPP project has been adjudged to be risky. Moreover, the inflexibility of the PPP model with the rapid changes in process and product, as well as the difficulty in predicting the costs over the long contractual period are the sources of uncertainty in this procurement mechanism [96]. Both sources of uncertaininty have their implications on the costs of the project and it is evident that one of the public or private stakeholders, or both, has to bear the losses. Generally, all packages, phases and stages of the project are associated with risks due to the unpredictibility of the future. Thus, all stakeholders within the PPP project need to consider the possible events that can occur and influence the scope and goals

of the project. Nonetheless, understanding the PPP lifecycle risks is an essential practice for the public and private stakeholders. A successful concession emerges from a comprehensive identification, classification and representation of PPP risks, which allow PPP professionals to reach to a healthy concession agreement [98]. Furthermore, the assessment and analysis of the identified PPP risks facilitates setting early measures through allocating sufficient resources. Alfen, Satyanarayana N. Kalidindi [95] provided recommendations of four risk management processes that allow project professionals to manage the risks throughout the project lifecycle:

- Risk Identification: Defining risk sources and identifying the risks that could arise for the project.
- Risk Assessment: Analyzing the risk based on its probability of occurrence and possible impact on the success of the project.
- Risk Allocation: distributing the risk to one of the stakeholders to bear its responsibility and consequences.
- Risk Mitigation: implementing measures that reduces the probability of risk occurrence and/ or its impacts.

There are several techniques that are available for implementing each of the four processes, where the nature of the risks and the available information dictates the choice of the technique. Moreover, implementing synchronized and effective communication within the project allows for efficient process implementation and risk treatment. Perfect risk management to the risks in PPP projects especially in the developing countries will offer a variety of benefits to both public and private by allocated those risks to the party (public or private) who is best able to manage them [99]. The researches about identification and assessment of PPP risks in developing countries considering their conditions are limited [93].

2.9 Risk factors in PPP projects

Many researches have tried to classify the PPP projects risk factors in various sectors of developed countries[5, 7, 100] and developing countries [4, 101]. Cheung and Chan [102] insistence that PPP projects need accurate risk factor identification and analysis that could adversely affect the project achievements. Karim [103] conduct a review study on risk factors of PPP projects by studying previous researches on PPP projects worldwide. 10 risk groups were namely identified. Furthermore, the

outcome indicate that the highest result of frequency factors were changes in law and delay in project approvals [104]. Ameyaw and Chan [4] indicate that, 22 serious risk factors have major impact on water supply projects. These factors are summarized and grouped into three principles risk factors; financial risk, legal and technical risks. Third party tort liability, instability of the interest rate, low changing and cost overrun of the construction projects was found as the critical risks associated with the PPP projects by Sarvari, Valipour [105]. However, to achieve best project performance, successful partnership is needed between public and private sector, and understanding properly to how share and allocate the risk between them [106]. Due to the long period and complex stakeholder relation- ships involved in PPP contracts, risk management in PPPs has attracted considerable attention from both scholars and practitioners. However, the lack of systematic risk assessment and management frameworks has been one of the critical reasons for the failures of PPP projects [29, 30]. Based on sophisticated legal frameworks and rich experience, most of the risks in PPP projects disappear or are strongly mitigated after the construction phase in developed countries, while some important risks (for example, political or regulatory risks) still exist during the operation phase in developing countries [17] (as cited in Albornoz and Soliño, 2015). Grimsey Darrin and Lewis [72] evaluated the risks of PPP projects and they found that most common and effective risks facing any infrastructure projects are; technical, construction, operating, revenue, financial, force majeure, political and environmental risks. In addition, airport projects as one of the biggest infrastructure projects through PPPs strategy are subjected to more risks than any other infrastructure projects.

In this research a comprehensive review study for the PPP projects risk factors at the different publication at some search engine such as science direct, web of science and google scholar, 46 risk factors are collected to design a questionnaire question for local experts to specify the most important factors the affect airport project in Turkey (See Appendix). However, limitation from the previous studies is that there are several studies in the other sectors, such as water, energy, transportation, however, there aren't any studies concentrated on studying risk factors for airport projects in developing countries particularly in Turkey. So, this study will contribute to fill this gap.

2.10 Risk allocation in PPP projects

The practice of sharing and allocating the responsibility of project risks based on their impact analysis is called risk allocation, which is identified as one of the most important criteria for the PPP project success [39]. Bing, Akintoye [107], defined risk allocation as the assignment of the primary measure between the PPP stakeholders. Through allocating the risk to the side that has the better capabilities to control it in terms of possibility of occurrence and impact leads to better primary measures. Moreover, the party that handles a risk can manage it in an effective manner if it had the ability to acquire more information about the risk and has the ability to access this information, as well as having the commercial capacity to treat it [5]. Therefore, risk allocation is considered one of the unique features of the PPP model, differentiating it from the conventional procurement mechanisms [3, 108]. It is of a great significance to be able to allocate the risk to the side that can handle it effectively through an optimal risk allocation [109]. Risks in the PPP model can be allocated to one or more of three stakeholders; users, the private entity (investors) and the public entity (taxpayers), as it is not possible to remove the risks through the structure of the contract [81]. Dealing with risks is a difficult task due to the need of an appropriate management framework on the theoretical and practical levels. Therefore, researchers have given a special attention to risk allocation [110]. The decision to allocate a specific risk to a specific party mainly depends on the ability of a party to minimize its cost impact [110, 111]. The transfer and sharing of project risks are considered by many as one of the main benefits of PPPs [112]. In order to be able to manage the significant risks in the PPP model, it is important to conduct a research to explore the risks and their suitable treatment strategies. The main risk management practices; identification, analyzing, treatment and monitoring are also used in the PPP projects, where a proper application of these practices improves the use of risk management strategies [113]. In NCHRP (2009) report the risks are classified into three broad categories: (1) fiscal risks, (2) residual value or valuation risks; and (3) bidding risks. The risk allocation and responsibilities between public and private partners are shown in Figure 2.23 and summarized in Table 2.8 [114]. In any PPP project, there are positive implications for evaluating and ranking the risk factors. Firstly, an initial filtering and screening is applied by the PPP professionals

as part of the process through linguistic variables, which allows for a mechanism to identify the exposure of the project to a specific risk.

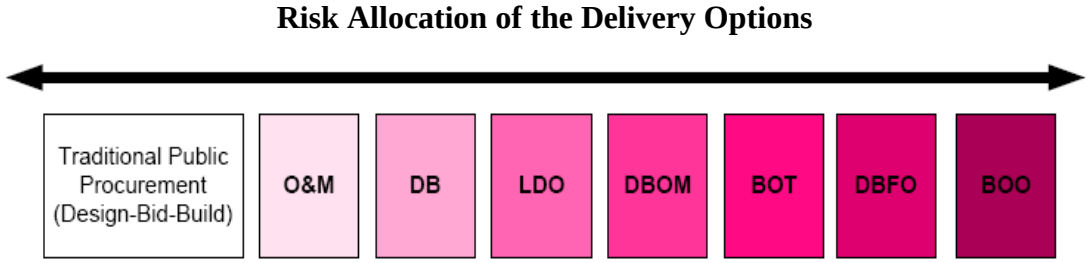


Figure 2.23. Risk Allocation for the PPP Delivery Options

Table 2.8. Risk Responsibilities of the PPP Delivery Options [114].

PPP options	Design	Construction	Financing	Ownership	Operations	Maintenance	Marketing
O&M	Public	Public	Public	Public	Private	Public or Private	Public or Private
DB	Private	Private	Public	Public	Public	Public	Public
LDO	Private	Private	Public or Private	Public or Private	Private	Public or Private	Public or Private
DBOM	Private	Private	Public	Public	Private	Private	Public or Private
BOT	Private	Private	Public or Private	Public or Private	Private	Private	Private
DBFO	Private	Private	Private	Public or Private	Private	Private	Private
BOO	Private	Private	Private	Private	Private	Private	Private

A detailed quantitative analysis is facilitated as the next step in order to calculate the most accurate cost of the risk [115]. The substantiality of the risk impact on the project success and budget is evaluated through knowing the inputs from the previous step, allowing the decision-makers to determine the necessary measures [115]. Secondly, as countermeasures are determined through a proper evaluation, the private investors will have the ability to study the feasibility of the PPP projects and choose the most lucrative one. Thirdly, the assessment of risks in the PPP model is a necessity in order to be able to perform an adequate risk allocation between the private and public stakeholders. Based on the identification, assessment and classification of the most significant risks, the involved parties in the PPP contract can be able to evaluate their capacities for risk management and allocation [4]. Risk allocation is a critical factor (Ng & Loosemore, 2007; Song, Song, Zhang, & Sun,

2013) and a key to controlling risks related to the public-private partnership project (Alireza Valipour & Sarvari, 2014) in developed and developing countries.

2.11 The Procurement Strategy

During the project delivery process, it is critical to take a decision about the most suitable procurement method, based on the best one that can balance the risks and costs with the outcomes and objectives. As the government entity identifies specific objectives, the procurement method shall aim to provide the optimal value for the investment. There are key issues and challenges that are considered prior selecting the delivery method of the projects, as follows:

- Identifying the core services, that the public entity chooses to retain their delivery responsibility, versus non-core services, which are asset-related and will be included within the scope of the private entity.
- The assessment for the optimal value for the investment, which is one of the advantages of the PPP model since the private entity has an interest in achieving this objective.
- Basing the investment decision on the capabilities and acceptance of the market through solid information from practical data and market studies, as well as the capabilities and motivations of the private sector to be involved.
- Selecting the procurement method that achieves the best interest of the public. Through establishing a procurement strategy, the analysis allows the public and private sector to choose between the procurement options [116]. Selecting a delivery model stages presented in figure 2.24.

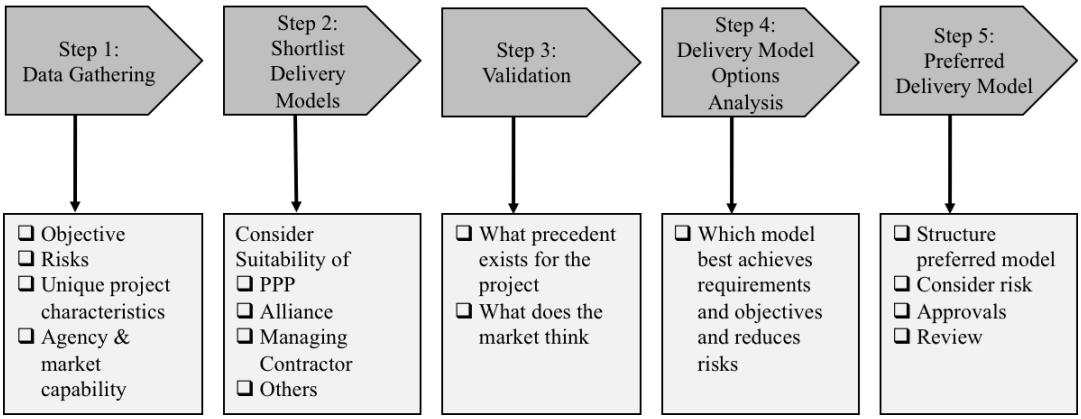


Figure 2.24. Stages of selecting a delivery model [116].

In general, the forecast for the project tariff and the costs associated with construction and operation are based on the public benefits and the investor's return on investment. Thus, the efficiency of the decision-making process for the BOT is directly influenced by the traffic forecast accuracy. (e.g., the evaluation ranking and selection of project tenderers) [117]. Xu et al. 2015, examined the bias in the choice of the PPP procurement for BOT model and developed two approaches to determine the level and opportunity of uncertainty resulting from selection bias; the expected value approach and the probability approach. They conclude that as a result of this analysis confirm a bias in choosing when the public sector uses the highest estimate of traffic prediction as a priority for selecting a BOT transportation project [117].

2.12 Decision Making Modelling in PPP projects

For a successful achievement of the objectives, it is imperative to reinforce the decision-making process as a key factor, through acquiring and utilizing the maximum knowledge and information [118]. In complex decision-making, using one of the multiple criteria decision-making methods (MCDMs) may be essential, as these methods allow the decision maker to base their selection based on the most significant criteria and alternatives. In order to perform a correct MCDM assessment, the criteria are weighted based on importance or influence against each other, as well as againt the possible alternatives, in order to identify the most influential ones [119].

A review study has been done in this research study to summarize the different decision model which used in PPP area of study by searching in some data base such as Scopus and Since direct search engines. The key words that used in this search are "Decision making model in PPPs" "Decision making models in BOT projects". 27 articles and papers have been reviewed to indicate the common and effective decision-making model that used and to summarize the important result as shown in (Appendix III). Most of the decision models which have been used in these studies passed through three steps. Method of data collection: All relevant information about project collected and organized, filtered to reduce the number of the alternatives to fully evaluated by different methods such as SWOT analysis, Questionnaire survey and experts' interview. Models applications: After gathering the needed data, applied the models to specify the aim of the studies which were mainly about certain topics such as, concession period of the PPP projects, improving the negotiation process,

risk identification and allocation and understanding and selecting the proper PPP project or private sector. In addition, to the decision-making models type that has been used in these studies focused about; Fuzzy techniques models, system dynamic models, bargaining-game models, choosing by advantage method and others. Model validation: Case study method was the most used method for the model's validation in addition to simulation method. Based on this review study, there is no specific study that uses AHP-PROMETHEE approach for PPP model selection. Details of this review are shown in Table 2.9.

2.13 Multi Criteria Decision Making Method (MCDM)

In order to be able to take rational, justified and complex decisions, a need emerged to create mathematical tools that take into consideration relevant criteria and alternatives. Thus, (MCDM) methods were developed to achieve this aim based on the objectives of the application. The analysis is carried out through suitable opinion of independent or interactive criteria. There are factors that are considered during the multi-criteria assessment:

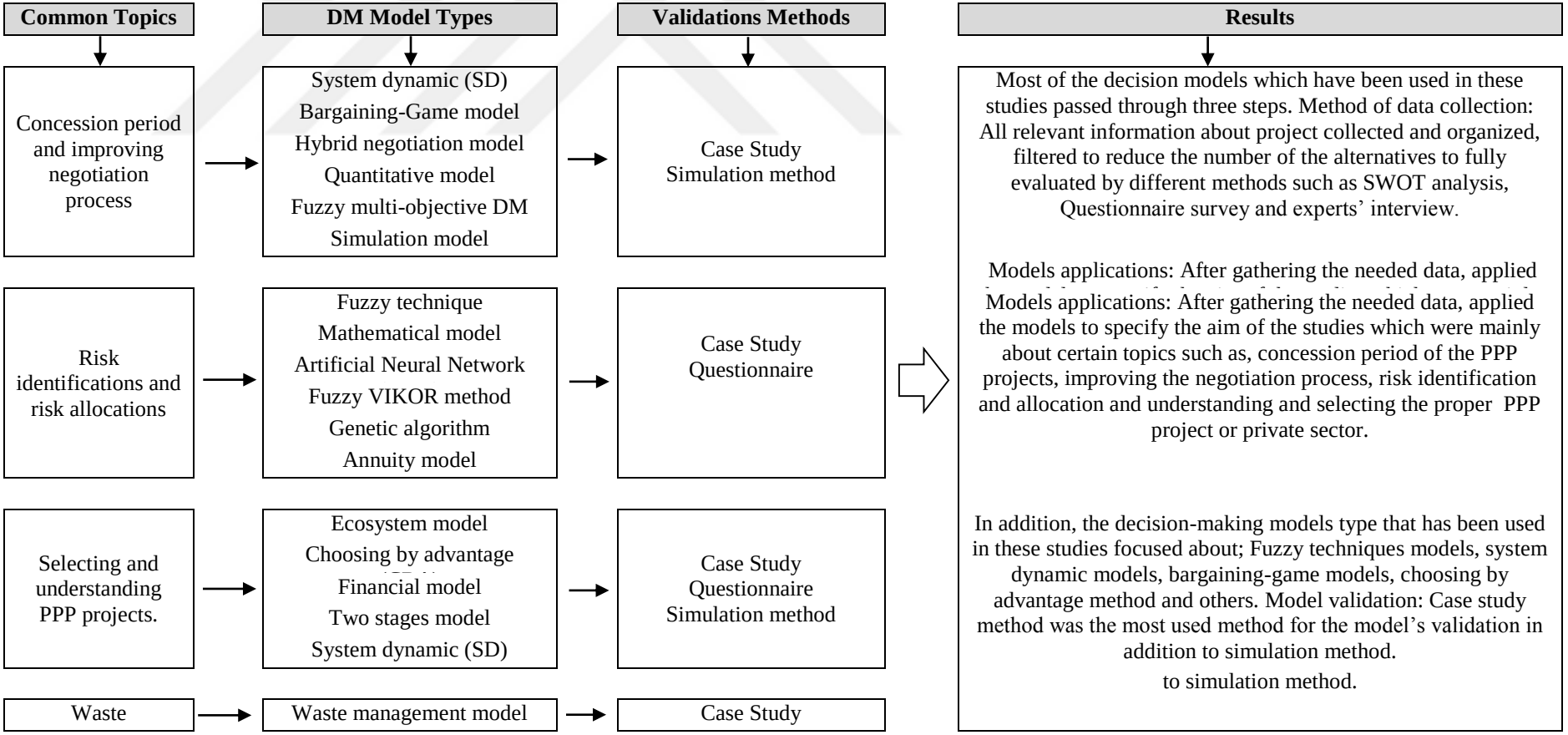
- A general aim is identified, which can be also called the ‘‘goal’’, and should be checked for achievement throughout the process.
- The involvement of a Decision Maker (DM) or several Decision Makers (DMs) in the assessment process.
- Alternatives are compiled based on the relevance to the MCDM problem.
- Criteria and sub-criteria that are used for evaluation against each other, as well as against the alternatives.
- The preferences and the evaluations of the decision maker are expressed through weights of each comparison between the criteria, and with the alternatives.
- Scores are produced through comparing a certain quality of alternative or criterion (i) with respect to criterion (j).

The MCDM methods operates through two main parameters with the decision makers; the assessment of each alternative against each criterion and the assessment of the criteria against each other according to the quality aimed by the method. Moreover, the MCDMs enables the decision makers to provide their evaluation based on their experience, opinion and knowledge, while the researcher can ensure that the results are not influenced by the process. Nonetheless, the validity of the

results can be checked through different procedures according to the method. Generally, the weights are evaluated on a zero to one scale for each criterion without changing the weights of the other criteria. The solution is considered stable, if the ranking of the other criteria does not change with the verification process [120]. The utilization MCDM methods is continuously increasing in the infrastructure sector, especially in solving public transportation challenges. In a literature survey, Pérez et al. (2015) [121] confirmed that between 1982 and 2014, issues in transportation systems have used 58 MCDM techniques for a solution, which shows their benefits and potential to the sector. Similar trends in problem solving and decision-making have been observed in other sectors, including construction and project management; however, professional experience and personal perceptions are often used for selecting structural and material systems without an objective systematic [122]. There are several steps in the synthesis of MCDM methods, where the general steps are developing the evaluation criteria, compiling the relevant alternatives, criteria and alternatives assessment by the decision makers, developing the results and monitoring the final choice performance [123].

As different MCDM methods can provide different results for the same problem, the specialists criticize them and call for taking this factor into consideration [124]. Such an issue makes selecting the suitable MCDM method a complex task that requires further studying of the problem and the used methods [125]. Although it is hard to ensure that a certain method is more suitable than another one, there has been methods that have proven their success in certain decision-making situations. Thus, it becomes important to ensure that the problem's objective is compatible with the selected MCDM method based on practical results [126]. MCDM's allows for a collective judgement between the alternative and the criteria simultaneously. The popularly used MCDM methods are AHP, ANP, TOPSIS and PROMETHEE [127]. MCDM methods include AHP (analytic hierarchy process), fuzzy AHP, TOPSIS (technique for order of preference by similarity to ideal solution), fuzzy TOPSIS, PROMETHEE (preference ranking organization method for enrichment evaluation), ELECTRE (elimination et choice translating reality), VIKOR (visekr iterijumsko kompromisno rangiranje) and multi-objective programming. The usual application of each method, as well as its advantages and disadvantages, are all factors that lead to choosing one of them over the others, while none of them is considered dominant.

Table 2.9. DM models in PPP projects review analysis (produced by the author)



Through understanding these factors, multiple MCDM method can be combined for a single problem for more reliable and healthy decision-making [125, 128]. In research and practical use, it is observed that the AHP method is the most utilized MCDM technique in technology, infrastructure, systems and transportation problems [121]. Moreover, due to its simplicity in alternative ranking, PROMETHEE is one of the most utilized methods in that manner, especially with the presence of finite alternative options and conflicting criteria [129, 130]. The advantages of PROMETHEE can be further enhanced through introducing the tree-like criteria judgement as provided by the AHP method [131]. Harputlugil, et al., 2011 [127] introduce a detail comparison for AHP and PROMETHEE methods with some other MCDM methods as shown in Table 2.10.

Table 2.10. Comparison between MCDM different methods [132]

	AHP	ANP	PROMETHEE	SAW	TOPSIS
Decision Making	Individual and Group	Individual and Group	Individual and Group	Individual & Group	Individual and Group
Methodology	Creating hierarchical structure and pairwise comparison matrices	Creating hierarchical structure and pairwise comparison matrices	Creating matrix structure and comparing pairs of alternatives to form an outranking relation	Creating matrix structure and calculating a global (total) score foreach alternative by adding contributions of alternative with respect to each attribute	Creating matrix structure and calculating distance to positive and negative ideal poin
Areas of Usage	To support decision making for complexity	To support decision making for complexity	To support decision making for complexity	To support decision making for complexity	To support decision making for complexity
Adaptability/Flexibility	+ easy to adapt case specific	+ easy to adapt case specific	- not easy to adapt	- not easy to adapt	- not easy to adapt
Consistency Measurement	+	+	No need	No need	No need
Weighting System	Pair Wise comparison	Pair Wise comparisons	No specific method.	No specific method.	No specific method. Linear or vector normalization
Criteria Evaluation	Tangible and intangible criteria	Tangible and intangible criteria	Tangible criteria	Tangible criteria	Tangible criteria
Pros	Can give consistent results for every decision-making process	Easy to implement, expressive power of modeling	Low level of interaction with decision maker (It may be defined as a negative issue for integrated design teams for assessment of design quality)	Low level of interaction with decision maker (It may be defined as a negative issue for integrated design teams for assessment of design quality)	Low level of interaction with decision maker (It may be defined as a negative issue for integrated design teams for assessment of design quality)
Cons	Linear evaluation	Several pairwise comparison questions. Complex survey process for non-expert participants	Identifying thresholds, incomparable results	Very easy, can give unreliable results	Easy, can give unreliable results

2.13.1 AHP method

AHP method is a common MCDM and it is developed by Saaty (1980) to help in solving difficult decision problems by catch both subjective and objective evaluation measures. AHP is a useful theory of relative measurement in the form of pairwise comparisons by decomposing a complex problem into simple and multilevel hierarchical structures. It can incorporate both tangible and intangible judgment criteria in a decision problem and analyze and model them based on the

formalization of experts' knowledge and experience [133]. The method uses hierarchy structures to break complex problems, as criteria is compared to each other based on their importance and with respect to the problem solving goal [134]. AHP is a method of measurement by pairwise comparisons and relies on the decision of experts to derive priority scales [135].

It builds up on three basic principles; breakdown of a decision making problem to simple problems; comparative evaluation of the hierarchy elements by pair wise comparison; and synthesis of priorities [136]. During the comparisons, it is suggested that odd numbers from 1 to 9 are used. If there are doubts in setting the preferences, use even numbers [137]. A detailed interpretation of the evaluation scale is given in Table 2.12 Six phases are presented in this method [135].

- Problem- and problem-solving goal definition.
- Constructing the hierarchy structure and evaluation of criteria.
- Based on the pairwise comparison, matrices are calculated for the results.
- Weight calculation for each element by the following steps:
    1. Value of columns is added for matrix normalization;
    2. The lines are summed up in the normalized matrix to calculate the criteria's relative priority;
    3. Matrix consistency is assessed through calculating the eigenvalues. The value is compared with random consistency value, which is based on the matrix size;
    4. Steps are repeated for each of the criteria;
    5. Calculate values of each alternative for each criterion are included in one matrix, with the application of calculated priority;
    6. Add the values of each alternative to obtain the final value. The best alternative is the one with the highest value
- Review and balance of decision.
- Decision documentation.

Figure 2.25 Show the pairwise comparison at each level is made between the criteria to identify the impact of each criterion compared to certain criteria at upper level [138].

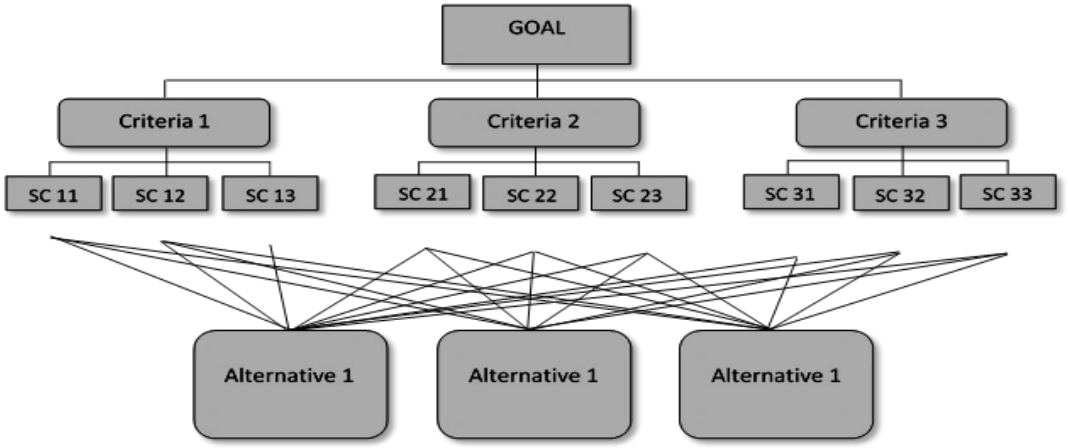


Figure 2.25. Hierarchical Structure for Alternatives and Criteria [134]

Unwritten scale ranges from "equal" (number 1) to "absolutely more important than" (number 9) is used for the measurement of quantitative as well as qualitative criteria. The preferred criterion cell of the matrix has the value and the other has the inverted value (1 / value). Pairwise comparisons levels are carried out using a 9-point standard scale presented in Table 2.11.

Table 2.11. Evaluation scale used in pairwise comparisons [137].

Intensity of importance	Definition	Explanation
1	Equal importance	• Two activities contribute equally to the objective
3	Moderate importance	• Experience and judgement slightly favour activity over another
5	Strong Importance	• Experience and judgement strongly favour activity over another
7	Very strong importance	• An activity is favoured very strongly over another; its dominance demonstrated in practice
9	Extreme importance	• The evidence favouring one activity over another is of the highest possible order of affirmation
2,4,6,8	For compromise between the above values	• Sometimes one needs to interpolate a compromise judgement numerically because there is no good word to describe it

Each criterion is counted by finding the value of raised eigenvalue (λmax), consistency index (CI) and consistency ratio (CR). CR index in AHP is used in order to maintain consistency in decision making of the participance. CR can be defined as follows:

$$CR = CI/RI$$

CI can be defined as:

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

RI is the random index and is selected from Table 2.12 according to the rank of the matrix and CI is the consistency index.

Table 2.12. Random consistency indices [139]

Matrix rank	2	3	4	5	6	7	8	9	10
RI	0.00	0.58	0.90	1.12	1.24	1.35	1.41	1.45	1.49

The inconsistency should not be higher than 10% (CR ≤ 0.10), because when the inconsistency level is higher than 10% means that the consistency of the pairwise comparisons is insufficient and cannot be used[140] . If CR< 0.1 the comparisons are acceptable, while the pairwise comparison by the decision makers requires revision, if the consistency evaluation is not passed. In case of the CR value more than 0.2, then repetitively repeat the same process through feedback until the maximum eigenvalue, CI, and CR value are suitable, or remove the outcome of such participance [131, 141].

Normally, the development process AHP requires six stages [142]. Started with definition to the problem and continue with the steps in figure 2.26 until choosing the best alternative. AHP is well-known for its reliability in considering the decision makers' point of view instead of considering decision, with a sensitivity analysis for the criteria and their sub-criteria and compatibility calculation for the decisions. The AHP method allows for a high-quality result with a less development process, as well as including subjective and objective evaluations and allowing for a consistency check for a reduced bias in decision making. Furthermore, several issues are avoided through using the AHP method, including issues in planning, focus and participation, which are often the causes of error in the decision-making process [91].

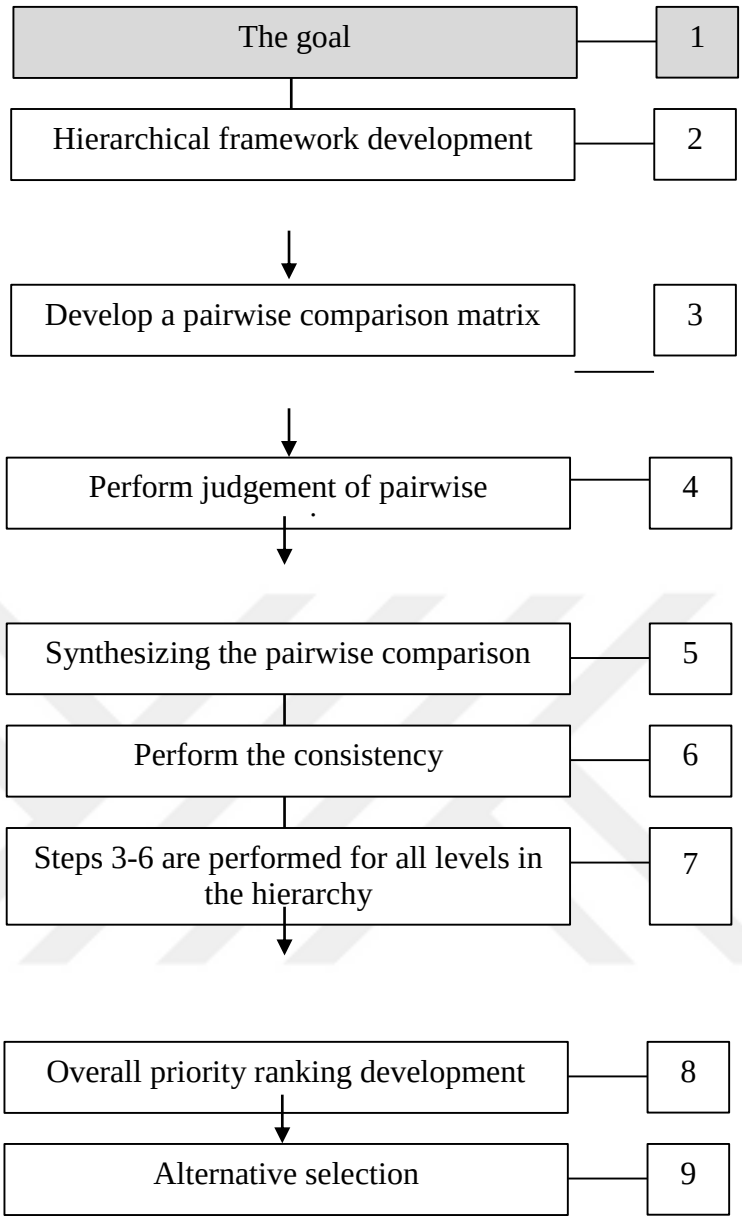


Figure 2.26. Analytical hierarchy process (AHP) steps [142]

Figure 2.27 indicate that, the AHP based decision support framework. The increase in interaction and engagement of the decision-makers is one of the important features of the AHP method. The pairwise comparison requirement allows the participants to think during the evaluation process and assess the criteria and alternatives on several levels. Another advantage of AHP is its ability to measure quality and quantity indicators by using mental preferences, expertise, and objective information. By classifying criteria from top to bottom in a decision tree, AHP systematically assesses difficult problems, particularly by incorporating opinions than decision from

experts and decision makers. Because it is based on decision makers' points of view rather matrices AHP is a reliable method for calculating the weight of each criterion. In addition, it allows performing sensitivity analysis over criteria and sub-criteria [138].

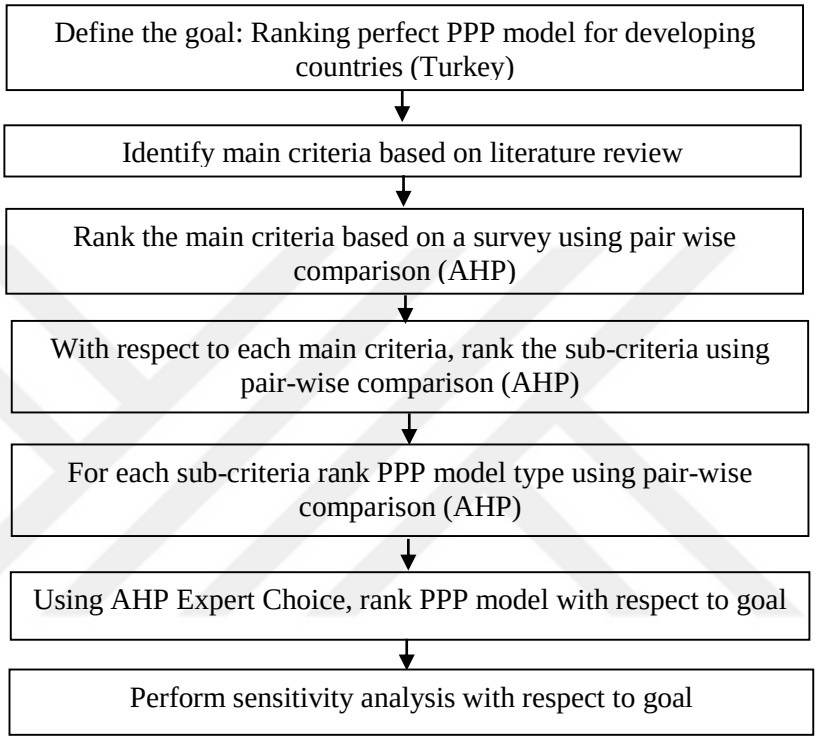


Figure 2.27. AHP based decision support framework [134]

Bhushan [143] states that since the development of the AHP method, it has been used for different purposes, including selecting an alternative amongst others and prioritizing a set of alternatives. In addition, resource allocation for finding best combination of alternatives subject to a variety of constraints. Also, benchmarking of processes or systems with other, known processes or systems. Furthermore, in quality management that have seen many applications of the AHP include healthcare, defense, project planning, technological forecasting, marketing, new product pricing, economic forecasting, policy evaluation, social sciences, etc. Besides its applications in conflict analysis, military operations research, regional and urban planning, R&D management and space exploration, the AHP has developed as a widely accepted methodology for decision-making. As a technique it has evolved over the years and

has been applied in conjunction with other mathematical modeling and analysis techniques [143].

2.13.2 PROMETHEE Method

The PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluations) family of outranking methods, including the PROMETHEE I for partial ranking of the alternatives and the PROMETHEE II for complete ranking of the alternatives, were developed by Brans, 1982. A few years later, several versions of the PROMETHEE methods such as the PROMETHEE III for ranking based on interval, the PROMETHEE IV for complete or partial ranking of the alternatives when the set of viable solutions is continuous, the PROMETHEE V for problems with segmentation constraints [144]. PROMETHEE method is a quite simple ranking method in terms of concept and application compared with many other methods for multi-criteria analysis [122]. The PROMETHEE method is an interactive multi-criteria decision-making approach designed to handle quantitative as well as qualitative criteria with discrete alternatives. In this method, pair-wise comparison of the alternatives is performed to compute a preference function for each criterion. The PROMETHEE method can classify the alternatives which are difficult to be compared because of a trade-off relation of evaluation standards as non-comparable alternatives and the PROMETHEE method has significant advantages over the other MCDM approaches [141]. The PROMETHEE I method can provide the partial ordering of the decision alternatives, whereas, PROMETHEE II method can derive the full ranking of the alternatives [141, 144]. Mokrini et al, [145] This method has been applied in several research area including supply chain management like partner selection problem, disassembly line balancing problems [145]. The first step in PROMETHEE method is to create the evaluation table. This table shows two types of information; the weights of evaluation criteria (wi): PROMETHEE method cannot distribute weights to the criteria. Therefore, the priority weights of selection criteria are calculated using AHP method in the previous steps; the performance level of each action according to each evaluation criteria.

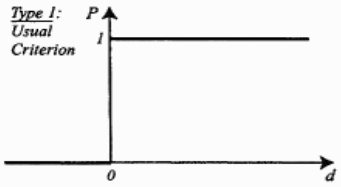
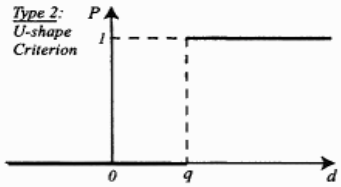
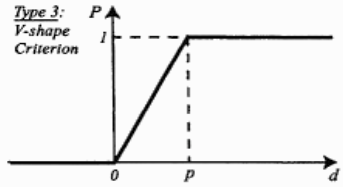
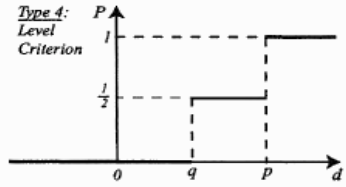
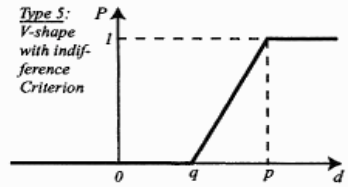
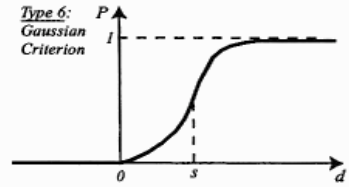
There are several reasons for using PROMETHEE; first of all, it is an outranking method suitable for ranking the alternatives among conflicting criteria; the second is that PROMETHEE is a rather simple ranking method with respect to conception and

application when compared with the other MCDM methods; and third one is the popularity of it [146]. PROMETHEE has the advantages to deal simultaneously with qualitative and quantitative parameters. It provides an overall ranking of the different alternatives with respectively positive and negative outranking flows, with the ability to permit thorough sensitivity analysis and establishment of the highest allowable deviations from the original weights. However, it does not provide a specific method according to which the weights can be determined. Therefore, in the case of a significant number of criteria (more than seven), it becomes very difficult for the decision maker to design the problem and to evaluate the pertinence of the obtained results [147].

2.13.3 PROMETHEE II Method

PROMETHEE II method is basic for other PROMETHEE methods' implementation. This method is depend mainly on the pairwise comparison of alternative with respect to the criteria [144]. According to each criterion, each alternative is evaluated, that have to be maximized or minimized based on the response evaluated. To implement this method, two additional steps are needed. The first is determination of the weights for the criteria, at least when it is number not large. The second is the performance function evaluation based on the proposed six basic types that introduced by Vincke and Brans in 1985: (1) usual criterion, (2) U-shape criterion, (3) V-shape criterion, (4) level criterion, (5) V-shape with indifference criterion and (6) Gaussian criterion as shown in Table 2.13 [148]. The steps of the PROMETHEE II implementation are started by defining the weight of the criteria and this step can be done by using another method based on the pairwise comparison. Then for each criterion, using a suitable performance function, followed by calculating the outranking for each alternative by the positive and negative outranking flow based on the partial ranking firstly then by the complete ranking by the net outranking flow. Generally, PROMETHEE method have three main tools for alternatives ranking, PROMETHEE I for partial ranking, PROMETHEE II for complete ranking and GAIA to display graphically comparative for the alternatives positions in term of the criteria contributions [130, 149].

Table 2.13. Generalized criteria types for preference function.

Generalised criterion	Definition	Parameters to fix
	$P(d) = \begin{cases} 0 & d \leq 0 \\ 1 & d > 0 \end{cases}$	–
	$P(d) = \begin{cases} 0 & d \leq q \\ 1 & d > q \end{cases}$	q
	$P(d) = \begin{cases} 0 & d \leq 0 \\ \frac{d}{p} & 0 \leq d \leq p \\ 1 & d > p \end{cases}$	p
	$P(d) = \begin{cases} 0 & d \leq q \\ \frac{1}{2} & q < d \leq p \\ 1 & d > p \end{cases}$	p, q
	$P(d) = \begin{cases} 0 & d \leq q \\ \frac{d-q}{p-q} & q < d \leq p \\ 1 & d > p \end{cases}$	p, q
	$P(d) = \begin{cases} 0 & d \leq 0 \\ 1 - e^{-\frac{d^2}{2s^2}} & d > 0 \end{cases}$	s

2.13.4 AHP and PROMETHEE Approach.

Mathematically simplified and representing solutions are required by professionals and decision-makers. Moreover, the approach of using multiple MCDMs requires supporting it through previous research and results. Through the review of AHP and PROMETHEE methods, the literature shows that they have been used frequently in separate and combined manners for several years due to their reliability and proven results [122]. Sources shows recommendation for such an integration to combine the useful features of each one of them. The AHP allows for a decision-making process based on a hierarchy structure in weighing criteria and alternatives [131], in addition to decomposing the problem into parts and tasks, which are advantage that are not provided in the PROMETHEE method for the criteria more than seven, it will be difficult for the decision makers to evaluate the result and get clear view for the problem [131]. AHP and PROMETHE integrated approach for selection problem consist four stages, started with gathering the important date for the problem, then application AHP method for criteria weight evaluation by constructing a decision hierarchy by the selected decision team (Experts), followed by alternative ranking by PROMETHEE method and finalizing with the final decision making [130, 149].

2.14 Chapter Summary

The concept of public-private partnerships was introduced in this chapter, in addition to its definition and the main types of these projects such as BOT, BOO, BOOT. Furthermore, the history of these projects in the developing countries was presented, particularly in Turkey and the PPP in airport sector. An extensive systematic review of relevant current materials from journal articles, conference papers, reports, and books were performed to perform a solid background knowledge about PPP procurement and CSFs, risk factors for PPP projects and the MCDM methods that used in this area of research. An in-depth study has been conducted to define the most effective CSFs for PPP projects in PPP publications from 2000 to 2018. Another objective was to identify the most significant and common PPP projects risk factors. As a result of this review, 20 CSFs have been identified and 46 RFs for PPP projects.

Moreover, a multidisciplinary review of the literature on MCDM methods used for similar research was conducted in this chapter. The main result for this review shows

that the AHP-PROMETHEE approach was not used before for PPP model selection, specifically for airport projects. The review in this area does not only aim to reveal the important CSFs and risk factors, but also shows the lack of a comprehensive decision-making model for selecting an appropriate PPP model. Based on these findings, KPIs of public-private partnership projects, particularly airports projects, in developing countries (Turkey) are compiled and a methodology approach for appropriate PPP model's selection is developed for the analysis of this critical issue.

CHAPTER III

RESEARCH METHODOLOGY

3.1 Overview

Based on the research problem, this chapter analyzes the methodology that was applied by the researcher for data collection. As several strategies for data collection are used worldwide like questionnaire, case study, interview and observation and based on the review study that has been done in this research it found that the most proper method for data collection related to PPP projects is questionnaire method. This method is chosen based on it is workability it is effectiveness.

3.2 Research Plan and Process

Research process of this study started with selection general area of study (PPP for infrastructure projects). Then conducting a comprehensive systematic literature review for the publications data at the international search engines such as Scopus, Web of Science, Science direct. The main results of this step are; problem statement identification DMM to select best fit PPP procurement method for airport projects

(New Antalya airport) based on KPIs by using AHP-PROMETHEE approach and common CSFs, Risk factors and PPP models for airport projects based on international point of view. The second main process is questionnaire survey design to specify the significant CSFs and Risk Factors for PPP airports projects in Turkey through selecting research sample (PPP airports experts from public and private sectors in Turkey). Data which collecting from the survey are analyzing with SPSS software. Results in this step are a ranking list of PPP airport KPIs and Common PPP models for airport projects in Turkey. Those factors produce the KPIs which will be used as criteria in the MCDM method with a pair wise comparison by using the effective method in this issue (AHP). Criteria are evaluating by the experts who are selected from the participate in the survey to evaluate and priorities the criteria by using Expert Choice Software v11. Final ranking for the alternatives done by PROMETHEE I, II methods. Finally, the validation process to the results and the DMM. The research plan detail is explained in figure 3.1

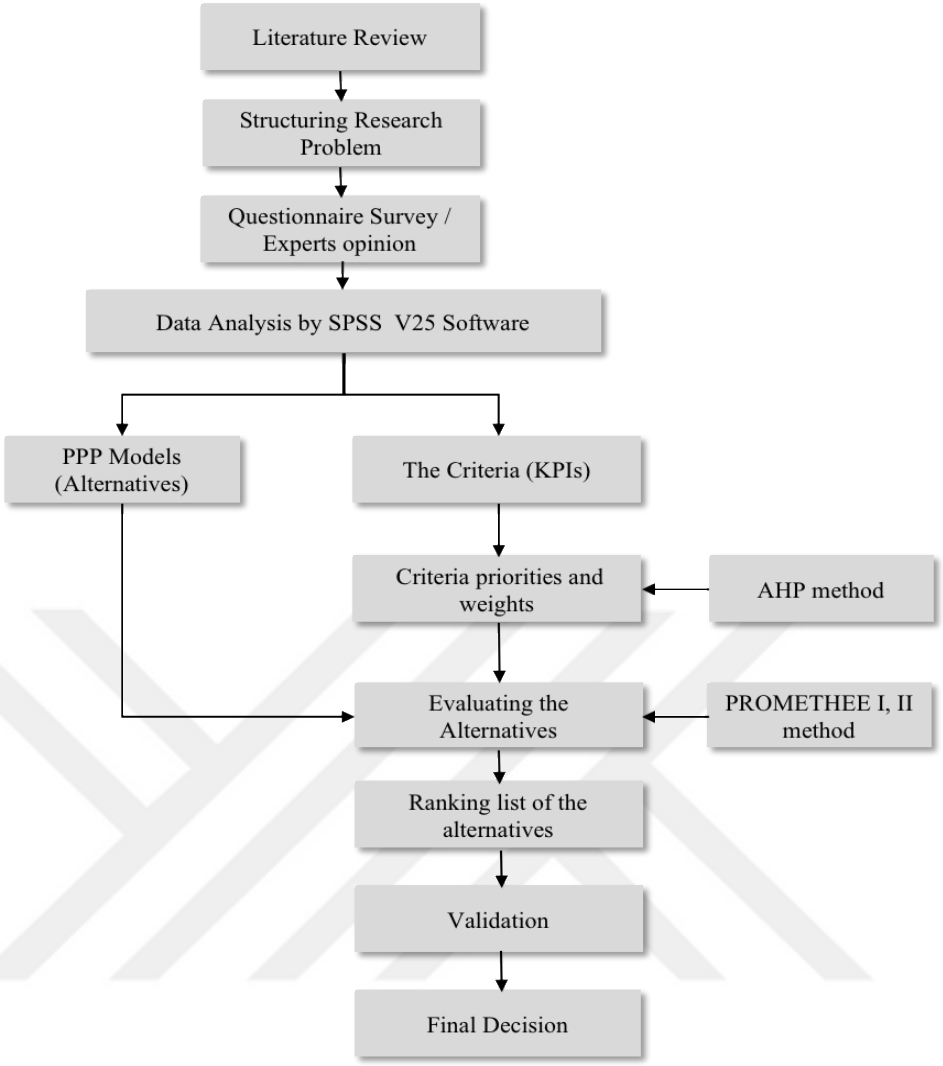


Figure 3.1 Research Plan and Process

3.3 Research Methodology Stages

The Research methodology strategy used for systematically solving the research problem which lead to understand scientifically how research is done [150]. [151, 152] Defined the methodology as a systematic evaluation and theoretical assessment of the method used in an area of research. However, the research methodology and design for conducting a research should be guided by the research questions, study aims and objectives [153]. The objective of this study is to develop a methodology approach for a DMM to determine best PPP procurement method for airport projects (New Antalya airport) based on AHP-PROMETHEE approach. For this aim, a five phases methodology including pre-evaluation and problem definition phase are introduced as shown in figure 3.3. Within the first stage a comprehensive literature

review for the secondary date in Public-Private Partnership projects which published in a high rank scientific data base such as Scopus, Web of Sciences and ScienceDirect. These target publications have been reviewed and summarized to specify the main research problem. The other four phases are the main part for this methodology including AHP-PROMETHEE approach. At the end of phase 2, the criteria and the alternatives are determined based on the questionnaire results. After prioritizing and finding the weights of the criteria by using AHP method, alternatives are ranked via applying PROMETHEE method. As shown in figure 3.2 the stages of the research methodology used is summarized below: Stage 1: (Problem definition): A comprehensive systematic literature review to identify the research problem, identify the most common critical success, risk factor and the common DM methods have used for PPP projects from the international publications.

Stage 2: (Exploration): Questionnaire survey to validate and identify the Risk and CSFs for airport projects for developing countries based on Turkish experts (67 Public and Private experts, Exploring their opinions and judgements). These factors are combined together to form the KPIs for PPP airport projects.

Stage 3: (Criteria Evaluation): AHP Collection): AHP interview to specify the criteria weights and it is priorities with PPP airports experts (3 public and 3 private) who's their answers in the previous survey are almost same to the final survey results and have been chosen by using SPSS v25 software.

Stage 4: (Alternatives Selection): Partial ranking for the alternatives with PROMETHEE I, then complete ranking with PROMETHEE II.

Stage 5: (Validation): Final decision making will be taken after conducting analysis with many scenarios. Then decision model will validate by interviewing the same experts in stage 3.

Using an integrated and combined methodology based on MCDM methods are used and applied successfully in many studies and various areas [122, 125, 146, 154-156]. For that, AHP and PROMETHEE method applied in this study. Furthermore, this technique is effective, applicable and suitable for such decision situation [130, 131].

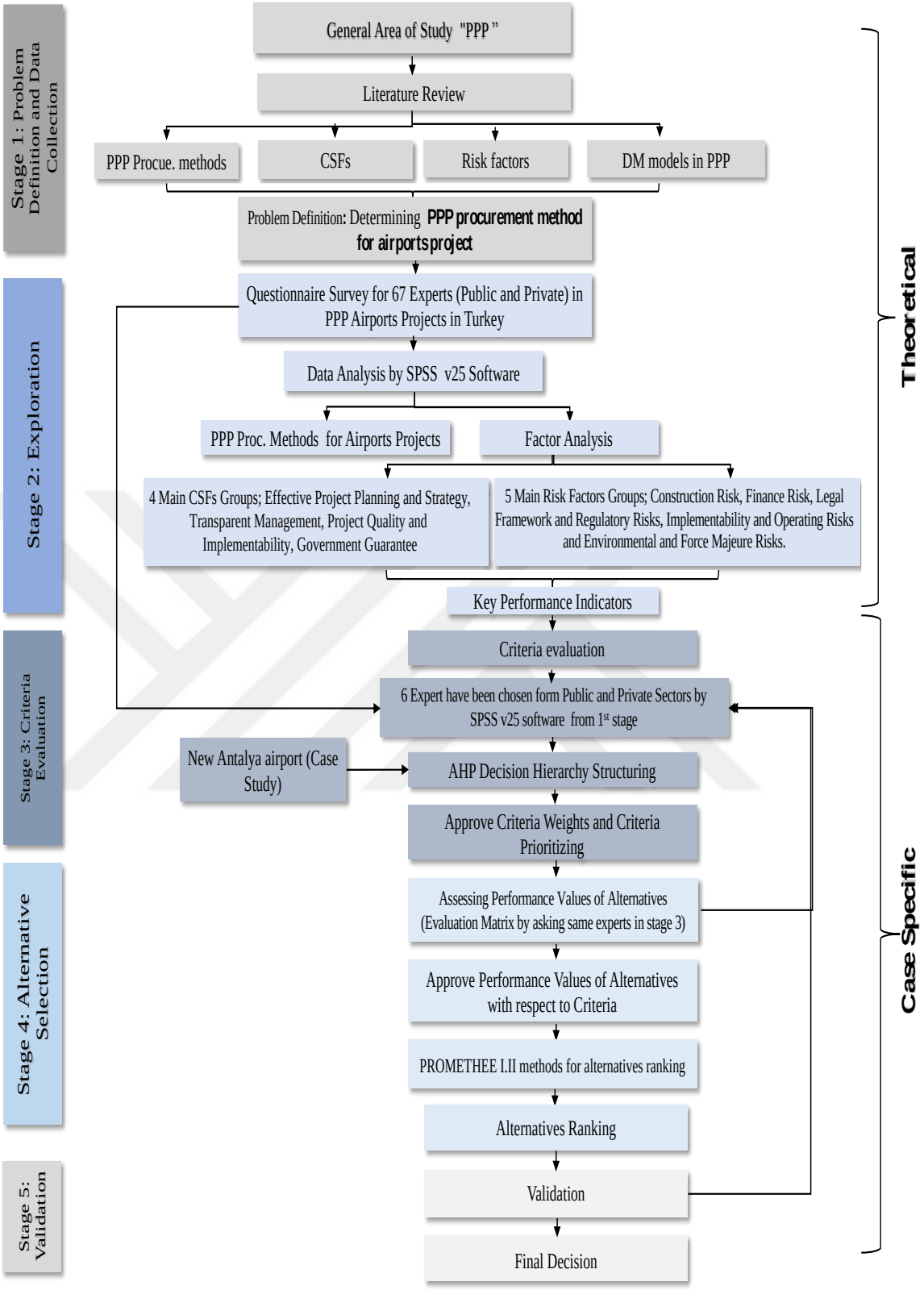


Figure 3.2. Proposed Research methodology

3.5 Data Collection Stages

Most methods of data collection can be used in both qualitative and quantitative research [157]. The quality of the data is related to the method employed for data collection. Two major types of data collection are the primary and the secondary data collection methods [158]. Primary date refers to the date that collected directly from the respond for the first time, fresh date. On the other hand, the secondary data, , are refers to those which have already been collected in previous by someone else [150]. the major secondary data sources are journals, websites, books and newspapers.

3.5.1 Literature Review and problem definition stage

Although, reviewing and analyzing the findings of the research studies in academic journals in particular research areas from previous publications is necessary [159, 160]. Using specific an acadmic search engines for general searches, such as Scopus and Web of science, are more effective. For that, this research depends mainly on the secondary data (articles and conference papers) which have been published at powerful search engines available at Can kaya University library database such as Scopus, Web of Science, Science Direct and Google Scholar. This review study has passed through three stages as shown in figure 3.3. Beginning with identification of the search engines, followed by selection of the target articles and papers, analyses and examinations of these articles and papers as the final stage. Different keywords have been used for searches in the area of CSFs of PPP projects, such as "CSFs, Critical success factors of Public Private Partnership", "Risk Factors of Public Private Partnership" and "Decision Making Models in Public Private Partnership" in the second stage, selected target articles, papers based on Title / Abstract / keywords were used firstly, followed by visual and detailed searches in the selected search engines. All the publications which were selected were subjected to detailed examinations in order to select the target publications. Examining and analyzing target papers was the final stage.

3.5.2 Questionnaire Survey process and population sample (Exploration Stage)

Questionnaire survey as a strategy of collecting data is considered as an effective and popular method in many area of studies [28]. Several researchers have used this approach to gain a comprehensive understanding of PPP risk factors and their

allocation as well as critical success factors of PPP projects [4, 101, 161-163]. A questionnaire is a powerful tool used to collect expert opinions, for this research a ranking-type questionnaire survey was adopted to collect accurate data.

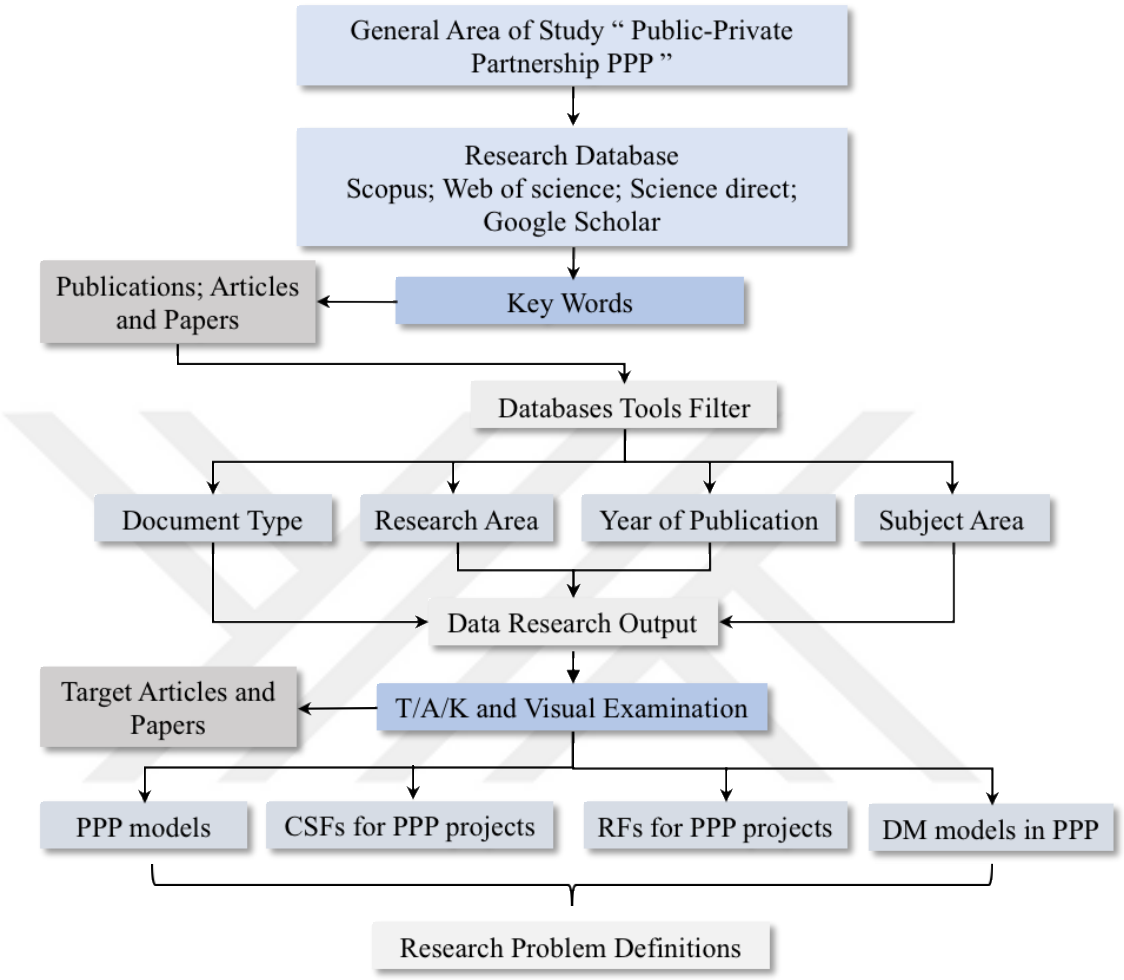


Figure 3.3. Literature Review Process, Source [15, 158]

3.5.3 Questionnaire Survey Process

Ranking and evaluating the significant airports PPP risk factors and CSFs required accurate information collecting from experienced participants. Consequently, the survey focused on institutions that have direct involvement in airport PPPs from public and private sectors as shown in table 3.1. The sample population for this survey have chosen based on their experience in PPP airports sector from both public and private sectors in Turkey. The written questionnaire was mainly distributed by hand to respondents in Turkey (Ankara - Istanbul). 167 respondents were selected from ministries and private companies in Turkey, 67 participants were retrieved and

5 of them were excluded. 62 questionnaires as a total were interred to the analysis stage. The rate of response was 41.3%, while the valid data response rate was 37.6% as an outcome of all the questionnaires. The respondents were asked to evaluate and rank the importance of 20 CSFs and 46 risk factors of PPP private projects which collected and evaluated from the literature review based on 5-point Likert scale. The Likert scale has been adopted by many studies in many countries [161, 164]. 73% of the respondents who completed the survey have a good experience and knowledge of PPPs. Moreover, respondents of the questionnaire are needed to write some information and mark √ for the multiple-choice questions based on their experience. The questions in the questionnaire are developed based on the preparatory of literature review of the research and the type of the questionnaire appropriated with the aims of the research study. Furthermore, the questions in the questionnaire are designed in a simple way that explain clearly the aim and objectives of the questionnaire. To make the survey clearer, it is titled as "the critical success criteria and risk factors for public-private partnership projects for 'airports' in turkey".

Table 3.1. Detail information of the Survey Respondents.

Variables	Category	Frequency	Percent	Valid Percent	Cumulative Percent
Academic Degree	B.Sc.	33	53.2	54.1	54.1
	M.Sc.	26	41.9	42.6	96.7
	Ph.D.	2	3.2	3.3	100.0
	Total	61	98.4	100.0	
Missing	System	1	1.6		
Total		62	100.0		
Primary Role	Engineer	14	22.6	28.6	28.6
	PPP Expert	14	22.6	28.6	57.1
	Financer	7	11.3	14.3	71.4
	General Director	6	9.7	12.2	83.7
	Consultant	3	4.8	6.1	89.8
	Academics	2	3.2	4.1	93.9
	Contractor	2	3.2	4.1	98.0
	Sub-Contractor	1	1.6	2.0	100.0
	Total	49	79.0	100.0	
Missing	System	13	21.0		
Total		62	100.0		
Industrial Experience	5 years below	19	30.6	32.8	32.8
	6 – 10 years	14	22.6	24.1	56.9
	11 – 15 years	10	16.1	17.2	74.1
	21 years or above	9	14.5	15.5	89.7
	16 – 20 years	6	9.7	10.3	100.0
	Total	58	93.5	100.0	
Missing	System	4	6.5		
Total		62	100.0		
Sector Experience	Public sector (State)	40	64.5	67.8	67.8
	Private sector	19	30.6	32.2	100.0
	Total	59	95.2	100.0	
Missing	System	3	4.8		
Total		62	100.0		

3.5.4 Preparation of instrument.

The questionnaire was divided into 4 sections (see Appendix). The first section was about participant information such as level of knowledge and the respondent's profile. The second part aimed to investigate the experience of precipitance with PPPs. The third part contained scale-based questions that took into consideration the importance level of CSFs on PPP airport projects in Turkey. The last part contained the evaluation and the level of risk factors significance based on their effect on PPP airport project in Turkey. The questionnaire was written in both English and Turkish to guarantee an active questionnaire design and distribution to the participances directly.

Section	Section Title	Section Objective
Section 1.	Respondent's Information	Obtain the respondent information such age, academic degree, primary role and industrial experience.
Section 2.	General experience with PPP	Specify years of experience with PPP projects, PPP models for airport projects.
Section 3.	Critical success factors	Ranking the CSFs based on the participance experience for PPP airports projects.
Section 4.	Risk Factors	Ranking the risk factors based on the participance experience.

3.5.5 Sample Selection Technique

The participances in this research have to meet two criteria before participating in this survey study that include 1. Having an experience in PPP projects, the number of years shall reflect an extensive knowledge in the area of public private partnerships projects. In addition, the amount of years shall reflect superiority and a managerial level. 2. Working at Turkish public or private sector that related to PPP projects. The expert needs to be sensitive of the current regulations and standards in Turkey and worldwide in the PPP projects development field. The survey population defined as; The public sector, those persons working at public agencies that responsible and have relation to the PPP airports projects. The population sample have been selected from the public sector agencies those responsible about developing, managing and planning PPP airports projects in Turkey, which are; General Directorate of State Airports (DHMI), Ministry of development, Ministry of transportation, Ministry of

economy and Ministry of transportation and Infrastructure. Whereas, the private sectors, those persons who working at the private sectors (Construction Companies) and have an experience in PPP projects specially for airports projects. They sampled from the local industrial companies that have doing PPP projects, the detail information of those companies was adopted from their web sites at the internet and by visiting them personally (Ankara – Istanbul).

3.5.6 Questionnaire Distribution Method

Because it provides a direct contact with the participances to ensure that the respondent is interested in answering the question and have a good experience by explaining to the respondent the objective of the survey before submitting the questionnaire. via hand by hand method was adopted in this study. Hard copy of the questionnaire including cover letter that explain the objective of the study have been submitted to each respondent. To avoid the low response from the participances from public and private sector, phone call and consecutive visits to the respondents were conducted when some of them need any more information and if some respondents were behind the date of summation.

3.5.7 Questionnaire data analysis technique.

(SPSS) v 25.0, Statistical Package for Social Scientists, has been used for questionnaire data analysis. Statistical tests such as reliability analysis, mean analysis, variance analysis (ANOVA), correlation test and factor analysis were conducted.

3.6 AHP-PROMETHEE approach

Based on the results and the data collected from the questionnaire which used as an input data for AHP method (figure 3.5). This method is used mainly to identify the criteria weight and criteria prioritizing, that used in PROMETHEE method for alternatives ranking. In this research, the proposed AHP-PROMETHEE approach consists of three main stages which is; data collection; AHP method for criteria prioritizing and PROMETHEE I, II methods for alternatives ranking. The alternatives and the criteria are evaluated and identified based on the decision makers from both sectors experiences. Criteria which collected from the experts in forms of

key performance indicators are used to set-up a hierarchy shape, that used in an Expert Choice v11.5 software to get criteria weights and their prioritization. Then, to measure the contribution of the alternatives (PPP procurement methods) on the criteria, the performance function values are determined. Alternatives are ranked partially by applying PROMETHEE I and then for complete ranking for the alternatives PROMETHEE II and GAIA plane conducted figure 3.4. Sensitivity analysis can be applied based on the information obtained from PROMETHEE II method.

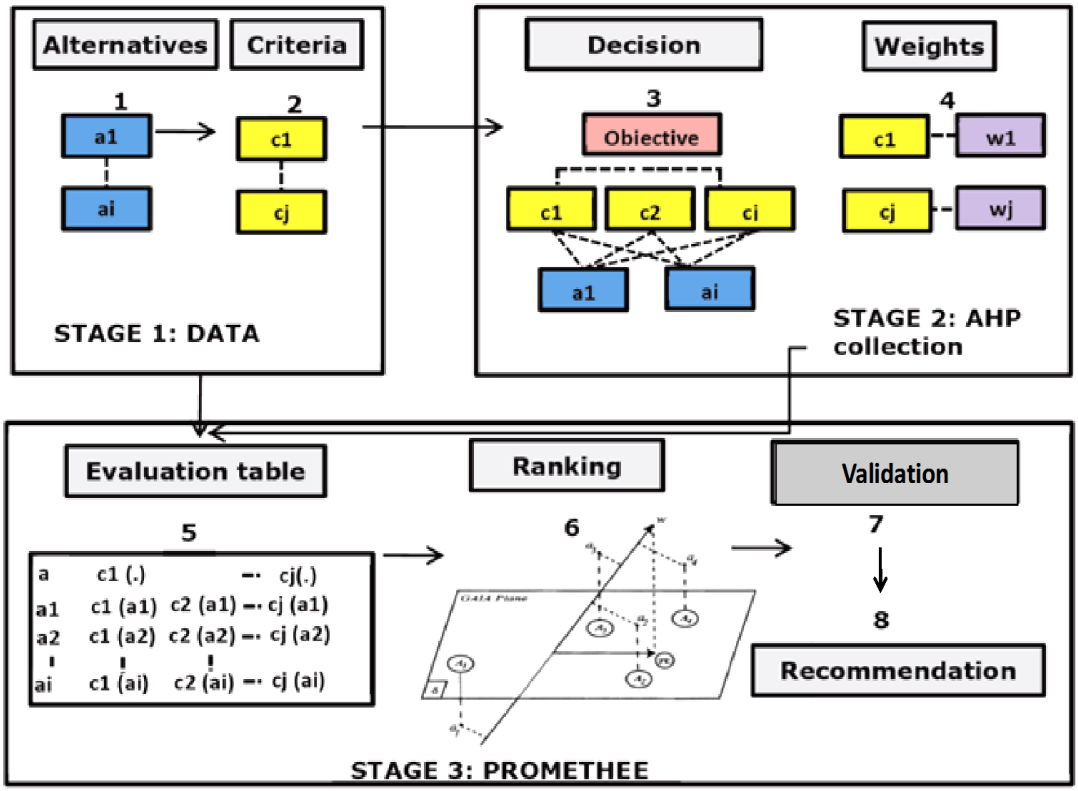


Figure 3.4. AHP-PROMETHEE approach source (Turcksin et al, in 2011 [149]

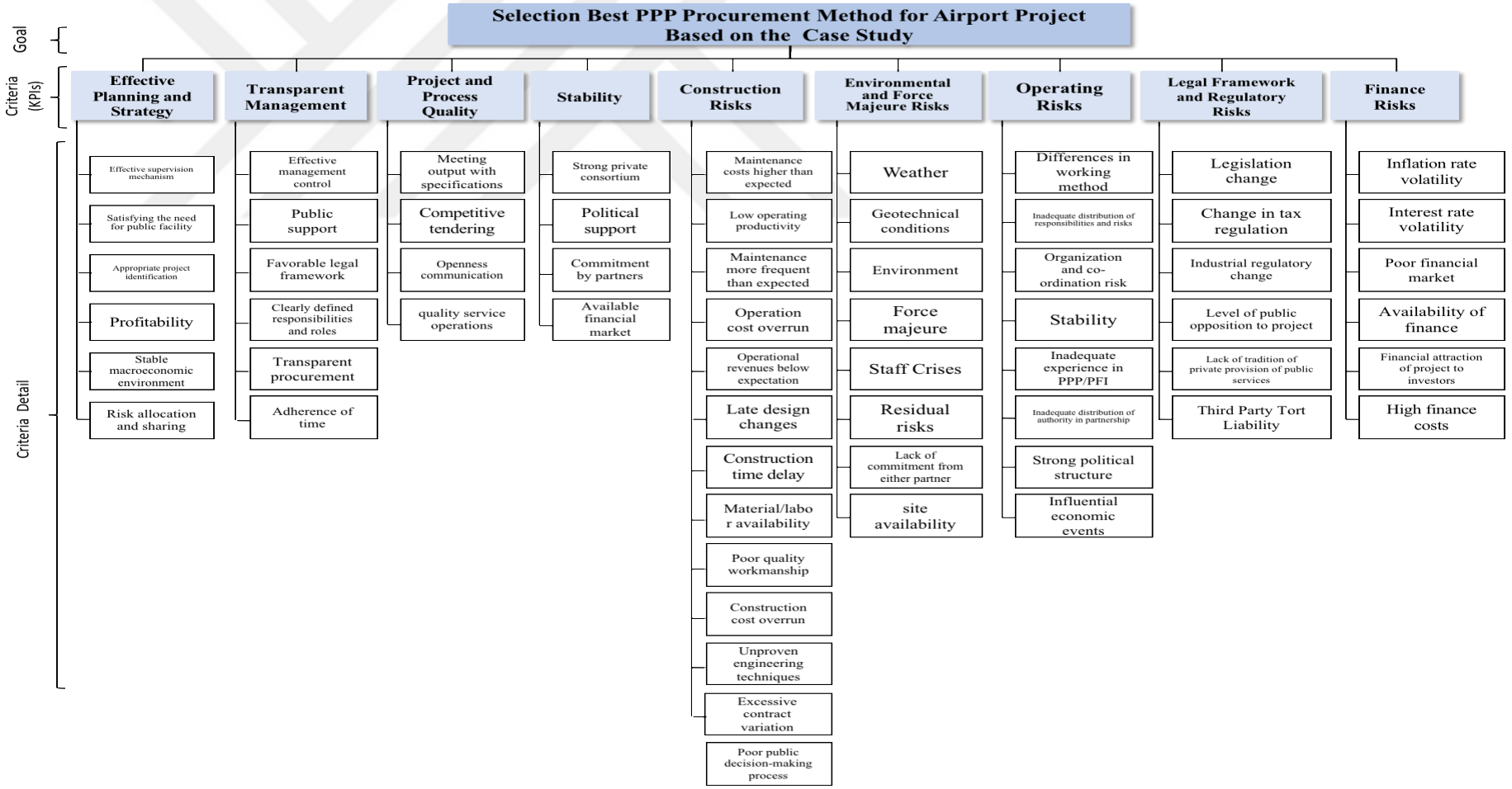


Figure 3.5. Analytical Hierarchy Process (AHP) Structure.

3.7 PROMETHEE Methods Application (Alternatives Selection Stages)

Main three PROMETHEE tools that can be used to analyze the evaluation problem; starting with PROMETHEE I which can provide the partial ranking for the alternatives; for final and complete ranking, the PROMETHEE II method can obtain the full ranking of the alternatives. The basic principle of PROMETHEE II is based on a pair-wise comparison of alternatives with respect to the criterion; the (GAIA) plane displays the relative position of the alternatives graphically, in terms of contributions to the different criteria [133, 152].

3.8 Validation Stage

Based on the results and the research process in the previous research stages, each participances from the selected experts have been interviewed personally or by e-mail to verify the reliability of the proposed methodology, proposed DMM and the outcomes of the research by filling the table below with grading (1- worst to 10-best). Furthermore, in this study the validation process is limited to the experts who participance in this research from the beginning.

Questions		Grade									
		1	2	3	4	5	6	7	8	9	10
1	Do you think that the proposed research methodology is an effective for PPP model selection?										
2	Do you think that the proposed research methodology can applied for other developing countries?										
3	Do you think that the proposed DM model has good applicability?										
4	Do the research study results reflect your personal prioritizing?										
5	Do you think that the research results are acceptable and logical?										
6	Do the PPP alternatives ranking reflect your prospective?										
7	Do you think that using MCDM methods for PPP model ranking are effective?										
8	How do you grade the overall of the research results?										

3.9 Proposed Decision-Making Model Process.

The proposed research methodology in this research is based on developing a decision-making model for determining the best PPP procurement method for airport project based on a case study as shown in figure 3.6. This model starting with the

problem definition from the literature review, which is the main aim for this model, Followed by expert definition. The experts were chosen based on the work place, from public and private sector and based on their experience in PPP projects particularly in airport sectors. For instance, for public sector, experts whose working at DHMI at the airport sectors were a target for this study. For this study the aim for the number of experts was 50, but 62 experts were participating in this research from public and private sectors. KPIs for PPP airports projects were defined based on risk analysis test by using SPSS v25 software in addition to the alternatives which are the PPP procurements systems for airports projects. Sample from the main expert's population have been chosen from the public and private sectors by using SPSS v 25 software.

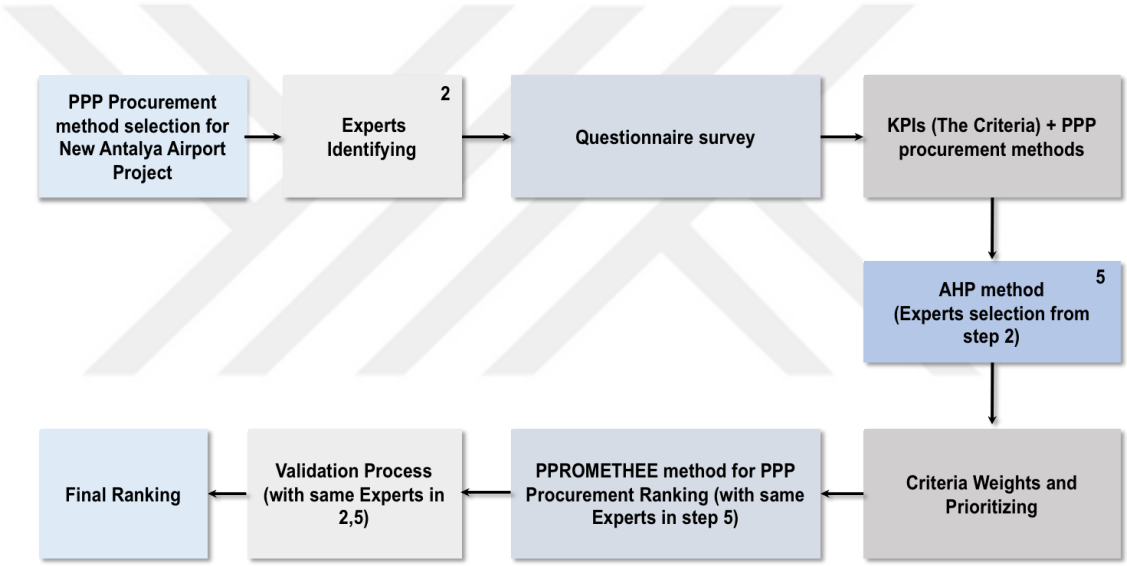


Figure 3.6. Proposed decision-making model steps

This sample interviewed to weight and priorities the criteria (KPIs) based on the case study, new Antalya airport by using AHP method. The same selected experts' sample are interviewed to evaluate the alternatives with respect to each criterion in form of the evaluation matrix that used in PROMETHEE method for the alternatives final ranking. The validation for the proposed methodology, decision making model and the outcomes of the research study have been done by prepared a validation sheet and interviewing the same selected experts.

3.10 New Antalya Airport (Case Study)

The largest Turkish city on the Mediterranean coast is Antalya, which is located 36.91 latitude and 30.70 longitude and it is located at elevation 61 meters above sea level with over one million people in its metropolitan area [165] see figure 2.16. In 2018 for the 10 months, 12.5 million tourists have visited Antalya, that made it the primary touristic place of the turkey's cities. This huge number of touristic need a big transportation facility. Antalya Airport is the major portal that located 13 kms far in the south west from Antalya city center. The airport is close to the main important touristic resorts of the Mediterranean coast of turkey, such as Alanya, Anamur and Manavgat. Reaching Antalya, one of Turkey's most popular tourist destinations, has now become easier with the addition of a new terminal building to Antalya Airport. Joint venture of Fraport AG and IC İçtaş was awarded the tender for operation of Antalya Airport terminals that took place in May 2007. Within the scope of the concession agreement, the joint venture this has got the right to operate the Domestic Terminal, International Terminal 1, VIP and CIP terminals and, since 2009, International Terminal 2, until the end of 2024 [166].

Airport project investment is very important to Turkish economic development and value of money, job foundation, attracting foreign companies and offering new commercial opportunities for the local economy. For that and based on the 2023 vision in Turkey, eight new airports are going to be built, two of them will be constructed by PPP method in Antalya and Cukurova [67]. Limited data for the case study is listed in text based on confidential reasons.

CHAPTER IV

IMPLEMENTATION OF THE DECISION-MAKING MODEL

4.1 Overview

Chapter four identify the researcher results by detail for the questionnaire survey finding such as the most important CSFs and risk factors of PPP airport projects in Turkey. Questionnaire finding are divided into four Sub sections according to the structure of the questionnaire. The results of the implementation of AHP and PROMETHEE method based on the case study (New Antalya airport) also presented in this chapter.

4.2 Questionnaire Survey Data Analysis

The questionnaire data analysis is divided into 3 main parts, the first deals with the characterization of the survey participances, whereas the second part present the critical success factors analysis, then the last part examines the risk factors of public private partnership airports projects in Turkey based on the experiences of the experts from both sectors, public and private.

4.2.1 Reliability analysis test

Reliability tests were carried out for reliability analysis which was carried out in order to check the consistency of the 20 critical success factors and 46 risk factors and as well as the reliability of the survey instrument. Cronbach alpha coefficient indicator normally used as an indicator, that when it is above 7.0 means the scale is considered acceptable and if it is more than 8.0 will be preferable [167]. The overall Cronbach’s Alpha values for critical success factors and risk factors of PPP airport projects are 0.851 and 0.930, respectively, indicating a high internal consistency and reliability for the dataset. Table 4.1 shows scale Cronbach's Alpha and the number of cases for each scale.

Table 4.1. Reliability coefficient Cronbach's alpha

Scales	Reliability Statistics		
	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
Critical Success Factors	**.851**	**.849**	**20**
Risk Factors	**.930**	**.931**	**46**

4.2.2 General Characteristics of Questionnaire Participants

Based on the questionnaire sample that participated in this study, the respondents from the public and private experts in the local organizations and regarding to respondent's distribution by sector, 65% of the participances in this research came from the public sector, while 35% came from private sector. In addition, figure 4.1 Present the percentage of the two groups of the questionnaire sample.

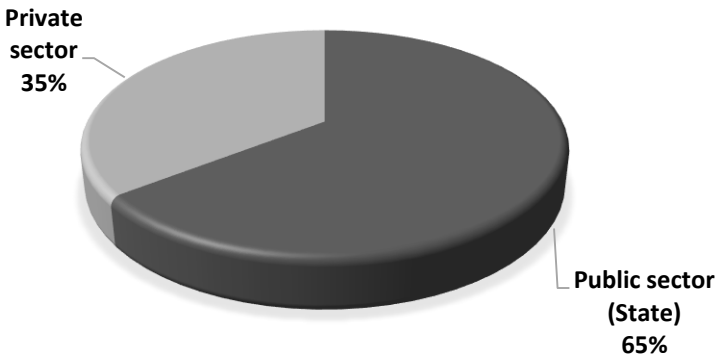


Figure 4.1. Respondents percentages by sector (n=62)

Furthermore, figure 4.2 Present the detail of the survey participations in term of job title. The majority of them were engineers and PPP experts, about one-half (45.2%), as well as (11.3 %) was finance and the other percentage was varying between consultants, contractors and academics.

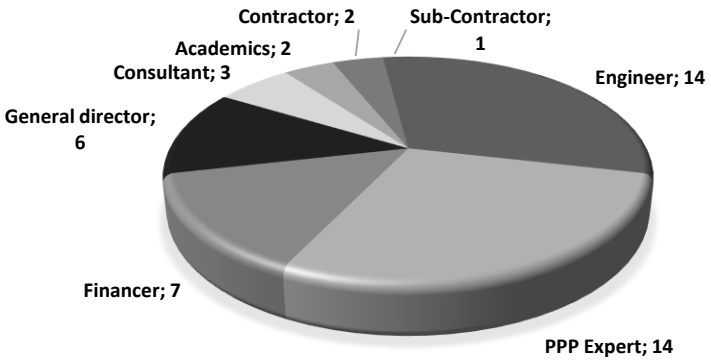


Figure 4.2. Respondents job title.

Figure 4.3 Show the percentage by age, which refer to the time experience, ability and skills of the respondents. The majority of the respondents are between 31-60 years old by (73%), while 27% of them are between 20-30 years old. Besides, just (2%) of the respondents were above 60 years old.

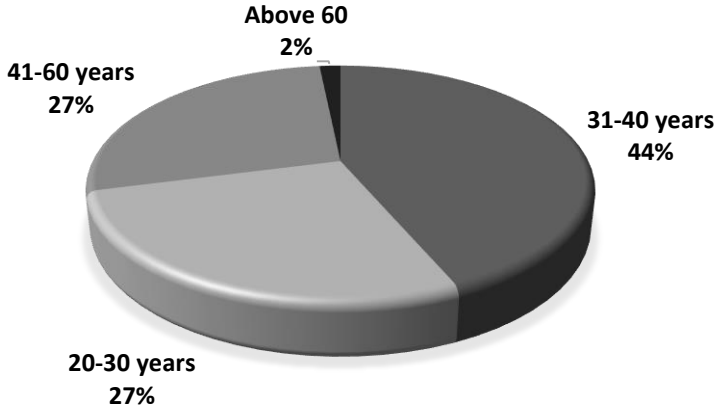


Figure 4.3. Respondents percentage by age

In addition, figure 4.4 indicate that about (63%) of the respondents had an industrial experience more than 5 years. 14% of them had very good experience, more than 21 years, whilst 37% had 5 years and below working experience.

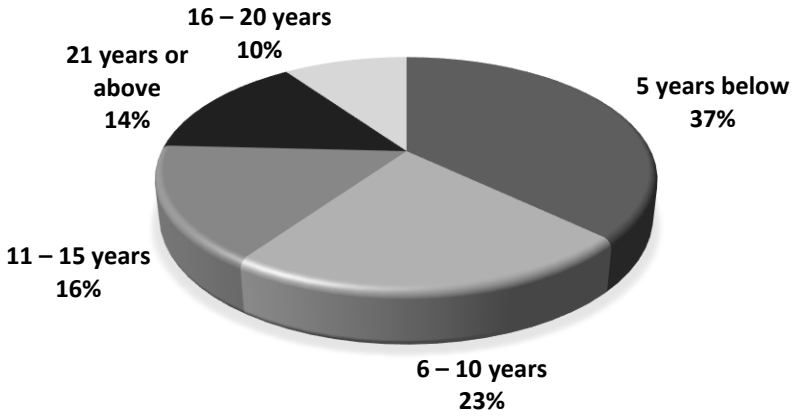


Figure 4.4. Respondents percentage by industrial experiences.

4.2.3 Critical Success Factors of PPP airport projects

Twenty Critical Success Factors are ranked (1 being the most important and 5 being the least important, order is reversed in analysis) according to respondents in what they consider to be the level of importance for PPP airports projects in Turkey. The mean value for each factor is ranked according to the categories; Public sector (State), Private Sector and combined. ANOVA analysis was used to compare the evaluation of each factor in both sectors. Table 4.2 shows the Descriptive of Critical Success Factors and the significance of the F test. Ranking 20 CSFs based on their importance to airport PPP projects were asked to the survey participant according to a 5-point Likert Scale. As shown in table 4.2 the mean values for the 20 CSFs range from 4.53 to 3.42. Therefore, mean values above 3.00 indicates the importance of that factor [62]. All the factors displayed mean value are more than 3 but seven important factors displayed mean values are more than 4.00, and the others showed mean values range between 4.00 and 3.00 based on the ANOVA analysis test, where it is used to compare the evaluation of each factor in both sectors. The most important seven CSFs are namely; available financial market, risk allocation and sharing, profitability, favorable legal framework, private consortium, effective supervision mechanism and appropriate project identification for PPP airports projects in Turkey. It is clear that there are some differences in the result of choosing the importance of these factors based on the opinion of the public and private experts. For example, public participates chose favorable legal frame work as the significant CSF for airports projects, while private ranked it at 16. On the other hand,

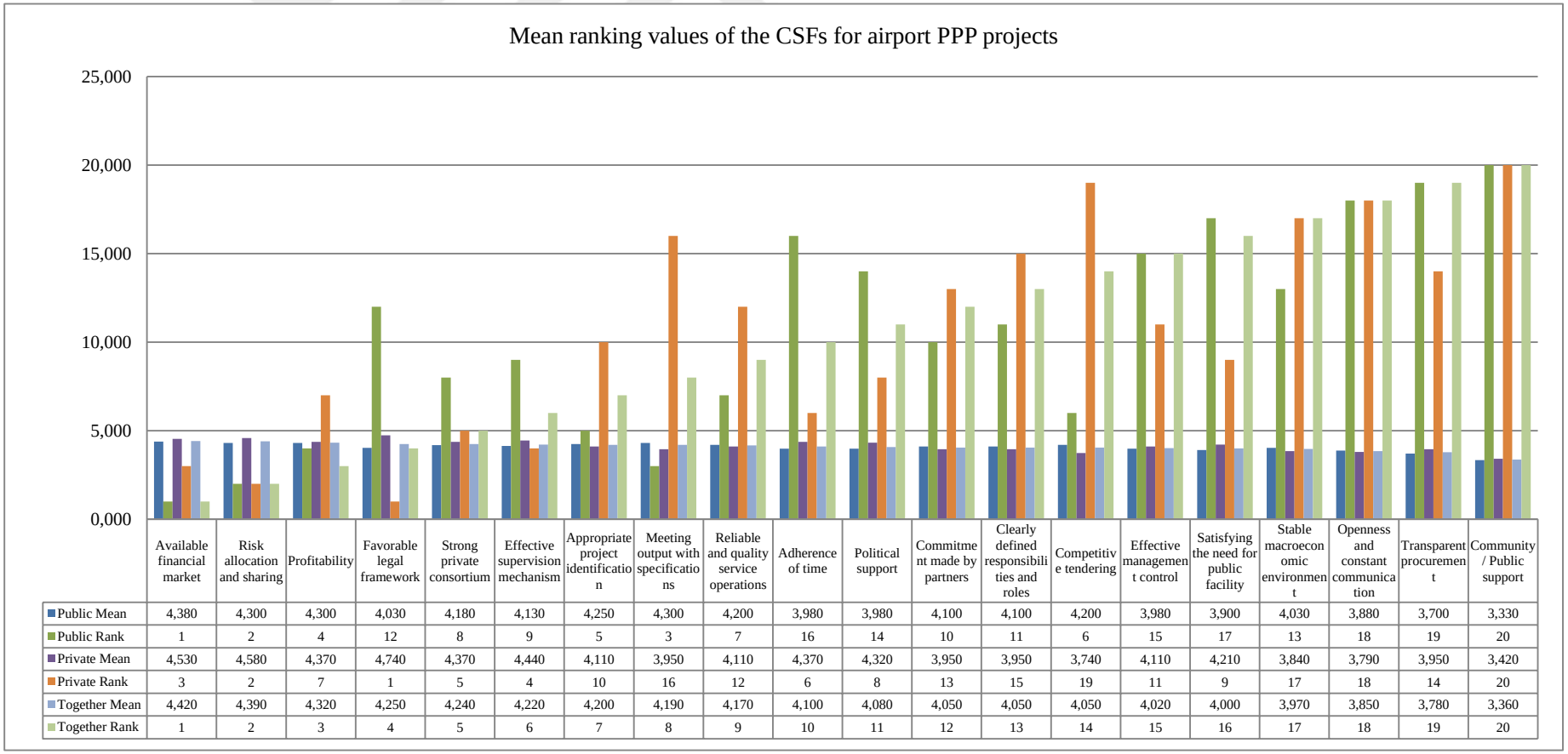
both of them ranked some factors at the same level of importance, such as risk allocation and sharing, openness and constant communication, and public support. Similarly, they ranked the availability of the financial market as the most important factor for achieving success when it came to these projects.

The most important CSFs from both views, public and private sectors, are: available financial markets, risk allocation and sharing, profitability, favorable legal framework, private consortium, effective supervision mechanisms and appropriate project identification for PPP airport projects in Turkey. However, public-sector experts, in comparison to those from the private sector, stated that some factors were more important than the others. For instance, public experts rank favorable legal framework (C01) as the most important factor and at 1st position, while experts from the private sector rank it 12th out of 20, which indicates that the private sector in Turkey may not be as affected by the country's legal framework as the public sector, or perhaps the impact does not appear to be a major one or one that creates much concern for the private sector. Similarly, the period of time for finishing the project is an important critical success factor for the public sector and perhaps not as important for the private sector, referred to as adherence of time (C10).

Table 4.2. Mean ranking values of the CSFs for airport PPP projects.

	CSF	Criticality									Sign.
		Public			Private			Together			
		Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank	
C01	Available financial market	4.380	0.705	1	4.530	0.697	3	4.420	0.7	1	0.443
C02	Risk allocation and sharing	4.300	0.966	2	4.580	0.607	2	4.390	0.871	2	0.254
C03	Profitability	4.300	0.853	4	4.370	0.831	7	4.320	0.84	3	0.773
C04	Favorable legal framework	4.030	1.121	12	4.740	0.452	1	4.250	1.01	4	0.010
C05	Strong private consortium	4.180	0.931	8	4.370	0.831	5	4.240	0.897	5	0.444
C06	Effective supervision mechanism	4.130	1.042	9	4.440	0.784	4	4.220	0.974	6	0.251
C07	Appropriate project identification	4.250	1.032	5	4.110	0.875	10	4.200	0.979	7	0.600
C08	Meeting output with specifications	4.300	0.791	3	3.950	0.848	16	4.190	0.819	8	0.123
C09	Reliable and quality service operations	4.200	0.853	7	4.110	0.737	12	4.170	0.813	9	0.679
C10	Adherence of time	3.980	0.974	16	4.370	0.831	6	4.100	0.941	10	0.135
C11	Political support	3.980	1.074	14	4.320	0.946	8	4.080	1.039	11	0.242
C12	Commitment made by partners	4.100	0.632	10	3.950	0.78	13	4.050	0.68	12	0.425
C13	Clearly defined responsibilities and roles	4.100	0.852	11	3.950	0.78	15	4.050	0.826	13	0.506
C14	Competitive tendering	4.200	1.067	6	3.740	1.195	19	4.050	1.121	14	0.139
C15	Effective management control	3.980	0.891	15	4.110	0.809	11	4.020	0.861	15	0.591
C16	Satisfying the need for public facility	3.900	0.955	17	4.210	0.787	9	4.000	0.91	16	0.224
C17	Stable macroeconomic environment	4.030	0.743	13	3.840	0.834	17	3.970	0.772	17	0.400
C18	Openness and constant communication	3.880	1.159	18	3.790	0.918	18	3.850	1.08	18	0.779
C19	Transparent procurement	3.700	1.114	19	3.950	1.177	14	3.780	1.131	19	0.437
C20	Community / Public support	3.330	1.163	20	3.420	1.17	20	3.360	1.156	20	0.768

On the other hand, some factors are much more important to the private sector than to the public, such as profitability (C03), meeting output with specifications (C08) and competitive tendering (C14) (see figure 4.5 and figure 4.6 below).



	Available financial market	Risk allocation and sharing	Profitability	Favorable legal framework	Strong private consortium	Effective supervision mechanism	Appropriate project identification	Meeting output with specifications	Reliable and quality service operations	Adherence of time	Political support	Commitment made by partners	Clearly defined responsibilities and roles	Competitive tendering	Effective management control	Satisfying the need for public facility	Stable macroeconomic environment	Openness and constant communication	Transparent procurement	Community / Public support
Public Mean	4,380	4,300	4,300	4,030	4,180	4,130	4,250	4,300	4,200	3,980	3,980	4,100	4,100	4,200	3,980	3,900	4,030	3,880	3,700	3,330
Public Rank	1	2	4	12	8	9	5	3	7	16	14	10	11	6	15	17	13	18	19	20
Private Mean	4,530	4,580	4,370	4,740	4,370	4,440	4,110	3,950	4,110	4,370	4,320	3,950	3,950	3,740	4,110	4,210	3,840	3,790	3,950	3,420
Private Rank	3	2	7	1	5	4	10	16	12	6	8	13	15	19	11	9	17	18	14	20
Together Mean	4,420	4,390	4,320	4,250	4,240	4,220	4,200	4,190	4,170	4,100	4,080	4,050	4,050	4,050	4,020	4,000	3,970	3,850	3,780	3,360
Together Rank	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Figure 4.5. Mean ranking values of the CSFs for airports projects in Turkey

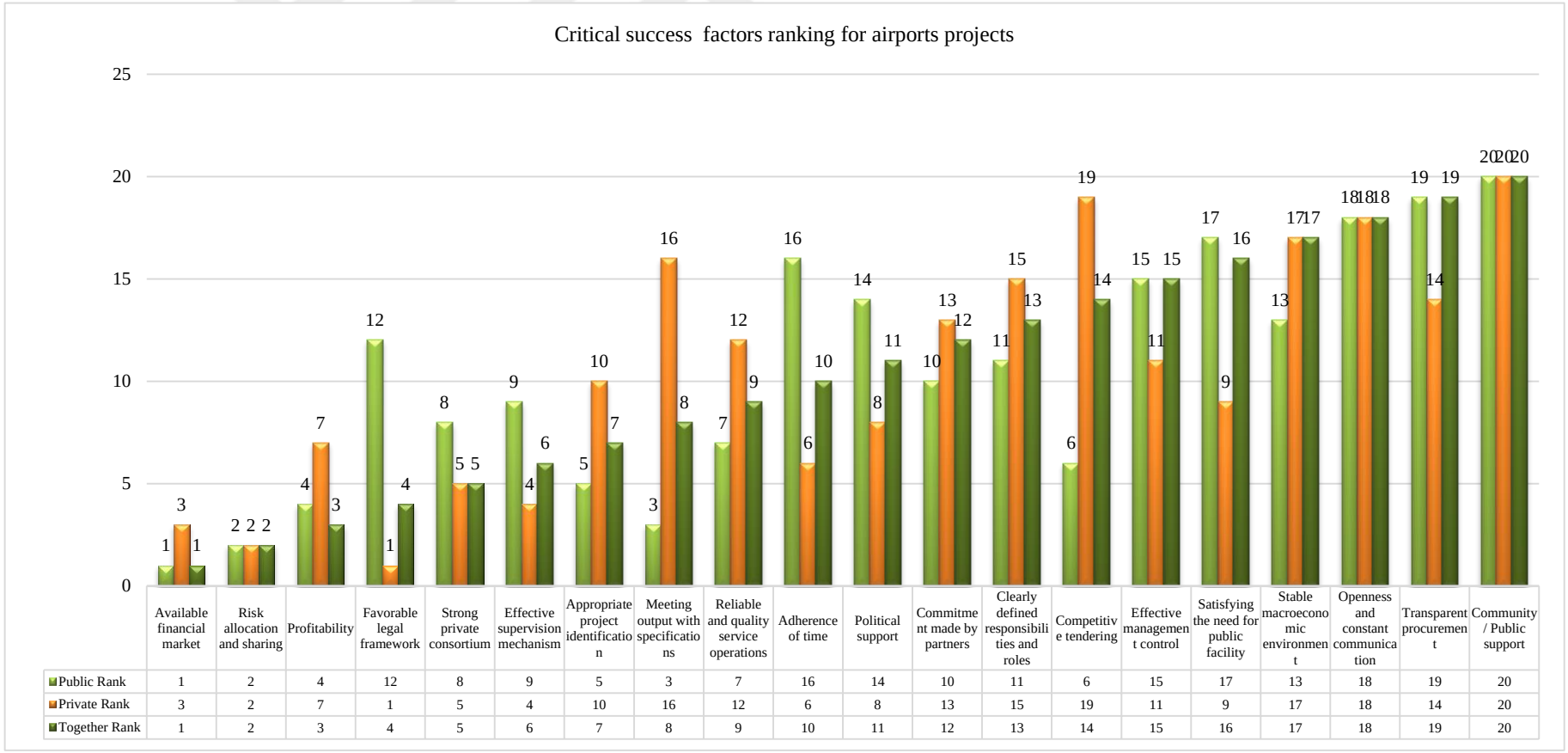


Figure 4.6. CSFs Ranking for airports projects in Turkey

4.2.4 Risk Factors of PPP airport projects:

Forty-six risk factors used in the survey are ranked based on the 5-point Likert scale (1 being the most important and 5 being the least important, order is reversed in analysis) according to respondents in what they consider to be the level of importance for PPP airport projects in Turkey. The mean value for each factor is ranked according to the categories; Public Sector (State), Private Sector and both sectors as shown in table 4.3. ANOVA analysis was used to compare the evaluation of each factor in both sectors. The mean values can be interpreted as important since most of the factors had a mean value of more than 3.0. In this regard, 46 risk factors were examined and ranked based on public and private experts' opinion in PPP airport projects.

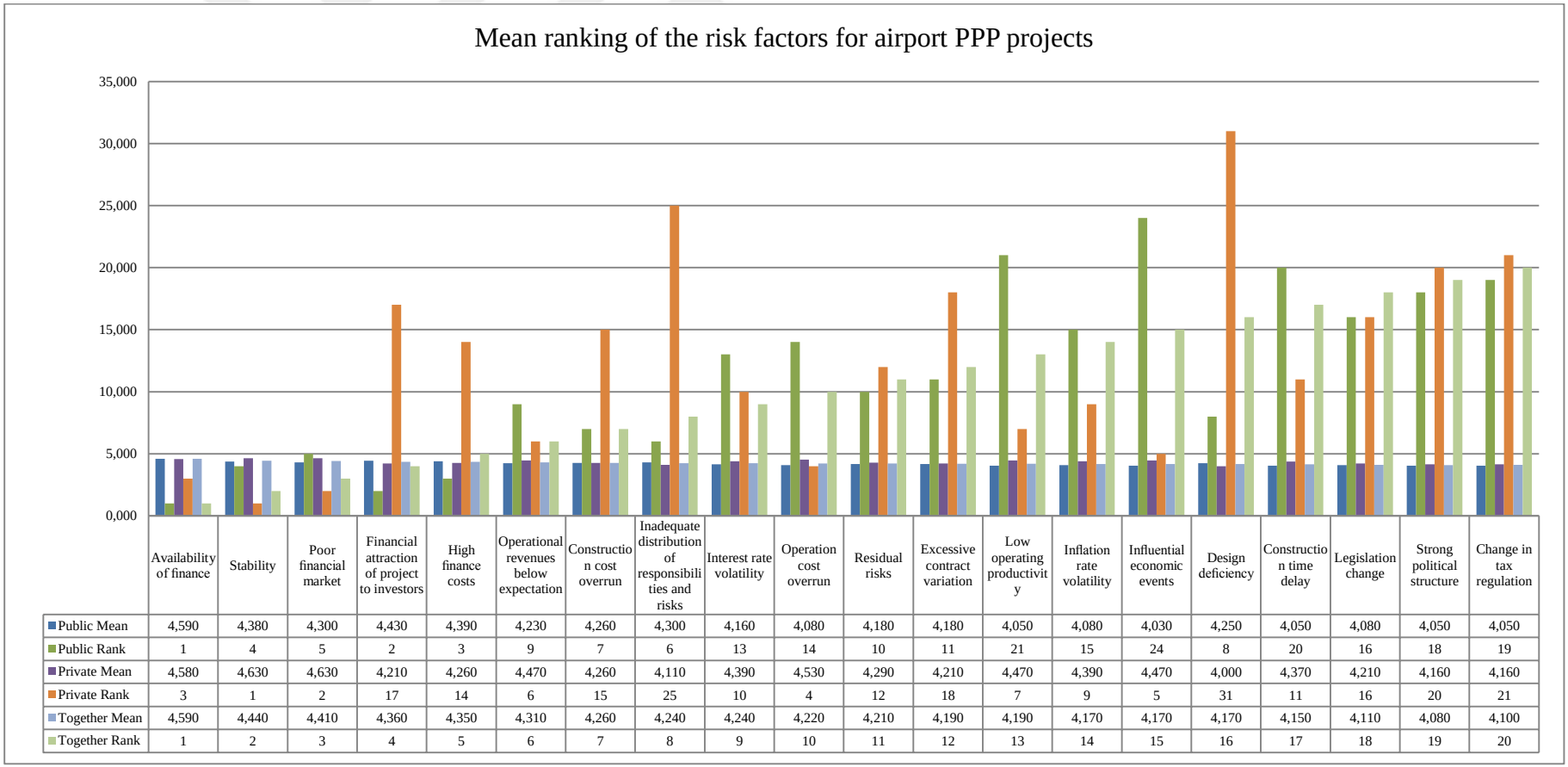
According to the data result, as shown in table 4.3, the most important risk factors for these projects from both the public and private point of view, are indicated as; availability of finance, stability, and poor financial market. Furthermore, it was evident that, experts from the public sector concentrated on financial factors as the most 10 important factors, similar to the private sector, which indicates that financial factors should be further studied and investigated. From another perspective, there were some differences in ranking the importance of some factors between the outlooks of public and private experts. For instance, construction overrun risk and inadequate distribution of responsibilities and risk were picked as top risk factors from the public sector, while the private sector didn't give much importance to those factors. However, they classified some factors on the same level such as; availability of finance, residual risk, legislation change, strong political structure, change in tax regulation and maintenance costs that are higher than expected.

Table 4.3. Mean ranking of the risk factors for airport PPP projects:

CSF		Criticality									Sign.
		Public			Private			Together			
		Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank	
R01	Availability of finance	4.59	.715	1	4.58	.692	3	4.59	.702	1	0.957
R02	Stability	4.38	.774	4	4.63	.597	1	4.44	.738	2	0.208
R03	Poor financial market	4.30	.911	5	4.63	.496	2	4.41	.904	3	0.144
R04	Financial attraction of project to investors	4.43	.844	2	4.21	.787	17	4.36	.826	4	0.356
R05	High finance costs	4.39	.823	3	4.26	1.284	14	4.35	.991	5	0.641
R06	Operational revenues below expectation	4.23	.862	9	4.47	.697	6	4.31	.815	6	0.277
R07	Construction cost overrun	4.26	.818	7	4.26	.991	15	4.26	.870	7	0.978
R08	Inadequate distribution of responsibilities and risks	4.30	.723	6	4.11	.994	25	4.24	.817	8	0.397

R09	Interest rate volatility	4.16	.898	13	4.39	.850	10	4.24	.881	9	0.376
R10	Operation cost overrun	4.08	.870	14	4.53	.697	4	4.22	.839	10	0.055
R11	Residual risks	4.18	.844	10	4.29	.920	12	4.21	.861	11	0.637
R12	Excessive contract variation	4.18	.813	11	4.21	.918	18	4.19	.840	12	0.881
R13	Low operating productivity	4.05	.876	21	4.47	.513	7	4.19	.798	13	0.056
R14	Inflation rate volatility	4.08	.917	15	4.39	.850	9	4.17	.901	14	0.223
R15	Influential economic events	4.03	.891	24	4.47	.697	5	4.17	.854	15	0.059
R16	Design deficiency	4.25	.840	8	4.00	1.054	31	4.17	.913	16	0.330
R17	Construction time delay	4.05	1.011	20	4.37	.684	11	4.15	.925	17	0.220
R18	Legislation change	4.08	.888	16	4.21	1.182	16	4.11	1.010	18	0.625
R19	Strong political structure	4.05	.904	18	4.16	1.015	20	4.08	.934	19	0.682
R20	Change in tax regulation	4.05	.876	19	4.16	1.119	21	4.10	.936	20	0.688
R21	Maintenance costs higher than expected	4.05	.749	22	4.16	.765	22	4.08	.749	21	0.610
R22	Level of demand for project	4.08	.694	17	3.94	.938	35	4.03	.772	22	0.556
R23	Inadequate distribution of authority in partnership	4.05	.783	23	4.00	.816	33	4.03	.787	23	0.822
R24	Inadequate experience in PPP/PFI	4.18	.712	12	3.67	1.085	42	4.02	.868	24	0.038
R25	Delay in project approvals and permits	3.83	.931	35	4.42	.838	8	4.02	.938	25	0.021
R26	Poor quality workmanship	4.03	.920	25	4.00	.943	32	4.02	.919	26	0.923
R27	Organization and co-ordination risk	3.98	.832	26	4.05	1.224	30	4.00	.965	27	0.776
R28	Poor public decision-making process	3.85	.921	29	4.28	.752	13	3.97	.894	28	0.090
R29	Lack of commitment from either partner	3.85	.864	33	4.21	.855	19	3.97	.870	29	0.138
R30	Differences in working method and know-how between partners	3.85	.893	32	4.16	.834	23	3.95	.879	30	0.212
R31	Land acquisition (site availability)	3.88	1.042	28	4.11	.963	24	3.95	1.016	31	0.418
R32	Maintenance more frequent than expected	3.90	.995	27	4.05	.848	29	3.95	.944	32	0.562
R33	Unproven engineering techniques	3.85	.949	30	4.05	.911	27	3.92	.934	33	0.441
R34	Force majeure	3.83	1.13	34	4.05	1.353	26	3.90	1.199	34	0.500
R35	Material/labour availability	3.83	.874	36	4.05	.911	28	3.90	.885	35	0.360
R36	Late design changes	3.85	.802	31	3.89	1.049	37	3.86	.880	36	0.857
R37	Environment	3.70	1.203	38	3.95	1.026	34	3.78	1.146	37	0.443
R38	Geotechnical conditions	3.60	1.215	42	3.89	1.150	36	3.69	1.198	38	0.380
R39	Level of public opposition to project	3.73	.987	37	3.58	1.17	43	3.68	1.041	39	0.619
R40	Expropriation or nationalization of assets	3.63	1.03	40	3.74	.933	39	3.66	.974	40	0.690
R41	Insolvency/default of sub-contractors or suppliers	3.55	1.154	44	3.89	1.049	38	3.66	1.124	41	0.275
R42	Industrial regulatory change	3.63	.774	41	3.68	1.003	41	3.64	.848	42	0.804
R43	Third Party Tort Liability	3.70	.939	39	3.53	1.264	44	3.64	1.047	43	0.556
R44	Weather	3.55	1.239	43	3.74	1.240	40	3.61	1.232	44	0.591
R45	Lack of tradition of private provision of public services	3.50	.847	46	3.44	1.097	45	3.48	.922	45	0.834
R46	Staff Crises	3.53	1.281	45	3.21	1.228	46	3.42	1.262	46	0.376

The ranking analysis in terms of the factors' importance indicates that all the factors are important. However, those such as availability of finance (R01), stability (R02), poor financial market (R03) and financial attraction of project to investors (R04) are the most crucial risk factors for these projects from both points of view, public and private, for successful airport projects in Turkey. It is clear that for both sectors the significant risk factors for these projects in Turkey are those related to finance, and this is perhaps to be expected in nations with a fast pace in economic development. Moreover, other risk factors like financial attraction of project to investors (R04), high finance costs (R05), construction cost overrun (R07), inadequate distribution of responsibilities and risks (R08), and inadequate experience in PPP/PFI (R24) have been ranked much important in the public sector than the private sector. Further, low operating productivity (R13), influential economic events (R15), delay in project approvals and permits (R25), and poor public decision-making process (R28) are ranked as less important (see figure 4.7 and 4.8).



	Availability of finance	Stability	Poor financial market	Financial attraction of project to investors	High finance costs	Operational revenues below expectation	Construction cost overrun	Inadequate distribution of responsibilities and risks	Interest rate volatility	Operation cost overrun	Residual risks	Excessive contract variation	Low operating productivity	Inflation rate volatility	Influential economic events	Design deficiency	Construction time delay	Legislation change	Strong political structure	Change in tax regulation
Public Mean	4,590	4,380	4,300	4,430	4,390	4,230	4,260	4,300	4,160	4,080	4,180	4,180	4,050	4,080	4,030	4,250	4,050	4,080	4,050	4,050
Public Rank	1	4	5	2	3	9	7	6	13	14	10	11	21	15	24	8	20	16	18	19
Private Mean	4,580	4,630	4,630	4,210	4,260	4,470	4,260	4,110	4,390	4,530	4,290	4,210	4,470	4,390	4,470	4,000	4,370	4,210	4,160	4,160
Private Rank	3	1	2	17	14	6	15	25	10	4	12	18	7	9	5	31	11	16	20	21
Together Mean	4,590	4,440	4,410	4,360	4,350	4,310	4,260	4,240	4,240	4,220	4,210	4,190	4,190	4,170	4,170	4,170	4,150	4,110	4,080	4,100
Together Rank	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Figure 4.7. CSFs Ranking for airports projects in Turkey

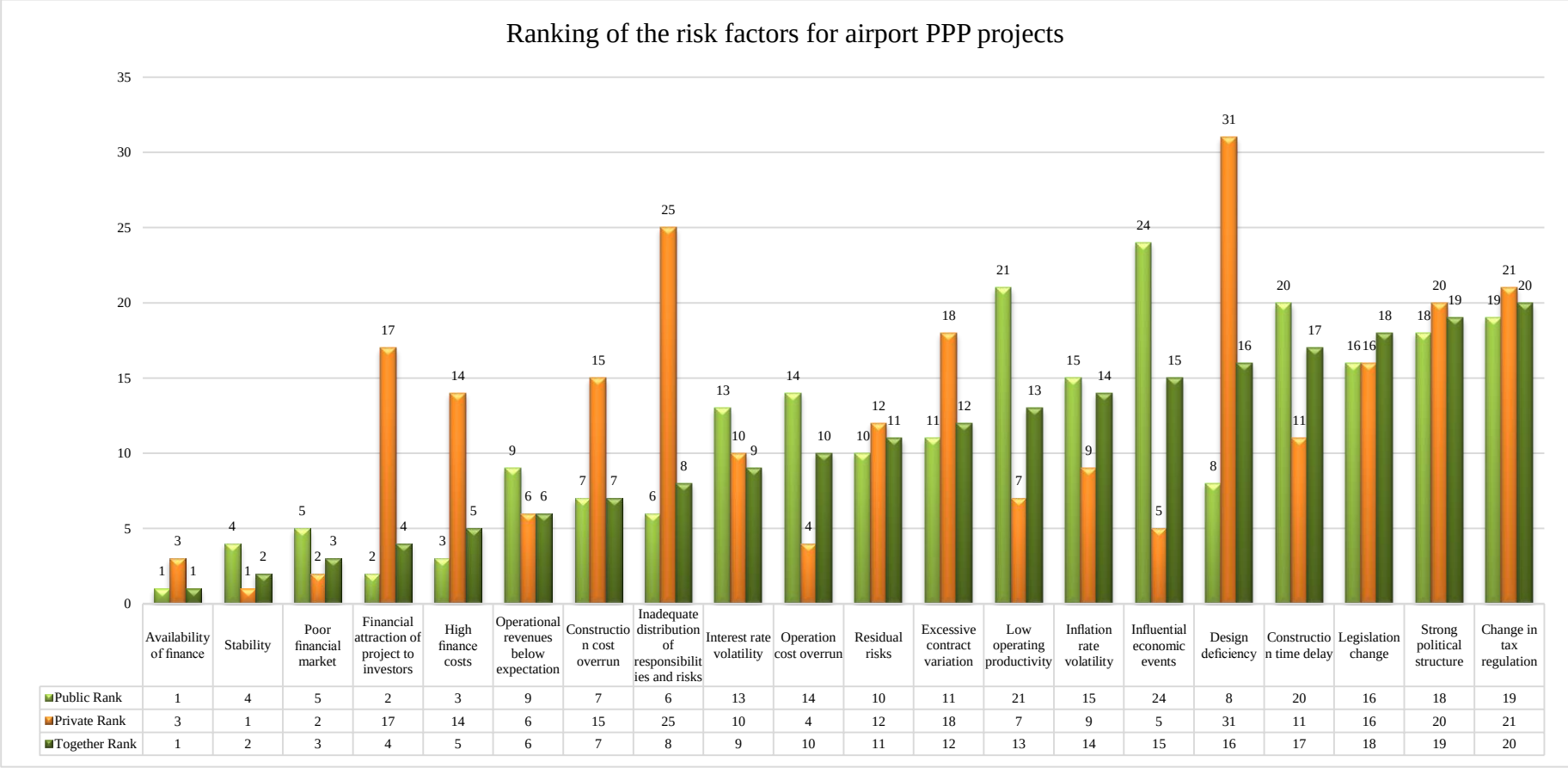


Figure 4.8. Risk Factors ranking for airports projects in Turkey

4.2.5 One Sample t Tests

This test is used here to evaluate whether the mean of the level of importance in ranking the Critical Success Factors and Risk Factors for PPP airports projects in Turkey varies significantly. The test value used is the midpoint of a five-point scale namely (3). Table 4.4 shows one sample t test of the level of importance in ranking the CSFs for PPP airports projects in Turkey. Available financial market had the highest mean difference in being the most important (1.419) while Community / Public support had the lowest mean difference in being the least important (.306). Mean differences are significant at p <.05 for all CSF. Figure 4.9 represents CSF mean differences. The results support the conclusion that there are differences in level of importance in ranking the CSF for PPP airports projects in Turkey.

Table 4.4. One-Sample Test for Critical Success Factors

CSFs	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Available financial market	16.182	61	.000	1.419	1.24	1.59
Risk allocation and sharing	12.643	61	.000	1.371	1.15	1.59
Profitability	12.227	61	.000	1.306	1.09	1.52
Strong private consortium	11.271	61	.000	1.274	1.05	1.50
Favorable legal framework	9.749	61	.000	1.242	.99	1.50
Effective supervision mechanism	9.871	60	.000	1.230	.98	1.48
Appropriate project identification	9.346	61	.000	1.194	.94	1.45
Meeting output with specifications	11.370	61	.000	1.194	.98	1.40
Reliable and quality service operations	11.178	61	.000	1.145	.94	1.35
Competitive tendering	7.695	61	.000	1.081	.80	1.36
Political support	8.200	61	.000	1.065	.80	1.32
Commitment made by partners	11.603	61	.000	1.032	.85	1.21
Adherence of time	8.200	61	.000	1.032	.78	1.28
Effective management control	8.929	61	.000	1.016	.79	1.24
Clearly defined responsibilities	8.556	60	.000	1.000	.77	1.23
Stable macroeconomic environment	9.873	59	.000	.967	.77	1.16
Satisfying the need for public facility	8.206	61	.000	.952	.72	1.18
Openness and constant communication	6.088	61	.000	.823	.55	1.09
Transparent procurement	5.238	61	.000	.742	.46	1.03
Community / Public support	2.042	61	.045	.306	.01	.61

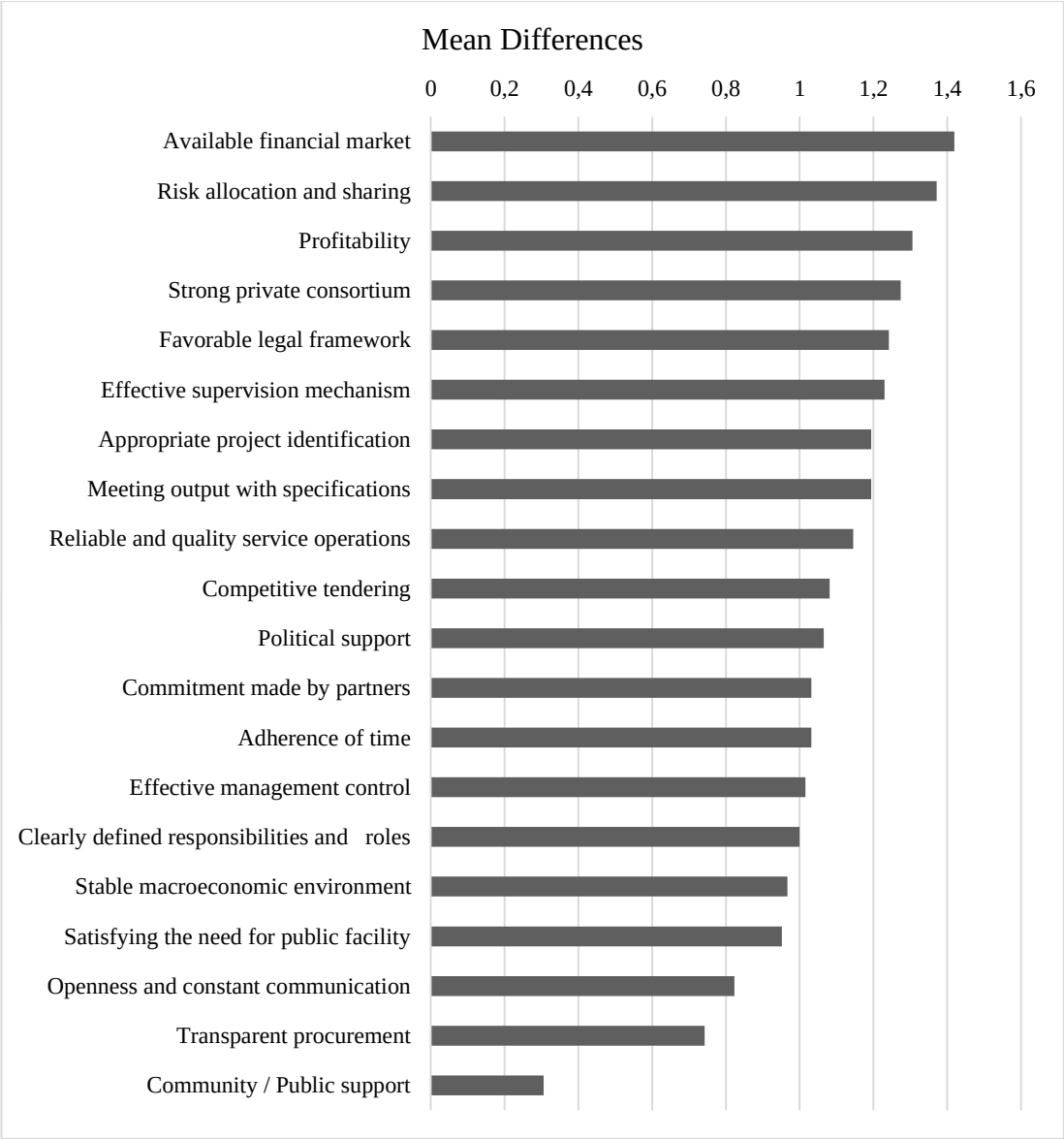


Figure 4.9. CSFs mean value differences

Table 4.5 shows one sample t test of the level of importance in ranking the Risk Factors for PPP airports projects in Turkey. Availability of finance had the highest mean difference in being the most important (1.607) while Staff Crises had the lowest mean difference in being the least important (.387). Mean differences are significant at p <.05 for all Risk Factors. Figure 3.7 represents these mean differences. The results support the conclusion that there are differences in level of importance in ranking the Risk Factors for PPP airports projects in Turkey.

Table 4.5. One-Sample Test for Risk Factors

RFs	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Availability of finance	18.188	60	.000	1.607	1.43	1.78
Stability	15.311	61	.000	1.435	1.25	1.62
High finance costs	10.981	59	.000	1.383	1.13	1.64
Financial attraction of project to investors	13.254	61	.000	1.371	1.16	1.58
Poor financial market	11.656	61	.000	1.339	1.11	1.57
Operational revenues below expectation	12.836	61	.000	1.306	1.10	1.51
Residual risks	11.146	59	.000	1.217	1.00	1.44
Construction cost overrun	10.794	60	.000	1.213	.99	1.44
Inadequate distribution of responsibilities and risks	11.571	60	.000	1.213	1.00	1.42
Interest rate volatility	10.373	56	.000	1.211	.98	1.44
Design deficiency	10.414	61	.000	1.194	.96	1.42
Excessive contract variation	11.370	61	.000	1.194	.98	1.40
Operation cost overrun	10.342	60	.000	1.164	.94	1.39
Construction time delay	9.867	61	.000	1.161	.93	1.40
Influential economic events	10.654	61	.000	1.145	.93	1.36
Low operating productivity	10.654	61	.000	1.145	.93	1.36
Inflation rate volatility	9.587	60	.000	1.131	.90	1.37
Legislation change	8.677	61	.000	1.113	.86	1.37
Change in tax regulation	9.228	61	.000	1.097	.86	1.33
Strong political structure	8.834	61	.000	1.081	.84	1.33
Maintenance costs higher than expected	10.697	61	.000	1.081	.88	1.28
Level of demand for project	10.726	60	.000	1.033	.84	1.23
Delay in project approvals and permits	8.585	61	.000	1.016	.78	1.25
Inadequate distribution of authority in partnership	9.489	61	.000	1.000	.79	1.21
Lack of commitment from either partner	9.067	61	.000	1.000	.78	1.22
Poor quality workmanship	8.474	61	.000	.984	.75	1.22
Inadequate experience in PPP/PFI	8.872	60	.000	.984	.76	1.21
Poor public decision-making process	8.452	60	.000	.967	.74	1.20
Maintenance more frequent than expected	7.981	59	.000	.967	.72	1.21
Land acquisition (site availability)	7.143	60	.000	.951	.68	1.22
Organization and co-ordination risk	7.498	60	.000	.951	.70	1.20
Differences in working method and know-how between partners	8.157	61	.000	.935	.71	1.16
Force majeure	6.147	61	.000	.919	.62	1.22
Unproven engineering techniques	7.031	61	.000	.887	.63	1.14
Material/labor availability	7.654	61	.000	.871	.64	1.10
Late design changes	7.503	61	.000	.871	.64	1.10
Environment	4.982	61	.000	.742	.44	1.04
Geotechnical conditions	4.452	61	.000	.677	.37	.98
Expropriation or nationalization of assets	5.345	61	.000	.661	.41	.91
Industrial regulatory change	6.139	61	.000	.661	.45	.88
Level of public opposition to project	4.936	61	.000	.661	.39	.93
Insolvency/default of sub-contractors or suppliers	4.312	61	.000	.629	.34	.92

Third Party Tort Liability	4.818	61	.000	.629	.37	.89
Weather	3.741	61	.000	.581	.27	.89
Lack of tradition of private provision of public services	3.961	60	.000	.459	.23	.69
Staff Crises	2.396	61	.020	.387	.06	.71

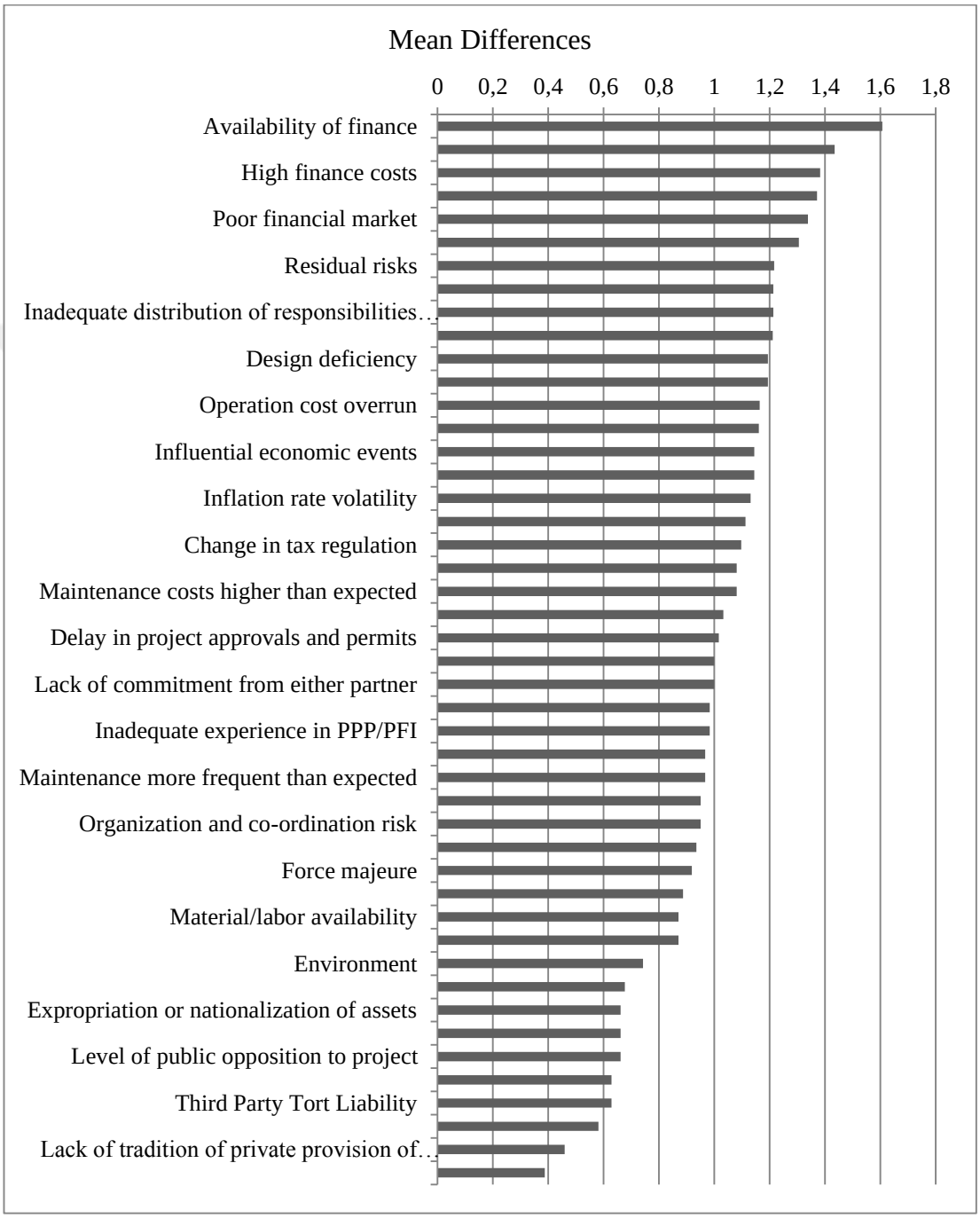


Figure 4.10. Risk Factors mean differences

4.2.6 Factor Analysis

Factor Analysis of CSFs and Risk Factors (RFs) is carried out to identify the dimensions that are latent (not easily observed). Correlations among variables are calculated using the SPSS V 25 software. A traditional correlation matrix (correlations among variables) is produced. Each data matrix has sufficient correlations to justify the application of factor analysis for both scales. Factor analysis test as a method for factors grouping has been adopted from many researchers, such as Kyei-Robert and Ofori- Kuragu to study the reasons of adopting PPP for construction projects in Ghana [168]. The Bartlett test of sphericity which provides the statistical importance that the correlation matrix has clear correlations among some of the variables [169]. were significant, $p < .001$. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO/MSA) for CSF was .674 and for RF was .596, an indicative of middling measurement.

4.2.6.1 Latent Root Criterion:

In this criterion only, the factors having values more than one at the latent roots or eigen values are considered significant; but factors that have latent roots less than one are disregarded [169]. This criterion is used initially as a guideline and it is compared to the third criterion "Monte Carlo PCA test" later on. Based on this criterion CSF scale is made up of seven components that explain 73.2% of variance and RF scale is made of eleven components that explain 76.150% of variance.

4.2.6.2 The Scree Test Criterion

For the optimum factors number identification, that can be extracted before the amount of unique variance begins to dominate the common variance structure the scree test is used. This test is obtained by plotting the latent roots against the number of factors in their order of extraction, and the shape of the resulting curve is used to evaluate the cut-off point. Scree test results did not give clear cut indication of the number of factors in both CSF and RF scales. Figures 4.11 and 4.12 show scree tests plot each scale.

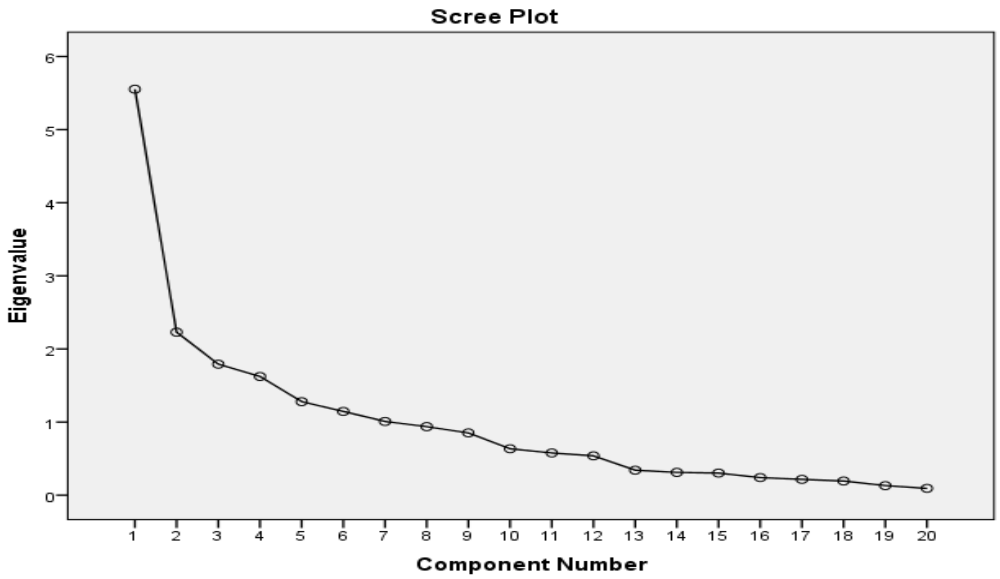


Figure 4.11. Scree test plot for CSF scale

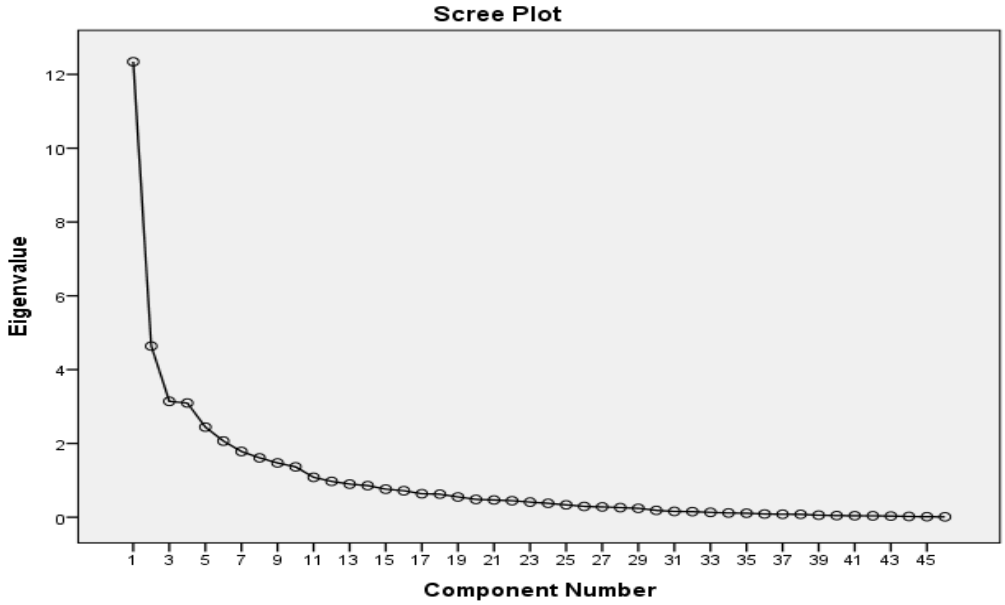


Figure 4.12. Scree test plot for RFs scale

4.2.6.3 Monte Carlo PCA test criterion

This test is taken from Parallel Analysis which was introduced by Horn (1965). It compares the observed Eigen values obtained from the correlation matrix to be analyzed with those gained from uncorrelated normal variables. A factor is considered significant if the associated Eigen value is bigger than the mean of those

obtained from the random uncorrelated data. Eigen values obtained in the Latent Root Criterion method are compared with Eigen values obtained from the random uncorrelated data. Monte Carlo PCA test criterion results indicate that the CSF scale is represented by four factors and RFs scale is represented by five factors. We can see that the fifth scale Eigen value in the CSF scale is less than the corresponding Monte Carlo value and the sixth scale Eigen value in the RF scale is less than the corresponding Monte Carlo value. Table 4.6 shows comparisons of Scales Eigen values with Monte Carlo PCA random Eigen values for both scales.

Table 4.6. Comparing Scales Eigen values with Monte Carlo PCA random Eigen values

Scales	Eigen Values	1	2	3	4	5	6
Critical success Factors (CSF)	CSF Values	5.5530	2.2300	1.7920	1.6240	1.2790	1.145
	Monte Carlo values	2.1703	1.9233	1.7599	1.6092	1.4711	1.3439
Risk Factors (RF)	RF Values	12.343	4.637	3.141	3.094	2.442	2.063
	Monte Carlo values	3.2032	2.9220	2.6870	2.5274	2.3724	2.2223

Based on the Monte Carlo PCA test criterion results mentioned above, factor analysis test was run again with four factors for CSF and five factors for Risk Factors. One criterion is used in interpreting the factor; factor loading which it is the correlation of the variables and the factors [169]. Table 4.7 shows the structure matrix of factor loadings for each factor of the CSF scale and indicates the result of the principal factor for 20 identified CSFs for PPP airport projects. It clear that, the total Eigen values for the three factors retained ranged from 2.032 to 3.337. The percentage of variance explained by the 1st factor is 27.703%, the 2nd factor is 11.130%, the 3rd factor is 8.946% and the fourth factor is 8.106%. The 4 CSFs component are represented as: Effective planning and strategy; Transparent Management; Project and Process Quality; and Stability.

Table 4.7. CSFs for PPP airport projects grouping after rotated factor matrix

CSFs Groupings		Factor Loading	Total	% 0f variance explained	Cumulative % of variance
CSFs Groups 1: Effective planning and strategy			3.337	27.703	27.703
C06	Effective supervision mechanism	.780			
C16	Satisfying the need for public facility	.732			
C07	Appropriate project identification	.635			
C03	Profitability	.585			
C17	Stable macroeconomic environment	.516			
C02	Risk allocation and sharing	.446			
CSFs Groups 2: Transparent Management			3.961	11.130	38.833
C15	Effective management control	.777			
C20	Community / Public support	.758			
C04	Favorable legal framework	.743			
C13	Clearly defined responsibilities and roles	.647			
C19	Transparent procurement	.613			
C10	Adherence of time	.610			
CSFs Groups 3: Project and Process Quality			3.558	8.946	47.779
C08	Meeting output with specifications	-.831			
C14	Competitive tendering	-.824			
C18	Openness and constant communication	-.700			
C09	Reliable and quality service operations	-.694			
CSFs Groups 4: Stability			2.032	8.106	55.885
C05	Strong private consortium	.696			
C11	Political support	.654			
C12	Commitment made by partners	.594			
C01	Available financial market	.484			

Table 4.8 shows the Structure Matrix of factor loadings for each factor of the Risk Factors scale. It is indicated that the total Eigen values for the five grouped factors ranged from 4.847 to 8.937. The percentage of variance explained by the five factors are 26.833%, 10.080%, 6.828%, 6.727% and 5.309% respectively. Similarly, the cumulative percentage of variance explained by the extracted five factors. It is noticeable that the risk factors of PPP airport projects are grouped into five sufficient component factors. Therefore, it can adequately represent the data of the five risk factors groupings. The five risk factors component are represented as: Construction Risks; Environmental and Force Majeure Risks; Operating Risks; Legal Framework and Regulatory Risks; and Finance Risks

Table 4.8. Risk factors for PPP airport projects grouping after rotated factor matrix.

Risk Factors Grouping		Factor Loading	Total	% 0f variance explained	Cumulative % of variance explained
Risk Factors Groups 1: Construction Risks			8.937	26.833	26.833
R21	Maintenance costs higher than expected	.816			
R13	Low operating productivity	.786			
R32	Maintenance more frequent than expected	.785			
R10	Operation cost overrun	.773			
R06	Operational revenues below expectation	.746			
R36	Late design changes	.744			
R17	Construction time delay	.660			
R35	Material/labor availability	.649			
R26	Poor quality workmanship	.605			
R07	Construction cost overrun	.558			
R33	Unproven engineering techniques	.547			
R12	Excessive contract variation	.545			
R28	Poor public decision-making process	.448			
Risk Factors Groups 2: Environmental and Force Majeure Risks			7.138	10.080	36.914
R44	Weather	-.844			
R38	Geotechnical conditions	-.819			
R37	Environment	-.817			
R34	Force majeure	-.710			
R11	Insolvency/default of sub-contractors or suppliers	-.682			
R46	Staff Crises	-.678			
R41	Residual risks	-.667			
R29	Lack of commitment from either partner	-.569			
R31	Land acquisition (site availability)	-.559			
Risk Factors Groups 3: Operating Risks			5.980	6.828	43.742
R30	Differences in working method and know-how between partners	.778			
R08	Inadequate distribution of responsibilities and risks	.729			
R27	Organization and co-ordination risk	.710			
R02	Stability	.627			
R24	Inadequate experience in PPP/PFI	.622			
R23	Inadequate distribution of authority in partnership	.616			
R19	Strong political structure	.594			
R15	Influential economic events	.547			
Risk Factors Groups 4: Legal Framework and Regulatory Risks			5.123	6.727	50.469
R18	Legislation change	.783			
R20	Change in tax regulation	.765			
R42	Industrial regulatory change	.751			
R39	Level of public opposition to project	.617			
R45	Lack of tradition of private provision of public services	.532			
R43	Third Party Tort Liability	.519			
Risk Factors Groups 5: Finance Risks			4.847	5.309	55.777
R14	Inflation rate volatility	.863			
R09	Interest rate volatility	.852			

R03	Poor financial market	.652			
R01	Availability of finance	.649			
R04	Financial attraction of project to investors	.585			
R05	High finance costs	.566			
	Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization				

KPIs for PPP airports projects have been concluded from the combination of risk factors and critical success factors groups that result from previous factor test. These KPIs used as a criterion for AHP method and listed as; Construction Risks; Environmental and Force Majeure Risks; Operating Risks; Legal Framework and Regulatory Risks; and Finance Risks; Effective planning and strategy; Transparent Management; Project and Process Quality; and Stability.

4.3 AHP-PROMETHEE Approach Results:

Based on the results and the data collected from the questionnaire which used as an input data for AHP method. This method is used mainly to identify the criteria weight and criteria prioritizing, that used in PROMETHEE method for alternatives ranking.

In this research, AHP-PROMETHEE approach involves three stages which is; data collection; AHP method for criteria prioritizing and PROMETHEE I, II methods for alternatives ranking. The alternatives and the criteria are evaluated and identified based on the decision makers from both sectors experiences. Criteria which collected from the experts in forms of key performance indicators are used to set-up a hierarchy shape, that used in an Expert Choice v11.5 software to get criteria weights and prioritization. Then, to measure the contribution of the alternatives (PPP procurements) on the criteria, the evaluation matrix and performance function values are determined. Alternatives are ranked partially by applying PROMETHEE I and then for complete ranking for the alternatives PROMETHEE II and GAIA plane are applied as explained in figure 3.5 in chapter 3.

The first stage in this approach have been done by the literature review and the questionnaire to identify the criteria (KPIs) for PPP airports projects. In the second stage, criteria which collected from the experts in forms of key performance indicators are used to construct a hierarchy shape, that used in an Expert Choice v11.5 software to get criteria weights and prioritization based on assessments of the experts from both sectors as explained below.

4.3.1 Assessment of Public Sector Experts

The public experts as shown in Figure 4.13 gave the highest rank for operation risk with (23.1%) followed by finance risk with (22.6%) as a most importance criteria from public sectors point of view. Legal framework and regulatory risks came in the third position with (11.3%), followed by environmental and force majeure risks (8.2%), project planning and strategy (5.9%), project and process quality (5.2%), stability (5.0%), transparent management (3.9%) and the last ranking criteria was the construction risk with (1.5%).

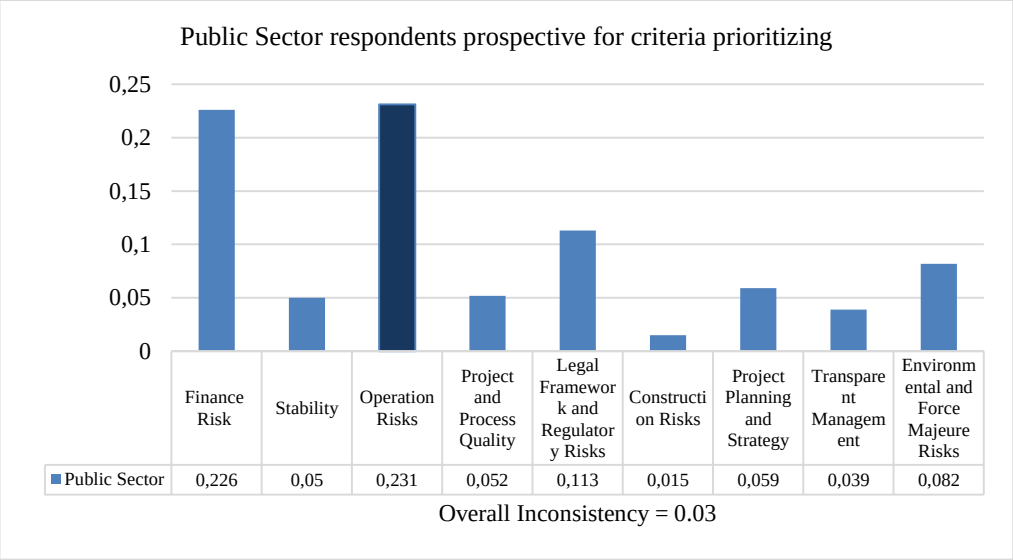


Figure 4.13. Criteria prioritization by public sectors experts

4.3.2 Assessment of Private Sector Experts

Private sectors experts provide their evaluation and ranking to the criteria based on their experiences and knowledge as illustrated in figure 4.14. It is clear that, the most important criteria for public sector in the stability which had given a score (26.2%), followed by finance risk with (23.7%), while project and process quality, transparent management, project planning and strategy, legal framework and regulatory risks, operation risks, construction risks and environmental and force majeure risks were given (14.1%), (10.2%), (7.5%), (5.6%), (5.2%), (4.1%) and (3.4%) respectively.

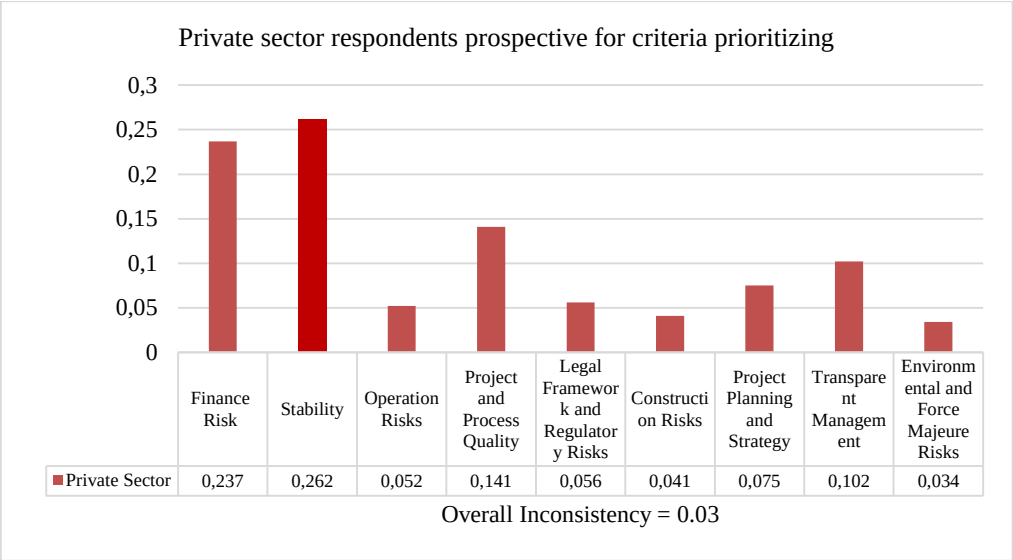


Figure 4.14. Criteria prioritization by private sectors experts

4.3.3 Assessment of both Sectors Experts

For the combination of both experts from public and private sector point of view for the criteria prioritization, they classified finance risks as the most important criteria for PPP airports projects selection with (26.3%), followed by stability with (12.9%), operation risks (12.4%), project and process quality (9.7%), legal framework and regulatory risks (9%), construction risks (8.9%), project planning and strategy (7.6%), transparent management (7.2%) and environmental and force majeure risk with (5.9%) as shown in figure 4.15.

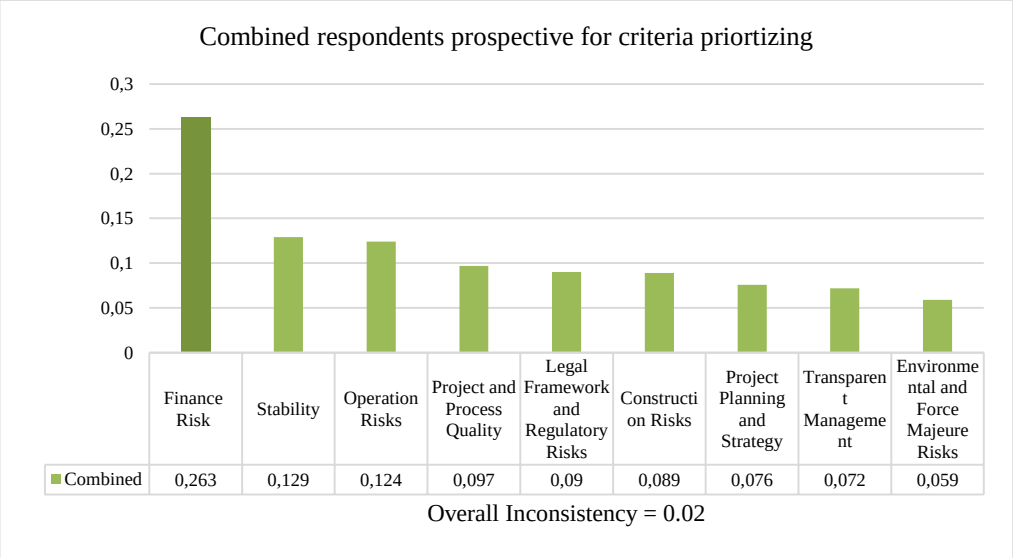


Figure 4.15. Criteria prioritization by both sectors experts (Combined)

4.4 Application of PROMETHEE Method (First Scenario, Combined)

After conducting AHP method for criteria prioritization and criteria weight evaluation, PROMETHEE method is applying for alternatives ranking. This method is MCDM method approach considered to handle quantitative as well as qualitative criteria with separate alternatives [141]. The PROMETHEE method was selected for this research to take the interests of various experts from both sectors (Public and Private) into consideration [122]. Furthermore, this method is based on the utilization of a valued outranking evaluation through pairwise comparisons between the alternatives with respect to the criteria [145]. PROMETHEE method cannot determine the criteria weight. Thus, the AHP method has been used to evaluate the priority of the criteria weights as explained in the previous steps. PROMETHEE method is applied in order to determine the most appropriate PPP procurement method for airports projects based on a case study in order to reduce risks and increase the opportunity of projects success by encouraging public and private sectors to adopt the proposed methodology and the decision-making model in this research for PPP procurement selection. In this research AHP method have been applied to structure the problem and to determine the criteria weight and the criteria prioritization. Based on this information from AHP method, the evaluation matrix is constructed by evaluation the alternatives against the criteria by asking the same experts whose participating in AHP method survey. For many qualitative criteria a 5-point scale (1- very low) to (5 - very high) is appropriate [170]. Once the evaluation matrix is evaluated, VISUAL PROMETHEE free edition will be applied to evaluate and rank the alternatives.

Visual PROMETHEE academic is developed by VP Solutions for 30 years by Professor Bertrand Mareschal with Professor Jean-Pierre Brans from Université Libre de Bruxelles (ULB) and VUB universities in Brussels. It is the last and most complete software for PROMETHEE and GAIA plane methods implementation. This method is designed to help for different decisions evaluation or items according to multiple criteria and for best possible decision determination, in addition to rank the alternatives from the best to the worst one Furthermore, to list items into predefined classes with better understanding evaluation for the problem and the decisions consensus achievement when many decision-makers have conflicting

points of view; validate the decisions based on objective elements [170]. The appearance window of the software is shown in figure 4.16.

Visual PROMETHEE Academic - Best PPP model.vpg (saved)

File Edit Model Control PROMETHEE-GAIA GDSS GIS Custom Assistants Snapshots Options Help

	Public and Private E...	Finance Risk	Stability	Operation Ri...	Project and ...	Legal Frame...	Construction...	Project Plan...	Transparent ...	Environment...
	Unit	5-point	5-point	5-point	5-point	5-point	5-point	5-point	5-point	5-point
	Cluster/Group									
	Preferences									
	Min/Max	max	max	max	max	max	max	max	max	max
	Weight	26,57	13,10	12,29	9,48	9,34	8,63	7,86	7,08	5,65
	Preference Fn.	Usual	Usual	Usual	Usual	Usual	Usual	Usual	Usual	Usual
	Thresholds	absolute	absolute	absolute	absolute	absolute	absolute	absolute	absolute	absolute
	- Q: Indifference	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	- P: Preference	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	- S: Gaussian	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Statistics									
	Minimum	2	3	3	4	3	3	4	4	3
	Maximum	4	4	4	5	4	4	5	5	4
	Average	3	4	4	4	3	4	4	4	4
	Standard Dev.	1	0	0	0	0	0	0	0	0
	Evaluations									
☑	BOO (Build-Own...	High	High	High	High	High	High	High	High	High
☑	BOT (Build-Oper...	High	High	High	very high	High	High	High	High	High
☑	LTR (Long-Term-...	Low	High	Medium	High	Medium	Medium	very high	High	High
☑	Concession model	Medium	Medium	High	High	Medium	Medium	High	High	Medium
☑	BOOT (Build-Ow...	Medium	High	Medium	High	Medium	High	High	very high	Medium

Figure 4.16. Visual PROMETHEE software main menu (Combined).

4.4.1 PROMETHEE GAIA plane

GAIA plane is suitable for presenting of problem features through geometrical explanations. Graphical GAIA shows the alternatives relation by their position, in terms of contributions to the different criteria. Alternatives are plotted by points and criteria by lines [122]. For good understanding to the decision problem, it is better to start by the GAIA analysis because it is a descriptive method [170]. The first most important step in GAIA plane is its quality level. In this research study the GAIA quality level as shown in figure 4.17 is 74.0% which is rather good.

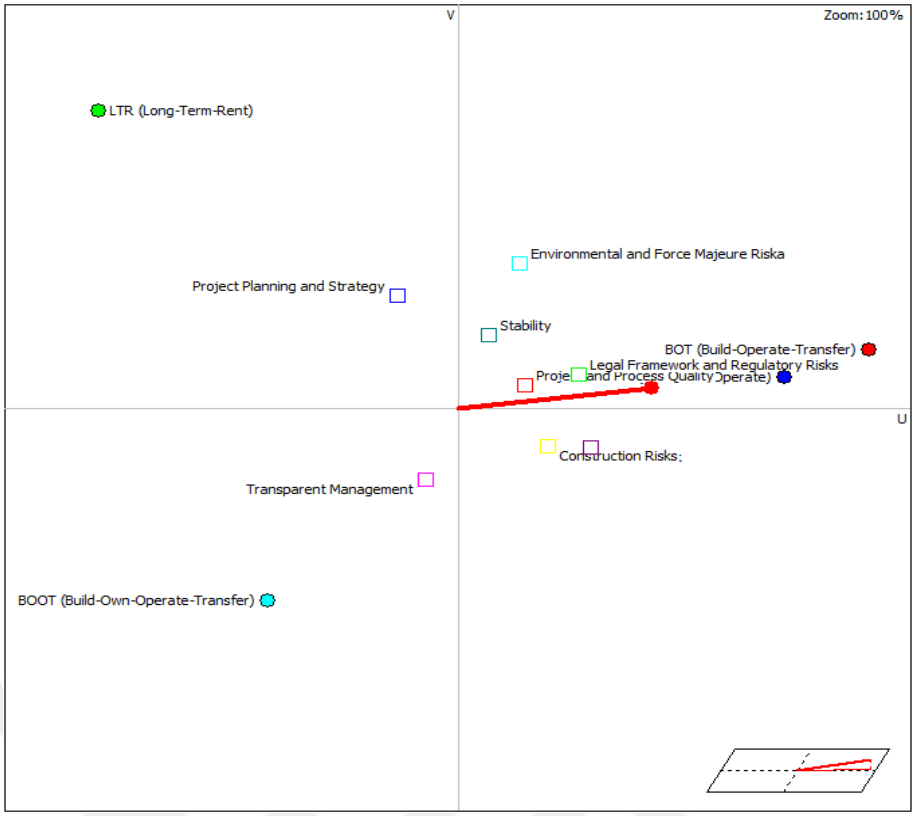


Figure 4.17. GAIA plane for PPP model selection (Combined).

For the GAIA plane, the three PPP models are fairly far away from each other which indicates that most PPP models are quite different from each other accept BOO and BOT are near from each other. Each criterion is represented a different colour square shape which three groups are indicated as shown below.

1. Operation risks, project planning and strategy, project and process quality; It is indicated that, built-operate-transfer (BOT) and (BOO) models have a best quality for project process and a clear strategy and project planning, in addition to good dealing with the operation risk.
2. Transparent management; from figure 5.5 it is show that, the long-term-rent (LTR), concessions and build-operate-own-transfer (BOOT) models have a clear and transparent management and good planning and effective strategy.
3. Stability, legal framework and regulatory risks, environmental and force majeure risks and the finance risks; from GAIA plane chart it is observed that, the built-own-operate (BOO) and (BOT) models have more affected by those criteria.

In general, it is indicated from GAIA chart that, LTR, BOOT and Concession models are good in transparent management and project planning, while BOO and BOT are good in stability and dealing with legal framework, operation, finance, construction

and environment risks in addition to, they have a good process quality. Furthermore, for the different actions (PPP models), the action profile for each action is shown below separately and the effect of each criteria.

Build-Own-Operate (BOO); as it is presented in figure 4.18 the BOO model has a good legal framework and good ability for project constructions and it performs well with respect to construction, environmental, and operation risks. In addition, it is clear that this type of project has a good capacity to deal with financial risk aversion and this indicates the availability of financial resources and this is probably due to the good stability resulting from good planning capacity. But on the other side there is weakness in transparent management, planning and project and process quality.

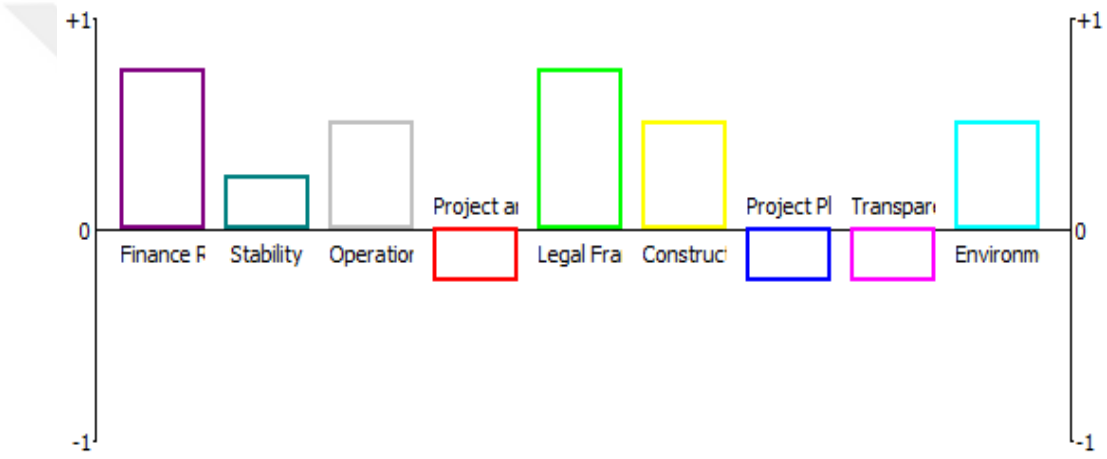


Figure 4.18. Build-Own-Operate (BOO) action profile

Build-Operate-Transfer (BOT); It is evident in this type of projects that it has positively affected with most of the criteria as clearly shown at figure 4.19. It is obvious that, BOT model has good ability for process project operations and high capacity to deal with environmental risks and operational risks. As well as a good ability to deal with the rest of the criteria, but it is considered to have a weakness in the transparency of the project management and the planning that needs to develop more attention. That might be leading to that, this type of PPP model needs to develop a new regulation for a specific project such as airports projects.

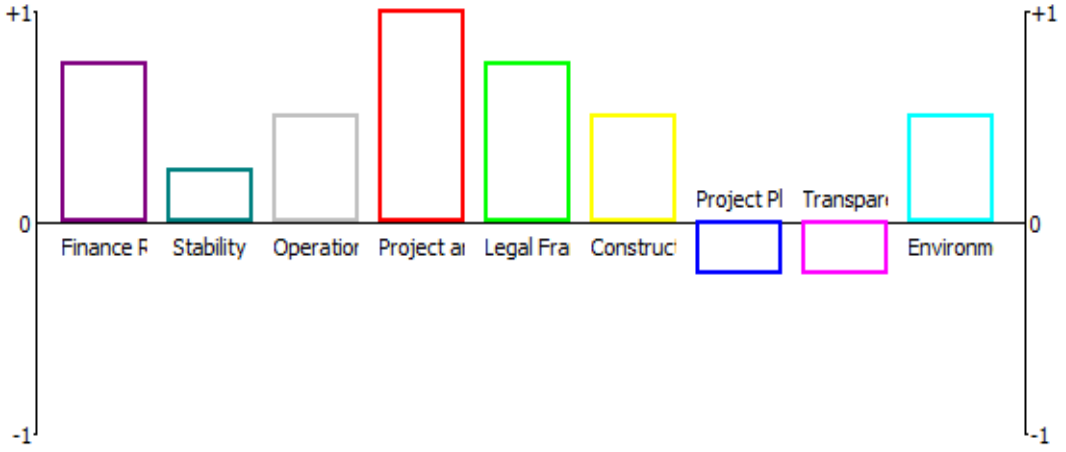


Figure 4.19. Build-Operate-Transfer (BOT) action profile

Long-Term-Rent (LTR); In construct to the previous project models as revelled in figure 4.20, LTR model has a perfect project planning and a good stability in addition to good dealing with the environment and force majeure risks, while it has a weakness in the others which need more improvement. Particularly, for the finance and construction risks.

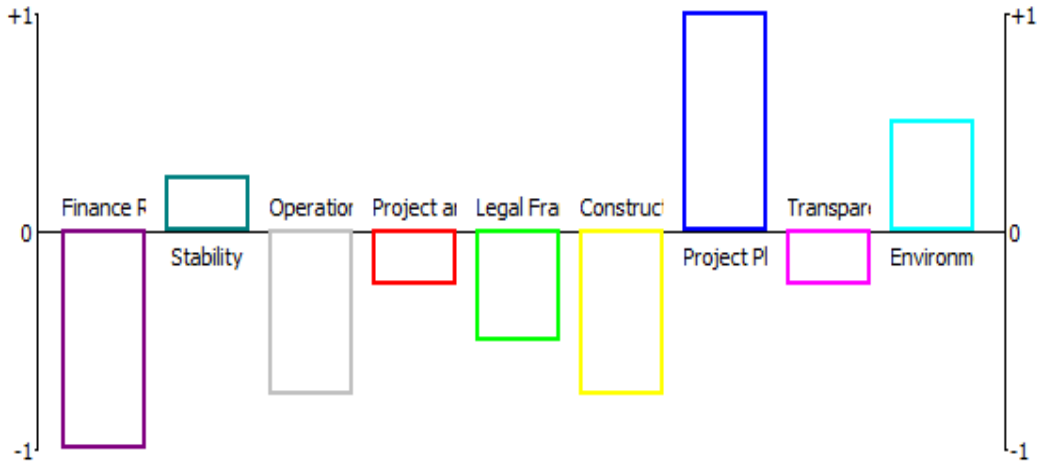


Figure 4.20. Long-Term-Rent (LTR) action profile

Concession model; It is clear that as indicated in figure 4.21 this type of PPP model suffers from several shortcomings such as the inability to work in the low stability and it needs to pay attention to the transparency of the management. In addition, it is weak with certain risks such as financial risks, construction risks,

environmental risks and operational risks. On the other hand, it has a good availability to deal with the operation risks.

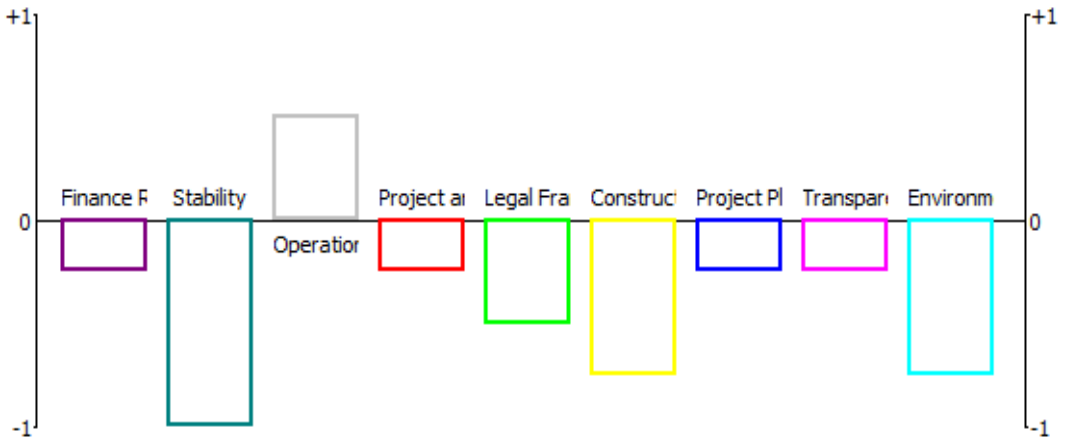


Figure 4.21. Concession model action profile

Build-Own-Operate-Transfer; Based on figure 4.22, BOOT model alternative has a perfect transparent management and high evaluation for the construction risks in construct with finance risk which had a negative prospective. Furthermore, the stability in this model is good because it has a positive grade. From another point of view for this model, it needs an improvement for operation and the environment risks in addition to finance availability.

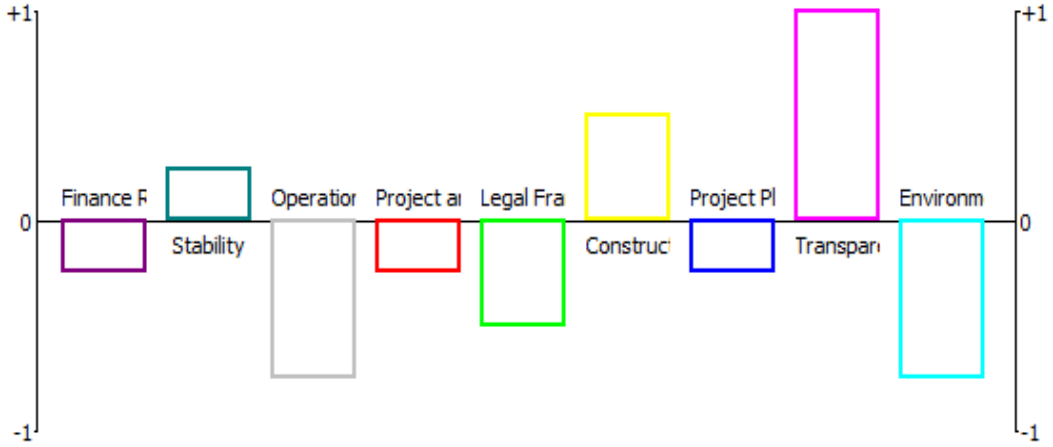


Figure 4.22. Build-Own-Operate-Transfer (BOOT) action profile

4.4.2 PROMETHEE I (Partial Ranking) Results

As explained in visual PROMETHEE method manual [170], The PROMETHEE I is based on the measuring of two preference flows ; positive flow (Phi+) is a measure of strength. It is appeared on the left-side bar with the best (largest) values in green at the top of the bar and red in the bottom for the worst, and negative flow (Phi-) is an amount of weakness values. It is appeared on the right-side bar with the best values in green color at the top of the bar and the worst in red color at the bottom. In this method partial ranking are showed by drawing a line each alternative between Phi+ and Phi-. The main weakness of the partial ranking method, it is incomparable to measure the action when two lines are crossing each other. As represented in figure 4.23, the PROMETHEE I ranking is clear, five alternatives are appearing. Build-Operate-Transfer (BOT) and Build-Own-Operate (BOO), almost at the same ranking at the top, while Build-Own-Operate-Transfer (BOOT) model appear at the middle. But the action (LTR) model and the Concession model are incomparable with each other, and the best way to perform the results for the incomparable actions is by PROMETHEE II method by using the Phi net flow which indicated in the next section.

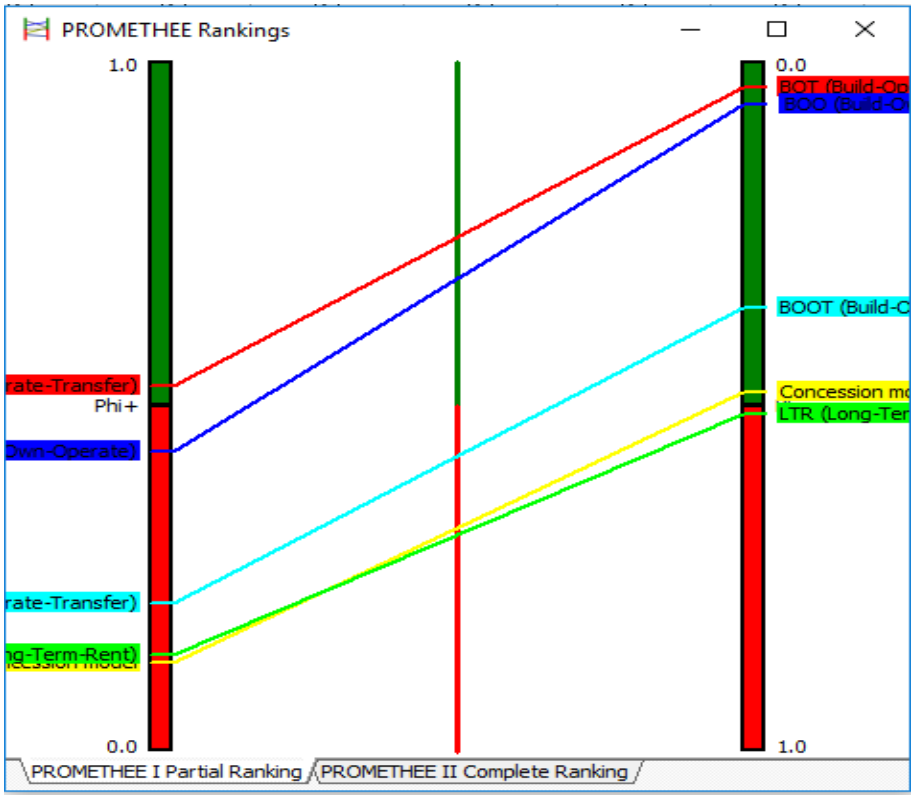


Figure 4.23. PROMETHEE I, Partial Ranking Result (Combined).

4.4.3 PROMETHEE II Result, Complete Ranking (Combined).

Complete ranking method, PROMETHEE II is depended on the (Phi) net flow which is the balance between Phi+ and Phi-. It is represented by a vertical bar which is Phi. Phi scale is ranged between -1 to +1. The method PROMETHEE II results in the complete ranking of PPP models are shown in figure 4.24. It is clear from the figure that the (BOT) model is located in the top with highest ranked by 0.4923. Immediately (BOO) followed in the second place with very small different than the first ranked model by 0.3739. Followed by (BOOT) in the third place, while both of the (LTR) and concession models are located at the bottom of the rank.

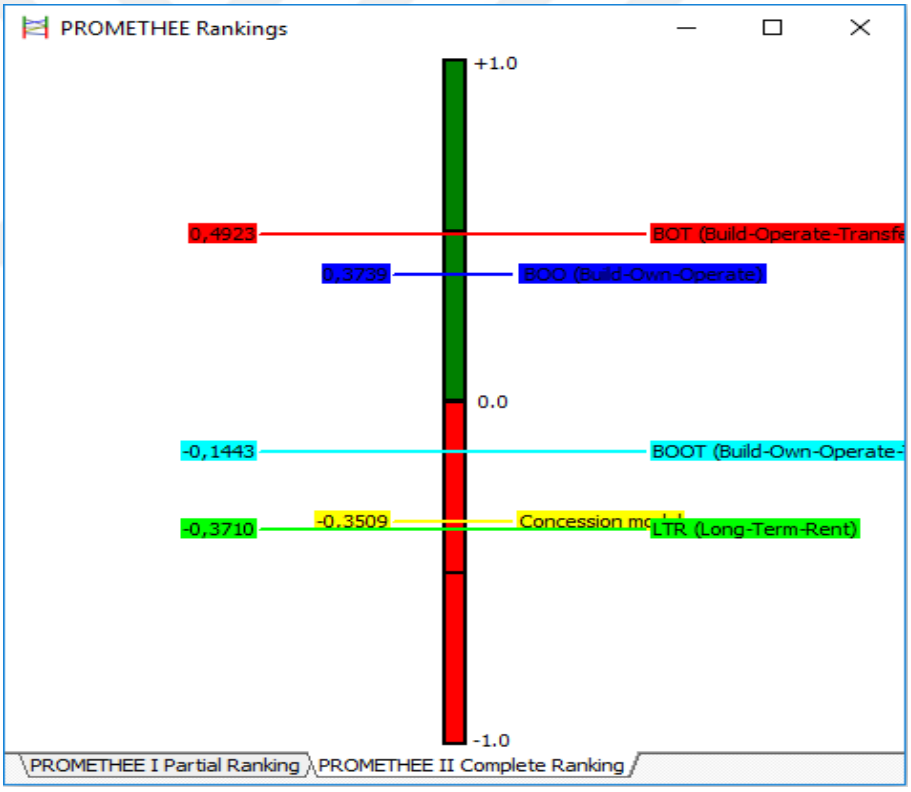


Figure 4.24. PROMETHEE II Complete ranking method (Combined)

4.4.4 PROMETHEE Rainbow for PROMETHEE II (Combined).

PROMETHEE Rainbow is a detail view of the PROMETHEE II method. Each alternative is represented by a bar that drawn with as many layers or slice as the number of criteria. Each layer match to the influence of the criterion to the Phi net

flow score of the alternatives taking into the account the weight of the criterion. Phi net flow score results from the summation of the positive slices minus the sum of the negative ones is equal to the Phi net flow score of the action. In this research; BOT model has just two negative contributions to its Phi score which are the transparent management and project planning and strategy, whilst other criteria are contributed positively. Similarly, BOO model has the same evaluation of the BOT model with a slightly different in with negative contribution for the project and process quality. In construct with BOO, BOOT model has a three positive criteria contribution; transparent management; construction risks; and stability, but it has a weakness in project planning, process quality, finance risks, operation risks, regulatory risks. On the other hand, the Concession models have large bars with negative slices, that indicate to the weakness on the finance risk for example, but they have different evaluation with respect to the operation risks. The LTR model has a positive bar or contribution for stability, project planning and strategy and force majeure risks while concession model has a negative contribution. The detail of PROMETHEE rainbow contribution is shown in figure 4.25.

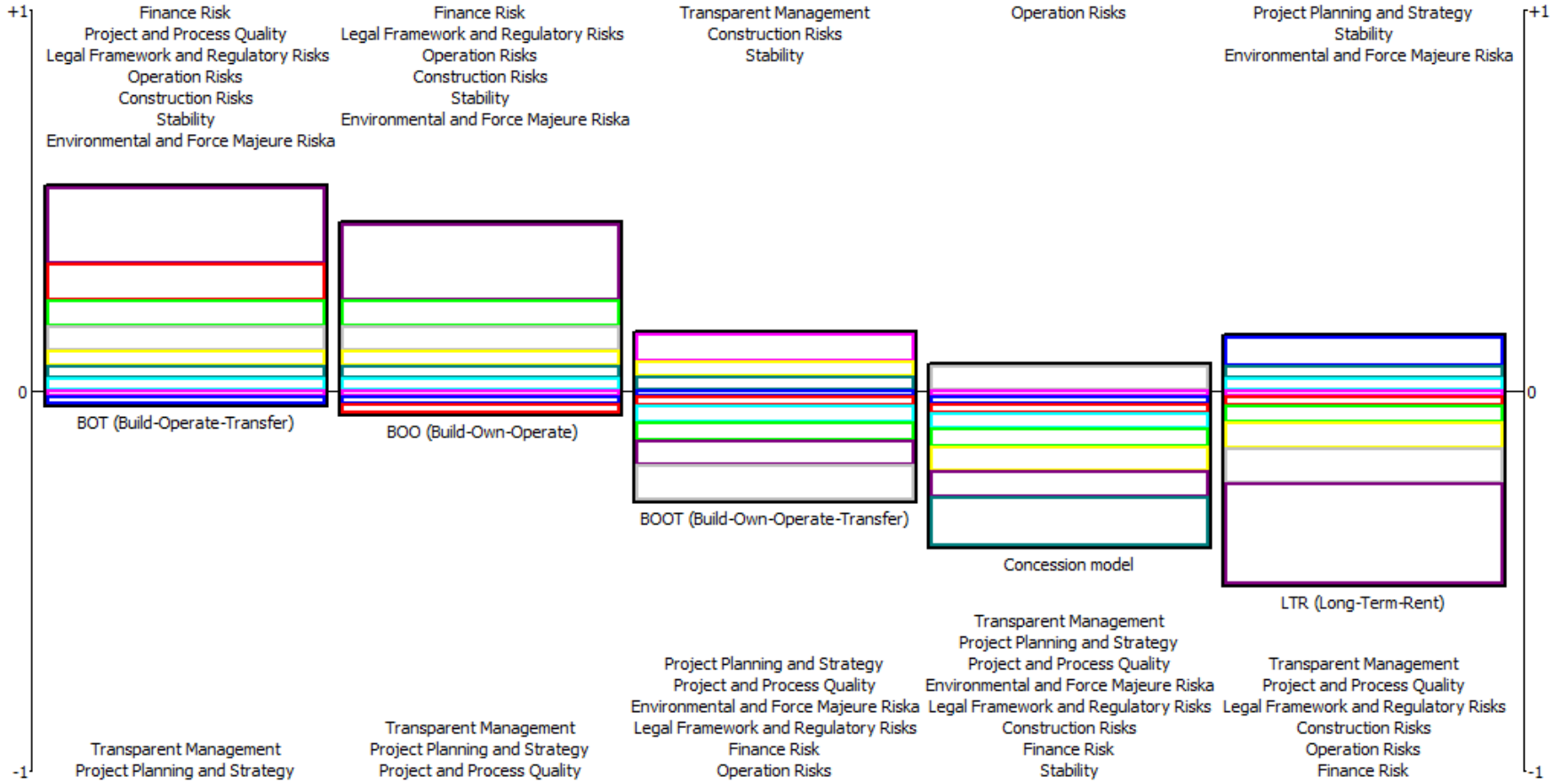


Figure 4.25. PROMETHEE Rainbow for PROMETHEE II (Combined).

4.5 PROMETHEE II Second Scenario (Public Experts Prospective)

Public experts indicate that BOO is the best alternative based on their prospective as shown in figure 4.26. It is clear from the figure that the (BO0) model is located in the top with highest ranked by 0.4829 Immediately (BOT) followed in the second place with very small different than the first ranked model by 0.4366. Followed by (BOOT) with 0.1902 in the third place, and all of them in the positive side of the Phi, while both of the concession and LTR models are located at the bottom of the rank by (-0.4409) and (-0.6688) respectively.

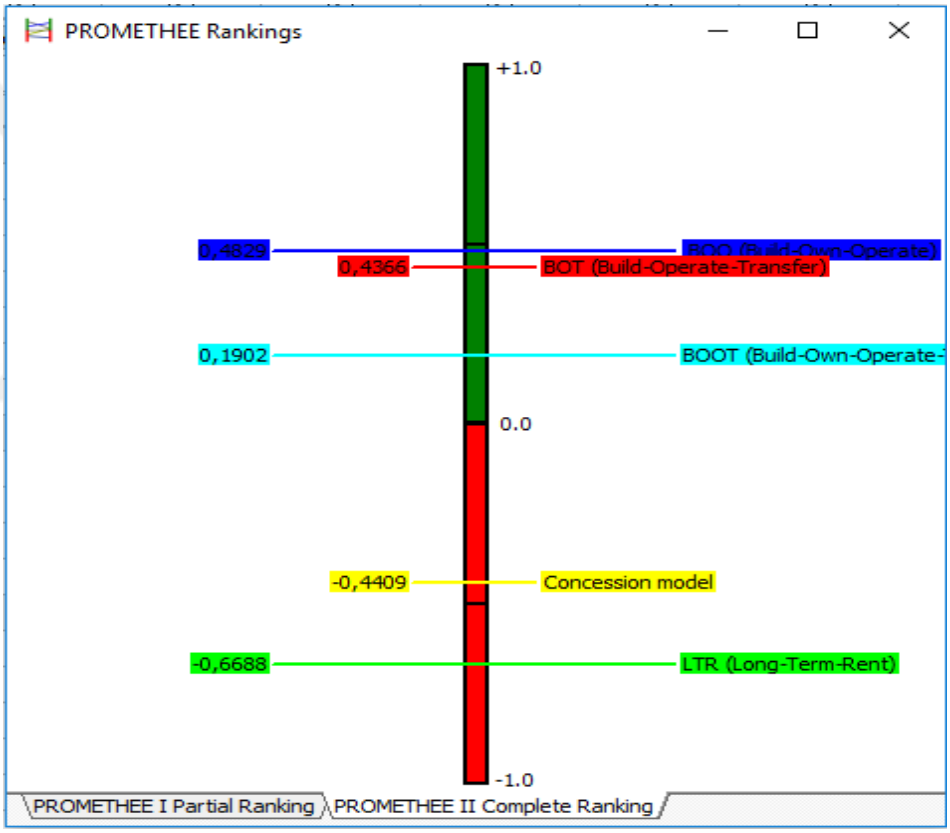


Figure 4.26. PROMETHEE II Complete ranking method (Public Experts Results)

4.6 PROMETHEE II Third Scenario (Private Experts Prospective).

Private experts have another prospective for the alternatives ranking, based on their experience they ranked long term rent model in the top with 0.1754 which mean the private sector prefer this type for some reasons. Followed by BOT model in the second place with 0.0733, as well as for the BOOT, BOO and concession models ranked with a small different between each other as shown in figure 4.27.

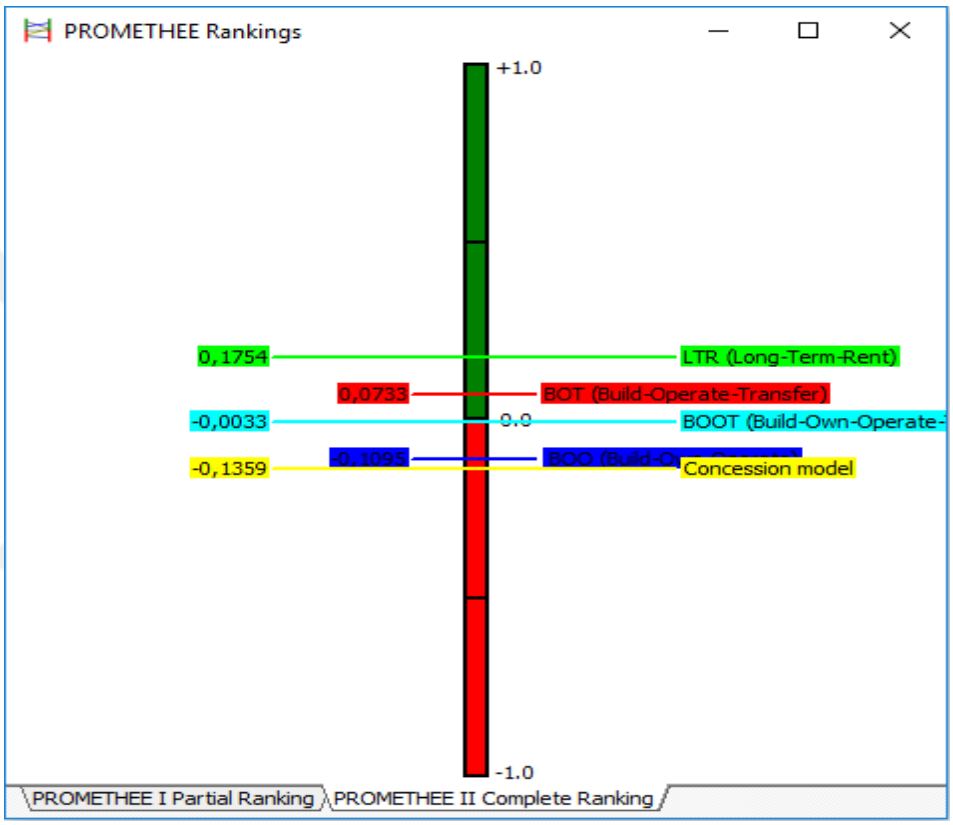


Figure 4.27. PROMETHEE II Complete ranking method (Private Experts)

Based on figure 4.30 It is showed the deferent between the public experts ranking the private ranking. Both of the sectors, public and private are ranked the BOT model in the same level almost in the second top ranked place. LTR model was ranked in the first place, while public sector ranks it in the last place which mean that this model is not preferred for public sector particularly for airport projects. Furthermore, BOO and concession models are ranked in the last place with respect to private sectors opinion, with a pit different than the public sector ranking which rank it in the fourth place. The negative and positive contribution for the criteria with respect to the

alternatives for the second and third scenarios are presented in figures 4.28 and 4.29 respectively.

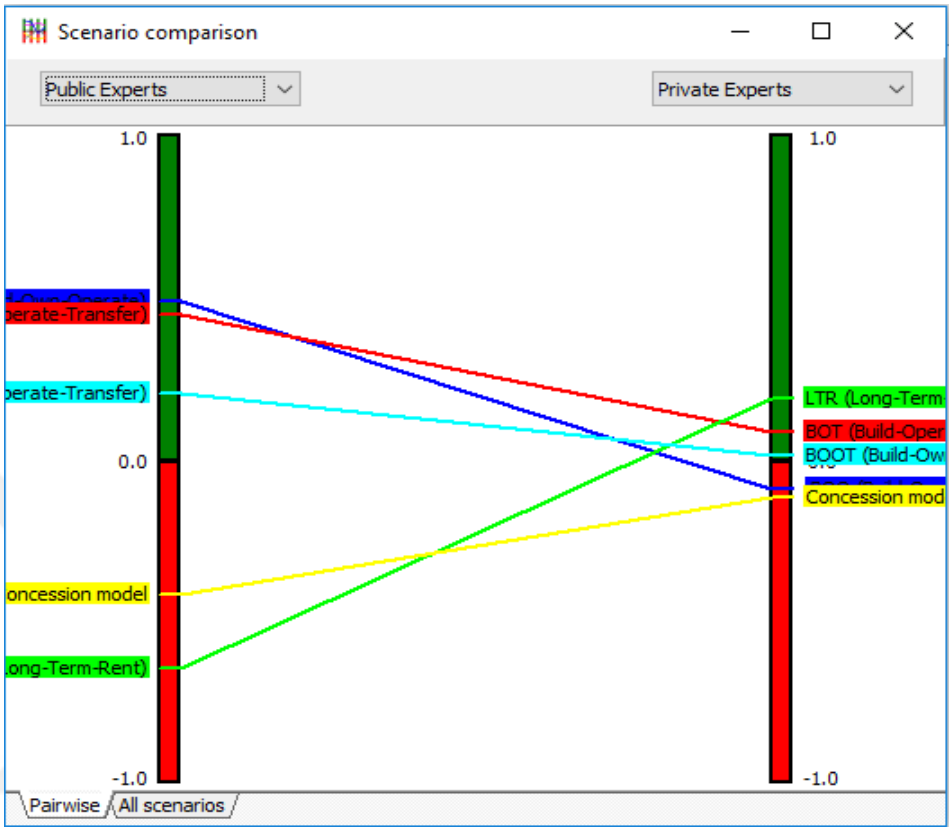


Figure 4.28. PROMETHEE II Complete ranking method (Public Vs Private Experts)

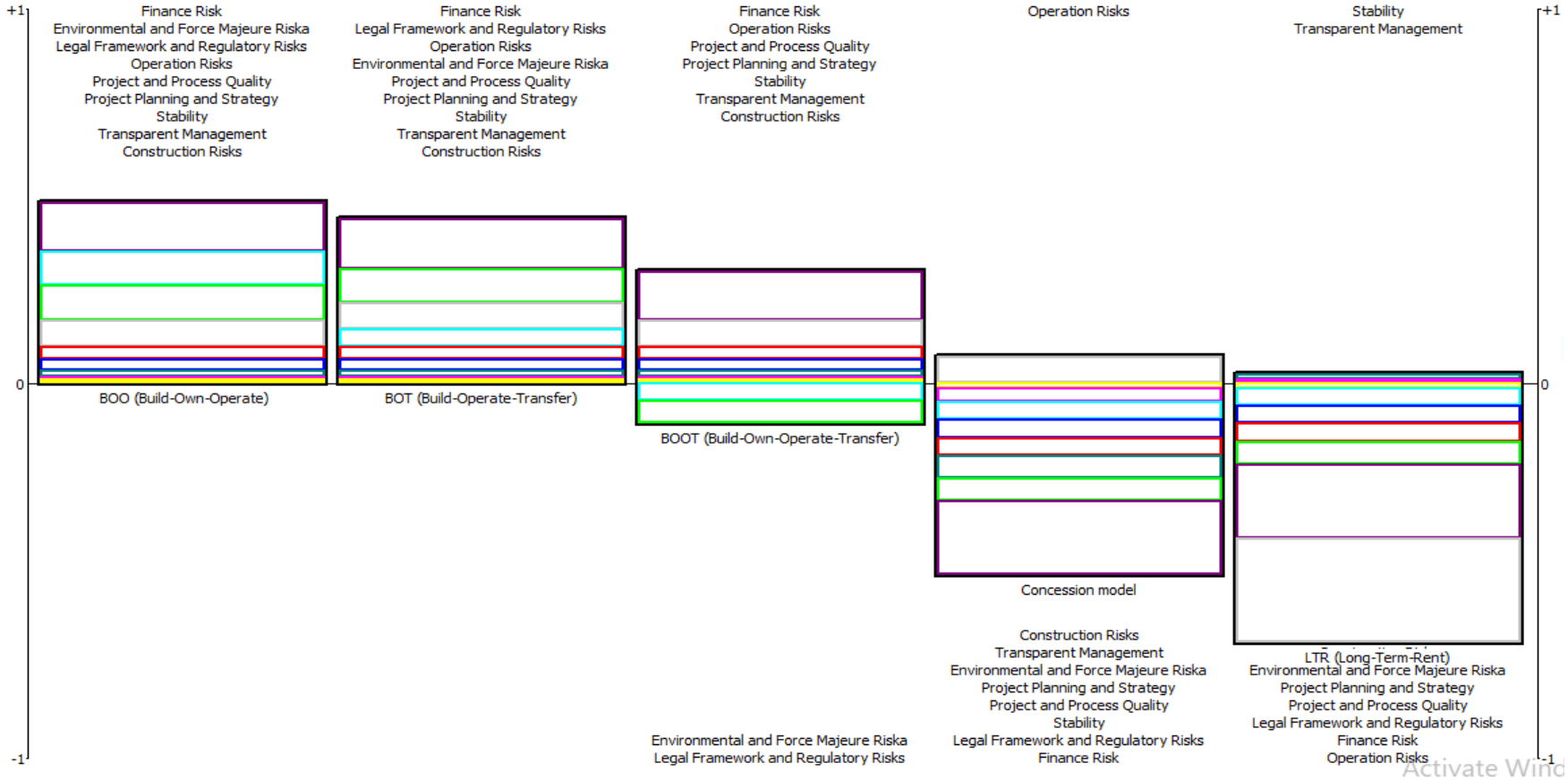


Figure 4.29. PROMETHEE Rainbow for PROMETHEE II (Public Experts Prospective).

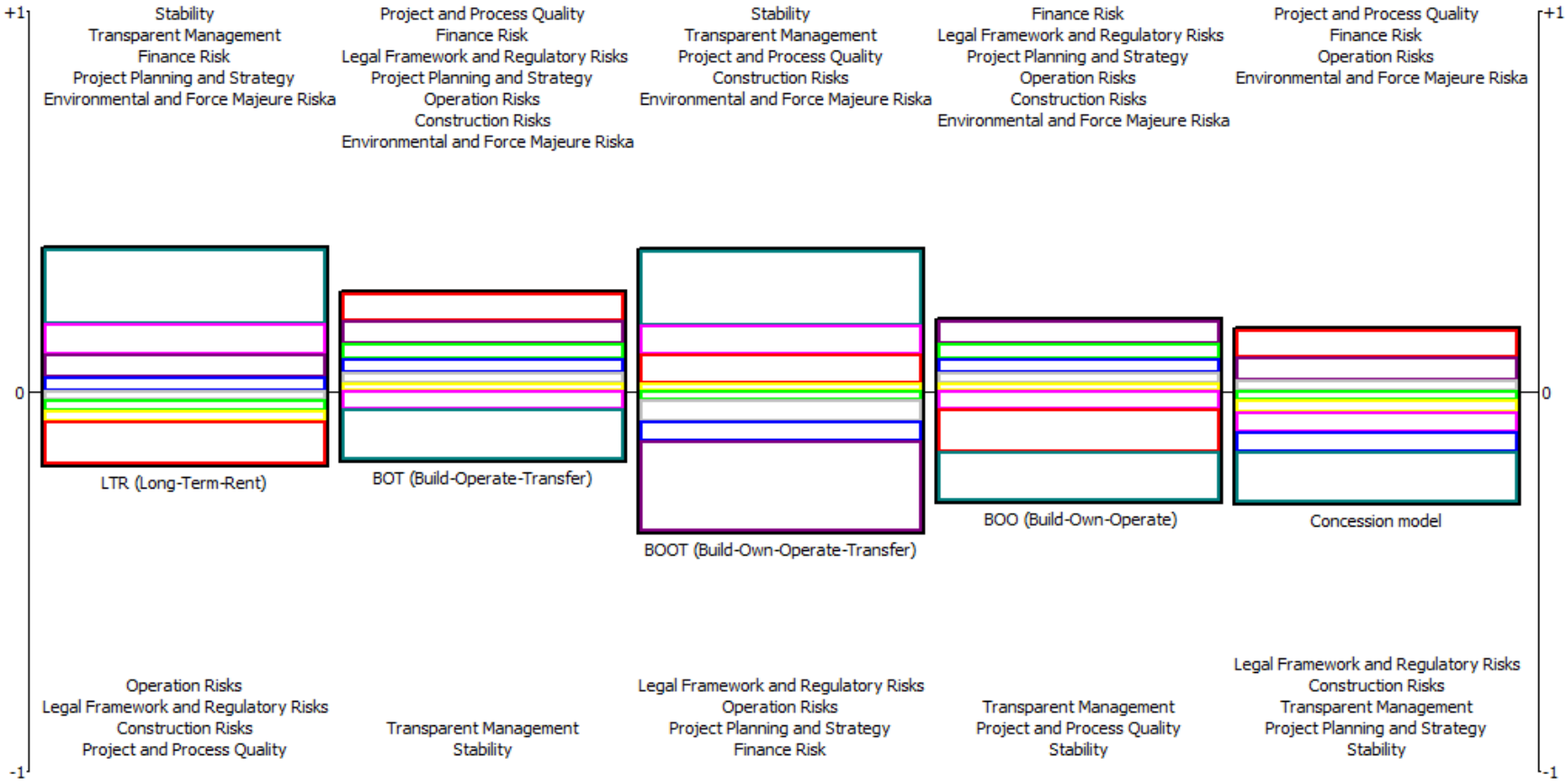


Figure 4.30. PROMETHEE Rainbow for PROMETHEE II (Private Sectors Prospective.

CHAPTER V

DISCUSSION

PPPs are popular procurement methods that are used in both developed and developing countries to deliver a series of infrastructure projects. Since PPP is complex, and normally have a long-time contract, selection of the best PPP procurement method for a certain project is not a simple process. In contrast with developed countries, the developing countries face many obstacles in terms of PPP implementations, such as the shortage of financial resources of the government, inefficiencies public support, contractual corruptions, weakness of public and private consortium, weak in political stability, and unstable administrative management. So, developing a new approach to choose the appropriate PPP model for the infrastructure project becomes critical issue. PPP is expected to achieve added value for money through transparent procurement and the best quality of service; however, PPPs are very complex and expensive. Furthermore, the success of these projects ensures significant outcomes for governmental organizations and practitioners. In this research study, the aim was identified to obtain a deep understanding of the definition of the PPP and its applications in the developing countries and to develop a methodological approach for the decision-making model to select the best-fit PPP procurement method by considering key performance indicators for infrastructure projects, mostly for airports. The DMM is structured on the MCDM methods by adopting AHP-PROMETHEE approach. The research has obtained important results that are discussed and presented in this chapter, where the next chapter provides the research conclusions and opportunities for future studies.

A comprehensive review of the literature on the critical success factors, risk factors and the decision-making tools of public-private partnership projects has been performed in this study from 2000-2018 as a first step of data collection and research problem definition. In table 2.7, it is explained that 20 CSFs were found the most significant for these projects. The most critical seven factors are list as the review

progressed, and the result of this review show that there are seven important popular criteria, which include risk allocation and sharing, strong private consortium, transparent procurement, available financial market, commitment made by partners, favorable legal framework, and political support. Comparing these results with other research such as Chan and Kyei [15], which contained a review study for these factors from 1990 to 2013, results show slightly differences with the current research results.

The differences emerge the increasing number of the publication in this area of study from 2013 to 2018, particularly in 2016. Not surprisingly, China, Australia, the United Kingdom and Hong Kong have conducted the largest number of research studies on PPP CSFs. However, it is clear that there is a revival in the research into CSFs in the area of PPP in some developing countries, such as; Nigeria, Ghana and the United Arab Emirates. The top seven PPP CSFs have been identified as major research findings in this review study, which includes, risk allocation and sharing, strong private consortium, available financial market, a commitment made by partners, transparent procurement, political support and favorable legal framework. Furthermore, questionnaires and case studies were found to be the primary research methods for data collection, which have been used by researchers, whereas few researchers adopt modeling and interviewing methods. That implies that for in-depth studies and solid information in this area, questionnaires and case study methods are considered the most effective. Furthermore, 46 RFs have been indicated from the literature review, where the most important RFs were related to availability of finance and the stability in addition to the proper risk identification and allocation. Additionally, the study review summarizes the different decision models, which were used in the PPP model area by searching in some data base, such as; Scopus, and since direct search engines (Table 2.10).

The main results of this review are; most of the decision models, which have been used in these studies, passed through three steps (1) Method of data collection (2) Model applications, and (3) Model validation. In addition to that, there are no studies that used the AHP-PROMETHEE approach to select the PPP procurement model for airport projects. Therefore, this comprehensive review of the literature on these factors and the decision-making tools of public-private partnerships projects not only

aims to reveal the importance of these factors, but also shows the lack of a comprehensive DMM for selecting an appropriate PPP procurement.

To specify the criteria in terms of KPIs, a questionnaire survey have been designed and distributed to the experts from public sector at (General Directorate of State Airports (DHMI), Ministry of Development, Ministry of Transportation, Ministry of Economy and Ministry of transportation and Infrastructure) in Turkey and private sectors (Turkish Companies). The respondents were asked to indicate the most important risk factors and CSFs of PPP airport projects based on a five-point Likert scale. Regarding the relevance of data analysis, the reliability tests for factors suggest high internal consistency and reliability of the data with values for critical success factors and risk factors at 0.851 and 0.930, respectively. Furthermore, ranking the significance of risk and the critical success factors by mean score values of the response data from the survey respondents was performed.

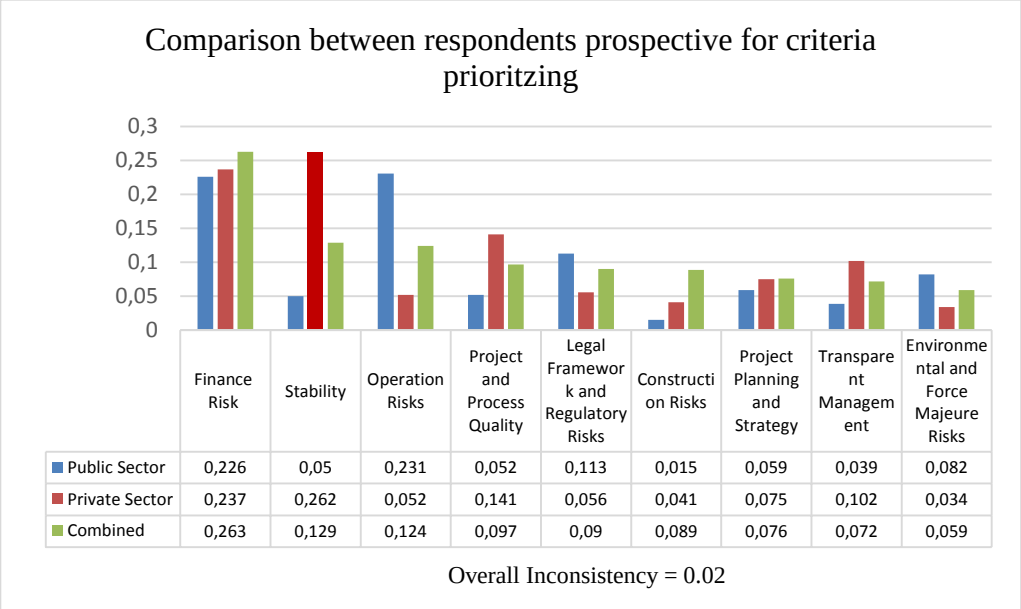
The most important CSFs from both views, public and private sectors, are: available financial markets, risk allocation and sharing, profitability, favorable legal framework, private consortium, effective supervision mechanisms and appropriate project identification for PPP airport projects in Turkey. However, public sector experts, in comparison to those from the private sector, stated that some factors were more important than the others. For instance, public experts rank favorable legal framework (C01) as the most important factor and at the 1st position, while experts from the private sector rank it in the 12th position out of 20, which indicates that the private sector in Turkey may not be as affected by the country's legal framework as the public sector, perhaps the impact does not appear to be a major one or one that creates much concern for the private sector. Similarly, the period of time for finishing the project is an important critical success factor for the public sector and perhaps not as important for the private sector, referred to as adherence of time (C10). Alternatively, some factors are much more important to the private sector than to the public sector, such as; profitability (C03), meeting output with specifications (C08) and competitive tendering (C14) (as shown in Table 4.2).

Using a similar approach, the study examined 46 risk factors for PPP airport projects. The ranking analysis in terms of the factors' importance indicates that all the factors are important. However, those such as availability of finance (R01), stability (R02), poor financial market (R03) and financial attraction of project to investors (R04) are

the most crucial risk factors for these projects from both points of view, public and private, for a successful airport project development in Turkey. It is clear that for both sectors the significant risk factors for these projects in Turkey are those related to finance, which could be an expected result for countries having a fast pace economic development. Moreover, other risk factors like financial attraction of project to investors (R04), high finance costs (R05), construction cost overrun (R07), inadequate distribution of responsibilities and risks (R08), and inadequate experience in PPP/PFI (R24) have been ranked much important in the public sector than the private sector. Furthermore, low operating productivity (R13), influential economic events (R15), delay in project approvals and permits (R25), and poor public decision-making process (R28) are ranked as less important. The 20 CSFs and 46 RFs were tested, identified by the public and private experts, grouped by factor analysis test, and the results were presented in terms of KPIs, which is used as a criterion for the next step in the AHP method.

The AHP method, as a one of MCDM methodologies, is selected for this research with the PROMETHEE method due to its ease of use, adaptability, flexibility and the simple step that can use a hierarchical structure, where a comparison case is built (Figure 3.6). This method breaks down the difficult and complex problems into simple decision-making problems. Consistency measurement is the most important advantage of the AHP method, which guarantees that the results from different participants (public and private) are consistent with each other. In the case of main criteria and the pairwise comparison between them by the experts, the most important and influential criteria for selecting the best fit PPP procurement method for airport projects based on the case study (New Antalya Airport) with their prioritization and weights are respectively: Finance Risks (26.3%), Stability (12.9%), Operation Risks (12.4%), Project and Process Quality (09.7%), Legal Framework and Regulatory Risks (09.0%), Construction Risk (08.9%), Project Planning and Strategy (07.6%), Transparent Management (07.2%), and Environmental and Force majeure Risks (05.9%). Figure 5.1 shows the overall assessment of the public and private experts for the criteria evaluation and weights. The most important criterion for choosing best fit PPP procurement method for airport projects is the financial risk with 26.3%, with a slightly difference between the private and public sectors' expectation with 23.7% and 22.6%, respectively. These results indicate that this

criterion is the most critical one for both sectors. Financial risks are followed by stability with overall assessment with 12.9%, but for this important criterion, there is a clear difference between the public and private sectors' ranking. The private evaluation is higher with a weight of 26.2%, while the public sector weighted it with 5% only. Public decision makers believe that the operation risk is an important criterion for selection PPP model evaluate it in the second position by 23.1% due to its relationship with the operation stages and being part of the private side responsibilities in some PPP types, whilst the private decision makers give this criterion a weight of 5.2%. The overall result for the combined sectors of the criteria are shown in Figure 5.1 below. After conducting AHP process for criteria prioritization and criteria weight evaluation, PROMETHEE method was applied for alternatives' ranking. This method is an interactive MCDM approach designed to deal with quantitative and qualitative criteria with discrete alternatives. Since this method cannot distribute weights to the criteria, the priority weights of selection criteria were calculated using AHP method.



	Finance Risk	Stability	Operation Risks	Project and Process Quality	Legal Framework and Regulatory Risks	Construction Risks	Project Planning and Strategy	Transparent Management	Environmental and Force Majeure Risks
Public Sector	0,226	0,05	0,231	0,052	0,113	0,015	0,059	0,039	0,082
Private Sector	0,237	0,262	0,052	0,141	0,056	0,041	0,075	0,102	0,034
Combined	0,263	0,129	0,124	0,097	0,09	0,089	0,076	0,072	0,059

Figure 5.1 Comparison between criteria prioritization.

PPP procurement methods ranking are found by using PROMETHEE computations. Firstly, preference functions and evaluation matrix were determined based on New Antalya airport as a case study by the decision-making team (Public and Private experts whose participate in AHP method evaluation). Then partial ranking by

PROMETHEE I and complete ranking followed by GAIA plan are determined after the approval of the functions. Visual PROMETHEE software was used in this process. In the last step of the proposed procedure, the alternatives are ranked based on their importance from the best to the worst. The best PPP procurement method was selected according the previous process. Using PROMETHEE method for this part of the study was for some reasons. Firstly, it is suitable for ranking the alternatives among conflicting criteria. Secondly, PROMETHEE is considered a simple ranking method. Finally, this MCDM method has a great popularity [146].

Before applying the PROMETHEE method for PPP procurement methods, preference function and thresholds were defined for each criterion. Usual preference function usually a good choice for qualitative criteria based on the guide report for this method. Furthermore, 5-point scale is appropriate for many qualitative criteria. Experts evaluated these criteria and values by taking into consideration the properties of the alternatives and the condition of the case study. Alternatives were evaluated fter determining the evaluation matrix and preference functions, by using the Visual PROMETHEE software. Partial ranking for the alternatives was determined via PROMETHEE I (Figure 4.11). In PROMETHEE I results, not all PPP methods/alternatives could have been compared with each other and some alternatives were simply incomparable such as the LTR model and the Concession model. LTR model was determined as the worst alternative according to the PROMETHEE I partial ranking. PROMETHEE I selected BOT as the best alternative with a very small difference with the BOO model in the second rank. PROMETHEE II is used for a complete ranking to identify the best alternative (Figure 4.12).

All the alternatives were ranked based on the experts' evaluations, opinions and judgments. These results are more clear and easier to use than the PROMETHEE I partial ranking. The BOT model was selected as the best PPP procurement method for New Antalya airport projects based on the provided information by PROMETHEE II, and the other ranked alternatives were BOO with a slight difference than BOT, followed by BOOT and LTR and the concession model. Three scenarios the first for public experts, second the private sector and for combined were conducted by using complete ranking PROMETHEE II, that indicate this result. As shown in Figure 5.2, there is a clear difference between the private and public

sectors' perspectives for the LTR model, as the private sector prefers this model, with the results possibly affected with the relation to the economic problems in last 8 months in Turkey, as most of the private sector was negatively affected from that problem. Nevertheless, both of the sectors agree that BOT model is very important for airports projects particularly for the case study, particularly for the case study.

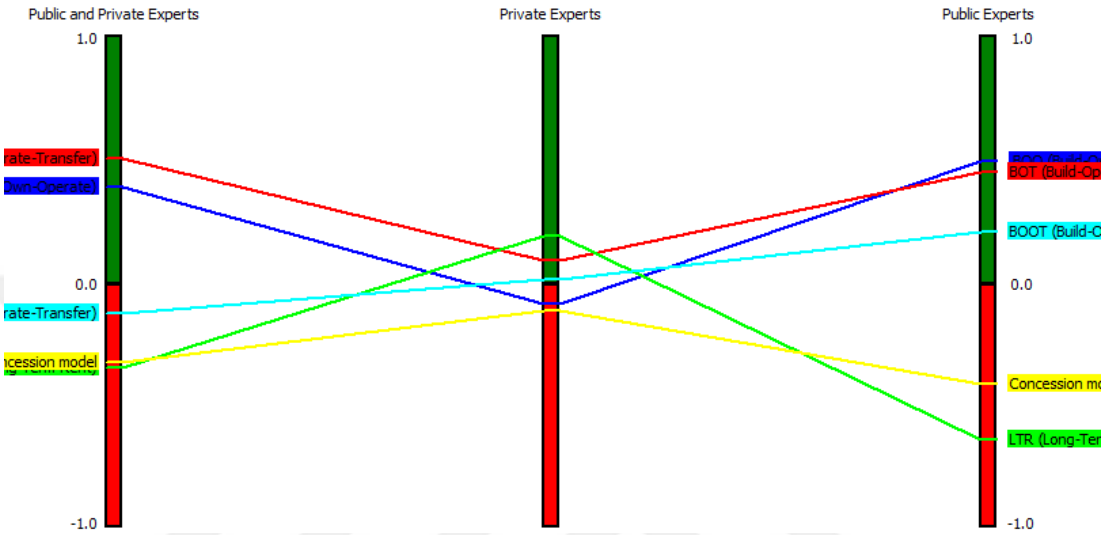


Figure 5.2. Comparison between three scenarios results.

The final step in this research was the validation process step based on the case study (New Antalya airport). The identified expert panel, who agreed to participate in the first stage of the current project has also been re-invited to validate the research outcome and practically to implement the proposed PPP procurement method for airport projects in developing countries. To achieve this, I have prepared a designated sheet containing a brief description of the research steps been undertaken and the main results generated. Moreover, using a 10-points-likert scale type questions graded as (1-point the worst to 10-points the best), a satisfactory consensus between the experts was achieved (mention the % of known) regarding the reliability of the overall proposed methodology and the applicability of DMM technique in particular. Table 5.1 shows the details of the experts' opinions during the validation process. In attempt to maintain and enhance the generalizability of the obtained opinions, attention was paid to include experts from both public and private sectors during the interview and the validation stages. This prospective combination has significantly produced more comprehensive, yet versatile, decision-making model

and flexible methodology to accommodate adaption of PPP procurement in both sectors alike. It is well-known that the validation based on judgmental opinions may be exposed to major methodological criticism due to the lack of scientific riggor. However, attempt to narrow down the divergence of views among experts on the topic under research seems suitable where dearth of the evidence on universal guidance (protocol) dominates. The current project was not an exception as the issues of data confidentiality in the case study (New Antalya Airport) and sampling have all led the investigator to use the penal list inputs as a reliable source of information. For this reason, further and more research is needed in the near future to enhance the representativeness of the results generated.

Table 5.1. Overall Research Validation Results.

Questions		Grade
1	Do you think that the proposed research methodology is an effective for PPP model selection?	8
2	Do you think that the proposed research methodology can applied for other developing countries?	8
3	Do you think that the proposed DM model has good applicability?	8
4	Do the research study results reflect your personal prioritizing?	7
5	Do you think that the research results are acceptable and logical?	8
6	Do the PPP alternatives ranking reflect your prospective?	7
7	Do you think that using MCDM methods for PPP model ranking are effective?	8
8	How do you grade the overall of the research results?	8

This validation process may not be an effective method. But, because of the confidentiality of the information for the case study (New Antalya Airport) and not easy task to find an airport project all the time and the limited expert's number, the proposed method was the suitable one that reflect the opinions and the prospective of the experts who have a good information about the case study from both sectors. For this reason, it is recommended for the further research to use more than one case study in addition to increasing the expert's number from both sectors, public and private.

CHAPTER VI

CONCLUSION

It is evident that PPP projects and selecting the appropriate procurement method for a specific project is one of the significant and influential topics within the project management sector. Therefore, many studies have researched the subject over the past two decades; however, limited researches have conducted an application on PPP procurement determination through following the proposed methodology in the current research. In this chapter, the outcomes of the research are presented through an overall summary of the findings of the literature, survey results, AHP-PROMETHEE application and implementation of the DMM through a case study. Moreover, the research questions are answered and explained based on the literature and the performed case study.

Variety of critical success and risk factors for PPP procurement method adoption were identified, examined and analyzed using a ranking technique. This research presents a systematic review of the literature, which concluded 20 CSFs of PPP projects that are summarized from the literature based of their importance, and the significant ones are; Risk allocation and sharing; Strong private consortium; Transparent procurement; Available financial market; Commitment made by partners; Favorable legal framework; and Political support. Additionally, 46 RFs were identified, and the most important factors are; factors related to finance risks, stability risks, and suitable risk allocation between the parties.

The factors that affect the selection of PPP procurement methods for airport projects have been analyzed by using SPSS v 25. Thus, providing a clear understanding of the

key performance indicators for the projects. The study examined 20 CSFs and 46 RFs, as per the viewpoints of the experts from both sectors by a questionnaire survey. Findings yielded overall reliability for the CSFs and RFs for PPP airport projects of 0.851 and 0.930, respectively, which indicates a high internal consistency and reliability for the dataset. Furthermore, the mean ranking values for 20 CSFs for airports projects are presented in Table 4.2 and Figure 4.5. The most important CSFs from the overall evaluation were; availability of financial market, risk allocation and sharing and profitability. Similarly, 46 RFs were evaluated by mean score ranking and listed in Table 4.3 and Figure 4.7. The most critical factors are; availability of finance, stability and poor financial market. Using a factor analysis test, the 20 CSFs and 46 RFs were tested and grouped in 9 categories in terms of KPIs, as shown in Tables 4.7 and 4.8, respectively. These KPIs are defined in the appendix and listed as; Construction Risks; Environmental and Force Majeure Risks; Operating Risks; Legal Framework and Regulatory Risks; and Finance Risks; Effective planning and strategy; Transparent Management; Project and Process Quality; and Stability.

The AHP method was used in this research mainly to define the criteria weights and for criteria prioritization. This method has an easy way of use, with high adaptability and flexibility, in addition to the consistency measurement, which is one of its most important advantages. According to the main criteria pairwise comparison based on the overall experts' judgments, the most important and influential criteria for selecting the best fit PPP procurement method for airport projects according to weights are: finance risks were classified as the most important criteria for PPP airports projects selection with (26.3%), followed by stability with (12.9%), operation risks (12.4%), project and process quality (9.7%), legal framework and regulatory risks (9%), construction risks (8.9%), project planning and strategy (7.6%), transparent management (7.2%) and environmental and force majeure risk (5.9%).

Based on the results from the AHP method for criteria prioritization and criteria weight evaluation, the PROMETHEE method was applied for alternatives' ranking. This method is an interactive MCDM approach that has not been used before for PPP procurement method determination for airports projects in the developing countries, based on the extensive literature review performed in the research. The method is designed to deal with quantitative, as well as qualitative, criteria with separate

alternatives. This method cannot distribute weights to the criteria, therefore, AHP method used calculate the priority weights of selection criteria. The main results of this method based on the overall judgment of the experts from public and private sectors by using PROMETHEE complete ranking are; The BOT model was selected as the best alternative for airport projects based on the provided information, followed by BOO model with a slight difference from the previous one, BOT model, BOOT model, LTR model and concession model. The optimal PPP models for the case study of this research based on both AHP and PROMETHEE approach were the BOT and BOO models. The main results of this study are based on the combined evaluation of the experts from both sectors, public and private according to their judgments and opinions. However, the proposed decision-making model and the methodology in this research is appropriate for the public sector use, as well as for private sector. Thus, the DMM for determining the best fit PPP procurement method for airports projects can be adopted from the public sector or the private sector for the selection of a proper PPP procurement method.

The proposed methodology and the DMM have passed through many steps of evaluation and development by the researcher based on the experts' opinions and judgments from different universities, projects and governmental entities. After obtaining the results of this study, a validation process sheet has been prepared for experts' interviews. The sheet contained the flow chart of the proposed methodology, proposed decision-making model, main research results and a validation table. Each expert performed his evaluation separately through this sheet. Five of the six experts participated in this interview and made their grading based on a scale (Grading 1-worst to 10-best). The details of the experts' overall grading is summarized below;

1. The overall evaluation is satisfactory and accepted, which indicates that this methodology is effective for PPP model selection and it can be applied in developing countries. The proposed methodology enables both sectors to contribute with their ideas, opinions, knowledge and expertise of the PPP models and can be used to select the appropriate alternative for a specific project.
2. The proposed decision-making model also can be adopted and used perfectly for the developing countries.

3. The overall evaluation indicates that the research results are acceptable and logical. The participants in this study found that this approach is useful and understandable for such a problem type.
4. The MCDM approach provided in this study is an effective method for ranking the alternatives. The approach was to use Expert choice 11.5 (academic version software) for criteria weighing and prioritization, followed with PROMETHEE Visual software for alternative ranking. Such an approach was proven effective for PPP model selection.
5. The results were satisfactory based on the validation results.

The validation process is based on the opinions and judgments of the experts from public and private sectors, who participated from the first stage of the research and understand the objectives of all steps of the case study. In future research, the validation process can be improved through adopting the proposed DMM on a real project through following the research methodology stages and by interviewing experts who are decision makers, constructors, engineers and all the stakeholders within the project. The validation of the proposed model shall include participants from public and private sectors. This study is limited with only one case study and for one airport project that not easy to find a such project all the time. The limitations of this study prevented from implementing the latter step due to project information confidentiality and the inclusion of experts who participated from the first stage in the validation process. Consequently,

Although the PPP concept is wide spreading in many developed and developing countries around the world, it does not possess a similar status in some other developing countries like Libya, and still in its early stages. For that and based on the research results, this status encourages the developing countries' governments to consider adapting the most current project management strategies, such as the proposed DMM to select the best fit PPP procurement method for the country's infrastructure development, particularly for airport projects. In addition to that, the experts from public and private sectors should raise their knowledge and acquire experiences in mathematical software and MCDM methods, such as the AHP method. For further research, it is recommended that the number of project management professionals and experts is increased in order to create more reliable and solid data in addition to the number of case studies. Based on the validation of

the results for the proposed methodology, discussed DMM and its applicability on a worldwide level at the developing countries, further research is recommended for countries that need to build it infrastructure such as Libyan case, and the developing countries generally.

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APPENDIXES

APPENDIX A: Questionnaire Survey Questions

A Survey on The Critical Success Criteria and Risk Factors for Public-Private Partnership Projects for 'Airports' in Turkey

Dear Madam / Sir,

My name is Ali MOHAMMED and I am a Ph.D. Candidate at Cankaya University. This voluntary questionnaire survey is prepared to be a part of a doctoral thesis entitled "Decision-Making Model Based on the Analytic Hierarchy Process (AHP) To Select the Best Public Private Partnership (PPP) Model for Airports in Developing Countries", undertaken at the Department of Interior design, Design programme, under the supervision of Supervisor Assist. Prof. Dr. Gülsu ULUKAVAK HARPUTLUGİL and Co-supervisor. Assist. Prof. Dr. Timuçin HARPUTLUGİL.

Airports projects, in particular, constitute some of the most capital-demanding infrastructures and the level of risks to which these investments are subject to is very significant, severely diminishing the ability of governments and/or private investors to undertake such endeavors.
So, this survey is conducted to specify the most important success criteria, risk factors for PPP airport projects from the perspective of the experts. The survey's main question is:

What are the important success criteria and risk factors for PPP airports projects for Turkey?

As an expert, you are invited to participate in a survey of the evaluating the success criteria and the risk factors of PPP airports projects in Turkey. Your input will be important to provide us with an understanding the factors and use them as key strategies to develop a decision-making model in future. This survey is carefully designed to take the shortest time possible. Please be sure that your personal data are going to be top confidential and I welcome your comments or questions relating to this survey, you can contact me at the bellow mentioned addresses.

Thanks a lot, in advance.

Sincerely

Ali Omar Ramadhan MOHAMMED
PhD. Candidate, Design Program
Department Interior Design
Cankaya University
Phone: (0090) 5418618974
E-mail: c1488602@student.cankaya.edu.tr
aligalied@yahoo.co.uk

Questionnaire Survey:

Section 1: About the Respondent:

Q1: Age:

1: 20-30 years
2: 31-40 years
3: 41-60 years
4: Above 60

Q2: Academic degree:

1: B.Sc.
2: M.Sc.
3: Ph.D.

Q3: Please select your primary role below:

1: Academics
2: Consultant
3: Engineer
4: Financer
5: PPP Expert
6: Contractor
7: Sub-Contractor
8: General director

Q4: How many years of industrial experience do you have?

1:5 years below
2: 6 – 10 years
3: 11 – 15 years
4: 16 – 20 years
5: 21 years or above

Q5: Which sector do you have experience with?

1: Public sector (State)
2: Private sector

Section 2: General Experience with PPP:

Q6: How many years of PPP experience do you have?

0: None
1: 1-2 years or below
2: 3 –5 years
3: 6 years or above

Was there or is there any PPP project undertaken by your company/organization?

Q7: Transportation
Q8: Energy and Power
Q9: Telecommunication&Inf. T.
Q10: Water and Sanitation
Q11: Health

What is the model type of the PPP project that undertaken by your company/organization (you may tick more than one box)?

Q12: Transfer of Operational Rights (TOOR)
Q13: Build-Operate- Transfer (BOT)
Q14: Concession model
Q15: Build-Own-Operate-Transfer (BOOT)
Q16: Build-Own-Operate (BOO)
Q17: Built-Rent-Transfer (BRT)
Q18: Long Term Rent (LTR)

Which PPP model do you think is better for airports projects for Turkey (you may tick more than one box)?

Q19: Build-Operate- Transfer (BOT)
Q20: Concession model
Q21: Build-Own-Operate-Transfer (BOOT)
Q22: Build-Own-Operate (BOO)
Q23: Long Term Rent (LTR)

Section 3: Critical Success Criteria/Factors:

From your experience, please rank the critical success factors below in what you consider to be the level of importance for PPP airports projects in Turkey. 1 being the most important and 5 being the least important.

No.	Critical Success Factors (CSFs)	Ranking				
		1	2	3	4	5
Q24	Risk allocation and sharing					
Q25	Strong private consortium					
Q26	Available financial market					
Q27	Commitment made by partners					
Q28	Transparent procurement					
Q29	Political support					
Q30	Favorable legal framework					
Q31	Community / Public support					
Q32	Stable macroeconomic environment					
Q33	Clearly defined responsibilities and roles					
Q34	Appropriate project identification					
Q35	Effective management control					
Q36	Competitive tendering					
Q37	Openness and constant communication					
Q38	Meeting output with specifications					
Q39	Reliable and quality service operations					
Q40	Adherence of time					
Q41	Satisfying the need for public facility					
Q42	Profitability					
Q43	Effective supervision mechanism					

Section 4: Risk Factors and Risk Allocations:

From your experience, please evaluate and rank risk factors below in what you consider to be the level of importance for PPP airports projects ın Turkey. 1 being the most important and 5 being the least important.

Risk factor category group	**Risk factors**	**Ranking**				
		1	**2**	**3**	**4**	**5**
	Q44: Stability					

Politics and policy	Q45: Expropriation or nationalisation of assets					
	Q46: Poor public decision-making process					
	Q47: Strong political structure					
Macroeconomic	Q48: Poor financial market					
	Q49: Inflation rate volatility					
	Q50: Interest rate volatility					
	Q51: Influential economic events					
Legal	Q52: Legislation change					
	Q53: Change in tax regulation					
	Q54: Industrial regulatory change					
Social	Q55: Lack of tradition of private provision of public services					
	Q56: Level of public opposition to project					
Natural	Q57: Force majeure					
	Q58: Geotechnical conditions					
	Q59: Weather					
	Q60: Environment					
Project selection	Q61: Land acquisition (site availability)					
	Q62: Level of demand for project					
Project finance	Q63: Availability of finance					
	Q64: Financial attraction of project to investors					
	Q65: High finance costs					
Residual risks	Q66: Residual risks					
Design	Q67: Delay in project approvals and permits					
	Q68: Design deficiency					
	Q69: Unproven engineering techniques					
Construction	Q70: Construction cost overrun					
	Q71: Construction time delay					
	Q72: Material/labour availability					
	Q73: Late design changes					
	Q74: Poor quality workmanship					
	Q75: Excessive contract variation					
	Q76: Insolvency/default of sub-contractors or suppliers					
Operation	Q77: Operation cost overrun					
	Q78: Operational revenues below expectation					
	Q79: Low operating productivity					
	Q80: Maintenance costs higher than expected					
	Q81: Maintenance more frequent than expected					
Relationship	Q82: Organisation and co-ordination risk					
	Q83: Inadequate experience in PPP/PFI					
	Q84: Inadequate distribution of responsibilities and risks					
	Q85: Inadequate distribution of authority in partnership					
	Q86: Differences in working method and know-how between partners					
	Q87: Lack of commitment from either partner					
Third party	Q88: Third Party Tort Liability					
	Q89: Staff Crises					

Thanks a lot, in advance

APPENDIX B: Questionnaire for Evaluation Matrix (3 Experts from Public and 3 from Private Sectors)

Dear Participance:
From your experience, please evaluate the alternatives (Public-Private Partnership models) with respect to the criteria (Key Performance Indicators) below in what you consider to be the level of impact (New Antalya airport as a case study).

1. To what extent do you think that the following projects have a **Clear Strategy and Effective Planning**?

	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
Build-Own-Operate (BOO)					
Build-Operate- Transfer (BOT)					
Long Term Rent (LTR)					
Concession model					
Build-Own-Operate-Transfer (BOOT)					

2. How do you evaluate the **Finance Risk** in following projects?

	Very high risk	High risk	Medium risk	Low risk	Very low risk
Build-Own-Operate (BOO)					
Build-Operate- Transfer (BOT)					
Long Term Rent (LTR)					
Concession model					
Build-Own-Operate-Transfer (BOOT)					

3. To what extent do you think that the following projects have **Transparent Management**?

	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
Build-Own-Operate (BOO)					
Build-Operate- Transfer (BOT)					
Long Term Rent (LTR)					
Concession model					
Build-Own-Operate-Transfer (BOOT)					

4. To what extent do you think that the following projects affected by **Stability**?

	Very high affect	High affect	Medium affect	Low affect	Very low affect
Build-Own-Operate (BOO)					
Build-Operate- Transfer (BOT)					
Long Term Rent (LTR)					
Concession model					
Build-Own-Operate-Transfer (BOOT)					

5. How do you evaluate the **Construction Risks** in following projects?

	Very high risk	High risk	Medium risk	Low risk	Very low risk
Build-Own-Operate (BOO)					
Build-Operate- Transfer (BOT)					
Long Term Rent (LTR)					
Concession model					
Build-Own-Operate-Transfer (BOOT)					

6. How do you evaluate the **Environmental and Force Majeure Risk** in following projects?

	Very high risk	High risk	Medium risk	Low risk	Very low risk
Build-Own-Operate (BOO)					
Build-Operate- Transfer (BOT)					
Long Term Rent (LTR)					
Concession model					
Build-Own-Operate-Transfer (BOOT)					

7. How do you evaluate the **Operation Risk** in following projects?

	Very high risk	High risk	Medium risk	Low risk	Very low risk
Build-Own-Operate (BOO)					
Build-Operate- Transfer (BOT)					
Long Term Rent (LTR)					
Concession model					
Build-Own-Operate-Transfer (BOOT)					

8. How do you evaluate the **Legal Framework and Regulatory Risk** in following projects?

	Very high risk	High risk	Medium risk	Low risk	Very low risk
Build-Own-Operate (BOO)					
Build-Operate- Transfer (BOT)					
Long Term Rent (LTR)					
Concession model					
Build-Own-Operate-Transfer (BOOT)					

9. To what extent do you think that the following projects affected by **Project and Process Quality**?

	Very high affect	High affect	Medium affect	Low affect	Very low affect
Build-Own-Operate (BOO)					
Build-Operate- Transfer (BOT)					
Long Term Rent (LTR)					
Concession model					
Build-Own-Operate-Transfer (BOOT)					

Name of Participant: ……...

Organization Name: ……

E-mail address:…….

Date: / / 2018

Thanks a lot, in advance

APPENDIX C: Questionnaire Participant Information Sheet

Çankaya Üniversitesi
Questionnaire Participant Information Sheet

Invitation to participate in research:

Decision-Making Model Based on Analytic Hierarchy Process (AHP) and PROMETHEE Methods to Select the Best Fit Public Private Partnership (PPP) Model for Airports Projects.

I invite you to take part in this research study.

- Procedures

This Participant Information Sheet provides information for participants to be fully aware of their involvement in this research study. You need to be informed of what is expected from participation and can freely decide if you consent to participate. The research study is to be conducted by Ali MOHAMMED as part of doctor of science in the department of interior architecture, Cankaya University supervised by Assist. Prof. Dr. Timuçin HARPUTLUGİL.

- Research aims

The aim of this study is to presents a methodology approach for a decision-making model to select the best PPP model for airport projects considering CSFs and risk factors as a key performance indicator for developing countries. The model is expected to be used for infrastructure projects, mostly for airports. The decision-making model is structured on MCDM methods (AHP-PROMETHEE approach). The decision-making model is expected to be adopted as a tool and contribute to decision makers for selecting the best fit PPP model for airports in order to enhance projects successfully at developing countries.

Ali Omar Ramadhan MOHAMMED
Ph.D. Candidate at Interior Architecture Department.
Cankaya University.
Tel: 05438618974
Email: c1488602@student.cankaya.edu.tr

Name of participant: ..... Date: .....

Organization Name: .....

Department:.....

GLOSSARY: Definition of the main KPIs (The criteria) for PPP airport projects based on the case study (New Antalya Airport):

1. **Operational Risk:** Operation risk is a necessity for successful operations. It can be defined as the risk that any network interface does not work as expected, or that the cost of operating and maintaining the asset is unexpected, including the risk of service secession or asset availability.
2. **Financial Risk:** The availability of flexible and attractive financial instruments, such as debt, equity, supplier and purchaser credit, and securities. It is also considered of crucial importance to enable the private sector to finance the PPP project.
3. **Legal Framework and Regulatory Risk:** The risk that a change in general law or regulation adversely affects the project, such as changes in general corporate taxation, or in rules governing currency convertibility, or repatriation of profits. For example, this could include failure to renew approvals appropriately, unjustifiably harsh regulatory decisions, or in the extreme, breach of contract or expropriation. This framework should assure the availability and effectiveness of laws related to PPPs to handle any legal issues arising in the process as well as offer essential legal systems within which the PPP procurement process can take place.
4. **Environmental and Force Majeure Risk:** It is the risk due to any external events which are beyond the control of the parties to the contract, such as uninsurable natural disasters, wars or conflicts.
5. **Project Planning and Strategy:** Management control and planning are essential for the successful operation of a facility. Contemporary network planning techniques and computer-based project management systems should be employed in PPP projects. Furthermore, management strategy and control of risk is one of the most important factors during the PPP life cycle. Properly implemented administrative processes are imperative for effective risk management. Therefore, the contract director should prepare the PPP contract management plan and strategy, paying attention to PPP contract administration responsibilities.
6. **Project and Process Quality:** Quality and the process of the project is defined as a set of policies, processes, and procedures required for planning

and execution (production/ development/ service) in the core business area of an organization. It is one of the main factors to ensure the quality of the project is the Staff who are qualified and experienced in managing the PPP projects in government and in the private sectors.

7. **Stability:** It is including economic and political stability. Economic stability is critical to the success of any kind of project. For a PPP infrastructure project, it is dependent on a number of factors, particularly on a long-term demand for the products/ services offered by the project; limited competition from other projects; sufficient profitability of the project to attract investors; long-term cash flow that is attractive to the lender; and long-term availability of supplier needed for the normal operation of the project. The political stability is also of crucial importance for the success of any PPP project.
8. **Transparent Management:** Transparent procurement management process is essential to reduce the transaction costs and reducing the time in negotiation and completing the deal in a satisfied form. Mainly PPP is a procurement process, therefore there is a need for transparency throughout this process. It must be highlighted that transparency does not only apply to the tendering process but it must be observed throughout the delivery of the PPP project. However, transparency relies on effective communication among parties and external stakeholders. Parties should openly consult each other for any clarification on the projects' delivery. Additionally, both the public and private sectors must be transparent and open to external stakeholders or users. In fact, information and reports on the projects must be made publicly available. Moreover, it is always important for governments to clear any doubts or rumors within the public domain concerning the delivery of PPP projects, as negative public perception could affect the successful implementation of the projects.
9. **Construction Risk:** Construction risk is the possibility that during the construction phase the actual project costs or construction time exceed those projected frames. Construction risks can be caused by defects or mistakes in the design, a lack of appropriate planning, a lack of proper project and schedule management of the construction program, defects in the methods used, or other causes related to under-performance or even negligence by the

private partner . This risk generally results from the private partner who will pass it through to the construction contractors.

APPENDIX E: Validation Sheet Process

Çankaya Üniversitesi
Participant Information Sheet for Validation Process

Invitation to participate in research validation process:

Decision-Making Model Based on Analytic Hierarchy Process (AHP) and PROMETHEE Methods to Select the Best Fit Public Private Partnership (PPP) Model for Airports Projects.

Dear Participance,

This research study is conducted by Ali MOHAMMED, a Ph.D. candidate in design program in department of interior architecture, Cankaya University supervised by Assist. Prof. Dr. Timuçin HARPUTLUGİL.

The aim of this research study is to presents a methodology approach for a decision-making model to select the best PPP model for airport projects considering CSFs and risk factors as a key performance indicator for developing countries. The model is expected to be used for infrastructure projects, mostly for airports (New Antalya airport as a case study). The decision-making model is structured on MCDM methods (AHP and PROMETHEE approach). The decision-making model is expected to be adopted as a tool and contribute to decision makers for selecting the best fit PPP model for airports in order to enhance projects successfully at developing countries.

You are invited to participate in this validation process for this study based on the results which I achieve in this research which is expected to assist in making appropriate decisions for PPP model selection. You will find a detail explanation for the research steps and the final results attached with this letter.

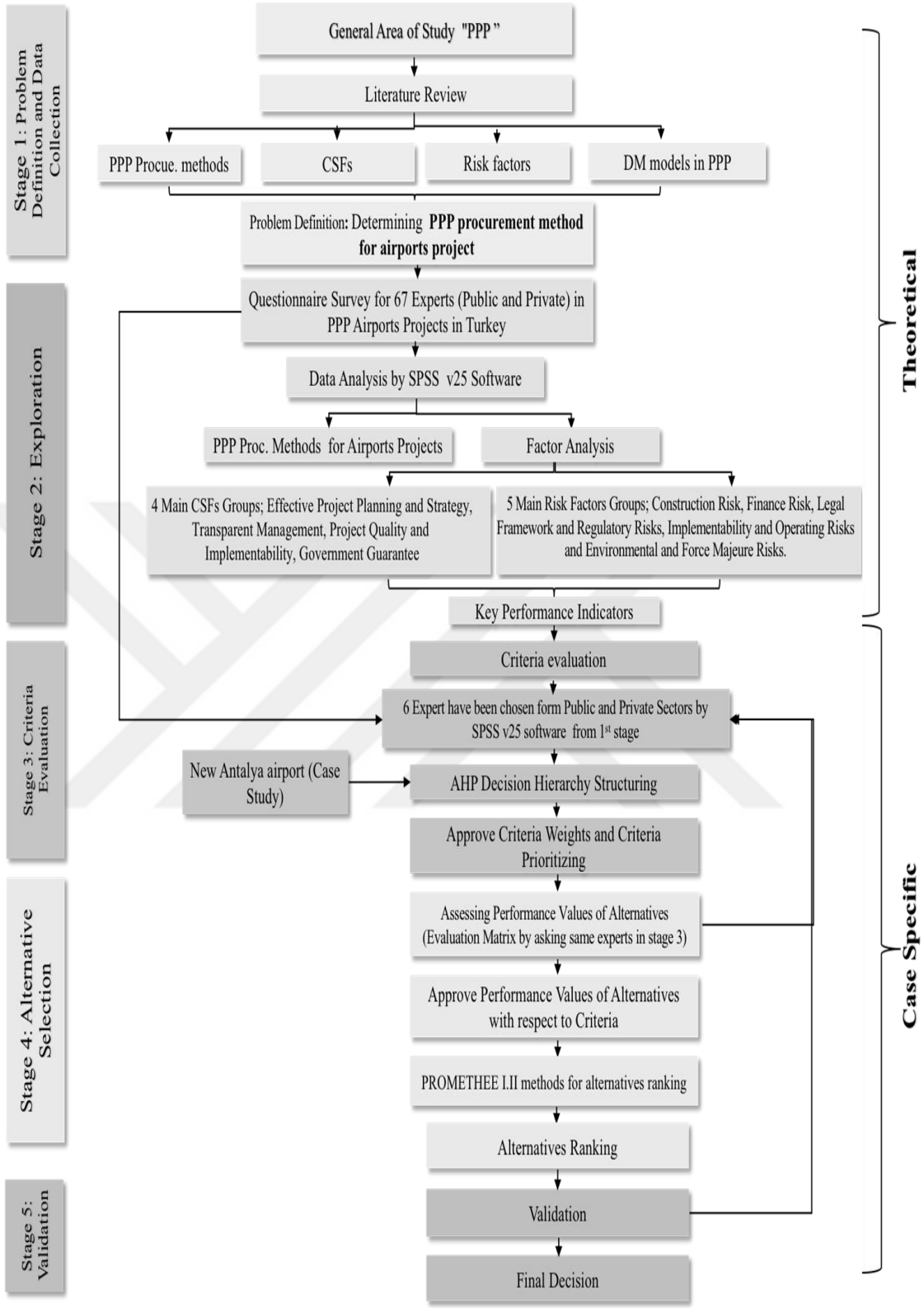
Best Regards

Ali Omar Ramadhan MOHAMMED
Ph.D. Candidate at Interior Architecture Department.
Cankaya University.
Tel: 05438618974
Email: c1488602@student.cankaya.edu.tr

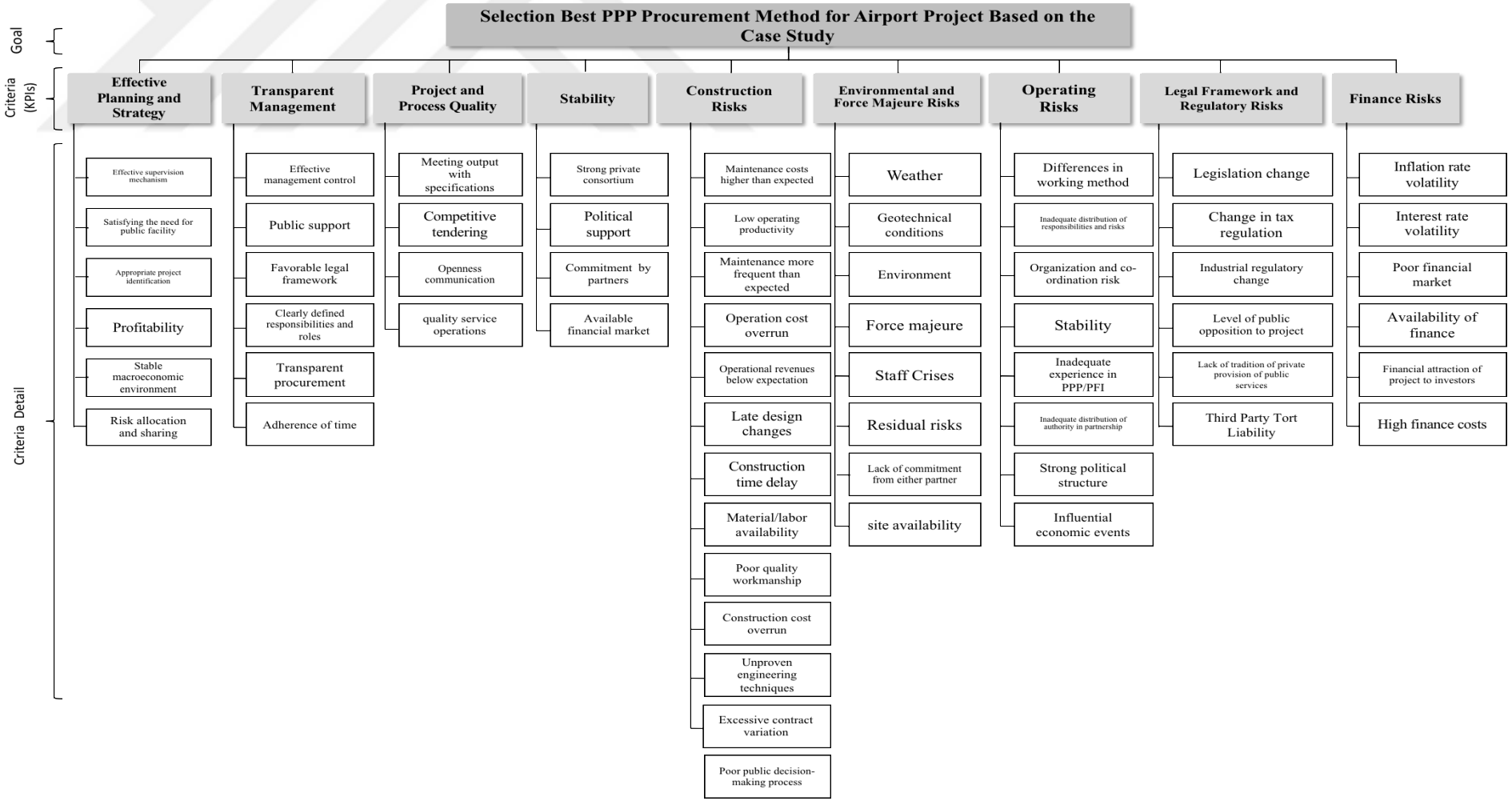
Name of participant: ..... Date: .....

Organization Name: ……
Department:……

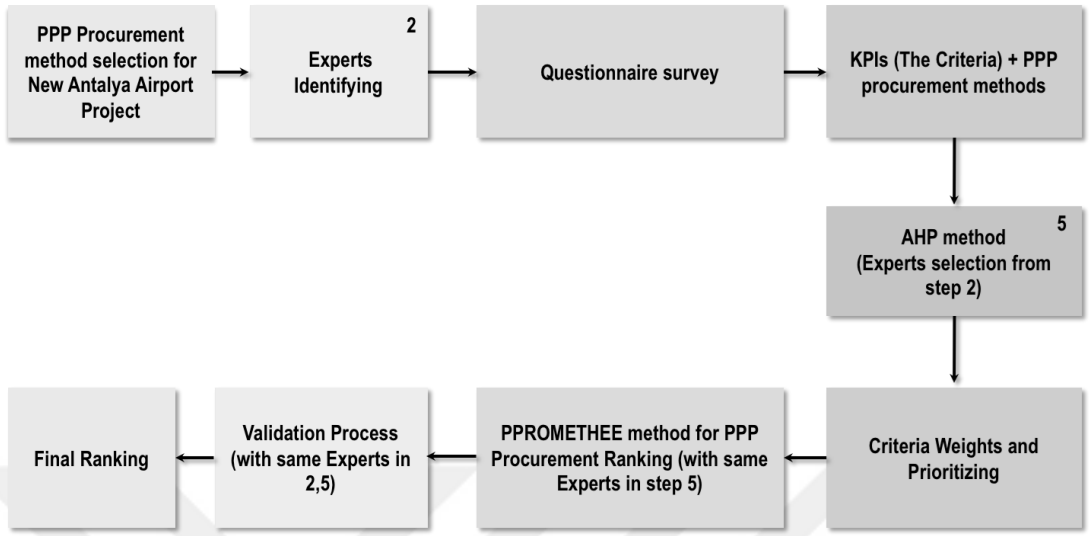
A. Proposed Research Methodology:


Stage 1: Problem Definition and Data Collection
Stage 2: Exploration
Stage 3: Criteria Evaluation
Stage 4: Alternative Selection
Stage 5: Validation
General Area of Study "PPP"
Literature Review
PPP Procue. methods
CSFs
Risk factors
DM models in PPP
Problem Definition: Determining PPP procurement method for airports project
Questionnaire Survey for 67 Experts (Public and Private) in PPP Airports Projects in Turkey
Data Analysis by SPSS v25 Software
PPP Proc. Methods for Airports Projects
Factor Analysis
4 Main CSFs Groups; Effective Project Planning and Strategy, Transparent Management, Project Quality and Implementability, Government Guarantee
5 Main Risk Factors Groups; Construction Risk, Finance Risk, Legal Framework and Regulatory Risks, Implementability and Operating Risks and Environmental and Force Majeure Risks.
Key Performance Indicators
Criteria evaluation
6 Expert have been chosen form Public and Private Sectors by SPSS v25 software from 1st stage
New Antalya airport (Case Study)
AHP Decision Hierarchy Structuring
Approve Criteria Weights and Criteria Prioritizing
Assessing Performance Values of Alternatives (Evaluation Matrix by asking same experts in stage 3)
Approve Performance Values of Alternatives with respect to Criteria
PROMETHEE I.II methods for alternatives ranking
Alternatives Ranking
Validation
Final Decision
Theoretical
Case Specific

B. Analytical Hierarchy Process (AHP) Structure.



C. Proposed Decision-Making Model:



D. Software's Used in This Research for analysis, Criteria Prioritizing and Alternatives Ranking:

A. SPSS V24: for questionnaire data analysis.

B. Expert Choice Software V 11.5: for criteria prioritizing and weight.

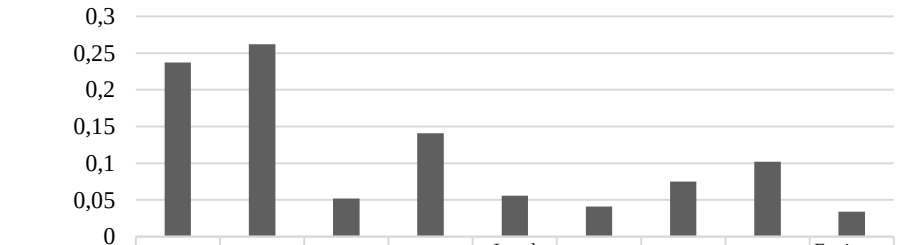
C. Visual PROMETHEE: software for alternatives ranking.

E. Main Research Results:

Table 1. Main Key Performance Indicators (Criteria) For PPP airports Projects:

KPIs (The Criteria)	Public Sector Ranking	Private Sector Ranking	Combined Ranking
Operation Risks	1	7	3
Finance Risks	2	2	1
Legal Framework and Regulatory Risks	3	6	5
Environmental and Force majeure Risks	4	9	9
Project Planning and Strategy	5	5	7
Project and Process Quality	6	3	4
Stability	7	1	2
Transparent Management	8	4	8
Construction Risk	9	8	6

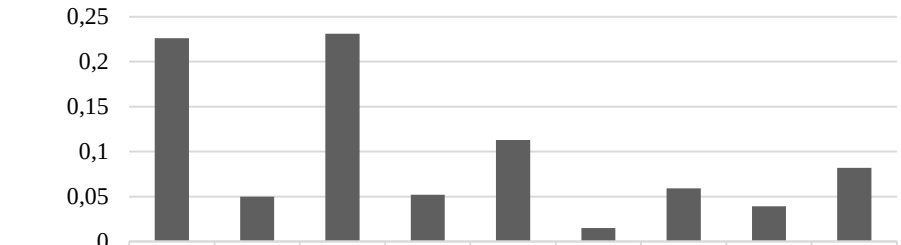
Figure 1. **Private** sector respondents prospective for criteria prioritizing



	Finance Risk	Stability	Operation Risks	Project and Process Quality	Legal Framework and Regulatory Risks	Construction Risks	Project Planning and Strategy	Transparent Management	Environmental and Force Majeure Risks
Private Sector	0,237	0,262	0,052	0,141	0,056	0,041	0,075	0,102	0,034

Overall Inconsistency = 0.03

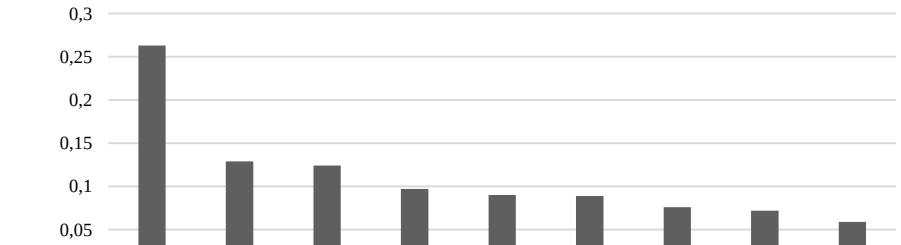
Figure 2. **Public** Sector respondents prospective for criteria prioritizing



	Finance Risk	Stability	Operation Risks	Project and Process Quality	Legal Framework and Regulatory Risks	Construction Risks	Project Planning and Strategy	Transparent Management	Environmental and Force Majeure Risks
Public Sector	0,226	0,05	0,231	0,052	0,113	0,015	0,059	0,039	0,082

Overall Inconsistency = 0.03

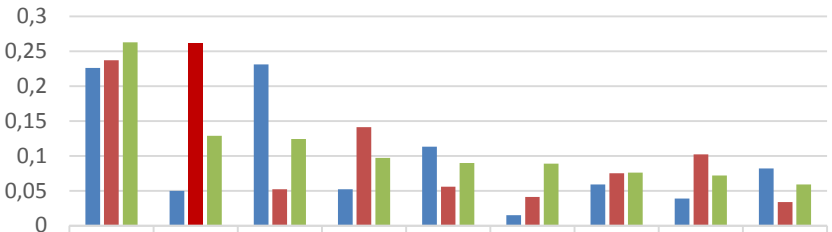
Figure 3. **Combined** respondents prospective for criteria priortizing



	Finance Risk	Stability	Operation Risks	Project and Process Quality	Legal Framework and Regulatory Risks	Construction Risks	Project Planning and Strategy	Transparent Management	Environmental and Force Majeure Risks
Combined	0,263	0,129	0,124	0,097	0,09	0,089	0,076	0,072	0,059

Overall Inconsistency = 0.02

Figure 4. **Comparison** between respondents prospective for criteria prioritzing



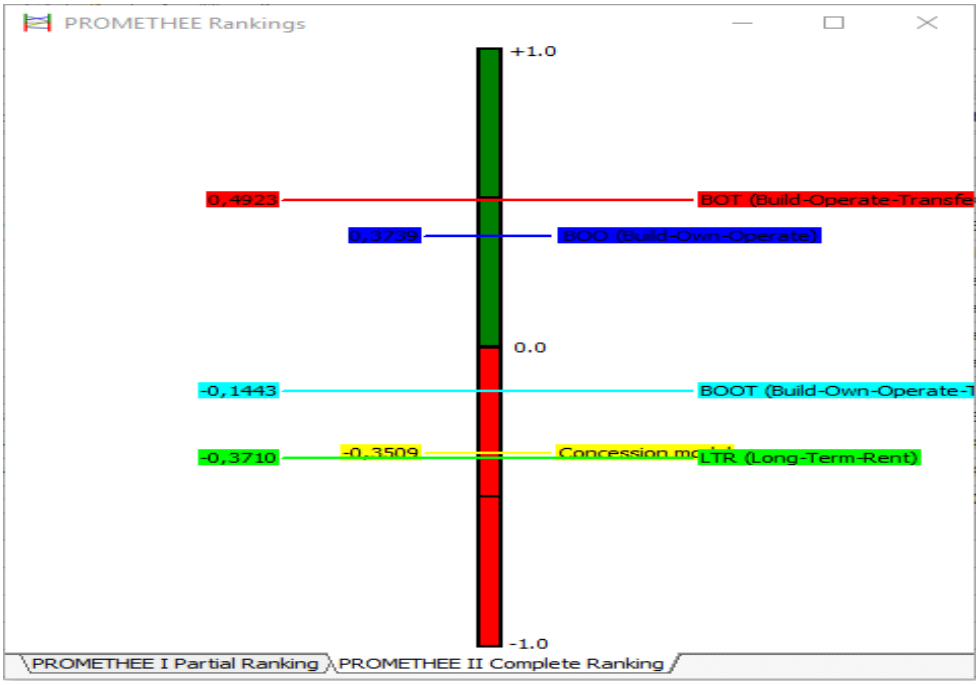
	Finance Risk	Stability	Operation Risks	Project and Process Quality	Legal Framework and Regulatory Risks	Construction Risks	Project Planning and Strategy	Transparent Management	Environmental and Force Majeure Risks
Public Sector	0,226	0,05	0,231	0,052	0,113	0,015	0,059	0,039	0,082
Private Sector	0,237	0,262	0,052	0,141	0,056	0,041	0,075	0,102	0,034
Combined	0,263	0,129	0,124	0,097	0,09	0,089	0,076	0,072	0,059

Overall Inconsistency = 0.02

F. PPP Models Ranking by PROMETHEE Method (Combined).

PROMETHEE Flow Table

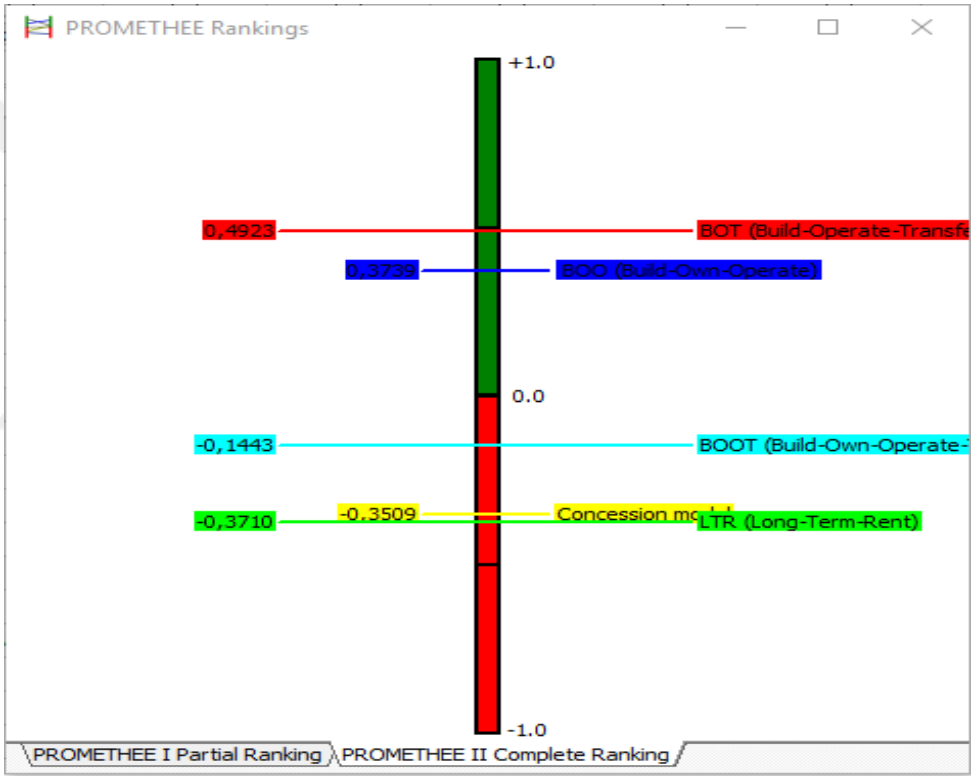
Rank	action	Phi	Phi+	Phi-
1	BOT	0,4923	0,5297	0,0374
2	BOO	0,3739	0,4349	0,0610
3	BOOT	-0,1443	0,2131	0,3574
4	Concession model	-0,3509	0,1279	0,4787
5	LTR (Long-Term-Rent)	-0,3710	0,1396	0,5107



G. PPP Models Ranking by PROMETHEE Method (Public Experts).

PROMETHEE Flow Table

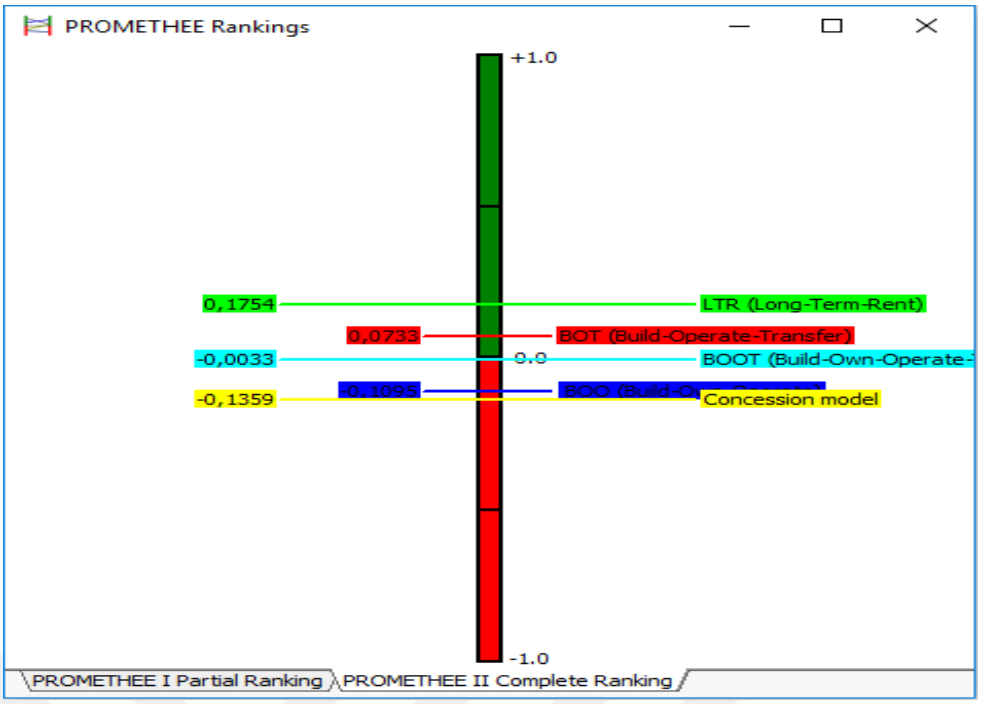
Rank	action	Phi	Phi+	Phi-
1	BOO	0,4829	0,4829	0,0000
2	BOT	0,4366	0,4597	0,0231
3	BOOT	0,1902	0,2980	0,1078
4	Concession model	-0,4409	0,0699	0,5108
5	LTR (Long-Term-Rent)	-0,6688	0,0243	0,6931



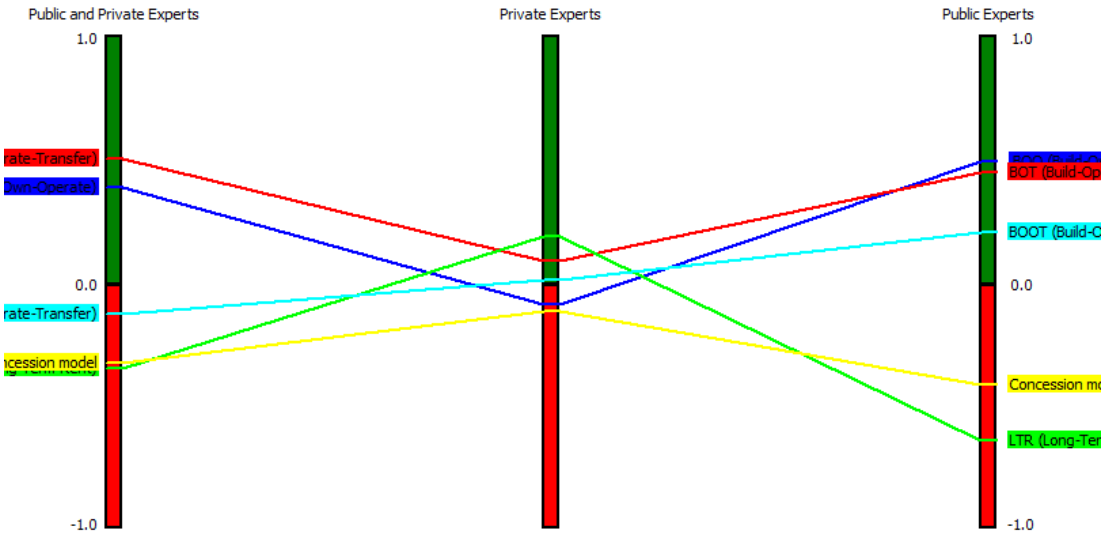
H. PPP Models Ranking by PROMETHEE Method (Private Experts).

PROMETHEE Flow Table

Rank	action	Phi	Phi+	Phi-
1	LTR (Long-Term-Rent)	0,1754	0,3823	0,2070
2	BOT	0,0733	0,2560	0,1827
3	BOOT	-0,0033	0,3672	0,3705
4	BOO	-0,1095	0,1829	0,2924
5	Concession model	-0,1359	0,1585	0,2944



İ. PPP Models Ranking by PROMETHEE Method (Public VS Private VS Public and Private).



J. From the results and the research process above, please verify the reliability of the proposed methodology, proposed Decision-Making Model and the outcomes of the research by filling the table below with grading (1- worst to 10- best).

Questions		Grade									
		1	2	3	4	5	6	7	8	9	10
1	Do you think that the proposed research methodology is an effective for PPP model selection?										
2	Do you think that the proposed research methodology can applied for other developing countries?										
3	Do you think that the proposed DM model has good applicability?										
4	Do the research study results reflect your personal prioritizing?										
5	Do you think that the research results are acceptable and logical?										
6	Do the PPP alternatives ranking reflect your prospective?										
7	Do you think that using MCDM methods for PPP model ranking are effective?										
8	How do you grade the overall of the research results?										

At the end of this research, I want to present my deep sense of gratitude and sincere thanks to you for your support, help and a nice hospitality, to be honest, I would have not been finishing my study without your help. I'm really appreciate that and thanks a lot

APPENDIX F: Risk allocation and Risk Factors in PPP projects Publication: 2005-2017

No	Title	Author / Date	Main Finding
1	A Proposal for Risk Allocation in Social Infrastructure Projects Applying PPP in Colombia	Lina María Sastoque, Carlos Alejandro Arboleda, Jose Luis Ponz, 2016	Responses demonstrate that the private sector has to assume natural risks, financial risks, macroeconomic indicators risks, construction risks, and operational risks, while, the public sector has to assume the social risks, selection project risk and political risks. Finally, the legal and legislation risks, residual risk, relationship risk should be shared by both sectors
2	A Fuzzy Approach for the Allocation of Risks in Public–Private Partnership Water-Infrastructure Projects in Developing Countries	Ernest Effah Ameyaw, and Albert P. C. Chan, 2016	It is possible to effectively distribute risks between the public–private parties based on fuzzy-set theory, RAC, and qualitative expert knowledge
3	Evaluation and ranking of risk factors in public–private partnership water supply projects in developing countries using fuzzy synthetic evaluation approach	Effah Ernest Ameyaw , Albert P.C. Chan, 2015	The fuzzy analysis, overall, confirmed that financial/commercial risk category is the most critical principal factor, followed by legal and socio-political category and technical category
4	The effect of institutional factors on public–private partnership success in ports	Photis M. Panayides , Francesco Parola , Jasmine Siu Lee Lam, 2015	Regulatory quality, Market openness, Ease to start a business and Enforcing contracts' are important institutional determinants of port PPP success.
5	Cross-country comparisons of key drivers, critical success factors and risk allocation for public-private partnership projects	Jui-Sheng Chou , Dinar Pramudawardhani, 2015	This study provides useful information for people seeking to invest in PPP projects, enabling them to enhance their understanding of key drivers, CSFs, and risk allocation in the researched countries.
6	Review of studies on the Critical Success Factors for PPP projects from 1990 to 2013	Robert Osei-Kyei , Albert P.C. Chan, 2015	The mostly identified CSFs are risk allocation and sharing, strong private consortium, political support, public support and transparent procurement
7	Risk allocation in public-private partnership water supply projects in Ghana	Effah Ernest Ameyaw and Albert P.C. Chan, 2015	The results show that it is appropriate to allocate risks according to both sectors' RM capability to manage them, using established RA principles and fuzzy set theory.
8	Effects of project governance structures on the management of risks in major infrastructure projects: A comparative analysis	Feng Guo , Yan Chang-Richards , Suzanne Wilkinson , Ti Cun Li, 2014	The research outcomes will inform the decision making among project stakeholders on establishing appropriate project governance arrangements in order to achieve target risk management outcome
9	Improving risk sharing and investment appraisal for PPP procurement success in large green projects	Khalid Almarri, Paul Blackwell 2014	Improve the risk simulation approach to improve the investment appraisal process through improving the type and quality of input variables

No	Title	Author / Date	Main Finding
10	Risk Identification and Assessment in Malaysian Public Private Partnership Projects	H. Sarvari, A. Valipour, N. Yahaya and N. Md Noor, 2014	The critical risks associated with the PPP projects include the third-party tort liability, interest rate volatility, construction cost overrun and the change in law
11	Identification and evaluation of risk allocation criteria and barriers: A Malaysian PPP project case study	Alireza Valipour, Farahbod Mohammadi, Nordin Yahya, Hadi Sarvari and Norhazilan Noor, 2014	Bear the risk at lower price, Control the chance of risk and Risk attitude are three major optimal risk allocation criteria
12	Research on the Effectiveness of Risk Sharing in the Management of Construction Contract	Yuhua AN and Jibao CHEN, 2014	The study provides an overview and information useful for the effective of risk sharing in construction contract management.
13	Assessment of Risk Allocation Criteria in Malaysian PPP Projects	Alireza Valipour, Hadi Sarvari, 2014	Bear the risk at lowest price, control the chance of risk and risk attitude are of three major optimal risk allocation criteria in Malaysian PPP project.
14	Risk allocation in a public–private partnership: a case study of construction and operation of kindergartens in Kazakhstan	Nikolai Mouravieva and Nada K. Kakabadseb, 2014	The most controversial element of risk allocation, as the study finds, is a revenue stream that an operator is supposed to receive from the provision of services unrelated to childcare, as neither partner is able to mitigate this revenue risk.
15	Public private partnership projects in Singapore: Factors, critical risks and preferred risk allocation from the perspective of contractors	Bon-Gang Hwang , Xianbo Zhao , Mindy Jiang Shu Gay, 2013	23 risk factors are indicated
16	Risk identification for PPP waste-to-energy in centration projects in China	Jinbo Song , DanrongSong , XueqingZhang , YanSun, 2013	10 key risk factors have been identified through interviews, surveys and visits to some selected projects.
17	Multiobjective Optimization Approach for Risk Allocation in Public Private Partnership Projects: A Case Study of Malaysia	Valipour Alireza, Yadollahi Mohammadreza, Rosli Mohamad Zin, Nordin Yahaya and Norhazilan Md. Noor,2013	The decision making for risk allocation problem in public-private partnership (PPP) projects is a vital process which directly affects on time, cost and quality of the project.
18	Risk misallocation in public–private Partnership projects in china	Albert p. C. Chan, 2013	Corruption, Government's intervention, Government's reliability and Approval and permit, Immature juristic system and Land acquisition were found to contribute considerably to the prediction of project performance
19	Critical factors and risk allocation for PPP policy: Comparison between HSR and general infrastructure projects	Jui-Sheng Chou , H.PingTserng , ChiehLin , Chun-PinYeh, 2012	This study provides a valuable reference for stakeholders interested in executing HSR via PPP, details at the article

No	Title	Author / Date	Main Finding
20	Risk Allocation in Public–Private Partnership Infrastructure Projects in Developing Countries: Case Study of the Tehran–Chalus Toll Road	Gholamreza Heravi, M.ASCE1; and Zeinab Hajihosseini, 2012	Authors identify the most important risks and they suggest ways to improve risk allocation to achieve better project performance for this and other PPP projects in developing countries
21	Fuzzy adaptive decision making model for selection balanced risk allocation	Garshasb Khazaeni , Mostafa Khanzadi, Abas Afshar, 2011	DMM for proper risk allocations by using fuzzy logic and AHP method.
22	Empirical Study of Risk Assessment and Allocation of Public-Private Partnership Projects in China	Albert P. C. Chan; John F. Y. Yeung; Calvin C. P. Yu; Shou Qing Wang; and Yongjian Ke	The private sector preferred to retain the principal risks within the specific project risk category, especially construction, operation, and relationship risks, in addition to economic risks within systematic risk category The remaining risk, environment risk, is preferred to be shared between the two sectors
23	Modelling optimal risk allocation in PPP projects using artificial neural networks	Xiao-Hua Jin , Guomin Zhang 2011	ANN models are satisfactory for modelling risk allocation decision-making process
24	Equitable risks allocation of projects inside China: analyses from Delphi survey studies	Yongjian Ke, ShouQing Wang, Albert P.C. Chan, 2011	The findings in this study are hence important to investors for a better understanding of the risks of PPP projects in China
25	Equitable Risk Allocation in Chinese Public–Private Partnership Power Projects	Yongjian Ke, ShouQing Wang, and Albert P. C. Chan, 2011	Change in law, Competition and Organization and coordination risk had different allocations.
26	Preferred risk allocation in China's public–private partnership (PPP) projects	Yongjian Ke , ShouQing Wang , Albert P.C. Chan , Patrick T.I. Lam, 2010	12 other risks related to government or government officials and their actions. 14 risks which neither the public nor private sector may be able to deal with them alone are preferred to be shared equally. The private sector would take 10 risks that are at the project level
27	Risk allocation in public-private partnership (ppp) project: a review on risk factors	Nur Alkaf Abd Karim, 2011	10 RFs groups namely: Political, Construction, Legal, Economic, Operation, Market, Project selection, Project finance, Relationship and Natural factor. Result shows that the highest score frequency factors are change in law, delay in project approvals & permits and land acquisition.
28	Risk perception analysis: Participation in China's water PPP market	Jae-ho Choi , Jinwook Chung , Doo-Jin Lee, 2010	The revocation of fixed return policy, current low level of water prices and its difficulty of adjustment are the most significant risks
29	Developing a Fuzzy Risk Allocation Model for PPP Projects in China	Yelin Xu; Albert P. C. Chan; and John F. Y. Yeung, 2010	23 principles and influencing factors for risk allocation were identified through a comprehensive literature review.
30	Risk Allocation in Public-Private Partnership Infrastructure Projects: Comparative Study	Yongjian Ke; ShouQing Wang; and Albert P. C. Chan, 2010	Difference in Risk Allocation Preferences among China, Hong Kong, U.K., and Greece have been identified and explained by detail in the article.

No	Title	Author / Date	Main Finding
31	Determinants of Efficient Risk Allocation in Privately Financed Public Infrastructure Projects in Australia	Xiao-Hua Jin, 2010	Risks are shared between the parties
32	Neurofuzzy Decision Support System for Efficient Risk Allocation in Public-Private Partnership Infrastructure Projects	Xiao-Hua Jin, 2010	A neurofuzzy decision support system NFDSS to assist in the risk allocation decision-making process in PPP projects.
33	The rule and method of risk allocation in project finance	Wu Shen-fa, Wei Xiao-ping, 2009	-
34	Risk Allocation in Public-Private Partnership Projects – An Innovative Model with an Intelligent Approach	Xiao-Hua JIN and Hemanta DOLOI 2011	DMM have proposed for generating an optimal risk allocation strategy in PPP projects in order to develop effective risk allocation strategies.
35	Public–private partnership projects in Greece: risk ranking and preferred risk allocation	Athena roumboutsos & konstantinos p. Anagnostopoulos, 2008	Risk factors are listed in the article
36	Interpreting risk allocation mechanism in public–private partnership projects: an empirical study in a transaction cost economics perspective	Xiao-Hua Jin and Hemanta Doloi 2008	partners' risk management routine, mechanism, commitment, cooperation history, and uncertainties associated with project risk management could serve to determine the risk allocation strategies adopted in a PPP project
37	Modelling risk allocation decision in construction contracts	K.C. Lam , D. Wang, Patricia T.K. Lee, Y.T. Tsang, 2007	Seven risk allocation criteria and a set of knowledge-based fuzzy inference rules are established according to the expert knowledge.
38	Risk allocation in the private provision of public infrastructure	A. Ng, Martin Loosemore, 2007	-
39	Good project governance for proper risk allocation in public–private partnerships in Indonesia	Martinus P. Abednego , Stephen O. Ogunlana, 2006	Results detail in the article, proper risk allocation in tall way projects
40	Role of public private partnerships to manage risks in public sector projects in Hong Kong Case study	Li-Yin Shen , Andrew Platten , X.P. Deng, 2006	Public site acquisition risk, legal and policy risks Private design and construction risks, operation risks, industrial action risks. Shared development risks, market risks, financial risks, and force majeure
41	The importance and allocation of risks in Indonesian construction projects	ANDI, 2005	
42	The allocation of risk in PPP/PFI construction projects in the UK	Li Bing a, A. Akintoye , P.J. Edwards , C. Hardcastle, 2005	Categorized catalogue of PPP/PFI project risk factors are listed in the article

APPENDIXES G: CSFs of PPP Review study results 2000-2018

No	CSF for PPPs	Repetition	Sources
1	Risk allocation and sharing	18	(Osei-kyei & Chan, 2015; Chou & Pramudawardhani, 2015; G. Aerts et al, 2014; E. Cheung, Chan & Kajewski, 2012; S. O. Babatunde & A. Opawole,2012; C. Jacobson and S. O. Choi, 2008; D. Jamali, 2004; W. Wen-Xiong et al, 2007; L. Qiao et al, 2001; X. Zhang & M.ASCE, 2005; X. Meng, Q. Zhao & Q. Shen, 2011; Aziz &M.ASCE1, 2007; E. Cheung, 2012; Effah & Ameyaw, 2017; Osei-Kyei & Chan, 2016; Sanni, 2016; Al-Saadi & Albdou, 2016; Sungmin et al, 2015)
2	Strong private consortium	14	(Osei-kyei & Chan, 2015; Chou & Pramudawardhani, 2015; G. Aerts et al, 2014; E. Cheung, Chan & Kajewski, 2012; S. T. Ng et al, 2012; M. Alhashemi et al, 2008; D. Jamali, 2004; M. Jefferies, 2006; M. Jefferies, R. Gameson & S. Rowlinson, 2002; X. Zhang & M.ASCE, 2005; E. E. Ameyaw &Chan, 2016; Edwards et al, 2001; Effah et al, 2016)
3	Available financial market	14	(G. Aerts et al, 2014; S. T. Ng et al, 2012; S. O. Babatunde & A. Opawole,2012; D. Jamali, 2004; B. li, Akintoye, 2004; W. Wen-Xiong et al, 2007; M. Jefferies, 2006; L. Qiao et al, 2001; X. Zhang & M.ASCE, 2005; A. Wibowo &H. W. Alfen, 2014; Aziz &M.ASCE1, 2007; E. Cheung, 2012; Edwards et al, 2001; S. Ismail, 2013; Cheng et al,2000; Mudi, 2016)
4	Commitment made by partners	13	(Chou & Pramudawardhani, 2015; C. Jacobson and S. O. Choi, 2008; A. P. C. Chan et al, 2010; E. E. Ameyaw &Chan, 2016; A. Wibowo &H. W. Alfen, 2014; Aziz &M.ASCE1, 2007; E. Cheung, 2012; S. Ismail, 2013; Effah et al, 2016; Sungmin et al, 2015)
5	Transparent procurement	11	(Osei-kyei & Chan, 2015; Chou & Pramudawardhani, 2015; T. Liu, Wang & Wilkinson, 2016; G. Aerts et al, 2014; E. Cheung, Chan & Kajewski, 2012; S. T. Ng et al, 2012; S. O. Babatunde & A. Opawole,2012; B. li, Akintoye, 2004; A. P. C. Chan et al, 2010; S. O. Babatunde et al, 2016; Aziz &M.ASCE1, 2007; Mudi, 2016)
6	Political support	9	(Osei-kyei & Chan, 2015; S. O. Babatunde & A. Opawole,2012; C. Jacobson and S. O. Choi, 2008; M. Alhashemi et al, 2008; B. li, Akintoye, 2004; L. Qiao et al, 2001; B. Zagozdzon, 2016; Osei-Kyei & Chan, 2017; Sanni, 2016)
7	Favorable legal framework	9	(Chou & Pramudawardhani, 2015; T. Liu, Wang & Wilkinson, 2016; S. O. Babatunde & A. Opawole,2012; W. Wen-Xiong et al, 2007; M. Jefferies, 2006; B. Zagozdzon, 2016; Aziz &M.ASCE1, 2007; E. Cheung, 2012; S. Ismail, 2013; Al-Saadi & Albdou, 2016)

APPENDIX H: Population Sample for the Questionnaire Survey.

Objective Peoples in the Questionnaire Survey on: The Critical Success Factors and Risk Factors for Public-Private Partnerships Transportation Projects 'Airports' in Developing Countries – Turkey''

1. Public Sector (Governments Ministries Turkey - Ankara):

No	Place (E/T)	Department / Note	Date of Distributed	Date of Received	Distributed	Received
1	DHMI Transport Ministry of Maritime and Communication General Directorate	Strategy office	3/8/2017	11/8/2017 8/9/2017	31	7
		(Civil Engineering Department) Inssat Emlak Dairesi Baskanligi	21/8/2017	8/9/2017 15/9/2017	15	10
		(Isleme Dairesi Baskanligi) Airport operations KOI (Kamu ozel isbirligi) Bolumu PPP Department	21/8/2017	8/9/2017 12/9/2017	10	8
2	Türkiye Cumhuriyeti Kalkinma Bakanliği (Ministry of Development)	Monitoring and evaluation department of PPP	23/8/2017	26/8/2017 8/9/2017 12/9/2017	10	7
3	Ministry of Transport and Maritime Affairs	They told me that, they are not interested in this area of study	7/8/2017	Friday 11/8/2017 11:00	30	1
4	hazine müsteşarlığı (Ministry Undersecretariat of Treasury)	-	7/8/2017	9/9/2017 12/9/2017	10	-
5	T. C. Ekonomi Bakanligi (Ministry of Economy)	Department for overseas contracting and engineering consultancy services	9/8/2017	8/9/2017 15/9/2017	35	8

2a - Companies in Ankara:

No	Company Name	Date of Submission/ Contact	No. of the Questionnaire		Company Address
			Distributed	**Collecting**	
1	Astaldi	20/9/2017	1	-	Ankara - Turkey
2	Aydeniz	20/9/2017	1	-	Ankara - Turkey
3	Cengiz	18/9/2017	5	2	Ankara - Turkey
4	Ic İçtaş Construction	21/9/2017	3	-	Ankara - Turkey
5	Kolin Ankara	19/9/2017	6	-	Ankara - Turkey
6	Onur Contracting Transportation Construction	29/9/2017	7	1	Ankara - Turkey
7	Tav	10/9/2017	1	1	Ankara - Turkey
8	Yda İnşaat Sanayi Ve Ticaret A.Ş.	19/9/2017	5	3	Ankara - Turkey
9	Bayburt Group	13/9/2017	3	2	Ankara - Turkey
10	Ronesas Holding	16/9/2017	6	2	Ankara - Turkey
11	Turkerler Holding	27/9/2017	2	2	Ankara - Turkey

2b - Companies in Istanbul:

No	Company Name	Date of Submission/ Contact	No. of the Questionnaires		Address
			Distributed	**Collecting**	
1	Makyol	5/10/2017	1	1	İstanbul - Turkey
2	Astaldi	29/9/2017 - 18/10/2017	1	-	İstanbul - Turkey
3	Kalyon Construction	4/10/2017-18/10/2017	1	1	İstanbul - Turkey
4	Limak Construction Industry	4/10/2017	4	4	İstanbul - Turkey
5	Cengiz	5/10/2017 - 18/10/2017	4	1	İstanbul - Turkey
6	İGA	4/10/2017	1	1	İstanbul - Turkey
7	Kolin Istanbul	4/10/2017	6	4	İstanbul - Turkey

APPENDIX VI: Review for Decision making models for public-private partnership projects article.

No	Title / year	Study aims	DM model	Methodology	Ref.
1	Pavement Maintenance–Focused Decision Analysis on Concession Periods of PPP Highway Projects - 2018	Providing a methodology to help either the public sector or the private investor evaluates concession decision-making by addressing pavement maintenance of the PPP highway project	A system dynamics (SD) model	Case study.	[171]
2	A Fuzzy-Based Evaluation of Financial Risks in Build–Own–Operate–Transfer Water Supply Projects - 2017	To identify and assess the critical financial risks associated with BOOT water supply projects and evaluate the financial risk level of the NSDP project.	Fuzzy technique “A fuzzy synthetic evaluation”	Questionnaire survey method	[172]
3	A Fuzzy Comprehensive Evaluation Model for Sustainability Risk Evaluation of PPP Projects - 2017	To evaluate the sustainability risk of PPP projects.	Mathematical model based on the method of fuzzy comprehensive evaluation model (FCEM)	Questionnaire survey method	[173]
4	A Hybrid Model Based on Fuzzy Approach Type II to Select Private Sector in Partnership Projects - 2017	To introduce a hybrid model for evaluation and selection of the private sector for partnership projects.	An integrated SWOT , Fuzzy VIKOR method.	Case Study	[174]
5	Financial risk assessment and modelling of PPP based Indian highway infrastructure projects - 2017	To investigates financial risk associated with highway infrastructure projects.	Net Present Value (NPV)-at-risk model tool which uses Monte Carlo Simulation	Case study	[175]
6	Public-Private Partnerships for Energy Efficiency Projects: A Win-Win Model to Choose the Energy Performance Contracting structure - 2017	To choose the EPC structure which ensures that interests of the two parties.	A computational model for assessing and benchmarking the different Energy Performance Contracting (EPC) structures.	Case study	[176]
7	Using bargaining-game model to negotiate compensation for the early termination of BOT highway projects - 2017	To evaluate the compensation amount for projects with incomplete contracts using game theory.	The bargaining-game model for compensation negotiation	Case Study	[177]

No	Title / year	Study aims	DM model	Methodology	Ref.
8	Optimizing an Equity Capital Structure Model for Public–Private Partnership Projects Involved with Public Funds - 2017	To facilitate relevant decision-making for both private and public sector.	Genetic Algorithm Method + Monte Carlo Simulation	Case study	[178]
9	A negotiation decision model for public–private partnerships in brownfield redevelopment - 2016	To investigate how the negotiation process in brownfield redevelopment projects can be improved by providing an understanding of the characteristics of a brownfield area and the interaction between the parties involved	Hybrid negotiation model	Reconstructed case study and fuzzy Delphi method (FDM)	[179]
10	A model for determining the optimal project life span and concession period of BOT projects - 2016	Determining the optimal build-operate-transfer (BOT) project life span and concession period endogenously and interdependently by maximizing the combined benefits of stakeholders	New quantitative model consists from any steps	Case study	[180]
11	A new method for two-sided matching decision making of PPP projects based on intuitionistic fuzzy choquet integral- 2016	To constructed a bilateral matching satisfaction index system for the PPP project at both the government and enterprise levels, and established the matching satisfaction judgment matrices of the two sides via intuitionistic fuzzy numbers.	Two-sided matching decision model based on intuitionistic fuzzy Choquet integral	Case study.	[181]
12	An integrated ecosystem model for understanding infrastructure PPPs 2016	To build a more holistic yet comprehensible framework that links these three levels to better understand PPPs especially in the context of infrastructure projects.	An integrated ecosystem model	infrastructure PPP projects	[183]
13	A System Dynamic Model – based Model for Making Decision to Run PPP Projects in Malaysia - 2016	To make decision faster when determining Building Lease Charges and facilitate the process of making decision.	System Dynamic Model (SDM)	Case study	[184]
14	Applying the choosing by advantages method to select the optimal contract type for road maintenance - 2015	Selecting the optimal contract type for road maintenance	Using the choosing by advantages analysis CBA	A literature review and an empirical analysis.	[185]

No	Title / year	Study aims	DM model	Methodology	Ref.
15	Waste Management Model Associated with Public-Private Partnership in Hamilton, Ontario, Canada - 2015	Developing Waste Management Model Associated with Public-Private Partnership in Hamilton, Ontario, Canada.	A waste management model associated with public-private partnerships (WMMPPP)	Case Study	[186]
16	Best practice for financial models of PPP projects - 2015	To use utilizing financial model as a tool for project evaluation and negotiation is highlighted in this study	financial models	structured questionnaire survey	[182]
17	An integrated method for ranking of risk in BOT projects - 2014	To rank the risks based on their severity and effect on project objectives	Proposed BOT project risk ranking model; namely Fuzzy TOPSIS and Fuzzy SAW.	Modeling	[187]
18	An alternative incomplete information bargaining model for identifying the reasonable concession period of a BOT project - 2014	To identify the reasonable concession period of a BOT project by utilizing incomplete information bargaining analysis	A hypothetical case from existing studies	Case study	[188]
19	Development of a Conceptual Critical Success Factors Model for Construction Projects: a Case of Lithuania - 2013	To develop a conceptual critical success factors model for construction projects in Lithuania	Conceptual CSFs Model	Case Study Construction Projects in Lithuania	[189]
20	System Dynamics (SD) -based concession pricing model for PPP highway projects - 2012	to develop a reliable, objective, and systematic model for determining a rational concession price for PPP highway projects.	System Dynamics (SD) -based concession pricing model Case-based Reasoning (CBR) technique	Case Study real toll tunnel project located in China	[190]
21	Two-stage Decision-making Method of PPP Project Model Selection - 2012	To select an appropriate PPP model for a specific public project.	Two-stage Decision-making Method	Case Study	[191]
22	Modelling optimal risk allocation in PPP projects using artificial neural networks (ANN) - 2011	To establish, train, validate, and test artificial neural network (ANN) models for modelling risk allocation decision-making process in (PPP) projects.	artificial neural networks (ANN)	questionnaire survey	[192]
23	Risk identification and assessment for build–operate–transfer projects: A fuzzy multi attribute decision making model - 2010	To understand risks in BOT projects and to develop a model for analyzing them.	Fuzzy Multi Attribute Decision Making (FMADM)	Case Study Iran BOT power plant project	[193]

APPENDIXES G: CSFs of PPP Review study results 2000-2018

No	Title / year	Study aims	DM model	Methodology	Ref.
24	A simulation model for optimizing the concession period of public–private partnerships schemes - 2007	To assist the public partner to determine an optimal concession period is proposed.	A simulation model	Simulation Model	[194]
25	A fuzzy simulation model for evaluating the concession items of public–private partnership schemes - 2007	To identify the concession period based on the expected investment and tariff regime.	Fuzzy multi-objective decision model	Simulation and fuzzy comprehensive evaluation	[195]
26	Traffic revenue risk management through Annuity Model of PPP road projects in India - 2006	This paper discusses the contractual and risk allocation framework of Annuity based PPP model.	Annuity Model of PPP	Case Study	[196]
27	A decision-making model for infrastructure projects selection in developing countries - 2005	To investigate and analyse the current state of the process of selecting projects. To investigate possible ways of integrating concepts and techniques from different disciplines into a model to improve the selection of investment projects in engineering. To produce a model which allows the effective selection of projects incorporating different evaluation techniques.	Satisfying heuristics model: Multiple Criteria Decision Making (MCDM):	Case Study	[197]

No	CSF for PPPs	Repetition	Sources
1	Risk allocation and sharing	18	(Osei-kyei & Chan, 2015; Chou & Pramudawardhani, 2015; G. Aerts et al, 2014; E. Cheung, Chan & Kajewski, 2012; S. O. Babatunde & A. Opawole,2012; C. Jacobson and S. O. Choi, 2008; D. Jamali, 2004; W. Wen-Xiong et al, 2007; L. Qiao et al, 2001; X. Zhang & M.ASCE, 2005; X. Meng, Q. Zhao & Q. Shen, 2011; Aziz &M.ASCE1, 2007; E. Cheung, 2012; Effah & Ameyaw, 2017; Osei-Kyei & Chan, 2016; Sanni, 2016; Al-Saadi & Albdou, 2016; Sungmin et al, 2015)
2	Strong private consortium	14	(Osei-kyei & Chan, 2015; Chou & Pramudawardhani, 2015; G. Aerts et al, 2014; E. Cheung, Chan & Kajewski, 2012; S. T. Ng et al, 2012; M. Alhashemi et al, 2008; D. Jamali, 2004; M. Jefferies, 2006; M. Jefferies, R. Gameson & S. Rowlinson, 2002; X. Zhang & M.ASCE, 2005; E. E. Ameyaw &Chan, 2016; Edwards et al, 2001; Effah et al, 2016)
3	Available financial market	14	(G. Aerts et al, 2014; S. T. Ng et al, 2012; S. O. Babatunde & A. Opawole,2012; D. Jamali, 2004; B. li, Akintoye, 2004; W. Wen-Xiong et al, 2007; M. Jefferies, 2006; L. Qiao et al, 2001; X. Zhang & M.ASCE, 2005; A. Wibowo &H. W. Alfen, 2014; Aziz &M.ASCE1, 2007; E. Cheung, 2012; Edwards et al, 2001; S. Ismail, 2013; Cheng et al,2000; Mudi, 2016)
4	Commitment made by partners	13	(Chou & Pramudawardhani, 2015; C. Jacobson and S. O. Choi, 2008; A. P. C. Chan et al, 2010; E. E. Ameyaw &Chan, 2016; A. Wibowo &H. W. Alfen, 2014; Aziz &M.ASCE1, 2007; E. Cheung, 2012; S. Ismail, 2013; Effah et al, 2016; Sungmin et al, 2015)
5	Transparent procurement	11	(Osei-kyei & Chan, 2015; Chou & Pramudawardhani, 2015; T. Liu, Wang & Wilkinson, 2016; G. Aerts et al, 2014; E. Cheung, Chan & Kajewski, 2012; S. T. Ng et al, 2012; S. O. Babatunde & A. Opawole,2012; B. li, Akintoye, 2004; A. P. C. Chan et al, 2010; S. O. Babatunde et al, 2016; Aziz &M.ASCE1, 2007; Mudi, 2016)
6	Political support	9	(Osei-kyei & Chan, 2015; S. O. Babatunde & A. Opawole,2012; C. Jacobson and S. O. Choi, 2008; M. Alhashemi et al, 2008; B. li, Akintoye, 2004; L. Qiao et al, 2001; B. Zagozdzon, 2016; Osei-Kyei & Chan, 2017; Sanni, 2016)
7	Favorable legal framework	9	(Chou & Pramudawardhani, 2015; T. Liu, Wang & Wilkinson, 2016; S. O. Babatunde & A. Opawole,2012; W. Wen-Xiong et al, 2007; M. Jefferies, 2006; B. Zagozdzon, 2016; Aziz &M.ASCE1, 2007; E. Cheung, 2012; S. Ismail, 2013; Al-Saadi & Albdou, 2016)

APPENDIX I:

CURRICULUM VITAE

PERSONAL INFORMATION

Surname, Name: Ali Omar Ramadhan MOHAMMED

Date and Place of Birth: 24 March 1973, ALBAYIDHA

Marital Status: Married

Phone: +90 5438618974

Email: c1488602@student.cankaya.edu.tr, aligalied@yahoo.co.uk

EDUCATION

Degree	Institution	Year of Graduation
M.Sc.	University Putra Malaysia, Faculty of Civil Engineering, Structural Engineering & Construction	2006
B. Sc	Engineering Academy Tajoura, Faculty of Civil Engineering, Structural Engineering & Construction	1997
High School	Alfateh High School, ALBAYIDHA	1992

WORK EXPERIENCE

Year	Place	Enrollment
2014 - Present	Çankaya Univ. The Graduate School of Natural and Applied Science	Ph.D. student
2011 - 2013	Engineering Academy Tajoura	Head of CED
2007 - 2011	Engineering Academy Tajoura	Lecturer
1997 - 2007	Engineering Academy Tajoura	Teaching Assistance

LANGUAGE SKILLS

- Arabic-Mother Language.
- English (reading, written & speaking).

COMPUTER SKILLS

- Microsoft Office Programs, (Word, Excel, and PowerPoint).
- SPSS Program
- Decision Making Methods (AHP + PROMETHEE)

PUBLICATIONS

- Ali MOHAMMED & W. S. Masoud (2010). Effect of external prestressing on box beams subjected to combined load, snaping and strengthening. International conference on Advances in civil engineering ACE 2010, Trivandrun, India.

- Ali MOHAMMED & Timuçin HARPUTLUGIL (2017). Conceptual Framework for a Decision-Making Model Based on Analytic Hierarchy Process (AHP) To Choose the Best Public Private Partnership (PPP) Model for Airports. International Conference on Civil Engineering, Construction Management & Structural Design (CCS 2017).

HOBBIES

Travelling, Football and Swimming.