PUBLIC – PRIVATE PARTNERSHIP: APPLICATION OF ANALYTIC HIERARCHY PROCESS (AHP) AND MULTI ATTRIBUTE UTILITY THEORY (MAUT) IN SELECTION FOR PRIVATE PARTNERS IN SAUDI ARABIA FOR HOUSING PROJECTS

BY

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Table of Contents

List of Figures

List of Tables

Abbreviations

AHP	Analytic Hierarchy Process
BBO	Buy-Build-Operate
BDO	Build-Develope-Operate
BLOT	Build-Lease-Operate-Transfer
BOO	Build-Own-Operate
BOOT	Build-Own-Operate-Transfer
BOT	Build-Operate-Transfer
BROT	Build-Rent-Own-Transfer
CCPPP	Canadian Council for Public-Private Partnership
CI	Consistency Index
CMSM	Construction Method Selection Model
CR	Consistency Ratio
DCMF	Design-Construct-Manage-Finance
FANP	Fuzzy Analytic Network Process
GDP	Gross Domestic Product
HM	Her Majesty
IMF	International Monetary Fund
IPPR	Institute for Public Policy Research
KSA	Kingdom of Saudi Arabia
LDO	Lease-Develop-Operate
MAUT	Multi Attribute Utility Theory
MCDM	Multi-Criteria Decision Making
MIVES	Integrated Value Model for Sustainable Assesment
N	The population size
n	The sample size

NCP	National Center for Privatization/Public Private Partnership
NHC	National Housing Company
no	First estimate of sample size
p	The proportion of the characteristic being measured in the target population
P3 or 3P	Public-Private Partnership
PDA	Preference Degree Approach
PFI	Private-Finance Initiative
PFP	Privately-Financed Projects
PPI	Private-Participation in Infrastructure
PPP	Public-Private Partnerhip
PSB	Public Sector Benchmark
PSC	Public Sector Comparator
PSP	Private-Sector Particiaption
RI	Random Index
SMART	Simple Multi-Attrubute Rating Technique
TBL	Triple Bottom Line
TOPSIS	Technique for Order of Preference by Similarity to Ideal Solution
USA	United States of America
USD	United States Dollars
V	The maximum percentage of standard error allowed
VFM	Value for Money
WAA	Wrap-Around-Addition

ABSTRACT

Full Name : Abdullah Khalid Abdelgafour Abdullah

Thesis Title : Public – Private Partnership: Application of Analytic Hierarchy Process (AHP) and Multi Attribute Utility Theory (MAUT) in Selection for Private Partners in Saudi Arabia for Housing Projects

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The Saudi Arabia market is considered one of the pioneering market in the area. Recently the country has declared its 2030 vision in an attempt to achieve sustainability for the nation. This transition the country is taking will strengthen the private sector role within the country. Public-Private Partnerships (PPP) agreements will be carried out for multiple industries. The housing industry is one of the targeted industries in the program. It has been reported that countries with less experience have reached up a combined 70 percent in PPP cancellations. Selection of the private partner is one of the crucial factors identified in the literature for PPP success. Currently the ministry of housing delegated the overseeing process to National housing company (NHC) and Wafi. As semi-government organizations, they are responsible for the selection of private partners for "Sakani" projects and monitoring the progress of the work. Their current published qualification requirements are not in depth. Furthermore, there is a noticeable lack of research conducted on selection of private partner for PPP contracts. Only 3 papers were found for infrastructure projects. Win housing projects in Saudi Arabia. This paper aims to present a model developed for selecting private partner for housing projects in Saudi Arabia using an Analytic Hierarchy Process (AHP) and the Multi Criteria Decision Making Technique (MCDMT). The developed model accounts for four criteria of selection: Financial (C1), Technical (C2), Managerial (C3), and Safety/Environment (C4). The criteria of selection were identified through a comprehensive literature review and meeting with local experts. AHP and MAUT were utilized to assess the significant influence of the identified main and sub-criteria on the selection process, from the owner point of view. An overview with an application of the developed model is conducted after sharing the model with a public sector representative. The obtained results show that Technical and Safety/Environment criteria are the most weighted criteria by the experts with a slight advance on the remaining criteria, Financial and Managerial criteria.

ملخص الرسالة

الاسم الكامل: عبد الله خالد عبد الغفور عبد الله

عنوان الرسالة: شراكة القطاع العام والخاص: تطبيق التحليل الهرمي في إختيار شريك القطاع الخاص للمشاريع السكنية في المملكة العربية السعودية

التخصص:هندسة وإدارة التشييد

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يعتبر السوق الخاص بالمملكة العربية السعودية من رواد الأسواق في المنطقة. حديثا الدولة قد أعلنت رؤيتها لسنة 2030 وذلك في جهود لتحقيق الإستدامة للبلد. هذه النقلة التي تخطوها الدولة سوف تقوي دور القطاع الخاص في الدولة. إتفاقيات الشراكات مابين القطاع العام والخاص سوف تقام على صناعات مختلفة. إلتزام بأربعة عشر عقد تحت مظلة الشراكة مابين القطاع العام والخاص سوف تقدم كجزء من برنامج التحول الوطني لسنة 2020 المقدم من المركز الوطني للتخصيص.قطاع الإسكان أحد القطاعات المستهدفة بالبرنامج. قد وجد بتقارير سابقة ان الدول بخبرة أقل قد وصلت نسبة إلغاء عقود الشراكة بنسبة 70 بالمئة. إختيار الشريك من القطاع الخاص من العوامل الأساسية لنجاح الشراكة من خلال النظر بالبحوث السابقة. حاليا منظمة " وافي"، منظمة نصف حكومية مسؤولة عن متابعة وأختيار الشركاء من القطاع الخاص للإسكان. منظمة وافي قد نشرت مجموعة من معايير التأهيل المتطلبة متطلبة من المتقدمين من القطاع الخاص للشراكة ولكن المؤهلات المنشورة لا تغطي جميع النواحي. غير عن ذلك، يوجد قلة بحوثات علمية منشورة تناقش إختيار الشريك الخاص بالشراكات مابين القطاعين. هذا البحث يهدف لتطوير نموذج لإختيار الشريك الخاص للمشاريع السكنية تحت نطاق الشراكة مابين القطاع العام والخاص. البحث يعتمد على إستبيانات تسمح للخبراء لتعيين أوزان ونقاط تحت طريقيت التحليل الهرمي و Multi Attribute Utility Theory>. فد تم إيجاد ان معايير التقنية والسلامة/البيئة اهم المعايير للإختيار واكثرهم وزنا بالتساوي بتقدم بسيط عن المعايير الأخرى مثل معايير المالية والإدارية. نموذج الإختيار تم بناءه على مدخلات الخبراء التي كونت اسس التقييم لإختيار الشريك الخاص من القطاع الخاص.

CHAPTER 1 - INTRODUCTION

1.1 Background and Motivation

The economic development of countries rely on multiple industries , the construction field is a major part of growth in the economy for nations (Husein, 2013; Ikediashi, Ogunlana, & Alotaibi, 2014). it was reported in 2007 that over USD 300 billion will be utilized in the construction of new projects ranging from residential to industrial types in the Kingdom (Ikediashi et al., 2014). (Mohammed, 2017) stated that as of 2014, the share of construction in the Saudi Arabia's GDP would account up to 5 percent. This could be attributed to the accumulation of wealth that the Saudi Arabia has achieved during the last two decades as an outcome of the oil market (Husein, 2013; Ikediashi et al., 2014; Mohammed, 2017), Consequently the fall in economy due to drop of oil priced occurred in 2015 impacted the market and the continued development in construction in the country. However, a recovery is expected in the meantime. (MEFIC Captial, 2018) reported that in 2018 a grow at 3.5% is expected during this year. An increase that will steadily increase till it reaches its peak in 2020 with a percentage of growth expected at 7.6% (Figure1.1.1).

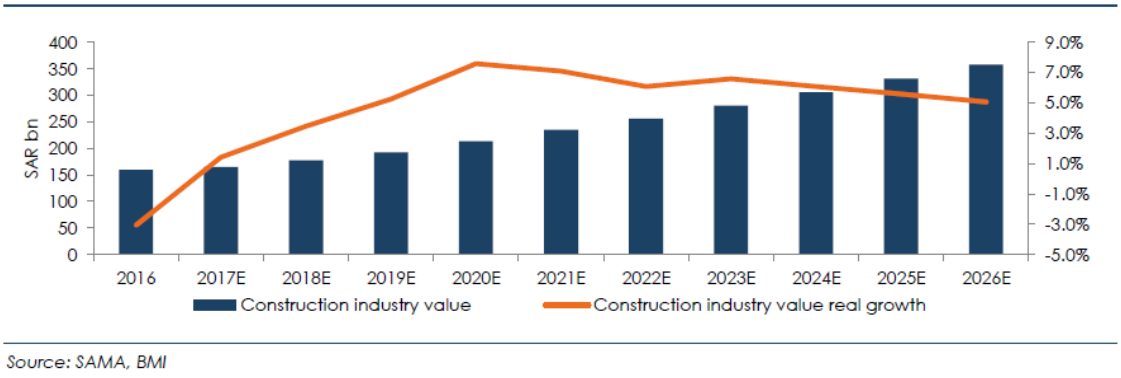

Figure 1.1 The expected growth in construction industry. Adapted from (MEFIC Captial, 2018)

In the midst of the rise and fall of the economy, the increasing annually demands challenge the Governments to look for alternatives approaches to fund the projects that would meet the public needs. This includes financing, planning and construction of projects (Aziz, 2008; Crosslin, 1991; Girmscheid, 2009; Gurgun, Ph, Touran, Ph, & Asce, 2014). Additional motivation for pursuing Public-Private Partnership (PPP) are, acquiring special expertise that is not available locally to execute complex projects, mitigate deficiency and improve performance, adapting innovative implementation and gain further background from the established collaboration with the service providers (Aziz, 2008; Gurgun et al., 2014). Recently, multiple developed and developing countries witness an increase in demand for housing. along with financial constraints and economic driven reasons, these governments have turned their interest for other alternatives that may offer a greater value for money in comparison with traditional procurement (Moskalyk, 2011).

1.2 Statement of the Problem

The status of the real estate market in Saudi Arabia remains underdeveloped regardless of it being 10 times larger than the adjacent countries' market. Its reported that only 30% of Saudi citizens own homes (Samba, 2010). Following up this concern, the government has turned its focus on the shortage of housing for its citizens (Llp, 2017) The 2030 vision of KSA includes a delivery plan that is segmented into 5 years segments. In 2020, commitments of having 14 contracts of PPP and increasing ownership up to 60% are targeted (SaudiVision2030,2018). and evidently, housing development is one of these targeted areas for PPP of the 2020 delivery plan (Privatization Program, 2018; Saudi Vision 2030, n.d.-a)

On plain sight, it might appear that PPPs could guarantee profitable outcome for both sides of the agreement; the government get the service or the project without the need to use the public

funds and on the other hand the private partner would get new investing sources (Crosslin, 1991).on the contrary, The nature of PPP contracts could raise a lot of risk and uncertainties to projects that would come between the mutual success goals of parties. success factors such as the long term duration of project, parties involved and their experience, and many other success/failure factors (Chan, Lam, Chan, Cheung, & Ke, 2010; Crosslin, 1991; Zhang, 2005). The high involvement of the private partner in the different stages of delivering the service which starts from financing and could extend up to the operation/maintenance stage in certain form of delivery contracts plays a vital role in obtaining the favorable result (Gurgun et al., 2014). This would emphasize on the importance of selecting the right partner with the suitable expertise and capability to execute the project.

A national center was launched in 2017 to oversee the operation of these partnerships. The center has acknowledged the challenges that they may face in the aims of involving the private sector into delivering projects and services. Main challenges stated were: limited and lack of experience in certain targeted sectors, lack of a sufficient number of locally experienced private sector companies involved with privatization and PPP schemes, vagueness in procedures and legislative frameworks to enable the private sector to work smoothly. (SaudiVision2030,2018). Such challenges stated by the center necessities a need of research studies that would aid the program. At the moment the national center of privatization hasn't released the official framework legislation for such procurement law, even though projects that were executed under the concept of partnering between government and private sector were executed in accordance with the Government Tenders and Procurement Law (Royal Decree No. M/58 4 Ramadan 1427H / 27 September 2006) and its related Implementing Regulations (the "Procurement Law") previously (Llp, 2017). There have been few researches on initiating a selection criterion for choosing the

private partner in other regions for infrastructure projects. However, these studies were situated in other countries and only found to be 3 current studies published which show a serious and the criteria could differ by the influence of the local circumstances and laws of the country. This study will aim identify the most suitable set of criteria for selecting private partners for housing projects in Saudi Arabia and develop an approach of selection utilizing analytic hierarch process (AHP) and Multi Attribute Utility Theory (MAUT)

1.3 Objective of the Study

The main objective of the research is to propose a model for decision making for the purpose of selecting a private partner under the 3P contract form in the housing industry in Saudi Arabia. This involves the following sub-objectives:

1. Identifying criteria influencing the selection of a private partner for housing industry from the published literature worldwide and locally and Experts input.
2. Proposing the selection criteria appropriate for the practice of Saudi Arabia projects

1.4 Significance of the Study

The current study aims to develop a selection model for decision makers in saudi arabia and contribute in the following:

- increasing the efficiency of the selection process for private partners
- Providing a decision making tool for the public sector in the housing industry
- Providing weights or priorities of selection criteria
- Adding to the literature of Public Private Partnerships and the selection criteria for private partners
- Impact the performance of housing project by successful selection of private partners

1.5 Scope and Limitations

1. This study covered the selection of private partner in the housing development sector in Saudi Arabia.
2. The targeted experts were public agents, real estate developers, and engineers that are experts and have experience in Saud market and knowledge about Public-Private Partnerships in the central region, Riyadh.
3. The study is limited to certain utility and input from experts

CHAPTER 2 - LITERATURE REVIEW

2.1 Introduction

This chapter provides an overview of Public-Private partnership by enlisting the various types of PPP definitions and terminologies, characteristics and model types used worldwide. Furthermore the chapter will discuss the distinguish of PPP in housing by determining the obstacles governments face in that industry. Then, the chapter reviews the selection process for both project and private partners. Finally, gaps and limitations are identified and listed.

2.2 Public-Private Partnership Overview

Limitations and boundaries within a nation could be one of the obstacles in the creativity in project/construction management. Such limitations as resources constraints, lack of confidence and knowledge about a specialty or expertise, have given the motivation for project stakeholders to demand immediate change (Loosemore, 1999). Therefore, Keating in 1998 have mentioned that governments have turned their direction to form partnerships with the private sector in order to fulfill these limitations and to provide an improved service and delivery of projects to the public. This would ensure a better use of tax money. The concept of partnerships has existed for centuries in the united states and the Europe but only recently became distinguished and impacting to the local economic development (Li & Akintoye, 2003).The prime concept of a public private partnership (PPP) is for a governmental agency and one or multiple private ventures to agree on the delivery of a long term project or service. This provides the government an opportunity to serve a public need while utilizing the allocated funds on other prioritized matters. (Anastasopoulos, Haddock, & Peeta, 2014; Aziz, 2008; Gurgun et al., 2014).

(as cited in Li & Akintoye, 2003) According to England government's document of introducing a newer approach for PPP in 2000,it stated the benefit that both parties; private and public, could achieve mutually during these formed partnerships. The variety of types of partnerships the document has included are:

1. Using different possible structures for the governement would allow the the intiation of private sector ownership into businesses owned by the statem such as, flotation, along with sharing the stake (Whether majority or minor) by selling.
2. The contraction wirth the private partner to purchase their services on a long term agreement, which give advantage to the public by having the expertise and skills of the private sector. Consequently this would include franchises and concessions, which puts more responsblity on the second party of the agreement to maintain providing the public service
3. Exposure of the private sector expertise in financial management by franchising the state assets into wider market

2.2.2 Public-Private Partnership (PPP) Definitions and Terminology

PPP relies mainly on partnership but this partnership can't be defined under the general concept of it and shouldn't be confused with other construction management definitions such as "partnering" (Cartlidge, 2006) or "Purchasing Power Parity", a macroeconomic metric used for analysis. It's evident that PPP comes in various forms and structures suiting the purpose of the agreement (Grimsey & Lewis, 2004; Li & Akintoye, 2003). Such arrangement differs in different countries. In Holland they deal with PPP arrangement through a central body, whereas in the United Kingdom the frameworks are set for the applications required (Grimsey & Lewis, 2004).

This made it difficult to set one definition for PPP(Li & Akintoye, 2003; Urio, 2010; World Bank Institute, 2014)

(World Bank Institute, 2014) defined it as "a long-term contract between a private party and a government agency, for providing a public asset or service, in which the private party bears significant risk and management responsibility". The Canadian Council for P3s (CCPPP) defined the partnership as: "A cooperative venture between the public and private sectors, built on the expertise of each partner, that best meets clearly defined public needs through the appropriate allocation of resources, risks and rewards." (The Canadian Council for Public-Private Partnerships, 2016). Another definition given by the Public Policy Research (IPPR) for PPPs is "a risk sharing relationship based on an agreed aspiration between the public and the private sectors to bring about a public policy outcome." (as cited in Cartlidge, 2006). (Grimsey & Lewis, 2004) gave their own insight and proposition on PPP

> The PPP is a strongly incentive-compatible contracting arrangement. The cost effectiveness of a PPP relative to traditional procurement is a result of upfront engineering of the design solution and the financing structure combined with downstream management of project delivery and the revenue stream. All of this is a consequence of the incentives built in to the services payment mechanism and the risk transfer in the PPP model (Grimsey & Lewis, 2004, p.6)

The frequently used terminology "public-private partnerships" believed to be coming from the united starts of America. Specifically, when the programs of funding education sector between the two sectors. Again the term was used in the 1950s for utilities funding. Accordingly, the term has been widely spread throughout the other provisions such as social and urban

development, health, and research, etc. Several of currently used terminology for PPP by different organizations and parties:

• Private Participation in Infrastructure (PPI), this term is frequently utilized in financing development sector, which is known to be under the specialty of the world bank. An exception to this is the programs conducted in South Korea

• Private-Sector Participation (PSP), a similar term to PPI due to its involvement n the development of banking sector, it should be noted that both PPI and PSP could go beyond the scope of PPP

• P3 or 3P, prominent in North America;

• "Privately-Financed Projects (PFP), used in Australia"

• P-P Partnership which is used in countries that would confuse PPP abbreviation with "Purchasing Power Parity", a methodology for the comparison of exchange of rates

•" Private Finance Initiative (PFI), a term originating in Britain, and now also used in Japan and Malaysia." (Yescombe, 2007)

2.2.3 Public-Private Partnership (PPP) Characteristics

(Cartlidge, 2006) discussed the essential from of partnership by giving a general definition of partnership; "a partnership will be implied by the law when two or more people are in a business relationship together with the view to making a profit."

(Cartlidge, 2006) have identified essential elements for the concept of partnership, which are listed below:

- All individuals share the risks and rewards of the business.
- Each partner is entitled to share the net profits of the business. A contract need not provide for equal shares which may depend upon how much the partner has invested.

- Partners are jointly and severally responsible for all the debts and obligations of the business without any limit, including loss and
- Damages arising from wrongful acts or omissions of their fellow partner and potential liability to third parties.
- Partners have equal rights to make decisions which affect the business or the business assets.
- All individuals share the ownership of the assets of the business, although they may have agreed that the firm will use an asset which is bought by one of the partners individually. (Cartlidge, 2006,p. 2)

In reality, PPP falls into a defined time frame window that maybe called "project based" partnership unlike the mentioned above definition of partnership (Yescombe, 2007). Many aspects of PPP distinguish the type of contract from the other traditional contracts. (Zhang, 2005) identified 5 main significant fundamentals aspect. These are: 1- the risks and uncertain events related with the long term commitment; 2- the distribution of risk, responsibilities and rewards among the participants of the projects; 3- responsibilities and risks are inherited more by the private partner than the traditional contractor of a project; 4-"nonrecourse or limited recourse and off-balance transactions"; and 5-"Complicated contractual arrangements between project participants". Whereas (Yescombe, 2007) identified the following key elements that distinguishes between PPP and the common partnership

- a long-term contract (a 'PPP Contract') between a public-sector party and a private sector party;
- for the design, construction, financing, and operation of public infrastructure (the 'Facility') by the private-sector party;

- with payments over the life of the PPP Contract to the private-sector party for the use of the Facility, made either by the public-sector party or by the general public as users of the Facility; and
- With the Facility remaining in public-sector ownership, or reverting to public-sector ownership at the end of the PPP Contract. (Yescombe, 2007, p.3)

2.2.4 Public-Private Partnership (PPP) Models

PPP agreements could form many arrangements and could be described widely (Internation Monetary Fund, 2004). Some of these types are named after their main functions governed in the agreement (Grimsey & Lewis, 2004; World Bank Institute, 2014). For instance, the DBFO (Design-Build-Finance-Operate-Maintain) contract type that would transfer these responsbilities to a second party, the private party, to execute them. (International Monetary Fund, 2004) believes that the DBFO is the general main type of PPP that many other branches of the agreements could fall under it. However, the IMF doesn't strictly limit PPP under this scheme. A description of multiple PPP arrangements is given from IMF in Table 2.1 below.

Table 2.1 Types of PPP Contracts

Contract types	Description
Build-own-operate (BOO) Build-develop-operate (BDO) Design-construct-manage-finance (DCMF)	In these contract types, the private partner is not committed to transfer the ownership of the developed assets to the government. The responsibility of designing, building, owning developing, operating and managing the asset falls
Buy-build-operate (BBO) Lease-develop-operate (LDO) Wrap-around addition (WAA)	An asset built by the government would be sold or leased to the private partner who would operate, manage, and renovate this existing asset without the contractual obligation of transferring back the ownership.
Build-operate-transfer (BOT) Build-own-operate-transfer (BOOT) Build-rent-own-transfer (BROT) Build-lease-operate-transfer (BLOT)	Designing, constructing, operating and then transferring an asset to the government is the functions of these arrangement by the private partner

Note: Adapted from International Monetary Fund. (2004). Public-Private Partnerships, *23*(3), 419–428.

Further expansion of PPP arrangement exist due to the diversity of countries and organization perception to the concept (World Bank Institute, 2014) such as:

- Joint venture; An equal share of stakes between both parties is usually fall under the arrangement of joint venture (Grimsey & Lewis, 2004)
- A concession type of arrangement would involve the private partner in the responsibility of operating an asset that is already designed, and built by the government. Usually payments are collected from users and doesn't involve the public party in payment (World Bank Institute, 2014; Yescombe, 2007)

- A minor involvement of private party occurs in the outsourcing contractual types. These are mainly operations and maintenance services for a governmental asset already existing(World Bank Institute, 2014; Yescombe, 2007).

2.2.5 PPP in Housing

It may occur to a large amount of people that PPP agreements are mainly about funding infrastructure projects for a country. This is a misconception commonly spread and not strictly correct. The main concept of PPP is that the public agency doesn't require to purchase an asset, but to acquire bundle of services under certain agreement between the two parties. This misconception is due to the impression made based on the PPP models that were established in the United Kingdom, Australia, Canada and South Africa Such models have the basic characteristics of (as cited in Grimsey & Lewis, 2004):

- A long term of services is issued by the public sector to be bid for, with a period ranging from 15-30 years by a reference to a targeted output specification and performance criteria specified
- Payments are due once the operation stage has started and the following payments might face reduction if the performance has deteriorated
- Major risks rely on the private sector and the public agency isn't obliged to fund during the construction phase, this includes cost overruns, delays.
- Design risk in aspect of deciding the number of assets to reach the targeted performance requirement set from the government is also on the responsibility of the private sector alone

However, PPP can cover a wide range of applications due to its flexibility and variety in the delivery method. One of these application is the social housing (Grimsey & Lewis, 2004; Yescombe, 2007).

It was estimated in 2011 that more than half of the world's population is living in city, towns and other classified urban areas. Urban population growth was predicted to increase rapidly especially in the developing world rather more than in the developed one. Its noted that There is an immense financing need for urban development projects that might not be possible to obtain by the traditional procurement alone (Moskalyk, 2011). Many challenges may face affordable housing in a country, high cost of lands, and discouragement of real estate developers by not having clear structures for urban investing. Legalizing PPP structure could motivate the private sector (Ministry of Housing and Urban Affairs Government of, 2017). In the kingdom of Bahrain, the ministry of housing and in its attempt to meet the housing demands due to the increasing national population rapidly has partnered with Sharaka for Housing Projects BSC for the purpose of providing 2817 affordable housing and apartment units for the public including the needed infrastructure and landscaping for the units the project was awarded with a concession period of 5 years. The contract begun in June 2014 and the period is scheduled to finish in mid of 2019.

2.2.6 Public-Private Partnership (PPP) in Saudi Arabia

KSA has been one of the most prominent oil exporters to the world. This helped the Kingdom to raise its economy and thus the industries within the country is significantly impacted and influenced by it (Husein, 2013; Ikediashi et al., 2014; Mohammed, 2017). In April 2016 a strategy document has been released, announcing the vision 2030 of KSA. One of the main visions of 2030 of KSA is to diversify the public funds by expanding its investment and to

sustain its major economy pillars (Privatization Program, 2018). This is planned to be done by privatization multiple of the government services and projects, thus the kingdom is aiming to seek partnerships with private partners in order to achieve this part of the vision. Its stated in the strategy document that the private sector contribution to the gross domestic product (GDP) is less than 40% (Privatization Program, 2018). In 2017 a national center was launched to act on behalf of the country and be the central unit for privatization and PPP projects. This center will be oversighting and planning the partnered projects with the private sector(Llp, 2017; PPP, 2017), it will also provide other consultation in the various aspects such as, financial, strategy, risk, marketing and project management (PPP, 2017). NCPs mandate will cover 5 main areas that can be listed below as(PPP, 2017):

1- Policy making

2- Privatization/PPP Framework Development

3- Advisory and Control

4- Monitoring and reporting

5- Enablement

The implementation of PPP in Saudi Arabia has taken place before, for example, Prince Mohammed bin Abdulaziz Airport located in almadinah is project delivered through a partnership between General Authority of Civil Aviation and Al-Taiba consortium. However; currently the Saudi Arabia doesn't have an issued PPP law that governs the practice of these type of agreements. Public infrastructure projects have been executed traditionally in accordance with the Government Tenders and Procurement Law (Royal Decree No. M/58 4 Ramadan 1427H / 27 September 2006) and its related Implementing Regulations (the "Procurement Law") (Llp, 2017). As a part of the 2030 vision,

2.2.6.1 Public-Private Partnership (PPP) in Saudi Arabia for the housing industry

Ministry of Housing along with the Real Estate Development Fund started a housing program named “sakani” in 2017. This was the start of the collaboration and partnership between the government and the private sector which took place to achieve one of 2020 national transformation program goals, which is to increase citizen ownership up to 60% (“Sakani,” n.d.; Saudi Vision 2030, n.d.-b). “Sakani” program showcase the housing units which are ready made and others under construction through “Off-plan sales” platform which is run by “Wafi”. In the aims to encourage and provide a proper investing environment for investors and the private sector to invest, The government established the National Housing Company (NHC) as an investing entity which will oversee the executing of programs and initiatives provided by the ministry (Saudi Vision 2030, n.d.-b).

Off-plan Sales or Rent Program (Wafi) aims to market and sell the real estate unit before or during the development or construction stage, by putting the description of the house plan or a building model in its final form after the completion of the development or construction, and ensure the commitment of the real estate developer to implement according to the model and agreed specifications.

the Off-plan sales or Rent Program work as facilitator between many parties: Beneficiaries, Real estate developers, Contractors, Consultant and financial advisor. The main objectives of this entity is to

1. Reduce the cost of the real estate unit ownership.
2. Reserve the buyer's rights through the implementation of regulations and procedures.
3. Increase transparency in the real estate sector.

4. Encourage the spirit of competition among developers through the subdivision system.
5. Contribute to increased supply through the development of real estate projects.
6. Enhancing the ability of developers to shift from individual to institutional work.
7. Limit speculations that have adverse impact on real estate prices.
8. Obtaining high quality real estate units.(Wafi, n.d.)

The private partner, which is the developer in this case, is the main party that would require to find formal and legally agreements with the other parties in order to bid for the project. The dealing of the banks is directly related to the developer and the beneficiary with no commitment from the Ministry of housing. The beneficiary will be evaluated by the bank for his eligibility to be admitted into the program based on his income and liabilities. Subsequently if the beneficiary is eligible a loan is assigned and the handover of the housing unit takes place by the approval of the housing industry. Where as for the developer may be able to take loans from the banks along with the option of taking incentives that could go up to 40% of the project from the Ministry. Figure 2.1 illustrates the relationship between the parties involved.

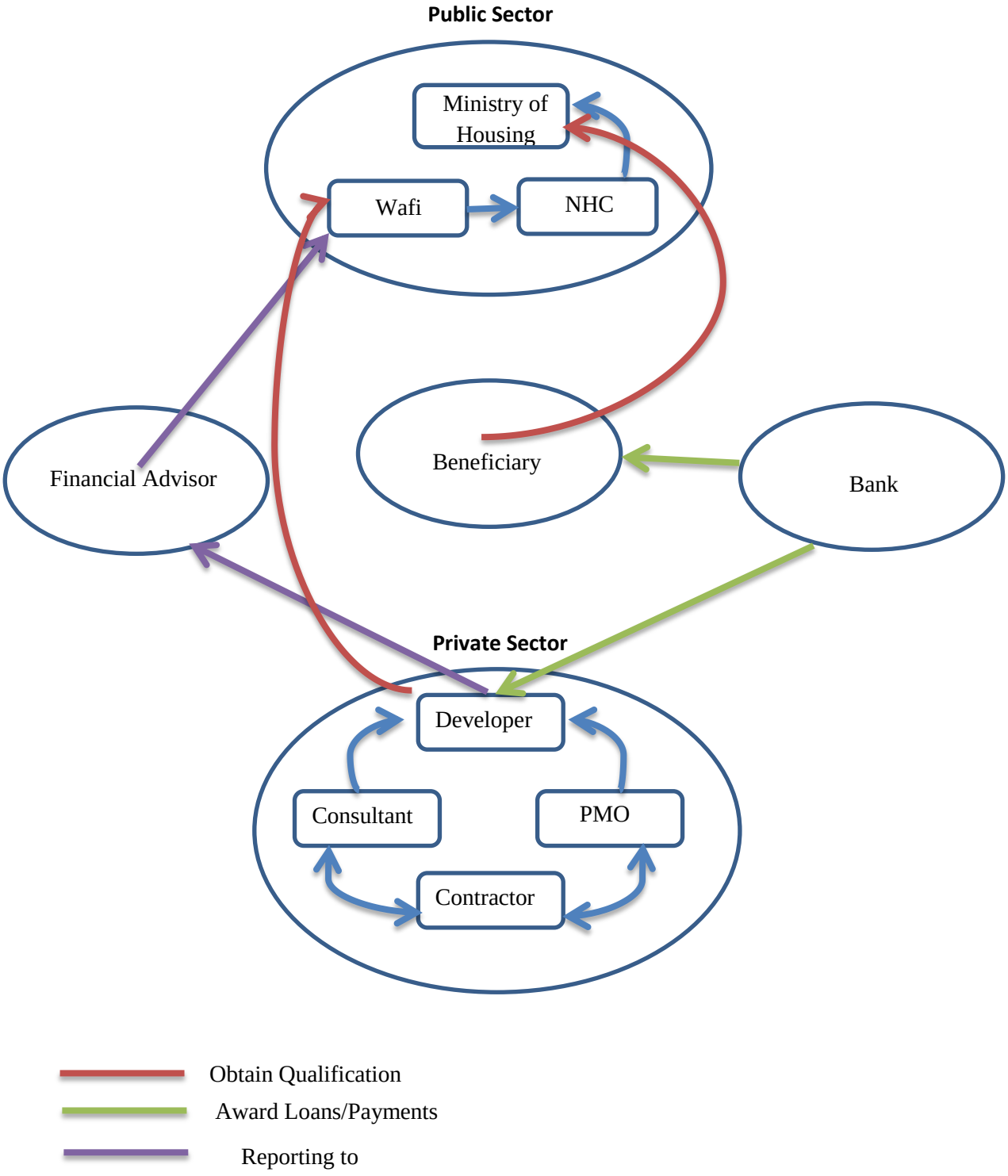

Figure 2.1 The relationships of parties involved in “Sakani” project

2.3 Project and Private Partner Selection

Due to the limitations that many developing countries face with their budgets, the consideration of Public-Private Partnerships (PPPs) to be the escape and another way to avoid exhausting the public funds. in reality the public representative should take into account many factors before deciding on a procurement method such as PPP for a certain project (United Nations ESCAP, n.d.). The nature of PPP agreements govern broad range of risks, given the number of parties involved, and level of experience in the country (Chan et al., 2010). Statistics have shown that PPP contracts cancellation goes up to 70%, in countries that have less experience in dealing with such type of agreements (Noorzai, Jafari, Heshmatnezhad, & Vahedi, 2016). Once an agreement is reached, the public and private sectors unite their efforts to reach their desired objectives; the government to choose PPP contracts to fulfill a public need and transfer the higher risk on to the other party, while on the other side; the private partner is looking for a commercial profit with a pleasing rate of return for their investment(El Fathali, 2015; Moskalyk, 2011) . Thus putting emphasis on the relationship between the two parties and its impact on the success of the partnership (El Fathali, 2015). (Chan et al., 2010) discussed the need of having a clear protocol and legal basis to conduct partnership agreements and to encourage the private partner into investing. (Aziz, 2008) argued that the perception of the private sector on all levels of parties involved in the project about the PPP in a country may hinder the success. Thus requiring having clear and stabilized procedures for the private partner to be in confidence to work under the partnership. The author followed that statement with an analysis conducted on the United Kingdom and British Columbia programs and structures to identify main principles at the program level to avoid impediments in the execution of PPP:

1. the importance of understanding the objectives of using private finance when selecting a PPP arrangement

2. the consequences and impact of allocating project risks to the private party
3. the need of an existing comprehensive PPP legal framework;
4. value for money assessment before selecting a delivery system;
5. control and oversight of by having a unit for PPP to deal with the implementation and policy development
6. the necessity of maintaining the transparency in the selection process;
7. the significance of standardizing the procedures and contracts
8. utilizing performance specifications

while (Marques, 2018) emphasized on the various problems and obstacles that could occur during the bidding process which is the stage a private partner is selected. Some of these problems are: lack of clarifications of each side's task, and the possibility of "lowballing" (ie offering a pleasing bid with the intention of re-negotiating after acquiring the contract). For the government or the public agency to select the fitting consortium for partnership, selection criteria shall be set for the evaluation of bidders. Criteria should match the country circumstances and laws. Surveying the literature for previous studies, (Zhang, 2005) identified main four package criteria for selecting a private partner by looking at the critical success factors of PPP agreements and conducting interviews with worldwide practitioners. These four main criteria were: financial, technical, safety, health, and environmental, and managerial. Consequently, the author calculated and analyzed the significance of these criteria to each other by conducting structured questionnaire and then applying statistics tools including validity and reliability analysis, Mann Whitney U tests, direct comparisons of mean criterion significance indexes and criterion rankings. (El Fathali, 2015) conducted a recent research by proposing integrating two models. First model is selection of private partner for infrastructure projects by identifying through

conducting surveys and interviews. Process of selection is then made by using a fuzzy analytic network process (FANP) and the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS). Second model is to assess the private partner financial ability or bankability from public records showing financial information which is utilized to reach an understanding and have more insight about the private partner's free cash flow. Not many studies are published on selecting private partners in Public-private Partnerships, whereas those that are published are for infrastructure projects. (Ouenniche, Boukouras, & Rajabi, 2016) adapted a different method for selecting a private partner for public-private partnerships. an ordinal game theory framework was in an algorithm. The algorithm determines a ranking of the bidders proposing to PPP contracts while taking into consideration the possible multiple criteria evaluating the performance of a private sector consortium based on both the public and private sectors' perspectives. The study didn't define a set of criteria; however, the author claim the framework is created to adapt various set of criteria for each project. (Kumaraswamy & Ã, 2008) discussed the selecting of project teams for PPP schemes by defining main set of categories of selection criteria such as technical, sustainability and relation factors. The author utilized Delphi ranking method to structure the survey which was shared with both industry and academic experts. (Dulaimi, Alhashemi, Yean, & Ling, 2010) researched the success critical factors for PPP projects in United Arab Emirates based on three previous case projects. A qualitative approach was adopted for the study rather than the quantitative approach due to the limited projects and information available in the country. The study concluded that the political acceptance and the availability of a strong consortium private partner are the most critically factors for the success of this kind of partnership.

Locally, Wafi is the organization that represents the government, which is responsible for the selection of the private partner through a qualification process. the selection criteria as presented in their website includes (Wafi, n.d.)

- General information of the company
- Required local qualifications and certificates
- Past experience in designing housing projects
- Past experience in supervising and managing projects
- Past experience in designing and supervising infrastructure projects
- General information of the Engineering staff

The current criteria is limited to Experience and qualifications acquired without a further look and depth of the essential Public private partnership aspects.

2.3.1 Value for money

Committing to a long term partnership govern many objectives to achieve among to find an alternative for financing as well as to ensure the optimum effectivity and benefit of such partnership with the private sector in order to deliver a service to the public. This has been evident in countries with a vast experience in Europe such as the United Kingdom, Netherlands. Also in America (Demirag, Dubnick, & Khadaroo, 2004). Therefore the decision of involving the private sector into the public services or projects must be analyzed in the aspect of its value in exchange of the money (Girmscheid, 2009). Furthermore, a different source of financing may create a bias to choose PPP over other procurements alternatives. This is another motive for governments to conduct proper value for money assessment (International Monetary Fund, 2004).

HM treasury defined VFM as " the optimum combination of whole-of-life costs and quality (or fitness for purpose) of the good or service to meet the user's requirement"(HM Treasury, 2006). (Ismail, n.d.) Discussed the concept of VFM and its association with of three Es: economy, efficiency and effectiveness through the complete life of the agreement between two parties. To achieve the objectives of a project, the assessment must be conducted throughout the different levels of project delivery: predesign stage or programming level, project stage and construction stage (Pitt, Collins, & Walls, 2006).

2.3.1.1 Generic Factors driving Value for Money

PPP value for money is a major concern, its decisive for the decision of taking a project or not, HM Treasury and the world bank have discussed general factors that give the motive and purpose for assessing the value of money for projects under the PPP Framework (HM Treasury, 2006; World Bank Institute, 2014):

- **Proper distribution of risks between the involved parties;** demands that the involved parties are allocated their defined risks in order to best handle risks over the project period.
- **Emphasizing on the complete life cycle:** prioritizing the full costs of the asset through its life span instead of merely looking at the upfront costs
- **Integrated planning and design of the facilities-related services** ensures the delivery of VFM benefits. As the integration of hard services and soft services may not achieve the targeted outcomes.

- **Determining and ensuring the product specification and performance**, this will encourage that level of innovation and effort to meet with the government requirements to be met from the potential bidders.

- **A thorough transfer of parties risk**, by binding commitment to transferring these risks to the allocated sides and that the consequences with their costs will be bear by the agreement set initially.

- **To offer Sufficient flexibility:** a clear conducted VFM could give an insight when the possibility of amendments to the delivery of project or the specifications through the life span of project and whether this change will maintain the overall benefit for the value of the money

- **Motivate the parties by ensuring the expected timeline of sufficient incentives:** this can be illustrated via the structure of procurement and clauses of contracts to ensure the services and assets that are targeted for is delivered in accordance to the agreed timeline of deliverables. It governs rewards and deductions

- **The term of the contract:** arrangement and multiple crucial elements of the project may alter through the period over agreement. Such elements like the design life of the project, policies, potential changes in mechanism of delivering services. Thus giving the clauses and the terms of the contract to be referenced to the predicted period.

- **Effective use of both parties' expertise and skills for the project during the procurement and the delivery**

- "**Managing the scale and complexity** of the procurement to ensure that procurement costs are not disproportionate to the underlying project(s)." ("Value for money: Assesment Guidance," n.d.,P.8)

Consequently in order to achieve value for money, the authority reprehensive should follow the (Grimsey & Lewis, 2004):

- Unbiased awarding of projects through a competitive bidding for bidders
- A thorough application of economic assessment techniques along with proper allocation of risk between the involved parties to ensure maximized level of value for money.
- A comprehensive trade off analysis between the two options of funding; publicly and privately.

2.3.2.1 Public Sector Comparator (PSC): Value for Money Tool

PPP projects require a high level of commitment and long-term relationship with a partner. Thus considering only numeric factors such as costs would not guarantee success for the projects. A set of qualitative factors shall be assessed alongside with the quantitative aspects of PPP. For example, the viability, achievability and desirability of the PPP procurement decision (Australian Government Department of Infrastructure and Regional Development, 2008; HM Treasury, 2006). An essential tool to assess the value for money is the public sector comparator (PSC) and also known as Public sector Benchmark (PSB) (Yescombe, 2007).

when there's a request to issue a project (Australian Government Department of Infrastructure and Regional Development, 2008; Grimsey & Lewis, 2004) The public sector comparator is an essential tool used by governments to act as a benchmark to reach a decision on implementing a project or a service in a particular procurement approach for the project and whether they offer the satisfying value of money or not (Grimsey & Lewis, 2004),. (Ismail, n.d., P.3) defined it as "the technical construct developed to test whether privately financed arrangements provide superior VFM to traditional bundled procurement methods." Another definition is given by (Cruz & Marques, 2013) "The PSC is a theoretical calculation of the total costs for the public sector of developing and operating an infrastructure and/or service. It is basically the sum of cash-flows for a pre-determined duration, incorporating the efficiency gains arising from the manager learning curve and the retained risk, assuming a public management model" The life cycle of an asset beginning from pre-design stage to operation and maintenance stage would have multiple risks with range of probabilities thus the comparator shouldn't only include occurring direct costs but to include risks of all levels of association through the project. (Shaoul, 2005). Nevertheless, PSC isn't a tool that beyond limitations, due to the need of forecasting the various costs including expenses and rewards, complexity ,and ambiguity of the tool; making the comparator a hypothetical estimate, not an accurate actual cost to the public sector (Australian Government Department of Infrastructure and Regional Development, 2008; Grimsey & Lewis, 2004; Shaoul, 2005; Yescombe, 2007).

(Cruz & Marques, 2013; Grimsey & Lewis, 2004) listed essential elements that are incorporated into the tool to conduct the assessment for countries such as Canada and UK (Figure 2.2):

- Base or raw cost: The cost that the government would have to spend if the services or assets were provided by the public funds. This includes operating and maintaining these services over the predicted whole life cycle of the project accordance with the desired performance specification.
- Retained risks: this type of risk could amount to similar amount of loss for both parties. Demand risk, laws and regulations, such risks could influence the services provided and their return of investment
- Risk adjustments: adjustments of transferable risks that influence the chances of services delivery are made and estimated in the raw or the base cost projections. This is believed to be due because of the possibility of managing and handling the potential reduction of service quality occurring. Cost overruns, technical issues, such problems could be quarantined if they are related to service quality.
- Competitive neutrality: is to ensure equality in the aspect of costs that may occur to one party rather than the other due to status. For example, Local government's taxes permit fees and other charges that may apply on the private party.

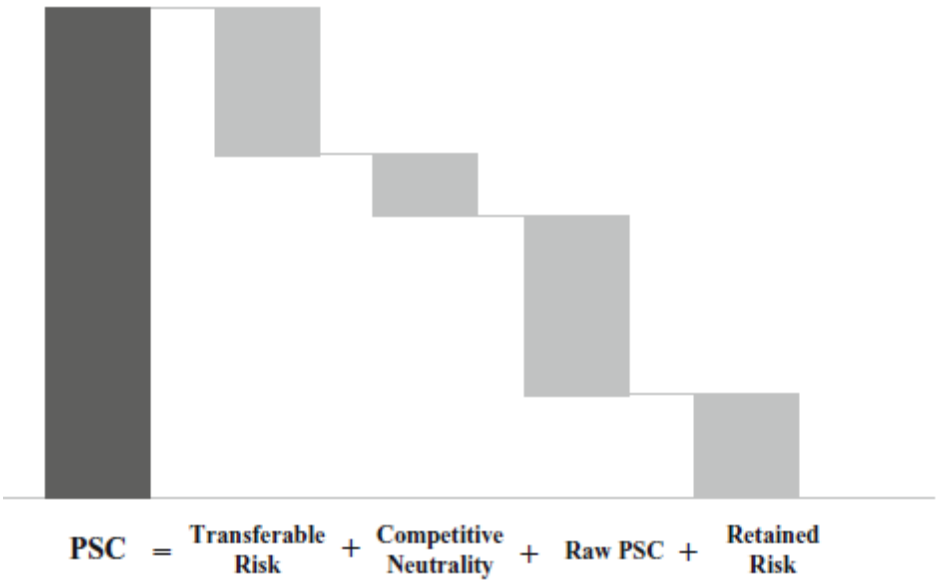

Figure 2.2 PSC Elements (Cruz & Marques, 2013)

Value for money is accounted for when the above mentioned costs are estimated, incorporated and adjusted into the tool. The margin difference between the PSC and other procurement alternatives suggested measured in present value cost would show the value each alternative and whether its plausible to choose an alternative procurement method or remain with the government methodology (Dewulf, Blanken, & Bult-Spiering, 2012; Grimsey & Lewis, 2004). (Figure 2.3) demonstrate a generic comparison between two alternatives of procurement with regard of assuming fair equality for the two alternatives (Grimsey & Lewis, 2004).

PSC structure could vary into multiple components that construct the comparator and that may differ based on each country criteria and prioritization of the appropriate PSC components (Figure 2.4, 2.5) (Cruz & Marques, 2013)

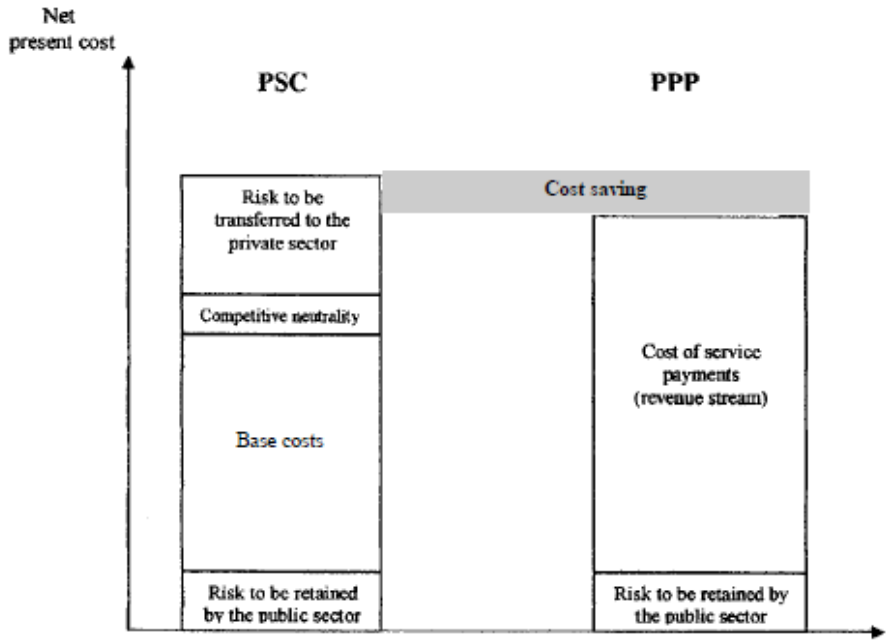

Figure 2.3 VFM analysis utilizing PSC (Grimsey & Lewis, 2004)

Items	Hong Kong	South Africa
Definition & Characteristics	• An estimated, risk adjusted, cost of the government itself in delivering the project output. • The PSC is expressed in terms of the NPV to the government, using a discounted cash flow analysis that adjusts the future value of the expected cash flow to a common reference date.	• The base PSC model represents the full costs to the institution of delivering the required service according to the specified outputs via the preferred solution option using conventional public sector procurement. • Expressed as the NPV of a projected cash flow based on the appropriate discount rate for the public sector. • Based on the cost for the most recent similar public sector project or a best estimate.
Purpose	• To provide the basis of comparison between the PPP and the Public sector alternatives. • To provide a benchmark of what the government believes is an appropriate level of investment	• Promote full cost pricing at early stage • Initial indication of VFM. • Consistent benchmark and evaluation tool • Encourage bidding competition by creating confidence in the financial robustness and integrity of the feasibility process.
Components of PSC	• **Raw PSC** –Direct cost , indirect cost and expected third party revenue. i. Expected cash flow of the raw PSC need to be forecast over the life of the ref. project • **Competitive neutrality** (government rent, taxes, duties, fees and charges, accommodation costs) • **Transferable risks** • **Retained risk**	• **Base cost** (Capital and operating costs) i. Direct and indirect cost ii. Revenue cost iii. Assumption Depreciation cost are not included • Cost of risk adjusted
Discount rate	• Sought from the economic analysis division of EABFU on the appropriate discount rate to be applied.	• Discount rate to be the same as the risk adjusted cost of capital to government. • Treasury does not prescribe a rate to use. • Using the yield of a government bond with a remaining maturity similar to the duration of the project.
Refining the PSC process	• Conducted at the strategy formulation stage and procurement stage	• Conducted at the strategy formulation stage and procurement stage
The criteria of PSC	• **Quantitative factors** (Raw cost, competitive neutrality and risk) i. Evaluate private bids against the PSC. ii. Identify the least cost procurement option. iii. Output specification and allocation of risk	• **Quantitative factors** (Raw cost and risk) i. Evaluate private bids against the PSC. ii. Identify the least cost procurement option. iii. Output specification and allocation of risk

Sources: National PPP guidelines. Volume 4: Public sector comparator (2008) and PPP Hong Kong guide (2006)

Figure 2.4 PSC in different countries.a (Ismail, n.d.)

Items	Ireland	Australia
Definition & Characteristics	• It is represented as a single monetary value that represents the full estimated cost, risk, income to the public of delivering the project by using traditional public sector procurement.. • Presented as estimated annual values arising over the whole lifetime of the project. These values will then be discounted back to a present day value. • PSB does not include any costs/income/risks that will be retained by the sponsoring agency itself.	• An estimate of the hypothetical, whole life cost of a public sector project if delivered by government. It is developed in accordance with the required output specification, risk allocation based on the most efficient form of government delivery, adjusted for the lifecycle risks of the project. • Expressed as the Net Present cost of a projected cash flow based on the project specific discount rate over the life of the contract. Included an adjustment for competitive neutrality • Contain an assessment of the value of the risks transferred to bidders and risk retained by government.
Purpose	• Provide a structured approach to the costing of a PPP project at an early stage before invitations to tender are issued. • To reassess at an early stage prior to the initiation of the tendering process whether the project and the procurement method chosen have the potential to offer value for money. • To be used as a quantitative benchmark against which are the highest ranking bids can be evaluated in the formal VFM comparison.	• To provide government with a quantitative measure of the VFM. It provides the government with an approximate measure of the range of outcomes. It is accompanied by qualitative consideration, subject to sensitivity testing and scenario analysis.
Components of PSC	• Capital cost (upfront cost of providing a capital asset for the project eg: design cost, raw materials, off site works, equipment, professional fees, service connection and building cost) • Operating, maintenance and life cycle costs (costs of daily running of the capital asset to meet the output specification eg: consumables cost, waste management, security, asset refurbishment, facilities management, administration and staffing cost) • Third part income (income that can be generated by charging third parties for the use of an asset. • Transferred risk (Risks for which the private sector will be asked to tender)	• Raw PSC (base costing of direct and indirect cost – using discount rate, real pre- tax rate and inflation assumption). i. Financial costs and revenue (economic and cost benefit analysis are considered) ii. cash flow forecast (excluding depreciation costs, including fixed asset and maintenance costs) iii. Exclude risk and contingencies • Retained risk (operating risk, demand risk and security risk) • Competitive neutrality(Land tax, local government rate, stamp duty and payroll tax) • Transferred risk (Design and construction risk, operating risk, maintenance risk and technology risk)
Discount rate	• Equivalent public sector project and reflect the relative value of the cash flows from the state authority's perspective..	• Risk free rate and adjusting for risk using classic methods based on the capital asset pricing model (CAPM). • Real discount rate used 6.5%
Refining the PSC process	• Conducted at the strategy formulation stage and procurement stage	• Conducted at the strategy formulation stage and procurement stage
The criteria of PSC	• Quantitative factors (Capital, operating, maintenance, life cycle cost, third party income and transferred risk) i. In light of the quantifications in the PSB should the project still proceed using a PPP ii. Does the highest ranking bid compare favorably with the PSB from a quantitative perspective in term of the impact.	• Quantitative factors (Raw cost, competitive neutrality and risk) i. Evaluate private bids against the PSC. ii. Identify the least cost procurement option. iii. Output specification and allocation of risk • Qualitative factors (reputation of the bidder, sustainability of service delivery and design amenity) i. Identify material factors which have been included in the PSC ii. Consider impact of qualitative factors on the private bids Construct the list of all qualitative factors at an early stage conjunction with PSC

Sources: National Treasury PPP, South Africa (2004) and PPP Guideline (2007), Ireland government

Figure 2.5. PSC in different countries.b (Ismail, n.d.)

2.3.2 Selection Criteria

This section will present the selection criteria extracted from the literature. A total of 5 main criteria and 23 sub-criteria were identified. The identification of these criteria is essential to develop the model and present the preliminary list of criteria to the experts to conduct a pilot study. The criteria are listed below in Table 2.2.

Table 2.2. Identified criteria list from the literature review

Cat.	Criteria	Brief description	References
Financial	**Shareholders Equity/Debt**	The distribution of the capital invested by the PPP project consortium or sponsors of the project. Debt is the money or capital loaned from banks or other financial funding association to the shareholders.	(El Fathali, 2015; Infrastructure Ontario, 2015; Infrastructure Ontario, 2015; Pitt et al., 2006; Pitt et al., 2006; Zhang, 2005)
	Government Control on user fees	refers to the government system that set fees or tolls for services to the public	
	Financial capacity	the capacity and limitation of the private partner to manage assets and provide services without major disruption	
	Foreign Financing:	is the part to study the dynamic of exchange rate, foreign investment	
	Expected revenue Method	expected payment option (if applicable) between the parties	
Technical	**Capacity of design firm and its proposed design standards**	capacity refers to the size and number of units within the design firm, the proposed design standard and its applicability in the area	(Cartlidge, 2006; El Fathali, 2015; Zhang, 2005)

	Operation and maintenance program	the plan to run the asset and maintain its excellence during the operation stage	
	Construction program and Milestone timeline	a comprehensive schedule of construction activities and their timeline indicating the milestone of the project	
	Proposed Construction technology and methods	refers to the technology and methods, equipment used for constructing the project.	
	Technical transfer to public operation	plan for handing over operation to the public partner once the concession period or lease period is over	
Managerial	**Past experience in executing similar projects**	the level of experience of the personnel comprise the management team that they have over the years on similar projects	(APMG International, n.d.; El Fathali, 2015; Li & Akintoye, 2003; Yescombe, 2007; Zhang, 2005))
	Commitment and acceptance of risk transfer	adhering to the major risk governed in constructing the project, financially and technically.	
	Clear responsibility allocation in consortium	a clear structure of leadership positions and individual responsibilities allocated	
	Working and contractual relationships among participants	rapport within the consortium working relationship	
	Change of ownership	the possibility of shareholder's ownership of the project company changes or transfer within the consortium and the effect of it with the prior agreements with the public authority	

	Proposed Contingency plan	contingency possibilities for situations where the project may be affected by the economic environment of the country	
Safety/Environment	**Comprehensiveness of proposed environmental policy and management plan**	a policy demonstrating the management of construction environment and its operation.	(Cartlidge, 2006; El Fathali, 2015; Zhang, 2005)
	Project Sustainability plan	Plan for how "the asset are procured and erected, used and operated, maintained and repaired, modernized and rehabilitated and reused or demolished and recycled constitutes the complete life cycle of sustainable construction activities"	
	Compliance to laws and regulations	clearing commitment to the laws, specification, policies, or standards that the public authority aspire the private personnel would have it	
	Qualification/ experience of safety and environmental personal	assessment on the personnel involved in the project and their qualifications and experience within the scope of safety and environment	
Political/public acceptance	**Understanding of legal requirements**		Demirel et al., 2017; El Fathali, 2015; Zhang, 2005
	Compliance with permit requirements		
	Compliance with boycott trade law		

2.4 Analytic Hierarch Process (AHP)

Being bound to make a decision might be troublesome. Most individuals might rely on intuition, past experience or advice from peers and for some situations these aren't suffice enough to make the right decision (Clemen & Reilly, 2013; Harker, 1989). Hard decisions require a deep look into them to avoid longer repercussions (Clemen & Reilly, 2013; Mu & Pereyra-Rojas, 2017). Uncertainty exists in almost everything and the world is becoming more uncertain and disordered. Therefore analytical decision making is required to aid decision makers (Mu & Pereyra-Rojas, 2017). (Clemen & Reilly, 2013) discussed the main sources that make decisions hard:

- The complexity of a situation is one of the sources that could make the decision maker job harder and overwhelming. Multiple layers might hinder the proper analysis of each component of the problem.
- The uncertainty inherited in each problem. The fact that the decision maker most probably will have no control over multiple factors thus a decision may hae to be made before the uncertainty is revealed or resolved.
- Another source of difficulty for the decision maker is to work on multiple objectives based. In some situation, working on one objective might hinder the progress on the others.
- The involvement of more than one decision maker may lead to difficulty to reach for a unanimous decision. This is mainly due to the subjective opinion and take of each individual on the problem. Such disagreements might occur on the probability or the predicted worth of outcomes.

Thus for a better comprehension of the situation, problems are better de-structured to be understood more and to communicate the justification of the chosen action to be taken (Harker, 1989). Decision analysis tools enable to breakdown complex problems which that would add clarity and insight to the decision maker by using the mathematical analytical tool (Clemen & Reilly, 2013). The analytic hierarchy process (AHP) is one of these decision analysis tools. Professor Thomas Saaty is the inventor of this tool which was developed in the 1970s for the purpose of structuring problems in hierarchal way to reduce the complexity of the problem, a tool that enable the user to input their expertise and preference is considered an advantageous tool (Golden, Wasil, & Harker, 1989; Mu & Pereyra-Rojas, 2017). (Harker, 1989) defined it as "an intuitive and relatively easy method for formulating and analyzing decisions". First application of AHP is reported to date back to 1973. The developing of transportation infrastructure in Sudan. Ever since various theoretical studies and research have been dedicated to extend the applications of the tool (Golden, Wasil, & Harker, 1989).

2.4.1 Understanding AHP

(Golden, Wasil, & Harker, 1989) gave a brief discussion on the meaning and the philosophy behind the terms "Analytical", "Hierarchy" and "Process":

- Analytic: in association with the word, the inclusion of the mathematical/logical reasoning in the decision making to understand and provide description of the alternatives.
- Hierarchy: to deal with the complexity of the problem and understanding the situation. The tool arranges elements in levels, thus the decision maker is more clear sighted and focused.

- Process: reaching to a decision while handling a a delicate situation requires mostly require a process and effort that wouldn't be done in one meeting. AHP was designed to help this process for individuals and not to decide blindly for the person.

A common hierarchy usually consists of three levels with the goal being on the first level, criteria consequently following in the second level and finally the alternatives being at the last level. (Figure 2.6). Hierarchical decomposition offers the ability to deal with diversity of the information at hand. (Ali, Šaparauskas, & Turskis, 2017)

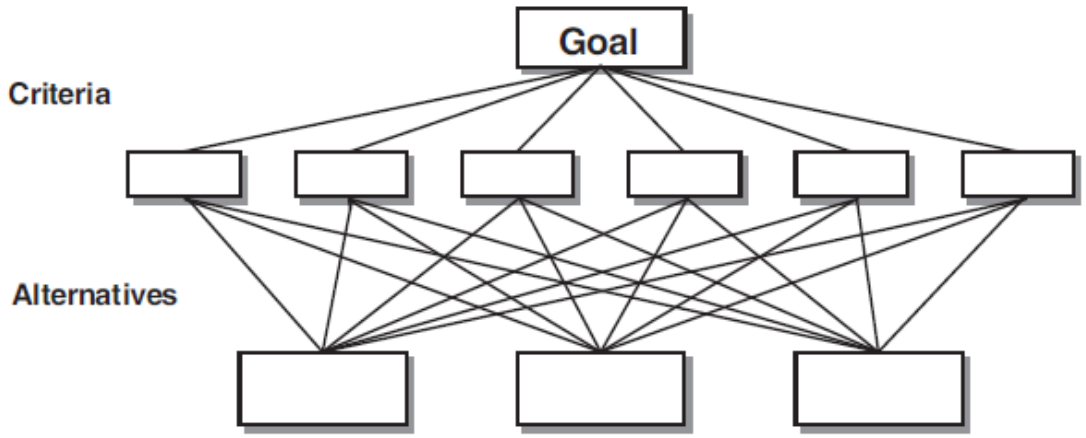

Figure 2.6 Hierarchy of AHP (Ali et al., 2017)

The following steps demonstrate how to conduct an analysis using Saaty tool,

1. Define the problem and determine the kind of knowledge sought.
2. Structure the decision hierarchy from the top with the goal of the decision, then the objectives from a broad perspective, through the intermediate levels (criteria on which subsequent elements depend) to the lowest level (which usually is a set of the alternatives).

3. Construct a set of pairwise comparison matrices. Each element in an upper level is used to compare the elements in the level immediately below with respect to it.
4. Use the priorities obtained from the comparisons to weigh the priorities in the level immediately below. Do this for every element. Then for each element in the level below add its weighed values and obtain its overall or global priority. Continue this process of weighing and adding until the final priorities of the alternatives in the bottom most level is obtained. (Saaty, 2008,P.85)

To construct the pairwise comparison tables a numbered scaled which will act as an indicator to the decision maker by determining each alternative importance and priority to the other with the respect to the set criteria of the study (Saaty, 2008).Table 2.3 shows the scale.

Table 2.3 The fundamental scale of absolute numbers (Saaty, 2008)

Scale	Intensity	Description
1	Equal Importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgement slightly favor one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgement strongly favor one activity over another
6	Strong plus	
7	Very strong or	An activity is favored very strongly over another; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
Reciprocals of above	If activity *i* has one of the above non-zero numbers assigned to it when compared with activity *j*, then *j* has the reciprocal value when compared with *i*	A reasonable assumption

2.4.2 AHP in Construction

The application of the analytic hierarchy process to model and structure hard decisions has been widely varying in the industries. Including qualitative and quantitative enabled the spread of the tool in the diverse areas such as, space exploration, urban planning and health care (Golden, Wasil, & E. Levy, 1989). Nevertheless, the construction industry is one of these industries. Construction processes are tending to be known risky, legally and financially to the parties involved (Ali et al., 2017). Thus decision makers when facing a decision of choosing between alternatives based on multiple criteria best to rely on decisions analysis tools to mitigate these risks (Gutierrez-bucheli, Vallejo-borda, Luis, & Tienda, 2016). AHP has its fair usage in the construction industry as a multi criteria decision tool. (Darko et al., 2018) have reviewed the published papers from the period of 2004 to 2014 on the application of AHP in construction management. Risk management and sustainable construction were the two most covered areas in in 8 peer-review journals. AHP tool in these 77 papers reviewed was conducted solely and also in conjunction with other tools. (Ali et al., 2017) has given a case study that took place in turkey. A 3 stars hotel consisting of 7 stories was being constructed at its last stage. Stakeholders of the hotel had decided that the hotel require a swimming pool, thus the project manager at that time was under the situation of making a hard decision to select a contractor that is required to carry the job in the desired manner. The main objectives for the selection of a contractor were: good quality, good design and optimum financial bid for the work. List of the criteria and their sub-criteria were reviewed from literature to conduct the analysis on the available contractors: TE - Technical Experience, PE - Performance Record, FS - Financial Stability, and ME - Management and employees' qualification, CA -Capacity, SR - safety record, OE operation equipment. Criteria were evaluated based on its origin. Consequently, the analytic hierarchy process was completed then by the expert choice software. The software which has the AHP

method built within. Whereas (Doloi, 2008) implemented the tool to identify critical factors to suggest improvement in construction productivity to establish managerial procedures for that purpose. Surveys were structured and distributed to 19 experts, including 72 questions that were formulated to cover three categories: project planning, incentives/disincentives and job satisfaction. The analysis showed planning and programming to be the major influence on productivity.

2.5 Multi Attribute Utility Theory

Multi-Attribute Utility theory is one of the decision making tools that allow the decision maker or the interested party to evaluate different alternatives with multiple attributes in consideration of several criteria, and allow to assign values to these attributes for assessment and eventually the alternative with the best expected utility score is selected (Jansen, 2011; Lin, 2004; Sawalhi, 2017). Zeleny, in 1982 stated that MAUT was developed out of the unidimensional utility theory and its central principle of "rational" behavior (as cited in Lin, 2004). Subsequently, It was in 1993, when a proposal of five-point assessment procedure was proposed by (L.Keeney & Raiffa, 1993) to base the utility function on it. USA and many European countries has been utilizing MAUT regularly in the process of selection and decision making due to its simplicity for usage, thus contractor selection process used MAUT (Patil, Mudgal, & Patil, 2016). There are main elements to construct a model based on Multi attribute utility theory listed in Table 2.4..

Table 2.4.1 Concepts of multi attribute theory utility.

Concepts	Description
Alternatives	Options where the decision-maker has to choose from, for example, various private partners.
Attributes	Important ('salient') characteristics of the alternatives, for example, "Past experience" and "Design firm capacity".
Attribute levels	Levels of the attributes. For example, "2 years" is a level of the attribute "Past expereince".
Attribute value	The numerical value that is attached to a particular attribute level. A higher value is generally related to more attractiveness.
Importance score	A numerical value that indicates the importance of each attribute. A higher score is generally related to more importance.
Weight	The importance score after transformation such that, for each respondent, all attribute weights add up to one.
Single attribute utility	The numerical strength of preference of an attribute level. It results from the multiplication of the attribute value with the attribute weight.
Combination rule	The rule that is used to aggregate over the single-attribute utilities. Usually, the simple additive rule is applied: the single-attribute utilities are simply added to obtain the multi-attribute utility.
Multie attribute utility	The numerical strength of preference of an alternative. It results from the aggregation of single-attribute utilities.

Note: Adapted from Jansen, S. J. T. (2011). The Multi-attribute Utility Method

2.5.1 Steps to construct MAUT

Von Winterfeldt and Edwards, (1986) stated that The steps of making MAUT and constructing its model, it could change and differ in the way of obtaining weights or evaluation of single attributes (as cited in Jansen, S. J. T. (2011).

1- Define Alternatives and Value-Relevant Attributes
2- Evaluate Each Alternative Separate lyon Each Attribute
3- Assign Relative Weights to the Attributes
4- Aggregate the Weights of Attributes and the Single- Attribute Evaluations of Alternatives to Obtain an Overall Evaluation of Alternatives
5- Perform Sensitivity Analyses and Make Recommendations

2.5.2 MAUT in construction

(Sawalhi, 2017) made a research utilizing the multi attribute utility theory for the selection of an appropriate procurement method for projects constructed in Gaza strip, Palestine. The methods subjected to the study were traditional procurement method, design-build, Management and Public-Private partnership. A model was developed based on the theorem. Post identifying the factors that are considered important and influential to the performance of the procurement methods which were determined based on the experts feedback. Weights were assigned to prioritize these factors. Following this, three existing project cases were presented to evaluate the methods;. Three experts were requested to give attributes values or performance values to these factors based on the suitability of each method with the factors and multiplied it by the weights. The results showed the traditional method was the most appropriate form of contracting due to the lack of experience and knowledge about the others methods.

Another research done by (Patil et al., 2016) on the selection of contractors and assessing the criteria suitable for evaluation of contractors. The goal was to assess both qualitative and quantitative factors for a development of a model to be used for Indian companies to select contractors for projects as the bid price or choosing the lowest price may be misleading and govern many risks on the quality, commitment and duration in the project. Thus, a model was developed after investigating the criteria influential to the selection process and performance of the candidates. based on the findings for the decision makers MAUT was chosen due its simplicity and to evaluate contractors alternatives based on the set criteria.

On another side of the construction industry, MAUT was taken as a study for selecting the appropriate construction method. (Y. Chen, Okudan, & Riley, 2010) reviewed a model named "Construction Method Selection Model" (CMSM), which essentially was developed to aid designers and building teams to decide whether to prefabricate concrete building systems or not for a certain project. The model consisted of two levels to deal with strategic and tactical planning for selection. The first level implemented a simplified version of MAUT which is called Simple Multi-Attribute Rating Technique (SMART) for the strategic part which dealt with the preliminary project attributes that would decide whether to proceed with prefabrication or not. The attributes were project characteristics, site conditions, market attributes, and local regulations once the project is set to be prefabricated, the second level, of the model, which is the tactical level, assess further attributes that deal with uncertainty by using The Multi-Attribute Utility Theory (MAUT). Such attributes affect to what extent the prefabrication should take place, thus its evaluated. These attributes were concerning economic factors: "long-term cost", "constructability", "quality" and "first cost"; social factors: "impact on health and community",

“architectural impact”; and environmental factor: “environmental impact”. The review stated that the model is useful and could be utilized for such purposes.

2.6 Integration of Decision Making

Multi-criteria decision-making (MCDM) techniques vary as their procedure could govern different mechanism to reach to optimum solution. Integration of more than one MCDM to construct a model is an approach adapted by many researchers and decision makers to enhance models and make them as efficient as possible (CHANG, 2014; Hanine, Boutkhoum, Tikniouine, & Agouti, 2016). In the software industry (Hanine et al., 2016) integrated an analytical modeled governing AHP (Analytical Hierarchy Process) method and TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) in order to select an ETL software, which are extracting data software, after evaluating both qualitative and quantitative criteria taken specifically from decision makers’ requirement. AHP was used for prioritizing the multi criteria that could be conflicting. Whereas, TOPSIS was used to for the purpose of rating the different available alternatives of ETL software. A similar model was made by (Rashid, Razzaq, Ahmad, Rashid, & Tariq, 2017) consisting both AHP and TOPSIS. The study was an experimental study on sustainable recycled concrete to achieve less ecological influences. The problem was to determine the amount of replaced concrete aggregate with the ceramic waste aggregate. 30 % was the optimum percentage of replacement that would achieve the highest compressive strength.

A growing market for the intelligent building systems is in present and a variety of technologies with wide range of applications incorporated in building design. (Hatefi, 2019) implemented both AHP and PDA (Preference Degree Approach) for constructing a model for the aim to select an intelligent building technologies that would meet the expectations of those who develop it,

sell it and use it. AHP was used under the fuzzy nature to obtain weights of the related criteria to the systems. Whereas the PDA was used to rank the five alternatives available in Isfahan, Iran. In the infrastructure industry.

Developing countries focus on the improvement of infrastructure and thus, it became a top priority to push the economy of a country forward. Infrastructure is considered the key to create balance among the economic, social and environmental aspects forming the Triple Bottom Line (TBL) in these countries. However, there is lack of published tools for this aim. (Diaz-sarachaga, Jato-espino, & Castro-fresno, 2017) presented a development of rating system that was made for sustainable infrastructure. The author utilized AHP and MIVES (Integrated Value Model for Sustainable Assessment) as the MCDM tools for model. AHP as usual dealt with the weight of criteria by taken the importance of each from experts while MIVES was used to evaluate the given project infrastructure to the contribution to the Triple Bottom Line. (Alshamrani, 2015) had conducted a study to create an integrated selection model for sustainable alternatives that would provide the optimum alternative for school building envelopes in Canada that would offer a well structurally and environmentally performance. In the research, the author had applied both AHP and MAUT methods for identifying, calculating the weights for a set of selection criteria through experts. Only one expert had participated in the preliminary survey which was originally sent to seven school administrators to identify the selection criteria. Secondly, the main first survey which governed the AHP process sent to 250 schools boards and only 13 valid responses passed the consistency test. The criteria were initial costs, running costs, environmental impact costs and sustainability principles. Afterwards, experts were asked to fill in utility function values based on their preference for the criteria, these

values helps to develop the utility curves for the criteria mentioned above. Only five respondents participated in the second survey that governed the MAUT method process.

2.7 Identified Gaps and Limitations

- There is lack of research conducted on selection of the private partner for 3P projects as only 4 published papers were found for infrastructure projects and almost non for housing projects.
- There is shortage in data for PPP case studies and research in Saudi Arabia
- The current procedures for selecting suppliers and contractors may not be applied to the private partner in PPP as the nature of contract and project vary significantly

CHAPTER 3 - RESEARCH METHODOLOGY

3.1 Introduction

As discussed above, Saudi Arabia market is taking steps into transitioning; a transition that would involve the private sector into multiple national industries. These efforts are working in allegiance with the major vision; 2030 vision. The government is aiming to encourage the private sector to work under the schemes of Public-Private Partnerships to deliver projects and services to the public by issuing legislative and a national unit to oversight the operations. The shortage and demand of housing for kingdom's citizens made urban housing one of the industries included in the delivery plan. Selecting the private partner for a project is a crucial success factor and may avoid many complications and delays although major risks such as cost overruns and technical risks are relying on the private partner.

In this chapter, the research methodology will be discussed on to set a criterion for selection of private partner under the PPP agreements for housing projects in Saudi Arabia. Data required to be collected; methods of collecting data, and the analysis methods that will be used in this research will be in the upcoming sections

3.2 Research Approach

To achieve the aims of this study, which is to define selection criteria for PPP in housing projects in Saudi Arabia, the developed methodology is designed to overcome the identified limitations of current practice in selecting PPP. The methodology consists of the following phases:

Phase 1: Investigation the current practice applied in KSA for the selection of PPP through reviewing the meetings with local experts.

Phase 2: Identification of the selection criteria of PPP through conducting a comprehensive literature review and meetings with local experts for the unreported criteria.

Phase 3: Combining the identified criteria from the literature with that obtained from interviewing local experts

Phase 4: Development of the model for the selection of PPP based on integration of AHP and MAUT techniques.

Phase 5: An overview of the model showing an application of the developed model for a hypothetical example.

An overview of the full research approach is illustrated in Figure 3.1 below.

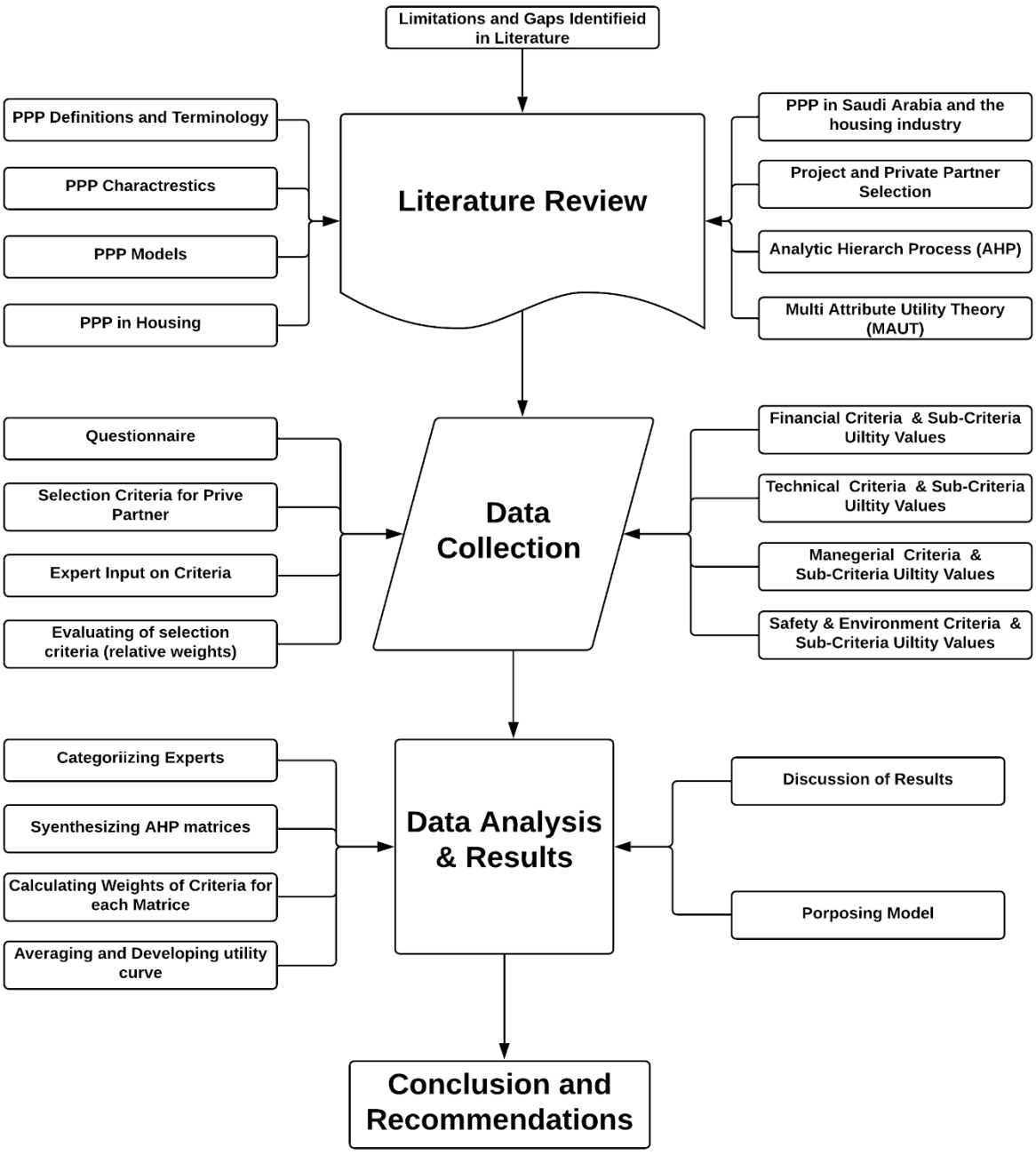

Figure 3.1 Research Methodology

3.3 Selection Criteria Identification

The selection criteria may vary from an industry and the other, countries and regions. In this study, the identification of the selection criteria suitable for private partners in the housing industry was defined into two stages. An initial list of selection criteria is extracted from a comprehensive literature review of scientific papers and previous research studies that discuss the criteria selection of private partners and related success factors in order to define a preliminary list for a pilot study. This pilot study will be designed into a questionnaire and presented to sample of experts. Post the set of criteria being listed. A targeted sample of population in the central region of the kingdom of Saudi Arabia will participate that would allow them to add and remove main/sub-criteria of selection suitable for private partners for housing projects in Saudi Arabia. The participants targeted are from both public and private sectors that directly involved in partnered housing projects.

3.4 AHP

AHP may have different procedures incorporated on them as the technique can be utilized differently (Akaa, Abu, Spearpoint, & Giovinazzi, 2016) and has been broadly evolved with the year (Golden, Wasil, & Harker, 1989). The AHP procedure followed for this study is as follow.

3.4.1 Step1: Defining the problem

The problem and goal for the current study concerns the selection of the optimum private partner suitable for housing projects in partnership with the housing ministry (public sector) based on the selection criteria identified previously in the literature.

3.4.2 Step 2: Structuring of Hierarchical model for the problem

The first step for the study is to decision modelling, which is the prime advantage of the technique which allows for the problem to be broken down into hierarchy (Mu & Pereyra-Rojas, 2017; Saaty, 1994). The hierarchy starts from the goal, which is in this study the selection of private partner, and then it identifies its criteria that would satisfy the goal. After that a third level is made for the sub-criteria which aims to satisfies the main previous criteria (Augusto & Marins, 2013; Saaty, 1994). These criteria were previously extracted from literature and pilot study as explained above. The structured hierarchy for this study is demonstrated in Figure 3.2

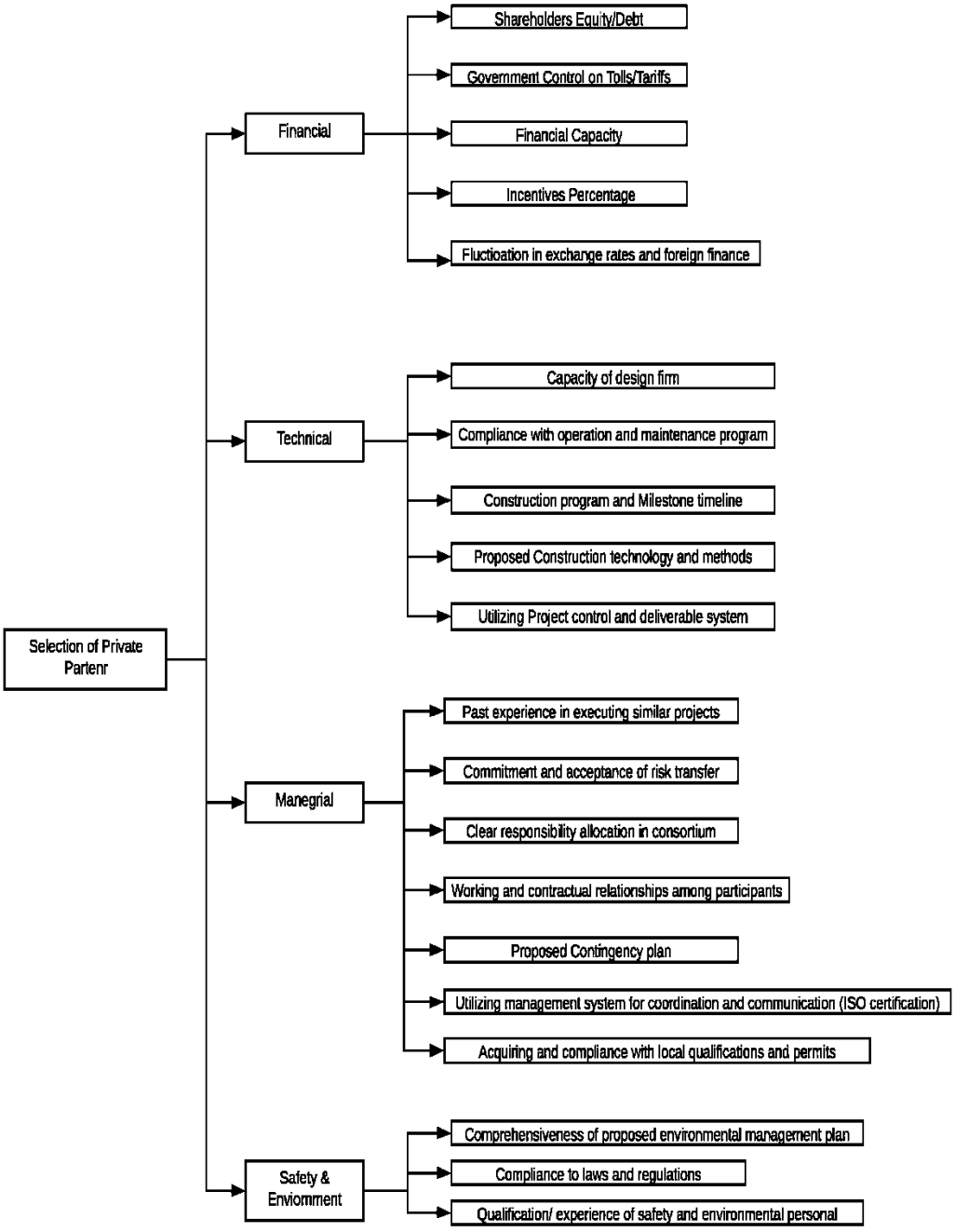

Figure 3.2 Study hierarchy structure

3.4.3 Step 3: Judging and evaluating the criteria

In order to carry on an AHP study, pairwise comparison is needed. In this step the pairwise comparisons of the hierarchy model is made to be presented to those who would assign their judgements. Similar matrices for each criterion are made also for the purpose of defining the importance of each criterion to the other and obtain subsequently the relative priorities of these criteria based on the expertise of the experts. The saaty's scale (1, 2, 3……-9) (Table 3.1) is used for filling the pairwise comparisons and then to generate the relative importance of each subjected criterion in the different levels as shown in the hierarchies. The numeric value of 1 from the scale means that that the two compared subjected criteria are equal in the importance and the numeric value 9 represents the maximum possible importance for the chosen criterion when relatively compared to the other. (Saaty, 1994). Let us denote criteria as C1,C2,C3…..Cn (n is the number of criteria in the pairwise comparison) and a_{ij} as the representation of the expert preference for the comparison taken from the scale. row number represented by i and column number is represented by j Briefly, for example if the experts think "C1" is moderately more important than "C2", the expert would choose number 3 from which taken from the scale that represents that appropriate numeral values for verbal judgments. The lower diagonal part of the matrix should be calculated as the reciprocal of preference inputted by the expert (equation number) in Table 3.2

$$a_{ji} = \frac{1}{aij}$$

$$a_{ij} > 0$$

$$a_{ij} = 1$$

Table 3.1 Example of pairwise

	C1	**C2**	**C3**	**C4**
C1	**1**	**3**	a_{ij}	a_{ij}
C2	**1**/ 3	**1**	a_{ij}	a_{ij}
C3	**1**/ a_{ij}	**1**/ a_{ij}	**1**	a_{ij}
C4	**1**/ a_{ij}	**1**/ a_{ij}	**1**/ a_{ij}	**1**

Table 3.2 Saaty scale

Verbal Judgment	Numeric Value
Extremely Important	9
	8
Very Strongly more important	7
	6
Strongly more important	5
	4
Moderately more important	3
	2
Equally important	1
Reciprocals	$\frac{1}{2} - \frac{1}{9}$

Adapted from (Mu & Pereyra-Rojas, 2017)

3.4.4 Step 3: Calculate the weights or priorities for the criteria

To compute the weights of the matrix the eigenvector procedure is implemented on the matrices (C. Chen, 2006). First, the matrices are normalized by equation. Second the preferences of the criteria in the matricides are calculated by computing the arithmetic averages from the row of the normalized comparison matrix (Cabala, 2010).Calculating the preference between the elements under investigation (eigenvector)

w = [wi])

$a_{ij*} = \frac{aij}{\sum_{i=1}^{n} aij}$

$W_i = \frac{\sum_{j=1}^{n} aij*}{n}$

3.4.5 Step 5: Checking Consistency

A pairwise comparison would not be required if the elements to be compared are in the same elements. However this necessitates the need of consistency (Cabala, 2010). Matrices once filled by experts, should be checked for validation the consistency of their opinion input. (Saaty, 1990). Saaty has been able to find a connection or a relationship between the weights and the matrix for the comparison. As $\lambda_{max\ value}$ was identified to be as a reference index for obtaining the consistency ratio of a matrix. The λ_{max} value is calculated by the following equation

$$\lambda_{max} = \frac{1}{n} \sum_{i=1}^{n} \frac{(Aw)i}{wi}$$

$$Aw = \lambda_{max}\, w$$

A consistency index is calculated by incorporating the $\lambda_{max\ value}$ in the equation. Saaty stated that the number expressed by the difference $\lambda_{max} - n$ is a measure of the deviation of the inconsistent matrix from the consistent comparison matrix. On this basis, we can construct indicators showing the consistency of the expert's estimates. For evaluations of consistency (Cabala, 2010; C. Chen, 2006; Saaty, 1994).

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

A random index is specified by Saaty based on the number of the rows of the matrix. where RI is the random consistency index obtained from a randomly generated pairwise comparison matrix. Basically its an average over a large number of reciprocal matrices of the same order whose entries are random .Table 3.3 displays the values of these random indices

Table 3.3 Saaty inconsistency index

1	2	3	4	5	6	7	8	9	10
0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

Adapted from (Saaty, 1990)

Subsequently, the consistency ratio can be obtained by dividing the consistency index over the random index for inconsistency of matrices. Saaty have set a ratio of 0.1 (10%) to be the upper limit for an acceptable pairwise comparison. If a matrix exceeds consistency ratio of 10%, it is advises to revise the matrix and the expert input/judgements (Saaty, 1990).

$$CR = \frac{CI}{RI}$$

3.4.6 Step 6: Synthesizing AHP

Once the responses are collected and tested for consistency. The relative weights of the selection criteria are combined and computed for every pairwise comparison made by respondents. the mean, median, mode, and standard deviation are calculated in order to demonstrate the final weights.

3.4.7 AHP Questionnaire Design

The questionnaire designed to conduct the Analytic Hierarchy Process is sectioned into two parts. Part 1 requests the respondent to fill up their general information that would to allow them to be categorized based on their sector, experience, position, and educational background. Only those who are involved directly with PPP housing projects in Saudi Arabia from both sectors were targeted. Part 2 presented to respondents the main goal of the questionnaire which is to evaluate the criteria listed into pairwise comparisons to calculate their priorities that would be suitable to select a private partner. A sample of explaining the steps of filling the pairwise comparison matrix is illustrated in figure 3.3.

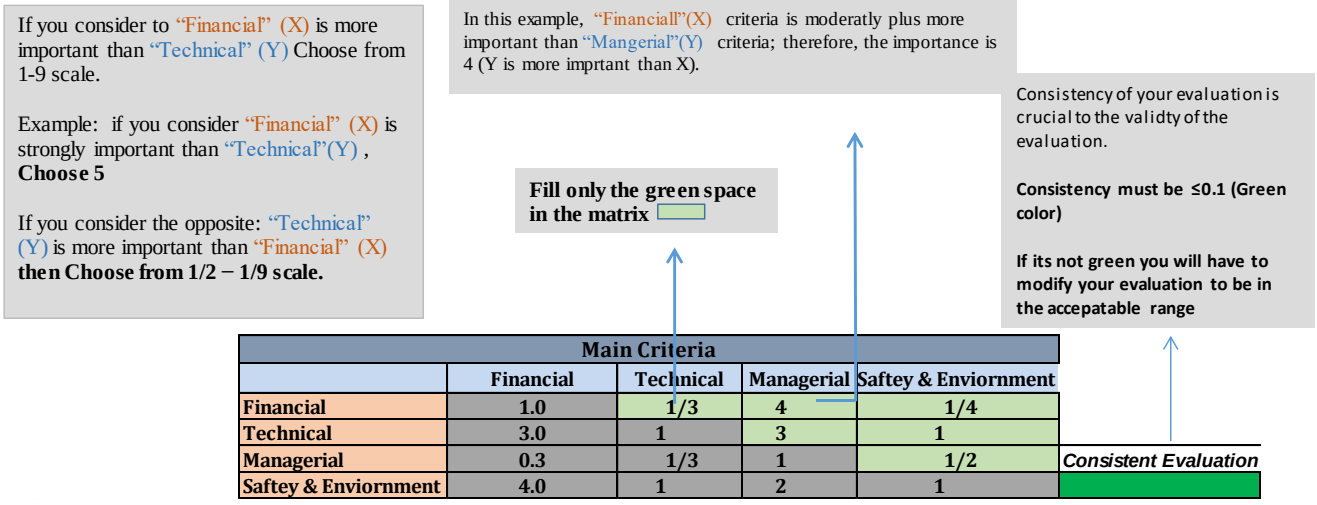

Figure 3.3 AHP questionnaire sample

3.5 MAUT

3.5.1 Step 1: Define value attributes

Post determining weights and the relative priorities for the selection criteria and their sub-criteria from AHP. Set of attributes is required to be set in order to construct a model. Alternatives further in, would be judged based on these salient attributes (Jansen, 2011). " The set of attributes has to be complete, operational, decomposable, non-redundant and minimal" (Keeney & Raiffa, 1979 p.50) also the number of attributes in this study is kept as small as possible as advised by (Keeney & Raiffa, 1979 p.50) . Von Winterfeldt and Edwards in 1986 gave few guidelines in determining value attributes to criteria:

1. a maximum and minimum limit is preferred to be specified prior to determining other midpoints.
2. The scale of attributes may be either quantitative or qualitative depending on the nature of them.
3. Qualitative scales may not always have intermediate points. (as cited in Jansen, 2011)

3.5.2 Step 2: Aggregate the Weights of Attributes and the Single-Attribute Evaluations of Alternatives

This step comes post identifying all the values for the attributes of this study and post AHP synthesize which determined the weights of attribute previously to this stage. A combination rule would be applied to each attribute and its value multiplied by the weight. The multi-attribute utility for alternative x is:

$v(x) = \sum_{i=n}^{m} Wi\ Vi\ (Xi)$

where vi (xi) is the value of alternative x on the ith attribute, wi is the importance weight of the ith attribute taken from AHP, and n is the number of different attributes (Von Winterfeldt and Edwards 1986, p. 263, p. 275).

3.5.3 MAUT Questionnaire Design

The questionnaire designed to collect utility scores of the identified criteria under the scheme of MAUT. The questionnaire is sectioned into two parts similarly to the AHP questionnaire. Part 1 requests the respondent to fill up their general information that would to allow them to be categorized based on their sector, experience, position, and educational background. Only those who are involved directly with PPP housing projects in Saudi Arabia from both sectors were targeted. Part 2 presented to respondents the main goal of the questionnaire which is to define utility scores for each criteria identified previously to generate utility curves. Table 3.4 presents a sample of part 2 of the questionnaire. In the table the criteria is explained and number of scores points are set for the expert to fill. Based on the input of the expert a utility curve is generated as shown in Figure 3.4.

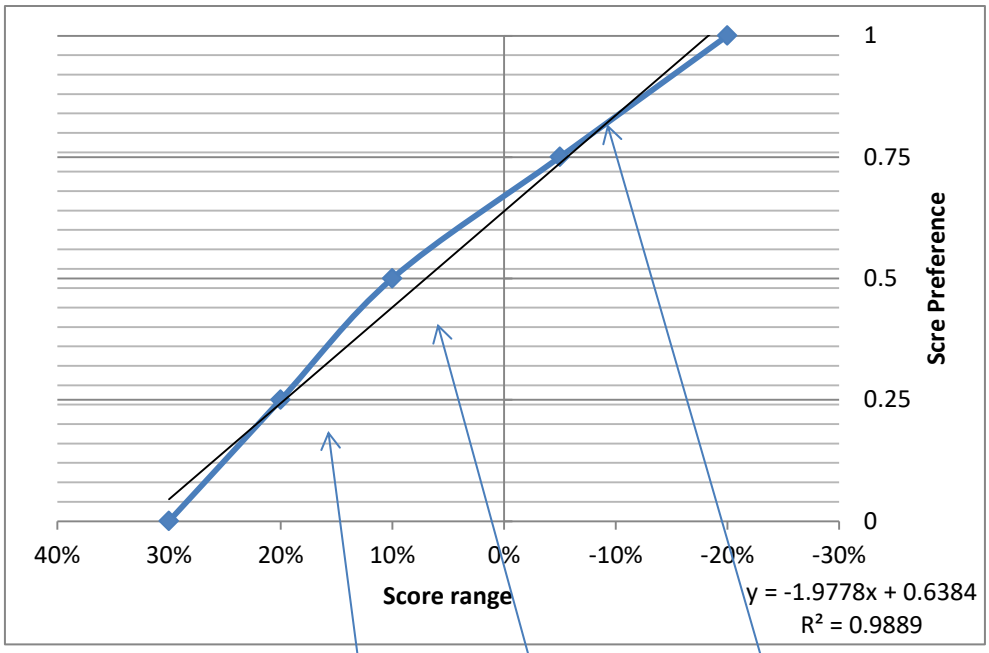

Figure 3.4 Sample utility curve

Table 3.4 Sample of utility scores filled by expert

Description of scale	**Government Control on Land Rates:** Sakani projects could be built on private lands and government lands. Private partner acceptance to the proposed rates from the government is crucial for the selection process				
Question	What is the desirable acceptance or compliance to the land rate from the private partner based on the average of the land rate. The scale is from 1-5				
Score Scale	0	0.25	0.5	0.75	1
Score	Average + 30%	Average + 20%	Average + 10%	Average – 5%	Average – 20%

The Minimum

The Maximum

3.6 Sample size

There are many approaches when it comes to selecting sample sizes. The targeted sample for this study and completed the questionnaires above to assess criteria for selection of private partner for housing projects consisted of project managers, engineers and administrators from both public and private sector in Dammam and Riyadh. Real estate developers (private partner) were obtained from the housing ministry

The sample of respondents that completed the survey and assessed the identified sustainable building materials criteria consisted of architects/ engineers who work in consultant offices in the Eastern Province were obtained from the Chambers of Commerce.

The sample size was determined using the following equations (kish, 1995)

$no = (p*q)/v2$

$n = no/ [1+ (no/N)]$

Where:

no: First estimate of sample size

p: The proportion of the characteristic being measured in the target population.

q : Completion of p or 1-p.

V: The maximum percentage of standard error allowed (10% for this study)

N: The population size.

n: The sample size.

Note: To maximize the sample, both p and q are each set at 0.5

3.7 Developing the Model

Based on the methodology steps explained above, a model of selection with a goal of determining a private partner for public-private partnership in the housing industry in the kingdom of Saudi Arabia is developed. The model incorporates the criteria identified earlier from the literature and pilot study as explained in both chapter 2 and 3 along with the attributes that were taken from databases and expert interviews. This study adopted an integration of multi decision making techniques which were: the analytic hierarchy and multi attribute utility theory. (Figure 3.5)

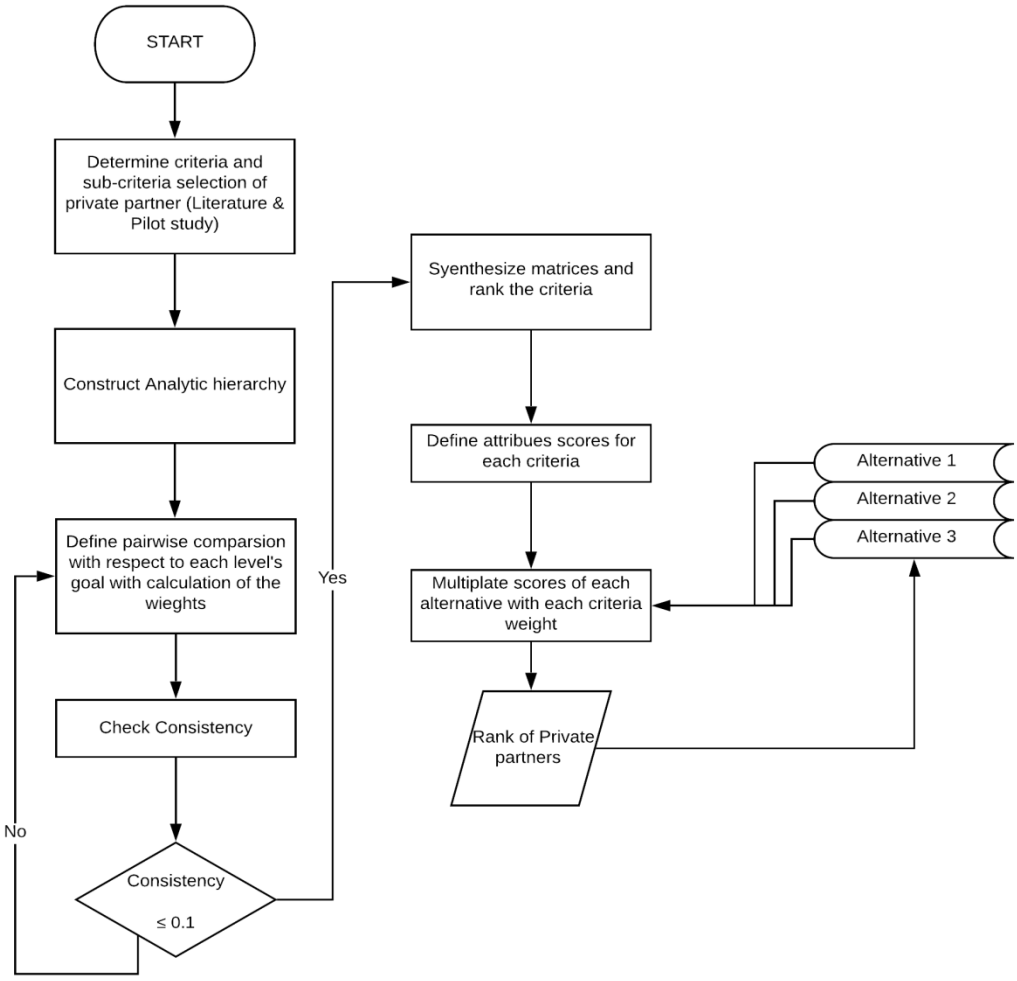

Figure 3.5 Flowchart of the selection model

CHAPTER 4 - DATA ANALYSIS AND DISCUSSION OF RESULTS

4.1 Introduction

This chapter displays the results and its discussion of the experts given the questionnaire along with an analysis of selected sample of experts that participated in the creating of model selection of private partners.

4.2 Identification of Population and Sample

The targeted population was mainly registered real estate developers with the Ministry of Housing for partnered projects and Public representatives related to the housing industry in Riyadh region. A list of 19 real estate developers has been obtained from “Sharakat” website. Where as there are 2 public entities representing the Ministry of housing. The sample size is then calculated by kish equation as explained in chapter 3.

For a total population of 21 entities and developers in the central region:

the sample size (n) = 25/ [1+ (25/21)] = 12 questionnaires is required.

4.3 Distribution of the Questionnaire

Three questionnaires were developed and distributed for the purpose of this research study was made in the capital of Saudi Arabia, Riyadh. The questionnaires were distributed in three different stages separately to satisfy the needs of the study. Mainly the population of the research were real estate developers (private partners), designers, financial advisors and public representatives for the following objectives.

4.3.1 Analysis of Pilot Study Questionnaire

Firstly, multiple initial interviews were conducted for the pilot study stage to investigate selection criteria with experts for selection of private partners in “sakani” project, and to assess the given criteria to them based on their experience. The experts were asked to fill The first part of questionnaire which is to identify and obtain the respondent’s background such as personal information, education level, occupation and experience.

Finally, the second part presents the experts with a list of criteria taken from the literature review for them to add, modify or remove. 17 requests of interviews and pilot study lists were sent to experts in the different sectors that is related to the public-private partnership in the housing industry. 7 responses for the were obtained with a rate of response of 41%. 57% of the respondents were working for the private sector where as 43% were working for the public sector. The experiences and the positions of the respondents differed. Such positions were engineers who are project managers, sales operation manager with business administration background. Figure 4.1 and figure 4.2 display the sectors of respondent and positions in graphs. Public sector respondents were mainly with urban planners education background that hold administration positions. On the other side the private sectors had different positions with different academic background. This enabled to get the wider views and input on the criteria for the selection of the private partner as shown in figure 4.3.

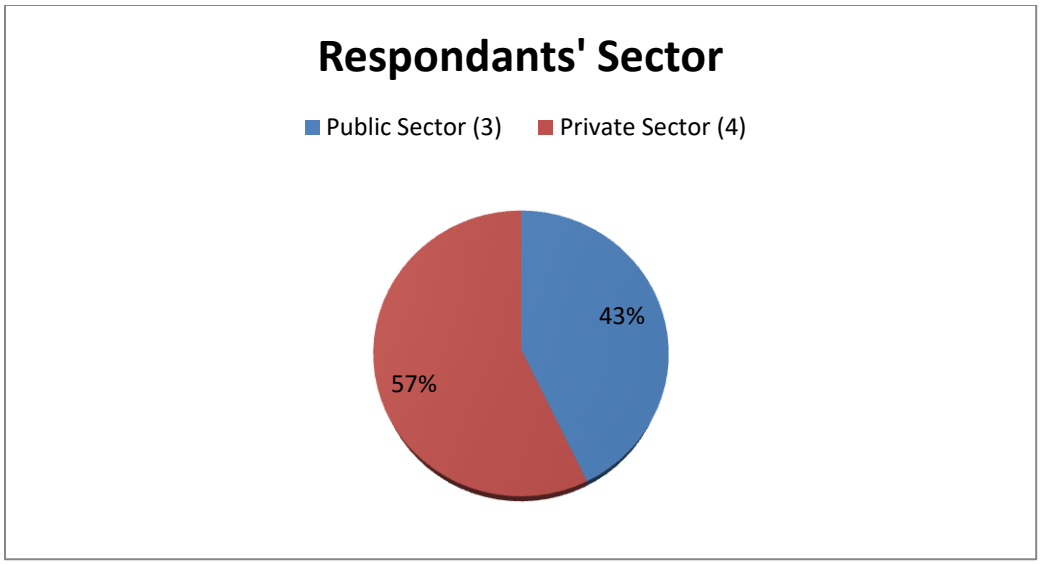

Figure 4.1 Respondents' sector

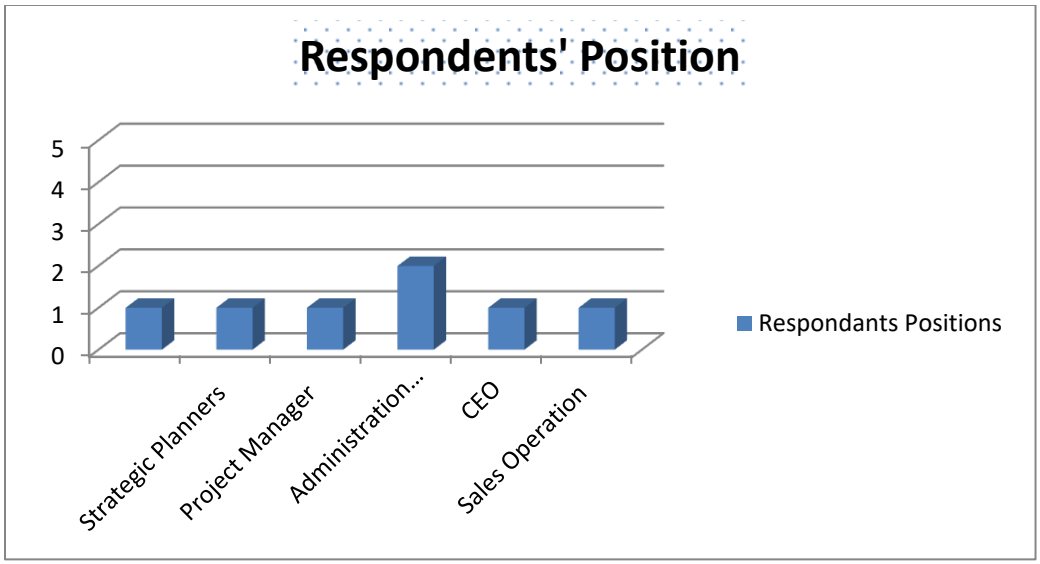

Figure 4.2. Respondents' Positions

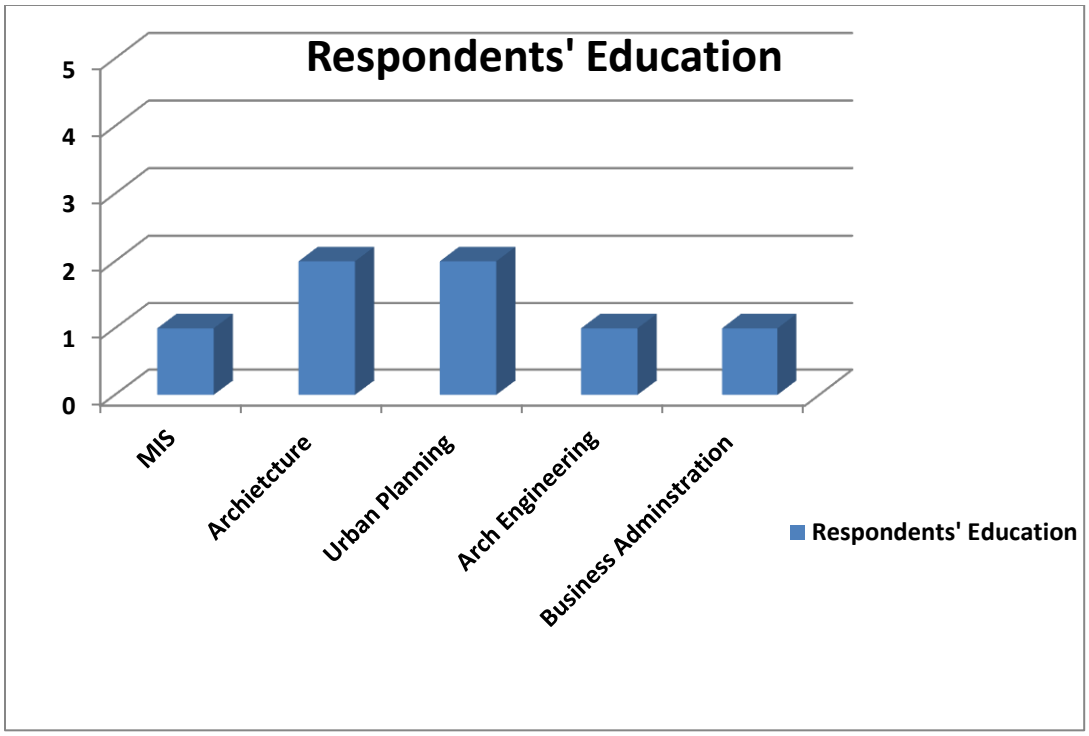

Figure 4.3 Respondents' academic background

Years of experiences for these respondents were categorized into 4 categories. 42% of the respondents in the pilot stage were in the "6-10 Years" category, where as 28% were in the "11-15 Years" category. Only 14 % were in the "1-5 Years" and "More than 15 years" categories. The graph below shows the categories and the distribution of the respondents among these categories (Figure 4.4).

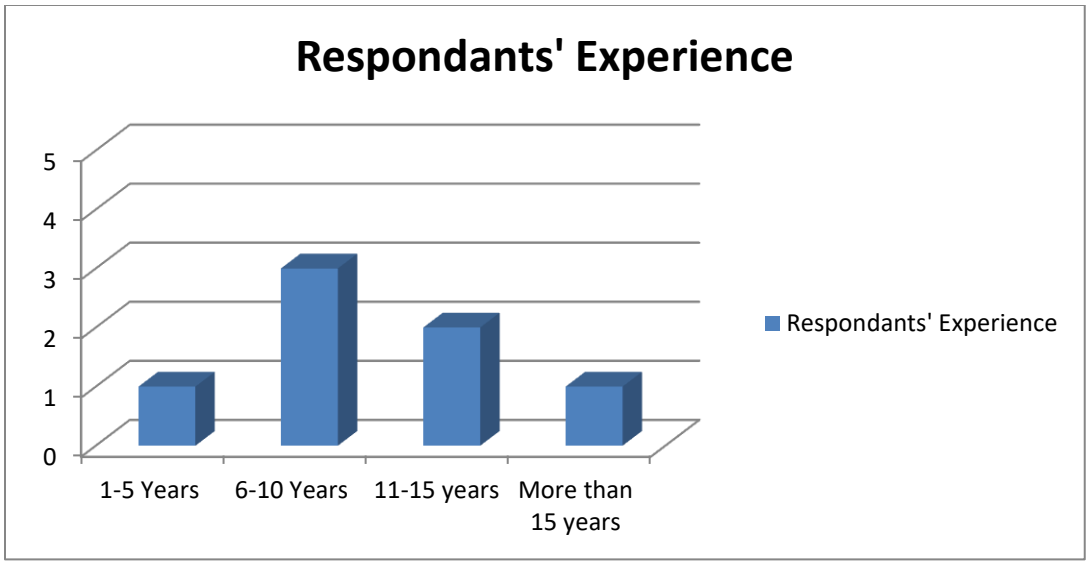

Figure 4.4 Respondents' Experience

A final list for selection of private partners for "sakani" projects after interviews with experts from both the public and private sectors is defined for the study to proceed. The results of the interviews has modified few of the financial criteria to suit the country regulations and the program, removed the political acceptance criteria due to its inapplicability to housing industry. Also the pilot study resulted in removing other sub-criteria such as "change of ownership", "technical transfer to public operation", and "expected revenue method" the final is listed below in Table 4.1.

Table 4.1 Identified criteria list by pilot study

Cat.	**Criteria**	Source
Financial	Debt/Equity of Project Finance	Modified by Experts
	Government Control on Land Rates	Modified by Experts
	Government Incentives	Modified by Experts
	Financial Capacity of Shareholders	Modified by Experts
Technical	Capacity of design firm and its proposed design standards	From Literature
	Operation and maintenance program	From Literature
	Construction program and Milestone timeline	From Literature
	Proposed Construction technology and methods	From Literature
	Utilizing Project control and deliverable system	Added by Experts
	Past experience in executing similar projects	From Literature
	Commitment and acceptance of risk transfer	From Literature

	Clear responsibility allocation in consortium	From Literature
	Working and contractual relationships among participants	From Literature
	Proposed Contingency plan	From Literature
	Utilizing management system for coordination and communication (ISO certification)	Added by Experts
	Acquiring and compliance with local qualifications and permits	Added by Experts
Safety/Environment	Environmental policy and management plan	From Literature
	Compliance to laws and regulations	From Literature
	Qualification/ experience of safety and environmental personal	From Literature

4.3.2 Analysis of AHP Questionnaire

The second one demonstrates matrices for pairwise comparison of criteria for the respondent to evaluate the relative importance of each to the goal of selecting a private partner for "sakani" housing projects. The criteria presented to the experts were set after the pilot study to determine the final list of criteria as listed previously. Main criteria and sub criteria didn't exceed 9 elements. (Saaty, 2008) argued that the individual's working memory have a limited capacity

based on the suggestions made from the findings of cognitive science. It was set that the person memory ideally should deal with 7±2 of elements. The matrices were made in spreadsheets and taken manually via conducting interviews with experts to fill their judgment and sent out to others.

The distributed surveys and requests of interviews reached up to 21, 9 responses were obtained back. The response rate was 43%. The majority of the respondents were from the private sector as the percentage is 89% to 11% of the public sector (Figure 4.5).

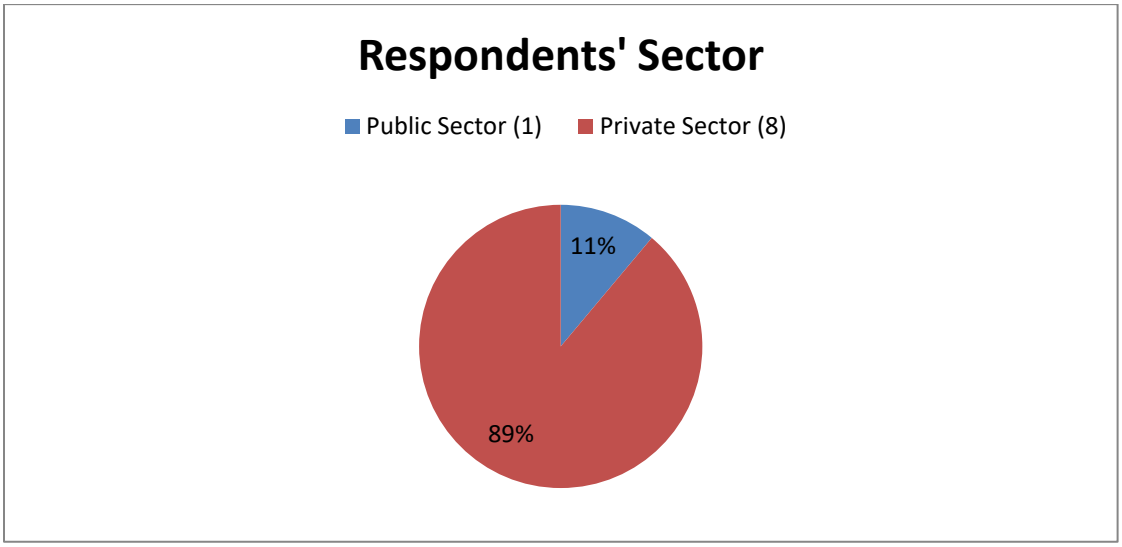

Figure 4.5 AHP respondents' sector

The criteria for selection governs a broad range type of criteria such as managerial, technical, financial and safety/environmental. The respondents of questionnaires and the interviews conducted hold sporadic positions in their organizations that deal with the different aspects of criteria for selection. 44% of the positions were a variety of managerial positions such as project managers, contract managers, Business development manager and sales operation manager. Where as the rest were engineers and planners (Figure 4.6).

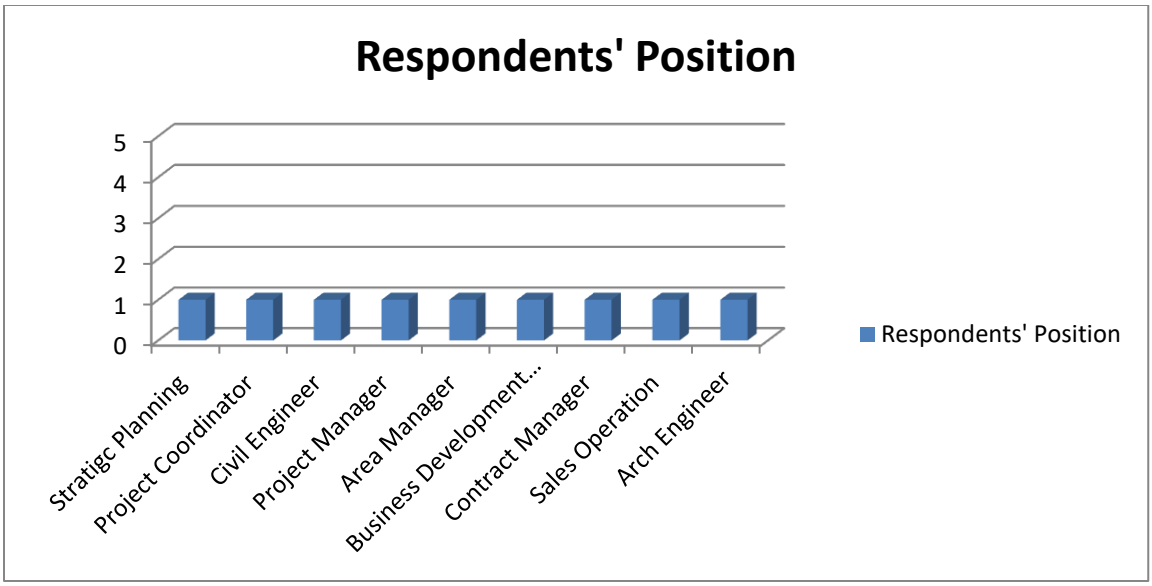

Figure 4.6 AHP respondents' position

The academic background of these respondents are displayed in the Figure 4.7 66 % of the sample participating in the study has an engineering degree in either architectural or civil engineering. Where as 34% of the rest have different degrees in business administration and accounting.

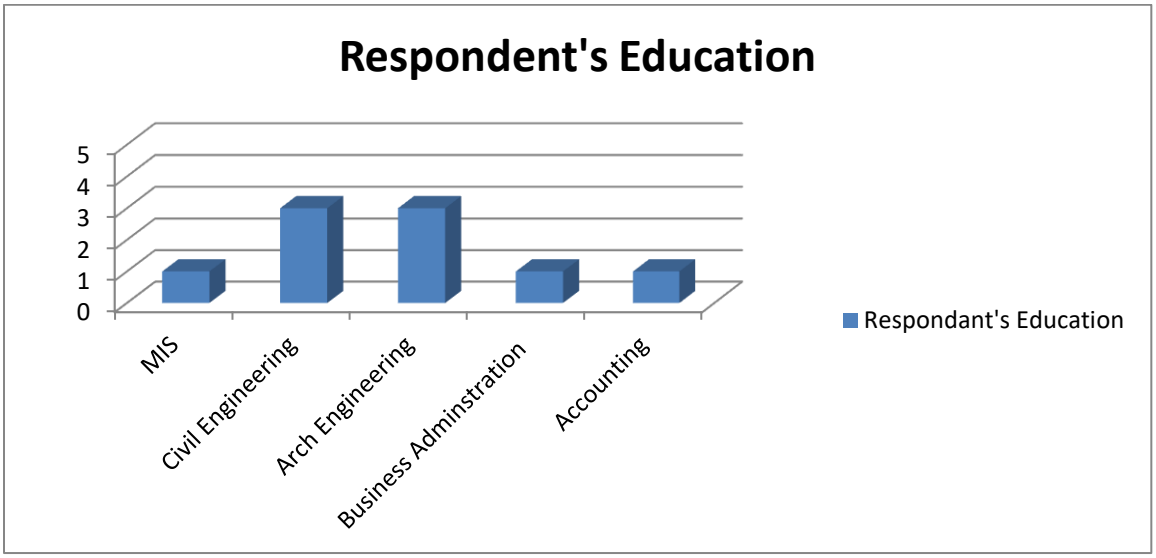

Figure 4.7 AHP respondents' academic background

The Figure 4.8 below indicates to a majority of experts being in their mid-career "6-10 years" level with a percentage of 44.4%. Senior experts with a career level more than 15 years were following with a high percentage of 33.3%, while the remaining of the respondents were under "1-5 years" category with a percentage of 22.3%.

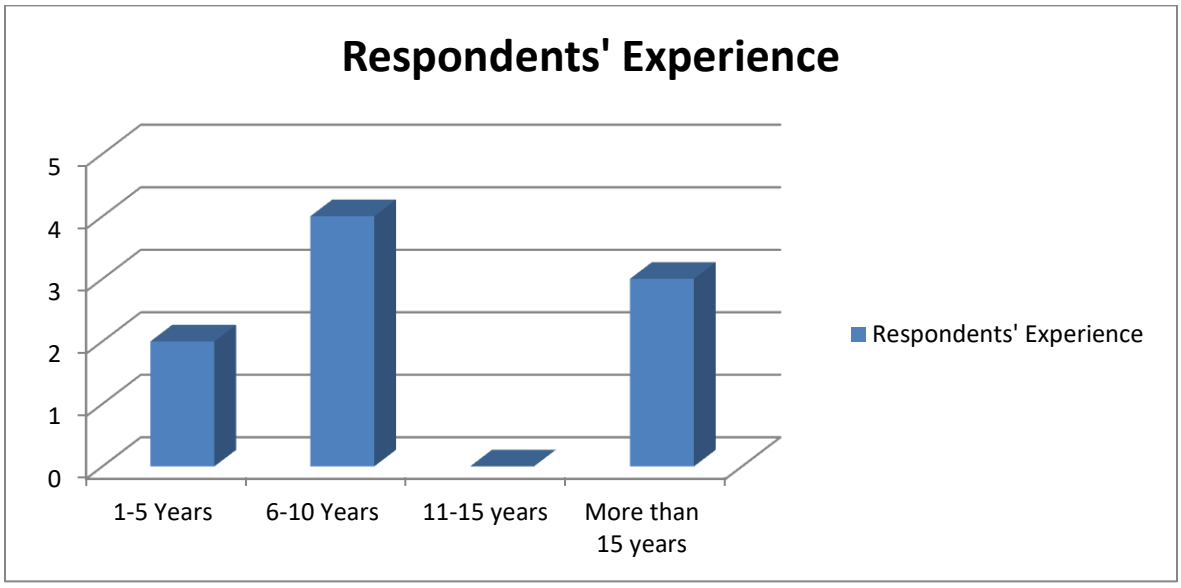

Figure 4.8 AHP respondents' Experience

4.3.3 Analysis MAUT Questionnaire

The last questionnaire was designed to identify attributes for the criteria, which would enable the procedure of assigning values or scores, by experts input. This would be used to create the selection model based on the multi attribute utility theory. (L.Keeney & Raiffa, 1993) stated that determining the attributes isn't an easy task. As the researcher would require to conduct multiple face-to-face interviews with experts along with literature search. It was noted from meeting with experts that the values of attributes is easily influenced by many variables such as project size, economic fluctuations and housing regulations which periodically are subject to changes. Respondents were presented with tables enlisting the criteria and requested to assign preference utility score for each criteria in a compatible unit as suggested in the tables in a scale of 0-1.0.

The best scores which are the most preferred values were assigned with a utility score of 1.0 while the lowest preferred utility score would be assigned with a score of 0. The expert is asked to set utility scores for each criterion to develop utility curves for the various selection criteria. The default utilities curves are made according to the experts' opinions. As noted before that modification might occur to the attribute values and parameters of these criteria which then would require re-setting the curves when it's required, to adapt to the changes made.

8 experts out of total 21 respondents participated in this part of the study to establish the utility curves of these criteria. Response rate is 38%. 87.5 % of the respondents were from the private sector and 12.5% of the respondents were from the public sector as shown in the Figure 4.9.

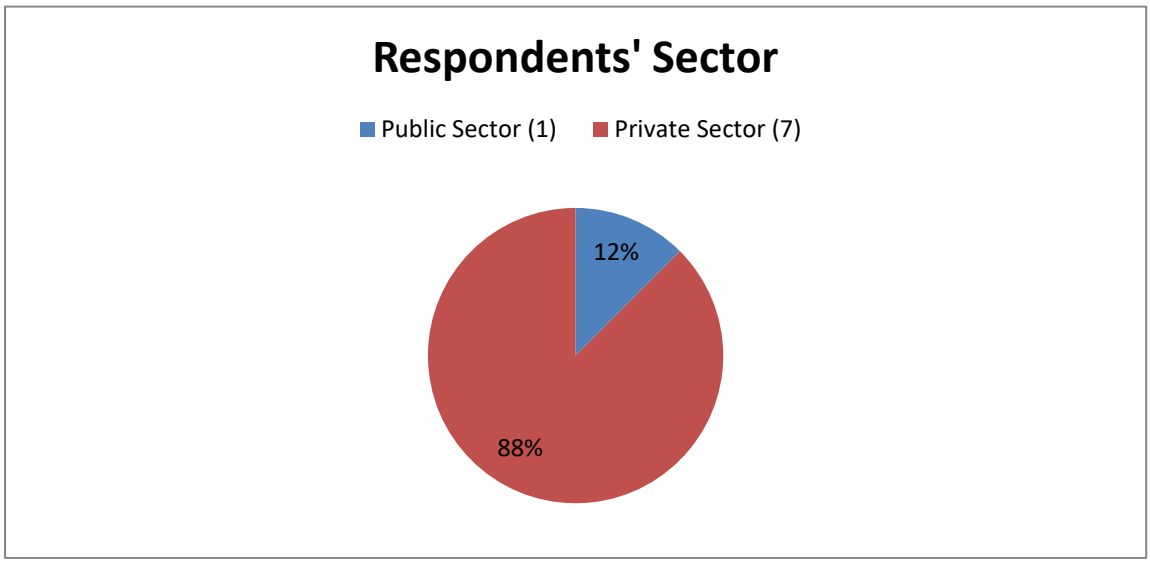

Figure 4.9 MAUT respondents' sector

Positions respondents are as indicated in the graph below Figure 4.10, followed the same trend of the AHP questionnaire with a major variety of career positions in managerial and engineering positions. The distribution of the 8 respondents for the positions is equal for the 8 experts. The academic background of these experts also is equally distributed between a variety of academic

majors except for the civil engineering major which has two experts having a degree in the major (Figure 4.11).

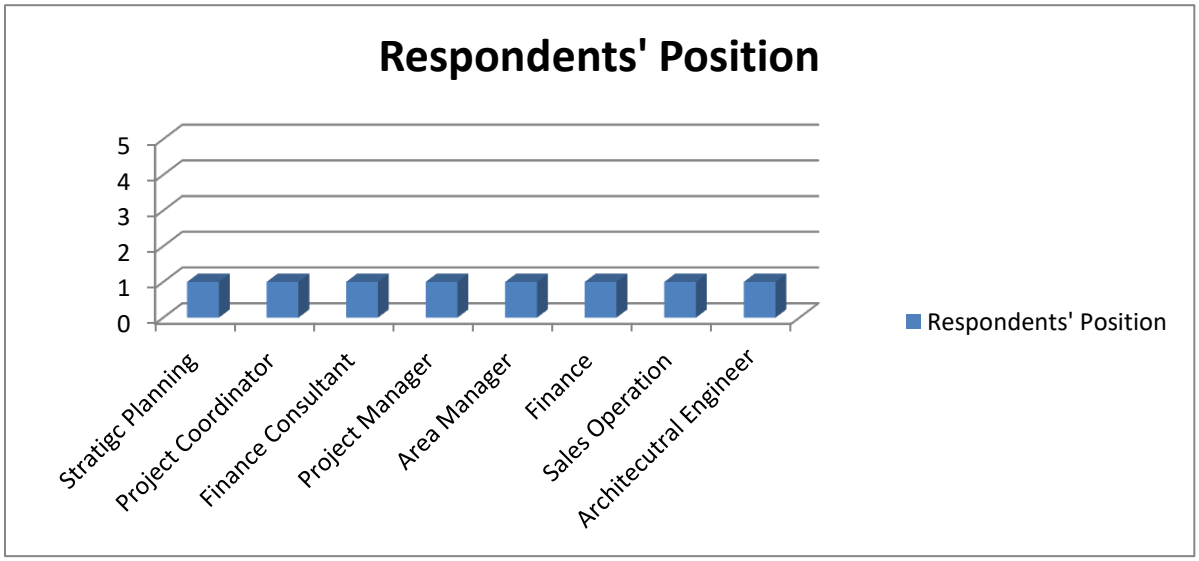

Figure 4.10 MAUT respondents' position

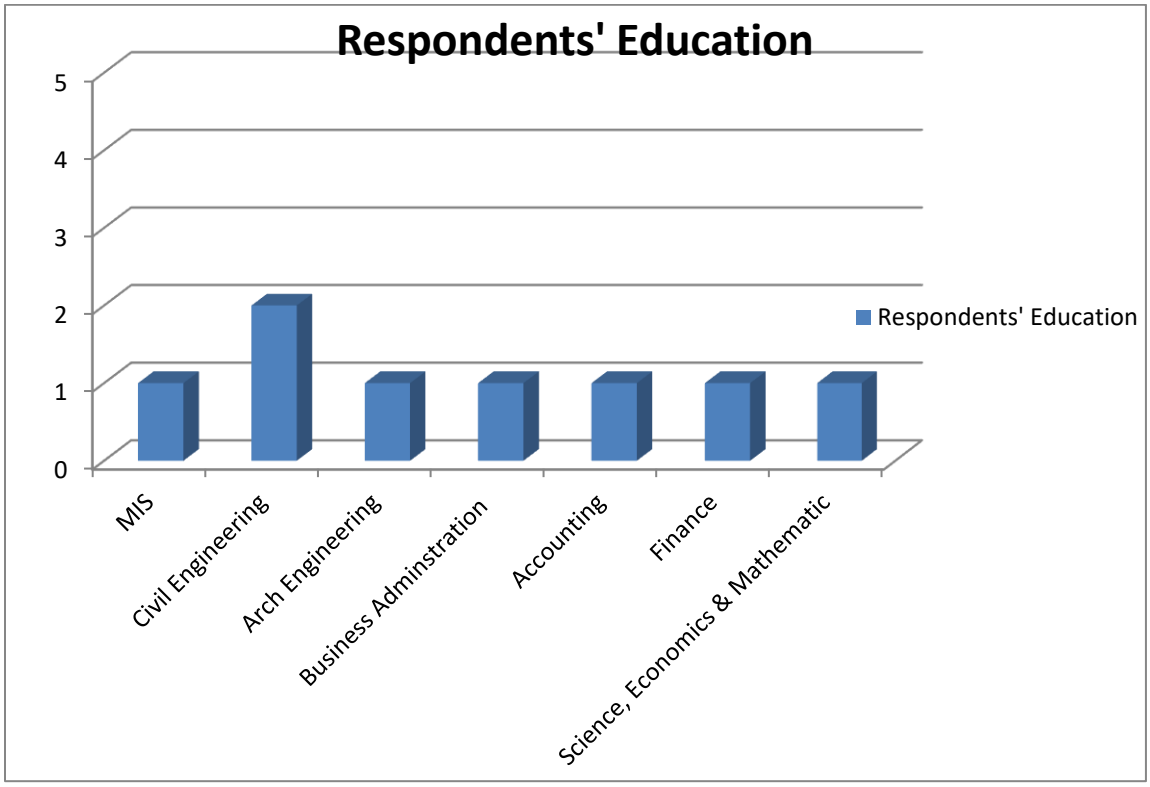

Figure 4.11 MAUT respondent's academic background

The relevant experience of the experts undertaking the questionnaires show an equal majority percentage of experts being under the categories “6-10 years” and “more than 15 years”. Whereas the rest of the percentage of the respondents was noted to be equally distributed between the “1-5 years” and “ 11-15 years”. Figure 4.12 below illustrates the distribution of the experts.

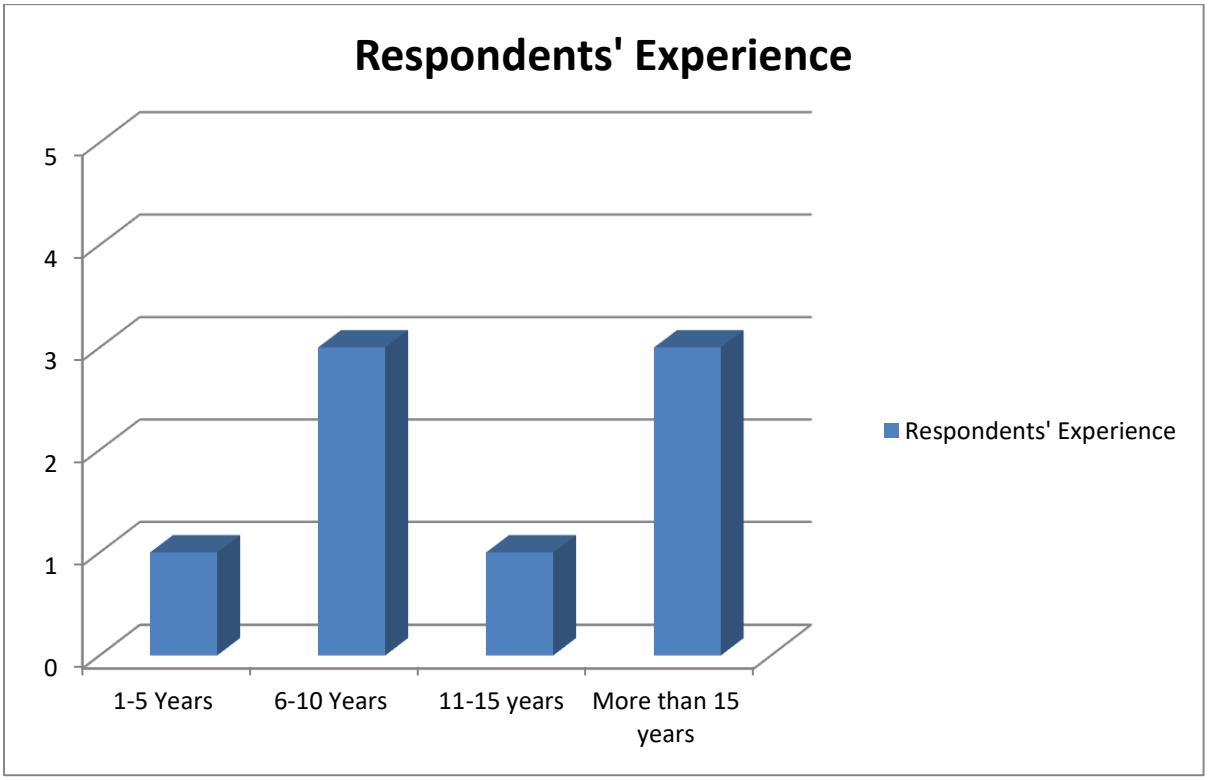

Figure 4.12 MAUT Respondent's experience

4.4 Results and Discussions

Results of AHP pairwise comparisons and MAUT utility functions and curves will be displayed, summarized and discussed in lower sections as per the obtained data from respondents on the questionnaire.

4.4.1 Selection criteria weights using AHP

After obtaining 9 responses from the experts, a synthesizing process was conducted on the pairwise comparisons to identify the relative weights of the criteria and their sub-criteria. the mean, mode and standard deviation were calculated and the weights were computed based on the mean as summarized in Table 4.2 and Figure 4.13. The weight of the main criteria resulted to be closely distributed with technical and safety and environment being equal on the importance with a percentage of 27% while managerial followed with 24% and financial trailed with 22%. Further discussion of the sub-criteria will follow below

Table 4.2 Relative weight of selection criteria

Criteria	Weight	Sub-Criteria	Weight
Financial	**0.22**	Debt/Equity of Project Finance	**0.23**
		Government Control on Land Rates	**0.21**
		Government Incentives	**0.24**
		Financial Capacity	**0.31**
Technical	0.27	Capacity of design firm and its proposed design standards	**0.172**
		Compliance with operation and maintenance program	**0.172**
		Construction program and Milestone timeline	**0.275**
		Proposed Construction technology and methods	**0.1286**
		Utilizing Project control and deliverable system	**0.251**
Managerial	**0.24**	Past experience in executing similar projects	**0.255**
		Commitment and acceptance of risk transfer	**0.101**
		Clear responsibility allocation in consortium	**0.190**

		Working and Contractual relationships among participants	**0.130**
		Contingency Plan	**0.117**
		Utilizing management system for coordination and communication (ISO certification)	**0.044**
		Acquiring and compliance with local qualifications and permit	**0.159**
Safety & Environment	**0.27**	Comprehensiveness of proposed environmental policy and management plan	**0.304**
		Compliance to laws and regulations	**0.348**
		Qualification/ experience of safety and environmental	**0.346**

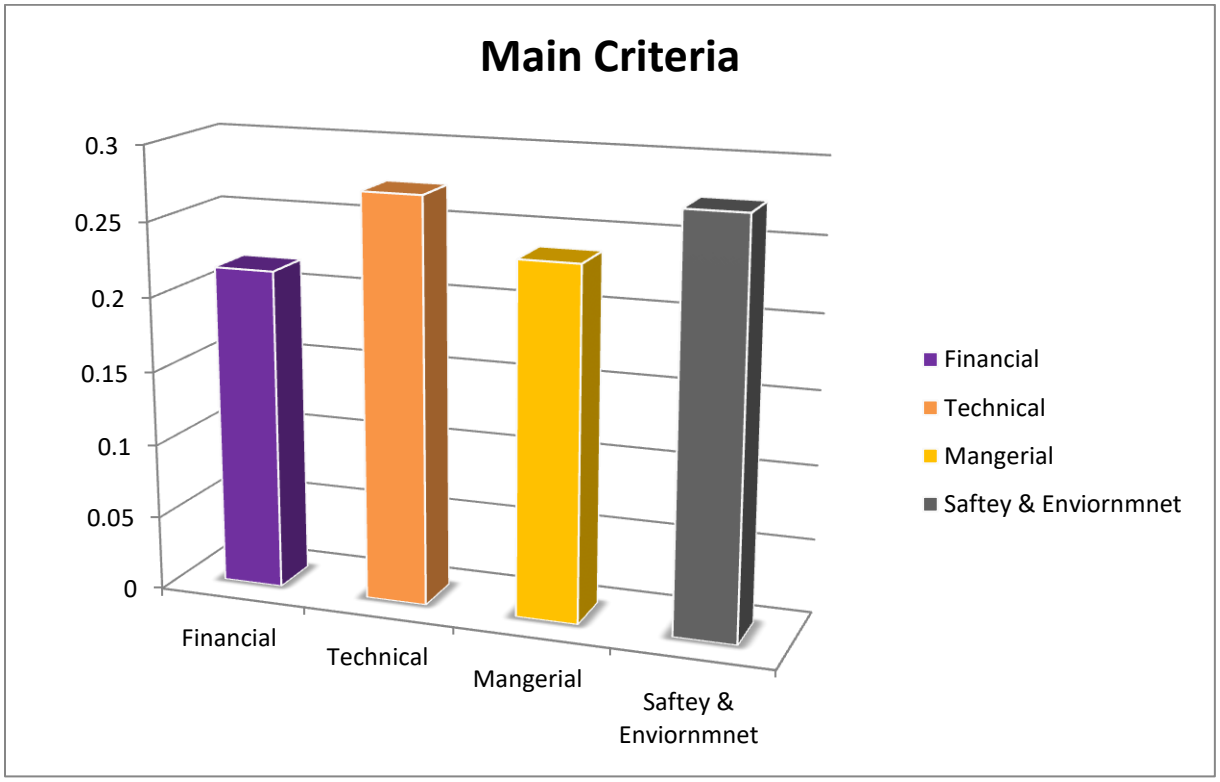

Figure 4.13 Main criteria weights

4.4.1.1 Financial Sub-criteria

Financial criteria had four sub-criteria, namely Debt/Equity of Project Finance, Government Control on Land Rates, Government Incentives and Financial Capacity. According to Table 4.3,

the financial capacity resulted to be the highest weighted financial criteria with 31% due to the emphasizing on the need of ensuring the private partner to be able to finalize the project without withdrawing in middle stages. the remaining sub-criteria which followed with fairly close percentages of 24% for Government Incentives ,23% and 21 % for Equity/Debt of project Finance and Government Control on Land Rates. Figure 4.14 indicates further approximate equal importance for all the financial sub-criteria from the respondents working in the real estate industry.

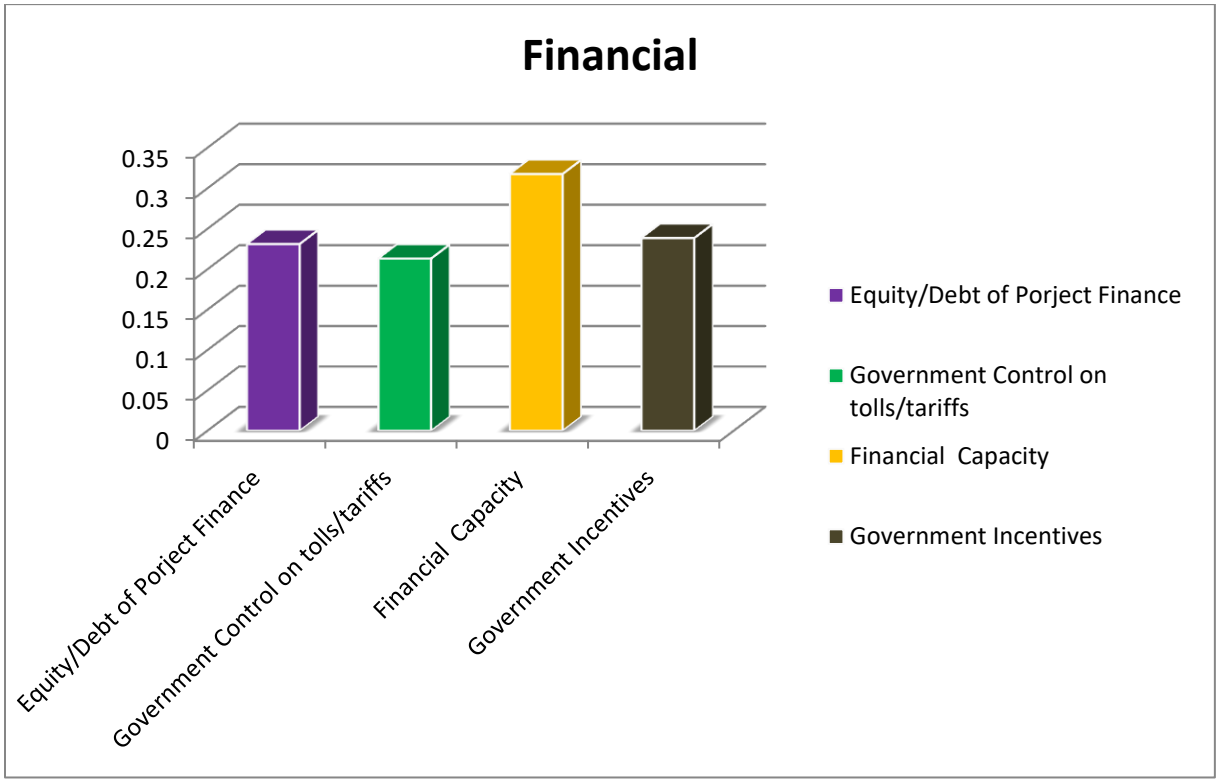

Figure 4.14 Financial Sub-criteria Weights

4.4.1.2 Technical Sub-Criteria

The technical aspect of selection for private partners had five criteria, which were: Capacity of design firm and its proposed design standards, Maintenance program, Construction program and Milestone timeline, proposed construction technology and methods, Utilizing project control and

deliverable system. Figure 4.15 shows that the importance of a private keeping up with the timeline specified for a project is the most weighted important criteria with a percentage of 27.5%, followed by the Utilizing Project control and deliverable system with a percentage of 25.1% which emphasizes on the importance of the process of monitoring the progress of work while communicating with all parties as this reflect both private and public parties importance on the issue of obstacles that hinder project deliverance on time. The maintenance and capacity of the design firm scored equal importance with weightage percentage of 17.2%, while the construction technology proposed for the project is ranked last with a percentage of 12.86% due to the simplicity of the construction housing units relatively to other large projects.

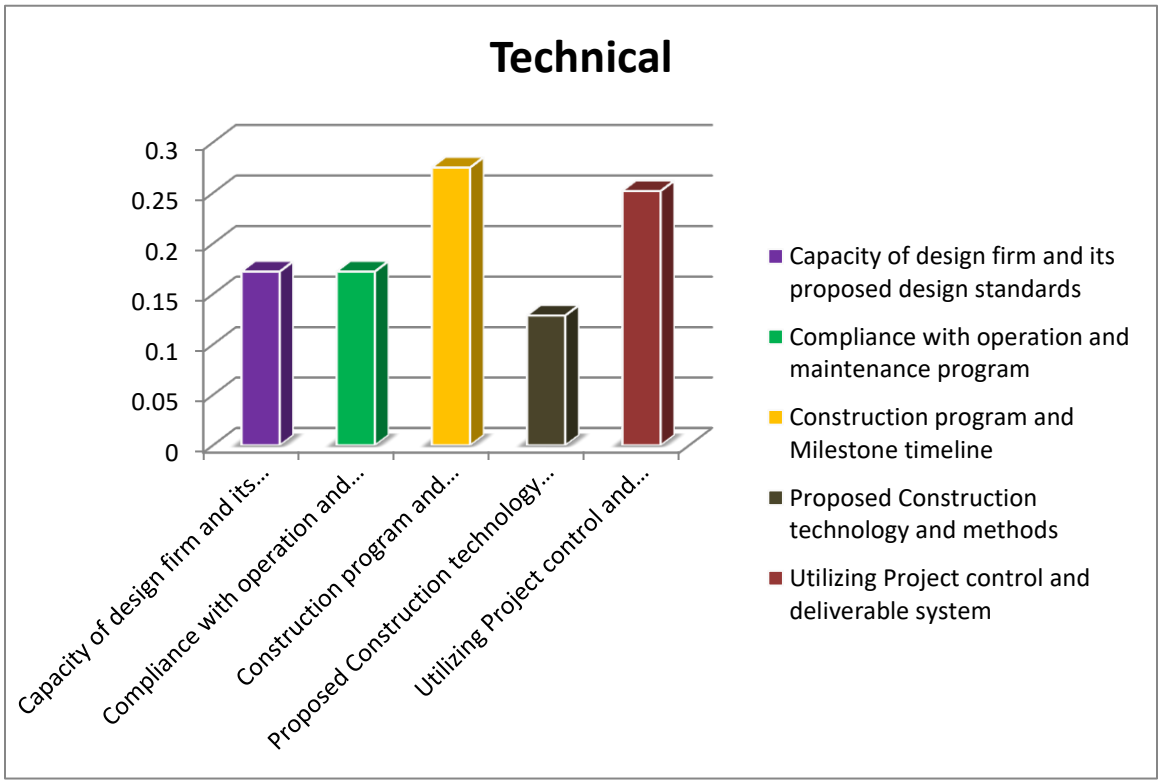

Figure 4.15 Technical sub-criteria weights

4.4.1.3 Managerial Sub-Criteria

The managerial criteria had 7 sub-criteria which are as follow: Past experience in executing similar projects, Commitment and acceptance of risk transfer, Clear responsibility allocation in consortium, Working and Contractual relationships among participants, Contingency Plan, Utilizing management system for coordination and communication (ISO certification), and acquiring and compliance with local qualifications and permit. The past experience of executing and managing similar projects has surpassed the other criteria with a percentage of 25.5% of the total weight of the managerial criteria. Sakani projects are multi layered projects that involve many parties which could easily confuse new comers and raise the possibility of late or poor deliverance of project. While in second rank, the responsibility allocating of partners in a consortium weighted 19%, which will give an insight and ensure to the public sector of the consortium ability to work coherently to execute the project. Subsequently, the acquiring qualifications criteria came after with almost 3 percentages difference, 15.9%. The contractual relationship of the partners was averaged with a percentage 13% weight. Accepting the risks and providing a contingency plan were relatively close to each other with weight percentages of 11.7% and 10.1% respectively. Risks in sakani projects considered less impactful on a the real estate developer rather than other construction fields due to the encouragement from the government by providing 0% interest incentives that could reach up to 40% of the project cost. At last the experts input ranked the importance of having a management accreditation would only be 4.4% important when relatively compared to the remaining criteria. Figure 4.16 displays the average weight of these sub-criteria.

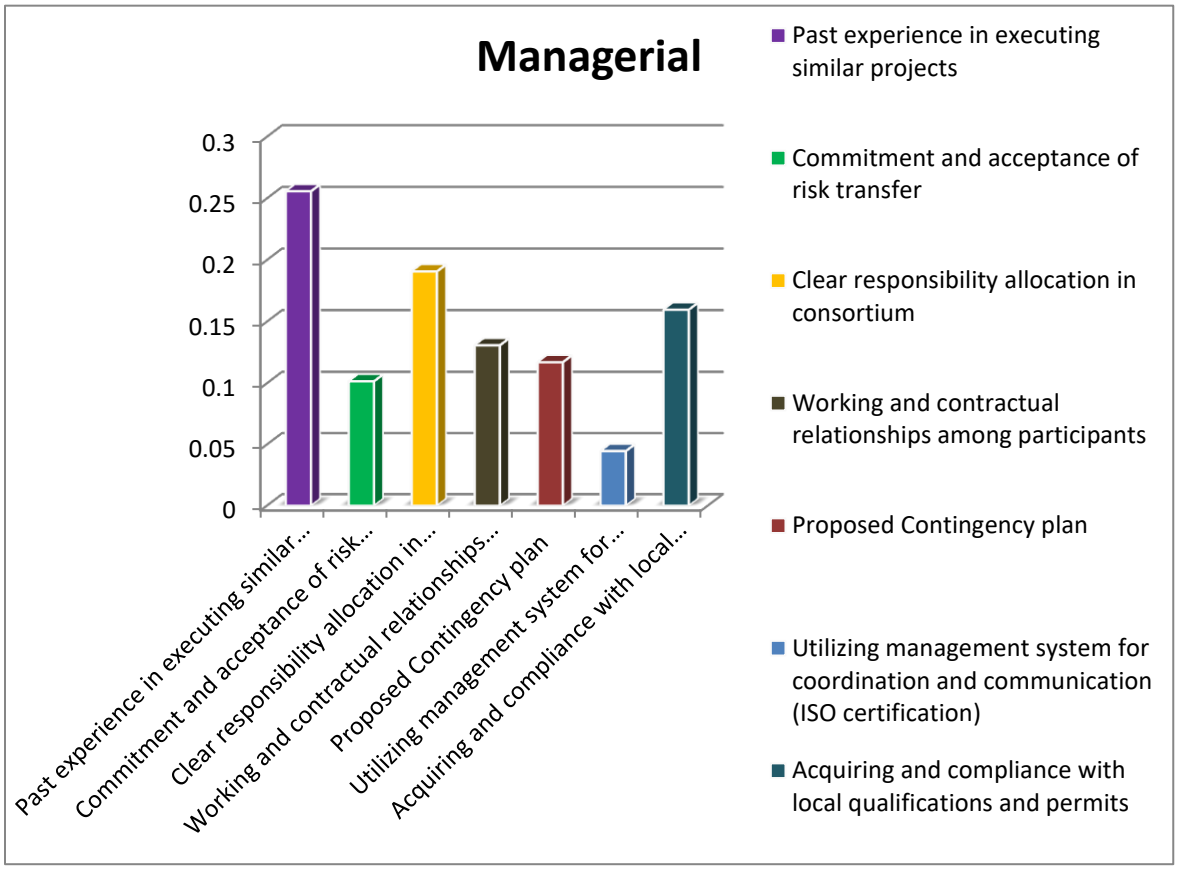

Figure 4.16 Managerial sub-criteria weights

4.4.1.4 Safety/Environment Sub-Criteria

The last category of criteria governed the safety and environment sub-criteria for selection. the experts averaged compliance to laws and regulations almost equally with the experience of the safety department with percentages of 34.8% and 34.6% due to their equal importance and criticality while the proposing an environmental came third with only 4 percentages less than the others. It was noted that yet the environmental management plan is not yet heavily introduced to the housing construction industry as it only restricted to sewage system studies and removal of construction waste/debris (Figure 4.17).

Figure 4.17 Safety/Environment sub-criteria weights

4.4.2 Preference utility values Using MAUT

Post obtaining experts input on the selection criteria for private partners in the housing industry in the pairwise comparisons and calculating the weight of the criteria and its sub-criteria. Utility values were assigned to develop utility curves for each criterion; the values were combination of decision makers, engineer and architects along with data taken from database relative to the criteria. A summary of the utility scores and its average from the 8 participants is displayed in Tables 4.3 – 4.6 In lower sections graphs of utility curves developed from the average quantitative of utility scores of the sub-criteria. The functions of these utilities would determine as

explained previously the most preferred suitable attribute value of a criteria based on its unit of a measure for five points when possible (0, 0.25, 0.5,0.75, 1).

Table 4.3 Utility scores of financial

Financial Criteria					
Criteria	**Debt/Equity of Project Finance Unit: Ratio**				
Respondents	0	0.25	0.5	0.75	1
1	4	2.30	1.00	0.30	0.10
2	2 1/3	1.00	0.66	0.33	0.18
3	9	2.33	1.00	0.33	0.00
4	1	0.66	0.42	0.25	0
5	0	4	1.5	0.66	0.25
6	0	4	2.33	1	0.42
7	1	1.5	2.33	3	4
8	1/4	1.22	2.33	5.66	0
Average	2.20	1.88	0.89	0.32	0.09
Criteria	**Government Control on Land Rates Unit: Price of the average land price in % (Average ±)**				
Respondents	0	0.25	0.5	0.75	1
1	-5	0	8	15	20
2	-15	-8	0	5	10
3	0	5	10	15	20
4	-8	-4	0	5	10
5	-25	-10	0	10	25
6	10	20	30	40	50
7	5	0	-5	-10	-15
8	0	4	8	15	30
Average	-4.75	0.875	6.375	11.875	18.75
Criteria	**Government Incentives Unit: Percentage**				
Respondents	0	0.25	0.5	0.75	1
1	20	25	30	35	40
2	0	10	20	30	40
3	0	10	15	20	40
4	0	15	20	25	40
5	10	20	25	30	40
6	15	20	30	35	40
7	10	20	25	30	40
8	40	30	20	10	0
Average	11.875	18.75	23.125	26.875	35

Criteria	Financial Capacity of Shareholders Unit: Debt/Equity ratio				
Respondents	0	0.25	0.5	0.75	1
1	0.42993	-	0.411597	0.400765	0.347037
2	1.30991	-	1.012758	0.987948	0.847166
3	1.916975	-	1.87694	1.244346	1.236905
4	0.396141	-	0.370302	0.202523	0.166406
5	0.652745	-	0.649667	0.604162	0.546115
Average	0.94114	-	0.864253	0.687949	0.628726

Table 4.4 Utility scores of technical criteria.

Technical Criteria					
Criteria	Capacity of design firm and its proposed design standards Unit: Number of employees				
Respondents	0	0.25	0.5	0.75	1
1	15	25	30	40	50
2	8	10	15	20	25
3	12	17	20	25	30
4	10	12	15	17	20
5	5	8	10	12	15
6	10	12	15	20	25
7	4	6	8	10	15
8	3	5	6	8	10
Average	8.375	11.875	14.875	19	23.75
Criteria	Compliance with operation and maintenance program Unit: Number of years in Guarantees				
Respondents	0	0.25	0.5	0.75	1
1	1	2	3	4	5
2	1	3	5	6	8
3	1	3	5	7	10
4	4	6	10	12	20
5	1	2	3	5	8
6	2	4	6	8	10
7	0	1	2	3	5

8	2	4	5	7	10
Average	1.5	3.125	4.875	6.5	9.5
Criteria	**Construction program and Milestone timeline Unit: Duration of project in percentages (Whether its over or less required)**				
Respondents	0	0.25	0.5	0.75	1
1	10	5	0	-5	-10
2	-10	0	5	10	20
3	-10	0	15	30	50
4	10	20	25	30	40
5	5	10	25	50	75
6	-5	0	10	30	50
7	10	15	20	25	30
8	10	15	20	25	39
Average	2.5	8.125	15	24.375	37.9875
Criteria	**Proposed Construction technology and methods: This criteria will be evaluated by experience and capability of the private partner to execute the technology**				
Score	0	0.25	0.5	0.75	1
Respondent	Novice	Beginner	Moderate	Capable	Expert
Criteria	**Utilizing Project control and deliverable system: A system to convey deliverables and allow easier and faster collaboration/management Unit: Number of years**				
Respondent	0	0.25	0.5	0.75	1
1	3	5	7	10	15%
2	3	3	7	9	10
3	3	1	2	3	4
4	3	2	3	4	5
5	3	3	5	7	10
6	3	5	10	15	20
7	3	5	8	10	12
8	3	3	5	10	20
Average	3	3.375	5.875	8.5	10.14375

Table 4.5 Utility scores of managerial criteria.

Managerial Criteria					
Criteria	**Past experience in executing similar projects:**				
Respondent	0	0.25	0.5	0.75	1
1	has no projects in the program	One project in progress	Has finished 1 project	One project in progress and finished 1	Has finished more than 1 project in the program
Criteria	**Commitment and acceptance of risk transfer: Public-Private partnerships impose risks on both parties. How much of a percentage the private is willing to take on would be decisive to the selection**				
Score	0			1	
1	not willing to accept the risk			willing to accept all the risks	
Criteria	**Clear responsibility allocation in consortium Unit: Percentage**				
Respondent	0	0.25	0.5	0.75	1
1	60.00	75.00	90.00	95.00	100
2	20.00	30.00	50.00	70.00	80.00
3	30.00	45.00	60.00	75.00	90.00
4	20.00	40.00	60.00	80.00	100.00
5	10.00	30.00	50.00	70.00	100.00
6	50.00	60.00	80.00	95.00	100.00
7	24.00	40.00	50.00	75.00	100.00
8	10.00	40.00	60.00	70.00	80.00
Average	28	45	63	79	9
Criteria	**Working and Contractual relationships among participants: (Subjective) (4 points)**				
Respondent	1	2	3	4	5
1	No written agreement	Clarifying legal relationships with partners	Clarifying legal relationships with third parties	-	Clarifying all relationships with disputes resolution

					methods
Criteria	**Contingency Plan: Providing a contingency plan**				
Respondent	1	2	3	4	5
1	No contingency plan	Ambiguous Content	Not compliant with local authority	Compliant and cleat but outdated	Complete contingency plan
Criteria	**Utilizing management system for coordination and communication (ISO certification) Unit: Number of years**				
Respondent	0	0.25	0.5	0.75	1
1	2.00	3.00	5.00	7.00	10.00
2	0.00	1.00	2.00	3.00	5.00
3	0.00	1.00	3.00	5.00	7.00
4	1.00	2.00	3.00	4.00	5.00
5	5.00	7.00	8.00	10.00	13.00
6	2.00	4.00	5.00	8.00	10.00
7	2.00	5.00	8.00	10.00	15.00
8	0.00	2.00	4.00	6.00	8.00
Average	1.50	3.13	4.75	6.63	9.13
Criteria	**Acquiring and compliance with local qualifications and permits**				
Score	0		1		
	No		Yes		

Table 4.6 Utility scores of safety and environment.

Safety & Environment					
Criteria	**Comprehensiveness of proposed environmental policy and management plan Unit: Saving in energy consumption (Percentage)**				
Score	0	0.25	0.5	0.75	1
Building Code	20%	25%	30%	35%	40%
Criteria	**Compliance to laws and regulations**				
Score	0		1		

	No		Yes		
Criteria	**Qualification/ experience of safety and environmental Unit: LTI index (Loss Time Injury)**				
Database	0	0.25	0.5	0.75	1
1	20	16	8	7	5
2	10	8	7	5	3
3	8	6	4	3	2
4	7	5	3	1	0
5	9	5	4	2	0
6	11	8	7	3	1
7	6	5	3	1	0
8	13	10	5	3	2
Average	10.50	7.88	5.13	3.13	1.63

4.4.2.1 Financial Criteria utility curve

As shown in the utility curve graph, Figure 4.18, the utility values of debt/equity of project finance are illustrated. Where the respondents determined their preference values for the ratio of the debt/equity of project finance to a real estate project and the acceptable range is 2.20-0.09

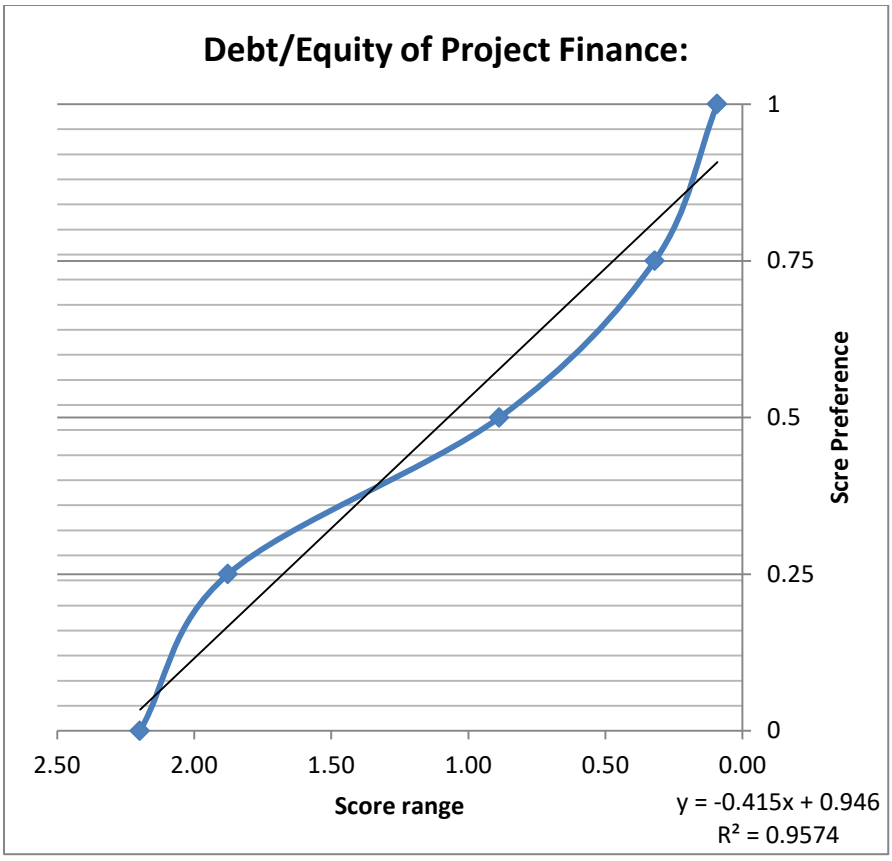

Figure 4.18 Debt/Equity of project finance utility curve

The second financial criterion is the acceptance of government control on land rates which would affect the final unit price sold to the beneficiaries. The lands that are utilized for sakani projects are either lands owned by the government or lands that are owned by a private investor. The measure of this criterion was the acceptance of the private partner on the land price based on the average of prices for the project land. The experts defined the acceptable average range from -5% less than the land average up to 19% more than the land average as shown in Figure 4.19.

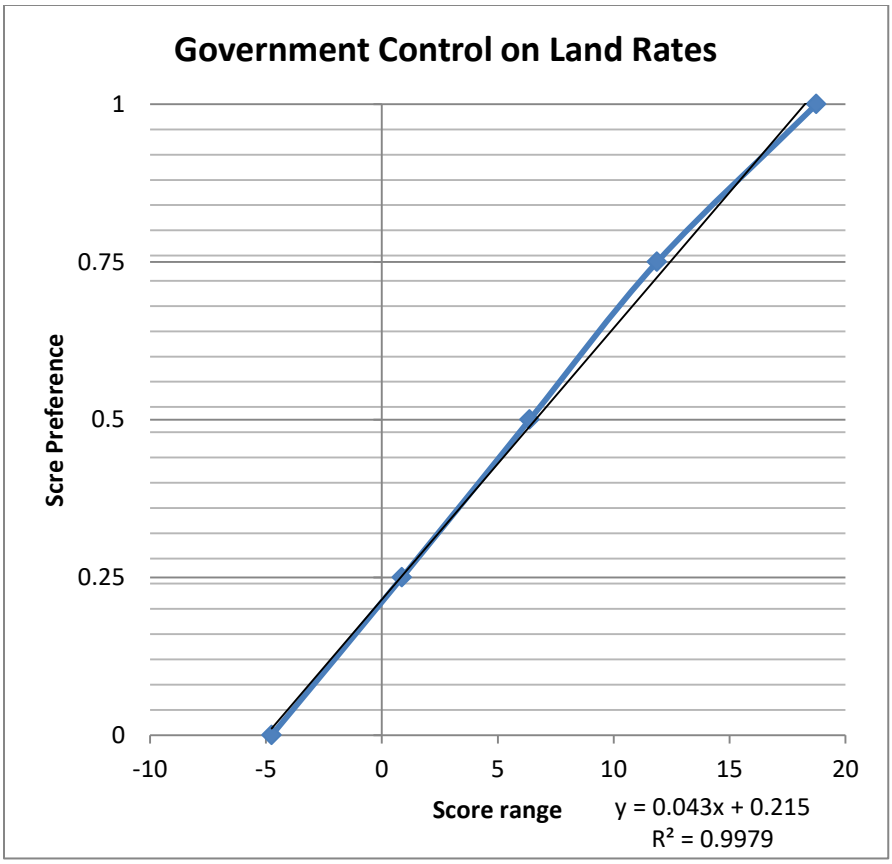

Figure 4.19 Government control on land rates

Currently the government provides up to 40% interest incentives to real estate developers in a step of encouragement for them. The maximum percentage of the incentives given has been and will be subject to change based on government changes and update on regulations. The respondents have determined the acceptable average range for incentives to be 12%-38% as shown in utility curve chart in Figure 4.20.

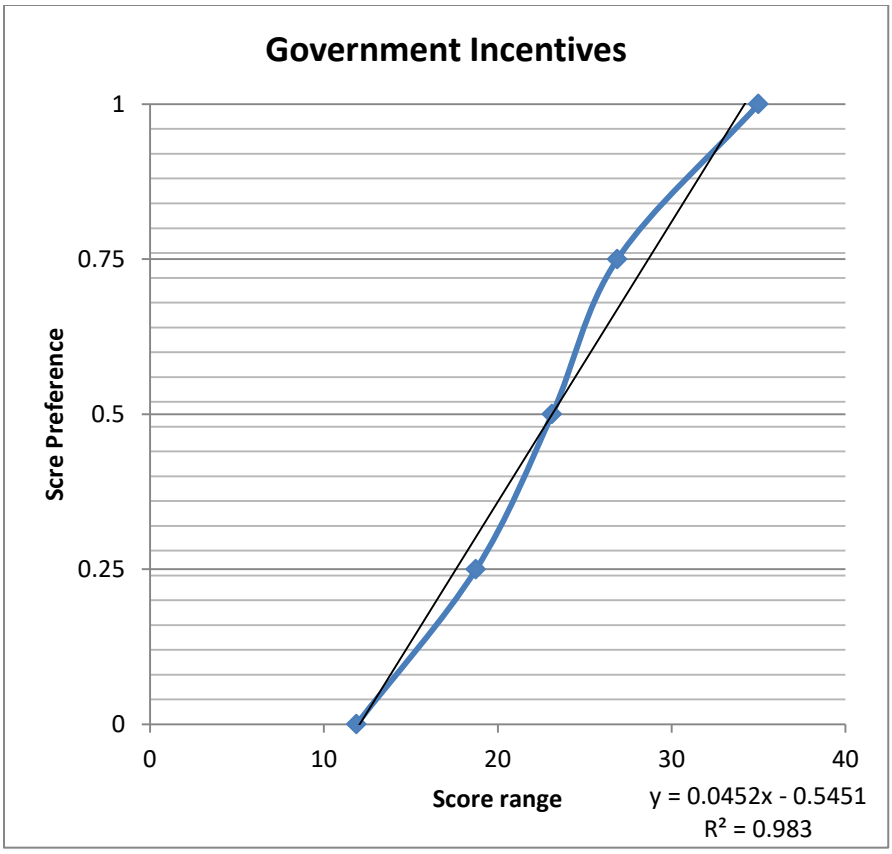

Figure 4.20 Government incentives utility curve

The financial capacity of the private partner was measured with the total amount of liabilities over the total amount of equity the private partner has which gives a clear indication on the financial capacity. Based on database of the real estate developers average in the last four years taken from tadawul website for stock exchange , the range specified was 0.95 – 0.62 as shown in Figure 4.21

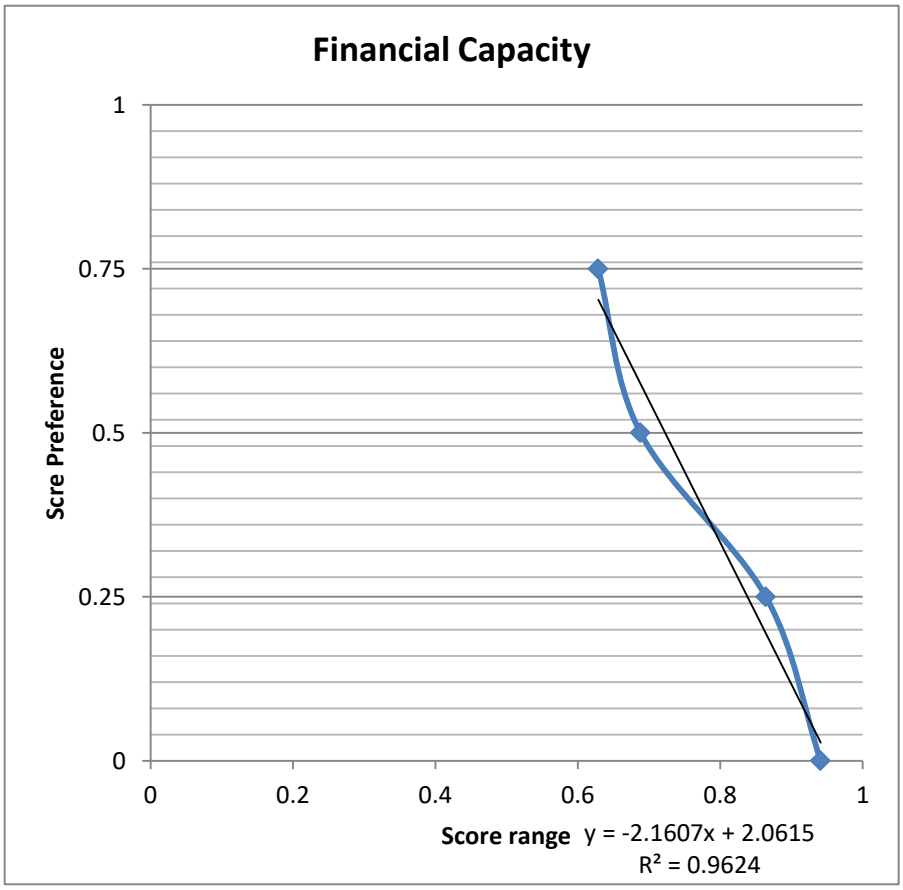

Figure 4.21 Financial capacity utility curve

4.4.2.2 Technical Criteria utility curves

The private partner is evaluated technical by the capacity of design firms. Respondents have defined the acceptable average range from 8-24 employees for the design firm as shown in Figure 4.22.

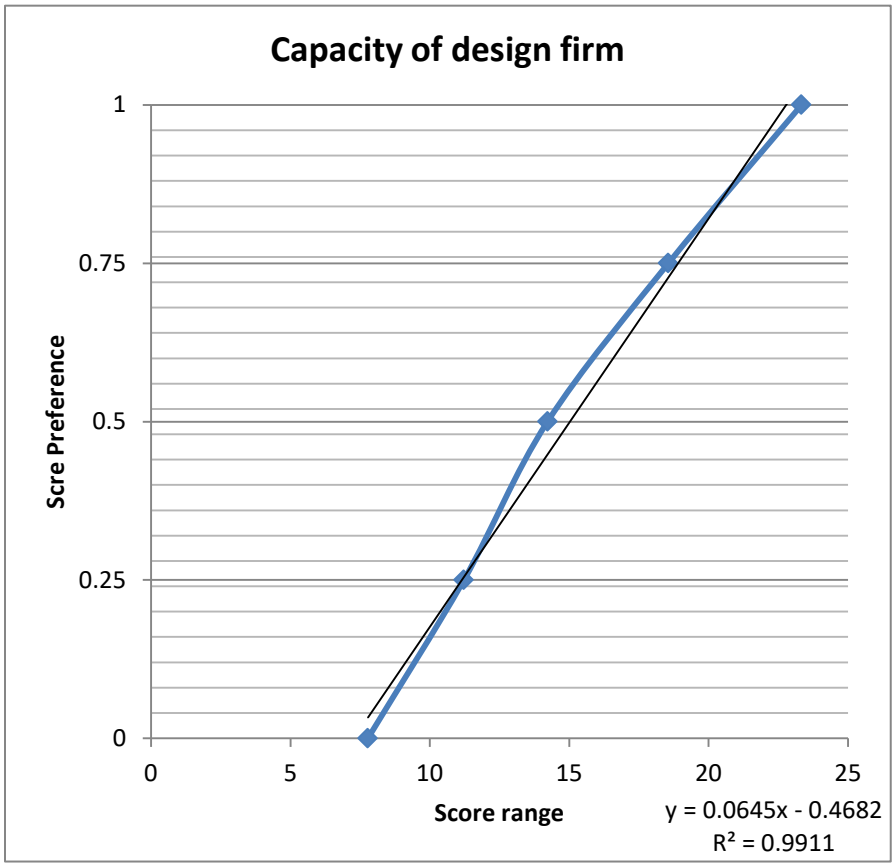

Figure 4.22 Capacity of design firm utility curve

Maintenance program is the second technical criterion was measured with the years offered by the private partner to maintain the housing units after the handover of the project. The respondents defined the average acceptable 2 – 10 years as illustrated in Figure 4.23.

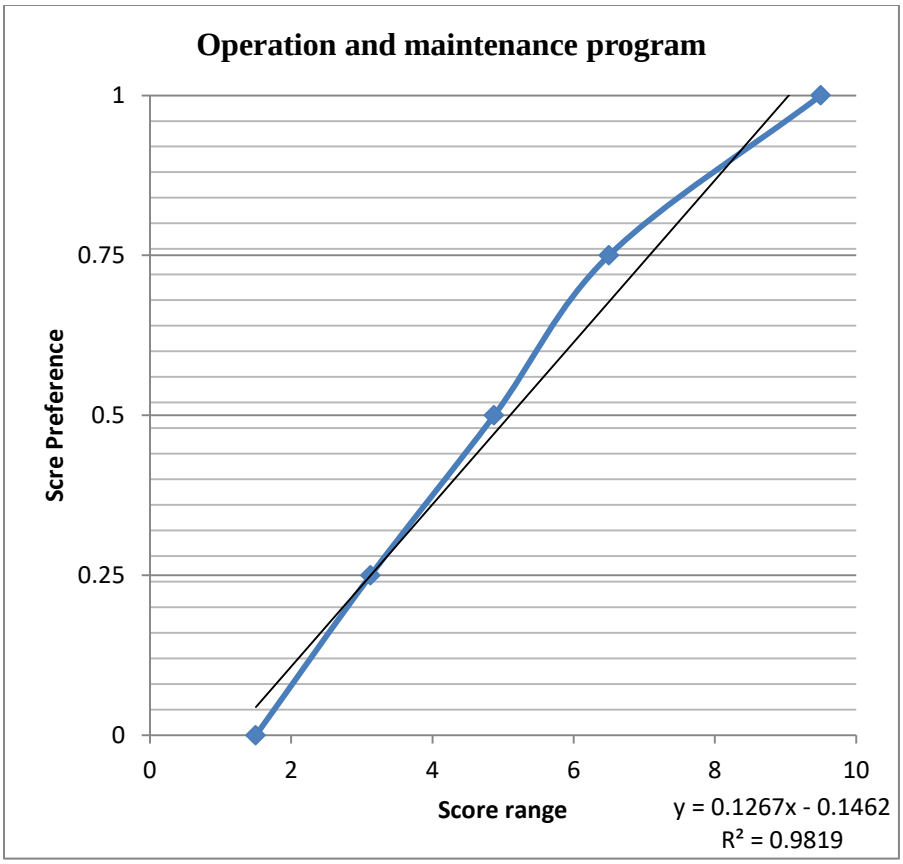

Figure 4.23. Operation and maintenance program utility curve

The construction timeline for the private partner another crucial criterion that was measured by the percentage of a private partner agreeing to the demanded time from the public sector to finalize milestones and handover the project represented by percentages. Experts' responses for the average acceptable range for the time accepted in percentages as shown in Figure 4.24 is 2.5-38%

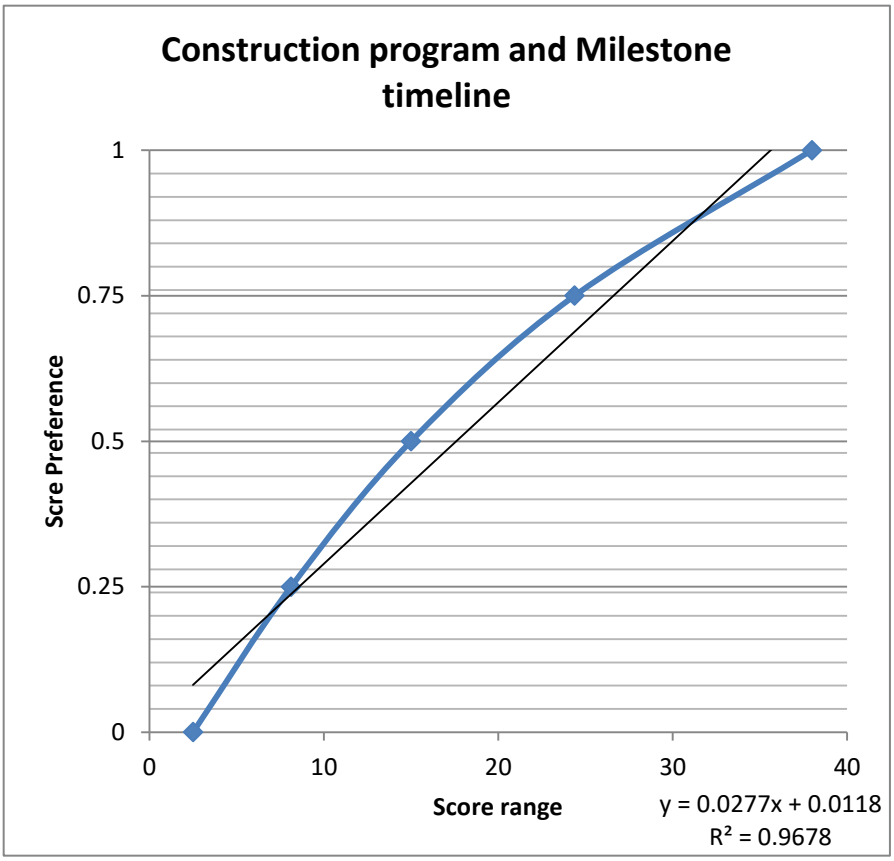

Figure 4.24 Construction program and milestone timeline utility curve

The utility values for utilizing project control and deliverable system are illustrated in Figure 4.25. Respondents have specified the acceptable range for the amount of years for the experience of a private partner utilizing.

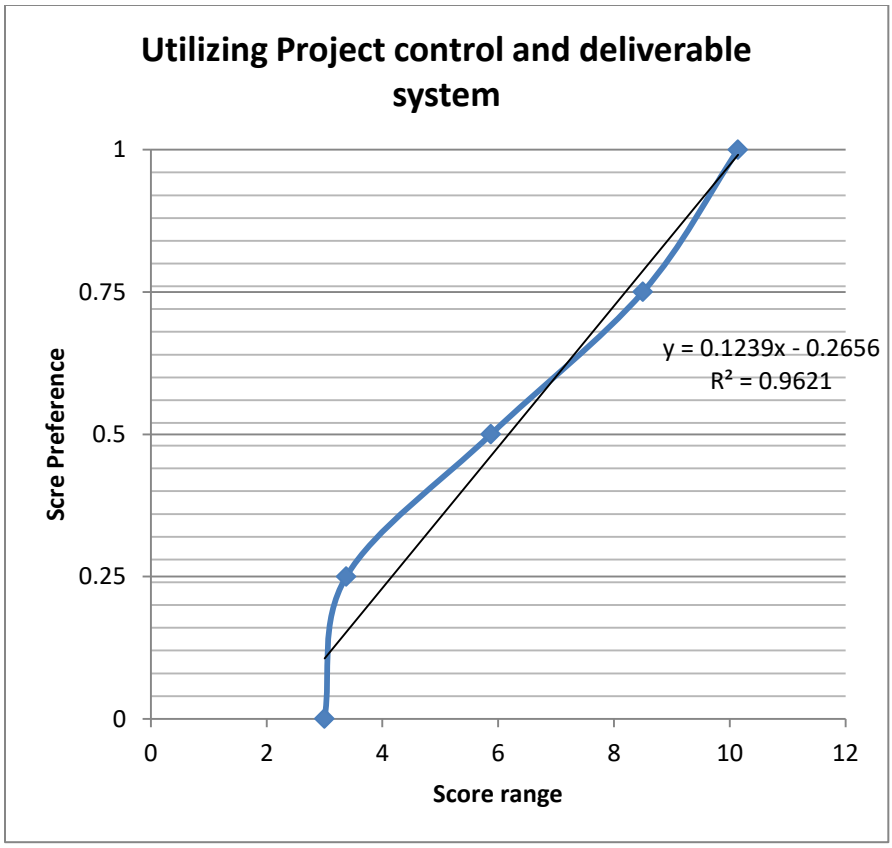

Figure 4.25 Utilizing project control and deliverable system utility curve

4.4.2.3 Managerial Sub-criteria

The utility values for the allocation of responsibilities in the consortium are illustrated as shown in the Figure 4.26 respondents have specified the acceptable range for the sub-criteria by measuring it by percentage of experience matching. The range is 21-71%.

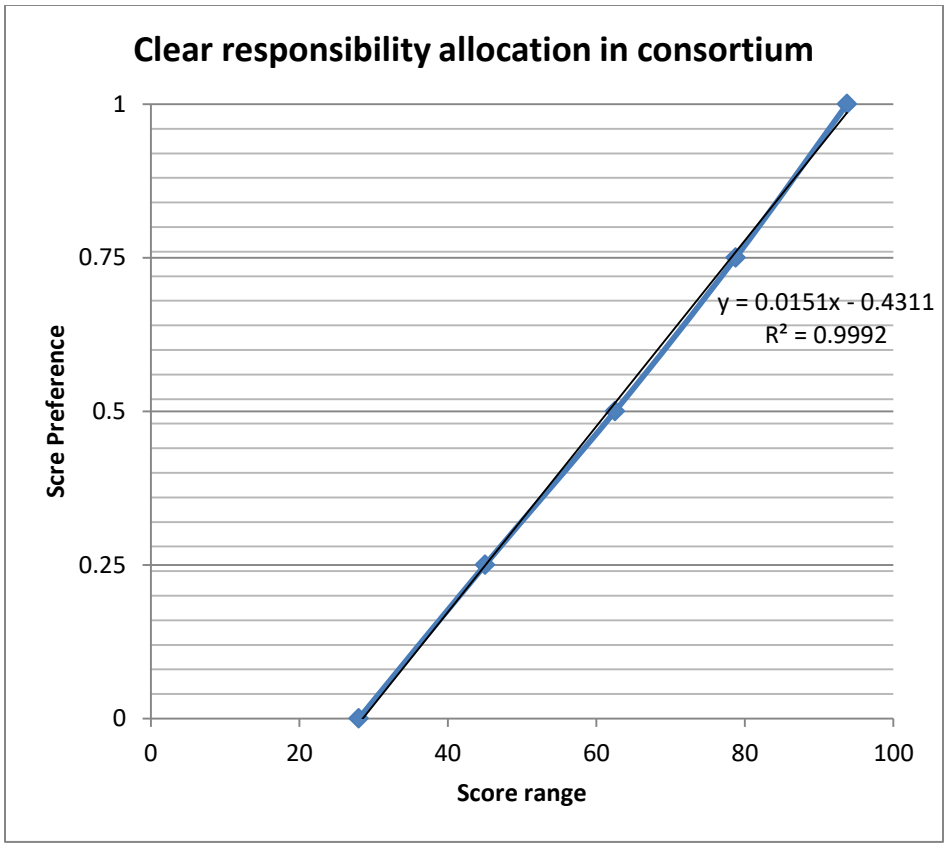

Figure 4.26 Clear responsibility allocation in consortium

The experts have specified the average acceptable range for the experience of the iso certificate for the private partner management to be 2-10 years of experience with the certification as shown in the utility curve in Figure 4.27.

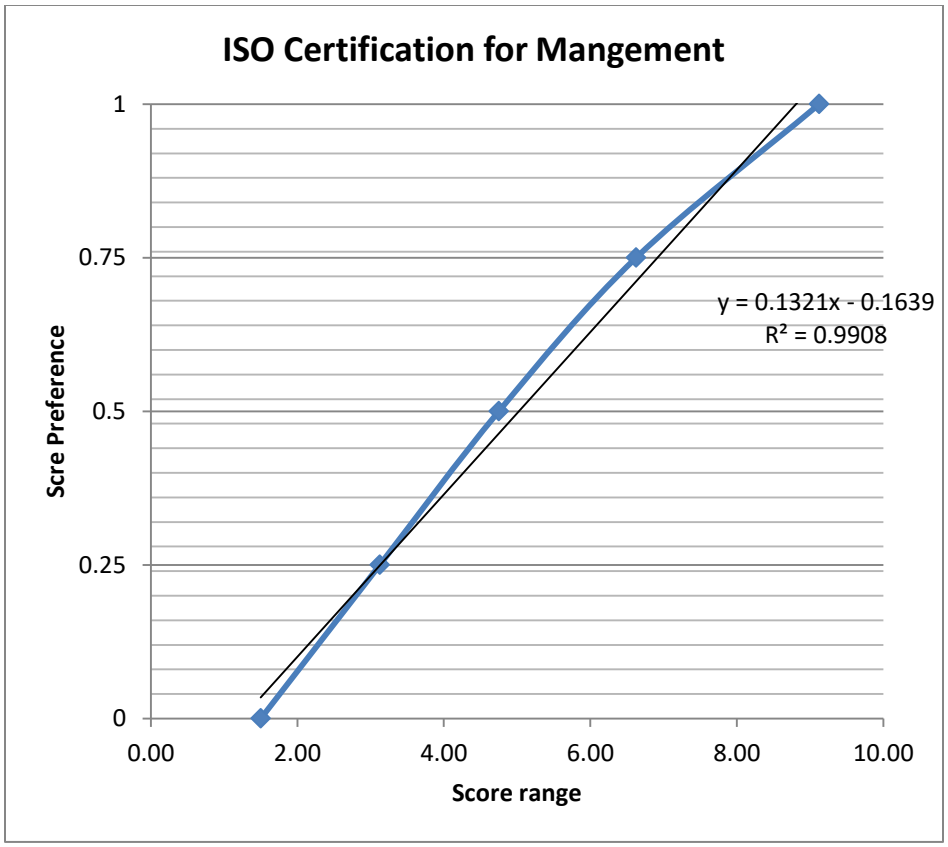

Figure 4.27 ISO Certification for management utility curve

4.4.2.4 Safety/Environmental Sub-criteria

The utility values for the environmental management plan is based on the recent Saudi code requirement for the residential sector which has set the required saving of energy which in return will have positive impact on the environment to be 40% of energy saving as shown in Figure 4.28.

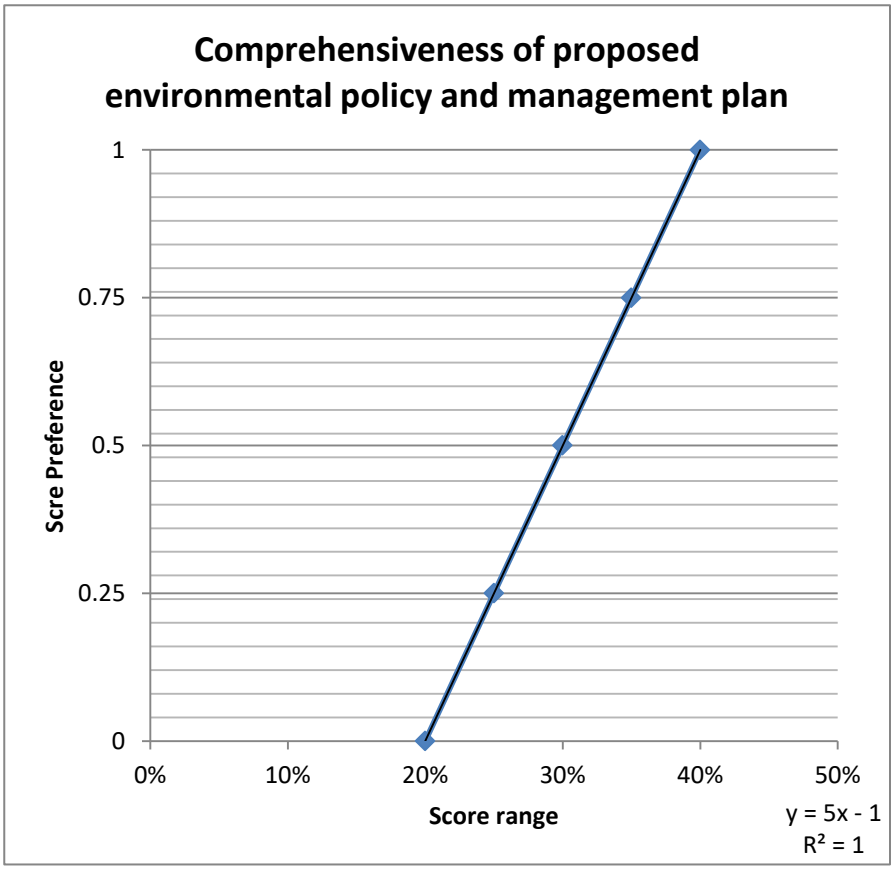

Figure 4.28 Comprehensiveness of proposed environmental policy and management plan utility curve.

Experience of Safety criteria utility values were measured based on the Lost time injury factor which is an international indicator of the performance of an organization safety based on the lost time of an employee due to an injury. Experts specified the average acceptable range for the LTIFR to be 10.5 – 1.63 as shown in the Figure 4.29 below.

Figure 4.29 Qualification/Experience of safety and environmental utility curve.

4.5 Model Implementation

The model of the study relied mainly on statistical methods for analysis after obtaining local experts input. In the following sections an overview of the proposed model is elaborated for selection of private partners for housing project in Saudi Arabia by using AHP and MAUT on a respondent response.

4.5.1 AHP and Pair-Wise Comparison

As explained and stated previously, a need of qualitative input from local experts was required to model the selection process. This is due to the lack of information available for the public in the country. The analytic hierarchy was adopted for the study. AHP is a suitable decision making tool to intake experts and calculate weightages of subjected selection criteria. Questionnaires containing pairwise comparison matrices were subsequently designed to intake respondents input and perspectives on the identified list of criteria. The relative weights of selection criteria is calculated based on the eigenvector (EV) method as a result of collected pairwise comparisons from experts. A single response of the respondents is applied below. Table 4.7 shows the matrix including the input of an expert on the main criteria of the study. After that, the matrix was normalized and the average (Wi) of the matrix is calculated (Table 4.8) as a step to check the consistency of the response.

Table 4.7 Expert's response in a pairwise comparison matrix

	Financial	**Technical**	**Managerial**	**Safety & Environment**	**CR**	**CI**
Financial	1.0	1/4	1/6	3		
Technical	4.0	1	1/3	3		
Managerial	6.0	3	1	6		
Safety & Environment	1/3	1/3	1/6	1		
Total	***11.333333***	***4.583333***	***1.666666***	***13***	***CI=0.084***	***CR= 0.09***

Table 4.8 Normalization of expert's response in a pairwise comparison matrix

	Financial	**Technical**	**Managerial**	**Safety & Environment**	**Average (Wi)**
Financial	0.088	0.055	0.100	0.231	0.118
Technical	0.353	0.218	0.200	0.231	0.250
Managerial	0.529	0.655	0.600	0.462	0.561
Safety & Environment	0.029	0.073	0.100	0.077	0.070
Total	***1***	***1***	***1***	***1***	***1***

To check the consistency

Let M1= Pairwise comparison matrix

M2=Weightage of matrix (Wi)

$$M1=\begin{pmatrix} 1 & 1/4 & 1/6 & 3 \\ 4 & 1 & 1/3 & 3 \\ 6 & 3 & 1 & 6 \\ 1/3 & 1/3 & 1/6 & 1 \end{pmatrix} \quad M2=\begin{pmatrix} 0.118 \\ 0.250 \\ 0.561 \\ 0.070 \end{pmatrix}$$

$$\text{Then M3 (A.w) = M1x M2 = } \begin{pmatrix} 0.484 \\ 1.120 \\ 2.442 \\ 0.286 \end{pmatrix} \quad \text{Then M4 } (\lambda_{max}) = M3/M2 = \begin{pmatrix} 4.087 \\ 4.473 \\ 4.350 \\ 4.103 \end{pmatrix}$$

The average of $\lambda_{max} =$ ***4.253*** is used in Equation below to calculate the consistency index (CI)

$CI = \frac{\lambda max - n}{n-1} = \frac{4.253 - 4}{4-1} = 0.084$

The last step for checking the consistency is to apply the consistency ratio equation to calculate the Consistency of the matrix

$CR = \frac{CI}{RI} = \frac{0.084}{0.9} =$ 0.09 <0.1, the matrix is consistent

4.5.2 Measuring the Performance of the Identified PPP using MAUT

The next consistent of the model is to measure each criteria in a specified scale which enables to assign utilities scores under the concept of Multi Attribute Utility Theory. Both qualitative and quantitative for criteria value were utilized based on the expert input. The minimum utility score is set for two points as elaborated previously, whereas the maximum points were five.

Lastly, after obtaining the weightages and the values of each criterion, to work the model, the weights of each sub-criterion needs to be multiplied by their values as per the equation below. The results of the multiplication of each respective sub-criteria group is summed and multiplied by the weight of their relative main criteria. Eventually the summation of the utilities sets the rank of each alternative.

For example, the sub criteria "Capacity of design firm". The sub-criterion falls under the "Management" Main criteria, the experts given the values for this sub-criteria. If a private partner has 15 employees working in their design firm. The score assigned for that is 0.5. The score is then multiplied by the weight of the sub-criteria. Which is in this case is 0.172.

The utility of this sub criterion is $= \mathrm{Wi}\ \mathrm{Vi}\ = 0.172 \text{ x } 0.5 = 0.086$

This process is repeated for every sub-criteria falls into a category or a group of a main criteria to specify the rank of candidates or private partners ultimately.

4.6 Study Feedback

The model has been shared with experts from the public sector to obtain their feedback on the proposed model. A semi structured interview was conducted currently with an employee from NHC (National Housing Company) and a WAFI personnel. The experts were asked about their opinion on the calculated weightage of the selected criteria, the possible contribution of the model, and the possible enhancement of the model.

Figure 4.30 below displays the model structure for the selection of the private partner for the housing industry in Saudi Arabia. Alternatives with their profiles input are evaluated by inserting their put against the criteria identified and weighted. The value of the alternatives for each criterion is multiplied by the weight and the summation of the value multiplied with the weight would determine the rank of alternatives.

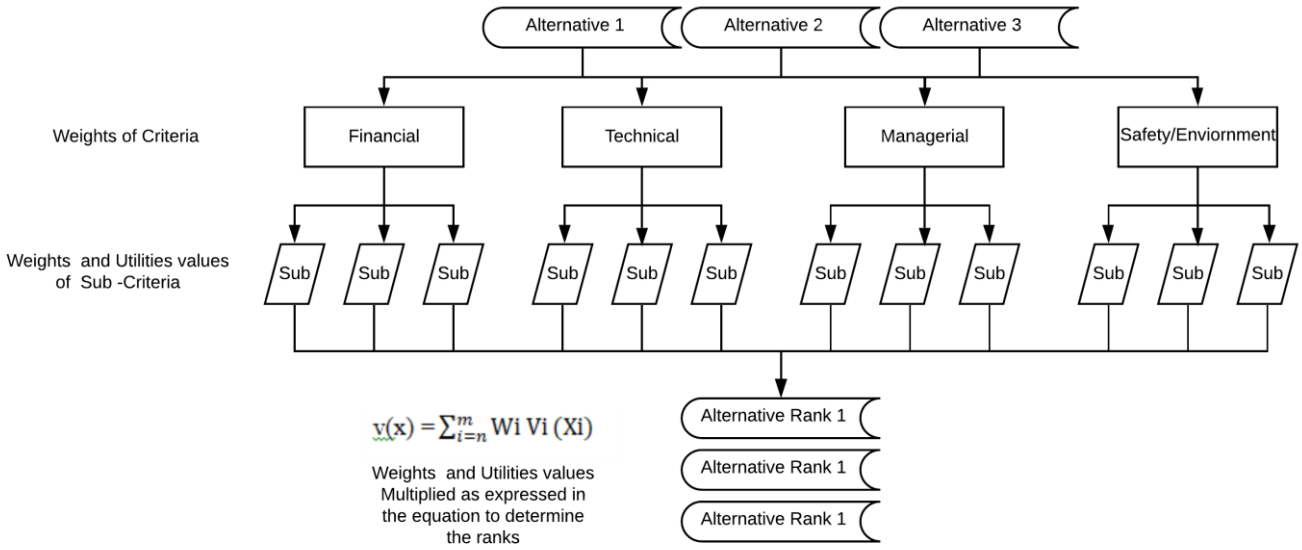

Figure 4.30 Model Proposal

Respondents Feedback stated the following:

- The feedback on the model criteria was positive as the respondent mentioned that the criteria are covering the main points the ministry is looking for.
- Currently “Sakani” program focuses on finishing on time and to provide the citizen with an affordable units in best quality possible for approval rate
- The country is heading towards sustainability and reducing environment harm but not yet fully implemented.
- The criteria could be done for two different stages.
- Rules and regulations are subject to change

CHAPTER 5 - CONCLUSION AND RECOMMENDATIONS

5.1 Summary of the Study

The selection of a private partner is a crucial success factor for any partnered project with the public sector. Studies have shown a high percentage of failure in 3P projects. Currently, Saudi Arabia is considered a developing country with less experience in partnered projects with the private sector. However, the country is moving towards involving the private sector further. The literature has showed a lack of research on selection of private partners in the housing industry especially in Saudi Arabia. This research aimed to develop a decision making tool for the public sector concerning the housing industry under the partnership scheme.

Based on reviewing the literature and conducting semi- structured interviews with 7 experts from both sectors, the public and the private, to identify and refine a list of criteria for selection of private partner for housing projects in Saudi Arabia. A total of 4 main criteria and 19 sub-criteria were identified as a result of scanning the literature and conducting interviews. The criteria was categorized under the four main aspects; Financial, Technical, Managerial and Safety/Environment. Two questionnaires were distributed on different stages to conduct the AHP and MAUT methods. The targeted sample was Public representatives, real estate developers, engineers, and architects that are involved in housing partnered projects between the public and private sectors. The results revealed that the most weighted criteria were the technical criteria with 27% of importance in tie with the safety/environment. This is due to the time factor and along with the 2030 vision plan to achieve sustainability and environment saving measures. The managerial followed by 24% and then the financial trailed by 22%. It’s fairly can be noticed that the main criteria were closer to each other. It was justified that the encouragement given to the real estate developers financially to participate in the partnership what influenced the percentage

of the financial criteria. Also currently to an environmental management plan isn't required but was found to Regulations and criteria are subjects to change based on the future conditions of the country and what's required by the ministry.

5.2 Findings

Post completing collecting data and conducting the AHP and MAUT methods on it, the findings from the study are:

- The literature lacks papers and research for selection criteria of private partners for the housing industry, especially in Saudi Arabia and the middle east
- 4 main criteria and 19 sub-criteria from both the literature and interviewing the experts were identified
- The weightage and priorities of selection criteria of private partner for the housing industry is identified. The technical and safety/environment criteria were the most weighted with 27%. Followed by the managerial and financial with 24%, 22% respectively
- The study contributes to the literature locally and internationally and also it contributes to the Saudi public sector of housing.

5.3 Conclusion

In conclusion, Saudi Arabia is one of the largest economical leaders in the area and globally. Its market attracts many parties from around the world. At present, Saudi Arabia constructs its projects by the procurement law, which was issued back in 2006 in accordance with a royal decree. However, the kingdom has issued its official document for the 2030 vision, which tackled and mentioned the need of involving the private sector into many industries through Public-Private Partnership schemes. The housing industry is one of these industries to be targeted as there is a high demand of housing in Saudi Arabia. In the efforts to achieve its deliverables, the national housing company has been established to oversight the procedures and provide consultations for the operations that will be taken with the private sector with the collaboration of Wafi.

It's been published and discussed previously that countries with less experience in such agreements may face high number of PPP contracts cancellation. A critical factor for the success of partnerships is the selection of the private partner, due to the majority of risks being transferred to this partner.

This research has developed a framework for selection model using AHP and MAUT. Firstly, a comprehensive literature review has been made on Public Private Partnerships for this paper. Definitions and concepts for PPP were mentioned and discussed due to the many terminologies and definitions used around the world. It's stated by many researchers that there isn't a universal or standard definition of for PPP as the structure may be flexible to fit the requirements and the need of both parties. Subsequently, the types of PPP structures were enlisted and discussed. The assessment of value for money is another vital element that helps to reach a decision to choose a

PPP as a procurement alternative. The practice of the assessment in different countries has been highlighted in the paper. Such tool should be carried out by the PPP unit in this matter.

Multiple of studies have been made on the critical success factors for the PPP schemes. But only four were made to set a criterion for private partner selection. Notably, these studies were made for infrastructure projects. Also there is a clear lack of research on PPP in Saudi Arabia. The aim of this study is to investigate selection criteria suitable for housing projects in Saudi Arabia based on experts opinions.

To achieve the main goal of the study, 9 questionnaires were filled containing matrices for pairwise comparison to calculate weights of criteria such as financial, Technical, Managerial and Safety/Environment, via the analytical hierarchy process. 8 Questionnaires with Tables to fill in utility functions or values via the Multi Attribute Utility Theory were filled. Experts put their input for the questionnaires through conducted face-to-face interviews. It was found that the main four criteria were relatively close to each other in importance based on the subjective input of the experts with the Technical and Safety/Environment Criteria tying equally with 27% followed by the managerial with 24% and trailed by the Financial with 22%

The Financial capacity is the most weighted financial sub-criteria due to known possibility of long duration of projects, the current economic climate and the delay of government payments. A well-financed private partner is critically important. Private partners also rely on the 0% interest incentives provided by the government as an encouragement that could reach up to 40% currently as a funding source for the project. However, the percentage is subjected to change as the government regulations and rules have been frequently changed.

As its being a part of the vision 2030 to raise the ownership of citizens to 60% in housing. Construction program including the milestone timeline was the most weighted sub-criteria in the technical category along with utilizing project control and deliverable systems which is the national housing company is working on to create, a digital system that would enable an overseeing of each project instead of the traditional method of submission of progress.

The experience of the private partners is highly mattered due to the involvement of multiple parties, procedures and qualifications in the nature of "Sakani" housing Projects system. A private partner is preferred to have experience.

Currently private partners are not requested to provide a comprehensive environmental management plan for the project and only limited to provide a study for the infrastructure of the site and the site location to check weather hazards such as floods from rain. It's noted that the criteria and the attribute values may be subjected to change based on regulations and rules for the housing by the ministry of housing in Saudi Arabia.

5.4 Future Studies

This research is one of the few and first scientific research on Public-Private Partnerships in Saudi Arabia for the housing industry. Future researches may consider multiple directions:

- Considering the uncertainty of input for developing a selection model by utilizing on fuzzy analytic hierarchy process or fuzzy analytic network process
- Conduct a study on the identification main factors affecting performance of private partners and actual progress against the planned progress of "Sakani" housing projects.
- Conduct and apply a similar study on selection of private partners for other construction industries such as Infrastructure projects, Hospitals, Airports….Etc. in Saudi Arabia

- Develop a digital computerized model that allows adapting multiple industries and the updates of the input and the weight of the criteria.

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Vitae

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Date of Birth :6/11/1993

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Address :Al-Bandariyah, Al-Khobar

Research interest :Construction management, Life cycle cost and Decision Making Tools

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Academic Background :Abdullah Khalid is a master student at Department of Construction Engineering and Management, College of Environmental Design, King Fahd University of Petroleum & Minerals. He received his bachelor's degree in Architectural Engineering at Imam Abdulrahman Bin Faisal University. Currently working as an Architectural engineer in the construction field. He is interested in construction management, life cycle cost and decision making tools.

Appendix

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
Construction Engineering and Management Department
Thesis

Private Partner Selection Criteria

Dear Sir

I would like to express my high appreciation of your participation in this questionnaire, sharing your expertise and knowledge. The aim of the survey is to determine criteria that would help to select the optimum private partner for the Public-Private Partnership in housing projects in Saudi Arabia. This questionnaire is part of my on-going Masters Thesis research under the supervision of Prof.Adel Al-Shibani in the department of construction engineering and management, King Fahad University of Petroleum & Minerals.

The information collected in this document will be only used or academic research purposes and personal information will be strictly confidential (Refer to the signed letter).

Many Thanks for your effort and support

Researcher:
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1

PART 1

Any personal information given below is confidential and not applicable for the use of public its only used to distinguish between respondents' categories (Private sector, Public representative or Academia personnel). Circle the appropriate category

- Private sector (Real Estate developer,Bank, Contractor)
- Public Sector (National Centre of Privatization, Housing Ministry)
- Academic Sector

PART 1.2. Respondent Information (optional):

Name	
Position	
Experience	
Education	
E-mail	
Phone	

PART 2

The present work will aim to address the local views and the Saudi market in the housing development in order to investigate and develop selection criteria suitable for the practice. This will be beneficial to the country which is focusing on implementing the 2030 vision.

Listed below is a table of main criteria and their sub criteria referenced from literature and other sources for selection of private partners for housing projects in Saudi Arabia. Further explanation of these criteria if needed starts from page 6

Based on your experience and knowledge is the criteria below requires addition or partial removal by clicking on the fields electronically.

اضافة معايير
Add criteria

البحث الحالي يهدف إلى إستطلاع الآراء المحلية في التطوير السكني للتحقيق وتطوير معايير إختيار شريك من القطاع الخاص مناسبة للمجال السكني. وسوف تعيد الفائدة للدولة بحيث في دورها تكرث جهودها لتحقيق رؤية 2030. بالأسفل قائمة بمعايير اساسية وفرعية لإختيار المستثمر او الشريك من القطاع الخاص للمشاريع السكنية مستخرجة من بحوث علمية سابقة ومصادر أخرى. وصف هذه المعايير متوفرة تبدأ من الصفحة 6. بناء على خبرتك وخلفيتك في المجال السكني والمشاركة مع القطاع الخاص هل ترى الحاجة لإضافة معايير اخرى او حذف بعض المعايير التي قد تكون غير متوافقة مع المجال السكني عن طريق النقر في الحقول الكترونيا.

Main criteria / Sub criteria	Financial	Technical	Managerial	Safety & Environment	Political/Public acceptance
	Shareholders Equity/Debt	Capacity of design firm and its proposed design standards	Past experience in executing similar projects	Comprehensiveness of proposed environmental policy and management plan	Understanding of legal requirements
	Government Control on tolls / tariffs	Operation and maintenance program	Commitment and acceptance of risk transfer	Compliance to laws and regulations	Compliance with permit requirements
	Financial Capacity	Construction program and Milestone timeline	Clear responsibility allocation in consortium	Qualification/ experience of safety and environmental personnel	Compliance with boycott trade laws
	Foreign Financing	Proposed Construction technology and methods	Working and contractual relationships among participants		
	Expected revenue method	Technical transfer to public operation	Change of ownership		
	Transfer of financing plan		Proposed Contingency plan		

4

المعايير الأساسية / معايير فرعية	المالية	التقنية	الإدارية	الامن والسلامة	القبول السياسي والعامي
	الحقوق الملكية/ ديون المساهمين	سعة المكتب المصمم ومعايير التصميم	الخبرة السابقة	سياسة وخطة ادارة البيئة	إستيعاب المتطلبات القانونية
	تحكم الحكومة على الرسوم	برنامج الصيانة والتشغيل	قبول المخاطر	الإلتزام بالقوانين والقواعد	الإلتزام بمتطلبات التصاريح
	القدرة المالية	برنامج التشييد وتواريخ إنجاز المشروع	وضوح المسؤوولية في المجموعة	مؤهلات وخبرة طاقم الأمن والبيئة	الإلتزام بقوانين التجارة للمقاطعة
	المالية الدولية	التقنية والطرق للتشييد	العلاقة العملية مابين المساهمين		
	الية الإسترداد	نقل او تسليم التشغيل	تغيير الملكية		
	انتقال تمويل المشروع		خطة إدارة المخاطر		

5

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
Construction Engineering and Management Department
Thesis

Private Partner Selection Criteria

Dear Sir

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The information collected in this document will be only used or academic research purposes and personal information will be strictly confidential (Refer to the signed letter).

Many Thanks for your effort and support

Researcher:
Abdullah Khalid
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College of Environmental Design.
King Fahad University of Petroleum & Minerals
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Example

Fill in the evaluation on

If you consider to "Financial" is more important than "Technical" Choose from 1-9 scale.

Example: "Financial" is strongly important than "Technical", **write 5**

If you consider the opposite: "Technical" is more important than "Financial" then Choose from $\frac{1}{2} - \frac{1}{9}$ scale.

In this example, "Mangerial" criteria is moderatly more important than "Technical" criteria; therefore, the importance is 1/3 (Y is more imprtant than X).

Main Criteria				
X \ Y	**Financial**	**Technical**	**Managerial**	**Safety & Environment**
Financial		**5**	**8**	**3**
Technical			**1/3**	**8**
Managerial				**5**
Safety & Environment				

Importance Scale

If X is more important than Y choose from scale below

1= Equal	2= Weak	3= Moderate	4= Moderate plus	5= Strong	6= Strong plus	7= Very Strong	8= very, very strong	9= Extreme

If Y is more important than X choose from scale below

1= Equal	$\frac{1}{2}$= Weak	$\frac{1}{3}$= Moderate	$\frac{1}{4}$= Moderate plus	$\frac{1}{5}$= Strong	$\frac{1}{6}$= Strong plus	$\frac{1}{7}$= Very Strong	$\frac{1}{8}$= very, very strong	$\frac{1}{9}$= Extreme

Part 2:Main criteria

Below is the a list of main criteria for selection, compare the relative importance of these factors to the goal of selecting the optimum private partner

`

Main Criteria				
X \ Y	**Financial**	**Technical**	**Managerial**	**Safety & Environment**
Financial		1	1	1
Technical			1	1
Managerial				1
Safety & Environment				

Importance Scale

If X is more important than Y choose from scale below

1= Equal	2= Weak	3= Moderate	4= Moderate plus	5= Strong	6= Strong plus	7= Very Strong	8= very, very strong	9= Extreme

If Y is more important than X choose from scale below

1= Equal	$\frac{1}{2}$= Weak	$\frac{1}{3}$= Moderate	$\frac{1}{4}$= Moderate plus	$\frac{1}{5}$= Strong	$\frac{1}{6}$= Strong plus	$\frac{1}{7}$= Very Strong	$\frac{1}{8}$= very, very strong	$\frac{1}{9}$= Extreme

Below is the a list of Financial Sub-Criteria, compare the relative importance of these factors to the goal of selecting the optimum private partner under the financial criteria

Financial				
X \ Y	**Debt/Equity of Project Finance**	**Government Control on Land Rates**	**Government Incentives**	**Financial Capacity of Shareholders**
Debt/Equity of Project Finance		1	1	1
Government Control on Land Rates			1	1
Government Incentives				1
Financial Capacity of Shareholders				

Importance Scale

If X is more important than Y choose from scale below

1= Equal	2= Weak	3= Moderate	4= Moderate plus	5= Strong	6= Strong plus	7= Very Strong	8= very, very strong	9= Extreme

If Y is more important than X choose from scale below

1= Equal	$\frac{1}{2}$= Weak	$\frac{1}{3}$= Moderate	$\frac{1}{4}$= Moderate plus	$\frac{1}{5}$= Strong	$\frac{1}{6}$= Strong plus	$\frac{1}{7}$= Very Strong	$\frac{1}{8}$= very, very strong	$\frac{1}{9}$= Extreme

Below is the a list of Financial Sub-Criteria, compare the relative importance of these factors to the goal of selecting the optimum private partner under the Technical criteria

Technical					
y / x	**Capacity of design firm and its proposed design standards**	**Compliance with operation and maintenance program**	**Construction program and Milestone timeline**	**Proposed Construction technology and methods**	**Utilizing Project control and deliverable system**
Capacity of design firm and its proposed design standards		1	1	1	1
Compliance with operation and maintenance program			1	1	1
Construction program and Milestone timeline				1	1
Proposed Construction technology and methods					1
Utilizing Project control and deliverable system					

Importance Scale

If X is more important than Y choose from scale below

1= Equal	2= Weak	3= Moderate	4= Moderate plus	5= Strong	6= Strong plus	7= Very Strong	8= very, very strong	9= Extreme

If Y is more important than X choose from scale below

1= Equal	$\frac{1}{2}$= Weak	$\frac{1}{3}$= Moderate	$\frac{1}{4}$= Moderate plus	$\frac{1}{5}$= Strong	$\frac{1}{6}$= Strong plus	$\frac{1}{7}$= Very Strong	$\frac{1}{8}$= very, very strong	$\frac{1}{9}$= Extreme

Below is the a list of Financial Sub-Criteria, compare the relative importance of these factors to the goal of selecting the optimum private partner under the Managerial criteria

Managerial							
X \ Y	Past experience in executing similar projects	Commitment and acceptance of risk transfer	Clear responsibility allocation in consortium	Working and contractual relationships among participants	Proposed Contingency plan	Utilizing management system for coordination and communication (ISO certification)	Acquiring and compliance with local qualifications and permits
Past experience in executing similar projects		1	1	1	1	1	1
Commitment and acceptance of risk transfer			1	1	1	1	1
Clear responsibility allocation in consortium				1	1	1	1
Working and contractual relationships among participants					1	1	1
Proposed Contingency plan						1	1
Utilizing management system for coordination and communication (ISO certification)							1
Acquiring and compliance with local qualifications and permits							

Importance Scale

If X is more important than Y choose from scale below

1= Equal	2= Weak	3= Moderate	4= Moderate plus	5= Strong	6= Strong plus	7= Very Strong	8= very, very strong	9= Extreme

If Y is more important than X choose from scale below

1= Equal	$\frac{1}{2}$= Weak	$\frac{1}{3}$= Moderate	$\frac{1}{4}$= Moderate plus	$\frac{1}{5}$= Strong	$\frac{1}{6}$= Strong plus	$\frac{1}{7}$= Very Strong	$\frac{1}{8}$= very, very strong	$\frac{1}{9}$= Extreme

Below is the a list of Financial Sub-Criteria, compare the relative importance of these factors to the goal of selecting the optimum private partner under the Safety/Enviornment criteria

Safety & Environment			
X \ y	**Comprehensiveness of proposed environmental policy and management plan**	**Compliance to laws and regulations**	**Qualification/ experience of safety and environmental personal**
Comprehensiveness of proposed environmental policy and management plan		1	1
Compliance to laws and regulations			1
Qualification/ experience of safety and environmental personal			

Importance Scale

If X is more important than Y choose from scale below

1= Equal	2= Weak	3= Moderate	4= Moderate plus	5= Strong	6= Strong plus	7= Very Strong	8= very, very strong	9= Extreme

If Y is more important than X choose from scale below

1= Equal	$\frac{1}{2}$= Weak	$\frac{1}{3}$= Moderate	$\frac{1}{4}$= Moderate plus	$\frac{1}{5}$= Strong	$\frac{1}{6}$= Strong plus	$\frac{1}{7}$= Very Strong	$\frac{1}{8}$= very, very strong	$\frac{1}{9}$= Extreme

بسم الله الرحمن الرحيم

Ministry of Education
King Fahd University of Petroleum & Minerals
COLLEGE OF ENVIRONMENTAL DESIGN
Dept. of Construction Engineering & Management
(036)

وزارة التعليم
جامعة الملك فهد للبترول والمعادن
كلية تصاميم البيئة
قسم هندسة وإدارة التشييد
(٠٣٦)

Letter of requesting informational interview

الى من يهمه الأمر

هذا الخطاب للتأكيد بأن م.عبد الله خالد عبد الله طالب دوام جزئي في برنامج إدارة وهندسة التشييد في جامعة الملك فهد للبترول والمعادن وبرقم الطالب:**201605020**. الطالب المذكور اعلاه يقوم بعمل رسالة الماجستير بعنوان **"شراكة القطاع العام والخاص: معايير اختيار شريك القطاع الخاص في المملكة العربية السعودية لمشاريع البنية التحتية"** تحت إشراف د.عادل الشيباني. وبأن الطالب بحاجة إلى عمل مقابلات وإستبيانات لجمع الأراء والمعلومات من خلال طرفكم والتي سوف تستخدم لأهداف بحث علمي. شاكرين لكم حسن تعاونكم واهتمامكم.

أطيب التحيات،،

To Whom It May Concern

This is to certify that **Eng. Abdullah Khalid Abdullah** is a bonafied Part-time student in the Construction/Engineering Management Masters program at KFUPM with **Student ID: 201605020**. He is conducting a research thesis entitled "**Public – Private partnership: Multi criteria selection for Private partners in Saudi Arabia for infrastructure projects**" under the supervision of **Prof.Adel Alshibani,** a professor at KFUPM. Eng.Abdullah needs to conduct interviews and surveys to gather views and data from your organization/company for educational purposes; your cooperation will be highly appreciated.

Best Regards,

Academic Advisor

Dr. Adel Alshibani

For Review,

CEM Chairman

Dr. Khalaf Al-Ofi

Oct. 24, 2018

الظهران ٣١٢٦١ • المملكة العربية السعودية • هاتف: ٨٦٠-٣٥٩٠ (٠١٣) • فاكس: ٨٦٠-٤٠١٩ (٠١٣)
DHAHRAN, 31261 • SAUDI ARABIA • Telephone : (013) 860-3590 • Fax : (013) 860-4019

Expert 1 response in a pairwise comparison matrix of Main Criteria

	Financial	Technical	Managerial	Safety & Environment
Financial	**1.0**	**1/4**	**1/6**	**3**
Technical	**4**	**1**	**1/3**	**3**
Managerial	**6**	**3**	**1**	**6**
Safety & Environment	**1/3**	**1/3**	**1/6**	**1**
CR	*=0.09*			

Expert 1 response in a pairwise comparison matrix of Financial Sub-Criteria

	Debt/Equity of Project Finance	Government Control on Land Rates	Financial Capacity	Government Incentives
Debt/Equity of Project Finance	**1**	**4**	**1/4**	**5**
Government Control on Land Rates	**1/4**	**1**	**1/3**	**2**
Government Incentives	**4**	**3**	**1**	**8**
Financial Capacity	**1/5**	**1/2**	**1/8**	**1**
CR	=0.10			

Expert 1 response in a pairwise comparison matrix of Technical Sub-Criteria

	Capacity of design firm and its proposed design standards	Compliance with operation and maintenance program	Construction program and Milestone timeline	Proposed Construction technology and methods	Utilizing Project control and deliverable system
Capacity of design firm and its proposed design standards	**1**	**7**	**5**	**3**	**8**
Compliance with operation and maintenance program	**1/7**	**1**	**1/5**	**1/4**	**3**
Construction program and Milestone timeline	**1/5**	**5**	**1**	**3**	**7**
Proposed Construction technology and methods	***1/3***	***4***	***1/3***	***1***	**5**
Utilizing Project control and deliverable system	***1/8***	***1/3***	***1/7***	***1/5***	***1***
CR	=0.10				

Expert 1response in a pairwise comparison matrix of Managerial Sub-Criteria

	Past experience in executing similar projects	Commitment and acceptance of risk transfer	Clear responsibility allocation in consortium	Working and contractual relationships among participants	Proposed Contingency plan	Utilizing management system for coordination and communication (ISO certification)	Acquiring and compliance with local qualifications and permits
Past experience in executing similar projects	1	3	4	3	6	5	1
Commitment and acceptance of risk transfer	1/3	1	2	1	4	4	1/2
Clear responsibility allocation in consortium	1/4	1/2	1	1	1	3	3
Working and contractual relationships among participants	1/3	1	1	1	3	2	1/3
Proposed Contingency plan	1/6	1/4	1	1/3	1	2	1/4
Utilizing management system for coordination and communication (ISO certification)	1/5	1/4	1/3	1/2	1/2	1	1/7
Acquiring and compliance with local qualifications and permits	1	2	1/3	3	4	7	1
CR	=0.09						

Expert 1 response in a pairwise comparison matrix of Safety/Environment Sub-Criteria

	Comprehensiveness of proposed environmental	Compliance to laws and regulations	Qualification/ experience of safety and environmental personal
Comprehensiveness of proposed environmental	**1**	**1/6**	**1/6**
Compliance to laws and regulations	**6**	**1**	**1/2**
Qualification/ experience of safety and environmental personal	**6**	**2**	**1**
CR	=0.05		

Weight of criteria obtained from expert 1

Criteria	Weight	Sub-Criteria	Weight
Financial	0.118	Debt/Equity of Project Finance	0.278
		Government Control on Land Rates:	0.121
		Financial Capacity	0.543
		Government Incentives	0.058
Technical	0.250	Capacity of design firm and its proposed design standards	0.489
		Compliance with operation and maintenance program	0.065
		Construction program and Milestone timeline	0.249
		Proposed Construction technology and methods	0.162
		Utilizing Project control and deliverable system	0.036
Managerial	0.561	Past experience in executing similar projects	0.407
		Commitment and acceptance of risk transfer	0.083
		Clear responsibility allocation in consortium	0.045
		Working and Contractual relationships among participants	0.069
		Contingency Plan	0.202
		Utilizing management system for coordination and communication (ISO certification)	0.030
		Acquiring and compliance with local qualifications and permit	0.164
Safety & Environment	0.070	Comprehensiveness of proposed environmental policy and management plan	0.077
		Compliance to laws and regulations	0.359
		Qualification/ experience of safety and environmental	0.564

Expert 2 response in a pairwise comparison matrix of Main Criteria

	Financial	Technical	Managerial	Safety & Environment
Financial	1	3	6	7
Technical	1/3	1	4	7
Managerial	1/6	1/4	1	4
Safety & Environment	1/7	1/7	1/4	1
CR	*=0.10*			

Expert 2 response in a pairwise comparison matrix of Financial Sub-Criteria

	Debt/Equity of Project Finance	Government Control on Land Rates	Financial Capacity	Government Incentives
Debt/Equity of Project Finance	1	4	1	5
Government Control on Land Rates	1/4	1	1/4	4
Government Incentives	1	4	1	4
Financial Capacity	1/5	1/4	1/4	1
CR	=0.08			

Expert 2 response in a pairwise comparison matrix of Technical Sub-Criteria

	Capacity of design firm and its proposed design standards	Compliance with operation and maintenance program	Construction program and Milestone timeline	Proposed Construction technology and methods	Utilizing Project control and deliverable system
Capacity of design firm and its proposed design standards	1	1/4	1/4	4	1/3
Compliance with operation and maintenance program	4	1	1	4	4
Construction program and Milestone timeline	4	1	1	4	3
Proposed Construction technology and methods	1/4	1/4	1/4	1	1
Utilizing Project control and deliverable system	3	1/4	1/5	1	1
CR	=0.09				

Expert 2 response in a pairwise comparison matrix of Managerial Sub-Criteria

	Past experience in executing similar projects	Commitment and acceptance of risk transfer	Clear responsibility allocation in consortium	Working and contractual relationships among participants	Proposed Contingency plan	Utilizing management system for coordination and communication (ISO certification)	Acquiring and compliance with local qualifications and permits
Past experience in executing similar projects	1	3	4	3	6	5	1
Commitment and acceptance of risk transfer	1/3	1	2	1	4	4	1/2
Clear responsibility allocation in consortium	1/4	1/2	1	1	1	3	3
Working and contractual relationships among participants	1/3	1	1	1	3	2	1/3
Proposed Contingency plan	1/6	1/4	1	1/3	1	2	1/4
Utilizing management system for coordination and communication (ISO certification)	1/5	1/4	1/3	1/2	1/2	1	1/7
Acquiring and compliance with local qualifications and permits	1	2	1/3	3	4	7	1
CR	=0.10						

Expert 2 response in a pairwise comparison matrix of Safety/Environment Sub-Criteria

	Comprehensiveness of proposed environmental	Compliance to laws and regulations	Qualification/ experience of safety and environmental personal
Comprehensiveness of proposed environmental	1	1/5	1/5
Compliance to laws and regulations	5	1	2
Qualification/ experience of safety and environmental personal	5	1/2	1
CR	=0.05		

Weight of criteria obtained from expert 2

Criteria	Weight	Sub-Criteria	Weight
Financial	0.548	Debt/Equity of Project Finance	0.399
		Government Control on Land Rates:	0.149
		Financial Capacity	0.382
		Government Incentives	0.070
Technical	0.289	Capacity of design firm and its proposed design standards	0.105
		Compliance with operation and maintenance program	0.355
		Construction program and Milestone timeline	0.334
		Proposed Construction technology and methods	0.078
		Utilizing Project control and deliverable system	0.127
Managerial	0.114	Past experience in executing similar projects	0.296
		Commitment and acceptance of risk transfer	0.141
		Clear responsibility allocation in consortium	0.143
		Working and Contractual relationships among participants	0.103
		Contingency Plan	0.056
		Utilizing management system for coordination and communication (ISO certification)	0.038
		Acquiring and compliance with local qualifications and permit	0.222
Safety & Environment	0.049	Comprehensiveness of proposed environmental policy and management plan	0.090
		Compliance to laws and regulations	0.556
		Qualification/ experience of safety and environmental	0.354

Expert 3 response in a pairwise comparison matrix of Main Criteria

	Financial	Technical	Managerial	Safety & Environment
Financial	**1.0**	**1**	**1**	**5**
Technical	**1.0**	**1**	**1**	**5**
Managerial	**1.0**	**1**	**1**	**5**
Safety & Environment	**1/5**	**1/5**	**1/5**	**1**
CR	*=0.00*			

Expert 3 response in a pairwise comparison matrix of Financial Sub-Criteria

	Debt/Equity of Project Finance	Government Control on Land Rates	Financial Capacity	Government Incentives
Debt/Equity of Project Finance	**1**	**5**	**3**	**1**
Government Control on Land Rates	**1/5**	**1**	**1/3**	**1/4**
Government Incentives	**1/3**	**3**	**1**	**1**
Financial Capacity	**1**	**4**	**1**	**1**
CR	=0.04			

Expert 3 response in a pairwise comparison matrix of Technical Sub-Criteria

	Capacity of design firm and its proposed design standards	Compliance with operation and maintenance program	Construction program and Milestone timeline	Proposed Construction technology and methods	Utilizing Project control and deliverable system
Capacity of design firm and its proposed design standards	**1**	**1/3**	**1/2**	**1/4**	**1/3**
Compliance with operation and maintenance program	**3**	**1**	**1**	**1**	**1**
Construction program and Milestone timeline	**2**	**1**	**1**	**1**	**1**
Proposed Construction technology and methods	***4***	***1***	***1***	***1***	**1**
Utilizing Project control and deliverable system	***3***	***1***	***1***	***1***	***1***
CR	=0.01				

Expert 3 response in a pairwise comparison matrix of Managerial Sub-Criteria

	Past experience in executing similar projects	Commitment and acceptance of risk transfer	Clear responsibility allocation in consortium	Working and contractual relationships among participants	Proposed Contingency plan	Utilizing management system for coordination and communication (ISO certification)	Acquiring and compliance with local qualifications and permits
Past experience in executing similar projects	**1**	**3**	**1**	**2**	**2**	**3**	**3**
Commitment and acceptance of risk transfer	**1/3**	**1**	**1/2**	**1**	**1**	**3**	**1/2**
Clear responsibility allocation in consortium	**1**	**2**	**1**	**2**	**3**	**5**	**4**
Working and contractual relationships among participants	**1/2**	**1**	**1/2**	**1**	**1**	**2**	**1**
Proposed Contingency plan	**1/2**	**1**	**1/3**	**1**	**1**	**2**	**1**
Utilizing management system for coordination and communication (ISO certification)	**1/3**	**1/3**	**1/5**	**1/2**	**1/2**	**1**	**1**
Acquiring and compliance with local qualifications and permits	**1/3**	**2**	**1/4**	**1**	**1**	**1**	**1**
CR	=0.03						

Expert 3 response in a pairwise comparison matrix of Safety/Environment Sub-Criteria

	Comprehensiveness of proposed environmental	Compliance to laws and regulations	Qualification/ experience of safety and environmental personal
Comprehensiveness of proposed environmental	**1**	**1/3**	**1/5**
Compliance to laws and regulations	**3**	**1**	**1/2**
Qualification/ experience of safety and environmental personal	**5**	**2**	**1**
CR	=0.003		

Weight of criteria obtained from expert 3

Criteria	Weight	Sub-Criteria	Weight
Financial	**0.31**	Debt/Equity of Project Finance	**0.412**
		Government Control on Land Rates:	**0.074**
		Financial Capacity	**0.214**
		Government Incentives	**0.299**
Technical	**0.31**	Capacity of design firm and its proposed design standards	**0.080**
		Compliance with operation and maintenance program	**0.230**
		Construction program and Milestone timeline	**0.215**
		Proposed Construction technology and methods	**0.245**
		Utilizing Project control and deliverable system	**0.230**
Managerial	**0.31**	Past experience in executing similar projects	**0.241**
		Commitment and acceptance of risk transfer	**0.108**
		Clear responsibility allocation in consortium	**0.272**
		Working and Contractual relationships among participants	**0.112**
		Contingency Plan	**0.105**
		Utilizing management system for coordination and communication (ISO certification)	**0.061**
		Acquiring and compliance with local qualifications and permit	**0.102**
Safety & Environment	**0.06**	Comprehensiveness of proposed environmental policy and management plan	**0.110**
		Compliance to laws and regulations	**0.309**
		Qualification/ experience of safety and environmental	**0.581**

Expert 4 response in a pairwise comparison matrix of Main Criteria

	Financial	Technical	Managerial	Safety & Environment
Financial	**1**	**1/4**	**1/3**	**1/2**
Technical	**4**	**1**	**2**	**1/2**
Managerial	**3**	**1/2**	**1**	**1/2**
Safety & Environment	**2**	**2**	**2**	**1**
CR	*=0.09*			

Expert 4 response in a pairwise comparison matrix of Financial Sub-Criteria

	Debt/Equity of Project Finance	Government Control on Land Rates	Financial Capacity	Government Incentives
Debt/Equity of Project Finance	**1**	**1/2**	**1/3**	**1/2**
Government Control on Land Rates	**2**	**1**	**2**	**3**
Government Incentives	**3**	**1/2**	**1**	**1**
Financial Capacity	**2**	**1/3**	**1**	**1**
CR	=0.06			

Expert 4 response in a pairwise comparison matrix of Technical Sub-Criteria

	Capacity of design firm and its proposed design standards	Compliance with operation and maintenance program	Construction program and Milestone timeline	Proposed Construction technology and methods	Utilizing Project control and deliverable system
Capacity of design firm and its proposed design standards	**1**	**1/2**	**1/5**	**1**	**1/7**
Compliance with operation and maintenance program	**2**	**1**	**1/3**	**2**	**1/4**
Construction program and Milestone timeline	**5**	**3**	**1**	**6**	**1**
Proposed Construction technology and methods	***1***	***1/2***	***1/6***	***1***	**1/4**
Utilizing Project control and deliverable system	***7***	***4***	***1***	***4***	***1***
CR	=0.01				

Expert 4 response in a pairwise comparison matrix of Managerial Sub-Criteria

	Past experience in executing similar projects	Commitment and acceptance of risk transfer	Clear responsibility allocation in consortium	Working and contractual relationships among participants	Proposed Contingency plan	Utilizing management system for coordination and communication (ISO certification)	Acquiring and compliance with local qualifications and permits
Past experience in executing similar projects	**1**	**3**	**1**	**1**	**2**	**3**	**1**
Commitment and acceptance of risk transfer	**1/3**	**1**	**1/2**	**1**	**1/3**	**1**	**1/3**
Clear responsibility allocation in consortium	**1**	**2**	**1**	**2**	**2**	**3**	**1**
Working and contractual relationships among participants	**1**	**1**	**1/2**	**1**	**1/3**	**1**	**1**
Proposed Contingency plan	**1/2**	**3**	**1/2**	**3**	**1**	**2**	**1/2**
Utilizing management system for coordination and communication (ISO certification)	**1/3**	**1**	**1/3**	**1**	**1/2**	**1**	**1/5**
Acquiring and compliance with local qualifications and permits	**1**	**3**	**1**	**1**	**2**	**5**	**1**
CR	=0.05						

Expert 4 response in a pairwise comparison matrix of Safety/Environment Sub-Criteria

	Comprehensiveness of proposed environmental	Compliance to laws and regulations	Qualification/ experience of safety and environmental personal
Comprehensiveness of proposed environmental	**1**	**1/2**	**2**
Compliance to laws and regulations	**2**	**1**	**6**
Qualification/ experience of safety and environmental personal	**1/2**	**1/6**	**1**
CR	=0.02		

Weight of criteria obtained from expert 4

Criteria	Weight	Sub-Criteria	Weight
Financial	**0.107**	Debt/Equity of Project Finance	**0.127**
		Government Control on Land Rates	**0.421**
		Financial Capacity	**0.250**
		Government Incentives	**0.201**
Technical	**0.310**	Capacity of design firm and its proposed design standards	**0.064**
		Compliance with operation and maintenance program	**0.119**
		Construction program and Milestone timeline	**0.365**
		Proposed Construction technology and methods	**0.069**
		Utilizing Project control and deliverable system	**0.383**
Managerial	**0.205**	Past experience in executing similar projects	**0.192**
		Commitment and acceptance of risk transfer	**0.073**
		Clear responsibility allocation in consortium	**0.196**
		Working and Contractual relationships among participants	**0.110**
		Contingency Plan	**0.152**
		Utilizing management system for coordination and communication (ISO certification)	**0.067**
		Acquiring and compliance with local qualifications and permit	**0.210**
Safety & Environment	**0.377**	Comprehensiveness of proposed environmental policy and management plan	**0.269**
		Compliance to laws and regulations	**0.613**
		Qualification/ experience of safety and environmental	**0.118**

Expert 5 response in a pairwise comparison matrix of Main Criteria

	Financial	Technical	Managerial	Safety & Environment
Financial	1.0	1/3	1/6	1/7
Technical	3.0	1	1/2	1/4
Managerial	6.0	2	1	1/5
Safety & Environment	7.0	4	5	1
CR	*=0.08*			

Expert 5 response in a pairwise comparison matrix of Financial Sub-Criteria

	Debt/Equity of Project Finance	Government Control on Land Rates	Financial Capacity	Government Incentives
Debt/Equity of Project Finance	1	1/5	1/4	4
Government Control on Land Rates	5	1	1	5
Government Incentives	4	1	1	6
Financial Capacity	1/4	1/5	1/6	1
CR	=0.07			

Expert 5 response in a pairwise comparison matrix of Technical Sub-Criteria

	Capacity of design firm and its proposed design standards	Compliance with operation and maintenance program	Construction program and Milestone timeline	Proposed Construction technology and methods	Utilizing Project control and deliverable system
Capacity of design firm and its proposed design standards	1	6	5	4	1/2
Compliance with operation and maintenance program	1/6	1	2	1/3	1/7
Construction program and Milestone timeline	1/5	1/2	1	2	1/6
Proposed Construction technology and methods	1/4	3	1/2	1	1/6
Utilizing Project control and deliverable system	2	7	6	6	1
CR	=0.10				

Expert 5 response in a pairwise comparison matrix of Managerial Sub-Criteria

	Past experience in executing similar projects	Commitment and acceptance of risk transfer	Clear responsibility allocation in consortium	Working and contractual relationships among participants	Proposed Contingency plan	Utilizing management system for coordination and communication (ISO certification)	Acquiring and compliance with local qualifications and permits
Past experience in executing similar projects	1	4	7	7	6	6	8
Commitment and acceptance of risk transfer	1/4	1	3	3	3	6	6
Clear responsibility allocation in consortium	1/7	1/3	1	1/2	3	4	5
Working and contractual relationships among participants	1/7	1/3	2	1	1/2	4	4
Proposed Contingency plan	1/6	1/3	1/3	2	1	3	3
Utilizing management system for coordination and communication (ISO certification)	1/6	1/6	1/4	1/4	1/3	1	3
Acquiring and compliance with local qualifications and permits	1/8	1/6	1/5	1/4	1/3	1/3	1
CR	=0.10						

Expert 5 response in a pairwise comparison matrix of Safety/Environment Sub-Criteria

	Comprehensiveness of proposed environmental	Compliance to laws and regulations	Qualification/ experience of safety and environmental personal
Comprehensiveness of proposed environmental	1	5	5
Compliance to laws and regulations	1/5	1	2
Qualification/ experience of safety and environmental personal	1/5	1/2	1
CR	=0.05		

Weight of criteria obtained from expert 5

Criteria	Weight	Sub-Criteria	Weight
Financial	**0.055**	Debt/Equity of Project Finance	**0.134**
		Government Control on Land Rates	**0.408**
		Financial Capacity	**0.399**
		Government Incentives	**0.060**
Technical	**0.136**	Capacity of design firm and its proposed design standards	0.303
		Compliance with operation and maintenance program	0.068
		Construction program and Milestone timeline	0.077
		Proposed Construction technology and methods	0.087
		Utilizing Project control and deliverable system	0.465
Managerial	**0.225**	Past experience in executing similar projects	0.440
		Commitment and acceptance of risk transfer	0.196
		Clear responsibility allocation in consortium	0.111
		Working and Contractual relationships among participants	0.096
		Contingency Plan	0.085
		Utilizing management system for coordination and communication (ISO certification)	0.044
		Acquiring and compliance with local qualifications and permit	0.027
Safety & Environment	**0.584**	Comprehensiveness of proposed environmental policy and management plan	0.703
		Compliance to laws and regulations	0.182
		Qualification/ experience of safety and environmental	0.115

Expert 6 response in a pairwise comparison matrix of Main Criteria

	Financial	Technical	Managerial	Safety & Environment
Financial	**1.0**	**1**	**1**	**5**
Technical	**1.0**	**1**	**1**	**5**
Managerial	**1.0**	**1**	**1**	**5**
Safety & Environment	**0.2**	**1/5**	**1/5**	**1**
CR	*=0.00*			

Expert 6 response in a pairwise comparison matrix of Financial Sub-Criteria

	Debt/Equity of Project Finance	Government Control on Land Rates	Financial Capacity	Government Incentives
Debt/Equity of Project Finance	**1**	**5**	**3**	**1**
Government Control on Land Rates	**1/5**	**1**	**1/3**	**1/4**
Government Incentives	**1/3**	**3**	**1**	**1**
Financial Capacity	**1**	**4**	**1**	**1**
CR	=0.04			

Expert 6 response in a pairwise comparison matrix of Technical Sub-Criteria

	Capacity of design firm and its proposed design standards	Compliance with operation and maintenance program	Construction program and Milestone timeline	Proposed Construction technology and methods	Utilizing Project control and deliverable system
Capacity of design firm and its proposed design standards	**1**	**1/3**	**1/2**	**1/4**	**1/3**
Compliance with operation and maintenance program	**3**	**1**	**1**	**1**	**1**
Construction program and Milestone timeline	**2**	**1**	**1**	**1**	**1**
Proposed Construction technology and methods	***4***	***1***	***1***	***1***	**1**
Utilizing Project control and deliverable system	***3***	***1***	***1***	***1***	***1***
CR	=0.01				

Expert 6 response in a pairwise comparison matrix of Managerial Sub-Criteria

	Past experience in executing similar projects	Commitment and acceptance of risk transfer	Clear responsibility allocation in consortium	Working and contractual relationships among participants	Proposed Contingency plan	Utilizing management system for coordination and communication (ISO certification)	Acquiring and compliance with local qualifications and permits
Past experience in executing similar projects	**1**	**3**	**1**	**2**	**2**	**3**	**3**
Commitment and acceptance of risk transfer	**1/3**	**1**	**1/2**	**1**	**1**	**3**	**1/2**
Clear responsibility allocation in consortium	**1**	**2**	**1**	**2**	**3**	**5**	**4**
Working and contractual relationships among participants	**1/2**	**1**	**1/2**	**1**	**1**	**2**	**1**
Proposed Contingency plan	**1/2**	**1**	**1/3**	**1**	**1**	**2**	**1**
Utilizing management system for coordination and communication (ISO certification)	**1/3**	**1/3**	**1/5**	**1/2**	**1/2**	**1**	**1**
Acquiring and compliance with local qualifications and permits	**1/3**	**2**	**1/4**	**1**	**1**	**1**	**1**
CR	=0.03						

Expert 6 response in a pairwise comparison matrix of Safety/Environment Sub-Criteria

	Comprehensiveness of proposed environmental	Compliance to laws and regulations	Qualification/ experience of safety and environmental personal
Comprehensiveness of proposed environmental	**1**	**1/3**	**1/5**
Compliance to laws and regulations	**3**	**1**	**1/2**
Qualification/ experience of safety and environmental personal	**5**	**2**	**1**
CR	=0.00		

Weight of criteria obtained from expert 6

Criteria	Weight	Sub-Criteria	Weight
Financial	0.313	Debt/Equity of Project Finance	0.412
		Government Control on Land Rates	0.074
		Financial Capacity	0.214
		Government Incentives	0.299
Technical	0.313	Capacity of design firm and its proposed design standards	0.080
		Compliance with operation and maintenance program	0.230
		Construction program and Milestone timeline	0.215
		Proposed Construction technology and methods	0.245
		Utilizing Project control and deliverable system	0.230
Managerial	0.313	Past experience in executing similar projects	0.241
		Commitment and acceptance of risk transfer	0.108
		Clear responsibility allocation in consortium	0.272
		Working and Contractual relationships among participants	0.112
		Contingency Plan	0.105
		Utilizing management system for coordination and communication (ISO certification)	0.061
		Acquiring and compliance with local qualifications and permit	0.102
Safety & Environment	0.063	Comprehensiveness of proposed environmental policy and management plan	0.110
		Compliance to laws and regulations	0.309
		Qualification/ experience of safety and environmental	0.581

Expert 7 response in a pairwise comparison matrix of Main Criteria

	Financial	Technical	Managerial	Safety & Environment
Financial	**1.0**	**1/3**	**3**	**1/3**
Technical	**3.0**	**1**	**4**	**1**
Managerial	**0.3**	**1/4**	**1**	**1/2**
Safety & Environment	**3.0**	**1**	**2**	**1**
CR	*=0.08*			

Expert 7 response in a pairwise comparison matrix of Financial Sub-Criteria

	Debt/Equity of Project Finance	Government Control on Land Rates	Financial Capacity	Government Incentives
Debt/Equity of Project Finance	1	**1**	**1/3**	**1/7**
Government Control on Land Rates	**1**	**1**	**2**	**1/4**
Government Incentives	**3**	**1/2**	**1**	**1/5**
Financial Capacity	**7**	**4**	**5**	**1**
CR	=0.10			

Expert 7 response in a pairwise comparison matrix of Technical Sub-Criteria

	Capacity of design firm and its proposed design standards	Compliance with operation and maintenance program	Construction program and Milestone timeline	Proposed Construction technology and methods	Utilizing Project control and deliverable system
Capacity of design firm and its proposed design standards	**1**	**4**	**1**	**1**	**3**
Compliance with operation and maintenance program	**1/4**	**1**	**1/5**	**1/4**	**1/5**
Construction program and Milestone timeline	**1**	**5**	**1**	**4**	**1**
Proposed Construction technology and methods	***1***	***4***	***1/4***	***1***	**1/2**
Utilizing Project control and deliverable system	***1/3***	***5***	***1***	***2***	***1***
CR	=0.10				

Expert 7 response in a pairwise comparison matrix of Managerial Sub-Criteria

	Past experience in executing similar projects	Commitment and acceptance of risk transfer	Clear responsibility allocation in consortium	Working and contractual relationships among participants	Proposed Contingency plan	Utilizing management system for coordination and communication (ISO certification)	Acquiring and compliance with local qualifications and permits
Past experience in executing similar projects	**1**	**5**	**3**	**3**	**5**	**8**	**1**
Commitment and acceptance of risk transfer	**1/5**	**1**	**2**	**1/3**	**3**	**2**	**1/4**
Clear responsibility allocation in consortium	**1/3**	**1/2**	**1**	**1**	**2**	**4**	**1/3**
Working and contractual relationships among participants	**1/3**	**3**	**1**	**1**	**2**	**3**	**1/3**
Proposed Contingency plan	**1/5**	**1/3**	**1/2**	**1/2**	**1**	**2**	**1/6**
Utilizing management system for coordination and communication (ISO certification)	**1/8**	**1/2**	**1/4**	**1/3**	**1/2**	**1**	**1/5**
Acquiring and compliance with local qualifications and permits	**1**	**4**	**3**	**3**	**6**	**5**	**1**
CR	=0.05						

Expert 7 response in a pairwise comparison matrix of Safety/Environment Sub-Criteria

	Comprehensiveness of proposed environmental	Compliance to laws and regulations	Qualification/ experience of safety and environmental personal
Comprehensiveness of proposed environmental	**1**	**2**	**1**
Compliance to laws and regulations	**1/2**	**1**	**1/3**
Qualification/ experience of safety and environmental personal	**1**	**3**	**1**
CR	=0.02		

Weight of criteria obtained from expert 7

Criteria	Weight	Sub-Criteria	Weight
Financial	0.171	Debt/Equity of Project Finance	0.092
		Government Control on Land Rates	0.159
		Financial Capacity	0.143
		Government Incentives	0.607
Technical	0.387	Capacity of design firm and its proposed design standards	0.285
		Compliance with operation and maintenance program	0.049
		Construction program and Milestone timeline	0.298
		Proposed Construction technology and methods	0.154
		Utilizing Project control and deliverable system	0.213
Managerial	0.105	Past experience in executing similar projects	0.307
		Commitment and acceptance of risk transfer	0.095
		Clear responsibility allocation in consortium	0.101
		Working and Contractual relationships among participants	0.120
		Contingency Plan	0.053
		Utilizing management system for coordination and communication (ISO certification)	0.037
		Acquiring and compliance with local qualifications and permit	0.287
Safety & Environment	0.337	Comprehensiveness of proposed environmental policy and management plan	0.387
		Compliance to laws and regulations	0.170
		Qualification/ experience of safety and environmental	0.443

Expert 8 response in a pairwise comparison matrix of Main Criteria

	Financial	Technical	Managerial	Safety & Environment
Financial	**1.0**	**1/3**	**3**	**1/3**
Technical	**3.0**	**1**	**4**	**1**
Managerial	**0.3**	**1/4**	**1**	**1/2**
Safety & Environment	**3.0**	**1**	**2**	**1**
CR	*=0.08*			

Expert 8 response in a pairwise comparison matrix of Financial Sub-Criteria

	Debt/Equity of Project Finance	Government Control on Land Rates	Financial Capacity	Government Incentives
Debt/Equity of Project Finance	**1**	**1**	**1/2**	**1/3**
Government Control on Land Rates	**1**	**1**	**1/4**	**1**
Government Incentives	**2**	**4**	**1**	**1**
Financial Capacity	**3**	**1**	**1**	**1**
CR	=0.09			

Expert 8 response in a pairwise comparison matrix of Technical Sub-Criteria

	Capacity of design firm and its proposed design standards	Compliance with operation and maintenance program	Construction program and Milestone timeline	Proposed Construction technology and methods	Utilizing Project control and deliverable system
Capacity of design firm and its proposed design standards	**1**	**1**	**1/4**	**1**	**1/7**
Compliance with operation and maintenance program	**1**	**1**	**1**	**3**	**1/3**
Construction program and Milestone timeline	**4**	**1**	**1**	**2**	**1**
Proposed Construction technology and methods	***1***	***1/3***	***1/2***	***1***	**1/6**
Utilizing Project control and deliverable system	***7***	***3***	***1***	***6***	***1***
CR	0.07				

Expert 8 response in a pairwise comparison matrix of Managerial Sub-Criteria

	Past experience in executing similar projects	Commitment and acceptance of risk transfer	Clear responsibility allocation in consortium	Working and contractual relationships among participants	Proposed Contingency plan	Utilizing management system for coordination and communication (ISO certification)	Acquiring and compliance with local qualifications and permits
Past experience in executing similar projects	**1**	**2**	**1**	**1/3**	**1**	**5**	**1**
Commitment and acceptance of risk transfer	**1/2**	**1**	**1**	**1/4**	**1**	**4**	**1/4**
Clear responsibility allocation in consortium	**1**	**1**	**1**	**1/3**	**5**	**8**	**1**
Working and contractual relationships among participants	**3**	**4**	**3**	**1**	**3**	**5**	**1/2**
Proposed Contingency plan	**1**	**1**	**1/5**	**1/3**	**1**	**1**	**1/2**
Utilizing management system for coordination and communication (ISO certification)	**1/5**	**1/4**	**1/8**	**1/5**	**1**	**1**	**1/5**
Acquiring and compliance with local qualifications and permits	**1**	**4**	**1**	**2**	**2**	**5**	**1**
CR	=0.09						

Expert 8 response in a pairwise comparison matrix of Safety/Environment Sub-Criteria

	Comprehensiveness of proposed environmental	Compliance to laws and regulations	Qualification/ experience of safety and environmental personal
Comprehensiveness of proposed environmental	**1**	**1**	**2**
Compliance to laws and regulations	**1**	**1**	**3**
Qualification/ experience of safety and environmental personal	**1/2**	**1/3**	**1**
CR	0.02		

Weight of criteria obtained from expert 8

Criteria	Weight	Sub-Criteria	Weight
Financial	0.171	Debt/Equity of Project Finance	0.142
		Government Control on Land Rates	0.169
		Financial Capacity	0.380
		Government Incentives	0.309
Technical	0.387	Capacity of design firm and its proposed design standards	0.085
		Compliance with operation and maintenance program	0.171
		Construction program and Milestone timeline	0.249
		Proposed Construction technology and methods	0.079
		Utilizing Project control and deliverable system	0.416
Managerial	0.105	Past experience in executing similar projects	0.137
		Commitment and acceptance of risk transfer	0.086
		Clear responsibility allocation in consortium	0.182
		Working and Contractual relationships among participants	0.261
		Contingency Plan	0.075
		Utilizing management system for coordination and communication (ISO certification):	0.037
		Acquiring and compliance with local qualifications and permit	0.223
Safety & Environment	0.337	Comprehensiveness of proposed environmental policy and management plan	0.387
		Compliance to laws and regulations	0.443
		Qualification/ experience of safety and environmental	0.170

Expert 9 response in a pairwise comparison matrix of Main Criteria

	Financial	Technical	Managerial	Safety & Environment
Financial	**1**	**3**	**1**	**1/6**
Technical	**1/3**	**1**	**1/4**	**1/5**
Managerial	**1**	**4**	**1**	**1/4**
Safety & Environment	**6**	**5**	**4**	**1**
CR	*=0.08*			

Expert 9 response in a pairwise comparison matrix of Financial Sub-Criteria

	Debt/Equity of Project Finance	Government Control on Land Rates	Financial Capacity	Government Incentives
Debt/Equity of Project Finance	**1**	**1/3**	**1/5**	**1/3**
Government Control on Land Rates	**3**	**1**	**2**	**1**
Government Incentives	**5**	**1/2**	**1**	**2**
Financial Capacity	**3**	**1**	**1/2**	**1**
CR	=0.08			

Expert 9 response in a pairwise comparison matrix of Technical Sub-Criteria

	Capacity of design firm and its proposed design standards	Compliance with operation and maintenance program	Construction program and Milestone timeline	Proposed Construction technology and methods	Utilizing Project control and deliverable system
Capacity of design firm and its proposed design standards	**1**	**1/8**	**1/9**	**1**	**1/4**
Compliance with operation and maintenance program	**8**	**1**	**1**	**4**	**1**
Construction program and Milestone timeline	**9**	**1**	**1**	**8**	**8**
Proposed Construction technology and methods	***1***	***1/4***	***1/8***	***1***	**1/4**
Utilizing Project control and deliverable system	***4***	***1***	***1/8***	***4***	***1***
CR	=0.09				

Expert 9 response in a pairwise comparison matrix of Managerial Sub-Criteria

	Past experience in executing similar projects	Commitment and acceptance of risk transfer	Clear responsibility allocation in consortium	Working and contractual relationships among participants	Proposed Contingency plan	Utilizing management system for coordination and communication (ISO certification)	Acquiring and compliance with local qualifications and permits
Past experience in executing similar projects	**1**	**4**	**1/5**	**1/9**	**1/5**	**2**	**1/4**
Commitment and acceptance of risk transfer	**1/4**	**1**	**1/9**	**1/9**	**1/9**	**1/2**	**1/5**
Clear responsibility allocation in consortium	**5**	**9**	**1**	**3**	**1**	**9**	**4**
Working and contractual relationships among participants	**9**	**9**	**1/3**	**1**	**1**	**6**	**1**
Proposed Contingency plan	**5**	**9**	**1**	**1**	**1**	**9**	**1**
Utilizing management system for coordination and communication (ISO certification)	**1/2**	**2**	**1/9**	**1/6**	**1/9**	**1**	**1/6**
Acquiring and compliance with local qualifications and permits	**4**	**5**	**1/4**	**1**	**1**	**6**	**1**
CR	=0.06						

Expert 9 response in a pairwise comparison matrix of Safety/Environment Sub-Criteria

	Comprehensiveness of proposed environmental	Compliance to laws and regulations	Qualification/ experience of safety and environmental personal
Comprehensiveness of proposed environmental	**1**	**1**	**1**
Compliance to laws and regulations	**1**	**1**	**1**
Qualification/ experience of safety and environmental personal	**1**	**1**	**1**
CR	=0.00		

Weight of criteria obtained from expert 9

Criteria	Weight	Sub-Criteria	Weight
Financial	0.153	Debt/Equity of Project Finance	0.083
		Government Control on Land Rates	0.344
		Financial Capacity	0.331
		Government Incentives	0.242
Technical	0.070	Capacity of design firm and its proposed design standards	0.041
		Compliance with operation and maintenance program	0.277
		Construction program and Milestone timeline	0.463
		Proposed Construction technology and methods	0.050
		Utilizing Project control and deliverable system	0.168
Managerial	0.186	Past experience in executing similar projects	0.052
		Commitment and acceptance of risk transfer	0.022
		Clear responsibility allocation in consortium	0.322
		Working and Contractual relationships among participants	0.200
		Contingency Plan	0.221
		Utilizing management system for coordination and communication (ISO certification):	0.030
		Acquiring and compliance with local qualifications and permit	0.152
Safety & Environment	0.591	Comprehensiveness of proposed environmental policy and management plan	0.333
		Compliance to laws and regulations	0.333
		Qualification/ experience of safety and environmental	0.333