

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

COLLEGE OF GRADUATE STUDIES
CONSTRUCTION ENGINEERING AND MANAGEMENT

CEM-520
CONSTRUCTION CONTRACTING

Done For
Dr. Sadi A. Assaf

A Thesis Summary Of

A Conceptual Model for Consultant
Selection in Saudi Arabia
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December, 1998

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December 25, 2004

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ABSTRACT

There are many factors participating in making A/E selection process as the public sector considers engaging consultants (A/E) for professional services. The selection should be consistent, comprehensive and flexible. This research is regarding the improvement of the A/E selection process in Saudi Arabia.

At the beginning, there are thirteen criteria for the A/E selection. Then, it is reduced to only eight which are the most important. Thirty public sector organizations and thirty consultants were surveyed to identify the major selection criteria of A/E. As a result, Work Experience, Project Management, Capability, Staff and Qualification, Quality Performance, Past Performance, Quality Control, References and Firm Capacity were identified to be the major selection criteria. They were used in conjunction with the Analytic Hierarchy Process (AHP) theory concept and a computerized software program "Expert Choice" based on AHP in structuring the A/E consultant conceptual selection model (CCSM). The CCSM was used for solving the selection problem. As results, the (CCSM) model is proved to be practical, complete and flexible enough to meet public sector demand to incorporate any additional criteria.

CHAPTER - 1: THE NEED FOR A/E PRE-QUALIFICATION

1-1 Introduction

The lack of in-house experience forced the public sector to limit the in-house engineer's responsibilities only to contract administration and to seek external professional consultation from the local and foreign consulting firms. The selection processes of A/Es in Saudi Arabia are bound by Saudi recruitment regulation. (14)

Many factors make the selection processes A/Es very inconsistent and complicated. Some factors are: the large and complex projects, phenomenal technical changes in industries, essence of time, needs for specialized technical expertise, the political needs or legal constraints and the presence of serious problems in many technical areas requiring solutions beyond the capabilities of regular in-house engineers. (9)

It will engage only the ones that meet the owners' needs through a systematic selection method. The difficulties and comprehensive evaluation of related complex criteria make the A/E selection process is not an easy task.

1-2 Statement of The Problem

Experienced professionals for large and complex projects, especial requirements for complex or specialized design, and technical areas for serious problems are all beyond the capabilities of the regular engineers in the public sector. However, the regulations and the implementations currently used by the public sector are not clear and leave the proponent agencies unguided to select A/E firms based on their own developed and adopted selection criteria. So, different agencies performing the A/E selection use different standards in selection procedures.

This research study is an attempt to standardize the A/E selection process in the Kingdom of Saudi Arabia. This aim is dedicated from one of the tendering regulations which state that *"The minister concerned shall select the best proposal. Study and design services shall be compensated on a lump sum basis"* indicating the best proposal should be selected (10). There are different factors contributed to the difficulties of A/E selection. The factors contributed to the difficulties of A/E selection cause engagement of unqualified A/E and many other disadvantages, such as:

- Low quality of services.
- Poor quality design.
- Inaccurate estimate of construction costs.
- Poor quality of contract documents.
- Exclusion of good and experienced A/Es.
- High chance of selecting A/Es with experienced A/Es.
- Deteriorated A/E-owner relationship.

Thus, the research problem is stated as follows:

"The development of an A/E consultant conceptual multiple-criteria decision-making model for prequalification and selection of A/E is essential for the good of the public sector. The model will assist the proponent agencies to minimize the mentioned problems and ensure the selection of the most qualified A/E who will achieve the desired professional services satisfactory to the public sector objectives, high quality, low costs, and clear time frame."

1-3 Objectives of The Research

The research's main objectives are as follow:

- 1- To identify the major A/E selection criteria to be considered by the Saudi Public owners when considering the engagement of a consultant (A/E) for professional services.
- 2- To develop a consultant conceptual selection model (CCSM) using the selection criteria and the Analytic Hierarchy Process (AHP).

1-4 Limitations of the Research

This study is limited only to the public sector (Public Agencies) in Saudi Arabia requiring any of the A/Es' wide professional services. The public agencies are assumed to be well trained, experienced, and capable of performing the selection process.

1-5 Significance of the Research

The A/E selection will affect the efficiency, convenience, and the quality of the project. This study will try to eliminate the selection of incompetent A/Es and clarify the advantages and disadvantages of the selection of the A/E process currently used by the public sector in Saudi Arabia. At the end of the day, all utilities and services provided by the government to all citizens will be improved. The standards of living in the country will be raised. (5)

CHAPTER - 2: LITERATURE REVIEW

The factors that compel the public sector are: the sizes and complexity of construction projects, the high changes in technology in construction industry, the lack of in-house engineering capabilities, the need for specialized technical expertise in both design and construction, and the political or legal regulations and the non-repetitive work.

The A/E selection through a systematic pre-qualification process has been one of the most important decisions to be taken by the public sector. The development of the A/E consultant conceptual model (CCSM) to deal with multiple criteria would be of great benefit to public sector organizations in solving selection difficulties.

2-1 Saudi Consulting Practice Review

Definition of Consultant: The consulting engineer is a professional with practical professional experience and rendering the professional services to clients.

A Consultant's Clients: Public organizations are the main client. Other clients include government agencies, private owners, semi-public sector, industry and commerce, and other professionals like lawyers. (4)

Consulting Services: The professional consulting services are required in all construction phases. These services may range from the comprehensive services to life cycle costing. (4)

Figure 2 – 1 A/E-Owner Relationships under Traditional C. Contract

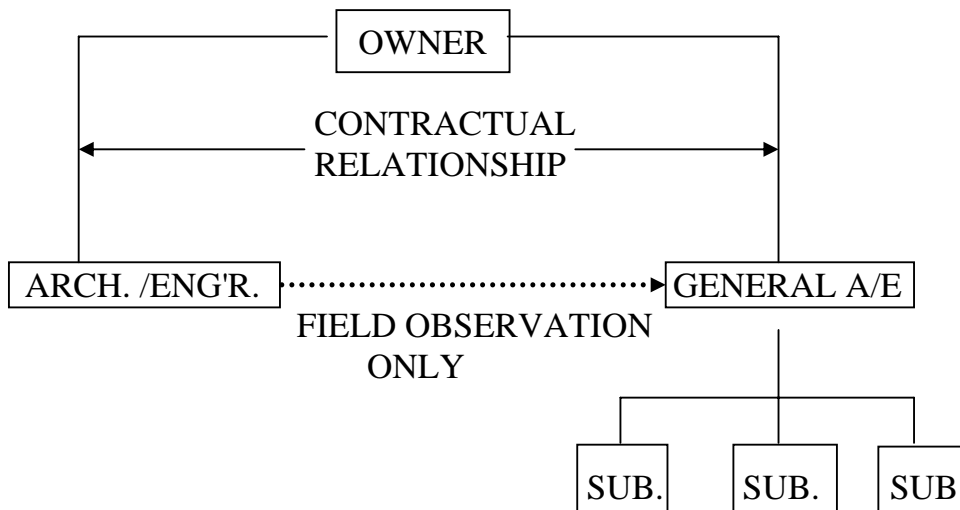


Figure 2 – 2 A/E-Owner Relationships under Design/Construction Manager Contract.

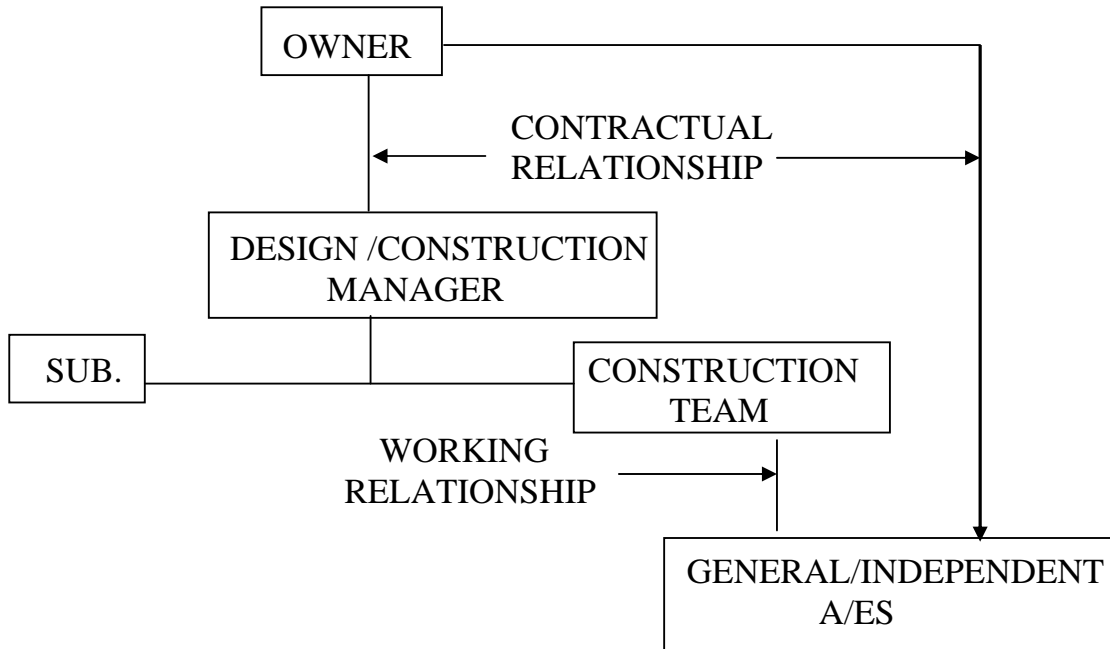


Figure 2 – 3 A/E-Owner Relationships under a Professional Construction Manager Contract

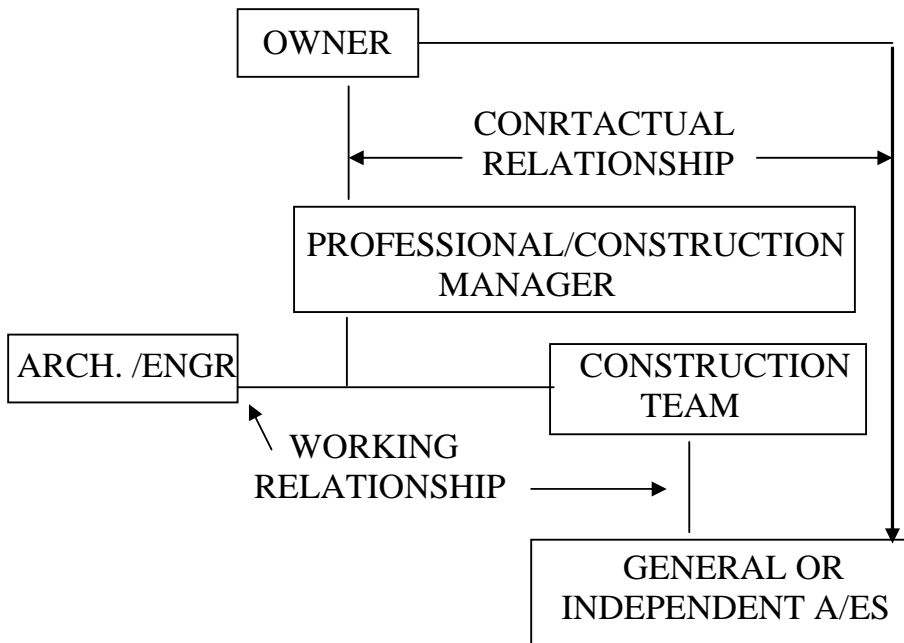


Figure 2 – 4 A/E-Owner Relationships under a Professional Construction Manager Contract

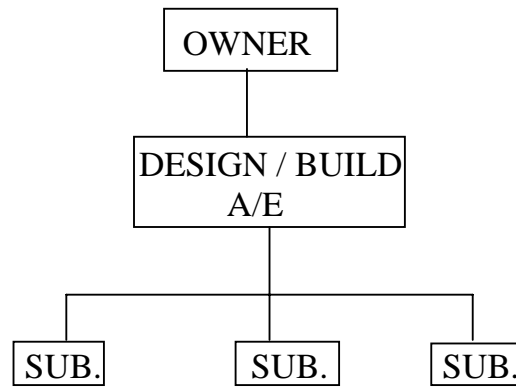


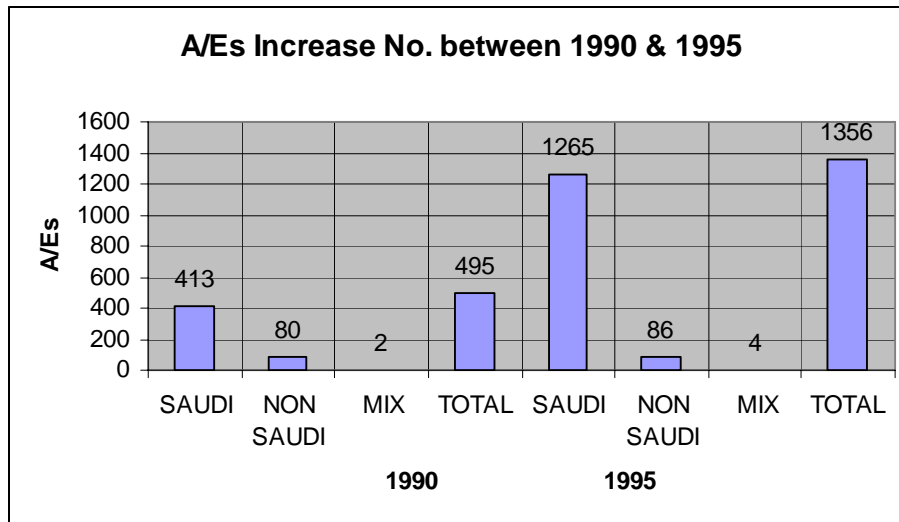
Table 2 – 1: Services Offered by A/Es
Source: Al-Musallami 1992

- Comprehensive services
- Basic design services
- Construction management
- Quantity survey
- Feasibility studies
- Budgeting
- Site selection & analysis
- Value engineering
- Marketing studies
- Environmental studies
- Life cycle costing

The Saudi Consulting Organizations: In the Ministry of Commerce, the issuance of licenses for the consulting and engineering offices is done by the engineering consulting division.

There are **four major categories of the A/E** firms based on the owners and the firms' nationality. These major categories are: Saudi Engineering Office - Saudi Consulting Office - Non-Saudi Engineering Office - Foreign Consulting Office

In Saudi Arabia, the consulting practice is toward specialization. The specialized A/Es are increased from 1990 to 1995. The following table represents the numbers.



2-1-1 The Selection Methods

The owners always influence the selection methods. But, the best practice in selection method is based the professional qualifications and competences. There are three different selection methods.

- 1- **Direct Selection Method:** This method is based on the A/E reputation. It is preferred when there is a full trust in selecting A/E. It is not preferred when dealing with small and new A/Es. (2)
- 2- **Competitive Selection Method:** It is based on fee and design submissions by A/Es. **Fee selection** is controversial and opposed by many officials and design professionals. **Design competition** is preferred by A/Es due to competences. A/Es use this method to deceive owners and owners use it to encourage new talented A/Es. (7)
- 3- **Comparative Selection Method:** It is based on objective evaluation of the A/Es ' qualifications and technical experience. It is the most widely used methods. The final A/E selection will be based on possessing a good standing in technical competence, professional experience, business capacity, creativity, and ability. In Saudi Arabia, the selection methods used by the public sector are competitive bidding, direct selection, and design competition method.

Table 2 – 2: A/E Selection (As Indicated by Public sector)

Source: Al-Musallami 1992.

A/E Selection Methods	Frequency %
Competitive bidding	66
Direct method	48
Design competition	39
Nomination	30

2-2 Previous Studies

Back to literature review, the A/E selection procedures have been developed to assist the public sector organizations. Unfortunately, limited researches were conducted on the A/E practice in Saudi Arabia. In some other earlier researches, the A/E pre-qualification and selection procedures have been mentioned as subtitles only.

In a study conducted by Al-Musallami (1992), he had concluded that the public clients are the major users of A/E design services and the A/Es are selected by the comparative method which is used by 66% of owners.

Some researchers and their findings are listed below:

- Al-Shiha (1993) found that the A/E poor selection affects not only the design and construction stages. But also, it will add to maintenance costs of buildings.
- Aitath (1988) found that projects in Saudi Arabia awarded only on the basis of the lowest bid had lower performance quality compared to those awarded on the basis of proper qualification and competence.
- All these mentioned researches have one common objective. It is "**shortlist the competing A/Es and select only capable A/Es having the proper qualifications.**"
- Kasma (1987) in his research recommended a policy and procedure for the public sector in procuring and selecting A/Es for professional engineering services.
- Potter and Sanvido (1994, 1995) presented a model to help the public sector to select the most appropriate A/E for a proposed project. This model will allow the public sector to perform a consistent evaluating procedure to evaluate the A/E ability using a systematic, strong, and outstanding professional prequalification approach.
- The most highly recommended approach is to utilize and benefit from the multiple criteria decision-making process (MCDM).
- In Saudi Arabia, Assaf and Jannadi (1995) proposed a method for prequalification and selection of contractor based on MCDM.
- The Analytic Hierarchy Process (AHP) is another powerful method found and applied using multiple criteria approach.
- Abdelrazig (1996) structured a methodology to help contractors in Saudi Arabia to make their bid/no bid decisions by using the AHP approach. Hanratty (1992) used the AHP to solve the chemical laboratory reactor selection by comparing the different reactor configurations.
- Mustafa (1991) used AHP in the assessment of risk in constructing the Jamuna Multiple-Purpose Bridge in Bangladesh.

CHAPTER - 3: THE CONSULTANT SELECTION CRITERIA

To ensure the best professional services in the A/E selection, the quality of the project's specific criteria should be objective. The procedure of the A/E selection must be a clearly defined systematic approach. It will establish the financial, technical, managerial capability and competence of each A/E to perform the proposed work. (10)

Literature and previous studies are carefully investigated to identify the most important criteria for A/E pre-qualification and selection (7). Each of these criteria has a certain level of importance to the owner and the project itself. The objectivity of the evaluation these criteria will ensure the successful of the A/E selection and accomplishment of the overall goals of the selection process.

3-1 The Selection Criteria

The following criteria should be considered regardless of the selection method used.

- 1- **Current Work Load:** adequate to add a new project to its current work schedule.
- 2- **Experience:** technical knowledge, experience, and understanding of the capabilities of how to execute different tasks required in all stages of the project.
- 3- **Economic Constraint:** the cash flow in conducting any project.
- 4- **Quality Control:** owner satisfaction, operation and maintenance cost.
- 5- **Experience in Geographic Location:** familiarity and understanding of the local construction conditions, laws, labor law, building codes, whether, environment conditions, and other requirements.(6)
- 6- **Firm Capacity:** completion the work of any project. Technical competence, managerial ability, staff and financial resources.
- 7- **Firm Organization:** resources to carry out information/instruction and accomplish the work by taking decisions accurately and effectively.
- 8- **Staff Availability and Qualifications:** manpower resources, quality of the work.
- 9- **Head Office Location:** communication and the project operation.
- 10- **Project Management Capabilities:** managerial ability and the overall performance. (8)
- 11- **Reference and Past Performance:** reputation, and quality of completed projects.

3-2 The Pre-qualification in Saudi Arabia

In Saudi Arabia, each public sector agency has its own list that might be different than other agencies. The quality's evaluation, criteria, and how these criteria are related to the project in hand will lead to either successful or poor selection method.

CHAPTER - 4: MULTIPLE CRITERIA DECISION-MAKING (MCDM)

Multiple Criteria Decision-Making (MCDM) approaches are used to achieve more than one objective or criteria to have successful and final selections from different alternatives. The A/E selection process depends mainly on committee members' experience and intuitions. So, it is appropriate to utilize one of the MCDM approaches to solve A/E selection procedure difficulties. One of these approaches is the Analytic Hierarchy Process (AHP). AHP approach has many wide applications in many fields but no literature was found in the process of A/E selection as it will make this selection a consistency one.

4-1 The Analytic Hierarchy Process (AHP)

To use this process, we need to prioritize and weigh all alternatives by using a framework (13). AHP can deal with the intuitive, the rational, and the irrational selection factors. The method used by AHP includes the following steps:

- 1) Construct a decision hierarchy by breaking down the decision problem into a hierarchy of its elements.
- 2) Collect input by a pairwise comparison of decision elements.
- 3) Determine whether the input data satisfy a consistency test; if not, redo the pairwise comparisons.
- 4) Calculating the relative weights of the decision elements.
- 5) Aggregate the relative weight to obtain scores and hence rankings for the decision alternatives.

The AHP combines the deductive approach, which focuses on the parts, and system approach, which concentrates on the working of the whole, into one integrated, logical framework. AHP has many advantages. Some of them are; consistency, measurement, hierarchic structures, interdependence, complexity, unity, process repetition, judgment and consensus, tradeoffs, systematic and synthesis.

4-2 The Decision Support System

One the common Decision Support System is the Expert Choice (EC) version 9.5. It is a valuable and flexible software package for performing multiple-criteria decision analysis, with its capacity to conduct massive computations. It reflects the expertise of the decision-maker, not the computer, replaces the lengthy paper report with a brief one, and has the capability of doing "what if" types of analyses. The EC software is applied in hundreds of business operations and government decision applications, including total quality management, resource allocation, cost benefit analysis, engineering design evaluations, selecting alternatives "what-if" forecasting, and product research and development, among others.

CHAPTER - 5: THE RESEARCH METHODOLOGY

5-1 Data Collection and Survey

The approach to meet the objectives was by conducting the survey and interviews based on identified A/E selection criteria. The selection criteria were gathered through: the available literature on the consultants' prequalification, direct interviews with construction professionals, and samples of the public sector prequalification and selection process. A small pilot study was conducted for the questionnaire shown in (Appendix- A) because there were no conducted researches in this particular field in Saudi Arabia. Two of the public sector organizations that involved heavily in A/E selection for professional services were selected to make their judgments of the criteria and alternatives in pairwise comparison matrices. The number of these criteria was 13. The conceptual consultant A/E selection (CCSM) model was implemented to show the consistency and completeness of the model for A/E selection.

5-2 Scoring Method

The respondents had nine options for rating the criteria because of the use of the Analytic Hierarchy Process (AHP). The options were shown in the questionnaire itself. For the identified A/E selection criteria, the Average Rank (A.R.) = 6.5 and Importance Index (I.I.) = 72.2%. Consequently, the selection criteria were ranked in descending order according to their average ranks and three lists were obtained; namely public sector's list, consultant's list, and a list for both together.

5-3 Sample Size

Thirty public agencies with approved budgets and thirty consultants practicing in Saudi Arabia (15 from Dammam and 15 from Riyadh) participated in the survey. The following table will give detailed information about the participants.

No	Description	No. of questionnaires		Percentage
		PS	A/E	
1	Total No. of the questionnaires that was handed out.	60	30	100
2	Total No. of the questionnaires completed and returned.	49	26	82
3	Total No. of the respondents who did not return questionnaire.	11	4	18

To develop a consultant conceptual A/E Selection Model (CCSM), the final identified criteria, AHP, and computerized software "Expert Choice Version 9.5" based on AHP were used.

CHAPTER - 6: THE DATA RESULTS AND ANALYSIS

6-1 Statistical Methods

In the table below, the results are presented.

No.	Criteria Description	MEAN	STD	STD ERROR OF MEAN	VAR	COEFF. OF VARIATION CV	95% CONFIDENCE INTERVAL	
							LOWER LIMIT	UPPER LIMIT
CR.1	Current Work Load	6.93	1.23	0.17	1.50	17.71	6.60	7.25
CR.2	Experience	8.19	0.83	0.11	0.68	10.09	7.96	8.41
CR.3	Experience in Geographic Location	6.09	1.33	0.18	1.78	21.89	5.74	6.45
CR.4	Economical Constraints	6.44	1.77	0.24	3.12	27.41	5.97	6.92
CR.5	Firm Capacity	6.11	1.74	0.24	3.04	28.55	5.65	6.58
CR.6	Firm Organization	6.52	1.75	0.24	3.05	26.78	6.05	6.98
CR.7	Head Office Location	5.52	2.01	0.27	4.03	36.37	4.98	6.05
CR.8	Past Performance	7.37	1.48	0.20	2.20	20.12	6.97	7.77
CR.9	Project Management Capacity	7.31	1.52	0.21	2.30	20.71	6.91	7.72
CR.10	Quality Performance	8.06	1.07	0.15	1.15	13.30	7.77	8.34
CR.11	References	7.63	0.90	0.12	0.80	11.75	7.39	7.87
CR.12	Staff and Qualification	8.15	0.90	0.12	0.81	11.03	7.91	8.39
CR.13	Quality Control	7.69	0.89	0.12	0.79	11.53	7.45	7.92

Where STD: Standard Deviation, and VAR: Variation

The sample value may not be close to the population value due to the locations of the sample. To overcome this problem, a confidence coefficient of 95% is used.

The importance of the criteria to the **public sector** is shown below:

No.	Criteria Description	1	2	3	4	5	6	7	8	9	Average Rank	Rank	Importance E Index
		NUMBER OF RESPONSES											
CR.1	Current Work Load	0	0	0	0	2	6	10	2	6	7.15	8	79.49
CR.2	Experience	0	0	0	0	0	2	0	10	14	8.38	2	93.16
CR.3	Experience in Geographic Location	0	0	0	0	4	10	6	6	0	6.54	12	72.65
CR.4	Economical Constraints	0	0	0	0	8	6	4	4	4	6.62	11	73.50
CR.5	Firm Capacity	0	0	0	0	4	10	2	6	4	6.85	10	76.07
CR.6	Firm Organization	0	0	0	0	4	6	6	4	6	7.08	9	78.63
CR.7	Head Office Location	0	2	2	0	4	4	12	2	0	5.92	13	65.81
CR.8	Past Performance	0	0	0	0	0	4	2	12	8	7.92	5	98.29
CR.9	Project Management Capacity	0	0	0	0	0	4	0	14	8	8.00	4	88.89
CR.10	Quality Performance	0	0	0	0	0	0	2	16	8	8.23	3	91.45
CR.11	References	0	0	0	0	2	2	10	10	2	7.31	7	81.20
CR.12	Staff and Qualification	0	0	0	0	0	0	2	10	14	8.46	1	94.02
CR.13	Quality Control	0	0	0	0	0	2	14	4	6	7.54	6	83.76

The ranks of the **consultant opinions** are shown in the following table:

No.	Criteria Description	1	2	3	4	5	6	7	8	9	Average Rank	Rank	Importance Index
		NUMBER OF RESPONSES											
CR.1	Current Work Load	0	0	0	0	4	8	12	0	4	6.71	7	74.60
CR.2	Experience	0	0	0	0	0	0	8	12	8	8.00	1	88.89
CR.3	Experience in Geographic Location	0	0	3	0	12	4	4	4	0	5.67	11	62.96
CR.4	Economical Constraints	0	0	4	4	0	4	8	4	4	6.29	9	69.84
CR.5	Firm Capacity	0	0	8	0	4	8	4	4	0	5.43	12	60.32
CR.6	Firm Organization	0	0	4	4	4	0	8	8	0	6.00	10	66.67
CR.7	Head Office Location	0	0	12	0	4	4	4	0	4	5.14	13	52.69
CR.8	Past Performance	0	0	0	0	12	0	0	12	4	6.86	6	85.71
CR.9	Project Management Capacity	0	0	0	4	4	4	4	9	3	6.68	8	74.21
CR.10	Quality Performance	0	0	0	0	4	1	0	12	11	7.89	3	87.70
CR.11	References	0	0	0	0	0	1	4	19	4	7.93	2	88.10
CR.12	Staff and Qualification	0	0	0	0	0	4	4	12	8	7.86	4	87.30
CR.13	Quality Control	0	0	0	0	0	0	12	9	7	7.82	5	86.90

The results of the ranks of the criteria with respect to **all parties** are expressed in the following table:

No.	Criteria Description	1	2	3	4	5	6	7	8	9	Average Rank	Rank	Importance Index
		NUMBER OF RESPONSES											
CR.1	Current Work Load	0	0	0	0	6	14	22	2	10	6.93	8	76.95
CR.2	Experience	0	0	0	0	0	2	8	22	22	8.19	1	90.95
CR.3	Experience in Geographic Location	0	0	3	0	16	14	10	10	0	6.09	12	67.71
CR.4	Economical Constraints	0	0	4	4	8	10	12	8	8	6.44	10	71.60
CR.5	Firm Capacity	0	0	8	0	8	18	6	10	4	6.11	11	67.90
CR.6	Firm Organization	0	0	4	4	8	6	14	12	6	7.04	9	78.17
CR.7	Head Office Location	0	2	14	0	8	8	16	2	4	5.28	13	58.67
CR.8	Past Performance	0	0	0	0	12	4	2	24	12	7.37	6	81.89
CR.9	Project Management Capacity	0	0	0	4	4	8	4	23	11	7.31	7	81.28
CR.10	Quality Performance	0	0	0	0	4	1	2	28	19	8.06	3	89.51
CR.11	References	0	0	0	0	2	3	14	29	6	7.55	5	83.84
CR.12	Staff and Qualification	0	0	0	0	0	4	6	22	22	8.15	2	90.53
CR.13	Quality Control	0	0	0	0	0	2	26	13	13	7.69	4	85.39

6-2 Satisfaction of the Restriction

To avoid unrealistic responses and ensure good fairness, the selected public organization were approached personally to explain the objectives, the proposed A/E selection criteria, and the proposed rating system. The questionnaire kept simple and handled to the top management personnel within the public sector and consultants.

6-3 Statistical Results

The data analysis will be summarized in three main statistical results, namely: Coefficient of Variation (C.V.), Ranking, and Correlation.

- The data is homogenous if the C.V. is less than 10%, but the C.V. for this study between 10% and 37%. The differences in level of experience of participants' top level management made the C.V. to be somehow large.
- The difference in ranks between the public sector and the consultants is because the public sector desire to establish and evaluate the project management professionalism among the consultant staff. The criteria "Staff and Qualifications" is ranked by the public sector to the first criteria. This criterion is the basic foundation for any positive indication that might be realized for A/E. It is based on educated, qualified, and well trained staff. The public sector is not satisfied with the quality of the information regarding reference. So, they ranked "References" seventh among the thirteen selection criteria. The Geographical Area and Head Office Location are not important criteria because Saudi geographical location is closed, the codes and regulations are identical, and the country's provinces are identical. Finally, the criterion "Economical Constraints" is not applicable to the A/E selection process in Saudi Arabia as it is in selecting a design/build team. The design/build team's financial statement must be investigated carefully to establish team credibility.

Ranking by Public Sector	The A/E Selection Criteria Description	Ranking by Consultants
1	CR.12 Staff and Qualification	4
2	CR.2 Experience	1
3	CR.10 Quality Performance	3
4	CR.9 Project Management Capacity	8
5	CR.8 Past Performance	6
6	CR.13 Quality Control	5
7	CR.11 References	2
8	CR.1 Current Work Load	7
9	CR.6 Firm Organization	10
10	CR.5 Firm Capacity	12
11	CR.4 Economical Constraints	9
12	CR.3 Experience in Geographic Location	11
13	CR.7 Head Office Location	13

- The correlation coefficient (r) between public sector organizations and the consultants was calculated to be a positive direction with a strong agreement of (0.8242). The difference between the two parties is due to the difference in the experience level of participants' personnel. The null hypothesis is that "There is no agreement between public sector and consultants." The alternative hypothesis is that "There is agreement between public sector and consultants." The significant level for testing the hypothesis is 5%. The rank correlation ($r_s=0.8242$) is larger than the critical test value $t_{0.05}= 0.5549$ which means that the null hypothesis is rejected and there is strong rank correlation between public sector and consultants in ranking the selection criteria.

6-4 Current A/E Selection Practice

The competitive selection process is used currently among public sector organizations. The A/E fee is the major deciding factor that finalized the selection process.

CHAPTER - 7: THE DEVELOPMENT OF A/E CONSULTANT CONCEPTUAL SELECTION MODEL (CCSM)

The public sector is in need of a consistent methodology to insure the proper and successful A/E selection and considering the A/E ability and qualifications as well as the project's specific risk factors. The characteristics of the method should be comprehensive, flexible, simple in performance, easy to review, adaptable for both individual and group, and does not require specialization to master and communicate.

7-1 Recommended A/E Selection Criteria

The A/E Consultant Conceptual Selection Model (CCSM) will be developed in this chapter using the Analytic Hierarchy Process (AHP). The percentage of weight of each criterion was used to determine the total weight for the combined selection criteria. Some of criteria, like Geographical Location, Economic Constraints, and Head Office Location, were omitted in this calculation. The combined A/E selection criteria are shown in the following table.

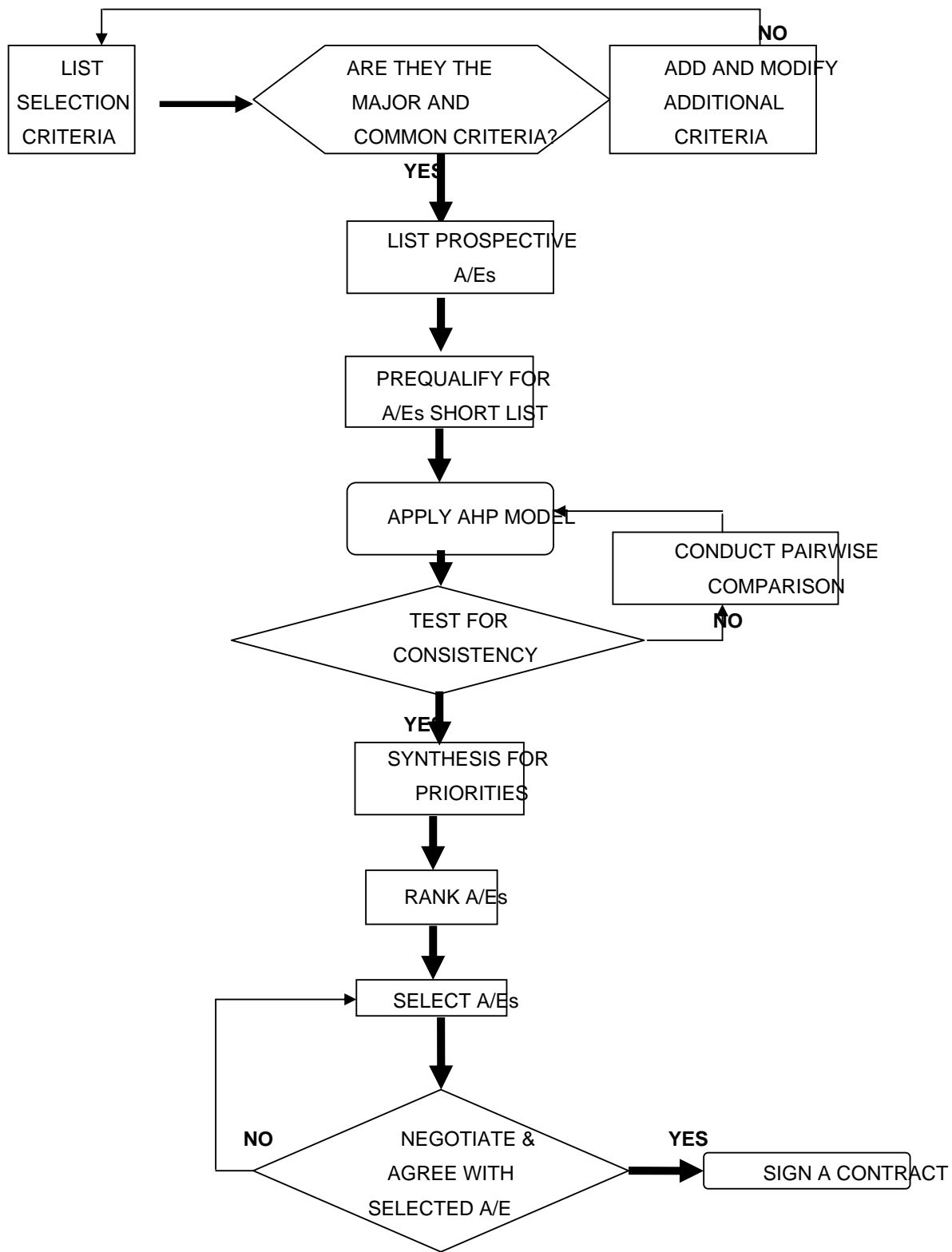
No.	Combined Criteria	The A/E Selection Criteria Description	Total Combined % Weight of Criteria
1	CR1, CR2	Experience	20.20
2	CR6, CR9	Project Management Capacity	19.60
3	CR12	Staff and Qualification	11.00
4	CR10	Quality Performance	10.70
5	CR8	Past Performance	10.30
6	CR13	Quality Control	9.80
7	CR11	Reference	9.50
8	CR5	Firm Capacity	8.90
TOTAL WEIGHT			100

7-2 The CCSM Model Development

From the combined A/E selection criteria, the CCSM will be developed. This process will lead to the most qualified A/E. The figure of the CCSM model's schematic will be shown later. The main steps of this model will follow:

- 1- List the desired selection criteria.
- 2- Check for major and common criteria.
- 3- Add and modify criteria.
- 4- List prospective A/Es.
- 5- Prequalify for short list.
- 6- Apply AHP model.
- 7- Test the consistency.
- 8- Conduct pairwise comparison.
- 9- Synthesize for overall results.
- 10- Rank A/Es.
- 11- Select A/E.
- 12- Negotiate and agree with A/E.
- 13- Sign a contact.

Figure 7 – 1 Development of an A/E Consultant Conceptual Selection Model (CCSM)



7-3 Structuring a CCSM Model

In this section, the main objective of this research will be accomplished. The A/E selection criteria, AHP, and the computerized decision support system (Expert Choice, Version 9.5) were used to structure the CCSM model. The structure of the model was as follows:

Model Name: A/E Consultant Conceptual Selection Model (CCSM)

Goal Definition: Selecting the Most Qualified A/E

Entering Main Criteria: the identified criteria

Entering Alternatives: Alternative criteria

The following table shows the model nodes and their definitions.

Node Name	Definition
CR1. WEXP	Work Experience
CR2. FCAP	Firm Capacity
CR3. PPER	Past Performance
CR4. REFS	References
CR5. PMC	Project Management Capability
CR6. QPER	Quality Performance
CR7. SQ	Staff and Qualification
CR8. QC	Quality Control
A/E1	Consultant Number One
A/E2	Consultant Number Two
A/E3	Consultant Number Three
A/E4	Consultant Number Four
A/E5	Consultant Number Five

CHAPTER - 8: APPLICATION OF THE A/E CONSULTANT CONCEPTUAL SELECTION MODEL

Two public sector organizations (PSO1, and PSO2) were selected to test and use the A/E CCSM model developed at the end of chapter seven (Ch. 7). Their responses are collected and inserted into the Expert Choice program for calculating priorities, testing the consistency of the judgments, and conducting an overall synthesis to determine the overall results.

8-1 Pairwise Assessment

It is a process of comparing the relative preference or importance of two selection elements with respect to a parent element in the level above. It will lead to a derivation of the priorities for each selection alternative.

Three comparison types are available in the Expert Choice, namely:

- Importance: for comparing one criterion with another
- Preference: for comparing the alternatives
- Likelihood: for comparing probability of outcome.

Three comparison modes are there: Verbal – Graphical – Numerical.

8-2 Calculating Priorities

It is the main activity of the pairwise assessment for establishing the priorities of the selection elements of the model. The numerical comparison mode was used throughout the pairwise assessment.

8-3 Inconsistency

For this research study, the earlier judgments provided results in higher inconsistency. An improvement of this inconsistency was accomplished by reexamining judgments provided. The inconsistency ratio was lowered into an acceptable range by contacting the selected organizations with highly inconsistency.

8-4 Synthesizing

Synthesis is when generating global weights of the nodes by combining the local priorities throughout the entire model. There are two synthesis modes, namely, Ideal and Distributive. The distributive mode was used to perform the synthesis from the goal node to get the overall results.

8-5 Sensitivity Analysis

It is a way of investigating the responsiveness or of testing the sensitivity of the alternatives behavior to changes in the priorities of the main criteria in the model. The Expert Choice software has the ability to deal with such changes.

CHAPTER - 9: CONCLUSION AND RECOMMENDATIONS

The selection method of a qualified A/E will vary from one public sector to another due to the number of factors and the difficulties in the selection process. The existence selection methodology will not help the Saudi public sector to choose a consistent, an effective, an efficient and well-defined A/E service based on qualifications, ability, and full consideration each project special criteria.

9-1 Results Compare to Research's Main Objectives

The main objective, which is the second objective, of this research is to develop an A/E selection method in Saudi Arabia using major criteria and structuring a conceptual consultant selection model (CCSM) to ensure the success of the public projects.

The first objective as stated earlier was to identify major selection criteria. Thirteen criteria were identified to be most valuable ones. Then, five of them were omitted due to the inapplicability or similarity of some criteria. The results of this research were analyzed carefully using the AHP to develop the CCSM model to contribute to the success and quality of projects.

All data are obtained from literature, interviews of public sector organizations and consultants, and examination of the current practice. Out of 60 distributed questionnaires, 49 (about 82%) were returned.

9-2 Major Findings

To summarize the major findings of this research, the following notes are listed below:

- 1) The current A/E selection methodology failed to be efficient, and effective to achieve the needed services.
- 2) There thirteen major selection criteria ranked and identified are: Staff and Qualifications, Experience, Quality Performance, Project Management Capability, Past Performance, Quality Control, References, Current Work Load, Firm Organization, Firm Capacity, Economical Constraints, Experience in Geographical Are, Head Office Location.
- 3) There is a strong agreement between the public sector and consultants in ranking these criteria and it is proved to be by the high coefficient of rank correlation ($r_s=0.8242$). Also, this number was larger than the critical value $t_{0,05} = 0.5549$ which means that the null hypothesis is rejected and there is strong rank correlation between the public sector criteria and the consultants' criteria. The small difference is due to different level of experience of parties.
- 4) Both the public sector and the consultants agreed upon the first rank to be the staff and qualifications. This criterion is the most important one to the public to ensure proper and successful selection, and any realized positives in the A/E side.
- 5) The public sector ranked the references as the seventh because they believe that the consultants' references data need to be updated.
- 6) The Economic Constraint, Experience in Geographic Area and Head Office Location are not applicable issues in Saudi public sector and might be omitted from the whole list.
- 7) After omitted the least important criteria among the thirteen one, we end up with: Work Experience, Project Management Capability, Staff and Qualification, Quality Performance, Past Performance, Quality Control, References and Firm Capacity.

- 8) The reputation of any A/E consultant must play a major role in the selection process. This fact is reflected by finding 40% of the total weight of the selection criteria to be the Work Experience and Project Management Capability.

9-3 Conclusion

The main objectives of this research: Identifying the Major Selection Criteria and Developing an A/E Consultant Conceptual Selection Model (CCSM) were achieved. Practically, the CCSM model is useful in comparing prospective A/Es in terms of selection criteria. The CCSM proved that being qualified, having previous work experience and capability will ensure to accomplish special professional services within a time frame and with the required quality. The implementation of CCSM is consistent, flexible, practical, and effective selection for selecting a qualified A/E.

9-4 Recommendations

Based on the findings of this research, the use of the developed CCSM model is highly recommended for the following reasons:

- The model is a standard method to maximize the usage and the experience among the public sector organizations.
- The model is tested to be fast, successful and accurate in A/E selection.
- The model is flexible for the user to modify it as needed while ensuring a high quality selection.
- It could be used for both, the evaluation and selection of the best technical proposals.
- It could be used by individuals as well as groups of judgments with different level of management.

9-5 Recommendations for Future Studies

- 1) The major selection criteria were identified, but it is recommended that the secondary or sub-criteria be studied and to determine their effects on the selection process.
- 2) A further separate study on the A/Es should be conducted to ensure the quality available in the Saudi market.
- 3) The available contract forms should be reviews and studied carefully to be a standard agreement and meet minimum conditions and requirements.
- 4) A classification of A/E should be established based on further studies to inform the owner regarding the qualifications and abilities of each A/E before any engagement in a contract.
- 5) A similar selection model for the private sector should be developed based on similar study.

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