EVALUATION OF CONSULTANT PERFORMANCE

BY

MOHAMMAD FOUAD ABDULWAHAB

A Thesis Presented to the
DEANSHIP OF GRADUATE STUDIES

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

DHAHRAN, SAUDI ARABIA

In Partial Fulfillment of the
Requirements for the Degree of

MASTER OF SCIENCE

In

CONSTRUCTION ENGINEERING AND MANAGEMENT

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

JUNE, 2006

On account of the sophisticated, dynamic, and uncertain nature of civil engineering projects, many vital decisions have to be reached by the clients based on the recommendations of the consultants they appoint. However, since decisions affecting as much as 80% of the construction cost are taken when the sketch design is formulated, any design errors and omissions, if undetected or unresolved, could be the origins of serious claims and rework once the construction work begins. While the cost of design errors exceeds that what is attributable to those generated by construction (9.5% as opposed to 2.5% of the total project cost), some clients recruit consultants on a competitive basis without due attention to the suitability and performance of their consultants *(Thomas and Lai-Kit, 2004).*

A consulting engineer is an independent, professional engineer who performs professional engineering services for clients on a fee basis *(Maxwell, 1982).* On the other hand, performance measurement is a debatable subject. Different industries have different performance measurement systems and even within the same industry there could be many types of performance measurement systems. In the construction industry, for example, different clients have different performance measurement systems. Some clients stress cost performance, some stress schedule or quality performance while others look for a combination of two or more performance measures. Unfortunately, consultant firms' performance has not been tackled enough by writers, especially in the construction industry, in spite the fact that the performance of a construction consultant is a very important element in the construction process. The consulting engineer plays an important role in the private and public sectors of nearly all countries. The consulting engineer furnishes valuable professional services to

municipal, state, and national governments, as well as to industrial and commercial organizations, and other clients *(Maxwell, 1982).*

During the construction process, some clients do not care about the consultant performance and its effects. In some cases, the consultant can not see some work mistakes or give the contractor the right instruction for his work. As a result, the scope and quality of the project will be badly affected. On the work processes, consultant performance should be watched out by the client in addition to the consultant himself. If they ignore evaluation of consultant performance, both parties may face serious problems in most cases.

1.2 Statement of the Problem

In order to properly manage projects, accurate information is needed to diagnose performance. Accurate information relies on accurate measurements or control systems, especially for larger and complex projects. Performance is reflected by measurements upon which corrective action is suggested and taken. Accurate measurements help ensure successful projects. Accurate measurements should provide not only what they measure, but also how well they differentiate performance *(Chang and Ibbs, 1999).* Poor engineering consultant performance is a major cause of construction process inefficiency, leading directly to delays, rework and variations, and contributing to increases in project time and cost, for both owner and contractors alike.

There are many evaluation criteria which might be taken into consideration while evaluating the performance level of the engineering consultant. Among these criteria are:

- Quality of feasibility study report.
- Quality of design.
- Accuracy of cost estimate.
- Administration of contract.
- Supervision of contractor.
- Project schedule control.

The problem is to study these evaluation criteria and find out their weight importance for the consultant performance evaluation process.

1.3 Research Objectives

The objectives of this research are:

1. To identify the main criteria used to evaluate the engineering consultant performance in Saudi Arabia's construction process.
2. To determine the weight importance of each criteria on the engineering consultant performance evaluation.
3. To provide recommendations for improvement of the overall engineering consultant performance in Saudi Arabia's construction industry, using the

result of the evaluation survey and available evaluation forms used worldwide.

1.4 Significance of the Study

Every project owner is concerned about design and execution of his project. To achieve the end results of having the project done with the least cost, the shortest time, and the best quality. Under full control by the project consultant, the project owner should be aware of the project consultant's performance. Consultant performance should be monitored by both parties, the owner and the consultant, to ensure the quality of the project.

To facilitate continuous improvement by consultants and to monitor performance, government agencies need to acquire, maintain and exchange information about the performance of consultants on projects. A rigorous consultant reporting system is also an important tool to provide feedback to a consultant on his performance on each project *(DPWS, 2000).*

Performance assessments during the course of a consultancy engagement help both the agency and the consultant to reach a common understanding of the expectations of both parties about the work. They help to identify areas where the consultant is excelling and any areas that need improvement. Performance reports are used in the assessment of a consultant for future engagements: registration, pre-qualification, and expressions of interest or approving a consultant engagement *(DPWS, 2000).*

The research will show what criteria might be taken into consideration while the process of the consultant performance evaluation and the weight importance of each criterion. By knowing the weight of these criteria and evaluating the consultant performance, they can be watched out by the project owner and the consultant himself in order to get achieve performance. Also, this research will be a base for future studies in this field in Saudi Arabia.

1.5 Scope and Limitations

1. The contractor selected will be large construction contractors (Grade 1, 2 or 3) as classified by the Ministry of Municipalities and Rural Affairs (MOMRA).
2. The consultants selected will be reputable and have past experience of more than 10 years in the construction field.
3. All building projects built only in the Eastern province of Saudi Arabia.
4. Building construction projects of 10 million Saudi Riyals or more.

1.6 Thesis Organization

This thesis is divided into five chapters. The first chapter gives general background information on construction consultancy process. It also presents a statement of the problem, the objectives of the study, its scope and limitations, and significance of the study.

Chapter two summarizes the literature related to the engineering consultant practice, performance evaluation, and the criteria used to evaluate the engineering consultant performance.

Chapter three addresses the research methodology, questionnaire design, the pilot study and a method of collecting data from construction professionals (experts) related to the problem discussed.

Chapter four discusses the statistical methods used, tables and information deduced from statistical analysis, the statistical results and interpretation of these tables and information. It also contains the ranking by importance index of the criteria used for consultant performance evaluation by, consultants, contractors, owners and for combined response.

Finally, the last chapter contains summary of the study, conclusions, suggested recommendations and recommendations for further study.

CHAPTER TWO

LITRATURE REVIEW

2.1 INTRODUCTION

This chapter outlines the background information about the engineering consultant, duties, responsibilities, engineering consultancy professional practices, performance management, and performance evaluation criteria. Further this chapter includes identification of the criteria used for consultant performance evaluation conducted from previous studies and performance evaluation forms used worldwide. This review includes academic and professional studies, journals, textbooks, conference's papers, and reports from international organization like AIA, FIDIC, DPWS, etc.

2.2 THE ENGINEERING CONSULTANT

2.2.1 DEFENITION OF ENGINEERING CONSULTANT

Consultancy refers to the professional help provided to the client in return for a fee, during which the consultant has certain powers and liabilities *(Jones and AL-Musallami, 1988)*. The consultant-client relationship should be based on mutual trust and confidence. On the other hand, the consultant should exert every possible effort to act as an agent, and advisor to the client, in a similar manner as a doctor views his patients. Ideally, the consultant is not just somebody who makes designs; he is usually

involved in deciding and achieving the best solution to all of the client's requirements and interest *(AL-Musallami, 1992).*

Consulting engineer (qualified individual or firm) is a chartered civil or structural engineer who is approached by an architect or client or another engineer for the purpose of designing a structure. The engineer advises the client on the choice of the structure. Once the structure is chosen, the engineer ceases to advice and begins to draw out a structural scheme, expanding it in detail after the client's approval *(ASCE, 1995)*.

Generally a consulting engineer is defined as a professional who mainly has two mixed capabilities of practical professional experience and those of a business person who is applying his knowledge in rendering the professional services to the clients in return for money *(Al-Basher, 1998)*.

2.2.2 DUTIES AND RESPONSIBILITIES OF THE CONSULTANT

Duties and responsibilities of E/C include, but are not limited to, providing professional architectural or engineering expertise in the assigned program area; performing prior studies; performing the most complex and advanced architectural or engineering work; maintaining continual, high-level contacts with public and private officials; project management; defining drawings and design calculations required for works; making independent decisions on a continual basis; and managing project budgets and approving the disbursement of funds *(Ofori, 2001)*.

The standard of practice is for engineers to be given responsibility for studying, conceiving and designing, observing construction, and assisting in the programming for operating and maintaining engineering works. The health, safety, well being and comfort of the public in using a facility, and the ultimate facility cost, all depend to a considerable extent on how well members of the project team fulfill their contractual responsibilities. The consulting engineer, therefore, has the obligation as trustee to the public interest as well as to the private interests of clients *(ASCE, 1995)*.

Consultant may require feasibility studies before design begins. The design must not only be aesthetically satisfactory, but also satisfy the need for it, and give an optimum balance between initial costs and future life costs. The client will expect the consultant to advise him in, arrange for bids and then to suggest a suitable contract for construction. The client will also expect proper supervision of the building process to ensure quality, and control cost. Finally, the client will expect to have his building ready on time, built to the best standards, free from future maintenance problems and at no extra cost to the sum first estimated at the design stage *(AL-Musallami, 1992).*

A good design: *(Garret, 1985)*

- Meets the basic owner's requirements
- Is functional, aesthetically pleasing.
- Is cost effective to acquire, own and operate.
- Is well coordinated and readily biddable."

The Architect/Engineer is (A/E) entitled for a reasonable fee to enable him to carry out the above duties. The client should realize the A/E's role in achieving overall project success and be ready and willing to pay for the services. The A/E is liable for the client for any negligence in the design, or the finished building being unfit for its purposes, or in cost advice, contract advice and supervision. In general the A/E should fulfill the client's needs. However, these needs might not all be fully satisfied due to the owner himself *(Medallah et al., 1989).*

The client's duties were outlined by one study. The client should fulfill these duties himself as mandatory requirements for project success. The client must:

1. Make basic firm decisions during the initial briefing period.
2. Make every effort to understand what he is being told and what his initial decisions mean.
3. Realize that the pre-costing of building is not an exact science.
4. Be closely involved during design stage and make further decisions as design develop.
5. Approve the cost plan at the end of design stage with a full understanding of what he is approving *(Pszenicki, 1980).*

The above reinforces the proposition that the client's input and participation should never be overlooked in determining and fulfilling his own needs.

The AIA manual of professional practice outlined the following duties of the client that shall help the consultant reach a successful solution to the client's needs:

The owner should:

- Clearly state his requirements
- Furnish the A/E with full legal, utility, and physical information about the building site.
- Enter with the A/E into a formal detailed agreement stating all conditions relating to the project.
- Give full attention and consideration to documents prepared and presented by the consultant.

Clients have the right to question the consultant's ability to meet their needs in the total sense, and to get the best possible value for their money in terms of cost, quality and time. The consultant duties are to help the client in achieving his targets*(AL-Musallami, 1992).*

The question is: Does the consultant work to the quality expected? Does he really care about protecting the client's interest in the widest sense of the word, including proper site investigations, optimal design, good supervision, avoidance of less attractive alterations, proper decisions, and good relations with the contractor? *(Pszenicki, 1980)*

As projects increase in size and complexity, the need arises for different approaches to the contractual relationships between owner, A/E, and contractor. There has been a shift in the scope of services needed for the new arrangements. During the early eighties, there was a trend for A/E firms in the USA to shift or add professional CM

to their menu of services. Owners currently prefer to package design and CM services. This is because they need to get things done quickly in the face of increased construction claims as conflicts derive demand for management services *(AL-Musallami, 1992).*

2.2.3 SERVICES OFFERED BY ENGINEERING CONSULTANT FIRMS

Services offered by E/C firms include *(ADB Guidelines, 1998*):

Pre investment studies

- Studies to establish investment priorities and sectored policies.
- To assess government operations and institutions for project formulation and implementation.
- To determine feasibility and justification of investment projects.

Detailed engineering and design:

- Preparation of detailed design.
- Specifications.
- Cost estimates, and
- Tender documents etc.

Project implementation:

- Supervision of project execution.
- Assistance in project operation for initial period.
- Execution of training programs.
- Institution building or financial studies for successful implementation of the project.

Special services:

- Environmental evaluations
- Forensic engineering
- Geotechnical engineering
- Operational assistance
- Process design, pilot studies, computer modeling
- Safety engineering
- Surveying engineering
- Toxic and hazardous waste evaluation
- Permit and application services

2.3 Performance Models

Vroom (1964) suggested on the basis of a number of experiments that the effects of motivation on performance are dependent on the level of ability of the worker, and the relationship of ability to performance is dependent on the motivation of the worker. He suggested a multiplicative relationship:

Performance = ζ (ability) x (motivation).

Porter and Lawler (1968), in their study of the relationships between motivation and performance, presented a conceptual model. Their model suggested that there are two factors determining the effort people put into their jobs: the value of the rewards to the individual insofar as they are likely to satisfy their needs, and the probability that rewards depend on effort, as perceived by the individual. They suggested two additional variables to effort that affect task achievement ability and role perceptions. They formulated the relationship:

Performance = ζ (effort) x (ability) x (role perception).

Ability comprises individual characteristics such as intelligence, manual skills, and know-how. Role perception is what the individual wants to do or thinks one is required to do. The Porter-Lawler model was further developed by *Schwab and Cummings (1970).* Two refinements were introduced into this model. The first was that performance results in intrinsic or extrinsic rewards, that through a feedback loop, affect perceptions about the relationships between effort and reward and, hence, the amount of

effort. The second was that satisfaction is affected not only by the existence of reward, but also by perceptions about the extent to which the reward is fair and equitable. By a feedback process this determines the value of the reward, which also influences the amount of effort. Their model shows the interactive nature of performance and satisfaction. Satisfaction is contingent upon the receipt of equitable rewards following performance, but it influences perceptions about the value of rewards and therefore, effort and performance. *(Refaat, 1997)* **".**

In construction-related studies, *Laufer and Borcherding (1981)* focused on the effects of financial incentives on productivity, using the performance determinants: performance = ζ (ability) x (motivation) x (role perception X facilitating and inhibiting conditions not under the control of the individual). They suggested that the last two variables in the equation depend, to a large degree, on the quality of management and concluded that there are three main factors influencing construction workers' performance: ability, motivation, and quality of management *(Laufer and Borchcrding 1981)*. Maloney and McFillen presented a model of worker performance and reported research that validates the model within a construction context *(Maloney and McFillen 1983, 1986)*.

The model identifies four variables that influence the level of worker performance:

1. The worker's motivation as evidenced by the worker's effort.
2. The degree to which the worker possesses the requisite job specified knowledge and skills.

3. The degree to which the worker possesses the requisite innate mental and physical abilities.
4. The effectiveness of management in organizing the work and providing the necessary resources. *(Refaat, 1997)*

The first three variables combine in a multiplicative fashion, whereas organizational constraint is an intervening variable. Maloney, using his model, presented a framework for the rationalizations of his analysis of construction performance that will improve the effectiveness and efficiency of the analysis. The framework provides a decision tree that will guide construction managers as they analyze and hence, improve performance *(Maloney, 1990).*

2.4 Performance Evaluation

2.4.1 Objectives

The ultimate objective of CONSULTANT PERFORMANCE EVALUATION is to improve the quality of professional services. It therefore presents another facet of Quality Assurance (QA) which includes internal QA procedures and external peer review. From the consultant's point of view, it is vital that external performance evaluation be an ongoing process and that results be discussed periodically so that necessary corrective action can be taken in a timely fashion and positive features may be further enhanced *(FIDIC, 2001).*

Within the general scope of the ultimate objective, the weight given to different sub-objectives may vary, depending on the point of view of project participants (the Lending Agency, the Borrower/Client, other involved parties or the consultant). The sub-objectives would normally include:

- Improvement of performance on the specific project assignment
- Achievement of better results and increased efficiency for the money invested
- Record(s) of performance for the purpose of qualifying consultants for future assignments *(FIDIC, 2001).*

The objectives of performance reporting are to have implemented procedures for measuring and reporting consultant performance. Its intention is to:

- Encourage consultants to implement a business culture of continuous improvement to benefit themselves and their clients.
- Provide the owner with performance scoring data from past and current contracts and engagements to identify the best performing consultants.
- Ensure that the best-performing pre-registered consultants are offered more business opportunities with the owner than other consultants.
- Share information on past and current consultant performance with other clients. *(FIDIC, 2001).*

2.4.2 The Process of Performance Evaluation

It is of paramount importance that CONSULTANT PERFORMANCE EVALUATION be viewed as a continuing process involving regular communications between the parties involved. Weaknesses as well as strengths should be discussed at the earliest possible times. The formal performance evaluation is merely the culmination of this continuing process involving Lending Agency, Borrower/ Client and Consultant with the Borrower/Client taking the lead. All parties must be aware from the beginning that an evaluation will take place and that results may impact future relations between the parties and others. The results of the formal evaluation should come as no surprise to any of the parties. The evaluation process (including the form) should be included as part of the Consultancy Agreement. All parties should have a mutual understanding and agreement as to which criteria are paramount *(FIDIC, 2001).*

2.4.3 Benefits of Performance Reporting

- Consultants can secure more business opportunities due to favorable Performance Reports, as past performance is taken into account whenever tender panels are chosen and tenders are evaluated.
- Performance Reports, particularly those prepared at the completion of a consultant engagement may be used as an endorsement when marketing services to clients.
- Concerns about unsatisfactory performance are raised at the earliest opportunity, when there is the greatest scope for improvement.
- Participation in regular performance monitoring and formal reporting encourages cooperative contracting through proactive and constructive discussion at the project level.
- Performance reporting helps consultants demonstrate their commitment to a culture of continuous improvement.
- Performance reporting will particularly benefit consultants already committed to a corporate culture of continuous improvement and client satisfaction, as it assists them to identify those aspects of their performance requiring improvement.
- Maintaining records of Performance Reports will assist consultants to monitor performance trends over the longer term, to set targets for performance improvement and to identify and correct adverse trends at the earliest opportunity.

- Performance Reports provide the basis for consultants to periodically discuss their performance and business relationships with the clients at a senior management level. *(FIDIC, 2001).*

2.4.4 The Consultant Contract

The Consultant's Contract is the basic reference point against which performance must be measured. Clarity of expression in the Consultant's Contract, and in its interpretation, are thus of vital concern. It is against stated objectives specified in the Consultant's Contract that performance must be measured, in terms of effectiveness relating to time, quality and cost. Thus, it is vital that, for performance evaluation purposes, the Consultant's Contract should clearly indicate. Keeping in mind:

- The proposal leading to the contract
- Requirements for local associates (including names and participation of local associates/sub-associates/subcontractors)
- Identification of Lending Agency, Borrower/ Client, and Consultant's key personnel
- Scope of work
- Terms of reference
- Required standards of performance
- Time constraints
- Costs
- General and specific conditions

- Schedules and budget
- Material and services to be supplied by the Borrower/Client
- End products to be supplied by the consultant.

Given a clear statement of these items in the consultant's contract, the performance criteria to be utilized and the weight given to each should be discussed and agreed at the time of contract negotiation. These are often divided into technical, managerial and overall output criteria.

2.5 COSULTANT PERFORMANCE MEASUREMENT

Performance levels are represented by descriptive conditions for the qualitative measures. The conditions, which exist in performance norms in the real world, need to be analyzed in order to derive meaningful levels. To achieve this purpose, performance norms were sought from research studies, project documents, and interview with project managers. References may not be available for some measures to analyze performance norms *(Chang and Ibbs, 1999)*.

Accurate measurements should provide not only the measures are but also how well they differentiate performance. Forty-two (42) measures for evaluating A/E consultants' deliverables and work processes were developed, adapted from previous paper *(Chang and Ibbs, 1999).* Those measures are shown in Figure (2.1)

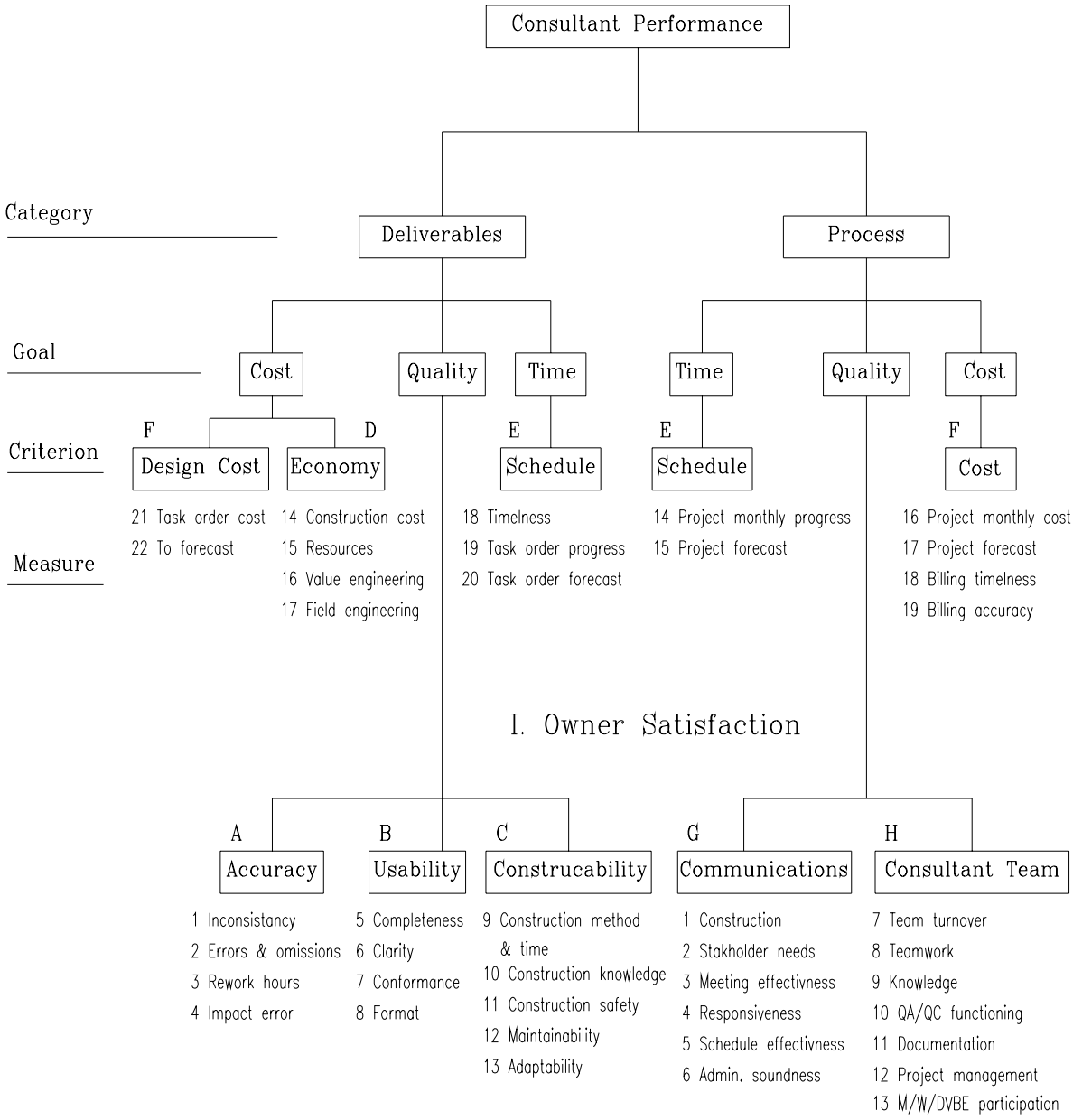

Figure 2.1: Consultnat's Performance Measurement Framework

(adapted from *Chang and Ibbs, 1999*).

2.6 CONSULTANT PERFORMANCE EVALUATION CRITERIA

In order to compile a list of criteria pertinent to Consultant Performance Evaluation (CPE), relevant guidelines and procedures were gathered from clients for analysis, and a long list of 40 CPE criteria was drawn-up after thorough consolidation. A detailed inspection of the available procedures reveals that those criteria could vary according to different stages of project life cycle. It was considered necessary to seek experts' opinions in classifying the evaluation criteria into meaningful categories and subcategories *(Thomas and Lai-Kit, 2004)*.

The criteria were classified into two broad categories (Fig. 2.2) including those related to:

1. Various stages of a project, feasibility, design, bidding, construction, and post construction;
2. General performance (project resources, programming, relationship, etc.)

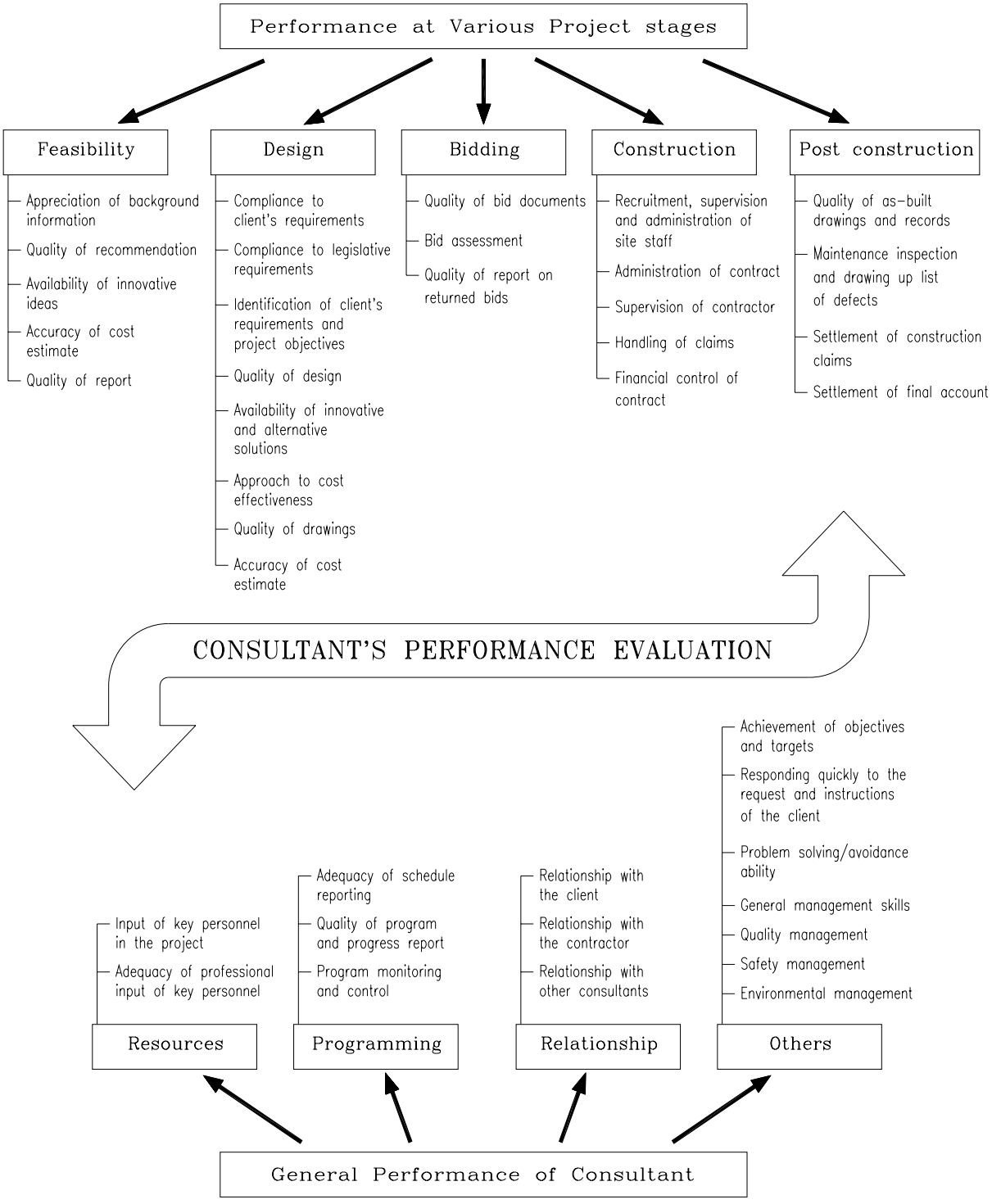

Figure 2.2: Consultnat's Performance Evaluation Categories and Criteria

(adapted from *Thomas and Lai-Kit, 2004*).

2.6.1 CRITERIA RELATED TO VARIOUS PROJECT STAGES

A project is in a continual state of change as it progresses from its start, as a need by the owner, through design development and, finally, construction. As the project moves from one phase to another, additional parties become involved and more information is obtained to better identify scope, budget, and schedule *(Garold, 2000)*. The various stages during the life of project can be divided into the following stages:

2.6.1.1 Feasibility

The purpose of this stage is to advise the client whether the proposed scheme is likely to be completed within the required time, cost, quality, safety, environmental and risk constraints, and identify any potential threats or pitfalls so that precautionary measures can be put forward. Consultants should, therefore, have a clear understanding as to the background and requirements of the project and client. The quality of their investigation will inevitably be reflected in their reports and recommendations. Innovative ideas are needed if threats and pitfalls are likely to occur *(Thomas and Lai-Kit, 2004).*

2.6.1.2 Design

During this stage, design and details are prepared by the engineering consultants. With an aim to provide the clients with the best value design, consultants should not just observe the client's requirements, but also make every endeavor to assist the client in identifying and developing other crucial objectives for the project. A good consultant

should be able to propose an innovative and alternative design to improve the quality and reduce the time, cost, and risk. The most obvious measures at this stage are the quality of design and drawings, as substandard and ambiguous design outputs are always the origins of claims and disputes *(Thomas and Lai-Kit, 2004).*

2.6.1.3 Bidding

Tenders should be assessed by people with relevant skills and knowledge and who are free of any conflict of interest that might undermine the objectivity of the assessment. Tenders should be assessed in a consistent fashion against the pre-determined criteria contained in the tender documents. Any tender which does not comply with the tender documents may be rejected. Where clients reject a tender, the reasons for such action should be clearly documented by the client *(DPWS, 1996)*.

Tenderers may be encouraged to offer alternative, better value for money proposals. Clients should specify the conditions under which alternative proposals are to be submitted. Otherwise alternative proposals should only be considered when submitted with a conforming tender. Where a tenderer offers an alternative, a comparable price for the alternative should not be obtained from other tenderers nor should the detailed alternative be used as the basis for the recall of tenders. *(DPWS, 1996)*

In order to avoid the need for any subsequent variation orders, it is important that the drawings, specifications, and other relevant documents are produced at a high-quality standard. With an increasing popularity of design and build contracts, the assessment and reporting stages are crucial as consultants are required to assess and comment on the

technical aspects of different design, construction methods and materials proposed by the bidders *(Thomas and Lai-Kit, 2004).*

2.6.1.4 Construction

Consultants are responsible for administering and monitoring the project during the construction stage to ensure client's interests are duly observed (compare *GDOT, 2002).* Therefore, the client should aim to establish whether the consultants have fulfilled their responsibility in administering the contract and supervising the contractor *(NYSDOT, 2003).* In order to avoid over budgeting, consultants should demonstrate their abilities in handling the claims and controlling the project costs properly *(Thomas and Lai-Kit, 2004).*

2.6.1.5 Post Construction

Consultants' duties will continue throughout the defect liability period. During this stage, they are required to draw up a list of defects, settle any outstanding claims, and work out the final cost of the project *(ASCE, 1995).* Their performance in relation to these aspects is under close scrutiny as some consultants might tend to slow down their progress when their fees at this stage are normally minimal *(Thomas and Lai-Kit, 2004).*

2.6.2 CRITERIA RELATED TO GENERAL PERFORMANCE

2.6.2.1 Resources

Consultants' key staff should have contributed sufficient time and effort to the project. In some cases, the key staff originally allocated to the project might have been assigned to another new job, which is particularly obvious if the fee is too low. This could affect the overall quality of the project, and should be avoided and/or rectified *(Thomas and Lai-Kit, 2004).*

2.6.2.2 Programming

The client may suffer a severe loss should the project be delayed by the contractor and it is important for the progress to be kept under constant monitoring and control. Consultants should not only report their program and the contractor, on a periodic basis, but also demonstrate that the submitted program is realistic by substantiating the time allowed in major critical activities in the program. Besides, a responsible consultant should alert the contractor as to the extent of delay and bring the schedule back to the proposed milestone dates *(Thomas and Lai-Kit, 2004).*

2.6.2.3 Relationship

Client-consultant relationship is the one of the important factors in the development of the Engineering and Consulting firms and good relation with the client's fuel progress and successful practices. Satisfied clients are the important source of new work for the consulting firms either through repeat business or through referrals by them

to other clients. The ideal client consultant relationship is one that is both challenging and cooperative. Challenging clients constantly hold high standards of performance and the cooperative clients work along. On the other hands difficult clients are those who offer resistance and criticism and are hard to satisfy *(Shafuddin, 2004)*.

Points for good client relations in public sector include *(Hicks and Mueller, 1996):*

1. Public sector clients are more difficult to satisfy as they feel lot of pressure from the public to complete the project quickly and at a minimal cost.
2. Consulting firms should maintain constant contacts with the public sector and continue demonstrating interest in the project.
3. The firm should generate fresh and creative ideas continuously and show the public officials and show the public officials that the firm is interested in the enhancing the public standing of the client.
4. Perform high quality engineering that will be remembered by each client and will bring additional assignments.

Engineering consultants should be approachable and helpful to the client (compare *Ling 2000; Ling et al. 2000*). If sub consultants are employed, it is important that the consultant has a good working relationship with them as any adversarial relationship could affect the team bonding and hence affect the outcomes. Consultants should handle and deal with all opinions and complaints of the contractor in an impartial manner and provide the necessary support *(Thomas and Lai-Kit, 2004).*

2.6.2.4 Other Consultant Capabilities

Consultants should be conscientious to the project by responding to all requests and instruction of the client promptly. In addition, consultants should identify and analyze potential problems and propose mitigation measures to prevent the problems from arising or escalating *(Ling 2003)*. The general management skills of consultants in a project can be reflected by the effectiveness and efficiency of their staff, time, and financial management systems; while the quality, safety, and environmental management systems would determine the performance of consultants in controlling the overall quality, minimizing the number of accidents and reducing the overall environmental impacts *(Thomas and Lai-Kit, 2004).*

2.7 Practical Usage of Performance Evaluation

As shown in Figure. 2.3, the CPE scores can be utilized for various purposes, including

1) monitor and control
2) Incentive and sanction
3) Pre-selection
4) Technical assessment
5) Bid evaluation.

The cycle will reiterate again once an assignment is awarded to a particular consultant.

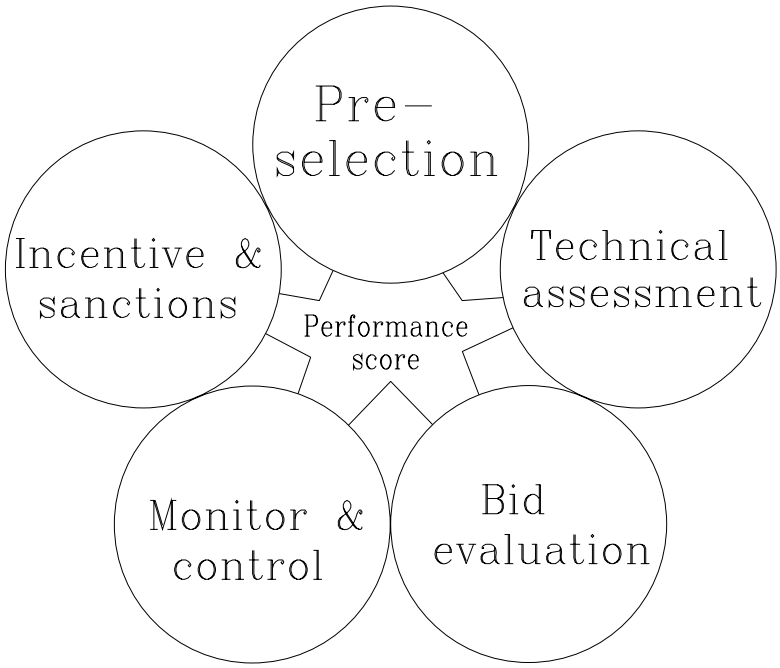

Figure 2.3: Practical Usage of Consultant's Performance Evaluation

(adapted from *Thomas and Lai-Kit, 2004*)

2.7.1 Monitor and Control

Some clients believed that the quality of the final product is the ultimate performance indicator, and hence CPE will not be conducted until a particular project stage is completed. However, they have discounted the possibility that a huge amount of time and effort could have been attributed to the management and supervision of consultants to ensure they perform satisfactorily. Moreover, there is a greater scope for

improvement, should unsatisfactory performance be raised at the earliest opportunity, as regular performance monitoring encourages cooperative contracting through proactive and constructive discussion at the project level *(Thomas and Lai-Kit, 2004).*

2.7.2 Incentive and Sanction

It is not uncommon for the clients to impose sanctions to nonperforming consultants. For minor faults, consultants might receive verbal or written warnings from the clients. However, serious offenses may result in the deprivation of opportunities to submitting proposals until consultant's performance is improved. In Hong Kong, consultants who receive two consecutive adverse reports in a government project will be suspended from submitting technical and fee proposals for at least 3 months while the suspension period will be extended to 12 months after receiving the third consecutive adverse report in the same project. According to the New York State Department of Transportation, when clearly unsatisfactory work has been performed, it is possible to deny payment of a proportion or all of the fees until the problems are rectified. When the use of the partnering and/or target cost fees approaches, a bonus may be awarded to those consultants who have achieved time and cost savings for their services provided. The scores of CPE could assist the clients in determining the amount of incentives to be awarded to facilitate quality-based consultant selection *(Thomas and Lai-Kit, 2004).*

2.7.3 Pre-selection

The consulting engineer's competence in specialty fields, performance on other projects of similar nature, interrelationship with the design team members, personnel assignments, provision for independent reviews, and quality assurance will all influence the construction, operation, and maintenance costs, insurance and other annual charges, and the resulting life-cycle costs of the project. Therefore the client should recognize that selecting an engineer based on quality and expertise is somewhat subjective. It is imperative that clients assign those individuals who are best suited within their organization to make that decision *(Hicks and Mueller; 1996*).

The performance evaluation scores are used by some public clients in assessing the qualification of the consultants, so that performing consultants may be included in the standing list of consultants and/or offered more business opportunities. Consultant's general performance accounts for up to 20% of the total pre-selection score in Hong Kong and 50% of the total score at the expression of interest stage in Canada *(Thomas and Lai-Kit, 2004).*

2.7.4 Technical Assessment

The requirement for consultants to submit both the technical and fee proposals has become increasingly popular. The successfulness of consultants in performing a similar type of project is a sign of a consultant's technical and managerial capabilities. This proposes a greater emphasis on the performance reports in the same category of work being produced, but if work in one category requires similar extent of technical

competency, as in another category, the reports in both categories will be reviewed *(Thomas and Lai-Kit, 2004).*

2.7.5 Proposal Evaluation

In order to keep the price proposal low, under the fee competition based arrangement, a consulting firm must interpret work in its narrowest sense, and this often requires the firm to charge clients for extra during the assignment. The concept of incorporating the CPE score to bid evaluation could encourage consultants to submit realistic financial proposals while producing work at the highest-quality standard. A forerunner in the development and implementation of performance-based selection (PBS) is the Ministry of Transportation, in Ontario. In their model, consultants are assessed according to a 50, 30, and 20% weighting for performance, proposal, and price, respectively. It is anticipated that the use of the PBS system not only could result in fewer errors and omissions, but also lead to cost saving by having less claims and a reduced life-cycle cost *(Thomas and Lai-Kit, 2004).*

2.8 List of consultant performance evaluation criteria and their definitions

Following is a list of forty (40) criteria used in the questionnaire survey and interviews with experts. They are listed in the same order as appeared in the distributed research survey questionnaire and according to the various project stages, with their respective definitions:

A. Feasibility Stage

1) *Appreciation of background information*; consultants should have clear understanding about project background information collected by either clients or consultant.

2) *Quality of recommendation*; during feasibility stage, consultant gives clients recommendations about the project proposed scheme to help them completing the project within the required time, cost, and quality.

3) *Availability of innovative ideas*; innovative ideas are needed if threats and pitfalls are likely to occur. Consultants who have innovative ideas help clients to achieve their project targets with the least project cost and time.

4) *Accuracy of cost estimate*; clients need initial cost estimation to compare it with heir expected project budget.

5) *Quality of report*; a feasibility report usually includes such items as purpose of study, requirements, and needs of project. The results of

studies and investigations are usually submitted in written report. The quality of consultant investigation will inevitably be reflected in their reports.

B. Design Stage

6) *Compliance to client's requirements*; clients should clarify their project requirements to the consultant. Consultants should be sure that the project design includes all of those requirements.

7) *Compliance to legislative requirements*; consultant should take into their consideration the project location legislative requirements, such as project maximum built area, height, no of floors and etc.

8) *Identification of client's requirements and project objectives*; Consultants should not just observe the client's requirements, but also make every endeavor to assist the client in identifying and developing other crucial objective for the project.

9) *Quality of design;* project design is concerned with the conceptual, functional, and other characteristics of the project. Design work is not limited to limited to conceptual and technical analysis, and to the preparation of plans and specifications. It requires study, investigation and research about project targets.

10) *Availability of innovative and alternative solutions*; which help consultant to improve the project quality and reduce the project time, cost, and risk.

11) *Approach to cost-effectiveness*; project design usually involves comparison of arrangement and layouts from economic, engineering, and architectural points of view to determine most beneficial and cost-effective

12) *Quality of drawings*, the most obvious measures at this stage are the quality of design and drawings, as substandard and ambiguous design outputs are always the origins of claims and disputes.

13) *Accuracy of cost estimate*; a cost estimate at a given stage of project development represents a prediction provided by the cost engineer or estimator on the basis of available data.

C. Bidding stage

14) *Quality of bid document*s; it is important that the project design drawings, specifications, and other relevant documents are produced in high-quality standard

15) *Bid assessment*; is crucial stage as consultant are required to assess and comment on the technical aspects of different design, construction methods, and materials proposed by the bidders.

16) *Quality of report on returned bids*; a bid report usually includes such items as purpose of bid, proposals prices and comments, and consultant engineer recommendations. The results of studies and assessment are usually submitted in written report

D. Construction Stage

17) *Recruitment, supervision and administration of site staff;* consultants are responsible for administering and monitoring the project during the construction stage to ensure client's interests are duly observed

18) *Administration of contract,* consultant engineer should review construction process to determine if the project is completing in conformance with the construction contract

19) *Supervision of contractor*; is the main object which consultant should do it to ensure that the project construction is proceeding as per design documents and specifications requirements.

20) *Handling of claims*; in order to avoid over budgeting, consultants should demonstrate their abilities in handling the claims and controlling the project costs properly,

21) *Financial control of contract*; consultant engineer or owner's representative is the person who can control financial issues of project contract.

E. Post construction

22) *Quality of as-built drawings and records*; any project change during construction stage should be recorded and documented for later needs and revisions.

23) *Maintenance inspection and drawing up list of defects*; the purpose of maintenance inspection to ensure satisfactory operation or to precisely

determine the efficiency or operating characteristics of the project equipments to make sure that performance matches the guarantees specified by consultant or proposed by supplier.

24) *Settlement of outstanding claims*; by technical recommendations, consultant engineer may help the client to finalize any claims are still outstanding with the project contractor or supplier.

25) *Settlement of final account*; after final project inspection, final account must be done by consultant engineer or owner's representative to be sure all project changes are taken into account.

F. Consultant General Resources

26) *Input of key personnel in the project*; consultant engineer may input his personal proficiency to help the contractor or achieve projects targets.

27) *Adequacy of professional input of key personnel*; Consultants' key staff should have contributed sufficient time and effort to the project.

G. Consultant Programming

28) *Adequacy of schedule reporting*; the client may suffer a severe loss should the project be delayed by the contractor, and it is important for the progress to be kept under constant monitoring and control.

29) *Quality of program and progress report*; consultants should not only report the program of themselves and the contractor on a periodic basis, but also demonstrate the submitted program is realistic by substantiating the time allowed in major critical activities in the program.

30) *Program monitoring and control*; a responsible consultant should alert the contractor as to the extent of delay and bring the schedule back to the proposed milestone dates

H. Consultant Relationship

31) *Relationship with the client*; the relationship between consulting engineer and client is a professional one. The relationship is less personal than other relations because the consulting engineer is usually engaged by an organization rather than an individual. Engineering consultants should be approachable and helpful to the client

32) *Relationship with the contractor*; the consultant's work is usually concerned with contractors and manufacturers who are building or supplying equipments and materials for client's project

33) *Relationship with other consultants*; if sub consultants are employed, it is important that the consultant has a good working relationship with them as any adversarial relationships could affect the team bonding and hence affect the outcomes. Consultants should handle and deal with all opinions and complaints of the contractor in an impartial manner, and provide the necessary support

I. Other Consultant Capabilities

34) *Achievement of objectives and targets*;

35) *Responding quickly to the request and instructions of client*; consultants should be conscientious to the project by responding to all requests and instruction of the client promptly.

36) *Problem solving/avoidance ability*; consultants should identify and analyze potential problems and propose mitigation measures to prevent the problems from arising or escalating

37) *General management skills*; the general management skills of consultants in a project can be reflected by the effectiveness and efficiency of their staff, time, and financial management systems

38) *Quality management*; the purpose of quality management is to ensure that the work done is accomplished in accordance with the requirements specified in the project contract.

39) *Safety management*; safety management systems would determine the performance of consultants in minimizing the number of accidents.

40) *Environmental management*; environmental management systems would determine the performance of consultants in reducing the overall environmental impacts.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

The research methodology is the set of processes that will be taken or utilized to obtain the objectives of the research and to solve the research problem. The specific research strategy or methodology utilized in this research is a combination of quantitative and qualitative approaches in applied research that is common for the construction engineering and management related problems. The combination of both approaches will assist in solving the overall problem.

This chapter includes the research methodology, sampling and statistical techniques or analysis used to measure the weight importance of the criteria used to evaluate the consultant's performance in the construction industry in Saudi Arabia. The respondents who participated in this study are divided into three major categories: Consultants, Owners/Owners' representatives, and Contractors. Respondents interviewed are experts in the building construction industry in the East Province of Saudi Arabia.

3.2 METHODOLOGY

The literature reviews and previous study done in Hong Kong by *(Thomas and Lai-Kit, 2004)* are the major resources to obtain the list of criteria which may taken into consideration while evaluation of consultant performance. The method of approach of acquiring data consists of the following resources:

1. Literature review, previous study done, and discussions with professionals in the construction industry.
2. Consultant Performance Evaluation forms used worldwide.
3. A questionnaire, which is the output of the literature review and previous study.

The research methodology is distributed into the following phases of research program as shown in the following flowchart:

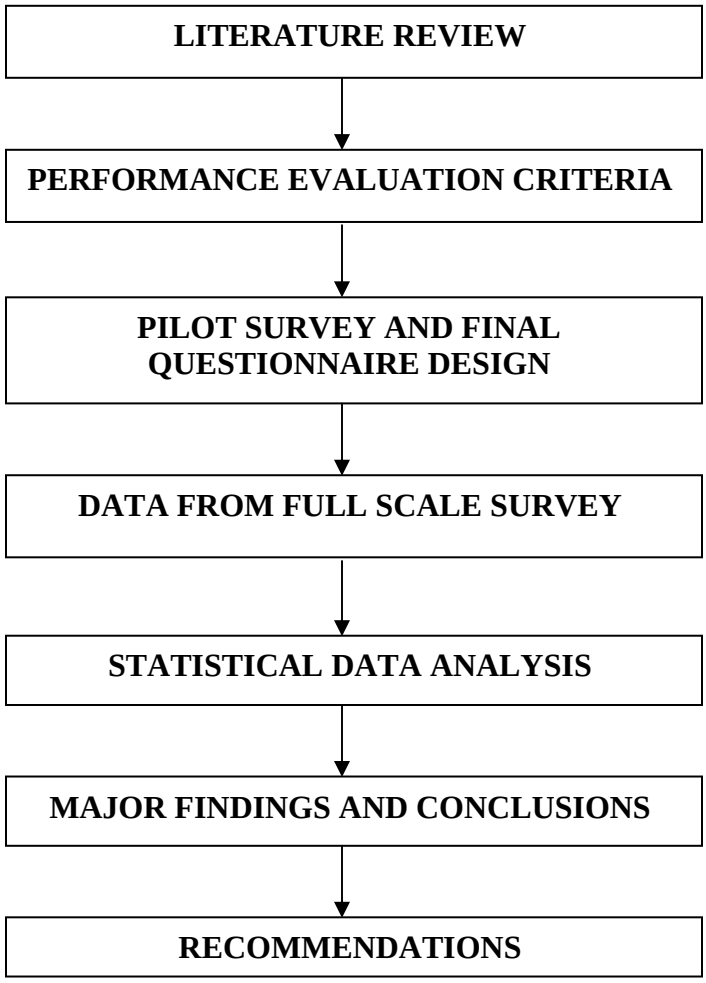

Figure 3.1: Research Methodology

3.3 Questionnaire Design

After reviewing the literature and previous study, the most important performance evaluation criteria were determined and presented in the questionnaire. The questionnaire developed through comprehensive analysis of data, and pilot study discussions with the participants. Finally, the current questionnaire was prepared and distributed, attached as Appendix I.

The questionnaire preparation took into consideration the main performance evaluation criteria adapted previously and comments from six experts' interview during the pilot study. There were two copies of questionnaire forms, one in Arabic and the second in English, to make the thesis topic easily understood by respondents. There are two main parts in the questionnaire. The first part contains general information questions including specialization, experience and nationality of the company. The respondent was requested to choose the most appropriate answer. The second part concerns the weight importance of each consultant performance criteria. For each question, the respondent had five options, “Extremely Important” , ”Very Important” , “Important” , “Somehow Important”, and “Not Important”.

3.4 POPULATION AND SAMPLE SIZE

There research population is limited to the four restrictions were identified earlier, which are.

1. The contractor selected will be large construction contractors (Grade 1, 2 or 3) as classified by the Ministry of Municipalities and Rural Affairs (MOMRA).
2. The consultants selected will be reputable and have past experience of more than 10 years in the construction field.
3. All building projects built only in the Eastern province of Saudi Arabia.
4. Building construction projects of 10 million Saudi Riyals or more.

According to those restrictions, the list of consultants and contractors as presented in the Chamber of Commerce and MOMRA classifications was searched. The list includes (72) consultants and (148) contractors in the Eastern Province of Saudi Arabia.

The sample size required for the research was determined based on the statistical principles to reflect a confidence interval of 95%. The sample was determined using the equation given by *(Kish, 1995)*

$$n_0 = \left(\frac{p * q}{V^2} \right) \quad \text{..... (Eq. 3.1)}$$

$$n = \frac{n_0}{\left(1 + \frac{n_0}{N} \right)} \quad \text{.....} \quad \text{(Eq. 3.2)}$$

Where:

N = Population size

n = Sample size

n_0 = Sample size from an infinite population

V = Maximum standard error allowed

p = Proportion of characteristic being measured in the target population

q = Compliment of p (i.e. 1-p)

To maximize n, p is set to be 0.5. The target populations N are 72 and 148 for consultants and contractors respectively. To account for more error in qualitative answers of this questionnaire, maximum standard error V is set at 10% or 0.1. Substituting in Equations 3.1 and 3.2 above, minimum required sample is calculated to be 18.55 and 21.38 for consultants and contractors respectively. This means that minimum sample size for consultants' population is 19 and minimum sample size for contractors' population is 22.

For owners' population, only public owners dealing with large building projects (10 million SR and above) were considered (i.e. Saudi Aramco, SEC, Sabic ... etc.). A total population of 88 owners is dealing with large projects *(AI-Juwairah, 1997)*. Using the same formula mentioned above, about 13 owners dealing with large projects in the Eastern Province of Saudi Arabia can be taken as sample size.

3.5 Data Gathering

Data was obtained in this part of the study by direct interviews with the consultant engineers, contractors, and owner representatives, in order to determine the importance of the evaluation criteria identified earlier. As the researcher has good direct contact with a large number of construction experts from all parties, the majority of data was collected by the method of meetings, emails, and by faxes. The research by these methods collected responses from about 180 engineers are working in the construction industry and distributed among the main three categories (consultants, owners, and contractors). According to the limitation of this study and aiming for homogenous number between categories, the total final number of respondents, which is taken into statistical data analysis, is 35 consultants, 35 contractors, and 30 owners.

3.6 SCORING SYSTEM

For the first part of the questionnaire, no scoring was used since this consisted of general information related to respondents' companies and characteristic's of the project. For the second part of the questionnaire, the weight importance of the criteria was considered. They were then organized according to their importance level (index). The main section of the questionnaire was about the performance evaluation criteria and its weight importance using an ordinal scale. The ordinal scale does not offer in its qualitative 5-point scales a direct quantitative comparison between its intervals. This scale was transformed into an interval scale by assigning a weight to each interval. Therefore, by thinking of intervals from `Extremely Important" to "Not Important ' as an interval scale from zero to 100, this transformation could be achieved which will enable

us to carry the required parametric statistics. As long as keeping in view of the "possibility of gross inequality of intervals", it could be proceeded with treating the 5 point scale as an interval scale and using parametric statistics. The arithmetic mean could be used as the measure of central tendency, standard deviation as the measure of dispersion, and other parametric tests as statistical procedures (*Cooper and Emory, 1995).*

The scale interval value assigned for each response appearing in the questionnaire is as follows in Table 3.1:

Extremely important	1	100%
Very Important	2	75%
Important	3	50%
Somehow Important	4	25%
Not Important	5	0%

Importance Index will be calculated using the following formula:

Imp Ind = 100 X1 + 75 X2 + 50X3 + 25X4 +0X5 / (x1+ x2 +x3 + x4 + x5) … (Eq.3.3)

Where:

Imp Ind: Importance Index

X1: Number of respondents answering "Extremely Important"

X2: Number of respondents answering "Very Important"

X3: Number of respondents answering "Important"

X4: Number of respondents answering "Somehow Important"

X5: Number of respondents answering "Not Important"

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 INTRODUCTION

This chapter presents and discusses the analysis of the obtained data from the survey questionnaire. The first section will discuss the results on general information about the respondents. These include their level of experience and classification, their organizations nationality, types of projects completed, and information about organization methods of evaluation of consultant performance.

In the second section, data on evaluation of consultant performance and the list of criteria used will be analyzed. Minimum and maximum values of the mean, standard deviation, and Importance Indexes (Imp Index) as reported from respondents. Factors will be ranked based on their importance indexes.

The third section will discuss the analysis of data collected about evaluation of consultant performance and criteria used and also discuss results obtained from each category of respondents (consultant, owners' representatives, and contractors). The date will be also analyzed for the all the respondents.

The fourth section will test the correlation agreement between all categories of respondents (consultants, owners' representatives, and contractors) about their responses of importance level of criteria used to evaluate the consultant’s performance.

4.2 RESPONDENTS' GENERAL INFORMATION

Respondents who participated in the research questionnaire and satisfied the limitations of research as shown in Figure 4.1 were 35 consultants, 30 owners' representatives, and 35 contractors totaling a number of 100 respondents. About 80 other respondents were excluded from the data analysis as they were not satisfied limitations for this research. The respondents' general information included in this section gives an overall idea about respondents and their organization profiles in the field of large building construction in Saudi Arabia. This information includes the level of experience of each respondent category, organization nationality, type of projects completed by them and their opinions about the importance of evaluation of consultant performance.

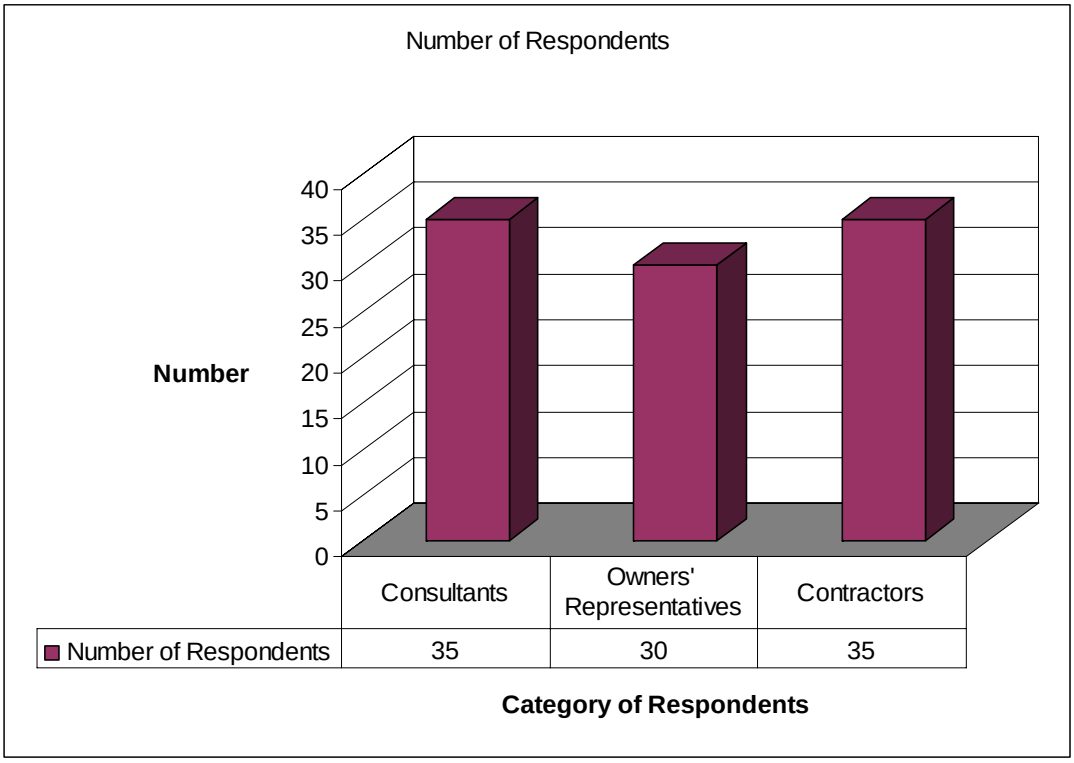

Figure 4.1: **Numbers and Categories of Respondents**

4.2.1 RESPONDENTS' EXPERIENCE

The level of experience of respondents (consultants, owner, contractors, and total respondents) is shown in Figures 4.2, 4.3, 4.4 and 4.5 respectively. Respondents were asked to indicate their experience level as per questionnaire design which includes four categories:

Category 1: Less than 5 Years (Low Experience)

Category 2: Between 5 and 10 Years (Moderate Experience)

Category 3: Between 10 and 15 Years (High Experience)

Category 4: More than 15 Years (Very High Experience)

We can deduct from the next figures that almost 86% percentage of consultants, 50% of owners' representatives, and 89% of contractors have very high experiences (more than 15 years) in the field of construction. Also, we can notice that almost 14% of consultants, 50% of owners' representatives, and 11% of contractors have high experiences (between 10 and 15 years), and none of the respondents have experience of less than 10 years. Almost 76% of the total respondents have experiences of more than 15 years. This indicates that respondents who participated in this research have excellent experience in the field of construction industry in Saudi Arabia.

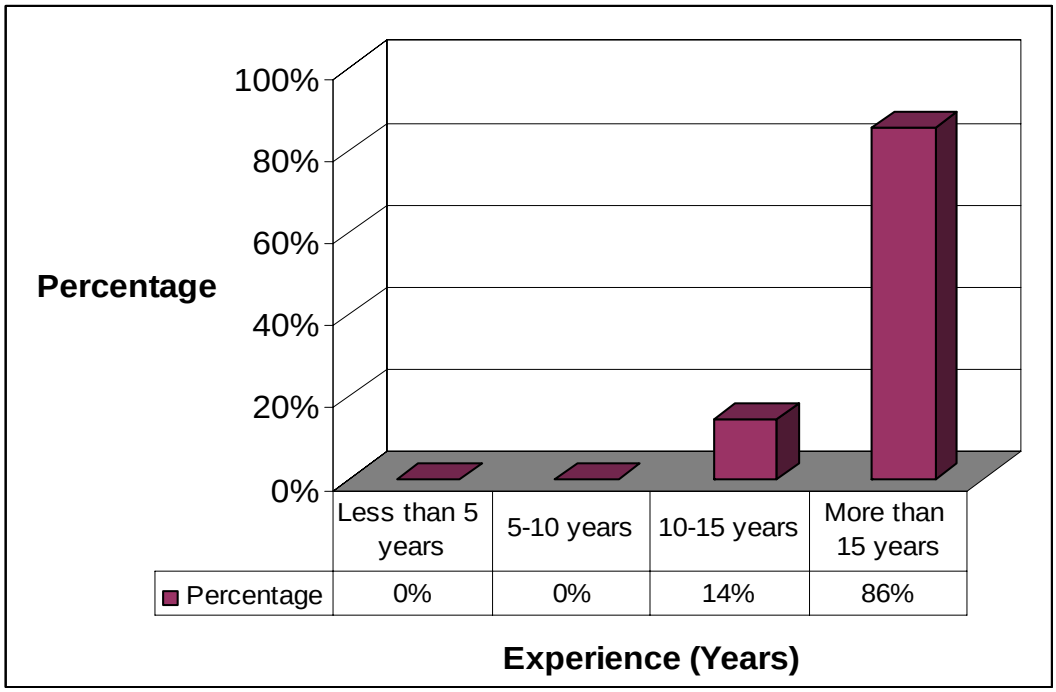

Figure 4.2: **Experiences of Consultants**

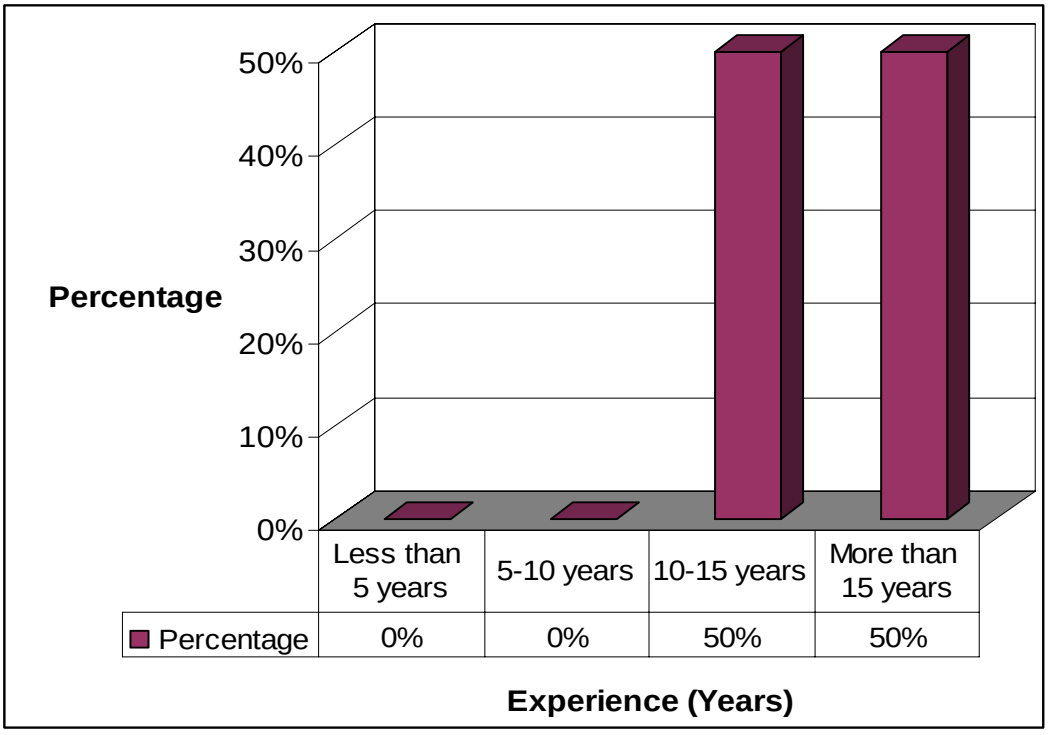

Figure 4.3: **Experiences of Owners' Representitives**

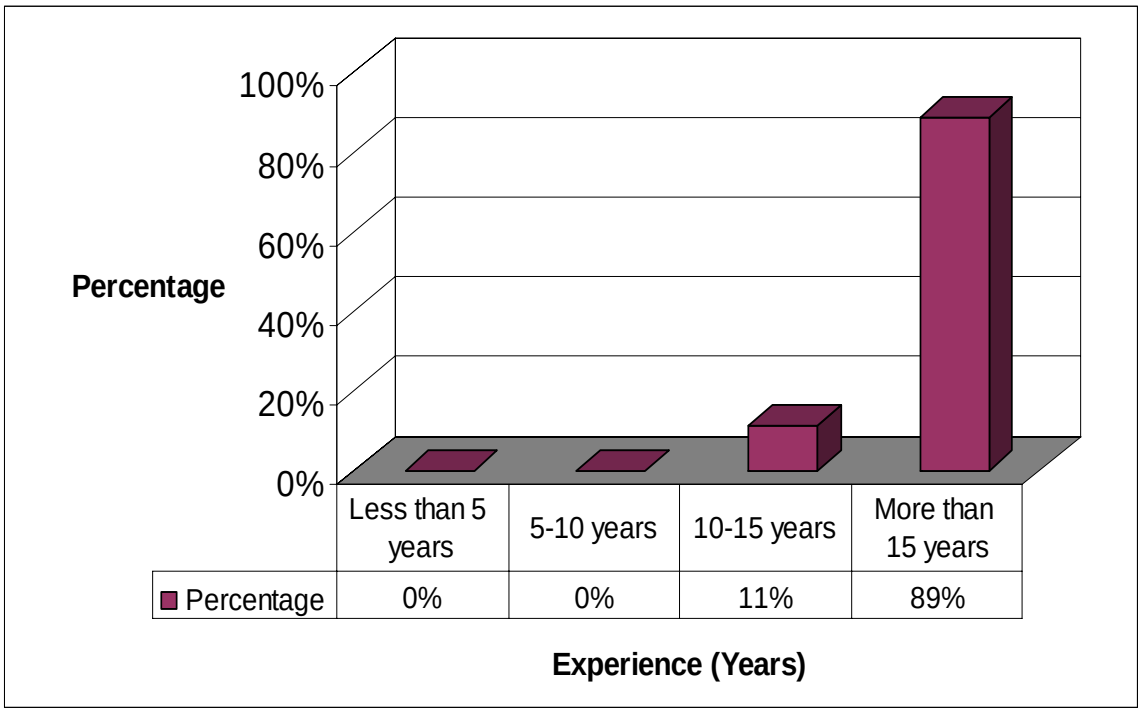

Figure 4.4: **Experiences of Contractors**

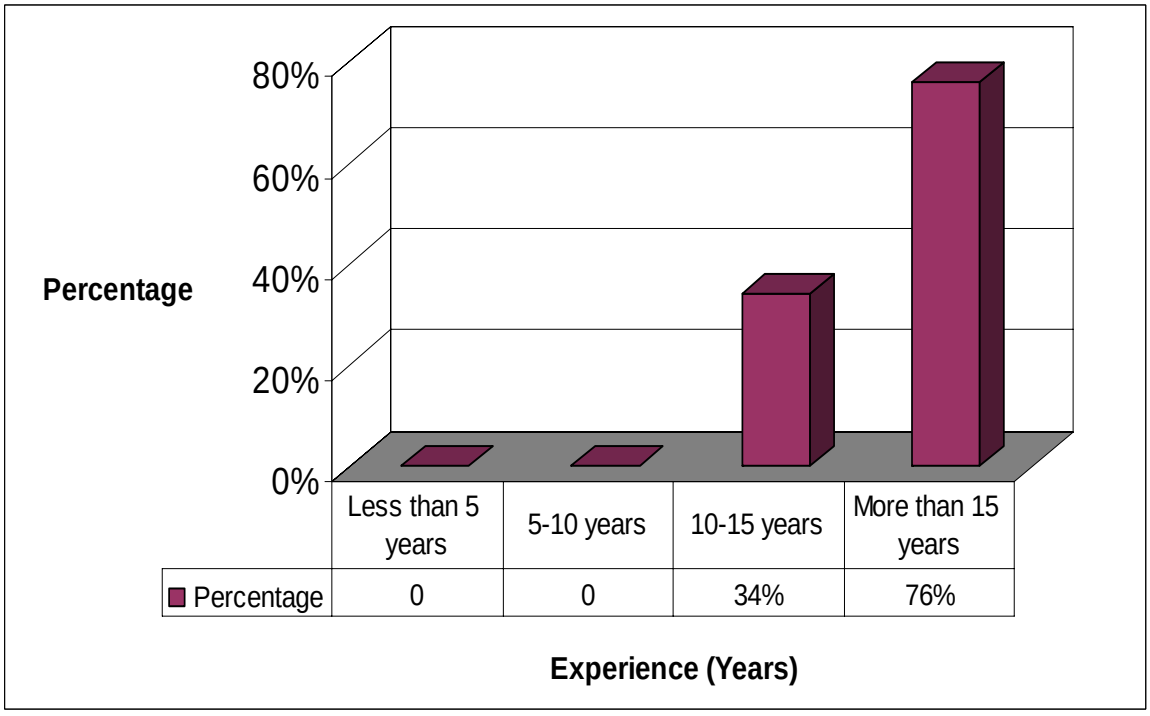

Figure 4.5: **Experiences of Total Respondents**

4.2.2 RESPONDENTS' ORGANIZATION TYPE

The organization types of respondents (consultants, owners' representatives, contractors, and total respondents) are shown in Figures 4.6, 4.7, 4.8 and 4.9 respectively. Respondents were asked to indicate their organization types which were divided as per questionnaire design into three categories:

Category 1: Saudi organizations

Category 2: Joint venture organizations

Category 3: Other organizations

About 89% of consultants, 93% of owners' representatives, and 63% of contractors, and 81% of total respondents were working in Saudi organizations. This indicates that respondents that participated in this research actually represent the field of construction industry in Saudi Arabia and its characteristics. Also, none of the respondents was working in completely non-Saudi organizations. This may indicate that non-Saudi organizations were not involved in this research survey, and somehow were not in Saudi construction industry.

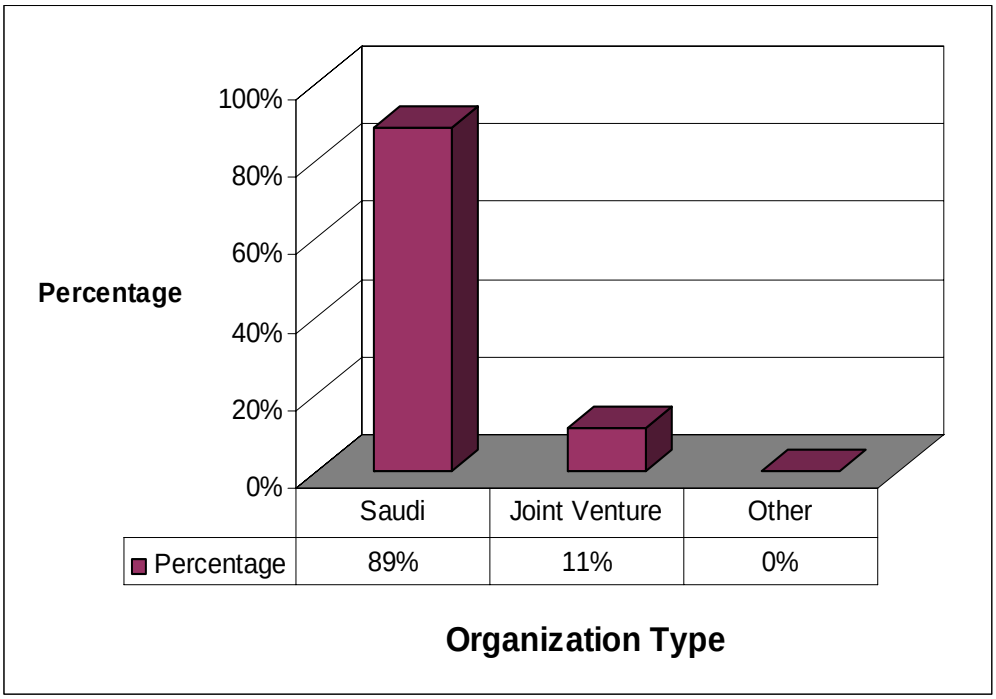

Figure 4.6: **Organization Type of Consultants**

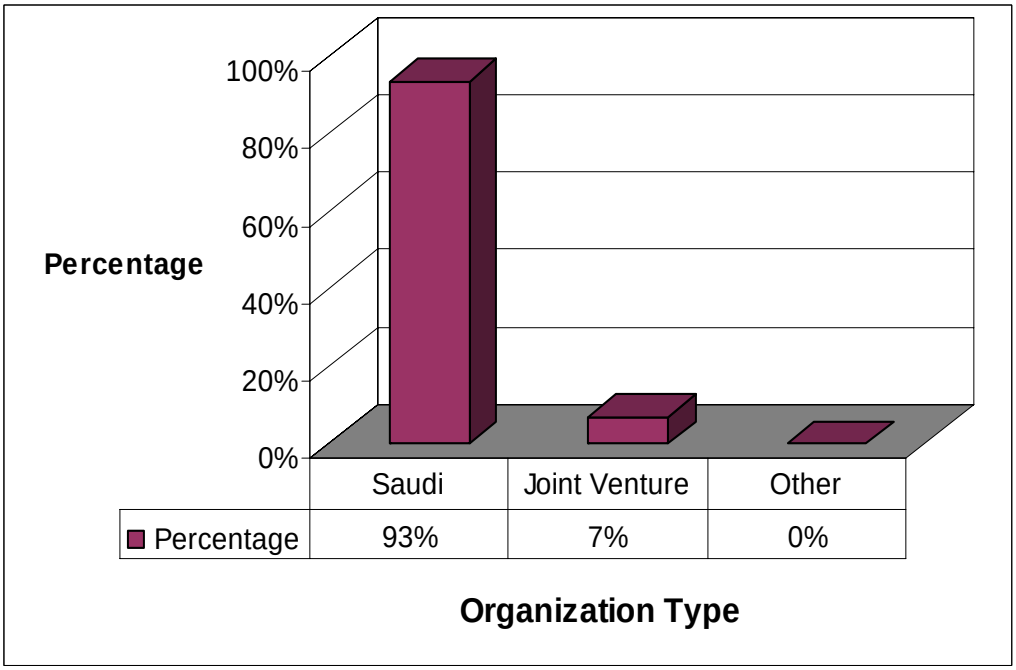

Figure 4.7: **Organization Type of Owners' Representitives**

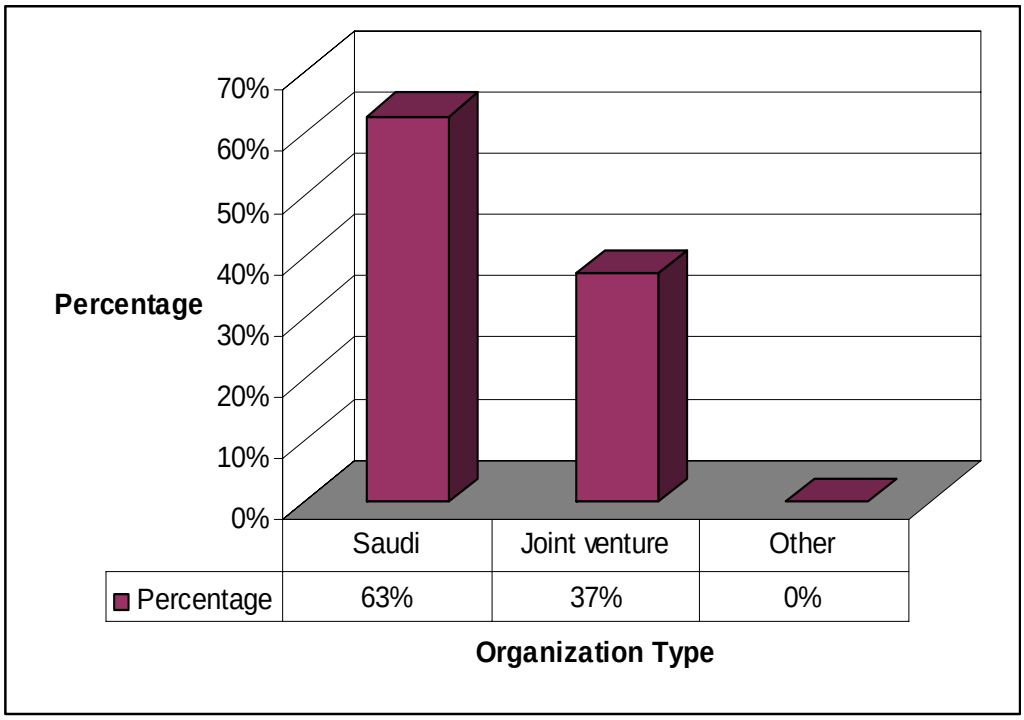

Figure 4.8: **Organization Type of Contractors**

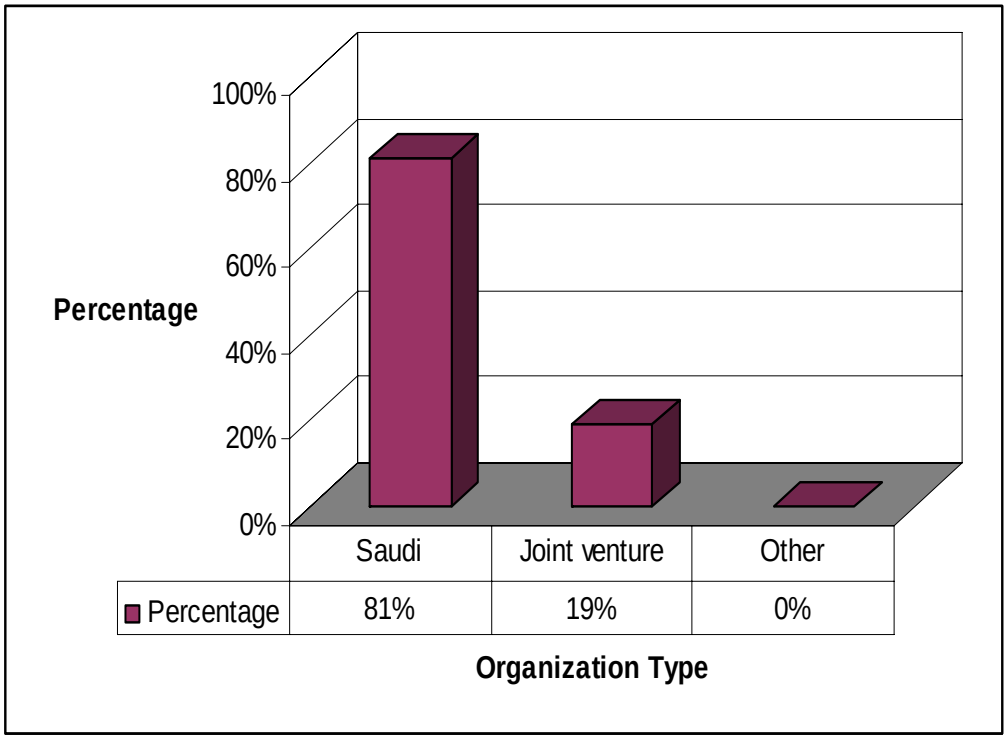

Figure 4.9: **Organization Type of Total Respondents**

4.2.3 PROJECT TYPES DONE BY RESPONDENTS

The projects types done by respondents (consultants, owner, contractors, and total respondents) are shown in Figures 4.10, 4.11, 4.12 and 4.13 respectively. Respondents were asked to indicate their project type most recently finished by them. The project types done by respondents as per questionnaire design were divided into three categories:

Category 1: Governmental projects

Category 2: Semi-Governmental projects

Category 3: Private projects

About 80% of consultants, 17% of owners, 46% of contractors, and 49% of total respondents had recently finished semi-governmental projects. Also, about only 6% of consultants, 83% of owners, 14% of contractors, and 32% of total respondents had recently finished governmental projects. Meanwhile, 14% of consultants, none of owners, 40% of contractors, and 19% of total respondents had finished private projects. This variety of respondents having finished different types of projects can give us a good image about the overall Saudi construction industry.

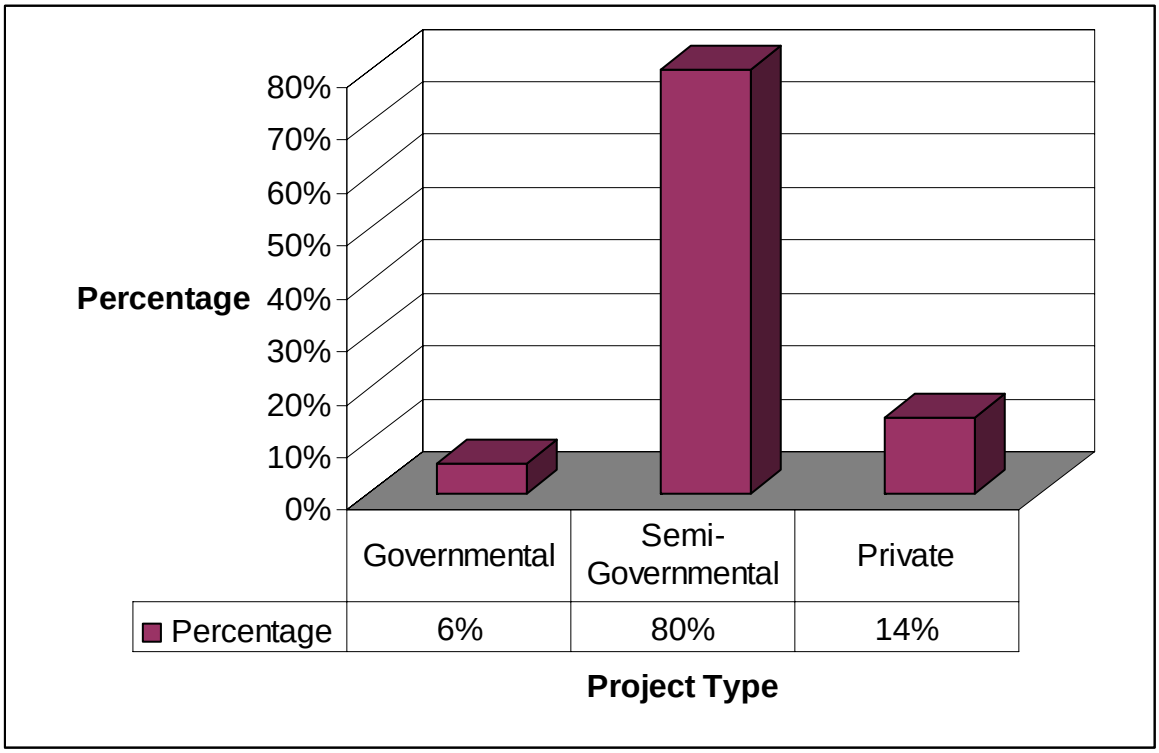

Figure 4.10: **Project Types done by Conusltants**

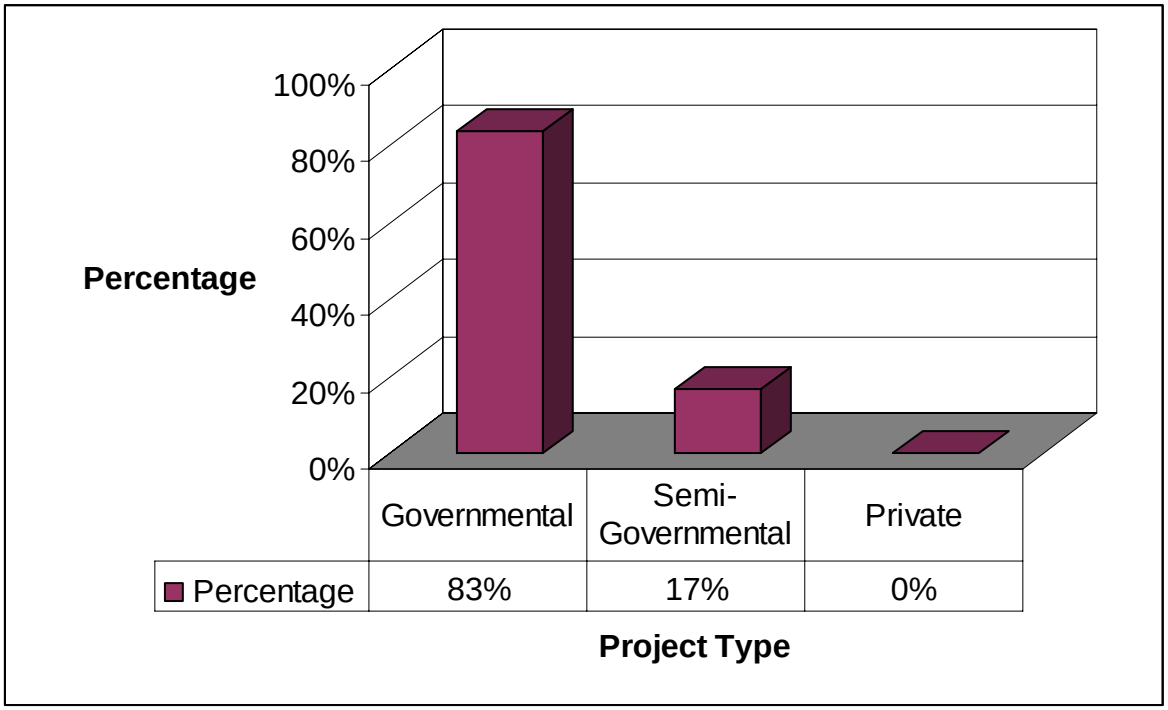

Figure 4.11: **Project Types done by Owners' Representitives**

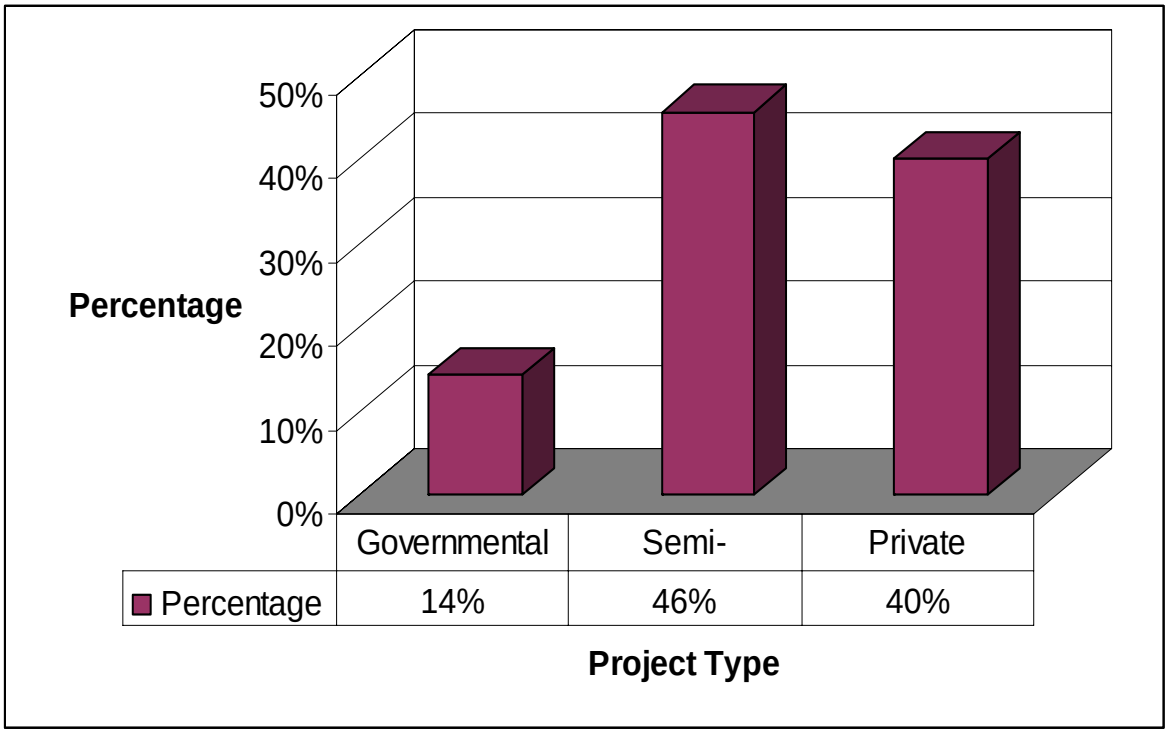

Figure 4.12: **Project Types done by Contractors**

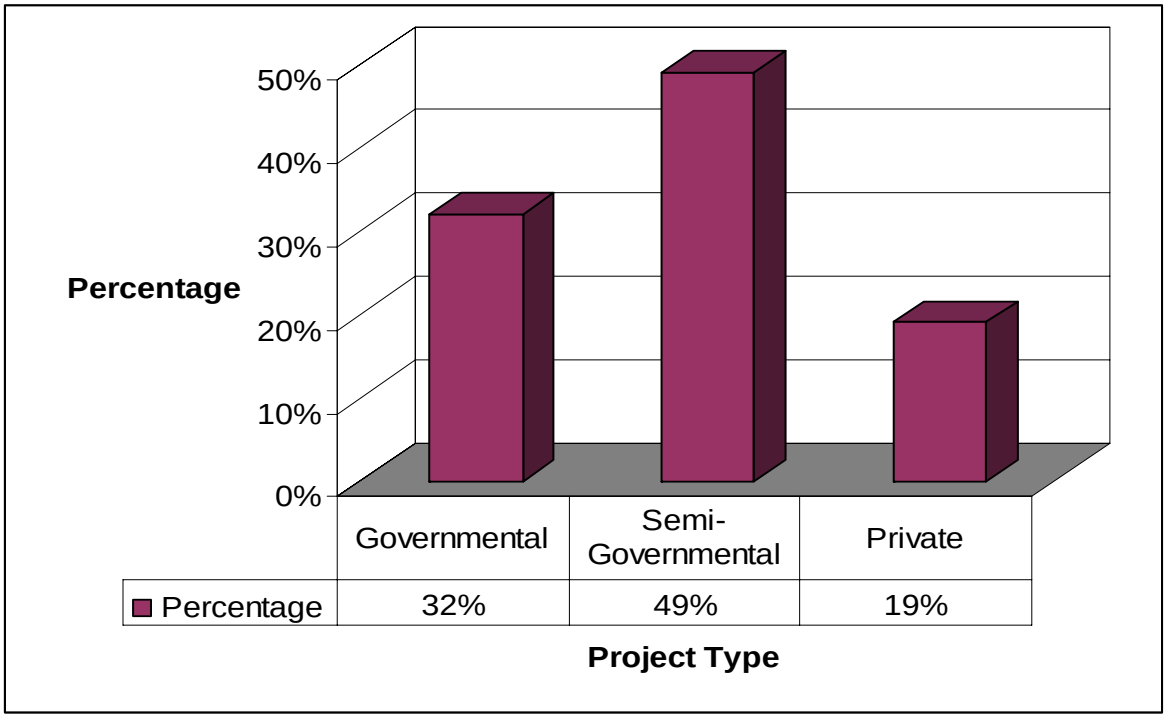

Figure 4.13: **Project Types done by Total Respondents**

4.2.4 Contractor Organizations Classification

The contractor respondents asked for the classification of their organizations according to the Ministry Of Municipal and Rural Affairs (MOMRA). Four choices can be selected by respondent:

Choice 1: Grade 1 Choice 2: Grade 2

Choice 3: Grade 3 Choice 4: Other

According to the limitation of this research, contractors who have a MOMRA grade higher than Grade 3 were excluded from analysis of data. The data obtained from the remaining 35 respondents about contractor classification grades are shown on Figure 4.14. About 54% of contractors were working in the grade 1 organization class, with 37% in the grade 2 organization class. The least 9% were working in grade 3 organization class. These percentages tell us that most contractors were working on large and valuable projects.

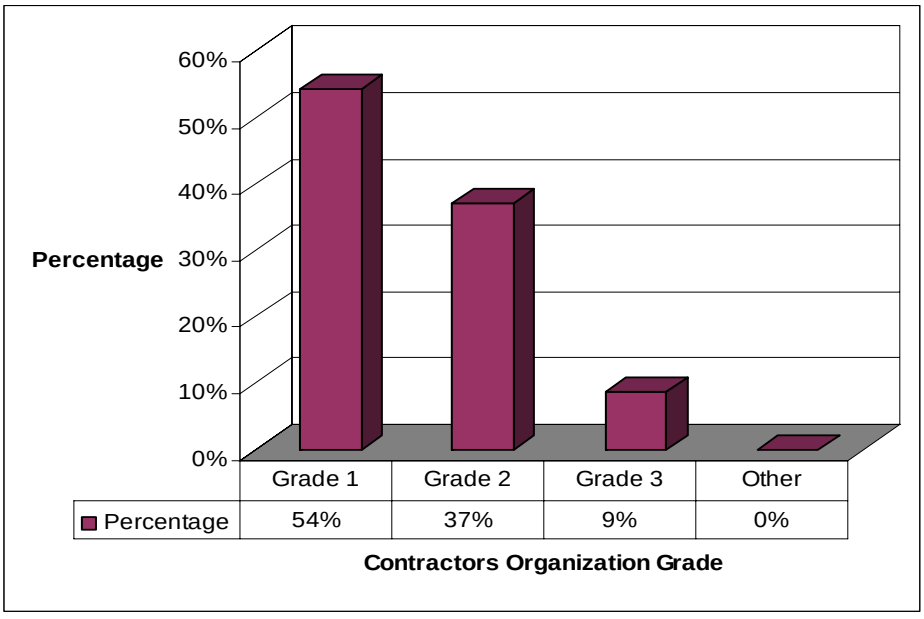

Figure 4.14: **Classification of Contractor Organization**

4.2.5 Consultant Performance Evaluation CPE procedure

The respondents who participated in this research were asked whether their construction process has a Consultant Performance Evaluation (CPE) procedure or not. Three choices can be selected by the respondent:

Choice 1: Have CPE

Choice 2: Don't Have CPE

Choice 3: Unsure

Data obtained from respondents about their construction process CPE are shown on Figures 4.15, 4.16, 4.17 and 4.18 respectively.

The respondents were also asked their opinion whether a CPE system process can improve the overall consultant performance or not. Three choices were available:

Choice 1: Yes

Choice 2: No

Choice 3: Unsure

Data obtained from respondents about their construction process CPE are shown on Figures 4.19, 4.20, 4.21 and 4.22 respectively.

About only 46% consultants, 27% of owners, 23% of contractors, and 32% of total respondents had a CPE system for evaluation of consultant performance. Those percentages are considered somewhat low values and represent that organizations don't give this issue the required importance in the construction industry. Meanwhile, 94% of consultants, 97% of owners, 94% of contractors, and 95% of total respondents believed that a CPE system can improve the consultant performance and the overall project performance further.

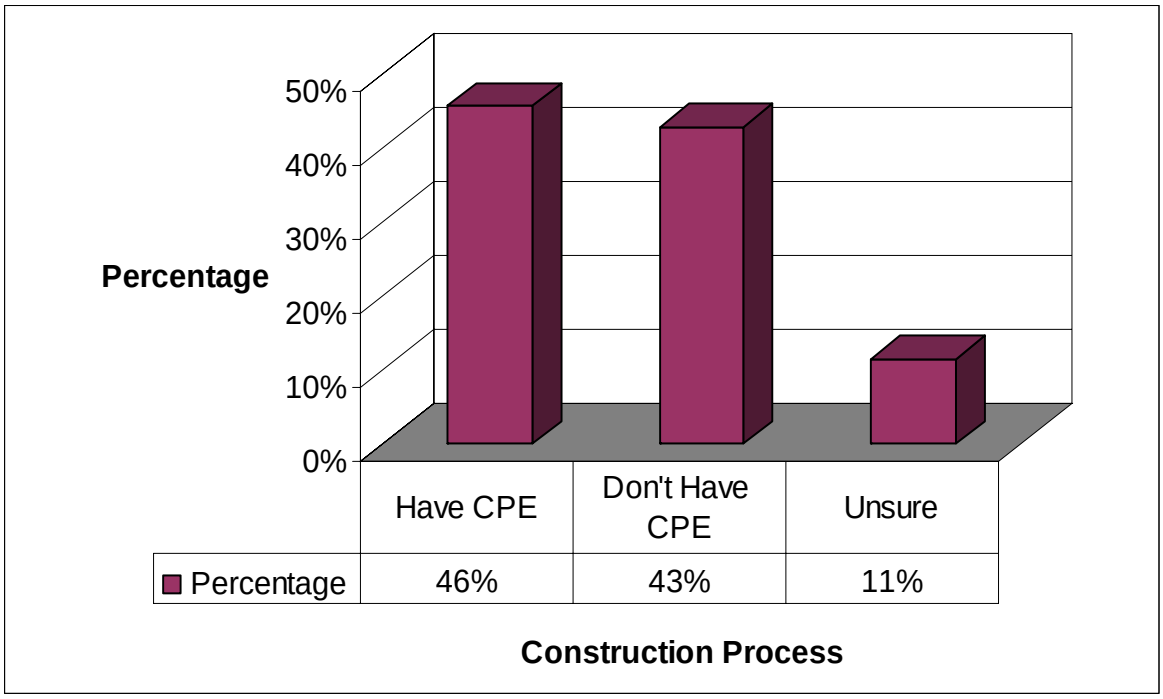

Figure 4.15: **Construction Process CPE from Consultants**

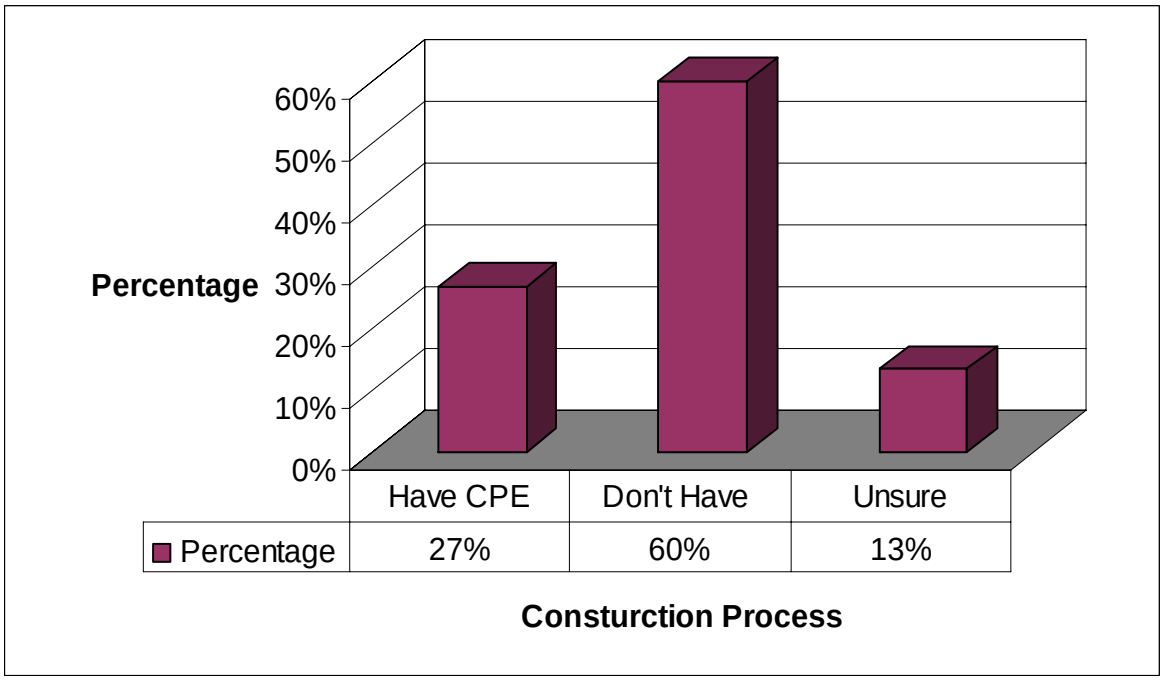

Figure 4.16: **Construction Process CPE from Owners' Representitives**

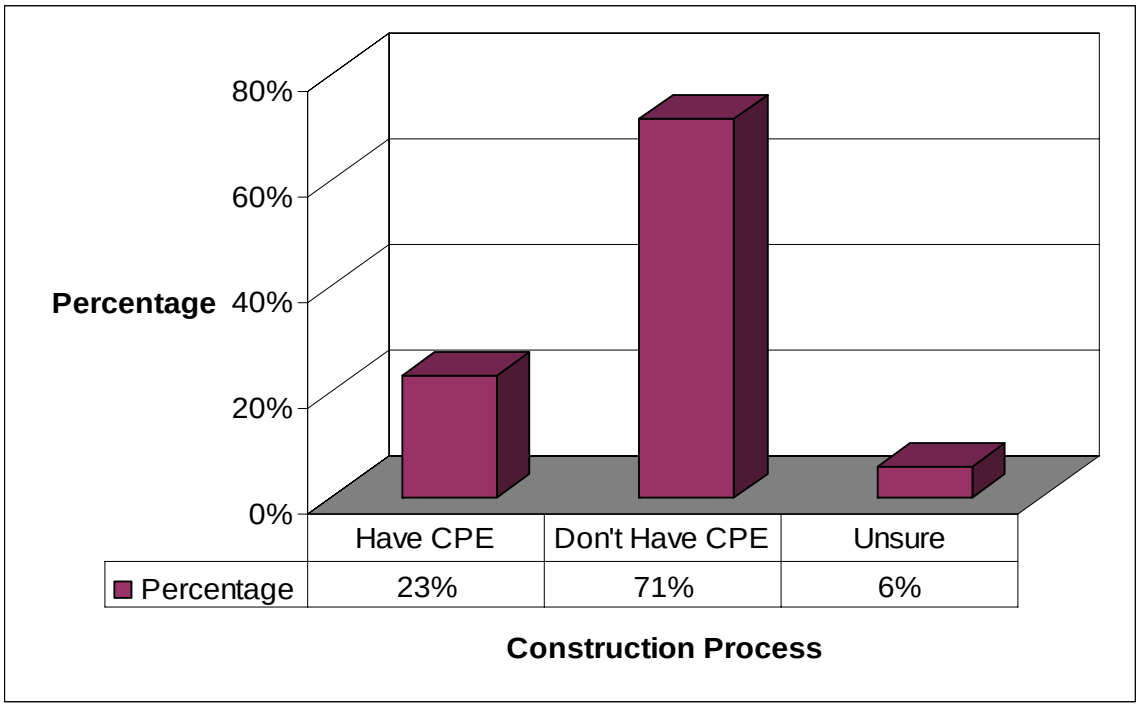

Figure 4.17: **Construction Process CPE from Contractors**

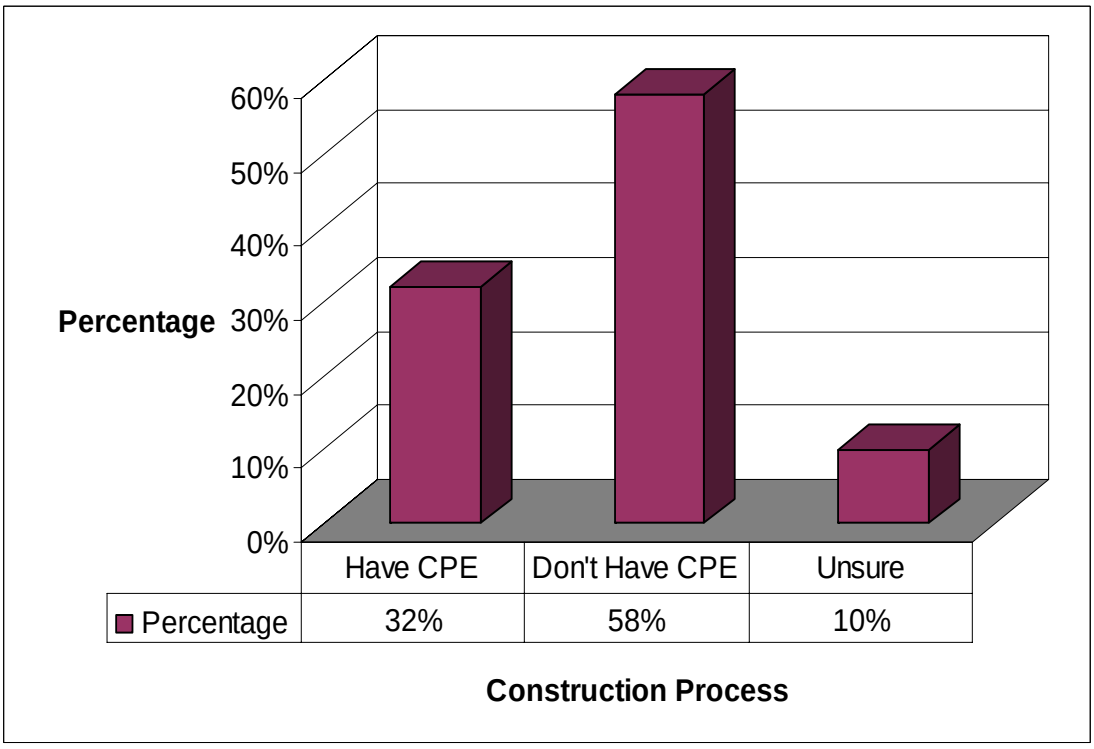

Figure 4.18: **Construction Process CPE from Total Respondents**

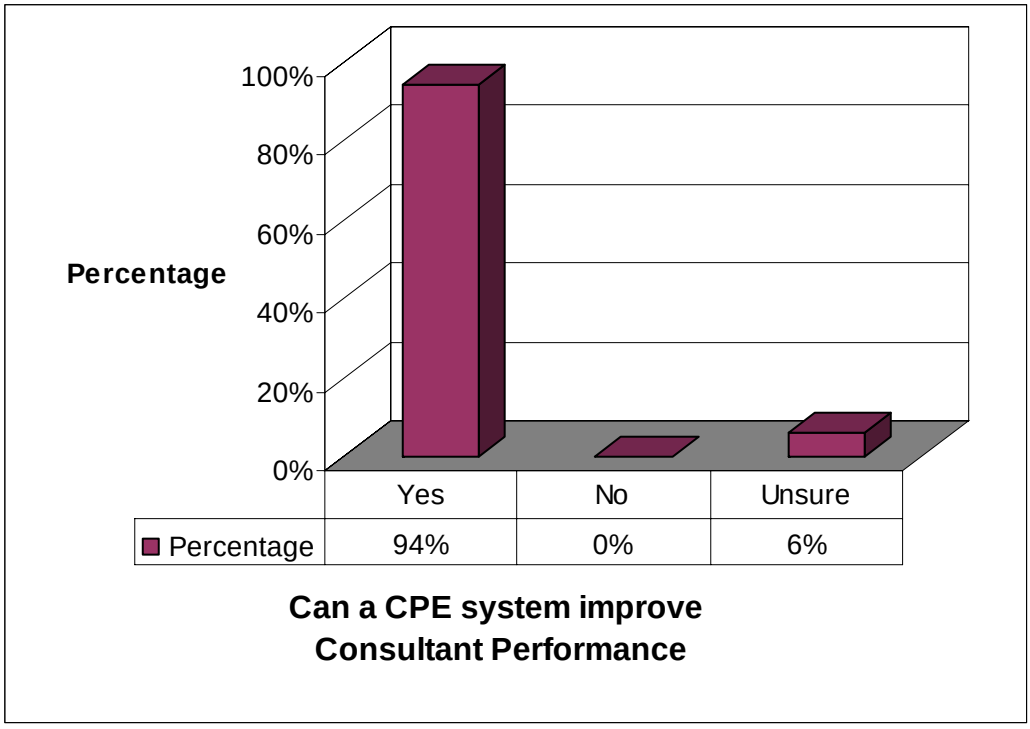

Figure 4.19: **Response from Consultants**

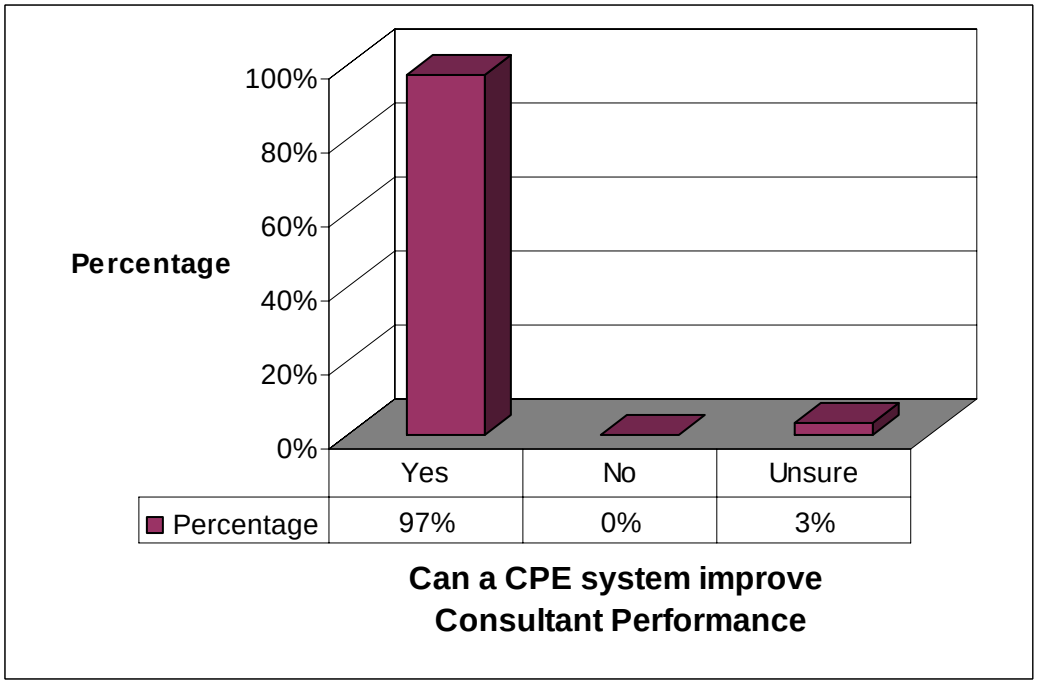

Figure 4.20: **Response from Owners' Representitives**

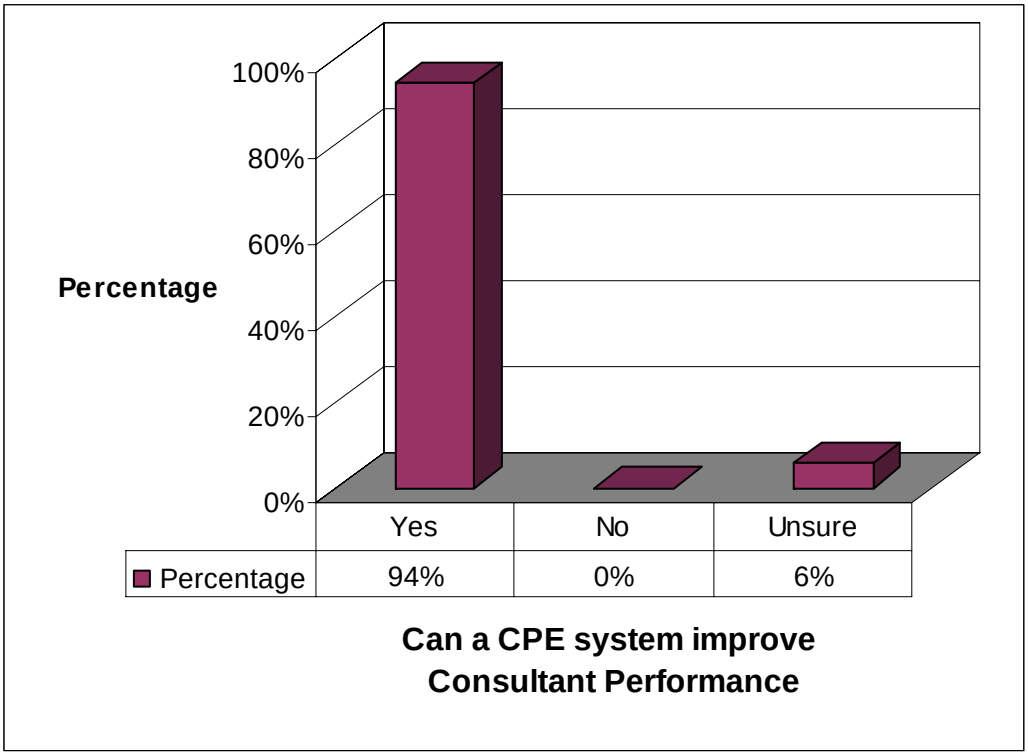

Figure 4.21: **Response from Contractors**

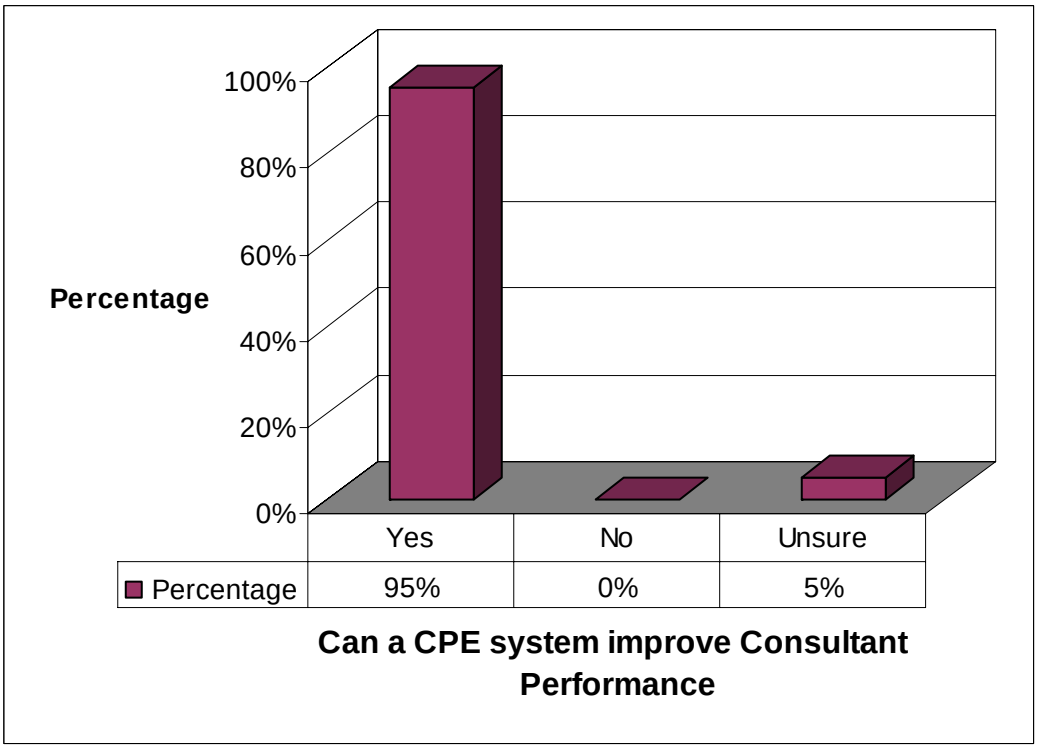

Figure 4.22: **Response from Total Respondents**

4.3 STATISTICAL METHODS

Methods used for calculating and presenting the survey results include:

1. Statistical Techniques
2. Ranking
3. Correlation

All data analysis were performed by computer software spread sheets and are arranged and tabulated as will be shown in this section.

4.3.1 STATISTICAL TECHNIQUES

The survey questionnaire was distributed to evaluators had 40 performance criteria. Table 4.1 represents the results of the statistical techniques used to analyze the collected data from respondents. The statistical techniques *(Schiff and Ralph, 1996*) used are as follows:

4.3.1.1 The Weighted Mean

The weighted mean is obtained by adding all the values in the distribution and dividing it by the total number of all the values. The next equation can be used for calculation

$$\overline{X} = \left(\sum \left(fX \right)_n \right) / n \qquad \text{(Eq. 4.1)}$$

Where,

$\overline{X}$ = the weighted mean

$X_n = 0$ (scoring scale for Not Important)

$X_n = 1$ (scoring scale for Somehow Important)

$X_n = 2$ (scoring scale for Important)

X_n = 3 (scoring scale for Very Important)

X_n = 4 (scoring scale for Extremely Important)

f = frequency of each observation of each criterion

n = number of observations for each criterion (total respondents = 100)

4.3.1.2 Standard Deviation

The standard deviation is a measure of the distance from the observation in a data collection to the middle of that correlation. The next equation can be used for calculation

$$S_n^2 = [\sum f_i (X_i - \overline{X})^2 / (n-1)] \qquad \text{(Eq. 4.2)}$$

Where:

S_n = Standard Deviation for each Criterion

n = number of observation for each Criterion (total =100)

4.3.1.3 The Confidence Interval

A point estimate of a population parameter is a single value calculated of the sample data. Unfortunately samples are not usually perfect reflections of the population from which they were drawn, which implies that researchers are not sure how close the sample value is to the population value. The sample value is the point estimate and the interval is called the confidence interval. Its size depends on the degree of confidence desired in the results by the researcher *(Hank et al, 1984)*. The confidence interval used in this research is 95% which can be calculated as follows:

$$95\% \text{ confidence interval} = \overline{X} \pm 1.96 * S_E \qquad \text{(Eq. 4.3)}$$

Where:

$\overline{X}$ = the weighted mean

S_E = The Standard Error of Mean

4.3.1.4 The Standard Error of Mean

The standard error of mean is used to represent the deviation of sample means from their population mean. *(Schiff and Ralph, 1996)*. It can be calculated using next equation:

$$S_E = \frac{S_n}{\sqrt{n}} \qquad \text{(Eq. 4.4)}$$

Where:

S_E = Standard Error of Mean

n = number of observation for each Criterion (Total Respondents =100)

4.3.1.5 Coefficient of Variance (CV)

Coefficient of Variance (CV) measures the precision of the estimator. It shows how the variation is with respect to the mean. *(Schiff and Ralph, 1996)*. It can be calculated using next equation:

$$\text{Coefficient of Variance (C.V)} = S_n / \overline{X} \qquad \text{(Eq. 4.5)}$$

Where:

S_n = Standard Deviation

$\overline{X}$ = the weighted mean

The statistical results for respondents categories (Consultants, Owners, Contractors, and Total combined respondents) are shown from Table 4.1 through Table 4.4 respectively.

4.3.2 RANKING

The performance evaluation criteria were ranked according to the respondent's survey questionnaire evaluation. Ranking was done using measurement of the Importance Index (IMP. IND.) conducted from applying Equation (3.3). This importance index has a range from 0 to 100 percent. Four tables from Table 4.5 through Table 4.8 were obtained to represent the performance evaluation criteria ranking according to respondents categories (Consultants, Owners, Contractors, and Total combined respondents)

4.3.3 CORRELATION

The correlation coefficient measures the extent to which two variables are linearly related to each other. In this research, correlation is used to represent the degree of agreement or disagreement between the different respondents' categories (Consultants, Owners, and Contractors). The Kendall's coefficient of concordance (Γ) used in this research is a measure of degree of agreement among sets of rankings. The range of the coefficient of concordance (Γ) is from zero to one. One indicates a perfect agreement and zero indicates no agreement. It can be calculated by using the following formula *(Thondike, 1978).*

$$(\Gamma) = \frac{\sum_{i=1}^{K} (R_i - R)^2}{n(n^2 - 1)/12} \qquad \text{(Eq. 4.6)}$$

Where:

R_i = average of the ranks assigned by individual.

R = average of the ranks assigned to the nth variable factor (sum of Ri / n)

k = number of judgments

n = the number of aspects of a problem or criteria being ranked (40)

n (n^2-1) /12 = the maximum possible squared deviations; i.e. the numerator which occur if there were perfect agreement among k sets of ranks, and the average ranking being 1,2,3..... n

This calculation for the Kendall's coefficient will be used for four cases as follows:

1. Between Consultants and Owners Ranking orders
2. Between Consultants and Contractors Ranking orders
3. Between Owners and Contractors Ranking orders
4. Among all Respondent Parties

Kendall's Concordance analysis calculations will be shown from Table 4.9 through Table 4.12 respectively.

4.3.3.1 Kendall's Correlation Coefficient

Using data obtained from Table 4.9 through Table 4.12, we can calculate the Kendall's Correlation Coefficient using Equation 4.6 as follows:

$$(\Gamma_1) \text{ Between Consultants and Owners} = \frac{4692}{40(40^2-1)/12} = 0.88$$

$$(\Gamma_2) \text{ Between Consultants and Contractors} = \frac{4579}{40(40^2-1)/12} = 0.859$$

$$(\Gamma_3) \text{ Between Owners and Contractors} = \frac{4700}{40(40^2-1)/12} = 0.882$$

$$(\Gamma_4) \text{ Among all Respondent Parties} = \frac{4432.67}{40(40^2-1)/12} = 0.832$$

The above value of the Kendall's correlation coefficient indicates a **strong positive correlation** between the each group of respondents and among all participated respondents.

4.3.3.2 Pearson's Correlation Coefficient

To test the correlation results of the Kendall's Correlation Coefficient, Pearson's correlation coefficient will be used for that.

Using the formula of Pearson's correlation coefficient r,

$$r = \frac{\sum (X - \bar{X})(Y - \bar{Y})}{\sqrt{\sum (X - \bar{X})^2 \sum (Y - \bar{Y})^2}} \qquad \text{(Eq. 4.7)}$$

Where:

r = Pearson's correlation coefficient.

X and Y = the sample mean average for each group

Using the data obtained from the statistical results, the values of Pearson's correlation coefficients are:

(r_1) Between Consultants and Owners = 0.789

(r_2) Between Consultants and Contractors = 0.814

(r_3) Between Owners and Contractors =0.790

The above value of the Pearson's correlation coefficient indicates a **strong positive correlation** between the each two groups of respondents.

4.4 STATISTICAL RESULTS AND DISCUSSION

This section will present and discuss the statistical analysis results which we obtained from a previous statistical method as seen from Table 4.1 through Table 4.9. According to respondents' evaluation, the list of criteria used for evaluation of consultant performance is ranked by the measurement of the importance index according to Equation (3.3).

4.4.1 CONSULTANTS' PERSPECTIVE

According to their evaluation, consultants believe that the (Construction and Design) stages are the most important project stages which have more valuable evaluation criteria for consultants' performance. The arrangement of project stages as per their weighted importance is:

- Construction stage
- Design stage
- Bidding stage
- Post construction stage
- Feasibility stage

Also, the five most important consultant performance evaluation criteria identified by consultants are listed below:

1. Quality of design
2. Recruitment, supervision and administration of site staff
3. Supervision of contractor
4. Compliance to client’s requirements

5. Quality of bid documents (working drawings, BOQ. etc.)

According to the ranking by the Consultant Criteria Evaluation, the most important criterion was (Quality of design).This may reflect on the consultants' opinion of the importance of project design and its effect on all other project issues. However, there are also some criteria ranked which have relation with other project stages like Biding and Construction stages.

On the other hand, the least important criteria ranked were:

1. Environmental management
2. Availability of innovative ideas
3. Relationship with other consultants
4. Relationship with the contractor
5. Availability of innovative and alternative solutions

The above mentioned least important criteria ranking gives us an idea about consultant beliefs. They believed that environmental management is not related to their performance evaluation and may be someone else, like the contractor, should be concerned about it.

4.4.2 OWNERS' REPRESENTITATIVES PERSPECTIVE

According to their evaluation, owners' representatives believe that the (Design and Construction) stages are the most important project stages which have more valuable evaluation criteria for consultants' performance. The arrangement of project stages as per their weighted importance is:

- Design stage
- Construction stage
- Bidding stage
- Post construction stage
- Feasibility stage

Also, the five most important consultant performance evaluation criteria identified by owners are listed below:

1. Problem solving/avoidance ability
2. Appreciation of background information
3. Compliance to client’s requirements
4. Recruitment, supervision and administration of site staff
5. Quality of design

According to the ranking by Owners' Criteria Evaluation, the most important criterion was problem solving/avoidance ability. This may reflect that owners need to avoid any problems which may occur during construction. However, there are also some criteria ranked that have a relation with other owners' personal issues, such as their requirements and consultant background information.

On the other hand, the least important criteria ranked were:

1. Availability of innovative ideas
2. Input of key personnel in the project (using his experience and capabilities)
3. Environmental management
4. Relationship with other consultants
5. Approach to cost-effectiveness

Owners believed that there is no need for innovative ideas by consultants during the project feasibility stage. Owners believed that it will not affect project quality or consultant performance evaluation as it is related to the first stage of the project.

4.4.3 CONTRACTORS' PERSPECTIVE

Like Owners' representatives evaluation, contractors also believe that the (Design and Construction) stages are the most important project stages which have more valuable evaluation criteria for consultants' performance. The arrangement of project stages as per their weighted importance is:

- Design stage
- Construction stage
- Bidding stage
- Post construction stage
- Feasibility stage

Also, the most important consultant performance evaluation criteria identified by contractors are listed below:

1. Quality of design
2. Compliance to client’s requirements
3. Quality of bid documents (working drawings, BOQ. etc.)
4. Quality of drawings
5. Supervision of contractor

The most important criteria chosen by contractors were basically related to their jobs. They selected all criteria to avoid any problems during their involvement in the project. Quality of design is the most important criteria they selected to avoid any problems or owners' changes during the construction stage

On the other hand, the least important criteria ranked were:

1. Environmental management
2. Relationship with other consultants
3. Relationship with the contractor
4. Approach to cost-effectiveness
5. Availability of innovative ideas

Contractors believed, like consultants, that the environmental management criterion is not important for consultant performance evaluation. They may think that this should be handled by someone else who is a specialized professional in this field.

4.4.4 OVERALL RESPODENTS' PERSPECTIVE

According to their evaluation, overall respondents believe that the (Design and Construction) stages are the most important project stages which have more valuable evaluation criteria for consultants' performance. The arrangement of project stages as per their weighted importance is:

- Design stage
- Construction stage
- Bidding stage
- Post construction stage
- Feasibility stage

Also, the most important consultant performance evaluation criteria identified by all respondents are listed below:

1. Quality of design
2. Compliance to client's requirements
3. Quality of bid documents (working drawings, BOQ. etc.)
4. Recruitment, supervision and administration of site staff
5. Supervision of contractor

The most important criteria chosen by all respondents are basically related to the main consultant job which is project design and its quality. We can notice from the results shown in Table 4.5 that all the five most important criteria are closer to each other in their importance index, and that all criteria are related to the main duties

of a consultant. This means that there is a strong agreement between all respondents with the importance of these criteria for evaluation of consultant's performance.

However, the criteria that all respondents believed has lesser importance for consultant performance evaluation are:

1. Availability of innovative ideas
2. Environmental management
3. Relationship with other consultants
4. Approach to cost-effectiveness
5. Relationship with the contractor

We can notice from these criteria that almost all personal issues of a consultant are the least important criteria to be used for their performance evaluation. The respondent's judgment is more practical and has valuable professionals from respondents. However, these criteria have some importance for the performance evaluation, but we can ignore them with reference to the evaluation of a consultant performance.

Table 4.1: Statistical Results for Consultants' Responses

No.	Criteria	Min.	Max.	Mean	Std. Dev.	Std. Error of Mean	95% Conf. Interval	Coeff. of Variance
1	Appreciation of background information	0	4	3.37	0.69	0.12	3.37 ± 0.23	0.20
2	Quality of recommendation during study	0	4	2.77	1.03	0.17	2.77 ± 0.34	0.37
3	Availability of innovative ideas	0	4	2.57	0.98	0.17	2.57 ± 0.32	0.38
4	Accuracy of early cost estimate	0	4	2.86	0.94	0.16	2.86 ± 0.31	0.33
5	Quality of study report	0	4	2.89	0.87	0.15	2.89 ± 0.29	0.30
6	Compliance to client's requirements	0	4	3.43	0.70	0.12	3.43 ± 0.23	0.20
7	Compliance to legislative requirements	0	4	3.34	0.68	0.12	3.34 ± 0.23	0.20
8	Identification of client's requirements and project objectives	0	4	3.37	0.81	0.14	3.37 ± 0.27	0.24
9	Quality of design	0	4	3.57	0.70	0.12	3.57 ± 0.23	0.20
10	Availability of innovative and alternative solutions	0	4	2.63	0.84	0.14	2.63 ± 0.28	0.32
11	Approach to cost-effectiveness	0	4	2.71	0.83	0.14	2.71 ± 0.27	0.30
12	Quality of drawings	0	4	3.37	0.77	0.13	3.37 ± 0.26	0.23
13	Accuracy of cost estimate	0	4	3.23	0.88	0.15	3.23 ± 0.29	0.27
14	Quality of bid documents	0	4	3.40	0.69	0.12	3.40 ± 0.23	0.20
15	Bid assessment (quality of bidding control)	0	4	3.11	0.76	0.13	3.11 ± 0.25	0.24
16	Quality of report on returned bids	0	4	2.89	0.80	0.13	2.89 ± 0.26	0.28
17	Recruitment, supervision and administration of site staff	0	4	3.51	0.66	0.11	3.51 ± 0.22	0.19
18	Administration of contract	0	4	3.29	0.89	0.15	3.29 ± .30	0.27
19	Supervision of contractor	0	4	3.51	0.66	0.11	3.51 ± .22	0.19
20	Handling of claims	0	4	2.94	0.91	0.15	2.94 ± 0.30	0.31

Table 4.1: Statistical Results for Consultants' Responses (Continued)

No.	Criteria	Min.	Max.	Mean	Std. Devn	Std. Error of Mean	95% Conf. Interval	Coeff. of Variance
21	Financial control of contract	0	4	3.09	0.85	0.14	3.09 ± 0.28	0.28
22	Quality of as-built drawings and records	0	4	2.97	0.86	0.14	2.97 ± 0.28	0.29
23	Maintenance inspection and drawing up list of defects	0	4	2.91	0.85	0.14	2.91 ± 0.28	0.29
24	Settlement of claims	0	4	2.83	0.89	0.15	2.83 ± 0.30	0.31
25	Settlement of final account	0	4	3.23	0.84	0.14	3.23 ± 0.28	0.26
26	Input of key personnel in the project	0	4	2.89	1.13	0.19	2.89 ± 0.37	0.39
27	Adequacy of professional input of key personnel	0	4	3.09	0.78	0.13	3.09 ± 0.26	0.25
28	Adequacy of schedule reporting	0	4	3.00	0.84	0.14	3.00 ± 0.28	0.28
29	Quality of program and progress report	0	4	3.03	0.79	0.13	3.03 ± 0.26	0.26
30	Program monitoring and control	0	4	3.11	0.80	0.13	3.11 ± 0.26	0.26
31	Relationship with the client	0	4	3.14	1.00	0.17	3.14 ± 0.33	0.32
32	Relationship with the contractor	0	4	2.63	1.00	0.17	2.63 ± 0.33	0.38
33	Relationship with other consultants	0	4	2.60	1.19	0.20	2.60 ± 0.40	0.46
34	Achievement of objectives and targets	0	4	3.20	0.58	0.10	3.20 ± 0.19	0.18
35	Responding quickly to the request and instructions of client	0	4	3.17	0.66	0.11	3.17 ± 0.22	0.21
36	Problem solving/avoidance ability	0	4	3.26	0.66	0.11	3.26 ± 0.22	0.20
37	General management skills	0	4	3.03	0.75	0.13	3.03 ±0.25	0.25
38	Quality management	0	4	3.09	0.92	0.16	3.09 ± 0.30	0.30
39	Safety management	0	4	3.06	0.87	0.15	3.06 ± 0.29	0.29
40	Environmental management	0	4	2.49	0.85	0.14	2.49 ± 0.28	0.34

Table 4.2: Statistical Results for Owners' Representatives Responses

No.	Criteria	Min.	Max.	Mean	Std. Dev.	Std. Error of Mean	95% Conf. Interval	Coeff. of Variance
1	Appreciation of background information	0	4	3.53	0.57	0.10	3.53 ± 0.20	0.16
2	Quality of recommendation during study	0	4	2.93	0.94	0.17	2.93 ± 0.34	0.32
3	Availability of innovative ideas	0	4	2.04	1.12	0.16	2.04 ± 0.31	0.55
4	Accuracy of early cost estimate	0	4	3.20	0.76	0.14	3.20 ± 0.27	0.24
5	Quality of study report	0	4	3.07	0.69	0.13	3.07 ± 0.25	0.23
6	Compliance to client's requirements	0	4	3.53	0.63	0.11	3.53 ± 0.23	0.18
7	Compliance to legislative requirements	0	4	2.80	0.92	0.17	2.80 ± 0.33	0.33
8	Identification of client's requirements and project objectives	0	4	3.43	0.63	0.11	3.43 ± 0.22	0.18
9	Quality of design	0	4	3.47	0.63	0.11	3.47 ± 0.23	0.18
10	Availability of innovative and alternative solutions	0	4	2.73	0.87	0.16	2.73 ± 0.31	0.32
11	Approach to cost-effectiveness	0	4	2.67	1.18	0.22	2.67 ± 0.42	0.44
12	Quality of drawings	0	4	3.27	1.01	0.19	3.27 ± 0.36	0.31
13	Accuracy of cost estimate	0	4	3.10	0.80	0.15	3.10 ± 0.29	0.26
14	Quality of bid documents	0	4	3.43	0.77	0.14	3.43 ± 0.28	0.23
15	Bid assessment (quality of bidding control)	0	4	2.90	0.76	0.14	2.90 ± 0.27	0.26
16	Quality of report on returned bids	0	4	2.83	0.87	0.16	2.83 ± 0.31	0.31
17	Recruitment, supervision and administration of site staff	0	4	3.53	0.68	0.12	3.53 ± 0.24	0.19
18	Administration of contract	0	4	3.27	0.91	0.17	3.27 ± 0.32	0.28
19	Supervision of contractor	0	4	3.40	0.89	0.16	3.40 ± 0.32	0.26
20	Handling of claims	0	4	2.67	0.99	0.18	2.67 ± 0.36	0.37

Table 4.2: Statistical Results for Owners' Representatives Responses (Continued)

No.	Criteria	Min.	Max.	Mean	Std. Devn	Std. Error of Mean	95% Conf. Interval	Coeff. of Variance
21	Financial control of contract	0	4	2.70	1.24	0.23	2.70 ± 0.44	0.46
22	Quality of as-built drawings and records	0	4	3.13	0.90	0.16	3.13 ± 0.32	0.29
23	Maintenance inspection and drawing up list of defects	0	4	3.23	0.86	0.16	3.23 ± 0.31	0.27
24	Settlement of claims	0	4	2.70	0.79	0.15	2 70 ± 0.28	0.29
25	Settlement of final account	0	4	2.87	1.01	0.18	2.87 ± 0.36	0.35
26	Input of key personnel in the project	0	4	2.40	1.00	0.18	2.40 ±0.36	0.42
27	Adequacy of professional input of key personnel	0	4	2.97	0.81	0.15	2.97± 0.29	0.27
28	Adequacy of schedule reporting	0	4	2.93	0.74	0.14	2.93 ± 0.26	0.25
29	Quality of program and progress report	0	4	2.91	0.77	0.13	2.91 ± 0.26	0.26
30	Program monitoring and control	0	4	3.10	0.80	0.15	3.10 ± 0.29	0.26
31	Relationship with the client	0	4	3.10	0.80	0.15	3.10 ± 0.29	0.26
32	Relationship with the contractor	0	4	2.87	1.04	0.19	2.87 ± 0.37	0.36
33	Relationship with other consultants	0	4	2.50	1.17	0.21	2.50 ± 0.42	0.47
34	Achievement of objectives and targets	0	4	3.33	0.61	0.11	3.33 ± 0.22	0.18
35	Responding quickly to the request and instructions of client	0	4	3.03	0.85	0.16	3.03 ± 0.30	0.28
36	Problem solving/avoidance ability	0	4	3.57	0.57	0.10	3.57 ± 0.20	0.16
37	General management skills	0	4	2.93	0.74	0.14	2.93 ± 0.26	0.25
38	Quality management	0	4	3.13	0.78	0.14	3.13 ± 0.28	0.25
39	Safety management	0	4	3.17	0.87	0.16	3.17 ± 0.31	0.28
40	Environmental management	0	4	2.43	0.97	0.18	2.43 ± 0.35	0.40

Table 4.3: Statistical Results for Contractors' Responses

No.	Criteria	Min.	Max.	Mean	Std. Dev.	Std. Error of Mean	95% Conf. Interval	Coeff. of Variance
1	Appreciation of background information	0	4	3.29	0.67	0.11	3.29 ± 0.22	0.20
2	Quality of recommendation during study	0	4	2.94	0.68	0.12	2.94 ± 0.23	0.23
3	Availability of innovative ideas	0	4	2.54	0.78	0.13	2.54 ± 0.26	0.31
4	Accuracy of early cost estimate	0	4	2.77	0.77	0.13	2.77 ± 0.26	0.28
5	Quality of study report	0	4	2.94	0.87	0.15	2.94 ± 0.29	0.30
6	Compliance to client's requirements	0	4	3.46	0.66	0.11	3.46 ± 0.22	0.19
7	Compliance to legislative requirements	0	4	3.03	0.82	0.14	3.03 ± 0.27	0.27
8	Identification of client's requirements and project objectives	0	4	3.26	0.74	0.13	3.26 ± 0.25	0.23
9	Quality of design	0	4	3.51	0.56	0.10	3.51 ± 0.19	0.16
10	Availability of innovative and alternative solutions	0	4	2.91	0.78	0.13	2.91 ± 0.26	0.27
11	Approach to cost-effectiveness	0	4	2.54	1.04	0.18	2.54 ± 0.34	0.41
12	Quality of drawings	0	4	3.37	0.65	0.11	3.37 ± 0.21	0.19
13	Accuracy of cost estimate	0	4	2.91	0.85	0.14	2.91 ± 0.28	0.29
14	Quality of bid documents	0	4	3.46	0.74	0.13	3.46 ± 0.25	0.21
15	Bid assessment (quality of bidding control)	0	4	2.80	0.76	0.13	2.80 ± 0.25	0.27
16	Quality of report on returned bids	0	4	2.83	0.82	0.14	2.83 ± 0.27	0.29
17	Recruitment, supervision and administration of site staff	0	4	3.26	0.82	0.14	3.26 ± 0.27	0.25
18	Administration of contract	0	4	2.97	0.66	0.11	2.97 ± 0.22	0.22
19	Supervision of contractor	0	4	3.37	0.65	0.11	3.37 ± 0.21	0.19
20	Handling of claims	0	4	3.00	0.87	0.15	3.00 ± 0.29	0.29

Table 4.3: Statistical Results for Contractors' Responses (Continued)

No.	Criteria	Min.	Max.	Mean	Std. Devn	Std. Error of Mean	95% Conf. Interval	Coeff. of Variance
21	Financial control of contract	0	4	2.63	1.17	0.20	2.63 ± 0.39	0.44
22	Quality of as-built drawings and records	0	4	3.03	0.66	0.11	3.03 ± 0.22	0.22
23	Maintenance inspection and drawing up list of defects	0	4	3.06	0.64	0.11	3.06 ± 0.21	0.21
24	Settlement of claims	0	4	3.03	0.82	0.14	3.03 ± 0.27	0.27
25	Settlement of final account	0	4	2.77	1.14	0.19	2.77 ± 0.38	0.41
26	Input of key personnel in the project	0	4	2.94	0.91	0.15	2.94 ± 0.30	0.31
27	Adequacy of professional input of key personnel	0	4	2.94	1.00	0.17	2.94 ± 0.33	0.34
28	Adequacy of schedule reporting	0	4	2.89	0.63	0.11	2.89 ± 0.21	0.22
29	Quality of program and progress report	0	4	2.77	0.55	0.09	2.77 ± 0.18	0.20
30	Program monitoring and control	0	4	2.97	0.79	0.13	2.97 ± 0.26	0.26
31	Relationship with the client	0	4	3.00	0.87	0.15	3.00 ± 0.29	0.29
32	Relationship with the contractor	0	4	2.49	1.01	0.17	2.49 ± 0.33	0.41
33	Relationship with other consultants	0	4	2.46	0.98	0.17	2.46 ± 0.32	0.40
34	Achievement of objectives and targets	0	4	3.26	0.89	0.15	3.26 ± 0.29	0.27
35	Responding quickly to the request and instructions of client	0	4	2.89	0.90	0.15	2.89 ±0..30	0.31
36	Problem solving/avoidance ability	0	4	3.17	1.01	0.17	3.17 ± 0.34	0.32
37	General management skills	0	4	2.83	0.57	0.10	2.83 ± 0.19	0.20
38	Quality management	0	4	3.06	0.68	0.12	3.06 ± 0.23	0.22
39	Safety management	0	4	2.86	0.85	0.14	2.86 ± 0.28	0.30
40	Environmental management	0	4	2.46	1.17	0.20	2.46 ± 0.39	0.48

Table 4.4: Statistical Results for Total Responses

No.	Criteria	Min.	Max.	Mean	Std. Dev.	Std. Error of Mean	95% Conf. Interval	Coeff. of Variance
1	Appreciation of background information	0	4	3.39	0.65	0.06	3.39 ± 0.13	0.19
2	Quality of recommendation during study	0	4	2.88	0.89	0.09	2.88 ± 0.17	0.31
3	Availability of innovative ideas	0	4	2.34	1.01	0.09	2.34 ± 0.18	0.43
4	Accuracy of early cost estimate	0	4	2.93	0.84	0.08	2.93 ± 0.17	0.29
5	Quality of study report	0	4	2.96	0.82	0.08	2.96 ± 0.16	0.28
6	Compliance to client's requirements	0	4	3.47	0.66	0.07	3.47 ± 0.13	0.19
7	Compliance to legislative requirements	0	4	3.07	0.83	0.08	3.07 ± 0.16	0.27
8	Identification of client's requirements and project objectives	0	4	3.35	0.73	0.07	3.35 ± 0.14	0.22
9	Quality of design	0	4	3.52	0.63	0.06	3.52 ± 0.12	0.18
10	Availability of innovative and alternative solutions	0	4	2.76	0.83	0.08	2.76 ±.016	0.30
11	Approach to cost-effectiveness	0	4	2.64	1.01	0.10	2.64 ± 0.20	0.38
12	Quality of drawings	0	4	3.34	0.81	0.08	3.34 ± 0.16	0.24
13	Accuracy of cost estimate	0	4	3.08	0.85	0.08	3.08 ± 0.17	0.28
14	Quality of bid documents	0	4	3.43	0.73	0.07	3.43 ± 0.14	0.21
15	Bid assessment (quality of bidding control)	0	4	2.94	0.76	0.08	2.94 ± 0.15	0.26
16	Quality of report on returned bids	0	4	2.85	0.82	0.08	2.85 ± 0.16	0.29
17	Recruitment, supervision and administration of site staff	0	4	3.43	0.73	0.07	3.43 ± 0.14	0.21
18	Administration of contract	0	4	3.17	0.83	0.08	3.17 ± 0.16	0.26
19	Supervision of contractor	0	4	3.43	0.73	0.07	3.43 ± 0.14	0.21
20	Handling of claims	0	4	2.88	0.92	0.09	2.88 ± 0.18	0.32

Table 4.4: Statistical Results for Total Responses (Continued)

No.	Criteria	Min.	Max.	Mean	Std. Devn	Std. Error of Mean	95% Conf. Interval	Coeff. of Variance
21	Financial control of contract	0	4	2.81	1.10	0.11	2.81 ± 0.22	0.39
22	Quality of as-built drawings and records	0	4	3.04	0.80	0.08	3.04 ± 0.16	0.26
23	Maintenance inspection and drawing up list of defects	0	4	3.06	0.79	0.08	3.06 ± 0.15	0.26
24	Settlement of claims	0	4	2.86	0.84	0.08	2.86 ± 0.16	0.29
25	Settlement of final account	0	4	2.96	1.01	0.10	2.96 ± 0.20	0.34
26	Input of key personnel in the project	0	4	2.76	1.04	0.10	2.76 ± 0.20	0.38
27	Adequacy of professional input of key personnel	0	4	3.00	0.86	0.09	3.00 ± 0.17	0.29
28	Adequacy of schedule reporting	0	4	2.94	0.74	0.07	2.94 ± 0.14	0.25
29	Quality of program and progress report	0	4	2.90	0.71	0.07	2.90 ± 0.14	0.24
30	Program monitoring and control	0	4	3.06	0.79	0.08	3.06 ± 0.15	0.26
31	Relationship with the client	0	4	3.08	0.90	0.09	3.08 ± 0.18	0.29
32	Relationship with the contractor	0	4	2.65	1.02	0.10	2.65 ± 0.20	0.38
33	Relationship with other consultants	0	4	2.52	1.11	0.11	2.52 ± 0.22	0.44
34	Achievement of objectives and targets	0	4	3.26	0.71	0.07	3.26 ± 0.14	0.22
35	Responding quickly to the request and instructions of client	0	4	3.03	0.81	0.08	3.03 ± 0.16	0.27
36	Problem solving/avoidance ability	0	4	3.32	0.79	0.08	3.32 ± 0.15	0.24
37	General management skills	0	4	2.93	0.69	0.07	2.93 ± 0.13	0.23
38	Quality management	0	4	3.09	0.79	0.08	3.09 ± 0.16	0.26
39	Safety management	0	4	3.02	0.86	0.09	3.02 ± 0.17	0.29
40	Environmental management	0	4	2.46	1.00	0.10	2.46 ± 0.20	0.41

Table 4.5: Consultants' Ranking of the Consultant Evaluation Criteria

Criteria No.	Criteria	Importance Index %	Rank
9	Quality of design	89.29	1
17	Recruitment, supervision and administration of site staff	87.86	2
19	Supervision of contractor	87.86	3
6	Compliance to client's requirements	85.71	4
14	Quality of bid documents (working drawings, BOQ. etc.)	85.00	5
1	Appreciation of background information	84.29	6
8	Identification of client's requirements and project objectives	84.29	7
12	Quality of drawings	84.29	8
7	Compliance to legislative requirements	83.57	9
18	Administration of contract	82.14	10
36	Problem solving/avoidance ability	81.43	11
13	Accuracy of cost estimate	80.71	12
25	Settlement of final account	80.71	13
34	Achievement of objectives and targets	80.00	14
35	Responding quickly to the request and instructions of client	79.29	15
31	Relationship with the client	78.57	16
15	Bid assessment (quality of bidding control)	77.86	17
30	Program monitoring and control	77.86	18
27	Adequacy of professional input of key personnel	77.14	19
21	Financial control of contract	77.14	20

Table 4.5: Consultants' Ranking of the Consultant Evaluation Criteria (Cont.)

Criteria No.	Criteria	Importance Index %	Rank
38	Quality management	77.14	21
39	Safety management	76.43	22
37	General management skills	75.71	23
29	Quality of program and progress report	75.71	24
28	Adequacy of schedule reporting	75.00	25
22	Quality of as-built drawings and records	74.29	26
20	Handling of claims	73.57	27
23	Maintenance inspection and drawing up list of defects	72.86	28
16	Quality of report on returned bids	72.14	29
5	Quality of study report	72.14	30
26	Input of key personnel in the project	72.14	31
4	Accuracy of early cost estimate	71.43	32
24	Settlement of claims	70.71	33
2	Quality of recommendation during study	69.29	34
11	Approach to cost-effectiveness	67.86	35
10	Availability of innovative and alternative solutions	65.71	36
32	Relationship with the contractor	65.71	37
33	Relationship with other consultants	65.00	38
3	Availability of innovative ideas	64.29	39
40	Environmental management	62.14	40

Table 4.6: Owners' Representatives Ranking of the Consultant Evaluation Criteria

Criteria No.	Criteria	Importance Index %	Rank
36	Problem solving/avoidance ability	89.17	1
1	Appreciation of background information	88.33	2
6	Compliance to client's requirements	88.33	3
17	Recruitment, supervision and administration of site staff	88.33	4
9	Quality of design	86.67	5
8	Identification of client's requirements and project objectives	85.83	6
14	Quality of bid documents (working drawings, BOQ. etc.)	85.83	7
19	Supervision of contractor	85.00	8
34	Achievement of objectives and targets	83.33	9
18	Administration of contract	81.67	10
12	Quality of drawings	81.67	11
23	Maintenance inspection and drawing up list of defects	80.83	12
4	Accuracy of early cost estimate	80.00	13
39	Safety management	79.17	14
38	Quality management	78.33	15
22	Quality of as-built drawings and records	78.33	16
13	Accuracy of cost estimate	77.50	17
30	Program monitoring and control	77.50	18
31	Relationship with the client	77.50	19
5	Quality of study report	76.67	20

Table 4.6: Owners' Representatives Ranking of the Consultant Evaluation Criteria (Cont.)

Criteria No.	Criteria	Importance Index %	Rank
35	Responding quickly to the request and instructions of client	75.83	21
27	Adequacy of professional input of key personnel	74.17	22
37	General management skills	73.33	23
28	Adequacy of schedule reporting	73.33	24
2	Quality of recommendation during study	73.33	25
29	Quality of program and progress report	72.73	26
15	Bid assessment (quality of bidding control)	72.50	27
32	Relationship with the contractor	71.67	28
25	Settlement of final account	71.67	29
16	Quality of report on returned bids	70.83	30
7	Compliance to legislative requirements	70.00	31
10	Availability of innovative and alternative solutions	68.33	32
24	Settlement of claims	67.50	33
21	Financial control of contract	67.50	34
20	Handling of claims	66.67	35
11	Approach to cost-effectiveness	66.67	36
33	Relationship with other consultants	62.50	37
40	Environmental management	60.83	38
26	Input of key personnel in the project	60.00	39
3	Availability of innovative ideas	51.02	40

Table 4.7: Contractors' Ranking of the Consultant Evaluation Criteria

Criteria No.	Criteria	Importance Index %	Rank
9	Quality of design	87.86	1
6	Compliance to client's requirements	86.43	2
14	Quality of bid documents (working drawings, BOQ. etc.)	86.43	3
12	Quality of drawings	84.29	4
19	Supervision of contractor	84.29	5
1	Appreciation of background information	82.14	6
17	Recruitment, supervision and administration of site staff	81.43	7
8	Identification of client's requirements and project objectives	81.43	8
34	Achievement of objectives and targets	81.43	9
36	Problem solving/avoidance ability	79.29	10
23	Maintenance inspection and drawing up list of defects	76.43	11
38	Quality management	76.43	12
22	Quality of as-built drawings and records	75.71	13
24	Settlement of claims	75.71	14
7	Compliance to legislative requirements	75.71	15
31	Relationship with the client	75.00	16
20	Handling of claims	75.00	17
18	Administration of contract	74.29	18
30	Program monitoring and control	74.29	19
2	Quality of recommendation during study	73.57	20

Table 4.7: Contractors' Ranking of the Consultant Evaluation Criteria (Cont.)

Criteria No.	Criteria	Importance Index %	Rank
5	Quality of study report	73.57	21
27	Adequacy of professional input of key personnel	73.57	22
26	Input of key personnel in the project	73.57	23
10	Availability of innovative and alternative solutions	72.86	24
13	Accuracy of cost estimate	72.86	25
28	Adequacy of schedule reporting	72.14	26
35	Responding quickly to the request and instructions of client	72.14	27
39	Safety management	71.43	28
37	General management skills	70.71	29
16	Quality of report on returned bids	70.71	30
15	Bid assessment (quality of bidding control)	70.00	31
29	Quality of program and progress report	69.29	32
4	Accuracy of early cost estimate	69.29	33
25	Settlement of final account	69.29	34
21	Financial control of contract	65.71	35
3	Availability of innovative ideas	63.57	36
11	Approach to cost-effectiveness	63.57	37
32	Relationship with the contractor	62.14	38
33	Relationship with other consultants	61.43	39
40	Environmental management	61.43	40

Table 4.8: Total Respondents' Ranking of the Consultant Evaluation Criteria

Criteria No.	Criteria	Importance Index %	Rank
9	Quality of design	88.00	1
6	Compliance to client's requirements	86.75	2
14	Quality of bid documents (working drawings, BOQ. etc.)	85.75	3
17	Recruitment, supervision and administration of site staff	85.75	4
19	Supervision of contractor	85.75	5
1	Appreciation of background information	84.75	6
8	Identification of client's requirements and project objectives	83.75	7
12	Quality of drawings	83.50	8
36	Problem solving/avoidance ability	83.00	9
34	Achievement of objectives and targets	81.50	10
18	Administration of contract	79.25	11
38	Quality management	77.25	12
13	Accuracy of cost estimate	77.00	13
31	Relationship with the client	77.00	14
7	Compliance to legislative requirements	76.75	15
23	Maintenance inspection and drawing up list of defects	76.50	16
30	Program monitoring and control	76.50	17
22	Quality of as-built drawings and records	76.00	18
35	Responding quickly to the request and instructions of client	75.75	19
39	Safety management	75.50	20

Table 4.8: Total Respondents' Ranking of the Consultant Evaluation Criteria (Cont.)

Criteria No.	Criteria	Importance Index %	Rank
27	Adequacy of professional input of key personnel	75.00	21
5	Quality of study report	74.00	22
25	Settlement of final account	74.00	23
15	Bid assessment (quality of bidding control)	73.50	24
28	Adequacy of schedule reporting	73.50	25
4	Accuracy of early cost estimate	73.25	26
37	General management skills	73.25	27
29	Quality of program and progress report	72.57	28
2	Quality of recommendation during study	72.00	29
20	Handling of claims	72.00	30
24	Settlement of claims	71.50	31
16	Quality of report on returned bids	71.25	32
21	Financial control of contract	70.25	33
10	Availability of innovative and alternative solutions	69.00	34
26	Input of key personnel in the project(using his experience and capabilities)	69.00	35
32	Relationship with the contractor	66.25	36
11	Approach to cost-effectiveness	66.00	37
33	Relationship with other consultants	63.00	38
40	Environmental management	61.50	39
3	Availability of innovative ideas	58.61	40

Table 4.9: Kendall's Coefficient Analysis between Consultants and Owners' Representatives Ranking

No.	Criteria	Cons. Rank	Owner Rank	Sum of Ranking	Mean R_i	R_i-R	Square of (R_i-R)	Rank
9	Quality of design	1	5	6	3	-17.50	306.25	1
6	Compliance to client's requirements	4	3	7	3.5	-17.00	289.00	2
14	Quality of bid documents (working drawings, BOQ. etc.)	5	7	12	6	-14.50	210.25	3
17	Recruitment, supervision and administration of site staff	2	4	6	3	-17.50	306.25	4
19	Supervision of contractor	3	8	11	5.5	-15.00	225.00	5
1	Appreciation of background information	6	2	8	4	-16.50	272.25	6
8	Identification of client's requirements and project objectives	7	6	13	6.5	-14.00	196.00	7
12	Quality of drawings	8	11	19	9.5	-11.00	121.00	8
36	Problem solving/avoidance ability	11	1	12	6	-14.50	210.25	9
34	Achievement of objectives and targets	14	9	23	11.5	-9.00	81.00	10
18	Administration of contract	10	10	20	10	-10.50	110.25	11
38	Quality management	21	15	36	18	-2.50	6.25	12
13	Accuracy of cost estimate	12	17	29	14.5	-6.00	36.00	13
31	Relationship with the client	16	19	35	17.5	-3.00	9.00	14
7	Compliance to legislative requirements	9	31	40	20	-0.50	0.25	15
23	Maintenance inspection and drawing up list of defects	28	12	40	20	-0.50	0.25	16
30	Program monitoring and control	18	18	36	18	-2.50	6.25	17
22	Quality of as-built drawings and records	26	16	42	21	0.50	0.25	18
35	Responding quickly to the request and instructions of client	15	21	36	18	-2.50	6.25	19
39	Safety management	22	14	36	18	-2.50	6.25	20

Table 4.9: Kendall's Coefficient Analysis between Consultants and Owners' Representatives Ranking (Cont.)

No.	Criteria	Cons. Rank	Owner Rank	Sum of Ranking	Mean R_i	R_i-R	Square of (R_i-R)	Rank
27	Adequacy of professional input of key personnel	19	22	41	20.5	0.00	0.00	21
5	Quality of study report	30	20	50	25	4.50	20.25	22
25	Settlement of final account	13	29	42	21	0.50	0.25	23
15	Bid assessment (quality of bidding control)	17	27	44	22	1.50	2.25	24
28	Adequacy of schedule reporting	25	24	49	24.5	4.00	16.00	25
4	Accuracy of early cost estimate	32	13	45	22.5	2.00	4.00	26
37	General management skills	23	23	46	23	2.50	6.25	27
29	Quality of program and progress report	24	26	50	25	4.50	20.25	28
2	Quality of recommendation during study	34	25	59	29.5	9.00	81.00	29
20	Handling of claims	27	35	62	31	10.50	110.25	30
24	Settlement of claims	33	33	66	33	12.50	156.25	31
16	Quality of report on returned bids	29	30	59	29.5	9.00	81.00	32
21	Financial control of contract	20	34	54	27	6.50	42.25	33
10	Availability of innovative and alternative solutions	36	32	68	34	13.50	182.25	34
26	Input of key personnel in the project(using his experience and capabilities(	31	39	70	35	14.50	210.25	35
32	Relationship with the contractor	37	28	65	32.5	12.00	144.00	36
11	Approach to cost-effectiveness	35	36	71	35.5	15.00	225.00	37
33	Relationship with other consultants	38	37	75	37.5	17.00	289.00	38
40	Environmental management	40	38	78	39	18.50	342.25	39
3	Availability of innovative ideas	39	40	79	39.5	19.00	361.00	40
Total					**820**		**4692**	

Table 4.10: Kendall's Coefficient Analysis between Consultants and Contractors Ranking

No.	Criteria	Cons. Rank	Cont. Rank	Sum of Ranking	Mean R_i	R_i-R	Square of (R_i-R)	Rank
9	Quality of design	1	1	2	1	-19.50	380.25	1
6	Compliance to client's requirements	4	2	6	3	-17.50	306.25	2
14	Quality of bid documents	5	3	8	4	-16.50	272.25	3
17	Recruitment, supervision and administration of site staff	2	7	9	4.5	-16.00	256.00	4
19	Supervision of contractor	3	5	8	4	-16.50	272.25	5
1	Appreciation of background information	6	6	12	6	-14.50	210.25	6
8	Identification of client's requirements and project objectives	7	8	15	7.5	-13.00	169.00	7
12	Quality of drawings	8	4	12	6	-14.50	210.25	8
36	Problem solving/avoidance ability	11	10	21	10.5	-10.00	100.00	9
34	Achievement of objectives and targets	14	9	23	11.5	-9.00	81.00	10
18	Administration of contract	10	18	28	14	-6.50	42.25	11
38	Quality management	21	12	33	16.5	-4.00	16.00	12
13	Accuracy of cost estimate	12	25	37	18.5	-2.00	4.00	13
31	Relationship with the client	16	16	32	16	-4.50	20.25	14
7	Compliance to legislative requirements	9	15	24	12	-8.50	72.25	15
23	Maintenance inspection and drawing up list of defects	28	11	39	19.5	-1.00	1.00	16
30	Program monitoring and control	18	19	37	18.5	-2.00	4.00	17
22	Quality of as-built drawings and records	26	13	39	19.5	-1.00	1.00	18
35	Responding quickly to the request and instructions of client	15	27	42	21	0.50	0.25	19
39	Safety management	22	28	50	25	4.50	20.25	20

Table 4.10: Kendall's Coefficient Analysis between Consultants and Contractors Ranking (Cont.)

No.	Criteria	Cons. Rank	Owner Rank	Sum of Ranking	Mean R_i	R_i-R	Square of (R_i-R)	Rank
27	Adequacy of professional input of key personnel	19	22	41	20.5	0.00	0.00	21
5	Quality of study report	30	21	51	25.5	5.00	25.00	22
25	Settlement of final account	13	34	47	23.5	3.00	9.00	23
15	Bid assessment (quality of bidding control)	17	31	48	24	3.50	12.25	24
28	Adequacy of schedule reporting	25	26	51	25.5	5.00	25.00	25
4	Accuracy of early cost estimate	32	33	65	32.5	12.00	144.00	26
37	General management skills	23	29	52	26	5.50	30.25	27
29	Quality of program and progress report	24	32	56	28	7.50	56.25	28
2	Quality of recommendation during study	34	20	54	27	6.50	42.25	29
20	Handling of claims	27	17	44	22	1.50	2.25	30
24	Settlement of claims	33	14	47	23.5	3.00	9.00	31
16	Quality of report on returned bids	29	30	59	29.5	9.00	81.00	32
21	Financial control of contract	20	35	55	27.5	7.00	49.00	33
10	Availability of innovative and alternative solutions	36	24	60	30	9.50	90.25	34
26	Input of key personnel in the project(using his experience and capabilities(	31	23	54	27	6.50	42.25	35
32	Relationship with the contractor	37	38	75	37.5	17.00	289.00	36
11	Approach to cost-effectiveness	35	37	72	36	15.50	240.25	37
33	Relationship with other consultants	38	39	77	38.5	18.00	324.00	38
40	Environmental management	40	40	80	40	19.50	380.25	39
3	Availability of innovative ideas	39	36	75	37.5	17.00	289.00	40
Total					**820**		**4579**	

Table 4.11: Kendall's Coefficient Analysis between Owners and Contractors Ranking

No.	Criteria	Cons. Rank	Owner Rank	Sum of Ranking	Mean R_i	R_i-R	Square of (R_i-R)	Rank
9	Quality of design	5	1	6	3	-17.50	306.25	1
6	Compliance to client's requirements	3	2	5	2.5	-18.00	324.00	2
14	Quality of bid documents	7	3	10	5	-15.50	240.25	3
17	Recruitment, supervision and administration of site staff	4	7	11	5.5	-15.00	225.00	4
19	Supervision of contractor	8	5	13	6.5	-14.00	196.00	5
1	Appreciation of background information	2	6	8	4	-16.50	272.25	6
8	Identification of client's requirements and project objectives	6	8	14	7	-13.50	182.25	7
12	Quality of drawings	11	4	15	7.5	-13.00	169.00	8
36	Problem solving/avoidance ability	1	10	11	5.5	-15.00	225.00	9
34	Achievement of objectives and targets	9	9	18	9	-11.50	132.25	10
18	Administration of contract	10	18	28	14	-6.50	42.25	11
38	Quality management	15	12	27	13.5	-7.00	49.00	12
13	Accuracy of cost estimate	17	25	42	21	0.50	0.25	13
31	Relationship with the client	19	16	35	17.5	-3.00	9.00	14
7	Compliance to legislative requirements	31	15	46	23	2.50	6.25	15
23	Maintenance inspection and drawing up list of defects	12	11	23	11.5	-9.00	81.00	16
30	Program monitoring and control	18	19	37	18.5	-2.00	4.00	17
22	Quality of as-built drawings and records	16	13	29	14.5	-6.00	36.00	18
35	Responding quickly to the request and instructions of client	21	27	48	24	3.50	12.25	19
39	Safety management	14	28	42	21	0.50	0.25	20

Table 4.11: Kendall's Coefficient Analysis between Owners and Contractors Ranking (Cont.)

No.	Criteria	Cons. Rank	Owner Rank	Sum of Ranking	Mean R_i	R_i-R	Square of (R_i-R)	Rank
27	Adequacy of professional input of key personnel	22	22	44	22	1.50	2.25	21
5	Quality of study report	20	21	41	20.5	0.00	0.00	22
25	Settlement of final account	29	34	63	31.5	11.00	121.00	23
15	Bid assessment (quality of bidding control)	27	31	58	29	8.50	72.25	24
28	Adequacy of schedule reporting	24	26	50	25	4.50	20.25	25
4	Accuracy of early cost estimate	13	33	46	23	2.50	6.25	26
37	General management skills	23	29	52	26	5.50	30.25	27
29	Quality of program and progress report	26	32	58	29	8.50	72.25	28
2	Quality of recommendation during study	25	20	45	22.5	2.00	4.00	29
20	Handling of claims	35	17	52	26	5.50	30.25	30
24	Settlement of claims	33	14	47	23.5	3.00	9.00	31
16	Quality of report on returned bids	30	30	60	30	9.50	90.25	32
21	Financial control of contract	34	35	69	34.5	14.00	196.00	33
10	Availability of innovative and alternative solutions	32	24	56	28	7.50	56.25	34
26	Input of key personnel in the project	39	23	62	31	10.50	110.25	35
32	Relationship with the contractor	28	38	66	33	12.50	156.25	36
11	Approach to cost-effectiveness	36	37	73	36.5	16.00	256.00	37
33	Relationship with other consultants	37	39	76	38	17.50	306.25	38
40	Environmental management	38	40	78	39	18.50	342.25	39
3	Availability of innovative ideas	40	36	76	38	17.50	306.25	40
Total					**820**		**4700**	

Table 4.12: Kendall's Coefficient Analysis among all Respondents

No.	Criteria	Cons. Rank	Owner Rank	Cont. Rank	Sum of Ranking	Mean R_i	R_i-R	Square of (R_i-R)	Rank
9	Quality of design	1	5	1	7	2.33	-18.17	330.03	1
6	Compliance to client's requirements	4	3	2	9	3.00	-17.50	306.25	2
14	Quality of bid documents (working drawings, BOQ. etc.)	5	7	3	15	5.00	-15.50	240.25	3
17	Recruitment, supervision and administration of site staff	2	4	7	13	4.33	-16.17	261.36	4
19	Supervision of contractor	3	8	5	16	5.33	-15.17	230.03	5
1	Appreciation of background information	6	2	6	14	4.67	-15.83	250.69	6
8	Identification of client's requirements and project objectives	7	6	8	21	7.00	-13.50	182.25	7
12	Quality of drawings	8	11	4	23	7.67	-12.83	164.69	8
36	Problem solving/avoidance ability	11	1	10	22	7.33	-13.17	173.36	9
34	Achievement of objectives and targets	14	9	9	32	10.67	-9.83	96.69	10
18	Administration of contract	10	10	18	38	12.67	-7.83	61.36	11
38	Quality management	21	15	12	48	16.00	-4.50	20.25	12
13	Accuracy of cost estimate	12	17	25	54	18.00	-2.50	6.25	13
31	Relationship with the client	16	19	16	51	17.00	-3.50	12.25	14
7	Compliance to legislative requirements	9	31	15	55	18.33	-2.17	4.69	15
23	Maintenance inspection and drawing up list of defects	28	12	11	51	17.00	-3.50	12.25	16
30	Program monitoring and control	18	18	19	55	18.33	-2.17	4.69	17
22	Quality of as-built drawings and records	26	16	13	55	18.33	-2.17	4.69	18
35	Responding quickly to the request and instructions of client	15	21	27	63	21.00	0.50	0.25	19
39	Safety management	22	14	28	64	21.33	0.83	0.69	20

Table 4.12: Kendall's Coefficient among all Respondents (Cont.)

No.	Criteria	Cons. Rank	Owner Rank	Cont. Rank	Sum of Ranking	Mean R_i	R_i-R	Square of (R_i-R)	Rank
27	Adequacy of professional input of key personnel	19	22	22	63	21.00	0.50	0.25	21
5	Quality of study report	30	20	21	71	23.67	3.17	10.03	22
25	Settlement of final account	13	29	34	76	25.33	4.83	23.36	23
15	Bid assessment (quality of bidding control)	17	27	31	75	25.00	4.50	20.25	24
28	Adequacy of schedule reporting	25	24	26	75	25.00	4.50	20.25	25
4	Accuracy of early cost estimate	32	13	33	78	26.00	5.50	30.25	26
37	General management skills	23	23	29	75	25.00	4.50	20.25	27
29	Quality of program and progress report	24	26	32	82	27.33	6.83	46.69	28
2	Quality of recommendation during study	34	25	20	79	26.33	5.83	34.03	29
20	Handling of claims	27	35	17	79	26.33	5.83	34.03	30
24	Settlement of claims	33	33	14	80	26.67	6.17	38.03	31
16	Quality of report on returned bids	29	30	30	89	29.67	9.17	84.03	32
21	Financial control of contract	20	34	35	89	29.67	9.17	84.03	33
10	Availability of innovative and alternative solutions	36	32	24	92	30.67	10.17	103.36	34
26	Input of key personnel in the project	31	39	23	93	31.00	10.50	110.25	35
32	Relationship with the contractor	37	28	38	103	34.33	13.83	191.36	36
11	Approach to cost-effectiveness	35	36	37	108	36.00	15.50	240.25	37
33	Relationship with other consultants	38	37	39	114	38.00	17.50	306.25	38
40	Environmental management	40	38	40	118	39.33	18.83	354.69	39
3	Availability of innovative ideas	39	40	36	115	38.33	17.83	318.03	40
Total						**820**		**4432.67**	

4.5 Comparison Between Saudi's and Joint venture's Engineers Responses

There are 19% of total respondents working in Saudi organizations and there are 19% of total respondents working in joint venture organizations. Statistical analysis was assessed to explore the differences between both groups' opinions. Ranking of evaluation criteria for Saudi and joint venture groups can be shown in Table 4.13 and Table 4.14 respectively.

According to the ranking of evaluation criteria by both groups, we can notice that there are differences between their opinions. The most important consultant performance evaluation criteria identified by Saudi's organizations respondents are listed below:

1. Quality of design
2. Recruitment, supervision and administration of site staff
3. Appreciation of background information
4. Compliance to client's requirements
5. Supervision of contractor

On the other hand, the most important consultant performance evaluation criteria identified by joint venture's organizations respondents are listed below:

1. Compliance to client's requirements
2. Quality of bid documents
3. Quality of design
4. Supervision of contractor
5. Safety management

Those differences may be come as the two organization types, Saudi and joint venture, are different in their skeleton and targets. Also, the mixture of joint venture organizations employee may has an important role in their opinions. There is a big difference between the two groups opinion about (Safety management) criterion. The joint venture's respondents evaluated it as the fifth important evaluation criteria while the Saudi's organizations' respondents evaluated it as the twenty fifth criterions.

Table 4.13: Saudi Organizations Respondents' Ranking of the Consultant Evaluation Criteria

Criteria No.	Criteria	Importance Index %	Rank
9	Quality of design	88.27	1
17	Recruitment ,supervision and administration of site staff	87.35	2
1	Appreciation of background information	86.42	3
6	Compliance to client's requirements	85.80	4
19	Supervision of contractor	85.49	5
14	Quality of bid documents (working drawings, BOQ. etc.)	84.88	6
36	Problem solving/avoidance ability	84.57	7
8	Identification of client's requirements and project objectives	84.26	8
12	Quality of drawings	83.64	9
34	Achievement of objectives and targets	81.17	10
18	Administration of contract	78.70	11
13	Accuracy of cost estimate	77.47	12
38	Quality management	77.47	13
7	Compliance to legislative requirements	76.85	14
23	Maintenance inspection and drawing up list of defects	76.85	15
30	Program monitoring and control	76.54	16
22	Quality of as-built drawings and records	76.54	17
31	Relationship with the client	75.93	18
27	Adequacy of professional input of key personnel	75.00	19
25	Settlement of final account	74.38	20

Table 4.13: Saudi Organizations Respondents' Ranking of the Consultant Evaluation Criteria (Cont.)

Criteria No.	Criteria	Importance Index %	Rank
35	Responding quickly to the request and instructions of client7	74.38	21
5	Quality of study report	73.77	22
15	Bid assessment (quality of bidding control)	73.77	23
37	General management skills	73.77	24
39	Safety management	73.46	25
4	Accuracy of early cost estimate	73.15	26
28	Adequacy of schedule reporting	73.15	27
29	Quality of program and progress report	72.92	28
2	Quality of recommendation during study	72.84	29
16	Quality of report on returned bids	71.30	30
21	Financial control of contract	70.99	31
24	Settlement of claims	70.68	32
20	Handling of claims	70.37	33
10	Availability of innovative and alternative solutions	70.37	34
26	Input of key personnel in the project	69.14	35
32	Relationship with the contractor	65.74	36
11	Approach to cost-effectiveness	65.12	37
33	Relationship with other consultants	63.27	38
40	Environmental management	59.26	39
3	Availability of innovative ideas	58.50	40

Table 4.14: Joint venture Organizations Respondents' Ranking of the Consultant Evaluation Criteria

Criteria No.	Criteria	Importance Index %	Rank
6	Compliance to client's requirements	90.79	1
14	Quality of bid documents (working drawings, BOQ. etc.)	89.47	2
9	Quality of design	86.84	3
19	Supervision of contractor	86.84	4
39	Safety management	84.21	5
34	Achievement of objectives and targets	82.89	6
12	Quality of drawings	82.89	7
35	Responding quickly to the request and instructions of client7	81.58	8
18	Administration of contract	81.58	9
8	Identification of client's requirements and project objectives	81.58	10
31	Relationship with the client	81.58	11
20	Handling of claims	78.95	12
17	Recruitment ,supervision and administration of site staff	78.95	13
1	Appreciation of background information	77.63	14
36	Problem solving/avoidance ability	76.32	15
7	Compliance to legislative requirements	76.32	16
30	Program monitoring and control	76.32	17
38	Quality management	76.32	18
13	Accuracy of cost estimate	75.00	19
24	Settlement of claims	75.00	20

Table 4.14: Joint venture organizations Respondents' Ranking of the Consultant Evaluation Criteria (Cont.)

Criteria No.	Criteria	Importance Index %	Rank
5	Quality of study report	75.00	21
27	Adequacy of professional input of key personnel	75.00	22
23	Maintenance inspection and drawing up list of defects	75.00	23
28	Adequacy of schedule reporting	75.00	24
4	Accuracy of early cost estimate	73.68	25
22	Quality of as-built drawings and records	73.68	26
25	Settlement of final account	72.37	27
15	Bid assessment (quality of bidding control)	72.37	28
40	Environmental management	71.05	29
16	Quality of report on returned bids	71.05	30
37	General management skills	71.05	31
29	Quality of program and progress report	71.05	32
11	Approach to cost-effectiveness	69.74	33
32	Relationship with the contractor	68.42	34
26	Input of key personnel in the project	68.42	35
2	Quality of recommendation during study	68.42	36
21	Financial control of contract	67.11	37
10	Availability of innovative and alternative solutions	63.16	38
33	Relationship with other consultants	61.84	39
3	Availability of innovative ideas	59.21	40

4.6 Comparison with Previous Study done in Hong Kong

Thomas and Lai-Kit (2004) had finished the same study of evaluation of consultant performance in Hong Kong. They had only two groups of respondents (Consultants and Clients). A comparison between results of performance criteria importance which were conducted from both studies can be shown from Table (4.15) through Table (4.17)

4.6.1 Comparison between Both Consultants' Perspectives

Ranking of the most important criteria can used for consultant performance evaluation identified by consultants in both studies is shown in Table (4.15).

Table 4.15: Consultants' Ranking of both Studies

Rank	Recent Study in Saudi Arabia	Previous Study in Hong Kong
1	9. Quality of design	34. Achievement of objectives and targets
2	17. Recruitment, supervision and administration of site staff	6. Compliance to client's requirements
3	19. Supervision of contractor	7. Compliance to legislative requirements
4	6. Compliance to client's requirements	8. Identification of clients' requirements and project objectives
5	14. Quality of bid documents	14. Quality of bid documents

4.6.2 Comparison between Both Owners Representatives' Perspectives

Ranking of the most important criteria can used for consultant performance evaluation identified by owners' representatives (clients) in both studies is shown in Table (4.16).

Table 4.16: Owners' Representatives Ranking of both Studies

Rank	Recent Study in Saudi Arabia	Previous Study in Hong Kong
1	36. Problem solving/avoidance ability	34. Achievement of objectives and targets
2	1. Appreciation of background information	14. Quality of bid documents
3	6. Compliance to client's requirements	6. Compliance to client's requirements
4	17. Recruitment, supervision and administration of site staff	7. Compliance to legislative requirements
5	9. Quality of design	8. Identification of clients' requirements and project objectives

4.6.3 Comparison between Overall Respondents' Perspectives

Ranking of the most important criteria can used for consultant performance evaluation identified by overall respondents' perspectives in both studies is shown in Table (4.17).

Table 4.17: Overall Respondents' Ranking of both Studies

Rank	Recent Study in Saudi Arabia	Previous Study in Hong Kong
1	9. Quality of design	34. Achievement of objectives and targets
2	6. Compliance to client's requirements	6. Compliance to client's requirements
3	14. Quality of bid documents	14. Quality of bid documents
4	17. Recruitment, supervision and administration of site staff	7. Compliance to legislative requirements
5	19. Supervision of contractor	8. Identification of clients' requirements and project objectives

There are big differences between both study respondents' opinions about the importance of consultant evaluation criteria. Those differences may represent the actual difference between the construction industry issues in both study regions. However, there are some agreement between both groups about importance of some criteria like *Compliance to client's requirements* and *Quality of bid documents*.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter includes the summary of the whole thesis, conclusions drawn from the research results, suggested recommendations, and with recommendations for further studies.

5.2 SUMMARY OF THE STUDY

The evaluation of consultant's performance is crucial to the success of a consulting assignment especially when today's construction projects are becoming more sophisticated, large-scale, and risky. However, since individual clients have developed their own consultant's performance evaluation (CPE) procedures, the sharing of performance information, though desirable, may not be too meaningful, as the results of the evaluation could be inconsistent *(Thomas and Lai-Kit, 2004).*

The main objective of this research was to identify the main criteria used to evaluate the engineering consultant performance in the Saudi Arabian construction process, and to determine the importance of each criterion on the engineering consultant performance evaluation.

The first chapter of this research gives a general background about the construction consultant performance and how we can evaluate it. It also reviews the

previous studies conducted and various criteria used for a performance evaluation. It includes statement of the problem, the research objectives, significance of the study, and the scope and limitation of the study. This study is limited to all building projects built in the Eastern Province of Saudi Arabia and that have a value of 10 million Saudi Riyals or above. The contractors selected will be large Construction Contractors (Grade 1, 2 or 3) as classified by Ministry of Municipalities and Rural Affairs (MOMRA). The consultants selected will be reputable with have past experience of more than 10 years in the Saudi Arabian construction field.

The second chapter of this research gives detailed information about the criteria used to measure the construction consultant performance and the most important criteria used worldwide for consultant performance evaluation. A list of forty criteria was developed and arranged into six main categories which expressed the consultant performance to be evaluated.

The third chapter discusses the research methodology, and the different methods used to gather the required data. A pilot study including six construction experts was conducted to develop the survey questionnaire. An adopted revision of the questionnaire was made, and an Arabic copy of the questionnaire was created to explain the idea of the research and to obtain the data required for valuable results.

The fourth chapter explains the general information about survey respondents and their organization. It also includes the statistical method, used to analyze data, the detailed data analysis calculations, the statistical results, a comparison between the

recent study and the previous study done in Honk Kong, a discussion of the results, and all tables obtained from the data analysis.

This fifth chapter contains the summary of the research, conclusions, research recommendations, and recommendations for further studies.

5.3 CONCLUSIONS

There is a high agreement between all professionals who participated in this research survey with the importance of the criteria identified. However, there are some differences in their opinion about some criteria. On the other hand, a comparison was assessed between recent study and a previous study done in Hong Kong by *(Thomas and Lai-Kit, 2004)*. The results of this comparison showed that there are big differences between participated respondents in their opinions about the importance of consultant evaluation criteria.

Based on the data analysis and the results of this research, the following conclusions are selected and summarized:

1. According to consultants' perspective, the arrangement of project stages as per their weighted importance is:

- Construction stage
- Design stage
- Bidding stage
- Post construction stage
- Feasibility stage

2. According to owners' representatives' perspective, the arrangement of project stages as per their weighted importance is:

- Design stage
- Construction stage
- Bidding stage
- Post construction stage
- Feasibility stage

3. According to contractors' perspective, the arrangement of project stages as per their weighted importance is:

- Design stage
- Construction stage
- Bidding stage
- Post construction stage
- Feasibility stage

4. According to overall respondents' perspective, the arrangement of project stages as per their weighted importance is:

- Design stage
- Construction stage
- Bidding stage
- Post construction stage
- Feasibility stage

5. The five most important consultant performance evaluation criteria identified by all respondents (Consultants, Owners, and Contractors) were:

- Quality of design (Design Stage).
- Compliance to client's requirements (Design Stage).
- Quality of bid documents (working drawings, BOQ. etc.) (Bidding Stage).
- Recruitment, supervision and administration of site staff (Construction Stage).
- Supervision of contractor (Construction Stage).

6. The five most important consultant performance evaluation criteria identified by consultants were:

- Quality of design (Design Stage).
- Recruitment, supervision and administration of site staff (Construction Stage).
- Supervision of contractor (Construction Stage).
- Compliance to client's requirements (Design Stage).
- Quality of bid documents (working drawings, BOQ. etc.)(Bidding Stage).

7. The five most important consultant performance evaluation criteria identified by owners were:

- Problem solving/avoidance ability (Other Consultant Capabilities).
- Appreciation of background information (Feasibility Stage).
- Compliance to client's requirements (Design Stage).

- Recruitment, supervision and administration of site staff (Construction Stage).
- Quality of design (Design Stage).

8. The five most important consultant performance evaluation criteria identified by contractors were:

- Quality of design (Design Stage).
- Compliance to client's requirements (Design Stage).
- Quality of bid documents (Bidding Stage).
- Quality of drawings (Design Stage).
- Supervision of contractor (Construction Stage).

9. The five least important consultant performance evaluation criteria identified by all respondents (Consultants, Owners, and Contractors) were:

- Availability of innovative ideas (Feasibility Stage)
- Environmental management (Other Consultant Capabilities)
- Relationship with other consultants (Consultant Relationship)
- Approach to cost-effectiveness (Design Stage)
- Relationship with the contractor (Consultant Relationship)

5.4 RECOMMENDATIOS

As a result of this research survey, the following recommendations are set to help construction parties evaluate the consultant performance and to improve it in reference to the various project stages:

1. Consultant characteristics have to be studied carefully from the owners' side before awarding a contract and starting the project stages.
2. As Quality of Design is the most important consultant performance evaluation criteria, consultants should improve their capabilities in design and its quality issues.
3. Before project construction, careful and proper review of project design by all parties in the construction industry can improve overall consultant performance.
4. Consultants need to carefully consider their clients' requirements when they design the project to ensure that it meets their requirements and objectives.
5. Training courses are very important issues to improve the consultant performance.
6. Responsibilities of the consultant should be clearly understood by owners and other parties during all project stage.
7. Consultancy organization should invest in development, training, and acquire requirements needed for design improvement and quality supervision.

5.5 RECOMMENDATIOS FOR FURTHER STUDIES

The following areas are recommended for further studies based on the results of this study:

1. Further studies could be conducted on the methods required to improve overall consultant performance.
2. The detailed evaluation of consultant performance during project design and construction stages.
3. As the scope of this study is limited to large construction building projects in the Eastern Province of Saudi Arabia, it is therefore recommended to make similar studies in other construction project types and in different regions of Saudi Arabia.
4. Researches can be carried out on different consultancy issues, construction management, and different project performance types.

5.6 References

ADB Guidelines on the use of consultants by Asian Development Bank and its borrowers. (1998).

AIA. (1997). "The Architect's Handbook of Professional Practice." Volume 1, American Institute of Architects.

Al-Basher, Mubarak Faraz Saeed (1998). "A Conceptual Model for Consultant Selection in Saudi Arabia." MSc dissertation, King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia.

Al-Juwairah, Y. (1997). "Factors Affecting Construction Cost in Saudi Arabia." MSc dissertation, King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia.

AL-Musallami, Ahmed Ismail (1992). "Owner Satisfaction with Consultancy Practices in Saudi Arabia." MSc dissertation, King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia.

Chang, Andrew, and Ibbs, C. William (1999). "Designing Levels for A/E Consultant Performance Measures." Project Management Journal, 30(4), 42-54.

ASCE. (1995). "Consulting engineering: A guide for the Engagement of Engineering services." ASCE Manuals and Reports on Engineering Practice No. 45, New York.

Cooper, D.R. and Emory, C.W. (1995). “Business Research Methods.” Fifth edition, Irwin, Inc., Chicago.

Department of Public Works and Services (DPWS). (1996). “Code of Tendering for the construction Industry.” New South Wales, Australia.

Department of Public Works and Services (DPWS). (2000). “Guidelines of Consultant Performance Reporting and Exchange of Reports between Government Agencies.” New South Wales, Australia.

FIDIC, (2001). “GUIDELINES FOR THE EVALUATION OF CONSULTANTS PERFORMANCE.”.

Garold, D. Oberlender, (2000). “Project Management for Engineering and Construction.” McGraw-Hill, Inc., New York.

Garret Lee s. (1985). “Quality in Planning & Design: Meeting the owner's objectives.” Proceedings of a workshop sponsored by ASCE. Edited by: Arther J. Fox, Jr.

Georgia Department of Transportation (GDOT). (2002). “Consultant performance evaluation form.” DOT-OCD100, Atlanta.

Hank, J., Reitsch, A., and Dickson, J. (1984). "Statistical Decision for Management." Allyn and Bacon, Inc., Boston.

Hicks, Tyler G. and Mueller, Jerome F. (1996). "Standard Handbook of Consulting Engineering Practice." McGraw-Hill, Inc., New York.

Jones J. P., and AL-Musallami, A. I. (1988). "Psychological Survey into Engineers Motive Towards The Choice of Structural Systems For Low Rise Residential Projects In The Kingdom." Part of a KACST project ref. No. 13.

Kish, L. (1995). "Survey Sampling." John Wiley and Sons Inc., New York.

Laufer, A., and Borcherding, J. D. (1981). "Financial incentives to raise productivity." Journal of Construction Division, ASCE, 107(4), 745-755.

Ling , Y. Y. (2000). "A theoretical framework for selection of consultant by design-build contractors." Journal of Construction Procurement, 6(2), 147-163.

Ling, Y. Y., Ofori, G., and Low, S. P. (2000). "Importance of design consultants' soft skills in design-build projects, Eng." Engineering Construction Architecture Management, 7(4) 389–398.

Ling, Y. Y. (2003). "A conceptual model for selection of architects by project managers in Singapores." International Journal Project Management, 21(2), 135–144.

Maloney, W. F., (1990). "Framework for analysis of performance." Journal of Construction Engineering and Management, ASCE, 116(3), 399-415.

Maloney, W. F., and McFillen, J. M. (1983). "Research needs in construction worker performance." Journal of Construction Engineering and Management, ASCE, 109(2), 245-254.

Maloney, W. F., and McFillen, J. M. (1986). "Motivation in unionized construction." Journal of Construction Engineering and Management, ASCE, 112(1), 122-136.

Maxwell, C. Stanley (1982). "The Consulting Engineer." John Wiley and Sons, Inc., New York.

Medallah K. Y., Fakhry, Abu Ella, Numan M. Y., J. P. Jones, and AL-Musallami A. I. (1989). "A study of one of the building systems currently in extensive use in Saudi Arabia." A KACST project No. API/ 24.

New York State Department of Transportation (NYSDOT). (2003). "MURK Part 1D." Construction consultant manual.

Ofori, George. (2001). "Indicators For Measuring Construction Industry Development In Developing Countries." Building Research And Information, 29(1), 40-50.

Porter, L.W., and Lawler E. E. (1968). “Managerial attitudes and performance.” Lrwin-Dorsey, Homeward, III.

Pszenicki, M. (1980). Discussion: Finance & the Client." proceedings of a conference sponsored by RIBA. "Construction Projects Their Financial Policy and Control" Edited by RA Burgess.

Refaat, H. Abdel-Razek (1997). “How Construction Managers Would Like Their Performance to Be Evaluated.” Journal of Construction Engineering and Management, ASCE, 123(3), 208-213.

Schiff, P. and Ralph B.D. (1996). “Practical Engineering Statistics” John Wiley and Sons, Canada.

Schwab, D. P., and Cummings, L. L. (1970). “Theories of Performance and Satisfaction” Industrial Relations, 9(4), 26-29.

Shafuddin, Mohammad, (2004). “FACTORS AFFECTING THE DEVELOPMENT OF ENGINEERING CONSULTING FIRMS” MSc dissertation, King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia.

Thomas, S. Ng, and Lai-Kit, Chow (2004). “Framework for Evaluating the Performance of Engineering Consultants.” Journal of Professional Issues in Engineering Education and Practice, 130(4), 280-288.

Thondike, R. M. (1978). “Correlation Procedures for Research.” Gardner Press, Inc., New York.

Vroom, V. H. (1964). “Work and motivation.” John Wiley and Sons, Inc., New York.