TQM AND THE CONSTRUCTION INDUSTRY

(SAUDI ARABIA - A CASE STUDY)

by

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DEDICATION

To those who love me for myself

To those who wish me to be better than them

To those who see me as their continuity

Those are:

My mother for her continuous moral support

My father for everything that words cannot express

With my sincere love for both of them.

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LIST OF ACRONYMS

1. AAQC: Administrative Area Quality Council
2. A/E: Architecture/Engineer
3. ASCE: American Society for Civil Engineers
4. ASQ: American Society for Quality
5. BLQC: Business Line Quality Council
6. BSC: Balanced Score Card
7. BSI: British Standards Institute
8. BPR: Business Process Re-engineering
9. CEO: Chief Executive Officer
10. CII: Construction Industry Institute
11. DQC: Department Quality Council
12. GCC: Gulf Cooperation Council
13. GDP: Gross Domestic Product
14. IPA: Independent Project Analysis
15. ISO International Standards Organization
16. MBO: Management By Objectives
17. OJI: On- Job-Implementation
18. PDCA: Plan- Do- Check- Act
19. QA: Quality Assurance
20. QC: Quality Control
21. QIT: Quality Improvement Team
22. QM: Quality Management
23. SAMA: Saudi Arabian Monetary Agency
24. SPC: Statistical Process Control
25. SR: Saudi Riyal
26. TQM: Total Quality Management
27. UAECA: United Arab Emirates Contractor's Association

ABSTRACT

The objective of this thesis is to investigate Total Quality Management (TQM) as a means of making the Saudi construction industry more efficient. The thesis also examines the effect of TQM on industry in general. Although TQM is a management concept that has been implemented in many industries effectively and with encouraging results, adopting TQM in the construction industry is more challenging due to its unique characteristics.

The research has examined the compliance of the Saudi contractors and design offices with the principles of TQM qualitatively through personal interviews, and quantitatively through a mailing questionnaire. The objective of this part of the thesis is to determine the levels of industry compliance with the principles of TQM, and to detect the potential obstacles to compliance.

In addition, this thesis has examined the effectiveness of TQM implementation in the Saudi construction industry. A case study of TQM implementation in one of the largest project owners (client) in Saudi Arabia has been reported and analysed. In addition, the findings of interviews with contracting companies, to determine the effectiveness of TQM as a solution to the problems of the Saudi construction industry, have been reported and discussed. Furthermore, practical TQM implementation experience in a small construction firm has been reported to augment the findings of other sources, namely the personal interviews and the questionnaire.

The interviews with the contractors identified the major problems of the Saudi construction industry, which have been reported in this research. These problems have been further investigated in order to determine their significance through the mailing of a questionnaire.

The results of the questionnaire have been reported and analysed in this study. The thesis has discussed those problems that have been identified statistically as significant (major) problems, and proposed solutions to them.

CHAPTER-1

INTRODUCTION

1.1 General

The construction industry is characterized by being a highly fragmented and extremely competitive business. The contractual arrangement of the construction industry creates a large number of problems. The four major participants - owner, contractor, Architect/Engineer (A/E), and supplier - have different and conflicting interests and priorities. Total Quality Management (TQM) can help to bring all the parties involved in the construction industry closer to meeting their expectations. Also, it can help to reduce adversarial relations and increased litigations (Chase, 1993).

The British Standards (BS4778-2:1991) defines TQM as:

> *A management philosophy embracing all activities through which the needs and expectations of the customer and the community and the objectives of the organization are satisfied in the most efficient and cost effective way by maximizing the potential of all employees in a continuing drive for improvement.*

However, the construction industry differs from the manufacturing industry where TQM has proven its effectiveness, in a way that makes the introduction of TQM more challenging. While the manufacturing industry is characterized by a steady-state process, the construction industry is a one-time process. The construction industry is unique for the following factors: (1) the mobility of labour, (2) diversity in the types, forms and shapes of construction projects, (3) geographical dispersion, (4) the contractual relationships, (5) the susceptibility to weather, and (6) the fact that almost every job is a prototype (Hadavi and Krizek, 1994; and Ashford, 1989).

1.2 Statement of the Problem

The conventional objective of any project management programme is to complete a project on time and within the budget, but this is not the case in Saudi Arabia. Most projects in Saudi Arabia experience delay and budget overrun. Assaf (1995) discussed the causes of delay in large building construction projects. The most important factors in causing delays according to owners were design errors, excessive bureaucracy in project-owner organizations, labour shortages and inadequate labour skills. It is obvious that these factors would not arise if there were sufficient quality in general. Also, Al-Barrak (1993) has identified some of the Saudi contractors' problems (see section 2.10).

The depression of 1983/1984 revealed how fragile the construction industry in Saudi Arabia is. Many contractors went out of business and could not survive the depression of 1983/1984.

Nesan and Holt (1999) indicated that the participants in the construction industry tend to be reactive to changes being imposed on them such as economic, political, and technological pressures, which results in poor performance in the industry. Love *et al* (1998) proposed that TQM can make the organization cope with the change as the norm, rather than being reactive to such pressures of change.

Love *et al* (2000b) suggest that the construction industry problems will remain until all participants in the construction take their responsibility for initiating changes within their own organization. Love *et al* indicated that such change can be initiated through the effective implementation of TQM.

Introducing the Total Quality Management concept into the Saudi construction industry might be a step in the right direction to improve the situation of the Saudi construction

industry and resolve its problems. However, some of the construction problems such as fluctuation of demand (non-steady state) create difficulties in TQM implementation and TQM could only help the organization to cope with such fluctuations. In other words, while TQM could be a solution for the construction industry problems, some of the construction industry problems are themselves obstacles for TQM implementation. In fact, the problems of the construction industry can be classified into internal and external problems. Generally, an organization is in a position to deal with and resolve internal problems since they are related to the business processes of the organisation and management. For example, a construction firm with a high rate of project re-work due to poor workmanship should be able to improve the situation and resolve such a problem. On the other hand, the resolution of external problems is a more challenging task, and in most cases the industry has no control over such difficulties. The possible negative impact of labour laws and taxes, for example, are two of the external problems facing the industry. At the same time, many such external challenges could be resolved through direct Government involvement.

Throughout this research the TQM concept will be considered through its principles (see section 2.3 TQM elements) because it is not necessary that an organization complying with TQM elements designates itself as a TQM organization.

1.3 Significance of the Study

The construction industry plays an important role in the Saudi economy. The construction sector represents around 6% of the Saudi Gross Domestic Product (GDP) in 2001 and employs around 9 % of the total number of civilian workers in Saudi Arabia. However, the Saudi construction industry suffers many problems and faces many challenges.

The amount of research and studies that address the Saudi construction industry are limited and are not proportionate to such an important and major sector of the economy. One of the major sources of what can be considered as quality studies are the master theses of the Construction Engineering and Management Programme at the King Fahd University of Petroleum and Minerals. However, these studies generally address a particular phenomenon (problem) and try to identify it and provide a solution that will not impact the industry or improve it. Also, these researchers avoid addressing sometimes real problems especially if the solution to the problem might be interpreted as a criticism of the political regime. Furthermore, these studies provide fragmented solutions to discrete problems where the suggested solutions might conflict with each other. In Saudi Arabia, there is no public body or agency that is responsible to study and monitor the construction industry. In many cases, the suggested solutions do not suit or take into account the uniqueness of the business environment of Saudi Arabia. Most of the studies address the internal problems of the industry rather than external factors such as regulations. The reason for this might be the perception that external factors cannot be challenged or improved. This study revealed that, sometimes, in order to improve the industry priority should be given to the external factors rather than internal factors.

In order to improve the construction industry and find solutions for its problems, this study could provide a basis for any serious attempt to improve the Saudi construction industry for the benefit of the industry and the local economy in general. Also, the results of this study could be extended to other countries where the business environment is similar to the one in Saudi Arabia such as Gulf Cooperation Countries (GCC) (Bahrain, Kuwait, Qatar, United Arab Emirates and Oman).

This study could help the other researchers to change their approach in addressing the Saudi construction industry and trigger important areas where it could be further studied for the benefit of the industry.

Although this study addresses the construction industry, the owner and the suppliers have been excluded from the scope of this research. A case study of one owner organization has been studied and reported in this research; however, the survey for the size of TQM awareness was limited to the contractors and the design offices. Also, the identified problems of the Saudi construction industry have been determined based on the contractor's perspective only.

The reason for these limitations is to focus the study on one specific direction, especially that the scope of the topic is broad and any attempt to cover all dimensions would lead to a scope beyond this study. Furthermore, the contractor plays the major role in the construction industry and has more effect in comparison with the other three participants of the industry: owner, design office, and supplier. Stating this shall not undermine the importance of the other participants: owner, design office, and supplier. Future researches could address the same scope of this research from others' perspectives.

1.4 Research Dimension

The hypothesis for this research states:" *Introducing the TQM concept, with its aspect of totality, in the Saudi construction industry is a step in the right direction to improve the situation and solve the problems of the Saudi construction industry*".

The objective of this research is to explore the above stated hypothesis. In fact, the intention of stating the above hypothesis is to provide the assumption upon which this research was developed.

The research will attempt to answer the following questions:

1. How popular is TQM in the Saudi construction industry?
2. What are the obstacles for TQM implementation?
3. Is TQM effective in improving the Saudi construction industry?
4. What are the major problems of the Saudi construction industry?
5. What are the possible solutions for the major Saudi construction industry problems?

1.5 Objectives of the Study

The main objectives of this research are to:

1. identify the size of TQM awareness in the Saudi construction industry;
2. identify and analyze the difficulties of introducing TQM in the Saudi construction industry;
3. determine the effectiveness of TQM as a solution for Saudi construction industry problems;
4. identify the major problems of the Saudi construction industry;
5. provide solutions for the major problems of the Saudi construction industry.

By achieving the above research objectives, the research questions stated above (Section 1.4) will be answered.

1.6 Thesis Organization

The thesis is divided into seven chapters. Background, statement of the problem, significance of the study and objectives of the study are introduced and discussed in Chapter One. Literature related to the concept of TQM, TQM and the construction industry and the construction industry in Saudi Arabia are reviewed in Chapter Two. Survey methodology forming the basis of the research techniques, questionnaire design,

and data collection and analysis are found in Chapter Three. The findings of personal interviews with contractors and design offices related to TQM awareness and the difficulties of TQM implementation in the Saudi construction industry are presented, analyzed, and discussed in Chapter Four. Chapter Five provides the results of the questionnaire that was sent to validate the findings of the personal interviews with the contractors and design offices. Chapter Five also presents the analysis for the reported results. Chapter Six provides the feedback of TQM effectiveness from a case study of TQM implementation in one of the largest project owners in Saudi Arabia and contractors who have made a quality management system implementation attempts and a practical TQM implementation experiment in a small firm is reported. Chapter Six also reports the major problems of the Saudi construction industry as they are identified by a number of contractors. In addition, Chapter Six discusses the problems of the Saudi construction industry and proposes possible solutions for these problems. Finally, Chapter Seven contains the conclusion and recommendations.

CHAPTER-2

LITERATURE REVIEW

2.1 Overview

The literature review focuses upon recent definitions of TQM and the useful distinction to be made between TQM, Quality Assurance (QA) and Quality Control (QC). This is followed by a discussion of the various elements, which are typical (in one combination or another), of TQM implementation. The benefits of implementing TQM are discussed alongside the very real issue of obstacles to implementation. Implementation cost is also looked at prior to a discussion of TQM measurement.

Finally, the literature review focuses upon TQM and the construction industry in particular which brings us to an overview of TQM in Saudi Arabia and the present state of affairs.

As will be demonstrated later in the thesis, the literature review also serves as a fundamental backdrop to the research methodology incorporated into the thesis itself.

2.2 The Concept of Total Quality Management (TQM): Towards A Definition

In 1980s and 1990s, the world witnessed what could be called a "quality revolution" due to the globalization of the marketplace and increased competition. As a result, Total Quality Management (TQM) became one of the dominant managerial themes in the 1990s. The successful experience of the manufacturing sector within both Japan and the United States in implementing TQM in the 1980s encouraged other nations, as well as other sectors, to adopt the approach. Indeed, the widespread interest in adopting TQM has spread beyond profit-oriented organizations into public services organizations.

The British Standards (BS4778) defines TQM as:

> *A management philosophy embracing all activities through which the needs and expectations of the customer and the community and the objectives of the organization are satisfied in the most efficient and cost effective way by maximizing the potential of all employees in a continuing drive for improvement.*

The BS 4778 definition for TQM is a comprehensive and inclusive definition for TQM. The key word in this definition is that TQM is a *philosophy.*

The American Society for Quality (ASQ) defines TQM as:

> *The management approach of an organization centered on quality , based on the participation of all of its members and aiming at long-term success through customer satisfaction and benefits to all members of the organization and to society* (http://www.asq.org/inf/faq/).

The key word in this definition is that TQM is *approach.*

On the other hand, Integrated Quality Dynamics, Inc, a consultant firm, defines TQM as:

> *A structured system for satisfying internal and external customers and suppliers by integrating the business environment, continuous improvement and breakthroughs with development , improvement, and maintenance cycles while changing organizational culture* (http://www.iqd.com/hoshin-def.thm).

This definition considers TQM as a *structured system.*

From the review of various definitions of TQM, it seems that academics and quality gurus perceive TQM to be a philosophy or concept; while consultants and practitioners prefer to think of TQM as a structure or system. Perceiving TQM as a philosophy or concept liberates TQM from constraints. On the other hand, perceiving TQM as a structure or system could push TQM away from one of its main essences, which is continuous improvement and adaptability to change.

At the same time, it is necessary to translate TQM as a philosophy or concept into a set of actions in a form of structure or system in order to implement it. Therefore, it can be said that TQM is a *philosophy by definition and structure by implementation.* It is important, therefore, to have a reciprocal interaction between TQM as a philosophy and its structure or system.

Aims of TQM

The aims of TQM are to achieve customer satisfaction, cost effectiveness, and defect-free work. The customer will be satisfied only if the product has a very low rate of defect (literally none) and is competitive in price with offerings from other suppliers. TQM achieves customer satisfaction through focusing on process improvement, customer and supplier involvement, teamwork, training, and education.

TQM is a culture advocating a total commitment to customer satisfaction, through continuous improvement and innovation in all aspects of the business. The customer, in the TQM culture, does not mean only the final recipient of the organization's end product or services. The "customer" is also every individual or department stakeholder within the organization (Logothetis, 1992, Oakland, 2000).

TQM can be viewed as a new way of thinking about organizational theory and a new approach to management. Adopting TQM as the guiding philosophy of an organization gives that organization a better chance of surviving and, further, flourishing in the present competitive market place. The impact of TQM implementation is not merely in enhancing the quality of the final product or service, which might have a substantial effect on marketing, but also goes to the foundation of the organization.

TQM and the Construction Industry

The construction industry has tended to confuse TQM and Quality Control (QC) and Quality Assurance (QA), believing that compliance with QA Standards is all that there is to the application of TQM on construction projects (Jaafari,2001). This confusion has led to the use of these expressions interchangeably. QA and QC may be considered as separate sub-elements of TQM. However, QA and QC do not represent the only elements of TQM. TQM is a much more comprehensive and broader concept. QA and QC are applied during project implementation while TQM is a strategic philosophy adopted by an organization and implemented on a continuous basis, even if the organization is waiting to perform a new project.

The TQM culture varies from one company to another and from one industry to another. However, the TQM culture, regardless of its differences, aims to achieve common objectives: namely, removal of waste, reduction of costs, improvement of reputation and increased market share. As can be observed, TQM objectives are dynamic in their nature and this dictates continuous updating and upgrading (Logothetis, 1992).

2.3 Elements of TQM

TQM can be modelled by a structure that consists of the basic elements of TQM. These elements represent the basic ingredients or the philosophical pillars of TQM. The number and priority of these elements vary from one author to another. Figure 2.1 shows the structure of TQM as viewed by the researcher. The structure consists of nine elements where their importance might vary from one organization to another. These nine elements were utilized in developing the mailing questionnaire to measure the size of TQM awareness among the participant parties of the Saudi Arabian construction industry, as will be seen in Chapter 3 (Research Methodology).

It is worth mentioning that most of the literature which addresses the elements of TQM elements is old. The recent literature to address TQM does not emphasise the elements of TQM, since these elements have been exhaustively addressed in the literature that appeared when the TQM was in its introductory stage. Sufficient writings about TQM and its elements appeared in late 1980s and early 1990s. The recent literature is more focused on difficulties and the appropriate approaches of TQM implementation.

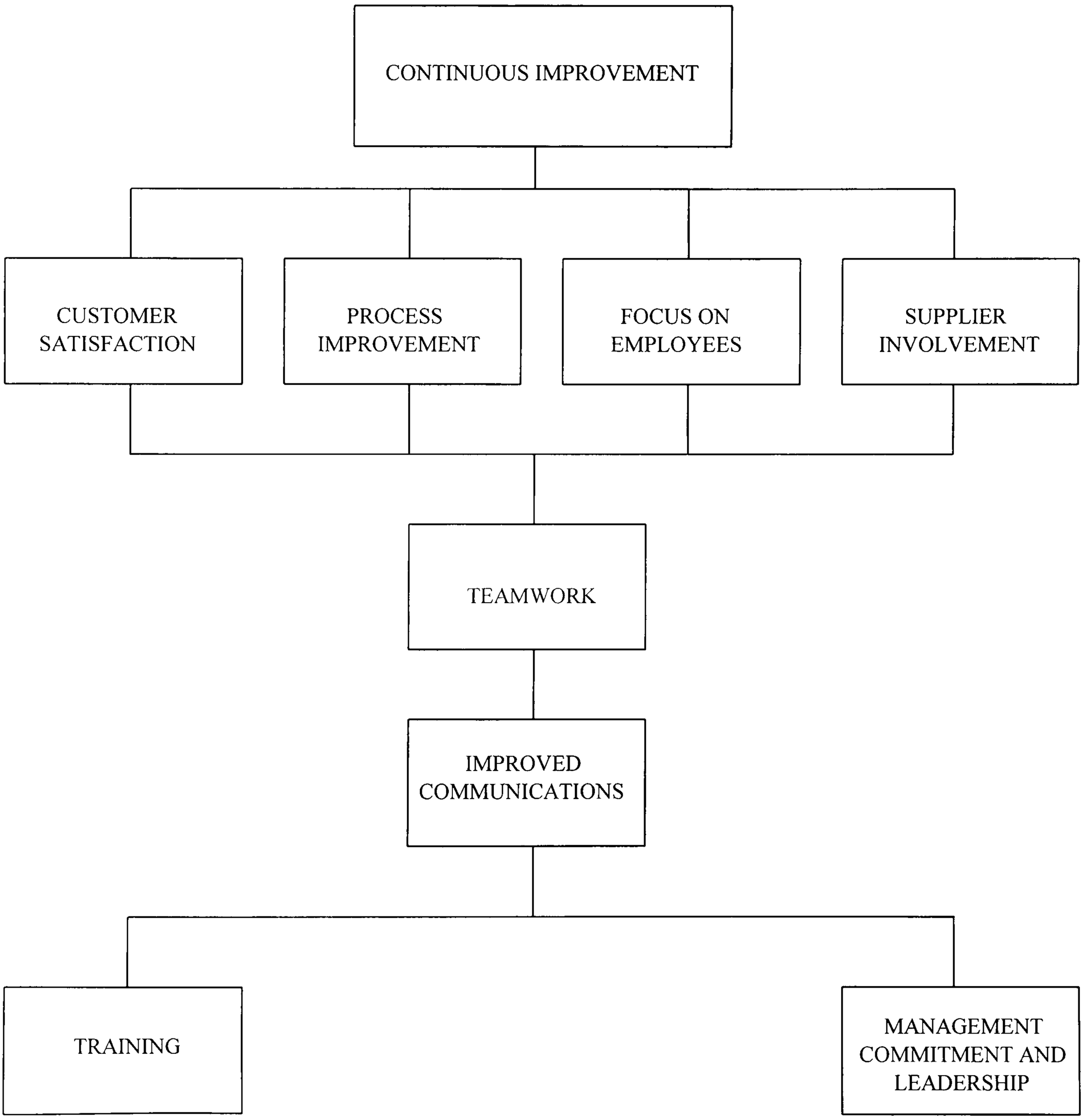

Figure 2.1: The Structure of TQM (Modified from Chase, G.W. (1993))

Training and Management commitment and leadership represent the two basic elements for the structure and they can be considered to be the foundation for the TQM structure. Improved communication and teamwork represent the linkage between the foundation and the other elements of the TQM structure. The improved communications element lies below the teamwork element to indicate that improved communication has higher priority than team-work. The customer satisfaction, process improvement, focuses on employees, and supplier involvement elements are parallel to indicate that they are equal in their importance. Continuous improvement lies on the top of the structure as an umbrella that covers the rest of the elements.

The elements of the TQM structure are discussed in detail in subsequent material.

2.3.1 Training

Training is a fundamental element for any successful quality management programme. Quality experts and Chief Executive Officers (CEOs), who have successfully implemented TQM in their organizations, unanimously recognize the importance of training. The training programme must target everyone in the organization, since quality under TQM is everyone's responsibility. All employees from top management to labour should understand the need for TQM, understand what TQM is and how it works and its payoff (Burati, 1992, Chase, 1993, and Oakland, 2000).

Any training programme should include an orientation to the basic concepts and procedures of TQM. This provides employees with a fundamental knowledge which can be linked to more advanced topics. TQM requires a participative, disciplined and organized approach to improving process, thus team training is very important. The training programme should cover cause-and-effect analysis, team problem solving,

interpersonal communication and interaction, rudimentary statistical methods, cost of quality measurement, and the collection and evaluation of quantitative information (Burati, 1992, Chase, 1993 and Oakland 2000).

The training programme should be tailored to the group being trained. The training material should be relevant to the group's job function, so that abstract concepts can be realized as a concrete fact. The material objective in the training programme should be applied to the job as quickly as possible. Training should be continuous even during a crisis situation. Furthermore, management should demonstrate their commitment to the training programme through their participation and support.

2.3.2 Management Commitment and Leadership

Management commitment and leadership are absolutely essential for the success of any TQM programme. Prior to management commitment, management should have a thorough understanding of TQM. This commitment must be coupled with leadership and support to make it happen. Once management is committed to TQM, it will provide the necessary resources of time and money to permit improvement.

Senior management, in the form of a Quality Steering Committee, might need to draft a vision statement and a mission statement, which summarizes the organization's philosophy with emphasis upon customer satisfaction and quality.

TQM requires employees to do things differently; therefore, participation by management is essential. To achieve the changed behaviour of the staff and improve quality, it is very important to change the organizational environment. Without these fundamental cultural changes, an organization's attempt at TQM will fail. This fundamental change cannot be

achieved unless the management has a long-term obsession with quality work and continued improvement (Culp, 1993). Management should learn to deal with challenge. They should cause changes and not continue to execute policy and cope with existing organizational systems.

2.3.3 Communication

Good communication is very important in achieving TQM. Good communication will result in eliminating fear. Fear makes employees reluctant to voice their opinions or question policies, procedures, and decisions. In other words, fear prevents employees from being involved. Deming's advises "drive out fear". This requires a change in management behaviour (Chase, 1993).

An employee should know the reasons for rejection of his/her work. The employee should also know the use and the importance of the work he/she produces. If the message is not clearly communicated to the employee, then this could be interpreted to mean to him/her that he/she has no value (Strange, 1993).

TQM is a conscious process of improvement, and thus good communication and a good feedback system are important to convey ideas to the management and to incorporate the necessary changes. One effective strategy might be open lines of communication that allow direct access for any employee, at any level, to contact upper management regarding an idea for improvement or a particular concern. Prior to adopting open lines of communication, employees and management should be trained in this system. Otherwise, it will be an ineffective theoretical approach. It is very important that management reacts to the concerns and ideas of the employees (Sanders, 1993).

2.3.4 Teamwork

Under TQM, teams are very important in achieving an organization's goals. It has been noticed that individuals working together in teams or groups toward common goals are generally more effective than individuals working alone. TQM recognizes that the team approach should not be limited to the internal organization's team, but it should cover vendors and external customers under its umbrella. TQM benefited from the successful experience of 'Quality Circles' in Japan. The essence of Quality Circles is to have collective awareness and efforts to achieve quality.

The quality team is the Advisory Committee responsible for establishing and developing the policies and procedures for the TQM implementation process. The committee members should be capable of determining the needs of the organization. The team leader should not play the authority role but rather act as facilitator for these meetings. It is assumed that the team leader should be skilled in such areas as communication, group dynamics, statistical methods, problem solving methods and techniques and group leadership (Imai, 1986 and Burati, 1992).

The major responsibility of a quality team is to identify the areas of improvement and the reasons for the problem. After this, the team should select a specific goal for improvement. The solutions to overcome the causes of the problem should then be implemented. The effectiveness of the solution should be checked for any necessary corrective actions. Once the solution proves its effectiveness a new standard should be developed and continuously tracked (Burati, 1993 and Imai, 1986).

2.3.5 Customer Satisfaction

The main objective of TQM is to achieve customer satisfaction whether the customer is internal (e.g. departments in the same organization) or external (e.g. final product recipient). The first step in achieving customer satisfaction is to define the customer's needs and wants and then to translate these needs and wants into standards. Customer satisfaction should not be limited to meeting the customer's expectations, but it should try to exceed them through continuous improvement.

In order to meet the customer's expectations, the organization must adopt an information gathering programme that measures the level of customer satisfaction. Such a programme will help the organization to identify areas of dissatisfaction, so corrective action can be taken to eliminate the source of dissatisfaction. Two information gathering programmes should be developed: one to measure external customer satisfaction: and another to measure internal customer satisfaction (Chase, 1993).

Customer satisfaction can be achieved by implementing the following steps (Chase, 1993):

1. Make the customer (internal and external) aware of the organization's quality management initiative.
2. Determine customer expectations.
3. Measure the customer's degree of satisfaction.
4. Take action to improve satisfaction.

2.3.6 Continuous Improvement

In the words of Thomas Oswald and James Burati, "*Total Quality Management is often termed a journey, not a destination.*" This is because of its nature as a collection of improvement-centred processes and techniques which are performed in a transformed

management environment. The concept of "continuous improvement" holds that this environment must prevail for the life of the enterprise, and that the methods will become routinely used on a regular, recurring basis. The improvement process never ends; therefore, “no true destination is ever reached" (Oswald and Burati, 1992).

Management under TQM must be supportive to the advancement of technology and management techniques. Major shifts in the levels of performance can be achieved through innovation (Burati, 1992).

Deming's “plan-do-check-act” (PDCA) cycle is a systematic procedure for improving methods and procedures by focusing on correcting and preventing defects. Avoiding defects is usually less costly than the typical approach of attempting after the fact to determine defects. The PDCA cycle can maintain any improvement and prevent deterioration (Burati, 1992).

Continuous improvement entails focusing on processes so that they can be changed to be more efficient. The degree of success can be determined by comparing the progress against certain criteria. The process of measuring and comparing the degree of success against predetermined criteria is known as “benchmarking”. Benchmarking is a systematic search for best practices that leads to superior performance (Fisher, 1995 and Lema, 1995).

The American Productivity and Quality Centre in its publication "Planning, Organizing and Managing Benchmarking Activities: User's Guide" defines Benchmarking as (Lema, 1995):

> *a systematic and continuous measurement process; a process of continuously measuring and comparing an organization's business process against business leaders anywhere in the world to gain information which will help the organization to take action to improve its performance.*

2.3.7 Process Improvement

Process improvement has a mutual relationship with continuous improvement. In some literature, process improvement is referred to as statistical methods or Statistical Process Control (SPC) because measurement and analysis of data are very important for process improvement. Accurate data are very important for both employees and management to make better decisions regarding process improvement.

A quality improvement team can be formed in any organization to examine the processes. The quality improvement team should consist of a representative from each area that might be involved in a process. The team has to identify and separate causes of quality problems and propose solutions. The proposed solutions should then be screened and the best solution should be selected for implementation. Subsequent performance should be measured and evaluated to determine if further action is necessary (Chase, 1993).

Several tools can be used by the quality improvement team to assist it in studying processes. These tools include histograms, cause-and-effect diagrams, check sheets, Pareto diagrams, graphs, control charts, and scatter diagrams.

2.3.8 Focus on Employees (Empowerment)

TQM views employee satisfaction as an essential factor in improving the contribution of each employee. TQM considers the employees as internal customers with whom the company exchanges information and services. TQM promotes the concept that employees are customers of each other. As a result, each employee should try to satisfy his or her internal customers. This can be achieved through training and management emphasis (Chase, 1993).

Management should make the working environment open, so honest comments can be made without fear of punishment. In fact, it is the employees who know best what is right or wrong with a process, since they are the ones who do it. In addition, management should be responsible for providing extensive training to its employees to ensure that the system is used properly. Furthermore, management should encourage suggestions and a procedure should be developed for taking action on suggestions. Failure of management to act on suggestions within a reasonable time will discourage employees from spending time in preparing their suggestions. Recognition and reward should be extended for valuable suggestions to the organization (Chase, 1992).

It might be helpful for an organization to conduct an employee survey to determine employee attitude about quality, management, safety and working conditions. Such a survey will serve two purposes. First, it will send a message to the employees that the management cares about the needs of its employees; second, it will identify areas that need to be improved. The survey can be conducted as a one-to-one interview or it can be a written survey. The result of the survey should be shared with top management and with employees. Sharing the result with employees will indicate to the employees the management's sincerity (Chase, 1993).

2.3.9 Supplier Involvement

TQM recognizes that the quality of any stage in a process is dependent on the quality of the previous stage. Thus, TQM pays attention to the suppliers or vendors of an organization. Maintaining close and long-term relationships with the suppliers results in achieving the best economy and quality. Having close working relationships with a small number of suppliers means that each supplier can be given larger orders, which helps win their loyalty. Conducting frequent and routine visits and other communications can help to

enhance the relationship between the supplier and the organization. Maintaining a close relationship and open communication with the suppliers helps them to have a good understanding and a feel for their customers' requirements. This can result in better products satisfying the needs of the organization (Burati, 1992 and Pyzdek, 1991).

Deming emphasized the importance of maintaining special relations with suppliers. Deming stresses this and states:

> "*End the practice of awarding business on the basis of price tag alone. Instead, minimize total cost by working with a single supplier.*"

This point can be achieved through partnership relationships. Stuart (1993) defined a partnership as:

> "*a purchasing method and philosophy that expands the relationship with a supplier beyond traditional purchasing methods. A partnership involves many characteristics including long-term contracts, fewer supply sources and high degree of mutual trust.*"

Contrary to the traditional procurement methods, which depend on multiple suppliers for each commodity, partnership requires a single or very limited number of suppliers. Although multiple sources can provide the organization with flexibility in case of problems or supplier's failure to meet the delivery date, multiple suppliers require sizeable resources of the organization to service a large supply base, and this results in high cost. The high cost of servicing a large supply base can be more than the possible saving yielded from the competition among multiple suppliers (Burati, 1992 and Stuart, 1993).

A task force of the Construction Industry Institute (CII), Austin, Texas, defines partnering as (Weston, 1993):

> *A long term commitment between two or more organizations for the purpose of achieving specific business objectives by maximizing the effectiveness of each participant's resources. This requires changing traditional relationships of a shared culture without regard to organizational boundaries. The relationship is based upon trust, dedication to common goals and an understanding of each other's individual expectations and values. Expected benefits include improved efficiency and cost effectiveness, increased opportunity for innovation and the continuous improvement of quality products and services.*

2.4 Benefits of TQM

In order to appreciate the importance of TQM and to have a feel for its impact, the benefits of TQM to the organization should be known.

Bardoel and Sohal (1999) reported the benefits achieved by adopting TQM in seven Australian organizations based on case study research. The reported benefits are:

- Better control of processes resulting in consistency from design through to delivery.
- Reduced production time.
- A reduction in the quantity of goods damaged in transit.
- Reduced delivery time.
- Decreased set up time.
- Reduced usage of chemicals.
- Increased measurement of performance, and
- Improvement in customer perceptions of the company.

However, the major benefits of a TQM programme are the increased awareness and focus of all employees on satisfying internal and external customers.

Management objectives such as: customer satisfaction, meeting specifications, larger market share, higher productivity, zero defects, X % increase in sale and Y% decrease in costs can be achieved by embodying TQM ethics in all aspects of the organization, and those objectives become a natural consequence.

2.5 The Difficulties in Implementing TQM

The implementation of TQM into an organization requires fundamental organizational culture change. Changing an organization's culture is a very difficult task, which often faces resistance. The challenge of implementing TQM results from the fact that TQM is not a slogan, nor a tool, nor a programme; it is an organizational paradigm. The concept of TQM is broad enough to be the frame-work or foundation of an organization's culture. Therefore, implementing TQM might deal with replacing, not only modifying, the organization's culture. Furthermore, the transformation from the traditional western paradigm to the TQM paradigm is a radical change.

Lakhe and Mohanty (1994) discussed a case study of a TQM implementation in a company located in Bombay, India. The analysis of their case study demonstrated the major obstacles in implementing TQM, specifically in developing nations (Lakhe and Mohanty, 1994):

- Inadequate knowledge and information about TQM.
- Doubts of employees about management's intentions.
- Failure of management to maintain interest and commitment over a long period of time.
- Difficulty in measuring the effectiveness of TQM.
- Poor internal communication.
- Difficulty in assessing customer expectations and satisfaction.
- Insufficient training resources.

Furthermore, some individuals actually enjoy problems resulting from poor planning or poor performance. Thus, those personalities are not motivated by the assurance that TQM will provide in making their daily activities more rational and predictable. Special attention should be paid to those individuals since they might handle the TQM implementation process (Demski, 1993).

Among the other difficulties in implementing TQM is the failure to have some means of monitoring and managing the overall progress of the TQM implementation. In addition, the failure to provide training skills immediately before TQM is to be applied. Finally, regarding TQM only as an internal process and thus failing to involve suppliers, subcontractors, and others in the process chain creates a major difficulty in implementing TQM.

Broadly Brown *et al* (1994) have reported similar findings.

2.6 TQM Implementation

Implementing TQM is one of the most challenging tasks for any organization. There is no definitive procedure for implementing TQM. However, there are some common steps that have proven to be effective. The first step in any attempt to implement TQM is to determine where to begin. Determining where to begin is a very difficult step. Successful TQM implementation requires a systematic, pragmatic, and well-structured approach. There have been many different approaches suggested for TQM implementation. Those different approaches complement each other (Burati, 1992, and Lakhe, 1994).

Prior to TQM implementation, an organization might need to benchmark its current position. This can be accomplished in several different ways, such as a literature review to identify the state-of-the-art for TQM implementation. A second benchmarking technique is

to hire experts from outside the organization to review and assess current work process and recommend the best way for the tentative implementation. A third strategy is to visit other organizations who have successfully deployed TQM and take their accomplishments as a benchmark (Sanders, 1993).

Lakhe and Mohanty (1994) suggest that organizations, prior to any attempt for TQM implementation, must ask the questions:

- What do we want from TQM?
- What are the implications (human and non-human) for the organization?

Sometimes, it is very helpful for the organization to hire a TQM consultant to provide the resources, experience, and discipline necessary for the process to start. The consultant should neither be perceived as an initiator of TQM and the improvement process nor as the "TQM champion" or the organization expert on TQM. The role of the consultant should be limited to the transfer of skills and knowledge; when the task is completed, the training and the knowledge provided by the consultant must remain within the organization in order for the process of improvement to progress and develop autonomously. The organization must select the consultant carefully to ensure that its choice is best suited for its needs (Dale, 1994).

Lakhe and Mohanty (1994a) propose a framework for implementing TQM:

1. Identify the degree of commitment and area of key interest, and list the long-term changes required.
2. Define the objective of TQM.
3. Identify resources available and develop understanding of the organizational system with the quality system.

4. Specify top management commitment through quality policies, procedures and processes.

5. Create company-wide awareness and a participative work environment by emphasizing customer-oriented value. Encourage quality commitment.

6. Design action plans. Develop specifics about the future.

7. Identify key issues and constraints on implementation. Develop strategies for implementation.

8. Identify and allocate resources. Execute plans. Build momentum for change.

9. Implement and monitor.

10. Measure benefits in terms of achievement.

Others have proposed models for the implementation of TQM, including Burati *et al* (1992), Longenecker (1993), and Oakland (1994) . However, these models are only guidelines and it is difficult to devise a universal 'cookbook' for TQM implementations. The effectiveness of each TQM implementation guideline differs from one industry to another and from one organization to another. Teixeira (1999) concluded his paper "How to Navigate in the Sea of Quality Management Literature" by stating:

> *The fact that TQM does not have a universal definition leaves a great amount of freedom to those developing solutions under its main guidelines. As solutions are not directly transferable, each organization must develop its own framework and each manager his mind set of Quality Management (QM) and any tentative desire to theorize QM must take this into account.*

2.7 The Cost of TQM

There is a tradeoff between cost and quality which sometimes makes it difficult for the decision maker to adopt a quality programme. Two questions usually arise in the mind of the decision maker (Radhakrishnan, 1994, and Omachonu, 1994):

1. How much will it cost to improve quality?
2. How much will it cost not to improve quality?

Today, there is a disagreement about the value of quality costs, with views falling into one of the following three areas (Ross, 1995):

1. Higher quality means higher cost: This view believes that an enhancement in quality requires investment in terms of labour, materials, design and other costly resources. At the same time, the additional benefits from improved quality do not compensate for the additional expenses.
2. The cost of improving quality is less than the resulting savings: This view believes that the saving resulting from less rework, scrap, and other direct expense related to defects is the drive for continuous improvement of process. This view shares the above view to a certain degree in that the trade-off between costs and quality is not financially in favour of quality.
3. Quality costs are those incurred in excess of those that would have been incurred if the product had been built or the service performed exactly right the first time. This view might be the nearest to what TQM advocates. Costs include the indirect (hidden cost) costs such as lost customers, lost market share, and many hidden costs and opportunities, which are not identified by cost accounting systems.

In 1999, Hendricks and Singhal published the results of their research on the link between TQM and financial performance in Quality Progress Magazine (ASQC). The research established the link between TQM and financial performance for firms that have implemented TQM effectively. The sample consists of 600 quality award winners in the U.S. from about 140 different award givers. The financial performance was examined over two five year periods. The research reported that no significant differences in performance are observed during the implementation period. This could suggest that the implementation costs may not be as high as widely believed. The results of the post-implementation period, which starts one year before and ends four years after the winner wins the first quality award, show significant growth in operating income. The research concluded that the benefits of TQM are achieved over a long period and it takes at least two years before the financial performance starts to improve.

2.8 TQM and Measurement

In order to discover the results of deploying a quality programme and the area of future improvement, a quality measure is necessary. Under TQM, a number of measures can be used to verify and control the output in order to meet the customer (internal/external) requirements. The measurement provides the organization with a measurement for both satisfaction before an action of quality improvement takes place and the degree of improvement after implementation. For example, increasing the employees' satisfaction with the intention of increasing productivity requires measuring employees' satisfaction and the productivity initially. Later, when the recommendations for the actions to improve employees' satisfaction are launched, both the employees' satisfaction and productivity must be re-measured. It is very important to examine the effectiveness of the improvement activities. The cost of increasing employee satisfaction versus the financial gains of the productivity increase are studied. This is

important especially for profit oriented organizations. TQM assumes that employee satisfaction can be increased without incurring great expense. Monetary incentive is not the only approach, which can be used to increase the employees' satisfaction in TQM. Improved communication, recognition, removing fear and leading employees to work with pride result in an increase in employee satisfaction, which, in turn, materialize in their work quality and quantity (productivity). Furthermore, the satisfaction of the employee reflects on his attitude toward others namely his customers and this is important in some businesses (e.g. services) where the attitude of the employees is the marketing tool.

In fact, there are a number of reasons for adopting Quality Measurements which may be achieved (Oakland, 1995):

- To be able to attain and sustain reasonable objectives.
- To justify the use of resources.
- To provide standards for establishing comparisons.
- To determine priority areas that require improvement.
- To provide a scale to allow people (employees) to monitor their performance level.
- To identify quality problems.
- To detect any decline in performance.

The ingredients of any organization are: Human resources (employees), process, external customers, suppliers and other resources (materials and equipment). All these elements are governed by management and organization policies and procedures. The TQM journey considers all these elements and tries to improve them. Different measures and the desired results should be designed for each element.

TQM Measurement in Construction Industry

For the construction industry, it might be appropriate to concentrate on the measurement of labourers' productivity since it is a labour-intensive industry. Furthermore, increasing labour productivity would result in a direct increase in profit, which justifies any investment in time and money. Other measures could be developed to measure the rework and the effect of the training on minimizing the rework, the effect of improvement in inventory and materials handling and equipment operation.

Measurements that are commonly used in the construction industry include cost, schedule, performance rating, customer satisfaction, policies and procedures, degree of attainment, return on investment, and non-conformance. The most quantitative measurements used in the construction industry are measures of cost and schedule. However, there is a trend in the construction industry to recognize items other than classical cost and schedule measurements as indicators of project success.

In the construction industry, there are three criteria for selecting measurements (Steven, 1996):

1. The measurement verifies progress toward project objectives.
2. The measurement can be used for continuous improvement.
3. The measurement results can predict something about the project's future.

The construction industry is one of the last industries to embrace objective performance measurement, because of the diversity of processes and products associated with the procurement of projects. However, numerous methods of measurement can be applied to help construction organizations improve their quality and even productivity. The cost

of quality, for example, provides information about rework and activities for prevention. It is after the fact measurement which can be used as a mechanism to learn from the past to improve the future (Love, 1999).

Benchmarking is one of the tools which may be used for obtaining quality improvement in TQM. Benchmarking in the construction industry is not used positively as a tool for servicing internal and external customer requirements but more for measurement such as project time performance. It is suggested that organizations in the construction industry establish benchmark measurements that focus on (Love, 1999):

- Effectiveness: measurements that determine whether the organization/project/ process is achieving the desired results.
- Efficiency: measurements that determine performance and input such as labour/staff efficiency and material efficiency.
- Productivity: measurements that relate the process outputs to its inputs.
- Quality: measurements that have voice of the customer and quality cost.
- Improvement: measurements that lead to key performance indicators for the organization/project and include monitoring improvement such as rework and material waste.

2.9 TQM and the Construction Industry

The development of the TQM concept originally took place in the manufacturing industry. Thus, most literature addresses the manufacturing industry and this gives the misleading impression that the TQM concept cannot be applied to any industry other than manufacturing. One of the main principles of the TQM concept is to achieve customer satisfaction and this is an important objective for any organization, including construction firms. However, the implementation of TQM might differ from one industry to another.

The construction industry differs from the manufacturing industry in such a way that makes introducing TQM more challenging. While the manufacturing industry is characterized by a steady-state process, the construction industry is one time process (uniqueness). The construction industry is also unique in the following factors (Hadavi, 1994 and Ashford,1989):

(1) The mobility of labour,

(2) Diversity in the types, forms and shapes of construction projects,

(3) Geographical dispersion,

(4) The contractual relationships,

(5) The susceptibility to weather,

(6) The fact that almost every job is a prototype

In the 1970s, Japanese construction firms, taking advantage of the successful experience of Japanese manufacturers, introduced TQM into their industry. Since the mid-1970s, three Japanese contractors have been awarded the Deming Prize for Quality Improvement.

In the late 1980s, as the U.S. construction industry began to develop an interest in TQM, many argued that TQM would not work in the U.S. construction industry. The successful experience in Japan's construction industry could not take place in the U.S. or in Western countries due to the cultural differences between Japan and the U.S. Time has proven the fallacy of that belief. A few years later, many owners and contractors in the construction industry have implemented TQM successfully in the U.S. as well as in some other Western countries.

The Construction Industry Institute in the U.S.A. summarized the history of TQM in the engineering and construction industry as follows (Fisher, 1995):

> *The engineering and construction industry has followed the lead of the manufacturing and service industries in implementing Total Quality Management. Owners began to adapt TQM concepts to their engineering and construction programmes based on the experience of their main manufacturing businesses. Contractors.... witnessed the owners' adaptations and were soon aware of changes in market conditions and the resulting increase in both domestic and international competition. Owners have directly challenged contractors to study the TQM processes and apply the techniques to their design and construction efforts. The industry, as a result, is experiencing growth in TQM.*

In May 1992, in Dallas, Texas, the Construction Engineering Programme at Iowa State University held its third "Total Quality Management (TQM) in Building Design and Construction Workshops". The objective of this Workshop was to share participants' experiences in implementing TQM in their businesses. Four topics were selected for discussion in the break-out sessions: (1) recommendations for beginning the Quality Journey, (2) quality implementation in small and large companies, (3) recommendations for improving job and site quality, and (4) recommendations for the development and use of quality - improvement teams. The workshops developed lists of observations and recommendations for each of the four topic areas. Some of the participants were with companies with as much as 10 years of experience with TQM, which added substantial value to the workshop. The workshops reflected the increasing interest in TQM within the construction industry (Federle and Chase, 1993).

2.9.1 TQM and Construction Industry Problems

The construction industry in many parts of the world suffers from problems such as time and cost overrun. As a result, numerous Governments initiated reports such as the Gyles Report (1992) Australia; the Latham Report (1994) UK and Egan Report (1998) UK. These reports have been critical of the construction industry and its poor performance. A

need for change becomes inevitable in order to improve the condition of the construction industry. According to Love *et al* (2000b) and Nesan and Holt (1999), the industry problems will remain until each organization in the procurement of construction industry begins to take the responsibility for initiating changes within their own organization. Such change can be initiated through the effective implementation of TQM.

In other words, adopting TQM by the four major participant parties (owner, designer, contractor and supplier) in the construction industry will achieve the necessary change required for industry's improvement. Under TQM, there is a chain of supplier and customer relationship and TQM pays attention to this relationship. The relationship among the four participant parties of the construction industry can be viewed in the context of the supplier- customer relationship. Each party has a reciprocal supplier- customer relationship, even the owner, who might be viewed as a customer to the contractor at first glance, is a supplier to the contractor in certain activities such providing the work permits or paying the invoices. This integrated relationship enhances the delivery of each party to the benefit of the entire business environment. Consequently, the improvement of the entire industry can be achieved. In fact, this research hypothesis is based on the idea that by adopting TQM in the construction industry, participant party relationships in the industry will improve and its problems will be greatly reduced.

2.9.2 Difficulties of TQM Implementation in the Construction Industry

Strange and Vaughan (1993), addressed the reasons why implementation of TQM in the construction industry is challenging. They stated the reason for the challenge is the point of view, or 'paradigm', that construction leaders have about their industry. The construction leaders, they argued, believe in what can be called the five "*can'ts*" (Strange and Vaughan, 1993):

1. You can't apply industrial management solutions to construction, because of the unique nature of the construction industry.
2. You can't do statistical analysis of construction processes, because they are unique and non-repetitive.
3. You can't invest in training at the job level, because individual employment is short-term, the people have no company loyalty and the environment is too difficult.
4. You can't spend money on management programmes, because there is too much competition and the margins won't allow it.
5. You can't take time away from doing the work for seminars, retreats or symposia.

Strange and Vaughan suggested that the solution to overcoming the challenge is to have a new definition for the two words "product" and "success". They believe that "product" must be redefined to be the management service provided in planning and executing a construction project instead of defining it as the finished building or project. Also, "success" should be redefined to mean meeting the goals of the customers of that product instead of defining it as meeting company goals for profit, growth and so on. Their suggested solution is more theoretical than practical. Redefining “product” and “success,” would not be that simple, since the redefinition requires more than a new understanding. At the same time the reality of the construction situation might prevent new definitions and what they imply in a practical terms. The stakeholders' interests, for example, cannot be given away to the customer merely to be a TQM organization.

It might be true that the above five "can'ts" could create obstacles in a case that a construction firm decided to adopt TQM. Furthermore, it seems that the "can'ts" two

through five are the result of the first "can't", which is the nature of the construction industry. However, collective efforts could help to overcome the above barriers. For example, contractors could share the training cost and public bodies such as contractors unions , if such exist in the local environment, could also play an important role in coordinating or even conducting those collective efforts. The time and money needed for TQM efforts could be distributed among contractors in the industry rather than having the same effort repeated by each individual contractor.

According to Yiwei and Eng (2000), one of the major difficulties preventing wider implementation and acceptance of TQM in the construction industry is the barrier caused by traditional or conventional practice. One example is the traditional way in which project bids are evaluated with the heaviest emphasis on price. It is widely known that the client usually selects the contractor based mainly on the lowest price with less consideration for past experience, current workload and reputation for quality. This situation does not give contractors any incentive to adopt TQM principles.

The long-term nature of a successful TQM implementation also creates a major problem, especially in the construction industry. The sudden change of the market, for example, that threatens the existence of the contractor could redirect the firm from the long-term objectives to the urgent corrective actions. The construction industry is known for its fluctuations, which has the effect of making construction firms reactive rather than proactive.

2.9.3 Partnership in the Construction Industry

Partnership is considered to be one of the concepts that fall under TQM. One of the main TQM elements is to enhance the relationship with the supplier through depending on a

limited number of suppliers. Abudayyeh (1994) reported and discussed the California Department of Transportation (Caltrans) experience in implementing the partnering concept. The paper did not indicate that partnering is within the context of TQM. However, partnering is one of the effective methods to enhance and maintain suppliers, which is one of the main objectives of TQM. The paper described an example of a partnering agreement between Caltrans and one of its contractors. The paper, also, indicated that partnering shows promise for improved relationships between contractor and owner. The paper summarized some of the benefits for both contractor and Caltrans (owner) in implementing the partnering concept. Some of Caltran's (owner) benefits in implementing partnering are:

1. Reduction in claims and improved conflict resolution strategies due to open communication.
2. Reduced cost overruns and delays due to improved cost and schedule control.
3. Increased opportunity for innovation through open communication that encourages proposals for new construction methods and for constructability improvement.

The contractor also gained benefits in implementing partnering such as:

1. Reduced costs related to potential claims and litigation.
2. Lower risk of cost overruns and delays.
3. Increased opportunity for financial success through innovative construction methods.

Weston and Gibson (1993) presented an overview of partnering as it applies to the U.S. Army Corps of Engineers and the results of a survey conducted to assess the status of

partnering in the 37 domestic districts of the Corps of Engineers. In addition, the paper provided an analysis of project performance for partnering projects compared with similar samples of non-partnering projects. The Corps of Engineers, as a public agency, is governed by regulations which require the use of an open, competitive, low-bid contracting strategy. Therefore, the Corps defines partnering as:

> "*creation of a relationship between the owner and the contractor that promotes mutual and beneficial goals. It is a non-contractual but formally structured agreement between the parties leading to an attitude that fosters risk sharing.*"

Based on the analysis and results of a survey, the paper concluded that partnering has a positive impact on project performance, terms of cost growth, schedule growth, change-order cost, claims cost and Value Engineering savings for these projects. The researcher believes that the results could be different and the impact more positive if a genuine partnership took place.

2.9.4 TQM vs. Business Process Re-Engineering (BPR)

In the past few years, interest in Business Process Re-engineering (BPR) seems to have replace the interest in TQM. Love *et al.* (2000) claimed that organizations in the construction industry have eschewed TQM practices because short-term benefits are relatively minimal. As a result, re-engineering has emerged as an alternative. Re-engineering is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvement in critical contemporary measures of performance such as cost, quality, services and speed (Hammer and Champy 1993).

However, TQM and BPR are considered by some researchers to be complementary (e.g. Berces and Hegyi 2001). For example, if a certain process is working effectively then

continuous improvement through TQM would be the more acceptable practice. On the other hand, sometimes it is necessary to redesign the whole process through BPR. Others introduce new concepts such as BPR competing with TQM and publish results that show BPR is more successful and effective.

Love *et al.* (2000) argue that before radical change can occur, culture change and learning should be engendered through gradual evolution. The benefits of adopting TQM with its totality will be realized gradually throughout the organization, paving the way for more radical changes in the future. Thus, there is an integrated relationship between TQM and BPR.

The review of the literature indicates that the construction industry follows the management trends of the other industries (e.g. manufacturing) and tries to fit these management trends and innovations into its own practice. However, it is not always easy to incorporate these ideas into the construction industry due to the nature of the industry. The nature of the industry refers, here, to the business environment, market structure and public rules and regulations. Contractors alone can not challenge the nature of the industry and can only hope to cope with it.

2.10 The Construction Industry in Saudi Arabia

The construction industry in Saudi Arabia, like anywhere else, is affected by the country's economic cycle. Prior to the oil price increase of 1973, Saudi Arabia was a poor country and government spending was very limited. The Saudi Arabian economy is dependent on government expenditure. The increase in oil prices and oil production during the 1970's and early 1980's led to a substantial increase in government revenue. These huge revenues gave the government an opportunity to overcome the limitations in the infrastructure of the

country. Both the First (1970-1975) and the Second National Development Plans (1975-1980) gave construction the first priority in spending which, in return, created a boom in the construction industry. The share of construction in GDP increased from 4.5% in 1970 to 14.4% in 1982.

During the boom period, the emphasis was merely on building and completing the projects, without any consideration for life cycle cost (operation and maintenance cost), the quality or even certain standards that fit the local environment. During that period, the government allocated a significant portion of its annual budget to be spent on building airports, transportation networks, schools, hospitals and other facilities. Money was not an issue and the budget was very generous. At the same time, government expertise was limited in building such huge projects. Consequently, contractors were operating at full capacity, realizing very large profit margins (Shash, 1992).

The Government's desire to build up the country in a short period of time resulted in opening the country to foreign construction companies, from all over the world, to conduct business. These companies had various methods of conducting business and they brought their own business culture, technology and management techniques. Furthermore, the inflow of foreign labour helped to surmount the existing labour shortage.

Foreign labour ranged from the highly skilled to unskilled. However, the unskilled labour represented the majority. They were paid low wages and came from high- unemployment countries such as Pakistan, India, Korea and Egypt. As a result, local nationals abandoned working in the construction industry and the industry became dominated by foreign labour. In this period, the government was the major source of construction expenditure and the private sector played a very limited role.

By 1983, the construction industry had witnessed a decline due to the decrease in government revenue and new priorities for the government which appeared on the horizon due to strategic policies. The sudden decrease in oil prices, which led to a sharp decrease in government revenues, forced the government to cut its expenditure. This economic situation provided beneficial lessons to the government. The government realized that the issue is not only to have the funds to build a certain project, but also to have continuous resources to maintain and operate it. In addition, it began to be recognised how much good planning and consideration of quality at the construction stage will pay off through the life of the project. Attempts have been made to enhance the construction industry and its effectiveness.

After the Gulf War, in 1991, the construction market in Saudi Arabia picked up. This time, the private sector, who considered construction to be an investment tool, played a dominant role. The construction industry benefited from the huge liquidity which was injected into the market during the war and the limited investment opportunities in the country. At same time, the private sector learned from the mistakes committed in the construction industry boom during the 1970's and early 1980's. The private sector paid attention to quality, which has been reflected in contractor practices.

2.10.1 Challenges of the Saudi Construction Industry

In 1989, the topic for the Fourth Saudi Businessmen's Conference was "The Progress of the Construction Industry in the Kingdom: Obstacles and Solutions". The conference was sponsored by the Chamber of Commerce and Industry in Jeddah, Saudi Arabia, between May 29 and June 1, 1989. The conference revealed that the construction industry in Saudi Arabia was very fragile despite the fact that it represents the biggest portion of the Gross

National Product outside of the non-petroleum sector. The conference summarized the problems that face Saudi Arabian contractors as follows:

1. Reduction of demand for construction in comparison with demand prior to 1983/1984.
2. Foreign competition and the illegal conduct of many foreign companies apparently thought necessary to survive in the Saudi market.
3. The existing debts and accumulated interest of Saudi contractors.
4. The difficult procedures for transferring expatriate labour sponsorship for various professions between construction firms.
5. There is no agency dedicated to consider and solve contractors' problems.
6. There are no funds dedicated to finance Saudi contractors, other than from commercial banks, as is the case with other non-petroleum sectors (e.g. industrial, agricultural).
7. Non-compliance of foreign companies performing some construction projects in the Kingdom with the government rules which require foreign companies to subcontract 30% of their business to local contractors.
8. Covering up for illegal workers especially within small firms.
9. The unsuitability of the existing Saudi contractor classification system for the present situation which needs due reconsideration.
10. The lack of clarity of the language used in contracts.

However, the above problems, after fourteen years, are still present. One reason for this is that there is no governmental body that has the authority to resolve the above problems. Furthermore, the above problems are more related to the business environment rather than the participant parties of the industry.

The fact that many of the above problems could have been resolved through direct governmental involvement indicates that the construction sector in Saudi Arabia receives insufficient attention from the Government. For example, the Government could have formed an agency dedicated to a consideration of the problems facing contractors, since this could be an essential and initial step towards solving a variety of major construction problems. The problems and challenges facing the construction industry in Saudi Arabia do not appear to be of serious concern to the Government.

The Ministry of Public Works and Housing and the local Municipalities are the only bodies who regulate the construction industry in Saudi Arabia. The Ministry of Housing and Public Affairs is responsible for the major public housing projects and contractor classifications. There has been no single public housing project in the past fourteen years. Thus, the role of the ministry, now, is limited to contractors' classifications plus other activities (http://www.mpwh.gov.sa/e/index.html). The local Municipalities are responsible for issuing construction permits.

Al-Barrak (1993) concluded that the major causes for contractor failure in Saudi Arabia are the following:

1. Insufficient experience of management at all levels.
2. Poor estimating which results in underestimating the bid for a contract.
3. Lack of any restriction or criteria on those entering the construction market which results in unqualified contractors entering the business.
4. The recession of the national economy forces the profit margins to become very small and very difficult to maintain.
5. Delays in payments, as a result of slow economy, cause a cash flow problem for contractors.

6. Poor labour productivity.

7. The autocratic characteristic of the management.

Al-Barrak's study identified internal problems as well as external problems as causes for Saudi contractor failure. Although solutions to these problems were not suggested, this study can be considered among the very few studies that addressed the Saudi construction industry and its challenges holistically. The solutions for those problems can not be thrown on the shoulder of the contractor only. Some of the problems need attention from the government or an independent institute supported by government.

2.10.2 Construction Management in Saudi Arabia

Al-Sedairy (1994) addressed the current state of project management among clients, consultants and contractors in public sector construction in the Kingdom of Saudi Arabia. He presented the results of a survey distributed among government agencies, design and engineering consultants, and the major general contractors in Saudi Arabia. The research revealed that the practice of project management in the industry varies from segment to segment and from owners to consultants to contractors. Owners appear to take the lead in setting standards for the industry because of their authority and their acquired expertise. Owners have been found to use sophisticated tools for project control. It is also found that owners place a high value upon the control of design quality. The research found that consultants have project management in place as a result of the pressure exerted by owners to develop a practice of project management. Findings have shown that contractors have developed well-defined routines for the logistics and scheduling and so on. However, the research found that contractors have matured sufficiently to adopt the state-of-art managerial techniques such as Total Quality Management. Al- Sedairy was positive and his findings were promising.

It is true that few owners in Saudi Arabia are using sophisticated tools for project management, such as Saudi Aramco. Saudi Aramco business practice as project owner is unique. The financial position of Saudi Aramco, in addition to its management style, makes its conduct of doing business an exceptional case. In fact, it sets an example for other organizations who strive for excellence. It is a noticeable observation that contractors, design offices and suppliers who deal with Saudi Aramco have a higher degree of professionalism and better quality than other firms as a result of dealing with Saudi Aramco because of its stringent requirements. However, it is not the case with the majority of the owners. At the same time, even those firms who deal with Saudi Aramco suffer from the common industry problems and many of them have difficulty in dealing with other owners.

Saudi Aramco strives always to implement state-of-the-art solutions when it comes to either managerial or technical innovations. It is usually influenced by the global trends, especially those in the U.S. It can be considered as a gateway for technology transfer.

2.11 Summary

This chapter has addressed Total Quality Management (TQM) concepts in general and the elements of TQM. The TQM elements that have been presented in this chapter will be utilized as a basis for the TQM data questionnaire. The literature review related to TQM in the construction industry has also been covered. A description of the Saudi construction industry has been provided.

CHAPTER-3

RESEARCH METHODOLOGY

3.1 Overview

The main purpose of this research is to find a practical solution to the construction industry problem in Saudi Arabia. This study is an exploratory piece of research involving multiple methodologies. In addition, given that there is very little available research into this topic, it was decided that an exploratory approach would be appropriate.

The use of multiple methodologies allows the data to be viewed from several perspectives to improve the validity of the findings and enable greater depth of the results. Both quantitative and qualitative methods were utilized in this research. However, the emphasis was on the qualitative approach since an important element of this research is to improve our understanding of a complex problem.

3.2 Research Techniques

Several research techniques have been utilized in the research. These techniques include a case study research method, survey techniques (in-depth interview and mailing questionnaire), and action research (pilot study). There are two reasons for using the various research techniques in this study:

1. Some of the research techniques are more appropriate to satisfy a certain research objective than others
2. Those various research techniques complement each other.

These techniques and the justification for their selection are described in the following sections.

3.2.1 Case Study Research Method

Yin (1994) defines the case study research method as:

> *"an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident."*

A case study research method is a useful technique in exploratory research. The case study used in this research may play an important role in influencing the industry practice in Saudi Arabia. The results of the case study in TQM implementation provided empirical evidence of the extent of TQM effectiveness.

3.2.2 In-depth Interviewing

Berry (1999) defines in-depth interviewing as:

> *"a type of interview which researchers use to elicit information in order to achieve a holistic understanding of the interviewee's point of view or situation; it can also be used to explore interesting areas for further investigation. This type of interview involves asking informants open-ended questions, and probing wherever necessary to obtain data deemed useful by the researcher. As in-depth interviewing often involves qualitative data, it is also called qualitative interviewing."*

In-depth interviewing is an effective method to collect data in this study because of the nature of the research. Understanding the problems and the circumstances of the construction industry and generating ideas without a predetermined knowledge makes this technique very useful.

3.2.3 Mailing Questionnaire

This is a quantitative research technique that has been employed to complement the results of the interviews and to overcome the drawbacks of the qualitative approach. The quantitative approach is suitable to test a theory. In this research, the quantitative approach (mailing questionnaire) was used to augment the results of the interviews and provide a framework to validate and generalize the results of the interviews in an objective manner. This research technique was appropriate in meeting some of the research objectives, as will be discussed below.

3.2.4 Action Research

Kemmis and McTaggart (1998) define action research as:

> *"The linking of the terms action and research highlights the essential feature of the method: trying out ideas in practice as a means of improvement and as a means of increasing knowledge."*

In action research the emphasis is to "improve while the traditional scientific approach is to prove". In fact, the goal of action research is to assist people in extending their understanding of their situation and thus resolve problems that confront them (Stringer, 1996). This research includes action research in the form of a pilot study. The researcher has attempted to implement TQM in a small firm and reported the outcomes in this research.

3.3 Required Data and Research Methods

According to the research objectives as stated in Section 1.6, data collected is related to the following objectives:

1. to identify the size of TQM awareness in the Saudi construction industry

2. to identify and analyze the difficulties of introducing TQM in the Saudi construction industry
3. to determine the effectiveness of TQM as a solution for Saudi construction industry problems
4. to identify the major problems of the Saudi construction industry
5. to provide solutions to the major problems of the Saudi construction industry

The data required for the first (TQM awareness) and second (difficulties of introducing TQM) objectives were collected through personal interviews and a mailing questionnaire. The personal interviews took place prior to the development of the mailing questionnaire. The data extracted from the interviews with the Saudi contractors and design offices and the literature review were used to develop the questionnaire.

Personal interviews as a qualitative approach have some advantages in this particular research. For example, the concept of TQM can be practiced fully or partially in an organization without designating it TQM *per se*. Furthermore, open-ended questions, which cannot be addressed in a mailing questionnaire, are very important to this study in order to have a better understanding of the efforts towards quality in the industry and the obstacles in their search for excellence.

However, because of the limitation of the number of interviews that could take place due to time and cost constraints, the mailing questionnaire was developed to expand the sample and to provide data that would add to the data which had been collected via the interviews. The drawbacks of the qualitative approach, such as lack of validity and objectivity, have been overcome through the utilization of the mailing questionnaire.

The data required for the third objective (effectiveness of TQM) were collected through a case study, personal interviews, and a pilot study. The case study approach was adopted because of the small number of organizations who have actually implemented TQM. The case study of the TQM implementation was reported in two sessions. There was a time- frame of five years between the first and the second session, which gave sufficient time to monitor the progress of the TQM implementation.

The second round of interviews emphasized the effectiveness of TQM as a solution to problems in the construction industry. The second round of interviews provided a vehicle to identify the construction industry problems and to answer the question of whether or not TQM is an appropriate solution. Thus, the interviews satisfied the fourth research objective (identifying construction industry problems).

In order to better understand the nature of TQM implementation, and the benefits and difficulties of TQM implementation, a pilot study was conducted. A practical TQM implementation in a small firm was conducted and reported. The purpose of the pilot study was to gain assurance and confidence in the data collected through the personal interviews.

The problems identified through the interviews are discussed and studied thoroughly in Chapter 6 of this research. Solutions to these problems are suggested based on the literature review and discussion with those who are involved in the construction industry and experiences of other countries in handling similar problems with consideration to the particular situation in Saudi Arabia. Through this, objective five of the research was satisfied.

3.4 Research Steps

The research steps that were followed to achieve the research objectives are discussed in detail in the following sections.

3.4.1 Literature Review

The research for this thesis consists of a literature review and data collection, which is simultaneously and complementarily employed. The literature review covers books, articles, seminars, Internet sites and previous studies addressing quality in general and quality in the construction industry in particular. The literature review in Chapter 2 of this thesis discusses the concept of TQM including the principles of TQM, the benefits of introducing TQM, the difficulties of implementing TQM. Furthermore, the literature review discusses TQM and the construction industry and previous studies which have addressed TQM in the construction industry. Finally, the literature review discusses the construction industry in Saudi Arabia since Saudi Arabia is the case study of this research.

The data extracted from the literature review were used:

1. to develop the research methodology and questionnaires
2. to analyze the collected data
3. to provide the researcher with the necessary knowledge to conduct the pilot study (action research)
4. to generate solutions to the identified problems

3.4.2 Personal Interviews

As a part of data collection, the researcher conducted personal interviews with contractors and design offices. TQM and the problems of the Saudi construction

industry is still a new field to be researched that requires open-ended questions, which are difficult to incorporate into a mailing questionnaire. In other words, the interviews overcome the limitation of information that can be collected via mailing questionnaires. Open-ended questions allow unusual responses to be derived and do not suggest certain kind of answers to respondents. They are useful in exploring new areas which the researcher might have overlooked (Bryman, 2001).

The interviews helped in refining the mailing questionnaire and extracting any ambiguity. The clarity of the questionnaire language and terminology was examined through the interviews. Some of the terms and questions in the initial mailing questionnaire draft were rephrased as a result of the interviews. Moreover, some questions were formed based on the dialogue of the interviews.

The researcher contacted each contractor and solicited their interest to participate in this research. Some contractors as well as design offices were sceptical about the interviews and showed no interest. Contractors interested in participating were asked about their addresses and convenient times and dates for visits.

In each organization, the researcher has endeavoured to interview the most senior manager available. The duration of the interviews varied based on the degree of the interviewee's cooperation and the value of his contribution. Some of the interviewees had limited knowledge about quality. It was difficult to maintain the course of the interviews within the outline of the objectives. The researcher was in many cases led into irrelevant discussion. Prior to the visits, an outline for interviews was prepared (see Appendix 3.A). The interview outline was adopted from the Guidelines for Implementing Total Quality Management in the Engineering & Construction Industry

(Oswald and Burati, 1992). However, the outline was modified to suit the scope and the objectives of the research. The time limitation often precluded covering all the questions.

The experience of one of the leading nationally-owned companies, which is considered to be one of the largest capital project owners, was investigated in detail. A number of interview sessions were held with various individuals who are involved in TQM implementation. The investigation was divided into two periods over a five year time-frame between the first and the second period of investigation.

3.4.3 Questionnaire Developments and Design

The purpose of distributing mailing questionnaires is basically to overcome the shortcomings of the personal (face-to-face) interviews. There are obstacles in wholeheartedly accepting the findings of the interviews with a high level of confidence due to the limited number of active participants. Therefore, in order to validate and generalize from the findings of the interviews, a quantitative approach (in the form of the mailing questionnaire) became necessary. However, there are limitations with the mailing questionnaire such as the type of questions (closed questions) where they may unwittingly suggest certain responses to the respondents and thereby affect any element of impartiality. In this context, the researcher is required to overcome the difficulties in generating knowledge and understanding the issues, especially in an exploratory research where the researcher has limited knowledge (Bryman 2001).

Two questionnaires were developed in order to service the following objectives:

1. The first questionnaire addressed the awareness and difficulties of TQM implementation in the Saudi construction industry in order to augment the findings of the personal interviews, which also addressed these issues.

2. The second questionnaire addressed the problems of the Saudi construction industry in order to determining the significance of each problem as identified in the personal interviews that addressed the effectiveness of TQM as a solution to the problems of the Saudi construction industry.

The questionnaires carry both the instructions and the questions for respondents. In addition, they contain blank spaces for respondents to write their own comments. The wording of each question was selected carefully. Each question was stated in a precise and concise manner. The interviews and visits to the field were extremely beneficial in helping to state the questions simply and clearly. Each questionnaire consists of a cover letter (See Appendix 3.B) and two parts. Part A addresses general information about the organization with respondents being requested to give general information pertaining to the size of their construction business. Part B provides questions that are related issues of the questionnaire.

The questionnaires were translated into Arabic. Both English and Arabic copies were sent to each respondent. The respondents were given the option to fill either copy. The researcher included envelopes with the return address for ease of use by the respondents.

The First Questionnaire

As indicated above, the purpose of this questionnaire was to determine the depth of compliance with the TQM principles and the difficulties of non-compliance.

TQM, as explained in the literature review, is a broad concept, which makes it difficult to set up specific criteria through which an organization can be designated as a TQM organization. However, there are certain elements that represent TQM structure. In other words, it is expected that a TQM organization is in compliance with these elements.

Those elements are discussed in detail in the literature review (Chapter 2):

1. Training
2. Management commitment and leadership
3. Communication
4. Team work
5. Customer satisfaction
6. Continuous improvement
7. Process improvement
8. Focus on employees
9. Supplier involvement

The design of the questionnaire and the selection of questions resulted from two sources. The first source was conducting a comprehensive study of TQM and its principles. The second source included field visits and interviews. The data collected from the interviews and visits were analysed carefully in order to develop the final questionnaire, which covers all dimensions of the subject. Furthermore, these interviews and visits assisted the researcher in examining the validity and clarity of the questions, which resulted in improving the questioning process. The questions were direct (See Appendix 3.B).

However, the interviews revealed that different organizations have different practices and degrees of TQM compliance. For example, the interviews indicated that contractors who

pay attention to customer satisfaction vary in their efforts and their understanding of customer satisfaction. Therefore, the respondent was asked to provide specific information to determine the degree of compliance and to eliminate unqualified responses that do not reflect the reality of the situation.

The interviews also identified the obstacles to compliance with the various TQM elements. Some of the descriptors were presented to identify the reasons for non-compliance with each TQM element. In other words, the respondent was directed to circle the reason for their non-compliance. These reasons (difficulties) were identified during the interviews.

The researcher also decided to avoid the term TQM in the questionnaire since it could have discouraged respondents due to their lack of knowledge of TQM or their perception of TQM. Furthermore, some organizations were in compliance with the TQM principles without defining themselves as a TQM compliant organization. The major reason for this was that some organizations used different terminologies such as quality management, or they implemented TQM principles without designating them as TQM.

The Second Questionnaire

The purpose of this questionnaire was to identify the significance of each problem as identified via the interviews that addressed the effectiveness of TQM and the construction industry problems. The problems were identified in the personal interviews and a questionnaire was designed to address each problem within a range of "strongly agree" to "strongly disagree" (See Appendix 3.C). The data collected through this questionnaire attempted to identify the major problems of the Saudi construction industry.

3.4.4 Pilot Study (Practical Experiment)

In order to determine the effectiveness of TQM in the Saudi construction industry, the implementation of TQM was examined with a small contractor. The results of this pilot study were reported in Chapter 6.

3.5 Population and Sample Selection

The following sections provide the basis of the sample selection and the sample size determination. These samples were selected in order to conduct statistically acceptable quantitative research through sending the mailing questionnaire.

3.5.1 Contractors

The first step in determining the sample size is to determine the population size. According to the Ministry of Commerce, in 2000 there were 11,375 active commercial registrations for construction and building activity in Saudi Arabia. However, this number covers any establishment that has commercial activities related to construction including construction material suppliers and maintenance firms (See: www.commerce.gov.sa/statistic/record.asp).

One the other hand, the Ministry of Public Works and Housing classifies contractors by fields and activities. The Ministry classifies each contractor in each field by a grade. The grade of contractor determines the ceiling for the project cost that the contractor is qualified to perform. Contractor classification is one of the requirements to compete for Government contracts. Table 3.1 shows the five classification grades for Saudi construction (civil) contractors. The ceiling is in Saudi Riyals (millions) (See: www.mpwh.gov.sa/e/contract.html).

Table 3.1: Financial Limits for Classification Grades - Saudi Contractors (Source: Ministry Of Public Works and Housing Classification, 2002)

Grade Activities	First	Second	Third	Fourth	Fifth
Buildings	Over 200	200	50	15	5
Roads	Over 300	300	100	30	10
Water & Sewage	Over 300	100	100	30	10
Dams	Over 100	100	50	15	5

* US$ 1 = SR.3.75

Table 3.2 shows the number of Saudi contractors under each classification grade for each civil activity. Any contractor can be classified under more than one activity with different grades. For example, a contractor might be classified as a grade one (1) building contractor and simultaneously as a grade four (4) dam's contractor. It is worth mentioning that contractors are not obliged to be classified in order to conduct business within the private sector, which means that the number of contractors is higher than that shown in Table 3.2. However, most large contractors (grades 1, 2, and 3) have a commercial motivation to be classified since the Government is the owner of most capital projects in Saudi Arabia.

Table 3.2: Number of Contractors for Each Classification Grade-Saudi Contractors (Source: Ministry Of Public Works and Housing Classification, 2002)

Grade Activities	First	Second	Third	Fourth	Fifth	Total
Buildings	41	89	122	345	349	946
Roads	15	31	76	160	194	476
Water & Sewage	14	26	52	203	173	468
Dams	1	6	6	95	40	148

From the above, it is obvious that the population from which the random sample will be taken is heterogeneous. Therefore, in order to reduce heterogeneity of the population, contractors from grades one (1), two (2), and three (3) for civil projects have been selected for the survey. The reasons for restricting the sample to grades (1), (2), and (3) are:

1. Small contractors (i.e. grade 5) cannot afford to have highly paid professionals who can appreciate and implement concepts such as TQM..

2. The structure of a small contractor firm does not justify implementation of TQM or its compliance with TQM principles.
3. The researcher's interview visits - with those who are involved in the construction industry - revealed that small contractors in Saudi Arabia (e.g. Grade 5) are, in many cases, no more than manpower suppliers.

Target Population

Based on the above, the size of the target population is difficult to precisely determine. As mentioned, the Ministry of Public Works and Housing Classification does not accurately identify the exact number of classified contractors since some contractors are classified under more than one activity. Furthermore, this official source does not include all contractors. Therefore, the researcher decided to use the sum of all the contractors classified as grade 1, 2 and 3 (civil) regardless of the repetition of some contractors. In other words, the worst case scenario was taken where all contractors are not necessarily included under one activity. Therefore, the target population has been inflated. However, the oversized population would cover for the contractors who are large but still not classified. Thus, the total target population is 479 contractors.

Sample Size

The number of firms in each category in Saudi Arabia can be estimated accurately. This enables us to determine a sample size using statistical techniques. In general, an undersized sample will not produce useful results, while an oversized sample uses more resources than necessary (Lenth, 2001).

It is shown in Appendix 3.D that we may estimate the minimum sample size that will guarantee a margin of error, d, at a $100(1-\alpha)\%$ confidence level as n, where n is given by:

$$n = \frac{N}{4\left(\frac{d}{z_{\alpha/2}}\right)^2 (N-1)+1}$$

Using this formula, we may generate the range of appropriate sample sizes for various values of d and $\propto$ as given in Table 3.3 below when the total population, N is 497 (the figure for Saudi contractors):

Table 3.3 Sample Sizes Needed for Various Confidence Intervals and Margins of Error for a Population of 497

Confidence Interval (%)	Margin of error on *p*			
	0.05	**0.1**	**0.15**	**0.2**
80	124	38	18	11
85	147	48	23	13
90	176	60	29	17
95	217	81	40	23
99	285	125	65	39

This may be shown graphically in Figure 3.1

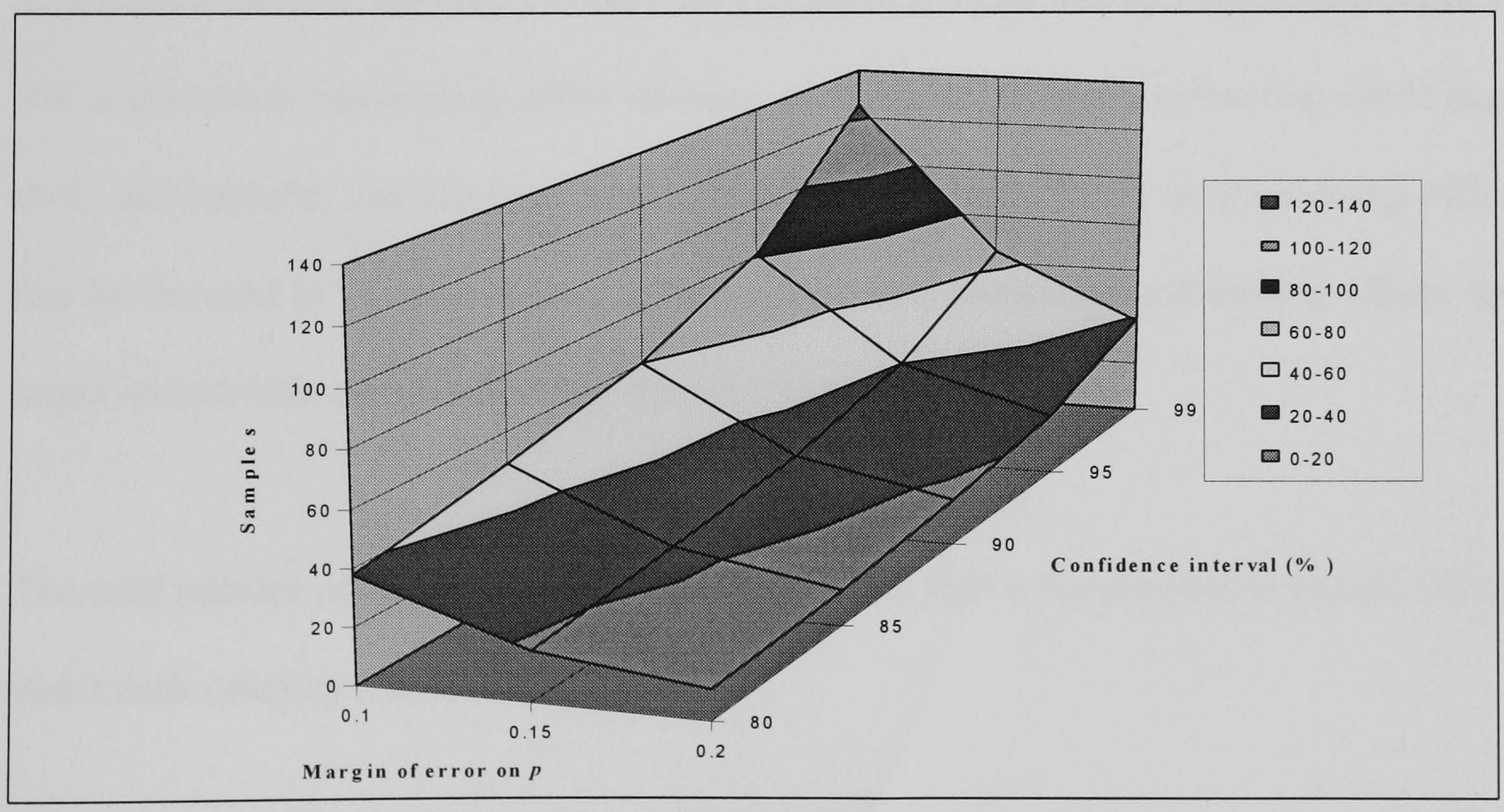

Figure 3.1 Sample Size Against Margin of Error and Confidence Interval

It is clear from the table and the figure that reducing the margin of error to a very low level at high confidence requires very extensive sampling: of the order of half the total population size. However, there is significant information to be gained from much smaller sample sizes. For example, setting our margin of error at 0.2 and the confidence at 80% means that a sample of only 11 is needed. In this study, a target margin for error of 0.1 and a confidence interval of 95% was chosen, which meant that the sample size had to be about 80. In fact, a sample size of 85 was used.

3.5.2 Design Offices

In Saudi Arabia design offices are classified into (www.saudieng.org):

1. Saudi Engineering Office
2. Saudi Consultant Engineering Office
3. Non-Saudi Engineering Office
4. Non-Saudi Consultant Engineering Office
5. Professional Engineering Company

The main difference between a consultant engineering office and an engineering office is that a consultant engineering office contains a minimum of three engineering fields (e.g. civil, architectural, and electrical engineering). On the other hand, an engineering office can be licensed to one individual engineer. Therefore, consultant-engineering offices are larger and provide a larger spectrum of engineering services.

The total number of design offices is 1661. Table 3.3 shows the number of design offices under each category (Al-Ghanam, 2002).

Table 3.4: Distribution of the Design Offices

Type of office	Number Of Offices
Saudi Engineering Office	993
Saudi Consultant Engineering Office	500
Non-Saudi Engineering	36
Non-Saudi Consultant Engineering Office	93
Professional Engineering Company	39
Total	1661

For the purpose of this study, the target population was limited to only consultant engineering offices and professional engineering companies. Engineering offices were excluded, since a concept like TQM is more appropriate for complete organizations. Furthermore, most of the engineering offices were small and have no more than two engineers. In addition, some of the engineering offices were inactive and did not provide engineering services and their engineer owners used them as a base for them to do alternative kinds of business. Therefore, the target population size was 632 design offices.

The sample size for consultant offices was calculated with the same equation that was used to calculate contractor sample size. A target margin for error of 0.1 and a confidence interval of 95% was chosen, which meant that the sample size had to be about 84. However, a sample size of 85 was used.

3.5.3 Non-Probability Sampling

The formula that was used to determine the size of the representative sample for contractors and design offices includes two assumptions:

1. The selection is random.
2. The rate of response is 100%.

By satisfying the above two assumptions, a probabilistic sample can be generated. For a probabilistic sample, the accuracy and precision could be calculated for any population distribution (Emory, 1991 and Salant, 1994).

The expected low rate of response created non-response errors and converted the sample from a probabilistic into a non-probabilistic sample. The major difference between a probabilistic sample and a non-probabilistic sample is that while the probabilistic sample gives a known non-zero chance for each population element to be selected, a non-probabilistic sample does not have a known non-zero chance of being included for each population element. Those who were selected initially to be included in the sample and refused to participate created a zero chance for them to be included. In other words, they played the role of converting the sample from probabilistic into non-probabilistic (Emory, 1991 and Salant, 1994).

The acute sampling problems in Saudi Arabia compel researchers to adopt non-probabilistic sampling methods in most of the surveys conducted (Al-Meer, 1989 and Bhuian, 1996). Furthermore, for the sake of argument, if we managed to receive the required response by increasing the number of selected respondents, then the sample would still be non-probabilistic and the non-response error would be the same. The rate of response would be the same for any larger sample.

The non-probabilistic sample is sufficient for an exploratory study. It provides us with a general indication. Any future study could utilize the rate of response to detect any variation in the population trends and interest in the topic of research. The advantage of setting up the sample size using a probabilistic approach is to set up a framework for the survey. In addition, it provides a comparable tool for future studies even if the population changes (Salant, 1994).

In order to reach the sample size, the researcher sent the questionnaire to double the number calculated for the sample size. Also, the researcher compensated for the low response by filling in the questionnaire through telephone calls.

3.6 Methods of Data Analysis

The methods used for analysing and presenting the survey results were:

1. Tabulation and Cross-Tabulation
2. The Spearman Rank Correlation Coefficient Test
3. Linear Regression Analysis
4. The Difference of Means Test
5. Importance Index
6. The Wilcoxon Signed-Rank Test For Matched Samples

3.6.1 Tabulation and Cross-Tabulation

Cross-tabulation involves placing the survey data into tabular form (a two way table) to show relationships between the data. Cross-tabulation is a technique that shows how the frequency or percentage distributions of one variable differ according to various levels of another variable. Visual examination of a cross-tabulation table reveals very quickly any discrepancies.

3.6.2 The Spearman Rank Correlation Coefficient Test

Based on Daniel and Terrell (1995), the Spearman Rank Correlation Coefficient (r_S) test was employed to test the correlation between the responses of the contractors and the design offices. As the name implies, r_S is computed from data consisting of ranks. r_S focuses on the differences between X (contractors) and Y (design offices) ranks

(denoted d_i) as a measure of the extent to which the paired rankings depart from perfect direct or inverse correlation. The number of variables is (n). The r_S test was used in the analysis of a questionnaire where the contractors and design offices were asked to choose one statement from a number of statements. For each set of statements, there will be (n) which is the number of statements.

$$r_s = 1 - \frac{6\sum d_i^2}{n\left(n^2 - 1\right)}$$

If there are no differences $\sum d_i^2$ will equal 0, r_S equal 1 and we consider the rankings perfectly and directly correlated. If we observe the maximum difference between the ranks of X and Y i.e., if the ranking of X is the reverse of the ranking of Y, in each case $\sum d_i^2$ will be a maximum and r_s will equal -1. When the rankings are less perfectly correlated, r_S will be somewhere between $+1$ and -1. r_S measures the strength of the association between ranks.

However, the effect of ties on the estimate of the Spearman rank correlation should be taken into account, since some trial statements have the same ranking for both the contractors and design offices. A correction term, T, needs to be brought into the calculation for the Spearman rank correlation coefficient, r_s (Theodore 1982):

$$r_s = 1 - 6\frac{\sum_{i=1}^{n} d_i^2 + T}{n^3 - n}$$

where

n is the number of trial statements

d_i is the difference between the contractors' ranking of statement i and that of the designers and T is the tie correction factor, given by:

$$T = \sum_{m}\left(\frac{m^3 - m}{12}\right)N_m$$

where N_m is the number of ties involving *m* observations in the two data-sets. Thus if N_2 is the number of two-way ties, N_3 is the number of three-way ties, etc. Then:

$$T = \frac{1}{2}N_2 + 2N_3 + 5N_4 + 10N_5 + 17.5N_6 + 28N_7 + \ldots$$

Moreover, the rank for ties is calculated in line with the following: a 2-way tie for third place is given as $\frac{3+4}{2} = 3.5$ for each statement and the next most popular statement is ranked 5th; meanwhile a 4-way tie for 8th place will be give a rank of $\frac{8+9+10+11}{4} = 9.5$, and the next most popular statement will be ranked 12th.

The criterion for a strong correlation is $r_S \geq 0.8$, $r \leq -0.8$, moderate $0.5 < r < 0.8$, $-0.8 < r < -0.5$, weak $-0.5 \leq r \leq 0.5$.

3.6.3 Linear Regression Analysis

The linear regression analysis was also employed to observe the relation between the responses of the contractors and the designers (see Chapter 5-Appendix 5.B). The concept of linear regression is that it uses the numerical data directly and while in most cases the estimate of the correlation coefficient is pretty similar, there are occasions when it is markedly different. We can also draw straight-line graphs, which give a good feel for how well or badly the two data sets match. A standard Excel statistical package was used to produce the linear regression analysis.

The linear regression analysis provides a mathematical expression, an equation, for estimating or predicting the values of one variable from the known values of one or

more other variables. Regression analysis is called *linear* if the equation of the method represents a straight line. Regression analysis is not only the basis for predicting the values of a variable, it also describes the nature as well as the importance of the relationship between two or more variables (Theodore 1982 and Walpole and Myers, 1978).

In testing the significance of regression, we want to determine whether the relationship between designers (y) and contractors (x) is important. From the model of simple linear regression (Neufeld,2001):

$$y = \beta_0 + \beta_1 x$$

it is clear that if the value of β_1 is zero, then the value of y remains the same regardless of the value of x. In other words, designers and contractors are not related.

So for us to test the importance of the relationship between the designers (y) and contractors (x), we test the following hypothesis.

$$H_0 : \beta_1 = 0$$

$$H_1 : \beta_1 \neq 0$$

H_0 is the null hypothesis and H_1 is the alternative hypothesis. Accepting the null hypothesis implies that regression is insignificant and rejecting it means that regression is significant.

To test the significance of regression, we set the level of significance (i.e. the probability with which we could reject the true null hypothesis) to be 5%. We then read the P-value for the x-variable and make the following conclusion.

If the P-value is less than the level of significance (5%), we reject the null hypothesis.

Otherwise, accept the null hypothesis.

3.6.4 The Difference of Means Test

The difference of means test was employed to determine whether the contractors and designers have a statistically significant difference between their means. In fact, this test was employed in order to determine the similarity and dissimilarity between contractors' and designers' responses.

In other words, the test was employed as one way of detecting correlation between the contractors and designers.

For each trial statement, an arbitrary mark (weight) was assigned based on the importance of the statement. The marks range from 7 to 1, since the maximum number of trial statements under any category was 7. A mark of seven was assigned to the most significant statement and so on. Aggregate marks were calculated for the overall responses. Means, variances and standard deviations were calculated for both contractors and designers.

Correlation Test

As mentioned above, this test was employed as a correlation test. Based on Larsen and Marx (2001), the basis of the correlation test using the difference between the means is described below:

The basic format is to test the hypothesis $H_0 : \mu_X = \mu_Y$ against $H_1 : \mu_X > \mu_Y$ or against $H_1 : \mu_Y > \mu_X$.

Let $X_1, X_2 ... X_n$ be the independent random samples from the one population (we will make them the designers' scores for each of the topics) and $Y_1, Y_2 ... Y_m$ be the

independent random samples from the other population (we will make them the contractors' scores for each of the topics). Let the means be μ_X and μ_Y. Let us assume the standard deviation is the same, and approximated by the pooled sample standard deviation, S_p:

$$S_p^2 = \frac{\sum_{i=1}^{n}\left(X_i - \bar{X}\right)^2 + \sum_{i=1}^{m}\left(Y_i - \bar{Y}\right)^2}{n+m-2}$$

Form the *t*-statistic:

$$t = \frac{\bar{x} - \bar{y} - \left(\mu_X - \mu_Y\right)}{s_p\sqrt{\frac{1}{n}+\frac{1}{m}}}$$

$$= \frac{\bar{x} - \bar{y}}{s_p\sqrt{\frac{1}{n}+\frac{1}{m}}} \text{ since } \mu_X = \mu_Y \text{ is the null hypothesis}$$

Find the level of significance, α, for marginal rejection of $H_0 : \mu_X = \mu_Y$ from the implicit equation:

$$t_{\alpha, n+m-2} = t$$

Since in this case $n = m = 85$, it follows that $n + m - 2 = 168$, which means that we can approximate the *t* distribution by the normal distribution, and so find , α, for marginal rejection of $H_0 : \mu_X = \mu_Y$ from the implicit equation:

$$z_\alpha \approx t$$

We may then set up the following categorisation:

α	**Conclusion on means**
$\alpha \leq 0.001$	Very dissimilar
$0.001 < \alpha \leq 0.05$	Dissimilar
$0.05 < \alpha < 0.10$	Similar
$\alpha > 0.10$	Very similar

3.6.5 Importance Index

For the second set of questionnaires, an importance index was used to determine the rank of the problems of the construction industry. The idea behind the importance index is a weighted mean.. Five points are assigned to "strongly agree" , 4 points to "agree" , 3 points to "undecided" 2 points for "disagree" and 1 point for strongly "disagree" The following formula was used to calculate the importance index:

$$(I) = \sum_{i=1}^{5} \frac{a_i x_i}{5}$$

where: I = *importance index*, a_i = constant expressing the weight of ith response, where $a_i = 5,4,3,2,1$ for $i = 1,2,3,4,5$ respectively; x_i = frequency of ith response given as a percentage of the total responses for each problem ; i = *response* category index where $i = 1,2,3,4,5$, x_i = *strongly agree* , and x_5 = *strongly disagree* response.

3.6.6 The Wilcoxon Signed-Rank Test for Matched Samples

In order to determine the significance of each problem that was surveyed (see section 6.3) the Wilcoxon Signed-Rank Test for Matched Samples was used. The Wilcoxon test is a non-parametric test which is more appropriate to use than testing hypotheses by means and variances (Walpole and Myers 1978). In the construction industry problems survey the respondent was given the choice to select one of five responses namely: *strongly agree*, *agree*, *undecided*, *disagree* and *strongly disagree*. During the analysis, it was decided to exclude respondents who chose the *"undecided"* response, since these respondents were not certain about that particular problem either because they had not encountered it or were not sure of its significance. Therefore, the Wilcoxon test, which is a distribution-free (nonparametric) test, is a more appropriate test.

The Wilcoxon test requires three steps (Theodore 1982):

1. Find the signed difference *d* between each paired measurement.
2. Rank the absolute values *d* of these differences.
3. List the positive and negative ranks in separate columns and sum each column

The null hypothesis is that the differences between the paired measurements are systemically distributed around a mean zero; this means that if the null hypothesis is true, the sum of the positive ranks is equal to or greater than the sum of the negative ranks. In symbols, the null and the alternative hypotheses are :

$$H_0 : \sum rank(+) \geq \sum rank(-)$$

$$H_1 : \sum rank(+) < \sum rank(-)$$

3.7 Summary

This chapter has addressed the research methodology of this research. The research techniques that have been utilized to achieve the research objectives have been discussed in detail. The justification of the selection of each research technique has been provided. The sample selection and sample size have been discussed and presented. Finally, this chapter has addressed the analytical techniques that have been utilized to achieve the research objectives.

APPENDICES

APPENDIX 3.A

INTERVIEW OUTLINE

1. TQM Process, General

   Describe the company's TQM process. Is it formally designed? Is it formally documented?

2. TQM Implementation

   - Describe the implementation process including duration, main participants and sequence.
   - When is implementation considered to have begun? When was it considered to be fully implemented?
   - What are the problems encountered in implementation? Problem solution? Who was the driving force for TQM within the company?
   - To what degree was formal implementation planning accomplished?
   - From your experience, and your observation, what is the main success factors in effectively implementing TQM?
   - To what would you attribute TQM failure among companies?

3. Organizational Issues

   - Describe any organizational changes resulting from TQM implementation.
   - What is the relationship between the traditional QA/QC function and the TQM process?
   - Describe any changes in company policy and procedures.
   - Describe how quality improvement goals and objectives are established.

4. Management Commitment

   - Describe management commitment toward TQM.
   - Provide examples or certain practices that show management commitment.

5. Training

   Describe your training programmes. What is your TQM training cost as a percentage of the total annual payroll?

6. Communication

Describe the general environment with respect to communication between employees and the management and between the company and the owners/suppliers.

7. Customers' Satisfaction

- Are formal customers' surveys conducted on a regular basis? If so, what form do they take?

- How important is the customer/supplier relationship in your full achievement of a full-scale TQM implementation?

- What does your company do to achieve customer satisfaction?

8. Focus on Employees

- What does your company provide for its employees that others do not? What is the percentage of annual resignations to overall number of employees? Does your company believe that employee satisfaction is important to achieve TQM? Explain.

- Do you conduct surveys to measure employee satisfaction? If yes, what type?

9. Improving Process

- What is the model that is used for problem solving?

- What do you do for process improvement?

10. Supplier Involvement

How do you select your suppliers? Describe your relation with the suppliers.

11. Miscellaneous Issues

- Is TQM regarded as an element for strategic planning?
- Is there any data or opinion on increased market share due to the TQM effort?

APPENDIX 3.B

QUESTIONNAIRE 1

1. Number of years in business : _____

2. Number of employees : _____

3. Annual business volume
(in Saudi Riyals) : _____

4. Average project size (in Saudi Riyals) : _____

5. Distribution of your business among different sectors (as percentages) :
   - Public _____
   - Semi-Public _____
   - Private _____

6. Distribution of your business among different types of construction projects (as percentages) :
   - Residential construction _____
   - General building (non-residential) _____
   - Utility construction _____
   - Industrial const. _____
   - Others (specify) _____

7. Is your organization ISO 9000 Certified?: ☐ Yes ☐ No

8. Job Title of Respondent : _____

Please circle the appropriate statements for each question:

1. Which the following statements describe best your firm's training activity?

   (a) All employees and workers are sent for training
   (b) Some employees are sent for training
   (c) Employees are not sent for training because of cost
   (d) Employees are not sent for training because appropriate training is not available.
   (e) Employees are not sent for training because the high turnover of employees means it is not worthwhile.
   (f) Employees are not sent for training for reasons other than above.

2. Which of the following statements describe best your firm's management commitment towards quality?

   (a) Management reviews the quality issues at its meetings regularly.
   (b) Management has adopted a formal strategy for improving quality.
   (c) Quality is not an issue in our organization
   (d) Management is too busy with other activities
   (e) QC/ QA manger is the one responsible for quality

3. Which of the following statements describe best the communication in your firm?

   (a) You keep all employees informed of the firm's plans
   (b) Any employee/worker can approach management with suggestion and complaints
   (c) Language barrier is a problem in communication
   (d) Each employee should focus on its own function
   (e) The nature of the employer – worker relationship in construction industry create a problem in communications

4. Which of the following statements describe best the teamwork in your firm?

   (a) The firm assigns groups to perform some activities
   (b) There is a difficulty of grouping individuals with different backgrounds
   (c) The nature of the business does not allow performing work through groups

5. Which of the following statements describe best your firm's efforts in customer satisfaction?

   (a) You have a <u>formal</u> procedure to deal with customer complaint
   (b) You have a formal procedure to identify and satisfy customer satisfaction
   (c) The temporary relationship with our customers reduces our emphasis on their satisfaction.
   (d) Customer satisfaction is important but no procedure is established.

6. Which of the following statements describe best your firm's focus on employees?

(a) The firm has a recognition/reward programme for all employees
(b) The firm has a recognition/reward programme for professional only
(c) The firm has a formal procedure to ensure the satisfaction of all employees
(d) The firm has a formal procedure to ensure the satisfaction of professional employees only
(e) The firm's financial constraint prevents the firm to focus on employees
(f) The calibre of employees in the construction industry prevents to pay them attention
(g) The high turn over because of the business fluctuation prevents to focus on employees

7. Which of the following statements describe best your firm's improvement process strategy ?

(a) You perform Statistical Process Control (SPC)
(b) You have a technique for process improvement
(c) The processes in construction industry are not repetitive which prevents process improvement efforts
(d) The process improvement techniques are too sophisticated to be implemented in construction industry

8. Which of the following statements describe best your firm's relationship with suppliers?

(a) You have a partnership agreement with specific suppliers
(b) You deal with limited number of suppliers
(c) The firm policy does not allow a special relationship with certain suppliers
(d) Not applicable

9. Which of the following statements describe best your firm's continuous improvement as a strategy?

(a) You conduct benchmarking
(b) You pursue best practices in your business formerly
(c) The fluctuation of the construction market prevents to adopt continuous improvement strategy.

APPENDIX 3.C

QUESTIONNAIRE 2

General Questions about your Organization

1. Number of years in business : _____

2. Number of employees : _____

3. Annual business volume (in Saudi Riyals) : _____

4. Average project size (in Saudi Riyals) : _____

5. Distribution of your business among different sectors (as percentages)
   - Public : _____
   - Semi-Public : _____
   - Private : _____

6. Distribution of your business among different types of construction projects (as percentages)
   - Residential : _____
   - General Building (non-residential) : _____
   - Utility construction : _____
   - Industrial construction: _____
   - Others (specify) : _____
     _____
     _____

7. Is your organization ISO 9000 Certified? : O Yes O No

8. Job Title of Respondent : _____

Note:

The objective of this questionnaire is to identify the problems of the Saudi construction industry.

Please put a cross in the appropriate space for each problem of the Saudi construction industry. The responses for each item vary on five levels from strongly agree to strongly disagree. Strongly agree means that you accept or concede 100% the statement. Level (4) means that you 75% accept and agree with the item. Level (3) means that you are neutral and you agree 50% with the statement. Level (2) means that you 75% disagree with the statement. Finally, level (1) means that you 100% disagree with the statement.

No.	Problem	1 Strongly Agree	2 Agree	3 Undecided	4 Disagree	5 Strongly Disagree
1.	The Government 's requirement to hire Saudi nationals					
2.	The restriction on visas for foreign labour					
3.	Delay of payments					
4.	High competition (awarding contracts to the lowest bidder)					
5.	High turnover of labours					
6.	Unavailability of agencies dedicated for the construction industry					
7.	Legal system and arbitration					
8.	Multi-culture labour force					
9.	Various procurement procedures					
10.	Financial constraints					
11.	Lack of information about the market demand and future projects					
12.	Poor utilization and non-standardization of Information Technology					
13.	Poor specifications and contract documents of some project owners					
14.	Lack of coordination and bureaucracy of owners project team					
15.	Poor quality of workmanship					
16.	Lack of adequate planning					
17.	Poor communications (language wise)					
18.	Poor focus on customer					
19.	Fluctuation of the demand					
20.	Poor bid estimate					
21.	Design errors and delay of change orders					
22.	Poor productivity of untrained labours					

Please specify any other problem of the Saudi construction industry:

1.
2.
3.
4.
5.

APPENDIX 3.D
DERIVATION OF FORMULA FOR SAMPLE SIZE

The formula given derives from the normal approximation to the hypergeometric distribution (where there is a binary choice of outcome and samples are drawn without replacement).

The problem may be posed as follows. We may estimate the probability of a statement being agreed with as $\frac{X}{n}$, where X is the random variable denoting the number of favourable responses and n is the size of the sample. Suppose we want $\frac{X}{n}$ to have at least a $100(1-\alpha)\%$ probability of lying within a distance, d, of the true probability, p. The problem is solved if we can find the smallest n for which

$$P\left(-d \le \frac{X}{n} - p \le d\right) = 1-\alpha \qquad (1)$$

The probability will be unchanged if we divide all sides of the bracketed inequality by the standard deviation of $\frac{X}{n}$, $\sigma_{X/n}$, where for a hypergeometric distribution,

$$\sigma^2_{X/n} = \frac{p(1-p)}{n}\left(\frac{N-n}{N-1}\right) \qquad (2)$$

to produce

$$P\left(-\frac{d}{\sigma_{X/n}} \le \frac{\frac{X}{n}-p}{\sigma_{X/n}} \le \frac{d}{\sigma_{X/n}}\right) = 1-\alpha \qquad (3)$$

But

$$\frac{\frac{X}{n}-p}{\sigma_{X/n}} \approx Z \qquad (4)$$

where Z is the standard, normal random variable (representing the distance from the mean, measured in units of standard deviations). Hence equation (3) may be rewritten

$$P\left(-\frac{d}{\sigma_{X/n}} \le Z \le \frac{d}{\sigma_{X/n}}\right) = 1-\alpha \qquad (5)$$

But for a standard normal variable, the following equation holds:

$$P\left(-z_{\alpha/2} \le Z \le z_{\alpha/2}\right) = 1-\alpha \qquad (6)$$

where $z_{\alpha/2}$ is the distance from the mean at which the probability of exceeding is $\alpha/2$:

$$P\left(Z \ge z_{\alpha/2}\right) = \frac{\alpha}{2} \qquad (7)$$

Comparing equations (5) and (6), it is clear that

$$\frac{d}{\sigma_{X/n}} = z_{\alpha/2} \qquad (8)$$

Hence, using (2), we have

$$\frac{d}{\sqrt{\frac{p(1-p)}{n}\left(\frac{N-n}{N-1}\right)}} = z_{\alpha/2} \qquad (9)$$

Which may be rearranged to give:

$$n = \frac{Np(1-p)}{\left(\frac{d}{z_{\alpha/2}}\right)^2 (N-1) + p(1-p)} \qquad (10)$$

We are attempting to estimate p, and do not know it in advance. But we can calculate the maximum value that n will take for any value of p by differentiating and setting to zero:

$$\frac{dn}{dp} = N\frac{\left(\frac{d}{z_{\alpha/2}}\right)^2 (N-1)}{\left[\left(\frac{d}{z_{\alpha/2}}\right)^2 (N-1) + p(1-p)\right]^2}(1-2p) = 0 \qquad (11)$$

which implies $p = ½$. Hence the maximum value of n, whatever the value of p, is given by putting $p = ½$ into equation (10):

$$n = \frac{N/4}{\left(\frac{d}{z_{\propto/2}}\right)^2 (N-1) + \frac{1}{4}} = \frac{N}{4\left(\frac{d}{z_{\propto/2}}\right)^2 (N-1) + 1} \qquad (12)$$

For the given value of $N = 497$, the following table may be constructed:

Confidence Interval (%)	**Margin of error on *p***			
	0.05	**0.1**	**0.15**	**0.2**
80	124	38	18	11
85	147	48	23	13
90	176	60	29	17
95	217	81	40	23
99	285	125	65	39

So if the requirement is to be 95% confident that the estimation will produce an estimate within a distance of 0.1 of the true probability, then a sample of 81 is required.

But, for instance, reducing the requirement to 90% confidence that the estimate will be within 0.15 of the true probability means that a sample of only 29 is required.

And there is certainly information to be gained from even smaller samples.

CHAPTER-4

TQM IMPLEMENTATION IN THE SAUDI CONSTRUCTION INDUSTRY: QUALITATIVE RESULTS

4.1 Overview

This chapter presents the results of the feedback from personal interviews, which were conducted with contractors and design offices.

Throughout this chapter the following research objectives are satisfied (see section 1.5):

1. to identify the size of TQM awareness in the Saudi construction industry
2. to identify and analyse the difficulties of introducing TQM in the Saudi construction industry.

The nature of the search (exploratory), and the lack of previous studies in this area, dictates the use of a qualitative approach in the form of personal interviews. The personal interviews were important to achieve a better understanding of the overall situation. The personal interviews allowed unusual responses to be derived and provided an effective vehicle to build up a wider and deeper understanding of the reality of the situation. However, it is acknowledged that results from personal interviews can also be difficult to generalize and validate. Therefore, a quantitative approach was employed (see Chapter 5) in order to examine the validity of the results collected via the personal interviews.

The findings and the results of this chapter were employed in preparing the mailing questionnaire to identify the awareness and difficulties of TQM implementation in the Saudi construction industry. The results of the mailing questionnaire (quantitative) are reported in Chapter 5.

4.2 Contractors' Interviews Results

Ten contractors were interviewed. The objectives of these interviews were to identify the size of TQM awareness in the Saudi construction industry and the difficulties that Saudi contractor companies experienced in attempting to comply with the principles of TQM. These contractors were relatively large and had an average of 25 years business experience. The average labour force of these companies was about 3,200 employees. The average project size of these contractors was approximately SR 30 million ($8million) and the average project duration was 16 months. Most of their business was with the semi-public sector and most of their projects were industrial projects.

Although none of the contractors, who were interviewed, classified themselves as being a TQM firm, all of them were interested in and had made efforts to enhance the quality of their services and products. Three contractors were ISO 9002 certified firms. In fact, it was obvious from the interviews that there was an interest and trend among Saudi contractors in becoming ISO 9002 certified.

Those who were not certified indicated that they were either in the process or thinking seriously of becoming ISO 9000 certified firms. Those who were ISO 9002 certified firms indicated that the initial idea for certification was to use it as a marketing tool. However, later these contractors discovered the advantages of ISO 9000 and gained a return as a result of the activities that were required by ISO 9000 certification.

The interviews revealed that the best approach for ISO 9000 deployment was to designate a Q/A engineer to work as a full time Quality Manager and develop the procedures required by ISO 9000. The discussion regarding ISO 9000 versus TQM indicated that ISO 9000 is a very well-structured approach and can be achieved easier. On the other hand,

TQM was sometimes seen as mysterious because it does not have a specific structure and was perceived to be difficult to implement in the construction industry. The contractors were profit-oriented and the gains of implementing TQM are not guaranteed and difficult to measure.

Being ISO 9002 certified, even if it is costly, was a marketing tool for many contractors as well as preparation for the future, in the event that owners might request it as a part of the technical pre-qualification. One contractor indicated that ISO 9000 was the path toward TQM and TQM implementation was the next step in their future plans.

TQM principles and tools were discussed during the interviews. Some of the principles and tools of TQM have been implemented by Saudi contractors. Others, if not most, have not implemented for many different reasons. These reasons are discussed in the contractors' feedback regarding TQM principles and tools for implementation in the Saudi construction industry, which is summarized below

Contractor Company Feedback on TQM Principles Implementation

4.2.1 Training

The employees can be divided into professionals and labourers. Professionals are engineers, architects, accountants, etc., who are assumed to be experts in their fields, since they are hired with in-depth experience and higher level qualifications. These professionals come from different countries. Indeed, it is rare to find Saudi nationals working for Saudi contractors in the professional categories. Furthermore, the uncertainty and instability of the construction industry created more difficulty in investing in training employees. The number of labourers varies drastically from one time to another in the same company due to business cycle fluctuations. The uncertainty and competition in the

construction industry represented the major obstacles to investing in training human resources.

It was rare to find a Saudi contractor who allocates a reasonable training budget. None of the contractors interviewed had a training division or even a training coordinator. And according to those who were interviewed, this is the case with all the contractors in Saudi Arabia. Some of the more successful construction firms occasionally send their engineers and management personnel for short courses and seminars. There is no training given to labourers. Labourers are looked on as 'doers' and it is assumed that they can learn their skills on the job. It would appear that contractors in Saudi Arabia are not willing to spend money on training their workers. However, one of the interviewees indicated that his firm was willing to invest in training workers if such training programmes are available at reasonable cost in the market.

4.2.2 Management Commitment and Leadership

Management commitment towards quality in Saudi Arabia varies from one firm to another. The senior management in construction firms are very much influenced by the company owners. Most of the construction firms are owned by an individual or family and the president and the vice presidents are commonly the owners. Hence, the background, experience and education of the owner play an important role in the management style. It is difficult for the management to be committed toward any issue without the owner's commitment and support. Many large construction firms established in the early 1970s are experiencing changes in their style of management due to the transformation of the ownership from the older generation to the younger. The young owners usually have a broader perspective and better education than their fathers. They are more enthusiastic about experimenting with new techniques, concepts and

management styles. For example, the research found one of the companies had considered TQM and had an interest in quality management in a distinctive manner. According to the Quality Manager, who was interviewed, the company witnessed a dramatic change in its style of management after the son of the owner assumed the responsibility for running the company. The son of the owner is an engineer and more educated than his father who had established the company 30 years previously.

It is not within the scope of this study to determine the relationship between management commitment and their backgrounds. However, it was one of the major observations throughout the interviews findings.

Management commitment towards quality reflected management mentality. However, it is very difficult to measure management commitment towards quality. As the answer to a direct question, all interviewees claimed that their management is committed towards quality; however, most of them failed to provide hard evidence to support their claims. A more specific question regarding whether their management participate in activities that are related to quality improvement, respondents indicated that the upper management in only 3 out of the 10 companies are directly involved in activities related to quality management. For those who indicated that their management is not involved in such activity, the following reasons were given:

1. Lack of management time
2. Management should not be directly involved in quality activities
3. Management delegates quality improvement to a Quality Manager

4.2.3 Communication

Construction firms have poor communication. Labourers and even project managers are not informed about the firm's goals, objectives and plans. The language barrier creates difficulties in conveying instructions to the labourers when the foreman speaks a different language to them. Most labourers have a poor understanding of languages other than their own mother tongue.

A number of the interviewees indicated that one of the reasons for not keeping the labour-force or even field engineers informed about the company is that the relationship between the field workers and the firm is viewed as temporary. There is always a feeling that these field workers might be laid off after the completion of a project. Furthermore, there is a feeling that keeping workers informed would not add any benefit to the firm

Fear is also one of the reasons for poor communication. Fear prevents labourers, as well as other employees, from articulating their suggestions, concerns or even complaints. Labourers are afraid of their foremen and project managers. The fear increases when the labourers come from poor countries such as the Indian subcontinent and South-East Asia while their foremen come from Western or Middle East countries. Fear drives labourers to pretend that they have understood the foreman's instructions even if they do not have the slightest idea about his message. Management in construction firms ignore the labourers' fears and in some cases they even instil it through encouraging foremen and project managers to be rough with their workers. Management in construction firms confuse leadership with being ferocious.

4.2.4 Team Work

The construction firms who are in the ISO 9000 certification process conduct meetings and sometimes form committees to review the documents required for ISO 9000. In the administrative activities, the team work approach is very common. However, on the operational level, some companies group their labourers into small crews working under the supervision of one foreman.

One of the interviewees indicated that teamwork is only effective in one form: the grouping of labourers into a crew, where a foreman is responsible and accountable for the productivity and workmanship of that crew. Another interviewee indicated that it is advisable to have the nationality of a foreman different than the nationality of his crew in order to remove any possible sympathy between the foreman and the crew. Certainly, this attitude defeats the purpose of teamwork. However, there is a noticeable perception in the industry that the construction industry is a tough business where you need to force people to work, especially at the low level of the operation.

4.2.5 Customer Satisfaction

From the interviews, it was observed that Saudi contractors do not pay sufficient attention to customer satisfaction. Both internal and external customers are left without serious consideration. Some contractors claimed that they do their best to satisfy their clients through meeting their expectations. However, these contractors failed to come up with examples of the ways in which they measured customer satisfaction to support their claims. The claim of some contractors that they do their best to achieve customer satisfaction is only a slogan that has no material impact on their activities and practices.

External Customers

According to the contractors, the nature of the construction industry, and the relationship with their clients, prevented them from conducting an information gathering programme that would measure the level of customer satisfaction. The lack of continuity in the relationship between the contractors and their clients made them look on each project as nothing more than a temporary binding tie in their relationship. Owner companies in Saudi Arabia award their contracts based upon the lowest-bid commercial proposal of any technically qualified contractor. The technical qualification criteria do not take into consideration the relationship between the contractor and the client. In fact, it is difficult to quantify the customer satisfaction element in technical qualification criteria.

Internal Customers

Labourers, professionals (e.g. engineers, project managers and foremen) and departments are defined as the internal customers in any construction firm.

The authoritarian relationship between the labourers and their management is a typical characteristic in the industry. The relationships among different departments and divisions within the organization are generally healthy, especially in ISO 9000 certified firms. One reason behind this is that the preparation of quality manuals requires coordination and liaison between different divisions and departments and this enhances communication and sometimes even personal relationships as one of the interviewees indicated.

4.2.6 Focus on Employees

This element of TQM is very much related to customer satisfaction (i.e. internal customer). The construction industry is a labour-intensive industry. The satisfaction of labourers as internal customers in Saudi Arabia is different from anywhere else and contradicts the

basic requirements for TQM. Labourers come from poor countries with very low income. Most of the construction firms in Saudi Arabia do not pay any attention to these labourers. The interviews revealed that there is a split among those in the construction industry in their assessment of labour satisfaction in Saudi Arabia.

Westerners view the standard of living, working conditions and the treatment the labourers receive as unacceptable and "inhuman". This point of view is stronger among westerners who have limited international experience. On the other hand, Middle Easterners and even those who come from the labourers' countries have a different perspective on labour satisfaction. These argue that the labourers have a worse standard of living and work conditions in their own countries.

There is a consensus agreement, even among those who are sympathetic toward labour, that poor treatment of labour has no impact on the quality of their performance. However, improving the treatment might increase their productivity. The effect of enhancing the labourers' treatment can materialize in higher productivity.

Some construction firms realized the importance of the labourers' morale on their productivity, which led them to take it into consideration. One of the companies surveyed organizes various games and contests to boost the morale of labour and to occupy their limited leisure time. However, there was no hard evidence that workers with high sense of morale would have better productivity. On the other hand, one the interviewees indicated that paying attention to the labours' morale helps in earning their loyalty.

The professional workforce in Saudi construction firms receive different treatment than labourers. The interviews indicated that their treatment is generally fine and they feel that their level of satisfaction will not differ much anywhere else.

4.2.7 Process Improvement

Some construction firms perceive improving processes as cutting corners. However, it has been noted throughout the interviews that Saudi construction firms do not have structured approaches for improving processes. Improvements usually occur as a result of their experiences or the initiatives of individual engineers or management personnel on an ad-hoc basis.

One of the interviewees indicated that his company conducts project evaluation for their major projects. The interviewee, who was the Quality Manager, indicated that his company applies Statistical Quality Control (SQC) and Statistical Process Control (SPC) techniques in monitoring defective work and re-work. The Quality Manger has a good background in SPC and the company is involved in executing pipelines projects. This could explain the reasons for conducting SPC techniques in this company.

On the other hand, another interviewee indicated that process improvement techniques are not popular in the construction industry because of the discontinuity of the business. For example, the large investment in terms of time and money in conducting SPC analysis might not be worth it in the construction industry where each project is discrete from others. He added that SPC is useful in manufacturing where there are steady state processes.

Two interviewees indicated that their firms conduct reviews for their business processes, especially the office activities but not the field activities. One of them indicated that ISO 9000 deployment involves review of the business processes. However, even those who review their processes for improvement do not measure the performance effect and depend merely on their subjective judgment and observation.

4.2.8 Suppliers Involvement

Most of the construction firms send their requests for quotation to as many suppliers as are available in the marketplace and then evaluate their quotations on a lowest-bid financial basis only. Only a few of them (three out of the 10 firms interviewed) deal with a limited number of suppliers provided that they have a special rate. In other words, the concept of partnership, which is one of the concepts that TQM advocates, is not popular in the Saudi construction industry.

One of the interviewees explained to the researcher what he believes is the situation of the relationship between the contractor and the suppliers. According to him, the contractors have two different strategies depending on the type of contract. If the contract is a lump sum, the contractor surveys the market for the best price. However, if the material is not part of the contract, the contractor recommends certain suppliers to the owner where the owner can benefit from such recommendation such as favourable prices when the contractor has a lump sum contract or even a special commission.

It was clear from the interviews that the major concern of the contractors is cost and they have little consideration for other issues such the time of delivery.

4.2.9 Continuous Improvement

The discussion with the interviewees regarding continuous improvement revealed that the competitive nature of the construction industry creates a major challenge for any contractor who is interested to adopt continuous improvement as a strategy. One the interviewees explained that the incentive to adopt a continuous improvement strategy is to observe the impact on the firm's performance. However, in the construction industry the performance, especially financial performance, is related to the national economy. In other words, external factors, such as the demand on construction, are more influential on the firm's intentions to adopt continuous improvement as a strategy.

Discussion

The interviews indicated that Saudi contractors are interested in seeing a rapid positive impact on their profitability. This was obvious through their enthusiasm for ISO 9000 certification, which is viewed as a marketing tool. In other words, the strongest motivator for Saudi contractors is the monetary impact. The benefits of TQM implementation require patient and long-term commitment before they can be realized (Hendricks and Singhal ,1999). This makes Saudi contractors hesitant to invest their time and money in TQM implementation.

Furthermore, the interviews revealed that business cycle fluctuation mitigates against contractors investing in training their labourers, whose number will naturally vary from time to time. This factor is an external one and contractors have no control over it. The decision whether the training will pay off or not cannot be made since the continuity of the labour force is not guaranteed. Furthermore, it seems that appropriate training at reasonable cost is not available.

The discontinuous nature of the construction industry also affects other elements of TQM such as customer satisfaction and supplier involvement. Customer satisfaction which is one of the essences of TQM does not pay off and consequently management, in some cases, are not committed towards quality. This is more prevalent for the contractor bidding on competitive projects where reputation is not an issue.

The competition in the market, and the effect of the demand fluctuations, work against the contractor forming a long-term vision. This also leads to scepticism towards continuous improvement.

The nature of the construction industry creates challenges for any contractor who is interested in adopting TQM, and complying with its elements as they are presented in Chapter 2 (Literature Review). However, quality management in general, and TQM in particular, can help in building up what could be called a conscious awareness of quality and the benefits of reconsidering the business practice of the firm. Some interviewees revealed that their companies benefited from deploying an ISO 9000 certification process and realized the importance of quality management.

4.3 Design Offices' Interview Results

Employees from ten design offices were interviewed in the study. The interviews included mainly large design offices with more than 200 employees. Small design offices were excluded because they mainly provide their services to individuals with little or no basic engineering background. In these cases, quality is not of primary importance; it is only the cost and aesthetic aspect of the design that are areas of major concern to their clients.

The interviewed design offices exhibited various degrees of a quality management system implementation. TQM terminology is not well known to most of the interviewees. Most of the interviewees had heard about TQM. However, they did not have a good understanding of the TQM concept. On the other hand, there is a trend among large design offices to adopt certain quality management systems. As in the case with contracting companies, ISO 9000 certification is being considered by a number of design offices.

The interviews revealed that, as is the case with contractors, the motivation to implement a quality system is to fulfil the expectations and requirements of the largest and most influential owners in the market.

Furthermore, design offices have a belief in the benefits of introducing a quality management system. Some design offices believe that enhancing the quality will result in reducing cost and increasing their profit margins. In addition, avoiding mistakes increases the productivity and the efficiency of their operation.

One of the ten largest design offices in Saudi Arabia established a scale to measure quality improvement. The scale was designed to maintain a record of the number of mistakes in each project design. Their ultimate objective is to produce "a mistake-free design". According to the Quality Manager, quality improvement should be reflected in their final product which is the final design. Each mistake or comment received either from owner or contractor on each project is recorded and investigated to avoid its occurrence in future projects.

The interviewees claimed that TQM, or any quality system if implemented by design offices, has a better chance of success and is less challenging than it is for construction firms. The main reasons for this were found to be the following:

1. The calibre, background and education of the employees who are working in design offices are influential factors. These employees are professional in most instances while construction firms have workers and semi-professional employees.
2. Design offices have smaller numbers of employees, which results in making any attempt to implement TQM more controllable and practicable. On the other hand, construction firms have large numbers of employees.
3. The nature of design office business adds an advantage over construction firms for successful TQM implementation. This reason is very much related to the first and second reasons. The output of each employee, quality and quantity, can be monitored more easily in the design offices.

4. Resistance from employees towards changes required by TQM implementation is less in design offices. This reason is very much related to the first reason.

TQM principles and tools were discussed during the interviews. Given below is a summary of the feedback from design offices regarding TQM principles and tools in their business.

Designers' Feedback on TQM Principles Implementation

4.3.1 Training

Design offices pay attention to training. However, the size and cost constraint of design offices do not justify having a full-time training coordinator. Design offices realize that their employees are their major asset. Therefore, it is important for design offices to have well-trained employees. Two approaches are available for design offices to build up their human resources assets. Some offices are very selective in hiring their employees. These offices look for highly qualified engineers, draftsmen, etc., who are at the same time highly paid. On the other hand, some offices are more interested in hiring young engineers and employees with limited experience. They are underpaid, and investment is made in their training over time. Nationality plays an important role in either approach. The design offices who are more interested in hiring young employees usually hire Asians, such as Indians and Filipinos because they are very much underpaid in relation to their academic background and in comparison with the salaries of other nationals. Furthermore, Asians are much more likely to continue with the same employer than other nationals. Recently, design offices have begun to hire a few Saudi engineers, draftsmen and others as a result of the Government policy in nationalization of jobs as a solution of the unemployment problem. Owners of the design offices who were interviewed indicated that they are eager to invest in training Saudis in order to make better use of them, especially as Saudis are

more costly than expatriates who are more experienced. However, Saudis are free to leave any time and owners are afraid that Saudis will quit their jobs after they gain experience and are well-trained.

Some large design offices conduct in-house training. Furthermore, some design offices send their engineers and employees for short courses and seminars conducted locally. The decision regarding sending an employee to a course is influenced by certain factors such as the duration of the course, the cost and the immediate benefits on the employees' work. Most design offices in which interviews were conducted are more interested in training directed towards a certain skill rather than training that will add indirectly towards an employee's growth. For example, design offices are interested in training CAD operators and in software training.

4.3.2 Management Commitment and Leadership

Management commitment towards TQM comes from the design office owner. The role of the design office owner is essential in any strategic management decision in design offices. In fact, it was noticed through the interviews that those offices which have progressed furthest in deploying a quality management system have owners who have a deep understanding and appreciation of quality.

As for the contractors, the interviews indicated that their management is committed towards quality. However, the interviews revealed that the management of design offices are more committed towards quality and that was obvious throughout the examples that the interviews cited to support their claims. For example, the management of the design offices discuss issues of quality regularly with their employees.

4.3.3 Communication

The interviewees claimed that design offices have a healthy environment which reflects itself in good communication among the employees on one hand and between the employees and their management on the other. The education and background of the design office employees help to create good communication. Language barriers rarely exist, even though employees come from different countries. English is the business language in Saudi design offices. The relatively smaller number of employees in design offices and the direct involvement of the owner also play an important role in fostering good communication.

4.3.4 Team work

Employees in design offices work independently. The Design Project Manager usually divides the design and assigns each engineer and draftsman to do his portion. Collective activities scarcely exist in design offices. However, some design offices conduct peer review to assure the correctness of the design. Design offices consider peer review as an extra attempt to enhance the quality of the design and avoid mistakes. The sensitivity of the project and the client play an important role in whether the office conducts peer review as a quality assurance technique.

4.3.5 Customer Satisfaction

Those who were interviewed indicated that customer satisfaction is important and that special attention is paid to this. However, they could not provide concrete examples of the practices that they implement to satisfy their external customers, other than the previously mentioned "Mistake-free Design". Design offices have two kinds of external customers: individuals and organizations. Individuals' projects vary from residential projects to small and intermediate commercial projects. Individual clients are more interested in

perspectives and appearance. Technical details are usually not important unless the client has an engineering background.

Organization clients usually include companies with an engineering division, Government agencies, etc. Projects are usually larger and more complex. Design offices with this kind of client deal with technically qualified client representatives, which require them to pay extra attention to technical details.

4.3.6 Process Improvement

This element of the TQM concept is partially important for design offices due to the nature of design offices' services and operations. One of the interviewees explained that the design office business does not require the implementation of SPC techniques. Furthermore, the business process of design offices is not as complicated as in other businesses. However, the management aligns itself to adopting and benefiting from various feasible ideas. For example, the management might consider introducing new technology or purchasing new software. Such a decision, which might fall under process improvement, usually takes place as a result of the feasibility for such a decision.

4.3.7 Supplier Involvement

Most of the design offices were confused about the term supplier. Unlike the contractors who deal with material suppliers, design offices do not deal with suppliers other than those which provide the basic office stationery and equipment such as computers and furniture. In fact, the definition of suppliers under TQM is not limited to external suppliers. TQM recognizes the chain of customers and suppliers for any process including its internal business processes. Most of the interviewees did not have this perception of the suppliers' involvement. The interviewees indicated that good internal communication between the

supplier and customers guarantee a good business process. However, the interviewees indicated that suppliers as external material providers are not an important element for them, since such a need is not crucial in their business.

4.3.8 Focus on Employees

Interviews revealed that working conditions and the relationship between the management and the employees are much better than in construction firms. However, the management does not usually have a specific method or strategy for expressing their concern towards their employees. For example, none of the design offices which were interviewed conducted employee satisfaction surveys.

4.3.9 Continuous Improvement

The offices in which interviews were conducted indicated an interest in making continuous improvement. Continuous improvement for them is the only way to stay in the market and compete with others. Most of the offices interviewed compared the situation of their office in its early days with what it has reached over time and considered it a result of their desire for continuous improvement. This could be superficially thought of as a good example of their concern for the concept of continuous improvement. However, continuous improvement should be the continuous process of improvement rather than the natural growth in business due to internal and/or external factors. Continuous improvement dictates a continuous search for new ideas and requires a proactive attitude rather than a reactive attitude.

Discussion

The interviews with the design offices revealed that they are in a better position to comply with TQM elements. The high competition and the fluctuation of demand were not issues

that the researcher kept hearing from the interviewees as was the case with the contracting companies. Design offices do not have labour problems, which might make their business more efficient.

Some of the TQM tools, such as SPC techniques, might not be appropriate for design offices. TQM, as a concept, has appeared and evolved in the manufacturing industry where the business nature is different from that in the design offices. Furthermore, design offices have an 'artistic' sensibility and are in business to satisfy their customer tastes, which are intangible.

4.4 Summary

This chapter has reported the finding of face-to-face interviewees with ten contractors and ten design offices. The interviews addressed the TQM elements and the difficulties in complying with the TQM elements. The findings of these interviews were employed to develop the questions of the mailing questionnaire. The findings of the mailing questionnaire will be presented in Chapter 5. In other words, the findings of this chapter will be validated and generalized through the mailing questionnaire (quantitative) where statistical analysis and tests can be performed.

CHAPTER-5

TQM IMPLEMENTATION IN THE SAUDI CONSTRUCTION INDUSTRY: QUANTITATIVE RESULTS

5.1 Overview

This chapter complements the findings of Chapter 4, which has reported the findings of personal interviews with both contractors and design offices. The findings of these interviews are examined quantitatively in this chapter. The questionnaire which was distributed to the contractors and design offices is contained in Appendix 3.B (p. 75).

The objective of the mailing questionnaire is to examine, validate and generalize the findings of the personal interviews in a more quantitative way. In addition, this chapter provides a comparative analysis of the qualitative findings (personal interviews) and the quantitative findings (mailing questionnaire).

5.2 Data Collection

According to the calculations presented in Chapter 3, the sample size with a margin of error of 10% stands at 81 and 84 for contractors and design offices respectively. However, the researcher decided to increase the number of questionnaires to 150. The reason for increasing the sample size is to compensate for both low response and unusable[1] responses. The fact that the rate of response is less than 100% makes the selected sample as a non-probabilistic sample (See section 3.5.3- Chapter 3).

The sample is thus conditional on the firm being prepared to answer the questionnaire. Intuitively, this greater willingness to answer the questionnaire may imply a greater familiarity with and interest in the questionnaire's subject and hence, possibly, a greater propensity to apply some TQM concepts. To a certain extent, this potential bias was

[1] The unusable responses include respondents with wrong mailing addresses and when a major part of the questionnaire was not answered or more than one answer was given for the same question.

reduced through a decision to increase the rate of response by an additional, direct approach on the telephone, which converted a good many non-responders into responders

The responses received are 18 for contracting companies and 14 for design offices. In other words, 12% of the 150 surveyed contractors and 9% of the 150 surveyed design offices responded.

In order to increase the rate of response and to reach an acceptable sample size, the researcher also conducted telephone interviews. The researcher called the respondents and filled-out the questionnaire over the phone. Most of the respondents were cooperative. However, many of the respondents had reservations about revealing financial information such as their business volume. In fact, one of the respondents indicated that the question related to their annual business volume made him choose not to respond.

However, the researcher discovered that filling-out the questionnaire by phone had many advantages such as:

1. It provides the respondent with a better explanation to the questions
2. It eliminates the dubiousness of the intention and the source of the questionnaire.
3. The chance for refusal to respond is low

Nevertheless, drawbacks are evident in such a method. The problem with telephone calls is that they are time consuming. The researcher needed an average 30 minutes to fill each response. The actual time to fill-out each questionnaire should not have been more than 15 minutes. In many cases, the right person was not there and the researcher had to call on an alternative day. Also, the researcher in many cases had to carry out

irrelevant conversation with the respondents. Some of the respondents decided to fax their response as a result of the telephone call instead of responding over the telephone.

The respondents who participated in completing the questionnaire held various job-titles including Business Development Managers, General Managers, Project Engineers Architecture and Quality Managers/ Engineers. The majority of the respondents (more than 50%) were Senior Engineers.

5.3 Description of the Respondents

Contractors

The contractor respondents vary in their number of years in business, ranging between 15 to 43 years. The number of employees varies between 300 to 5500 employees. The annual business volume ranges from 25 Million Saudi Riyals(SR) ($1= SR 3.75) to 300 Million Riyals. The respondents have business distributed across both the public and private sectors. Seventeen (17) of the respondents are ISO 9000 certified. The questionnaire was answered by senior management personnel: President, General Manager, Quality Manager, Operation Manager and Project Manager and Site Engineer.

Design Offices

The respondents vary in the number of years in business, ranging from 8 to 25 years. The number of employees varies between 14 to 220 employees. The annul business volume ranges between 25 Million Saudi Riyals (SR) ($1= SR 3.75) and 300 Million Riyals. [2]Again, the respondents have business distributed across both the public and private sectors. Three (3) of the respondents are ISO 9000 certified. The questionnaire was answered by the General Manager, Quality Manager, Office Manager, Architect and Civil Engineer.

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[2] The annual business volume is not the annual income. It is the annual size of their design projects.

5.4 Results and Analysis

In order to gain a full understanding of the results, we start with the Spearman Rank Correlation test, then use the line fitting and correlation calculation of the Regression Analysis to gain an additional insight into the Spearman result, then use the Difference of Means test as a distinct check on the two correlation tests.

If all three tests were perfectly in unison, then we would expect the following sets of result:

Table 5.1: The Patterns of Test Results When the Tests Are Perfectly in Unison

Spearman Rank correlation conclusion	Regression correlation conclusion	Inference on Means	Similarity or otherwise of response of contractors and designers
Strong	Strong	Very similar	Significantly similar
Moderate	Moderate	Similar	Significantly Similar
Weak	Weak	Dissimilar or very dissimilar	Significantly different
Weak or strong negative	Weak or strong negative	Dissimilar or very dissimilar	Significantly different

Any break from this pattern should be investigated.

The questionnaire is of such a form that it may bring out differences between contractors and designers in the first instance, and then, via a sub-grouping of the questions and the associated responses, bring out similarities.

Appendix 5.A presents the results of the Spearman Rank Coefficient Correlation test and Appendix 5.B presents the results of the Linear Regression Analysis test. Appendix 5.C presents the results of the Difference of Means test between the contractors and

designers. Finally, Appendix 5.D presents a summary of the three tests. These tests were introduced in Chapter 3 (Research Methodology-sections 3.6.2, 3.6.3 and 3.6.4).

It is worth mentioning here that the difference of means test is based on assigning an arbitrary mark to each statement based on its importance. Therefore, there is a degree of subjectivity involved in this test since the mark of each trial statement is assigned based on a personal judgment of the importance of that statement.

As part of the analysis, some of the trial statements were combined by adding the percentage of the statements that have similarities and can be combined. Combining of trial statements was carried out for the following categories:

1. Training
2. Management Commitment
3. Communication
4. Customer Satisfaction
5. Focus on Employees (empowerment)
6. Process Improvement

Implicitly related trial statements were combined, and the means difference test, the Spearman rank correlation test and the linear regression test were conducted. The results of the analysis for combined statements are included as part of Appendices 5.A, 5.B, 5.C and 5.D.

5.4.1 Training

Figure 5.1 depicts the responses of contractors and design offices regarding training. The Spearman rank correlation test indicates that contractors and designers are weakly correlated in this respect (See Appendix 5.A). Furthermore, the linear regression

analysis concludes that the regression is weak between contractors and designers (See Appendix 5.B). The difference of means test indicates that that contractors and designers are different (dissimilar) in their responses (See Appendix 5.C). Thus, the conclusion that can be drawn is that contractors and designers have different responses regarding training.

On the other hand, the analysis of the combined statements draws a different conclusion. Figure 5.2 depicts the combined responses of contractors and design offices regarding training. The Spearman correlation test suggests strong correlation while the linear regression test indicates moderate to strong regression and the difference of means test indicates similarity between the contractors and designers. The reason for these different conclusions is that the combined statements include professional and unprofessional workers. For example, while 5.88% of the contractors indicated that all workers are sent for training, the combined statements demonstrated that 25.88% of the contractors send some or all workers for training. The personal interviews conducted earlier revealed that most Saudi contractors do not invest in training their workers at labour level (See section 4.2). On the other hand, some contractors send their professional staff for training. This could explain the significant change in the total number of responses when the statement of *some* was combined with the statement of *all*. Furthermore, while 20% of the contractors indicated that employees are not sent for training because of high turnover of employees, only 3.53% of the designers considered high turnover of employees as a reason for not sending their employees for training. High turnover of workers is an economic factor. Therefore, when this factor was combined with another factor, that of the cost of training, the gap in responses between the contractors and designers became smaller (35.29 % of the contractors and 31.77 % of the designers).

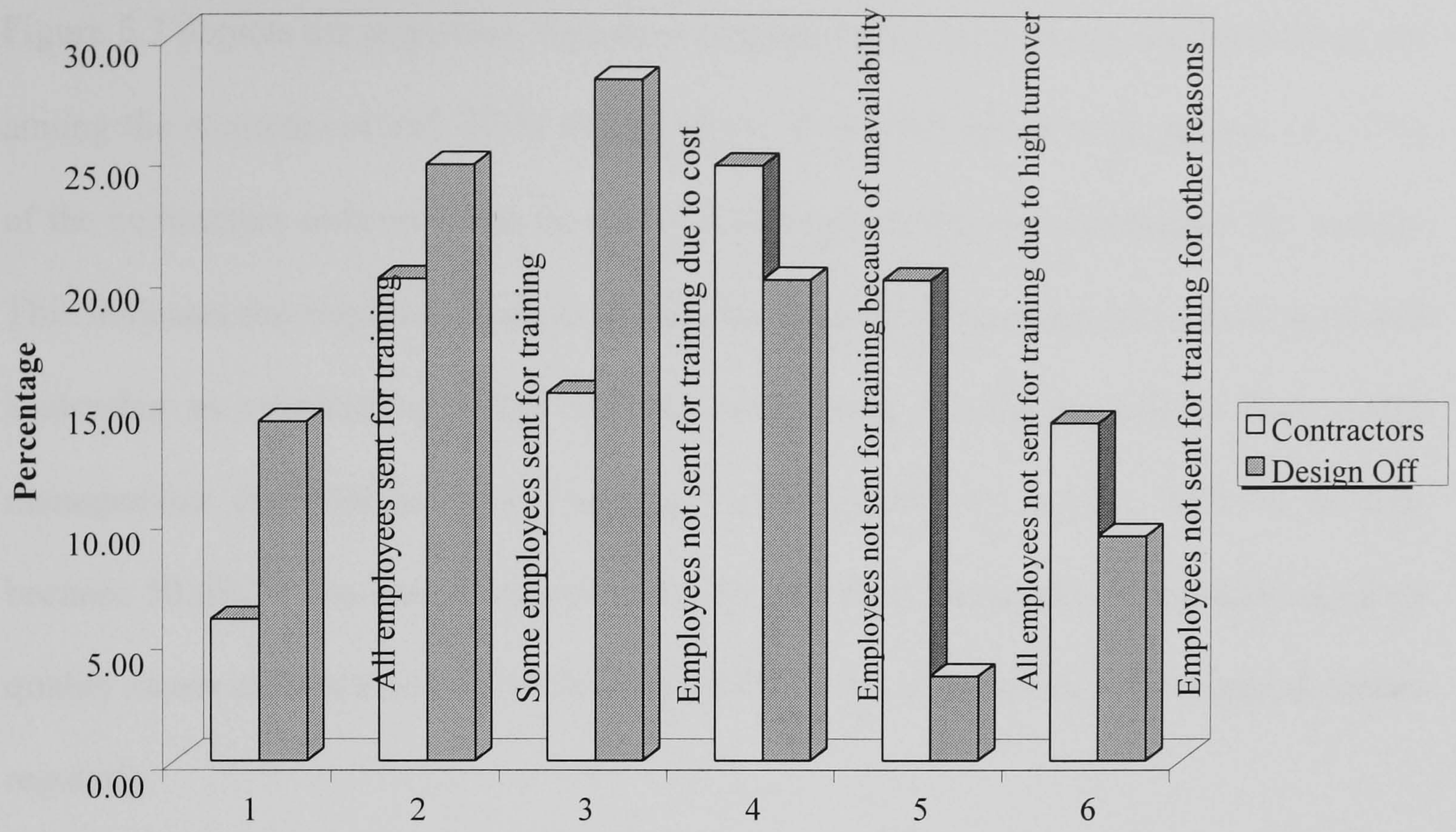


Figure 5.1: Responses of Statements Related to Training

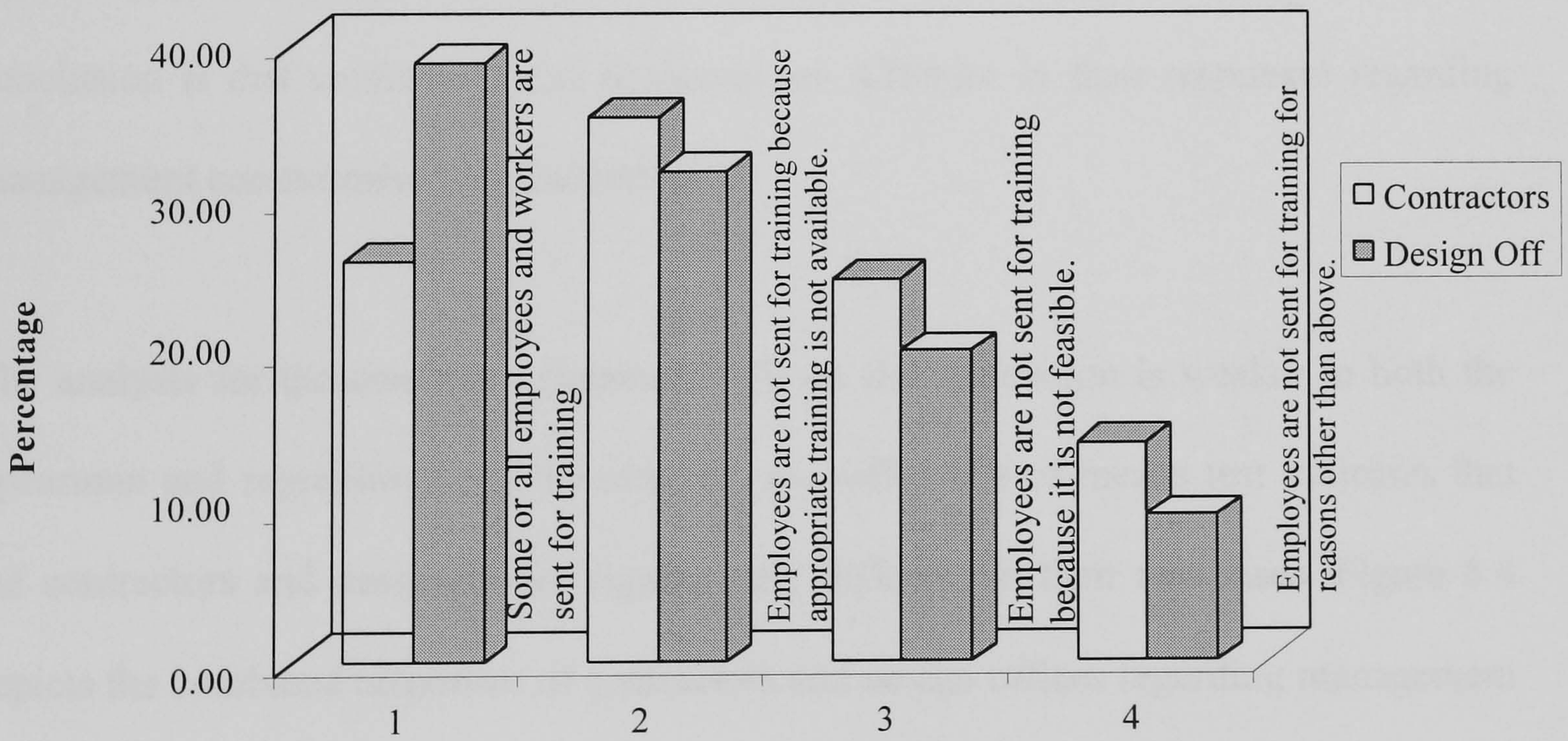


Figure 5.2 Combined Responses for Training Statements

5.4.2 Management Commitment and Leadership

Figure 5.3 depicts the responses regarding management commitment and leadership, are among the elements of any TQM organization. Forty-two point three percent (42.3 %) of the contractors indicated that the QC/QA manager is the one responsible for quality. This indicates the respondents do not have the necessary management commitment and leadership as required by TQM. On the other hand, the design offices have better management commitment and leadership with regards to quality. This is evident because 50.6% of the design offices indicated that their management regularly reviews quality issues at their meeting, while only 29.4% of the contractors review quality issues regularly.

The Spearman Rank Coefficient Correlation test indicates that contractors and designers have moderate correlation, while the linear regression test indicates weak correlation. In addition, the difference of means test demonstrates that contractors and designers are significantly different in their responses. Thus, the three tests agree with each other and conclusion is that contractors and designers are different in their responses regarding management commitment and leadership.

The analysis for the combined statements shows the correlation is weaker in both the Spearman and regression tests. In addition, the difference of means test indicates that the contractors and designers are significantly different in their responses. Figure 5.4 depicts the combined responses of contractors and design offices regarding management commitment and leadership.

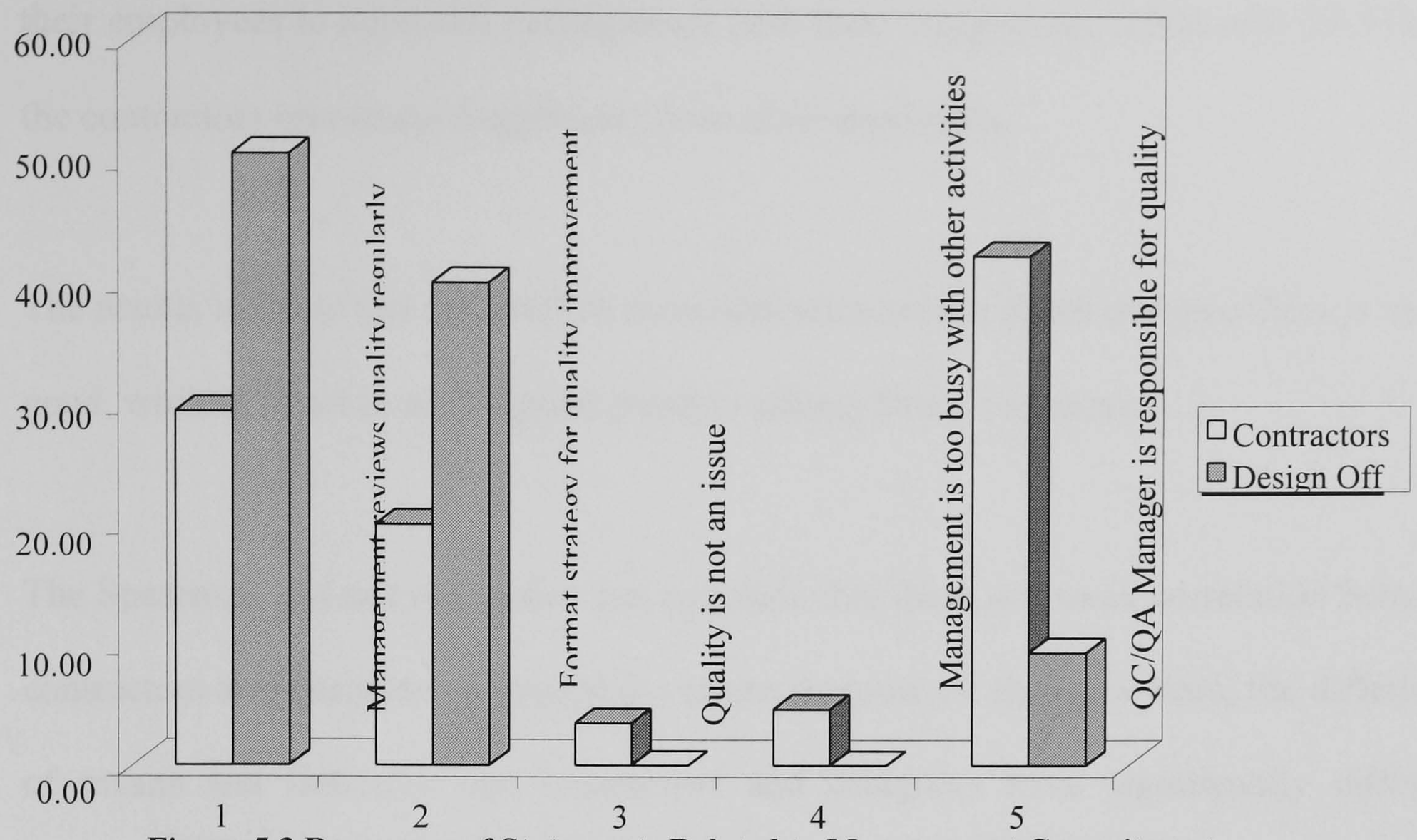


Figure 5.3 Responses of Statements Related to Management Commitment

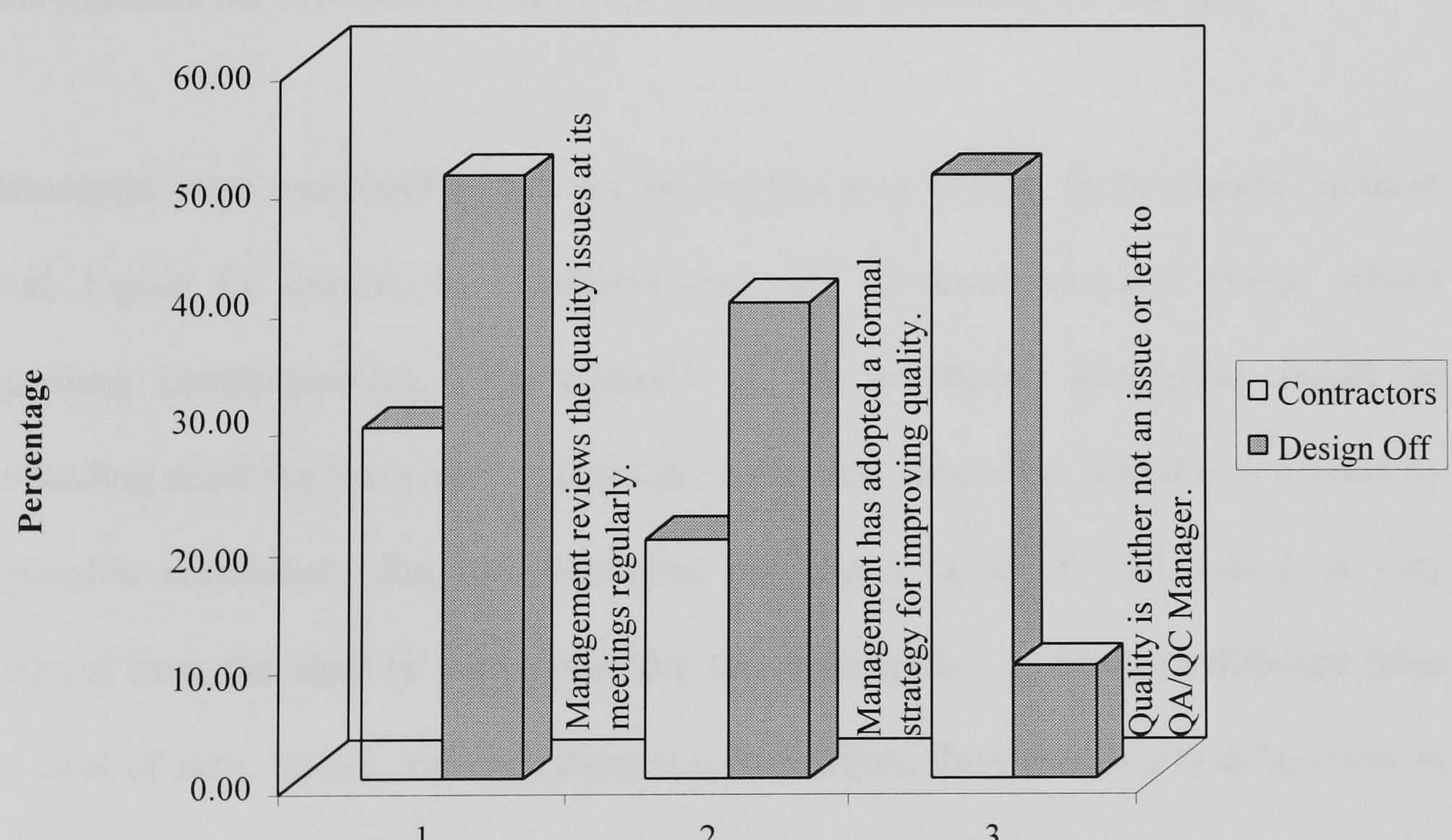


Figure 5.4 Combined Responses for Management Commitment and Leadership Statements

5.4.3 Communication

Figure 5.5 depicts the responses regarding communications. While 44.7% of the design offices stated that they keep all their employees informed of the firm's plans, only

14.1% of the contractors do so. Furthermore, 45.58% of the design offices encourage their employees to approach management with their suggestions, while only 23.53% of the contractors encourage suggestions from their employees.

The results indicate that the level of communication within Saudi design offices is very good, while it is not in such a good position among Saudi contractors.

The Spearman test and regression test conclude that there is a weak correlation between contractors and designers in regard to communication. At the same time, the difference of means test indicates that contractors and designers have significantly different responses. Hence, in simple English, the three tests augment each other and confirm that the level of communication among contractors is different from that of designers. This confirms the conclusions that can be drawn from observing the raw data.

Statements were combined to test for similarities at a higher, more coarsely defined level. Figure 5.6 depicts the combined responses of contractors and design offices regarding communication. The analysis of the combined statements might be misleading since the Spearman conclusion is a strong correlation, and this is echoed by regression correlation. But the regression line has a slope of 3.14, which is very different from the ideal of unity; similarly the intercept is –53.55, very different from the ideal of zero. Hence, although there is a correlation, there are clearly differences in the responses. These differences are highlighted by the Difference of Means test, which are very dissimilar.

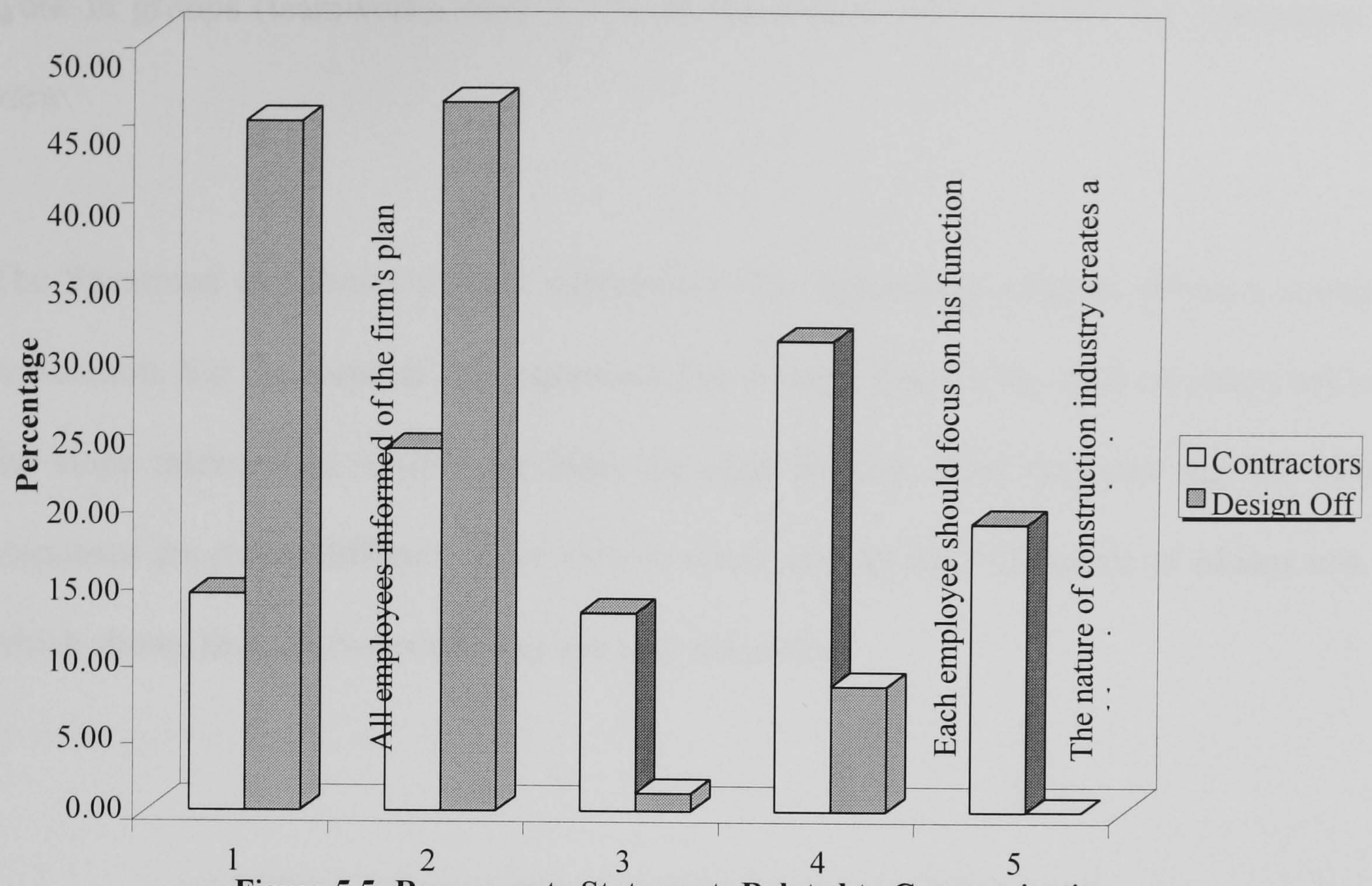


Figure 5.5: Responses to Statements Related to Communication

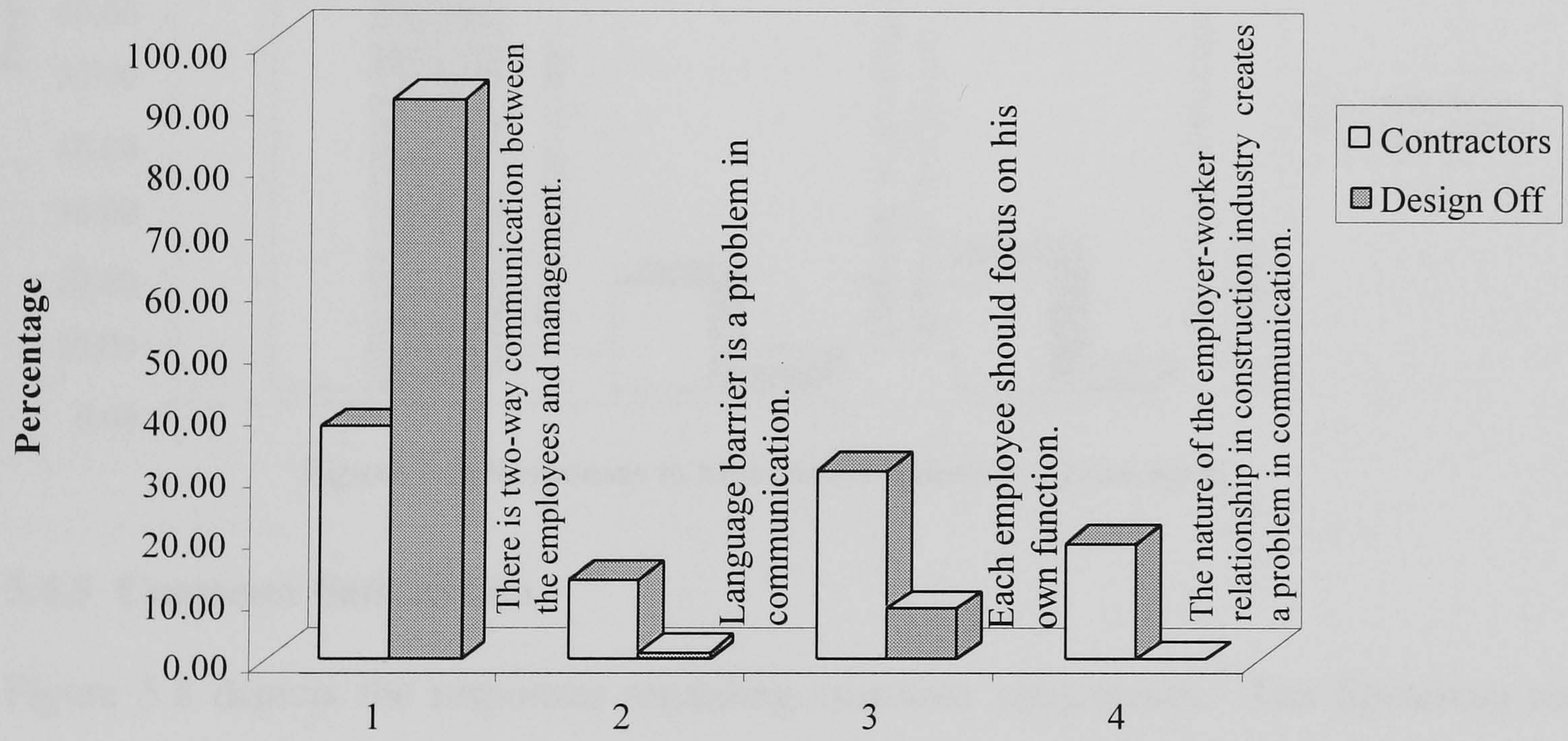


Figure 5.6 Combined Responses for Communication Statements

5.4.4 Teamwork

Figure 5.7 depicts the responses regarding teamwork. While 20% of the contractors stated that the nature of their business (construction) does not allow for performing

work in groups (teamwork), only 1.2 % of the design offices shared the contractors' view.

The Spearman test shows a weak correlation. The regression analysis shows a strong correlation, but the slope of the regression line is 2.04, double the ideal of unity, while the slope intercept is –34.65, far from the ideal of zero. This suggests that the two responses are rather different. This view is confirmed by the Difference of Means test, which shows that the two responses are very dissimilar.

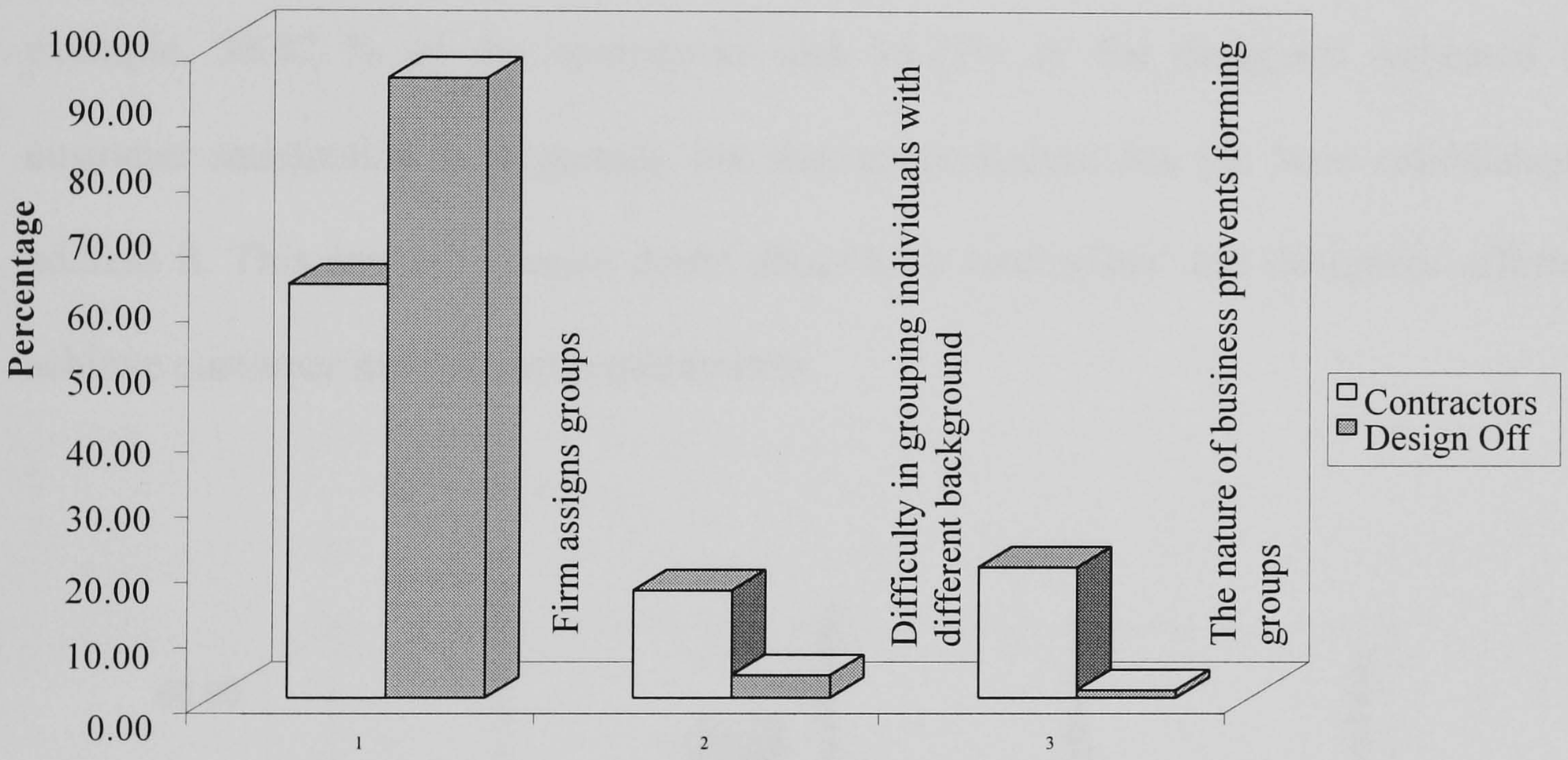


Figure 5.7: Responses to Statements Related to Teamwork

5.4.5 Customer Satisfaction

Figure 5.8 depicts the responses regarding customer satisfaction. The Spearman test indicates a strong correlation between contractors and designers. The linear regression test also indicates a strong correlation between contractors and designers. Furthermore, the difference of means test indicates that contractors and designers are very similar in their responses.

The analysis of the combined statements revealed a stronger similarity and correlation between contractors and designers. Figure 5.9 depicts the combined responses of contractors and design offices regarding customer satisfaction. Both the Spearman correlation test and linear regression test indicate a stronger correlation between contractors and designers under combined statements analysis. Furthermore, the difference of means test indicates that contractors and designers are very similar in their responses.

It should be stressed that strong correlation does not mean that either contractors or designers have achieved a high level of success with regard to customer satisfaction. For example, 38.82 % of the contractors and 34.12% of the designers indicated that customer satisfaction is important, but that no procedure has yet been established to address it. This serves to create doubt about both contractors' and designers' efforts to achieve customer satisfaction requirements.

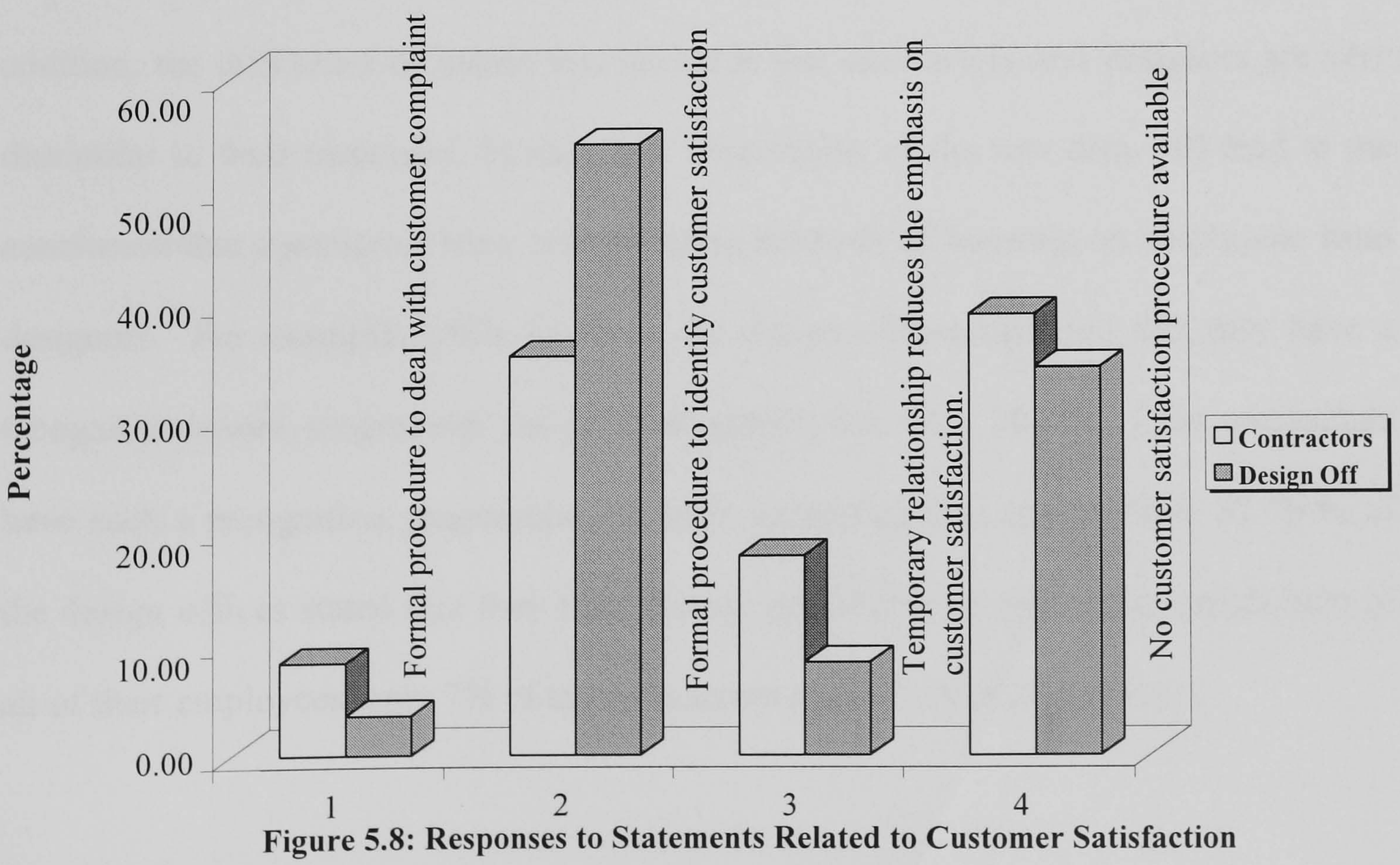


Figure 5.8: Responses to Statements Related to Customer Satisfaction

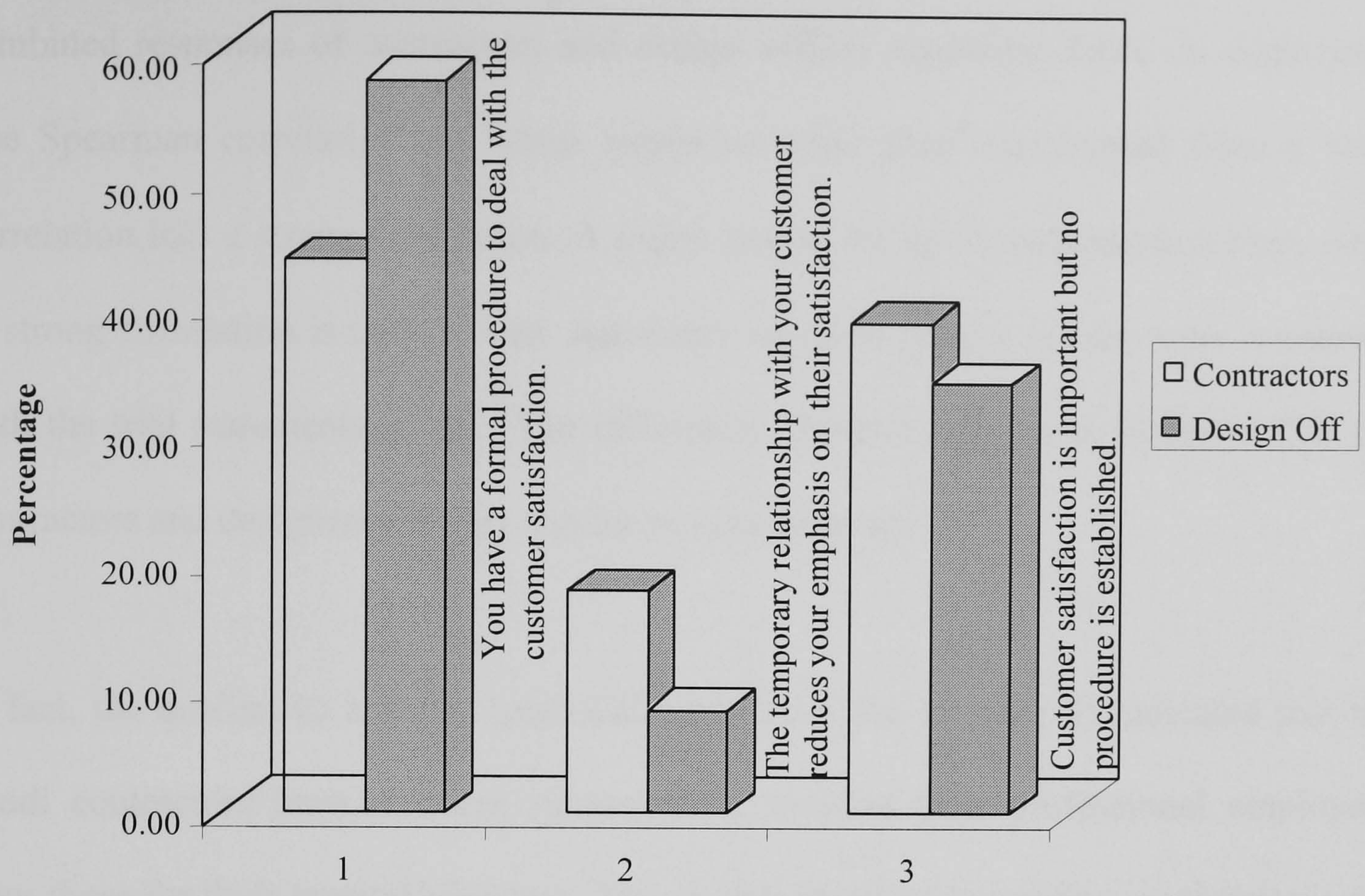


Figure 5.9 Combined Statements for Customer Satisfaction Statements

5.4.6 Focus on Employees (Empowerment)

Figure 5.10 depicts the responses regarding focus on employees. The Spearman and linear regression tests indicate that contractors and designers have a weak correlation. In addition, the difference of means test indicates that contractors and designers are very dissimilar in their responses. In fact, any observation of the raw data will lead to the conclusion that contractors have very different methods of focusing on employees from designers. For example, while 34 % of the design offices declared that they have a recognition/award programme for all their employees, only 10.6% of the contractors have such a recognition programme. Another interesting fact is that while 32.76 % of the design offices stated that they have formal procedures to ensure the satisfaction of all of their employees, only 7% of the contractors agreed with this statement.

The combined statement analysis has altered the picture. Figure 5.11 depicts the combined responses of contractors and design offices regarding focus on employees. The Spearman correlation and linear regression tests have transformed from a weak correlation into a strong correlation. A major reason for this transformation from weak to strong correlation is that the trial statements of *some* (professionals) were combined with the trial statements of *all*. The difference of means test, also, indicates that the contractors and designers are very similar in their responses.

In fact, the qualitative analysis (personal interviews- see Chapter 4) indicated that the Saudi contractors have different standards for treating their professional employees from those for their manual labourers. This double standard in treating employees is not noticeable in the design offices, where most of the employees are either professional or highly skilled workers. Saudi contractors might have a similar level of treatment of their professional employees to that of the design offices; however, the contractors' treatment of their manual labourers is far lower than the level of treatment that professional employees enjoy.

Sensitivity Analysis

In order to have a better understanding of the difference between contractors and designers, various tests were conducted with different weighting marks and a combination of statements (see Appendix 5.E). As it can be noticed, those contractors who provide either reward/recognition systems or a procedure to ensure employees' satisfaction are likely to concentrate on professional staff, but even when this is taken into account, they perform significantly worse as revealed by the difference of means test.

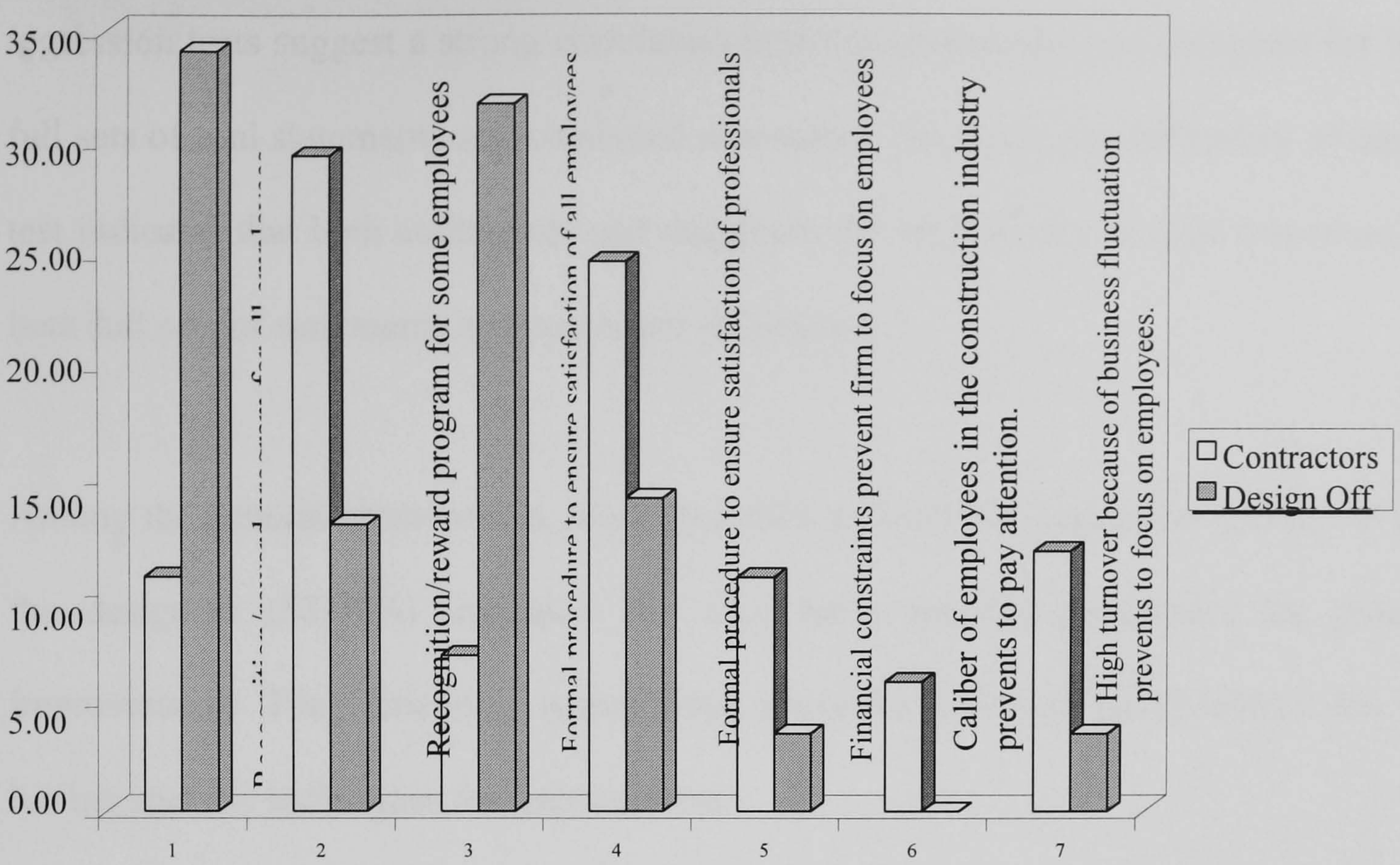


Figure 5.10: Responses of Statements Related to Focus on

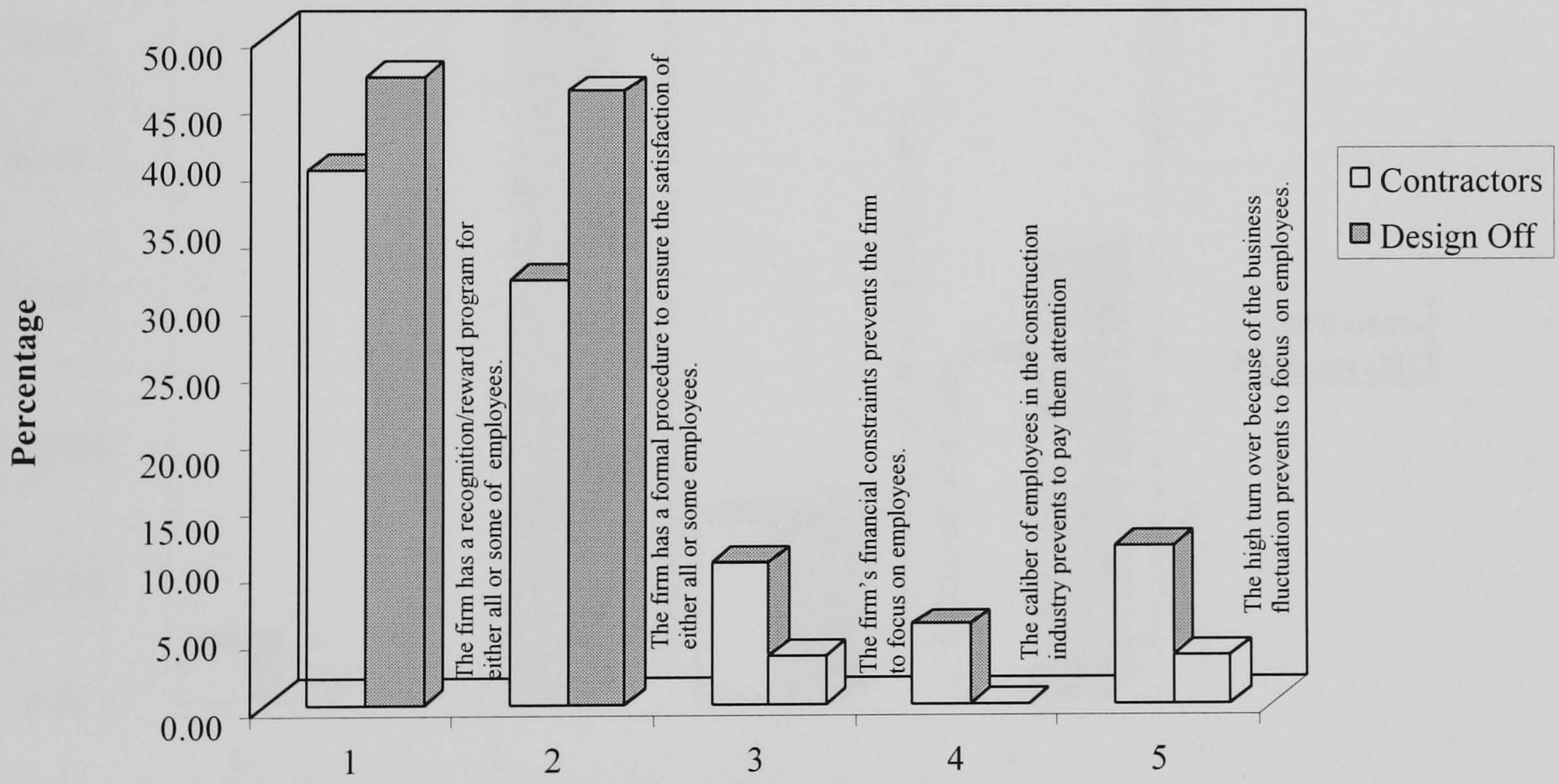


Figure 5.11 Combined Responses for Focus on Employees Statements

5.4.7 Process Improvement

Figure 5.12 depicts the responses regarding process improvement and Figure 5.13 depicts the responses for combined statements. The Spearman correlation and the linear

regression tests suggest a strong correlation between contractors and designers for both full sets of trial statements and combined statements. Similarly, the difference of means test indicates that both contractors and designers are very similar in their responses for both full sets of statements and combined statements.

Among the general observations, more than 50% of both the contractors (58.82 %) and the designers (52.94%) indicated that they have specific techniques for process improvement. The remaining respondents provided different justifications for not having specific techniques for improvement.

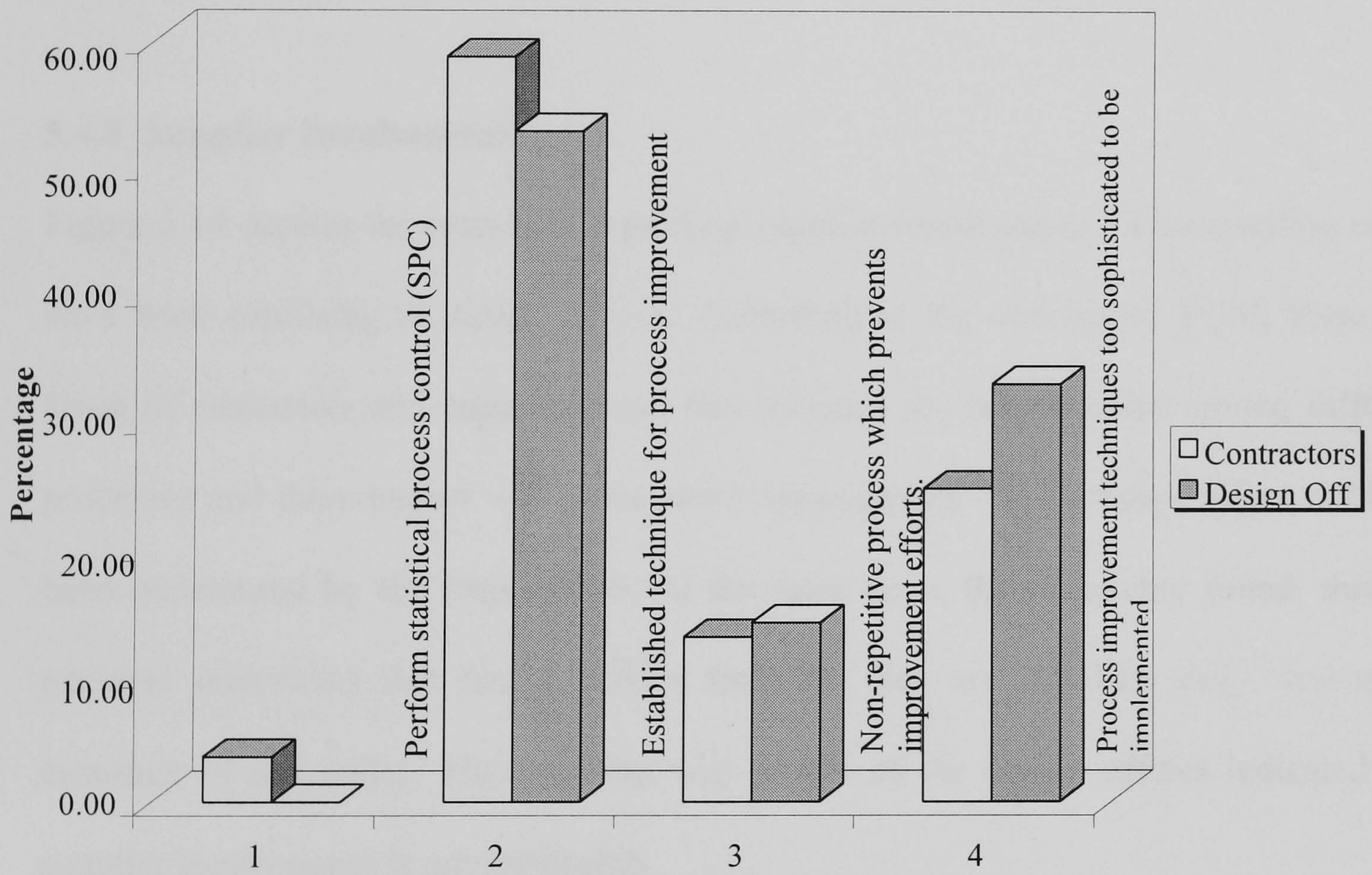


Figure 5.12: Response to Statements Related to Process Improvement

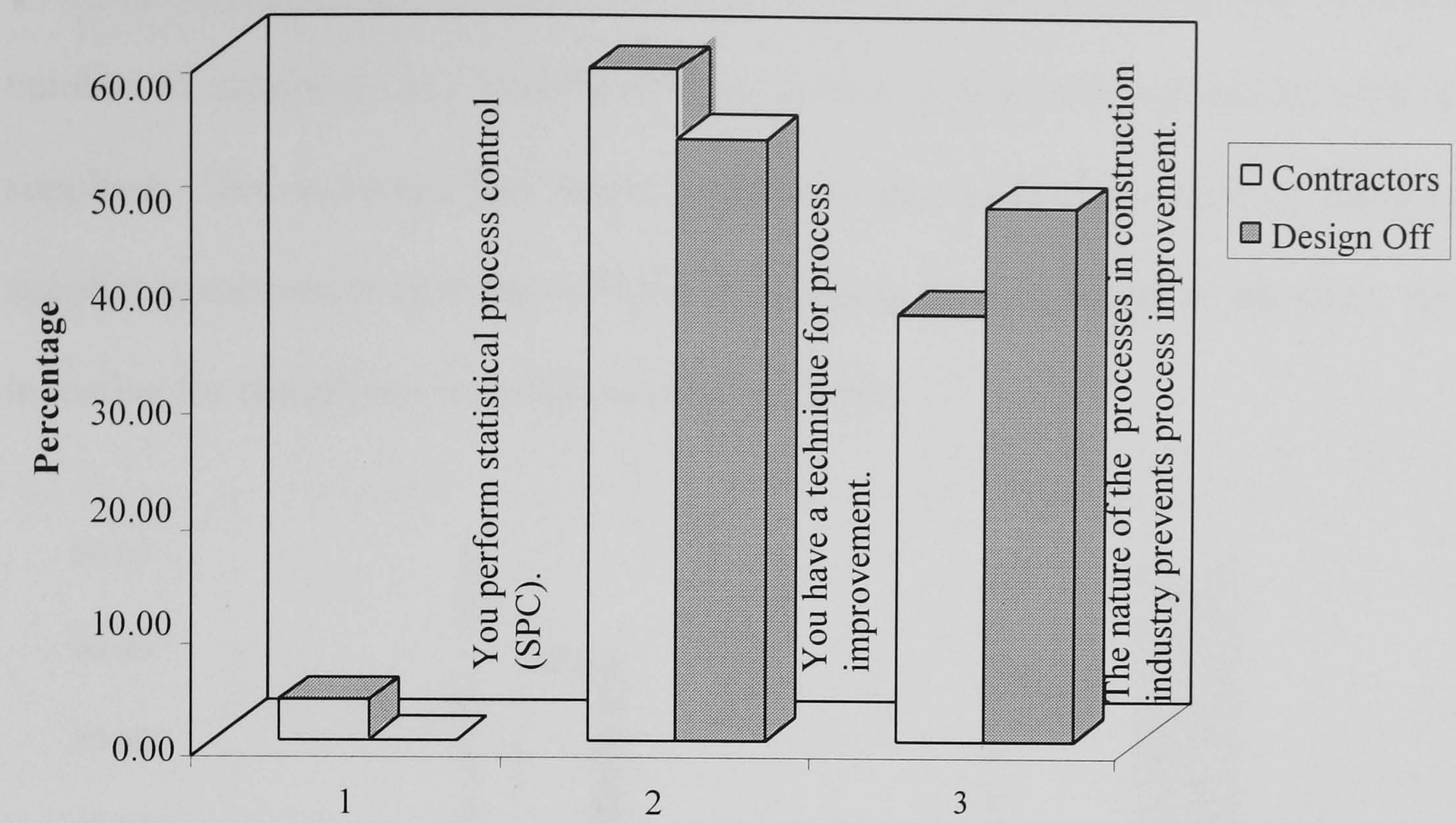


Figure 5.13 Combined Responses for Process Improvement Statements

5.4.8 Supplier Involvement

Figure 5.14 depicts the responses regarding supplier involvement. This question might have been confusing to design offices. According to the concept of TQM, there is a chain of customers and suppliers, and this includes the relationships among different processes and departments within the same organization. This concept might not have been understood by the respondents. At the same time, the researcher found, through personal interviews that design offices feel that they are suppliers only, and not a customer of any entity. This explains why 85.8% of the design offices indicated that supplier involvement is not applicable.

The Spearman correlation and the linear regression tests suggest a very weak correlation between contractors and designers. Furthermore, the difference of means test indicates that contractors and designers are significantly different in their responses.

One of the interesting observations is that 75.29% of the contractors deal with a limited number of suppliers, and 16.47% of them have a partnership agreement with specific suppliers. This indicates that Saudi contractors are performing well in satisfying the supplier involvement element of TQM. The reason for this might be the direct financial incentive for complying with this element of TQM.

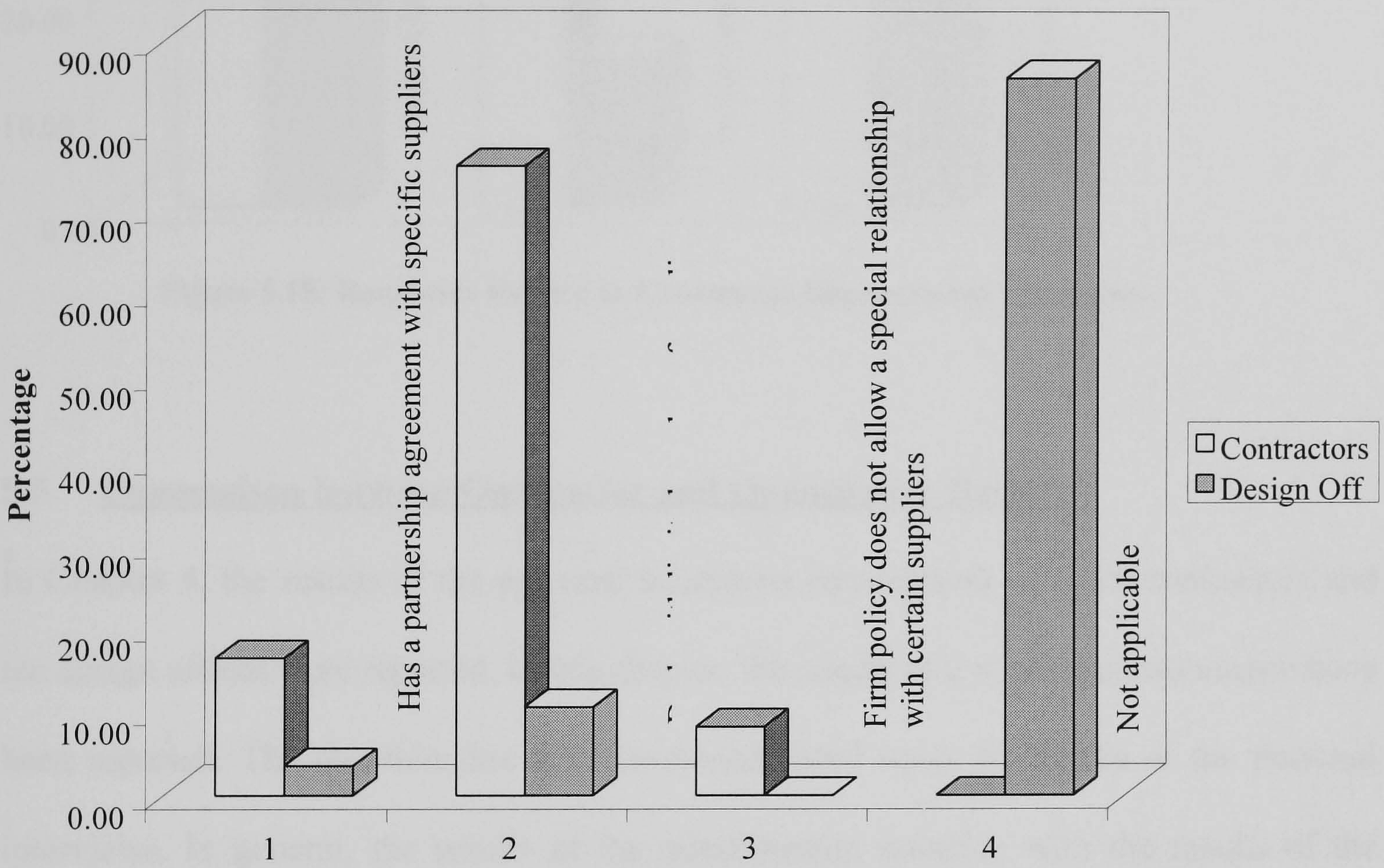


Figure 5.14: Responses of Statements Related to Suppliers' Involvement

5.4.9 Continuous Improvement

Figure 5.15 depicts the responses regarding continuous improvement. The Spearman correlation test and the linear regression tests suggest a very strong correlation between contractors and designers. Furthermore, the difference of means test indicates that contractors and designers are very similar in their responses.

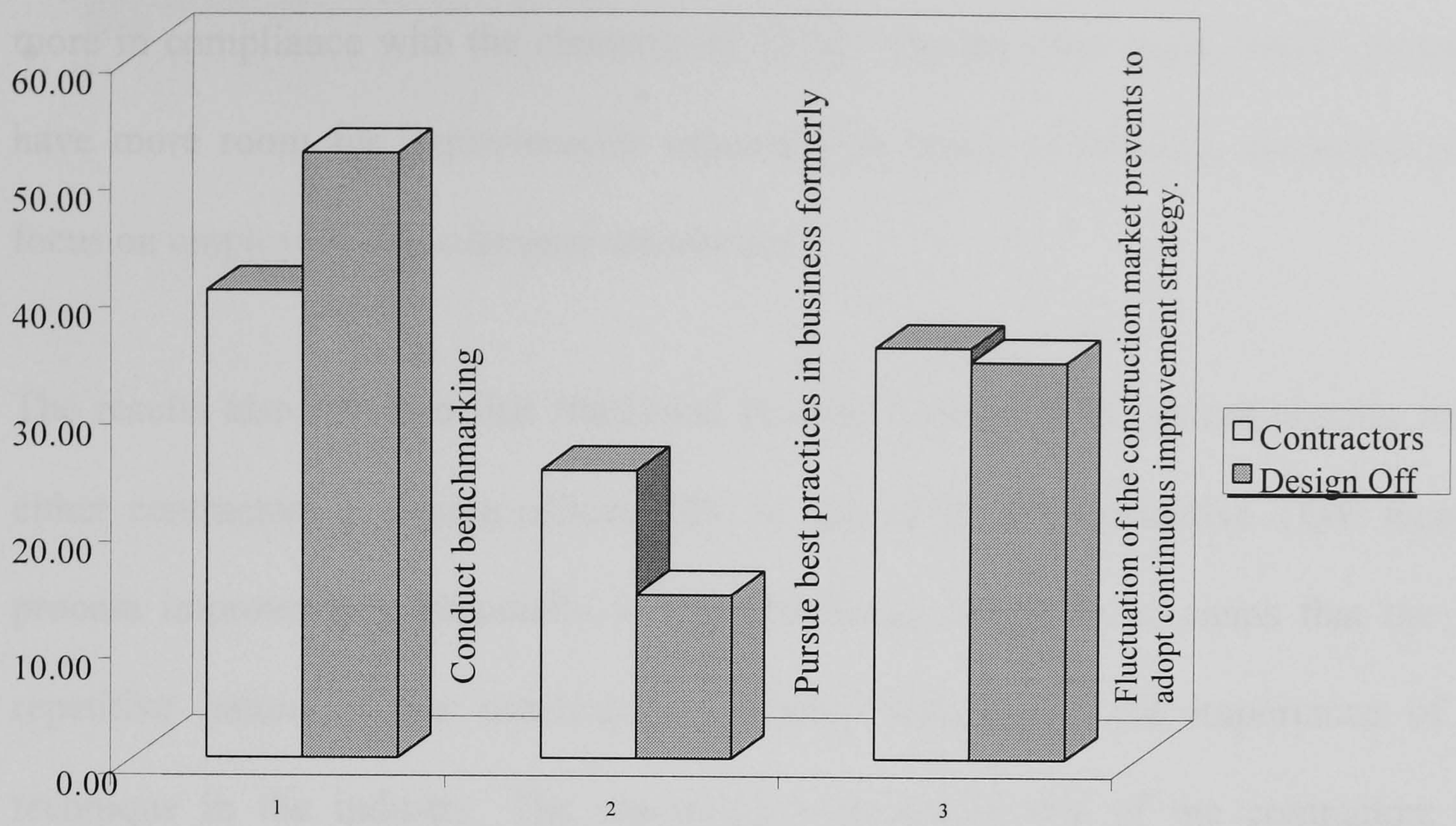


Figure 5.15: Responses Related to Continuous Improvement Statements

5.5 Comparison between Qualitative and Quantitative Results

In Chapter 4, the results of the personal interviews (qualitative) with ten contractors and ten design offices were reported. In this chapter, the results of a mailing questionnaire have been reported. The questionnaire was developed based upon the results of the personal interviews. In general, the results of the questionnaire coincide with the results of the personal interviews

However, it was found in some instances that the personal interviews failed to indicate the significance of various elements. For example, the unavailability of appropriate training was found to be one of the major reasons for contractors' (24.7% of respondents) not sending all their employees for training. During the personal interviews, however, only one of the interviewees indicated that unavailability of appropriate training was one of the reasons for not sending employees for training.

The results of the mailing questionnaire also support the general impression that was developed during the personal interviews, which indicates that Saudi design offices are

more in compliance with the elements of TQM. On the other hand, Saudi contractors have more room for improvements especially in terms of training, communications, focus on employees and customer satisfaction.

The results also revealed that Statistical Process Control (SPC) is not popular among either contractors or design offices. SPC is one of the most effective TQM tools for process improvement, especially in manufacturing. However, it seems that the non-repetitive nature of the construction industry undermines the importance of this technique in the industry. The researcher encountered one of the contractors who performs SPC in pipeline projects where the work is repetitive in nature.

5.6 Summary

This chapter has presented the results of the mailing questionnaire, which was sent to augment the personal interview findings reported in Chapter 4. The quantitative findings reported in this chapter coincide in general, with the qualitative findings, reported in Chapter 4. The results of this chapter suggested that Saudi design offices are more in compliance with the elements of TQM, while Saudi contractors have many areas that need to improve if they wish to excel in terms of quality in general, and to comply with the principles of TQM in particular. The results reported in this chapter provided some of reasons for not complying with the TQM elements for both contractors and design offices. Chapter 6 will address the effectiveness of TQM as a means for industry improvements and as a solution to problems in the Saudi construction industry. However, some of the findings of this chapter will be used as a basis for some of the research recommendations (Chapter 7).

APPENDICES

APPENDIX 5.A
THE SPEARMAN RANK CORRELATION TEST
OVERALL RESULTS OF QUESTIONNAIRE

Factor	Contractors	%	Rank	Designers	%	Rank
1. Training: All employees and workers are sent for training.	5	5.88	6	12	14.12	4
Some employees are sent for training.	17	20.00	2.5	21	24.70	2
Employees are not sent for training because of cost.	13	15.29	4	24	28.24	1
Employees are not sent for training because appropriate training is not available.	21	24.71	1	17	20.00	3
Employees are not sent for training because the high turnover of employees means it is not worthwhile.	17	20.00	2.5	3	3.53	6
Employees are not sent for training for reasons other than above.	12	14.12	5	8	9.41	5
Total	85	100%		85	100%	
Combined statements: Some or all employees and workers are sent for training.	22	25.88	2	33	38.82	1
Employees are not sent for training because it is not feasible.	30	35.29	1	27	31.77	2
Employees are not sent for training because appropriate training is not available.	21	24.71	3	17	20.00	3
Employees are not sent for training for reasons other than above.	12	14.12	4	8	9.41	4
Total	85	100%		85	100%	
2. Management Commitment: Management reviews the quality issues at its meetings regularly.	25	29.41	2	43	50.59	1
Management has adopted a formal strategy for improving quality.	17	20.00	3	34	40.00	2
Quality is not an issue in our organization.	3	3.53	5	0	0.00	4.5
Management is too busy with other activities.	4	4.71	4	0	0.00	4.5
QC/QA Manager is the one responsible for quality.	36	42.35	1	8	9.41	3
Total	85	100%		85	100%	
Combined statements: Management reviews the quality	25	29.41	2	43	50.59	1

Factor	Contractors	%	Rank	Designers	%	Rank
issues at its meetings regularly.						
Management has adopted a formal strategy for improving quality.	17	20.00	3	34	40.00	2
Quality is either not an issue or left to QA/QC Manager.	43	50.59	1	8	9.41	3
Total	85	100%		85	100%	
3. Communication: You keep all employees informed of the firm's plans.	12	14.12	4	38	44.70	2
Any employee/worker can approach management with suggestion and complaints.	20	23.53	2	39	45.88	1
Language barrier is a problem in communication.	11	12.94	5	1	1.18	4
Each employee should focus on his own function.	26	30.59	1	7	8.24	3
The nature of the employer — worker relationship in construction industry creates a problem in communications.	16	18.82	3	0	0.00	5
Total	85	100%		85	100%	
Combined statements: There is two-way communication between the employees and management.	32	37.65	1	77	90.58	1
Language barrier is a problem in communication.	11	12.94	4	1	1.18	3
Each employee should focus on his own function.	26	30.59	2	7	8.24	2
The nature of the employer-worker relationship in construction industry creates a problem in communication.	16	18.82	3	0	0.00	4
Total	85	100%		85	100%	
4. Teamwork: The firm assigns groups to perform some activities.	54	63.53	1	81	95.29	1
There is a difficulty of grouping individuals with different backgrounds.	14	16.47	3	3	3.53	2
The nature of the business does not allow performing work through groups.	17	20.00	2	1	1.18	3
Total	85	100%		85	100%	

Factor	Contractors	%	Rank	Designers	%	Rank
5. Customer Satisfaction: You have a <u>formal</u> procedure to deal with customer complaint.	7	8.24	4	3	3.53	4
You have a formal procedure to identify and satisfy customer satisfaction.	30	35.29	2	46	54.11	1
The temporary relationship with your customers reduces your emphasis on their satisfaction.	15	17.65	3	7	8.24	3
Customer satisfaction is important but no procedure is established.	33	38.82	1	29	34.12	2
Total	85	100%		85	100%	
Combined statements: You have a formal procedure to deal with the customer satisfaction.	37	43.53	1	49	57.65	1
The temporary relationship with your customer reduces your emphasis on their satisfaction.	15	17.65	3	7	8.23	3
Customer satisfaction is important but no procedure is established.	33	38.82	2	29	34.12	2
Total	85	100%		85	100%	
6. Focus on Employees: The firm has a recognition/reward programme for all employees.	9	10.59	4.5	29	34.12	1
The firm has a recognition/reward programme for professional only.	25	29.41	1	11	12.94	4
The firm has a formal procedure to ensure the satisfaction of all employees.	6	7.06	6	27	31.76	2
The firm has a formal procedure to ensure the satisfaction of professional employees only.	21	24.71	2	12	14.12	3
The firm's financial constraint prevents the firm to focus on employees.	9	10.59	4.5	3	3.53	5.5
The calibre of employees in the construction industry prevents to pay them attention.	5	5.88	7	0	0.00	7
The high turn over because of the business fluctuation prevents to focus on employees.	10	11.76	3	3	3.53	5.5
Total	85	100%		85	100%	

Factor	Contractors	%	Rank	Designers	%	Rank
Combined statements: The firm has a recognition/reward programme for either all or some employees.	34	40.00	1	40	47.06	1
The firm has a formal programme to ensure the satisfaction of either all or some employees.	27	31.76	2	39	45.88	2
The firm's financial constraint prevent the firm to focus on employees.	9	10.59	4	3	3.53	3.5
The calibre of employees in the construction industry prevents to pay them attention.	5	5.88	5	0	0.00	5
The high turn over because of the business fluctuation prevents to focus on employees	10	11.77		3	3.53	3.5
Total	85	100%		85	100%	
7. Process Improvement: You perform Statistical Process Control (SPC).	3	3.53	4	0	0.00	4
You have a technique for process improvement.	50	58.82	1	45	52.94	1
The processes in construction industry are not repetitive which prevents process improvement efforts.	11	12.94	3	12	14.12	3
The process improvement techniques are too sophisticated to be implemented in the construction industry.	21	24.71	2	28	32.94	2
Total	85	100%		85	100%	
Combined statements: You perform statistical process control (SPC).	3	3.53	3	0	0	3
You have a technique for process improvement.	50	58.82	1	45	52.94	1
The nature of the processes in construction industry prevents process improvement.	32	37.65	2	40	47.06	2
Total		100%		85	100%	
8. Supplier Involvement: You have a partnership agreement with specific suppliers.	14	16.47	2	3	3.53	3
You deal with limited number of suppliers.	64	75.29	1	9	10.59	2
The firm policy does not allow a special relationship with certain suppliers.	7	8.24	3	0	0.00	4
Not Applicable	0	0.00	4	73	85.88	1
Total	85	100%		85	100%	

Factor	Contractors	%	Rank	Designers	%	Rank
9. Continuous Improvement: You conduct benchmarking	34	40.00	1	44	51.76	1
You pursue best practices in your business formerly.	21	24.71	3	12	14.12	3
The fluctuation of the construction market prevents to adopt continuous improvement strategy.	30	35.29	2	29	34.12	2
Total	85	100%		85	100%	

Factor	Ranking by		Rank diff (d)	d^2
	Contractors	Designers	Contr-Design	Contr-Design
1. Training: All employees and workers are sent for training.	6	4	2	4
Some employees are sent for training.	2.5	2	0.5	0.25
Employees are not sent for training because of cost.	4	1	3	9
Employees are not sent for training because appropriate training is not available.	1	3	-2	4
Employees are not sent for training because the high turnover of employees means it is not worthwhile.	2.5	6	-3.5	12.25
Employees are not sent for training for reasons other than above.	5	5	0	0
			Total	29.5
	1	0	Tie corr	0.5
	(2-way tie)	-		30

Conclusion: since $r_S \leq 0.5$, the correlation can be considered as a weak correlation.

r_S	0.1428571
$\% r_S$	14.285714

Combined statements:

Some or all employees and workers are sent for training.	2	1	1	1
Employees are not sent for training because it is not feasible.	1	2	-1	1
Employees are not sent for training because appropriate training is not available.	3	3	0	0
Employees are not sent for training for reasons other than above.	4	4	0	0
			Total	2
$r_s = 1-\{ 6*(\Sigma d^2+T)/(n^3-n)\}$	0	0	Tie corr	0
r_s = Tie Spearman Correlation	-	-		2

d = Difference between ranking for each group

n = Number of factors (6)

Spearman's Statistic Coeff. (-1,1)

r_S	0.8
$\% r_S$	80

Conclusion: Since $r_S \geq 0.8$, the correlation can be considered as a strong correlation.

Factor	Ranking by		Rank diff (d)	d^2
	Contractors	Designers	Contr-Design	Contr-Design
2. Management Commitment: Management reviews the quality issues at its meetings regularly.	2	1	1	1
Management has adopted a formal strategy for improving quality.	3	2	1	1
Quality is not an issue in our organization.	5	4.5	0.5	0.25
Management is too busy with other activities.	4	4.5	-0.5	0.25
QC/QA Manager is the one responsible for quality.	1	3	-2	4
			Total	6.5
	0	1	Tie corr	0.5
	-	(2-way tie)		7
Conclusion: since 0.5 < r_S < 0.8, the correlation can be considered as a moderate correlation.			r_S	0.65
			$\% r_S$	65

Combined statements:

Management reviews the quality issues at its meetings regularly.	2	1	1	1
Management has adopted a formal strategy for improving quality.	3	2	1	1
Quality is either not an issue or left to QA/QC Manager.	1	3	-2	4
			Total	6
	0	0	Tie corr	0
	-	-		6
			r_S	-0.5
			$\% r_S$	-50

Conclusion: since -0.5 ≤ r_S ≤ 0.5, the correlation can be considered as a weak correlation.

Factor	Ranking by		Rank diff (d)	d^2
	Contractors	Designers	Contr-Design	Contr-Design
3. Communication: You keep all employees informed of the firm's plans.	4	2	2	4
Any employee/worker can approach management with suggestion and complaints.	2	1	1	1
Language barrier is a problem in communication.	5	4	1	1
Each employee should focus on his own function.	1	3	-2	4
The nature of the employer — worker relationship in construction industry creates a problem in communications.	3	5	-2	4
			Total	14
	0	0	Tie corr	0
	-	-		14
			r_S	0.3
			$\% r_S$	30

Conclusion: since $r_S < 0.5$, the correlation can be considered as a weak correlation.

Combined statements:

There is two way communication between the employees and their management.	1	1	0	0
Language barrier is a problem in communication.	4	3	1	1
Each employee should focus on his own function.	2	2	0	0
The nature of the employer — worker relationship in construction industry creates a problem in communication.	3	4	-1	1
			Total	2
	0	0	Tie corr	0
	-	-		2
			r_S	0.8
			$\% r_S$	80

Conclusion: since $r_S = 0.8$, the correlation can be considered as a strong correlation

Factor	Ranking by		Rank diff (d)	d^2
	Contractors	Designers	Contr-Design	Contr-Design
4. Team Work: The firm assigns groups to perform some activities.	1	1	0	0
There is a difficulty of grouping individuals with different backgrounds.	3	2	1	1
The nature of the business does not allow performing work through groups.	2	3	-1	1
			Total	2
	0	0	Tie corr	0
	-	-		2
			r_S	0.5
			$\% r_S$	50

Conclusion: since $r_S < 0.5$, the correlation can be considered as a weak correlation.

Factor	Ranking by		Rank diff (d)	d^2
	Contractors	Designers	Contr-Design	Contr-Design
5. Customer Satisfaction: You have a formal procedure to deal with customer complaint.	4	4	0	0
You have a formal procedure to identify and satisfy customer satisfaction.	2	1	1	1
The temporary relationship with your customers reduces your emphasis on their satisfaction.	3	3	0	0
Customer satisfaction is important but no procedure is established.	1	2	-1	1
			Total	2
	0	0	Tie corr	0
	-	-		2
			r_S	0.8
			$\% r_S$	80

Conclusion: since r_S = 0.8, the correlation can be considered as a strong correlation.

Combined statements:

You have a formal procedure to deal with the customer satisfaction.	1	1	0	0
The temporary relationship with your customers reduces your emphasis on their satisfaction.	3	3	0	0
Customer satisfaction is important but no procedure is established	2	2	0	0
			Total	0
	0	0	Tie corr	0
	-	-		0
			r_S	1.0
			$\% r_S$	100

Conclusion: since r_S = 1, the correlation can be considered as a very strong correlation (perfect).

Factor	Ranking by		Rank diff (d)	d^2
	Contractors	Designers	Contr-Design	Contr-Design
6. Focus on Employees: The firm has a recognition/reward programme for all employees.	4.5	1	3.5	12.25
The firm has a recognition/reward programme for professional only.	1	4	-3	9
The firm has a formal procedure to ensure the satisfaction of all employees.	6	2	4	16
The firm has a formal procedure to ensure the satisfaction of professional employees only.	2	3	-1	1
The firm's financial constraint prevents the firm to focus on employees.	4.5	5.5	-1	1
The caliber of employees in the construction industry prevents to pay them attention.	7	7	0	0
The high turn over because of the business fluctuation prevents to focus on employees.	3	5.5	2.5	6.25
			Total	45.5
	1 (2-way tie)	1 (2-way tie)	Tie corr	1
				46.5
			r_S	0.17
			$\%\, r_S$	17

Conclusion: since $r_S \leq 0.5$, the correlation can be considered as a weak correlation.

Combined statements:

The firm has a recognition/reward programme for either all or some of employees.	1	1	0	0
The firm has a formal programme to ensure the satisfaction of either all or some of employees.	2	2	0	0
The firm's financial constraint prevents the firm to focus on employees.	4	3.5	0.5	0.25
The caliber of employees in the construction industry prevents to pay them attention.	5	5	0	0
The high turn over because of the business fluctuation prevents to focus on employees.	3	3.5	-0.5	0.25
			Total	0.5
	0 -	1 (2-way tie)	Tie corr	0.5 1
			r_S	0.95
			$\%\, r_S$	95

Conclusion: Since $r_S \geq 0.8$, the correlation can be considered as a very strong correlation.

Factor	Ranking by		Rank diff (d)	d^2
	Contractors	Designers	Contr-Design	Contr-Design
7. Process Improvement: You perform Statistical Process Control (SPC).	4	4	0	0
You have a technique for process improvement.	1	1	0	0
The processes in construction industry are not repetitive which prevents process improvement efforts.	3	3	0	0
The process improvement techniques are too sophisticated to be implemented in the construction industry.	2	2	0	0
			Total	0
	0	0	Tie corr	0
	-	-		0
Conclusion: Since r_S = 1, the two groups are perfectly correlated.			r_S	1.0
			$\% r_S$	100

Combined statements:

You perform statistical process control (SPC).	3	3	0	0
You have a technique for process improvement.	2	1	0	0
The nature of the processes in construction industry prevents process improvement.	1	2	0	0
			Total	0
	0	0	Tie corr	0
	-	-		0
			r_S	1.0
Conclusion: Since r_S = 1, the two groups are perfectly correlated.			$\% r_S$	100

Factor	Ranking by		Rank diff (d)	d^2
	Contractors	Designers	Contr-Design	Contr-Design
8. Supplier Involvement				
You have a partnership agreement with specific suppliers.	2	3	-1	1
You deal with limited number of suppliers.	1	2	-1	1
The firm policy does not allow a special relationship with certain suppliers.	3	4	-1	1
Not Applicable	4	1	3	9
			Total	12
	0	0	Tie corr	0
	-	-		12
Conclusion: Since -0.5 ≤ r_S ≤ 0.5 the correlation can be considered as a weak correlation.			r_S	-0.2
			$\% r_S$	-20

	Ranking by		Rank diff (d)	d^2
	Contractors	Designers	Contr-Design	Contr-Design
9. Continuous Improvement				
You conduct benchmarking.	1	1	0	0
You pursue best practices in your business formerly.	3	3	0	0
The fluctuation of the construction market prevents to adopt continuous improvement strategy.	2	2	0	0
			Total	0
	0	0	Tie corr	0
	-	-		0

r_S	1.0
$\% r_S$	100

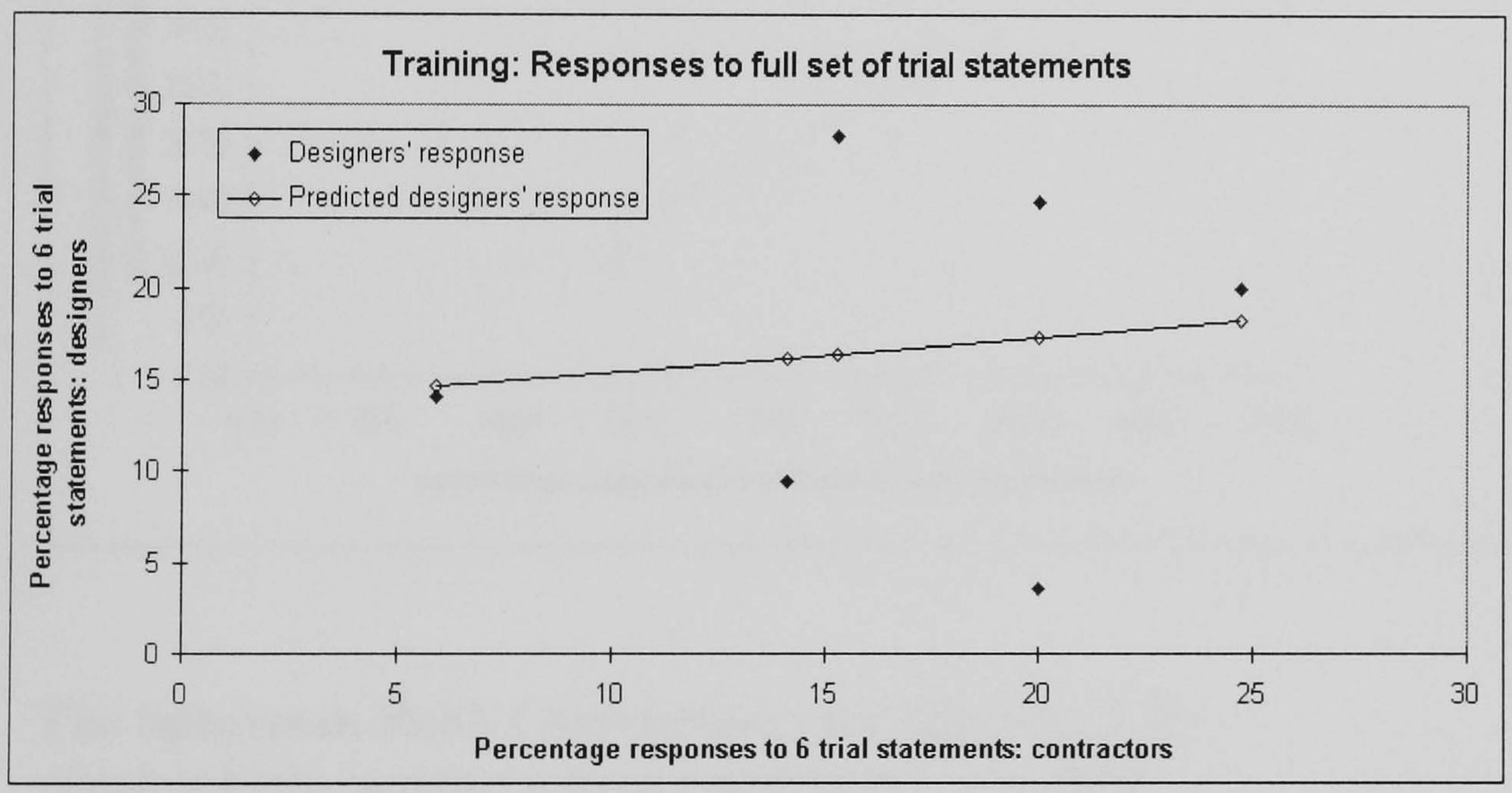
Conclusion: Since $r_S = 1$, the two groups are perfectly correlated.

APPENDIX 5.B
LINEAR REGRESSION ANALYSIS RESULTS

Training Responses
All 6 trial statements

Regression Statistics	
Regression Correlation Coefficient R	**0.130**
Observations	6
Coefficients	
Intercept	13.530
Slope	0.188

Observation	*Predicted Y*
1	14.637
2	16.188
3	16.409
4	17.295
5	17.295
6	18.182



The Spearman Rank Correlation: (see Appendix 5.A))
which is low, suggests a very weak correlation between the responses of the contractors and the designers to the trial statements. $r_S = 0.142$

Regression Analysis:
is similar to the calculated value for r_s Regression coefficient, $R = 0.130$

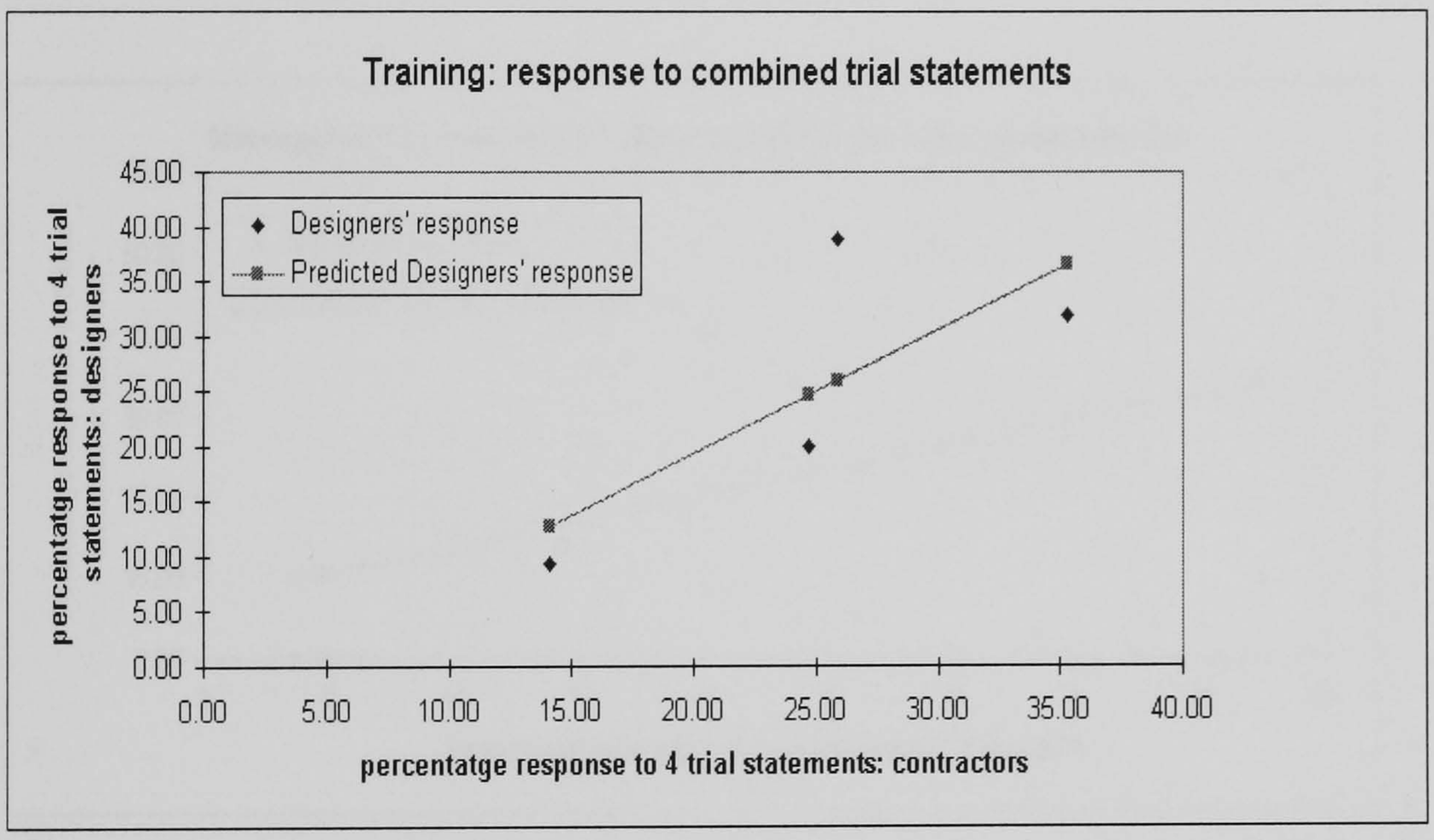
Graph (Linear Fit):
The equation of the line is: $P_D = 0.188\ P_C + 13.530$

The slope is far from unity (1) and the intercept is not close to zero (0).

Training: Response to combined trial statements

Regression Statistics	
Regression Correlation Coefficient R	**0.750**
Observations	4
Coefficients	
Intercept	-3.072
Slope	1.122

Observation	*Predicted Y*
1	25.990
2	36.559
3	24.669
4	12.780



The Spearman Rank Correlation: (see Appendix 5.A)
which is high, suggests a strong correlation. $r_S = 0.08$

Regression Analysis:
Regression coefficient, is similar to the calculated value for r_s $R = 0.750$

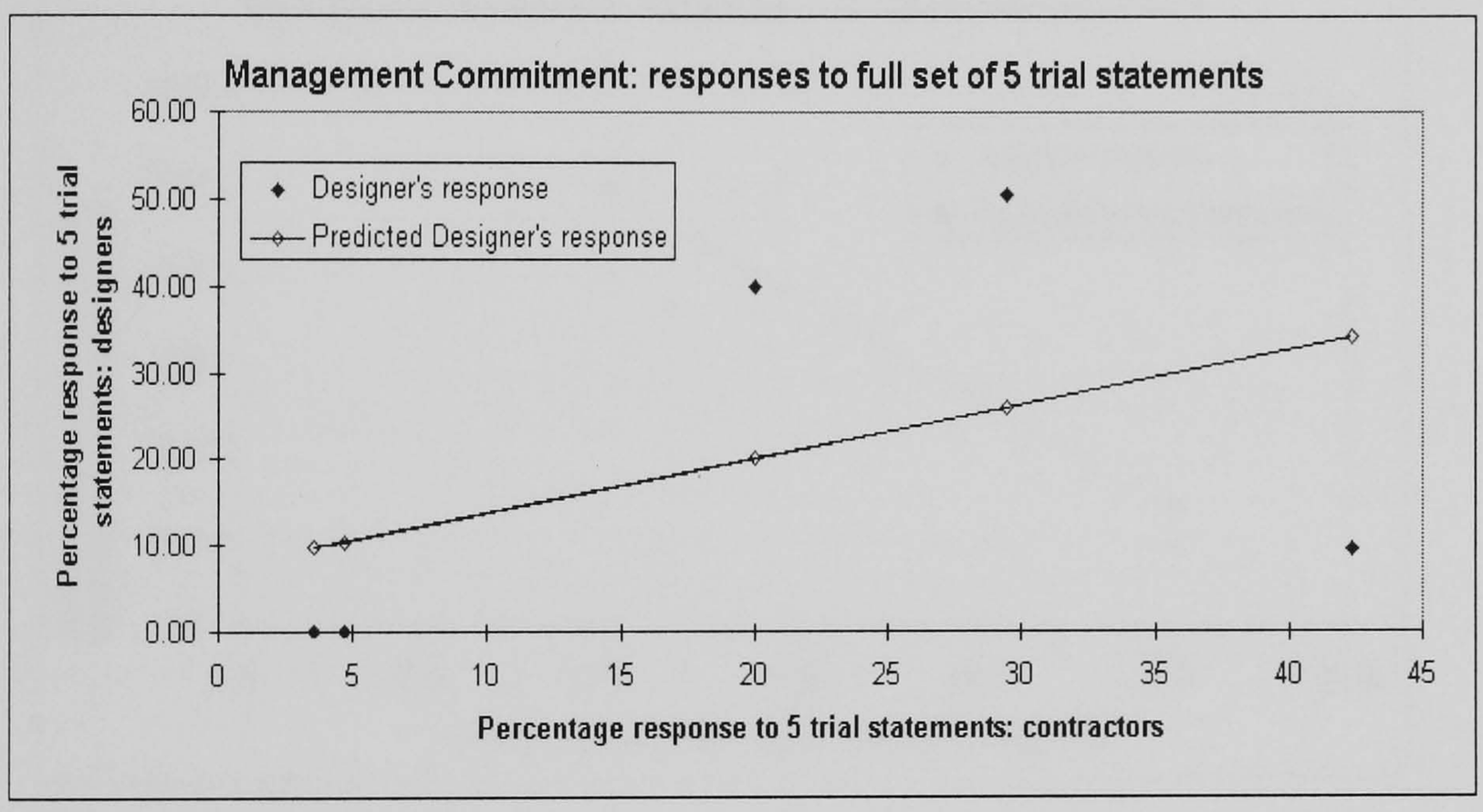
Graph (Linear Fit):
The equation of the line is: $P_D = 1.122\ P_C - 3.072$

The slope is reasonably close to unity (1) and the intercept is reasonably close to zero (0).

Management commitment: full set of trial statements

Regression Statistics	
Regression Correlation Coefficient R	**0.437**
Observations	5
	Coefficients
Intercept	7.441
Slope	0.627

Observation	*Predicted Y*
1	25.908
2	20
3	9.658
4	10.399
5	34.033



The Spearman Rank Correlation: (see Appendix 5.A)
suggests a moderate correlation. $r_S = 0.65$

Regression Analysis:
Regression coefficient, however indicates a weak correlation $R = 0.437$

Graph (Linear Fit):
The equation of the line is: $P_D = 0.627\ P_C + 7.441$

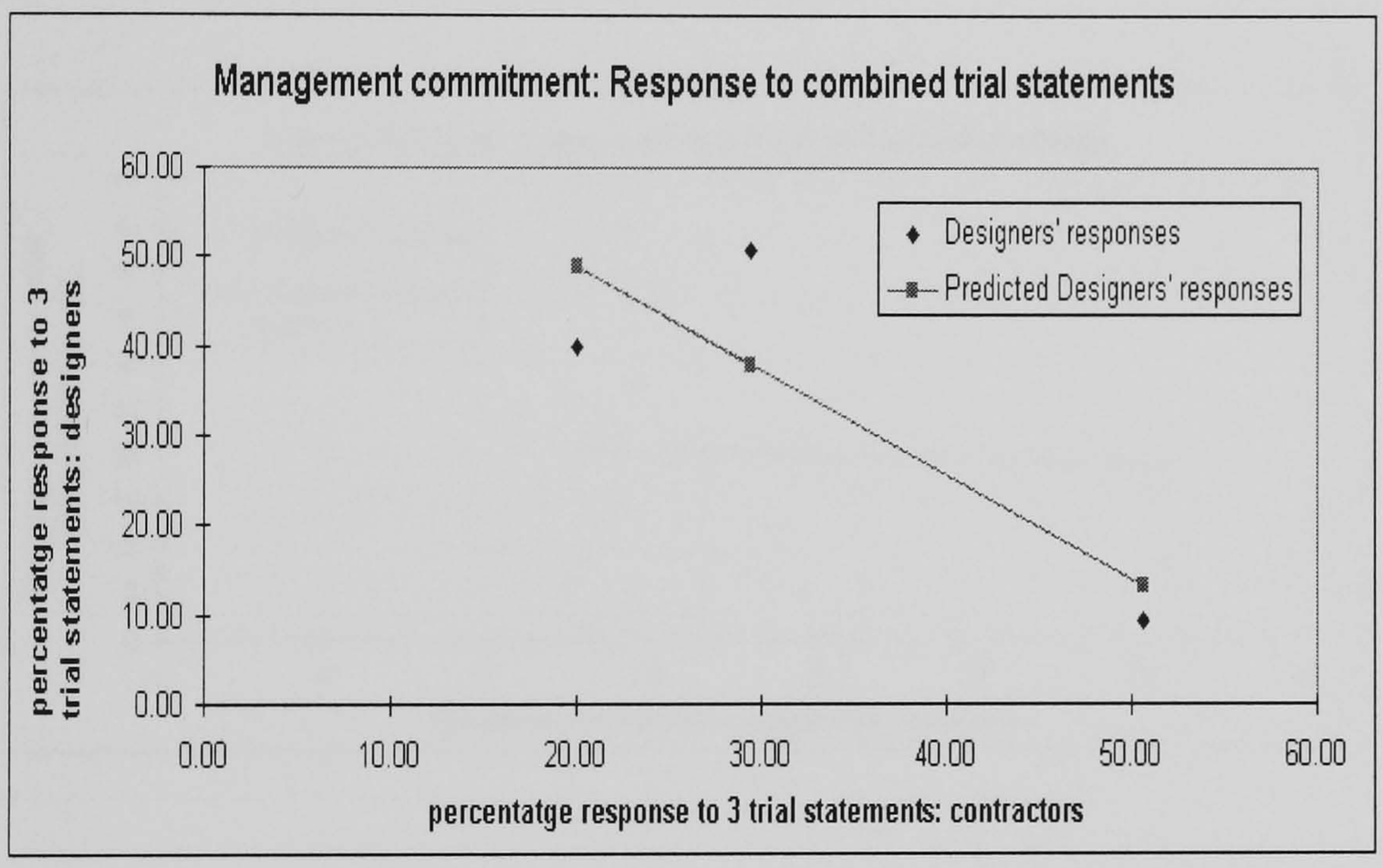
The slope is not far from unity (1) but the intercept is far from zero (0).

Management commitment: Response to combined trial statements

SUMMARY OUTPUT

Regression Statistics	
Regression Correlation Coefficient R	**0.849**
Observations	3
	Coefficients
Intercept	71.992
Slope	-1.159

Observation	*Predicted Y*
1	37.881
2	48.796
3	13.321



The Spearman Rank Correlation: (see Appendix 5.A)
suggests a correlation on the borderline between weak and moderate. $r_S = 0.5$

Regression Analysis:
Regression coefficient, however suggests a high correlation $R = 0.849$

Graph (Linear Fit):
The equation of the line is: $P_D = -1.159\ P_C + 71.992$

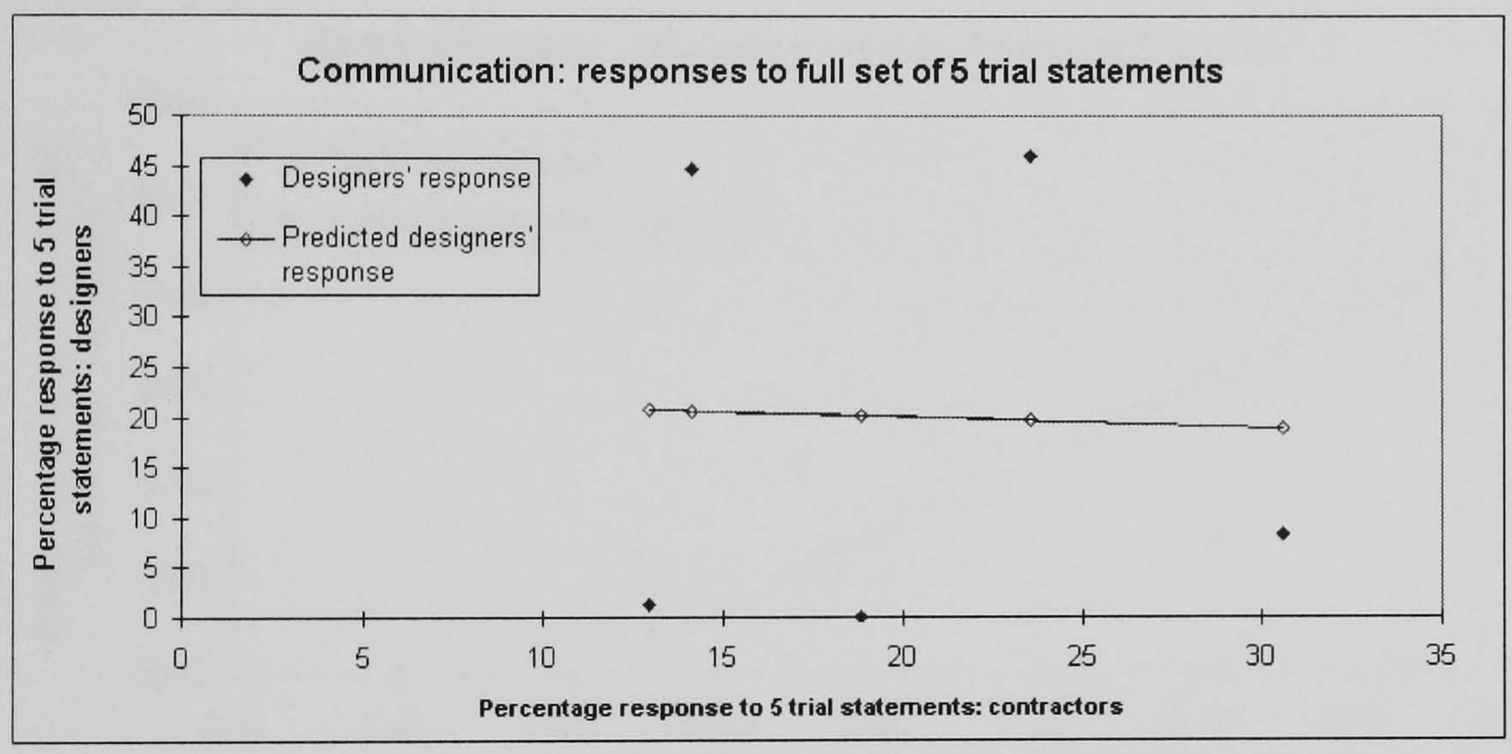
The slope is reasonably close to unity (1) but the intercept is very far from zero (0).

Communication: full set of trial statements

SUMMARY OUTPUT

Regression Statistics	
Regression Correlation Coefficient R	**0.032**
Observations	5
Coefficients	
Intercept	22.105
Slope	-0.105

Observation	*Predicted Y*
1	20.619
2	19.628
3	20.743
4	18.885
5	20.123



The Spearman Rank Correlation: (see Appendix 5.A)
which is low, suggests a very weak correlation between the responses of the contractors and the designers to the trial statements $r_S = 0.3$

Regression Analysis:
Regression coefficient, which supports the decision by the calculated value for r_s $R = 0.032$

Graph (Linear Fit):
The equation of the line is: $P_D = -0.105\ P_C + 22.105$

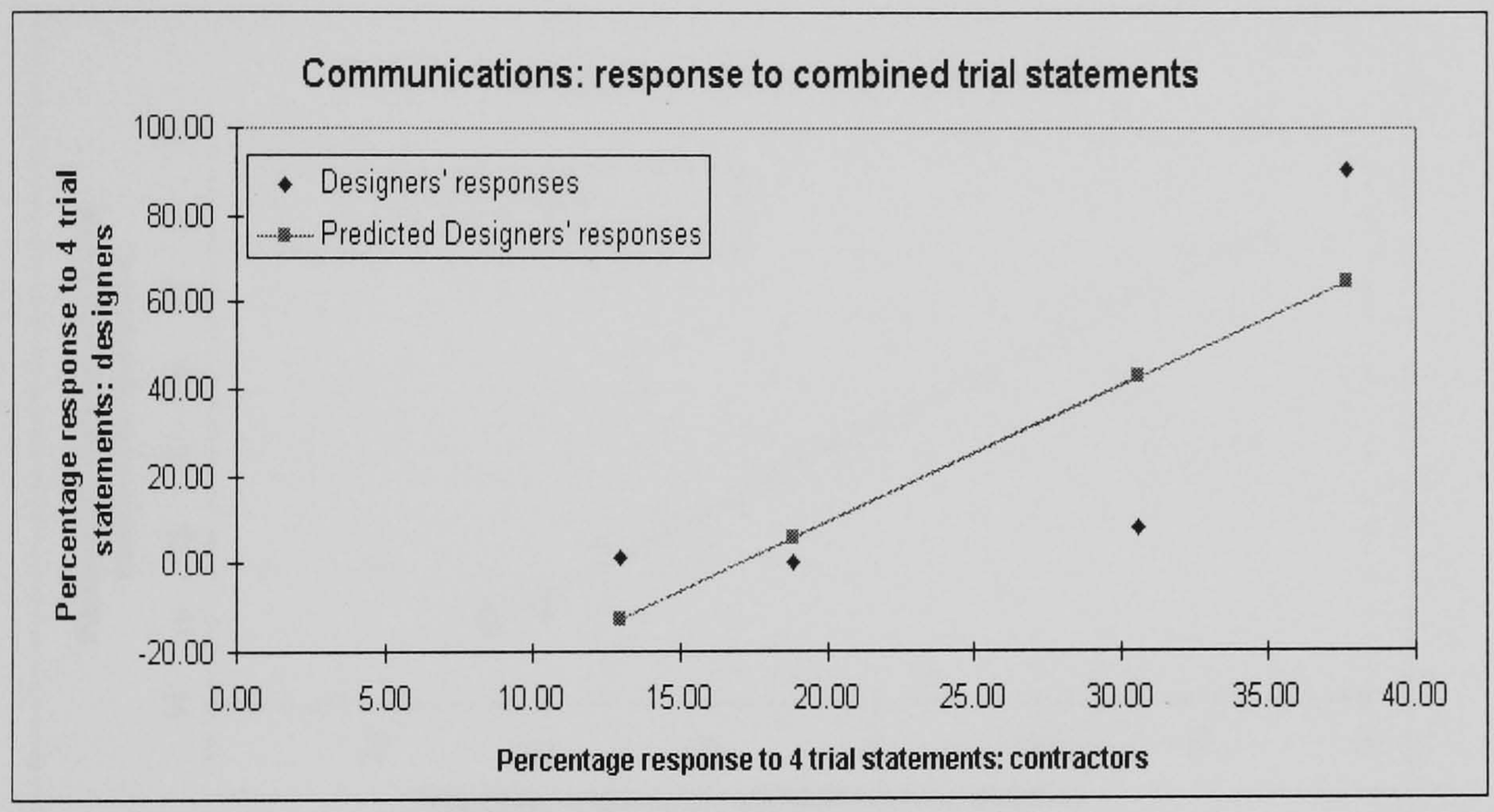
The slope is far from unity (1) and the intercept is not close to zero (0).

Communications: response to combined trial statements

SUMMARY OUTPUT

Regression Statistics	
Regression Correlation Coefficient R	**0.800**
Observations	4
Coefficients	
Intercept	-53.554
Slope	3.1421

Observation	*Predicted Y*
1	64.739
2	-12.891
3	42.559
4	5.592



The Spearman Rank Correlation: (see Appendix 5.A)
which is high, suggests a strong correlation. $r_S = 0.8$

Regression Analysis:
Regression coefficient, is similar to the calculated value for r_s $R = 0.800$

Graph (Linear Fit):
The equation of the line is: $P_D = 3.142\ P_C - 53.554$

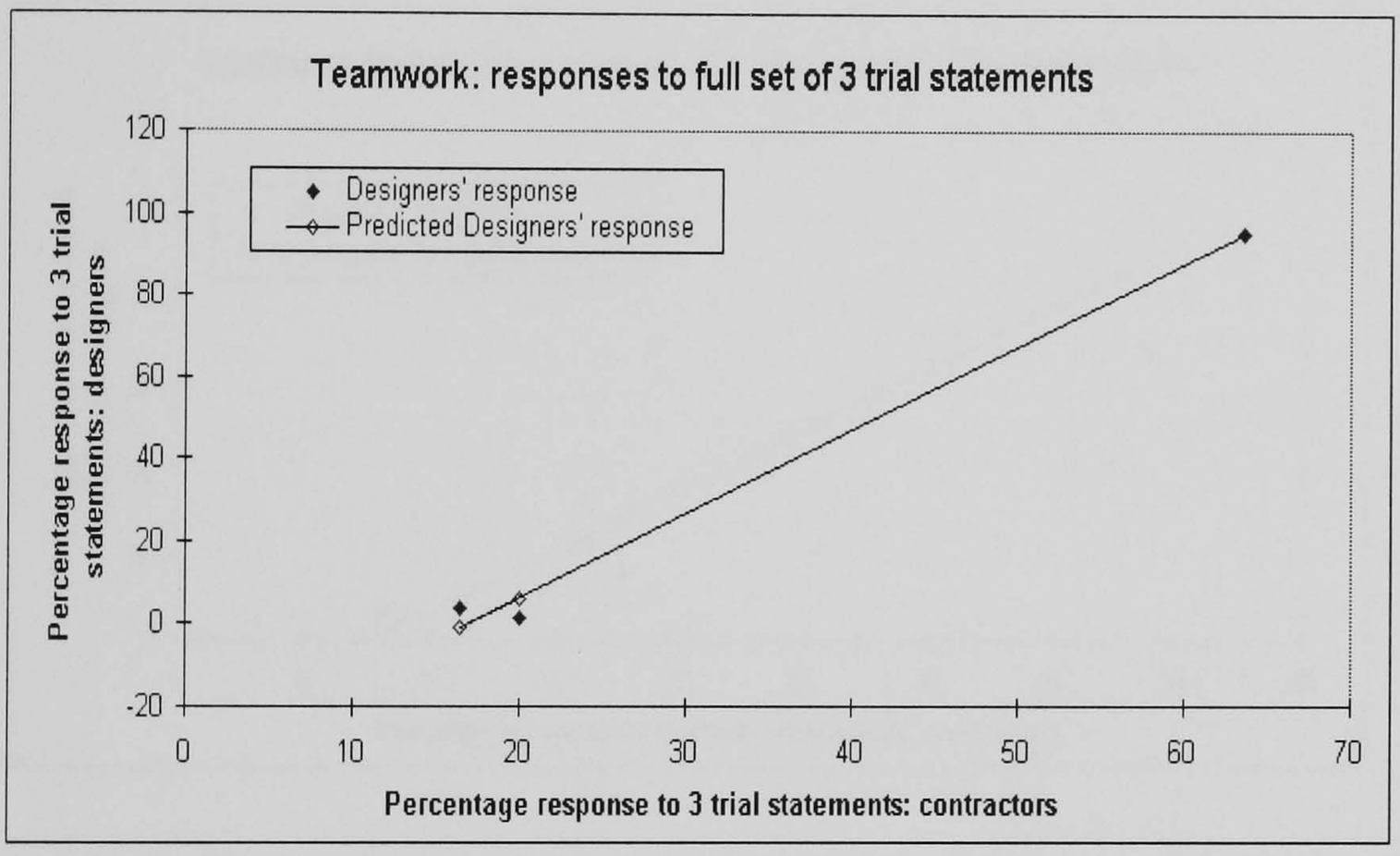
The slope is far from unity (1) and the intercept is not close to zero (0).

Teamwork: full set of trial statements

SUMMARY OUTPUT

Regression Statistics	
Regression Correlation Coefficient R	**0.996**
Observations	3
	Coefficients
Intercept	-34.654
Slope	2.039

Observation	*Predicted Y*
1	94.921
2	-1.060
3	6.138



The Spearman Rank Correlation: (see Appendix 5.A)
suggests a correlation on the borderline between weak and moderate $r_S = 0.5$

Regression Analysis:
Regression coefficient, however suggests a strong correlation $R = 0.996$

Graph (Linear Fit):
The equation of the line is: $P_D = 2.039\ P_C - 34.654$

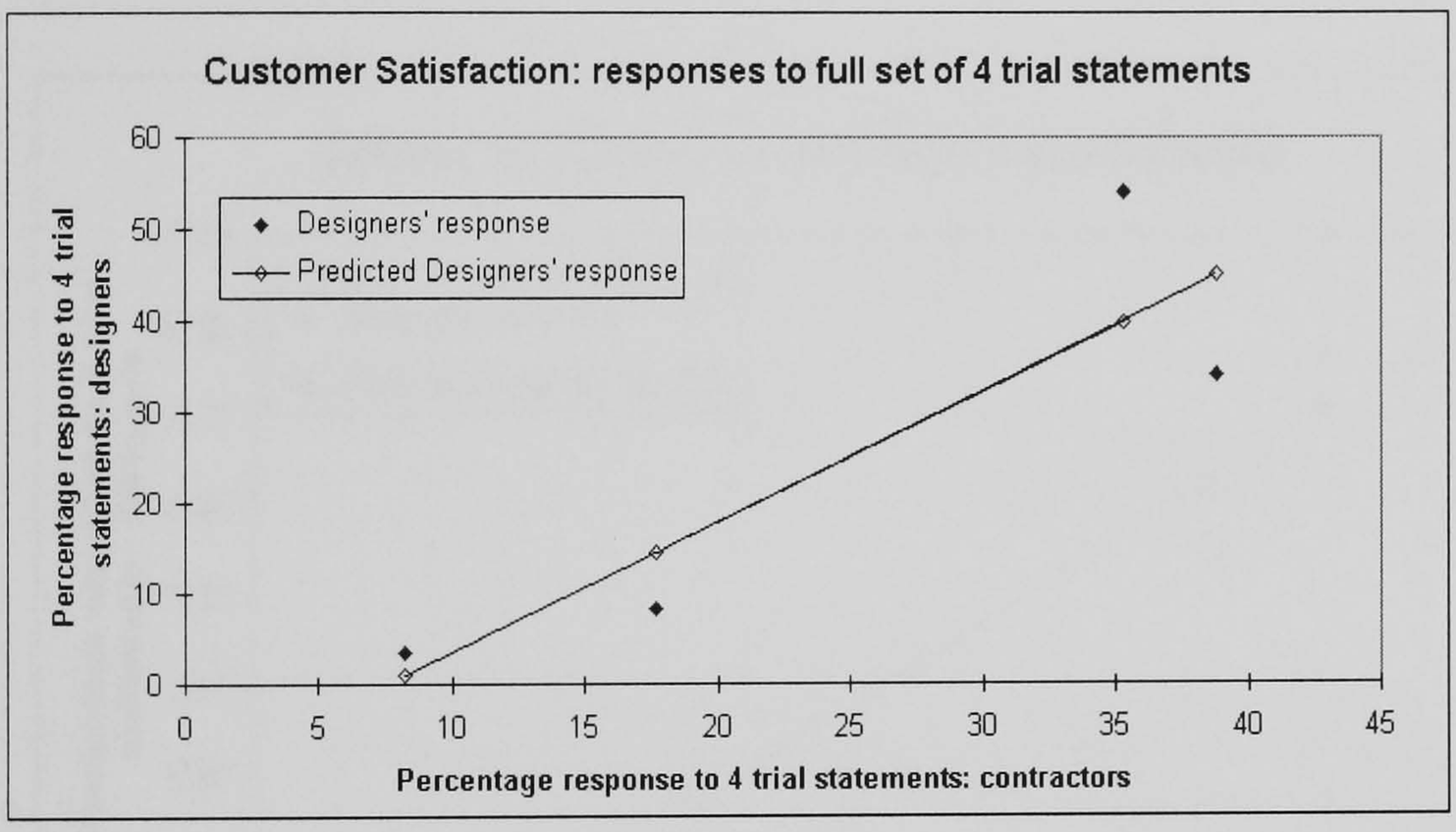
The slope is far from unity (1) and the intercept is not close to zero (0).

Customer Satisfaction: full set of trial statements

SUMMARY OUTPUT

Regression Statistics	
Regression Correlation Coefficient R	**0.883**
Observations	4
	Coefficients
Intercept	-10.946
Slope	1.437

Observation	*Predicted Y*
1	0.894
2	39.801
3	14.427
4	44.876



The Spearman Rank Correlation: (see Appendix 5.A)
which is high, suggests a strong correlation $r_S = 0.8$

Regression Analysis:
Regression coefficient, is similar to the calculated value for r_s $R = 0.883$

Graph (Linear Fit):
The equation of the line is: $P_D = 1.437\ P_C - 10.946$

The slope is reasonably close to unity (1) and the intercept is not close to zero (0).

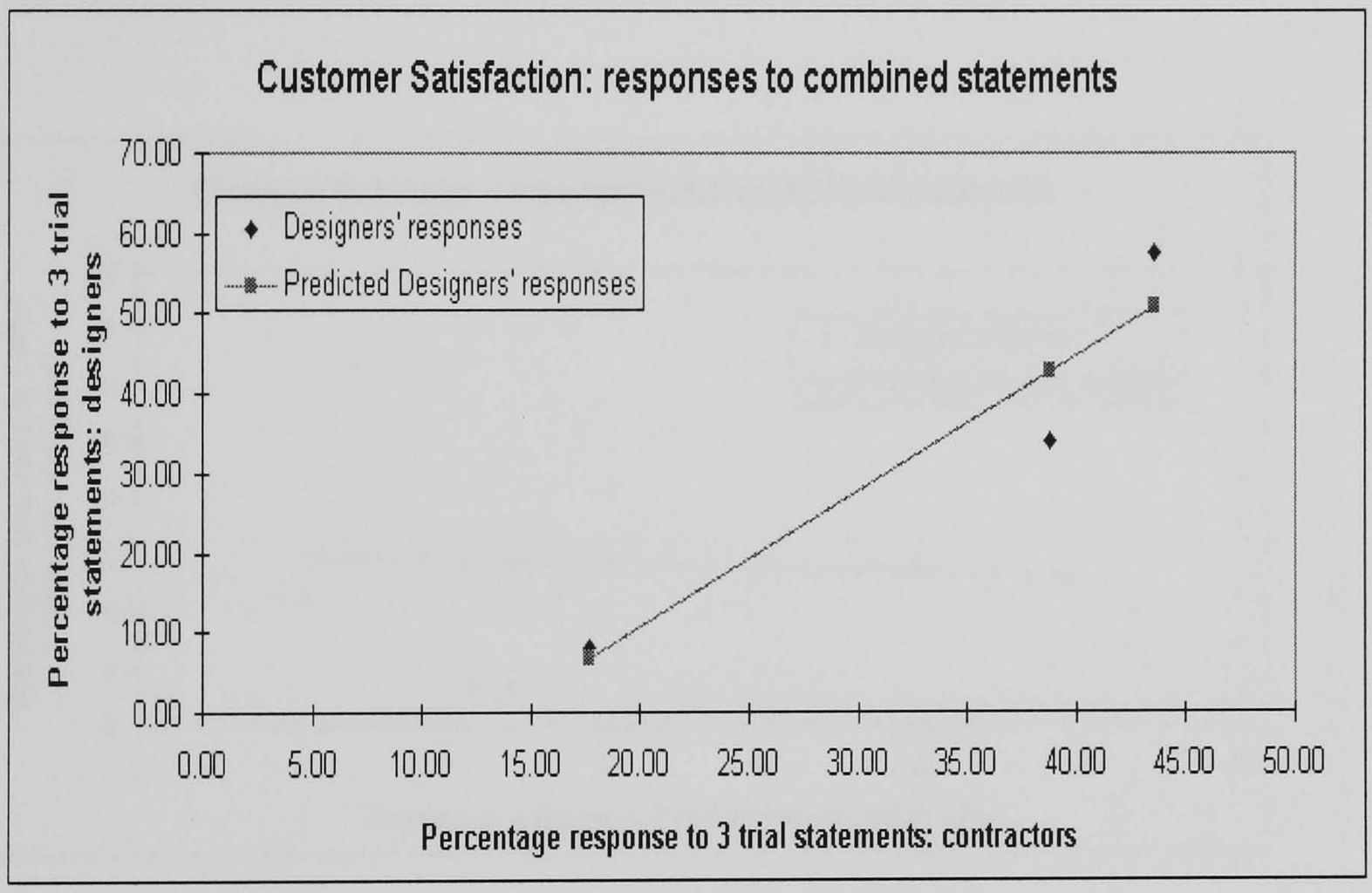
Customer Satisfaction: responses to combined statements

SUMMARY OUTPUT

Regression Statistics	
Regression Correlation Coefficient R	**0.947**
Observations	3

	Coefficients
Intercept	-23.300
Slope	1.699

Observation	*Predicted Y*
1	50.656
2	6.681
3	42.661



The Spearman Rank Correlation: (see Appendix 5.A)
which is very high, suggests a very strong correlation $r_S = 1.0$

Regression Analysis:
Regression coefficient, is similar to the calculated value for r_s $R = 0.947$

Graph (Linear Fit):
The equation of the line is: $P_D = 1.699\ P_C - 23.300$

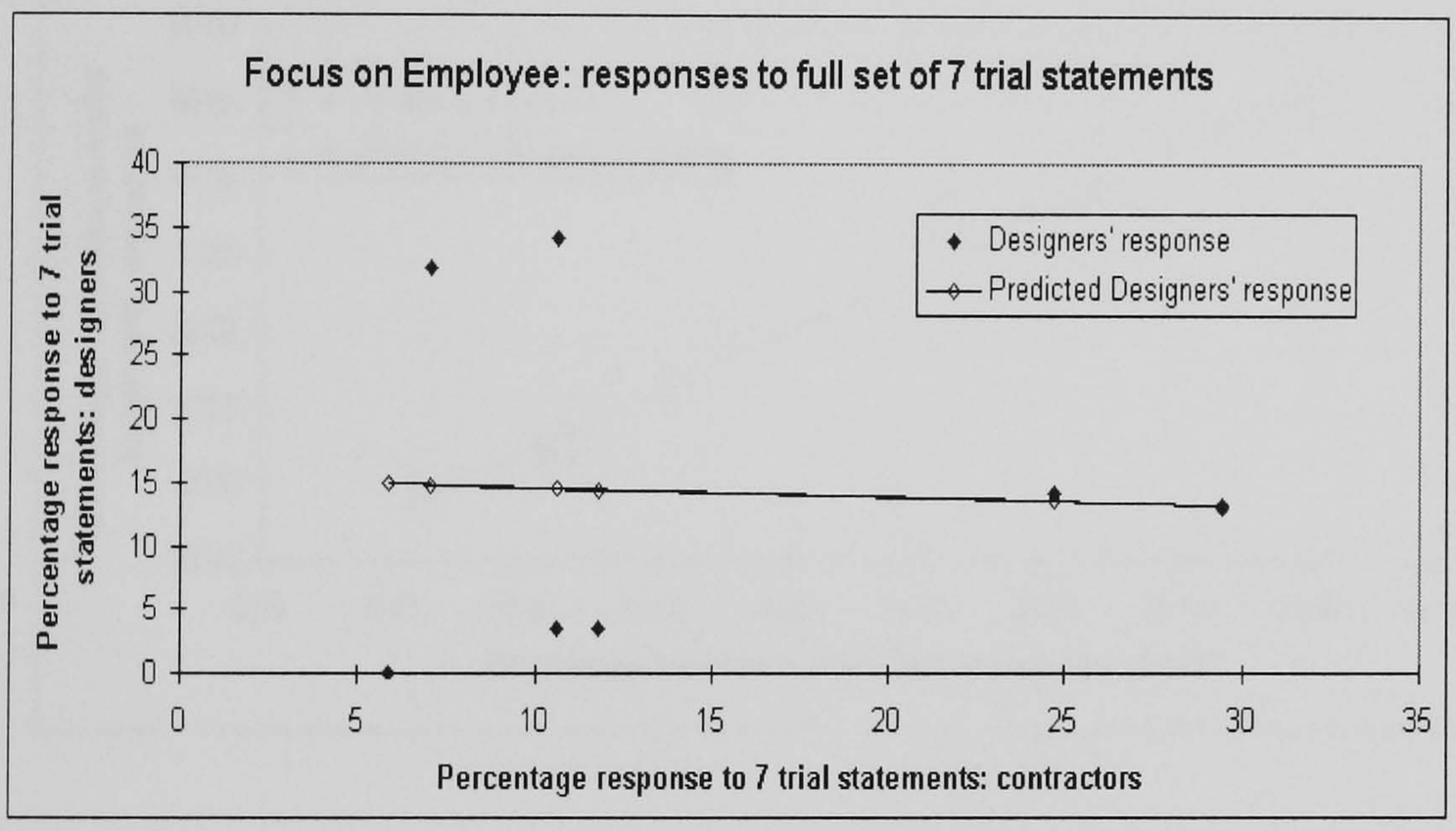
The slope is reasonably close to unity (1) and the intercept is not close to zero (0).

Focus on Employees: full set of trial statements

SUMMARY OUTPUT

Regression Statistics	
Regression Correlation Coefficient R	**0.0464**
Observations	7
	Coefficients
Intercept	15.292
Slope	-0.070

Observation	*Predicted Y*
1	14.546
2	13.219
3	14.794
4	13.551
5	14.546
6	14.877
7	14.463



The Spearman Rank Correlation: (see Appendix 5.A)
which is low, suggests a very weak correlation between the response of the contractors and the designers to the trial statements $r_S = 0.169$

Regression Analysis:
Regression coefficient, which supports the decision by the calculated value for r_s $R = 0.046$

Graph (Linear Fit):
The equation of the line is: $P_D = -0.070\ P_C + 15.292$

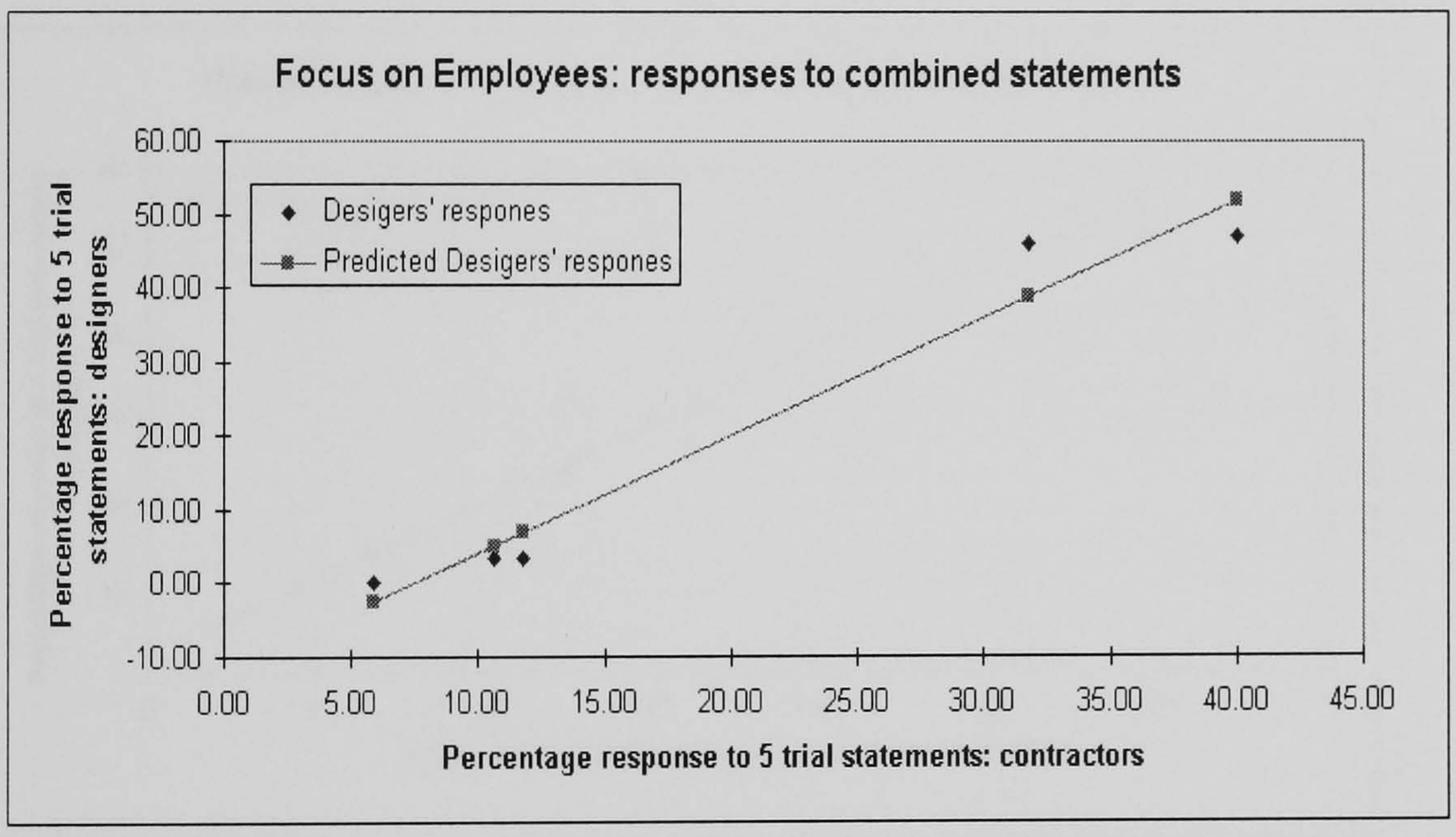
The slope is far from unity (1) and the intercept is not close to zero (0).

Focus on Employees: responses to combined statements

SUMMARY OUTPUT

Regression Statistics	
Regression Correlation Coefficient R	**0.979**
Observations	5
	Coefficients
Intercept	-11.733
Slope	1.586

Observation	*Predicted Y*
1	51.733
2	38.666
3	5.066
4	-2.400
5	6.933



The Spearman Rank Correlation: (see Appendix 5.A)
which is high, suggests a strong correlation. $r_S = 0.95$

Regression Analysis:

Regression coefficient, is similar to the calculated value for r_s $R = 0.979$

Graph (Linear Fit):

The equation of the line is: $P_D = 1.586\ P_C - 11.733$

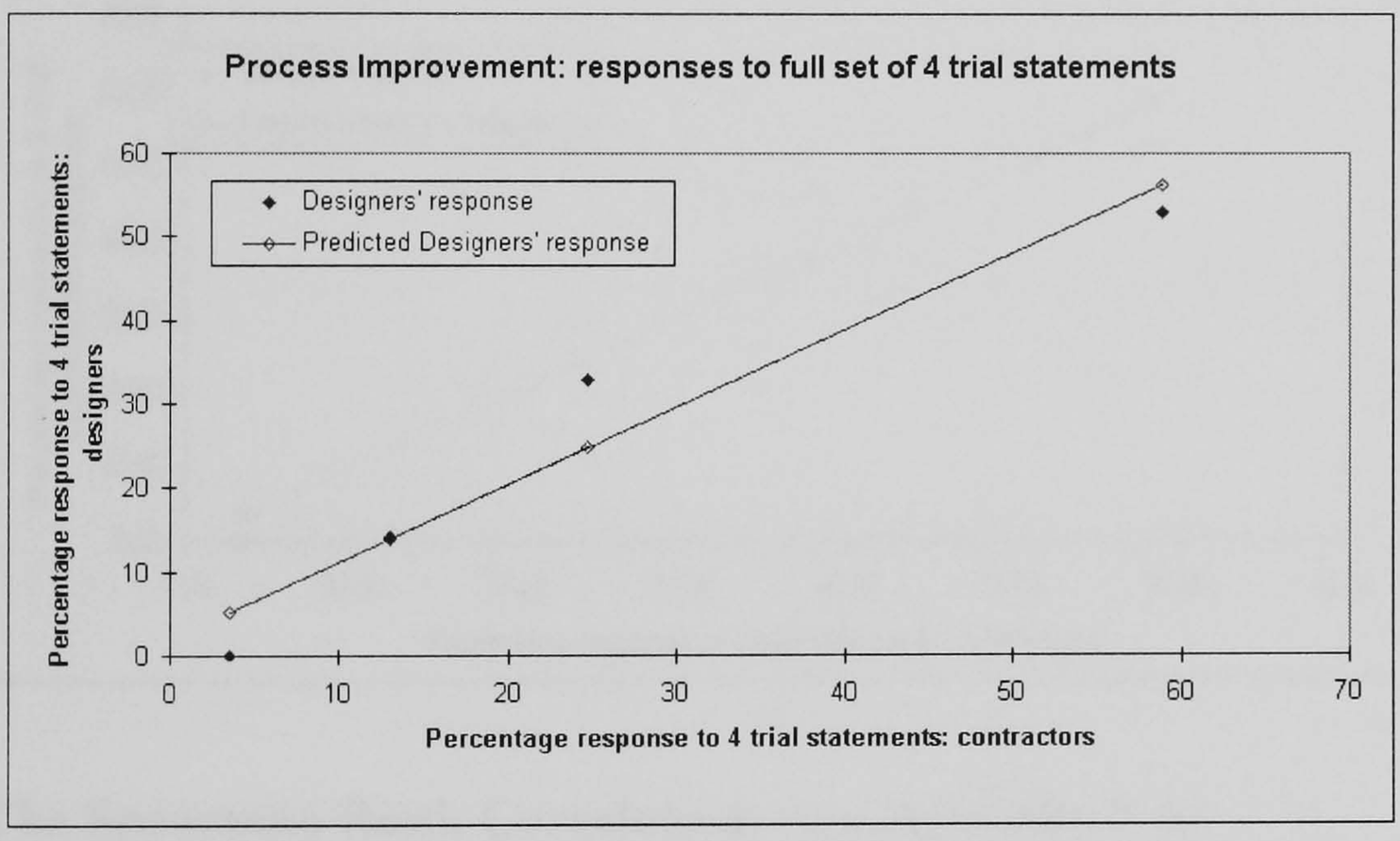
The slope is reasonably close to unity (1) and the intercept is not close to zero (0).

Process Improvement: full set of trial statements

SUMMARY OUTPUT

Regression Statistics	
Regression Correlation Coefficient R	**0.966**
Observations	4
	Coefficients
Intercept	1.996
Slope	0.920

Observation	*Predicted Y*
1	5.244
2	56.122
3	13.904
4	24.729



The Spearman Rank Correlation: (see Appendix 5.A)
which is very high, suggests a very strong correlation $r_S = 1.0$

Regression Analysis:

Regression coefficient, is similar to the calculated value for r_s $R = 0.966$

Graph (Linear Fit):

The equation of the line is: $P_D = 0.920\ P_C + 1.996$

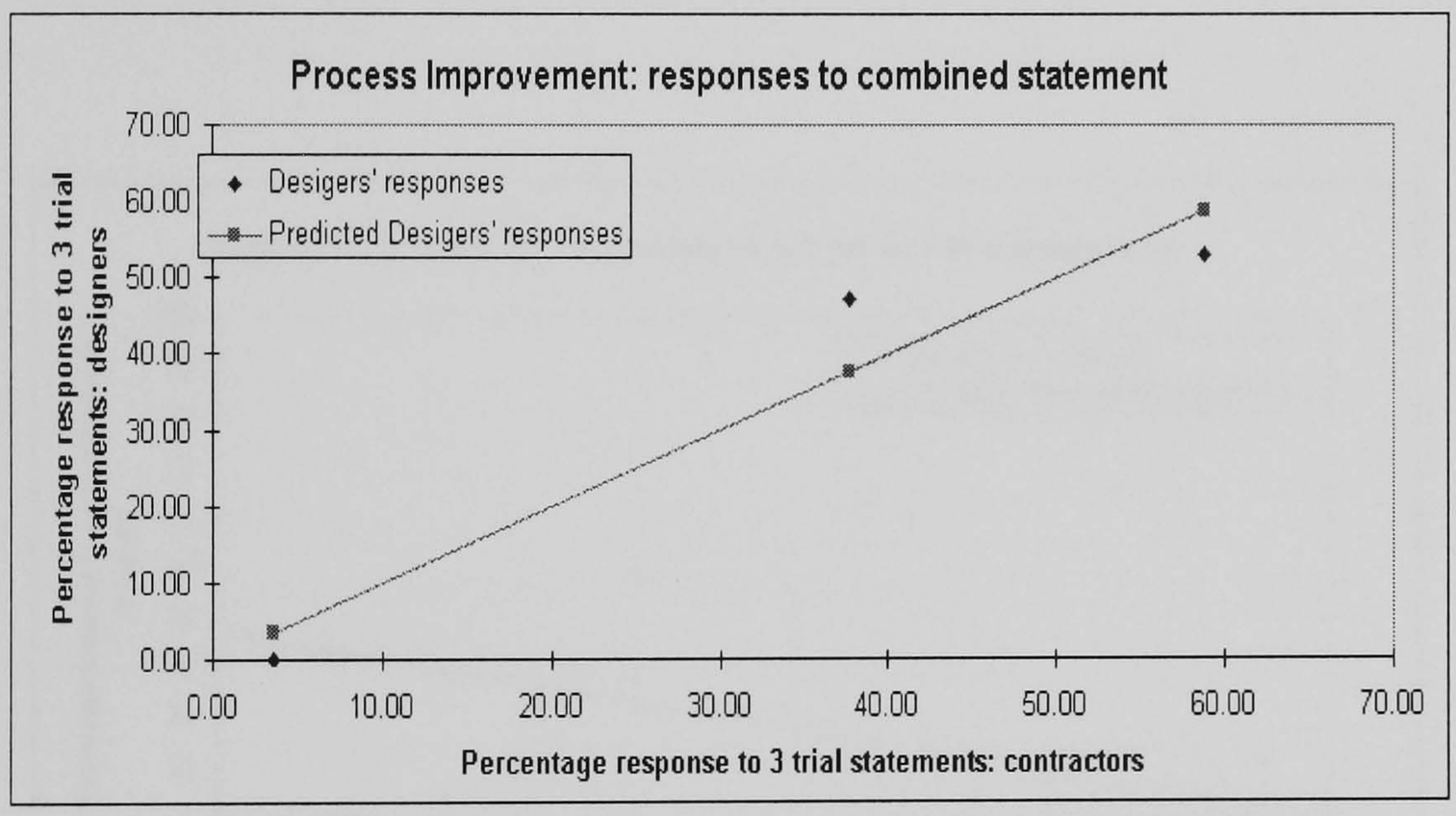
The slope is reasonably close to unity (1) and the intercept is far from being close to zero (0).

Process Improvement: responses to combined statements

SUMMARY OUTPUT

Regression Statistics	
Regression Correlation Coefficient R	**0.958**
Observations	3
	Coefficients
Intercept	0.088
Slope	0.997

Observation	*Predicted Y*
1	3.608
2	58.755
3	37.635



The Spearman Rank Correlation: (see Appendix 5.A)
which is very high, suggests a very strong correlation (perfect correlation). $r_S = 1.0$

Regression Analysis:
Regression coefficient, is similar to the calculated value for r_s $R = 0.958$

Graph (Linear Fit):
The equation of the line is: $P_D = 0.997\ P_C + 0.088$

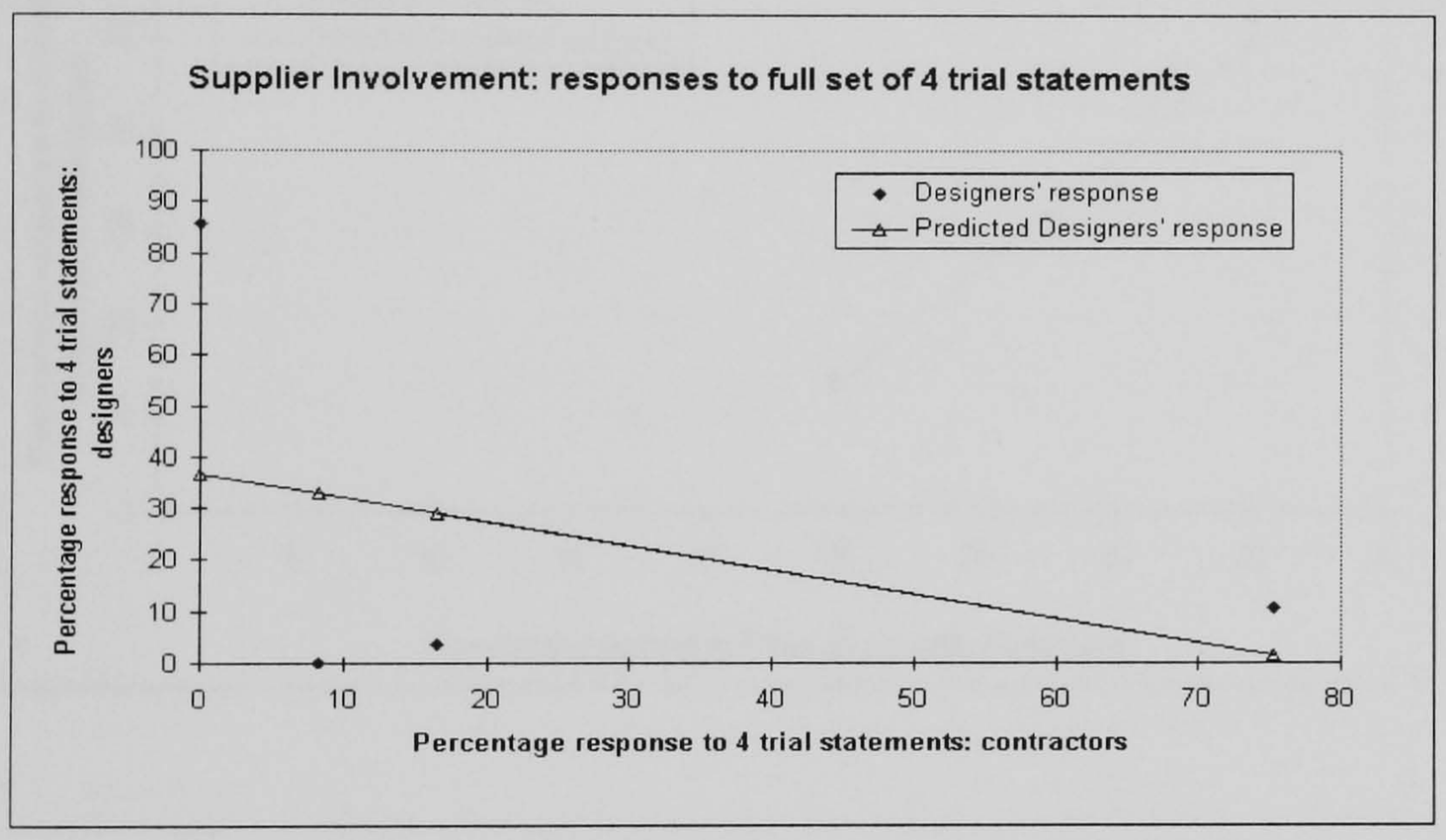
The slope is reasonably close to unity (1) and the intercept is reasonably close to zero (0).

Supplier Involvement : full set of trial statements

SUMMARY OUTPUT

Regression Statistics	
Regression Correlation Coefficient R	**0.392**
Observations	4
	Coefficients
Intercept	36.719
Slope	-0.468

Observation	*Predicted Y*
1	28.998
2	1.422
3	32.859
4	36.719



The Spearman Rank Correlation: (see Appendix 5.A)

whose absolute value is low, suggests a very weak correlation $r_S = 0.2$

Regression Analysis:

Regression coefficient, suggest a weak correlation similar to the conclusion of r_s value $R = 0.392$

Graph (Linear Fit):

The equation of the line is: $P_D = -0.468\ P_C + 36.719$

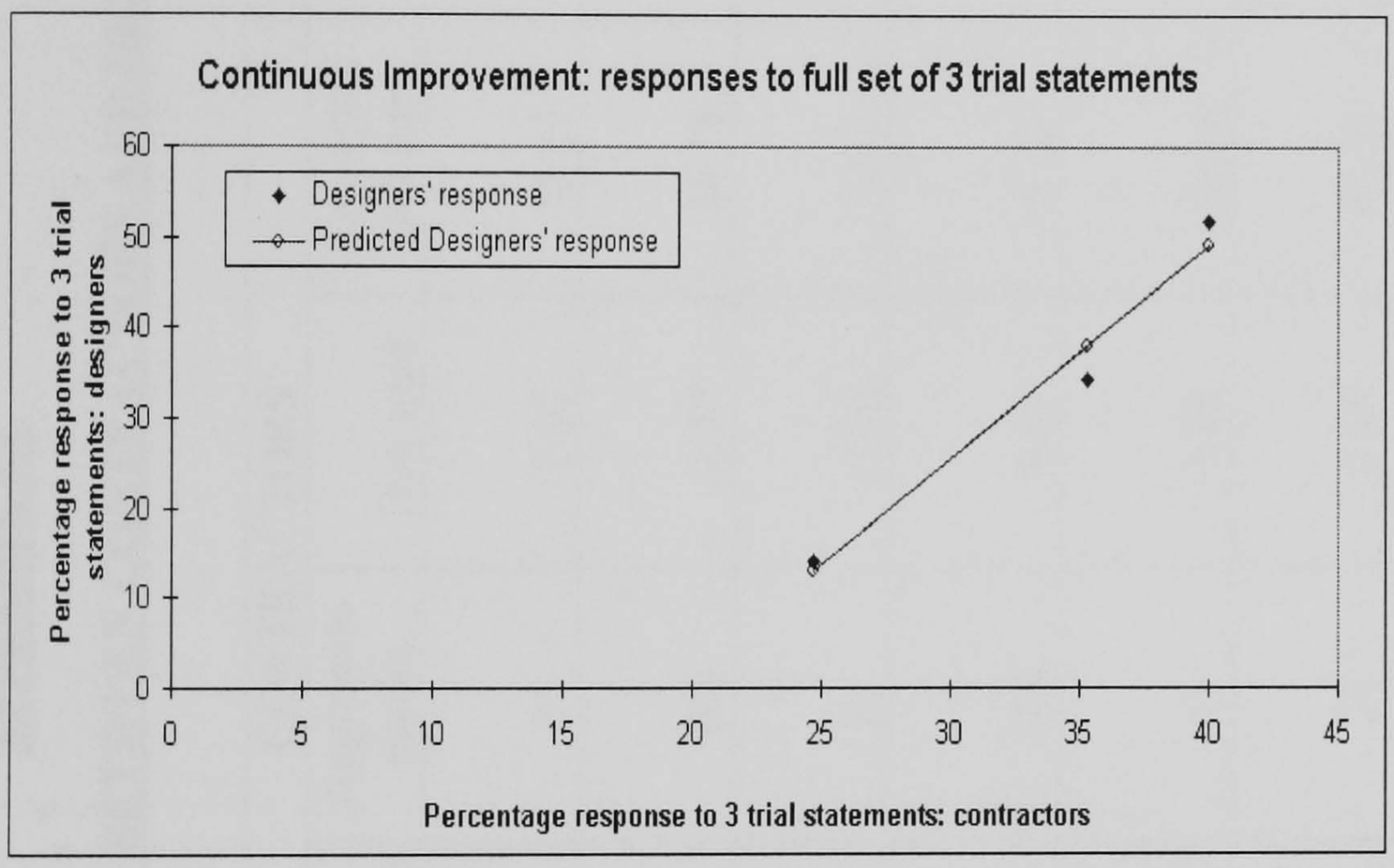
The slope is far from unity (1) and the intercept is not close to zero (0).

Continuous Improvement: full set of trial statements

SUMMARY OUTPUT

Regression Statistics	
Regression Correlation Coefficient R	**0.9836**
Observations	3
	Coefficients
Intercept	-45.488
Slope	2.364

Observation	*Predicted Y*
1	49.097
2	12.932
3	37.969



The Spearman Rank Correlation: (see Appendix 5.A)
which is very high, suggests a very strong correlation (perfect). $r_S = 1.0$

Regression Analysis:
Regression coefficient, is similar to the calculated value for r_s $R = 0.983$

Graph (Linear Fit):
The equation of the line is: $P_D = 2.364\ P_C - 45.488$
The slope is far from unity (1) and the intercept is close to zero (0).

APPENDIX 5.C

MEANS DIFFERENCE BETWEEN CONTRACTORS AND DESIGNERS

1. Training	marks for statement	CONTRACTORS				DESIGNERS			
statement		Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd	Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd
All employees and workers are sent for training.	7	5	35	7.07	35.35	12	84	4.43	53.22
Some employees are sent for training.	6	17	102	2.75	46.78	21	126	1.22	25.68
Employees are not sent for training because of cost.	4	13	52	0.12	1.51	24	96	0.80	19.19
Employees are not sent for training because appropriate training is not available.	5	21	105	0.43	9.12	17	85	0.01	0.19
Employees are not sent for training because the high turnover of employees means it is not worthwhile.	3	17	51	1.80	30.58	3	9	3.59	10.76
Employees are not sent for training for reasons other than above.	2	12	24	5.48	65.77	8	16	8.38	67.01
	Total	85	369		189.11	85	416		176.05
		mean = 4.34		stan Dev = 1.50 Variance = 2.25		mean = 4.89		stan Dev = 1.45 Variance = 2.10	
		Pooled variance = 2.17		*Pooled stan Dev = 1.47*		*t-statistic = 2.45*		*∝ 0.007*	
Conclusion:		*Since 0.001 <∝< 0.1, thus contractors and designers have dissimilar means.*							

1. Training	marks for statement	CONTRACTORS				DESIGNERS			
combined statements:		Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd	Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd
Some or all employees and workers are sent for training.	7	22.00	154.00	2.41	53.06	33.00	231.00	1.41	46.59
Employees are not sent for training because it is not feasible.	6	30.00	180.00	0.31	9.17	27.00	162.00	0.04	0.96
Employees are not sent for training because appropriate training is not available.	5	21.00	105.00	0.20	4.20	17.00	85.00	0.66	11.20
Employees are not sent for training for reasons other than above.	2	12.00	24.00	11.88	142.59	8.00	16.00	14.53	116.24
	Total	85.00	463.00		209.01	85.00	494.00		174.99
		mean = 5.45		stan Dev = 1.58		mean = 5.81		stan Dev = 1.44	
				Variance = 1.58				Variance = 2.08	
		Pooled Variance = 2.285		*Pooled stan Dev = 1.511*		*t-statistic = 1.572*		$\propto = 0.057$	
Conclusion:		*Since, 0.05 <∝< 0.1, contractors and designers have similar means.*							

2. Management Commitment and Leadership		CONTRACTORS				DESIGNERS			
statement	marks for statement	Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd	Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd
Management reviews the quality issues at its meetings regularly.	7	25	175	5.48	137.03	43	301	0.60	25.92
Management has adopted a formal strategy for improving quality.	6	17	102	1.80	30.58	34	204	0.05	1.70
Quality is not an issue in our organization.	1	3	3	13.39	40.16	0	0	27.29	0.00
Management is too busy with other activities.	2	4	8	7.07	28.28	0	0	17.84	0.00
QC/QA Manager is the one responsible for quality.	3	36	108	2.75	99.06	8	24	10.39	83.13
									0.00
	Total	85	396		335.11	85	529		110.75
		mean = 4.66		stan Dev = 2.00		mean = 6.22		stan Dev = 1.15	
				Variance = 3.99				Variance = 1.32	
		Pooled variance = 2.65		*Pooled stan Dev = 1.63*		*t-statistic = 6.26*		*∝ =0.000*	
	Conclusion:	*Since ∝< 0.001, thus contractors and designers have very dissimilar means.*							
Combined statements: Management reviews the quality issues at its meetings regularly.	7	25.00	175.00	2.95	73.76	43.00	301.00	0.47	20.02
Management has adopted a formal strategy for improving quality.	6	17.00	102.00	0.52	8.76	34.00	204.00	0.10	3.43
Quality is either not an issue or left to QA/QC Manager.	4	43.00	172.00	1.64	70.71	8.00	32.00	5.37	42.97
	Total	85.00	449.00		153.22	85.00	537.00		66.42
		mean = 5.28		stan dev = 1.35		mean = 6.32		Stan Dev = 0.89	
				Variance = 1.82				Variance = 0.79	
		Pooled Variance = 1.307		*Pooled stan Dev = 1.143*		*t-statistic = 5.903*		*∝ = 0.0*	
	Conclusion:	*Since ∝< 0.001, thus contractors and designers have very dissimilar means.*							

3. Communication	marks for statement	CONTRACTORS				DESIGNERS			
statement		Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd	Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd
You keep all employees informed of the firm's plans.	7	12	84	9.57	114.88	38	266	0.82	31.18
Any employee/worker can approach management with suggestion and complaints.	6	20	120	4.39	87.71	39	234	0.01	0.35
Language barrier is a problem in communication.	4	11	44	0.01	0.10	1	4	4.39	4.39
Each employee should focus on his own function.	2	26	52	3.63	94.44	7	14	16.76	117.33
The nature of the employer — worker relationship in construction industry creates a problem in communications.	2	16	32	3.63	58.12	0	0	16.76	0.00
	Total	85	332		355.25	85	518		153.25
		Mean = 3.91		stan Dev = 2.06		mean = 6.09		stan Dev = 1.35	
				variance = 4.23				variance = 1.82	
Pooled variance = 3.03				*Pooled sd = 1.74*		*t-statistic = 8.20*		*∝ =0.000*	
Conclusion:		*Since ∝< 0.001, thus contractors and designers have very dissimilar means.*							

3. Communication	marks for statement	CONTRACTORS				DESIGNERS			
combined statements:		Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd	Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd
There is two-way communication between the employees and management.	7	32	224	8.17	261.53	77	539	0.20	15.39
Language barrier is a problem in communication.	4	11	44	0.02	0.22	1	4	6.52	6.52
Each employee should focus on his own function.	2	26	52	4.58	119.20	7	14	20.73	145.10
The nature of the employer-worker relationship in construction industry creates a problem in communication.	2	16	32	4.58	73.35	0	0	20.73	0.00
	Total	85	352		454.31	85	557		167.01
		mean = 4.141		stan Dev = 2.33 Variance = 5.41		mean = 6.552		stan Dev = 1.41 Variance = 1.99	
		Pooled Variance = 3.698		*Pooled stan Dev = 1.923*		*t-statistic = 8.175*		$\propto = 0$	
Conclusion:		*Since $\propto < 0.001$, thus contractors and designers have very dissimilar means.*							

4. Teamwork	marks for statement	CONTRACTORS				DESIGNERS			
statement		Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd	Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd
The firm assigns groups to perform some activities.	7	54	378	2.87	154.98	81	567	0.03	2.52
There is a difficulty of grouping individuals with different backgrounds.	4	14	56	1.71	23.87	3	12	7.97	23.92
The nature of the business does not allow performing work through groups.	1	17	17	18.54	315.19	1	1	33.91	33.91
	Total	85	451		494.05	85	580		60.35
		Mean = 5.31		stan Dev = 2.43		mean = 6.82		stan Dev = 0.85	
				variance = 5.88				variance = 0.72	
		Pooled variance = 5.65		*Pooled stan Dev = 2.38*		*T=statistic = 4.16*		*∝ =0.000*	
Conclusion:		*Since ∝< 0.001, thus contractors and designers have very dissimilar means.*							

5. Customer Satisfaction		CONTRACTORS				DESIGNERS			
statement	marks for statement	Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd	Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd
You have a formal procedure to deal with customer complaint.	6	7	42	3.77	26.38	3	18	1.77	5.30
You have a formal procedure to identify and satisfy customer satisfaction.	7	30	210	8.65	259.52	46	322	5.43	249.60
The temporary relationship with your customers reduces your emphasis on their satisfaction.	4	15	60	0.00	0.05	7	28	0.45	3.15
Customer satisfaction is important but no procedure is established.	1	33	33	9.36	308.76	29	29	13.47	390.72
	Total	85	345		594.71	85	397		648.78
		Mean = 4.05		stan Dev = 2.66				stan Dev = 2.78	
				variance = 7.08		mean = 4.67		variance = 7.72	
		Pooled variance= 7.40		*Pooled stan Dev = 2.72*		*t-statistic = 1.47*		*∝ =0.071*	
	Conclusion:	*Since0.05 <∝< 0.10 thus contractors and designers have similar means.*							
combined statements: You have a formal procedure to deal with the customer satisfaction.	7	37	259	8.17	302.40	49	343	5.26	257.89
The temporary relationship with your customer reduces your emphasis on their satisfaction.	4	15	60	0.02	0.30	7	28	0.50	3.49
Customer satisfaction is important but no procedure is established.	1	33	33	9.87	325.61	29	29	13.73	398.27
	Total	85	352		628.31	85	400		659.65
				stan Dev = 2.73				stan Dev = 2.80	
		Mean = 4.141		Variance = 7.48		Mean = 4.706		Variance = 7.85	
		Pooled Variance = 7.666		*Pooled stan Dev = 2.769*		*t-statistic = 1.3296*		*∝ = 0.092*	
	Conclusion:	*Since0.05 <∝< 0.10 thus contractors and designers have similar means.*							

6. Focus on Employees		CONTRACTORS				DESIGNERS			
statement	marks for statement	Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd	Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd
The firm has a recognition/reward programme for all employees.	4	9	36	0.80	7.20	29	116	0.15	4.37
The firm has a recognition/reward programme for professional only.	1	25	25	4.43	110.87	11	11	11.48	126.28
The firm has a formal procedure to ensure the satisfaction of all employees.	7	6	42	15.16	90.98	27	189	6.82	184.18
The firm has a formal procedure to ensure the satisfaction of professional employees only.	2	21	42	1.22	25.68	12	24	5.70	68.44
The firm's financial constraint prevents the firm to focus on employees.	6	9	54	8.38	75.38	3	18	2.60	7.79
The calibre of employees in the construction industry prevents to pay them attention.	3	5	15	0.01	0.06	0	0	1.93	0.00
The high turn over because of the business fluctuation prevents to focus on employees.	5	10	50	3.59	35.88	3	15	0.37	1.12
	Total	85	264		346.05	85	373		392.19
		mean = 3.11		stan Dev = 2.03 variance = 4.12		mean = 4.39		stan Dev = 2.16 variance = 4.67	
		Pooled variance = 4.39		*Pooled stan Dev = 2.10*		*t-statistic = 3.39*		*∝ =0.000*	
Conclusion:		*Since ∝< 0.001, thus contractors and designers have very dissimilar means.*							

6. Focus on Employees		CONTRACTORS				DESIGNERS			
combined statements:	marks for statement	Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd	Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd
The firm has a recognition/reward programme for either all or some employees.	4	34	136	1.50	50.90	40	160	2.20	87.89
The firm has a formal programme to ensure the satisfaction of either all or som employees.	7	27	189	3.16	85.21	39	273	2.30	89.83
The firm's financial constraint prevents th firm to focus on employees.	6	9	54	0.60	5.43	3	18	0.27	0.80
The calibre of employees in the construction industry prevents to pay the attention.	3	5	15	4.94	24.72	0	0	6.16	0.00
The high turn over because of the busines fluctuation prevents to focus on employee	5	10	50	0.05	0.50	3	15	0.23	0.70
	Total	85	444		166.75	85	466		179.22
		mean = 5.223		stan Dev = 2.07 variance = 1.41		Mean = 5.482		Stan dev = 1.46 variance = 2.13	
		Pooled Variance = 2.059		*Pooled stan Dev = 1.435*		*t-statistic = 1.175*		*∝ = 0.119*	
Conclusion:		*Since ∝> 0.10, thus contractors and designers have very similar means.*							

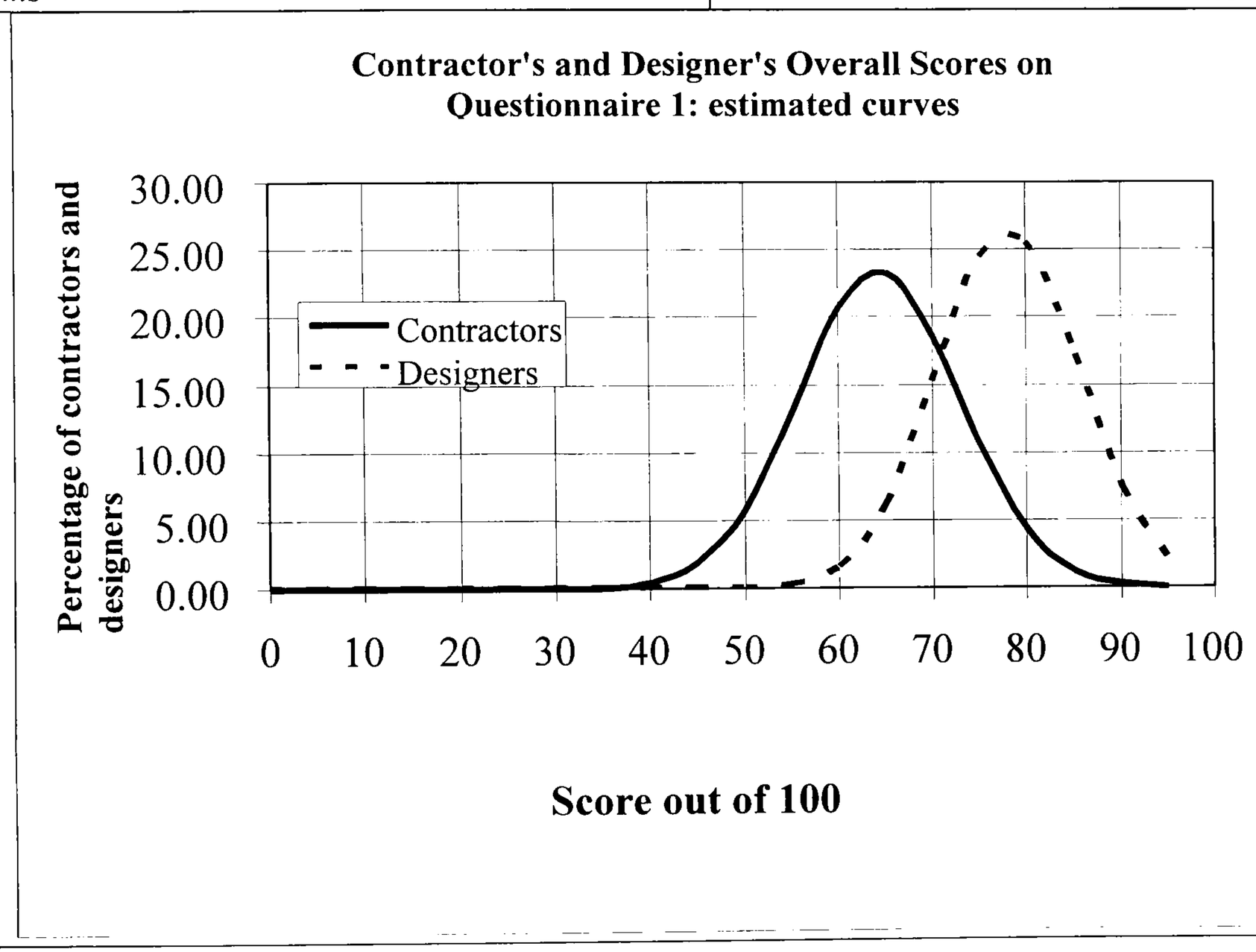
7. Process Improvement	marks for statement	CONTRACTORS				DESIGNERS			
statement		Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd	Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd
You perform Statistical Process Control (SPC).	6	3	18	0.82	2.46	0	0	1.96	0.00
You have a technique for process improvement.	7	50	350	3.63	181.62	45	315	5.76	259.20
The processes in construction industry are not repetitive which prevents process improvement efforts.	4	11	44	1.20	13.17	12	48	0.36	4.32
The process improvement techniques are too sophisticated to be implemented in the construction industry.	1	21	21	16.76	352.00	28	28	12.96	362.88
	Total	85	433		549.25	85	391		626.40
		mean = 5.09		stan Dev = 2.56 variance = 6.54		mean = 4.60		stan Dev = 2.73 variance = 7.46	
		Pooled variance = 7.00		*Pooled sd = 2.65*		*t-statistic = 1.22*		*∝ =0.117*	
	Conclusion	*Since ∝> 0.10, thus contractors and designers have very similar means.*							
combined statements: You perform statistical process control (SPC).	6	3.00	18.00	0.03	0.08	0.00	0.00	0.17	0.00
You have a technique for process improvement.	7	50.00	350.00	1.36	67.83	45.00	315.00	1.99	89.69
The nature of the processes in construction industry prevents process improvement.	4	32.00	128.00	3.37	107.79	40.00	160.00	2.52	100.90
	Total	85.00	496.00		175.69	85.00	475.00		190.59
		Mean = 5.84		stan Dev = 1.45 Variance= 2.09		Mean = 5.59		stan Dev = 2.27 Variance = 5.15	
		Pooled Variance = 2.180		*Pooled stan Dev = 1.476*		*t-statistic =-1.090*		*∝ = 0.862*	
	Conclusion:	*Since ∝> 0.10, thus contractors and designers have very similar means.*							

8. Supplier Involvement		CONTRACTORS				DESIGNERS			
statement	marks for statement	Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd	Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd
You have a partnership agreement with specific suppliers.	7	14	98	1.00	14.00	3	21	27.66	82.97
You deal with limited number of suppliers.	6	64	384	0.00	0.00	9	54	18.14	163.24
The firm policy does not allow a special relationship with certain suppliers.	4	7	28	4.00	28.00	0	0	5.10	0.00
Not Applicable	1	0	0	25.00	0.00	73	73	0.55	40.10
	Total	510		42.00	85	148		286.31	510
		mean = 6		stan Dev = 0.71		mean = 1.74		stan Dev = 1.85	
				variance = 0.50				variance = 3.41	
		Pooled variance = 1.95		*Pooled stan Dev = 1.40*		*t-statistic = 19.86*		*∝ =0.000*	
	Conclusion	*Since ∝< 0.001, thus contractors and designers have very dissimilar means.*							

9. Continuous Improvement		CONTRACTORS				DESIGNERS			
statement	marks for statement	Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd	Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd
You conduct benchmarking	7	34	238	6.82	231.92	44	308	5.43	238.75
You pursue best practices in your business formerly.	5	21	105	0.37	7.86	12	60	0.11	1.30
The fluctuation of the construction market prevents to adopt continuous improvemen strategy.	1	30	30	11.48	344.40	29	29	13.47	390.72
	Total	85	373		584.19	85	397		630.78
		Mean = 4.39		stan Dev = 2.64		mean = 4.67		stan Dev = 2.74	
				variance = 6.95				variance = 7.51	
		Pooled variance = 7.26		*Pooled stan Dev = 2.69*		*t-statistic = 0.68*		*∝ =0.247*	
	Conclusion	*Since ∝> 0.10, thus contractors and designers have very similar means.*							

OVERALL SCORES

	CONTRACTORS		DESIGNERS	
Overall scores	Mean = 41.988235	stan dev = 6.69	mean = 45.4	stan dev = 7.20
	variance = 44.72		variance = 51.78	
Percentage terms	Mean = 66.65	stan dev = 8.43	mean = 72.06	stan dev = 9.07
	variance = 70.99		variance = 82.20	
Scores Without Supplier Involvement	Mean = 35.99	stan dev = 6.44	mean = 43.66	stan dev = 6.19
	variance = 41.44		variance = 38.32	
Percentage terms	Mean = 64.26	stan dev = 8.60	mean = 77.96	stan dev = 8.27
	variance = 74.00		variance = 68.42	



		Contractor's	Designer's
0	0	0.00	0.00
0	2.5	0.00	0.00
5	7.5	0.00	0.00
10	12.5	0.00	0.00
15	17.5	0.00	0.00
20	22.5	0.00	0.00
25	27.5	0.00	0.00
30	32.5	0.01	0.00
35	37.5	0.08	0.00
40	42.5	0.48	0.00
45	47.5	2.00	0.01
50	52.5	6.01	0.09
55	57.5	13.01	0.56
60	62.5	20.29	2.41
65	67.5	22.79	7.22
70	72.5	18.42	15.15
75	77.5	10.72	22.32
80	82.5	4.49	23.06
85	87.5	1.36	16.72
90	92.5	0.29	8.50
95	97.5	0.05	3.03

APPENDIX 5.D
SUMMARY OF THE SPEARMAN CORRELATION, LINEAR REGRESSION AND MEANS DIFFERENCE TESTS

Topic	CONTRACTOR		DESIGNER		Significance for reject H0: equal means (reject at <0.05)	Inference on means	CONTRACTOR/DESIGNER CORRELATIONS			
	Score /7	Stan. dev	Score /7	Stan. dev			Spearman rank coeff	Spearman conclusion	RegressionCorrel ation coefficient	Regression Conclusion
Training										
Full set of statements	4.34	1.50	4.89	1.45	0.0072	dissimilar	0.14	weak	0.13	weak
Combined set	5.45	1.58	5.81	1.44	0.0579	similar	0.8	strong	0.75	mod/strong
Management Commitment										
Full set of statements	4.66	2.02	6.22	1.15	0.0000	v.dissimilar	0.65	moderate	0.44	weak
Combined set	5.28	1.35	6.32	.89	0.0000	v. dissimilar	-0.5	weak negative	0.85	strong negative
Communication										
Full set of statements	3.91	2.06	6.09	1.35	0.0000	v.dissimilar	0.3	weak	0.03	weak
Combined set	4.19	2.33	6.55	1.41	0.0000	v.dissimilar	0.8	strong	0.8	*strong
4. Team work										
Full set of statements	5.31	2.43	6.82	.85	0.0000	v.dissimilar	0.5	weak	0.99	*strong
5. Customer satisfaction										
Full set of statements	4.06	2.66	4.67	2.78	.0713	similar	0.8	strong	0.88	strong
Combined set	4.14	2.73	4.7	2.80	.09182	similar	1	strong	0.95	strong
6. Focus on Employees **										
Full set of statements	4.24	1.62	5.68	1.24	0.0000	v.dissimilar	0.17	weak	0.05	weak
Combined set	5.32	2.07	6.30	1.15	0.0119	similar	0.95	strong	0.98	strong
7. Process improvement										
Full set of statements	5.09	2.56	4.60	2.73	0.1170	v. similar	1	strong	0.97	strong
Combined set	5.84	1.45	5.59	2.27	0.8623	v.similar	1	strong	0.96	strong
8. Supplier involvement										
Full set of statements	6.00	.71	1.74	1.85	0.0000	v.dissimilar	-0.2	weak	0.4	weak
9. Continuous improvement										
Full set of statements	4.39	2.64	4.67	2.74	0.2468	v. similar	1	strong	0.98	strong

* The slope of the regression line is far from unity and the intercept is far from zero which suggest that the two responses are rather different.
** See Appendix 5.E

Note:

Score significance classification:

$\propto < 0.001$	v. dissimilar means
$0.001 < \propto < 0.05$	dissimilar means
$0.05 < \propto < 0.10$	similar means
$\propto > 0.10$	v.similar means

Note: the t-statistic has in each case 168 degrees of freedom, so that the t-distribution converges with the normal distribution. Hence the normal distribution was used in evaluating the value of the level of significance.

APPENDIX 5.E
TESTING VARIOUS WEIGHTING FOR "FOCUS ON EMPLOYEES" RESPONSES

6. Focus on Employees	marks for statement	CONTRACTORS				DESIGNERS			
statement		Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd	Num. of respondents	Aggregate marks	Dev sqrd	Aggregate Dev sqrd
The firm has a recognition/reward programme for all employees.	7	9	63	7.07	63.62	29	203	4.43	128.61
The firm has a recognition/reward programme for professional only.	5	25	125	0.43	10.85	11	55	0.01	0.12
The firm has a formal procedure to ensure the satisfaction of all employees.	6	6	36	2.75	16.51	27	162	1.22	33.02
The firm has a formal procedure to ensure the satisfaction of professional employees only.	4	21	84	0.12	2.44	12	48	0.80	9.59
The firm's financial constraint prevents the firm to focus on employees.	3	9	27	1.80	16.19	3	9	3.59	10.76
The calibre of employees in the construction industry prevents to pay them attention.	1	5	5	11.16	55.82	0	0	15.16	0.00
The high turn over because of the business fluctuation prevents to focus on employees.	2	10	20	5.48	54.81	3	6	8.38	25.13
	Total	85	360		220.25	85	483		207.24
		mean = 4.24		stan Dev = 1.62 Variance = 2.62		mean = 5.68		stan Dev = 1.57 Variance = 2.47	
		Pooled variance = 2.54		*Pooled stan Dev = 1.60*		*t-statistic = 5.91| ∝ 0.000*			
	Conclusion:	*Since ∝< 0.001, thus contractors and designers have very dissimilar means.*							
Combined statements, Case 1: The firm has a recognition/reward programme for either all or some employees.	7	34	238	7.07	240.36	40	280	4.43	177.39
The firm has a formal programme to ensure the satisfaction of either all or some employees.	5	27	135	0.43	11.72	39	195	0.01	0.44
There are obstacles that prevent from focusing on employees.	2	24	48	5.48	131.55	6	12	8.38	50.26
	Total	85	421		383.62	85	487		228.08

		mean = 4.95		stan Dev = 2.14		mean = 5.73		stan Dev = 1.65	
				Variance = 4.57				Variance = 2.72	
		Pooled Variance = 3.64		*Pooled stan Dev = 1.91*		*t-statistic =2.65*		*∝= 0.004*	
	Conclusion:	*Since 0.001 <∝< 0.05, thus contractors and designers have dissimilar means.*							
Combined statements, Case 2: The firm has a recognition/reward programme for either all or some employees.	7	34	238	7.07	240.36	40	280	4.43	177.39
The firm has a formal programme to ensure the satisfaction of either all or some employees.	4	27	108	0.12	3.14	39	156	0.80	31.18
There are obstacles that prevent from focusing on employees.	3	24	72	1.80	43.17	6	18	3.59	21.53
	Total	85	418		286.67	85	454		230.09
		mean = 4.92		stan Dev = 1.85		mean = 5.34		stan Dev = 1.66	
				Variance = 3.41				Variance = 2.74	
		Pooled Variance = 3.64		*Pooled stan Dev = 1.91*		*t-statistic =2.65*		*∝= 0.057*	
	Conclusion:	*Since 0.05 <∝< 0.10, thus contractors and designers have similar means.*							

CHAPTER-6

EFFECTIVENESS OF TQM AS A SOLUTION FOR SAUDI CONSTRUCTION INDUSTRY

6.1 Overview

This chapter addresses the effectiveness of TQM as a solution to problems (See Section 6.3) found in the Saudi construction industry. In addition, an in-depth analysis of these problems is given along with proposed solutions. In so doing, the third, fourth and fifth objectives of the research are addressed. These are:

- to determine the effectiveness of TQM as a solution for the Saudi construction industry problem;
- to identify the major problems of the Saudi construction industry;
- to provide solutions for the major problems of the Saudi construction industry.

This chapter reports a case study of TQM implementation in one of the largest owner companies for capital projects in Saudi Arabia. The case study is revisited to report the progress of TQM implementation five years after its initial deployment.

This chapter also provides the feedback of ten contractors who had implemented quality programmes for a number of years regarding their experiences with the TQM elements/ Quality Management implementation and whether (or not) TQM can serve as a solution to problems in the Saudi construction industry. The interviews identified a number of problems that the Saudi construction industry must attempt to deal with. These problems identified are examined through a mailing questionnaire (quantitative) and the results of a mailing questionnaire measuring the importance and significance of these problems are reported and analysed. This chapter discusses and analyzes the significant problems identified and proposes solutions to them.

Finally, this chapter provides practical experience of an attempt to implement TQM in a small construction firm. This TQM implementation attempt provides a realistic assessment of the effectiveness and the difficulties of implementing TQM in Saudi Arabia.

The long-term follow-up that is a feature of this chapter provides a stricter evaluation for an innovation in management technique than is generally applied. The results and conclusions are considered more realistic and solidly based in consequence.

6.2 A Case Study of TQM Implementation

6.2.1 A Case Study of TQM Implementation: Phase One

Organization Description

This national company is considered to be one of the largest private contractors for capital projects and its operation covers the whole Kingdom. The budget for its capital projects exceeds one billion U.S. Dollars a year. The company has more than 50,000 workers. It has very large engineering and project management sectors. These sectors are called Administrative (Admin.) Areas. Almost 2,000 employees work in the Engineering Admin Area and 2,000 in the Project Management Admin. Area. Its long history, and the respect it has earned over more than a half century, have made it a model for many organizations in Saudi Arabia. It has always been a focus of attention both for public and private organizations.

Although this company operates under 100% government ownership, the Government has always treated it as a separate entity and avoided interfering in its operations, regulations and policies. As a result, many Governmental agencies have benefited from this company's expertise in both technical and managerial arenas. The employees in this company come

from a variety of countries, with a majority being Saudi nationals. National workers represent more than 75% of the human resource base. Expatriates come from the U.S., the U.K., the Indian sub-continent, the Philippines and from other countries. English is the formal operational language. The relatively high incomes, positive treatment and other benefits encourage employees to continue working for it until the age of retirement, especially Saudi nationals. It is a life-time career for the majority of employees.

This company has played an important role in developing local industries especially in the Eastern Province of the Kingdom. It has also contributed substantially to technological transfer in the national marketplace and training of the national human resource base. Its organizational structure and success are noticeable characteristics of this organization and give it a uniqueness in relation to other public companies in the Middle East. The company has developed a culture over time which has been very much influenced by the American style of management.

Those who have been interviewed, indicated that the company was not in a position, at that stage (1997) to reveal the complete results of its experience with TQM. The reason given was that the implementation was still in process and any positive feedback might drive many local companies to experiment with TQM implementation blindly and with ineffective approaches. However, a substantial portion of the experience was provided by the interviewees.

Motivation for TQM Implementation

Interest in establishing a quality management programme in the Engineering and Project Management Admin Areas appeared as an avenue for reducing costs. Capital projects have always been viewed as a potential area for saving. However, attempts to reduce costs and enhance the efficiency of capital projects were not taken seriously until 1992. The

global economic situation exerted pressure on the Saudi Government to increase its revenue and minimize its continuous deficits and forced this large national company to adopt TQM in an attempt to meet the new challenges.

Pre-Implementation Phase

In 1992, representatives from the Engineering and Project Management Admin Area visited various American companies operating in the same marketplace. The objective of the visits was to learn from state-of-the-art project management practices in those companies. The representatives noted the interest these U.S. companies had had in implementing TQM in their project management work as a new way of enhancing their efficiency and reducing costs. Following the visits, TQM appeared in the Engineering and Project Management Admin Area as a concept worth formally investigating and attempting. In early 1993, a committee was formed, headed by the Senior Vice President for the Engineering and Operations business line. The Committee developed an action plan and recommended the initial steps necessary towards TQM deployment.

Implementation Phase

Once the decision was made by senior management to establish the Quality Management Programme a consultant firm was hired to assist in achieving the task. The consultant firm conducted a survey that covered all internal customers and suppliers of the Engineering and Project Management Admin Area, concurrently with its task of studying the activities and structure of the Engineering and Project Management Admin Area. Based on the consultant firm's recommendations, a steering committee was formed, chaired by the Engineering and Project Management Senior Vice President and a training programme was established. The training process took a top-down approach from the manager level to unit head through division head level. In this company, each department consisted of a

number of divisions and each division consisted of a number of units. The training was in the form of a two and a half day course entitled "Quality Management Skill". The course covered the basic ideas of the Quality Management concept and its techniques. In early 1994, a nine day Quality Improvement Team Facilitator course was offered. The objective of this course was to develop certified quality facilitators from each department. Two (2) persons were selected carefully from each department to attend the course. The certified facilitators conducted quality awareness courses for all employees in each department. The duration of quality awareness courses varied from 2-4 hours based on the level of the employee.

For process improvement, the Seven-Step Blue Print technique was used. This methodology was employed by the process improvement team to improve incrementally, redesign or create a process. The internal process improvement under this technique was designed to maintain customer satisfaction. The specific objective was to improve internal process performance through reducing cycle time, costs and defects and/or re-work. It was also supposed to improve the relationship with customers, suppliers and colleagues. This technique is taught through quality management skills courses, which are addressed, to all professional employees.

By mid 1995, three committees had been formed at three different levels. These three committees replaced the former steering committee. This time, these committees were called councils. Figure 6.1 shows the three councils. The objectives and tasks of these councils differ from one to another. The Business Line Quality Council (BLQC) was the highest quality committee in the hierarchy. It was chaired by the Senior Vice President and included all of the five Vice Presidents reporting to him. The BLQC was responsible for setting up the Admin Area quality strategy and long-term plans.

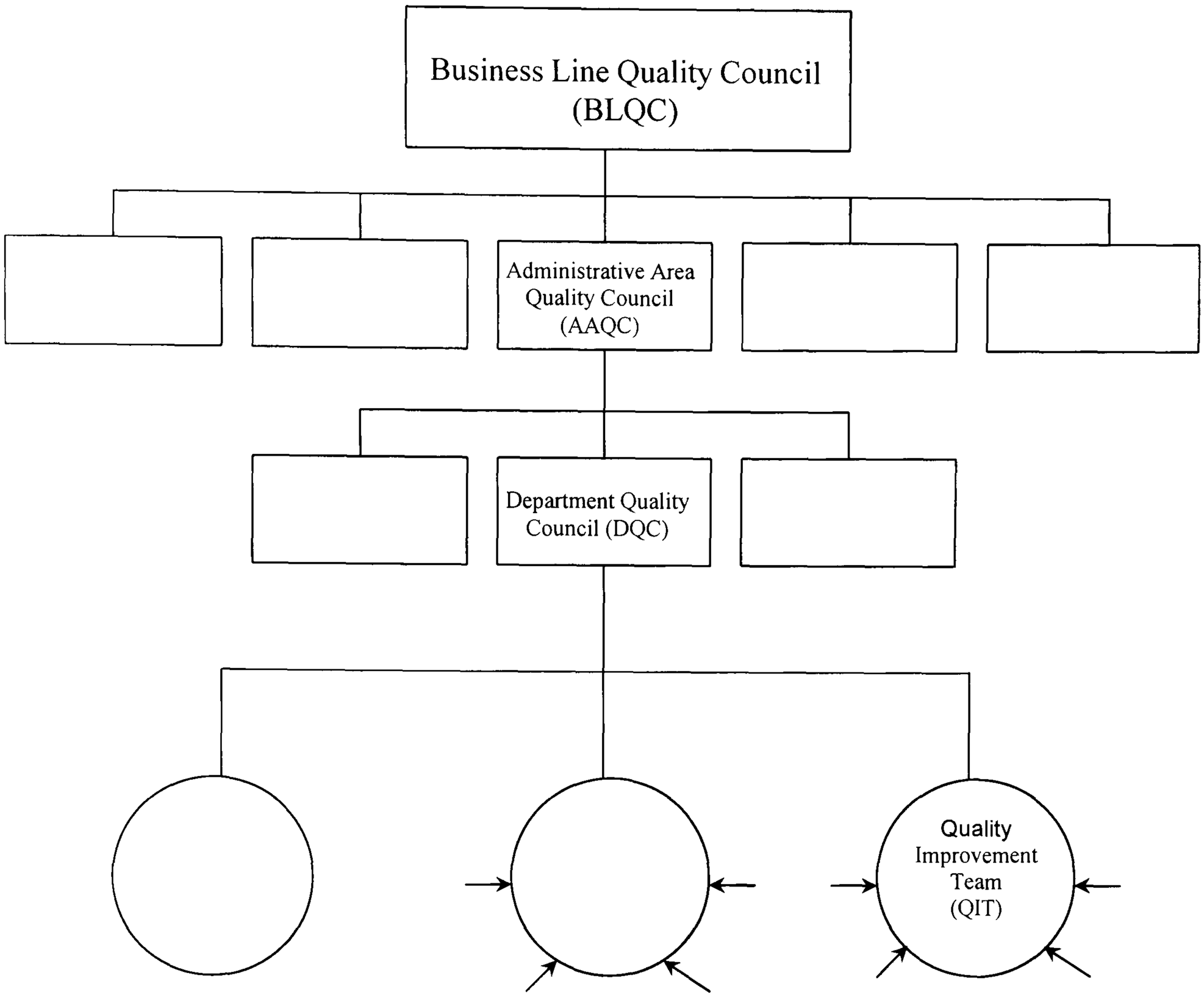


Figure 6.1: Hierarchy of Quality Committees

The second Council was the Administrative Area Quality Council (AAQC) which was chaired by the Vice President. In fact, there were five different AAQCs; one for each Administrative Area. This council consisted of the department managers as members. The task of this council was to set up the objectives and the Administrative Area implementation action plan. It also reviewed the progress and the difficulties in quality management implementation. Furthermore, it coordinated implementation efforts among the different departments within the Administrative Area.

The third council was the Department Quality Council (DQC) which was chaired by the Department manager and included the division heads as members. The task of this council was to conduct the quality management implementation and recommend the measures

necessary for process improvement. Furthermore, this council developed a TQM implementation plan for the department.

The Department TQM Implementation Plan provided an "On-Job-Implementation" (OJI) strategy for conducting TQM activities including safety. The safety plan was considered as part of the TQM implementation. The plan included the mission statements for corporate Admin Area, administration areas, department and divisions of the Department.

The most important responsibilities of DQC were as follows:

1. Define quality policy
2. Establish goals and objectives
3. Determine standard of quality to be measured
4. Provide leadership, direction and feedback on TQM effort
5. Establish goals and objectives of the training programme
6. Review the quality suggestions submitted by divisions
7. Review compliance and implementation of quality recommendations
8. Review recognition and reward nominations by division.

The DQC has formed quality improvement teams (QIT) to study and recommend the necessary measures to improve certain activities or processes. These teams met regularly and used a systematic approach to achieve their task objective, which was basically work improvement. The DQC selected the members of the QIT's carefully. QIT members usually had very good experience in the process under study and a quality improvement background.

The teams used quality management techniques to perform the following tasks:

1. Identify improvement opportunities
2. Identify customers and suppliers
3. Establish agreed-upon requirements

4. Identify the gaps
5. Describe and analyze the current process
6. Develop and execute solutions
7. Measure and monitor.

Impact of TQM

According to the supervisors, the employees' level of satisfaction and productivity increased due to the reward and recognition programme which is part of the TQM implementation effort. Rewards were simple and inexpensive but yet very meaningful to the employees. The reward distribution ceremony was held quarterly. Employees who were rewarded for their performance or contribution usually tried to maintain high standards. It has also been noticed that employees started to approach their management with creative suggestions. The "Let it go" attitude which was very common in large organizations was replaced gradually with "Let us do things better". The major change here was "us" versus "it". Those who have been interviewed stressed the positive impact of the TQM implementation on employees by referring to the statistics, which indicated reduced levels of sick leave and fewer late arrivals at work.

Difficulties in TQM Implementation

However, the positive impact of the TQM implementation was not the case with all employees. Some employees saw themselves as being outside the 'information loop' because their management had not kept them informed for different reasons. The belief on the part of direct management that frontline employees need not be informed was especially prevalent. In addition, many employees were sceptical about the whole issue of TQM and it was difficult to convince them of management commitment towards TQM. Indeed, some employees felt that the excitement surrounding TQM was attributable to the fact that it was a new idea for trial sponsored by senior management and that it would

gradually vanish. The company had witnessed many new concepts and slogans that had lost their thrust over time such as Management by Objectives (MBO). However, in the case of the TQM implementation, management was aware of the importance of maintaining the necessary thrust for the momentum of the TQM implementation. Management commitment towards TQM was continuously demonstrated and emphasized to the employees in different forms. Among the other difficulties in implementing TQM, was the struggle of supervisors to maintain their power. Some supervisors, and even higher level employees, felt that TQM diminished their power, even though they could not speak up against TQM implementation due to higher level management support. This could be observed indirectly through their jokes and informal conversation.

The cultural differences among the employees who come from different countries and backgrounds did not create any problem in TQM implementation. However, one of the westerners who was interviewed pointed out that some of the westerners felt that TQM was perceived as a potential threat: TQM appeared to have generated the notion that improving efficiency and reducing cost might lead to their being replaced by cheaper employees.

Among the other difficulties in the TQM implementation was that various company policies and regulations conflict with the spirit of TQM. For example, the rules and regulations did not have the flexibility to provide monetary reward for creative work beyond the formal salary increment structure. In addition, working after working hours to complete a job did not justify next day, late-morning arrival. A real-life example was the story of a Saudi national who worked as a programmer. He was regarded as an outstanding employee and his capabilities were formally recognized by his management. However, when he received a job offer in the U.S., the management could not compete on

account of the rules and regulations regarding salary. Consequently, the employee left, thereby incurring great loss to the company. This type of problem would disappear in tandem with the adoption of TQM as corporate strategy. The progress in the TQM implementation in Engineering and Project Management Admin Area was faster and stronger than any other Admin Areas in the company. Thus, this sometimes created problems at this initial stage.

Measuring Effectiveness

One of the remaining challenges in TQM implementation was measuring the effectiveness of TQM. Many advantages and benefits of TQM implementation were intangible, which made any attempt to assess the positive impact difficult, if not impossible. According to some of the interviewees, a periodic survey using standardized questionnaires could help to overcome this problem. However, this approach was not followed in the company under study. In the meantime, a procedure for measuring quality improvement was under preparation.

The experience of this company with TQM was still in its early stages, but the results were very encouraging according to some of the interviews. The commitment from the top management might be one of the most important reasons for initial encouraging results.

TQM and External Customers and Suppliers

The interviewees emphasized that it was important for them if they wanted to be a TQM organization to deal with TQM organizations. Therefore, it was important for the Project Management Admin Area to encourage their contractors and suppliers to adopt TQM principles. This could be achieved via giving preferences to contracting companies that have endeavoured to pursue TQM. However, this obviously poses the problem of how to determine the criteria to be utilized in classifying contractor **X** as a TQM contractor.

Discussion

A number of lessons could be learned from this case study. First, the case illustrated that the TQM concept could be implemented in environments like the one in Saudi Arabia and within Saudi publicly owned companies. The environment, here, means rules, regulations, multi-culture work force, etc. However, the organization in the case study is not typical of Saudi organizations. The regulations and policies of the organization in the study assisted in implementing new concepts such as TQM. Other public organizations do not enjoy such flexibility as to adopt TQM. The public sector in Saudi Arabia, such as the various Government ministries, are governed by rigid rules and regulations that are difficult to deviate from. The case illustrated that interest and enthusiasm for TQM increased during difficult times. The company had made the decision to explore new ideas such as TQM when it experienced pressure from the Government to reduce its budget. However, genuine interest and enthusiasm helped to bring about successful implementation. Furthermore, the case indicated that TQM implementation is a lengthy process and requires a vast investment in time. In addition, TQM implementation is more difficult in large organizations; it is important to coordinate strategies of TQM implementation among different Admin Areas and departments in any large organization.

The case study illustrated the importance of training and management commitment towards TQM. Furthermore, the case revealed that scepticism is one of the major challenges in the TQM implementation process. Fear of the impact of TQM implementation (e.g. job security, loss of power, etc.) was also one of the challenges it faced.

Alsinan *et al* (1997) reported the case study of the experience of one of the leading national companies in Saudi Arabia in implementing TQM. The same organisation was

revisited in this research and the progress in TQM deployment is reported. Section 6.2.1 (Phase One) above provides the results of Alsinan *et al* (1997) investigation, while section 6.2.2 below provides the latest progress in the TQM journey.

6.2.2 Revisit of TQM Implementation Case Study

The case study of TQM implementation, in one of the largest privately owned companies for capital projects in Saudi Arabia, reported above, was revisited. It was decided to revisit the case study company in order to report the progress of its TQM implementation. The timeframe between the initial investigation and the revisit is five years, which should provide a realistic picture of any progress and achievements. The previous manager of the TQM Department and a number of project engineers were interviewed. Some of the interviewees were met on more than one occasion.

Progress of TQM Implementation

A striking finding was that the TQM Department had been dismantled and the Quality Councils had been dissolved. However, according to the previous TQM Department Manager, the quality councils had achieved their objectives and their function was now redundant. He added that the basic objective of the quality council was to introduce quality concepts and awareness. According to him, it was found that a structured model for TQM implementation would not be effective. He elaborated and explained that the structured model for TQM implementation diverted the organization from the genuine search for excellence. He believed it was better to understand the TQM concept and quality tools and work with them in a more unstructured approach. The company had decided to leave quality improvement responsibilities under the ownership of each departmental manager following the introduction of the TQM concept and dismantling of the TQM department. Thus, it was found that there was a variance in the interest in

quality improvement among different departments. This variance could be traced to the different attitudes towards quality improvement among individual departmental managers. The CEO of the company encouraged the company managers to pay attention to quality improvement. However, it was left to each manager to decide the best approach for improvement. Some managers preferred a best practice approach while others emphasized other quality concepts such as employee empowerment. The previous TQM manager explained that one of the major advantages of the company's attempts to adopt and implement TQM was the success in changing the attitude towards business and instilling the perception that the business practices should be viewed as a dynamic process.

Measuring Effectiveness of TQM Initiatives

According to Alsinan *et al* (1997), measuring the effectiveness of TQM was one of the challenges that the company had been attempting to overcome. The previous TQM manager indicated that measures could be very dangerous and misleading. According to him, quality is something that you "feel" (intangible) rather than measure. The company decided to concentrate on people rather than numbers. Even benchmarking, a technique that falls under TQM, was found to be unsuitable. The CEO believed that each company had its own culture and should strive for continuous improvement. According to him, comparing the performance of the company with other companies is a useless endeavour and a non-value-added activity. At the same time, the company should monitor the progress in its performance as a result of its continuous improvement efforts.

One of interviewees indicated that the company had reviewed all of its processes during the TQM implementation and that the Quality Improvement Teams (QIT) had managed

to improve the business processes. However, after some time the QIT reached a point where, it was felt, there was no more to add. This contradicts the concept of continuous improvement, which is one of the TQM elements where the organization should set up a periodical review of its processes as a part of the company policy.

The Company Emphasis

According to the previous TQM department manager, the company's attempt to implement TQM resulted in the company realization that training, empowerment and employee satisfaction were the most important elements of any improvement programme, whether this improvement programme was called TQM or anything else. Therefore, the company made the decision to pay extra attention to people. The company believes that trained and empowered employees can make a difference.

The conversation with the previous TQM department manager gave the impression that the company had shifted its focus to people rather than the business processes. Five years previously, the company was focusing on both the business process and people with extra attention given to business processes. However, it was discovered (as can be seen below), that the company, in its Project Management Admin Area, had adopted well-structured tools that fall under the TQM umbrella such as internal benchmarking and best practice . This indicates that there is either a lack of communication among various departments and business lines in the organization or conflict in perceptions towards quality in general.

Best Practice and Benchmarking

The company has been a member of the Construction Industry Institute (CII), Texas since 1993. However, the Project Management Department felt that their membership

had not added tangible value to their business line. There was a feeling that the company could improve its business practice. In 2000, the company invited Independent Project Analysis (IPA), a consulting firm, to study the efficiency of its project management. IPA evaluated 30 projects collecting quantitative data and analyzing the data within their own database. The company had chosen IPA as a benchmarking consultant because of IPA's experience as a world-benchmarking leader and the large amount of resources they had at their disposal for data comparison.

IPA has developed a set of statistical models that can evaluate project outcomes in a number of key areas including cost, schedule, and operability. The group of models and databases are known as the Project Evaluation System (PES). The PES is a method for (http://www.ipaglobal.com/inside%20pages/About_IPA/PES/pes.html assessing project management systems over time.

Among the management techniques that the Project Management Admin Area has adopted since 2000, is Balanced Scorecard (BSC). A Balanced Scorecard is a method of measuring and managing business performance giving a balanced view of financial and operational perspectives to accelerate the management process.[1]

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[1] In the early 1990s, Robert Kaplan and David Norton developed the "balanced scorecard" system as an approach that provides a clear prescription as to what companies should measure in order to 'balance' the financial perspective. The Balanced Scorecard concept helps in translating strategy into action. BSC views the organization's performance from four perspectives (http://bsc.aramco.com.sa/BSC/ bsc_Concept/bsc_concept.html):

1. Financial perspective: To succeed financially, how should we appear to our shareholders?
2. Customer perspective: To achieve our vision, how should we appear to our customers?
3. Internal/Process perspective: To satisfy our shareholders and customers what business process we must excel at?
4. Learning and Growth: To achieve our vision, how will we sustain our liability to change and improve?

The four perspectives of the Balanced Scorecard provide a balance between short term and long term objectives, between desired outcomes and the drivers of those outcomes, and between an objective and subjective performance measure.

TQM and Contractors

The researcher also discussed the effect of TQM on the relationship between the company and its contractors. According to a senior Project Engineer, the company policy of awarding the contract to the lowest bidder is still a major obstacle to both the company and to quality contractors. Sometimes, the financial difference between the lowest bidder and the second lowest bidder is minimal while the quality of the second lowest bidder is by far better than the lowest bidder, but nevertheless the lowest bidder is awarded the contract. The policy of awarding the lowest bid deprives the company from obtaining the best value for its money. At the same time, it deprives the quality contractors from sustaining their quality.

Five years ago, at what could be described as the "TQM excitement period", the company considered introducing the "partnership" concept with its contractors. However, the company could not proceed with the partnership concept for many reasons. Among these reasons was the fact that the company was owned by the Government and the company had to be fair to all contractors. The fairness is in a sense that as many qualified contractors as possible are given the opportunity to enter in the bidding process. Another interesting reason is the fear of management being accused of favouritism if a bidder is identified as the company's partner contractor.

One of the interviewees indicated that Saudi contractors are not in a position to genuinely adopt TQM. The conditions of the construction market in Saudi Arabia do not help in the transfer to TQM. TQM does not necessarily pay off to the contractors. Contractors might 'pretend' their interest in being TQM conscious simply as a way to market themselves and draw attention to themselves. According to him, some

contractors were publicizing their interest in TQM when the company had enthusiasm for TQM especially in 1997 and 1998. However, once the company began to be less interested in TQM, those contractors likewise abandoned TQM.

Discussion

A major decrease in the enthusiasm for the TQM concept after five years of its initial TQM deployment has been observed. At the early stage of the company's attempt to implement TQM, it had been viewed as an ongoing strategic management approach with no return point. For example, the company formed what was thought to be permanent councils (committees) for quality improvement and quality improvement teams (QIT). However, these committees are no longer active. The justification of the previous TQM manager regarding the dismantlement of the quality councils and the assumption that their objectives have been achieved, contradicted what had been learned regarding the continuity of these councils five years ago.

It was discovered that the Senior Vice President of Project Management and Engineering, who had been a keen TQM advocate, retired from the company in 1998. This could be one of the reasons for the failure to sustain the necessary momentum towards maintaining the interest in TQM.

It is obvious that the expectations regarding the outcomes of TQM were much higher than what had been achieved. However, the interviewees refrained from referring to their attempt at TQM implementation as a failed experience. On the contrary, the interviewees considered the TQM deployment as a success, since that experience introduced a conscious awareness toward quality in general and paved the way to experiment with other concepts such as performance improvement.

The abandonment of the TQM implementation as a structured model indicates that the company felt that TQM implementation, as described in the literature and presented by the specialist consultants, was not an effective approach for improvement, despite the interviewees defending the TQM concept in general. The previous TQM manager claimed that their TQM implementation efforts were advantageous and the objectives of that exercise had been achieved. However, TQM is known to be an ongoing process rather than a one-time activity. It may be true that the company might have benefited from its attempt to implement TQM. However, the effectiveness of TQM could not be proven. The interviewees could not provide any hard evidence regarding the benefits gained.

TQM was viewed as any other "fashionable" management concept that arrives in a storm of excitement and as rapidly as it comes, it leaves. The only difference is that TQM has a totality aspect which affects every level of the organization including the frontline employees. The company was eager to pursue the TQM implementation and adopt it as a guiding philosophy. However, this was not finally the case and gradually within five years, the company drifted away from TQM.

6.3 The Effectiveness of TQM for Contractors

In order to determine the effectiveness of TQM in the construction industry, ten contractors were selected and interviewed. These companies were known to have an interest in quality management and had more than five years experience in deploying a quality management programme. All of these contractors were ISO9000 certified. Two contactors seriously considered implementing TQM a few years ago. In each company, more than one individual was interviewed. The interviewees consisted of quality managers, general mangers and project mangers. The emphasis in these interviews was

on the effectiveness of TQM as a solution for the Saudi construction industry in general based on their hands-on experiences. The interviewees also discussed the challenges and problems of the Saudi construction industry. The interviewees provided their knowledge about the industry in general based on their own experiences and their connections with those who were involved in the construction industry. In other words, they brought other companies' experiences and viewpoints into discussion quite readily.

Quality Management Efforts

The two contractors who had considered TQM implementation a few years previously argued that TQM is not suitable in the context of the construction industry. The nature of the construction industry in general, and in Saudi Arabia in particular, makes TQM unrealistic and an impractical model. According to one of the quality managers who had attempted to implement TQM, it might be more appropriate for public organizations where the management is appreciated for better services and quality regardless of the cost. The quality manager in the other company stated that "*TQM is a phrase that people use without understanding what it means to operate within TQM*".

Another contracting company Vice President, who had considered implementing TQM, indicated that the decision to adopt TQM was made as an immediate solution "magic wand" to solve company problems. TQM was thought to be capable of improving company performance and gives the firm advantage over others. However, the more you know about TQM, the more you realize that TQM is a concept that is good to know about and learn from, but not to be considered for implementation. These two contractors concluded that it is sufficient to realize the importance of continuous improvement.

The quality mangers who were interviewed indicted that there are some benefits for quality initiatives such as:

1. Better documentation; (e.g. ISO 9000)
2. Better Accountability;
3. Continuous Improvement;
4. Proactive Attitude;
5. Willingness for change;
6. Consistency in doing business (ISO 9000)

According to the interviewees, the above benefits are important but not essential for their survival. Contractors face major and more important problems that cannot be solved by TQM or any quality management programme.

The interviewees emphasized the importance of human resources, especially training and recruitment selection. A general manager of one firm mentioned that human resources are assets for them. The high turnover of workers and employees in the construction industry, due to the fluctuation of industry demand, creates a challenge for the contactor to invest in maintaining and earning the loyalty of their employees and workers.

Role of Owner on Quality

The researcher found that both contractors, who had made TQM implementation attempts, were influenced by one of their major clients (case study company). One of the interviewees indicated that the owner plays an important role in encouraging quality management initiatives among the contractors and the owner was in a position to upgrade the quality of the industry. For example, one quality manager mentioned that when Saudi Aramco introduced a new quality schedule in its standard contract document, his company reacted to the requirements of this schedule in order to comply

with the quality requirements. One advantage of this new requirement is that all contractors who are interested in bidding for Saudi Aramco construction contracts have to comply with the quality schedule requirements. The investment in quality in such cases is justifiable and rewarding for any contractor who is interested in doing business with Saudi Aramco. Contractors feel sometimes that they are taking a risk when they invest in quality under their own initiative since a contract is usually awarded to the lowest bidder. The cost and the time that are needed to deploy TQM could put the contractor in an uncompetitive position.

TQM as A Solution for the Industry Problems

According to the interviewees, the Saudi construction industry suffers from major problems that cannot be solved by merely adopting TQM. Furthermore, the condition of the industry puts obstacles in the way of TQM implementation or any other management technique. In other words, TQM cannot be a solution to the construction problems and the construction problems themselves constitute barriers towards benefiting from effective TQM implementation. The improvement of the industry should start with the business environment. However, quality management could help in dealing with various industry problems. For example, one contractor general manager indicated that because of quality improvement efforts, a procedure was introduced to verify their bid estimate in order to avoid wrong estimates due to poor contract documentation and specifications. Hence, quality initiatives could help in dealing with some of the industry problems.

It was obvious during the interviews that Saudi contractors feel that there are essential problems that need to be resolved as an initial step towards construction industry improvements. The contractors cannot resolve some of theses problems because they are beyond their control or even influence.

The interviews revealed that the Saudi construction industry suffers from a number of problems. Table 6.1 shows the major issues facing the construction industry that the research identified via the interviewees with the ten contractors.

Table 6.1: Major Issues Facing the Construction Industry and the Number of Respondents

No.	Problem	No. of Respondents
1.	The Government 's requirement to hire Saudi nationals	7
2.	The restriction on visas for foreign labour	6
3.	Delay of payments	5
4.	Intense competition (awarding contracts to the lowest bidder)	7
5.	High turnover of labour	6
6.	Unavailability of agencies dedicated to the construction industry;	1
7.	Legal system and arbitration	2
8.	Multi-cultural labour force	2
9.	Various procurement procedures	3
10.	Financial constraints	4
11.	Lack of information regarding market demand and future projects	1
12.	Poor utilization and non-standardization of Information Technology	1
13.	Poor specifications and contract documents of some project owners	2
14.	Lack of coordination and bureaucracy of owners project team	3
15.	Poor quality of workmanship	4
16.	Lack of adequate planning	1
17.	Poor communications (language wise)	2
18.	Poor focus on customer	1
19.	Fluctuation of demand	4

No.	Problem	No. of Respondents
20.	Poor bid estimate	1
21.	Design errors and delay of change orders	1
22.	Poor productivity of untrained labours	3

Analysis of the Construction Industry Problems

The above 22 problems, or "challenges" to the Saudi construction industry can be divided into two types: internal and external problems. Internal problems are those that can be controlled by the firm or the organization. On the other hand, external problems are those that are beyond the control of the organization and have more to do with the business environment. Some of these problems are interrelated.

The following problems can be considered as internal problems:

1. Poor quality of workmanship
2. Poor productivity of untrained labourers
3. Poor bid estimate
4. Multi-cultural labour force
5. Poor communication (language wise)
6. Lack of adequate planning
7. Poor focus on customers

The remaining 15 problems can be regarded as external problems. However, the internal problems cannot be segregated from the external factors. For example, the lack of planning is much related to the lack of information regarding market demand and future projects. It is very difficult for a firm to plan its operation in a vague market. One of the interviewees indicated to the researcher that his company experiences

difficulties in collecting information about forthcoming projects. In some instances, as a subcontractor for international industrial contractors, the contractor collects information about the future projects through their connections with the international contractors. The government should be far more transparent concerning its future projects.

The surveyed contractors almost *unanimously* identified some of the above problems as major issues. Other problems are considered major problems by individual interviewees based on their individual experiences.

The following are the unanimously agreed upon major problems of the Saudi construction industry:

1. Intense competition (awarding contracts to the lowest bidder)
2. Labour regulations

Problems related to labour dominate the problems identified above. These problems range from productivity to workmanship. The construction industry is a labour-intensive industry; therefore, it is logical to expect that most problems are related to labour.

In order to determine the significance of these problems, a mailing questionnaire was sent (see Appendix 3.C) to a random representative sample. The results and the analysis of the responses are presented in section 6.4 below.

6.4 Survey of Construction Problems

In the above section 6.3, the researcher has identified twenty- two (22) problems from interviews with ten contractors. However, in order to determine the significance of

these problems, a questionnaire (see Appendix 3.C) was developed and sent to 200 contractors. The objective of this questionnaire was to validate and generalize the significance of the problems that have been identified through the interviews with ten contractors.

The rate of response for this questionnaire was initially 19%. In other words 38 out of 200 responded. The researcher through telephone calls managed to increase the number of responses to 85 responses. In addition to these problems, a few respondents cited other problems. Among these additional problems (comments):

- Failure to recognise that contractors are entitled to make a profit.
- Voluminous documentation required by clients reduces performance efficiencies.
- The current bureaucracy of client should be simplified without sacrificing quality and safety.

Table 6.2 shows a summary of responses.

Table 6.2: Summary of Responses for Questionnaire 2

No.	Problem	1 Strongly Agree	2 Agree	3 Undecided	4 Disagree	5 Strongly Disagree
1.	The Government 's requirement to hire Saudi nationals	15	32	12	15	11
2.	The restriction on visas for foreign labour	14	33	9	20	9
3.	Delay of payments	11	28	11	27	8
4.	Intense competition (awarding contracts to the lowest bidder)	15	37	8	15	10
5.	High turnover of labours	12	33	13	19	8
6.	Unavailability of agencies dedicated for the construction industry	3	14	19	31	18
7.	Legal system and arbitration	5	21	12	29	18
8.	Multi-culture labour force	11	17	9	25	23
9.	Various procurement procedures	6	22	12	33	12

No.	Problem	1 Strongly Agree	2 Agree	3 Undecided	4 Disagree	5 Strongly Disagree
10.	Financial constraints	9	23	9	33	11
11.	Lack of information about the market demand and future projects	3	18	14	34	16
12.	Poor utilization and non-standardization of Information Technology	2	5	21	38	19
13.	Poor specifications and contract documents of some project owners	8	18	17	24	18
14.	Lack of coordination and bureaucracy of owners project team	10	27	12	23	13
15.	Poor quality of workmanship	7	24	9	34	11
16.	Lack of adequate planning	5	12	15	39	14
17.	Poor communications (language wise)	10	29	9	28	9
18.	Poor focus on customer	4	13	11	40	17
19.	Fluctuation of the demand	10	36	14	19	6
20.	Poor bid estimate	2	7	12	43	21
21.	Design errors and delay of change orders	7	25	9	27	17
22.	Poor productivity of untrained labours	17	18	7	28	15

The importance index formula (see section 3.6.3) was used in order to rank the above problems and determine the significance of each one of them. Table 6.3 shows the rank and the weight of each problem. The significant problems will be discussed in details in section 6.5 below.

Table 6.3: The Rank of the Construction Industry Problems

Rank	Problem	Importance Index
1	Intense competition (awarding contracts to the lowest bidder)	57.4
2	The Government's requirement to hire Saudi nationals	56
3	The restriction on visas for foreign labour	55.6
4	High turnover of labour	55.4
5	Delay of payments	52.4
5	Fluctuation of the demand	52.4

Rank	Problem	Importance Index
5	Poor productivity of untrained labour	52.4
6	Poor specifications and contract documents of some project owners	51.8
7	Poor communications (language wise)	51.6
8	Lack of coordination and bureaucracy of owners project team	50.6
9	Lack of information about the market demand and future projects	50.2
10	Financial Constraints	48.2
11	Poor quality of workmanship	47.4
12	Design errors and delay of change orders	46.6
13	Various procurement procedures	46.4
14	Multi-cultural labour force	44.6
15	Legal system and arbitration	44.2
16	Lack of adequate planning	42
17	Unavailability of agencies dedicated to the construction industry	41.6
18	Poor focus on customers	40.4
19	Poor utilization and non-standardization of Information Technology	37.6
20	Poor bid estimate	37

In order to determine the significance of each problem a Wilcoxon test was conducted (see section 3.6.4). The undecided responses were excluded from the analysis. Appendix 6.A shows the results of the Wilcoxon test. According to the results of the Wilcoxon test and based on the responses, the following problems can be identified as significant:

1. Intense competition (awarding contracts to the lowest bidder)
2. The Government's requirement to hire Saudi nationals
3. The restriction on visas for foreign labour
4. High turnover of labour
5. Delay of payments
6. Fluctuation of the demand
7. Poor productivity of untrained labours
8. Poor specifications and contract documents of some project owners
9. Poor communications (language wise)
10. Lack of coordination and bureaucracy of owner's project team

6.5 Saudi Construction Problems: Discussion and Solutions

This section discusses and analyses the significant problems identified in section 6.4 above, and proposes solutions to them. The proposed solutions are based on discussions with those involved in the construction industry, and the experiences of other countries in dealing with similar problems.

It is worth mentioning that some of the comments made below might not derive directly from the work addressed in this study; nevertheless, they reflect a more comprehensive understanding of, and insight into, the thoughts behind the work.

6.5.1 Intense Competition

The results of the survey presented in section 6.4 reveal that intense competition is ranked as the number one problem in the Saudi construction industry.

This intense competition might be due to the decrease in demand for the industry's services. Saudi Arabia witnessed a boom in the construction industry in the 1970's and early 1980's. However, the subsequent plunge in the economy resulted in a depression in the construction industry in which supply (number of contractors) began to surpass demand (market volume).

The majority of contractors surveyed, however, view competitive bidding (where the lowest bidder is awarded the contract) as responsible for the intense competition.

Generally, all Government contracts in Saudi Arabia are procured via a process of open bidding, in which the lowest bidder is awarded the contract. Some companies such as Saudi Aramco have open and closed (selective) competitive bidding; however, both types of bidding award the contracts to the lowest bidder.

In some cases, the difference between the lowest bidder and the second lowest bidder is negligible, although the quality of the second lowest bidder might be far better than the lowest. However, the system does not recognize the high quality of the second even if it is known from previous experience that the second would be able to deliver better quality services.

It has been commonly argued that normal competition can only be to the advantage of an owner, but excessive competition can potentially hurt an industry. Some contractors, anxious to secure work, undercut prices, which in some cases leads to the abandonment of work and, in severe cases, to bankruptcy. Contractors with financial problems due to underbidding often delay delivery of their projects, or fail to complete them at all. Furthermore, the growth of the industry will be negatively affected if this situation is allowed to continue (Addo-Abedi, 1999).

Yiwei and Eng (2000) argue that the traditional way of evaluating bids based on the lowest price is one of the principal difficulties in preventing wider implementation and acceptance of TQM in the construction industry. The findings of this research confirm their argument.

Furthermore, competitive bidding was the reason for the failure of the case study company to establish partnership with a limited number of quality contractors.

At the same time, a study of the Japanese construction industry reveals that until recently (i.e. 1996) it was well protected from competition (Tilton, 1997). This situation was one of the reasons for the success of the Japanese construction industry and its ability to invest in research and development (Cox and Townsend 1998). This

could explain why TQM has been successfully implemented in the Japanese construction industry since the late 1970s.

One possible solution to the problem of intense competition is to establish combined technical and financial criteria in which the evaluation process blends both the commercial and technical proposals. The weight of the commercial proposal might be higher than the weight of the technical one in order to ensure the cost effectiveness of the contract. At the same time, the evaluation criteria should be known to the bidders in advance. In fact, including a technical evaluation would be advantageous to the quality of the project, and will result in "best value for money" to the client. It would also encourage the contractors to compete to provide the best quality.

In Australia, the Code of Practice for the Building and Construction Industry, Department of Infrastructure of the Victoria Government (1999) recommends that the evaluation criteria of the tender should include as appropriate (www.building commission.com.au/CVICWeb/knowledge/Code%20of%20Practice%20Building.pdf).

- financial capacity
- organization capacity
- performance capacity
- resource availability
- health and safety management
- price

The weighting or priority given to each of these criteria by the client may vary depending on the results of the project.

6.5.2 Labour Regulations

Among the major problems of the Saudi construction industry identified through the survey (see section 6.4) are the visa restrictions and the requirement of the Government to hire Saudi nationals. These two problems are related because the restriction on issuing working visas for non-Saudi workers is aimed at replacing non-Saudi workers with Saudi nationals.

In recent years, the Saudi Government has introduced some regulations that restrict contractors from importing labourers from abroad. The reason for this is basically to assist in alleviating the problem of unemployment among local youths. All companies are required to employ a certain percentage of Saudi citizens before they can apply for visas for expatriate workers. The interviewees indicated that these restrictions on visas, as well as imposing regulations on hiring Saudi nationals, create a serious problem for them. These restrictions result in a shortage of labourers, which consequently causes delays in the carrying out of projects. The contractor faces difficulties in coping with these regulations.

The contractors interviewed in this research indicated that they have difficulty in hiring Saudi nationals. In the first place, Saudi nationals are not really interested in employment in the construction industry because it is considered to be difficult work, and they prefer to perform white-collar jobs. Some interviewees also claimed that Saudis perceive construction work to be demeaning. Therefore, it is difficult to keep them employed on a continuous basis.

Furthermore, interviewees indicated that young Saudi nationals need extensive training, an unattractive prospect since the contractor risks losing the worker after investing in

his training. It might be true that the training of young Saudis should be the responsibility of the Government and not solely of the private sector. While it is difficult for a non-Saudi worker to break his employment contract (which usually lasts for two years), a Saudi worker can leave his job at any time. In fact, the unavailability of training at a reasonable cost was one of the reasons for Saudi contractors not sending their workforce (Saudis and non Saudis) for training in general, as the survey results indicated in Chapter 5.

Moreover, the contractors are not in a position to pay satisfactory salaries to Saudi nationals. In Saudi Arabia, there is no minimum wage for either Saudis or non-Saudi workers; however, wages are conventionally based on the nationality of the worker. In fact, it seems that the cost of a Saudi worker in comparison with his non-Saudi counterpart is one of the main issues. Some contractors indicated that they are forced to hire Saudis merely in order to satisfy Government requirements before applying for visas. Hiring Saudis is an additional cost for them, especially when the utilization of Saudis is not as optimal as that of non-Saudi labour.

Solutions

The problems outlined above, which are related to labour, might not be the problems of the construction industry alone. These problems are also those of the Saudi labour market in general. However, the effect of these problems is more apparent in the construction industry, which is a labour intensive industry.

The Government should play a role in training Saudis before imposing a law on contractors to hire them. The Saudi Government allocates a high percentage of its budget every year to education and training; however, there is criticism that the training

programmes do not prepare young Saudis with the skills needed by the local labour market. This policy results in an ineffective training policy and waste of resources. On-the-job training is very important in producing skilful craftsmen; therefore, it might be prudent to send trainees to an industry at no cost to the contractor in order for them learn the trade (subsidized by the Government).

Furthermore, the labour law should give construction firms, as the employer, the right to lay-off Saudi workers when there is no need for them. The Saudi labour law is biased towards the labourer. The reason for this is that the current law was introduced in the late 1960's, when there was a strong global labour movement and the labour law had to compensate for the unavailability of labour unions, which are banned in Saudi Arabia. However, it seems that the overprotection of the national labour workforce is not to their advantage. In fact, the labour rules and regulations should be redesigned to encourage contractors to hire local labour.

At present, the concept of self-employment is not commonplace in the Saudi labour market. This concept should be introduced, promoted and regulated in the Saudi labour market. The barriers (e.g. lack of job-security) to self-employment should be studied and resolved. The construction industry, due to its nature, depends heavily on a self-employed labour force in many countries. For example, in the UK over 50% of the labour force is self-employed (Chileshe and Watson 2000). Similarly in Japan, many workers in the construction industry are classified as temporary (part-time). Temporary workers are hired in response to fluctuations in labour demand as a result of variations in business volume. On many construction sites, the employment of temporary workers is renewed on a daily basis. In some cases, sub-contractors merely hire agents who recruit casual or day labour. The main advantage of hiring part-time workers is that they can be easily terminated in times of economic downturn (Lambert *et al*, 1996).

6.5.3 Other Labour Issues

The interviews and results of the survey reported in sections 6.3 and 6.4 revealed other problems related to labour. These problems include:

1. High turnover of labourers, ranked fourth in significance
2. Poor productivity of untrained labour, ranked fifth in significance
3. Poor communications (language wise), ranked seventh in significance

High Turnover of Labourers

The high labour turnover is due to the fluctuation in business volume and not because of labour discontinuity at its own discretion. In fact, it is the contractor's management problem to sustain a stable business volume. However, high worker turnover has negative consequences, such as the inability to retain highly skilled labourers and the financial loss related to the cost of recruitment. In fact, the high turnover of labour is related to the fluctuation in demand, which is ranked fifth in significance. The problem of the high turnover of labour will be discussed below, along with the problem of fluctuation in demand as these two are directly related.

Labour Productivity

The interviews revealed that the nationality of the labourer has some effect on productivity. This might be related to systems of training, which differ from one country to another. However, the reasons for this variation in productivity could be related to other factors, such as cultural background or even physical attributes (Uwakweh, 2000). In any case, determining the reasons for these productivity variations is not within the scope of this research.

Although the cost of labour in Saudi Arabia is low, construction costs in the country are disproportionately high. Gardiner Theobald, an international project and cost-

management consulting firm, published an international construction cost survey in December, 2001. The report is for comparative purposes. From this report, Table 6.4 was derived. Table 6.4 shows the cost of labour in 10 countries. These countries are Saudi Arabia, three industrialized countries (the USA, the UK and Japan), three Middle Eastern countries (Oman, the United Arab Emirates and Israel) and three Far Eastern countries (India, the Philippines and Thailand).

Table 6.4: Labour Cost in Various Countries

No.	Country	Unskilled £/hour	Inclusive Rate Semi-Skilled £/hour	Skilled £/hour
1.	Saudi Arabia	1.68	2.24	2.80
2.	USA*	16.19	27.07	34.73
3.	UK	6.64	7.62	8.89
4.	Japan	15.72	19.76	25.86
5.	Oman	1.18	1.46	1.82
6.	United Arab Emirates	1.15	1.20	1.95
7.	Israel	4.64	7.45	8.61
8.	India	.20	.28	.34
9.	Philippines	.49	.58	.68
10.	Thailand	.40	.64	.88

The term "inclusive rates" means that they include such items as insurances and taxes. The rates for Saudi Arabia, Oman and the United Arab Emirates include the cost of importing labour, food and accommodation. The rate for the USA is the average rate, since there is a variance in labour cost depending on the state.

The construction cost per square metre for the same 10 countries is shown in Table 6.5. The construction cost is indicative as construction specifications and requirements will vary between countries.

Table 6.5: Construction Cost in Various Countries

No.	Country	High Rise Apartments £/m^2	
		Low	High
1.	Saudi Arabia	580	954
2.	USA*	687	1193
3.	UK	925	1,550
4.	Japan	1,122	1,378
5.	Oman	470	801
6.	United Arab Emirates	401	764
7.	Israel	298	331
8.	India	124	190
9.	Philippines	243	364
10.	Thailand	288	351

A comparison between Tables 6.4 and 6.5 shows that the labour cost in Saudi Arabia is not proportional to the construction cost. For example, while the hourly rate for unskilled labour in the UK is 6.64 GBP and the square meter cost is 925 GBP (low high- rise building), the hourly rate in Saudi Arabia for unskilled labour is 1.68 GBP and the square metre cost is 580 GBP for a similar project (low high-rise building). In other words, while the labour cost in the UK is almost four times that in Saudi Arabia, the project cost in the UK is only 60% more than that in Saudi Arabia.

Although the above comparison is not precise since there are many elements other than the cost of labour that make up construction costs, the comparison provides evidence that construction costs are not as low as labour costs. A senior estimator in one of the largest project owner (client) organizations in Saudi Arabia indicated that their cost benchmark revealed that the overall project cost in Saudi Arabia is around 10 % to 15 % lower than that of the same project in the USA. According to him, the cost of construction materials is very comparable between the States and Saudi Arabia. This leads him to conclude indirectly that cheap labour does not necessarily guarantee high productivity, or for that matter even cheaper construction costs.

Furthermore, the management of resources also plays an important role in determining costs. Contractors in Saudi Arabia keep their labourers on the payroll as long as they are in the country, since these labourers are not allowed to work for anyone else other than their sponsors. This means that the contractor must bear the cost of compensating employees for idle time when there is no work. It is difficult for any contractor, even those with good planning, to constantly utilize his resources effectively. This situation is different in other countries where the construction industry is considered to be a seasonal industry, and depends heavily on self-employed labourers as mentioned above. The interviewees recognized that there are individual differences among workers, and, this being the case, the common practice for the sake of planning is to view labour units as interchangeable. This view permits easy productivity planning. However, it is recognized that some workers produce more with better quality than do other workers. Uwakweh (2000) addressed this viewpoint in which workers are considered as interchangeable units, and concluded that this concept falls short as a useful analytical tool.

Poor Communications

Poor communication and a multicultural labour force are very much related. Those who identified multi-ethnic workers as a problem explained its effect mainly in terms of communication difficulties, which are due to the language barrier or cultural differences. However, the results of the survey revealed that to contractors the multi-background issue is ranked fifteenth (15th) in significance, while the language barrier is ranked seventh (7th). This might be related to the market tendency to hire cheap labour with low-level training and education.

Poor communication due to lack of common language is related to the construction labour market's dependency on cheap labour. This problem cannot be solved until the contractors recognize that cheap labour does not necessarily guarantee cost effectiveness. However, research may need to be done to determine whether the cost of hiring labourers with better communication skills (e.g. English or Arabic) is one worth paying.

6.5.4 Delay in Payments

This problem is well known in the industry; however, it is not a subject for discussion in public as it could be interpreted as unacceptable criticism of various governmental parties. The analysis of the questionnaire indicated that the problem of delay in payments has been ranked fifth in significance among Saudi construction industry problems.

Delays in payments are common, especially when dealing with governmental contracts. Such delays can often exceed one year. This problem has a substantial impact on a contractor's cash flow. When payments to contractors are delayed, the contractor must put off paying salaries and wages to his employees, and sometimes is forced to take out a loan with interest in order to finance his operations.

This situation discourages some Saudi contractors from entering into bidding for Government projects. In some cases, contractors add a premium to cover such delays. Generally, contractors are more interested in dealing with clients such as Saudi Aramco, where their invoices are paid in a timely manner.

The delay of payments has a domino effect. Sometimes, a contractor has two clients, one of whom is punctual in his payments and one of whom is not. The financial pressure due to the delay of payments from one client affects the entire performance of the contractor. In addition, the sub-contractor suffers from the delay in payment to the main contractor. Sometimes, this situation leads to the bankruptcy of the sub-contractor.

Overdue payments seem to be a widespread syndrome in the Saudi construction industry, even within the private sector. There might be two main reasons for this phenomenon:

1. The Government, by delaying its payments to contractors, legitimises such behaviour instead of setting a positive example by paying in a timely manner.
2. The fact that finance costs are not legally recognized in Saudi Arabia.

One of the solutions to this problem is to include a clause in the contract, which penalizes the client for late payments. This solution is acceptable within the Saudi legal system. Such penalties will at least protect the contractor from any additional costs incurred by taking out loans with interest to compensate for the interruption in cash flow due to late payments. Before pursuing this approach, however, it might be prudent to abet the process of enforcing contractual terms and conditions by improving the Saudi judicial system and arbitration.

However, the terms and conditions of Government contracts are not subject to modification, and contractors are not in a position to impose such clauses in their contracts.

The Government should realize the negative consequences of delay in payments on the industry, and problems resulting from such delays. The Government should change its current practice of signing a contract only when the fund is approved by the Ministry of Finance and not available within the Government agency account that entered into that contract. The Ministry of Finance should transfer any project funds to the beneficiary agency once the project budget is approved. This will guarantee the availability of the funds and help the Ministry of Finance to better plan its use of resources.

6.5.5 Fluctuation of Demand

Fluctuation of demand is one of the more complicated problems in the Saudi construction industry. The survey ranked this problem as fifth in significance (the same as delay in payments). This problem is directly related to the fluctuation in oil revenues, as the Saudi Arabian governmental budget depends primarily on this source of income. The Saudi national economy depends mainly on Government spending. The priority in the governmental budget is operations and salaries, while spending on capital projects comes in second. This explains why the construction industry prospers when the governmental budget is strong due to high oil revenues in a particular year. In many cases, capital projects are deferred if Government revenues are weak at the time when revenues are strong. This situation in fact leads to oscillation in the construction market.

The effect of intense competition, discussed earlier, appears more obvious when the demand on construction is low. Furthermore, contractors face a situation in which they have to lay off a number of workers because of the reduction in business. This leads to an additional problem in the form of the high turnover of labour.

Although the survey suggested that financial constraints are not a major problem in the Saudi construction industry, the discussion with some of the contractors indicates otherwise. Some contractors believe that financial constraints magnify the effect of fluctuations in demand. The respondents to the questionnaire might have overlooked the indirect effect of finance on the stability of demands in the industry.

In 2001, the Chief Economist at the Saudi American Bank (one of the largest banks in Saudi Arabia) addressed the problem of financing major construction projects in Saudi Arabia. He pointed out that Saudi Arabia's plans for infrastructure require capital expenditures of about $15 billion per year over the next 10 years (Dowland, 2001). He indicated that he believes the necessary funds will not be available locally.

The banking sector in Saudi Arabia plays a limited role in financing the construction industry, especially for the public sector. For example, Saudi banks do not grant long-term loans for citizens to build houses. Furthermore, there are no housing mortgage companies in Saudi Arabia. Some banks have recently launched loans with high interest for as long a period as ten years. This situation will lead to a national housing problem in the near future. In 2001, a study entitled "The Financial Capability and Average Spending of Riyadh Population" published by the Higher Committee for Riyadh Development indicated that less than 20% of Saudi families can afford to own a house without financial support.

From the above discussion, it is apparent that the solution lies in stabilizing demand and liberating the industry from its direct link to Government revenues through long- term planning. In fact, the demands on the construction industry, like those of any other industry, can to a certain extent be determined in advance and planned on a long- term

basis. The decision of when to execute construction projects should not be linked to the spontaneous availability of funds.

6.5.6 Poor Specifications and Contract Documents

The poor specifications and contract documents of some project owners is one of the major problems in the Saudi construction industry. The analysis of the mailing questionnaire resulted in a ranking of this problem as sixth in significance. The Fourth Saudi Businessmen's Conference (1989) also identified the lack of clarity of the language used in the contracts as one the main problems in the Saudi construction industry.

This particular problem is the only one of the significant problems linked directly to the relationship between the contractor and the owner. Therefore, introducing TQM in the construction industry should help in resolving such a problem. One of the TQM principles is that TQM recognizes the customer-supplier chain, and pays attention to the importance of such a relationship.

In fact, one of the theoretical advantages of introducing TQM into the construction industry is that the four major participants in the industry owner, contractor, engineering office and supplier - will see a reduction in adversarial relations and litigation amongst themselves (Chase 1993). Therefore, TQM can be viewed as a solution to the problem of poor specifications and contract documents on the part of the project owner.

However, even in cases where the industry has not adopted TQM this problem has to be resolved. One possible solution is to develop standard contracts to be used throughout the industry. Standardizing contract documents has many advantages, such as:

1. The participant in the industry will be familiar with these standard documents, which will improve understanding of contract documents and requirements.
2. The standard contract documents will be examined over time, and hence they can be improved to overcome any pitfalls that may arise.
3. Litigation due to differences in contract interpretations would be minimized.

Such an initiative to standardize contract documents needs to be launched by a body that has credibility and weight in the industry; thus, such an initiative would be adopted by the entire industry. For example, the Ministry of Municipalities, which grants construction permits, could require project owners to use such standard contract documents as a mandatory requirement.

The Saudi construction industry could benefit from the standard contracts that are used in developed countries. Furthermore, Saudi Aramco standard contract documents could also be used as a basis for developing national standard contract documents. Saudi Aramco contract documents have been in use in Saudi Arabia over many years, and they have proven their effectiveness.

General Discussion

The assumption (see section 1.4 –Research Hypotheses) upon which this research has been developed suggests that introducing the concept of TQM into the Saudi construction industry is a step in the right direction, and will both improve the industry's current situation of and assist in solving its problems. However, throughout this research it was found that the Saudi construction industry is characterised by a number of embedded problems that, instead of possibly being solved by TQM, constitute obstacles towards its implementation (see sections 6.3 and 6.4). In other words, solving these problems would

pave the road towards TQM implementation and industry development, and not vice-versa.

In Saudi Arabia there is no single agency that is dedicated to identifying and solving the problems of the construction industry.

On the other hand, many developing countries, as well as industrialized nations, have formed dedicated agencies to improve the performance of the construction industry and oversee its continuous development. Dedicated agencies in different countries have different objectives, responsibilities and levels of authority. For example, in the UK, the Construction Industry Board is an industry initiative, whereas its counterpart institutions in developing countries are government agencies. The Construction Industry Development Board of Malaysia, the Institute of Construction Training and Development of Sri Lanka, the National Construction Council of Tanzania, the Construction Industry Institute of Hong Kong (CII-HK) and Singapore's Building and Construction Authority are all government agencies (Ofori, 2000 and Yeng and Chan 2002).

In April 2000, the Construction Review Committee was appointed by the Government of Hong Kong to comprehensively review the current state of the industry and to recommend improvement measures. As a result, the Construction Industry Institute, Hong Kong (CII-HK) was established. This is a joint initiative of both the industry and academia, pioneered by the Hong Kong Society and Hong Kong Polytechnic University. The CII-HK is modelled on the Construction Industry Institute (CII) based in Austin, Texas, which was founded in 1983. The CII-Texas is a consortium of 90 companies that are either users or builders of constructed facilities (Yeung, 2002).

In the United Arab Emirates (UAE), which are very much similar to Saudi Arabia socially, politically, economically and culturally, the UAE Contractors' Association (UAECA) was established in 1985 by the Ministry of Labour and Social Affairs. One of the benefits of this organization is its capacity to discuss problems and issues among contractors, or between them and the authorities. It was found that collective handling of issues would be more effective than individual actions by contractors. After all, the problems are not unique to certain contractors, but rather they are common to the contracting community (//http//: www.uae_contractors.com). As mentioned earlier, some of the initiatives to establish agencies dedicated to improving the industry are sponsored by members of the private sector, such as CII-Austin, or jointly, such as CII-Hong Kong and in the UAE. However, most such initiatives undertaken in developing countries are sponsored exclusively by the Government.

In Saudi Arabia, the need to have a dedicated agency/institution to review and improve the construction industry is essential. Such an initiative should come from the government in order to secure the necessary effectiveness and collaboration with non-governmental agencies such as large contractors, large project owners, the Chamber of Commerce and the academic sector such as universities. The Ministry of Municipalities and Urban Affairs could take the initiative to form such an independent agency, since this Ministry has some interaction with the contractors.

Furthermore, the role of the Government is essential in solving the external problems that face the construction industry and its environment. The environment in this context does not refer to physical facilities, but is intended to include social, political, economic, and operating environments.

The Government affects all areas of society through its various policies (Fox *et al* 1999). The role of the Government is more obvious in a country like Saudi Arabia where the Government has full control, and the policies of the Saudi Government are evident to some degree throughout all of the country's industries. The effects of these policies on the construction industry are felt only indirectly; however, the Government, as a client, directly influences various workings of the industry.

Fox *et al* (1999) found that there is a strong emphasis on the external environment (factors) of the construction industry. According to him, construction firms in the industry can be aided in securing a competitive advantage by the Government's creating a conducive environment. He concluded, based on an in-depth survey of the opinions of experts, that the results indicate the influence of Government is substantial in assisting the construction industry to develop. In fact, it is the most important factor. The role of Government is not merely that of a client. On the contrary, the Government's role in creating and maintaining a conducive environment appears to be the dominant one. The Government's influence applies both at the level of the general business environment, as well as the specific task environment of the construction industry.

The findings of this research confirm the results of Fox *et al* (1999) regarding the importance of external factors and the subsequent role of the Government in improving the construction industry. The analysis of the major problems of the Saudi construction industry identified in this research (see section 6.4) indicates that most of these problems are influenced either directly or indirectly by the Government. For example, the second and third problems in order of significance, namely the requirement to hire Saudis and the restrictions placed on visas for foreign labourers, are the direct result of

Government labour policy. In fact, even the intense competition problem, which was ranked number one in significance, could be mitigated through Government adoption of a practice other than awarding their contracts to the lowest bidder as the Government is one of the main clients of the industry. The role of the government as one of the largest project owners (clients) could contribute to resolving problems such as the delay in payments, fluctuation in demand and the lack of information about demand and future projects.

6.6 Practical TQM Implementation Experiment in a Small Firm

In order to determine the effectiveness of TQM in the Saudi construction industry, the implementation of TQM within a small contracting firm was examined. A contractor was located who was willing to cooperate in this endeavour. It was difficult to find a larger, more well-established firm to cooperate in this endeavour, which might indicate a lack of enthusiasm towards new concepts in general and TQM in particular in the Saudi construction industry.

The owner was convinced of the advantages that could be gained by introducing TQM. Many examples were cited of the benefits that TQM could provide to his firm: that TQM could improve the performance of the firm and subsequently increase its profitability. It was very important, in order to encourage the owner, to indicate that the TQM implementation would not add any cost to overall overheads. An average 6 hours were devoted each week to the project over a six-month period.

Appendix 6.B provides the details of this attempt of practical TQM implementation.

Discussion

The results of the TQM implementation experience supported the results that were concluded throughout the qualitative and quantitative surveys of this research. The fact that the practical experience took place in a small construction firm, while the target population in the surveys were larger construction firms, revealed that the difficulties faced in quality improvement might be even more challenging in a small firm.

The fluctuation of the business, competition and financial constraints in general were the major obstacles to adopting such aspects of TQM as training and employees satisfaction, which are very important in any TQM implementation programme.

The experience with a small construction firm suggests that Business Process Reengineering (BPR) might be more appropriate. The change is radical when a quality programme is launched in a small construction firm. Although BPR is not within the scope of this research, it was found from the experience with the small-contractor that the TQM implementation transpired to be a BPR endeavour in certain aspects. The main difference between TQM and BPR is that TQM provides the elements for a business to grow and evolve, while BPR tries to redesign and develop a process immediately (Bubshait and Ali, 1997). Furthermore, BPR concentrates on the process and neglects the importance of continuous improvement. In this hands-on experience, the process improvement element of TQM was the most appropriate element that could be implemented and welcomed by the owner (management). The hands-on experience revealed the difficulties in setting up a continuous improvement policy due primarily to uncertainty and business fluctuation. Thus, one of the basic characteristics of TQM philosophy, which is the need for continuous incremental improvement, was not possible in the hands-on experience.

Once again, it is not within the scope of the research to conduct a comparison between BPR and TQM. However, the reality of the situation necessitates reporting this observation.

A few lessons could be learned from the practical attempt to implement TQM in the industry, albeit in a small firm. These lessons are:

1. It is difficult to plan a schedule for TQM implementation in the construction industry. The level of activities and cash flow play an important role in the construction industry. Contractors have difficulties in forecasting future business, which creates challenges for them to set up long-term plans or commit themselves towards an ongoing strategy.
2. Quality circles can be employed in the construction industry as an effective and practical approach to achieve some of the TQM elements to a certain degree.
3. It is very important to determine elements to be used as a measure for quality improvement. These elements should be defined and achieved within the spirit of TQM.
4. It is very difficult to measure customer satisfaction in the construction industry.
5. TQM activities could help in improving the contractor's performance, especially the process improvement element; however, the contractors are sceptical that these activities actually give results.
6. TQM can help a contractor to deal more effectively with construction industry problems; however, the industry suffers from fundamental problems that cannot be solved by TQM alone, and creates such obstacles to effective TQM implementation as the pressure of competition and maintaining demand.

6.7 Summary

This chapter has presented the progress of a TQM implementation in a case study in one of the largest project owners in Saudi Arabia. It has also reported the effectiveness of TQM in the Saudi construction industry. The problems of the Saudi construction industry have been identified via the surveying of ten construction firms. Those problems have been examined further to measure their significance through the application of a mailing questionnaire. The results of the mailing questionnaire analysis have been reported. The identified significant problems including intense competition, labour problems, delay in payments, fluctuation in demand and poor contract documentation and specifications have been discussed in detail along with suggested solutions to them. Also, this chapter has discussed the importance of forming a dedicated agency for improvement in the construction industry and the role of the Government in improving the industry in general. Finally, a practical TQM implementation experiment in a small firm has been reported.

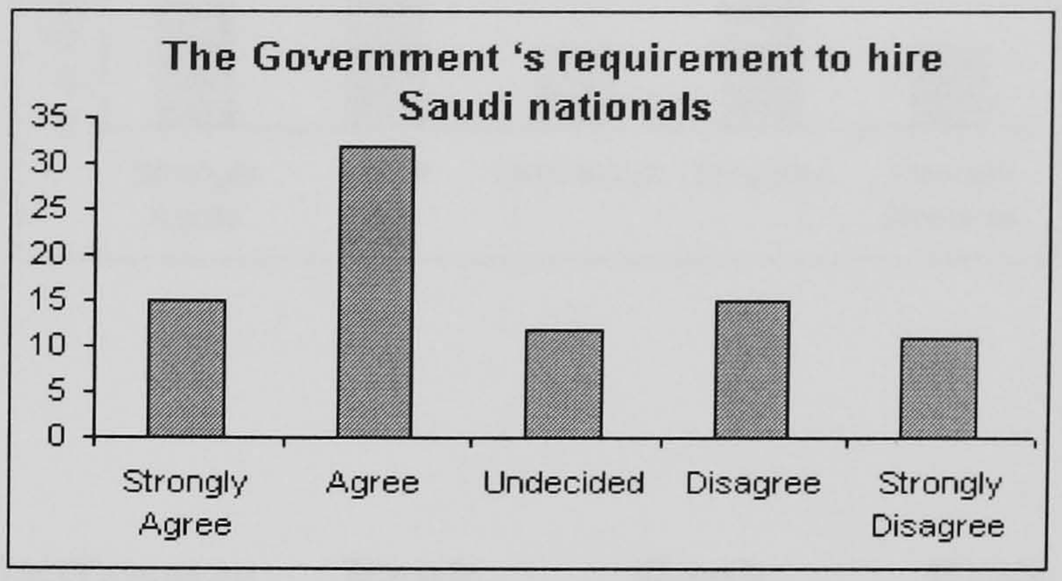
APPENDICES

APPENDIX 6.A

THE WILCOXON TEST FOR PAIRED OBSERVATION

The Government 's requirement to hire Saudi nationals

Category	# of Respondents	Percentage %
Strongly Agree	15	17
Agree	32	38
Undecided	12	14
Disagree	15	18
Strongly Disagree	11	13
Total	85	100%



Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	15	11	4	4	4	-
Normal	32	15	17	17	17	-
					21	0

$$\sum rank(+) = 21 \qquad \sum rank(-) = 0$$

$H_0 : \sum rank(+) \geq \sum rank(-)$ (The Government 's requirement to hire Saudi nationals is a major problem in the Saudi Construction Industry).

$H_1 : \sum rank(+) < \sum rank(-)$ (The Government 's requirement to hire Saudi nationals is NOT a problem in the Saudi Construction Industry).

Conclusion: The Government's requirement to hire Saudi nationals is a major problem in the Saudi construction industry.

The restriction on visas for foreign labour

Category	# of Respondents	Percentage %
Strongly Agree	14	16
Agree	33	39
Undecided	9	11
Disagree	20	23
Strongly Disagree	9	11
Total	85	100%

Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	14	9	5	5	5	-
Normal	33	20	13	13	13	-
					18	0

$\sum rank(+) =$ 18 $\sum rank(-) =$ 0

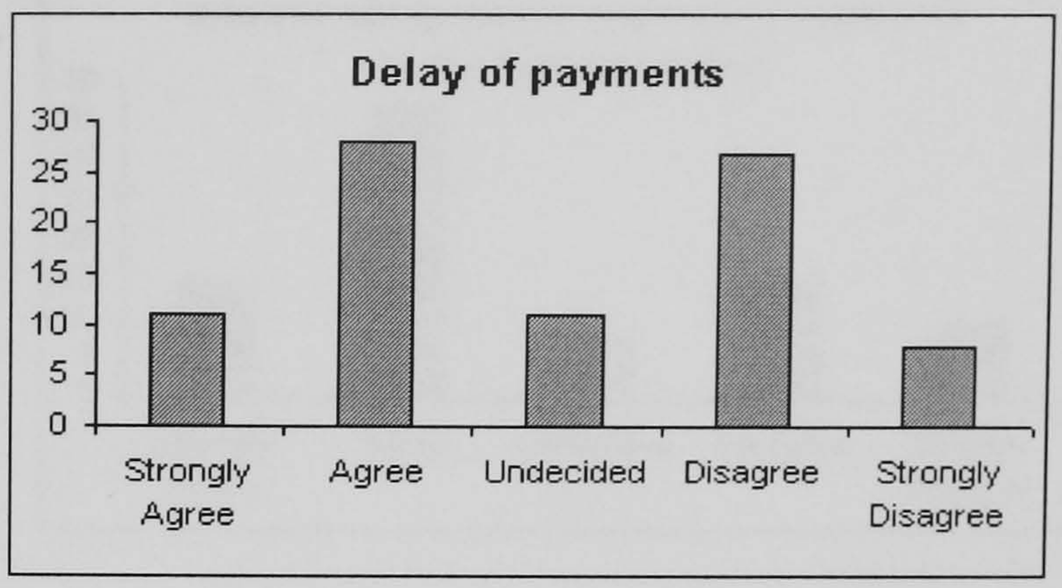
$H_0 : \sum rank(+) \geq \sum rank(-)$ (The restriction on visas for foreign labour is a major problem in the Saudi Construction Industry).

$H_1 : \sum rank(+) < \sum rank(-)$ (The restriction on visas for foreign labour is NOT a problem in the Saudi Construction Industry).

Conclusion: The restriction on visas for foreign labour is a major problem in the Saudi Construction Industry.

Delay of payments

Category	# of Respondents	Percentage %
Strongly Agree	11	13
Agree	28	33
Undecided	11	13
Disagree	27	32
Strongly Disagree	8	9
Total	85	100%



Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	11	8	3	3	3	-
Normal	28	27	1	1	1	-
					4	0

$\sum rank(+) = 4$ $\sum rank(-) = 0$

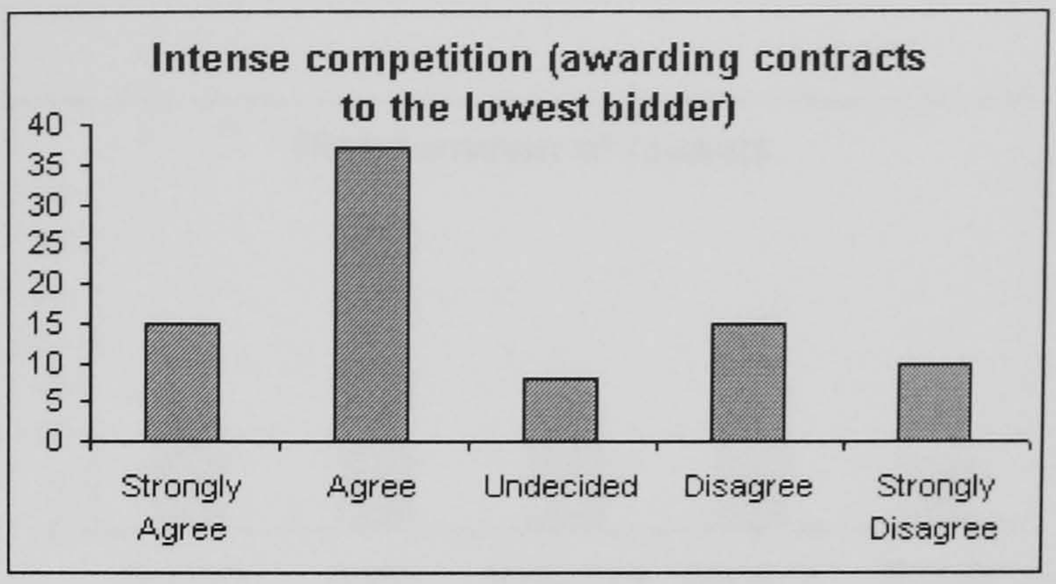
$H_0 : \sum rank(+) \geq \sum rank(-)$ (Delay of payments is a major problem in the Saudi Construction Industry).

$H_1 : \sum rank(+) < \sum rank(-)$ (Delay of payments is NOT a problem in the Saudi Construction Industry).

Conclusion: Delay of payments is a major problem in the Saudi Construction Industry.

Intense competition (awarding contracts to the lowest bidder)

Category	# of Respondents	Percentage %
Strongly Agree	15	18
Agree	37	44
Undecided	8	9
Disagree	15	18
Strongly Disagree	10	12



Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	15	10	5	5	5	-
Normal	37	15	22	22	22	-
					27	0

$\sum rank(+) = 27$ $\sum rank(-) = 0$

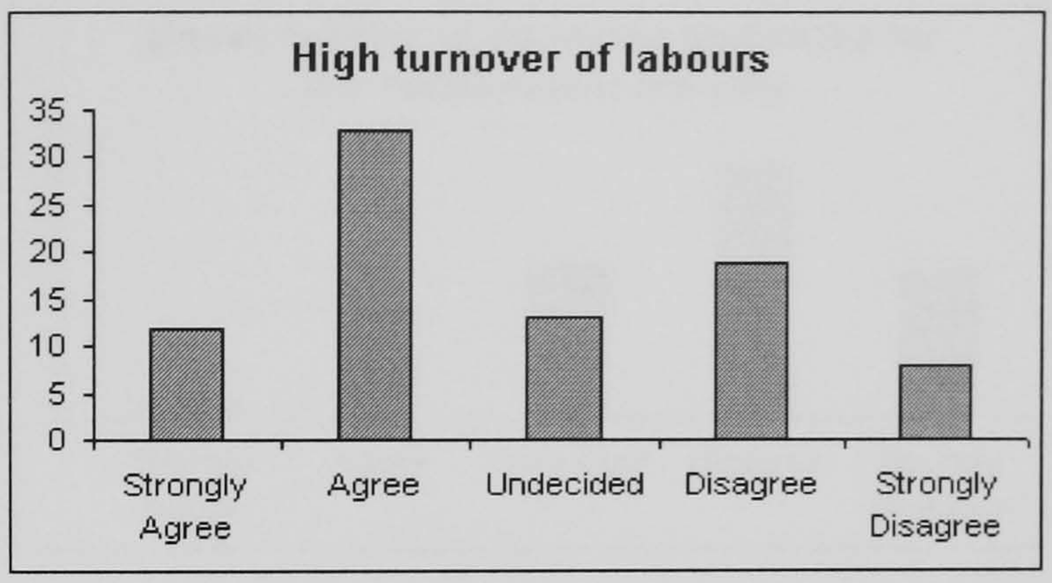
$H_0 : \sum rank(+) \geq \sum rank(-)$ (Intense competition is a major problem in the Saudi Construction Industry)

$H_1 : \sum rank(+) < \sum rank(-)$ (Intense competition is NOT a problem in the Saudi Construction Industry)

Conclusion: Intense competition is a major problem in the Saudi construction industry.

High turnover of labour

Category	# of Respondents	Percentage %
Strongly Agree	12	14
Agree	33	39
Undecided	13	15.3
Disagree	19	22.3
Strongly Disagree	8	9.4
Total	85	100%



Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	12	8	4	4	4	-
Normal	33	19	14	14	14	-
					18	0

$\sum rank(+) = 18$ $\sum rank(-) = 0$

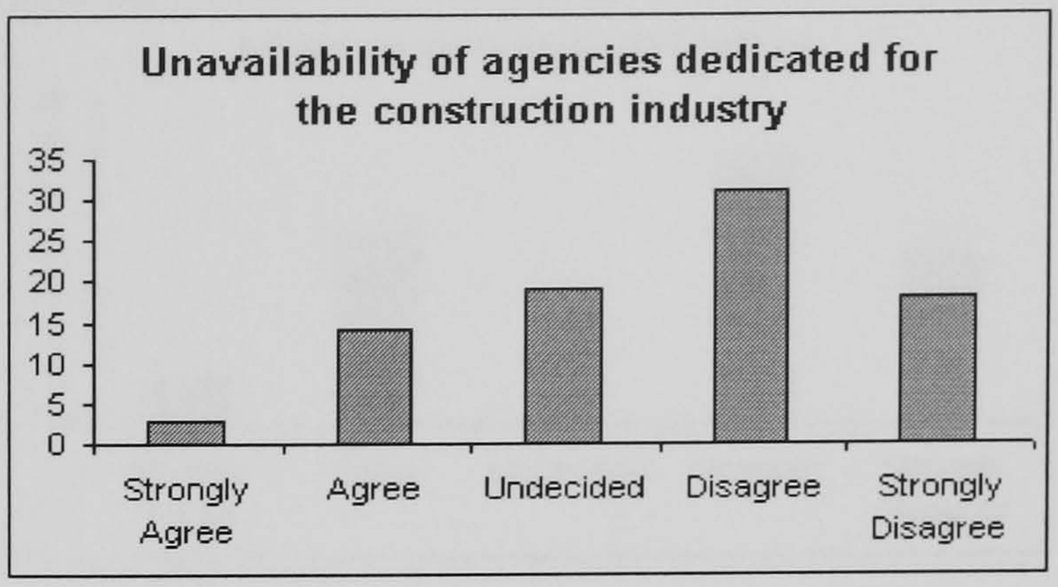
$H_0 : \sum rank(+) \geq \sum rank(-)$ (High turnover of labours is a major problem in the Saudi Construction Industry).

$H_1 : \sum rank(+) < \sum rank(-)$ (High turnover of labours is NOT a problem in the Saudi Construction Industry).

Conclusion: High turnover of labour is a major problem in the Saudi Construction Industry

Unavailability of agencies dedicated for the construction industry

Category	# of Respondents	Percentage %
Strongly Agree	3	3.5
Agree	14	16.5
Undecided	19	22.3
Disagree	31	36.5
Strongly Disagree	18	21.2
Total	85	100%



Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	3	18	-15	15	0	15
Normal	14	31	-17	17	0	17
					0	32

$\sum rank(+) = 0$ $\sum rank(-) = 32$

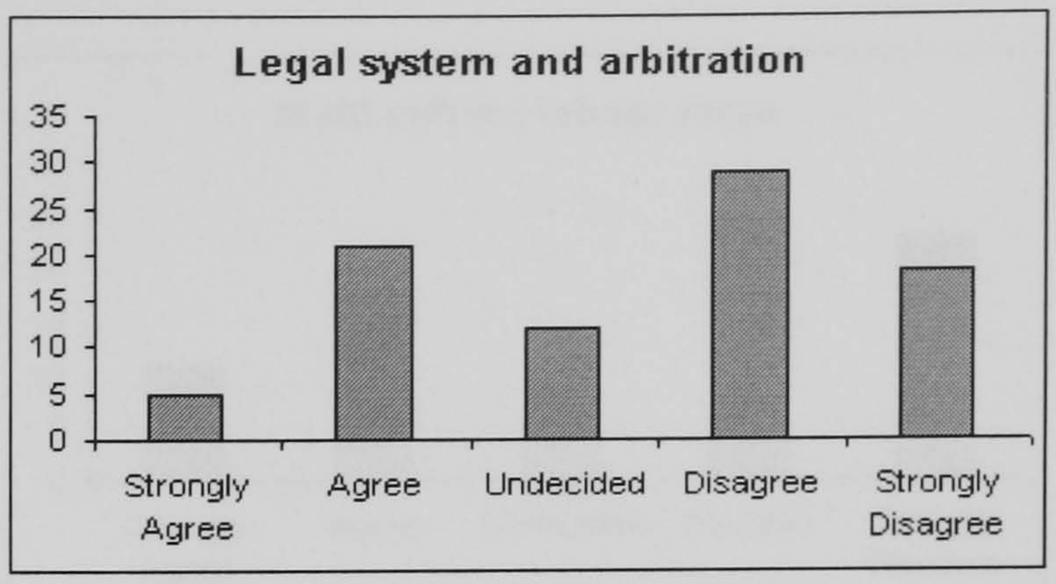
$H_0 : \sum rank(+) \geq \sum rank(-)$ (Unavailability of agencies dedicated for the construction industry is a major problem in the Saudi Construction Industry).

$H_1 : \sum rank(+) < \sum rank(-)$ (Unavailability of agencies dedicated for the construction industry is NOT a problem in the Saudi Construction Industry).

Conclusion: Unavailability of agencies dedicated for the construction industry is NOT a problem in the Saudi Construction Industry

Legal system and arbitration

Category	# of Respondents	Percentage %
Strongly Agree	5	6
Agree	21	25
Undecided	12	14
Disagree	29	34
Strongly Disagree	18	21
Total	85	100%



Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	5	18	-13	13	-	13
Normal	21	29	-8	8	-	8
					0	21

$\sum rank(+) = 0$ $\sum rank(-) = 21$

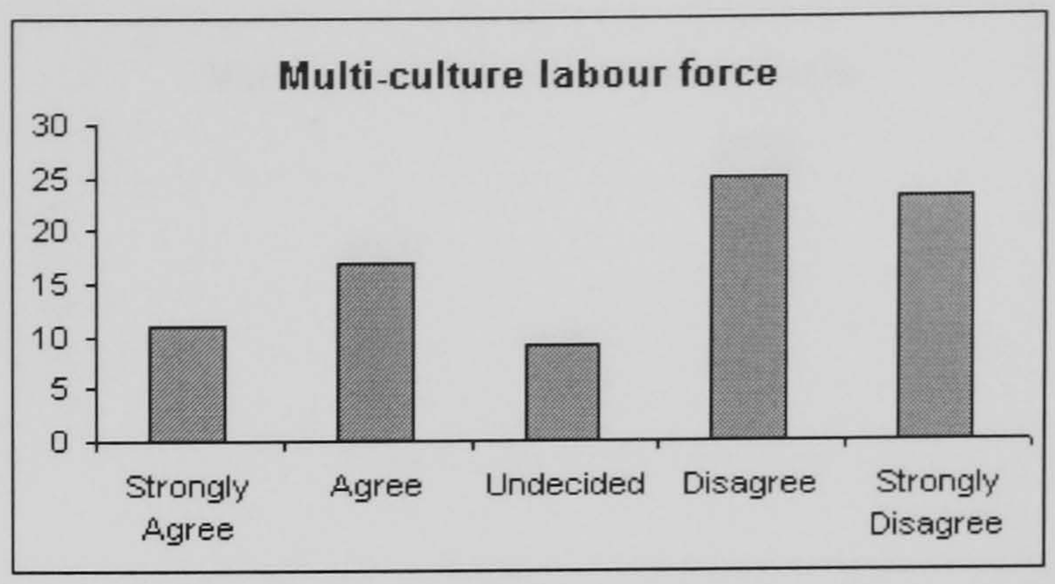
$H_0 : \sum rank(+) \geq \sum rank(-)$ (Legal system and arbitration is a major problem in the Saudi Construction Industry).

$H_1 : \sum rank(+) < \sum rank(-)$ (Legal system and arbitration is NOT a problem in the Saudi Construction Industry).

Conclusion: Legal system and arbitration is NOT a problem in the Saudi Construction Industry.

Multi-culture labour force

Category	# of Respondents	Percentage %
Strongly Agree	11	13
Agree	17	20
Undecided	9	11
Disagree	25	29
Strongly Disagree	23	27
Total	85	100%



Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	11	23	-12	12	-	12
Normal	17	25	-8	8	-	8
					0	20

$$\sum rank(+) = 0 \qquad \sum rank(-) = 20$$

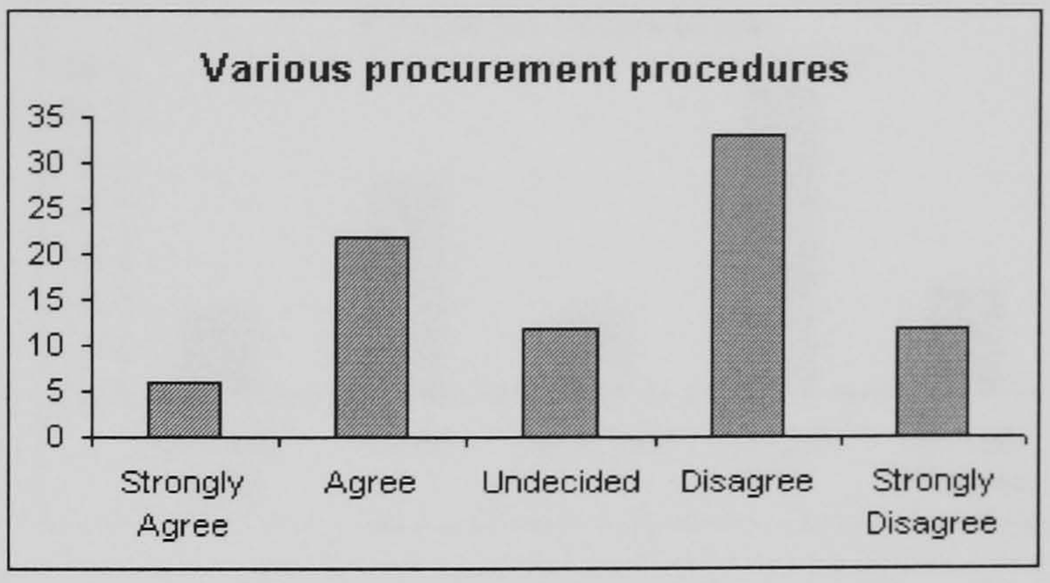
$H_0 : \sum rank(+) \geq \sum rank(-)$ (Multi-culture labour force is a major problem in the Saudi Construction Industry).

$H_1 : \sum rank(+) < \sum rank(-)$ (Multi-culture labour force is NOT a problem in the Saudi Construction Industry).

Conclusion: Multi-culture labour force is NOT a problem in the Saudi Construction Industry.

Various procurement procedures

Category	# of Respondents	Percentage %
Strongly Agree	6	7
Agree	22	26
Undecided	12	14
Disagree	33	39
Strongly Disagree	12	14
Total	85	100%



Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	6	12	-6	6	-	6
Normal	22	33	-11	11	-	11
					0	17
				$\sum rank(+) =$	0	$\sum rank(-) =$ 17

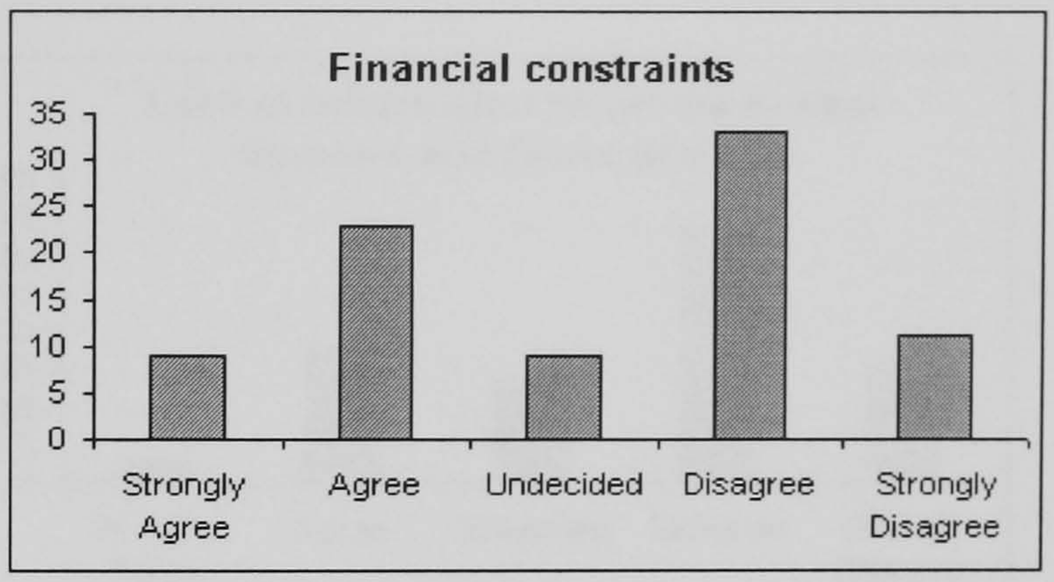
$H_0: \sum rank(+) \geq \sum rank(-)$ (Various procurement procedures is a major problem in the Saudi Construction Industry).

$H_1: \sum rank(+) < \sum rank(-)$ (Various procurement procedures is NOT a problem in the Saudi Construction Industry).

Conclusion: Various procurement procedures is NOT a problem in the Saudi Construction Industry.

Financial constraints

Category	# of Respondents	Percentage %
Strongly Agree	9	10.5
Agree	23	27
Undecided	9	10.5
Disagree	33	39
Strongly Disagree	11	13
Total	85	100%



Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	9	11	-2	2	-	2
Normal	23	33	-10	10	-	10
					0	12

$\sum rank(+) =$ 0 $\sum rank(-) =$ 12

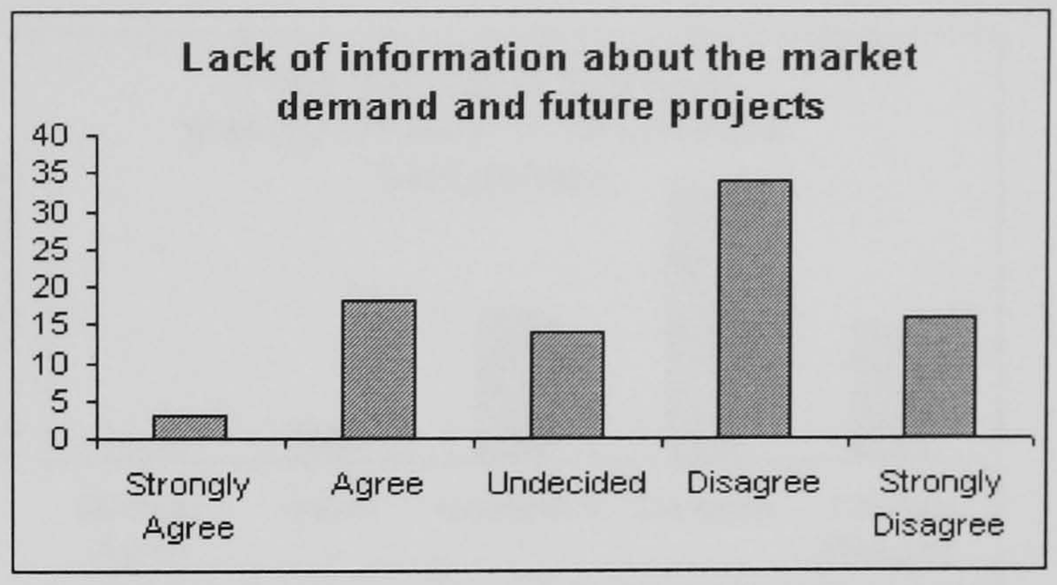
$H_0 : \sum rank(+) \geq \sum rank(-)$ (Financial constraints is a major problem in the Saudi Construction Industry).

$H_1 : \sum rank(+) < \sum rank(-)$ (Financial constraints is NOT a problem in the Saudi Construction Industry).

Conclusion: Financial constraints is NOT a problem in the Saudi Construction Industry.

Lack of information about the market demand and future projects

Category	# of Respondents	Percentage %
Strongly Agree	3	4
Agree	18	21
Undecided	14	16
Disagree	34	40
Strongly Disagree	16	19
Total	85	100%



Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	3	16	-13	13	-	13
Normal	18	34	-16	16	-	16
					0	29

$\sum rank(+) =$ 0 $\sum rank(-) =$ 29

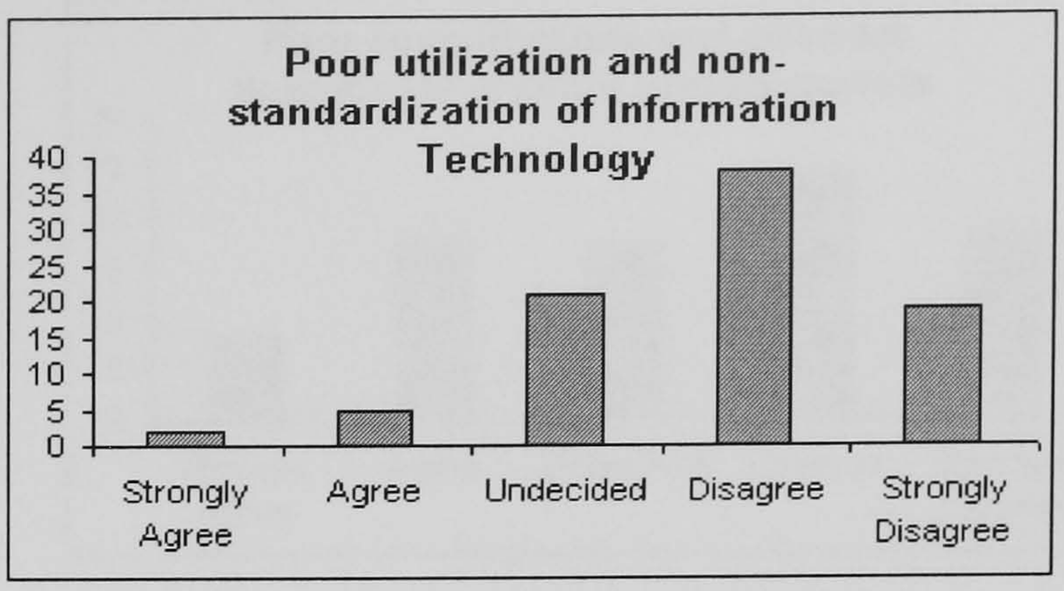
$H_0 : \sum rank(+) \geq \sum rank(-)$ (Lack of information about the market demand and future projects is a major problem in the Saudi Construction Industry).

$H_1 : \sum rank(+) < \sum rank(-)$ (Lack of information about the market demand and future projects is NOT a problem in the Saudi Construction Industry).

Conclusion: Lack of information about the market demand and future projects is NOT a problem in the Saudi Construction Industry.

Poor utilization and non-standardization of Information Technology

Category	# of Respondents	Percentage %
Strongly Agree	2	2
Agree	5	6
Undecided	21	25
Disagree	38	45
Strongly Disagree	19	22
Total	85	100%



Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	2	19	-17	17	-	17
Normal	5	38	-33	33	-	33
			$\sum rank(+) =$	0	$\sum rank(-) =$	50

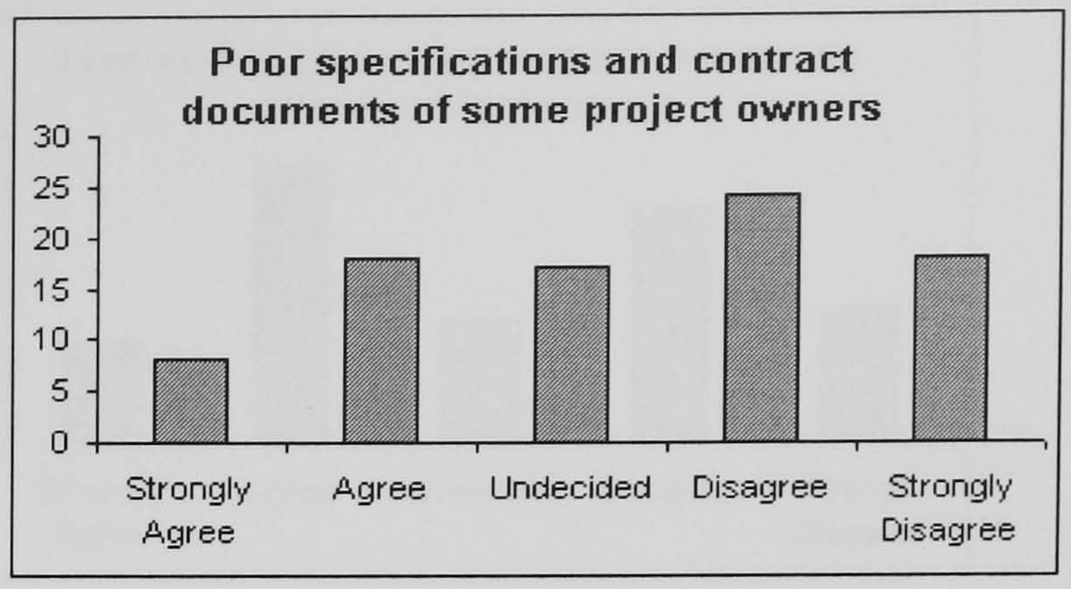
$H_0: \sum rank(+) \geq \sum rank(-)$ (Poor utilization and non-standardization of Information Technology is a major problem in the Saudi Construction Industry)

$H_1: \sum rank(+) < \sum rank(-)$ (Poor utilization and non-standardization of Information Technology is NOT a problem in the Saudi Construction Industry)

Conclusion: Poor utilization and non-standardization of Information Technology is NOT a problem in the Saudi Construction Industry

Poor specifications and contract documents of some project owners

Category	# of Respondents	Percentage %
Strongly Agree	8	9.4
Agree	18	21.2
Undecided	17	20
Disagree	24	28.2
Strongly Disagree	18	21.2
Total	85	100%



Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	8	18	-10	10	-	10
Normal	18	24	-6	6	-	6
					0	16

$\sum rank(+) =$ 0 $\sum rank(-) =$ 16

$H_0 : \sum rank(+) \geq \sum rank(-)$

$H_1 : \sum rank(+) < \sum rank(-)$

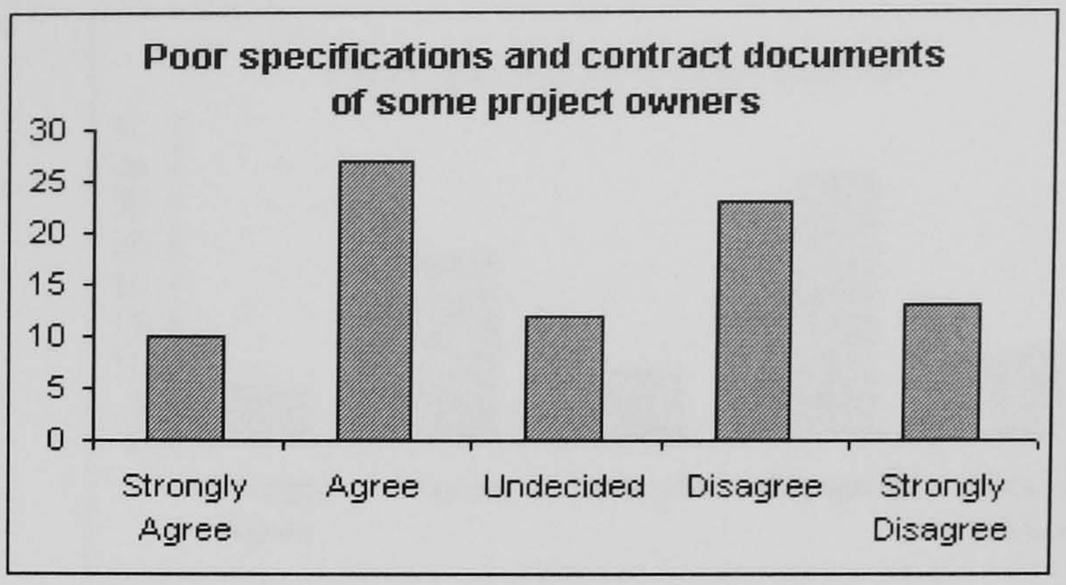
(Poor specifications and contract documents of some project owners is a major problem in the Saudi Construction Industry).

(Poor specifications and contract documents of some project owners is NOT a problem in the Saudi Construction Industry).

Conclusion: Poor specifications and contract documents of some project owners is NOT a problem in the Saudi Construction Industry.

Lack of coordination and bureaucracy of owners project team

Category	# of Respondents	Percentage %
Strongly Agree	10	12
Agree	27	32
Undecided	12	14
Disagree	23	27
Strongly Disagree	13	15
Total	85	100%



Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	10	13	-3	3	0	3
Normal	27	23	4	4	4	0
					4	3

$\sum rank(+) = 4$ $\sum rank(-) = 3$

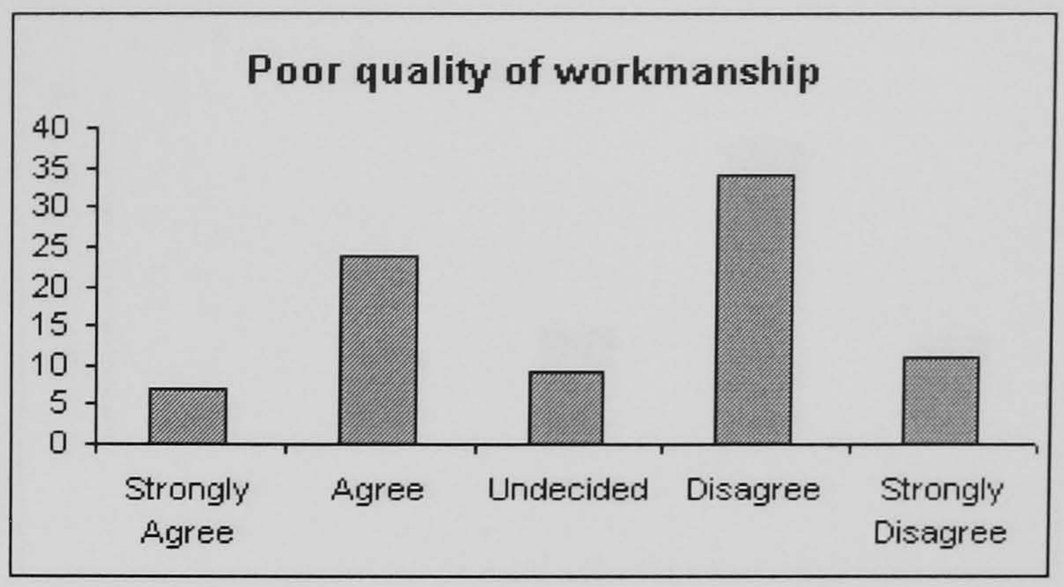
$H_0: \sum rank(+) \geq \sum rank(-)$ (Poor specifications and contract documents of some project owners is a major problem in the Saudi Construction Industry)

$H_1: \sum rank(+) < \sum rank(-)$ (Poor specifications and contract documents of some project owners is NOT a problem in the Saudi Construction Industry)

Conclusion: Poor specifications and contract documents of some project owners is a problem in the Saudi Construction Industry.

Poor quality of workmanship

Category	# of Respondents	Percentage %
Strongly Agree	7	8
Agree	24	28
Undecided	9	11
Disagree	34	40
Strongly Disagree	11	13
Total	85	100%



Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	7	11	-4	4	0	4
Normal	24	34	-10	10	0	10
					0	14
			$\sum rank(+) =$	0	$\sum rank(-) =$	14

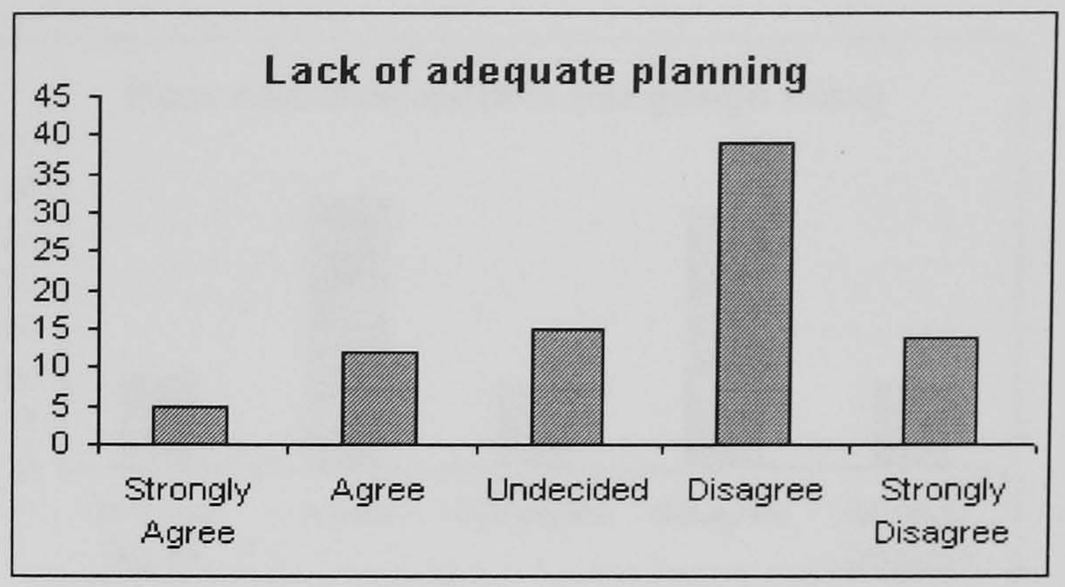
$H_0: \sum rank(+) \geq \sum rank(-)$ (Poor quality of workmanship is a major problem in the Saudi Construction Industry).

$H_1: \sum rank(+) < \sum rank(-)$ (Poor quality of workmanship is NOT a problem in the Saudi Construction Industry).

Conclusion: Poor quality of workmanship is NOT a problem in the Saudi Construction Industry.

Lack of adequate planning

Category	# of Respondents	Percentage %
Strongly Agree	5	6
Agree	12	14
Undecided	15	18
Disagree	39	46
Strongly Disagree	14	16
Total	85	100%



Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	5	14	-9	9	0	9
Normal	12	39	-27	27	0	27
					0	36
			$\sum rank(+) =$	0	$\sum rank(-) =$	36

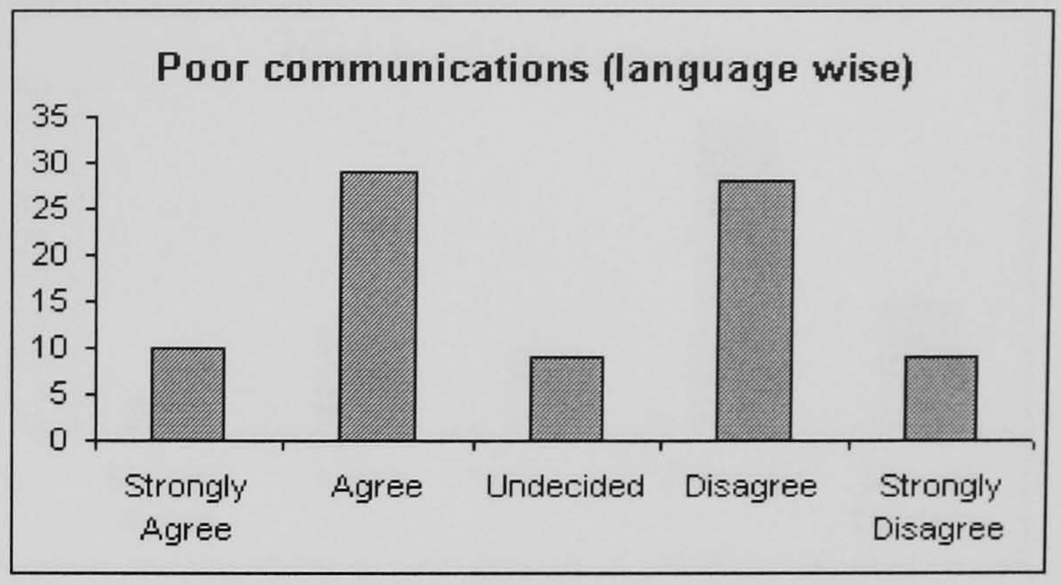
$H_0 : \sum rank(+) \geq \sum rank(-)$ (Lack of adequate planning is a major problem in the Saudi Construction Industry).

$H_1 : \sum rank(+) < \sum rank(-)$ (Lack of adequate planning is NOT a problem in the Saudi Construction Industry).

Conclusion: Lack of adequate planning is NOT a problem in the Saudi Construction Industry.

Poor communications (language wise)

Category	# of Respondents	Percentage %
Strongly Agree	10	12
Agree	29	34
Undecided	9	10.5
Disagree	28	33
Strongly Disagree	9	10.5
Total	85	100%



Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	10	9	1	1	1	0
Normal	29	28	1	1	1	0
					2	0
				$\sum rank(+) =$	2	$\sum rank(-) =$ 0

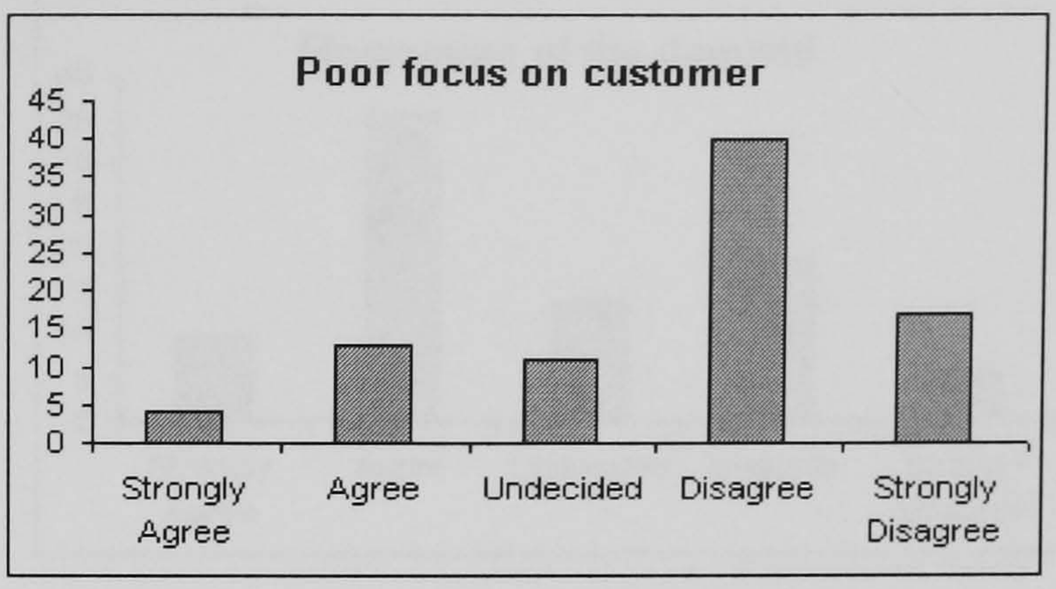
$H_0: \sum rank(+) \geq \sum rank(-)$ (Poor communications- language wise, is a major problem in the Saudi Construction Industry)

$H_1: \sum rank(+) < \sum rank(-)$ (Poor communications- language wise, is NOT a problem in the Saudi Construction Industry)

Conclusion: Poor communications- language wise, is a problem in the Saudi Construction Industry.

Poor focus on customer

Category	# of Respondents	Percentage %
Strongly Agree	4	5
Agree	13	15
Undecided	11	13
Disagree	40	47
Strongly Disagree	17	20
Total	85	100%



Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	4	17	-13	13	0	13
Normal	13	40	-27	27	0	27
					0	40

$\sum rank(+) =$ 0 $\sum rank(-) =$ 40

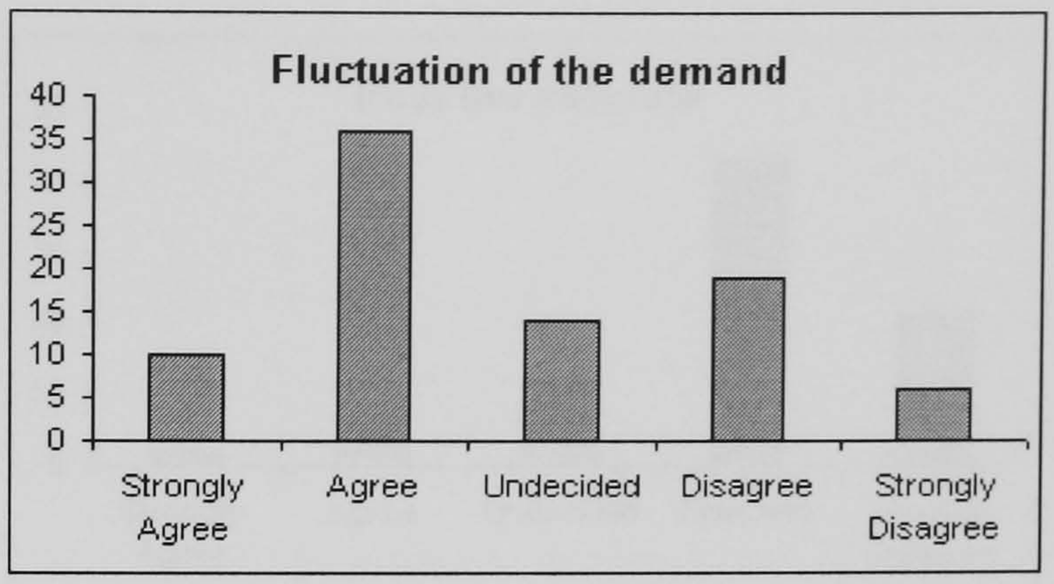
$H_0 : \sum rank(+) \geq \sum rank(-)$ (Poor focus on customer is a major problem in the Saudi Construction Industry).

$H_1 : \sum rank(+) < \sum rank(-)$ (Poor focus on customer is NOT a problem in the Saudi Construction Industry).

Conclusion: Poor focus on customer is NOT a problem in the Saudi Construction Industry.

Fluctuation of the demand

Category	# of Respondents	Percentage %
Strongly Agree	10	12
Agree	36	42.3
Undecided	14	16.4
Disagree	19	22.3
Strongly Disagree	6	7
Total	85	100%



Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	10	6	4	4	4	0
Normal	36	19	17	17	17	0
					21	0
				$\sum rank(+) =$	21	$\sum rank(-) =$ 0

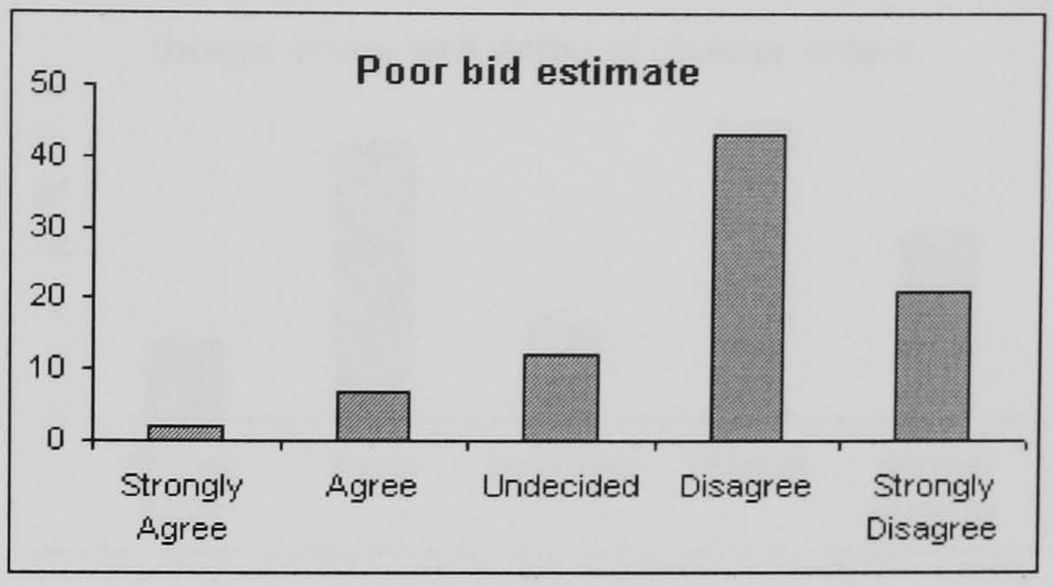
$H_0 : \sum rank(+) \geq \sum rank(-)$ (Fluctuation of the demand is a major problem in the Saudi Construction Industry).

$H_1 : \sum rank(+) < \sum rank(-)$ (Fluctuation of the demand is Not a problem in the Saudi Construction Industry).

Conclusion: Fluctuation of the demand is a problem in the Saudi Construction Industry.

Poor bid estimate

Category	# of Respondents	Percentage %
Strongly Agree	2	2
Agree	7	8
Undecided	12	14
Disagree	43	51
Strongly Disagree	21	25
Total	85	100%



Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	2	21	-19	19	0	19
Normal	7	43	-36	36	0	36
					0	55

$\sum rank(+) =$ 0 $\sum rank(-) =$ 5

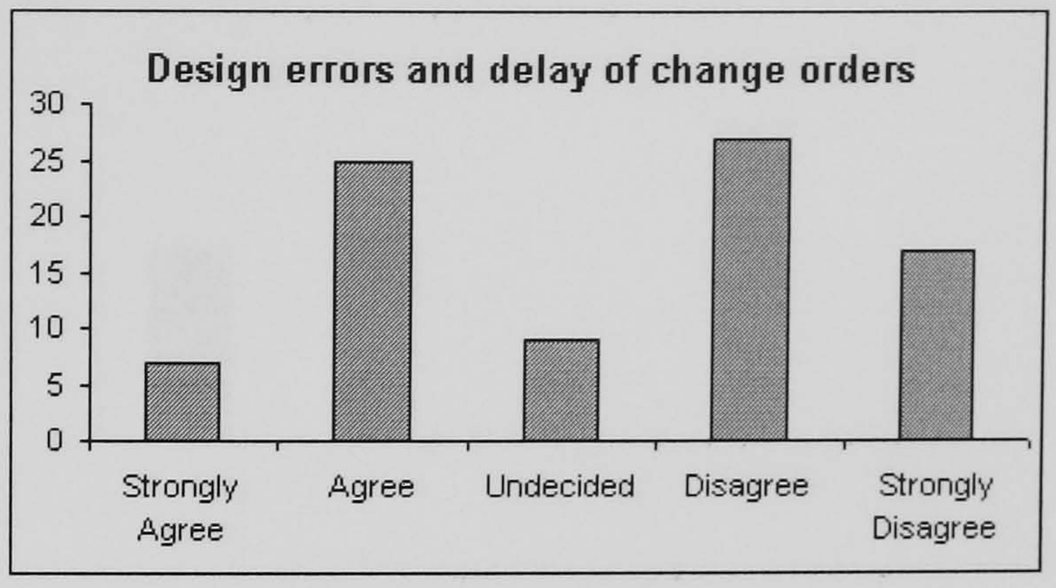
$H_0 : \sum rank(+) \geq \sum rank(-)$ (Poor bid estimate is a major problem in the Saudi Construction Industry).

$H_1 : \sum rank(+) < \sum rank(-)$ (Poor bid estimate is NOT a problem in the Saudi Construction Industry).

Conclusion: Poor bid estimate is NOT a problem in the Saudi Construction Industry.

Design errors and delay of change orders

Category	# of Respondents	Percentage %
Strongly Agree	7	8
Agree	25	29
Undecided	9	11
Disagree	27	32
Strongly Disagree	17	20
Total	85	100%



Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	7	17	-10	10	0	10
Normal	25	27	-2	2	0	2
					0	12
			$\sum rank(+) =$	0	$\sum rank(-) =$	12

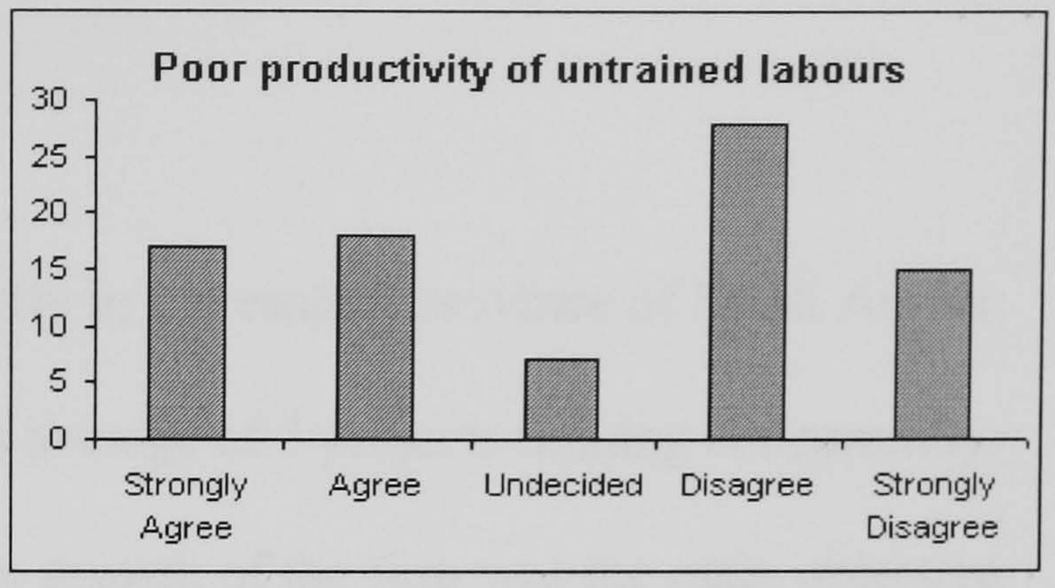
$H_0 : \sum rank(+) \geq \sum rank(-)$ (Design errors and delay of change orders is a major problem in the Saudi Construction Industry).

$H_1 : \sum rank(+) < \sum rank(-)$ (Design errors and delay of change orders is NOT a problem in the Saudi Construction Industry).

Conclusion: Design errors and delay of change orders is NOT a problem in the Saudi Construction Industry.

Poor productivity of untrained labours

Category	# of Respondents	Percentage %
Strongly Agree	17	20
Agree	18	21
Undecided	7	8
Disagree	28	33
Strongly Disagree	15	18
Total	85	100%



Sign-Rank Test

	Agree	Disagree	Difference (d)	Rank of |d|	Rank (+)	Rank (-)
Strong	17	15	2	2	2	0
Normal	18	28	-10	10	0	10
					2	10
				$\sum rank(+) =$	2	$\sum rank(-) =$ 10

$H_0 : \sum rank(+) \geq \sum rank(-)$ (Poor productivity of untrained labours is a major problem in the Saudi Construction Industry).

$H_1 : \sum rank(+) < \sum rank(-)$ (Poor productivity of untrained labours is NOT a problem in the Saudi Construction Industry).

Conclusion: Poor productivity of untrained labours is NOT a problem in the Saudi Construction Industry.

APPENDIX 6.B

TQM IMPLEMENTATION IN A SMALL FIRM

Description of the Firm

The construction firm is located in Dammam city in the eastern province of Saudi Arabia.

The number of employees was 30 and it had an average of 3 projects running concurrently. These projects were large residential villas. The growth of the firm was the main objective of the owner rather than the quest for immediate profit. At the same time the owner was under cash flow pressure.

The management of the firm consisted of the Owner, who also occupied the position of Managing Director, a Senior Engineer, three foremen, an Accountant and a Secretary. The average number of labourers was about 25. The role of the owner was to negotiate contract terms and manage the overall operation. The Senior Engineer was responsible for preparing project estimates (quotations), work schedules, and resolving problems during the construction phase. The foremen reported to the Senior Engineer.

All employees and labour came from Asia, with the exception of the Accountant who was an Arab national. The language of communication was English. However, it should be noted that labourers spoke poor English.

TQM Pre-Implementation

The first step was to study the firm in order to become familiar with its activities. The Owner introduced the TQM Leader to the employees and requested them to cooperate. The TQM Leader also met with the Senior Engineer and discussed his role and activities. The Senior Engineer did not have a full understanding of TQM and only had a very basic knowledge of QA/QC. In addition, the TQM Leader spent some time at the beginning with the foremen who work as field engineers.

The TQM Leader had various meetings with all staff and explained to them the concept of TQM and its elements and informed them of the intention of the Owner to introduce the concept of TQM, which was quite new to them.

A Quality Committee consisting of the Owner, Senior Engineer and the TQM Leader was formed. The TQM Leader provided the Owner and the Senior Engineer with some literature regarding TQM elements, TQM implementation and the benefits of TQM implementation. The committee conducted several meetings. The objective of these meetings was to discuss and plan the necessary requirements for TQM implementation. In addition, at the initial stage, the committee studied the activities of the firm. The purpose of this step was to eliminate any non-value added (NVA) activities and maintain any value-added activities. Any activity can be classified as either value-added or non-value added. The TQM Leader's intention was to improve the performance of the firm through reducing waste and increasing the efficiency of resources. The process of identifying non-value added activities and value added activities were in a sense brainstorming sessions. Although this process could be considered as part of the process improvement element, the TQM Leader decided to consider it as the best area to begin TQM implementation efforts. The reason for choosing this element was to maintain the interest of the owner in TQM by achieving some tangible improvement.

The following activities were discussed:

1. preparing quotations for non-potential clients
2. introducing a data-base to maintain financial records
3. having two company trucks versus three company trucks
4. renting/leasing equipment, such as compressors, versus purchasing them
5. providing standard uniforms and safety shoes to labour
6. preparing work-procedures of the firm

7. fixing up a large sign with the name of the contractor at each project site
8. introducing quality circles practice
9. investing more effort in marketing
10. dealing with a limited number of vendors (partnership)

Most of the above activities were not in action but they were under consideration. The activities that were in practice were the preparation of quotations for non-potential clients and fixing up a large sign with the contractor's name at each project site.

The senior project engineer was responsible for preparing quotations (estimates) for clients, who were in many cases not genuinely interested in signing a contract (bid shopping) with the firm or the owner would exclude dealing with them due to their poor reputation or financial condition. The Senior Engineer outlined the process of preparing detailed estimates (quotations), which took time from him and diverted his attention from more important activities. After discussion it was decided that the owner should determine from the beginning whether a client was a potential client or not. The Owner was conservative and selective in those who he dealt with, after he had lost a substantial amount of money on one of the projects where the client was not willing to pay on time and refused to pay the last payment due to dispute.

The owner was not interested in investing in marketing because he believed that word of mouth was the best marketing tool in his business, where he dealt with individuals.

Some of the activities were considered and found to be advantageous such as providing labour with a uniform which might have a positive psychological effect on the labourers and might earn their loyalty through instilling the feeling of belonging. However, this idea was excluded due to financial constraints. The cash flow of the firm was one of the major obstacles to introducing some of the initiatives that might have value-added consequences.

In fact, the definition of value-added activity is not merely the activity that has a positive monetary impact. For example, some activities on the surface appear to be non-value added, but in reality, they have an important indirect return "value". For example, fixing up a large sign with the name of the contractor at each project location is costly. However, it is a marketing device for the contractor and might help to bring in more business. Although the owner indicated earlier that he was selective in choosing his clients, and he was not interested in investing in marketing, he felt it was important to continue the practice of fixing up a sign with the name of the firm at each project site. His decision might have more to do with his own self-satisfaction.

The TQM Leader discussed with the Quality Committee the TQM elements (see section 2.3) in detail in order to determine what could be done for each of them. The conclusions of these discussions can be summarized as follows:

1. *Training*: the Owner indicated that it is not common practice for a firm of his size to send labour for training. Furthermore, the continuity of labour depended on future business, which cannot be guaranteed. The owner indicated later to the TQM Leader alone that even the Senior Engineer, whom he depended on, could not be provided with training since this would be infeasible. As an alternative, the TQM Leader suggested that the foremen shall be responsible for demonstrating the appropriate way to perform any activities if they observe mis-handling from one of the workers in order to prevent the repetition of errors.

2. *Management Commitment and Leadership*: the owner was committed towards improvement via TQM if it would work. However, the TQM Leader observed that the owner was reluctant to implement any activity that might require financial investment due to the cash flow problem in his firm and the uncertainty of the future. He was interested in seeing immediate positive results.

3. *Communications*: the communications between the owner and the Senior Engineer, as well as the Accountant, appeared to be healthy on the surface. However, it could be observed that the Senior Engineer avoided arguing or standing firm behind his personal opinions in discussions when he disagreed with the owner. In fact, it is a very delicate situation when you work directly for the owner in a small firm where the Owner can lay you off at any time for any reason. The situation turns to fear when you are always afraid of losing your job. This situation could be extended more considerably to the lower level, such as labour. The TQM Leader could not do much about this situation, however, he indicated to the Senior Engineer that he and his foremen should listen to the labour and he should listen to the concerns of the foremen and allow them to come with their own suggestions. Furthermore, the TQM Leader indicated to the TQM committee the benefits of good communication in general; however, no concrete results could be reported.

4. *Teamwork*: the quality committee itself was a form of teamwork effort. It was the practice of the firm to assign groups of labour to work under the supervision of a foreman in each project. However, the TQM Leader emphasised that the teams (groups) should be coherent, for example if two of the labourers do not get along they should be separated into different groups.

5. *Focus on Employees* (empowerment): the TQM Leader explained to the quality committee the focus on employees (empowerment) concept and its importance on the performance of the firm. However, the TQM Leader sensed that the financial constraints played an important role. The owner was not willing to provide labour with safety shoes since the firm was under cash flow pressure. The owner indicated that he agreed with the concept from the principles but the financial situation prevents him from any measures that could improve labour satisfaction and incurs cost at the same time. However, it was decided to think of some measures that

would improve the employee's satisfaction later.

6. *Process Improvement*: it was decided to divide the process improvement efforts (TQM) into office activities and field activities. The TQM Leader was assigned responsibility for the office improvement activities. The Senior Engineer was assigned to the field improvement activities under the guidance of the TQM Leader.

7. *Customer Satisfaction*: the Quality Committee discussed customer satisfaction. The Senior Engineer and the Owner indicated that finishing the project on time is the major concern of most clients. Also, the fact that most clients do not have construction experience creates a major problem in meeting their expectations. Furthermore, some clients are complainers by nature added to the fact that their lack of experience of the industry makes them fail to appreciate the quality of the services that they receive for what they are paying. Avoiding disputes might be a very realistic objective as a goal to achieve customer satisfaction. Furthermore, the owner felt that selecting the appropriate client could help to sustain a good reputation, through having more satisfied customers.

8. *Supplier Involvement*: it was the practice in the firm to deal with a limited number of suppliers so they could enjoy discounts. The Quality Committee decided to enhance the relationship and determine a specific vendor for each item, such as cement or steel, and to inform them formally that the firm will deal with them exclusively with the expectation of enjoying favourable prices. The Senior Engineer was asked to determine who could be considered best supplier based on his experience and their market reputation and to discuss the list with the owner before finalizing the selection. It was emphasised that the price and timely delivery should be taken into account. The quality of the material was excluded to be a criterion and it was justified by the Owner that the vendor should provide materials

that meet the technical specifications.

9. *Continuous Improvement*: the committee found this element an impractical one since the business was not steady. It was decided that for time being immediate implementation of what could improve the firm's performance and perform more effectively than other competitors would be satisfactory. The fact the firm was interested in performing better than their competitors would take them to conduct benchmarking although it might not be a structured benchmarking process.

As can be seen from the above, many of the TQM elements were not possible to be adopted effectively such as training, communication focus on employees and customer satisfaction.

Based on the above conclusions, the TQM Leader decided to employee Quality Circles as a simple and practical solution to overcome the difficulties in achieving some aspects of TQM such as training, communication and focus on employees (internal customer satisfaction). The concept of quality circles had its early beginnings in Japan in the 1960s. The concept of quality circles is that the supervisors and their workers form groups to meet and discuss the issues of quality and train themselves in quality techniques. Quality circles were an employee motivation and involvement programme (Bank 1989). However, the TQM Leader decided to extend the scope the benefits of the quality circles to cover not only quality in the sense of labourers workmanship but to compensate the lack of the solid steps that should have taken place towards communications and employees satisfaction.

<u>TQM Implementation</u>

The Senior Engineer and the TQM Leader worked to educate the foremen about what was necessary for them to know about TQM and directed them towards adopting attitudes in

the spirit of TQM. The foremen were asked to conduct Quality Circles for their workers on a weekly basis for a duration of about 30 minutes. The foremen were asked to discuss with their labourers their concerns and suggestions.

The Quality Circle sessions were utilized as a 'training session' as well for the labourers since the foremen could conduct demonstrations to show the effective way of performing a certain activity or operating a certain tool. For example, the Quality Circle sessions helped in improving the skills of carpenters. The waste wood during the removal of formwork was reduced. The Senior Engineer and the foremen addressed this issue to the labourers. The carpenters were asked to install formwork in a manner that would be simple to remove without damaging it. This resulted in a saving of around 10% of the wood according to the Senior Engineer.

The Quality Circles were an opportunity to extend recognition to high performing labourers. Furthermore, they provided an alternative approach to enhance the communications between the firm and its labourers and labourers' satisfaction (focus on employees).

Effectiveness of Quality Circles

In order to measure the effectiveness of the Quality Circles in particular, a sample of three masons and two helpers was observed and their productivity was measured. Prior to introducing the Quality Circle practice a foreman was asked to measure the productivity of each mason over a one-month period. Table 6B.1 shows the productivity of these five masons in the first month.

In the next months, Quality Circle sessions were conducted weekly and productivity was measured after one month. Table 6B.2 shows the masons' productivity after conducting the sessions.

Table 6B.1: Sample Productivity before Quality Circle Sessions

Day	Mason 1 Productivity (No. of Blocks)	Mason 2 Productivity (No. of Blocks)	Mason 3 Productivity (No. of Blocks)
1	78	45	66
2	74	48	64
3	70	50	68
4	80	50	54
5	78	54	66
6	80	44	58
7	78	48	63
8	60	58	45
9	54	45	58
10	70	56	50
11	44	24	48
12	42	44	44
13	46	50	66
14	72	40	68
15	60	45	62
16	78	38	48
17	42	54	56
18	44	50	54
19	54	40	64
20	74	38	44
21	82	60	45
22	74	44	46
23	74	54	64
24	66	44	48
Average	**65.58**	**45.96**	**56.20**
Total Average of the Sample = 55.90			

Table 6B.2: Sample Productivity After Quality Circle Sessions

Day	Mason 1 Productivity (No. of Blocks)	Mason 2 Productivity (No. of Blocks)	Mason 3 Productivity (No. of Blocks)
1	70	44	44
2	72	52	48
3	88	50	72
4	82	52	62
5	92	48	48
6	60	56	78
7	55	40	70

Day	Mason 1 Productivity (No. of Blocks)	Mason 2 Productivity (No. of Blocks)	Mason 3 Productivity (No. of Blocks)
8	78	72	54
9	45	62	50
10	48	44	72
11	74	60	68
12	48	40	64
13	82	52	72
14	66	70	68
15	72	56	56
16	82	60	70
17	86	64	66
18	56	58	68
19	74	44	54
20	72	54	66
21	84	72	66
22	88	48	54
23	78	46	64
24	70	44	66
Average	**71.75**	**53.67**	**62.5**
Total Average of the Sample = 62.64			

The comparison of these two tables shows that the productivity of the sample increased by 12% on average following the Quality Circle sessions. The above experiment is a tool to measure the effectiveness of a Quality Circle. However, Quality Circles by no means can replace the necessary aspect of TQM implementation.

Process Improvement

In the first few meetings, as mentioned above, some activities were identified to be determined if they were value added or non–value added activities. Later it was decided to divide processes (activities) into office activities and field activities in order to perform process improvement element of the TQM. The TQM Leader was assigned the office activities and the Senior Engineer was as assigned the field activities.

The office quality improvement that the TQM Leader was involved in included:

1. Computerizing some of the functions such as the accounting system, scheduling and estimating.

2. Preparing company guidelines as a written procedure for office activities.
3. Standardization contract documents.

The TQM Leader tried to determine the best and most feasible IT solution for the office functions of such a small firm. The Owner later indicated that the office staff (secretary, accountant and senior engineer) might not be ready to invest time working on such technology. The accountant used simple techniques and using Excel would be sufficient. The Senior Engineer did not have time to learn about new software or a system for scheduling and estimating.

The TQM Leader initiated setting up a written procedure for offices activities. However, it was obvious that direct involvement of the Owner in running the business would make such an exercise non-beneficial. The owner felt that such guidelines would be non-value added since his office staff was small.

The TQM Leader worked on a general structure of a contract document to be utilized for any new contract. The contract document was not reviewed by a lawyer since it is not common to send such contracts for legal review in Saudi Arabia. The general contract document was produced after reviewing various contract documents used by other contractors. The secretary was asked to save the final version as a Microsoft word document.

The Senior Engineer, was involved in the field processes. He mainly supervised the Quality Circles initiative which was one of the major improvement initiatives.

In addition to the above, the Senior Engineer and the TQM Leader were involved in making some decisions that can be regarded as efficiency improvement and indirectly

related to process improvement. For example, the cost effectiveness of maintaining two trucks instead of three.

Improvement Measures

It was found that it was very important to measure quality improvement to sustain the Owner interest with the hope that hard evidence would reveal the advantages of these efforts on the firm's performance. Therefore, the TQM Leader discussed with the Owner and the Senior Engineer the elements that were necessary (and possible) as a measure for improvement. The Owner was solely interested in profits to have it as a measure. After discussion, it was decided to have these two elements as measures:

1. Profit
2. Client satisfaction

Each element was analyzed to arrive at a practical way of measuring it. Although the TQM implementation efforts failed to satisfy the requirements needed to achieve the customer satisfaction to the extent that TQM literature recommends, it was decided to have client satisfaction as a measure due to its importance.

It was decided to consider the profitability of the firm in terms of improving labour productivity and reducing overheads. It would be misleading to define profit as a net monetary return for the firm, since this definition is associated with the market profit margin. After long discussion, the Owner agreed to adopt this definition of profitability. The second element, client satisfaction, was determined to mean achieving the target schedule with a quality satisfactory to the client. The challenge was how to measure the client satisfaction quantitatively.

From the above two measure elements four variables were determined to be considered as measures:

1. Worker productivity (Profit)
2. Overhead (Profit)
3. Completing projects on time (Client satisfaction)
4. Satisfactory quality to the client (Client satisfaction)

The TQM implementation efforts were not sufficient to expect major change in the performance. For example, training and worker satisfaction, which are supposed to have a direct impact on productivity, were not a feasible investment to the Owner. The Quality Circles were employed as a feasible alternative to achieve some of the TQM requirements but not to the necessary level.

The foremen were asked to record their labour activities on a daily basis and submit them to the office for monitoring and analysis. The foremen did not like this requirement since the productivity of some activities was difficult to report on a daily basis, such as electrical work. They were advised to report these activities in a form of percentage progress. The Senior Engineer indicated to the TQM Leader that he did not have time to monitor and analyse these reports. He indicated that if the business was larger then full time staff could be hired for this task. On the other hand, the Owner liked the idea because he felt this would give him better control over his projects. The TQM Leader found that this practice was abandoned two months after he ceased his involvement.

One of the measures was the overhead and the objective was to reduce the overhead. However, the overhead can be better measured as a percentage of the annual revenues. The Accountant would have difficulty in calculating the overhead of each project. Further scrutiny of this variable would reveal that this variable is proportionally related to the business volume. In other words, as the business volume increases the percentage of the

overhead would decrease under normal circumstances. Later it was decided not consider this variable because of the fluctuation of the revenues and the difficulty to trace the overhead for each project.

Completing the project on time was a simple variable to trace. However, the challenge was to complete the project on time. It was thought that monitoring the productivity and comparing it with the estimated schedule could assist in monitoring the work progress, and identify any delay ahead of time so that corrective action could take place.

A more challenging variable to be traced quantitatively was measuring client satisfaction. Therefore, it was decided to exclude it and the Owner indicated he could monitor the level of satisfaction of his clients qualitatively. One of the main objectives of TQM is to enhance customer satisfaction. The relationship between the firm and its external customers was relatively straight-forward. The limited number of villas that were constructed by the firm restricted the external customers to the individuals who own these villas. This situation might be different in large construction firms where they have to deal with many representatives form the project owners. The main advantage of customer satisfaction was to establish a good reputation, which is a very powerful marketing tool, especially in a culture like Saudi Arabia.

Hence, only two variables were considered finally as measures namely: productivity and work schedule (completing projects on time). These two variables are commonly used as project control tools in any project management programme. Furthermore, the difficulties that were experienced in implementing many aspects of TQM would not present a good case of TQM implementation.

CHAPTER-7

CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

In this thesis, an attempt was made to explore the effectiveness of TQM as a solution to problems in the Saudi construction industry. The thesis employed a number of research methods in order to arrive at its conclusions. The main topics covered in the thesis are:

1. the level of compliance with the principles of TQM.
2. the difficulties in implementing TQM in the Saudi construction industry
3. the effectiveness of TQM as a solution to the problems in the Saudi construction industry.
4. the major problems in the Saudi construction industry
5. suggested solutions to identified problems in the Saudi construction industry.

The research revealed that TQM cannot be considered to be a solution to the problems in the Saudi construction industry, as was initially proposed in the research hypotheses. The major problems in the Saudi construction industry are generally themselves barriers towards the effective implementation of TQM. Most of these problems are external problems which are influenced by government policy. In fact, resolving the major Saudi construction industry problems could pave the road towards effective implementation of TQM and development of the industry in general.

At the same time, adoption of TQM by the major participants (owner, contractor, designer and supplier) in the Saudi construction industry could help to resolve some of the industry's problems. For example, the survey found that one of the significant problems

within the industry is the lack of coordination and bureaucracy in the project team of the owner. This problem could be resolved by introducing TQM where the supplier–customer chain is recognized and appreciated under the principles of TQM.

Chapter Four discusses feedback from interviews, which were conducted with several contractors and design offices. The interviews revealed that Saudi contractors are interested in becoming ISO 9000 certified firm as a marketing tool. There is no incentive for a contractor or design office to adopt TQM for reasons of internal performance improvement. However, the competitive nature of the construction industry directs the focus of the contractor and design office to the market rather than to their internal performance.

The research also revealed that Saudi design offices are, in general, more in compliance with the elements of TQM (principles) than contractors. Thus, adoption of TQM by a design office has a better chance of success and is less challenging than it is for construction firms. This is due to the calibre, background, and education of the employees who work in design offices. These employees are mostly professionals, while construction firms tend to employ labourers and semi-professional employees.

Lessons From Case Study

The case study of TQM implementation in one of the largest privately owned (client) organizations indicated that it is not necessarily an effective approach to adopt TQM based on a specifically structured implementation model. However, the various TQM-implementation models could be useful as guidelines for TQM implementation.

The revisit to the case study after five years showed that there was a shift in the organizational perception towards TQM. The organization realized that the concept of TQM should not be dealt with as a rigidly structured model that must be implemented sequentially. The main advantage of adopting TQM was introducing a conscious awareness of the importance of quality in general. Another advantage was understanding quality from the TQM perspective, (which allows a firm to take advantage of the quality tools that fall under the TQM concept), such as best practice and benchmarking.

The case study revealed that owner organizations can be very influential in the construction industry. They can play a substantial role in instilling the concept of TQM (or quality awareness in general) within the Saudi construction industry, and improve the performance of the contractors.

A number of lessons were learnt from the case study:

- Interest and enthusiasm for TQM increased during periods of financial difficulty.
- TQM implementation is an extremely lengthy process.
- The perception of TQM changes as the organization goes through the TQM journey.

<u>Lesson Learned From Practical Experience</u>

The practical experience of implementing TQM in a small construction firm revealed the following:

1. It is difficult to plan a schedule for TQM implementation in the construction industry: the level of activities and cash flow play an important role. Contractors have difficulty in forecasting future business, which creates challenges for them to

establish long-term plans or commit themselves towards an on-going strategy.

2. Quality circles can be employed in the construction industry as an effective and practical approach to achieve some of the TQM elements to a certain degree.

3. It is very important to determine the elements to be used as a measure for quality improvement. These elements should be defined and achieved within the spirit of TQM.

4. It is very difficult to measure customer satisfaction in the construction industry.

5. TQM activities could help in improving the performance of the contractor, especially in terms of the process improvement element; however, contractor companies are sceptical that these activities actually pay off.

6. TQM can help a contractor to deal more effectively with construction industry problems; however the industry suffers from fundamental problems that cannot be solved by TQM alone, and which also create obstacles to effective TQM implementation, such as the pressure of competition and maintaining demand.

Wider Problems

The analysis of the survey revealed that most of the significant problems in the Saudi construction industry are beyond the control of the construction industry participant. Therefore, generally speaking, adoption of TQM by the Saudi construction industry will not solve these problems. For example, intense competition, the Government's requirement to hire Saudi nationals, and the restrictions on visas for foreign labourers have been identified as the three most significant obstacles in that order. Solving these problems is beyond the adoption of TQM by the industry. However, resolving those problems would make TQM implementation in the Saudi construction industry less of a challenge than it is at present.

The research indicated that labour-related problems constitute a number of major obstacles to the Saudi construction industry. Among the interesting findings is that the concept of self–employment is not popular in the Saudi construction industry, unlike in many other countries. This concept might need to be further studied and presented to the Saudi construction industry.

The findings of the research confirmed the results of Fox *et al* (1999) regarding the importance of the role of government in improving the construction industry. The research suggested that the Government should play a more effective role in resolving industry problems and improving the industry in general. In fact, the Saudi economy could benefit tremendously from the construction sector if it were utilized more wisely. For example, this sector could go a substantial way towards helping to resolve the problem of unemployment among young Saudis. The research suggested that the role of Government in solving the problems of the industry, and improving the industry in general, could be energized through the establishment of a construction industry institute similar to those established over the past few years in various developing countries.

7.2 Recommendations

7.2.1 General Recommendations

Based on the results of this research, the following general recommendations are proposed for Saudi Arabia:

1. Training for construction labourers should become available at a reasonable cost. This could be achieved via various means, such as forming non- profit labour training institutes supported by contractors.

2. The contract award outcome should not be based upon price only; an alternative to the competitive procurement method should be introduced. The alternative could be a bid evaluation system which considers other factors beside the price, such as the bidder's technical evaluation.

3. It is recommended that the banking sector, with support from the Government, establish a private real estate bank in order to stimulate demand in the construction sector.

4. The concept of self-employment should be fostered in the Saudi construction labour market as a means of overcoming the challenges of fluctuations in the demands of the construction industry.

5. Contractors should modify their attitude towards labour in harmony with the spirit of TQM, in which the labourers are considered to be internal customers.

7.2.2 Specific Recommendations for Government

In addition to the general recommendations above, specific recommendations are proposed for the Government, since the Government plays a controlling role in shaping the business environment of Saudi Arabia:

1. The Government, in cooperation with those who are involved in the construction industry, and academia should form a dedicated agency for construction industry improvement.

2. The Government should provide appropriate training to Saudi nationals before imposing percentage quotas on their employment in the construction industry.

3. The Government should take the necessary measures to prevent the delay of payments to its contractor companies.

4. The Government should be more transparent regarding its future construction projects.

7.2.3 Recommendations for Further Studies

In order to determine the validity of the above recommendations, and their impact upon TQM implementation in the Saudi construction industry, it is first necessary to formulate appropriate research objectives upon which further study can be based:

1. Research to study possible procurement methods, other than awarding the contract to the lowest bidder.
2. Research to study how to develop an effective training programme for the Saudi construction industry.
3. Research to study the effect of late payments on construction industry performance.
4. Research to study the ideal role of Government in the construction industry.
5. Research to study the benefits of introducing the concept of self-employment in the Saudi construction industry.

Finally, generally speaking, from this research it can be said that TQM in Saudi Arabia appears to have failed to make a substantial impact on the construction industry due to inherent and chronic obstacles in the present business environment. These obstacles have socio-economic, political and cultural roots making them difficult to overcome. Therefore, a large concerted effort is required in order to bring about a business environment where TQM would become an alternative and rewarding business tool for the Saudi construction industry.

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