

Quality Management of Reinforced Concrete Structures in the context of construction industry in Saudi Arabia in the moderate and small sector

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Abstract - In order to achieve the purpose of this research, two special questionnaires were designed to fulfill the task of this research, exemplified the subject of quality management of reinforced Concrete Structures in the context of construction industry in Saudi Arabia in the moderate and small sector, the questionnaires have been distributed in some construction companies and construction projects, distributed in different places located in Kingdom of Saudi Arabia, and has been narrowed in the moderate and small sector category, We discussed the problems of defining quality in construction industry, examined possible benefits of implementing quality, and looked at barriers to quality implementation in construction industry. We used data collected through an interview with contractors and data from the two questionnaire surveys.

Index Terms – Construction industry, Quality Management, Construction Projects, Reinforced Concrete Structures

1. INTRODUCTION

During the last decades construction industry in Saudi Arabia has been heavily criticized for its performance and productivity in compare to the other countries. A common discussion within the construction industry is that the quality is poor, budgets are unreliable and the prices are excessive. The industry has been accused of lagging behind other industries when it comes to efficiency. It has been stated that there are great possibilities for improvements within the industry. Failures and errors in the construction industry have many manifestations and their reasons and causes vary. Failures are indeed occurring over all the diverse steps of the construction process. Raising the quality status within the industry, the construction process as a whole would improve, resulting in lower costs, less project time and increased productivity.

Quality management systems are making a significant contribution to the internal organization of a company, while providing the necessary support in order to act on global markets by rising cost pressures and with consistently high quality of services. The definition of necessary structures and the description of integrated processes but also increase legal certainty and the solidarity in the company itself as well as the value of the company to the outside, as the company will be less vulnerable.

2. LITERATURE REVIEW

Previously, the quality of the products was determined mainly by manual skill and care. The watchful eye of the master ensured that the client was satisfied with the product. For today reaching to the limits of what is technically possible quality requirements, however, require more than a watchful eye, namely a self-contained quality management system. In addition, unwritten, but market crucial notions of the consumer on the quality characteristics have to be considered, such as ease of use, reliability and customer service.

Total quality management (TQM) is often defined as a complete management philosophy that permeates every aspect of a company and place quality as a strategic issue. It is accomplished through an integrated effort between all levels of a company to increase customers' satisfaction by continuously improving current performance (Biggar, 1990). ISO certification is nowadays a trend in most industries including construction industry.

The ISO 9001 requires that the introduction of a QM system not only means to meet the standard requirements on paper, but above all a strategic decision of the company management is to be realized and lived in the company.

The five clauses for its implementation are quality management system, management responsibility, resource management, product realization, and measurement, analysis, and improvement. The application of ISO standards has received much attention from researchers. Moatazed-Keivani, Ghanbari-

Parsa and Kagaya (1999) [1] argued that the ISO 9000 standards series can form and have formed the basis for an efficient and advantageous quality management system in the construction industry.

Liu (2003) [2] stated that it is indicative that ISO 9000 has an impact on the contractors' attitude towards quality.

As for the implementation of quality management in project management, the concepts of quality planning (identification of quality standards), quality assurance (evaluation of overall project performance) and quality control (monitoring of specific project results) in the quality management processes were defined by Project Management Institute (2000).

RESEARCH SUMMARY .3

Few studies in Saudi Arabia have focused on the quality and the use of quality management systems (QMS) within the Saudi Arabian construction sector. These studies have mostly been directly focused on the use of QMS in the construction industry with regards to client satisfaction and system benefits. No study has yet been performed on the extent of rectifying quality problems in the Saudi Arabian construction industry.

The construction industry and construction sector suffering more than other business in quality. The importance of the research, is **how** to measure quality performance, **how** to improve quality performance? And What are barriers to quality? The research also aims to study the necessary of the implementation of quality management in project management of reinforced Concrete Structures in the context of construction industry in Saudi Arabia in the moderate and small sector where the research methodology has two special questionnaires designed, and consistent with the standards of the KSA and international standards, were distributed to a group of companies that deal in the construction and construction sector in the KSA to complete this research, then to compare what they have, and used, and whether it conforms to those specifications?

4. METHOD

4.1 Interviews and site visits

In order to obtain more information about quality, and more specifically, quality performance measures used by contractors in construction industry, interviews were conducted. To learn about the participant's company effort in quality management, the following questions were asked: "What crucial factors are measured in improving quality performance?", "Who is responsible

for collecting/analyzing this data?", and "What [do you see as] barriers affecting quality performance?".

4.2 Questionnaire surveys

Two questionnaire surveys were used to address quality issues in construction industry. As part of a longitudinal questionnaire survey (Study 1) questions on quality measures were added to the questionnaire (see Table 1). Forty contractors participated in this study. A second questionnaire survey (Study 2) was conducted to examine the responses of the contractors to the importance of the implementation of quality in construction industry. 10 participated in this study.

4.3 The main objectives of the research and the hypothesis

- An awareness of quality related matters in the construction industry. The research aims for identifying the main problems the industry is having with quality. In addition
- Examine where the scope lies for improving and identifying barriers that might be standing in the way of quality improvements.
- The research focuses on shedding light on how the construction industry is standing in relation to quality and quality related matters. This involves analyzing the quality status theoretically as well as catching a glimpse at construction parties experience and views on quality related matters and their use of QMS. It is crucial to map the magnitude of quality problems as well as mapping the human aspects.
- Analyzing how well the two aforementioned items converge is of importance as well. In order to see the big picture, it is helpful to compare Saudi Arabia to other countries in relations to construction quality related topics. This should give a better understanding of what needs to be done raise the quality bar that must be met in the reinforced concrete industry .

4.4 Quality Management Systems

- Quality management systems are making a significant contribution to the internal organization of a company, while providing the necessary support in order to act on global markets by rising cost pressures and with consistently high quality of services. The definition of necessary structures and the description of integrated processes but also increase legal certainty and the solidarity in the company itself as

well as the value of the company to the outside, as the company will be less vulnerable.

- For the design of quality management systems, there are a number of general or sector-specific concepts, of which the most important are standardized. Best known are quality management systems according to the standard series ISO 9000. They are often the basis for further management systems where the environmental, safety at work or the safety are on the focus.

- The widespread use of quality systems according to ISO 9001 clearly shows that quality management is a proven tool for optimizing business performance, improve the competitive position and thus an important prerequisite for the survival in the market. "The customer should come back and not the *product*", that is the goal of quality management.

4.5 Integration of Management Systems

The ISO 9001 allows for easy integration of other management systems, especially of environmental management systems (ISO 14001, EMAS III), energy management systems (EN 16001, ISO50001) and occupational health and safety management systems, for example, OHRIS (Occupational Health and Risk Management). The high degree of compatibility between the different standards facilitates the construction of an integrated management system. Here, the QM system is often used as a base, which is extended to additional aspects.

4.6 The principles of quality management

- Long-term success does not come by chance but by deliberate guiding and controlling based on an effective and efficient management system, which is mainly geared to the needs of customers.

- Quality management cannot operate "with the left hand" man; you have the tasks and processes in their interactions recognize and describe to obtain transparency in the company, identify areas for improvement and to use, and to achieve clear, rational processes.

- Build a quality management **system** **or** develop it further and describe it in a manual. Put it first, determine how your business is structured and for which areas, locations and products the manual covers. Determine the relevant processes with their progressions and interactions and ensure that criteria and methods for an effective

steering of the processes are in place for each relevant process. Such criteria should be established if possible in the form of process / quality indicators, such as Productivity indexes, default / setup times, scrap rates, delivery reliability, editing times for quotes and orders, share new customers / new products, inventory turnover, benchmarking.

- Make sure that these indicators regularly calculated and assessed, and those affected are made available and create a forum for the continuous improvement of these values.

- If you have outsourced processes, you nevertheless have to provide a recognizable steering, for example, through appropriately designed contracts or under the care or supplier of Incoming inspection.

- The responsibility for the fulfillment of requirements for outsourced processes so is yours. The nature and extent of the steering outsourced processes shall be defined in the quality system.

Important: continuity is the "key" for the company adequate and effective quality management system!

4.6.1 Customer Orientation

The customer orientation is given to an outstanding importance. The company must carefully raise the customer needs and the demands of the market, check your own ability to fulfillment, produce the performance in accordance with the specifications and ultimately determine the customer satisfaction after completion.

The customer orientation enables the first step for more effective customer retention because a more rapid adaptation of the company to the customer's requirements and wishes are carried out. Through the internalization and application of the quality management principle, the company can also develop a flexible and quick responsiveness to market changes and thus strengthen their competitiveness.

4.6.2 System-orientated management approach

A system consists of a network of processes in different interactions with each other. Recognizing, understanding, manage and control of such systems contributes to the effectiveness and efficiency of the company in the achievement of its objectives.

4.6.3 Involvement of people

At all levels people or employees should contribute the know-how of a company. Their full involvement enables to use their skills for the benefit of the company. The involvement of employees in business processes increases motivation, commitment and creativity. Satisfied employees are willing to take responsibility for their performance and participate more actively in innovation processes.

4.6.4 process-oriented approach

The quality management system is intended to reflect the actual, optimized business processes. A desired result is achieved more efficiently when activities and related resources are managed as a process directed. The process orientation creates greater transparency of sometimes highly complex processes. This allows the use of resources optimized, potential of errors in time to be detected and, ultimately, costs are minimized.

4.6.5 Continuous improvement

Continuous improvement is essential for a healthy development of the company. With the market and customer expectations, successful businesses change through continuous improvement of its products / services and processes. With consistent and enterprise-wide application of continuous improvement, the performance potential of a company increases and the performance advantage can be secured. This is reflected in the company to improve the skills and minimizing failures (such as committee, overproduction).

4.6.6 Supplier relationships for mutual benefit

A company and its suppliers are interdependent. Relations for the mutual benefit of both sides increase the value added ability. With the QM principle, the confidence between companies and suppliers is strengthened, resulting in a developed long-term partnership (such as long-term supplier contracts). Through clear and open communication, increased knowledge transfer, reduction of controls and common advancing of developments costs and resources can be optimized.

4.6.7 Planning, inputs, results, Evaluation, verification, validation, Changes of products and Services

Development and construction are decisive for the subsequent quality. Here it is decided

whether a product may be manufactured easily or with great effort, and therefore cost or expensive. These market-oriented specifications are necessary. Anyone plans here carelessly and unsystematically, specifies, calculates and anyone selects only the price for materials and suppliers, who will get in trouble with himself and with the customer.

Even before the design phase, you should ensure through clear guidelines and responsibilities that your developments carried out efficiently and product risks are avoided. Such requirements for the development result from the stipulations in the contract (specifications) as well as internal standards and guidelines that result from the use, regulations, standards or a comparison with similar products.

Provide for the continuous updating of these plans and their coordination with the customer.

Provide a review and evaluation of the results in your development plan after the completion of milestones and by the end of your development. Here you can determine, for example by means of a tailor-made product checklist or in released meetings (Reviews) whether the conditions laid down in the specification development requirements, particularly all functional, safety and environmental requirements are met, whether the various alternatives that has been appropriate selected and whether all development results, the acceptance criteria are fully documented. In this release, all departments involved must be integrated (sales, manufacturing, purchasing, quality) ! When deviations from the specifications are to take appropriate action.

In a release log of the latest state of development results must be recorded. A review of whether all the requirements specified in the tender documents requirements are fulfilled (verification), and whether the development result is suitable for the intended use (validation), completes the development. Important for this is the identification of critical safety and environmental characteristics in the development documents and the clarification of the manner in which such a validation is to be achieved, for example, material investigations, environmental simulation or suitability tests.

Subsequent changes can be accepted in the documents only after review and approval by an authorized body.

The customer must often very early bind to a supplier to carry out development with him.

That's why he wants to be sure to have a competent, flexible and reliable partner. Developments no longer run one after the other (system, components, tools), but largely parallel. Is the system concept adopted, it starts with the first drafts for the items and at the same time working on the detail-regulation of the system.

This means that you adapt to more here on project work in flexible teams and create the conditions for a fast communication with the customer (eg exchange of CAD data). Procurement process, procurement specifications, testing of procured products and services. If you order only when the material runs out, your suppliers and your purchase will be constantly complaining of tight deadlines. Incomplete information or only on price-oriented shopping can lead to problems. If quality deviations are recognized only in the production or the customer, it can be expensive for you.

5. RESULTS AND DISCUSSION

5.1 Interviews

The construction industry's measure of quality performance was represented by a contractor's reputation from customers and buyers (or compliments received from a customer), which was indicated by 10 respondents. 8 respondents felt that getting continued business or work for clients was a measure for quality performance. The perceptions of how the construction industry could improve its quality performance varied from obligations of the supervision products (6) to better craftsmanship (5), more use of design/build (D/B) projects (3).

Table 1 shows the respondents' answers to questions concerning their perception of the construction industry's quality performance.

Results show that according to contractors, quality is most often measured through customer satisfaction. The best way to improve quality is through the obligation of the engineering supervision, education and training and the biggest barriers to quality is personnel.

5.2 Questionnaire surveys

TABLE 1: CONTRACTORS OPINIONS ABOUT QUALITY, RESPONSES FROM INTERVIEWS

	Responses from Contractors	Number of Responses
How to measure quality performance	Reputation or customer satisfaction	10
	Not possible, construction still favours low bid	6
	The marketing of his company	7
How to improve quality performance?	Testing or measurement of work and products	6
	Better craftsmanship	5
	Education and training	7
	Improve management-worker relations	3
	Obligated supervision according to instructions from the official authorities	6
What are barriers to quality?	more use of design/build (D/B) projects	3
	Lack of skilled workers	10
	Lack of supervision from the official authorities	10
	Lack of supervision from the Contractor himself	10
	Turnover in company	5

Study 1

The total search sample was 40 samples were distributed to a set of institutions and companies, which equal to 100%, and final result was as follow.

A. 8 samples, equal 20%, who are actually doing the full application of the criteria as stated in the questionnaire.

B. 8 samples, equal 18%, who had reservations on the credibility of the application of most of what is stated in the questionnaire items.

C. 5 samples, equal 12%, were flatter in application of what is stated in the questionnaire items.

D. 4 samples, equal 10% afraid to accomplish what came in the credibility of the questionnaire items, fearing for his job and for fear of accountability.

E. 10 samples, 25% stressed the application of what came in the questionnaire, in order of marketing to his company that implements the rules of quality management, but in fact they are not fully committed to what is stated in the questionnaire.

F. 6 samples, 15% who also stressed that the responsibility lies with the official

authorities, so as to cause the weakness of supervision and inspection and follow-up of the target sites by them . The results are represented in the following Chart 1 :

Ten 10 (23%) respondents said that they were aware of quality programs in construction industry; 30 (67%) said they were not aware of such programs. seven (18%) of the respondents said that their company has a quality program; thirty three (82%) said that this was not the case. Results show that contractors consider customer satisfaction, regular inspections,

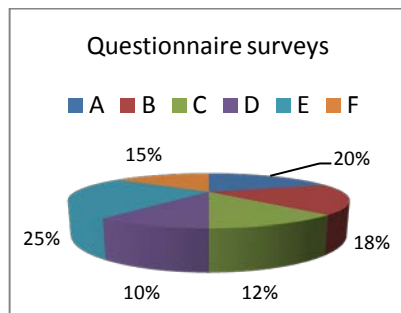


CHART 1: RESULTS OF THE QUESTIONNAIRE SURVEYS ABOUT QUALITY, RESPONSES FROM INTERVIEWS

skilled work force, return business, are the best measures for quality. Certified quality programs are considered far less important.

Based on the results of the questionnaires were designed, which were distributed to a set of institutions and companies, estimated at about 40 companies, and upon to the results of analyzing for the questionnaire, I got the following results that show the strengths and weakness points, then to make the suitable suggestions and recommendations upon to the findings that I got in this search, taking into the consideration the best solutions to avoid the main problems the industry is having with implementation of quality.

5.3 Application of the principles of quality management

The application of quality management principles includes the systematic reporting of customer expectations, their consideration by agreeing on appropriate targets and measures, their effective and efficient performance within the framework of

TABLE 2: WHAT DO YOU CONSIDER THE BEST MEASURE/INDICATOR FOR QUALITY IN CONSTRUCTION INDUSTRY?

PLEASE RANK FROM 0 (LEAST IMPORTANT) TO 5 (MOST IMPORTANT).

	Rank
Training and education	3.2
Skilled work force	3.2
Regular inspections	3.7
Overall customer satisfaction	4.3
Certified quality programs such as the ISO 9000 and 14000 series	1.5
Management commitment to quality	2.5
The length of warranty (in years) companies can give on their work	3.2
Being asked to come back to do more work (return business)	3.5

defined processes, utilizing the skills of all staff and maintained supplier relationships.

5.4 Benefits and applicability of ISO 9001 for contractors small and medium volume

The structure of ISO 9001 meets small and medium contractors. The process orientation enables structured reporting of activities and related resources. With the introduction of a quality management system, the transparency of business processes can increase, error rates and thus costs reduce, achieve higher customer satisfaction and market access will be improved.

A process-oriented quality management system is in practice, independent of the company size and industry affiliation, easy to use.

5.5 Tool for self-assessment possibilities for self-assessment in accordance with ISO 9004: 2009

The ISO 9004: 2009 promotes the self-assessment as an important tool for assessing the maturity of a company. Here, the implementation aspects, the strategy, the management system, the resources and the processes are handled, to identify strengths and weaknesses as well as improvement and innovation possibilities (see also Appendix A. A of ISO 9004: 2009).

Self-assessments can be used to determine the strengths and weaknesses of the company with regard to its performance and the best practices both as a whole and at the level of individual processes.

5.6 sustained success

The effectiveness of the activities of a company increases with his level of maturity. To achieve sustainable success, several points must be observed.

6. CONCLUSION & RECOMMENDATIONS

Based on the findings of the preliminary study on the implementation of quality management in construction projects in the context of construction industry in Saudi Arabia, several points can be preliminarily concluded:

- 1) Total quality management is not a common practice;
- 2) ISO registration is seldom known and when, mainly for marketing purpose;
- 3) Implementation of quality management is greatly perceived as a mean to fulfill contractual obligations instead of satisfying the needs of clients;
- 4) The engineering supervision from the contractors should be verifiable.
- 5) The supervision responsibility of the official authorities needs to be strengthened.
- 6) In terms of quality management tools and techniques, construction companies are commonly using the traditional methods such as experiments and inspections. Other methods might be used depend on the individual practices of a company or requirements from client/consultants;
- 7) The role of the Saudi council of engineers should be strengthened.
- 8) The Professional of every engineer should be accredited from the Saudi council of engineers before begin his activity in the Kingdom.

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