

DESIGN QUALITY MANAGEMENT ACTIVITIES

By Abdulaziz A. Bubshait,¹ Member, ASCE, and Ahmad Al-Abdulrazzak²

ABSTRACT: Quality in the design phase is a primary consideration in the construction industry. The inability to define quality as it relates to all functions within engineering consulting offices has resulted in the unsuccessful implementation of quality improvement programs. The assessment of quality management practices is important for the implementation of total quality management in the construction industry. As a step towards this end, 38 engineering consulting offices were surveyed regarding their design quality management activities. These activities include: writing job descriptions of quality managers, documentation, training, communication, control of drawings and specifications, qualification of key personnel, design reviews, standardization of office procedures, availability of office library facilities, peer reviews, monitoring of schedules and costs, and incentive systems.

INTRODUCTION

The selection and engagement of a design professional is a fundamental decision toward achieving quality in construction. Design quality is a concept that depends on each individual consultant's ability to identify and discuss the client's requirements and, at the same time, to act professionally as a technical specialist (Griffith 1993). The need to exert a special effort to improve quality in the design process is well recognized. The Construction Industry Institute has called for an integrated approach of total quality management (TQM) and quality assurance/quality control to improve the quality of the products and services provided by the construction industry (Burati 1990). TQM is a structured approach towards improvement. If applied properly, it will assist an engineering firm in improving its performance (Oberlender 1993).

In Middle Eastern countries, in general, the concept of quality in design is still in its elementary stages. The lack of long-term experience and the rapid economic and construction boom has provided little time for the local consultancy industry to establish its norms. Problems stemming from incomplete or incorrect engineering information have frequently been serious and costly, and have often not been discovered until the project has been completed or is in use. Such problems include cost and time overruns, disputes between the parties, omissions, errors, ambiguities in plans and specifications, reduced life span, and increased maintenance costs.

Large engineering firms in Saudi Arabia are now implementing some management activities to improve the quality of design. However, these activities are not organized or complete enough to form a TQM system. The objective of this study is to survey quality activities in engineering firms in Saudi Arabia and to determine the frequency of involvement. The assessment of quality management practice is a step towards better implementation of the TQM concept in the construction industry.

DESIGN QUALITY MANAGEMENT ACTIVITIES

In general, quality management in consulting engineering offices is an ongoing process of establishing requirements, communicating those requirements to all members of the project team, providing the proper leadership, and checking to see

that the requirements are met (Saarinen and Hobel 1990; Burati 1991). On the other hand, design assurance is defined as those planned and systematic actions taken to provide confidence that the completed design will satisfy the requirements of its intended use (Burgess 1988). The ASCE manual of quality in constructed projects (ASCE 1990) contains several suggestions for selection of quality design professional and assuring design quality.

Considering the current emphasis of modern management on customer satisfaction, the establishment of a quality management program in engineering consulting offices is an essential requirement for achieving success. A good design must satisfy the requirements set by the owner and the public. Poor quality design may expose the design professional to a lawsuit by a wide variety of claimants including the contractor and the public (Dickmann and Nelson 1985).

Design professionals use quality management techniques of varying levels. Many of them, however, do not name such a practice as quality management. They consider them, however, to be an integral part of design (Saarinen and Hobel 1990). Muller (1984) reported that there has been some resistance to the application of quality management programs to the design phase. There are three important areas for TQM implementation. These include: (1) organization, management involvement, and training; (2) customer and employee feedback mechanisms; and (3) teamwork, employee involvement, and recognition (Chase 1993; Staccatos 1994).

The Study

The population being studied consists of all the engineering consulting offices working in Saudi Arabia. The questionnaire was designed to identify design quality management activities. The questionnaire forms were mailed to 175 randomly selected consultant offices (the entire population is 358 offices). Only 38 offices responded to the survey. The questionnaire consisted of two parts. The first part included general information questions about the consulting offices. The second part listed eleven major quality management activities. The questions were presented so they could be answered either with yes or no. The results of this study should be viewed bearing in mind the inherent limitation of the sample size.

Design Quality Determinants

The quality management activities with the frequencies of implementation as indicated by the consulting offices are shown in part two of the questionnaire (see Appendix I). The results are discussed in the following paragraphs.

Definition of Responsibility

A clear definition of management policies, objectives, and responsibilities for each unit of the organization is essential

¹Chair, and Assoc. Prof., Constr. Engrg. and Mgmt. Dept., King Fahd Univ. of Petroleum and Minerals, Dhahran 31261, Saudi Arabia.

²Grad. Student, Constr. Engrg. and Mgmt. Dept., King Fahd Univ. of Petroleum and Minerals, Dhahran 31261, Saudi Arabia.

Note. Discussion open until December 1, 1996. To extend the closing date one month, a written request must be filed with the ASCE Manager of Journals. The manuscript for this paper was submitted for review and possible publication on June 22, 1995. This paper is part of the *Journal of Professional Issues in Engineering Education and Practice*, Vol. 122, No. 3, July, 1996. ©ASCE, ISSN 0733-9380/96/0003-0104-0106/\$4.00 + \$.50 per page. Paper No. 10985.

for setting up a quality system. Management should periodically review the status and adequacy of the quality program and should appoint a representative to ensure that quality program requirements are complied with. Most of the interviewed consulting offices (79%) indicated that they have a written job description for the quality program manager.

Documentation

Documentation and control of documents is an important element in any quality system. Control of documents is very important to design offices since it is concerned with precision and accuracy of review as well as issuance and revision of all documents related to the design. Most of the offices recognize the importance of such an activity. 89% of the respondents indicated that they have a system for documenting and controlling design-related documents.

Training

Another important element of quality system is training. Training might be through continuing education, seminars, or on-the-job training. A policy and budget for staff training should be established. Furthermore, design personnel should be encouraged to participate in continuing education programs and professional groups, since such participation will keep employees abreast of the latest current information on changing aspects of design and analysis methods (ASCE 1990). The survey showed that most of the offices (87%) have some form of on-the-job training. However, only 47% of the offices allow their employees to participate in continuing-education programs and seminars.

Another aspect of training is the availability of office library facilities. A library with available current reference material including codes, standards, categories, and design manuals is a catalyst for quality work in a design office. 87% indicated that they have office library facilities.

Communication

Communication among the design team members is a vital element in achieving quality in the design phase. Insufficient communication can lead to project failures and problems and to the dissatisfaction of all the team members. 95% of the respondents indicated that the project team hold regular meetings to discuss and communicate design related issues. 79% also indicated that they have a written communication procedure.

Drawing and Specification Control

The control of drawings and specifications is essential to any project design. Usually, the preparation, review, approval, and distribution of drawings is generally well-controlled. However, specifications are frequently allowed to become outdated (Burgess 1984). It is essential that the drawings and specifications be clear, concise, and uniform. All respondents indicated that they have a system to ensure the clarity, conciseness, and uniformity of drawings and specifications.

Design Review

Design review is a vital element in assuring quality in the design phase of a construction project. Experience indicates that a high percentage of contract modifications is due to design deficiencies such as errors, omissions, and ambiguities. There are several types of reviews that a design professional carries out to assure the quality of design. These reviews include a calculations check, space allocation, aesthetics, functionality, capacity, a review of client's comments, and a review

of the standards and regulations. All the consulting offices (100%) indicated that they perform drawing and functionality reviews. 97% indicated that they perform space allocation reviews, capacity reviews, clients' comments reviews, specification reviews, and reviews of standards and regulations. 95% indicated that they perform calculation reviews and aesthetics reviews.

Standardization of Office Procedures

One essential requirement of quality management is the standardization of office procedures and policies. Such standardization establishes a common basis for all projects to improve concentration on the owners' requirements for the design and production of the contract documents. 92% of the consultant offices indicated that their procedures are standardized.

Peer Review

Design peer review is an organized effort that promotes quality in design organizations and their services. Peer review can be grouped into several categories. The two most important categories are organizational peer reviews and project peer reviews. Organizational peer reviews consider a design organization as a whole, focusing on its locations, procedures, and practices. Project peer reviews consider particular projects, according to the organization's practice.

Although the concept of peer review is new in design, 47% of the consulting offices indicated that they carry out organization peer reviews, and 53% indicated that they carry out project peer reviews. The writers' assessment is that the concept of organizational peer review is not yet well developed in consulting offices in Saudi Arabia. These offices that indicated the implementation of peer review may have carried out some type of organizational auditing that is not necessarily well-oriented to quality improvement.

Schedule and Cost

Adherence of the design professional to key dates identified in the contract (e.g., milestones and delivery dates for submittals or reports) is an essential element of quality management. Attention to key dates keeps the project on schedule and provides the owner with a means of monitoring progress. It also allows the owner to comment on various aspects of the project as work progresses.

The financial progress report is an affective communication tool for the design professional to update the owner on design and project costs. The financial progress report shows budgeted versus actual expenditure. The expenditure should represent the amount of work performed. If a longer time is invested in developing the project than was budgeted, a clarification must be obtained and remedial action taken. If additional services not contained in the contract are required in order to meet the overall project requirements, such information should be communicated to the owner immediately. An amendment for the additional work should be negotiated and added to the contract. Most of the surveyed consulting offices (95%) indicated that they follow the practice of submitting financial and schedule progress reports.

Incentive System

The establishment of an incentive system to motivate persons whose activities affect the quality of work is very important. Incentive systems promote quality and increase productivity (ASCE 1990). The survey showed that 74% of the consulting offices have some form of an incentive system for their employees.

Qualification of Key Personnel

Assuring quality in the design comes also through having qualified staff. It should be the general attitude that quality is the responsibility of all employees. Every employee is responsible for his part of the overall quality plan. The results indicated that 95% of the offices have written qualification requirements for key personnel.

CONCLUSION

Quality in the design phase is a primary consideration in the construction industry. Quality management is a systematic way of guaranteeing that organized activities happen the way they are planned. It is a management discipline concerned with preventing problems from occurring by creating the attitudes and controls that make prevention possible. The objective of this study has been to identify the prevalent quality activities in engineering design firms. A survey has been carried out regarding quality management activities in engineering design offices in Saudi Arabia. Several management activities have been identified. These activities include writing job descriptions of quality managers, documentation, training, communication, control of drawings and specifications, qualification of key personnel, design reviews, standardization of office procedures, availability of office library facilities, peer reviews, monitoring of schedules and costs, and incentive systems.

The results of the study should be viewed as indicative and not conclusive since only a limited number of engineering firms participated in the survey. More studies are needed in this important area to facilitate the implementation of TQM in the local construction industry.

ACKNOWLEDGMENTS

The writers appreciate the support of King Fahd University of Petroleum and Minerals, Saudi Arabia, during the study. Thanks are also extended to the engineering firms who participated in the study.

APPENDIX I. QUALITY DESIGN ACTIVITIES QUESTIONNAIRE

Title of respondent: _____

1. General Questions about the Firm

- (a) Type of engineering firm (please indicate the percentage of work)
- (1) Building _____ (% of work)
- (2) Engineering (highways, etc.) _____ (% of work)
- (3) Industrial (power plants, refineries) _____ (% of work)
- (4) Others (please specify) _____ (% of work)
- (b) Annual business volume _____
- (c) Millions of U.S. dollars _____
- (d) Number of permanent employees _____
- (e) Number of temporary employees _____
- (f) Average contract duration (months) _____

2. Questions about the Quality Management Activities

Please indicate which of the following activities are implemented by your firms by putting a tick next to the appropriate answer:

#	Quality Management Activities	Yes	No
1	Job description for the quality assurance manager	30	8
2	Documentation of project-related documents	34	4
3	Training		
3.1	On-the-job training for employees	33	5
3.2	Short courses	18	20
3.3	Seminars	18	20
3.4	Availability of office library	33	5
4	Communication		
4.1	Frequent contacts between the project parties	36	2
4.2	A written communication procedure	30	8
5	A system to ensure the clarity, conciseness, and uniformity of drawings and specifications	38	0
6	Design review		
6.1	Calculation checks for the design	36	2
6.2	Review/check space allocation	37	1
6.3	Drawing checks/review	38	0
6.4	Review/check aesthetics	36	2
6.5	Functionality review	38	0
6.6	Capacity review	37	1
6.7	Review of clients' comments	37	1
6.8	Specification check/review	37	1
6.9	Review/check of standards and regulations	37	1
7	Standardization of office procedures	35	3
8	Peer review		
8.1	Organization peer review	18	20
8.2	Project peer review	20	18
9	Submission of progress reports to the owner	36	2
10	Incentive system	28	10
11	Qualification of key personnel	36	2

APPENDIX II. REFERENCES

- ASCE. (1990). "Quality in constructed project." *Manual and Rep. on Engrg. Pract. No. 73*, New York, N.Y.
- Burati, J. L. (1990). "Total management: The competitive edge." *Publ. No. 10-4*, Constr. Industry Inst., Austin, Tex.
- Burati, J. L. (1991). "Quality management in construction industry." *J. Constr. Engrg. and Mgmt.*, ASCE, 117(2), 341-359.
- Burgess, J. A. (1984). *Design assurance for engineers and managers*, 1st Ed., Marcel Dekker, New York, N.Y.
- Chase, G. W. (1993). *Implementing TQM in a construction company*. Associated General Contractors of America, Washington, D.C.
- Davis, K., Ledbetter, W. B., and Burati, J. L. Jr. (1989). "Measuring design and construction quality costs." *J. Constr. Engrg. and Mgmt.*, ASCE, 115(3), 385-399.
- Dickmann, J., and Nelson, M. (1985). "Construction claims: frequency and severity." *J. Constr. Engrg. and Mgmt.*, ASCE, 111(1), 74-81.
- Griffith, A. (1993). *Quality assurance in building*. Macmillan Education Ltd., London, U.K.
- Muller, F. (1984). "Assuring quality in development and design: an anti-technical approach." *Quality Progress*, 17(19), 18-21.
- Oberlender, G. D. (1993). *Project management for engineering and construction*. McGraw-Hill, New York, N.Y.
- Saarinen, W. Jr., and Hobel, M. A. (1990). "Setting and meeting requirements for quality." *J. Mgmt. in Engrg.*, ASCE, 6(2), 177-185.
- Staccatos, D. H. (1994). "Total quality management and project management." *Proj. Mgmt. J.*, XXV(3), 48-54.