Construction Management and Economics (1999) **17**, 799–809

Quality practices in design organizations

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Received 30 April 1998; accepted 25 February 1999

Design organizations play a major role in the construction industry: they are the media that transfer the requirements of the client to the contractor and ensure that they are met. Thus they need to provide a high quality of service to ensure that their client's project achieves the best possible standards of cost, time and quality. Seventy quality practices (QP) were identified as having a bearing on the quality of service provided by the local design organizations. These quality practices were grouped into fifteen sections termed quality sections (QS). The prevalence of these practices among the local design organizations was surveyed and determined. The results indicate a significant need for improvement in the quality sections 'working relationship', 'employee training and education', and 'performance quality audit'. The study reveals the need for the establishment of a design code, and evaluation standards for local design organizations.

Keywords: design organizations, quality practices, Saudi Arabia

Introduction

Quality in construction is defined as conformance with requirements, as defined by the owner, designer, contractor, and the regulatory agencies (ASCE, 1990). The objective of meeting these requirements rests with the design and construction organizations. There can be no doubt that design organizations bear the greater burden of ensuring quality as it defines the requirements of the owner's in the form of drawings and specifications to the contractor. Any deviations in defining the owner's requirements at this stage can lead to increased costs in their subsequent rectification. Ransom (1987) and Burati *et al.* (1992) showed that design deviations account for about 60% or more of construction project deviations. The costs due to poor quality in design and engineering have been estimated at about 9.5% (Burati *et al.*, 1992) and 8% (Trainor, 1983) of the total project cost.

To be able to control and overcome any potential deviations in design, the design organization needs to implement quality practices within its process. With very little information available regarding the quality practices of design organizations in Saudi Arabia, this study was undertaken with the dual objectives of 1. identifying quality practices relevant to local design organizations, and 2. determining their prevalence among the local design organizations. Hopefully the results of this study will contribute towards the establishment of a quality standard for the design organizations as per the local environment.

Quality in the design process

A design organization is the medium through which the owner states the requirements and objectives to the contractor. Therefore, a consulting organization has the triple task of ensuring that (Farooq, 1997): 1. it has collected all the information necessary for meeting the owner's requirements; 2. it has understood the said information and processed it correctly into

ISSN 0144–6193 print/ISSN 1466-433X online

the form of drawings and specifications; and 3. the contractor is able to understand clearly and implement the owner's requirements through the drawings and specifications.

Any shortfall in fulfilling these tasks can lead to quality deviations in the complete project due to faulty design. Ransom (1987) reported a study by the Building Research Establishment (BRE) in which the causes of failures were analysed to indicate whether they were due to faulty design, poor execution, the use of poor materials, or unexpected user requirements. The percentages of failure, with some overlap between these categories, were found to be 58%, 35%, 12%, and 1%, respectively. Faulty design was taken to include all cases where the failure could be attributed to not following the established design criteria.

Burati *et al.* (1992) collected data on quality deviation from nine completed construction projects. The data were collected to identify the direct costs associated with work re-design, repair, and replacement. The data indicated that deviations in the project accounted for an average of 12.4% of the total project costs. Furthermore, design deviations averaged 78% of the total number of deviations, 79% of the total deviation costs, and 9.5% of the total project cost. The construction deviations averaged 16% of the total number of deviations, 17% of the total deviation costs, and 2.5% of the total project cost. These values are conservative as they considered only the direct costs, but they are indications of the impact of design quality on the project. Other studies (Morgen, 1986; Kirby *et al.*, 1988) have identified the three major causes of the contract modifications as 'design deficiencies', 'user requested changes', and 'unknown site conditions'. These studies have revealed also that 56% of all contract modifications were for correcting design deficiencies.

Methodology of the study

The research, being of the exploratory type, consisted of a questionnaire survey among the local design organizations of the Eastern Province of Saudi Arabia. The questionnaire (Appendix) was designed to evaluate the prevalence of the quality practices among the design organizations. The questionnaire survey was conducted mostly by mailing the questionnaire and partly by conducting interviews with willing organizations. This method while obviously providing the information regarding the prevalence of quality practices among the design organizations also provided more details for assessing the reasons for the presence/lack of these quality practices among the design organizations.

Questionnaire design

Through a literature review the authors identified 15 quality sections (QS) as having a bearing on the quality of service provided by design organizations:

1. Organizational quality policy
2. Designer qualification
3. Employee training and education
4. Design planning
5. Design inputs
6. Design process
7. Interface control
8. Design review
9. Design changes
10. Subcontractor control
11. Document control
12. Design maintainability
13. Computer usage
14. Working relationship
15. Performance quality audit

The questionnaire consists of 70 statements, representing quality practices, grouped into the 15 quality sections (QS). This grouping ensured that each quality section was dependent on the practice of multiple quality practices (QP) instead of one. This also increases the study's understanding and accuracy in determining the true state of the local design organizations. Table 1 correlates the quality sections defined in this study with their corresponding sections in ISO 9000 and the Malcolm Baldridge standards.

The statements inquired about the extent of practice of the 15 quality sections, in the design organization. The respondents were requested to record their opinion regarding their extent of practice as 'always, 'mostly', 'sometimes', 'rarely', and 'never'. The responses were quantified as follows:

Table 1 Correlation of design quality sections with ISO 9000 and MB Standards

S. No.	Quality sections	ISO 9000	Malcolm Baldridge
1	Organizational quality policy	4.1.1	1.0
2	Designer qualification	–	4.1
3	Employee training and education	4.18	4.3
4	Design planning	4.4.2	5.3
5	Design inputs	4.4.4	5.1
6	Design process	4.9	5.3
7	Interface control	4.4.3	4.2
8	Design review	4.4.6	5.1
9	Design changes	4.4.9	5.1
10	Subcontractor control	4.6.2	5.4
11	Document control	4.5	2.1
12	Design maintainability	–	–
13	Computer usage	–	–
14	Working relationship	4.3	7.1
15	Performance quality audit	4.17	7.3

'always' – equal to 100%;
'mostly' – equal to 75%;
'sometimes' – equal to 50%;
'rarely' – equal to 25%;
'never' – equal to 0

The average prevalence of quality practices was determined by the following equation:

$$\text{Average prevalence} = \bullet (a_i\ x_i) \ / \ (\bullet\ x_i)$$

where a_i takes the values 100, 75, 50, 25, and 0; x_1 is the number of respondents answering 'always'; x_2 is the number of respondents answering 'mostly'; x_3 is the number of respondents answering 'sometimes'; x_4 is the number of respondents answering 'rarely'; and x_5 is the number of respondents answering 'never'.

Sample size

The study was limited to the design organizations in the Eastern Province of Saudi Arabia, a total of 100 consulting offices. The minimum sample size was determined to be 22 using the sample size equation of binomial distribution (Snedecor and Cochran, 1971; Kish, 1995). Questionnaires were sent to all the 140 consulting organizations, and of these 25 organizations participated in the survey, and 4 organizations officially declined to participate.

Study results

The average prevalence of the 15 quality sections, determined by taking the average of the quality practices measuring that quality section, is given in Table 2. The 15 quality sections (QS) and their relevant, quality practices (QP) are discussed below.

Organizational quality policy

The organizational quality policy seeks the establishment of a quality programme and the definition of organizational objectives and individual responsibilities. The establishment of a quality programme in an organization communicates the importance given by the organization in ensuring quality of its service. The definition of organizational objectives and individual responsibilities outline the details of how the organization intends to proceed towards achieving a high standard of service.

The quality manual contains information regarding the organizational objectives, the quality policy statement, the extent of application of the quality management programme documents, and the organizational objectives and responsibilities. Organizational procedures regarding quality are addressed also in the quality manual, and it is openly available to the employees (McLaughlin, 1995). As part of its organizational policy the organization also needs to specify the methodology it intends to follow to achieve quality of its service.

Table 2 Average prevalence of the fifteen quality sections

S. No.	Quality management sections	QS prevalence	Rank
1	Organizational quality policy	82.0	6
2	Designer qualification	81.0	8
3	Employee training and education	70.0	14
4	Design planning	83.3	4
5	Design inputs	80.5	9
6	Design process	79.5	11
7	Interface control	73.3	12
8	Design review	89.0	1
9	Design changes	87.3	2
10	Subcontractor control	82.0	6
11	Document control	86.5	3
12	Design maintainability	82.0	6
13	Computer usage	80.0	10
14	Working relationship	72.1	13
	Solely with the client	76.6	(12/16)
	Jointly with the client and contractor	67.2	(15/16)
15	Performance quality audit	63.3	15

The statement inquiring about the definition of organizational objectives and individual responsibilities (QP2) (88%) was the most prevalent in this quality section, followed by the establishment of a quality programme (QP1) (86%). The statement measuring a specified design methodology (QP4) (79%) has a somewhat lower prevalence than the above two statements due to what some respondents revealed as possible difficulties in getting the employees to follow a specific methodology. This could be explained by the fact that most of the local organizations have a multinational workforce where individuals already had some years of experience behind them before joining that particular organization. The workforce's previous experience causes some conflict in following a specified methodology as people can feel comfortable in working the way they have been before joining that particular organization. However, there is recognition of the benefits in following a specified design methodology by the respondents, and the prevalence of this quality practice may increase in the future.

The statement regarding the quality manual and its updating (QP3) (75%) scored the lowest in this quality section, highlighting a slight need for improvement. Overall the quality section measuring organizational quality policy (82%) revealed a good effort by the organization in their service.

Designer qualification

For the design–consulting organization the design professional is the essence of its being. Therefore it is no surprise that the design organization ensures that the design professionals it hires are highly qualified, and the measuring statement (QP5) (90%) has a very high prevalence rate.

Conversely the statement measuring the following of a single design methodology (QP6) (72%) has comparatively lower prevalence. The reason for the lower prevalence of QP6 can be cited as the fact that there is no established building code in Saudi Arabia, and most of the design staff are individuals from different countries who tend to follow the design methods/codes of their local countries. The design organizations tend not to do much about this quality practice due to the following reasons: 1. design organizations are satisfied with the service of their design professionals; 2. fear of becoming dependent upon design professionals from one country; and 3. impracticality due to high cost and time in training employees to follow a single design method.

Employee training and education

Training and education comprise one of the most widely recognized quality sections by quality experts. Employees should be given on-the-job-training, provided with facilities to improve their general skills, and provided with courses to enable them to handle special tasks.

While office library facilities (QP9) (82%) are usually provided for the employees there is significant drop in prevalence rate for the other two quality practices in this quality management section. The low prevalence rates for QP7 (68%) and QP8 (60%) can be explained by the following: 1. usually qualified employees are hired thus there is not much need for providing on job training; 2. usually training is limited to showing the ropes to new employees during their initial probation period; 3. short courses are provided only when there is an urgent need of a certain specialization; and 4. short and long term needs play a major role in deciding whether to provide training courses or hire a new specialist. These quality practices need to be increased by the A/E consulting organization to cope with the future demands of nationalizing of the local workforce.

Design planning

This covers the design organization's process with regard to how it ensures the planning of its design process, and identification of inputs and interfaces. An example of a design plan is shown in Figure 1. The project design plan usually is in the form of a flow chart identifying the various activities required to deliver the project to the client. The design plan identifies the relationships among the various activities promoting the completion of the project, and notes the responsibilities and assignments with regards to each activity (ASCE, 1990).

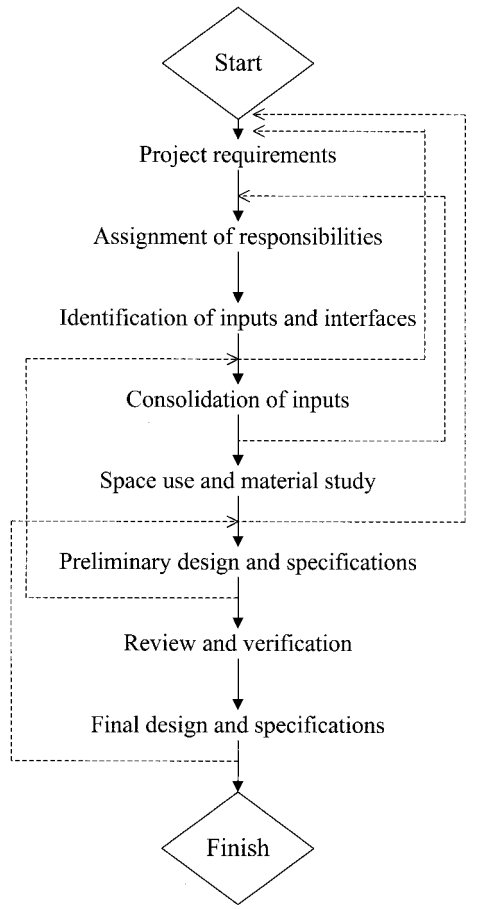

Figure 1 Example of a typical design plan (after Farooq 1997)

Planning the design process (QP10) (88%) ensures that plan drawings and reviews are conducted in a logical manner. Elaborating the design inputs required (QP11) (84%) ensures that all the required information is made available for that work to start and progress smoothly. These quality practices are satisfactorily practised.

It is not unusual in the construction industry to have part of a work done by one organization and the rest by another. Even in a single organization work on different parts of the project may be undertaken by different departments/teams. Thus the identification of

design interfaces in the preliminary design (QP12) (78%) can lead to smoother work by defining authorities and responsibilities clearly early on in the project. This quality practice needs to be enforced more often.

Design inputs

Design inputs cover the organizational policy in the identification, transmission, and agreeing upon of design inputs. Design inputs include codes/standards, project functions, design criteria, technical data (and their sources), and drawing arrangement and layout (Motor Columbus *et al.,* 1984; Peach, 1997).

Identifying and transmitting design inputs in written form (QP13) (80%), while being a good quality practice, also ensures accuracy by transmitting responsibility and making easier the identification of the source of potential deviations. The reviewing and agreeing upon of design inputs by the interfacing divisions (QP14) (81%) not only increases the accuracy of inputs by their cross-verification but also plays a role in ensuring the unity of design. An increase in the prevalence of this quality section will aid in enhancing the service provided by the design organization.

Design process

Design process covers general practices followed by the organization in ensuring quality in the design. Factors like assignment of project to a single team, efficiency of preliminary design, design procedures, investigation documents, and specification of special treatments (Motor Columbus *et al.,* 1984; Cornick, 1991) are intended to be measured in this quality management section.

Assigning of project work to a single team (QP15) (73%) encourages the quick transmission of data and minimization of delay, as members keep each other informed on any problems being faced by them and any changes required in the work and their consequences on their or other's work. Even if it is impractical to make all the design professionals assigned to a large project work in a single team, representatives from different divisions could form a team in an effort to increase the quality of their service. This quality practice needs to be enforced more often.

The preliminary design should take into consideration all discrepancies related to structure and equipment interaction, and important construction methods should be specified in the design documents (QP16 (76%) and QP20 (71%)). The belief by the design professionals that contractors may transfer responsibility upon the design organization, by explaining that this course of action was specified in the design documents, is one of the main reasons for the low prevalence of these quality practices in the local industry.

The other three quality practices, QP17 (81%), QP18 (89%), and QP19 (87%), of this quality section are practised satisfactorily.

Interface control

Interface control covers aspects of how organizational procedures ensure the integration of work done by different entities, both internal and external. The transmission of information, the how and when, also is covered in this quality section.

Local design organizations need to recognize the importance of 'interface control' and work towards increasing its prevalence. Transmission of information between organizations (QP22 (80%) and QP23 (77%)) is practised just satisfactorily, as this is perceived by the organizations as a way of minimizing disputes and upholding their case in the event of any disagreements. Standard procedures and templates (QP23) need to be used more often. The use of standard procedures clarifies the protocol to be followed while the use of standard templates ensures that no basic information is left out and also helps in deciding which information is to be given.

Design information also tends to be given to other interfacing organizations only when the party asks for it and the organization feels their request is justified, or when instructed upon by the client. This reluctance in implementing this quality section is reflected in the other two quality practices (QP21 (68%) and QP24 (68%)). The lower prevalence of this quality section stresses the need for building more trust and cooperation between the interfacing divisions.

Design review

The most effective means of identifying deficiencies and incorporating improvements into the construction documents is the establishment of a design review programme (Kirby *et al.,* 1988). Design reviews are conducted in addition to the ongoing checking process required by design professionals in the course of their work. The design review is an internal quality control process carried out by members of the design team and/or by employees selected for their expertise (ASCE, 1990). Such reviews are undertaken by the organization for detection and correction of errors and omissions, and technical deficiencies. These measures are undertaken by the organization as way of increasing the quality of its services and limiting exposure to liabilities (Kirby *et al.,* 1988).

The design review is vital to any organization for ensuring the quality of its design plans, and consequently this quality section recorded the highest prevalence rating of the 15 quality sections. It is suggested that a higher increase in independent design reviews (QP25) (85%) and aesthetic review (QP31) (80%) will lead to a complementary increase in the service quality of the organization.

Design changes

Design changes are an inevitable part of any construction project. Change of circumstances, equipment becoming obsolete, emergence of a better method of doing work, clients changing their mind, and other varied reasons may account for design changes. Whatever the reasons for change, it is vital that the proper procedures for managing design changes should be followed, so that only the correct design documents are used for the project.

There is a good prevalence of this quality section: design changes affecting contractual requirements (QP33) (91%) has one of the highest ratings of the total quality practices surveyed. The reason for such a high prevalence is the need for the design organization to protect itself in case of any possible disputes later on.

Subcontractor control

Lack of expertise/resources, or the client's insistence may prompt the design organization to subcontract part of their work. The well known principles of supplier control in other industries need to be modified in this case.

A design organization sometimes has to hire specialist designers for the execution of certain part of the project. Ensuring that these subcontracted designers are informed and selected according to the organization's quality programme (QP36) (80%) and working closely with them (QP37) (84%) provide the environment for creating a work of quality. Two possible reasons may account for this quality section not having a higher prevalence rate: specialist designers are known to have a high standard of quality in their work as they have been working in that specialization for a reasonable period; and specialist designers are expected to adapt as much as possible to the organization's main designs.

Document control

A quality conscious organization has a sound policy regarding the storage, filing, and transmission of documents. Any construction activity involves specifications, regulations, changes, checks, revisions, and the like; all these bring into being their own respective documents that need to be updated regularly to ensure work is conducted throughout the project with the same and latest information. This quality section is widely recognized as a major factor in increasing organizational efficiency (ASCE, 1990).

Proper document control is necessary for the success of any organization and more so for a design organization. Thus it is no surprise that this quality section ranks high in its prevalence (86.5%).

Design maintainability

This quality section involves principles from material selection and space allocation. An A/E consulting organization needs to ensure that materials specified by it can be maintained/replaced easily by the client. Proper allocation of space needs to be provisioned to provide for easy accessibility during any future maintenance works.

Ensuring maintainability and/or replacement facilitation in the design can go a long way in saving the client time and money in future maintenance of the project. A study by Al-Shiha (1993) revealed that design defects in ensuring maintenance practicality and adequacy was ranked seventh out of eleven factors by local maintenance contractors and defects due to construction materials sixth in severity.

It is highly advisable to increase the prevalence of QP42 (ease of maintainability when specifying materials in design) (81%).

Computer usage

Computers are becoming an integral part of any organization. The proper use of computers can lead to a decrease in the amount of doing work/rework, thus increasing the productivity of the organization. The increasing availability of design related software also increases the responsibility of the organization for proper selection (QP45) (82%). The use of CAD tools lessens the amount of rework done, thus improving the productivity of the employees concerned. The reason for a slightly lower usage of CAD tools (QP44) (78%) could be attributed to the organization not possessing that many draftsmen trained for working on the computer.

Working relationship

The successful working relationship of an organization takes into account the cooperation with and the

satisfaction of its customers. The reason behind naming this quality management section 'working relationship' and not 'customer satisfaction' is the posing of the question by some as to who is the real customer: the project owner or the project user (Turner, 1993). Other than the conventional definition, a customer can be defined also as any entity that in some way derives some benefit from the project. In increasing order of receiving benefit from the work of the design organization, customers can be enumerated as society, project users, maintenance contractors, construction contractors, and project owners. This study measures, in this quality section, the relationship of the design organization with only those entities with which it comes into direct contact, i.e. the project owner, and to a lesser extent the construction contractor. This quality section covers the design organization's interaction with the client and the construction contractor in working out ways to improve the quality of the project.

This quality section covers the largest number of quality practices, statements QP46 to QP66, in this study, and was divided into two subgroups: 1. working relationship solely with the client; and 2. working relationship jointly with the client and contractor.

Working relationship solely with the client

There is a low level of prevalence with the quality practices defining the role of team members (QP46) (73%) and working procedures (QP47) (72%). The possible reasons for this situation could be the following: client does not give much importance to the quality practices; and/or design organization believes that its way of doing these things is justified and they do not need any input from others.

Quality practices, QP48 (84%), QP49 (87%), and QP50 (88%), are highly prevalent, as these details need to be worked out with the client for the sake of the project, and they are performed at the start of the relationship. Quality practices, QP52 (79%), QP53 (81%), and QP56 (79%) also are prevalent but to a slightly lower degree than the above mentioned practices.

Among the less prevalent quality practices in this subgroup is the definition of methods for testing design correctness (QP51) (65%) which has a lower prevalence than the definition of methods for resolving design conflicts (QP54) (71%) as most design organizations leave it up to the client to test design correctness. Clients sometimes choose to test the correctness of the design by giving it to another design office for peer review, and ensure that the other design office remains anonymous. Location drawings and physical models (QP55) (63%) are made mostly upon the direct request of the client and charged extra unless specified in the contract.

Working relationship jointly with the client and contractor

Interestingly as the contractor comes into the picture there is a decline in the prevalence of these quality practices. Some of the respondents indicated that they sometimes prefer not to deal with the contractor and only with the client, and how the client deals with the contractor is none of their concern.

The reason for such a lower prevalence of quality management practices when dealing with the contractor than with the owner could be attributed to the traditional animosity between these two professions. This quality section reveals some interesting trends: there is a higher degree of contact with the client in the activities at the beginning of the project than at later stages; cooperation is mainly in sections vital for the successful completion of the contract; and design offices prefer to remain aloof from the contractors as compared with the clients.

Performance quality audit

Auditing can be defined as a methodical study and review of one or more quality practices, and the checking for compliance and effectiveness, for the purpose of verification and improvement (Hutchins, 1993; Mirams and McElheron 1995). This quality section assesses the design organizations' process in auditing its quality performance by self-examination and customer feedback.

This quality section reveals some interesting observations about the design organizations. Although there is a good average prevalence of keeping quality records (QP67) (83%) by the responding organizations, there is a significant drop in prevalence in studying significant characteristics at the end of the project (QP69) (55%). Studies done by the organization at the end of a project help the organization in learning from their experiences and also help in developing ways for overcoming any similar problems faced in the future. Persistent problems revealed in end-of-the-project studies highlight sections where drastic action for improvement is needed by the organization.

The responses to the other two statements (QP69 (55%) and QP70 (51%)) on evaluation by the owner and contractor, respectively, reveal a very low prevalence. End-of-the-project evaluations by both the owners and contractors help the design organization in maintaining better relations by getting to know their grievances and appreciation. These quality practices can be a great help in promoting partnering relationship in the future. At present these statistics reveal a clear lack of effort by the design organizations in requesting evaluation from the owner and more so from the contractor.

Conclusions

This study identifies quality practices having a bearing on the service quality of local design organizations and determines their prevalence among them. The most prevalent quality sections identified are design review, design changes, document control, and design planning, whereas the least prevalent sections are performance quality audit, employee training and education, working relationship, and interface control. Design organizations need to pay serious attention to their system to increase the prevalence of quality practices in the above mentioned four least prevalent quality sections.

The study reveals a strong need for the establishment of a design code for local organizations. There is also a need for design organizations to recognize the importance of training the local workforce and consequently being less dependent on the foreign workforce. There is also a lack of interest in the local construction industry towards promoting better relations and trust between the design and construction organizations. On the bright side there is a high recognition of the importance of ensuring a good design for the project.

Two important recommendations reached after discussions with some of the respondents are: (1) there is a need for ways to define and ensure the quality of service provided by design organizations (preferably by regulatory bodies); and (2) a method is needed for defining design organizations, on the basis of their service quality, in different grades, on the lines of grades applied to contractors in the local construction industry.

To accomplish these recommendations further research needs to be undertaken to gather quantitative data on the effect on design organizations due to enforcement of quality practices. Research also needs to be undertaken to determine the importance of quality practices as perceived by both design organizations and clients, for subsequent weights to be given for the evaluation of design organizations.

Acknowledgement

The authors would like to acknowledge the support of King Fahd University of Petroleum and Minerals (KFUPM) and the Research Institute, KFUPM, during the course of this study.

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APPENDIX

Response statistics of the quality practices

QP	Quality Practices	AQP	RQS	OAR
	Organizational Quality Policy			
QP 1	The organization has an established quality programme.	86	2	17
QP 2	Organizational objectives and individual responsibilities for quality are clearly defined.	88	1	10
QP 3	Quality manual is present and is updated to reflect current quality policies and procedures.	75	4	46
QP 4	The organization has a specified design methodology.	79	3	38
	Designer Qualification			
QP 5	All design professionals in the organization are qualified and the organization keeps a record of their qualifications.	90	1	7
QP 6	All the design professionals in the organization follow a single design method.	72	2	50
	Employee Training & Education			
QP 7	Employees are provided with on the job training.	68	2	55
QP 8	Short courses and seminars for employees are provided.	60	3	68
QP 9	The organization provides office library facilities.	82	1	27
	Design Planning			
QP 10	The design process is planned.	88	1	10
QP 11	Design inputs are elaborated before preparation of design documents.	84	2	22
QP 12	Design interfaces are identified in the preliminary design.	78	3	41
	Design Inputs			
QP 13	Design inputs are identified and transmitted in written form, thus defining responsibility.	80	2	34
QP 14	Design inputs are reviewed and agreed upon by the interfacing division early on in the design process.	81	1	29
	Design Process			
QP 15	Project is assigned to a single team.	73	5	48
QP 16	The preliminary design resolves all discrepancies related to structural and equipment interaction.	76	4	45
QP 17	The preliminary design allows for selection of major dimensions of the structures.	81	3	29
QP 18	Design activities (calculations, drawings, specifications, and others) are performed according to established procedures or standard templates.	89	1	9
QP 19	Documentation of investigations, assumptions, and computer calculations utilized for design activities is kept.	87	2	15
QP 20	Design documents specify important construction methods and data (special treatments, sequence of operations, applicable specifications, special equipment, and work methods).	71	6	53
	Interface Control			
QP 21	Interface control is practised and any activity affecting the design quality is identified in writing.	68	3	55
QP 22	Design information transmitted from one organization to another is documented and identified.	80	1	34
QP 23	Transmission of design information between organizations is done through the use of standard procedures or templates.	77	2	43
QP 24	Any verbally or informally transmitted information is promptly confirmed in writing.	68	3	55
	Design Review			
QP 25	Design review/verifications are made by persons other than those performing the particular design.	85	7	20
QP 26	Design calculations are reviewed and verified.	91	3	3
QP 27	Review/verification of design drafts and drawings.	90	5	7
QP 28	Review/verification of specifications and standards.	93	2	2
QP 29	Review/verification of design drawings.	94	1	1
QP 30	Review/verification of space allocation and capacity.	88	6	10
QP 31	Review/verification of aesthetics.	80	8	34
QP 32	Final project drawings and specifications are reviewed and any omissions corrected before being handed over to the construction contractor.	91	3	3

QP	Quality Practices	AQP	RQS	OAR
	Design Changes			
QP 33	Any design changes affecting contractual requirements are made available in writing and the client's and/or client's representative's approval obtained.	91	1	3
QP 34	Design changes are identified and documented for easy retrieval.	86	2	17
QP 35	Activities affected by design changes are identified and the concerned personnel duly notified.	85	3	20
	Subcontractor Control			
QP 36	Subcontracted designers are informed and selected according to the organization's quality programme.	80	2	34
QP 37	The organization works closely with any subcontracted designer to ensure unity of design.	84	1	22
	Document Control			
QP 38	Project documents are indexed and properly filed.	91	1	3
QP 39	Project documents are regularly updated.	86	3	17
QP 40	Project documents are easily available to the concerned personnel.	88	2	10
QP 41	Documents are revised and re-issued after practical number of changes have been issued.	81	4	29
	Design Maintainability			
QP 42	Ease of maintainability and/or replacement is kept in mind when specifying materials.	81	2	29
QP 43	Provisions are made in the design to provide easy accessibility for any future project maintenance.	83	1	25
	Computer Usage			
QP 44	There is a frequent use of CAD tools.	78	2	41
QP 45	Computer softwares utilized in the design process are selected based on their accuracy and checked for any errors.	82	1	27
	Working Relationship *(solely with the client)*			
QP 46	Roles of the project team members are defined through discussion with the client and/or client's representative.	73	9	48
QP 47	Working procedures and communication lines are defined through discussion with the client and/or client's representative.	72	10	50
QP 48	Project cost, schedule, and quality are defined through discussion with the client and/or client's representative.	84	3	22
QP 49	Contractual requirements and constraints are defined through discussion with the client and/or client's representative.	87	2	15
	Working Relationship *(solely with the client) cont.*			
QP 50	Project requirements are defined through discussion with the client and/or client's representative.	88	1	10
QP 51	Methods of testing design correctness are defined through discussion with the client and/or client's representative.	65	16	61
QP 52	The complete project brief is developed through discussion with the client and/or client's representative.	79	5	38
QP 53	Space utilization and material appropriateness is defined through discussion with the client and/or client's representative.	81	4	29
QP 54	Methods for resolving design conflict are defined through discussion with the client and/or client's representative.	71	12	53
QP 55	Location drawings and physical models are made for review.	63	17	63
QP 56	The correctness of the scheme design with regard to the project brief is checked with the client and/or client's representative.	79	5	38
	Working Relationship *(jointly with the client and contractor)*			
QP 57	Constructability of the detail design is checked with the client and/or client's representative, and the construction contractor.	66	14	59
QP 58	Specification classification is worked out with the client and/or client's representative, and the construction contractor.	63	17	63
QP 59	Contractual details for construction are worked out with the client and/or client's representative, and the construction contractor.	62	19	65
QP 60	Requirements for temporary works are worked out with the client and/or client's representative, and the construction contractor.	62	19	65
QP 61	Degree of accuracy of the drawings and the detail required is established with the client and/or client's representative, and the construction contractor.	66	14	59

QP	Quality Practices	AQP	RQS	OAR
QP 62	Practicality of the design drawings is verified with the client and/or client's representative, and the construction contractor.	62	19	65
QP 63	Material and workmanship requirements are established with the client and/or client's representative, and the construction contractor.	74	8	47
QP 64	Appropriate specifications and their details are worked out with the client and/or client's representative, and the construction contractor.	77	7	43
QP 65	Procedures for communicating design inconsistencies and their correction is established with the client and/or client's representative, and the construction contractor.	68	13	55
QP 66	There is regular review of the work performed by the construction contractor to help in any possible design changes required by the client and/or to improve project cost, schedule, and quality.	72	10	50
	Performance Quality Audit			
QP 67	Project quality records are kept with the results of any design verifications noted.	83	1	25
QP 68	After the project completion, a study of the significant project characteristics is made for future reference.	64	2	62
QP 69	An evaluation by the client regarding the services provided is requested at the end of each project.	55	3	69
QP 70	An evaluation by the construction contractor regarding the working relationship is requested at the end of each project.	51	4	70

AQP = Average Quality Prevalence
RQS = Rank in Quality Section
OAR = Overall Ranking