

Quality management in construction projects

Eng. Mosab Elbashir MSc, PMP, CQE ASQ.

Introduction

The quality as a concept has a deep root in the history, anyway the quality profession greatly evolved after World War II when suddenly people's lives could be destroyed by poor quality products ⁽¹⁾. Edwards Deming one of the famous quality expert and scholar emphasized that the keys to quality are in management's hand. According to him 85 percent of the quality problems are due to the system and only 15 percent are due to the employees. In other words, with a reliable system average people can achieve good results while, in the absent of the system it is difficult to achieve quality target. Joseph Juran is other famous quality scholar, and he is like Deming built his quality reputation in America and then took his expertise to Japan in 1950s. Juran introduced his ideas into (Juran Trilogy) which can be described as following:

- 1- Quality control: monitoring techniques to correct sporadic problems
- 2- Quality improvement: a break through sequence to solve chronic problems
- 3- Quality planning: an annual quality program to institutionalize managerial control and review

Quality can have different definitions in different situation, in The Certified Quality Engineer Handbook ⁽¹⁾ published by American Society of Quality different definition can be found. The below list contains some of these informal definitions:

- Quality is not program; it is an approach to business
- Quality is a collection of powerful tools and concept that are proven to work
- Quality is defined by the customer through their satisfaction
- Quality includes continual improvement and breakthrough events

Beside the above definitions there are many other definitions for quality. Juran defined quality as "fitness for use" while, Philip Crosby a well-known quality expert defined quality as "Conformance to specifications". The ISO 8402 Standard has a formal definition for the quality which is "Quality: the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs. Not to be mistaken for "degree of excellence" or "fitness for use" which meet only part of the definition" ⁽¹⁾.

In construction industry the quality is an essential part in construction projects. It becomes a competitive advantage and, has a large impact in organization success and profit. There are three constraints in construction projects, cost, schedule and the scope. The successful project should be completed within the predetermined time line, cost, scope and should meet the agreed specifications.

Quality Management

The American society of quality (ASQ) glossary defines quality management as “the application of quality management in managing a process to achieve maximum customer satisfaction at the lowest overall cost to the organization while continuing to improve the process”⁽²⁾.

Quality management is one of the knowledge area in the project management body of knowledge guide⁽³⁾. It includes “all processes and activities of the performing organization that determine quality polices, objectives and responsibilities so that the project will satisfy the needs of which it was undertaken”.

Figure 1 illustrate the total quality system process; it shows that the quality is everybody responsibility in the organization⁽²⁾.

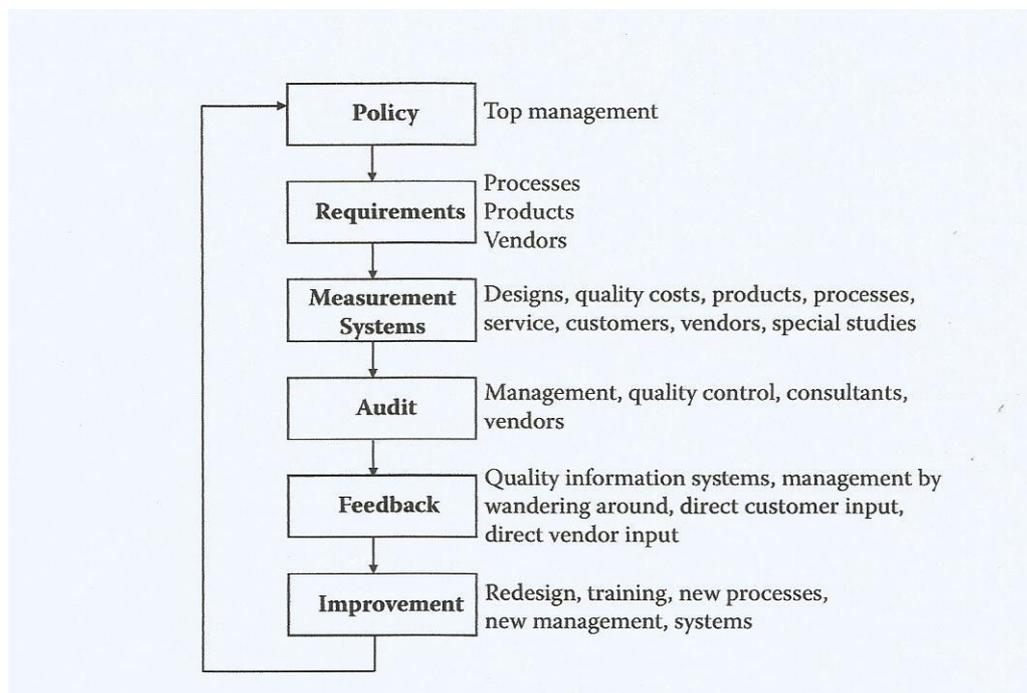


Figure 1: Total quality system (Adopted from Abdul Razzak Rumane, Quality Management in Construction Projects 2011)

Quality Cost

In construction projects, quality is defined and associated with project scope, Cost and time. Cost of quality refer to “the total cost incurred during the entire life cycle of construction project in preventing nonconformance to owner requirement”⁽²⁾. The project budget is fixed there for; it is important to avoid variation during the construction process. It is very difficult to get approval for variation during the project execution, and it is important to avoid such case. Quality cost related to construction project can be summarized as follow⁽²⁾:

Internal failure cost

- Rework
- Rectification
- Rejection of check list
- Corrective action

External failure cost

- Breakdown of installed system
- Repair
- Maintenance
- Warranty

Appraisal cost

- Design review/preparation of shop drawings
- Preparation of composite/coordination drawings
- Onsite material inspection/test
- Offsite material inspection/test
- Pre-checklist inspection

Prevention cost

- Preventive action
- Training
- Work procedures
- Method statements
- Calibration of instruments/equipment

Quality Planning

Project management body of knowledge guide ⁽³⁾ defines quality planning as the process of identifying quality requirements and/or standards for the projects and its deliverables and documenting how the project will demonstrate compliance with quality requirements. It is very important to plan all the quality activities during the project planning phase to avoid any discrepancies latter in the project. The PMBOK ⁽³⁾ identifies the below tool & techniques for quality planning:

- Cost-benefit analysis
- Cost of quality
- Benchmarking
- Seven basic quality tools
- Design of experiment
- Meeting

The most important output of the quality planning is the quality management plan.

Peter Fewings⁽⁴⁾ defines the quality planning process as a strategy to meet client requirements and expectation and should address service quality as well as product quality.

Quality Control

PMBOK⁽³⁾ describes quality control as the process of monitoring and recording results of executing the quality activities to assess performance and recommend necessary changes. The American society of quality (ASQ) termed quality control as process orientation that consist of product inspection and statistical quality control⁽²⁾. PMBOK identifies the following tools & techniques for quality control:

- Inspection
- Control charts
- Pareto diagrams
- Statistical sampling
- Flowcharting
- Scatter diagram
- Cause & effect diagram
- Histograms
- Check sheets

The following activities consider as a sample of quality control activities in construction projects:

- Inspection of steel and form work for concrete members
- Field density tests for soil
- Slump tests for concrete
- Crushing tests for concrete
- Earn value reports (Control schedule by schedule index and control cost by cost index)
- Flood test

The quality control activities are crucial to monitor and control the execution of the project. Failing to perform these activities has a catastrophic impact on the project.

Quality Assurance

PMBOK⁽³⁾ defines quality assurance as the process of auditing the quality requirements and the results from the quality control measurements to ensure that appropriate quality standards and operational definitions are used. The tools and techniques for quality assurance are:

- 1- Quality management & control tools
- 2- Quality audits
- 3- Process analysis

The American society of quality (ASQ) defines quality assurance as “all planned and systematic activities implemented within the quality system that can be demonstrated to provide confidence a product or a service will fulfill requirements of quality”⁽²⁾. Quality assurance in construction projects is the cover all activities performed by the design team, contractor, quality controller and consultant (supervision staff) to meet client’s objectives as specified and to ensure that the project/ facility is fully functional to the satisfaction of the client/ end users.⁽²⁾

Documentation & Records

Documentation is an essential part of any quality system. Documentation components include quality polices, quality procedures, quality records, contract documents...etc. The project will not be closed unless all the paper work is completed. The author compiled the below list as a sample of the documents that should be available and maintain at the project site. The contractor should store and handle these documents in a proper way to retrieve them upon request. The documents are:

- Contract documents, agreement and project technical specifications
- Overall project schedule
- Approved drawings
- QA/QC plan
- HSE plan
- Method of statements
- Request for inspections (RFI) & Request for material inspections (RMI)
- Tests records
- Marked up drawings
- Concrete pouring forms
- Factory acceptance tests (FAT) reports
- Inspection test plan (ITP)
- Site instructions
- Calibration certificate
- Approved material vendor list
- Vendor drawings
- Project organization chart
- Log sheet for all the documents (tests records, RFIs &RMIs, drawings, site instructions...etc.)

All the above documents should be updated and configured in a proper way.

Quality Improvement

Continuous improvement is a key factor to reduce quality cost and a key factor of quality improvement is a corrective action. Quality improvement is achieved by continuously improving the production and business process of an organization. It is optimized by⁽¹⁾:

- Viewing all work as process, whether it is associated with production or process

- Making all processes effective, efficient, and adaptable
- Anticipating change in customer need
- Controlling in-process performance using metrics such as scrap and cycle time, and monitoring tools such as control chart
- Maintaining constructive dissatisfaction with the present level of performance
- Eliminating waste and rework wherever it occurs
- Investigating activities that do not add value to the product or service, with the aim to eliminate those activities
- Eliminating nonconformities in all phases of everyone’s work, even if the increment of improvement is small
- Using benchmarking to improve competitive advantage
- Innovating to achieve breakthrough
- Holding gains so there is no regression
- Incorporating lesson learned into future activities
- Using technical tools such as statistical process control (SPC), experimental design, benchmarking, and so on

In the fixed price construction contract the schedule is the most important constraint for the client. The author proposes the below procedure to identify the most common reasons behind project’s delay. The same procedure can be used for the other constraint (Cost and Scope). This procedure is a sample of one of the continuous improvement methods to identify, analyze, and eliminate the defects. The procedure is as follow:

- 1- Designing a survey form as can be seen in figure 2
- 2- Sending the survey form to the stakeholders, who involve in the projects management in the organization
- 3- The Participant should fill in the form, mentioning the causes of the projects delay and how to eliminate the causes from their point of view
- 4- The collected data should be analyzed to figure out the most common reasons of delay. It is possible to use Pareto chart (See figure 3) to visualize and analyze the data
- 5- The final step is to figure out how to eliminate or mitigate the most common problems behind projects delay

No.	Causes of delay in projects	Suggestion to avoid the delay	Discipline (Civil, Elect. Mech.,....etc.)
1			
2			
3			
4			
5			
6			
7			

Figure 2: Survey form.

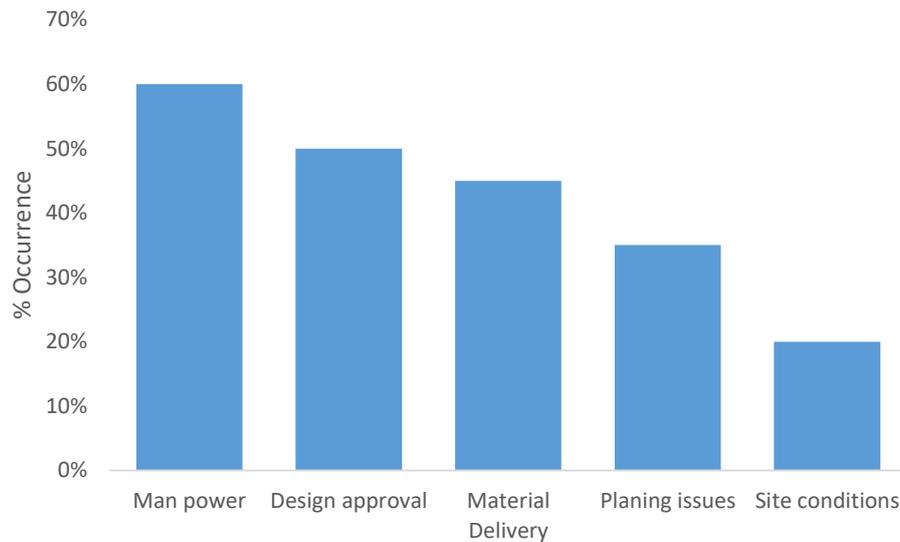


Figure 3: Sample of reasons can cause project's delay.

Quality Improvement Barriers

The certified quality engineer handbook ⁽¹⁾ identifies 12 obstacles to implement quality. The obstacles or barriers and how to overcome them are listed below:

- **Lack of time to devote quality initiatives**
Senior management must provide time for employees to devote to quality initiative, once the system is established, the quality activities will become part of the employee's routine.
- **Poor intra-organizational communication**
Organization must encourage and provide the means of two-way communication so that the information flows up as well as down the ladder.
- **Lack of real employee empowerment**
Individuals should be empowered to take decisions that affect the efficiency of their process or the satisfaction of their customers. Training is necessary to provide confidence.
- **Lack of employee trust in senior management**
It is important that the senior management to be honest with employee. It is the management responsibility to create an environment of trust.
- **Politics and turf issue**
The use of multifunctional teams will help resolve the differences between department and individuals. Restructuring the organization to be more responsive to customer need is necessary.

- **Lack of formalized strategic plan for change**

People normally resist change. The management should understand and utilize this basic concept of change:

1. People change when they want to meet their own needs
2. Never expect anyone to engage in behavior that services the organization's values unless an adequate reason has been given
3. For change to be accepted, people must be moved from a state of fear to trust

Honest two-way communication with respectful feedback increases the chances of success.

- **Lack of strong motivation**

It is the management's responsibility to create a conducive environment for individuals to become motivated.

- **View of quality program as a quick fix**

Quality improvement is a journey not a destination. Management should support the continuous improvement so that quality and productivity are continually and permanently improved and costs reduced.

- **Drive for short-term financial results**

Quality improvement requires an organization to have a strong future orientation and a willingness to make long-term commitment.

- **Lack of leadership**

Leadership is essential for organization success. Leadership requires commitment in terms of both management time and organization resources.

- **Lack of customer focus**

Organization need to meet the expectation of the internal and external customers. Effective feedback mechanisms are required for this purpose.

- **Lack of companywide definition of quality**

Experienced quality professionals recommend that all areas of the organizations be involved in writing the definition.

Conclusion

- Quality is a culture an attitude, without the commitment and support of the top management of the organization, no quality program is going to success
- No matter how qualified resources the organization has, without quality system the output will always be poor

- Quality has two aspects, processes documentation quality and products quality.
- Quality planning, quality assurance and quality control are an essential component of the quality system.
- Quality in the construction projects is a business need and a competitive advantage.
- Continuous improvement is a key factor to sustain the quality system.
- Senior management hold the responsibility to overcome the quality barriers.

References

- (1) Connie M.Borrer, Editor. Certified Quality Engineer Handbook. American Society of Quality, Quality Press, Milwaukee 53203, 2009.
- (2) Abdul Razzak Rummane. Quality Management in Construction Projects. CRC Press, Taylor & Francis Group, 2011.
- (3) Project Management Institute, PMI. A Guide to The Project Management Body of Knowledge (PMBOK). Fifth Edition. Project Management Institute Inc., 2013.
- (4) Peter Fewings. Construction Project Management. Taylor & Francis, 2005.

About the Author



Eng. Mosab Elbashir

Sudan - Saudi Arabia



Eng. Mosab Elbashir Msc, PMP, CQE ASQ, Construction projects management expert with 15 years of experience. Graduated from University of Khartoum (Sudan), faculty of engineering, civil engineering department in 2003 (BSc). Mosab, obtained his Master degree from Lund University (Sweden) in Water Resources in 2007. Certified quality engineer from American Society of Quality (CQE ASQ) and project management professional (PMP –PMI). Currently works as a consultant with The Saudi Electricity Company in Saudi Arabia since 2012. Interested in projects control and quality management. For more information, please visit

<https://www.linkedin.com/in/mosab-elbashir-44595a64/>

Email: mosab_555@hotmail.com