

# Review of Project Quality Plan

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## ABSTRACT

The construction industry has been struggling with quality issues for many years, and the cost to our economy is dramatic. The cost could potentially be reduced significantly if the industry were to embrace the concept of quality assurance that has been used with great success by many other sectors of the economy.

Identifying Key Performance Indicators in any critical activity is an essential part of any construction process to improve the quality and uniformity of the project. The need for KPI in construction projects has increased considerably in recent times due to significant changes, advancements in technology and high expectation of the users. The KPI maintain uniformity in construction process and ensure more economical utilization of materials resulting in significant reduction in cost to the users. The additional cost involved to improve quality by identifying KPI is directly proportional to the benefits. A methodology has been developed for identifying the KPI for different construct activity. The methodology accomplishes the desired quality in construction process. Due to a lack of a standard quality assurance program that meets the needs of the construction industry, a back-to-basics and streamlined construction quality assurance program has to be developed.

The goal is to develop a system that captures the essence of quality assurance, including: Assuring quality, Adding value, utilizing a risk-based approach (to minimize the cost of a quality system), Reducing the cost of quality (and increasing profit)

The objective of this paper is to study the current scenario of construction industry with regards to quality, and to understand the guidelines to prepare the quality manuals.

**Index Terms** – KPI, PQP, Quality Plan, Quality Manual.

## 1. INTRODUCTION

The construction industry has been struggling with quality issues for many years, and the cost to our economy is dramatic. The cost could potentially be reduced significantly if the industry were to embrace the concept of quality assurance that has been used with great success by many other sectors of the economy. The construction industry is unique, and therefore, the application of quality assurance requires an approach that meets the needs of the industry.

Building owners also need to be educated as to what is quality assurance so that they can begin using their voice to encourage adaptation of this approach to protect their investments and reduce the cost of construction.

### 1.1. Quality Control

The dictionary defines Quality Control as the inspection, analysis and action required to ensure quality of output; the operational techniques and the activities used to fulfil and verify requirements of quality; a procedure for keeping quality of inputs or outputs to specifications.

### 1.2. Quality Assurance:-

Quality assurance is about being “in control” of all major areas of your business so that you can assure quality. Being “in control” also reduces variation, which improves quality. “Control” and “variation reduction” is accomplished using various methods.

### 1.3. Plan quality

The following 5C’s of quality will provide an indication of the quality of the plans as follows

### 1.3.1 Complete

- The plans will be an accurate and thorough representation of the existing project site and terrain features.
- The plans will be an accurate and thorough representation of the proposed project features and details to be constructed.
- The plans will be supported by a thorough and detailed documented development process.
- The plans will be developed with the active involvement of all affected parties and developmental stage owners throughout all stages of development.

### 1.3.2 Consistent

The plans will be consistent with other plans developed and will comply with all standards and guidelines set by the design manuals.

### 1.3.3 Clear

The plans will not contain any design errors or omissions which will require more than one addendum during the project advertisement period.

### 1.3.4 Correct

The plans will not contain any design errors or omissions which will cause the delay, postponement, or cancellation of the project letting.

### 1.3.5 Constructible

The plans will not contain design errors or omissions that require more than two change orders throughout the construction phase which individually causes an increase or decrease of more than 3% of the original contract bid award amount or causes an increase or decrease in the contract time by more than one day.

It is recognized that good communication and significant effort by all “stakeholders” is necessary to meet the 5 C’s and achieve the desired result of a quality set of plans[1].

## 2. QUALITY ASSURANCE AND QUALITY CONTROL IMPLEMENTATION IN CONSTRUCTION SECTOR

### 2.1 Quality Assurance

#### 2.1.1 Introduction

Quality assurance activities are performed by the owner or his agents in monitoring the quality control programme established and administered by others. Most quality assurance activities focus on administration and surveillance functions. Surveillance functions encompass the monitoring of the contractor’s materials, methods, personnel and any inspection and testing activities. Whereas administrative functions include active coordination between contractor and designer and thorough documentation of all aspects of the construction process.

The Surveillance function will generally include:-

- a) Monitoring laboratory and field testing of construction material and completed works. Reviewing contractor’s compliance with specifications, requirement for construction methods and personals.
- b) Monitoring or performing pre-operational tests or both.
- c) Preparing and maintaining quality assurance manuals.

The administrative functions will include:

- a) Initiating, analyzing and approving design clarification or changes in contract documents.
- b) Documenting all project related tests, inspection and visits by official visitors.
- c) Maintain photographs of construction progress and other relevant construction events.
- d) Maintain record of job oriented communication like telephonic conversation memorandum and letters etc[2].

#### Organizational Set –Up Required for Ensuring Quality Assurance

##### Quality Policy

Before undertaking any construction, the department should enunciate in clear terms the policy of the department towards quality. The quality policy forms one element of the corporate policy and is authorized by the top management.

#### 2.1.2 Quality Management

It is that aspect of the departmental function that determines and implements the quality policy. The attainment of desired quality requires the commitments and participation of all members of the organization whereas the responsibility for quality management lies with the top management. The quality management includes strategic planning, allocation of resources and other systematic activities for quality: such as quality planning operations and evaluations.

### 2.1.3 Quality System

Several quality systems depending upon the environmental conditions, type of construction and specifications work are available. The organizational structure, responsibilities, procedures, processes and resources for implementation of quality management form a part of the system. The quality should only be as comprehensive as needed to meet the quality objectives. For contractual, mandatory and assessment purposes, demonstrations of identified elements in the system are required.

### 2.1.4 Quality Control

The quality control envisages the data collection, analysis and interpretation etc. It needs the operational techniques and activities that are used to fulfill requirements of quality. In order to avoid confusion, care should be taken to include a modifying term when referring to a sub-set of quality control such as "Production Quality Control" or when referring to a broader concept such as "Plant Use Quality Control". The quality control measures adopted in the country are embodied in the "Handbook of Quality Assurance and Quality Control for Project Effectiveness".

### 2.1.5 Quality Assurance

It contains all those planned and systematic actions necessary to provide adequate level of confidence that a product or service will satisfy for given requirements for quality. Unless given requirements fully reflect the needs of the user, quality assurance will not be completed. For effectiveness, quality assurance usually requires a continuing evaluation of factors that affect the adequacy of the design or specification intended applications, as well as verifications and details of production, installation and inspection operations. Within an organization, quality

assurance serves as a management tool. In contractual situations, quality assurance also serves to provide level of confidence in the supplier.

The entire quality management aspects are embodied in quality policy of the department. The quality systems are managed by the organization structure. The internal quality assurance aspects provide a certain level of confidence to the management while the quality control aspects control the operational activities and techniques adopted during the process. Both the quality control and internal quality assurance aspects provide confidence to users [3].

## 2.2 Quality Control

### 2.2.1 Introduction

Quality control can be maintained by the utilization of sound engineering practice, professional attitudes, good construction practices and quality. In the context of engineering structures. It may be understood as a function of making men, materials, machines and methods operate at the standards calculated to ensure that the end result of the construction conforms to the prescribed specifications as well as meets the owner/users requirement.

Quality control is a management activity applied to the construction processes to set purposes. Purpose in this case being achievement of prescribed standard of performance and cost. To achieve optimum quality at minimum cost, we have to consider all the factors that help to build quality into a product or service.

In the construction industry where majority of works are executed by the contractor the responsibility of quality control is in the hands of the contractor and he is responsible to the designer and the owner for this.

The main problems facing the development of construction projects and structures are the technological advancement of their fabrication, the improvement of their quality, reliability and factory finishing- These problems can be solved by developing and applying efficient and continuous quality control at each stage of production and by testing products and structures using the latest instruments and machines. In the present day competitive market of construction industry if a contractor has to survive, he should be able to meet the quality requirement of the owner/user and satisfy his needs as well as

meet the conformance standards. The various process involved to be able to meet the above requirement should be cost effective [4].

The construction phase of any construction project is the most demanding and difficult portion of the project for the engineer. During this phase the engineer's plan and specifications are put to the final test in terms of constructability, design performance and cost effectiveness. Too many projects are constructed that do not meet any of these basic requirements, to causing complications for the owner, engineer and the contractor and sometimes resulting in a failure to meet safety obligations to the general public.

In order to ensure this, a quality control program needs to be introduced in the project at an early stage.

A well defined quality control programme should be established for each project and the organizational structure should be very explicit. Quality control programme is an element of Quality Assurance Programme. It entails performing inspections, tests, measurements and documentation necessary to check, verify and correct the quality of materials and methods and through them the quality of construction. Quality can never come by accident. Unless there is a sense of involvement and as will to produce a superior product, it would be difficult to Achieve quality- The best way to achieve quality is to follow the simple though difficult maxim "Do things right the first time." Inspection of a work after it is completed can at best identify or locate the defect. The best concept of quality control has to be prevention of defect rather than detection and rectification.

### 2.2.2 Quality Control Activities

For getting a good quality product in construction industry certain activities must be followed by various people who are involved in the project. The activities are discussed in subsequent paragraphs.

- **Procedures**

The various procedures required to be followed are based on the requirements considered necessary for control of construction activity to obtain a quality product. These should include not only inspection and verification procedures but also the construction processes and work methods, which could affect quality.

The procedures control the process and when the quality of the process is controlled the quality of the completed work is automatically controlled.

- **Planning and Scheduling**

One of the most important aspects of ensuring effective quality control during construction is planning and scheduling. The plan or method of ensuring that all the requirements of the programme can be met must be fully developed. Such a plan includes the control of material and special process, utilization of qualified skilled personnel and assignment of responsibilities etc. Scheduling of the work must be in sufficient details, so that everyone concerned with supporting the work is aware of the actual work being performed and when it is performed. Inspection personals must be available to verify or inspect the work so that it continuous at the desired pace.

- **Documentation and Records:**

This is also an important activity. A good system must be established to control incoming documents such as specifications, drawings and control their distribution so that latest documents are used in the construction. The system should be stream lined and not made bulky by regular reviews. Adequate control of records and documents should be ensured until they are sent for filing.

- **Filing**

A good retrievable filing system using an indexing and cross reference system should be set up. The files will be required for auditing during the construction of the project and after the construction these can be microfilmed and kept for records and thus reduce space for storage.

- **Communication:**

The single most important item in assuring effective-quality during construction is communication. Each person on the site must know his responsibilities and the responsibilities of the others. Each must keep the appropriate people informed. The construction group and the quality control group must communicate to allow the work proceed in an effective manner.

- **Training**

Like communication, training is an area of vital importance to successful quality control. It is mandatory to have training for inspection personnel. The training should include training in procedures, instructions codes, standards and specifications which affect construction.

- **Quality Checks**

The objective of quality control programme is to verify achievement of the quality specified. At present generally one check is carried out in many government projects by the supervisory staff of public works department or the Military Engineering Service, the two major government constructing agencies. The supervisory staff is responsible for quality i.e. making sure by way of verification. Contractor on the other hand is happy changing the item which are detected and rejected. The item which go unnoticed really, will affect the quality at a later date. There is thus a need to introduce certain checks at various stages by the people who are responsible for the construction to ensure a quality product. The three stage check system should be:

**(a) Stage 1-By Suppliers/Manufacturers**

These are the checks and tests carried out by the suppliers or the manufacturers at the source before the item is sent to the site. The sources could be quarries, kiln, factories etc.

**(b) Stage 2- By Contractors**

He is responsible for the actual construction and it must be his endeavor to ensure that he produces a quality work in the specified time frame, for this he should take certain actions such as

- Carry out preliminary and preparatory checks to ensure that the correct materials are ordered from the right source.
- On receipt of material at site, he must conduct checks and tests to ensure that the material of the type and quality ordered have been received and there are no damages in transit.
- For the stored material the contractor must conduct periodical checks to ensure that the material has not deteriorated. These are also essential before the material is used at site.

**(c) Stage 3 -By Supervising Agency**

In this stage the supervising agency should carry out its own checks as part of the quality assurance programme which should have been specified at the time of finalizing the quality assurance programme before awarding the contract. During this stage the following needs to be done,

- Surveillance of the contractors quality control function.
- Witnessing the contractor's tests to ensure that they are conducted in the appropriate manner.
- Verification of the test results by independent test, where considered necessary-
- Detailed and independent inspection of the materials, methods and the finished items.[3]

**3. The Purpose of a Project Quality Plan (PQP)**

'Project Quality Plan' can be defined as a set of activities planned at the beginning of the project that helps achieve quality in the Project being executed.

The Purpose of the Project Quality Plan is to define these activities / tasks that intends to deliver products while focussing on achieving customer's quality expectations. These activities / tasks are defined on the basis of the quality standards set by the organization delivering the product.

Project Quality Plan identifies which quality Standards are relevant to the project and determines how they can be satisfied. It includes the implementation of quality Events (peer reviews, checklist execution) by using various quality materials (templates, standards, checklists) available within the organization. The holding of the quality event is termed as Quality Control. As an output of the various activities, quality metrics or measurements is captured which assist in continuous improvement of quality thus adding to the inventory of lessons learned. Quality Assurance deals in preparation of the quality Plan and formation of organization wide standards.

**3.1 Guidelines to write the Project Quality Plan**

Project Quality Plan should be written with the objective to provide project management with easy access to quality requirements and should have ready availability of the procedures and standards thus mentioned.

The following list provides you the various Quality Elements that should be included in a detailed Project Quality Plan:

- **Management Responsibility.** Describes the quality responsibilities of all stakeholders.
- **Documented Quality Management System.** This refers to the existing Quality Procedures that have been standardized and used within the organization.
- **Design Control.** This specifies the procedures for Design Review, Sign-Off, Design Changes and Design Waivers of requirements.
- **Document Control.** This defines the process to control Project Documents at each Project Phase.
- **Purchasing.** This defines Quality Control and Quality Requirements for sub-contracting any part / whole part of the project.
- **Inspection Testing.** This details the plans for Acceptance Testing and Integration Testing.
- **Non-conformance.** This defines the procedures to handle any type of non-conformance work. The procedures include defining responsibilities, defining conditions and availability of required documentation in such cases.
- **Corrective Actions.** This describes the procedures for taking Corrective Actions for the problems encountered during project execution.
- **Quality Records.** This describes the procedures for maintaining the Quality Records (matrices, variance reports, executed checklists etc) during project execution as well as after the project completion.
- **Quality Audits.** An internal audit should be planned and implemented during each phase of the project.
- **Training.** This should specify any training requirements for the project team.

### 3.2 Evaluating your Project Quality Plan

For quality assurance to be effective, two things must be ensured:

- First, the Project Quality plan must be sufficient to achieve the required quality standards expected of the organization. In this regard the plan must not only be specific and detailed listing all quality requirements and standards, but also include all the steps taken to ensure that those requirements and standards are met.
- Secondly, quality assurance (i.e. final product testing) should be independent of the project itself (as well as

the project manager). This comes down from the project management guidelines for effective quality assurance, and builds on a broad-based, organizational approach to standards-based product testing[5].

The development of a Project Quality Plan is a team process that depends as much on communicating information as it does on planning. The key objective is to create a cohesive dialog and subsequently develop awareness of potential quality issues assurance. Based on this awareness, project managers can prepare plans and actions to counter any weaknesses or deficiencies in the project execution, thus ensuring that all quality standards are met effectively.

### 3.3 Allocation of Responsibilities Duties

The Project manager is responsible for issuing the quality plan and for ensuring that all work complies with the drawings and specifications.

The Project Engineer is responsible for verifying that materials and workmanship comply with specifications before payments are made. He will be responsible for collecting and storing quality records. He will report departures from this quality plan to the Project Manager for his resolution.

The Regional Quality Engineer will prepare revisions of the plan, as necessary, which is jointly approved by him and the Project Manager and issue by the Project manager. The Purchase officer is responsible for ensuring that all orders for purchased materials are in compliance with specifications

The foremen and supervisors will ensure that the workers do the work process as outlined in work instructions issued by the Project Engineer.

### 3.4 Project Procedures

The project procedures specified in the contract for processing contract variation, conflicts with the requirements of 'Administration of contract variations'. The project quantity surveyor will prepare an amendment to conditions of contract incorporating necessary changes when required after approval by the CEO this will be issued as project procedures.

## 4. Important points to be consider while preparing Quality Manual for Construction Activities

The procedure for preparing a Quality Manual will initially begin by studying the various elements associated with the company and their details, know-how, etc., by which the processes/systems are functioning.

The preparation of comprehensive Quality Manual becomes very necessary for a company, as it will reflect the quality aspect of work in the functioning of the company as well as its execution of the projects.

The meticulous writing of a quality manual is tedious and exhaustive.

The foremost procedure for developing a manual that is acceptable necessitated the study of the existing systems and procedures of the organization. This facilitated an excellent understanding of the systems that is reflected in the systems created so as to obtain the quality of product that satisfies the client/customer.

The existing systems were studied by spending time on the site, enquiring about various activities at site and head office and the documents maintained to support the assessment of the quality obtained.

The existing systems were later analyzed for any discrepancies or flaws that were hindering the process of achieving and accounting for the quality of the product as required by the client/customer.

This part considered here addresses ISO 9000:2000 and analyses the principal requirements, scope of requirement in terms of what they apply to, their purpose and their meaning [7].

#### **4.1 Responsibility**

This emphasizes that the top management is always responsible for quality and must organize and plan for it. Top management cannot delegate its quality responsibility to lower levels of management. Just being involved is not enough; top management must be dedicated and committed to quality and prove it through words, deeds and commitment of resources, consistency and continuous improvement.

#### **4.2 Quality Systems**

This section indicates the establishment and maintenance of an effective documented quality system, which ensures that the product/service conforms to the specified requirements. The formal quality system documentation consists of a quality

manual, which makes references to quality system procedures and outlines the structure of the documentation process.

#### **4.3 Quality Policy**

This section ensures that the senior management develops and documents a written quality policy. The quality policy shall contain its mission, objectives and guidelines in order to demonstrate the commitment to quality. This section also ensures that the policy is understood, implemented and maintained at all levels in the organization,

#### **4.4 Responsibility and Authority**

This section tells to clearly define the responsibility, authority and interrelationship of all the personnel, whose work affects the quality. Often a quality organization chart is used for this purpose; Relationships among the quality personnel and their relationship to senior management are also defined. There should be no conflicting or overlapping of the responsibilities and authority.

This section indicates as to how the document is planning to meet the specific quality requirements for its products, projects and contracts. The quality plan supports the development of the product/services to achieve customer satisfaction.[6]

#### **4.5 Management Review**

This section addresses the timely review of the quality system. The quality system installed is reviewed at appropriate intervals by the senior management to ensure its continued suitability and effectiveness. This review may be formal or informal as long as critical information is reviewed and documented. Activities typically include internal audits, corrective actions, systems monitoring and any change in the regular activities.

#### **4.6 Contract Review**

The purpose of the contract review section is to make sure that the customer and the one offering the services have the same understanding of the requirements under the contract, the service offered has adequate resources to complete the job under the contract and that all the contract activities are properly documented and recorded. Basically, four procedural items are required under this section to ensure that:

1. The contractual requirements are adequately defined and documented
2. The service offered is capable of meeting the customer's requirement
3. Requirements that differ from the contractual agreement can be resolved and
4. All records related to above transactions are preserved.

Also there are procedures for amending the contract and for correctly transferring that information to the appropriate functions within the organization. All records of the contract Review are duly maintained.[7]

#### 4.7 Control of Non-Conforming Product

This section emphasizes establishing and maintaining procedures to prevent the inadvertent use or installation of the non-conforming product this section requires that all the non-conforming products be identified, segregated when practical, documented and evaluated and that the appropriate functions concerned be notified. This applies to both the suspect product and the non-conforming product [4].

#### 4.8 Corrective Action

This section sees that the corrective action procedures address:

- The cause(s) of non-conformity in order to implement effective and lasting corrective action and prevent recurrence.
- Analysis of all relevant quality records including service reports, customer complaints, work instructions, process controls and concessions for detecting and eliminating potential causes of non-conforming products.
- Preventive actions to deal with the problems at a level that corresponds to potential risks.
- Implementations of corrective actions to make sure that they are effective; and
- Recording of necessary procedures changes as result of the corrective action(s).

#### 4.9 Preventive Action

This section sees that the preventive action procedures address:

1. Use of appropriate sources of information
2. Necessary steps for problem solving and problem prevention
3. Effectiveness of preventive actions

4. Maintaining preventive action records for management review [9].

#### 4.10 Control of Quality Records

This section emphasizes the establishment of procedures fertile identification, collection, record keeping, maintenance, retention, storage, availability and disposition of all quality records, including those of the subcontractors, in order to demonstrate achievement of the required quality level and effectiveness of the quality system. This section also requires that all records be legible and identifiable to the product involved, easily retrievable and stored in a suitable environment to prevent damage, deterioration and loss. Retention times of the quality records must be established and recorded. Where contractually agreed, quality records must be made available to the customer's representative for review. Records may be stored using any media, such as paper or in the electronic format there are also additional requirements relating to record retention [10].

#### 4.11 Internal Quality Audit

This section emphasizes the need for the internal quality audit Once a quality system is in place, the supplier shall can out a comprehensive planned and documented internal audit to ensure that the system is effective and indeed in compliance with the said requirements. These audits must be planned and scheduled and all findings and follow-up actions must be recorded and maintained. The results of the audits shall be brought to die attention of the personnel responsible in the audited area, who in turn shall take the timely corrective action on the deficiencies found by the audits [5].

## 5. CONCLUSION

Having described the process of implementing Quality Assurance and Quality Control System, it is clearly understood that quality doesn't happen by chance, it has to be managed at every stage of the product. A quality system is a mechanism by which a company can organize and manage its resources to achieve, sustain and improve quality economically. Quality Systems are analogous to financial control systems, information technology systems and personnel management systems.

It is after all the time and effort expands in producing the initial system that a dangerous point is reached. The danger is that once the system is complete it will become a neatly packaged inviolate document. This is the very thing that must be avoided and positive action must be taken to prevent it. A well directed quality auditing programme should be focused upon making upon the procedures more effective in terms of both Total Quality and company's aims.

Most of the construction projects are executed through competitive tendering. The contractors at times quote very competitive rates with little margin of profit for securing the tenders. To offset this, they try to indulge in poor workmanship using substandard materials to prevent such mistakes and ensure QC of construction materials as well as workmanship; the works are inspected by an independent technical examination branch. It has been made mandatory for the contractor to employ qualified engineers for ensuring QA/QC. The system of approving samples of construction materials, workmanship and quarters by competent departmental engineers is strictly followed for ensuring QA/QC. The major concern of any construction firm is time while planning and execution of works. It also ensures that the best quality of construction materials available are used within the cost restraints of the project and maintenance works.

It is found during the study, Quality Assurance is about getting it right first time but this is an aim that will forever remain on the horizon, the important thing is that the journey is in the right direction. Having prepared the manual a culture must be developed by the company within the individuals who use the system to question and improve the procedure used.

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