



## Analysis of Quality in Project Quality Management Based on PMBOK®

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### ABSTRACT

Quality is a vital part of a successful organization. Quality is important to a process and result. A good process produces a good product, while a good product is produced through a good process. In project management, quality is used to assess project success. Quality is the degree to which the inherent characteristics meet requirements, while project quality is the process of meeting business objectives according to the project charter. The journal entitled 'Analysis of Quality in PMBOK-Based Project Management', discusses the definition, types, and processes of quality management, intending to explain projects and the process of managing them. The benefit is to explain knowledge about quality and its management. The method used is identification, description of the concept of project quality management, analysis of the management planning process, quality control, and conclusions. This research describes the quality management process, including quality control. The main input utilized in the process including Project Charter, PM Plan, Project Documents, EEF, OPA, Approved CR, Deliverables, and Work Performance Data. The Tools and technic utilized in the process include Expert Judgement, Data Gathering, Data Analysis, Decision Making, Data Representation, Test, and Inspection Planning/ audit, Design For X, Problem Solving Quality Improvement Methods, and Meetings. The results obtained from the above process include the main results consisting of QM Plan, Quality Metrics, Quality Reports, Test Documents, CR, QC Measurements, Verified Deliverables, and Work Performance Information.

### ARTICLE INFO

**Article History:**

*Submitted/Received 25 Oct 2022*

*First Revised 01 Nov 2022*

*Accepted 23 Nov 2022*

*First Available online 26 Nov 2022*

*Publication Date 01 Dec 2022*

**Keyword:**

*Project Quality,  
Project quality management.*

## 1. INTRODUCTION

### 1.1. Background

Quality or Excellence is a vital aspect for successful organizations. Quality is highly significant for any work or process and the resulting outcomes. Logically, a good process will yield good products, and good products are achieved through good processes. Quality management refers to the actions taken to maintain the desired level of quality by a company (Cristobal and Angel, 2011; Ebrahimi and Sadeghi, 2013; Siva et al., 2016; Weckenmann et al., 2015). In project management, quality is used as the main barometer to assess project success, indicating that a successful project must align with scope, time, budget, and quality constraints (PMI - PMBOK®).

Quality is defined as the degree to which a set of inherent characteristics fulfils requirements (see: [pm4id.org/pm4id/10-1-standards-of-quality-and-statistics](https://pm4id.org/pm4id/10-1-standards-of-quality-and-statistics)). The Oxford Dictionary defines quality as 1) distinctive attributes or characteristics possessed by someone or something, a standard against which similar things are measured; a level of excellence. This definition focuses on an individual's leadership abilities. And 2) a standard against which similar things are measured; a level of excellence. This definition emphasizes the improvement of product quality. On the other hand, project quality is defined as the process or terms of meeting business objectives specified in the project charter (PMI - PMBOK®).

Project quality includes or encompasses the processes and activities that determine quality policies, objectives, and responsibilities, ensuring that the project meets the required needs. The success of project implementation is at least determined by three elements: scope, time, and budget (PMI, PMBOK®), and these three elements will determine the project quality (Dharsika, Budhiartha and Yansen, 2017). The issues discussed in this journal include the understanding of quality, types, and processes of quality management in IT project management, analyzing quality issues in project management, and achieving good results through effective quality management processes.

### 1.2. Benefits

1. The expected benefits of this written work are to provide knowledge to the community in need regarding quality in project management and standard project quality management processes.
2. To contribute to the field of project management, specifically in the realm of knowledge.

## 2. METHODS

In conducting this research, the research method employed involved the following stages:

1. Identification and description of project quality management concepts; identify the main quality concepts and develop a description or explanation for each quality concept identified.
2. Analysis of the quality management planning process; conduct,
3. Analysis of the quality management implementation process,
4. Analysis of the quality control process,
5. Conclusion.

### 3. RESULTS AND DISCUSSION

#### 3.1. Key concepts identification of quality.

In PMBOK-guided quality management, there are three key concepts underlying the quality management process, which are compatibility, quality versus grade, and the importance.

**Table 1.** Quality concept explanation table.

Item Concept	Analysis and Discussion
<b>Compatibility concept</b>	This concept explains whether the implemented quality management processes align with existing standard quality frameworks such as ISO, COBIT, and others. It means that all quality management processes should reference one or more of these standards. Currently, there is integration between different standards, ensuring compatibility and alignment among them. For example, there is compatibility between COBIT and ISO, among others.
<b>Quality concept against grade,</b>	This concept, in principle, explains that quality management processes should fulfil both the element of "quality" and the element of "grade." The element of "quality" refers to whether all activities and deliverables meet the specified requirements, while the element of "grade" refers to the fulfilment of the planned product features. This facilitates the inspection process, particularly for project deliverables, to ensure their compliance with functional and non-functional requirements.
<b>The concept of the importance.</b>	Explaining the extent to which project quality management can implement the concept of prevention compared to the concept of inspection and the concept of cost of quality. The concept of prevention explains how meticulous quality planning can prevent errors or other quality-related incidents from occurring. The concept of inspection explains how quality inspections of processes and products that have been planned are conducted. Quality inspections of activities determine if the implemented activities align with the plan, while quality inspections of products assess the conformity of the produced items with the specified requirements or specifications.

#### 3.2. Tailoring Consideration

The quality management practices can vary between organizations as each organization has its unique characteristics or nature. Therefore, the implementation of quality management concepts for a particular organization needs to be adjusted according to the

specific needs and conditions of that organization. Similar considerations apply to the quality management activities within a project. Based on these considerations, the application of quality management concepts in each organization should involve tailoring or customization. To accomplish this, PMI suggests several considerations for tailoring, which include:

**Table 2.** Tailoring consideration analysis table.

Item tailoring	Analysis and discussion
<p>a. Availability of Compliance Policy and Auditing Policy within the organization, which includes policies and procedures,</p>	<ul style="list-style-type: none"> <li>● The availability of quality policies and procedures within an organization is essential for ensuring effectiveness. These policies and procedures provide clear guidelines for project implementation, ensuring consistent and standardized quality management practices. This encompasses the quality policies and procedures used by the project or organization in managing each activity or project.</li> <li>● The use of appropriate tools, techniques, and templates in the organization is crucial for efficient quality management and evaluation processes. Having suitable tools and templates assists in streamlining the development, implementation, and control of quality activities.</li> <li>● The availability of standards and procedures for administering quality processes provides guidance to individuals involved in executing their tasks. These standards and procedures offer direction and guidance to ensure that quality-related tasks are carried out consistently and according to established protocols.</li> </ul>
<p>b. Appropriateness of standards and regulations</p>	<ul style="list-style-type: none"> <li>● How will quality improvement efforts and processes be managed within the project.</li> <li>● Will they be managed at the organizational level or at the project level.</li> <li>● Continuous improvement of all policies and procedures ensures that the quality of processes and products consistently meets current conditions and requirements.</li> </ul>
<p>c. Continual improvement</p>	<ul style="list-style-type: none"> <li>● How quality improvement efforts and processes will be managed within the project.</li> <li>● Whether managed at the organizational level or managed at the level of each project</li> <li>● Continuous improvement of all policies and procedures will ensure that the quality of processes and products are always in line with current conditions and demands.</li> </ul>
<p>d. Stakeholder engagement</p>	<ul style="list-style-type: none"> <li>● Is there a collaborative environment for stakeholders and suppliers? In the current context, especially in software development or information system applications, the involvement of stakeholders, such as users, is</li> </ul>

Item tailoring	Analysis and discussion
	crucial. The focus of information system development is now on customer satisfaction, in addition to supporting smooth, accurate, and efficient business operations.

Quality in project management exists in two forms: project quality and product quality. Project quality refers to the quality applied to all activities within a project that aim to produce deliverables. It encompasses the processes involved in ensuring the project is executed effectively. Product quality, on the other hand, relates to the degree of fulfilment of all the required specifications for each project deliverable.

### 3.3. Quality processes

Quality Process refers to the procedures, methods, and mechanisms that consistently ensure and control the quality management process in the production of goods or services. It encompasses the quality assurance procedures that are implemented to guarantee the desired level of quality throughout the production process (see [www.lawinsider.com/clause/quality-assurance-procedures](http://www.lawinsider.com/clause/quality-assurance-procedures)).

According to PMI in the PMBOK® guide (Alwaly and Alawi, 2020; Chaves, et al., 2016; Guide, 2001; Kinsella, 2002; Reich and Wee, 2006; Rosenberger and Tick, 2021; Santos and Cabral, 2008; Tavan and Hosseini, 2016; Sobieraj and Nowak, 2021; Van Rooij, 2009), the process of managing quality in a project includes several stages: the planning process (plan quality management), the management process (manage quality), and the control process (control quality). The following diagram illustrates the sequence of quality management processes as depicted in **Figure 1**.



**Figure 1.** Stages of the quality management process according to PMBOK® version 6.

In the implementation of each of the above processes, the IPO principle is followed, which consists of input, process, and output. The Input section consists of documents or other forms that serve as the basis for executing the respective process. The Process section includes activities, methods, and tools used to carry out the quality management process. The Output section represents the results obtained from the related quality management process. Considering that the process group consists of several sequential stages, the output of one process generally becomes the input for another process. The detailed analysis and discussion of each quality management process can be described as follows:

1. Plan quality processes

The first stage is quality planning, which involves identifying the quality requirements and/or standards to be applied in the project activities and the resulting deliverables, as

well as the documentation processes used in the project. This stage aims to depict how the project will comply with the established requirements and standards. The activities involved in this stage include planning the type and level of quality to be applied in the project and determining the requirements for each deliverable.

During this stage, the planning includes determining which quality processes will be applied, specifying the functions and features to be incorporated into the project's product, and establishing the quality standards to be applied to each activity. It also involves defining the timeline for implementation and identifying the personnel responsible for carrying out the activities.

The complete process of quality planning, as outlined in PMBOK® version 6, is summarized below:

a. Input section

This section serves the purpose of identifying the inputs that can be used in the quality planning process, both as individual inputs and in combination. Inputs provide the necessary information, data, and resources to design the quality approach for the project (Hussien et al., 2021).

1. Project Charter
2. Project Manager/ management Plan
  - Requirements Management Plan
  - Risk Management Plan
  - Stakeholder Engagement Plan
  - Scope Baseline
3. Project Documents
  - Assumption Log
  - Requirements Documentation
  - Requirements Traceability Matrix
  - Risk Register
  - Stakeholder Register
4. Enterprise Environmental Factors
5. Organizational Process Assets

b. Processes section (tools and technique)

Tools and Techniques. Which are methods, techniques, and supporting tools that can be used in the quality management planning process (Le Bot, 2005).

1. Expert Judgement
2. Data Gathering
  - Benchmarking
  - Brainstorming
  - Interviews
3. Data Analysis
  - Cost-benefit Analysis
  - Cost of Quality
4. Decision Making (Multicriteria Decision Analysis)
5. Data Representation
  - Flowcharts
  - Logical Data Model

- Matrix Diagrams
  - Mind Mapping
6. Test and Inspection Planning
  7. Meetings

The above-mentioned tools and methods can be used individually or independently, or they can be used in combination. If using methods individually, it means using only one selected method for the planning process.

If using a combination of multiple methods, it is necessary to choose methods that can complement or support each other, such as testing and inspection methods, and meeting methods, among others. Generally, quality planning involves using various types of methods and tools simultaneously.

#### c. Output section

Result of the quality planning process which consists of several project quality management plan documents.

1. Quality Management Plan
2. Quality Metrics
3. Project Management Plan Updates
  - Risk Management Plan
  - Scope Baseline
4. Project Documents Update
  - Lessons Learned Register
  - Requirements Traceability Matrix
  - Risk Register
  - Stakeholder Register

## 2. Manage quality processes

The "Manage Quality" process is the terminology used in PMBOK® version 6, while in the previous version, version 5, it was known as "Perform Quality Assurance". In this process, the implementation of project quality activities and the quality of the products produced by each project activity are carried out.

Project quality management involves examining the execution of each activity and the status of the planned deliverables or products. The parameters used in quality inspection include the main components such as activity scope, schedule, cost, and resources.

The project scope and activities check includes the following criteria:

- a. Whether each activity carried out in the project is in accordance with the established activity plan and produces the product as specified.
- b. Whether the implementation time and duration of the activities carried out in the project are in accordance with the plan,
- c. Whether each implementation of each project activity has used funds as planned.
- d. Whether the implementers of activities or human resources involved in project activities are in accordance with the specifications set,
- e. And so on.



Examination of the result products and deliverables produced by project activities includes the following criteria:

- a. Conformity of product functions to the defined functional requirements, including what functions must be present in each product built.
- b. The suitability of the features of each product built with non-functional requirements, which include product performance in the form of size, shape, speed, color, and other characteristics.

Inspections are carried out in various ways, such as inspections, testing, data analysis, and feature/function-based examinations (Ali et al., 2020). The quality inspection process yields different types of results, including compliance with activity or product specifications, non-compliance with specifications, and the need for adjustments, among others. Actions taken based on the inspection results can include rejection, corrective actions, adjustments, and more.

Rejection results in project failure, corrective actions lead to necessary follow-up actions to rectify mistakes and achieve accuracy, and adjustments require further actions that require approval from relevant stakeholders. Adjustments resulting from testing need to be managed through a change request mechanism. The detailed process of managing quality, based on PMBOK®, is summarized as follows:

a. Input section

The documents used in managing quality are as follows (Dimitros and Georgia, 2012):

1. Project Management Plan (Quality Management Plan)
2. Project Documents
  - Lessons Learned Register
  - Quality Control Measurements
  - Quality Metric
  - Risk Report
3. Organizational Process Assets

b. Tool and technique

Tools and techniques that can be used in the process of managing quality are as follows (Popo, 2020):

1. Data Gathering Checklists
2. Data Analysis
  - Alternatives Analysis
  - Document Analysis
  - Process Analysis
  - Root Cause Analysis
3. Decision Making (Multicriteria Decision Analysis)
4. Data Representation
  - Affinity Diagrams
  - Cause and Effect Diagrams
  - Flowcharts
  - Histograms
  - Matrix Diagrams
  - Scatter Diagrams



5. Audits
6. Design For X
7. Problem Solving
8. Quality Improvement Methods

c. Output section

The output produced by the process of managing quality (Rush and Connolly, 2020):

1. Quality Reports
2. Test and Evaluation Documents
3. Change Requests
4. Project Management Plan Updates
  - Quality Management Plan
  - Scope Baseline
  - Schedule Baseline
  - Cost Baseline
5. Project Document Updates
  - Issue Log
  - Lessons Learned Register
  - Risk Register

3. Control quality processes

Quality control is the process of monitoring and recording the execution results of quality management activities to assess performance and ensure that each project deliverable is completed correctly and meets user requirements (Salvi and Kerkar, 2020). The quality control process determines that the project outcomes have achieved the intended objectives (PMI, PMBOK®). Product quality is measured by comparing the produced product's conformity to the defined product requirements (Jeyadurga and Balamurali, 2022), while project quality is established by how well the quality of each activity is planned, managed, and controlled.

Quality management involves two aspects: quality monitoring and quality control. The quality monitoring process involves gathering information about the status of planned activities' outcomes and the status of the produced products from each project activity. The quality control process occurs after the completion status of activities and the status of the produced products are determined.

Project control is conducted through various means, such as adjusting activities, timelines, resources, materials, and more, depending on the prevailing conditions. (Pellerin and Perrier, 2019) Product control is carried out by revising the product requirement plans. Importantly, all project and product controls are conducted through approvals obtained in the integrated change control process.

In general, the outcomes of quality inspections result in rejection, corrective actions, adjustments, and others. The quality inspection process produces a list of verified deliverables containing the testing data (Novitiara, Pratami and Bay, 2020). The actions taken in this process are:

- a. Accepted; The results of product inspection and project activities are implemented according to the plan and requirements set.

- b. Rejected; Non-conforming results must be changed or replaced or even canceled. Changes can be in the form of product substitution, or reduction of activities as agreed. The consequences of this action can change the project cost component.
- c. Fixed; the results of the inspection found errors in implementing the requirements, then improvements must be made without changing the requirements.

Adjusted; Results that require adjustments are adjusted so that the results are in accordance with the specified requirements. The form of adjustment can be in the form of product changes such as adding and reducing functions or features, and adding, reducing the time and resources of activities to meet the specifications set.

The detailed quality control process, based on PMBOK®, will be summarized/described below:

a. Input section

The input documents used in quality control are as follows:

1. Project Management Plan (Quality Management Plan)
2. Project Documents
  - Lessons Learned Register
  - Quality Metrics
  - Test and Evaluation Documents
3. Approved Change Requests
4. Deliverables
5. Work Performance Data
6. Enterprise Environmental Factors
7. Organizational Process Assets

b. Tools and technique section

The input methods, tools and techniques used in quality control are as follows:

1. Data Gathering
  - Checklist
  - Check Sheets
  - Statistical Sampling
  - Questionnaires and Surveys
2. Data Analysis
  - Performance Reviews
  - Root Cause Analysis)
3. Inspection
4. Testing/Product Evaluations
5. Data Representation
  - Cause and Effect Diagrams
  - Control Charts
  - Histogram
  - Scatter Diagrams
6. Meetings

c. Output section

The documents produced by the quality control process are as follows:

1. Quality Control Measurements Data Analysis
  - Performance Reviews
  - Root Cause Analysis
2. Verified Deliverables Testing/Product Evaluations
3. Work Performance Information
4. Change Requests
5. Project Management Plan Updates (Quality Management Plan)
6. Project Documents Updates
  - Issue Log
  - Lessons Learned Register
  - Risk Register
  - Test and Evaluation Documents

#### 4. CONCLUSION

Quality management is a process that explains how the quality of a project is planned, managed, and controlled. Each of these processes is accompanied by input data, techniques and tools, and output. The main objective of quality management processes, according to PMI, is to identify and document the challenges involved in planning, executing, and controlling project and product quality.

Through the analysis of quality management, three processes are followed using the PMBOK® framework, which encompass project quality and the resulting product quality. Product quality focuses on how all product requirements are fulfilled, while project quality focuses on how the project's scope, schedule, and budget are effectively implemented.

#### 5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirm that this paper is free from plagiarism.

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