# ICT Project Management

## Chapter 6: Project Planning Phase – Project Quality Management

### 6.1 Introduction - Quality

The International Organization for Standardization (ISO) defines quality as;-

1) the totality of characteristics of an entity that bear on it's ability to satisfy stated or implied needs.
2) "the degree to which a set of inherent characteristics fulfills requirements" (ISO9000:2000)

Some goals of quality programs include:

a) Fitness for use. (Is the product or service capable of being used?)
b) Fitness for purpose. (Does the product or service meet its intended purpose?)
c) Customer satisfaction. (Does the product or service meet the customer's expectations?)
d) Conformance to the requirements. (Does the product or service conform to the requirements?)

### 6.2. What is Project quality management

**Project quality management** ensures that the project will satisfy the needs for which it was undertaken
The project team must try to understand the key project stakeholders expectations especially what quality means to them. Thus it is important for them to create a good working relationship with them and understand their stated and implied needs.

### 6.3. Project Quality processes

Processes include:

a) Quality Planning
b) Quality Assurance
c) Quality Control

### 6.4. Quality Planning

It involves Identifying which quality standards are relevant to the project and determining how to satisfy them.

- Implies the ability to anticipate situations and prepare actions to bring about the desired outcome
- Modern quality management involves prevention of defects through a program of selecting proper materials and indoctrinating people in quality and planning a process that ensures the appropriate outcome

It involves

- Design of experiments – quality planning technique that helps identify which variables have the most influence on the overall outcome of a process.
- Communicating the correct actions for ensuring quality in a format that is understandable and complete eg. Organizations policies, project scope statements, product description and related standards and regulations.

### 6.4.1. Project Characteristics/Attributes of Scope that bears on quality.

It is often difficult for customers to explain exactly what they want in an IT project. Important scope management aspects of IT project that affect project quality includes;

1) **Functionality**; the degree to which a system performs its intended function.
2) **Features**; the systems special characteristics that appeal to users. It is important to specify which are required and which are optional
3) **System output**: the screens and reports the system generates. It is important to define clearly what screen and reports.
4) **Performance:** addresses how well a product or service perform the customers intended use. Need to know volumes of data and transactions, number of simultaneous users, required response time, etc.
    - Issues includes;
    - Volume of input data
    - Simultaneous logg-ins

- Projected growth in number of users
- Equipment requirements
- Response time etc

5) Producibility (technology required)
    a. Ability of a product or service to be produced within the existing technology, human resources, skills, knowledge, and materials at a cost compatible with market expectations. Producibility is one of the most critical aspects of developing any new product.
6) Usability (effort expended to use)
    a. The ability of a product to perform its intended function for the specified user under the prescribed conditions. Usability is determined by examining performance, function and condition of a product.
7) Reliability (MTBF)
    a. The degree to which a unit of equipment performs its intended function under specified conditions for a specified period of time.
    b. Computed by 2 methods of Mean-Time-Between-Failure (MTBF):
        i. Predicted MTBF: Based on a mathematical computation of a component failure using a tree diagram to determine sequential failure aspects of the component rated periods. Least desirable method because it cannot account for environmental variations that can degrade components to lower rates.
        ii. Actual MTBF: Use of field collected data to compute the failures under realistic operating conditions to find the average time between failure. The actual reliability will seldom be the same as the predicted reliability.
8) Maintainability (Mean-Time-To-Repair: MTTR)
    a. The ability of a unit to be restored within a specified time to its performance capability under the environmental operating conditions within a specified, average period of time.
9) Availability (Probability of performance)
    a. The probability of a product being capable of performing a required function under the specified conditions when called upon. The key parts of availability are reliability and maintainability.
10) Operability (Expected conditional use)
    a. The ability of a product to be operated by human resources for specified periods of time under given conditions without significant degradation of the output.
11) Flexibility (Expected variable use)
    a. The ability of a product to be used for different purposes at different capacities and under different conditions.
12) Social Acceptability (Environment and safety)
    a. The degree of compatibility between the characteristics of a product or service and the prevailing values and expectations of the relevant society
    b. The degree to which a public accepts a product for use.
13) Affordability (Return for quality required)
    a. The ability to develop, acquire, operate, maintain, and dispose of a product over its life.

### 6.4.2. Importance of Quality Planning

Important to prevent defects by:

- Selecting proper materials
- Training and indoctrinating people in quality
- Planning a process that ensures the appropriate outcome
- **Design of experiments** is a quality planning technique that helps identify which variables have the most influence on the overall outcome of a process
    - Computer chip designer would determine what combination of materials and equipment will produce the most reliable chips at a reasonable cost
- Also applies to project management issues, such as cost and schedule trade-offs

- Junior programmers cost less than senior programmers but will not produce the same level of work in the same amount of time
- An appropriately designed experiment to compute` project costs and durations for various combinations of staff can help determine an optimal mix of personnel
- Involves documenting important factors that directly contribute to meeting customer requirements

### 6.4.3. Who's Responsible for the Quality of Projects?

- Project managers are ultimately responsible for quality management on their projects
- Several organizations and references can help project managers and their teams understand quality
  - International Organization for Standardization (www.iso.org)
    - When products, systems, machinery and devices work well and safely, it is often because they meet standards. The organization responsible for many thousands of the standards which benefit the world is **ISO** (derived from the Greek *isos*, meaning "equal")
  - IEEE – Standards Association (www.ieee.org)
    - A leading, developer of industry standards in a broad-range of industries (Power and Energy, Information Technology, Telecommunications, Transportation, Medical and Healthcare, nanotechnology, cyber security, information assurance, and green technology) . Globally recognized

## 6.5. Quality Assurance

Quality assurance includes all the activities related to satisfying the relevant quality standards for a project. It involves periodically evaluating overall project performance to ensure the project will satisfy the relevant quality standards. Its goal is continuous quality improvement.

### 6.5.1. Tools for Quality Assurance

1. **Benchmarking:** the process of identifying, understanding and adapting outstanding practices and processes from an organization anywhere in the world to help an organization improve its performance.
   Benchmarking generates ideas for quality improvements by comparing specific project practices or product characteristics to those of other projects or products within or outside the performing organization

2. Q**uality audit** is a structured review of specific quality management activities that help identify lessons learned that could improve performance on current or future projects
   Performed by in-house auditors or third parties and can be scheduled or random.

## 6.6. Quality Control

Involves monitoring specific project results to ensure that they comply with the relevant quality standards
The main goal is to improve quality. Its main outcomes are:

- ***Acceptance decisions-*** determine if the products/services produced as part of the project will be acceptable or be rejected and rework is then necessary
  Accepted products are called validated deliverables
  Rejected products are called re-work
- ***Rework*** – action taken to bring rejected items into compliance with products requirements and specifications or other stakeholders expectations. Re-work can be very expensive
- ***Process adjustments*** – activities used to correct or prevent further quality problems based on quality control measurements (eg. purchase faster server if response time is too slow)

### 6.6.1. Tools and Techniques for Quality control

There are Seven Basic Tools of Quality that help in performing quality control

1. Pareto analysis: involves identifying the vital few contributors that account for the most quality problems . 80-20 rule ie. 80% of the problems are caused by 20% causes. Pareto diagram are histograms, column charts representing frequency distribution that helps identify and prioritize problem areas.

2. Statistical Sampling: involves choosing part of the population of interest for inspection. The sample size depends on how representative one wants the sample to be
   Formula
   Sample size = 0.25 x (certainty factor / acceptance factor)$^2$
   Commonly used certainty factors

| Desired Certainity | Certainity factor |
|---|---|
| 95% | 1960 |
| 90% | 1645 |
| 80% | 1281 |

Example
For 95% = 0.25 x (1960/0.5)$^2$ = 385
For 80% = 0.25 x (1281 /.20)$^2$ = 10

3. **Six Sigma:**

- **Six Sigma** is "a comprehensive and flexible system for achieving, sustaining, and maximizing business success. Six Sigma is uniquely driven by close understanding of customer needs, disciplined use of facts, data, and statistical analysis, and diligent attention to managing, improving, and reinventing business processes."

**Basic Information**

- The target for perfection is the achievement of no more than **3.4 defects per million opportunities**
- The principles can apply to a wide variety of processes – design and production of a product, a Help Desk or other customer-service process
- Six Sigma projects normally follow a five-phase improvement process called DMAIC Define, Measure, Analyse, Improve and Control.

**DMAIC**

- **DMAIC** is a systematic, closed-loop process for continued improvement that is scientific and fact based
  - **D**efine: Define the problem/opportunity, process, and customer requirements. Tool used include project charter, requirements, Voice of the Customer data.
  - **M**easure: Define measures (in terms of defects per million), then collect, compile, and display data
  - **A**nalyze: Scrutinize process details to find improvement opportunities; seeks root cause of problems
  - **I**mprove: Generate solutions and ideas for improving the problem; pilot test the solution
  - **C**ontrol: Track and verify the stability of the improvements and the predictability of the solution

**How Is Six Sigma Quality/ Benefits of Six Sigma**

- It requires an organization-wide commitment at all levels. Often huge training investments but pay off in higher quality goods and services at lower costs
- Training follows the "Belt" system as in a karate class
- Six Sigma organizations have the ability and willingness to adopt contrary objectives: *reducing errors and getting things done faster; creative and rational; focus on the big picture and minute details; make customers happy and make a lot of money*
- Leads to customer-focus and strives to drive out waste, raise levels of quality, and improve financial performance at *breakthrough* levels

Six Sigma and Project Management

- Joseph M. Juran stated, "All improvement takes place project by project, and in no other way"*
- It's important to select projects carefully and apply higher quality where it makes sense; companies that use Six Sigma do not always boost their stock values
- Minimizing defects does not matter if an organization is making a product that no one wants to buy. As Mikel Harry puts it, "I could genetically engineer a Six Sigma goat, but if a rodeo is the marketplace, people are still going to buy a Four Sigma horse."**

- Six Sigma projects must focus on a quality problem or gap between the current and desired performance, not have a clearly understood problem, the solution should not be predetermined and an optimal solution should not be apparent

Six Sigma Projects Use
Project Management

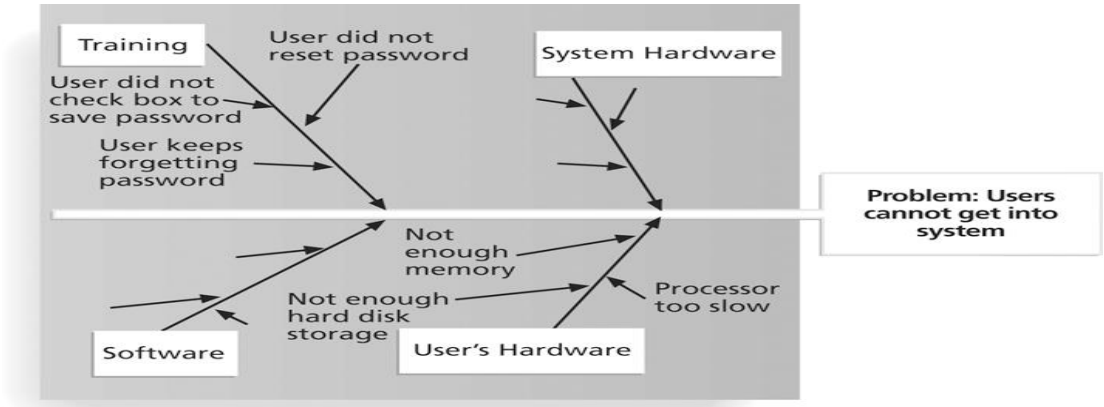
- The training for Six Sigma includes many project management concepts, tools, and techniques
- For example, Six Sigma projects often use business cases, project charters, schedules, budgets, and so on
- Six Sigma projects are done in teams; the project manager is often called the team leader, and the sponsor is called the champion
- Six Sigma projects are projects that focus on supporting the Six Sigma philosophy by being customer-focused and striving to drive out waste, raise levels of quality and improve financial performance at breakthrough levels

Six Sigma and Statistics

- The term *sigma* means standard deviation
- **Standard deviation** measures how much variation exists in a distribution of data
- Standard deviation is a key factor in determining the acceptable number of defective units found in a population.
    - A small S.D means the data clusters closely around the middle of a distribution and there is little variability in the data.
- Six Sigma projects strive for no more than 3.4 defects per million opportunities, yet this number is confusing to many statisticians

1. **Cause-and-effect diagrams** trace complaints about quality problems back to the responsible production operations
    - They help you find the root cause of a problem
    - Also known as **fishbone** or **Ishikawa diagrams**
    - Can also use the **5 whys** technique where you repeat the question "Why" (five is a good rule of thumb) to peel away the layers of symptoms that can lead to the root cause
        i. Why the users can not get into the system
        ii. Why they keep forgetting passwords
        iii. Why didn't they reset their passwords
        iv. Why didn't they check the box to save their password, etc

Sample Cause-and-Effect Diagram




Possible causes of staff leaving before the end of a project

- They may include environment, ambition, career prospects, satisfaction (variety, challenges, recognition), remuneration (basic pay, benefits - car, health, pension).

2. Quality Control Charts

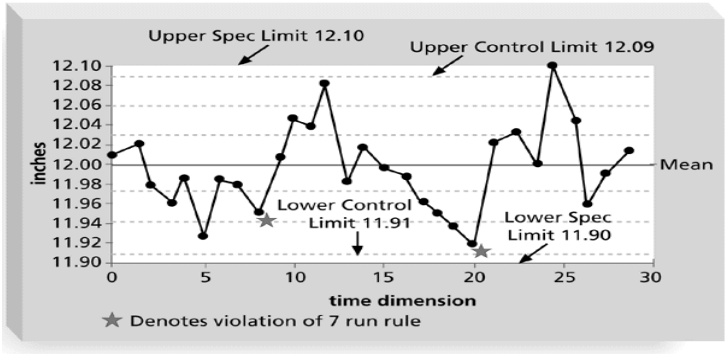
A **control chart** is a graphic display of data that illustrates the results of a process over time

- The main use of control charts is to prevent defects, rather than to detect or reject them
- Quality control charts allow you to determine whether a process is in control or out of control
  - ✓ When a process is in control, any variations in the results of the process are created by random events; processes that are in control do not need to be adjusted
  - ✓ When a process is out of control, variations in the results of the process are caused by nonrandom events; you need to identify the causes of those nonrandom events and adjust the process to correct or eliminate them

Seven run rule

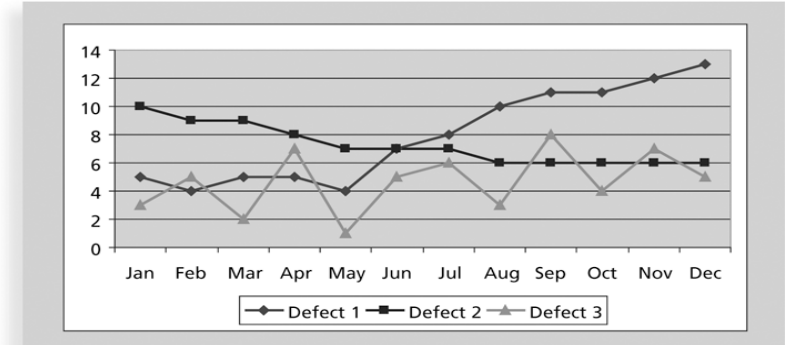
- You can use quality control charts and the seven run rule to look for patterns in data
- The **seven run rule** states that if seven data points in a row are all below the mean, above the mean, or are all increasing or decreasing, then the process needs to be examined for nonrandom problems
  - Example: The following slide is a control chart for the manufacture of 12" rulers
    - Upper and lower specifications are 12.10" and 11.9" – this is the range specified as acceptable by the customer for purchase
    - The controls limits of 11.91" and 12.09" mean that the manufacturing process is designed to produce rulers within that range

Sample Quality control chart




Run chart

- A run chart displays the history and pattern of variation of a process over time
- It is a line chart that shows data points plotted in the order in which they occur
- Can be used to perform trend analysis to forecast future outcomes based on historical patterns e.g., of defects




3. Scatter diagrams

- A **scatter diagram** helps to show if there is a relationship between two variables
- The closer data points are to a diagonal line, the more closely the two variables are related

## 6.7. Cost related to Quality

**Cost of Quality**

Cost of quality is the total price of all efforts to achieve product or service quality. The cost of quality considers the expense of all the activities within a project to ensure quality. This includes all work to build a product or service that conforms to the requirements as well as all work resulting from nonconformance to the requirements. The typical project should have a goal of between 3-5% of the total value as the cost of a quality program depending on the type of project and its total dollar value.

The cost of quality is broken into two major categories:

1. Cost of Conformance
2. Cost of Non-Conformance

***Cost of Quality = Cost of conformance + Cost of non-conformance***

1) Cost of conformance to requirements: This approach is the cost of completing the project work to satisfy the project scope and the expected level of quality.
   Examples of this cost include
   - Planning
   - Training and indoctrination
   - Process control
   - Field testing
   - Product design validation
   - Process validation
   - Test and evaluation
   - Quality audits
   - Maintenance and calibration
2) Cost of nonconformance: This approach is the cost of completing the project work without quality. The biggest issue here is the money lost by having to redo the project work; it's always more cost effective to do the work right the first time.
   - Scrap
   - Rework
   - Expediting
   - Additional material or inventory
   - Warranty repairs or service
   - Complaint handling
   - Liability judgments
   - Product recalls
   - Product corrective actions

Other cost includes;

1). Cost of Non-Quality:

- Waste of time and materials
- Rework of poor quality products
- Additional material
- Delays in schedule
- Product and service image
- Corporate image

Major Cost Types of Quality

1) Prevention Cost - cost to plan and execute a project so that it will be error-free
2) Appraisal Cost - cost of evaluating the processes and the Output of the processes to ensure the product is error-free

3) Internal Failure Cost - cost incurred to correct an identified defect before the customer receives the product
4) External Failure Cost - cost incurred due to errors detected by the customer. This includes warranty cost, field service personnel training cost, complaint handling, and future business losses.
5) Measurement and Test Equipment - capital cost of equipment used to perform prevention and appraisal activities.

Opportunities for Reducing Cost

- Just-in-Time - concept of zero inventory in a manufacturing plant. Reduces cost of storing and moving parts; cost of inventory; cost of parts damaged through handling, etc.
- Product Life Cycle Cost - concept of reducing overall product life cycle cost by linking the cost areas of the product life cycle (R&D, acquisition, and operations and maintenance) and considering each one's cost implications for the other.
- Product Maturity - Identifying, documenting, and correcting failures early helps products achieve stability earlier in the life cycle.

Areas of Waste in Projects

Waste in rejects of completed work
Waste in design flaws
Waste in work-in-process
Waste in motion for manpower (under-trained employee)
Waste in management (Improper direction of work)
Waste in manpower (Misplaced or waiting workers)
Waste in facilities (Ordering excess material)
Waste in expenses (Unnecessary meetings, travel)

## 6.8. Software in Project Quality management

1. Spreadsheet and charting software can be used to create the pareto diagrams
2. Statistical software to help determine standard deviations and perform many types of statistical analysis
3. Project management software to create Gantt charts that helps to plan and track work related to project quality management.