

**Software Project Management****2.1.1 Use Case Diagram**

- The designing and modeling based on the use case diagrams was originally developed by Jacobson in the 1990s. It was introduced into the first release of the UML. The use case modeling is widely used to support requirements gathering phase.
- A use case represents a simple view of what a user expects from a system. Each use case elaborates a different task involving external interaction with a system. A use case diagram is shown as an ellipse with the actors represented as stick figures.

Transfer data Use Case

A Use Case in the MHC-PMS



Fig. 2.1.1

- The Fig. 2.1.1 shows a use case for the **MHC-PMS**. This diagram represents the task of uploading data from the MHC-PMS to a more general patient record system. This generalized system maintains summary data about a patient instead of consultation. This is recorded in the MHC-PMS. There are two actors in this use case: operator who transfers the data and the patient record system itself.
- The stick figure notation can cover human interactions. Now-a-days, it is also used to represent other external systems and hardware. Ideally, the use case diagrams should use lines without arrows. The arrows in the UML indicate the direction of flow of messages. We can observe that the messages pass in both directions in a use case diagram. However, the arrows in the given figure are used informally indicating that the medical receptionist initiates the transaction and data is transferred to the patient record system subsequently.

**2.1.2 Class Diagram**

- A class diagram is a static diagram. It represents the static view of an application. It is generally used for visualizing, describing, and documenting different aspects of a system. It can also be used for constructing executable code of the software application.
- Class diagram describes the attributes and operations of a class along with the system constraints. They can be mapped directly with object-oriented languages. Hence, they are widely used in the modeling of object oriented systems. Class diagram shows a collection of classes, interfaces, associations, collaborations, and constraints. It is also known as a structural diagram.
- The purpose of the class diagram can be summarized as:
  - Analysis and design of the static view of an application.
  - Describe responsibilities of a system.
  - Base for component and deployment diagrams.
  - Forward as well as reverse engineering.

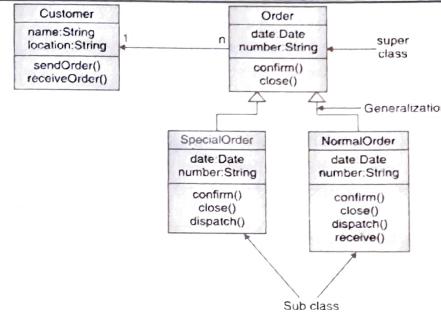


Fig. 2.1.2 : Sample Class Diagram for Order Management System

- The following points should be remembered while drawing a class diagram :
  - The name of the class diagram should ideally describe the aspect of the system.
  - Each element and their relationships should be identified in advance.
  - Responsibility (attributes and methods) of each class should be clearly identified
  - Minimum number of properties for a class should be specified as unnecessary properties.
  - Use notes whenever required to describe some aspect of the diagram.
  - At the end of the drawing it should be understandable to the developer or coder.
  - The diagram should be drawn on plain paper as many times as possible to make it correct.
- The class diagrams can be used for:
  - Describing the static view of the system.
  - Showing the collaboration among the elements of the static view.
  - Describing the functionalities performed by the system.
  - Construction of software applications using object oriented languages.

**2.1.3 Activity Diagram**

- Activity diagram is a very important tool to describe dynamic aspects of the system. It is a behavioral UML diagram. It is an advanced version of a flow chart. The flow chart is primarily used for modeling the flow of data from one activity to another activity. Activity Diagrams are used to describe how activities are coordinated inside a system. The coordination of all these activities is required to provide a service which can be at different levels of abstraction.
- An event needs to be achieved by some operations. The operation is intended to achieve a number of different things that require coordination. The focus should be on how the events in a single use case relate to one another. In some use cases, the activities may overlap and require coordination. The use case diagrams can be suitable for modeling how a collection of use cases coordinate to represent business workflows.

• Use-case diagram generation involves the following steps:

1. Identify candidate use cases, through the examination of business workflows
  2. Identify pre and post-conditions (the context) for use cases
  3. Model workflows between/within use cases
  4. Model complex workflows in operations on objects
  5. Model in detail complex activities in a high level activity diagram
- The activity diagram given below describes workflow for word processor document using the steps:

- Open the word processing package.
- Create a file.
- Save the file under a unique name within its directory.
- Type the document.
- If necessary, open the graphics package, create graphics, and paste graphics into the document.
- If needed, open spreadsheet package, create spreadsheet and paste spreadsheet in the document.
- Save the file.
- Print a hard copy of the document.
- Exit the word processing package.

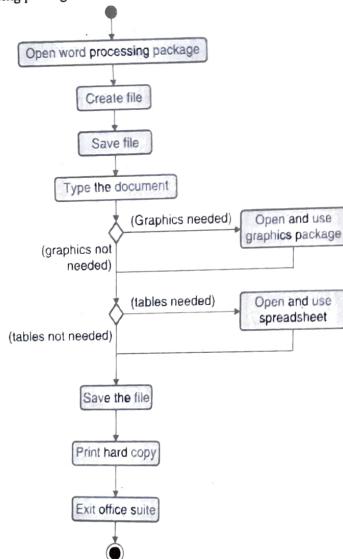


Fig. 2.1.3 Activity Diagram for Word Processor Document

## 2.1.4 State Diagram

- A state diagram shows the behavior of classes with respect to external factors. A state diagram describes the behavior of a single object as a response to a series of events in a system. Sometimes a state diagram is also known as a Harel state chart or a state machine diagram. This UML diagram can model the dynamic flow of control from state to state within a system. It is different from a flowchart in the sense that it illustrates processes that are executed in the system whereas a state diagram shows the actual changes in state, not the processes or commands that created those changes.
- The first step of a state diagram creation is to find the initial and final state of the object. Next, identify the states the object might undergo. Just like an e-commerce product has a release date, sold out state, restocked state, placed in cart state, saved on wish list state, purchased state, and so on. Certain transitions are not applicable in a particular state. A product can be either in a purchased state or a saved in cart state if its previous state is sold out state.
- Some of the common terms used in a State Diagram can be described as follows :
  - **States :** States are the situations that occur during the lifetime of an object. One can illustrate a state by using a rectangle with rounded corners as shown below.

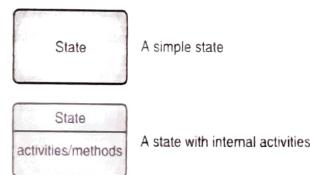


Fig. 2.1.4 State Diagram Notations

- **Transition :** A solid arrow gives the path between different states of an object. One can label the transition with the event that triggered it and the action that results from it. A state can also have a transition that points back to itself.

Transition

- **Initial State :** A solid circle followed by an arrow can be used to denote the object's initial state.

Initial state

- **Final State :** Arrow pointing to filled circle nested inside another circle is used for object's final state.

Final state

### State Diagram for an ATM Machine

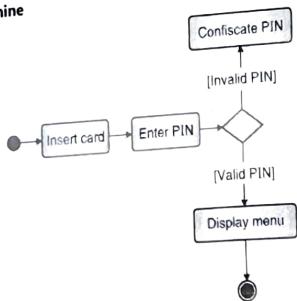


Fig. 2.1.5

### 2.1.5 Sequence Diagram

Sequence diagrams in the UML are primarily used to model the interactions between actors and objects in a system along with the interactions between the objects themselves. It can model various kinds of interactions. As the name suggests, a sequence diagram shows the sequence of interactions taking place during a particular use case or use case instance.

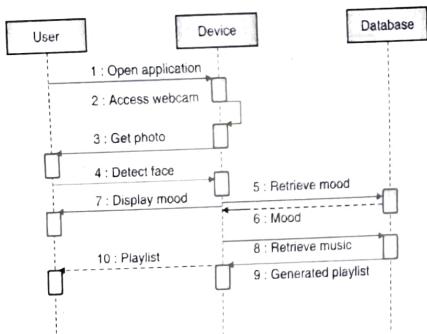


Fig. 2.1.6 Sequence Diagram for Emotion Based Music Player

We can design a sequence diagram for emotion based music player. It has the following steps :

- 1) First of all, the application is opened by the user.
- 2) Next, the device gets access to the web cam.
- 3) The webcam captures the image of the user.
- 4) The device then uses various algorithms to detect the face and predict the mood.
- 5) Then the device requests database for dictionary of possible moods.

- 6) The exact matching mood is retrieved from the database.
- 7) The subsequent mood is displayed to the user.
- 8) The music is requested from the database accordingly.
- 9) The playlist is generated and finally shown to the user for verification.

#### Uses of sequence diagrams :

- Used to understand the logic behind a sophisticated function, operation or procedure.
- Used to show the details of UML use case diagrams as well.
- Can be extensively used to understand the detailed functionality of current or future systems.
- Visualize how exactly the messages and tasks move between objects or components in a system.

### 2.1.6 Deployment Diagram

- Deployment diagrams can visualize the hardware processors, nodes and devices of a system. They can also model the links of communication between them and placement of software files on them. A deployment diagram shows the execution architecture of a system including nodes such as hardware or software execution environments and the middleware connecting them.
- They are typically used to visualize the physical hardware and software of a system. Using them, you can understand how the system will be physically deployed on the hardware. Deployment diagrams help model the hardware topology of a system in a much better manner compared to other UMLs who can just outline the logical components of a system.

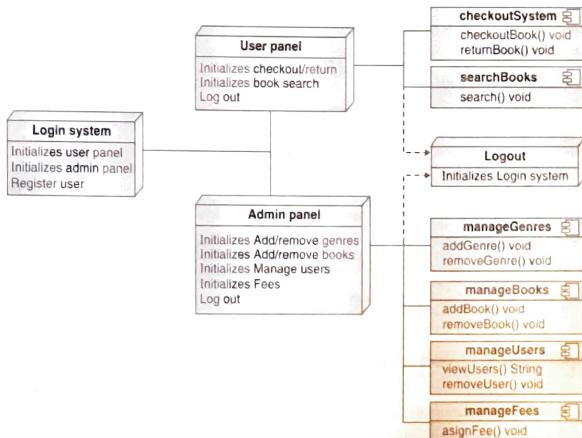
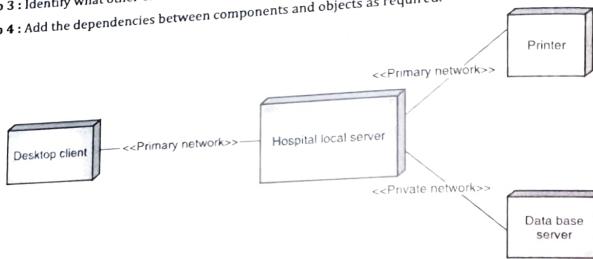


Fig. 2.1.7 : Deployment Diagram for Library Management System

**Software Project Management**

- One can follow the simple steps given below to draw a deployment diagram :
- Step 1 :** Identify the purpose of your deployment diagram. Identify nodes and devices within the system.
- Step 2 :** Figure out relationships between nodes and devices before adding communication associations.
- Step 3 :** Identify what other elements like components, active objects to be added to complete the diagram.
- Step 4 :** Add the dependencies between components and objects as required.

**Fig. 2.1.8 : Deployment Diagram for Hospital Management System****2.2 What Is Project Evaluation?****Oct.22 (In-Sem), 5 Marks****Q. What is project evaluation? Explain its importance.**

- Oct.22 (In-Sem), 5 Marks
- A high level assessment of the project is the need of the hour in today's world. To check a project's worth before we proceed with the project is necessary. One can also see whether the project will fit in the strategic planning of the whole organization.
  - Project evaluation is thus, a disciplined assessment of an ongoing or completed project. The aim is to determine the relevance of the project in the ongoing context. The level of achievement of project objectives, development effectiveness, efficiency, impact and sustainability are also considered.
  - Evaluation also includes lessons learned into decision-making process of all stakeholders. Design, monitoring and evaluation are all part of results-based project management. The key idea underlying project cycle management is to help those who manage resources and activities of a project to improve the results from short term to long-term perspective.
  - Every project should be accountable for achieving outcome and contributing to development impact. Long-term development changes depend on a number of factors. All outcomes of a project should contribute to the desired impact.

**2.3 Importance of Project Evaluation**

Project evaluation is very essential to any project or program. By using this process, the organizations can collect and analyze data to determine if a project has fulfilled its goals. Evaluation usually comes after the project monitoring phase gets over and assesses how well the program performed. Every organization should have a proper mechanism for project evaluation in place. Here are ten reasons why :

**Software Project Management****2.3.1 Better Transparency and Accountability**

As organizations analyze a project during the evaluation phase, there's more transparency. Information is freely circulated and available to stakeholders. This can give them more inputs on the project. Evaluation techniques make sure that no one is left in the dark. This transparency leads to better accountability. Organizations cannot hide anything from anyone. Also it is much harder to deceive stakeholders.

**2.3.2 Helps Organizations Catch Problems Early**

Projects never go perfectly according to plan, but a well-designed evaluation technique helps the project stay on track and perform well. It helps project managers in completing the project within the specified time as well as budget. Whenever the problems arise in a project, a quick and effective solution can be implemented without causing any interruptions to the project.

**2.3.3 Ensures Resource Optimization**

Every project needs resources. The cash on hand determines how many people work on a project. The information collected through evaluation reveals gaps or issues that require certain resources. Without proper evaluation, it may not be clear what areas should be of high priority. Resource wastage can thus be avoided using a proper evaluation technique.

**2.3.4 Helps Organizations Learn from their Mistakes**

Mistakes and failures are part and parcel of every organization. The project evaluation provides a detailed blueprint of everything that went right and everything that went wrong during a project. Thorough documents of evaluation allow organizations to pinpoint specific failures instead of guessing what caused problems. These organizations can learn more from their mistakes than from their successes.

**2.3.5 Improves Decision-Making**

Data should drive decisions. Project evaluation can provide essential information to see the big picture. After a project wraps up, an organization can identify mistakes, successes and things to be adapted and replicated for future projects. Decision-making is then influenced by what was learned through the past experiences.

**2.3.6 Helps Organizations Stay Organized**

Developing a good evaluation plan usually needs a lot of organization. That process in itself is very helpful to the organizations. It should have its own methods to collect, distribute and analyze information. Such a plan can be developed on the basis of many organization inputs about success, failure, etc. Good organizational skills benefit every area of an organization.

**2.3.7 Helps Organizations Replicate their Best Practices**

Organizations cannot waste time on projects or programs that are bound to fail. The activities of catching problems early, good resource management, and informed decisions are all very essential from the perspective of a project. The organizations can reuse only those things that are working and avoid those things that are not working for their projects.

### 2.3.8 Encourages Innovation

The project evaluation can induce innovative thinking and methods for data collection. Though some fields require specific methods, others can think about more unique ideas. The fields that mainly rely on questionnaires, focus groups, interviews can go for video/photo documentation, storytelling and fine arts. Innovative tools, however, can present different perspectives on data. They can devise their own ways to measure success.

### 2.4 Cost Benefit Evaluation Techniques

- Now, we will consider some methods for comparing projects on the basis of their cash flow forecasts. We can observe that the table given below illustrates cash flow forecasts for four projects. In each case, the cash flows are assumed to be taking place at the end of each year. For the short-term projects or the projects where there are significant seasonal cash flow patterns, the quarterly or even monthly cash flow forecasts could be considered.

Table 2.4.1 : Total Costs / Income over a period of Five Years

Year	Project 1	Project 2	Project 3	Project 4
0	-100,000	-1,000,000	-100,000	-120,000
1	10,000	200,000	30,000	30,000
2	10,000	200,000	30,000	30,000
3	10,000	200,000	30,000	30,000
4	20,000	200,000	30,000	30,000
5	100,000	300,000	30,000	75,000
Net profit	50,000	100,000	50,000	75,000

#### 2.4.1 Net Profit

In today's modern world, every organization is running behind only one thing, which is obviously, the **PROFIT**. The net profit of a project is the difference between the total costs and the total income involved in the project over its lifetime. Say for example, the Project 2 in Table 2.4.1 shows the greatest net profit but this is at the expense of a large investment. Indeed, if we had Rs. 1 million to invest, we might undertake all of the other three projects and obtain an even greater net profit.

#### 2.4.2 Payback Period

Each and every project involves certain initial investment. The investors are more focused on getting the invested amount back at the earliest. Certainly, a specific time period is needed to achieve this breakeven point. The *payback period* is the time taken by a project to pay the initial investment back to its investors. Normally, the projects with the shortest payback periods will be preferred by the organizations. The organizations wish to minimize the time for which a project remains 'in debt'. The breakeven point is the point of making or breaking for the project.

### 2.4.3 Return on Investment

**Q. Describe "Return on Investment" cost-benefits evaluation technique with example. Oct.22 (In-Sem), 5 Marks**

- The *Return on Investment* (ROI) or the *Accounting Rate of Return* (ARR) provides a way of comparing the net profitability to the investment required. The formula used to calculate the return on investment is :

$$\text{ROI} = \frac{\text{average annual profit} \times 100}{\text{total investment}}$$

- One can understand that the *return on investment* (ROI) is the most sought after criteria to judge the success or failure of a project in today's world.

### 2.4.4 Net Present Value

- The *net present value* deals with both the profitability of a project and the timing of the cash flows produced. The net present value (NPV) and internal rate of return (IRR) are collectively known as Discounted Cash Flow (DCF) techniques.
- This technique is based on the view that receiving Rs.100 today is much better than getting it next year. We could invest the Rs.100 in a bank today and have Rs.100 plus the interest in a year's time. The *present value* of Rs.100 in a year's time is actually Rs.91 considering the rate of inflation over a period of one year.

### 2.4.5 Internal Rate of Return

- The term 'capital' refers to the amount that is invested in a project by the organizations or investors. The NPV cannot be directly compared with certain costs and earnings.
- Like the earnings from other investments include all the incomes that are not directly generated from the prime investment (E.g. Dividends paid by the companies). The costs of borrowing capital involve all the costs that incur as a by-product of the investment (E.g. Interest paid on the amount invested).
- Such costs are usually quoted in terms of a percentage interest rate. The IRR can be easily calculated using a spreadsheet or other computer program having functions for calculation.
- Microsoft Excel, for example, provides IRR function which, provided with an initial guess or seed value (that may be zero), will search for and return back an Internal Rate of Return.

### 2.5 Process Evaluation and Improvement

- Project evaluation is nothing but a measure of how well the planning and managing for future impact is done during the project cycle. Projects are collaborative in nature.
- Project evaluation can form a basis for the overall project improvement. The project partners usually have the responsibility for achieving outcomes and impact. Some of the methods of project evaluation and improvement are as stated below :

#### 2.5.1 Project Monitoring

- The project monitoring focuses on activities, outputs and their contribution to outcomes. Monitoring is the continuous observation of a project's progress.
- It can be done by gathering key performance data in a systematic way and further analyzing the same data on a regular basis.

### 2.5.2 Annual Project Reviews

- The annual project reviews focus on outputs and outcomes. It is a form of self-evaluation during which stakeholders reflect upon how well the project is progressing towards achieving its objectives.
- It can be achieved by taking into account available monitoring and evaluation data. Project reviews are usually carried out annually but can also be called for specific issues.

### 2.5.3 Interim and Final Evaluations

- The interim and final evaluations mainly focus on the outcomes of the project and the likelihood that they will achieve the desired impact. The evaluation process provides an opportunity for in-depth reflection on the strategy and assumptions that guide a particular project.
- This step assesses progress for achieving project objectives & recommends adjustments to its strategy. It also assesses how well project-level actions link to and support higher level strategies and objectives.

### 2.5.4 Impact Assessments

- The impact assessments determine whether project interventions have contributed to longer-term impact. They can be kind of post evaluations of the projects or a part of issue-based local evaluations.
- These assessments can also consider linkages between different projects and interventions.

## 2.6 The Process Improvement Process

- Process Improvement is the art of identifying, analyzing and improving the existing business processes within an organization. It is done for optimization as well as to meet the new standards of quality.
- It often involves a systematic approach. It follows a specific methodology with different approaches to consider. Some examples are benchmarking or lean manufacturing.
- Each of these examples focuses on different areas of improvement and uses different methods to achieve the best results. Processes can be modified, complemented or eliminated for the ultimate goal of improvement.
- Process Improvement is an ongoing practice. It should always be followed up with the analysis of probable areas of improvement. The results can be measured in terms of product quality, customer satisfaction, customer loyalty, increased productivity, employee skills development, efficiency & increased profit.
- Process improvement is key feature of many software products. They products are used to automate processes that are added into the software suite. Once the processes are run via the software, the process managers and executives can see where improvements are needed by looking at process completion times.
- As the organizations go on working for a number of software projects, they invent a lot of things that can be helpful.
- The lessons learnt in each and every project can be more than a handful for all their future endeavors. Hence, the process improvement process is a never-ending process.

## 2.7 The Process Improvement Cycle

The process improvement cycle consists of a unique cycle named as PDCA. The concept of PDCA was designed by **Walter Andrew Shewhart** in 1930s. It was popularized by an American administrator **William D. Fleming**. The concept of PDCA was widely applied in the Japanese businesses. The acronym PDCA stands for **Plan, Do, Check, Act**. It is often referred to as a cycle. It involves a continuous improvement during every cycle of PDCA returning back to its beginning.

### 2.7.1 The PDCA Concept

The basis of this tool is repetition. It is applied again and again to the same set of processes that need a continuous improvement. Planning, standardization and documentation are essential practices for accurate measurements. PDCA also focuses on the talents and skills of the professionals involved.

### 2.7.2 Meaning of PDCA

PDCA consists of the names of the tools used in the process quality management. It can solve problems by following four phases: **Plan, Do, Check and Act**. It promotes continuous process improvement.

#### 1. Plan

- It is the first stage of the PDCA cycle. One can analyze the problems before solving them. This phase usually consists of:
  - Definition of problems
  - Setting goals
  - Choice of methods
  - Ask the question again and again: why did the problem occur?
- The PDCA concept shows a structured and organized repetition to find solutions. We cannot find solution to a problem without knowing its root cause, the root problem, the initial reason for everything.

#### 2. Do

- The second phase is all about getting hands-on. It involves the execution of what was determined in the previous step. This phase usually consists of:
  - Practice the method
  - Execute
  - Make changes
  - Go for a practical and acceptable way instead of going for the perfection
  - Measure and record the results
- One can note that you don't actually begin doing anything that will solve the problem in this phase. Rather it empowers the people to act to put things into practice. The execution of the PDCA cycle requires a proper training.
- Even in DO phase of the PDCA process, we are not looking for the perfection. Like any good statistician, Deming knew that a certain level of excellence can be more than enough for small problems.

**3. Check**

- It is one of the most important steps that define the PDCA concept cycle. After checking, we will see if the action has improved. This phase usually consists of:
  - Check whether the standard is followed
  - Check what's working and what's not working
  - At every step, ask why?
  - With the answers, improve and practice the defined method.

**4. Act**

- The next phase is nothing but to act in a strong way. If the things are going as per our planning, then continue with the same. If at all there are some problems, then act to correct and prevent the errors. Try to improve the work system by repeating the solutions that worked earlier.
- Here, the PDCA concept suggests that the cycle restarts again. This is done for a continuous and uninterrupted improvement. When we apply well-defined methods, the focus should be on the errors and deviations.
- When the noncompliance is found, the PDCA process restarts, in search of continuous process improvement. Hence, PDCA is a comprehensive in many situations, but sometimes specializations are needed as well.

**2.8 Process Measurement**

- Software development requires a measurement mechanism for feedback and evaluation. Measurement is a mechanism that creates a corporate memory by answering a variety of questions associated with the software process. The major activities of process measurement are as follows :
  - Helps support project planning (e.g. Cost of the new project);
  - Determines strengths and weaknesses of current processes and products (e.g. Frequency of errors)
  - Provides mechanism for adopting/refining techniques (e.g. Impact of a technique on the productivity)
  - Evaluates quality of specific processes and products (e.g. System's defect density after deployment)
- Measurement can be helpful during the course of a project. It can assess the progress of a project. It enables us to take corrective action based on the assessment. Moreover, it can help us in evaluating the impact of such action.
- Studies suggest that for a measurement to be effective, it must be :
  - Focused on specific goals
  - Applied to all life-cycle products, processes and resources
  - Interpreted based on characterization and understanding of the organizational context, goals, etc.
- The measurement must be defined in a top-down fashion. It must be focused, based on goals and models.

**2.8.1 Goal Question Metric (GQM) Approach**

Oct.22 (In-Sem), 5 Marks

**Q. Explain GQM paradigm.**

- This approach is based on the assumption that an organization must specify the goals for itself and its projects before going for measurement. It must trace those goals and provide a framework for interpreting the data with respect to the stated goals.
- Hence, the informational needs of an organization must be crystal clear so that they can be quantified. The quantified information can be analyzed to check whether or not the goals are achieved.

- GQM approach was originally defined for a set of projects in the NASA Goddard Space Flight Center environment. It involved many case study experiments and was expanded to include various types of experimental approaches.
- It was expanded to a larger context. It is used for evolutionary quality improvement paradigm of a software development organization. As a result of GQM approach, a measurement system came into existence that focuses on a set of issues and a set of rules. The resulting measurement model has three levels.

**2.8.2 Conceptual Level (GOAL)**

A goal can be defined for an object for a variety of reasons. It is defined with respect to various quality standards. It involves various points of view relative to a particular environment. The objects of measurement are:

- **Products :** Artefacts, deliverables and documents created during system life cycle;  
E.g. Specifications, designs, programs, test suites.
- **Processes :** Software related activities that are usually associated with time;  
E.g. Specifying, designing, testing, interviewing.
- **Resources :** Items used by the processes in order to produce their outputs;  
E.g. Personnel, hardware, software, office space.

**2.8.3 Operational Level (QUESTION)**

A set of questions is used to characterize the way the assessment/achievement of a specific goal is going to be performed. It may be based on some characterizing model. Questions try to characterize the object of measurement (product, process, resource) with respect to a selected quality issue. Finally, one can determine the quality of the said product, process or resource from the selected viewpoint.

**2.8.4 Quantitative Level (METRIC)**

A set of data is associated with every question. This data can be useful while answering the question in a quantitative manner. The data used can be objective or subjective.

- **Objective :** Depends only on the object to be measured, not on the viewpoint from which they are taken;  
E.g. Number of versions of a document, staff hours spent on a task, size of a program, etc.
- **Subjective :** Depend on both the object to be measured and the viewpoint from which they are taken;  
E.g. Readability of a text, level of user satisfaction.
- A GQM model is a hierarchical structure. It starts with a goal specifying purpose of measurement, object to be measured, issues to be measured, and viewpoint from which the measure is taken. Goal is decomposed into several questions. Each question, subjective or objective, is then refined into metrics.
- The same metric is used to answer different questions having similar goal. Several GQM models can also have various questions and metrics in common.
- When the measure is actually taken, the different viewpoints are taken into account correctly. The metric might have different values when taken from different viewpoints.

## 2.9 Process Analysis

**Q.** Enlist the techniques of process analysis and explain in brief. Oct. 22 (In-Sem), 5 Marks

Process Analysis typically breaks down a production process into different phases. The phases are critical to turn an input into the output. It analyzes the business process to transform an object with the aim of achieving and maintaining the process excellence. Process Analysis is nothing but a review of the entire process flow of an organization to arrive at a thorough understanding of the process. It is helpful in setting up the targets for process improvement. We can achieve this by discarding unnecessary activities that can reduce the wastage and increase the efficiency. It ends up improving overall performance of business activities.

### 2.9.1 Objectives of Process Analysis

Understanding, Quality and Efficiency are the three basic criteria through which one can analyze the process and determine the areas that require change. The major objectives of process analysis can be stated as follows:

1. Identify the factors that make the process difficult to understand.
2. Ensure the completeness of the process.
3. Remove bottlenecks
4. Find the redundancies
5. Manage the allocation of resources
6. Check out the process time

### 2.9.2 Techniques of Process Analysis

As they say, "don't blame the person, fix the process." We should always concentrate on refining the process rather than blaming others for any kind of failure. There is a great demand for better processes. When processes cause problems for your customers, employees and the bottom line, the business process analysis (BPA) can provide the solutions. The method is simple: locate the troublesome process, find its basic functionality, identify the true pain points then design a better process. A number of possible ways or techniques can be used to get the results. A misanalyzed process remains as a faulty one if the true problems are not discovered. With the following analysis methods, one can take decisions immediately :

- o Gap analysis
- o Value-added analysis
- o Root cause analysis
- o Observation analysis
- o Examining the experience
- Each one of them has its own value. Multiple techniques can be used to extract and solidify your ideas. While choosing analysis techniques to use, one can come across the following aspects :
  - o Identifying your process for analysis
  - o Gathering internal information about the process
  - o Analyzing the process "as-it-is"
  - o Developing the improved version of the process

• To start with information gathering, the examination and refinement of software project development is carried out. The four components of any business process are inputs, guides, outputs and enablers. **Inputs** enter the process to produce results or **outputs**. Resources known as **enablers** — tools, systems, human staff and various assets as well as the facilities are used to perform the process. **Guides** can decide when, why and how the process plays out. To collect and understand these components, one can discuss the process with stakeholders like frontline employees. All of them can pick and use suitable techniques for the specific processes.

### 2.9.2(A) Gap Analysis

- Gap analysis finds and bridges the "gap" between the performance you're getting and the performance you want to achieve. The key concepts of gap analysis are as follows :
  - o Your performance is where your results are now.
  - o Your potential is where you want to be.
  - o The gap is created by what's keeping you from reaching your potential.
  - o Closing the gap requires an action plan to overcome roadblocks and improve.
- Gap analysis is an important step to reconnect with your goals and change the path of your current performance. Evaluate the gap by considering the relationships between the four business process components. The input-output relationships can reveal redundancy, wasteful activity, poor task timing and missing steps. The role of guides and enablers can be examined to improve the productivity. Guides can reveal inconsistent and undocumented steps, overregulated tasks and unintended knowledge. The troublesome enablers may incur a negative impact on the performance. Gap analysis may be an excellent place to start with for improving the productivity. Obviously, it is a time consuming process.

### 2.9.2(B) Value Added Analysis

- It gives an idea about what all needs are met by each business process step. It helps your activities reduce the non-essential things. Steps that add a **value** must be completed to meet a need of a customer or the business itself. All the processes of value added analysis are classified into three categories as follows :
  - o **Real value-added (RVA) steps** meet an expectation or need of the customer.
  - o **Business value-added (BVA) steps** meet an expectation or need of the business.
  - o **Non-value-added (NVA) steps** do not meet any customer or business needs.

### 2.9.2(C) Root Cause Analysis

- Root cause analysis is more interested in finding the core reasons for problems. It can trace relationships between effects with their possible causes. Sometimes, the issues that are less visible can be neglected. It is an ideal technique to get down to the heart of an issue. The root cause analysis can get beyond assumptions about the problems. The root cause relationships can be established with the help of charts and tables. The Ishikawa diagram can clearly show who and what generates the undesired outcomes.
- The subjects investigated may include these specific enablers and guides :
  - o **People** or human stakeholders, including staff, supervisors, etc.
  - o **Guides** such as references, logs, and schedules.
  - o **Methods** like payment processing, request routing, etc.

- **Materials** including consumables like paper supplies, pens, ink toner, etc.
- **Equipment** such as physical machines, devices, tools, etc.
- **Environment** like onsite or offsite spaces supporting the process.

### 2.9.2(D) Observational Analysis

- Observation analysis gives a real-time, first-hand view of the process in motion. It can highlight an overlooked or undervalued step in a process. It can easily identify a missing part of the process. Observers can also confirm if the employees can recall the process accurately. Interviews can be conducted to get the process experience. Process analysts may find out the roadblocks that process has to generally bypass.
- An observer may operate under one of two modes :
  - **Passive observers** avoid interacting to keep the process natural and unaffected.
  - **Active observers** jump in with questions and may participate in process for real-time insights.

### 2.9.2(E) Experience Examination Analysis

- This technique can capture the process knowledge of longtime employees. Usually, an observation gathers information from a novice perspective. The experience examination focuses on the lessons learned by expert staff. Experience-based knowledge is typically not documented. It is not often discussed in an organization. Hence, the observations, interviews and other sessions alone may not be enough. Targeting veteran employees helps teams find out :
  - What fuels **high-level productivity** in the process?
  - What drives **faulty activities** within the process?

### 2.9.3 Getting the Most from BPA

- Selecting techniques for process analysis is actually not a simple choice. If you keep these goals in mind, you'll be on track to finding the results you need :
  - **Better documentation** to know and teach how your process works at its best.
  - **Fewer problem tasks** to cut the friction in the process.
  - **Ongoing improvement** to perpetually fine-tune the process to current needs.

## 2.10 Process Change

- The result of the lifecycle is a continuous process improvement. The changes in the process are regularly monitored, evaluated, and modified. The process change starts by defining the beginning and the end of the process. Obviously, it is for the process improvement.
- You must set specific goals and objectives to incorporate the change. Businesses must always evolve and adapt to meet variety of challenges. The changes in technology, rise of new competitors, shift in laws and regulations are certainly very big challenges.
- If they fail to overcome these challenges, a stagnation or worse failure can follow them. Nearly half of all organizational change initiatives are unsuccessful. Planning for a change, coordinating and carrying out a change is valuable skill for managers. The key steps of change management process can be elaborated with the help of following points.

### 2.10.1 What is Change Management ?

- Organizational change involves the actions taken by a business to change or adjust a significant component of its organization. It may include company culture, internal processes, underlying technology or infrastructure, corporate hierarchy. Organizational change can be either adaptive or transformational :
  - **Adaptive changes** are small, gradual, iterative changes. They can evolve the products, processes, workflows and strategies of an organization. Hiring a new team member or implementing a new work-from-home policy to attract more qualified job applicants are both examples of adaptive changes.
  - **Transformational changes** are larger in scale as well as scope. They can specify a dramatic and sudden departure from the status quo. Launching a new product, business division or deciding to expand internationally are the examples of transformational change.

### 2.10.2 Steps in the Change Management Process

- The change management mechanism involves the process of guiding organizational change to finalize from the earliest stages of conception. The intermediate steps may involve implementation as well as resolution. Change processes have a set of starting conditions (say point A) and a functional endpoint (say point B). The process in between can be dynamic in stages. The change management process may involve numerous key steps. Here is a summary of the key steps in the change management process:
  - Prepare the Organization for Change
  - Craft a Vision and Plan for Change
  - Implement the Changes
  - Embed Changes within Company Culture and Practices
  - Review Progress and Analyze Results

Let us explain each of these steps in detail as follows.

### 2.10.2(A) Prepare the Organization for Change

One must be prepared both logically and culturally for proper implementation of a change. The cultural preparation must first take place. The manager helps employees recognize and understand the need for a change. They can make them aware of various challenges or problems faced by the organization. These problems are acting as forces of change and generating dissatisfaction within the organization. The initial employee response can be crucial to overcome the resistance, if any.

### 2.10.2(B) Craft a Vision and Plan for Change

- Once the organization is ready for a change, the managers must develop a thorough and realistic plan to bring it about. The plan must be based on a particular vision. Every change in the process should improve the overall results in some way or the other. The plan should detail :
  - **Strategic goals** : What goals does this change help the organization work toward?

- o **Key performance indicators** : How to measure success? What metrics need to be moved?
- o **Project stakeholders and team** : Who will implement the change? Who will sign off at critical stage?
- o **Project scope** : What discrete steps and actions will project have? What is outside its scope?

#### **2.10.2(C) Implement the Changes**

Once the plan is created, everybody should follow the steps to implement the required change. It may involve changes to the company's structure, strategy, systems, processes, employee behaviors. During the implementation process, change managers should empower their employees to take the necessary steps. These steps can be helpful in achieving the respective goals. The employees should identify roadblocks and prevent, remove or mitigate them. Throughout the implementation, the organization's vision reminds team members why change is being carried out.

#### **2.10.2(D) Embed Changes within Company Culture and Practices**

After completing a change, the process or project should not come back to the same state again. This is mainly applicable for all the changes related to processes, workflows, culture, and strategies. A proper plan must be in place for all the employees to follow at the time of transition. To avoid any kind of backsliding, the changes within the company's culture and practices are carried out. New organizational structures, controls, and reward systems should all be considered as tools to help change remain forever.

#### **2.10.2(E) Review Progress and Analyze Results**

Completing any change doesn't mean it was successful. A thorough analysis, review, or a project post mortem can be helpful in understanding whether a change was a success, failure or mixed result. It can give valuable lessons that can be used in the future changes as well.

#### **Review Questions**

- Q.1** What is UML ? Why is it used ?
- Q.2** Explain the concept of Use Case Diagram with a proper example.
- Q.3** Explain the concept of Class Diagram with a proper example.
- Q.4** Explain the concept of Activity Diagram with a proper example.
- Q.5** Explain the concept of State Diagram with a proper example.
- Q.6** Explain the concept of Sequence Diagram with a proper example.
- Q.7** Explain the concept of Deployment Diagram with a proper example.
- Q.8** What is Project Evaluation ? Why is it important ?
- Q.9** State and explain various Cost Benefit Evaluation Techniques.
- Q.10** Can you give various ways of Project Evaluation and Improvement ?

**Q.11** Explain the concept of Process Improvement Process in detail.

**Q.12** What do you mean by PDCA ?

**Q.13** Is Process Management necessary? How ?

**Q.14** What is GQM Paradigm? Give its importance.

**Q.15** What do you mean by Process Analysis? What are its objectives ?

**Q.16** How can you evaluate various Techniques of Process Analysis ?

**Q.17** What is Process Change? Explain Process Change Management ?

**Q.18** Discuss various steps in Change Management Process.

