

Unit 1 Software Development Organization and Roles

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1.1 Introduction

Dear student, in software engineering you learnt to develop a software using Software Development Life Cycle. When you are working as a team for developing a huge project, you need to follow several guidelines. This self learning material will help you to achieve efficiency in developing a Software Project.

A generic model of the software development organization is a high-level process model of an organization, which is designed to regulate the functionality and interactions between the roles of developers, managers, and customers by a software engineering process system. For every software organization the key element is people. People are tuned to develop various products. Products requires life cycles for their development.

The current unit discusses about the management spectrum, organizational structures and job roles in organizational structures.

Objectives:

After studying this unit, you should be able to:

- explain the management spectrum
- discuss IT and organizational structures
- describe job roles in software development

1.2 The Management Spectrum

The effective software project management focuses on four P's – People, Process, Product, and Project.

The People:

The people factor is so important that the Software Engineering Institute (SEI) has developed a People Management Capability Maturity Model (PM-CMM). The PMM Model defines the following key practice areas for software people.

- Recruiting
- Selection
- Performance Management
- Training
- Compensation
- Career Development
- Organization and Work Design
- Team Culture Development

People are the essential element for any organization. The growth of the organization directly depends on the people's capability. They are considered as Intellectual Capital of the organization.

The Product:

Before a project can be planned, product objectives and scope should be established, alternative solutions should be considered and technical and management constraints should be identified. Without this information, it is impossible to define reasonable estimate of the cost, an effective assessment of the risk. The software developer and customer must meet to define product objectives and scope. In many cases, this activity begins as part of the system engineering. Objectives identify the overall goals of the product, without considering how these goals will be achieved. Scope

identifies the primary data, functions and behaviors that characterize the product. Once the product objectives and scope are understood, alternative solutions are considered.

The Process:

A Software process provides a framework, from which, a comprehensive plan for software development can be established. A small number of framework activities are applicable to all software projects, regardless of their size and complexity. Finally, umbrella activities such as quality assurance, software configuration management and measurement – overlay the process model. Software development process is concerned primarily with the production aspect of software development, as opposed to the technical aspect. These processes exist primarily for supporting the management of software development, and are generally skewed towards addressing business concerns.

The players

Players, who can be categorized into one of five constituents, populate the software process.

- **Senior Managers:** They define the business issues that often have significance influence on the project.
- **Project Manager:** They must plan, motivate, organize and control the practitioners who do software work.
- **Customers:** They specify the requirements for software to be engineered.
- **End-Users:** They interact with software once it is released for production.
- **Practitioners:** They deliver the technical skills that are necessary to engineer a product or application.

The Project

A Project is a collection of tasks handled in a planned and systematic order. If a project is small, (say, a team of one or two working for a few weeks), it can be executed somewhat informally. The requirements might be communicated in a note or even verbally. But these informal techniques however do not scales up for larger projects in which many people may

work for many months. The tasks in the project must be carefully planned and allocated to project personnel and then tracked as the project executes.

The problems in software projects come from three different viewpoints. There are project managers, developers and customers. Project managers will face problems, if they are poor in defining roles, estimating, planning and decision making. Project managers do need to face the schedule, budget and quality constraints. However, the problems faced by developers if he/she has lack of knowledge in application area, lack of standard, lack of up to date documentations, deadline pressure, changes of application requirement. Lastly, the problems faced by customers is the monetary constraints, receive the products out of the actual time that should be delivered.

Self Assessment Questions

1. The effective software project management focuses on four P's – People, Process, Product, and Project. (True / False)
2. People Management Capability Maturity Model (PM-CMM) has been developed by _____.
3. _____ must plan, motivate, organize and control the practitioners who do software work.
 - a) Project Managers
 - b) Senior Managers
 - c) Customers
 - d) End Users

1.3 Organizational Structure

Organizational structure depends on the product to be developed. Wheelwright and Clark define a continuum of organizational structures between two extremes, functional organizations and project organizations. Functional organizations are organized according to technological disciplines. Senior functional managers are responsible for allocating resources. The responsibility for the total product is not allocated to a single person. Coordination occurs through rules and procedures, detailed specifications, shared traditions among engineers and meetings (ad hoc and structured). Products that need a high level of specialized knowledge require a functionally organized structure.

A light-weighted matrix organization remains functional and the level of specialization is comparable to that found in the functional mode. What is different is the addition of a product manager who coordinates the product creation activities through liaison representatives from each function. Their main tasks are: to collect information, to solve conflicts and to facilitate achievement of overall project objectives. Their status and influence are less as compared to functional managers, because they have no direct access to working-level people.

A heavy-weighted matrix organization exists of a matrix with dominant project structure and underlying the functional departments. The product manager has a broader responsibility. Manufacturing, marketing and concept development are included. The status and influence of the product manager, who is usually a senior, is the same or higher as compared to the functional manager. Compared to functional managers, they have no direct access to working-level people.

A project organization exists of product-oriented flows: project and teams. The project members leave their functional department and devote all their time to the project. They share the same location. The professionals are less specialized and have broader tasks, skills and responsibilities. The functional manager is responsible for the personnel development and the more detailed technology research in the functional groups.

Companies can be classified according to their organizational structures. They can also be classified according to the nature of the projects undertaken. We characterize projects by the number of employees needed to perform the tasks, or workload, and the number of tasks that are fundamentally different in nature. An example of the latter aspect is PCB development and structural design.

Another way to classify organization structure is by one of the following four categories:

- i) The product to be developed is comprehensible for one person. One person is likely to have all the knowledge needed to develop Manufacturing and Assembly. The development departments in companies that undertake these kinds of projects are usually very small. If a company consists of more than one department, it is usually structured as a functional organization.

- ii) The product to be developed has a fairly low complexity, but total work is high. These kinds of products are likely to be developed within one functional department. A research department may also be an example of a department in which type II projects are undertaken. Are more departments involved, and then, the light weighted matrix structure is preferable. Employees are involved on a full-time basis. Tasks may be performed concurrently. The sequence can be determined using the Design Structure Matrix.
- iii) The product to be developed consists of a lot of different elements, such as software, PCB, power supply and mechanical structure. The product is however in the engineering phase, i.e. it is clear what needs to be done to get the product into production. Various disciplines perform their own tasks. These tasks have mostly a low workload. Employees cannot work full-time on one project. This creates a complex situation that may be compared to a job shop situation in production logistics. Though all product development managers do not accept the comparison between manufacturing and product development, it may yield good results. Studying each step in the Product Development Process and fluctuations in workloads reveals ways to reduce variation and eliminate bottlenecks. It is necessary to view the Product Development Process as a process and not as a list of projects. Three important findings regarding this are:
 - 1) Projects get done faster if the organization takes on fewer at a time.
 - 2) Investments to relieve bottlenecks yield disproportionately large time-to-market benefits.
 - 3) Eliminating unnecessary variation in workloads and work processes eliminates distractions and delays, thereby freeing up the organization to focus on the creative parts of the task. Creating cross-functional concurrent engineering teams is the right way to develop products. However, the pitfall is too many projects at the same time, so that key people from engineering, marketing and manufacturing work at five or more projects at once. This results in congestion. Striving to work at 100% of the product development capacity lengthens product development lead times enormously. A more realistic percentage is 80%. Attention must be focused on

bottlenecks, these days most commonly found at the software development side of the project.

- 4) The product is complex. Total work is high. Employees can thus participate on a full-time basis. A project organization is the most appropriate organizational structure for these kinds of products.

Self Assessment Questions

4. Organization structure depends on the people working in it. (True / False)
5. Wheelwright and Clark define a continuum of organizational structures between two extremes, _____ organizations and _____ organizations.
6. The realistic percentage for striving to work in Software Project Development is _____.
 - e) 40%
 - f) 80%
 - g) 50%
 - h) 100%

1.4 Types of Organizational Structures

Traditional organizations are hierarchical, flat or matrix in design. (Fig. 1.1)

- In hierarchical organizations, middle managers tell subordinates what to do and tell superiors the outcomes. IS supports this hierarchy.
- In flat structured organizations, work is more flexible and employee do whatever is needed. It allows offloading extra work and supports intra-firm communications.
- In matrix organizations, work is organized into small work groups and integrated regionally and nationally/globally. It reduces operating complexes and expenses by allowing information to be easily shared among different managerial functions.

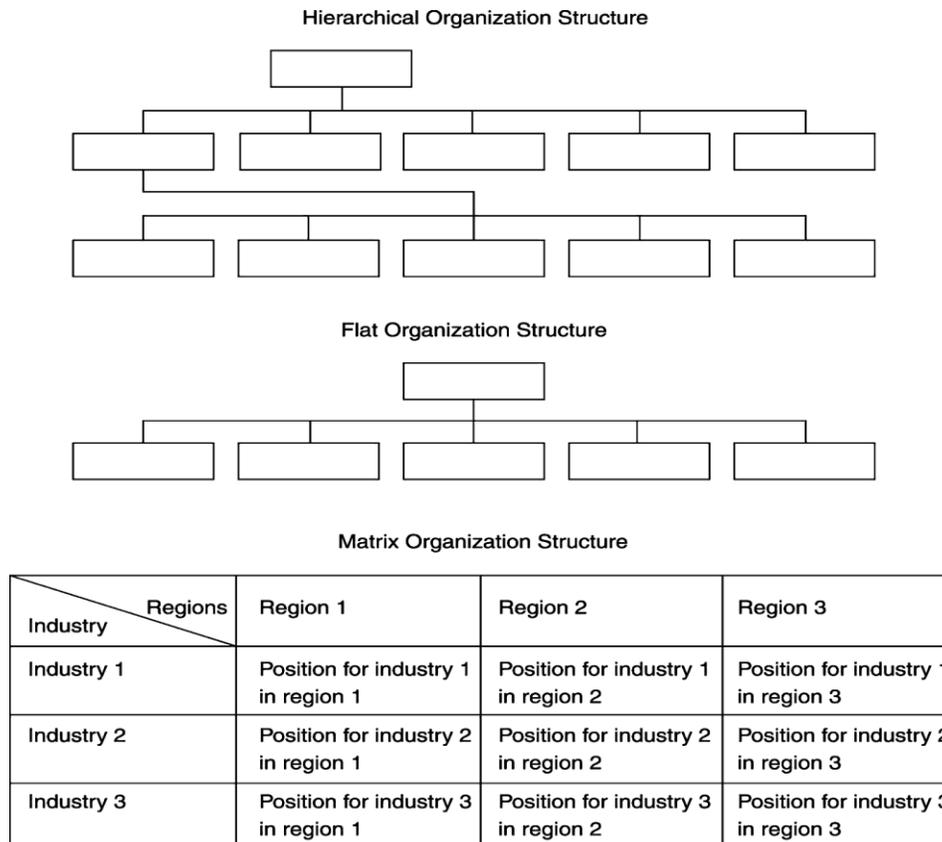


Fig. 1.1: Types of Organizational Structures

1.4.1 Hierarchical Organizational Structure

The key features of Hierarchical Organization Structure are given below:

- It is based on the concepts of division of labor, specialization, and unity of command.
- Key decisions are made at the top and filter down through the organization.
- Middle managers do the primary information processing and communication function.
- It is typically used to store and communicate information along the lines of the hierarchy and to support the info management function of the managers.

1.4.2 Flat Organizational Structure

Following are the key features of Flat Organizational Structure:

- Decision-making is centralized.
- As everyone does whatever needs to be done, they can respond quickly to dynamic, uncertain environments
- However, this organizational structure often becomes less flexible as the organization grows.
- Routine work is often off-loaded but, as a hierarchy develops, becomes the 'glue' tying parts of the organization that would not otherwise communicate.

1.4.3 Matrix Organizational Structure

The features of Matrix Organization Structure are listed below:

- This typically assigns workers with two or more supervisors in an effort to make sure multiple dimensions of the business are integrated, with each supervisor directing a different aspect of the employee's work.
- Matrix organizations often fail to enable managers to achieve their business strategies because of the inability to cope with increased information processing demands.

1.4.4 Networked Organizational Structure

Following are the advantages of Networked Organizational Structure:

- Rigid hierarchies are replaced by formal and informal communication networks that connect all parts of the company.
- Defined by their ability to promote creativity and flexibility while maintaining operational process control, which is achieved by substituting hierarchical controls with controls based on IS
- Extensive use of communication technologies and networks also makes it easier to coordinate across functional boundaries. The networked organization structure is shown in the Fig.1.2.

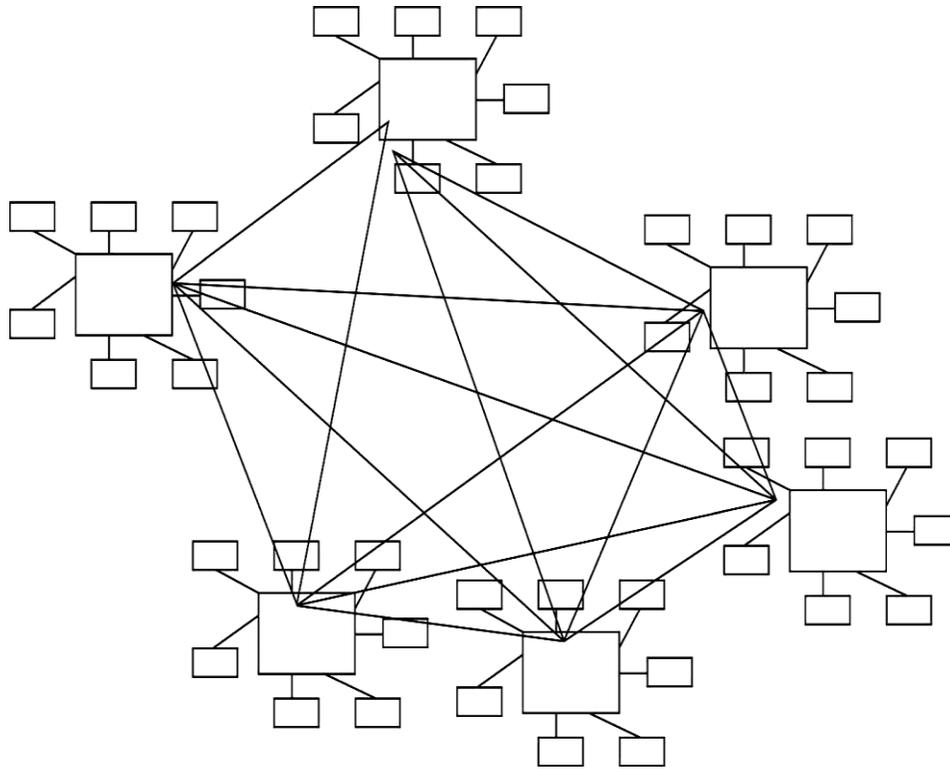


Fig. 1.2: Networked Organizational Structure

1.4.5 T-form Organization

Features of T-form Organization are as follows:

- T-form (“Technology-based”) organizations take the networked structure one step further by combining IT with traditional components to form new types of components.
- These include electronic linking, production automation, electronic workflows, electronic customer/supplier relationships and self-service Internet portals
- Work is often coordinated electronically, while systems enable information to more easily move around the organization, and decentralizing decision-making

Self Assessment Questions

7. In flat structured organizations, work is more flexible and employee do whatever is needed. (True / False)
8. In _____ organizations, work is organized into small work groups and integrated regionally and nationally/globally.
9. _____ organizations take the networked structure one step further by combining IT with traditional components to form new types of components.
 - i) Hierarchical
 - j) Flat
 - k) T-form (Technology-based)
 - l) Matrix

1.5 Job Roles in Software Development

The following are the roles based on the **Microsoft Solutions Framework (MSF)**.

- **Middle-Management Leadership**

Manage people, resources, and budgets. Oversee and provide vision for several major projects simultaneously. Review employees in all other positions. Work with other MM leaders for interaction between projects.
- **Team Leadership**

Manage people, resources, and timelines for one major project or several minor projects. Act as the central point of contact on those projects. Involve or aware of virtually every issue or decision in project. Team Leader is responsible for all aspects of the project. Work with all other positions.
- **Product Management**

Work with clients to define requirements and resolve issues. Design and maintain functional specifications and other documentation. Often provide prototypes for user interfaces or design interface of services. Work with Team Leadership and Software Development.
- **Logistics**

Manage hardware/software requirements for development, testing, validation, and production environments. Perform or oversee installations. Own the installation process and any installation utilities.

Work with resource teams to obtain servers/software and address issues within the environments. Work with Team Leader.

- **Software Development (Programming)**

Design and code the software to match the specifications, prototypes, and other documentation. Define timelines. Work with Product Management to refine expectations and clarify requirements. Often interact with Team Leader, Tester, User Documentation, and User Education.

- **Software Testing**

Define testing procedures and certification process. Define timelines. Create and execute tests on software. Manage a bug-tracking procedure. Work with Team Leadership. Collaborate with Product Management to define areas and specifics of testing. Often interact with Software Developer. Work with Team Leader.

- **User Documentation**

Create and maintain user-centric documentation. Work with Product Management and Software Development to define and document functionality. Often provide training materials for User Education. Work with Team Leader.

- **User Education**

Create training procedures and policies. Design training materials. Execute training sessions. Work with Product Management and User Documentation. Work with Team Leader.

- **Software Support**

Define support procedures. Handle user issues. Provide resolutions or formulate work-around for software issues. Forward hardware/infrastructure issues to Logistics. Notify Software Testing and Development of software bugs. Work with Team Leader.

Self Assessment Questions

10. Team Leader is responsible for all aspects of the project. (True / False)
11. _____ manage hardware/software requirements for development, testing, validation, and production environments.

12. _____ define testing procedures and certification process.
- m) Software Support
 - n) Software Development
 - o) Software Management
 - p) Software Testing

1.6 Summary

In this unit, you have learnt Software Development Organization and Roles in Software Development Industry. Let's summarize:

- Information Systems (IS) must be a key component of organizational design. Organizational designers must have an understanding of what IS can do.
- The flow of information can inhibit or facilitate organization structures.
- Virtual and networked organizations are rising in use and are replacing older legacy structures.
- IT affects managerial control mechanisms and managers must ensure that these controls are in place.
- Virtual organizations make it possible for employees to live any where. Virtual Teams are increasing in frequency and the challenges that they pose must be addressed.
- We have discussed the four important Ps, namely People, Process, Project and Product.
- We have discussed IT organizational structures - flat organizational structures, matrix organizational structure and network organizational structures etc. These organizational structures facilitate the communication among the teams in the organization.

1.7 Terminal Questions

1. Explain the IT and its organizational structures in detail.
2. Differentiate between different organizational structures.
3. Explain different roles of the software development?

1.8 Answers

Self Assessment Questions

1. True
2. Software Engineering Institute (SEI)
3. a
4. False
5. Functional, Project
6. b
7. True
8. Matrix
9. c
10. True
11. Logistics
12. d

Terminal Questions

1. Traditional organizations are hierarchical, flat or matrix in design. In hierarchical organizations, middle managers tell subordinates what to do and tell superiors the outcomes. IS supports this hierarchy. In flat structured organizations, work is more flexible and employee do whatever is needed. It allows offloading extra work and supports intra-firm communications. (Refer Section 1.4)
2. Hierarchical organizations are based on the concepts of division of labor, specialization, and unity of command. In flat organizations, decision-making is centralized. (Refer Sections 1.4.1 to 1.4.4)
3. Middle Management, Team Leader, Logistics, Product Development are some of the roles in Software Development. (Refer Section 1.5)