

**DEPARTMENT OF NUCLEAR TECHNOLOGY**  
**CHULALONGKORN UNIVERSITY, BANGKOK , THAILAND**

**CIDA COURSE ON QUALITY MANAGEMENT**

**" QUALITY in PROJECT MANAGEMENT "**

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**1. Objective Of Presentation :**

This presentation deals with "Project Management" as it applies to projects within a plant or to major capital project undertaken by the company.

Specifically, the following project management activities will be addressed :

- organization
- quality and safety
- planning
- execution
- control

**2. Introduction.**

2.1 Every organization, be it a utility or a plant, engages from time to time in a significant project, which because of its size, the amount of money involved or operational complications entails expenditure of considerable amount of time and money.

2.2 Projects are characterized by a **definite objective** to be accomplished within a **specified time**, which is usually of no more than several years duration. Once the objective of the project has been accomplished, the project organization is dissolved.

2.3 Thus, a key requirement within the project management process is the need to ensure that the stated objectives of the project are delivered within commitments made relative to cost, schedule and quality.

2.4 Projects usually involve many participants, each of whom makes a specialized contribution. The direction and coordination of these contributions is a complex undertaking where many managerial, technical and human issues have to be dealt with and resolved. Hence, the importance of a good **project management team** and well defined **interface procedures**.

2.5 During the operational phase of a plant, there are many projects undertaken whose complexity, quality requirements and costs require detailed planning and controls.

Examples of such projects are :

- retubing of a nuclear reactor
- major modifications to important systems, such as control computers or emergency cooling
- replacement of steam generators

### **3. Organization**

3.1 The nature or structure of an organization depends on the task the organization is to perform. All but the simplest projects involve the efforts of a diverse group of people who work together to serve the needs of a project but are drawn from various resource groups within the overall organization.

3.2 The following are the **three major participants** in a project :

#### **Committing Unit**

The unit in the organization having responsibility for determining the need for a project, specifying it, and recommending it to the appropriate authority level for approval. The committing unit is also referred to as **project sponsor or customer**.

#### **Controlling Unit**

The unit in the organization having responsibility for executing, within the committing unit's specification, a project, or part of a project and managing the project within stated objectives.

#### **Design Authority**

The unit accountable and responsible (by virtue of possessing the necessary competence, legal qualifications, and authority) for the design configuration of facilities, systems, equipment, components, and software, and approving any permanent additions, deletions, or modifications.

**3.3 Projects are executed** by teams who understand their respective mandates, roles, and responsibilities and have a clear understanding of their empowerment.

3.4 These teams can be categorized as:

- Business Team
- Program/Project Management Team
- Project Team

**3.5 Business Team** is responsible for continued review of the cost incurred by project versus the accomplishment.

**3.6 Project Management Team** includes program managers/project superintendents/project leaders from project controlling units as well as representatives from the committing , and resource coordinators from project support units. This is the **key team for the project**.

The project management team is responsible for:

- approval of Project Execution Plan (PEP) and subsequent changes.
- provision of adequate resources as required by project plans, budget, and schedule.
- monitoring of progress
- setting of strategic priorities and direction
- resolution of conflicts brought forward

3.7 Project Team member selection criteria should ensure that the team contains required competence in project management, technical, interpersonal, communications, time management, and leadership skills.

The Project Team is responsible for :

- establishment of Project Execution Plan (PEP)
- development of key objective and mileposts by which to measure progress
- assignment of duties, responsibilities and schedules to subordinate teams
- obtaining the necessary technical, financial, and regulatory approvals.
- management of arising issues
- management of change control process with the customer and documentation of changes.
- execution and monitoring of work progress by activities,
- monitoring of costs
- production of regular status reports.

#### 4. Quality and Safety programs

##### Quality Program

4.1 A significant cause of poor performance is the use of inadequate and outmoded management practices. Although the complexity and uniqueness of project work make adopting modern management techniques difficult, this difficulty must be surmounted. Quality Management techniques can significantly contribute to good management.

4.2 One of the fundamental duties of management is to assure that delivered products meet requirements. Project participants need to understand and use Quality Assurance and Quality Control programs in the planning, designing, and execution phases.

4.3 Quality assurance is a **management function** defining planned and systematic actions necessary to prevent errors (deviations) and thus provide confidence that a product or service will satisfy given requirements. Quality Control is a technical function carrying out inspections and tests.

4.4 The project must have a documented **Quality Assurance** program which meets the requirements of applicable standards. Requirements of the Program must be enforced. **Line management is responsible for Quality of performance.**

##### Safety Program

4.5 No safety initiatives can be considered a success until the issue of health and safety become instinctive within the workers. Accident prevention requires control over an individual's performance and physical environment.

4.6 Properly organized and managed safety programs can help control the factors which allow accidents to occur. An understanding of sound safety management techniques at all levels is indispensable to an effective cost saving prevention program.

4.7 Safety cuts across all activities and involves everyone without exception. All personnel must be made to understand that they are charged with the responsibility to **know and observe the safety rules** and regulations, established to reduce the factors which allow accidents to occur.

4.8 The Project must have a documented **Safety Program** which meets the requirements of local regulations with respect to establishing, maintaining and reporting on safety of working practices.

## **5. Project planning**

### **Project objectives.**

5.1 A basic element of planning is the **establishment of objectives**. The objectives govern numerous decisions required throughout a project. These decisions involve tradeoffs between time, cost, quality, and various technical, aesthetic, and administrative performance characteristics.

5.2 Objectives when developed must be clear and simply stated. Priority ranking on objectives should be completed in order to guide the decision making process.

5.3 Project objectives and priority ranking are to be maintained throughout the project management life cycle. Integration with all other project management processes is essential.

5.4 Once established, objectives must be communicated, supported, and maintained by all project team participants. A clear, consistent set of objectives and priorities should be communicated within the Project Execution Plan (PEP). Decisions, directions, communications, training, progress review, and remedial action processes should consistently reinforce objectives and priorities.

### **Project execution plan (PEP)**

5.5. On any project, it is necessary to ensure that all issues that are important to the success of the project are identified, defined, understood and that **a plan is put in place** to deal with these issues.

5.6 This plan is the Project Execution Plan (PEP) which will serve as a road map for project execution. PEP is a definition of the contract between the customer and the project team.

5.7 PEP is intended to define the overall approach for a particular project and is to be continually updated to ensure a current approved plan is always available to guide project execution.

5.8 Contents of a typical Project Execution Plan are as follows:

- project description (scope) and objectives : desired result, cost, schedule, quality, safety, environment, citizenship, human resource development.
- Organization and Responsibilities as shown on an organization chart
- customer satisfaction : customer-based performance measures
- project estimate and cash flow
- project controls : cost control and scheduling techniques, methods and practices . Plans for monitoring, analysis, and reporting
- resource management
- productivity measurement and performance evaluation
- project change control

### Project scope.

5.9 Good scope definition is essential to proper planning and management of projects. The ability to influence total project cost decreases as the project advances. When there is poor scope definition, final project costs can be expected to be higher because of the inevitable changes which disrupt project rhythm, cause rework, increase project time, and lower the productivity and morale of the work force. Scope definition begins with definition of **customer expectations**

5.10 Preparation of project scope encompasses the following stages :

#### Conceptual Engineering which contains

- Technical description of the system or product including performance requirements
- Technical standards
- Safety requirements
- Quality requirements
- Environmental considerations
- Rough process diagrams and preliminary plant arrangement sketches

Definition Phase Engineering which contains engineering details sufficient to define the work, such as :

- Final system design criteria
- System specifications
- Piping and instrumentation drawings
- Civil control drawings
- Major equipment specified, some committed
- Equipment/plant arrangement drawings

Execution Phase Engineering. At this stage, design is typically frozen, specifications completed, fabrication drawings prepared, purchase orders let, drawings released for construction, etc.

5.11 Project scope at this stage represents the project baseline. The change control process governs any changes to scope definition and documentation beyond this point.

## **Estimating**

5.12 Project estimates, once prepared evolve throughout the project life cycle based on quality of information and project progress. Estimates will normally carry a "modifier," such as *study, release, definitive, etc.*, intended to describe a confidence level of estimate accuracy

5.13 An estimate of high quality is essential because it is used as a **tool for a multitude of activities**, such as:

- Comparing alternatives
- Evaluating project feasibility
- Approving business plans and budgets
- Approving expenditures of funds
- Measuring change
- Measuring performance and progress

5.14 A well-defined project scope and a project organization team with a clear understanding and ownership of the work are the two essential ingredients that must be in place prior to undertaking an estimate. The scope of a project must be both a qualitative and quantitative description of work to be performed.

5.15 Failure to identify and deal with all known and unknown aspects of a project through a disciplined application of the entire estimating practices can result in estimates without meaning and a uninformed and inaccurate decision-making process by all levels of project management.

## **6. Project execution**

### **Customer satisfaction .**

6.1 The **establishment and maintenance of a cooperative working** relationship between the customer and the project team is essential for project success. The process to be followed include the establishment of performance measures, intended to measure customer satisfaction.

6.2 Typical performance measures are :

- Customer involvement in decision making
- Responsiveness of project team to customer concerns
- Effectiveness of communication between project and the customer
- Effectiveness of project reporting and controls
- Quality of translation of customer inputs into project outputs

6.3 Having established all measures above, the customer would then assign weights to the measures based on their relativity to overall customer satisfaction. These weightings can then be used to develop a customer based report card in a matrix format.

6.4 Throughout the life of the project, customer representatives will be asked to rate the project team on all identified performance measures, such that an overall ranking can be derived.

## **Constructability, Operability, Maintainability**

6.5 Project environments historically have separated the design function from the installation, operation, and maintenance functions. Each function individually have tended to minimize cost and schedule within their own function. Optimizing the individual parts, however, does not yield the most successful project. The most effective approach is when all units are committed to the effectiveness of the whole project.

Constructability is the optimum use of construction knowledge and experience in the planning, design, procurement, and site installations phases of projects in order to achieve overall project objectives.

Operability is the optimum use of plant operating knowledge and experience in the planning, design, procurement, and installation phases of projects in order to achieve overall project objectives.

Maintainability is the optimum use of plant maintenance knowledge and experience in the planning, design, procurement, and installation phases of projects in order to achieve overall project objectives.

6.6. **Integration** of construction, operations, and maintenance knowledge and experience into project planning and design should be a specific activity occurring early in the design phase so that the input influences the initial design.

6.7 The intention is to promote a forward looking, integrated planning approach rather than a backward looking review of completed design. This will minimize design rework and result in a higher quality design.

## **Risk Management/Contingency**

6.8 Generally risk is defined in terms of its parent - uncertainty. Uncertainty is the set of all potential outcomes, both favorable and unfavorable. Those outcomes which are unfavorable represent risk; where those which are favorable represent opportunity. Risk is also defined as the probability that an unfavorable outcome will occur.

6.9 Uncertainties, and therefore, risks and opportunities can be catalogued by source as follows:

- Technical
- Contractual
- Financial

6.10 In estimating the total cost of a project, a large number of potential outcomes exist, ranging from the best potential underrun (opportunity) to the worst potential overrun (risk).

6.11 A total risk management program has three stages as follows :

Identification - this is simply the categorizing of risks that may befall a project.

**Measurement** - this is measurement or evaluation of identified risks, in terms of potential impacts if the risk became an event.

**Control** - this includes risk avoidance, reduction, sharing, transfer, insurance, acceptance (with or without contingency), and containment.

6.12 Research on the subject of uncertainty shows an almost universal tendency for people to underestimate uncertainty and overestimate the precision of their own knowledge and judgment. Research also has shown that one can improve the confidence level by using evaluations and simulations that eliminate the biases of single-figure subjective judgments.

6.13 The attention of the project team should be focused on key risk items, with lesser surveillance of the remainder. A "**critical items report**" should be produced reporting any situation that has affected or has the potential for significantly affecting cost or schedule. This will allow these items to receive particular attention.

### **Resource Management**

6.14 Resource Management Process must include elements to:

- Plan and forecast skills needed/necessary to realize project objectives.
- Manage labor relations/jurisdictional issues.
- Determine availability of required resources.
- Arrive at strategies for contracting work - make/buy.
- Provide necessary skills development/training.

6.15 Skill requirements are to be developed over the project life based on the ongoing identification of detailed project task information. Skill needs in all areas including engineering, procurement, construction as well as all support groups are to be identified early in the project definition. These skill needs are to be consistent with the project team structure, and will be developed by project team members.

6.16 The availability of required resources is to be determined over the life of the project and must take into account other projects which may be competing for the same resources. In the case of purchased resources, the demands of the external marketplace must be considered.

## **7. Project control.**

### **Productivity Measurement**

7.1 Productivity is measured by comparing production to the corresponding work hours over a given period of time. Productivity measurement can be simple yet still provide a **valuable control tool**. On any given project, more than 50% of the work hours are devoted to much less than 50% of the work activities. The goal is to control that fraction of the work activities in which the work hours are concentrated.

7.2 Productivity reporting and performance measurement require accurate and consistent reporting of physical progress and effort expended. Effort expended should be based on hours worked.



## **Performance Evaluation**

7.3 Performance evaluation involves a comparative analysis. Work hours, quantities, and productivity are evaluated against the planned values used in the approved project estimate. Activity duration's can be projected and compared with the planned or required completion dates of the activities.

7.4 Productivity is the key ingredient of performance evaluation for it permits objective quantitative comparison of actual and estimated performance. The simplest form of evaluation is the performance index which is " the planned performance divided by the actual performance ".

7.5 A performance index greater than 1.0 indicates better than expected performance. A performance index applied to productivity becomes a "productivity index" and applied schedule, becomes a "schedule index".

7.6 **Earned value concept** is the measurement of work accomplished (performed) in terms of budgets planned for that work, and the use of these data to indicate cost and schedule performance. Without earned value, one can only compare how much has been spent with what was planned to be spent, with no objective indication of how much of the planned work was actually accomplished. **Earned value compared with planned value** provides a measure of work accomplishment against plan.

7.7 Earned value concept requires measurement of accomplishment against the plan at relatively low levels with summarized reporting to higher management. Desirable features of a good management control system also include reporting discipline, variance analysis, and corrective action.

7.8 The concept of **performance indices** and **earned value** can form the basis of integrated performance monitoring. While productivity performance measures a point in time against a total target, schedule performance requires resources to be flowed over time so that not only the percentage complete against a total target may be established but also the performance to date.

## **Change Control**

7.9 The purpose of change control is to ensure that :

- scope, cost, material, and schedule changes are identified.
- requested changes have the appropriate level of approval.
- the impact on the project, and program as a whole is recognized and understood.
- approved changes are accounted for in the project scope, schedule, and estimate.
- approved changes are communicated to all concerned parties.

7.10 Loss of scope control on projects is a leading cause of project cost overruns and schedule delays. On a poorly defined project, the impact of a change request is difficult to

**classify, quantify, and justify. Poor project definition precludes development of a clear baseline upon which project decisions can be made.**

**7.11 It is important for good project control to avoid changes as much as practical. Changes should be made based on project needs not wants, and only if the team consensus is that change is unavoidable.**

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