MANY ENGINEERS TRY TO AVOID PROJECT PLANNING BECAUSE:

- It takes time.
- You have to think ahead.
- It involves paperwork.
- You are bound to systematic procedures.
- You are committed to achieve a specific result within a specified time period.

"In preparing for battle, I have always found that plans are useless, but planning is indispensable."

Dwight David Eisenhower

Effective Planning

An effective plan will be:

- **Explicit** - leaving nothing merely implied.
- **Intelligible** - comprehensible to all.
- **Flexible** - able to accept change.
- **Controllable** - able to be monitored for control purposes.

Planning Fundamentals

- If the task is well understood prior to being performed, much of the work can be preplanned.
- If the task is not understood, then during the actual task execution knowledge is gained that leads to changes in priorities, resource allocations, and schedules.
- The more uncertain the task, the greater the number and frequency of changes.

Reasons for Planning

- To identify sources of uncertainty
- To improve efficiency of the operation
- To obtain a better understanding of the objectives and the means to achieve them
- To communicate with others (the customers and users, for example)
- To provide a basis for monitoring and controlling work
A TYPICAL PROJECT LIFE CYCLE

Phase | % Direct Hours
--- | ---
Conceptualization | 5
Feasibility | 10
Preliminary design | 15
Detailed planning | 20
Execution | 40
Commissioning | 10

FREQUENTLY ASKED QUESTIONS

- Who owns the product?
- Who plans the project?
- Who executes the project?
- Who is responsible for monitoring work?
- Who is responsible for providing feedback in the planning and execution phases?

Project Manager’s Responsibility

- The Project Manager will communicate:
  - Goals and objectives
  - Major milestones
  - Requirements
  - Ground rules and assumptions
  - Time, cost, and performance constraints
  - Operating procedures
  - Administrative policy
  - Reporting requirements

Functional Manager’s Responsibility

- The Functional Manager will define:
  - Detailed task descriptions to implement objectives, requirements, and milestones
  - Detailed schedules and manpower allocations to support budget and schedule
  - Identification of areas of risk, uncertainty, and conflict

Senior Management’s Responsibility

- Senior management (the project sponsor) will:
  - Act as the negotiator for disagreements between project and functional management
  - Provide clarification of critical issues
  - Provide communication link with customer’s senior management
**A Project without Adequate Planning**

1. Wild enthusiasm
2. Disillusionment
3. Chaos
4. Search for the guilty
5. Punishment of the innocent
6. Promotion of the non-participants
7. Definition of the requirements

**Project Manager’s Responsibilities:**

- Do the projects right.
- Do the right projects.

**Defining Requirements**

- Statement of Work (SOW)
- Project specifications
  - Functional specs
  - Technical specs
- Milestone schedule
- Work Breakdown Structure (WBS)

**STATEMENT OF WORK (SOW)**

Degree of detail is determined by management, customer, regulators, and/or user group(s).

For internal projects:
SOW is prepared by the project office and/or user group(s).

Who prepares the Statement of Work (SOW)

Preparation of internal SOWs
- Project office and/or user groups or marketing

Preparation of external SOWs
- Dependent on situation and complexity
- Project manager, line managers, and project sponsor
- Client who has the capability
- Client may contract to an independent body
- Client may contract for your services
**Statement of Work Elements**

- General scope of the work
- Objectives and related background
- Contractor's tasks
- Contractor end-item performance requirements
- Reference to related studies, documentation, and specifications
- Data items (documentation)
- Support equipment for contract end-item

**Continued**

- Customer-furnished property, facilities, equipment, and services
- Customer-furnished documentation
- Schedule of performance
- Exhibits, attachments, and appendices

**Problem Areas**

- Project objectives, goals, and scope are not agreed upon by all parties.
- Project objectives are too rigid to accommodate changing priorities
- Insufficient time exists to define objectives well.
- Objectives are not adequately quantified.
- Objectives are not documented.
- Efforts of client and project personnel are not coordinated.

**Misinterpretation Areas**

- Mixing tasks, specifications, approvals, and special instructions
- Using imprecise language ("optimum," "approximately," "or equal," etc.)
- No pattern, structure, or chronological order
- Wide variation in size of tasks
- Wide variation in detailed description of the work
- Failure to get third-party review

**WORK BREAKDOWN STRUCTURE**

(WBS)

**Purpose of WBS**

To structure the project into activities (work packages) in order that:
- Detailed planning can be performed
- Costs and budgets can be established
- Available resources can be allocated to activities and objectives
- Specific authority and responsibilities can be assigned
Work Breakdown Structure

- Can be developed using a top-down or bottom-up approach
- Can be hardware-related, function-related, location-related, or some combination
- Balance management effort against planning accuracy (for scope and cost control)
- Work packages objective and measurable
- Structured for objective estimating, monitoring, evaluation, and control

Total project is described as a summation of subdivided elements (work packages)
Planning can be performed
Costs and budgets can be established
Time, cost, and performance can be tracked
Objectives can be linked to resources in a logical manner
Schedules and status reporting procedures can be established

Network construction and control planning can be initiated
The responsibility assignments for each element can be established

The Activities in the WBS Must:
- Have clearly defined starts
- Have clearly defined ends
- Be able to be used as a tool for communicating the expected results
- Be estimated on a total time duration basis

Work Breakdown Structure (Continued)

- Network construction and control planning can be initiated
- The responsibility assignments for each element can be established

WORK BREAKDOWN STRUCTURE (WBS)

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total Program</td>
</tr>
<tr>
<td>2</td>
<td>Project(s)</td>
</tr>
<tr>
<td>3</td>
<td>Task(s)</td>
</tr>
<tr>
<td>4</td>
<td>Subtask(s)</td>
</tr>
<tr>
<td>5</td>
<td>Work Package(s)</td>
</tr>
<tr>
<td>6</td>
<td>Level of Effort</td>
</tr>
</tbody>
</table>

Six-Level WBS Hierarchical Structure
DEVELOPING A WORK BREAKDOWN STRUCTURE (WBS)

WBS Example

WBS Controls

WBS Interfaces

Work Package Control Point

WBS Work Packages
WBS Packages (Continued)

- Specify budgeted costs in dollars, man-hours, or other measurable units
- Define work to be performed in relatively short periods of time to facilitate planning, tracking, and forecasting

WBS – Waste to Energy (Greenfield)

- Project Management
- Civil/Structural
  - Site work
    - Clearing, grubbing, excavation
    - Grading, drainage
    - Access road
    - Landscaping, lighting, security
    - Switchyard

WBS – Waste to Energy (Greenfield) (Continued)

- Civil/Structural (continued)
  - Foundations
  - Building structures
  - Stack
- Boiler
  - Furnace/grate
  - Steam boiler
  - Steam lines
  - Boiler controls

WBS – Waste to Energy (Greenfield) (Continued)

- Turbine/Generator
  - Steam turbine
  - Generator
  - Condenser
  - Controls
- Mechanical draft cooling tower
- Materials handling
  - Loaders
  - Crane

WBS – Waste to Energy (Greenfield) (Continued)

- Electrical
  - Power
    - Power cables, MCCs
    - Power output
    - Switchyard
  - Instrumentation and controls
    - Control room
    - Computers
- Startup, test, and turnover

Some Reasons Why Plans Fail

- Corporate or customer goals are not understood throughout the organization.
- Unrealistic plans call for too much to be done in too little time.
- Poor estimates.
- Insufficient understanding of the project objectives.
- Insufficient time allocated for pre-project planning.
More Reasons Why Plans Fail

- Planning process not systematic or complete.
- Planning performed by a planning group (not the project team).
- Ultimate objectives not clear.
- Major milestone dates not defined.
- Project estimates are best guesses and are not based on any standards or history.

More Reasons Why Plans Fail

- No one determined that there would be personnel available with the necessary skills.
- People not working towards the same specs.
- Constant shuffle of personnel in and out of the project with little regard for the schedule.
- Change of management and their objectives.
- Changes in the environment.

Planning For Project Completion

Planned Closure

- Transferring responsibility
- Completion of project records
  - Historic reports
  - Post project analysis
- Documenting results to reflect “as built” product or installation
- Acceptance by sponsor/user
- Satisfying contractual requirements

Planned Closure (Continued)

- Releasing resources
  - Reassignment of project office team members
  - Disposition of functional personnel
  - Disposition of materials
- Closing out work orders (financial closeout)
- Preparing for financial payments

Managing Scope Changes
**Change Management**

- YOU CANNOT MANAGE YOUR CUSTOMER WITHOUT MANAGEMENT OF YOUR PROJECT MANAGEMENT PROCESS.
- WHEN YOUR CUSTOMER INITIATES A CHANGE REQUEST, YOU MUST BE ABLE TO PREDICT IMMEDIATELY THE IMPACT ON SCHEDULE, COST AND TECHNICAL PERFORMANCE.

**Unmanaged vs. Managed Changes**

<table>
<thead>
<tr>
<th>Where TIME is invested</th>
<th>How ENERGY is invested</th>
<th>Which RESOURCES are used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unmanaged Change</td>
<td>Back-end</td>
<td>Senior Management and key players only</td>
</tr>
<tr>
<td>Managed Change</td>
<td>Front-end</td>
<td>Stakeholders (internal) Suppliers Customers</td>
</tr>
</tbody>
</table>

**Cost of Corrections**

<table>
<thead>
<tr>
<th>Definition</th>
<th>Preliminary Planning</th>
<th>Detailed Planning</th>
<th>Execution</th>
<th>Implementation</th>
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</thead>
<tbody>
<tr>
<td>$1</td>
<td>$5</td>
<td>$25</td>
<td>$100</td>
<td>$1000</td>
</tr>
</tbody>
</table>

**Integrated Processes**

- Project Management
- Concurrent Engineering
- Total Quality Management
- Change Management
- Risk Management