Planning and Scheduling:
Basic tools & expectations for the SrD Project


Project plan: document used to keep the project under control.

Main functions of a plan:
• to clearly communicate the schedule
  (to the project team and outside reviewers)
• to track progress relative to the plan
• to assist in effective resource allocation
• to estimate costs
Planning and Scheduling:
Basic tools & expectations for the SrD Project

[References: *The Mechanical Design Process*, Ullman, 2003]
and *Product Design and Development*, Ulrich and Eppinger, 2000]

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Two Phases of Project Management

- Project Planning
- Project Control
Characteristics of a project plan:

- Like a time-sequenced Action Item Register
- Has both a near-term and a long-term focus
- Meant to be a working document
- Schedules have a combination of hard deadlines and soft deadlines (with slack)
- Schedules change frequently but should always reflect
  - Your best current estimate of what tasks (get specific) need to be done and which are most important (prioritize)
  - Who will do the tasks (responsibility)
  - How long they will take to complete (duration)
  - What is needed to get the job done (resources)

Remember: Schedules are useful even though they are almost always "wrong"
GET SPECIFIC

Generalities are useless.

Tasks must be specific and easily understandable by all team members to be useful.
RESPONSIBILITY

If it is everybody’s job,
then it is nobody’s job

Clear expectations (definition of who, what
and when for key deliverables) can
eliminate many potential problems
It is easy to be busy - it is hard to be effective.

The key is not to work harder but to work on the right things.
Basic Project Planning in 4+ steps

1. Identify the key project **tasks** (What)

2. Identify the **objective** for each task (Why)

3. Estimate the **Personnel, Resources, and Time** Required to meet each task objective (How)

4. Establish **priority** of tasks by arranging them in **time sequenced order** (When)

+ Estimate **Costs** (Project Budget)
Basic Project Planning in 4+ steps

1. Identify the key project tasks (What)
   a. Activities that need to be performed to proceed from problem to final product
      a. Examples: Perform patent search on personal commuter vehicles, Calculate power required to meet the acceleration target specification, rehearse presentation with faculty, ...

• The more specific the task statements are, the more useful they are
  • Generalities lead to confusion, not action
Basic Project Planning in 4+ steps

2. Identify the objective for each task

Tasks may be conceived as activities to be performed
  • Rehearse presentation with advisor

But the objective focuses on the desired result
  • The task objective answers the question – Why?
  • Why rehearse presentation with advisor? – Objective is to improve presentation content and style, verify readability of slides on screen, prepare for questions...

• Think Deliverables
  • It must be clear when the task is complete
3. Estimate the Personnel, Resources, and Time Required to Meet the Objectives for each task (How)

- **Who** is responsible
  - What % of their time should be spent on this task
- What specific/special **resources** are needed
- How long will the task take (duration) given the worker-hours and resources allocated

**Estimating Task Duration with the “Pessimistic” method:**
Make the best estimate of how long it should take, then **double the number** and **increase the units one step**.
- A 1 day estimate would be planned as 2 weeks
- Seems pessimistic, but it often ends up being true
Project Planning Example from Ullman

**Task:** Design 2 Concepts to address the problem statement

**Objective:**
Based on a clear understanding of the functions required, generate sketches of at least seven potential concepts. Evaluate each concept relative to customer requirements. Choose the best two.

Document the selection with the generation of decision matrices.

**Time:**
Starting Date: 1/22/01
Duration: 20 days

**Personnel:**
Design Engineer: 50% time
Technician: 50% time
Industrial designer: 30% time

Note: The technician aids the designer in evaluating concepts
Basic Project Planning in 4+ steps

3. Estimate the Personnel, Resources, and Time Required to Meet the Objectives for each task (How)

Realistic Time Estimation Method
as used in PERT (Program Evaluation and Review Technique)

Start by making 3 estimates
1. Optimistic estimate, $o$ (best case)
2. Most-likely estimate, $m$ (allowing for likely delays and problems)
3. Pessimistic Estimate, $p$ (worst case)

Realistic time estimate = \( \frac{o + 4m + p}{6} \)
PERT and CPM Charts

- Simple network diagrams are easy to understand.
- We cannot represent the coupled/iterative task relationships.
Basic Project Planning in 4+ steps

4. Establish priority of tasks by arranging them in time sequenced order (When)

Milestones established by design reviews and hard deadlines

Starting with main tasks
1) Identify task **predecessors** (tasks that must be done before it)
2) Identify task **successors** (tasks that must be done after it)

For dependent tasks, identify as
- **sequential** (one must be completed before beginning next)
- **parallel uncoupled** (can be worked on simultaneously)
- **parallel coupled** (Must be worked on simultaneously with frequent communication…For example aircraft conceptual design, where aerodynamics, structure and propulsion are highly coupled)
Project Management Example: Kodak Cheetah Microfilm Cartridge
Three Fundamental Activity Relationships

(a) Sequential
Receive and Accept Specification → Concept Generation/Selection → Design Beta Cartridges

(b) Parallel
Design Beta Cartridges → Produce Beta Cartridges
Design Beta Cartridges → Develop Testing Program → Test Beta Cartridges

(c) Coupled
Test Beta Cartridges → Design Production Cartridge → Select Assembly Equipment
Design Mold → Design Assembly Tooling

Example: Kodak Cheetah Microfilm Cartridge
Basic Project Planning in 4+ steps

4. Establish priority of tasks by arranging them in time sequenced order (continued)

Any Critical Path Method (CPM):

1) PERT
2) The Critical Chain Method
3) …

can be used to determine the most efficient task sequence.
PERT Chart and Critical Path

A. Receive and Accept Specification
B. Concept Generation/Selection
C. Design Beta Cartridges
D. Produce Beta Cartridges
E. Develop Testing Program
F. Test Beta Cartridges
G. Design Production Cartridge
H. Design Mold
I. Design Assembly Tooling
J. Purchase Assembly Equipment
K. Fabricate Molds
L. Debug Molds
M. Certify Cartridge
N. Initial Production Run

Task | Duration (weeks)
--- | ---
A | 2
B | 4
C | 8
D | 8
E | 5
F | 2
G |
H | 14
I |
J | 6
K | 10
L | 4
M | 2
N | 2

Duration of each task is printed in black.
Critical Chain Method

- Start with a sequential/parallel network.
- Use 50/50 task duration estimates.
- Compute the critical path, noting resources.
- Insert feeder and project buffers as safety.
- Ideal buffers are 50% of path duration.
- Monitor buffer status.
- Reduce buffers when tasks overrun.

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Basic Project Planning in 4+ steps

4. Establish priority of tasks by arranging them in time sequenced order (continued)

Presentation of project planning data is important for communication and usability.

A Gantt chart visually shows the timing and duration of steps
• Can also show progress
• Good tool for team members to work from (large poster in visible area with movable markers…)
• Time units can be days, weeks, months, quarters
  • Weekly timeline is appropriate for this project
• MS Project offers automated creation of Gantt charts
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<th>Year</th>
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<td><strong>Phase 1</strong></td>
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<td>Task 1: Evaluate and rank component and subsystem level alternative designs</td>
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<td>1. Investigate alternative photosynthetic agents (cyanobacteria) and their growth properties [Cooksey, Vis]</td>
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<td>3. Investigate growth surface subsystem design [Kremer]</td>
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<td>4. Investigate the use of a hydraulic jump to improve the system’s overall CO₂ conversion efficiency [Bayless]</td>
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<td>2. Evaluate alternative systems [Bayless, Kremer]</td>
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OU ME Sr. Design, Dr. Kremer, 14
DEFINE SPECIFIC TASKS
AND DELIVERABLES
ESTABLISH PRIORITY
ASSIGN RESPONSIBILITY
Expectations for this project

General long term schedule
• Key milestones, design reviews, and deliverable dates

Specific short term schedule (to next reporting period)
• What needs to be done now (prioritized actions)
• What are the potential bottlenecks (What could slow progress)
• Where should resources be used
• Short term schedule must be linked to long term plan
  • Be careful not to forget the overall goal

For Tollgate 1:
Very general long term schedule
Very specific tasks up to start of Winter Quarter (next reporting period)