Project Scheduling

- **Adapted from Pressman**

Why Are Projects Late?

- an unrealistic deadline established by someone outside the software development group
- changing customer requirements that are not reflected in schedule changes;
- an honest underestimate of the amount of effort and/or the number of resources that will be required to do the job;
- predictable and/or unpredictable risks that were not considered when the project commenced;
- technical difficulties that could not have been foreseen in advance;
- human difficulties that could not have been foreseen in advance;
- miscommunication among project staff that results in delays;
- a failure by project management to recognize that the project is falling behind schedule and a lack of action to correct the problem

Project Scheduling

- An action that distributes estimated effort across the planned project duration by allocating the effort to specific software engineering tasks
- Overly optimistic schedules result in longer ones and not actually shorter ones

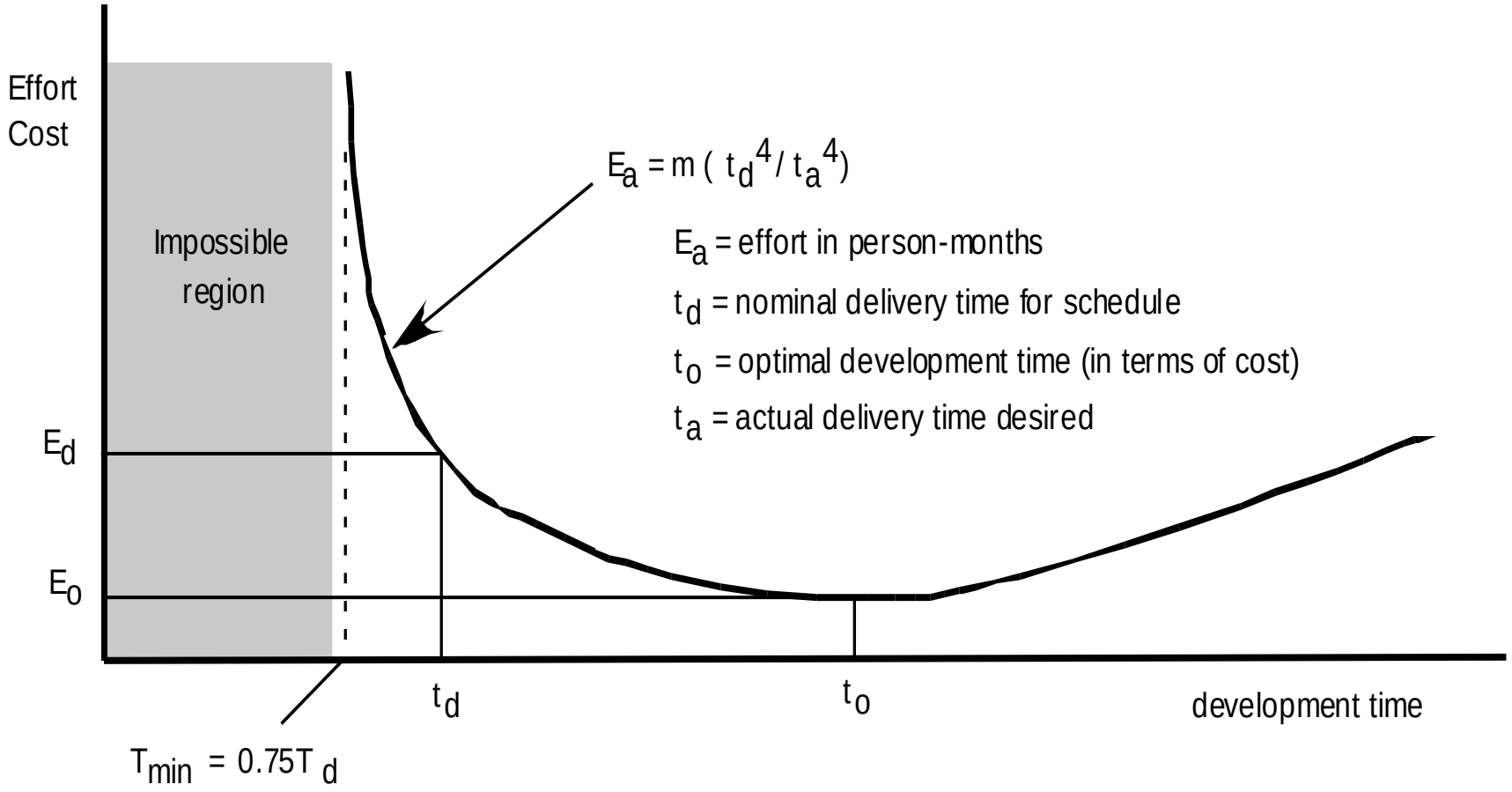
  ---- Steve McConnell
- If we fall behind the schedule, we can always add more programmers and catch up later – MYTH
  - Adding people late in project is disruptive and causes further delay in project

Scheduling Principles

- compartmentalization—define distinct tasks
- interdependency—indicate task interrelationship
- Time allocation – assign start and end time for each task
- effort validation—be sure resources are available
- defined responsibilities—people must be assigned
- defined outcomes—each task must have an output
- defined milestones—review for quality

Effort and Delivery Time

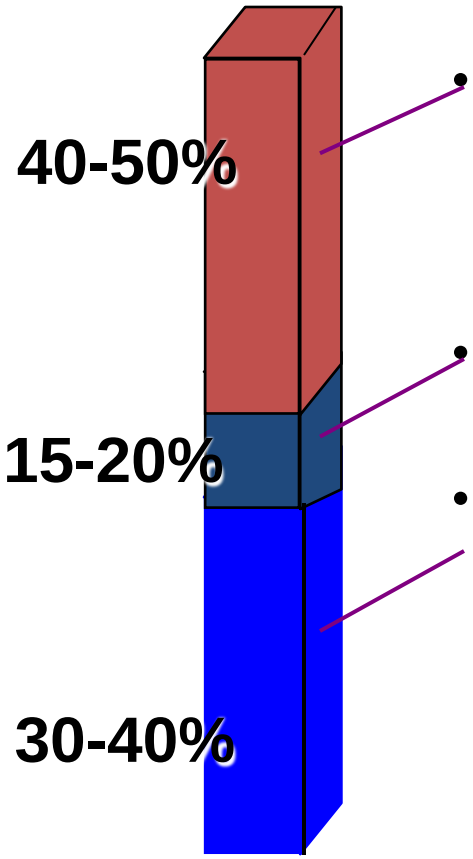
Putnam Nordon Rayleigh (PNR) curve



Homework

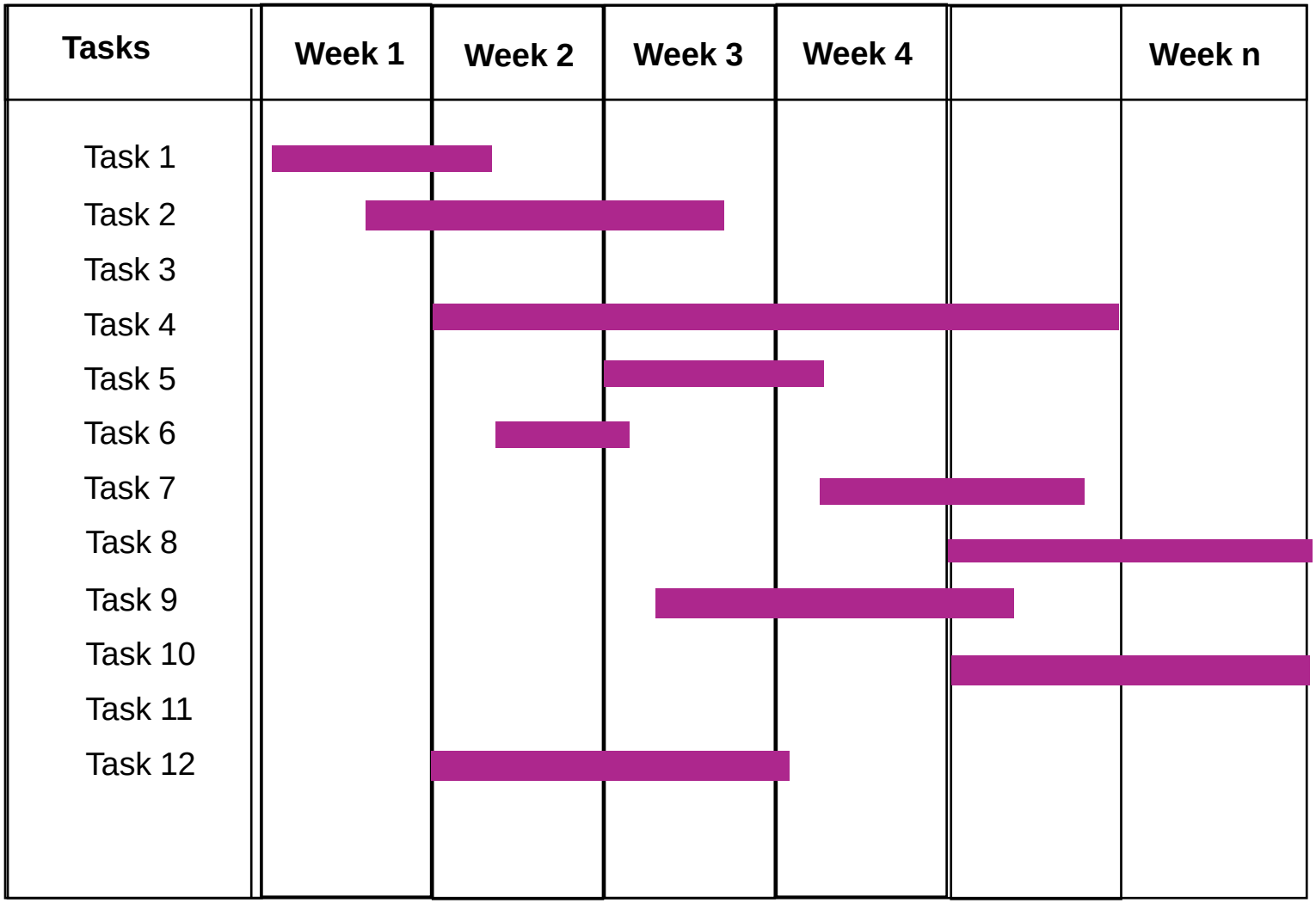
- Consider a complex, real-time software project estimated at 33,000 LOC, 12 person-years of effort. If eight people are assigned to the project team, the project can be completed in approximately 1.3 years. If, however, we extend the end date to 1.75 years, What will be the effort ? How many people can be reduced by extending the end date by 6 months?

Effort Allocation

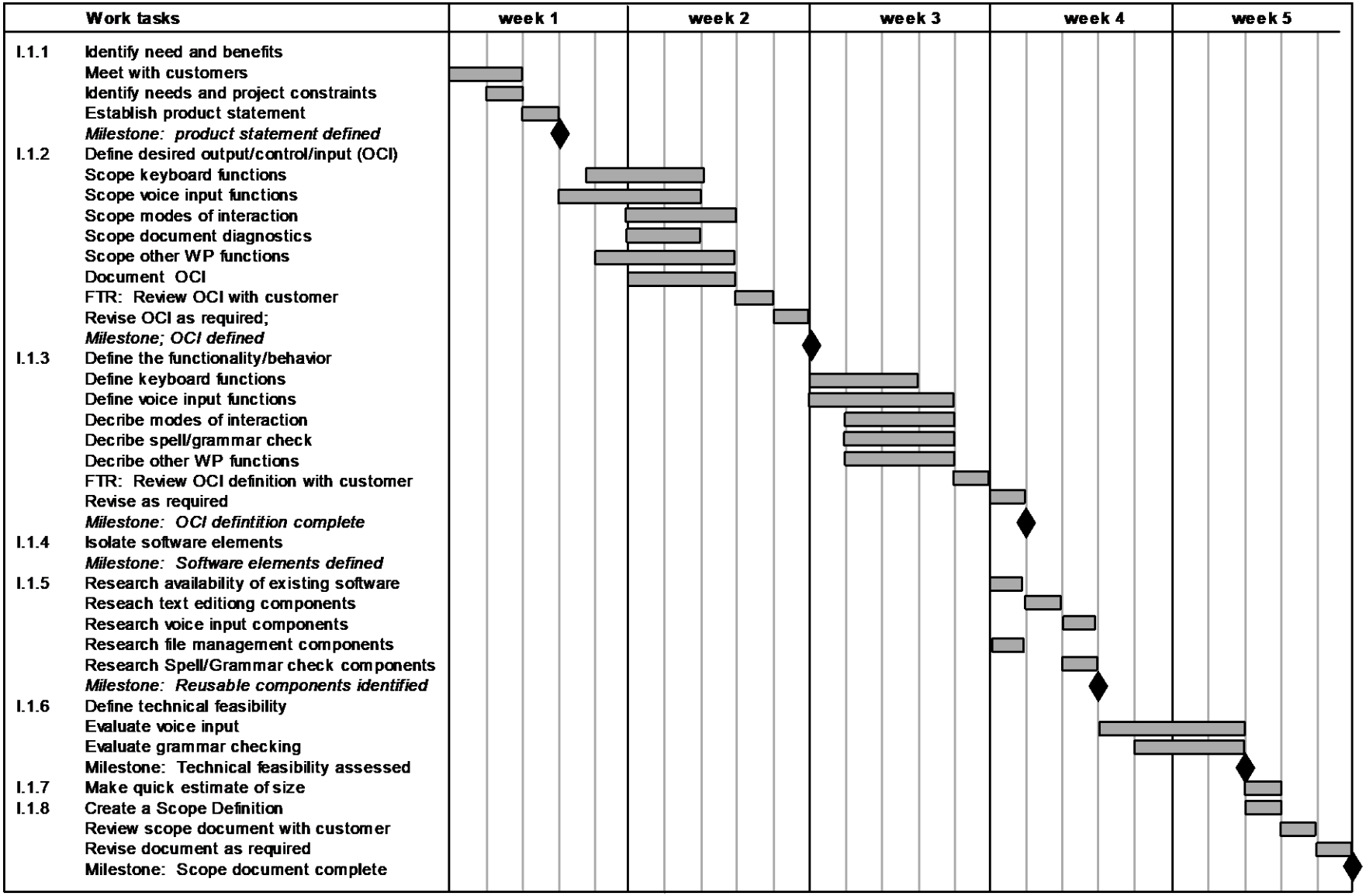


- "front end" activities
  - customer communication
  - analysis
  - design
  - review and modification
- construction activities
  - coding or code generation
- testing and installation
  - unit, integration
  - white-box, black box
  - regression

Scheduling tools - Timeline / Gantt Charts



Use Automated Tools to Derive a Timeline Chart



Scheduling Tools

- PERT
  - Program Evaluation and Review Technique
  - Event driven
  - A technique of planning and control of time.

- CPM
  - Critical Path method
  - Activity driven
  - A method to control cost and time.

Schedule Tracking

- conduct periodic project status meetings in which each team member reports progress and problems.
- evaluate the results of all reviews conducted throughout the software engineering process.
- determine whether formal project milestones have been accomplished by the scheduled date.
- compare actual start-date to planned start-date for each project task listed in the resource table
- meet informally with practitioners to obtain their subjective assessment of progress to date and problems on the horizon.
- use **earned value analysis** to assess progress quantitatively.

Earned Value Analysis (EVA)

- Earned value
  - is a measure of progress
  - enables us to assess the “percent of completeness” of a project using quantitative analysis
  - “provides accurate and reliable readings of performance from as early as 15 percent into the project.” [Fle98]

Computing Earned Value-I

- The *budgeted cost of work scheduled* (BCWS) is determined for each work task represented in the schedule.
  - $BCWS_i$ is the effort planned for work task *i.*
  - To determine progress at a given point along the project schedule, the value of BCWS is the sum of the $BCWS_i$ values for all work tasks that should have been completed by that point in time on the project schedule.
- The BCWS values for all work tasks are summed to derive the *budget at completion,* BAC. Hence,

$$BAC = \sum (BCWS_k) \text{ for all tasks } k$$

Computing Earned Value-II

- Next, the value for *budgeted cost of work performed* (BCWP) is computed.
  - The value for BCWP is the sum of the BCWS values for all work tasks that have actually been completed by a point in time on the project schedule.
- "the distinction between the BCWS and the BCWP is that the former represents the budget of the activities that were planned to be completed and the latter represents the budget of the activities that actually were completed." [Wil99]
- Given values for BCWS, BAC, and BCWP, important progress indicators can be computed:
  - Schedule performance index, SPI = BCWP/BCWS
  - Schedule variance, SV = BCWP – BCWS
  - SPI is an indication of the efficiency with which the project is utilizing scheduled resources. An SPI close to 1 indicates efficient execution.

Computing Earned Value-III

- Percent scheduled for completion = BCWS/BAC
  - provides an indication of the percentage of work that should have been completed by time *t.*
- Percent complete = BCWP/BAC
  - provides a quantitative indication of the percent of completeness of the project at a given point in time, *t.*
- *Actual cost of work performed,* ACWP, is the sum of the effort actually expended on work tasks that have been completed by a point in time on the project schedule. It is then possible to compute
  - Cost performance index, CPI = BCWP/ACWP
  - Cost variance, CV = BCWP – ACWP
  - CPI close to 1 indicates that project is within its defined budget
  - CV indicates cost savings or shortfall at a given stage of project