Lecture 3: Project Management

- Project Management
  - Planning Tools
  - PERT charts, Gantt Charts, etc.
  - Meetings
- Risk Management
  - Risk Assessment
  - Risk Control
- Measurement
  - choosing software metrics
  - some example metrics

Project Management Basics

Source: *Adapted from Blum, 1992, 426-7*
see also: *van Vliet Chapter 2*

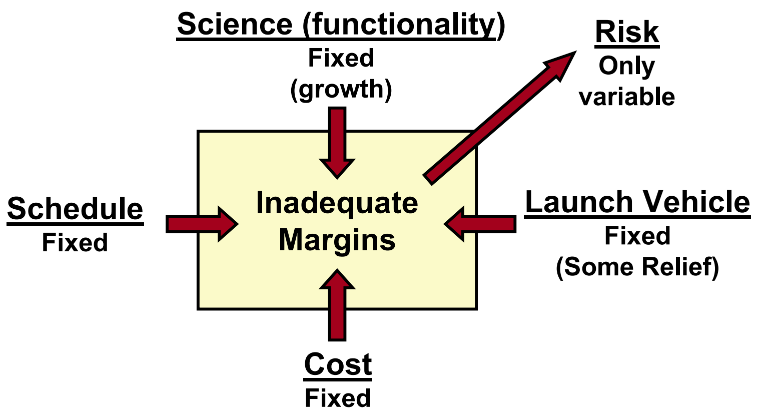
- Thankless job:
  - success is not noticeable
    - little evidence the manager did anything
    - project looks simple in hindsight
  - failure is very obvious
    - the manager will get blamed when things go wrong
- Difficult Job
  - Problems to solve include:
    - Do we have the resources (funding, people, time) for the task?
    - Are we certain the task is stated correctly?
    - How can we use limited resources most effectively?
    - How does recent (lack of) progress affect the plan?
    - What lessons can be learnt for future tasks?

Principles of Management

- A manager can control 4 things:
  - Resources (can get more dollars, facilities, personnel)
  - Time (can increase schedule, delay milestones, etc.)
  - Product (can reduce functionality - e.g. scrub requirements)
  - Risk (can decide which risks are acceptable)
- Approach (applies to any management)
  - Understand the goals and objectives
    - quantify them where possible
  - Understand the constraints
    - if there is uncertainty, use probability estimates
  - Plan to meet the objectives within the constraints
  - Monitor and adjust the plan
  - Preserve a calm, productive, positive work environment
- Note:
  - You cannot control what you cannot measure!

Critique of Mars'98 Program

Source: *Adapted from MPIAT 2000, p6*



Tool 1: Work Breakdown Structure

Source: *Adapted from Blum, 1992, p438*
see also: *van Vliet pp192-3*

1.1 Software Systems Engineering
- 1.1.1 Support to Systems Engineering
- 1.1.2 Support to Hardware Engineering
- 1.1.3 Software Engineering Trade Studies
- 1.1.4 System Requirements Analysis
- 1.1.5 Software Requirements Analysis
- 1.1.6 Interface Analysis
- 1.1.7 Support to Systems Test

1.2 Software Development
- 1.2.1 Deliverable Software
- 1.2.1.1 Requirements Analysis
- 1.2.1.2 Architectural Design
- 1.2.1.3 Procedural Design
- 1.2.1.4 Code
- 1.2.1.5 Unit Test
- 1.2.1.6 Software Integration Test
- 1.2.1.7 Technical Reviews
- 1.2.1.8 Technical Training
- 1.2.2 Non-deliverable Software
- 1.2.3 Purchased Software
- 1.2.3.1 Package Evaluation
- 1.2.4 Development facilities and tools

1.3 Software Test and Evaluation
- 1.3.1 Software Dev. Test & Evaluation
- 1.3.2 End-Product Acceptance Test
- 1.3.3 Test Bed & Tool Support
- 1.3.4 Test Data Management

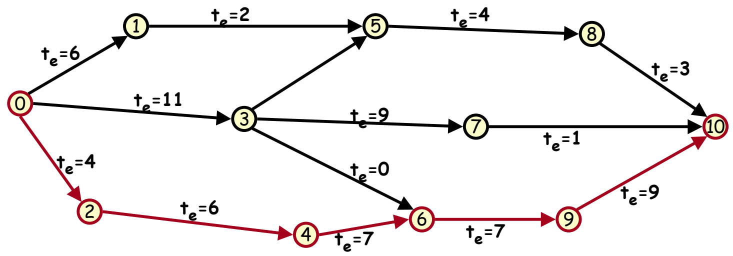
1.4 Management
- 1.4.1 Project Management
- 1.4.2 Administrative Support
- 1.4.3 Management Tools
- 1.4.4 Management Reviews
- 1.4.5 Management Training

1.5 Product Assurance
- 1.5.1 Configuration Management
- 1.5.2 Library Operations
- 1.5.3 Interface Control
- 1.5.4 Data Management
- 1.5.5 Quality Assurance
- 1.5.6 Quality Control

1.6 Operations and Support
- …

Tool 2: PERT charts

Source: *Adapted from Blum, 1992, p439*
see also: *van Vliet pp193-6*

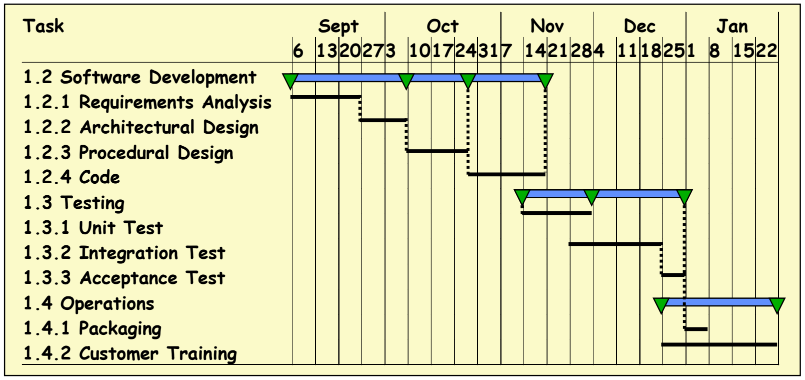


→ **Notation**
- Nodes indicate milestones
- Edges indicate dependencies
- Edges are labelled with time to complete

→ **Shows Critical Path**
- Longest path from start to finish
- any slippage on the critical path will cause project delay

see also: *van Vliet pp195-6*

Tool 3: Gantt Charts



→ **Notation**
- Bars show duration of tasks
- Triangles show milestones
- Vertical dashed lines show dependencies

→ **Shows high level view of whole project**

Tool 4: Meetings

Source: *Adapted from Pfleeger, 1998, 92*

→ **Meetings are expensive**
- E.g. 8 people on $40k. Meeting costs $320 per hour

→ **Meetings are necessary**
- Can save money by averting misunderstandings and coordination errors

→ **Time wasters:**
- Purpose of meeting unclear
- Attendees unprepared
- Essential people missing
- Discussion gets sidetracked
- Dominance by one or two people
- argumentative
- Decisions not followed up on

Meetings advice:
- Announce details in advance
  - ➢ who should attend
  - ➢ start and end times
  - ➢ goals of meeting
- Written agenda, distributed in advance
- Identify a chairperson who:
  - ➢ keeps the discussion on track
  - ➢ resolves arguments
- Identify a secretary who:
  - ➢ keeps track of decisions taken
  - ➢ records action items
  - ➢ ensures action items are carried out
- Associate a responsible person with each action item

Risk Management

Source: Adapted from Blum, 1992, p441-447
see also: van Vliet pp189-191

➔ Two Parts:

- Risk Assessment
- Risk Control

➔ Definitions

- Risk Exposure (RE) = p(unsat. outcome) X loss(unsat. outcome)
- Risk Reduction Leverage (RRL) = (RE_{before} - RE_{after}) / cost of intervention

➔ Principles

- If you don't actively attack risks, they will attack you
- Risk prevention is cheaper than risk detection
- Degree and Cause of Risk must never be hidden from decision makers

"The real professional … knows the risks, their degree, their causes, and the action necessary to counter them, and shares this knowledge with [her] colleagues and clients" (Tom Gilb)

Top Ten Risks (with Countermeasures)

Source: Adapted from Boehm, 1989
see also: van Vliet p192

- Personnel Shortfalls
  - use top talent
  - team building
  - training
- Unrealistic schedules and budgets
  - multisource estimation
  - designing to cost
  - requirements scrubbing
- Developing the wrong Software functions
  - better requirements analysis
  - organizational/operational analysis
- Developing the wrong User Interface
  - prototypes, scenarios, task analysis
- Gold Plating
  - requirements scrubbing
  - cost benefit analysis
  - designing to cost
- Continuing stream of requirements changes
  - high change threshold
  - information hiding
  - incremental development
- Shortfalls in externally furnished components
  - early benchmarking
  - inspections, compatibility analysis
- Shortfalls in externally performed tasks
  - pre-award audits
  - competitive designs
- Real-time performance shortfalls
  - targeted analysis
  - simulations, benchmarks, models
- Straining computer science capabilities
  - technical analysis
  - checking scientific literature

Principles of Measurement

Source: Adapted from Blum, 1992, p457-458
see also: van Vliet pp104-9

"You Cannot Control What You Cannot Measure"

➔ Types of Metric

- algorithmic vs. subjective
- process vs. product

➔ Good metrics are:

- simple (to collect and interpret)
- valid (measure what they purport to measure)
- robust (insensitive to manipulation)
- prescriptive
- analyzable

➔ 5 types of scale

- nominal (=, ≠ make sense; discrete categories)
- ordinal (<, >, =, make sense; e.g. oven temps: cool, warm, hot, very hot)
- interval (+, -, <, >, = make sense; e.g. temperature in centigrade)
- ratio (x, ÷, +, -, <, >, = make sense; e.g. temperature in Kelvin)
- absolute (a natural number count)

Some suggested metrics

Source: Adapted from Nusenoff & Bunde, 1993

- Plot planned and actual staffing levels over time
- Record number & type of code and test errors
- Plot number of resolved & unresolved problem reports over time
- Plot planned & actual number of units whose V&V is completed over time:
  - a) design reviews completed
  - b) unit tests completed
  - c) integration tests completed
- Plot software build size over time
- Plot average complexity for the 10% most complex units over time
  - (using some suitable measure of complexity)
- Plot new, modified and reused SLOCs for each CSCI over time
  - SLOC = Source Lines Of Code (decide how to count this!)
- Plot estimated schedule to completion based on deliveries achieved
  - (needs a detailed WBS and PERT or GANTT chart)

Summary

- Project management is difficult
- First Plan the project
  - Requires Work Breakdown Structure
  - Requires cost and effort data
- Then identify risks
  - Identify risk mitigation strategies
  - Try for risk prevention
- Keep Measuring Progress
  - Choose metrics that help track progress towards goals
  - Choose metrics that give early warning about risks

References

van Vliet, H. “Software Engineering: Principles and Practice (2nd Edition)” Wiley, 1999.

- van Vliet organizes this material differently from the way it is presented here, and provides a lot more detail on some aspects (especially people management and cost estimation). Chapter 2 provides a brief but excellent intro. Chapters 5, 6 and 8 are definitely worth reading at this stage in the course.

Blum, B. “Software Engineering: A Holistic View”. Oxford University Press, 1992.

Pfleeger, S. “Software Engineering: Theory and Practice”. Prentice Hall, 1997.

Nusenoff, R. and Bunde, D. “A Guidebook and a Spreadsheet Tool for a Corporate Metrics Program”. *Journal of Systems and Software*, Vol 23, pp245-255, 1993.

Boehm, B. “Software Risk Management”. IEEE Computer Society Press. 1989.

MPIAT - Mars Program Independent Assessment Team Summary Report, NASA JPL, March 14, 2000.

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