Project Management

OBJECTIVES

- To explain the main tasks undertaken by project managers
- To introduce software project management and to describe its distinctive characteristics
- To discuss project planning and the planning process
- To show how graphical schedule representations are used by project management
- To discuss the notion of risks and the risk management process

TOPICS COVERED

- Management activities
- Project planning
- Project scheduling
- Risk management

PROJECT MANAGEMENT – THE PROBLEM

- A KPMG survey of 256 companies indicated that only 14% of failures could be attributed to a company's inability to cope with technology. The other 86% were due to management problems:
  - improperly defined objectives (17 percent)
  - unfamiliar scope (17 percent)
  - lack of effective communication (20 percent)
  - poor project management skills (32 percent)

SOFTWARE PROJECT MANAGEMENT

- Concerned with activities involved in ensuring that software is delivered on time and on schedule and in accordance with the requirements of the organisations developing and procuring the software.
- Project management is needed because software development is always subject to budget and schedule constraints.

SOFTWARE MANAGEMENT DISTINCTIONS

- The product is intangible. Cannot see progress
- Software engineering (generally) is not recognized as an engineering discipline with the same status as mechanical, electrical engineering, etc.
- The software development process is not standardised (generally).
- Lessons learnt from previous projects may not be transferable to new projects.

THE 4 P'S OF PROJECT MANAGEMENT

-

- "Project management involves the planning, monitoring, and control of the people, process and events that occur as software evolves from preliminary concept to operational implementation." – Pressman, 2000
- Understand the four P's:
  - People – must be organized to work effectively
  - Product – must have effective communication with the customer to specify scope and requirements
  - Process – must be appropriate for people and product
  - Project – must estimate effort and time needed, define work products, establish quality checkpoints, establish methods to monitor and control work defined by plan

MANAGEMENT ACTIVITIES

- Proposal writing.
- Project planning, scheduling, and costing.
- Personnel selection and evaluation.
- Project monitoring and reviews.
- Report writing and presentations.

MANAGEMENT ACTIVITIES

- In general, these activities are not peculiar to software management.
- Many techniques of engineering project management are equally applicable to software project management.
- Technically complex engineering systems tend to suffer from the same problems as software systems.

MANAGEMENT ACTIVITIES

- Proposal writing:
  - Outside software engineering (still, much in parallel with feasibility report writing)
  - Describe the objectives of the project and how it will be carried out.
  - Usually includes cost and schedule estimates
  - Justifies why the project should be assigned/undertaken
  - Proposal writing is a skill that is acquired through practice and experience.

MANAGEMENT ACTIVITIES

- Project planning:
  - Identifying the activities, milestones, and deliverables produced by a project.
  - Guide the development to project goals.
  - A related activity is cost estimation & Scheduling of required resources

PROJECT PLANNING

- Probably the most time-consuming project management activity.
- Continuous activity from initial concept through to system delivery. Plans must be regularly revised as new information becomes available.
- Various different types of plan may be developed to support the main software Project Plan that is concerned with schedule and budget.

TYPES OF PLANS

Plan	Description
Quality plan	Describes the quality procedures and standards that will be used in a project. See Chapter 27.
Validation plan	Describes the approach, resources and schedule used for system validation. See Chapter 22.
Configuration management plan	Describes the configuration management procedures and structures to be used. See Chapter 29.
Maintenance plan	Predicts the maintenance requirements of the system, maintenance costs and effort required. See Chapter 21.
Staff development plan.	Describes how the skills and experience of the project team members will be developed. See Chapter 25.

THE PROJECT (DEVELOPMENT) PLAN

- The project plan sets out:
  - –The resources available to the project;
  - –The work breakdown;
  - –A schedule for the work.

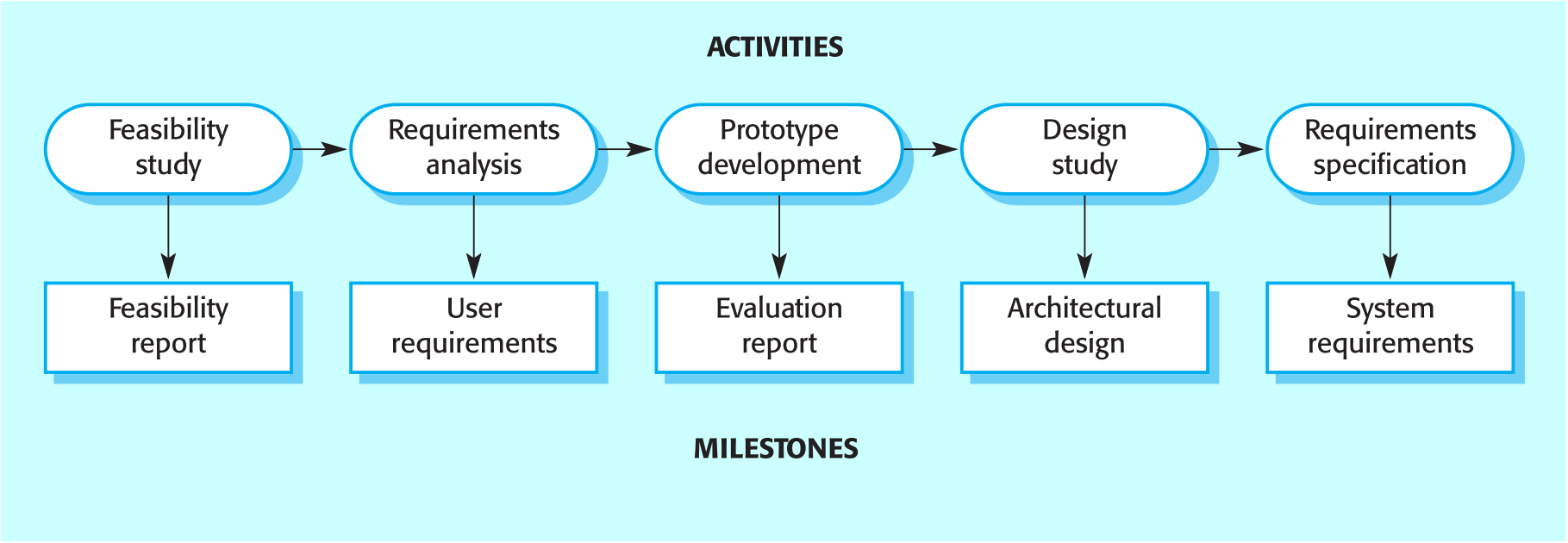
PROJECT (DEVELOPMENT) PLAN STRUCTURE

- Introduction: Objectives, constraints
- Project organisation: People, roles
- Risk analysis: Strategies
- Hardware and software resource requirements: Procurement plans, cost, schedule of delivery
- Work breakdown: Milestones and deliverables
- Project schedule: Task dependencies
- Monitoring and reporting mechanisms: Schedule of reports, types, how to evaluate progress

ACTIVITY ORGANIZATION

- Activities in a project should be organised to produce tangible outputs for management to judge progress.
- *Milestones* are the end-point of a process activity.
- *Deliverables* are project results delivered to customers.

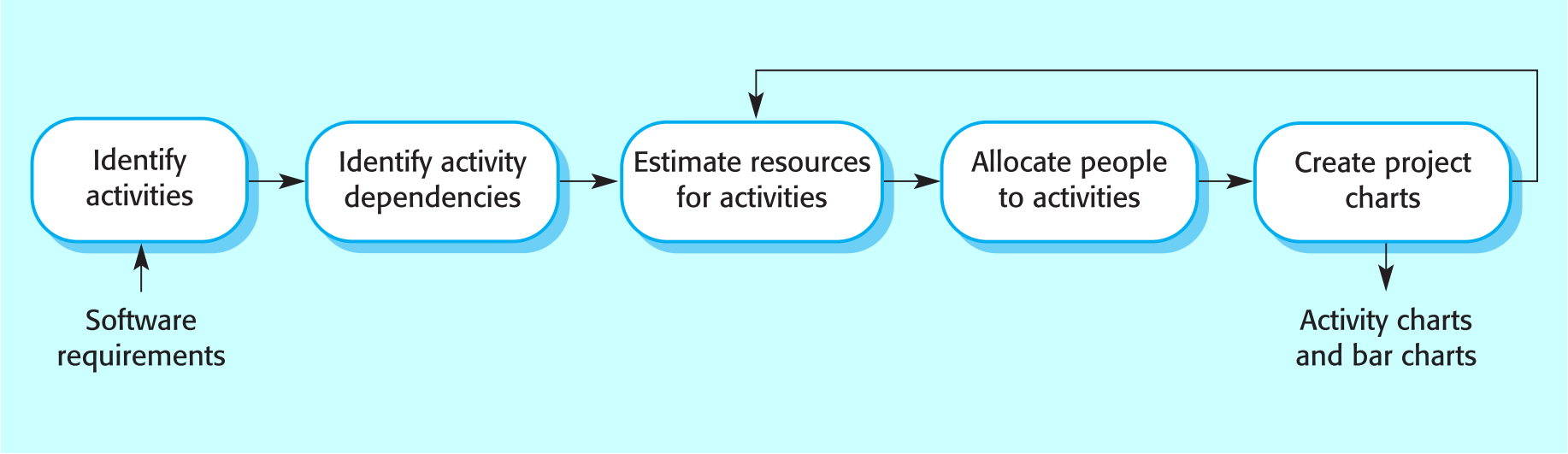
EXAMPLE: MILESTONES IN THE RE PROCESS



PROJECT SCHEDULING

- Split project into tasks and estimate time and resources required to complete each task.
- Organize tasks concurrently to make optimal use of workforce.
- Minimize task dependencies to avoid delays caused by one task waiting for another to complete.
- Dependent on project managers intuition and experience.

THE PROJECT SCHEDULING PROCESS



SCHEDULING PROBLEMS

- Estimating the difficulty of problems and hence the cost of developing a solution is hard.
- Productivity is not proportional to the number of people working on a task.
- Adding people to a late project makes it later because of communication overheads.
- The unexpected always happens. Always allow contingency in planning.

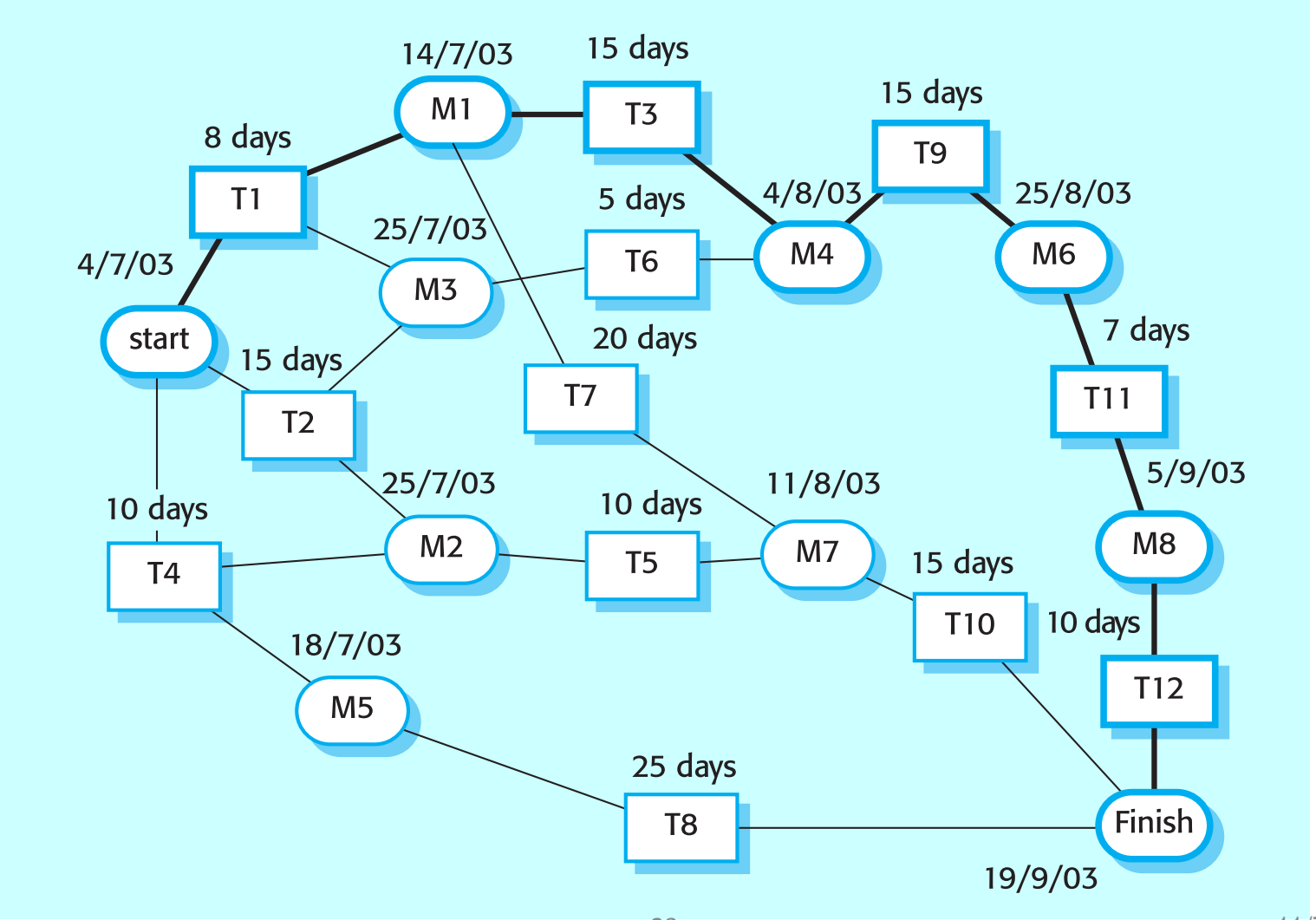
BAR CHARTS AND ACTIVITY NETWORKS

- Graphical notations used to illustrate the project schedule.
- Show project breakdown into tasks. Tasks should not be too small. They should take about a week or two.
- Activity charts show task dependencies and the critical path.
- Bar charts show schedule against calendar time.

TASK DURATIONS AND DEPENDENCIES

Activity	Duration (days)	Dependencies
T1	8	
T2	15	
T3	15	T1 (M1)
T4	10	
T5	10	T2, T4 (M2)
T6	5	T1, T2 (M3)
T7	20	T1 (M1)
T8	25	T4 (M5)
T9	15	T3, T6 (M4)
T10	15	T5, T7 (M7)
T11	7	T9 (M6)
T12	10	T11 (M8)

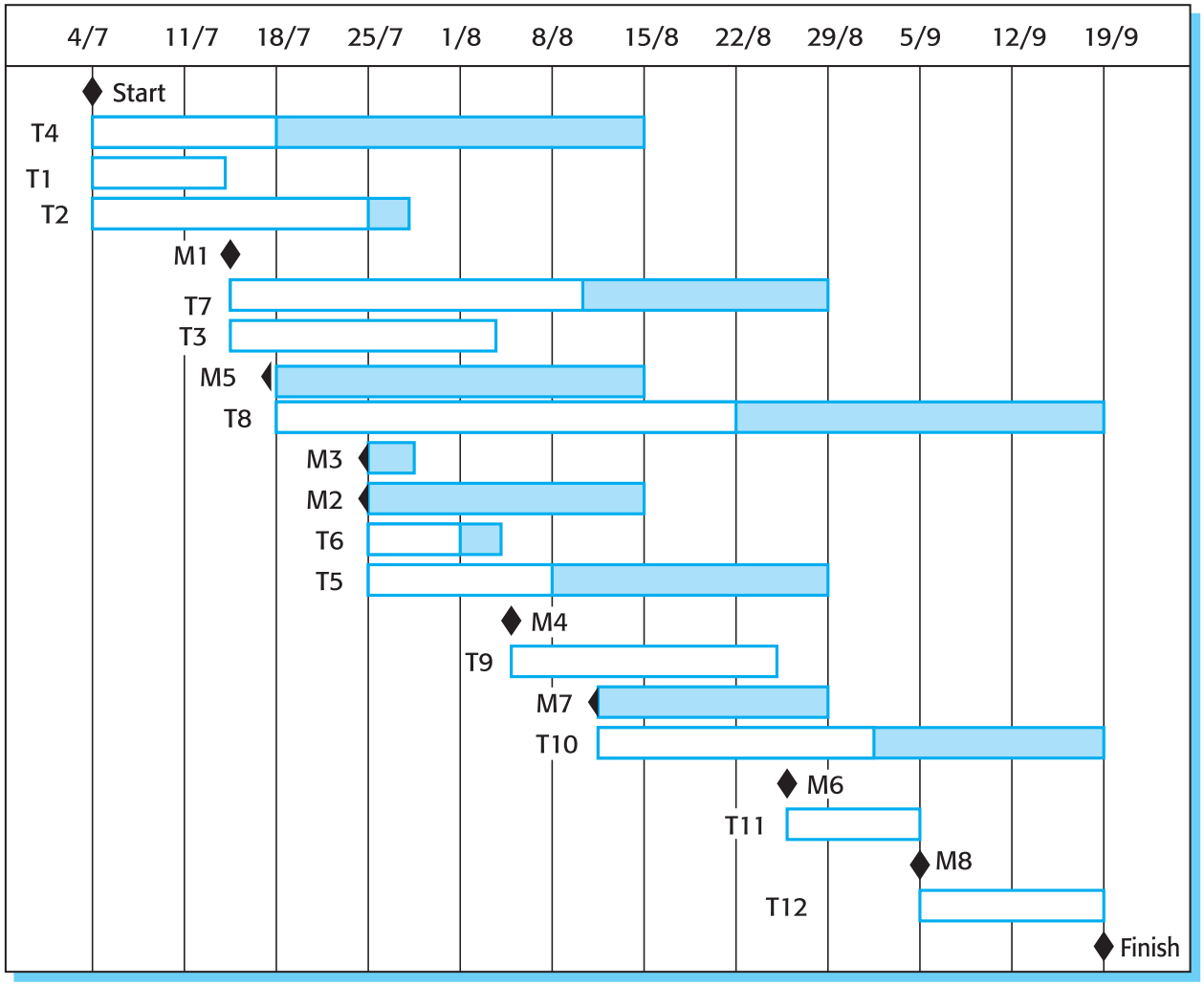
ACTIVITY NETWORK



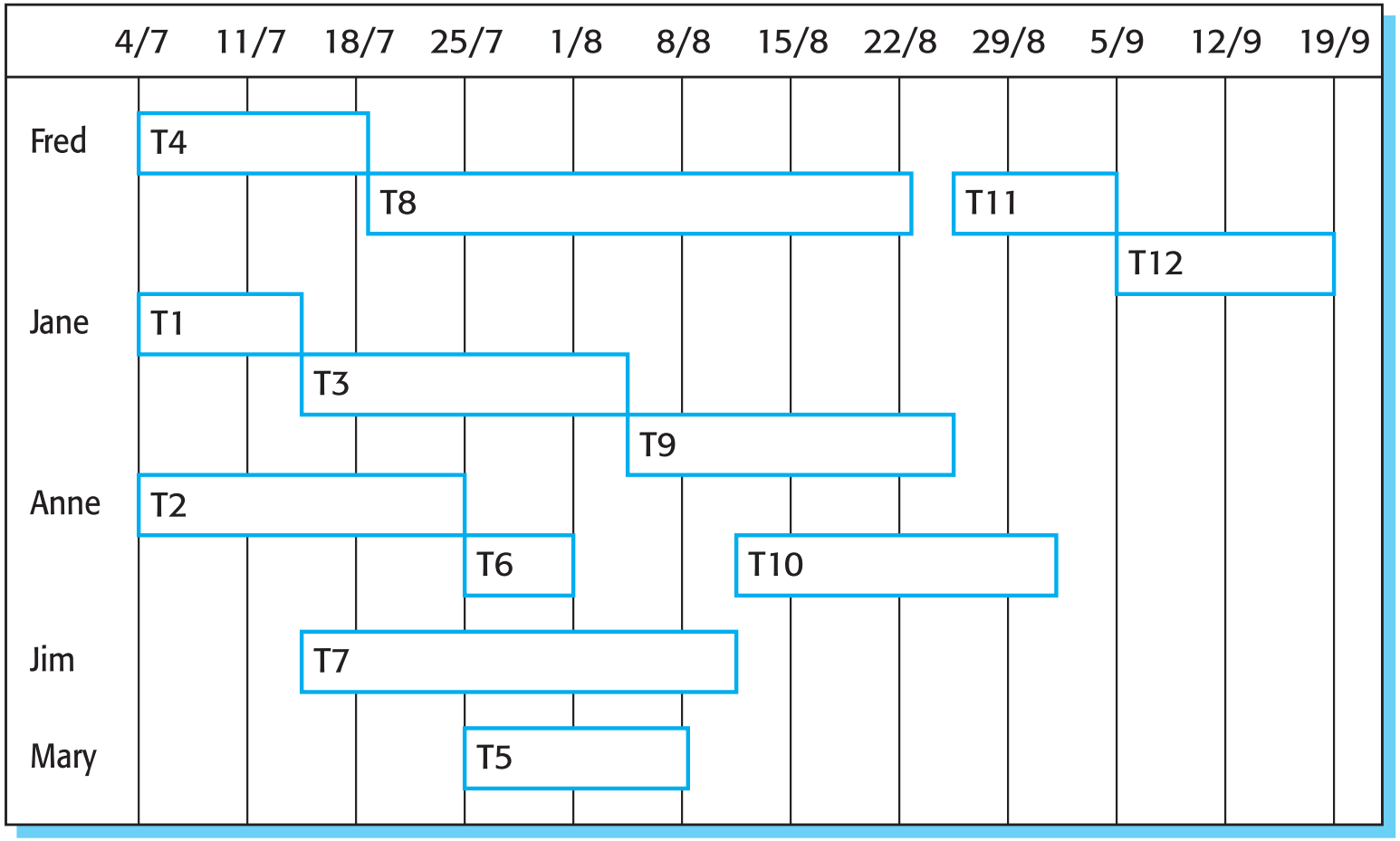
CRITICAL PATH

- The longest path in the activity network.
- The minimum time for the project to complete.
- T1,T3,T9,T11,T12
- 55 days

ACTIVITY TIMELINE



STAFF ALLOCATION



RISK MANAGEMENT

- Identifying risks and drawing up plans to minimise their effect on a project.
- A risk is a probability that some adverse circumstance will occur
  - Project risks affect schedule or resources;
  - Product risks affect the quality or performance of the software being developed;
  - Business risks affect the organisation developing or procuring the software.

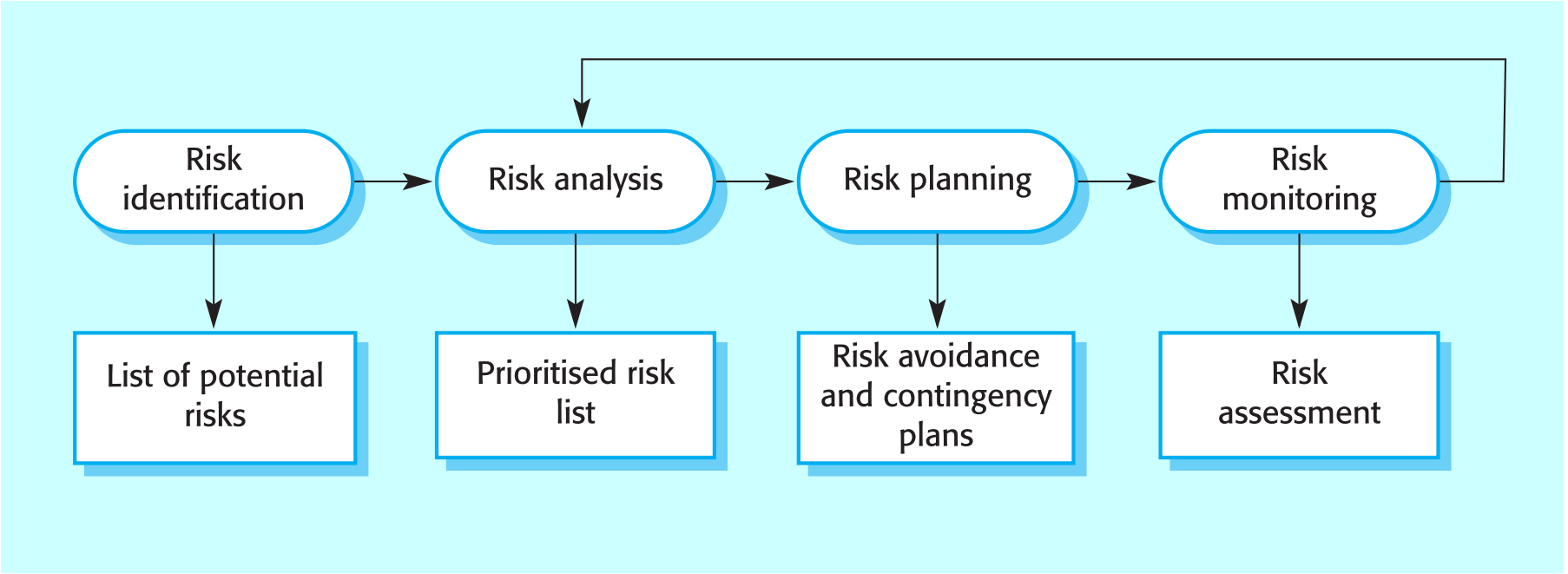
SOME COMMON SOFTWARE RISKS

Risk	Affects	Description
Staff turnover	Project	Experienced staff will leave the project before it is finished.
Management change	Project	There will be a change of organisational management with different priorities.
Hardware unavailability	Project	Hardware that is essential for the project will not be delivered on schedule.
Requirements change	Project and product	There will be a larger number of changes to the requirements than anticipated.
Specification delays	Project and product	Specifications of essential interfaces are not available on schedule
Size underestimate	Project and product	The size of the system has been underestimated.
CASE tool under-performance	Product	CASE tools which support the project do not perform as anticipated
Technology change	Business	The underlying technology on which the system is built is superseded by new technology.
Product competition	Business	A competitive product is marketed before the system is completed.

THE RISK MANAGEMENT PROCESS

- Risk identification
  - Identify project, product and business risks;
- Risk analysis
  - Assess the likelihood and consequences of these risks;
- Risk planning
  - Draw up plans to avoid or minimise the effects of the risk;
- Risk monitoring
  - Monitor the risks throughout the project;

THE RISK MANAGEMENT PROCESS



RISK IDENTIFICATION

- Technology risks.
- People risks.
- Organisational risks.
- Requirements risks.
- Estimation risks.

RISKS AND RISK TYPES

Risk type	Possible risks
Technology	The database used in the system cannot process as many transactions per second as expected. Software components that should be reused contain defects that limit their functionality.
People	It is impossible to recruit staff with the skills required. Key staff are ill and unavailable at critical times. Required training for staff is not available.
Organisational	The organisation is restructured so that different management are responsible for the project. Organisational financial problems force reductions in the project budget.
Tools	The code generated by CASE tools is inefficient. CASE tools cannot be integrated.
Requirements	Changes to requirements that require major design rework are proposed. Customers fail to understand the impact of requirements changes.
Estimation	The time required to develop the software is underestimated. The rate of defect repair is underestimated. The size of the software is underestimated.

RISK ANALYSIS

- Assess probability and seriousness of each risk.
- Probability may be very low, low, moderate, high or very high.
- Risk effects might be catastrophic, serious, tolerable or insignificant.
- Remember the 80/20 rule - 80%of the impact will come from 20% of the risks

RISK ANALYSIS (I)

Risk	Probability	Effects
Organisational financial problems force reductions in the project budget.	Low	Catastrophic
It is impossible to recruit staff with the skills required for the project.	High	Catastrophic
Key staff are ill at critical times in the project.	Moderate	Serious
Software components that should be reused contain defects which limit their functionality.	Moderate	Serious
Changes to requirements that require major design rework are proposed.	Moderate	Serious
The organisation is restructured so that different management are responsible for the project.	Low	Serious

RISK ANALYSIS (II)

Risk	Probability	Effects
The database used in the system cannot process as many transactions per second as expec ted.	Moderate	Serious
The time required to develop the software is underestimated.	High	Serious
CASE tools cannot be integrated.	High	Tolerable
Customers fail to understand the impact of requirements changes.	Moderate	Tolerable
Required training for staff is not available.	Moderate	Tolerable
The rate of defect repair is underestimated.	Moderate	Tolerable
The size of the software is underestimated.	High	Tolerable
The code generated by CASE tools is inefficient.	Moderate	Insignificant

RISK PRIORITIZATION

- With single values for probabilities and effects:

  Risk exposure (RE) = risk probability * risk effect

- RE is the expected value of loss for a risk
- Prioritization can be done based on risk exposure value
- Plans can be made to handle high RE risks

RISK PRIORITIZATION

- With value ranges for probabilities and effects:
  - Classify risk occurrence probabilities as: Low, Medium, High
  - Classify risk impact as: Low, Medium, High
  - Identify those that are HH, or HM/MH
  - Focus on these for risk mitigation
  - Will work for most small and medium sized projects

MCFARLAN'S RISK ASSESSMENT METHOD

- Relies upon examining three factors of a project
- Measurement conducted via a questionnaire
- Questionnaires based upon the past experience of the organization

MCFARLAN'S THREE FACTORS

1. Project Size
   - the larger the project, the greater the risk
   - project size is relative to the experience of the software development group
2. Experience with the Technology
   - the less experience the software development group has had with the technology used, the greater the risk
3. Project Structure
   - How well-defined are the requirements of the project and how liable are they to change
   - High structure where requirements are well-defined and stable, indicates lower risk

METHOD: ESTIMATING PROJECT RISK

		LOW STRUCTURE	HIGH STRUCTURE
LOW COMPANY-RELATIVE TECHNOLOGY	Large Project	Low risk (very susceptible to mismanagement)	Low risk
	Small Project	Low risk (very susceptible to mismanagement)	Very low risk
HIGH COMPANY-RELATIVE TECHNOLOGY	Large Project	Very high risk	Medium risk
	Small Project	High risk	Medium- low risk

RISK PLANNING

- Consider each risk and develop a strategy to manage that risk.
  - Avoidance strategies
  - Minimisation strategies
  - Contingency plans

RISK MANAGEMENT STRATEGIES (I)

Risk	Strategy
Organisational financial problems	Prepare a briefing document for senior management showing how the project is making a very important contribution to the goals of the business.
Recruitment problems	Alert customer of potential difficulties and the possibility of delays, investigate buying-in components.
Staff illness	Reorganise team so that there is more overlap of work and people therefore understand each other's jobs.
Defective components	Replace potentially defective components with bought-in components of known reliability.

RISK MANAGEMENT STRATEGIES (II)

Risk	Strategy
Requirements changes	Derive traceability information to assess requirements change impact
Organisational restructuring	Prepare a briefing document for senior management showing how the project is making a very important contribution to the goals of the business.
Database performance	Investigate the possibility of buying a higher-performance database.
Underestimated development time	Investigate buying in components, investigate use of a program generator

RISK CONTROL

- Can the risk be avoided?
  - E.g. if new hardware is a risk, it can be avoided by working with proven hardware
- otherwise, risk mitigation steps need to be planned and executed
  - Actions taken in the project such that if the risk materializes, its impact is minimal
  - Involves extra cost

RISK MITIGATION EXAMPLES

- Too many requirement changes
  - Convince client that changes in requirements will have an impact on the schedule
  - Define a procedure for requirement changes
  - Maintain cumulative impact of changes and make it visible to client
  - Negotiate payment on actual effort.

EXAMPLES ...

- Manpower attrition
  - Ensure that multiple resources are assigned on key project areas
  - Have team building sessions
  - Rotate jobs among team members
  - Keep backup resources in the project
  - Maintain documentation of individual's work

RISK MONITORING

- Assess each identified risk regularly to decide whether or not it is becoming less or more probable.
- Also assess whether the effects of the risk have changed.
- Each key risk should be discussed at management progress meetings.

RISK INDICATORS

Risk type	Potential indicators
Technology	Late delivery of hardware or support software, many reported technology problems
People	Poor staff morale, poor relationships amongst team member, job availability
Organisational	Organisational gossip, lack of action by senior management
Tools	Reluctance by team members to use tools, complaints about CASE tools, demands for higher-powered workstations
Requirements	Many requirements change requests, customer complaints
Estimation	Failure to meet agreed schedule, failure to clear reported defects

MANAGEMENT ACTIVITIES

- Project monitoring:
  - A continuing activity
  - Keep track of progress and compare with planned progress and cost
  - Informal: e.g. daily discussions with project staff
  - Formal reviews

MANAGEMENT ACTIVITIES

- Personnel Selection:
  - May not be possible to appoint the ideal people to work on a project
    - Project budget may not allow for the use of highly-paid staff;
    - Staff with the appropriate experience may not be available;
    - An organisation may wish to develop employee skills on a software project.
  - Managers have to work within these constraints especially when there are shortages of trained staff.

MANAGEMENT ACTIVITIES

- Report writing and presentations:
  - Oral as well as written
  - Write concise, coherent documents at different levels of detail

KEY POINTS

- Good project management is essential for project success.
- The intangible nature of software causes problems for management.
- Managers have diverse roles but their most significant activities are planning, estimating and scheduling.
- Planning and estimation are iterative processes which continue throughout the course of a project.

KEY POINTS

- A project milestone is a predictable state where a formal report of progress is presented to management.
- Project scheduling involves preparing various graphical representations showing project activities, their durations and staffing.
- Risk management is concerned with identifying risks which may affect the project, and planning to ensure that these risks do not develop into major threats.

SELF STUDY

- IEEE standard 1058 for **Software Project Management Plans** (copy provided)