Project management

Objectives

1. To explain the main tasks undertaken by project managers
2. Understand why the nature of software makes software project management more difficult than other engineering project management;
3. Understand the need for project planning in all software projects;
4. To show how graphical schedule representations (bar charts and activity charts) are used by project management
5. To discuss the notion (conception) of risks management and some of the risks that can arise in software projects.

Topics covered

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

Software project management

- Software project management is an essential part of software engineering.
- Good management cannot guarantee project success. However, bad management usually results in project failure.
- Software managers supervise the work to ensure that it is carried out to the required standards and monitor progress to check that the development is on time and within budget.
- Software project manager’s job is to ensure that the software project meets these constraints (the budget and schedule constraints from organizational requirement) and delivers software that contributes to the goals of the company developing the software.

Software management distinctions (compare other type of engineering)

1. The product is intangible (not easily to expressed)
   - It cannot be seen or touched. Software project managers cannot see progress, it unlike other shipbuilding or civil engineering project are visible, only rely on the documentation to review progress.
2. The software development process is not standardized.
   - In engineering disciplines with a long history, so the engineering process for some types of system, such as bridges and buildings is well understood their process and tested. However, software processes vary dramatically from one organization to another, this is especially true when the software project is part of a wider systems engineering project.
3. Many software projects are 'one-off' projects.
   - Large software projects are usually different in some ways from previous projects. Therefore, we can see it may difficult to anticipate (expect) problems. Furthermore, rapid technological changes in computers and communications can make a manager's experience **ob**solete (gone out of use) .

- Software systems are often new and technically innovative.
- Even engineering projects that are innovative (such as new transport systems) often also have schedule problems.
- Because of above problems, it is not surprising that some software projects are late, over budget and behind schedule.

5.1 Management activities

1. Proposal writing.
2. Project planning and scheduling.
3. Project costing.
4. Project monitoring and reviews.
5. Personnel selection and evaluation.
6. Report writing and presentations.

Proposal writing

- The first stage in a software project may involve writing a proposal to win a contract to carry out the work.
- Proposal writing is a critical task as the existence of many software organizations depends on having enough proposals accepted and contracts awarded.
- Proposal need to describes the objectives of the project and how it will be carried out. It usually includes cost and schedule estimates, and justifies why the project contract should be awarded to a particular organization or team.

Project staffing

- 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.

5.2 Project planning

- Effective management of a software project depends on thoroughly planning the progress of the project.
- Managers must anticipate problems that might arise and prepare alternative solutions to those problems.
- Manager may also have to draw up other types of plans. These are briefly described in Figure 5.1.

Types of project plan

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.

Figure 5.1

Project planning process

- The pseudo-code (fictitious-code) sown in Figure 5.2 set out a project planning process for software development.
- It shows that planning is an iterative process, which is only complete when the project itself is complete.
- As project information becomes available during the project, the plan should be regularly re**vi**sed (correct).
- The goals of the business are an important factor that must be considered when formulating (state in definite terms) the project plan. When the project's goals change so changes to the project plan are necessary.

Project planning process

```
Establish the project constraints
Make initial assessments of the project parameters
Define project milestones and deliverables
while project has not been completed or cancelled loop
        Draw up project schedule
        Initiate activities according to schedule
        Wait ( for a while )
        Review project progress
        Revise estimates of project parameters
        Update the project schedule
        Re-negotiate project constraints and deliverables
        if ( problems arise ) then
                Initiate technical review and possible revision
        end if
end loop
```

Figure 5.2

Project planning process

1. Begin of a planning process, should assess the constraints (required delivery date, staff available, overall budget, etc) affecting the project.
2. In conjunction with this, you should estimate project parameters such as its structure size, and distribution of functions.
3. Next you define the progress milestones and result deliverables.
4. Then process enters a loop
5. Draw up an estimated schedule for the project and the activities defined in the schedule are started or given permission to continue.
6. After some time (usually about two to three weeks), you should review progress and note inconsistency from planned schedule.
7. Because initial estimates of project parameters are trial (tentative), you will always have to modify the original plan.

8. As more information becomes available, you revise your original assumptions about the project and the project schedule.
9. If the project is delayed, you may have to renegotiate the project constraints and deliverables with the customer.
10. If renegotiation is unsuccessful and the schedule cannot be met, a project technical review may be held. The objective of this review is to find an alternative approach that falls within the project constrains and meets the schedule.

- Should never assume that everything will always to well. Problems always arise during a project. Your initial assumptions and scheduling should be pessimistic rather than optimistic. there should have sufficient space to allow con**tin**gency (accident) built into your plan so you do not need to renegotiated the constraints and milestones every time when round the planning loop.

5.2.1 The project plan

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

5.2.1 Project plan structure

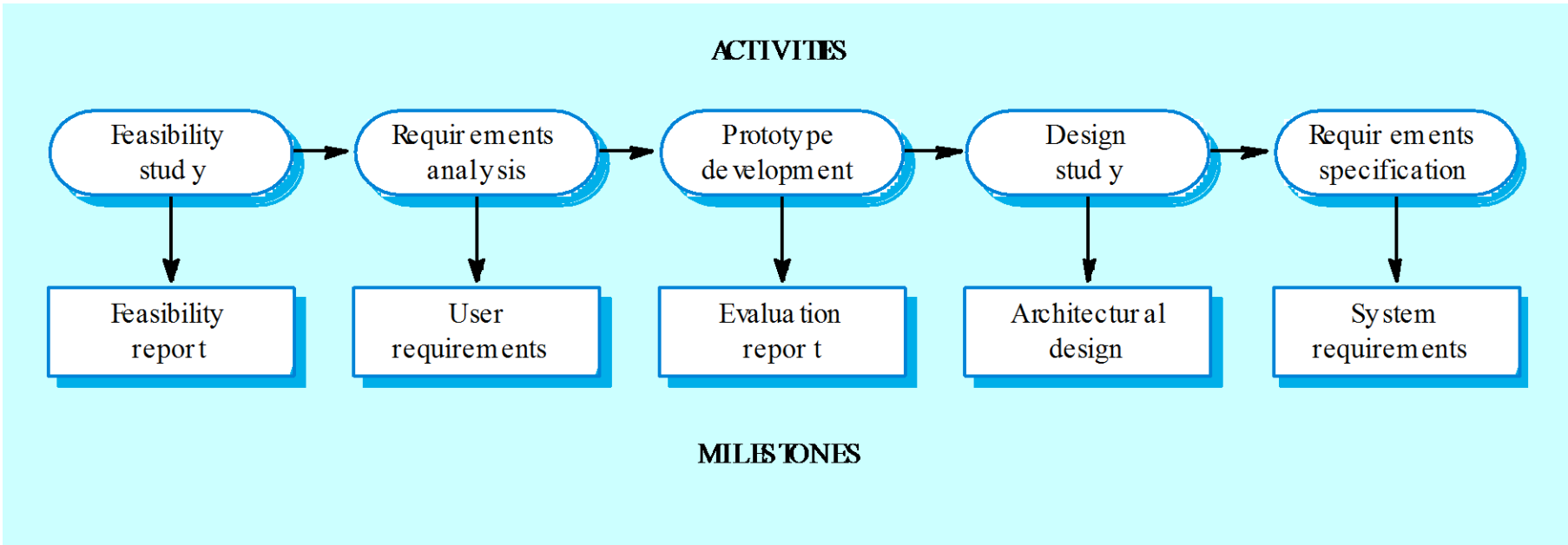
1. Introduction.
   - The briefly describes the objectives of the project and sets out the constraints (e.g., budget, time etc.) that effect the project management.
2. Project organisation.
   - Describes the way of development team is organized, the people involved and their roles in the team.
3. Risk analysis.
   - Describes possible project risks, the probability of these risks arising and the risk reduction strategies that are proposed (suggest).

4. Hardware and software resource requirements.
   - Specifies the hardware and support software required to carry out the development. If hardware has to be bought, estimates of the prices and the delivery schedule may be included.
5. Work breakdown.
   - Set out the breakdown of the project into activities and identifies the milestones and deliverables (achievement) with each activity.
6. Project schedule.
   - Show the dependencies between activities, the estimated time required to reach each milestone and allocation of people to activities.
7. Monitoring and reporting mechanisms.
   - This defines the management reports that should be produced, when these should be produced and the project monitoring mechanisms used

5.2.2 Activity Milestone Deliverable

- 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. At each milestone, there should be a formal output, such as a report, that can be presented to management.
- *Deliverables* are project results delivered to customers.
- The waterfall process allows for the straightforward definition of progress milestones.

Milestones in the RE process

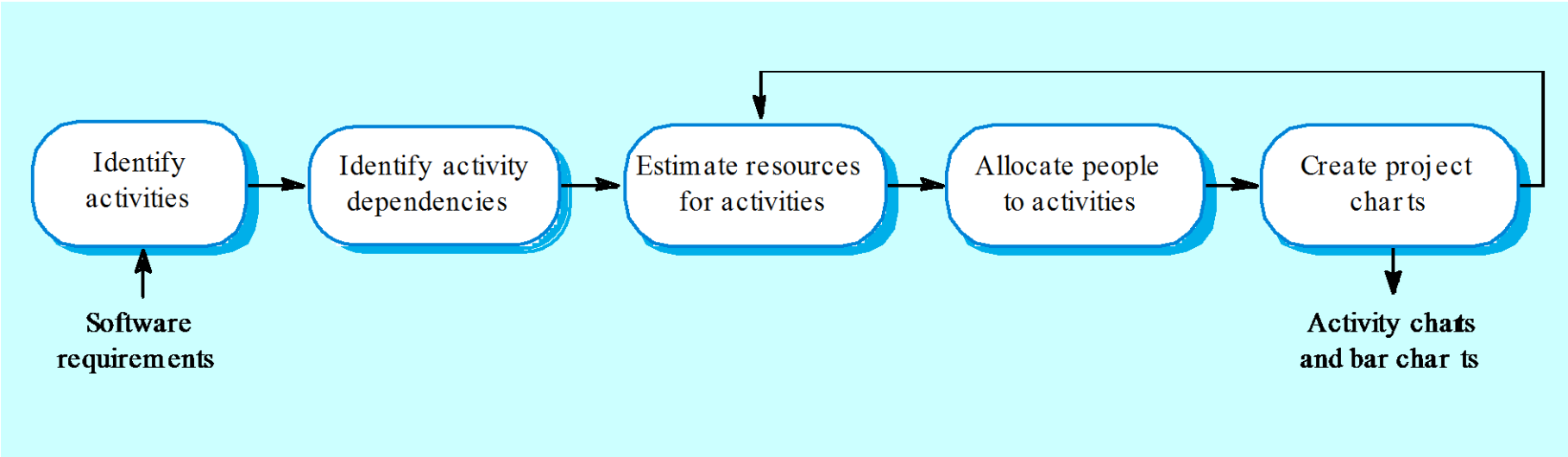


Feasibility (practicability)

5.3 Project scheduling

1. Split project into tasks and estimate time and resources required to complete each task.
2. Managers estimate the time and resources required to complete activities and organize them into a sequence.
3. Minimize task dependencies to avoid delays caused by one task waiting for another to complete.
4. Project activities should normally last at least a week, but no more than 8 to 10 weeks.
5. Also have to estimate the resources needed to complete each task. The principal resource is the human **ef**fort required.
6. Other resources may be the disk space required on a server, the time required on specialised hardware such as a simulator, and the travel budget required for project staff.
7. According to experience of the software engineers working on the project. Add 30% to original estimate for anticipated problems then other 20% to cover things that hadn’t thought of.

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 (accident) in planning.

5.3.1 Bar charts and activity networks

- Both Chars are 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.
- Bar charts show who is responsible for each activity and when the activity is scheduled to begin and end.
- Activity networks show task dependencies between the different activities and the the critical path.

Bar charts (Gantt chart 甘特圖) and activity charts can be generated automatically from a database of project information using a project management tool.

Figure 5.5

- In the next Figure 5.5, the table shows activities, their duration, and activity interdependencies, we can see that activity T3 is dependent on Activity T1. this means that T1 must be completed before T3 starts. For example T1 might be the preparation of a component design and T3 the implementation of that design. Before implementation start, the design should be complete then result a M1 Milestone.

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)

Figure 5.5

Figure 5.6

1. Given the dependencies and estimated duration of activities, then can generated (Figure 5.6)
2. This shows which activities can be carried out in parallel and which must be executed in sequence because of a dependency on an earlier activity.
3. Activities are represented as rectangles; milestones and project deliverables are shown with rounded corners.
4. Before progress can be made from one milestone to another, all paths leading to it must be complete. For example, when activities T3 and T6 are finished, then activity T9 can start.

Figure 5.6

5. The minimum time required to finish the project can be estimated by considering the longest path in the activity graph (critical path), in this case, it is 11 weeks or 55 days
6. Any make late in the completion in any critical activity cause project delays because the following activities cannot start until the delayed activity has been completed.
7. However, delays in activities that do not lie on the critical path so not necessarily cause an overall schedule slippage, if the delays time don’t over the total time of critical path.

Activity network

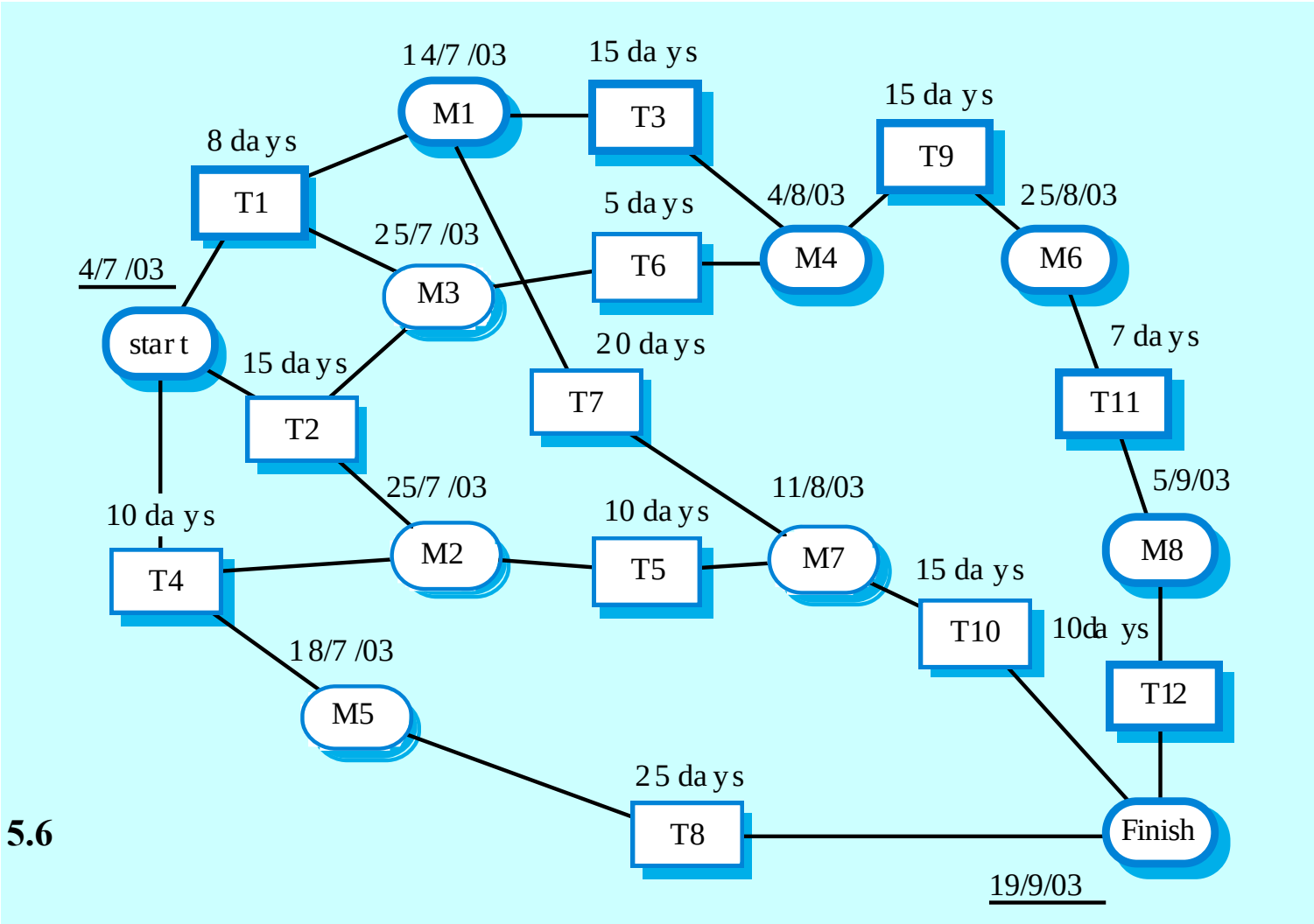


Figure 5.6

Figure 5.7

- Is a bar chart (Gantt chart) showing a project calendar and the start and finish dates of activities. Reading from left to right, the bar chart clearly shows when activities start and end.
- Some of the activities shown in the bar chart in Figure 5.7 are followed by a shaded bar. This highlights the flexibility in the completion date of these activities.
- Activities that lie on the critical path have no any flexibility because they have no associated shaded bar.

Activity timeline

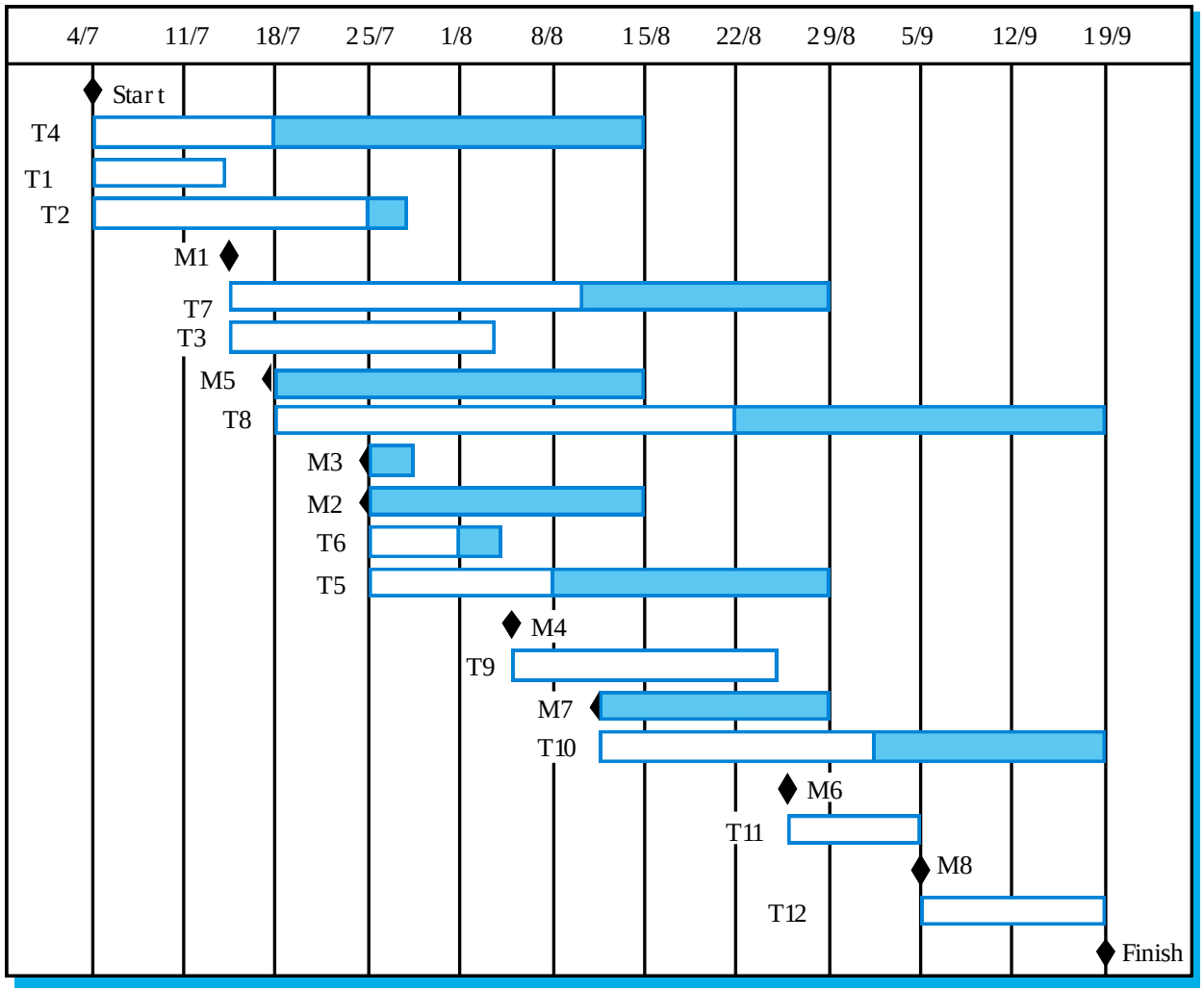
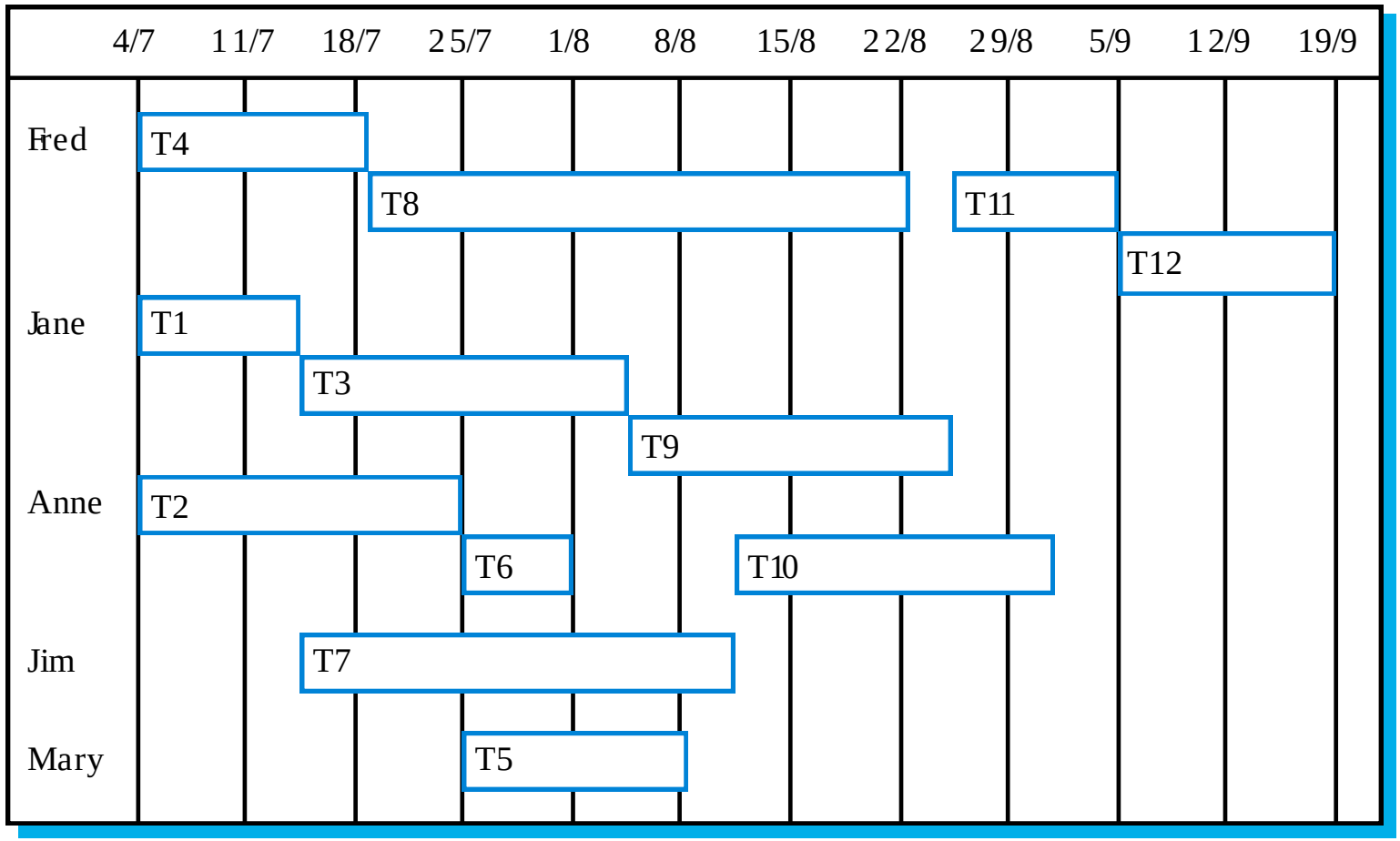


Figure 5.7

Staff allocation

Staff allocation



Risk management

- Risk management is concerned with 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.

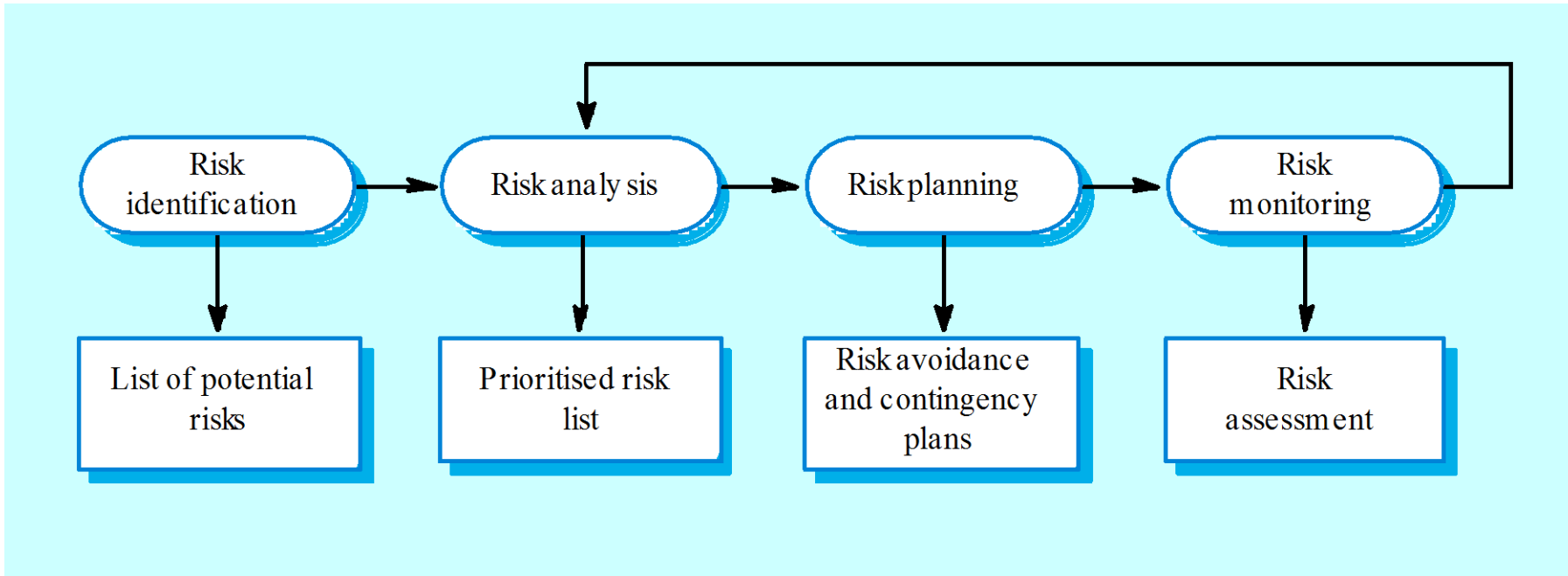
Software risks

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.

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.	High	Serious

Risk analysis (ii)

Risk	Probability	Effects
The database used in the system cannot process as many transactions per second as expected.	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 planning

- Consider each risk and develop a strategy to manage that risk.
- Avoidance strategies
  - The probability that the risk will arise is reduced;
- Minimisation strategies
  - The impact of the risk on the project or product will be reduced;
- Contingency plans
  - If the risk arises, contingency plans are plans to deal with that risk;

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, maximise information hiding in the design.
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 monitoring

- Assess each identified risks 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

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 estimating 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.