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# Project Management

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# Objectives

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- 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

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1. Management activities
2. Project planning
3. Project scheduling
4. Risk management

# Software project management

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

# Software management distinctions

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- The product is *intangible*.
- The product is uniquely *flexible*.
- Software engineering is not recognized as an engineering discipline with the same status as mechanical, electrical engineering, etc.
- The software development process is not standardized.
- Many software projects are '*one-off*' projects.

# 1. Management activities

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

# Management commonalities

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- 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.

# Project staffing

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- **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 organization 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.**



## 2. Project planning

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- 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 project plan

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

# Project planning process

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Establish the project constraints  (delivery data, staff available, budget etc.)
Make initial assessments of the project parameters  (project structure, size,
Define project milestones and deliverables  distribution of functions, etc.)
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
    
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# The project plan

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

# Project plan structure

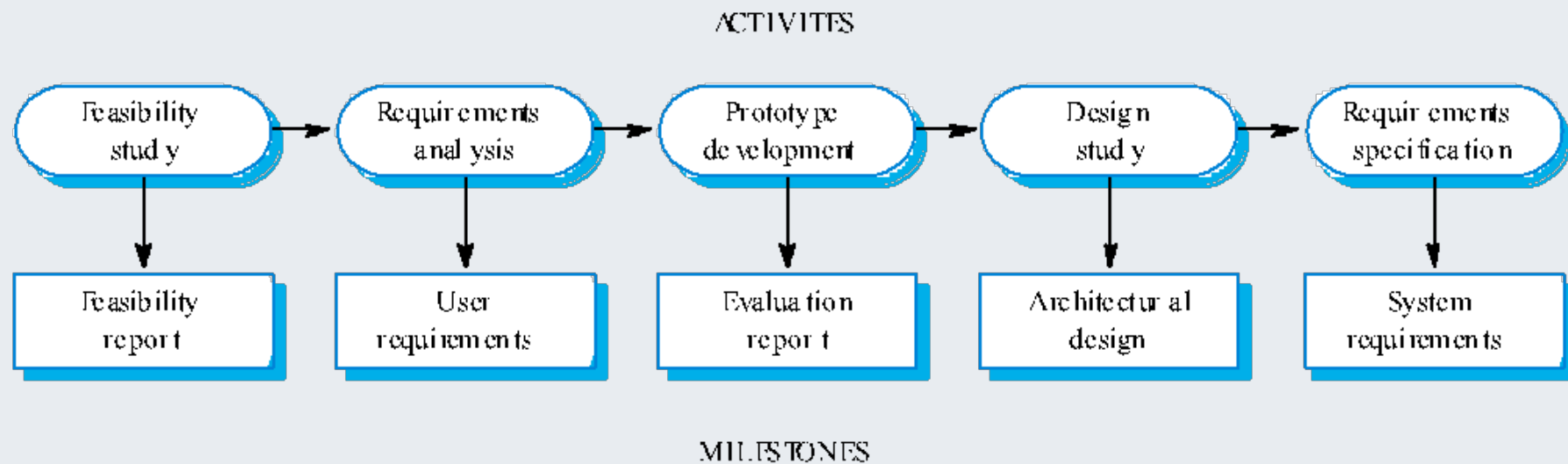
- **Introduction:** objectives of the project, constraints etc
- **Project organization:** development team (people, roles)
- **Risk analysis:** possible risks, likelihood, reduction strategies
- **Hardware and software resource requirements:** H/W, S/W for development, if buy, its price and delivery time
- **Work breakdown:** breakdown of the project into activities and milestones, deliverables
- **Project schedule:** dependencies between activities, estimate time for each milestone and the allocation of people to activities
- **Monitoring and reporting mechanisms:** management reports which should be produced, when these should be produced and the project monitoring mechanism used

# Activity organization

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- Activities in a project should be organized 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.
- The waterfall process allows for the straightforward definition of progress milestones.

# Milestones in the RE process



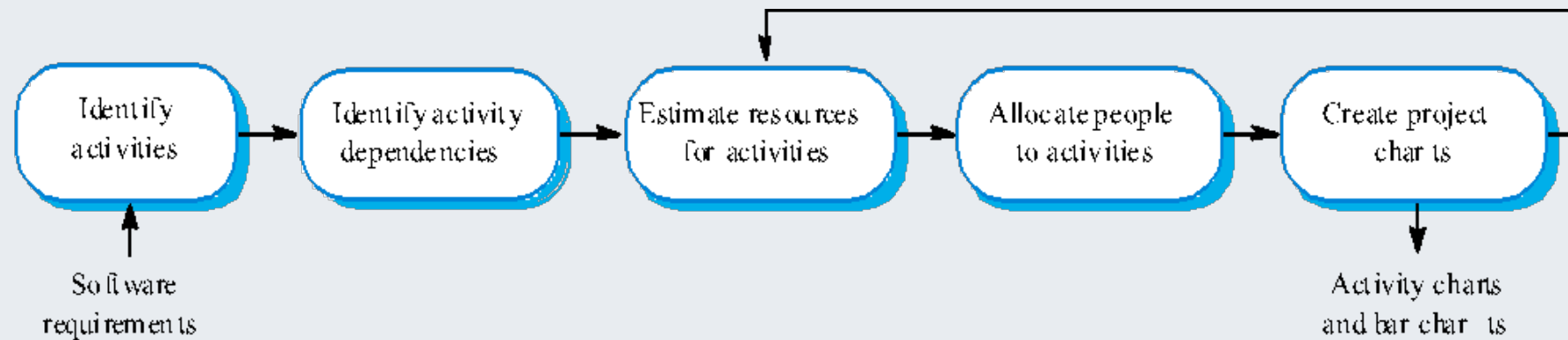
### 3. Project scheduling

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- 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

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- 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.(Brook's law)
- The unexpected always happens. Always allow contingency in planning.

# Bar charts and activity networks

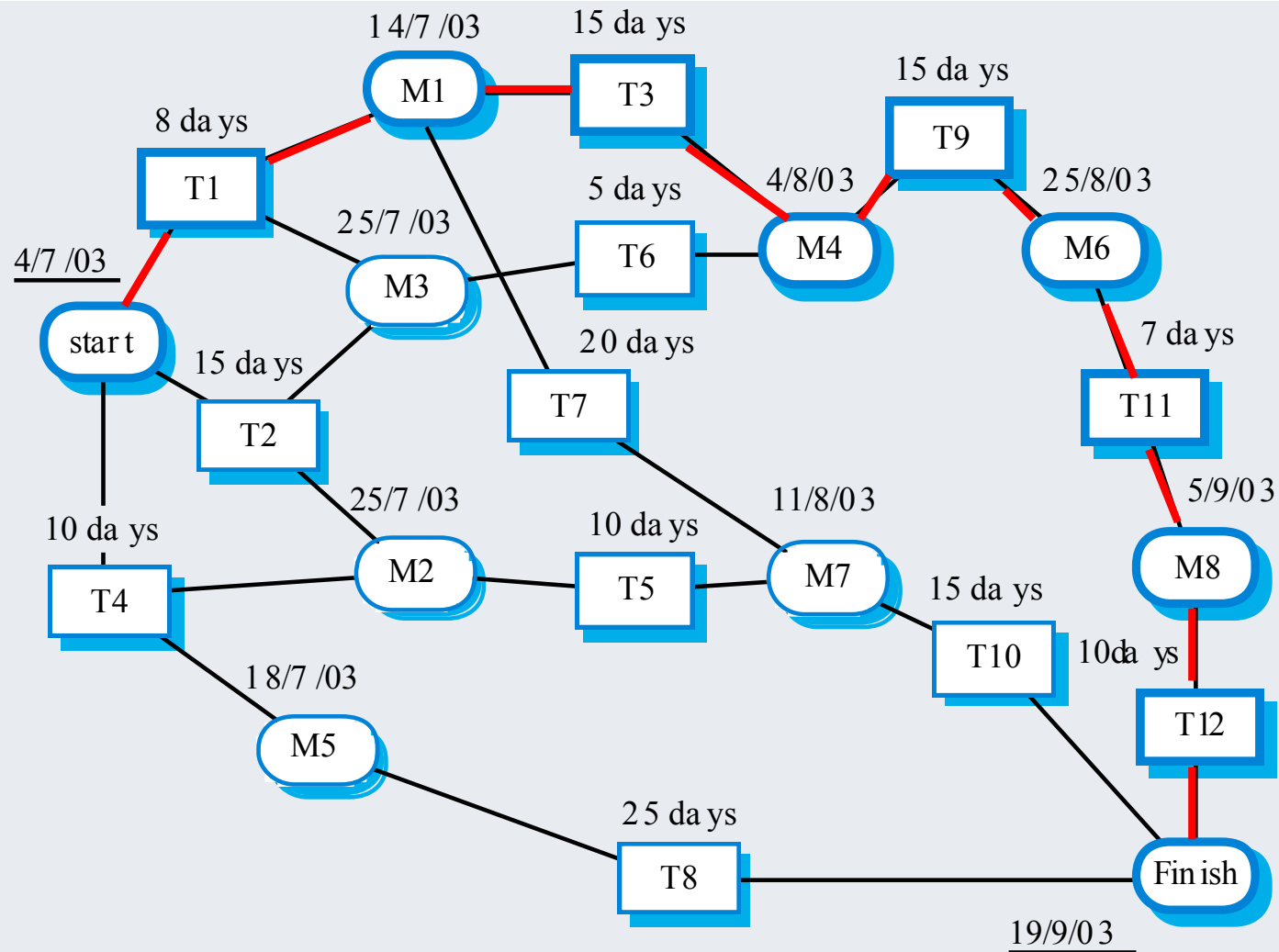
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- Graphical notations used to illustrate the project schedule.
- Show project breakdown into tasks. Tasks should not be too small. They should take about *a week or two*.
- **Activity charts** show task dependencies and the *critical path*.
- **Bar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

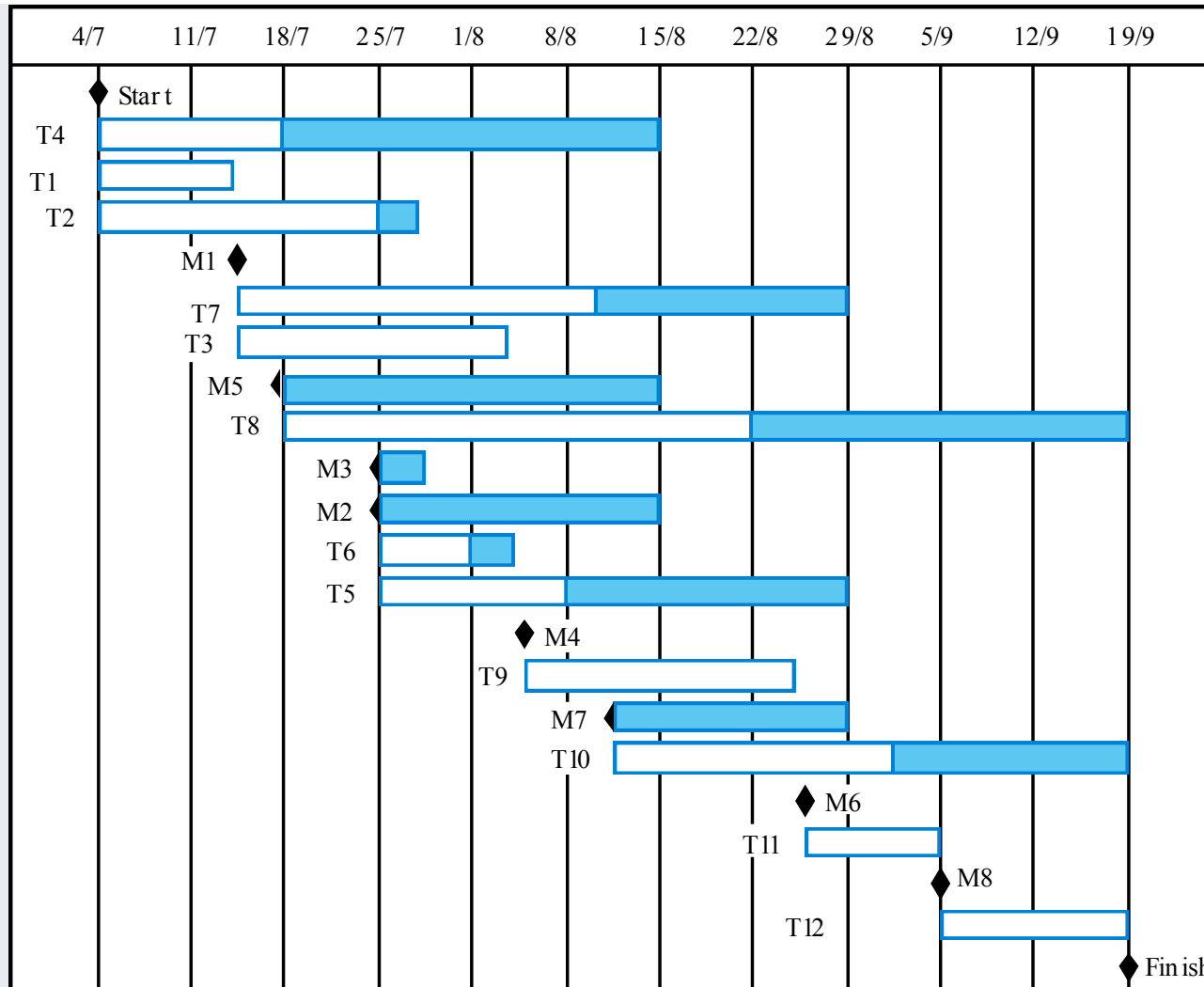
# Task durations and dependencies

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)

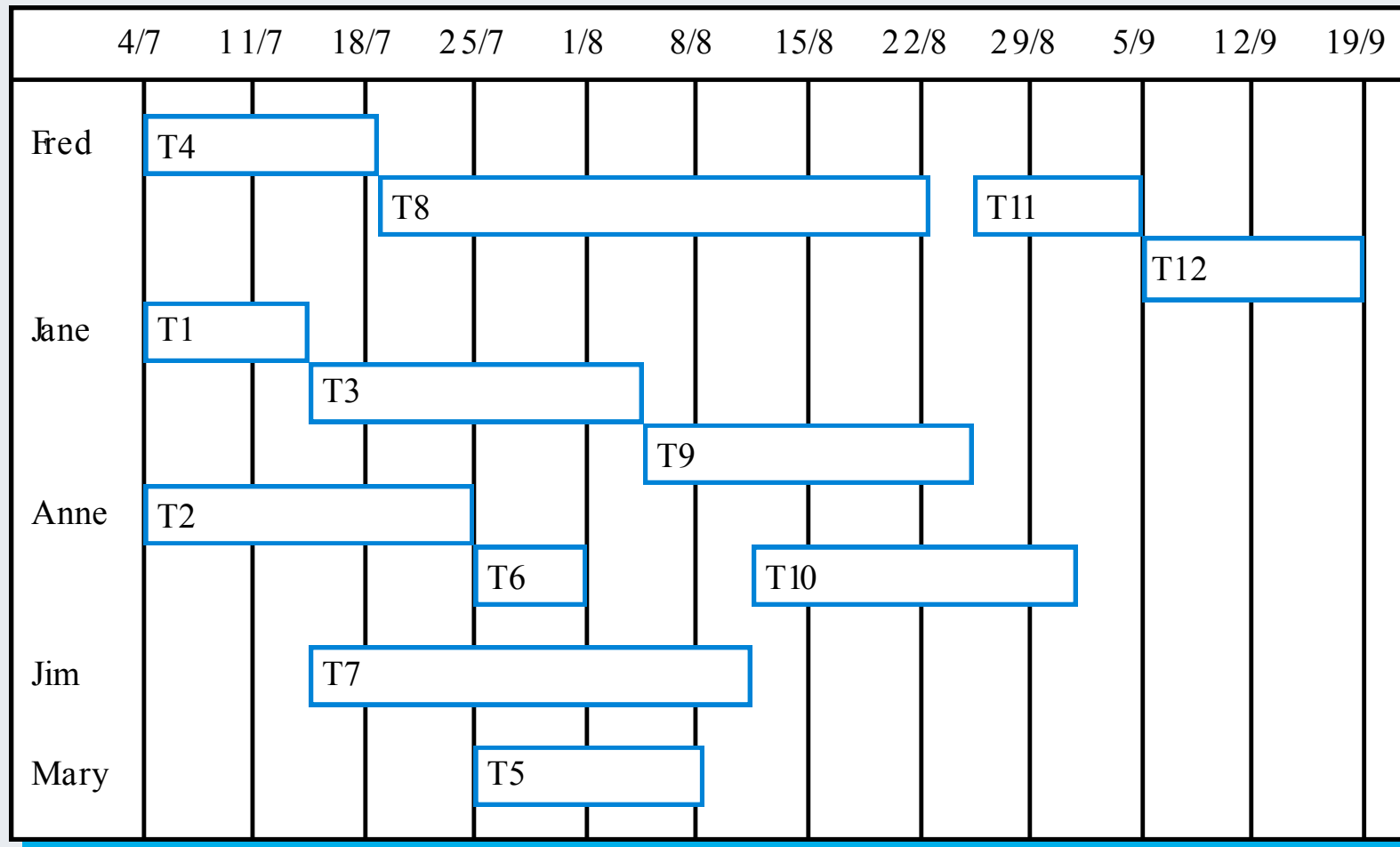
# Activity network



# Activity timeline



# Staff allocation



## 4. Risk management

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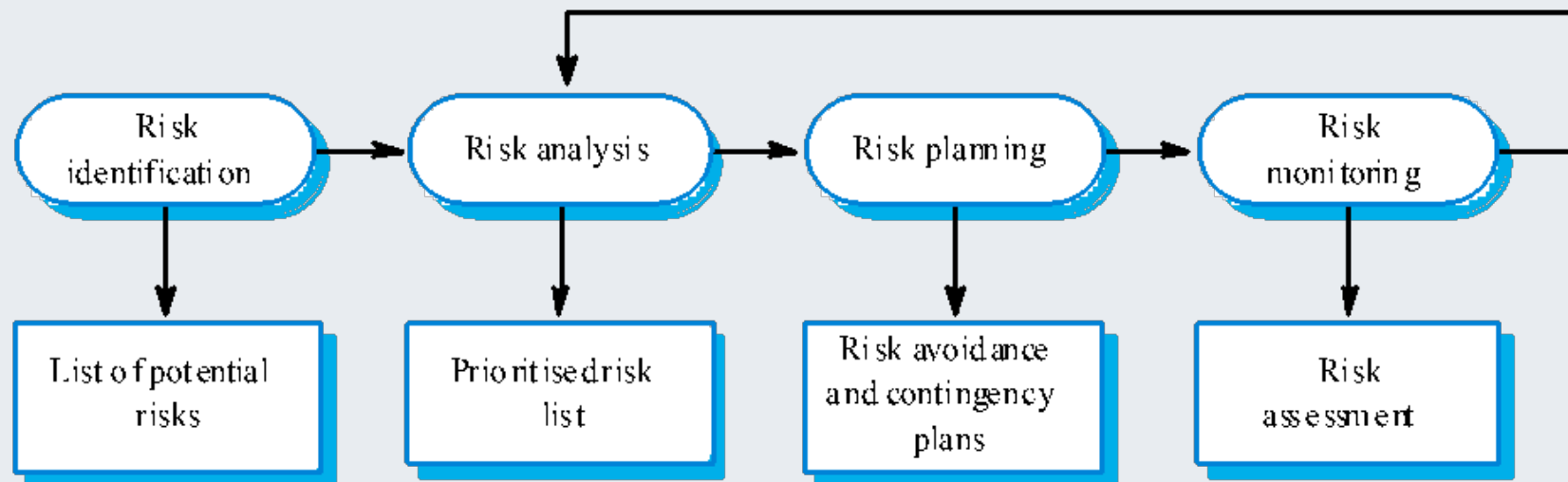
- Risk management is concerned with *identifying* risks and *drawing up* plans to minimize their effect on a project.
- A risk is a **probability that some adverse circumstance will occur**
  - **Project risks** affect schedule or resources;
  - **Product risks** affect the quality or performance of the software being developed;
  - **Business risks** affect the organization 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



# The risk management process

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- **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;

# Risk identification

- **Technology risks.** derive from the S/W and H/W technology which are being used as part of the system being developed
- **People risks.** associated with the people in the development team
- **Organizational risks.** derive from the organizational environment where the system is being developed
- **Requirements risks.** derive from changes to the customer requirements and the process of managing the requirements change
- **Tools risks.** derive from the CASE tools and other support SW used to develop the system
- **Estimation risks.** derive from the management estimates of the system characteristics and the resources required to build the system

# Risks and risk types

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

# Risk analysis

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- *Assess probability and seriousness of each risk.*
- Probability may be very low (<10%), low (10-25%), moderate (25-50%), high (50-75%) or very high.
- Risk effects might be catastrophic, serious, tolerable or insignificant.

# Risk analysis (1)

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 (2)

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

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- Consider each risk and develop a strategy to manage that risk.
- **Avoidance strategies**
  - The probability that the risk will arise is reduced;
- **Minimization 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 (1)

Risk	Strategy
Organizational 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	Reorganize 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 (2)

Risk	Strategy
Requirements changes	Derive traceability information to assess requirements change impact, maximize information hiding in the design.
Organizational 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

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- 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

<b>Risk type</b>	<b>Potential indicators</b>
Technology	Late delivery of hardware or support software, many reported technology problems
People	Poor staff morale, poor relationships amongst team member, job availability
Organizational	Organizational 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

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- 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

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- 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.