

Chap. 4 Project management

- Organising, planning and scheduling software projects

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Objectives

- To introduce software project management and to describe its distinctive characteristics
- To discuss the task of **SW project management** and the **project planning** process
- To show how **graphical schedule representations** are used by project management(**bar and activity charts**)
- To discuss the notion of risks and the **risk management** process(some risks arise in SW project)

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Topics covered

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

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Software project management

- Concerned with activities involved in ensuring that **software is delivered on time, on schedule, reliable** 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** that are set by the organisation developing the software (distinction of **professionals** not amateurs)

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Software management distinctions

SE is distinct from other types of engineering:

- The product is **intangible and flexible**(SW manager cannot see **progress**)
- Software engineering is not recognized as an **engineering discipline** with the same status as mechanical, electrical engineering, etc.
- The software development process is not **standardised**(cannot predict the relationship between **SW process** and **product types**)
- Many software projects are '**one-off**' **projects**(experience may not be transferable to the new project) → large SW project is different from previous project

Management includes **people**, **cost estimate** and **quality** management

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Management activities

Most managers take responsible at some stages for some of the following activities:

- Proposal writing(describe the **objective of project**)
- Project planning and scheduling(identify **activities**, **milestone**,**deliver time**)
- Project costing(**estimate the resources** required)
- Project monitoring and reviews(keep track of the **project progress** and **compare with the planned progress**, daily, weekly)
- Personnel selection and evaluation(select **skilled staff** with experience and the **new one** without any experience for cost consideration)
- Report writing and presentations(**report project status** to client and contractor organisation)

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Management commonalities

- 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 → 已發生之事, 一定會再出現

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Project staffing

- May not be possible to appoint the **ideal people** to work on a project because :
 - **Project budget** may not allow for the use of **highly-paid staff**
 - Staff with the **appropriate experience** may not be available(in or out)
 - An organisation may wish to develop **employee skills** on a software project(以戰養戰 or **on-job training**)
- Managers have to work within these constraints especially when (as is currently the case) there is an **international shortage of skilled IT staff**

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Project planning

- Probably the most **time-consuming** project management activity
- PM must **anticipate problem** which might arise and prepare tentative solution to those problems → should **evolve** iteratively
- Continuous activity from **initial concept** to **system delivery**. Plans must be regularly revised(evolved) 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**(constraints: staff, resource .. etc.)
- Estimation of **project parameters** such as its **structure, size, distribution of functions, project milestones** and **deliver time**

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Project planning process (iterative process)

```
Establish the project constraints
Make initial assessments of the project parameters
Define project milestones and deliverables (Pessimistic rather than optimistic)
while project has not been completed or cancelled loop
    Draw up project schedule
    Initiate activities according to schedule
    Wait ( for a while ) → 2 or 3 weeks
    Review project progress
    Revise estimates of project parameters → If progress discrepant
    Update the project schedule
    Re-negotiate project constraints and deliverables
if ( problems arise ) then
    Initiate technical review and possible revision
end if → Find alternative approach to meet the schedule
end loop
```

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Types of project plan

Plan	Description
Quality plan (Ch. 24)	Describes the quality procedures and standards that will be used in a project.
Validation plan(Ch. 19)	Describes the approach, resources and schedule used for system validation.
Configuration (Ch. 29) management plan	Describes the configuration management procedures and structures to be used.
Maintenance plan (Ch. 27)	Predicts the maintenance requirements of the system, maintenance costs and effort required.
Staff development plan. (Ch. 22)	Describes how the skills and experience of the project team members will be developed.

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Project plan structure

Project plan vary depending on the **type of project** and **organisation**.
Most of the project plans should include(regularly revised in project):

- Introduction(describe project objective and constraints →**budget**)
- Project organisation(**development team** is organized)
- Risk analysis(describe **possible project risk and solution**)
- Hardware and software resource requirements
- Work breakdown(break down the project into **activities** and identify each **milestones and deliverables of activities**)
- Project schedule(describe the **dependency of activities** and the **estimate time** required to reach the milestone)
- Monitoring and reporting mechanisms(describe **management report** for project monitoring mechanism use)

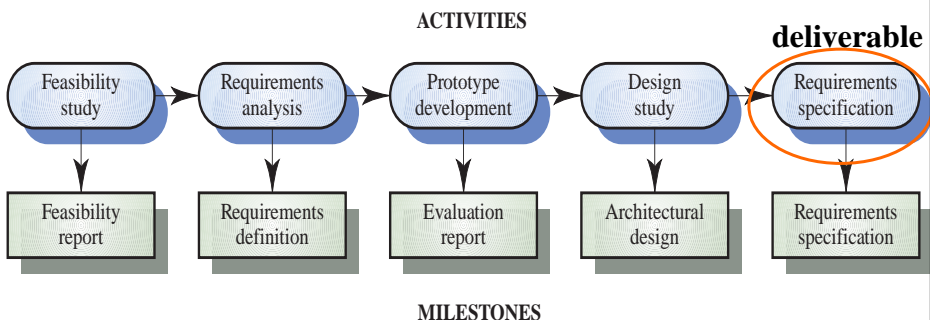
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Activity organization

- Activities in a project should be organised to produce **tangible outputs** for management to **judge progress and cost estimates**, schedules
- **Milestones** are the **end-point of a SW process activity**(internal project result to produce **short reports** for management)
- **Deliverables** are **project results delivered to customers**(at the end of some major project phase – specification, design)
- **Deliverables are usually milestones, milestones need not be deliverable**
- The waterfall process allows for the straightforward definition of progress milestones

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Milestones in the RE process



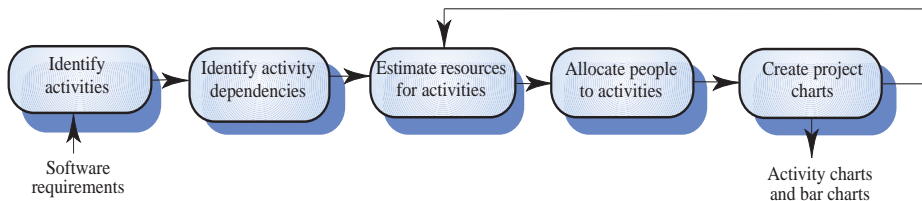
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Project scheduling

- Split project into tasks and estimate time and resources required to complete each task
- Organize the activities that are carried out in parallel to make optimal use of workforce
- Minimize task dependencies to avoid delays caused by one task waiting for another(critical task) to complete
- For any activity, it should be set to no more than 8-10 weeks. If longer than this, it should be subdivided for project planning and scheduling
- Estimate principal resources : human effort(ill), disk space on a server, time to specialize HW such as simulator, travel budget
- Dependent on project managers intuition and experience
- Project schedule is represented as a set of charts showing the work breakdown, activities dependency, staff allocation(MS project)

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The project scheduling process



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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 (Line of code, personal year)
- **Adding people to a late project makes it later** because of communication overheads
- The **unexpected** always happens. Always allow **contingency** in planning

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Bar charts and activity networks

- **Graphical notations** used to illustrate the project schedule
- **Activity networks** show **task dependencies** and the **critical path**
- **Bar charts** show **who is responsible for each activity** and when the activity is schedule to **begin and end**
- Show project breakdown into tasks. Tasks should not be too small. They should take about a week or two
- Bar charts and activity network can be generated by the **project management tools**
- **Activity** is represented as **rectangle**. **Milestone** or deliverable is shown as **rounded corner**
- The minimum time required to finish the project can be estimated by considering the **longest path** in the activity network

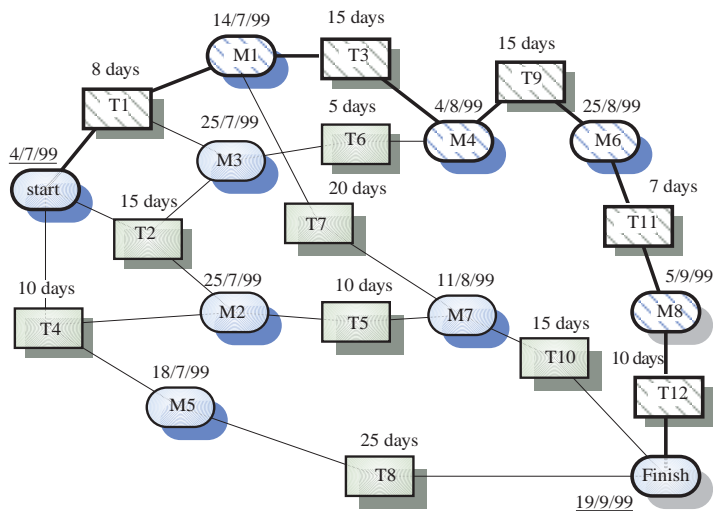
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Task durations and dependencies

Task	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)

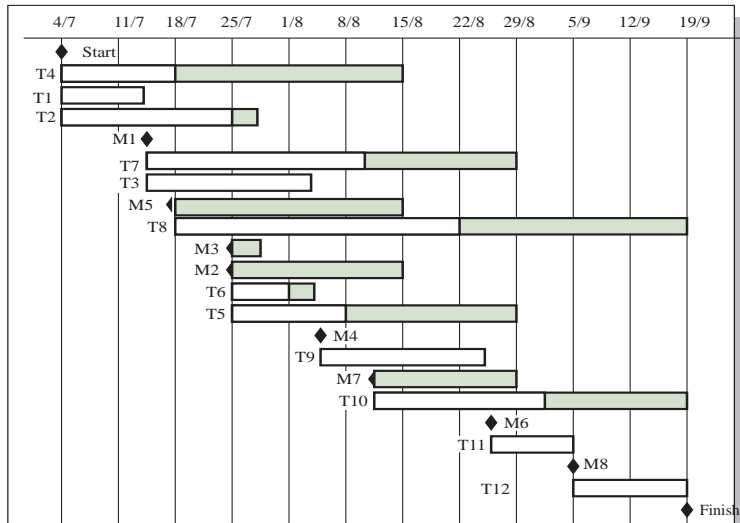
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Activity network



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Activity timeline(Gantt Chart)



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Bar charts and activity networks

- The **longest path** in the graph indicates the **critical path**
- The **overall schedule** of project depends on the critical path
- Activity network can provide the manager about the **activity dependencies which are not obvious**
- Modify the system design to reduce the project schedule by **reducing amount of time spend waiting for activities to finish**

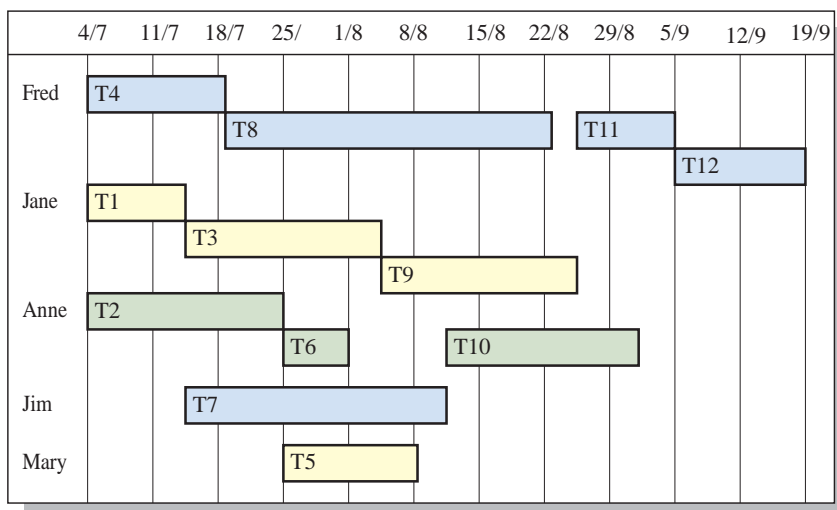
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Gantt Chart

- It shows the **calendar day** from **start to finish**
- It shows some flexibility in the **completion date** of these activity
- If an activity does not complete on time, **the critical path will not be affected until the end of the period marked by the shaded bar**
- Allocate **suitable staff** to the **suitable activity**
- Staff don't have to be assigned to a project at all time. During the intervening period, they may be on a **holiday, work on other project, attend a training course**

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Staff allocation and time chart



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Risk management

- Risk management is concerned with **identifying risks** and **drawing up plans** to minimise their effect on a project.
- Project plan contains the risk analysis to **anticipate the risk** might affect the **project schedule** or **SW quality** and take action to avoid these risks
- A risk is a **probability** that some adverse circumstance will occur.
 - **Project risks** -- affect **schedule or resources**(expert leaves a project)
 - **Product risks** -- affect the **quality or performance** of the software being developed(replacement product may make mistake because no experiences)
 - **Business risks** -- affect the **organisation developing** or **procuring the software**(the experience is not available for bidding another business)

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Software risks

Risk	Risk type	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 which 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.

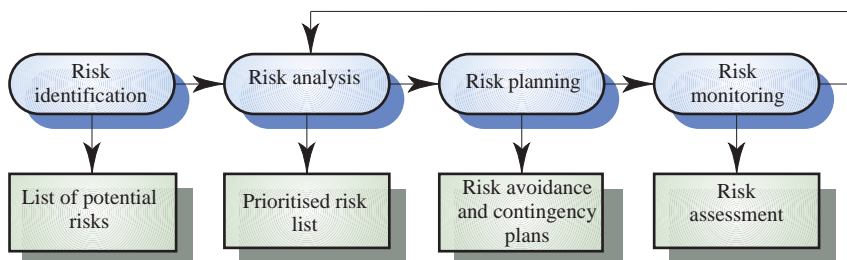
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The risk management process

- 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(constantly assess and plan for risk minimisation)

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The risk management process



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Risk identification

First stage of risk management to **discover the possible risks** to the project. It can be carried out by using a **team brainstorming process or manager's experience**. The possible risk types includes:

- Technology risks(HW/SW are used in the system)
- People risks(people in the team)
- Organisational risks(organisation environment)
- Tools risks(CASE tools used in the system)
- Requirements risks(change to customer requirement or managing the requirement changes)
- Estimation risks(management estimates of the system characteristics or resources needs)

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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 which should be reused contain defects which 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 which 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.

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Risk analysis

It rely on the **judgement and experience** of the project manager. No general precise numeric assessment

- 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(>75%)
- Risk effects might be **catastrophic, serious, tolerable or insignificant**

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Risk analysis

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 which should be reused contain defects which limit their functionality.	Moderate	Serious
Changes to requirements which require major design rework are proposed.	Moderate	Serious
The organisation is restructured so that different management are responsible for the project.	High	Serious
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

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Risk planning

Consider each risk and develop a strategy to **manage the identified risks**. The strategy falls into 3 categories:

- **Avoidance strategies**
 - The probability that the risk will arise is reduced(defective components)
- **Minimisation strategies**
 - The **impact of the risk** on the project or product will be reduced(staff sick)
- **Contingency plans**
 - If the risk arises, contingency plans are plans to deal with it(**organisation financial problems**)

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Risk management strategies

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 jobs.
Defective components	Replace potentially defective components with bought-in components of known reliability.
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.

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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 of the key risks should be considered separately** and discussed at **management progress meetings**
- Should be a continuous process and each key risk should be discussed at management progress meetings

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Risk factors

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

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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

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Key points

- A **project milestone** is a **predictable state** where some **formal report** of progress is presented to management.
- Risks may be **project risks, product risks or business risks**
- 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

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Homework

1. 4.5
2. 4.6(user defined Milestones Ex. T1 M1 T2...)
3. 4.9
 - Identify your project's risks and the management plan about how to solve them?
 - Estimate your **project's schedule and member jobs' allocation** [bar and activity charts...](see Fig. 4.5 – 4.9)?