
Software Engineering – Lecture 14

Software 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*
- To present *agile management* with Scrum

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* that are set by the organisation developing the software.

Software management distinctions

- The product is *intangible*.
- The product is *unique* and *flexible*.
- The software development *process is not standardised*.

Topics covered

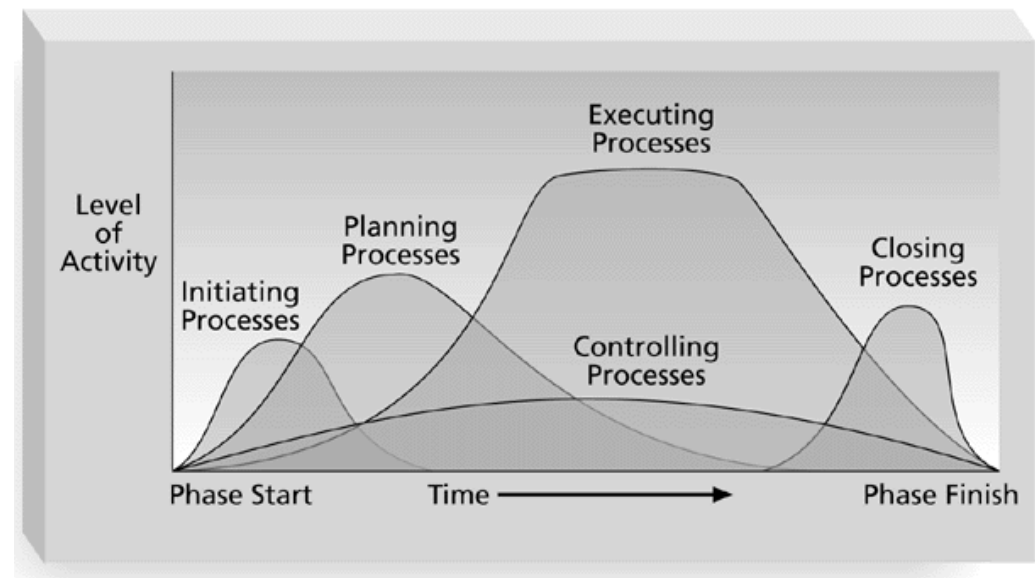
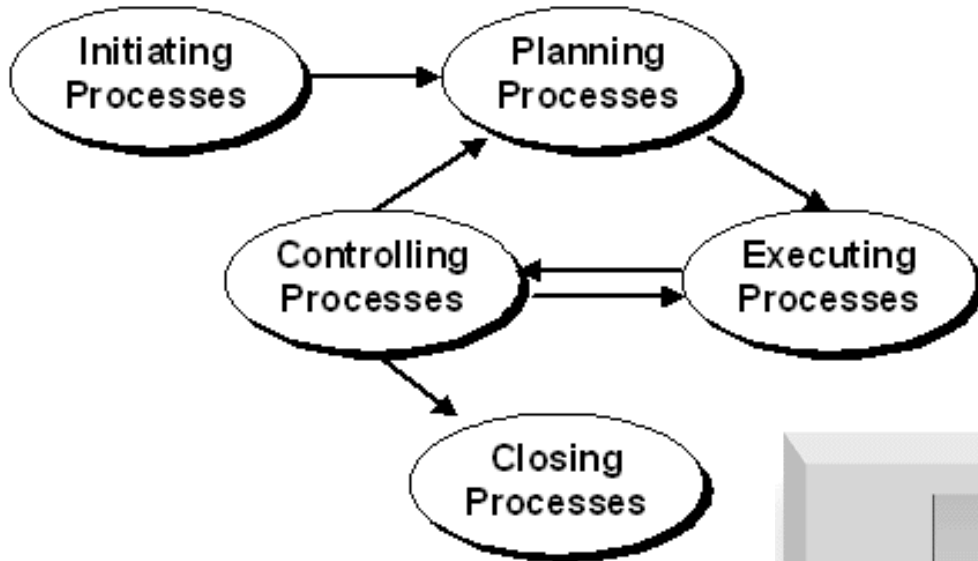
- **Management activities**
- Project planning
- Project scheduling
- Risk management
- Agile management

Typical management activities

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

Management process groups

PMBOK 4th ed.



Management processes PMBOK 4th ed.

Knowledge Area Processes	Project Management Process Groups				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring & Controlling Process Group	Closing Process Group
4. Project Integration Management	Develop Project Charter (4.1) Develop Preliminary Project Scope Statement (4.2)	Develop Project Management Plan (4.3)	Direct and Manage Project Execution (4.4)	Monitor and Control Project Work (4.5) Integrated Change Control (4.6)	Close Project (4.7)
5. Project Scope Management		Scope Planning (5.1) Scope Definition (5.2) Create WBS (5.3)		Scope Verification (5.4) Scope Control (5.5)	
6. Project Time Management		Activity Definition (6.1) Activity Sequencing (6.2) Activity Resource Estimating (6.3) Activity Duration Estimating (6.4) Schedule Development (6.5)		Schedule Control (6.6)	
7. Project Cost Management		Cost Estimating (7.1) Cost Budgeting (7.2)		Cost Control (7.3)	
8. Project Quality Management		Quality Planning (8.1)	Perform Quality Assurance (8.2)	Perform Quality Control (8.3)	
9. Project Human Resource Management		Human Resource Planning (9.1)	Acquire Project Team (9.2) Develop Project Team (9.3)	Manage Project Team (9.4)	
10. Project Communications Management		Communications Planning (10.1)	Information Distribution (10.2)	Performance Reporting (10.3) Manage Stakeholders (10.4)	
11. Project Risk Management		Risk Management Planning (11.1) Risk Identification (11.2) Qualitative Risk Analysis (11.3) Quantitative Risk Analysis (11.4) Risk Response Planning (11.5)		Risk Monitoring and Control (11.6)	
12. Project Procurement Management		Plan Purchases and Acquisitions (12.1) Plan Contracting (12.2)	Request Seller Responses (12.3) Select Sellers (12.4)	Contract Administration (12.5)	Contract Closure (12.6)

Excerpt from Table 3-45; PMBOK® Guide - Third Edition

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.

Topics covered

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

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 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, costs, and effort.
Staff development plan	Describes how the skills and experience of the project team members will be developed.

The project plan

The project plan sets out:

- The *resources available* to the project;
- The *work breakdown*;
- A *schedule* for the work.

Project plan structure

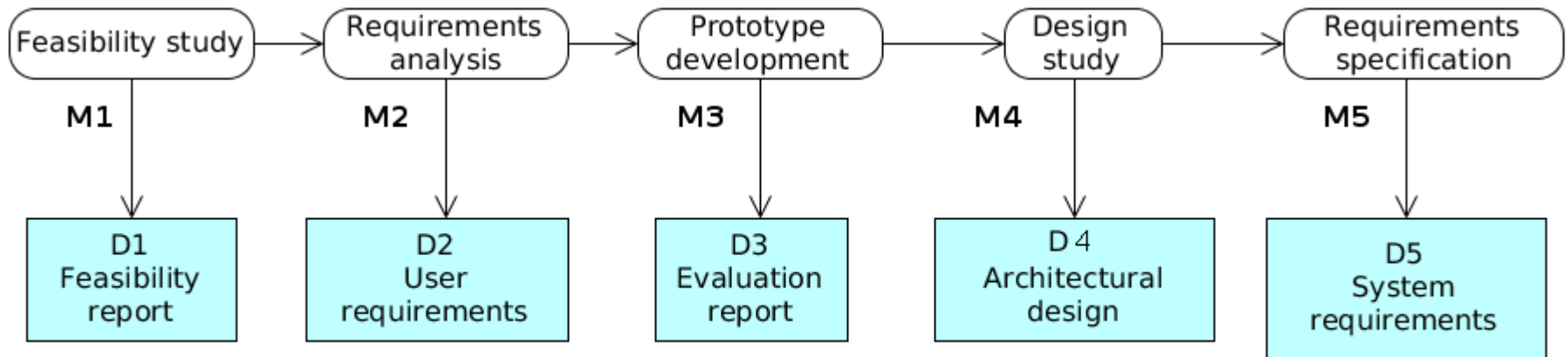
- Introduction.
- Project organisation.
- Risk analysis.
- Hardware and software resource requirements.
- Work breakdown.
- Project schedule.
- Monitoring and reporting mechanisms.

Activity organization

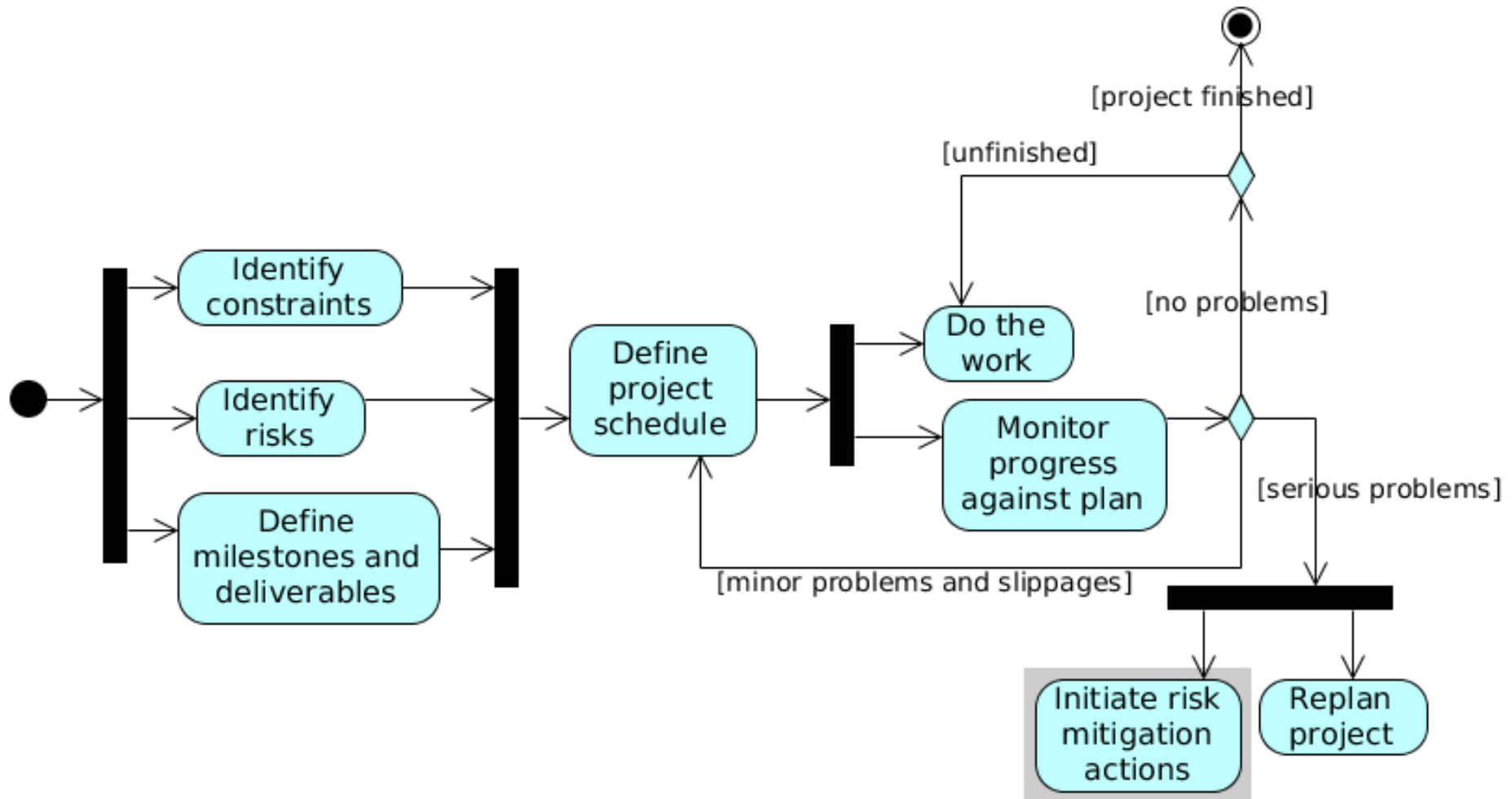
- Activities in a project should be organised to produce *tangible outputs* for management to judge progress.
- A *milestone* is the end-point of a process activity. It represents a predictable state where a formal report of progress is presented to management.
- *Deliverables* are project results delivered to customers.

Obs. The “waterfall” process allows for the straightforward definition of progress milestones.

Example: Milestones and deliverables in the RE process



The planning process



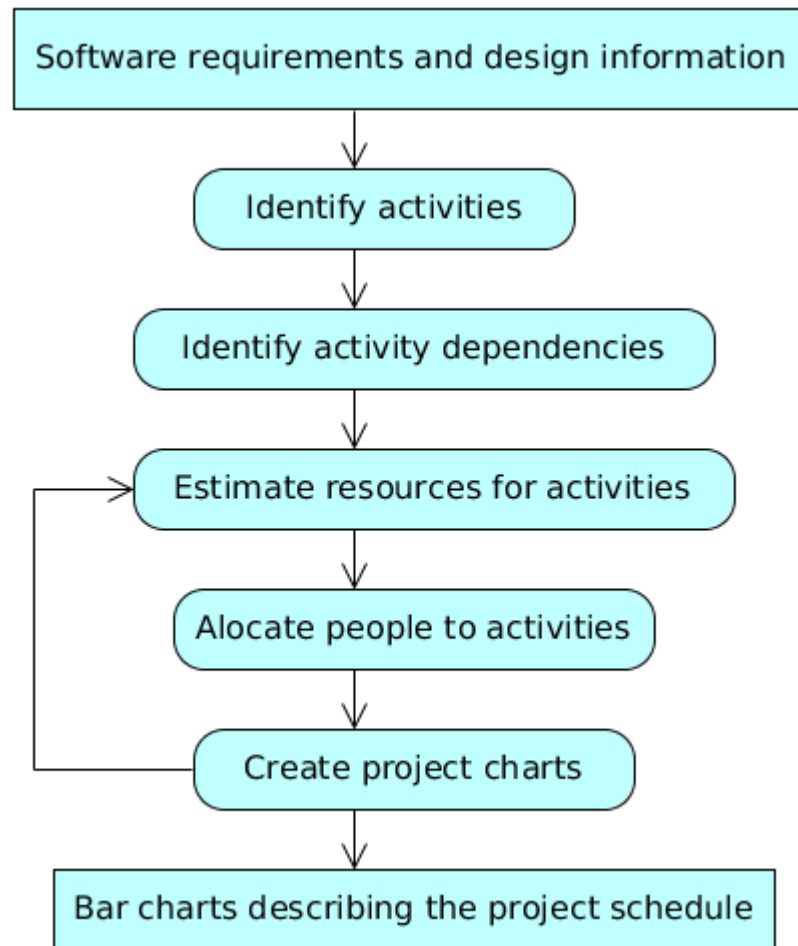
Topics covered

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

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 may make it later because of communication overheads.
- The unexpected always happens \Rightarrow Always allow contingency in planning.

Schedule representation

- Graphical notations used to illustrate the project schedule.
- Show project breakdown into tasks.

Recommendation:

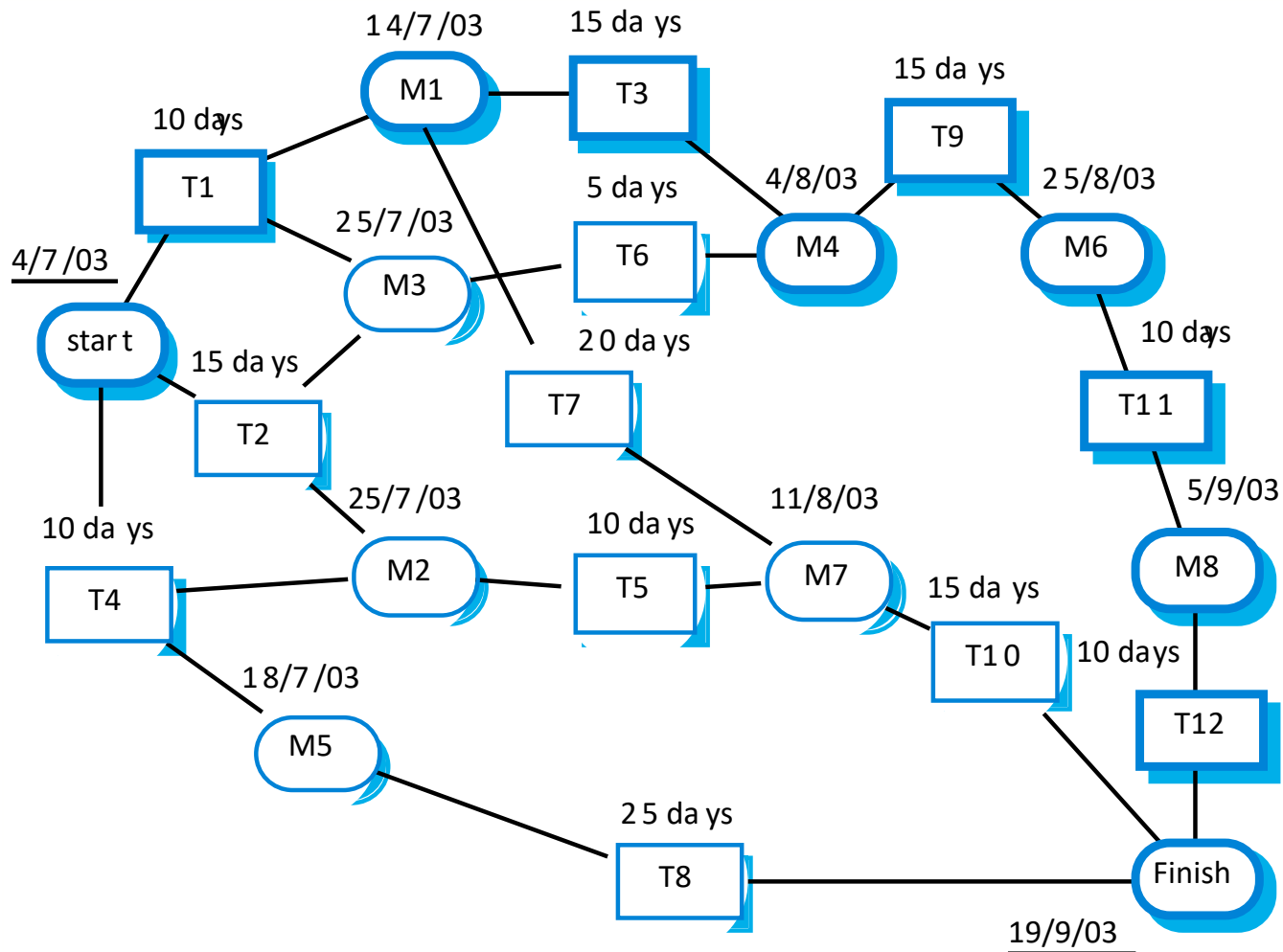
- Tasks should not be too small; they should take about a week or two.
- *Activity charts* show *task dependencies* and the *critical path*.
- *Bar charts* show *schedule against calendar time*.

Example:

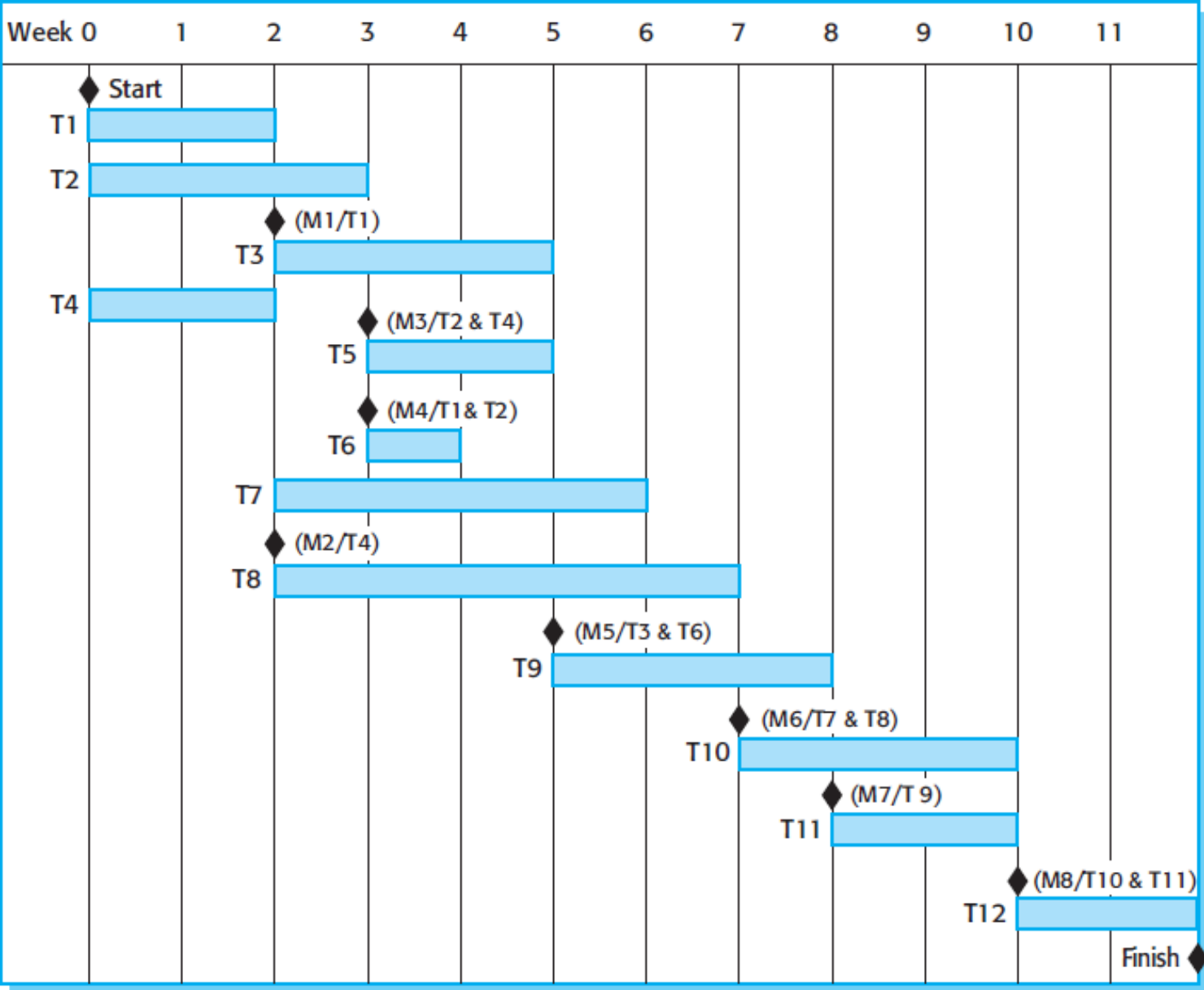
Task durations and dependencies

Task	Effort (person-days)	Duration (days)	Dependencies
T1	15	10	
T2	8	15	
T3	20	15	T1 (M1)
T4	5	10	
T5	5	10	T2, T4 (M3)
T6	10	5	T1, T2 (M4)
T7	25	20	T1 (M1)
T8	75	25	T4 (M2)
T9	10	15	T3, T6 (M5)
T10	20	15	T7, T8 (M6)
T11	10	10	T9 (M7)
T12	20	10	T10, T11 (M8)

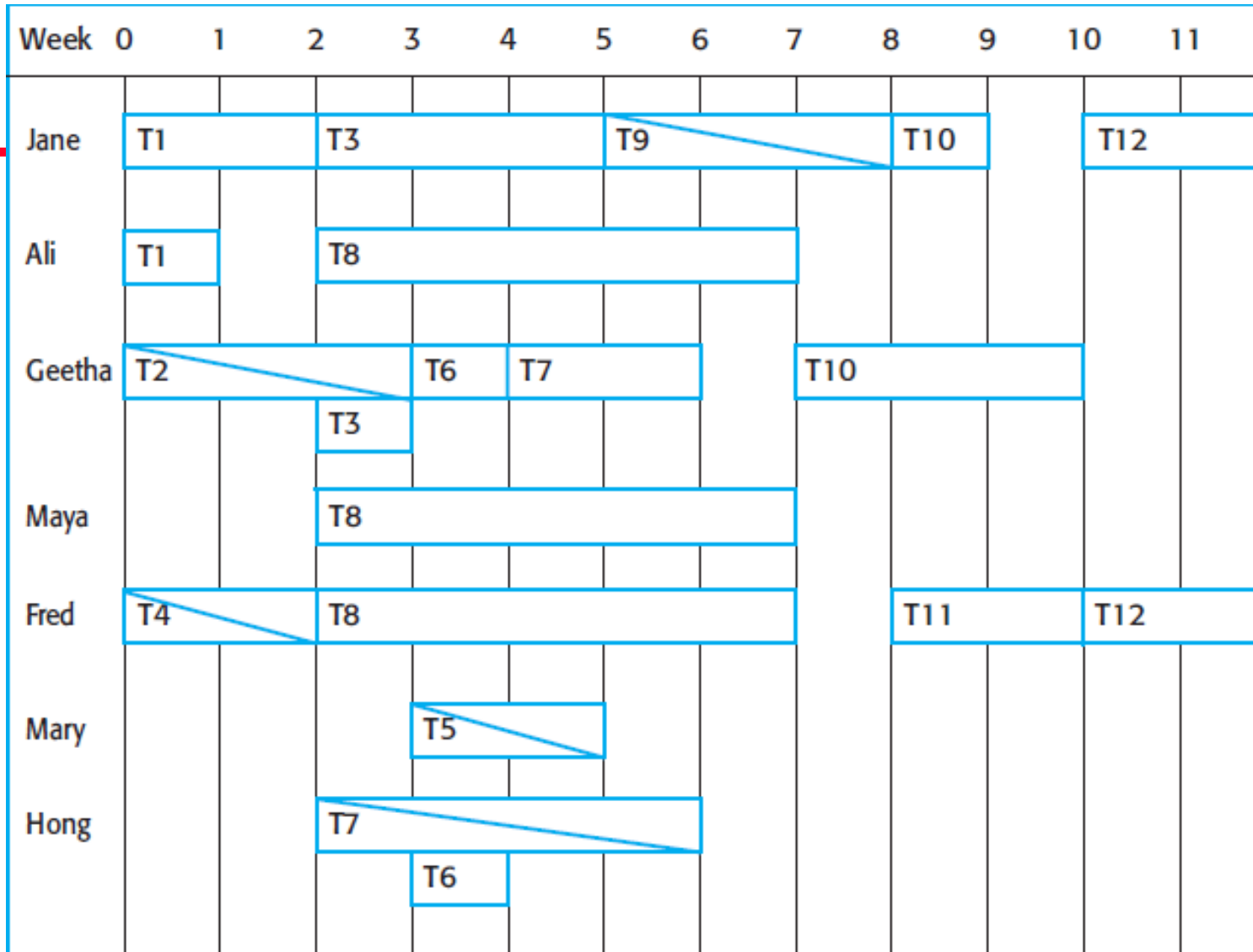
Example: Activity network



Example: Activity bar chart



Example: Staff allocation chart



Topics covered

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

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 (or favourable) 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.

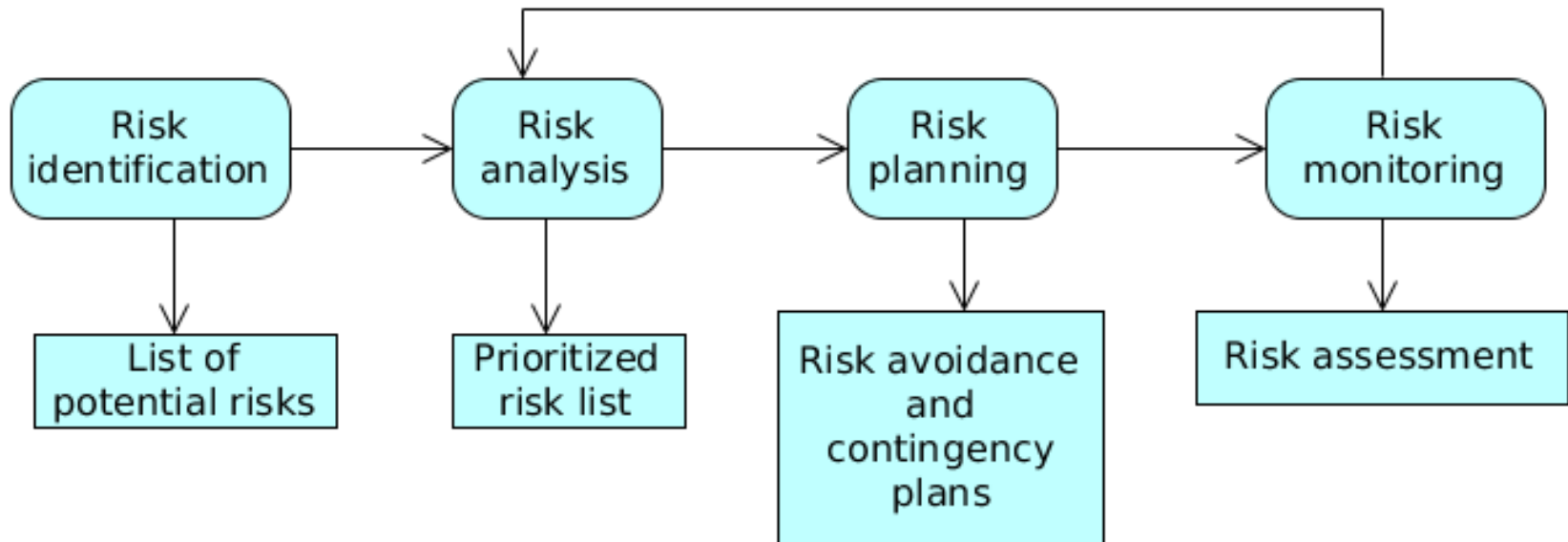
Software risks - examples

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 organizational 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 underperformance	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

Types of risks:

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

Risks and risk types

- Risk identification
- Risk analysis
- Risk planning
- Risk monitoring

Risk type	Possible risks
Technology	The database used in the system cannot process as many transactions per second as expected. (1) Reusable software components contain defects that mean they cannot be reused as planned. (2)
People	It is impossible to recruit staff with the skills required. (3) Key staff are ill and unavailable at critical times. (4) Required training for staff is not available. (5)
Organizational	The organization is restructured so that different management are responsible for the project. (6) Organizational financial problems force reductions in the project budget. (7)
Tools	The code generated by software code generation tools is inefficient. (8) Software tools cannot work together in an integrated way. (9)
Requirements	Changes to requirements that require major design rework are proposed. (10) Customers fail to understand the impact of requirements changes. (11)
Estimation	The time required to develop the software is underestimated. (12) The rate of defect repair is underestimated. (13) The size of the software is underestimated. (14)

Risk analysis

Assess probability and effects of each risk.

- **Probability** may be very low, low, moderate, high or very high.
- Risk **effects** might be catastrophic, serious, tolerable or insignificant.

- Risk identification
- Risk analysis
- Risk planning
- Risk monitoring

Risk analysis (1)

Example

Risk	Probability	Effects
Organizational financial problems force reductions in the project budget (7).	Low	Catastrophic
It is impossible to recruit staff with the skills required for the project (3).	High	Catastrophic
Key staff are ill at critical times in the project (4).	Moderate	Serious
Faults in reusable software components have to be repaired before these components are reused. (2).	Moderate	Serious
Changes to requirements that require major design rework are proposed (10).	Moderate	Serious
The organization is restructured so that different management are responsible for the project (6).	High	Serious
The database used in the system cannot process as many transactions per second as expected (1).	Moderate	Serious

- Risk identification
- Risk analysis
- Risk planning
- Risk monitoring

Risk analysis (2) Example

Risk	Probability	Effects
The time required to develop the software is underestimated (12).	High	Serious
Software tools cannot be integrated (9).	High	Tolerable
Customers fail to understand the impact of requirements changes (11).	Moderate	Tolerable
Required training for staff is not available (5).	Moderate	Tolerable
The rate of defect repair is underestimated (13).	Moderate	Tolerable
The size of the software is underestimated (14).	High	Tolerable
Code generated by code generation tools is inefficient (8).	Moderate	Insignificant

Risk planning

Consider each risk and develop a strategy to manage that risk.

Main strategies:

- Avoidance strategies
 - Reduce the *probability* that the risk will arise;
- Minimisation strategies
 - Reduce the *impact* of the risk on the project or product;
- Contingency plans
 - If the risk arises, contingency plans are plans to deal with that risk;

- Risk identification
- Risk analysis
- Risk planning
- Risk monitoring

Risk management strategies (1)

Examples

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 and presenting reasons why cuts to the project budget would not be cost-effective.
Recruitment problems	Alert customer to 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.
Requirements changes	Derive traceability information to assess requirements change impact; maximize information hiding in the design.

- Risk identification
- Risk analysis
- Risk planning
- Risk monitoring

Risk management strategies (2)

Examples

Risk	Strategy
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

- 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 identification
- Risk analysis
- Risk planning
- Risk monitoring

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 members; high staff turnover.
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.

Topics covered

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

Agile project management

- The principal responsibility of software project managers is to manage the project so that the software is delivered *on time* and *within the planned budget* for the project.
- The *standard approach* to project management is *plan-driven*. Managers draw up a plan for the project showing *what* should be delivered, *when* it should be delivered and *who* will work on the development of the project deliverables.
- Agile project management requires a different approach, which is adapted to *incremental development* and the *particular strengths of agile methods*.

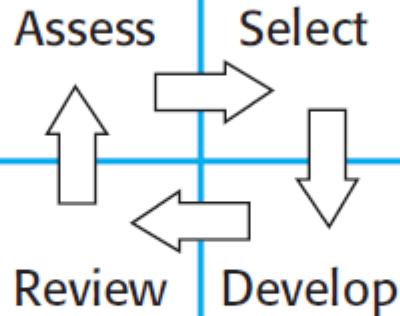
Scrum

- The Scrum approach is a *general agile method* but its focus is on *managing iterative development* rather than specific agile practices.
- There are three phases in Scrum:
 - The initial phase
 - A series of *sprint cycles*
 - The project closure phase

The Scrum process

A series of sprint cycles, where each cycle develops an increment of the system.

Outline Planning and Architectural Design



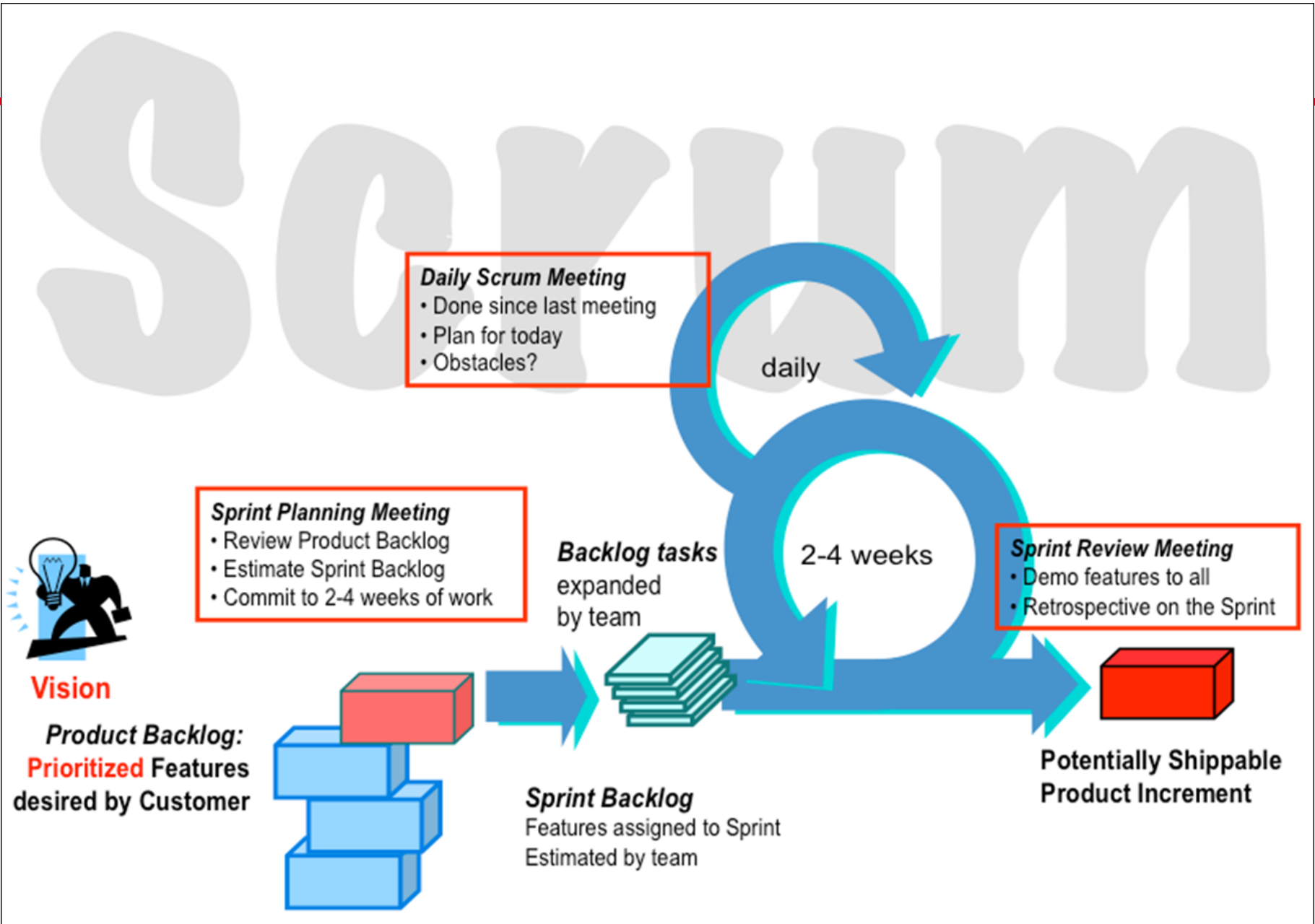
Project Closure

Sprint Cycle

Establish the general objectives for the project and design the software architecture.

Wraps up the project, completes required documentation such as system help frames and user manuals and assesses the lessons learned from the project.

The Scrum process



The Sprint cycle (1)

- Sprints are fixed length, normally 2–4 weeks. They correspond to the development of a release of the system in XP.
- The starting point for planning is the *product backlog*, which is the list of work to be done on the project.
- The selection phase involves all of the project team who work with the customer to select the features and functionality to be developed during the sprint.

The Sprint cycle (2)

- Then the team organize themselves to develop the software. During this stage the team is isolated from the customer and the organization, with all communications channelled through the so-called 'Scrum master'.
- The role of the Scrum master is to protect the development team from external distractions.
- At the end of the sprint, the work done is reviewed and presented to stakeholders. The next sprint cycle then begins.

Teamwork in Scrum

- The 'Scrum master' is a facilitator who arranges daily meetings, tracks the backlog of work to be done, records decisions, measures progress against the backlog and communicates with customers and management outside of the team.
- The whole team attends short daily meetings where all team members share information, describe their progress since the last meeting, problems that have arisen and what is planned for the following day.
 - This means that everyone on the team knows what is going on and, if problems arise, can re-plan short-term work to cope with them.

Scrum benefits

- The product is broken down into a set of *manageable and understandable chunks*.
- Unstable requirements *do not hold up* progress.
- The whole team have visibility of everything and consequently *team communication* is improved.
- Customers see on-time delivery of increments and gain *feedback* on how the product works.
- Trust between customers and developers is established and a *positive culture* is created in which everyone expects the project to succeed.

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, scheduling and monitoring.
- 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.
- The Scrum method is an agile method that provides a project management framework. It is centred round a set of sprints, which are fixed time periods when a system increment is developed.