# Software Processes

## Topics covered

✧ Software process models

✧ Process activities

✧ Coping with change

## The software process

- ✧ A structured set of activities required to develop a software system.
- ✧ Many different software processes but all involve:
  - Specification – defining what the system should do;
  - Design and implementation – defining the organization of the system and implementing the system;
  - Validation – checking that it does what the customer wants;
  - Evolution – changing the system in response to changing customer needs.
- ✧ A software process model is an abstract representation of a process. It presents a description of a process from some particular perspective.

## Software process descriptions

- When we describe and discuss processes, we usually talk about the activities in these processes such as specifying a data model, designing a user interface, etc. and the ordering of these activities.
- Process descriptions may also include:
  - Products, which are the outcomes of a process activity;
  - Roles, which reflect the responsibilities of the people involved in the process;
  - Pre- and post-conditions, which are statements that are true before and after a process activity has been enacted or a product produced.

## Plan-driven and agile processes

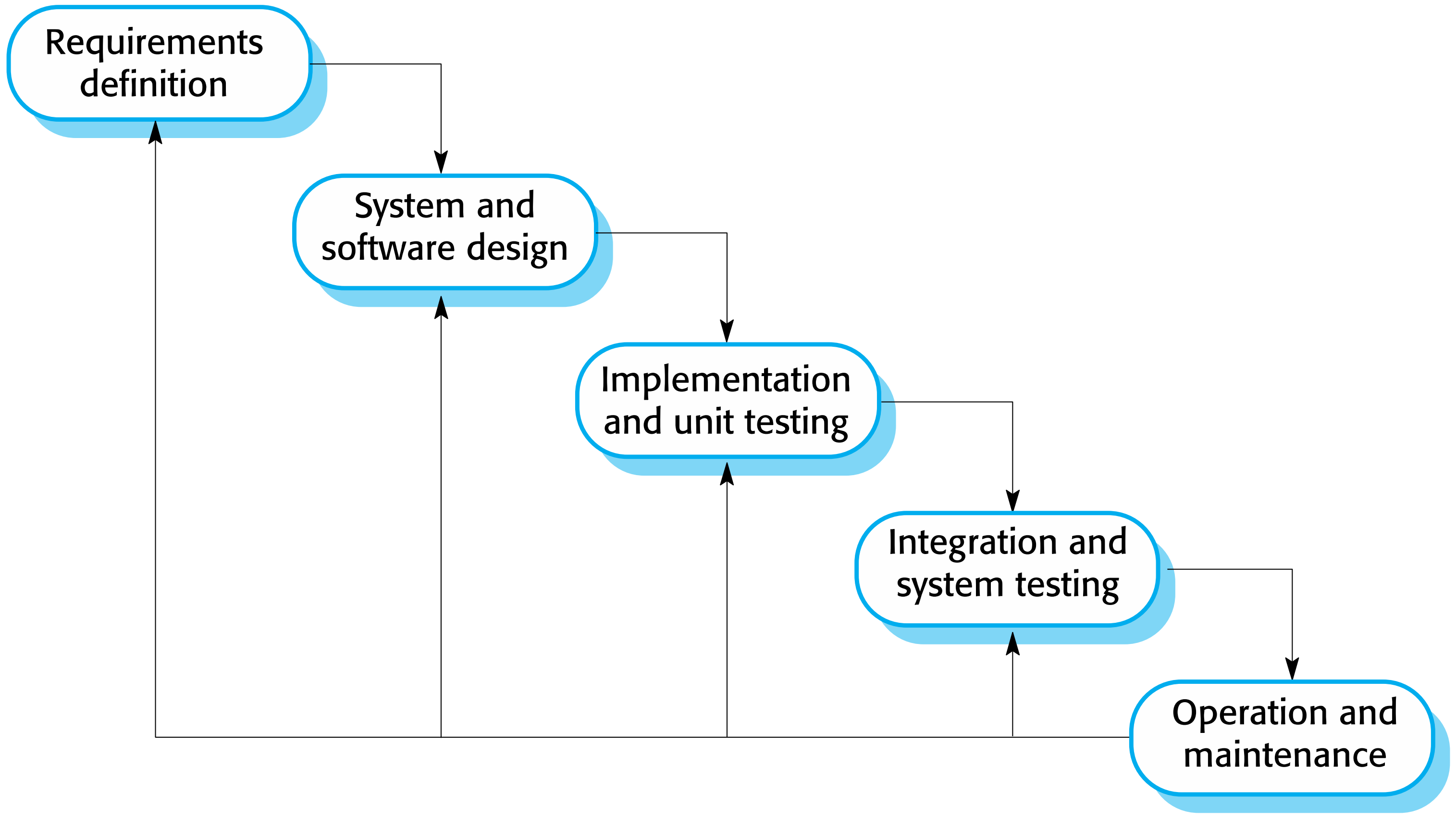
- ✧ Plan-driven processes are processes where all of the process activities are planned in advance and progress is measured against this plan.
- ✧ In agile processes, planning is incremental and it is easier to change the process to reflect changing customer requirements.
- ✧ In practice, most practical processes include elements of both plan-driven and agile approaches.
- ✧ There are no right or wrong software processes.

## Software process models

## Software process models

- The waterfall model
  - Plan-driven model. Separate and distinct phases of specification and development.
- Incremental development
  - Specification, development and validation are interleaved. May be plan-driven or agile.
- Integration and configuration
  - The system is assembled from existing configurable components. May be plan-driven or agile.
- In practice, most large systems are developed using a process that incorporates elements from all of these models.

## The waterfall model


Requirements definition
System and software design
Implementation and unit testing
Integration and system testing
Operation and maintenance

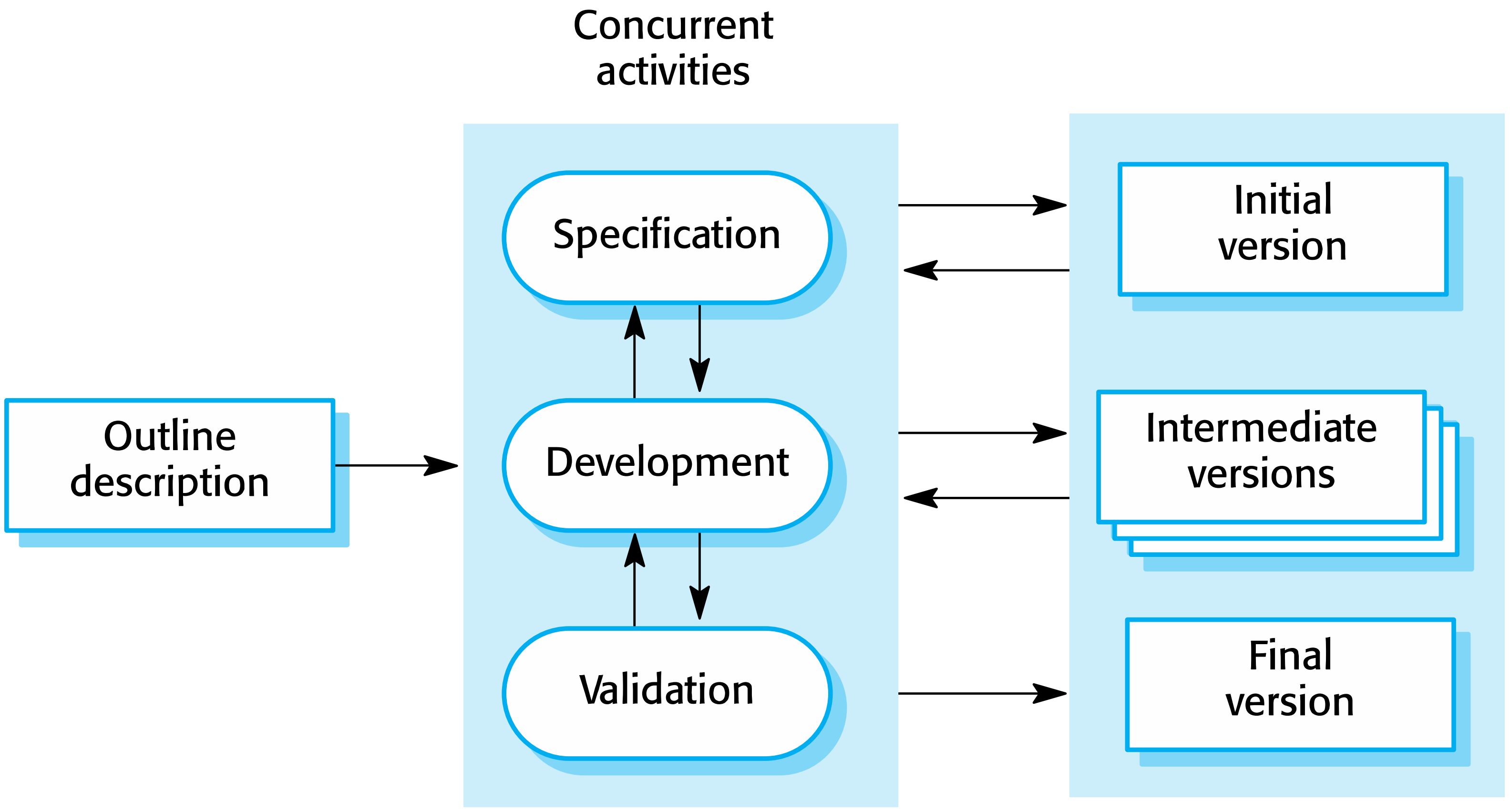
## Waterfall model phases

- There are separate identified phases in the waterfall model:
  - Requirements analysis and definition
  - System and software design
  - Implementation and unit testing
  - Integration and system testing
  - Operation and maintenance
- The main drawback of the waterfall model is the **difficulty of accommodating change after the process is underway**. In principle, a phase has to be complete before moving onto the next phase.

## Waterfall model problems

- Inflexible partitioning of the project into distinct stages makes it difficult to respond to changing customer requirements.
  - Therefore, this model is only appropriate when the requirements are well-understood and changes will be fairly limited during the design process.
  - Few business systems have stable requirements.
- The waterfall model is mostly used for large systems engineering projects where a system is developed at several sites.
  - In those circumstances, the <u>plan-driven nature of the waterfall model helps coordinate the work</u>.

# Incremental development



## Incremental development benefits

- ✧ The cost of accommodating changing customer requirements is reduced.
  - The amount of analysis and documentation that has to be redone is much less than is required with the waterfall model.
- ✧ It is easier to get customer feedback on the development work that has been done.
  - Customers can comment on demonstrations of the software and see how much has been implemented.
- ✧ More rapid delivery and deployment of useful software to the customer is possible.
  - Customers are able to use and gain value from the software earlier than is possible with a waterfall process.

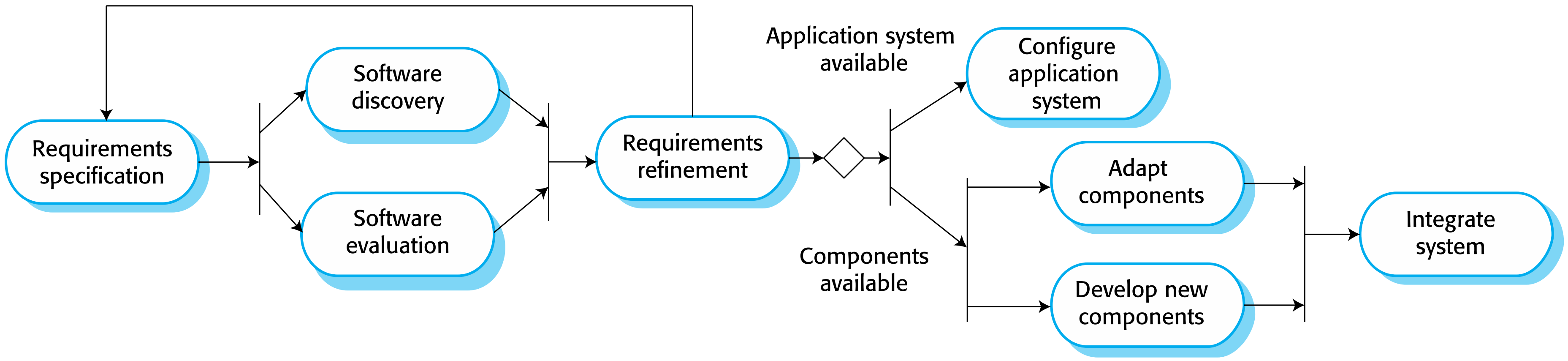
## Incremental development problems

- ✧ The process is not visible.
  - Managers need regular deliverables to measure progress. If systems are developed quickly, it is not cost-effective to produce documents that reflect every version of the system.
- ✧ System structure tends to degrade as new increments are added.
  - Unless time and money is spent on refactoring to improve the software, regular change tends to corrupt its structure. Incorporating further software changes becomes increasingly difficult and costly.

## Integration and configuration

- ✧ Based on software reuse where systems are integrated from existing components or application systems (sometimes called COTS -Commercial-off-the-shelf) systems).
- ✧ Reused elements may be configured to adapt their behaviour and functionality to a user’s requirements
- ✧ Reuse is now the standard approach for building many types of business system

## Reuse-oriented software engineering



## Key process stages

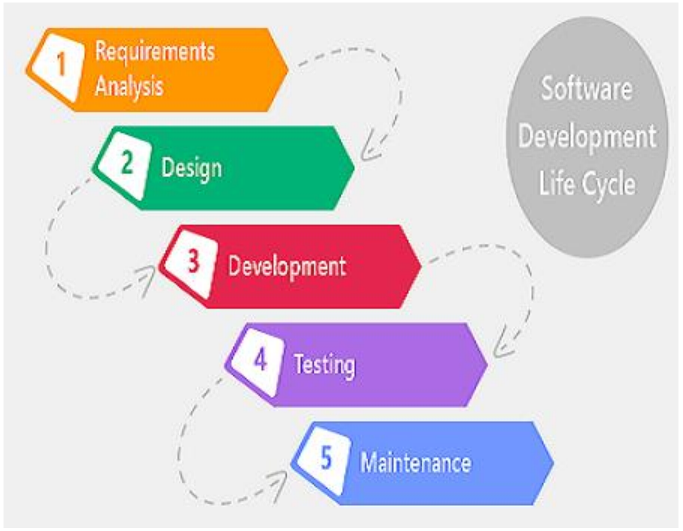
- ✧ Requirements specification
- ✧ Software discovery and evaluation
- ✧ Requirements refinement
- ✧ Application system configuration
- ✧ Component adaptation and integration

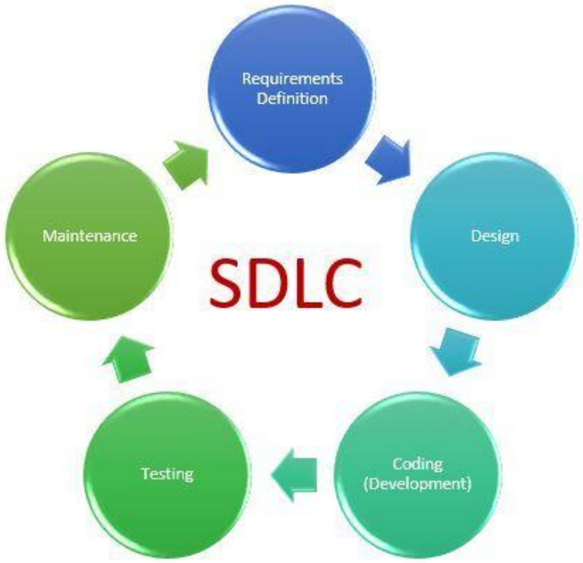
## Advantages and disadvantages

- ✧ Reduced costs and risks as less software is developed from scratch
- ✧ Faster delivery and deployment of system
- ✧ But requirements compromises are inevitable so system may not meet real needs of users
- ✧ Loss of control over evolution of reused system elements

## Process activities

## Software Engineering: Products, People & Process





## Software specification

- ✧ The process of establishing what services are required and the constraints on the system's operation and development.
- ✧ Requirements engineering process
  - Requirements elicitation and analysis
    - What do the system stakeholders require or expect from the system?
  - Requirements specification
    - Defining the requirements in detail
  - Requirements validation
    - Checking the validity of the requirements

## Requirement Types

✧ Functional –Internal to system

✧ Non-Functional – External to system

## Software design and implementation

- The process of converting the system specification into an executable system.
- Software design
  - Design a software structure that realises the specification;
- Implementation
  - Translate this structure into an executable program;
- The activities of design and implementation are closely related and may be inter-leaved.

## Design activities

- ✧ *Architectural design*, where you identify the overall structure of the system, the principal components (subsystems or modules), their relationships and how they are distributed.
- ✧ *Database design*, where you design the system data structures and how these are to be represented in a database.
- ✧ *Interface design*, where you define the interfaces between system components.
- ✧ *Component selection and design*, where you search for reusable components. If unavailable, you design how it will operate.

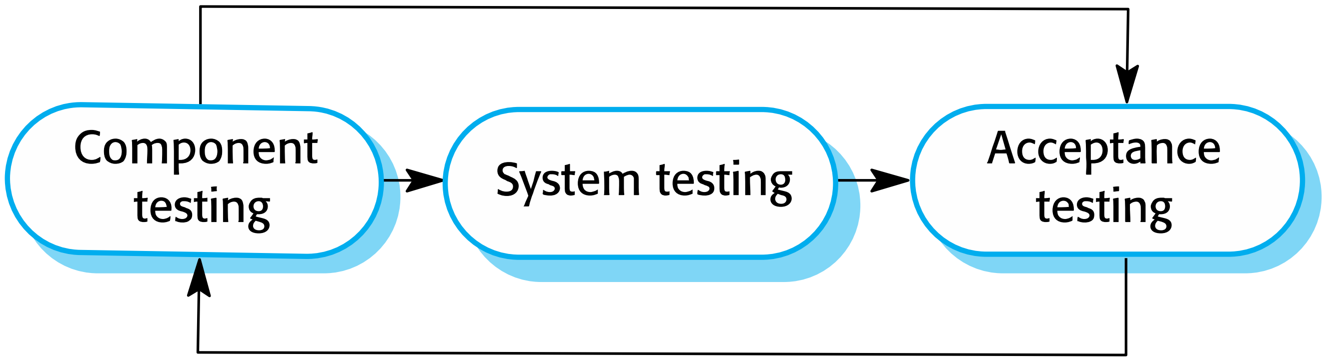
## UI Validation Examples… why do we need to test all ?

- ✧ Browser testing (IE, Chrome, etc. )
- ✧ Operating system (windows, Linux, mac)
- ✧ Hardware
- ✧ Mobile apps( for all versions)
- - Android
- - IOS, Windows

## Software validation

- ✧ Verification and validation (V & V) is intended to show that a system conforms to its specification and meets the requirements of the system customer.
- ✧ Involves checking and review processes and system testing.
- ✧ System testing involves executing the system with test cases that are derived from the specification of the real data to be processed by the system.
- ✧ Testing is the most commonly used V & V activity.

## Stages of testing



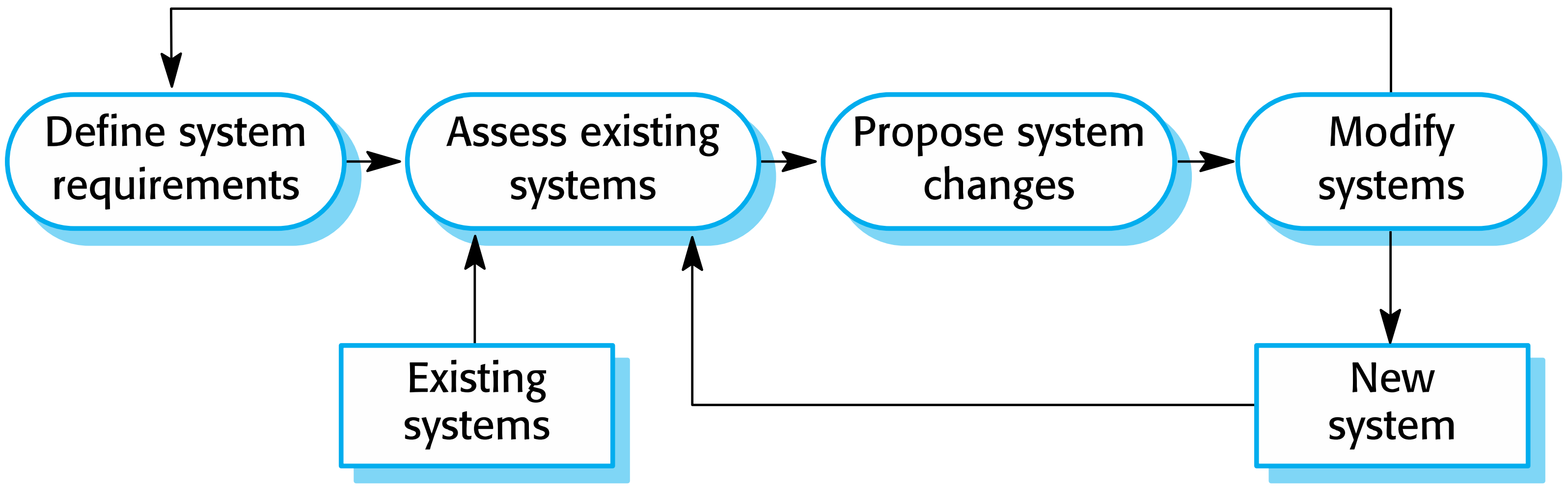
## Testing stages

- ✧ Component testing
  - Individual components are tested independently;
  - Components may be functions or objects or coherent groupings of these entities.
- ✧ System testing
  - Testing of the system as a whole. Testing of emergent properties is particularly important.
- ✧ Customer testing
  - Testing with customer data to check that the system meets the customer's needs.

## Software evolution

- Software is inherently flexible and can change.
- As requirements change through changing business circumstances, the software that supports the business must also evolve and change.
- Although there has been a demarcation between development and evolution (maintenance) this is increasingly irrelevant as fewer and fewer systems are completely new.
- Refactor : changing internal structure without changing external behaviour of the system/product.

# System evolution



## Key points

- ✧ Design and implementation processes are concerned with transforming a requirements specification into an executable software system.
- ✧ Software validation is the process of checking that the system conforms to its specification and that it meets the real needs of the users of the system.
- ✧ Software evolution takes place when you change existing software systems to meet new requirements. The software must evolve to remain useful.
- ✧ Processes should include activities such as prototyping and incremental delivery to cope with change.