SOFTWARE ENGINEERING

CO3001

CHAPTER 9 – SOFTWARE EVOLUTION

Adapted from https://iansommerville.com/software-engineering-book/slides/

WEEK 11

TOPICS COVERED

- ✓ Evolution processes
- ✓ Legacy systems
- ✓ Software maintenance

SOFTWARE CHANGE

- Software change is inevitable
  - New requirements emerge when the software is used;
  - The business environment changes;
  - Errors must be repaired;
  - New computers and equipment is added to the system;
  - The performance or reliability of the system may have to be improved.
- A key problem
  - implementing and managing change to their existing software systems.

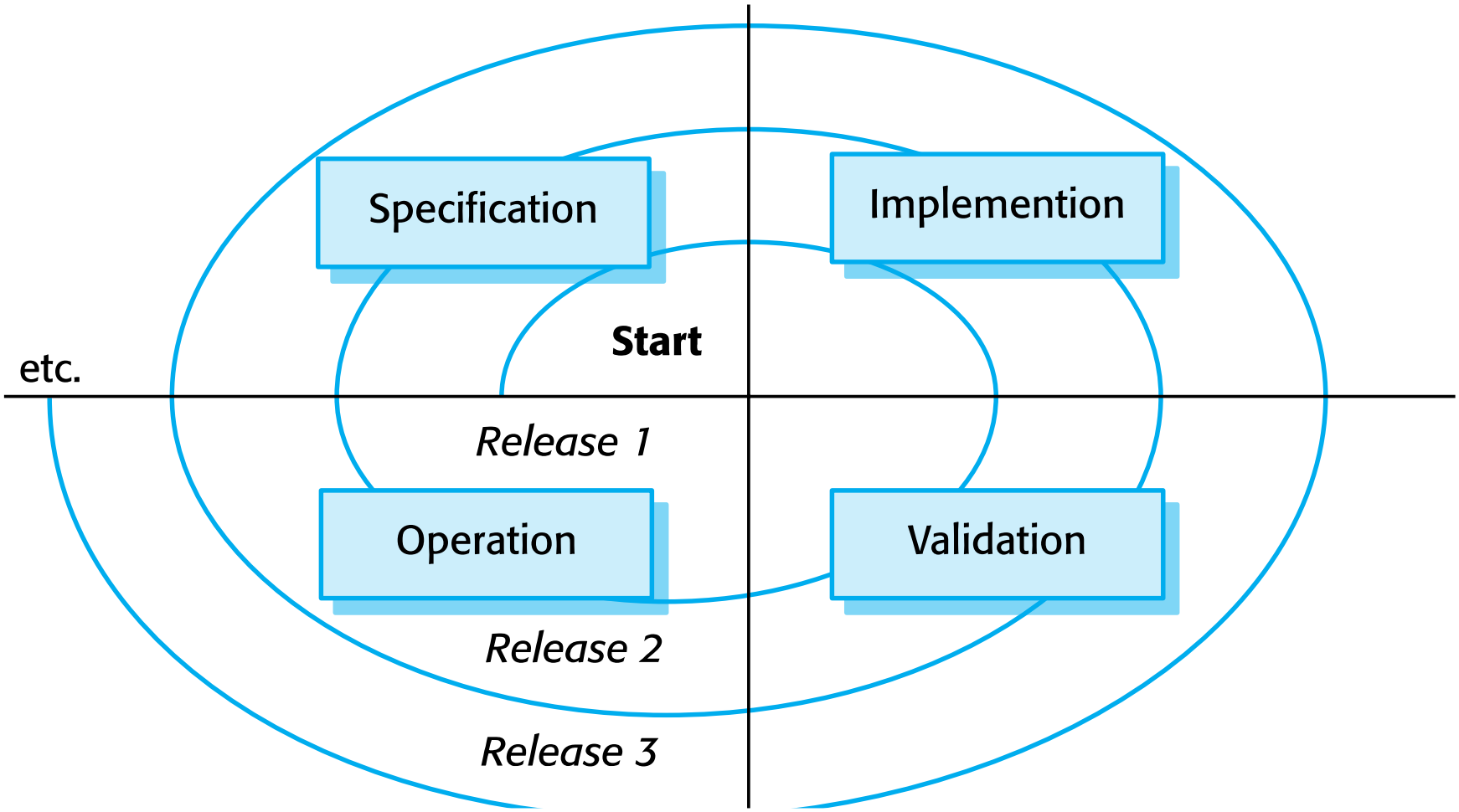
IMPORTANCE OF EVOLUTION

- ✓ Organisations have huge investments in their software systems - they are critical business assets.

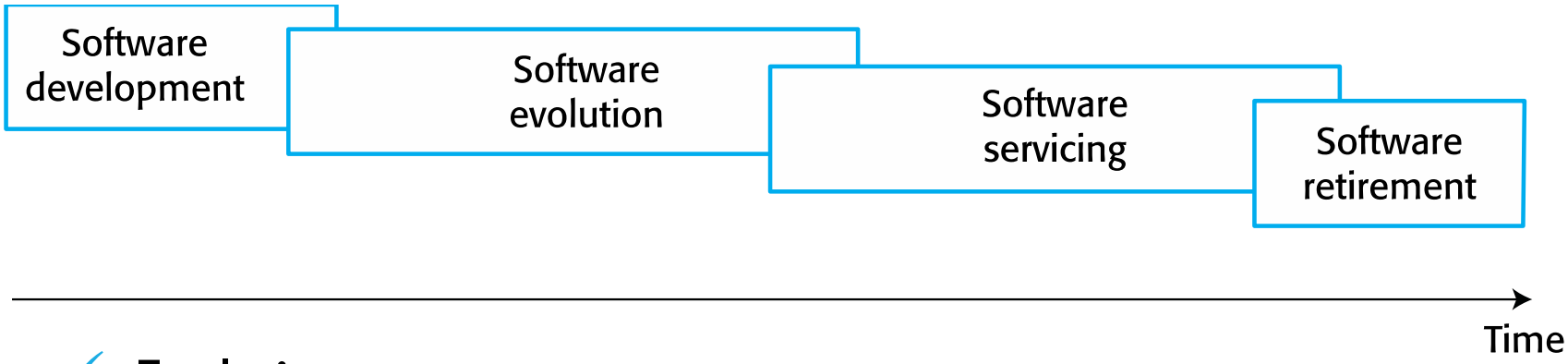
- ✓ To maintain the value of these assets to the business, they must be changed and updated.

The majority of the software budget in large companies is devoted to changing and evolving existing software rather than developing new software.

A SPIRAL MODEL OF DEVELOPMENT AND EVOLUTION



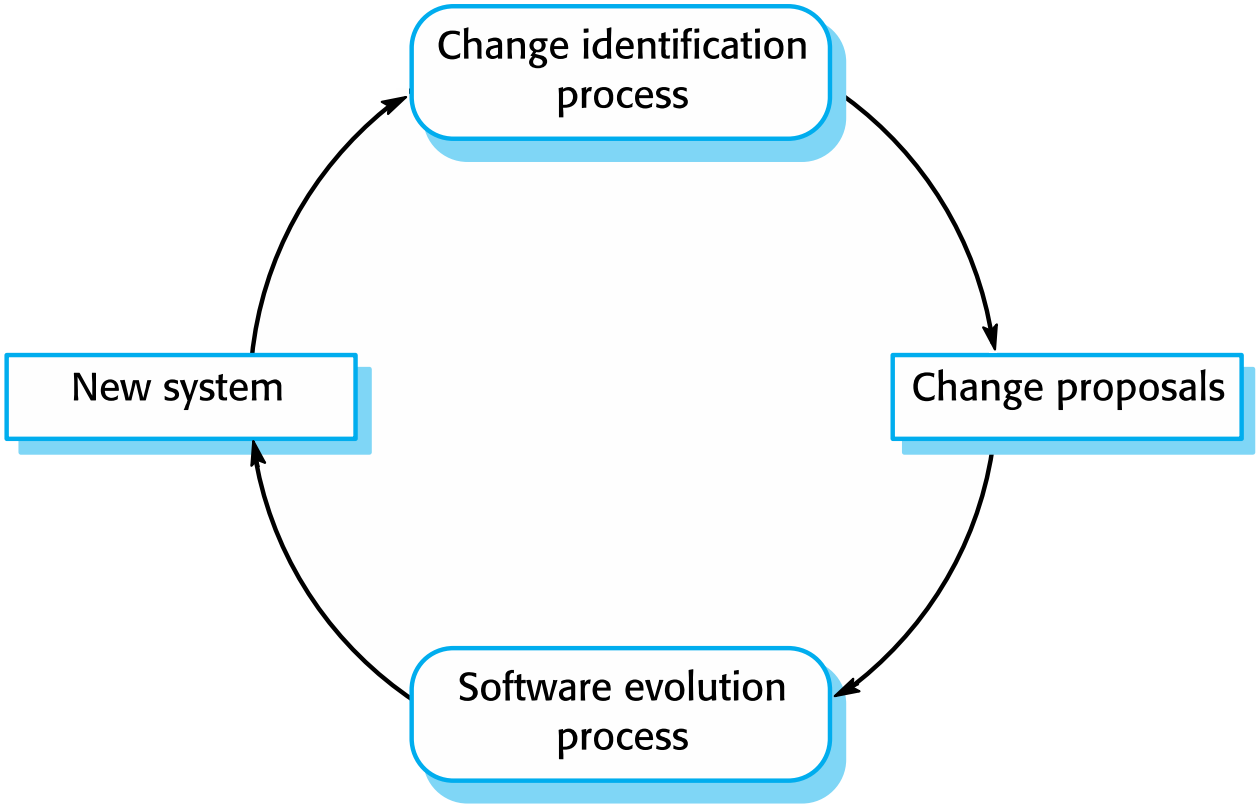
EVOLUTION AND SERVICING



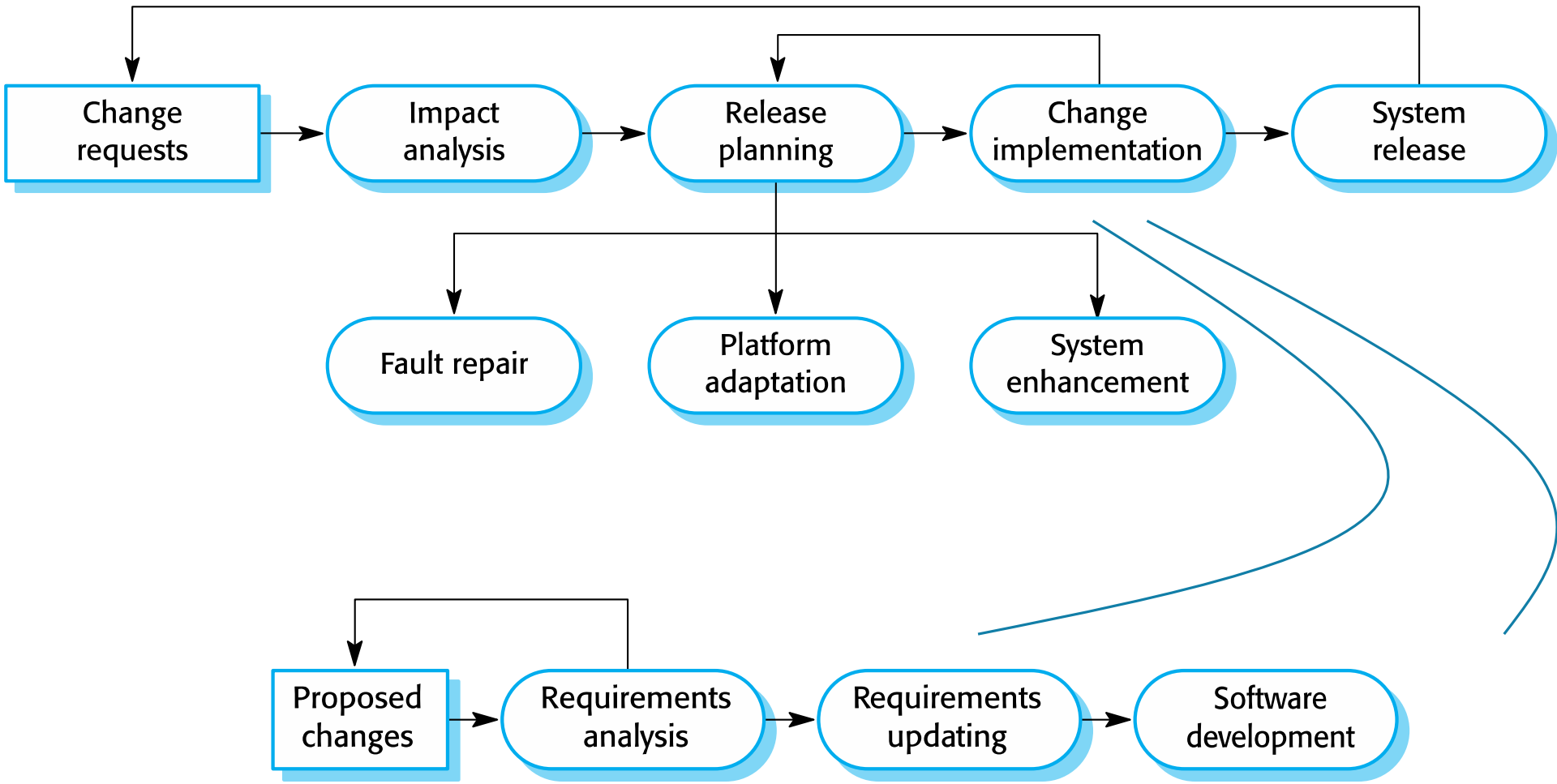
- ✓ Evolution
  - in operational use and is evolving as new requirements are proposed and implemented in the system.
- ✓ Servicing
  - the software remains useful but the only changes made are those required to keep it operational i.e. bug fixes and changes to reflect changes in the software's environment.
- ✓ Phase-out
  - The software may still be used but no further changes are made

EVOLUTION PROCESSES

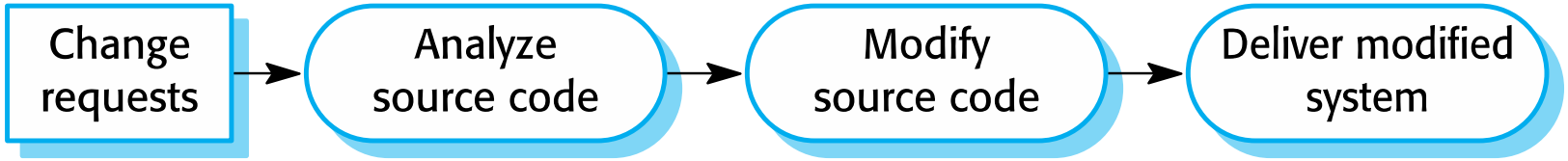
CHANGE IDENTIFICATION AND EVOLUTION PROCESSES



THE SOFTWARE EVOLUTION PROCESS



URGENT CHANGE REQUESTS



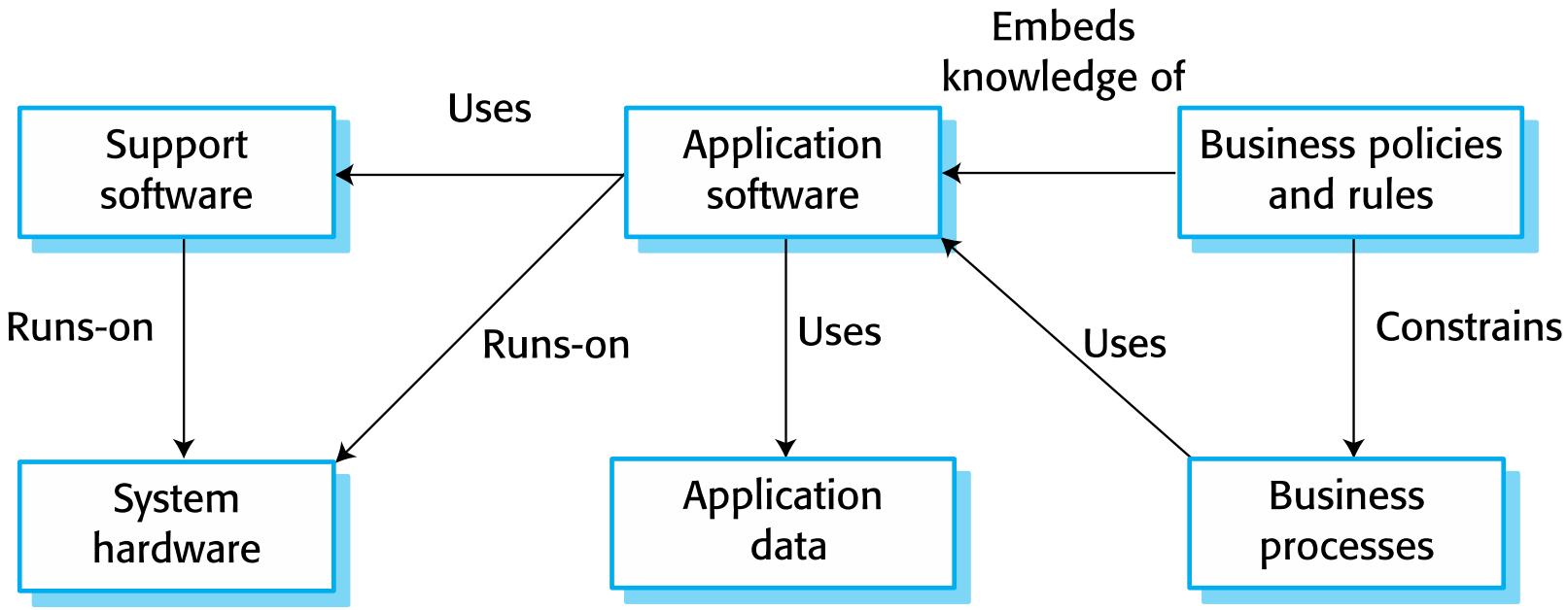
- Urgent changes may have to be implemented without going through all stages of the software engineering process
  - If a serious system fault has to be repaired to allow normal operation to continue;
  - If changes to the system's environment (e.g. an OS upgrade) have unexpected effects;
  - If there are business changes that require a very rapid response (e.g. the release of a competing product).

LEGACY SYSTEMS

LEGACY SYSTEMS

- Legacy systems are older systems that rely on languages and technology that are no longer used for new systems development.
- Legacy software may be dependent on older hardware, such as mainframe computers and may have associated legacy processes and procedures.
- Legacy systems are not just software systems but are broader socio-technical systems that include hardware, software, libraries and other supporting software and business processes.

THE ELEMENTS OF A LEGACY SYSTEM



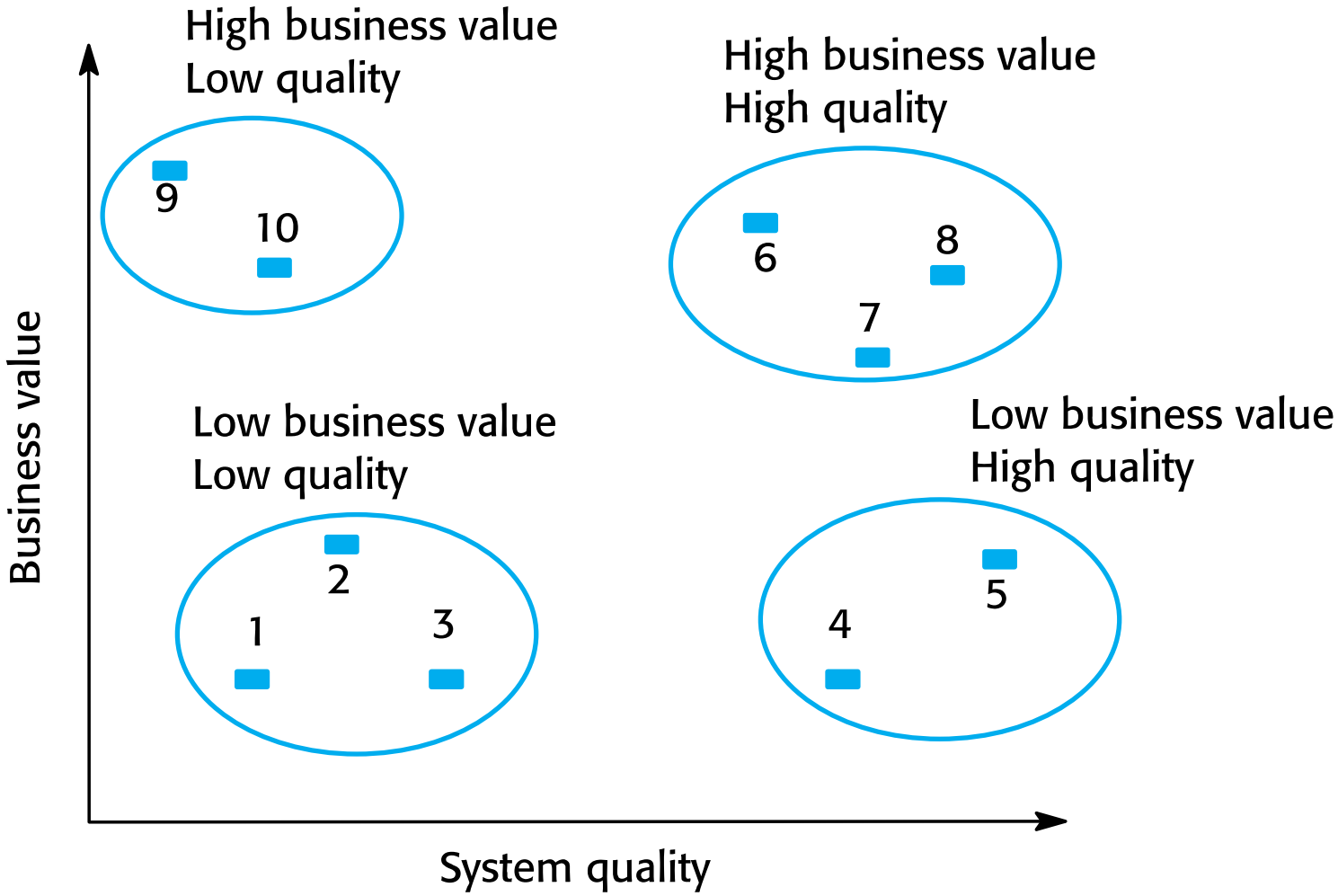
LEGACY SYSTEM REPLACEMENT, CHANGE, MANAGEMENT

- ✓ Legacy system replacement is risky and expensive
  - Lack of complete system specification
  - Tight integration of system and business processes
  - Undocumented business rules embedded in the legacy system
  - New software development may be late and/or over budget
- ✓ Legacy systems are expensive to change
  - No consistent programming style
  - Use of obsolete programming languages with few people available with these language skills
  - Inadequate system documentation
  - System structure degradation
  - Program optimizations may make them hard to understand
  - Data errors, duplication and inconsistency

LEGACY SYSTEM MANAGEMENT

- ✓ Organisations that rely on legacy systems must choose a strategy for evolving these systems
  - Scrap the system completely and modify business processes so that it is no longer required;
  - Continue maintaining the system;
  - Transform the system by re-engineering to improve its maintainability;
  - Replace the system with a new system.
- ✓ The strategy chosen should depend on the system quality and its business value.

FIGURE 9.13 AN EXAMPLE OF A LEGACY SYSTEM ASSESSMENT



LEGACY SYSTEM CATEGORIES

- ✓ Low quality, low business value
  - These systems should be scrapped.
- ✓ Low-quality, high-business value
  - These make an important business contribution but are expensive to maintain. Should be re-engineered or replaced if a suitable system is available.
- ✓ High-quality, low-business value
  - Replace with COTS, scrap completely or maintain.
- ✓ High-quality, high business value
  - Continue in operation using normal system maintenance.

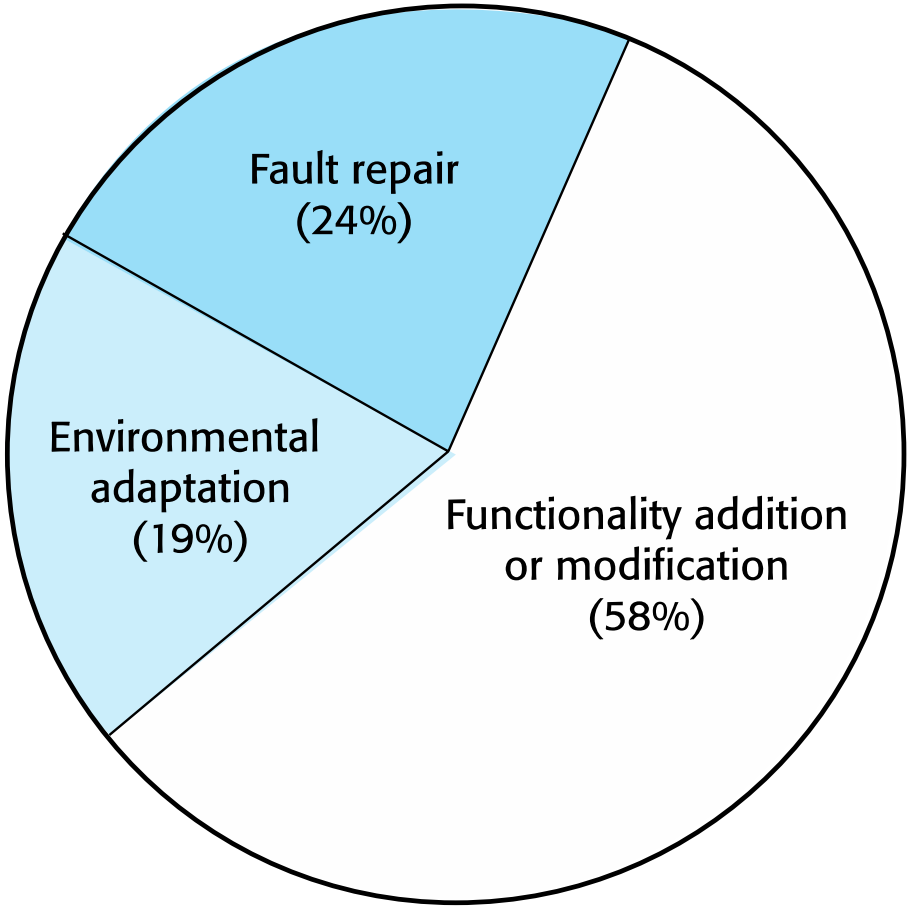
SOFTWARE MAINTENANCE

SOFTWARE MAINTENANCE

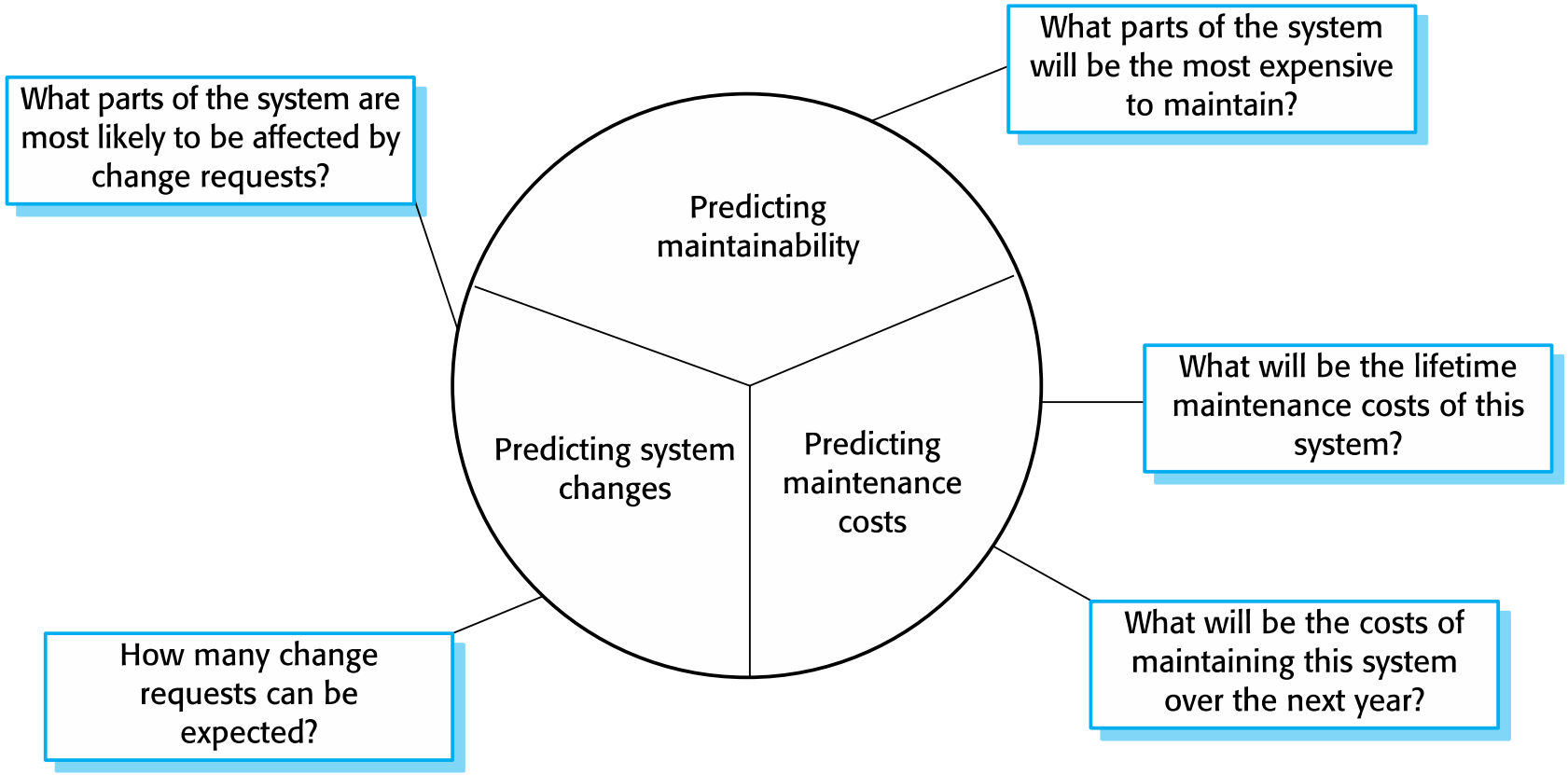
- ✓ Modifying a program after it has been put into use.
- ✓ The term is mostly used for changing custom software. Generic software products are said to evolve to create new versions.
- ✓ Maintenance does not normally involve major changes to the system's architecture.
- ✓ Changes are implemented by modifying existing components and adding new components to the system.

TYPES OF MAINTENANCE

- ✓ Maintenance to repair software faults
- ✓ Maintenance to adapt software to a different operating environment
- ✓ Maintenance to add to or modify the system's functionality



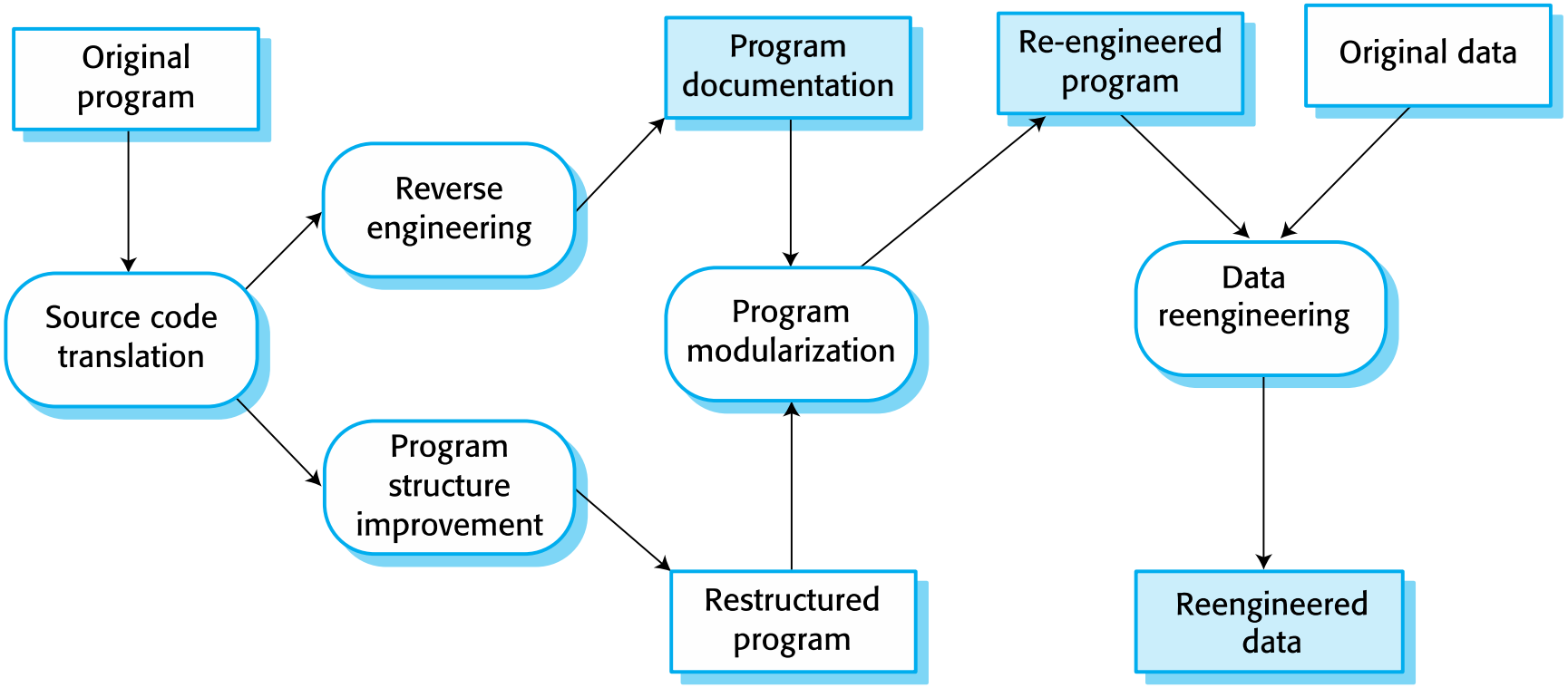
MAINTENANCE PREDICTION



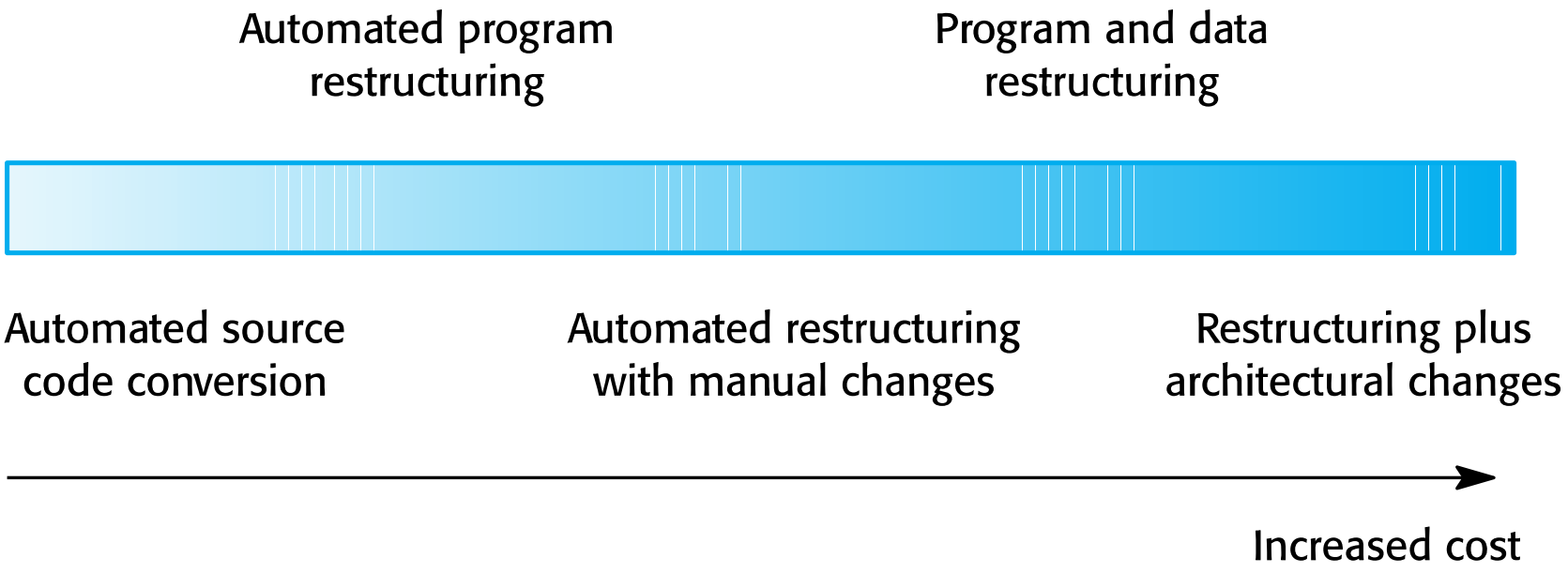
SYSTEM RE-ENGINEERING

- ✓ Re-structuring or re-writing part or all of a legacy system without changing its functionality.
- ✓ Applicable where some but not all sub-systems of a larger system require frequent maintenance.
- ✓ Re-engineering involves adding effort to make them easier to maintain. The system may be re-structured and re-documented.

THE REENGINEERING PROCESS



REENGINEERING APPROACHES



REFACTORING

- ✓ Refactoring => making improvements
  - to slow down degradation through change.
  - 'preventative maintenance' => reduces the problems of future change.
- ✓ Refactoring => modifying programs
  - to improve structure, reduce complexity, for easier to understand.
- ✓ Concentrate on program improvement.

REFACTORING AND REENGINEERING

- ✓ Re-engineering takes place after a system has been maintained for some time and maintenance costs are increasing. You use automated tools to process and re-engineer a legacy system to create a new system that is more maintainable.
- ✓ Refactoring is a continuous process of improvement throughout the development and evolution process. It is intended to avoid the structure and code degradation that increases the costs and difficulties of maintaining a system.

‘BAD SMELLS’ IN PROGRAM CODE

- ✓ Duplicate code
- ✓ Long methods
- ✓ Switch (case) statements
- ✓ Data clumping
  - Data clumps occur when the same group of data items (fields in classes, parameters in methods) re-occur in several places in a program. These can often be replaced with an object that encapsulates all of the data.
- ✓ Speculative generality
  - This occurs when developers include generality in a program in case it is required in the future. This can often simply be removed.

SUMMARY

- ✓ Development and evolution can be integrated, iterative
- ✓ The costs of maintenance usually exceed the development costs
- ✓ Software evolution is driven by
  - requests for changes; process: change impact analysis, release planning and change implementation.
- ✓ 3 types of software maintenance
  - bug fixing, modifying to new environment, new or changed requirements.
- ✓ Software re-engineering
  - re-structuring and re-documenting software: easier to understand and change.
- ✓ Refactoring
  - changes: preserve functionality; a preventative maintenance.
- ✓ Legacy system
  - Business value vs. quality