Software Evolution and Software Configuration Management

CS413 - Software Engineering Project Management

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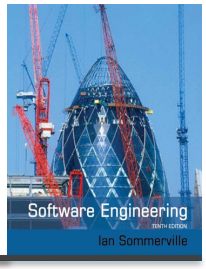
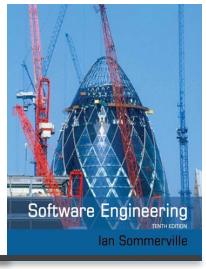


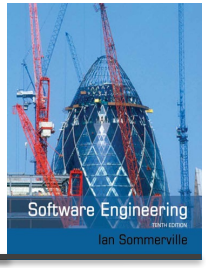
Chapter 9 – Software Evolution

Software change



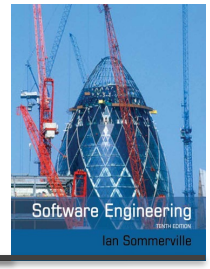
- Software change is inevitable
  - New requirements emerge when the software is used;
  - The business environment changes;
  - Errors must be repaired;
  - New computers and equipment is added to the system;
  - The performance or reliability of the system may have to be improved.
- A key problem for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

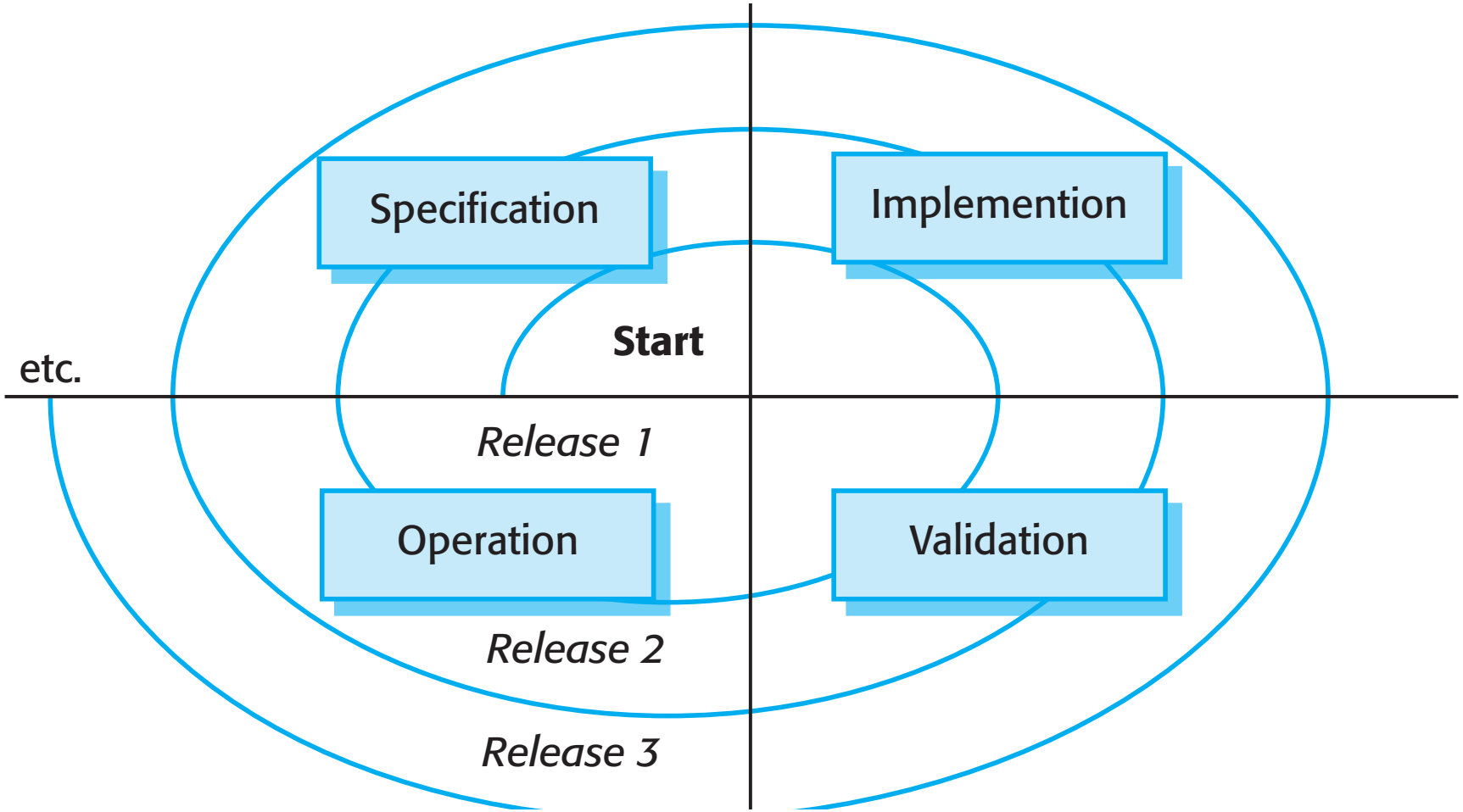
Importance of evolution



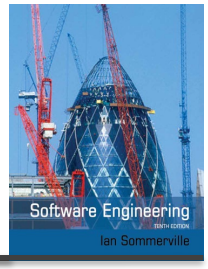
- Organisations have huge investments in their software systems - they are critical business assets.
- To maintain the value of these assets to the business, they must be changed and updated.
- The majority of the software budget in large companies is devoted to changing and evolving existing software rather than developing new software.

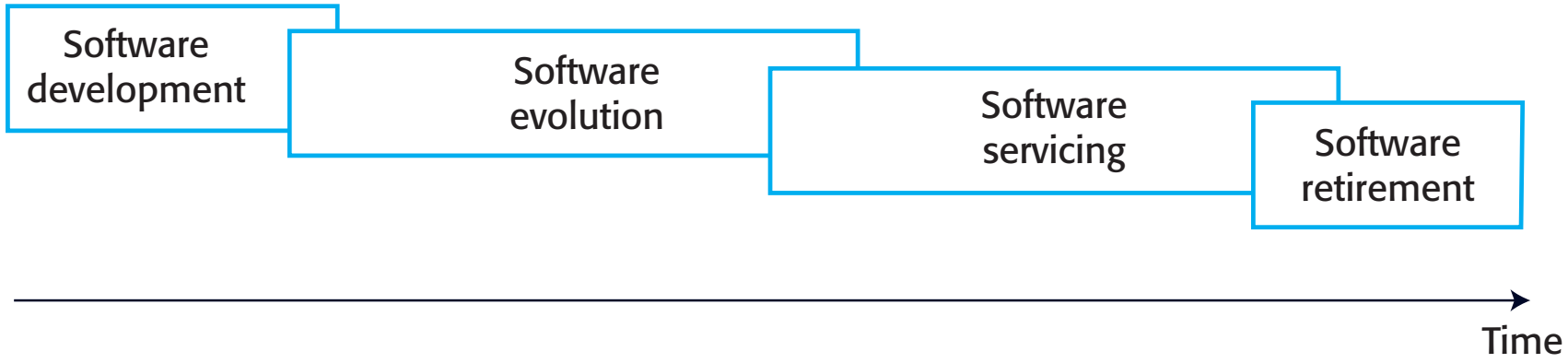
A spiral model of development and evolution





Evolution and servicing





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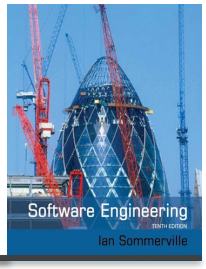
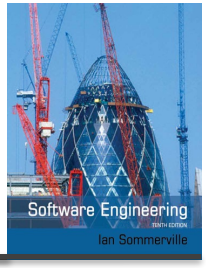


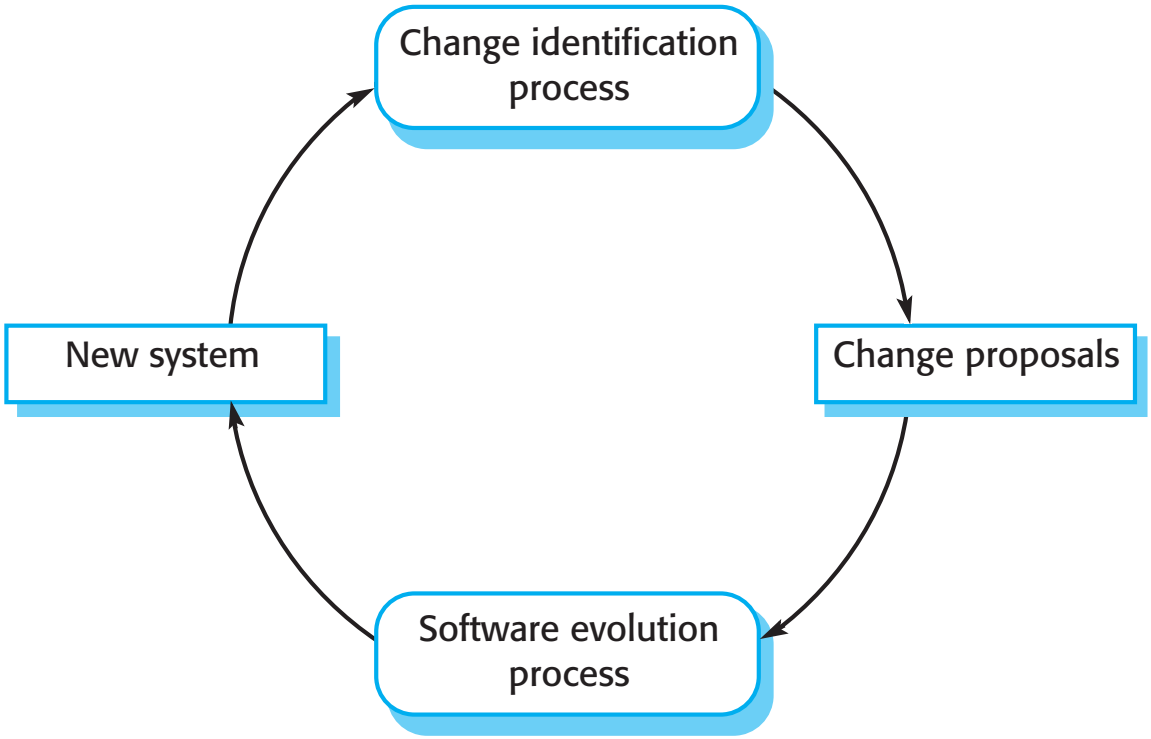
- Evolution
  - The stage in a software system's life cycle where it is in operational use and is evolving as new requirements are proposed and implemented in the system.
- Servicing
  - At this stage, the software remains useful but the only changes made are those required to keep it operational i.e. bug fixes and changes to reflect changes in the software's environment. No new functionality is added.
- Phase-out
  - The software may still be used but no further changes are made to it.

Evolution processes

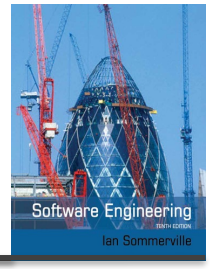


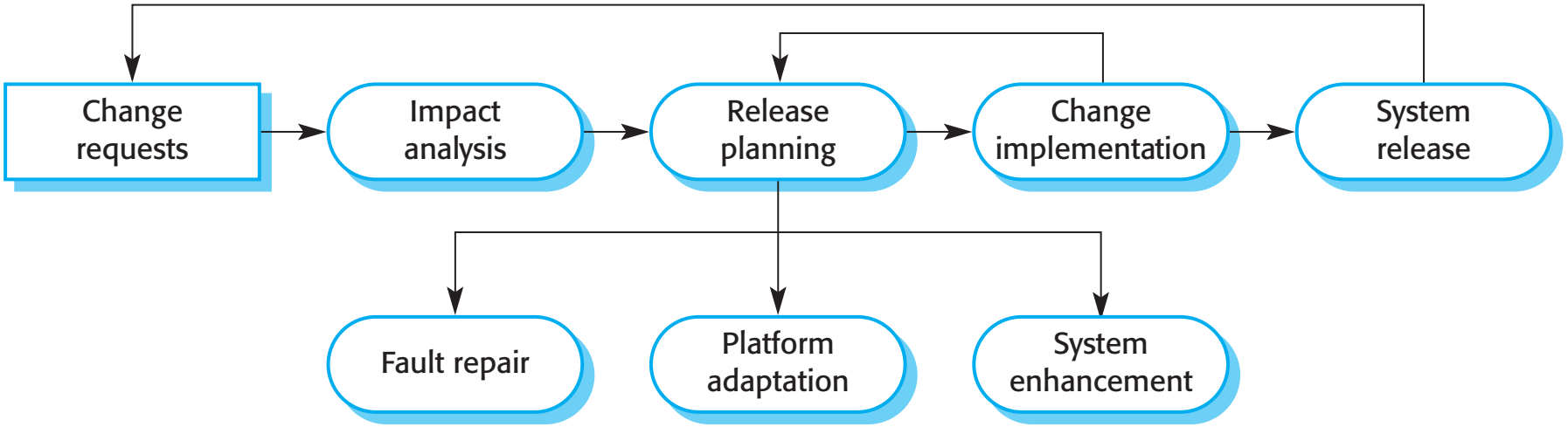
- Software evolution processes depend on
  - The type of software being maintained;
  - The development processes used;
  - The skills and experience of the people involved.
- Proposals for change are the driver for system evolution.
  - Should be linked with components that are affected by the change, thus allowing the cost and impact of the change to be estimated.
- Change identification and evolution continues throughout the system lifetime.

Change identification and evolution processes

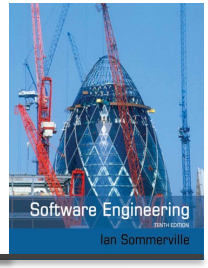


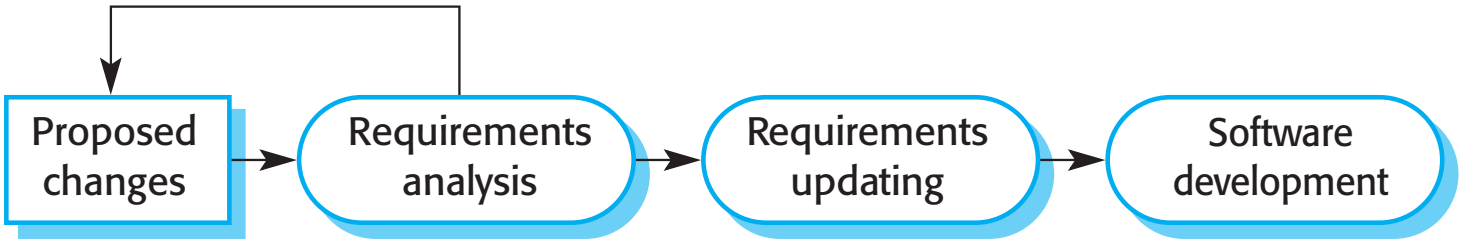
The software evolution process



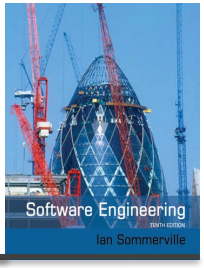


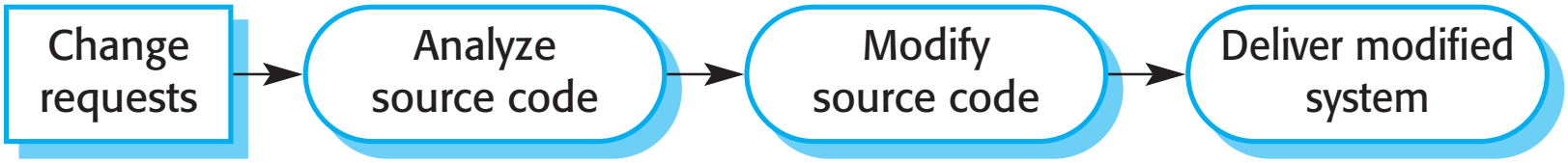
Change implementation



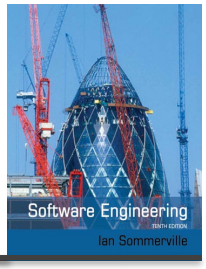


The emergency repair process



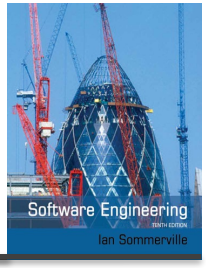


Agile methods and evolution



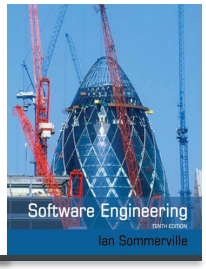
- Agile methods are based on incremental development so the transition from development to evolution is a seamless one.
  - Evolution is simply a continuation of the development process based on frequent system releases.
- Automated regression testing is particularly valuable when changes are made to a system.
- Changes may be expressed as additional user stories.

Legacy systems



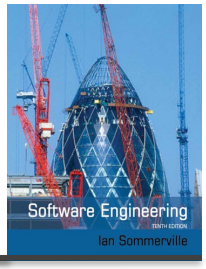
- Legacy systems are older systems that rely on languages and technology that are no longer used for new systems development.
- Legacy software may be dependent on older hardware, such as mainframe computers and may have associated legacy processes and procedures.
- Legacy systems are not just software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

‘Bad smells’ in program code



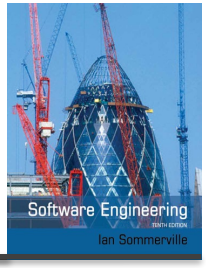
- Duplicate code
  - The same or very similar code may be included at different places in a program. This can be removed and implemented as a single method or function that is called as required.
- Long methods
  - If a method is too long, it should be redesigned as a number of shorter methods.
- Switch (case) statements
  - These often involve duplication, where the switch depends on the type of a value. The switch statements may be scattered around a program. In object-oriented languages, you can often use polymorphism to achieve the same thing.

‘Bad smells’ in program code



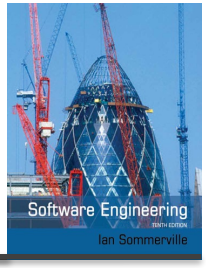
- Data clumping
  - Data clumps occur when the same group of data items (fields in classes, parameters in methods) re-occur in several places in a program. These can often be replaced with an object that encapsulates all of the data.
- Speculative generality
  - This occurs when developers include generality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

Key points



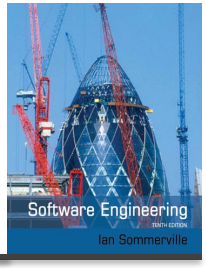
- Software development and evolution can be thought of as an integrated, iterative process that can be represented using a spiral model.
- For custom systems, the costs of software maintenance usually exceed the software development costs.
- The process of software evolution is driven by requests for changes and includes change impact analysis, release planning and change implementation.
- Legacy systems are older software systems, developed using obsolete software and hardware technologies, that remain useful for a business.

Key points

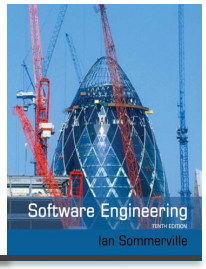


- It is often cheaper and less risky to maintain a legacy system than to develop a replacement system using modern technology.
- The business value of a legacy system and the quality of the application should be assessed to help decide if a system should be replaced, transformed or maintained.
- There are 3 types of software maintenance, namely bug fixing, modifying software to work in a new environment, and implementing new or changed requirements.

Key points

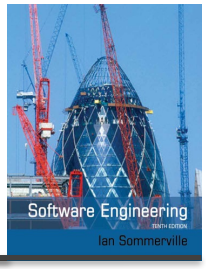


- Software re-engineering is concerned with re-structuring and re-documenting software to make it easier to understand and change.
- Refactoring, making program changes that preserve functionality, is a form of preventative maintenance.



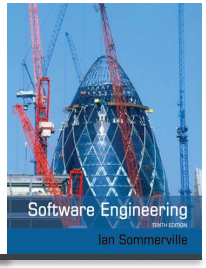
Chapter 25 – Configuration Management

Configuration management



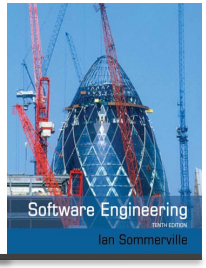
- Software systems are constantly changing during development and use.
- Configuration management (CM) is concerned with the policies, processes and tools for managing changing software systems.
- You need CM because it is easy to lose track of what changes and component versions have been incorporated into each system version.
- CM is essential for team projects to control changes made by different developers

CM activities



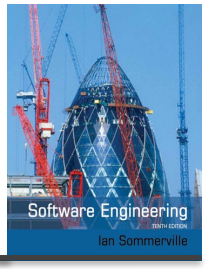
- Version management
  - Keeping track of the multiple versions of system components and ensuring that changes made to components by different developers do not interfere with each other.
- System building
  - The process of assembling program components, data and libraries, then compiling these to create an executable system.
- Change management
  - Keeping track of requests for changes to the software from customers and developers, working out the costs and impact of changes, and deciding the changes should be implemented.
- Release management
  - Preparing software for external release and keeping track of the system versions that have been released for customer use.

Agile development and CM



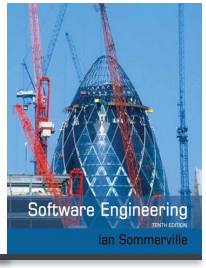
- Agile development, where components and systems are changed several times per day, is impossible without using CM tools.
- The definitive versions of components are held in a shared project repository and developers copy these into their own workspace.
- They make changes to the code then use system building tools to create a new system on their own computer for testing. Once they are happy with the changes made, they return the modified components to the project repository.

Multi-version systems



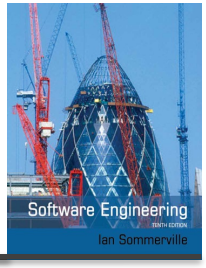
- For large systems, there is never just one ‘working’ version of a system.
- There are always several versions of the system at different stages of development.
- There may be several teams involved in the development of different system versions.

CM terminology



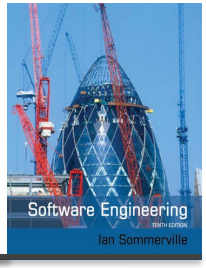
Term	Explanation
Baseline	A baseline is a collection of component versions that make up a system. Baselines are controlled, which means that the versions of the components making up the system cannot be changed. This means that it is always possible to recreate a baseline from its constituent components.
Branching	The creation of a new codeline from a version in an existing codeline. The new codeline and the existing codeline may then develop independently.
Codeline	A codeline is a set of versions of a software component and other configuration items on which that component depends.
Configuration (version) control	The process of ensuring that versions of systems and components are recorded and maintained so that changes are managed and all versions of components are identified and stored for the lifetime of the system.
Configuration item or software configuration item (SCI)	Anything associated with a software project (design, code, test data, document, etc.) that has been placed under configuration control. There are often different versions of a configuration item. Configuration items have a unique name.
Mainline	A sequence of baselines representing different versions of a system.

CM terminology

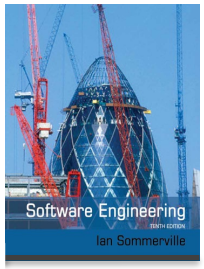


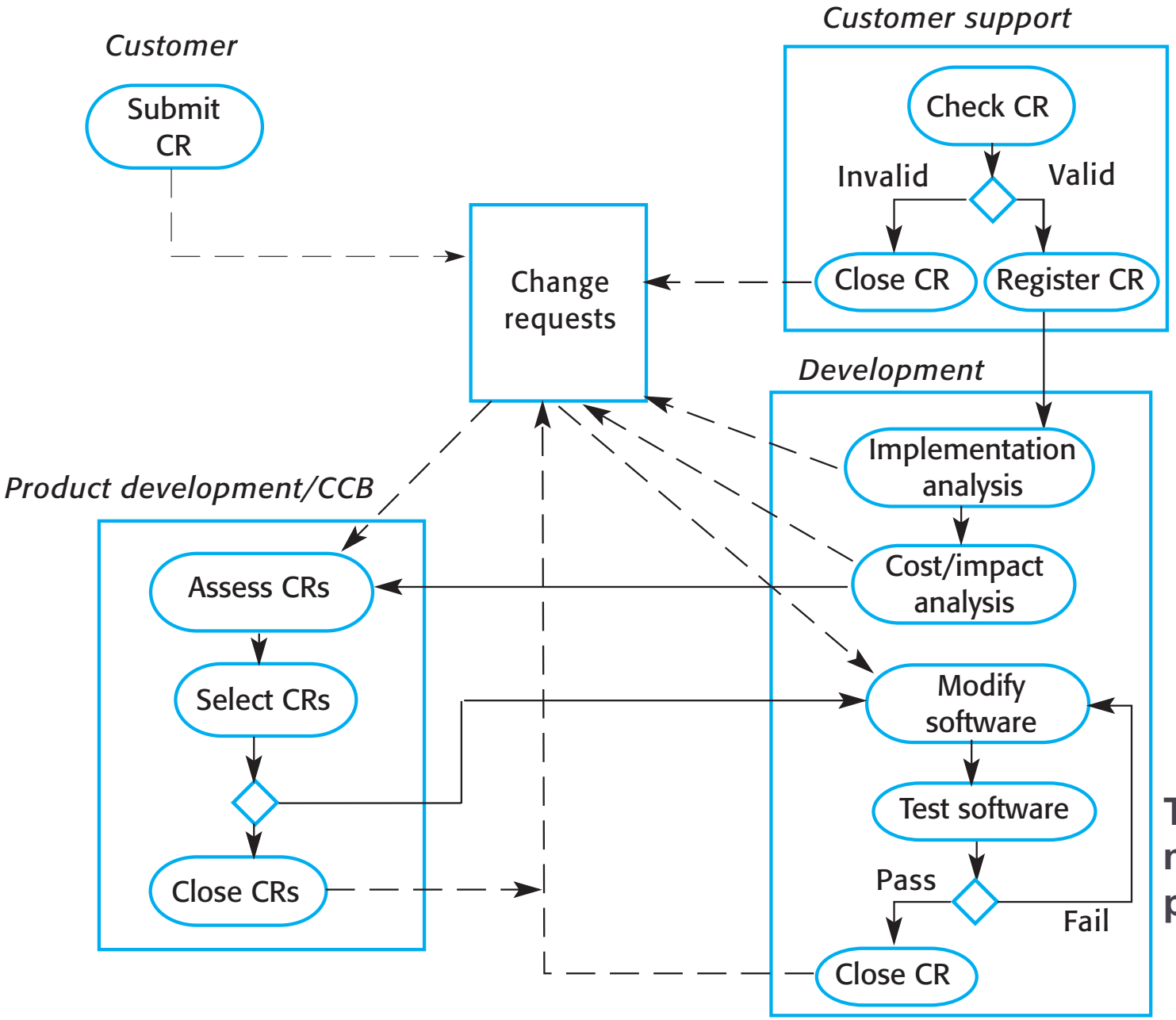
Term	Explanation
Merging	The creation of a new version of a software component by merging separate versions in different codelines. These codelines may have been created by a previous branch of one of the codelines involved.
Release	A version of a system that has been released to customers (or other users in an organization) for use.
Repository	A shared database of versions of software components and meta-information about changes to these components.
System building	The creation of an executable system version by compiling and linking the appropriate versions of the components and libraries making up the system.
Version	An instance of a configuration item that differs, in some way, from other instances of that item. Versions always have a unique identifier.
Workspace	A private work area where software can be modified without affecting other developers who may be using or modifying that software.

Change management



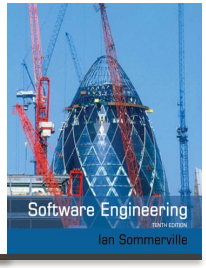
- Organizational needs and requirements change during the lifetime of a system, bugs have to be repaired and systems have to adapt to changes in their environment.
- Change management is intended to ensure that system evolution is a managed process and that priority is given to the most urgent and cost-effective changes.
- The change management process is concerned with analyzing the costs and benefits of proposed changes, approving those changes that are worthwhile and tracking which components in the system have been changed.





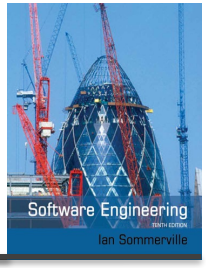
The change management process

Factors in change analysis



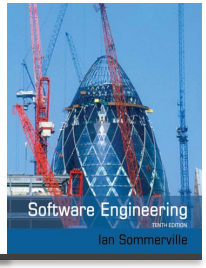
- The consequences of not making the change
- The benefits of the change
- The number of users affected by the change
- The costs of making the change
- The product release cycle

Change management and agile methods



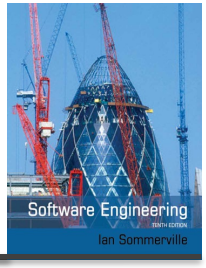
- In some agile methods, customers are directly involved in change management.
- The propose a change to the requirements and work with the team to assess its impact and decide whether the change should take priority over the features planned for the next increment of the system.
- Changes to improve the software improvement are decided by the programmers working on the system.
- Refactoring, where the software is continually improved, is not seen as an overhead but as a necessary part of the development process.

Key points



- Configuration management is the management of an evolving software system. When maintaining a system, a CM team is put in place to ensure that changes are incorporated into the system in a controlled way and that records are maintained with details of the changes that have been implemented.
- The main configuration management processes are concerned with version management, system building, change management, and release management.
- Version management involves keeping track of the different versions of software components as changes are made to them.

Key points



- System building is the process of assembling system components into an executable program to run on a target computer system.
- Software should be frequently rebuilt and tested immediately after a new version has been built. This makes it easier to detect bugs and problems that have been introduced since the last build.
- Change management involves assessing proposals for changes from system customers and other stakeholders and deciding if it is cost-effective to implement these in a new version of a system.
- System releases include executable code, data files, configuration files and documentation. Release management involves making decisions on system release dates, preparing all information for distribution and documenting each system release.

Reference

- Software Engineering, 10th Edition, Ian Sommerville.

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