SE345

Atılım University
Dept of Software Engineering

Asst. Prof. Dr. Aylin AKCA-OKAN

Tentative Course Schedule

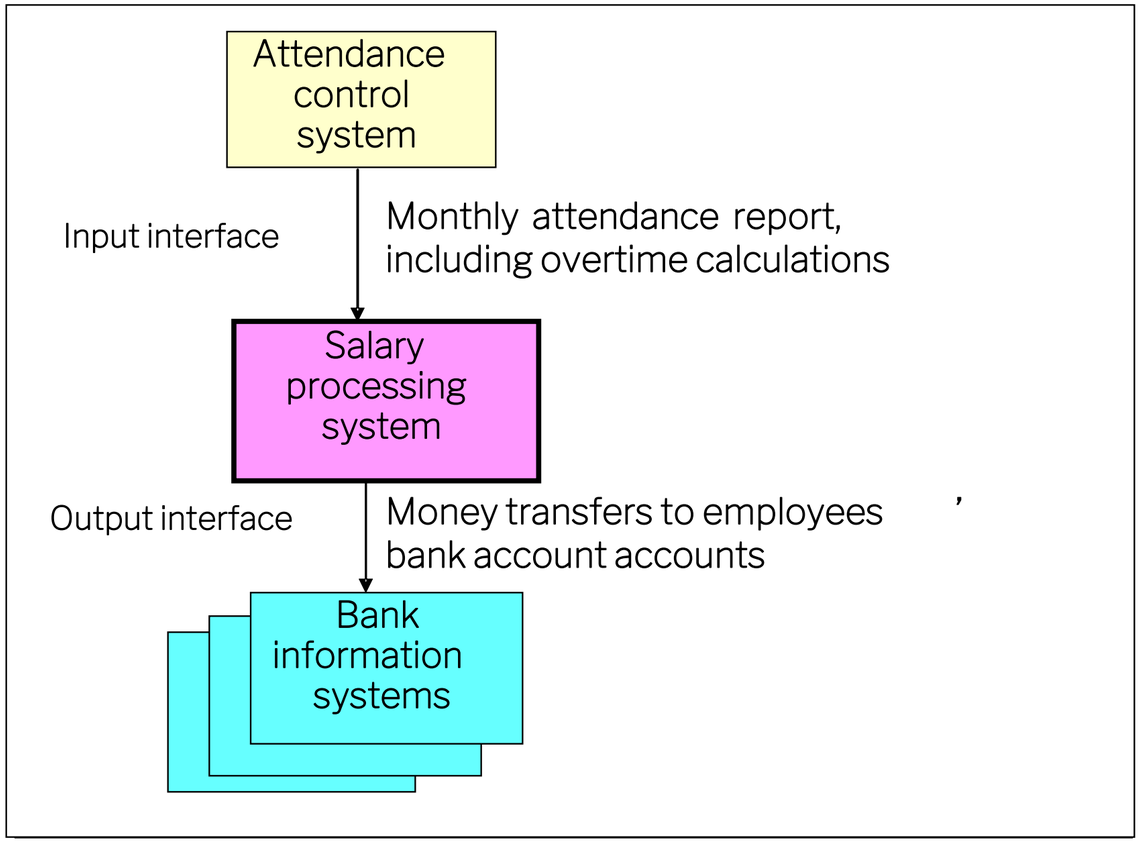
Wk	Subjects	Chapter
1	Introduction to Software Quality and Assurance	Chapter 1
2	Introduction to Software Quality and Assurance	Chapter 1
3	Software Quality Factors	Chapter 3
4	Overview of Components of the SQA System	Chapter 4
5	Overview of Components of the SQA System	Chapter 4
6	Presentation	Chapter 9
7	Midterm	
8	Integrating Quality Activities in Project Life Cycle	Chapter 7
9	Software Quality Metrics	Chapter 21
10	Reviews, Inspection and Audits	Chapter 8
11	Procedures and Work Instructions	Chapter 14
12	In-class Project	
13	Software Change Process	Chapter 18
14	SOA Process Standards	Chapter 23

Software - IEEE definition

Software is:

Computer programs, procedures, and possibly associated documentation and data pertaining to the operation of a computer system.

Salary software system – an example of software interfaces



Software Engineering

The application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software that is, the application of engineering to software.

IEEE Standard Computer Dictionary, 610.12, ISBN 1-55937-079-3, 1990

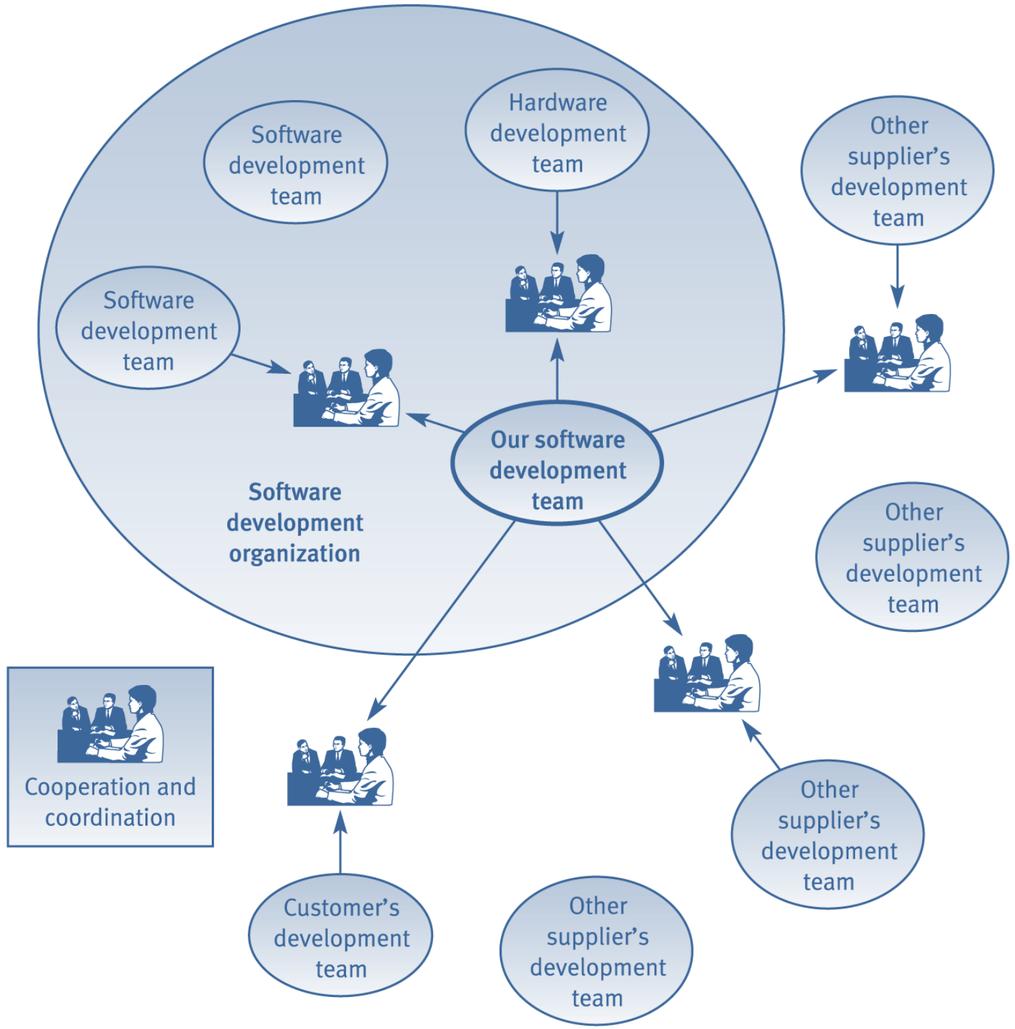
Software engineering is concerned with the theories, methods and tools for developing, managing and evolving software products.

I. Sommerville, 6ed.

A discipline whose aim is the production of quality software, delivered on time, within budget, and satisfying users' needs.

Stephen R. Schach, Software Engineering, 2ed.

Cooperation and coordination scheme for a software development project team



Warranty Lawsuit

Mortenson vs. Timeberline Software (TS)

- Mortenson used a TS application when creating a bid to build a hospital.
- The software created a bid that was $2M too low.
- TS knew about the bug, but had not sent an update to Mortenson.
- The State of Washington Supreme Court ruled in favor of TS.

Basic Questions

- What is the point of SQA?
- How necessary is SQA?
  - How good is software?
- Is software production different from producing other products? If so, how and why?

The uniqueness of the software development process

- High complexity
- Invisibility of the product
- Limited opportunities to detect defects (“bugs”)
- Product development lifecycle
- ??

Misplaced Assumptions !?!

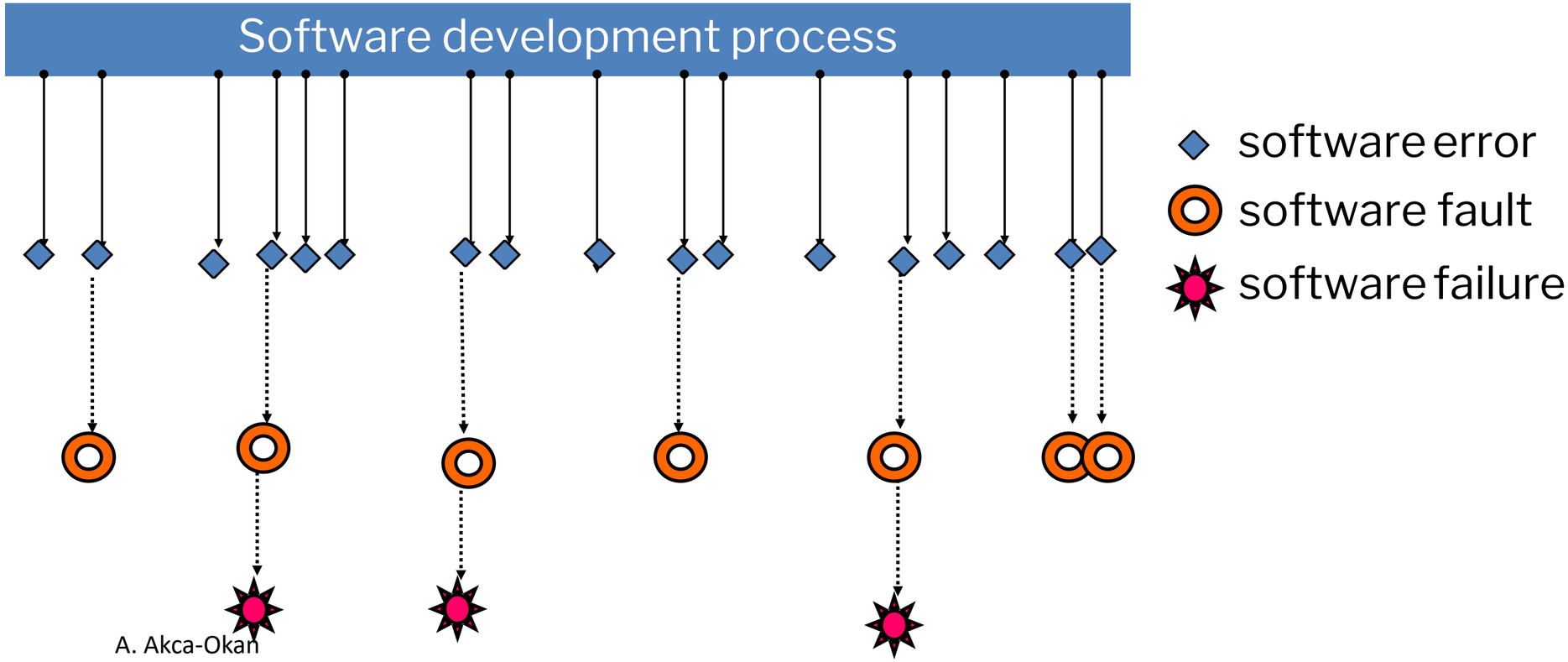
- All requirements can be pre-specified
- Users are experts at specification of their needs
- Users and developers are both good at visualization
- The project team is capable of unambiguous communication

The characteristics of the SQA environment process

- Being contracted
- Subject to the customer-supplier relationship
- Requirement for teamwork
- Need for cooperation and coordination with other development teams
- Need for interfaces with other software systems
- Need to continue carrying out a project while the team changes
- Need to continue maintaining the software system for years

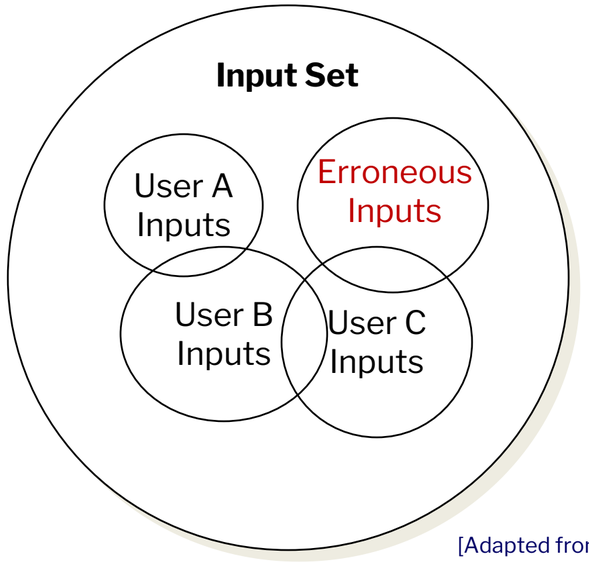
Software errors, software faults and software failures

- ***Bug/defect/fault*** consequence of a *human error*
  - results in non-conformance to requirements
  - manifests as *failure* in running software



Software Faults and Failures

- A failure corresponds to erroneous/unexpected runtime behavior observed by a user.
- A fault is a static software characteristic that can cause a failure to occur.
- The presence of a fault doesn't necessarily imply the occurrence of a failure.

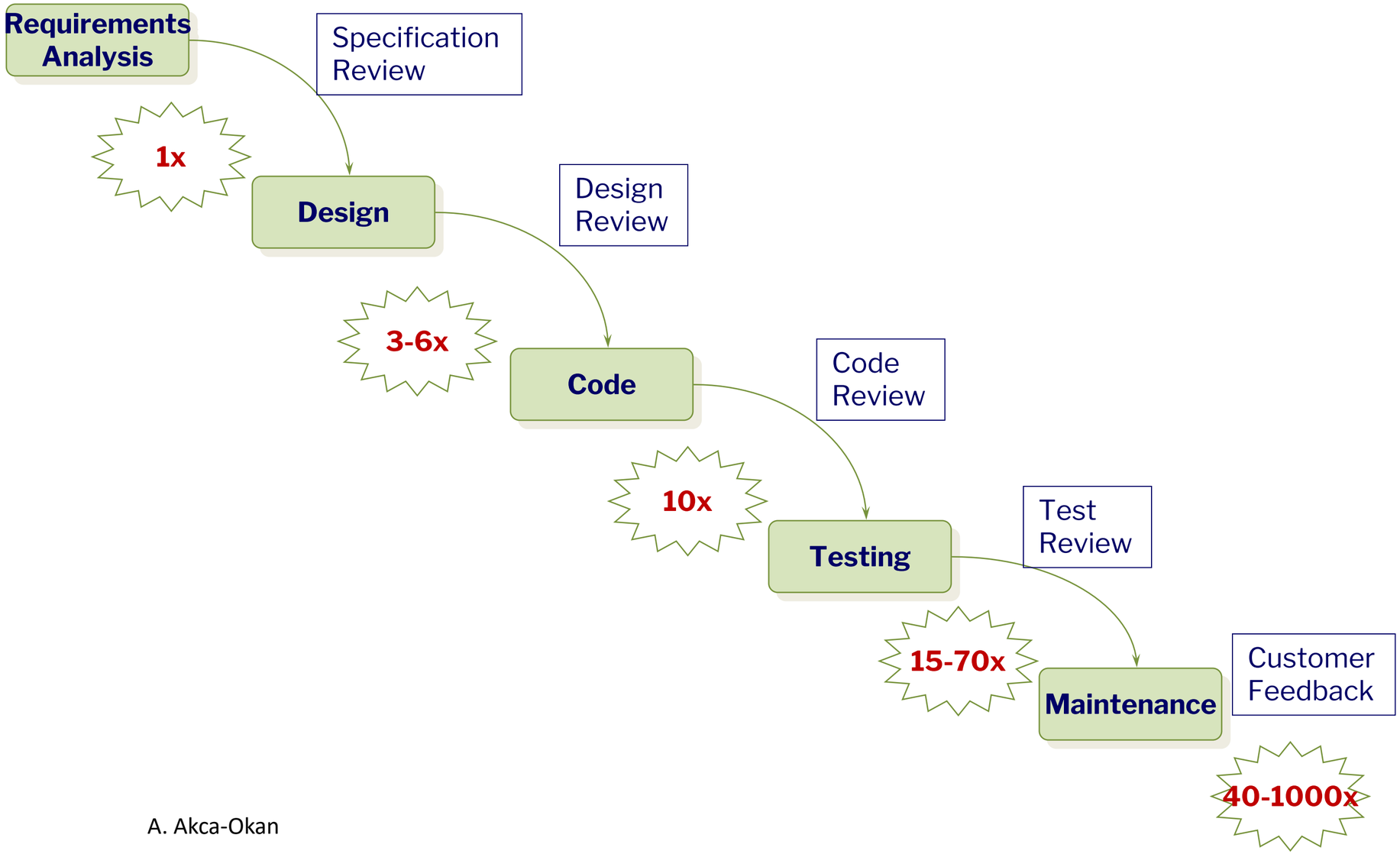


[Adapted from Sommerville 5th Ed]

The nine causes of software errors are:

1. Faulty requirements definition
2. Client-developer communication failures
3. Deliberate deviations from software requirements
4. Logical design errors
5. Coding errors
6. Non-compliance with documentation and coding instructions
7. Shortcomings of the testing process
8. User interface and procedure errors
9. Documentation errors

Quality Reviews



[Adapted from Pressman 4th Ed]

Quality Reviews

- The fundamental method of validating the quality of a product or a process.
- Applied during and/or at the end of each life cycle phase
  - Point out needed improvements in the product of a single person or team
  - Confirm those parts of a product in which improvement is either not desired or not needed
  - Achieve technical work of more uniform, or at least more predictable, quality than what can be achieved without reviews, in order to make technical work more manageable
- Quality reviews can have different intents:
  - review for defect removal
  - review for progress assessment
  - review for consistency and conformance

Software quality - IEEE definition

Software quality is:

(1) The degree to which a system, component, or process meets specified requirements.

(2) The degree to which a system, component, or process meets customer or user needs or expectations.

Software quality - Pressman’s definition

Software quality is :

Conformance to explicitly stated functional and performance requirements, explicitly documented development standards, and implicit characteristics that are expected of all professionally developed software.

SQA - IEEE definition

Software quality assurance is:

1. A planned and systematic pattern of all actions necessary to provide adequate confidence that an item or product conforms to established technical requirements.
2. A set of activities designed to evaluate the process by which the products are developed or manufactured. Contrast with: quality control.

SQA - expanded definition

Software quality assurance is:

A systematic, planned set of actions necessary to provide adequate confidence that the software development process or the maintenance process of a software system product conforms to established functional technical requirements as well as with the managerial requirements of keeping the schedule and operating within the budgetary confines.

The objectives of SQA activities in software development

(1) Assuring an acceptable level of confidence that the software will conform to functional technical requirements.

(2) Assuring an acceptable level of confidence that the software will conform to managerial scheduling and budgetary requirements.

(3) Initiation and management of activities for the improvement and greater efficiency of software development and SQA activities.

The objectives of SQA activities in software maintenance

(1) Assuring an acceptable level of confidence that the software maintenance activities will conform to the functional technical requirements.

(2) Assuring an acceptable level of confidence that the software maintenance activities will conform to managerial scheduling and budgetary requirements.

(3) Initiate and manage activities to improve and increase the efficiency of software maintenance and SQA activities.

Advantages of SQA

- Software will have fewer latent defects, resulting in reduced effort and time spent during testing and maintenance
- Higher reliability will result in greater customer satisfaction
- Maintenance costs can be reduced
- Overall life cycle cost of software is reduced

Three General Principles of QA

- Know what you are doing
- Know what you should be doing
- Know how to measure the difference

Three General Principles of QA

- **Know what you are doing**
  - understand what is being built, how it is being built and what it currently does
  - suppose a software development process with
    - management structure (milestones, scheduling)
    - reporting policies
    - tracking

Three General Principles of QA

- **Know what you should be doing**
  - having explicit requirements and specifications
  - suppose a software development process with
    - requirements analysis,
    - acceptance tests,
    - frequent user feedback

Three General Principles of QA

- **Know how to measure the difference**

– having explicit measures comparing what is being done with what should be done

Four complementary methods:

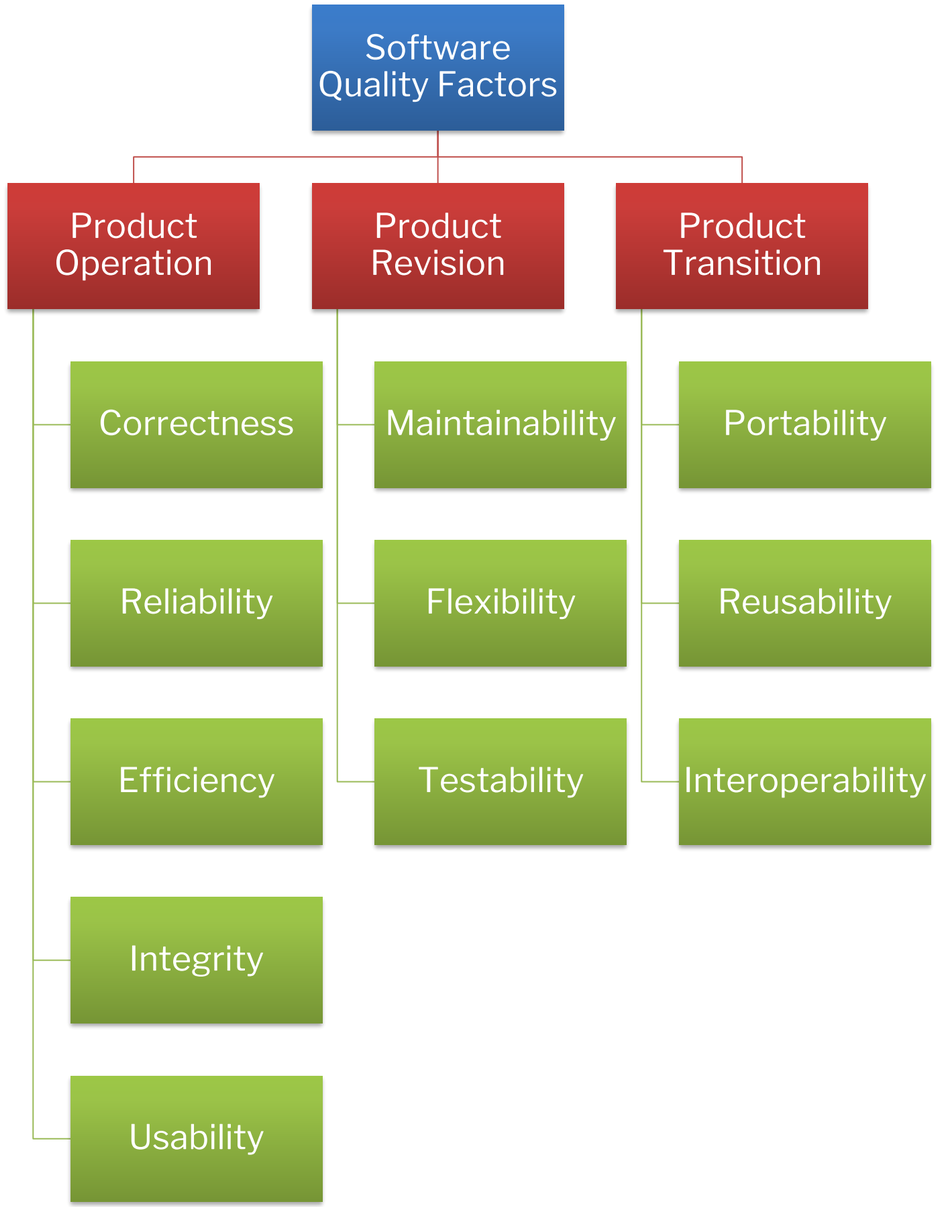
- formal methods – verify mathematically specified properties
- testing – explicit input to exercise software and check for expected output
- inspections – human examination of requirements, design, code, ... based on checklists
- metrics – measures a known set of properties related to quality

Disadvantages of SQA

- It is difficult to institute in small organizations, where available resources to perform necessary activities are not available
- It represents cultural change - and change is never easy
- It requires the expenditure of dollars that would not otherwise be explicitly budgeted to software engineering or QA

Software Quality Factors

McCall's software quality factor model



Software Quality Assurance

- **SQA:** Comprehensive lifecycle approach concerned with every aspect of the software product development process

- **Includes**
- comprehensive set of quality objectives
- measurable quality attributes (quality metrics) to assess progress toward the objectives
- quantitative certification targets for all components of the software development processes.

- **Takes into account:**
- customer product requirements,
- customer quality requirements, and
- corporate quality requirements.

Typical activities of a SQA process

- Requirements validation.
- Design verification.
- Static code checking (inspection/reviews).
- Dynamic testing.
- Process engineering and standards.
- Metrics and continuous improvement.

What is Quality Management?

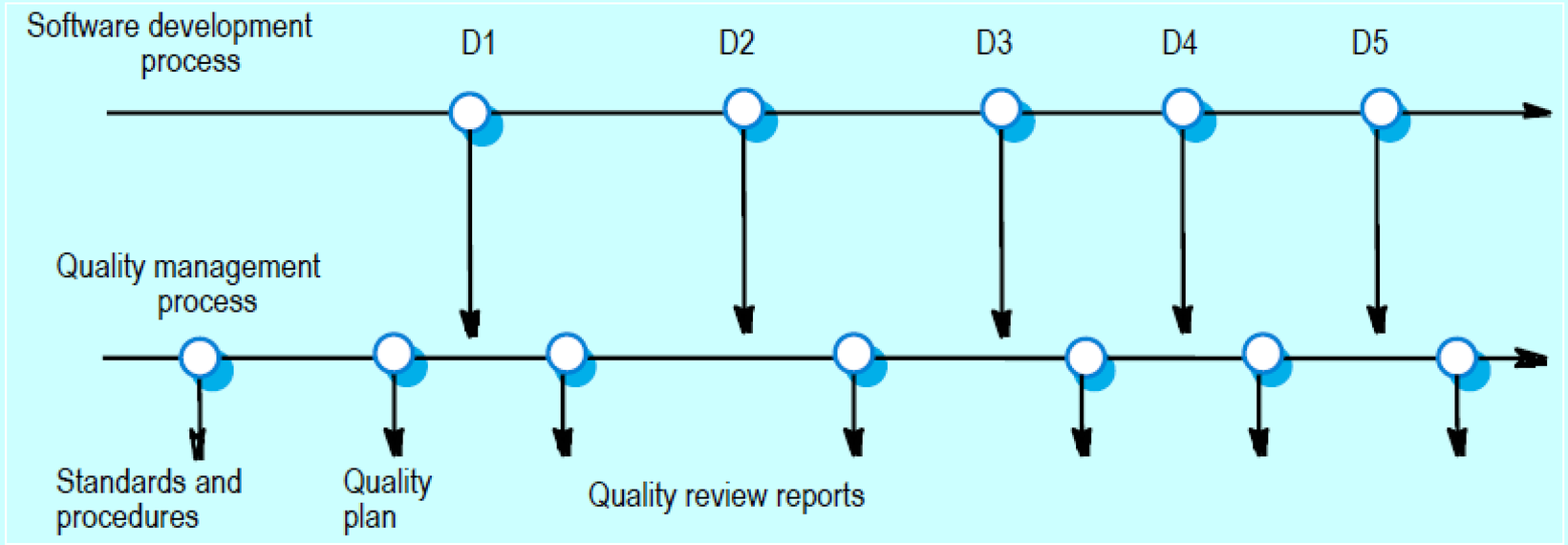
- **Quality Management System** [ISO 9000]:

The organizational structure, responsibilities, procedures, processes and resources for implementing quality management

  - Concerned with ensuring that the required level of quality is achieved in a software product.
  - Involves defining appropriate quality standards and procedures and ensuring that these are followed.
  - Should aim to develop a ‘quality culture’ where quality is seen as everyone’s responsibility.

- Quality management is crucial for large, complex systems.
- Quality documentation is a record of progress that supports continuity of development as the development team changes.
- For smaller systems, quality management needs less documentation and should focus on establishing a quality culture.

QA Management and Software Development



QA Management Activities and QA Overview

(1) Quality assurance

Establish organisational procedures and standards for quality.

(2) Quality planning

Select applicable procedures and standards for a particular project and modify these as required.

(3) Quality control

Ensure that procedures and standards are followed by the software development team.

Quality management should be **separate** from project management to ensure independence.

- **Software Quality Assurance** (activities)
- **Quality Assurance Management** (Project-based management)
- **Quality Management** (Organisation-based management, CMMI, ISO 9001, IEEE 12207, etc.)

Discussion Question

A programmer claims that because only a small proportion of software errors turn into software failures, it is unnecessary to make substantial investments in the prevention and elimination of software errors.

1. **Do you agree with this view?**
2. **Discuss the outcome of accepting these views.**