

# Chapter 1

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## ■ **Software & Software Engineering**

*Slide Set to accompany*

*Software Engineering: A Practitioner's Approach, 7/e*

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# What is Software?

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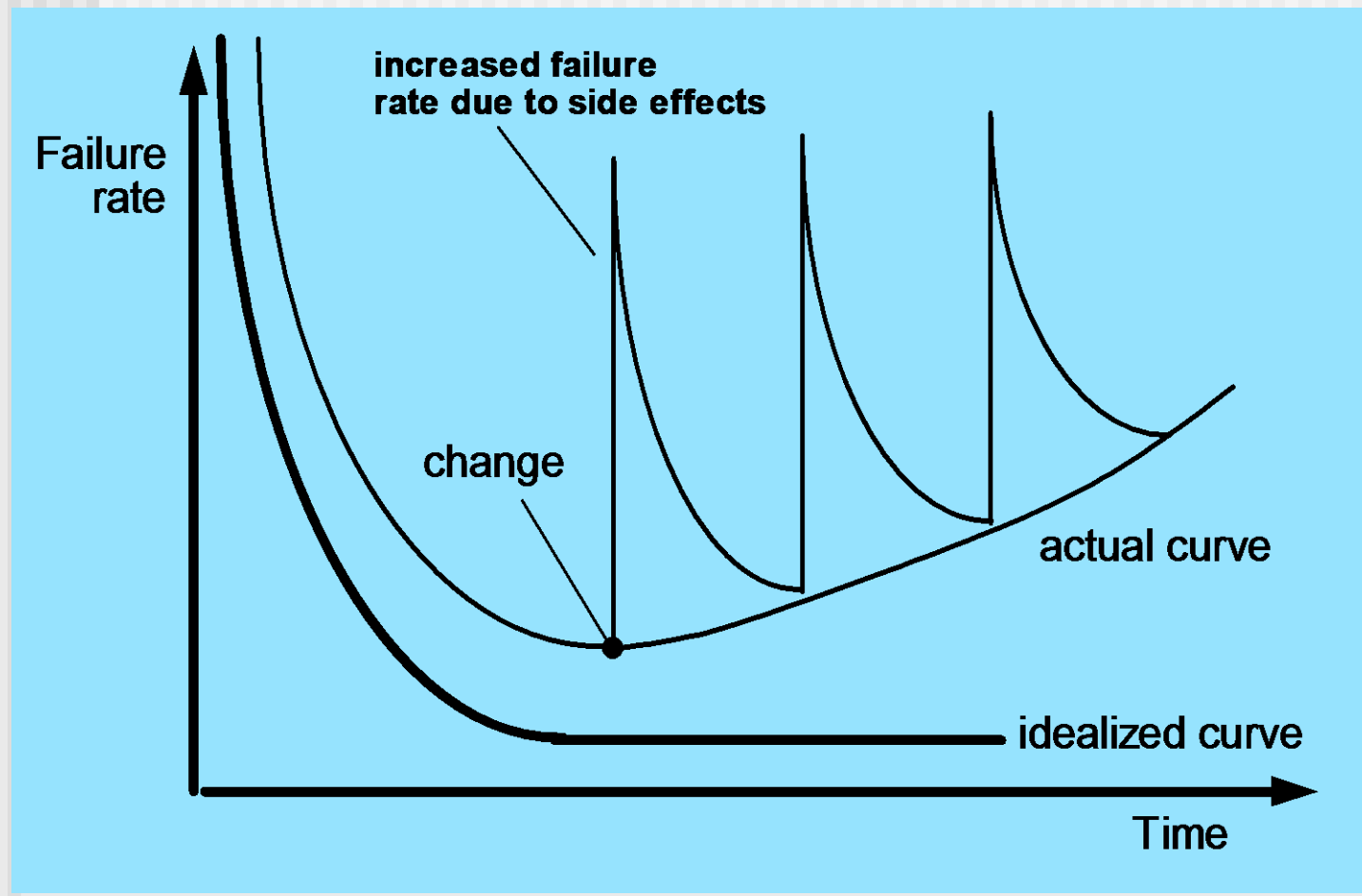
*Software is: (1) **instructions** (computer programs) that when executed provide desired features, function, and performance; (2) **data structures** that enable the programs to adequately manipulate information and (3) **documentation** that describes the operation and use of the programs.*

# What is Software?

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- ***Software is developed or engineered, it is not manufactured in the classical sense.***
- ***Software doesn't "wear out."***
- ***Although the industry is moving toward component-based construction, most software continues to be custom-built.***

# Wear vs. Deterioration



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# Software Applications

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- system software
- application software
- engineering/scientific software
- embedded software
- product-line software
- WebApps (Web applications)
- AI software

# Software—New Categories

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- **Open world computing**—pervasive, distributed computing
- **Ubiquitous computing**—wireless networks
- **Netsourcing**—the Web as a computing engine
- **Open source**—“free” source code open to the computing community (a blessing, but also a potential curse!)
- Also ... (see Chapter 31)
  - **Data mining**
  - **Grid computing**
  - **Cognitive machines**
  - **Software for nanotechnologies**

# Legacy Software

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## *Why must it change?*

- software must be **adapted** to meet the needs of new computing environments or technology.
- software must be **enhanced** to implement new business requirements.
- software must be **extended to make it interoperable** with other more modern systems or databases.
- software must be **re-architected** to make it viable within a network environment.

# Characteristics of WebApps - I

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- **Network intensiveness.** A WebApp resides on a network and must serve the needs of a diverse community of clients.
- **Concurrency.** A large number of users may access the WebApp at one time.
- **Unpredictable load.** The number of users of the WebApp may vary by orders of magnitude from day to day.
- **Performance.** If a WebApp user must wait too long (for access, for server-side processing, for client-side formatting and display), he or she may decide to go elsewhere.
- **Availability.** Although expectation of 100 percent availability is unreasonable, users of popular WebApps often demand access on a “24/7/365” basis.



# Characteristics of WebApps - II

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- **Data driven.** The primary function of many WebApps is to use hypermedia to present text, graphics, audio, and video content to the end-user.
- **Content sensitive.** The quality and aesthetic nature of content remains an important determinant of the quality of a WebApp.
- **Continuous evolution.** Unlike conventional application software that evolves over a series of planned, chronologically-spaced releases, Web applications evolve continuously.
- **Immediacy.** Although *immediacy*—the compelling need to get software to market quickly—is a characteristic of many application domains, WebApps often exhibit a time to market that can be a matter of a few days or weeks.
- **Security.** Because WebApps are available via network access, it is difficult, if not impossible, to limit the population of end-users who may access the application.
- **Aesthetics.** An undeniable part of the appeal of a WebApp is its look and feel.

# Software Engineering

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- Some realities:
  - *a concerted effort should be made to understand the problem before a software solution is developed*
  - *design becomes a pivotal activity*
  - *software should exhibit high quality*
  - *software should be maintainable*
- The seminal definition:
  - *[Software engineering is] the establishment and use of **sound engineering principles** in order to obtain **economically** software that is **reliable and works efficiently** on **real machines**.*

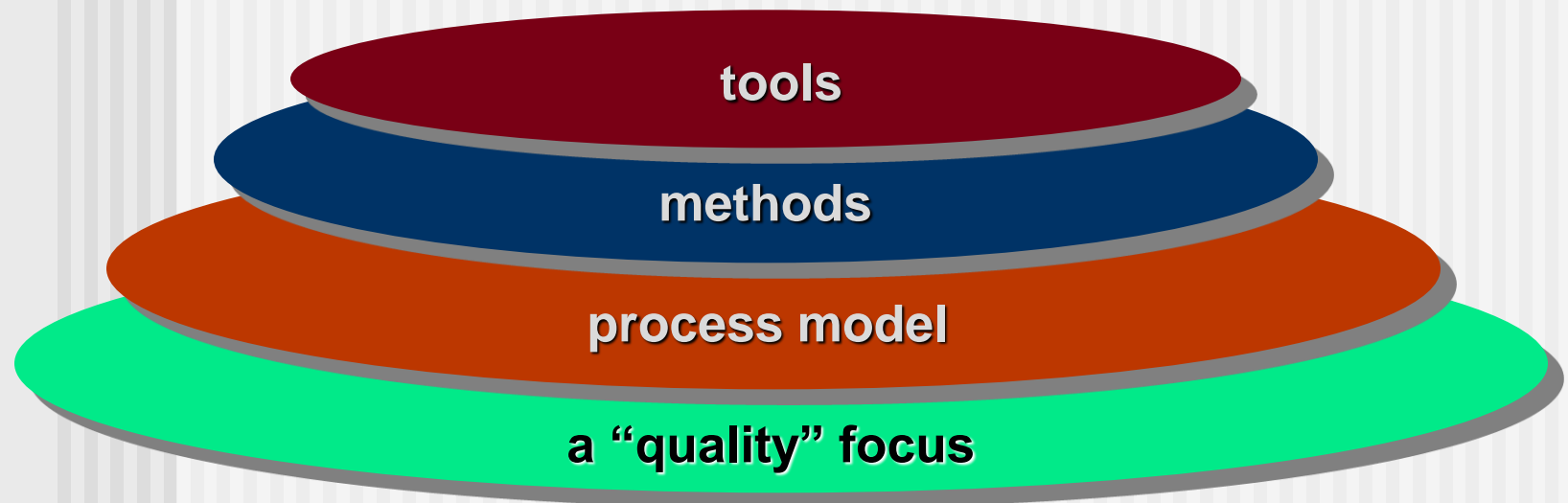
# Software Engineering

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- The IEEE definition:
  - *Software Engineering: (1) The application of a **systematic, disciplined, quantifiable approach** to the **development, operation, and maintenance** of software; that is, the application of engineering to software. (2) The study of approaches as in (1).*

# A Layered Technology

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***Software Engineering***

# A Process Framework

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**Process framework**

**Framework activities**

work tasks

work products

milestones & deliverables

QA checkpoints

**Umbrella Activities**

# Framework Activities

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- Communication
- Planning
- Modeling
  - Analysis of requirements
  - Design
- Construction
  - Code generation
  - Testing
- Deployment

# Umbrella Activities

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- Software project management
- Formal technical reviews
- Software quality assurance
- Software configuration management
- Work product preparation and production
- Reusability management
- Measurement
- Risk management

# Adapting a Process Model

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- the overall flow of activities, actions, and tasks and the interdependencies among them
- the degree to which actions and tasks are defined within each framework activity
- the degree to which work products are identified and required
- the manner which quality assurance activities are applied
- the manner in which project tracking and control activities are applied
- the overall degree of detail and rigor with which the process is described
- the degree to which the customer and other stakeholders are involved with the project
- the level of autonomy given to the software team
- the degree to which team organization and roles are prescribed



# The Essence of Practice

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- Polya suggests:

1. *Understand the problem* (communication and analysis).
2. *Plan a solution* (modeling and software design).
3. *Carry out the plan* (code generation).
4. *Examine the result for accuracy* (testing and quality assurance).

# Understand the Problem

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- *Who has a stake in the solution to the problem?* That is, who are the stakeholders?
- *What are the unknowns?* What data, functions, and features are required to properly solve the problem?
- *Can the problem be compartmentalized?* Is it possible to represent smaller problems that may be easier to understand?
- *Can the problem be represented graphically?* Can an analysis model be created?

# Plan the Solution

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- *Have you seen similar problems before?* Are there patterns that are recognizable in a potential solution? Is there existing software that implements the data, functions, and features that are required?
- *Has a similar problem been solved?* If so, are elements of the solution reusable?
- *Can subproblems be defined?* If so, are solutions readily apparent for the subproblems?
- *Can you represent a solution in a manner that leads to effective implementation?* Can a design model be created?

# Carry Out the Plan

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- *Does the solution conform to the plan?* Is source code traceable to the design model?
- *Is each component part of the solution provably correct?* Has the design and code been reviewed, or better, have correctness proofs been applied to algorithm?

# Examine the Result

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- *Is it possible to test each component part of the solution?* Has a reasonable testing strategy been implemented?
- *Does the solution produce results that conform to the data, functions, and features that are required?* Has the software been validated against all stakeholder requirements?

# Hooker's General Principles

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- 1: *The Reason It All Exists*
- 2: *KISS (Keep It Simple, Stupid!)*
- 3: *Maintain the Vision*
- 4: *What You Produce, Others Will Consume*
- 5: *Be Open to the Future*
- 6: *Plan Ahead for Reuse*
- 7: *Think!*

# Software Myths

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- Affect managers, customers (and other non-technical stakeholders) and practitioners
- Are believable because they often have elements of truth,  
*but ...*
- Invariably lead to bad decisions,  
*therefore ...*
- Insist on reality as you navigate your way through software engineering

# How It all Starts

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## ■ *SafeHome:*

- Every software project is precipitated by some business need—
  - the need to correct a defect in an existing application;
  - the need to the need to adapt a 'legacy system' to a changing business environment;
  - the need to extend the functions and features of an existing application, or
  - the need to create a new product, service, or system.