Chapter 1

- **The Nature of Software**

Slide Set to accompany

Software Engineering: A Practitioner's Approach, 8/e

by Roger S. Pressman and Bruce R. Maxim

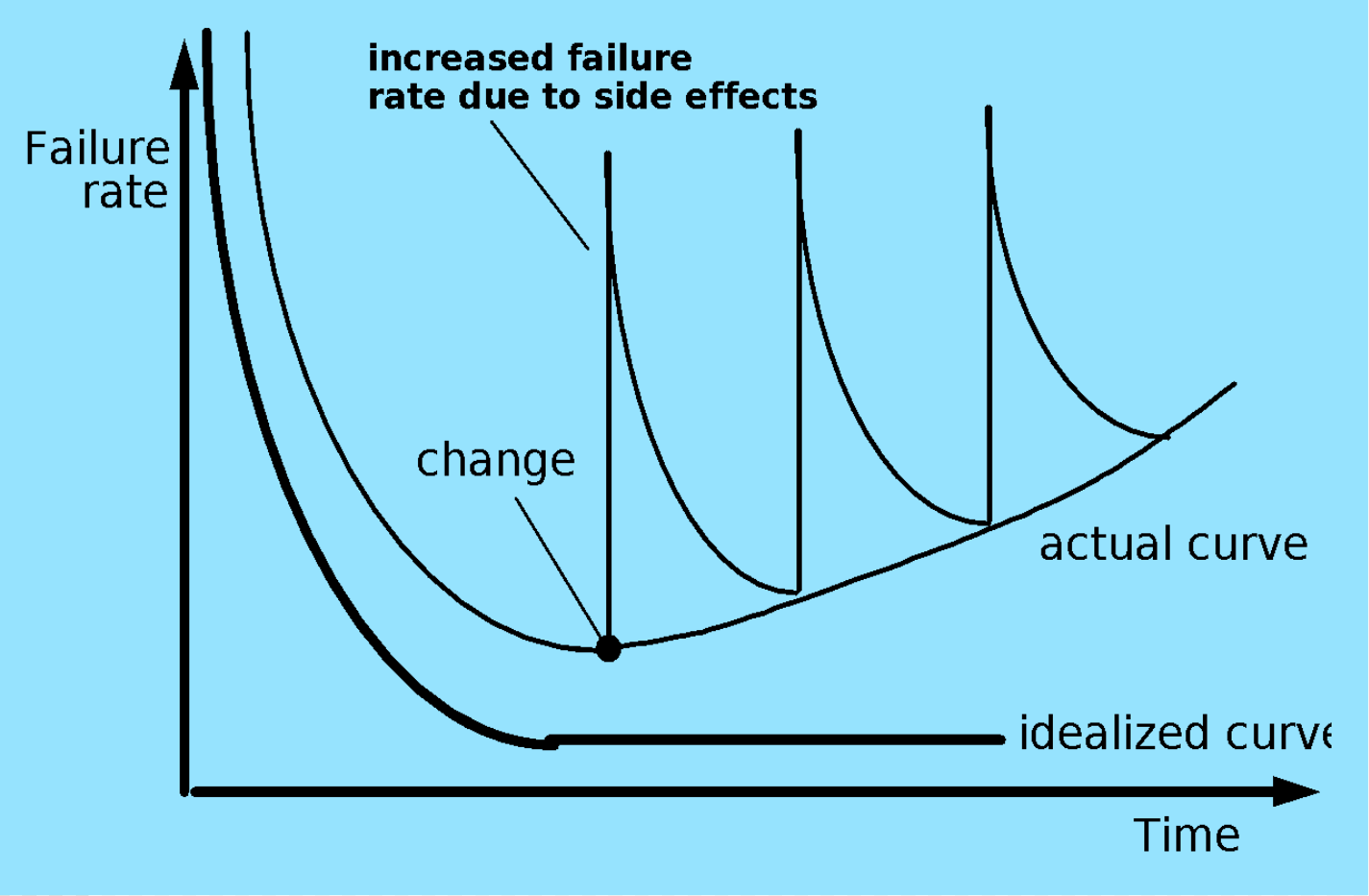
What is Software?

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?

- *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



Software Applications

- System software
- Application software
- Engineering/Scientific software
- Embedded software
- Product-line software
- Web/Mobile applications)
- AI software (robotics, neural nets, game playing)

Legacy Software

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.

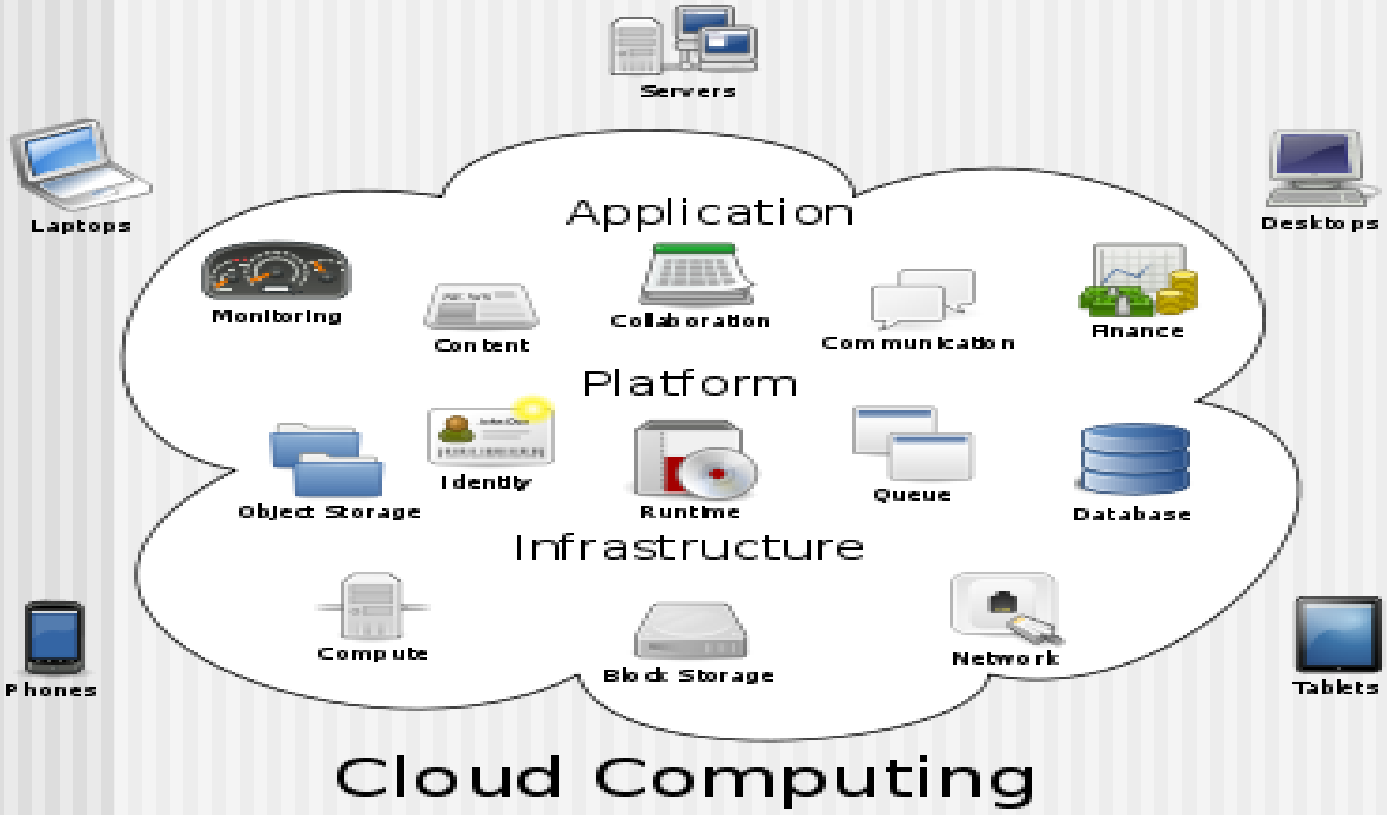
WebApps

- Modern WebApps are much more than hypertext files with a few pictures
- WebApps are augmented with tools like XML and Java to allow Web engineers including interactive computing capability
- WebApps may standalone capability to end users or may be integrated with corporate databases and business applications
- Semantic web technologies (Web 3.0) have evolved into sophisticated corporate and consumer applications that encompass semantic databases that require web linking, flexible data representation, and application programmer interfaces (API's) for access
- The aesthetic nature of the content remains an important determinant of the quality of a WebApp.

Mobile Apps

- Reside on mobile platforms such as cell phones or tablets
- Contain user interfaces that take both device characteristics and location attributes
- Often provide access to a combination of web-based resources and local device processing and storage capabilities
- Provide persistent storage capabilities within the platform
- A *mobile web application* allows a mobile device to access to web-based content using a browser designed to accommodate the strengths and weaknesses of the mobile platform
- A *mobile app* can gain direct access to the hardware found on the device to provide local processing and storage capabilities
- As time passes these differences will become blurred

Cloud Computing



Cloud Computing

- *Cloud computing* provides distributed data storage and processing resources to networked computing devices
- Computing resources reside outside the cloud and have access to a variety of resources inside the cloud
- Cloud computing requires developing an architecture containing both frontend and backend services
- Frontend services include the client devices and application software to allow access
- Backend services include servers, data storage, and server-resident applications
- Cloud architectures can be segmented to restrict access to private data

Product Line Software

- *Product line software* is a set of software-intensive systems that share a common set of features and satisfy the needs of a particular market
- These software products are developed using the same application and data architectures using a common core of reusable software components
- A software product line shares a set of assets that include *requirements, architecture, design patterns, reusable components, test cases,* and other work products
- A software product line allow in the development of many products that are engineered by capitalizing on the commonality among all products with in the product lin

Characteristics of WebApps - II

- **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.

Chapter 2

- **Software Engineering**

Slide Set to accompany

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by Roger S. Pressman and Bruce R. Maxim

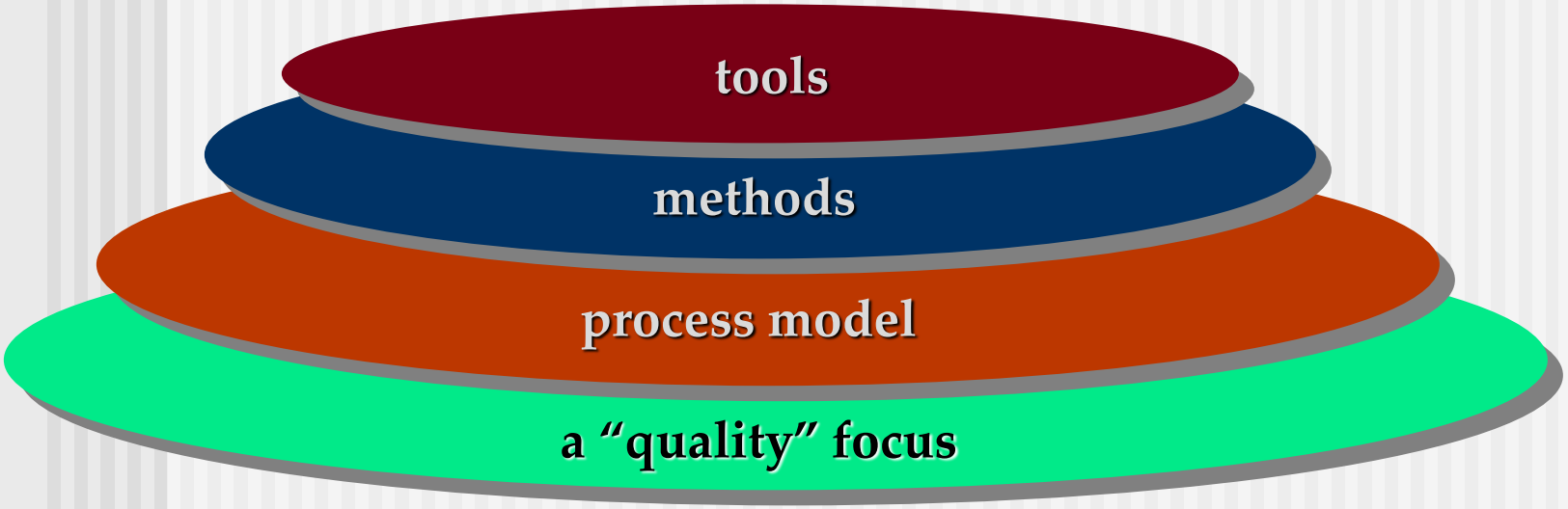
Software Engineering

- 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

- 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



Software Engineering

A Process Framework

Process framework

Framework activities

work tasks
work products
milestones & deliverables
QA checkpoints

Umbrella Activities

Framework Activities

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

Umbrella Activities

- Software project tracking and control
- Risk management
- Software quality assurance
- Technical reviews
- Measurement
- Software configuration management
- Reusability management
- Work product preparation and production

Adapting a Process Model

- 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

- 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

- *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

- *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

- *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

- *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

- 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

- 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

- *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.

Chapter 3

Software Process Structure

Slide Set to accompany

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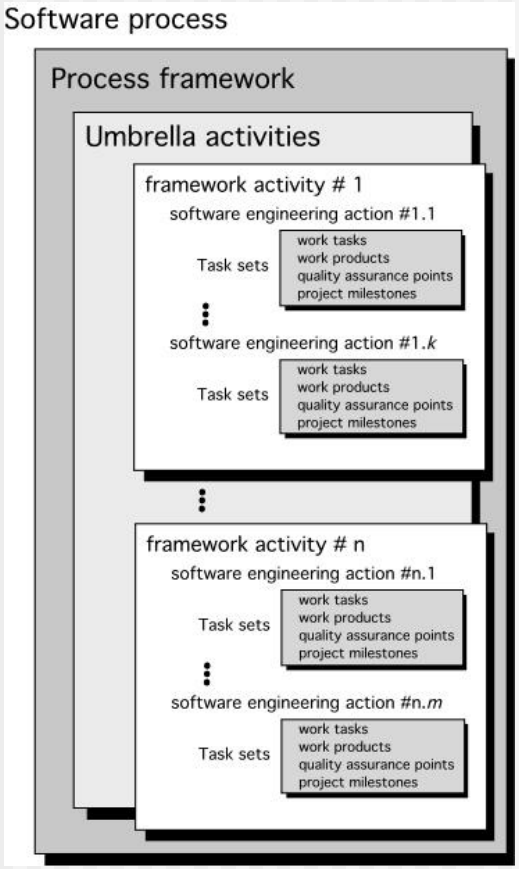
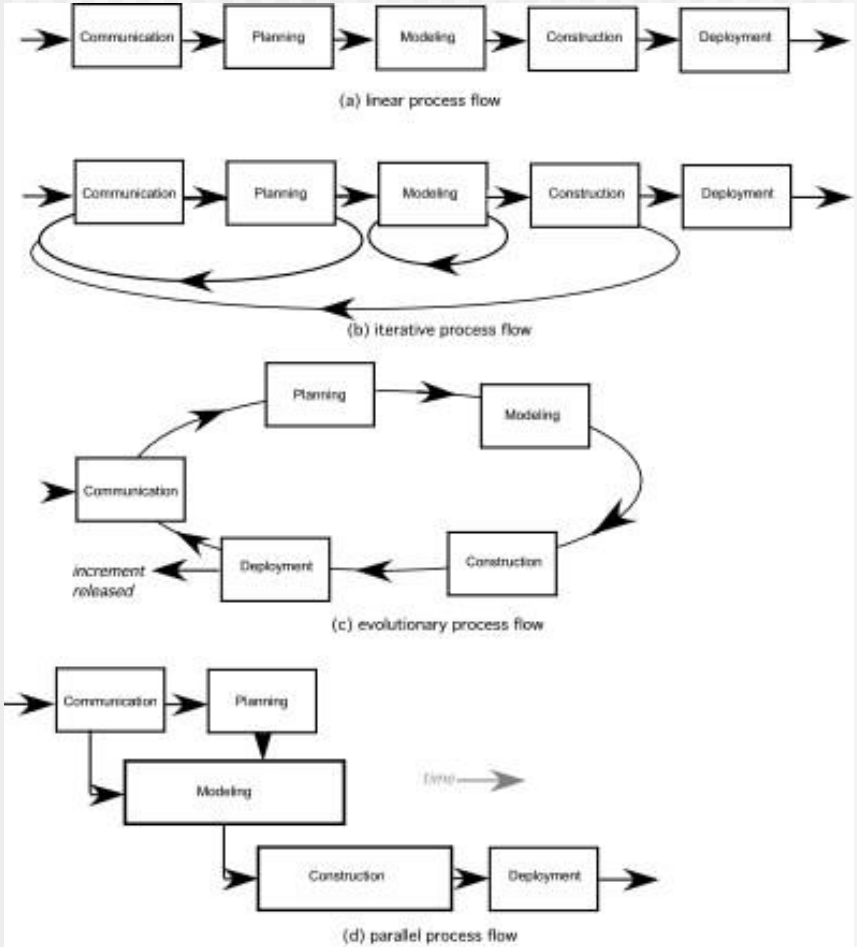
by Roger S. Pressman and Bruce R. Maxim

A Generic Process Model



Process Flow



Identifying a Task Set

- A task set defines the actual work to be done to accomplish the objectives of a software engineering action.
  - A list of the task to be accomplished
  - A list of the work products to be produced
  - A list of the quality assurance filters to be applied

Process Patterns

- A *process pattern*
  - describes a process-related problem that is encountered during software engineering work,
  - identifies the environment in which the problem has been encountered, and
  - suggests one or more proven solutions to the problem.
- Stated in more general terms, a process pattern provides you with a *template* [Amb98]—a consistent method for describing problem solutions within the context of the software process.

Process Pattern Types

- *Stage patterns*—defines a problem associated with a framework activity for the process.
- *Task patterns*—defines a problem associated with a software engineering action or work task and relevant to successful software engineering practice
- *Phase patterns*—define the sequence of framework activities that occur with the process, even when the overall flow of activities is iterative in nature.

Process Assessment and Improvement

- **Standard CMMI Assessment Method for Process Improvement (SCAMPI)** — provides a five step process assessment model that incorporates five phases: initiating, diagnosing, establishing, acting and learning.
- **CMM-Based Appraisal for Internal Process Improvement (CBA IPI)**—provides a diagnostic technique for assessing the relative maturity of a software organization; uses the SEI CMM as the basis for the assessment [Dun01]
- **SPICE—The SPICE (ISO/IEC15504)** standard defines a set of requirements for software process assessment. The intent of the standard is to assist organizations in developing an objective evaluation of the efficacy of any defined software process. [ISO08]
- **ISO 9001:2000 for Software**—a generic standard that applies to any organization that wants to improve the overall quality of the products, systems, or services that it provides. Therefore, the standard is directly applicable to software organizations and companies. [Ant06]

Chapter 4

- **Process Models**

Slide Set to accompany

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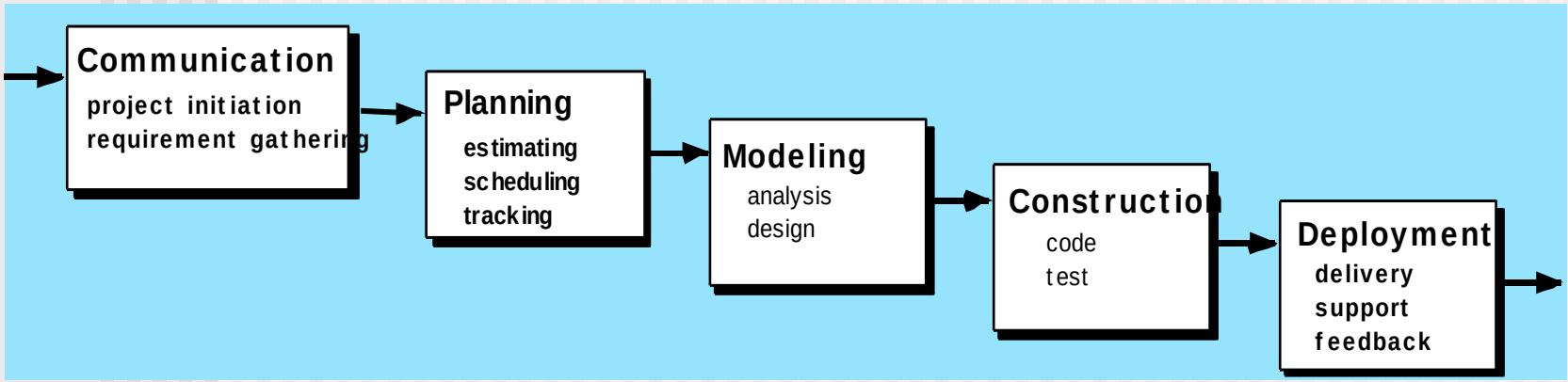
Prescriptive Models

- Prescriptive process models advocate an orderly approach to software engineering

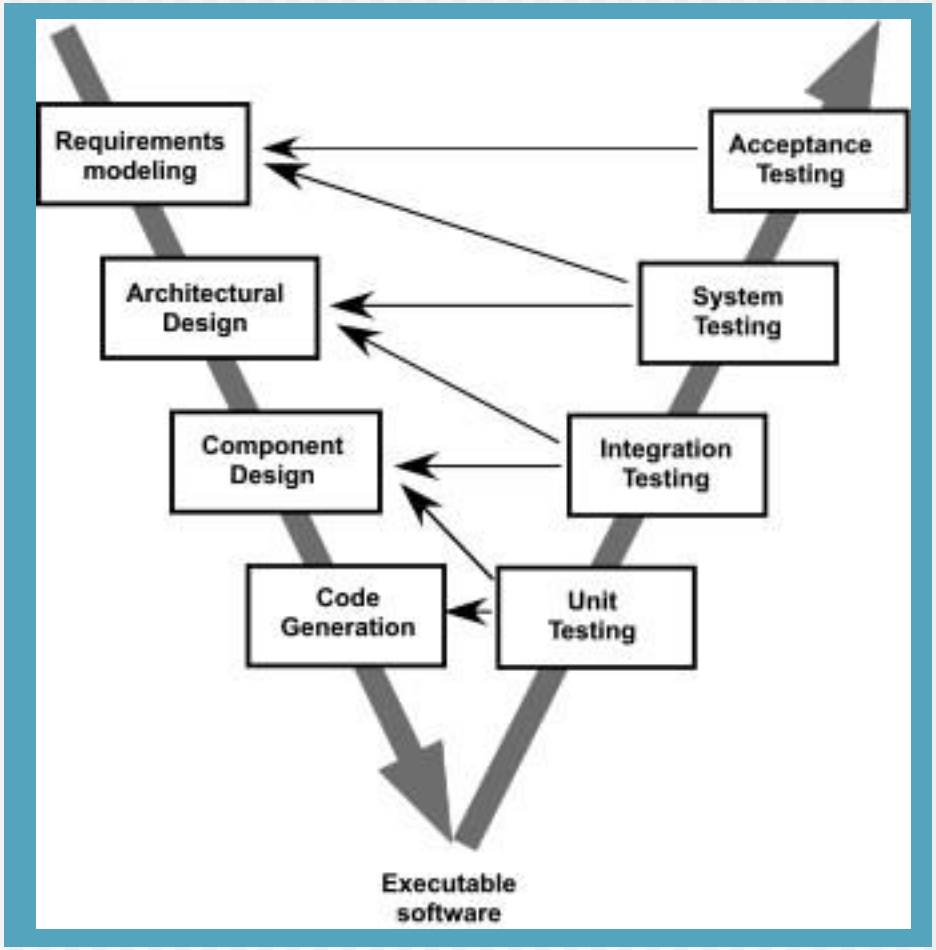
That leads to a few questions …

- If prescriptive process models strive for structure and order, are they inappropriate for a software world that thrives on change?
- Yet, if we reject traditional process models (and the order they imply) and replace them with something less structured, do we make it impossible to achieve coordination and coherence in software work?

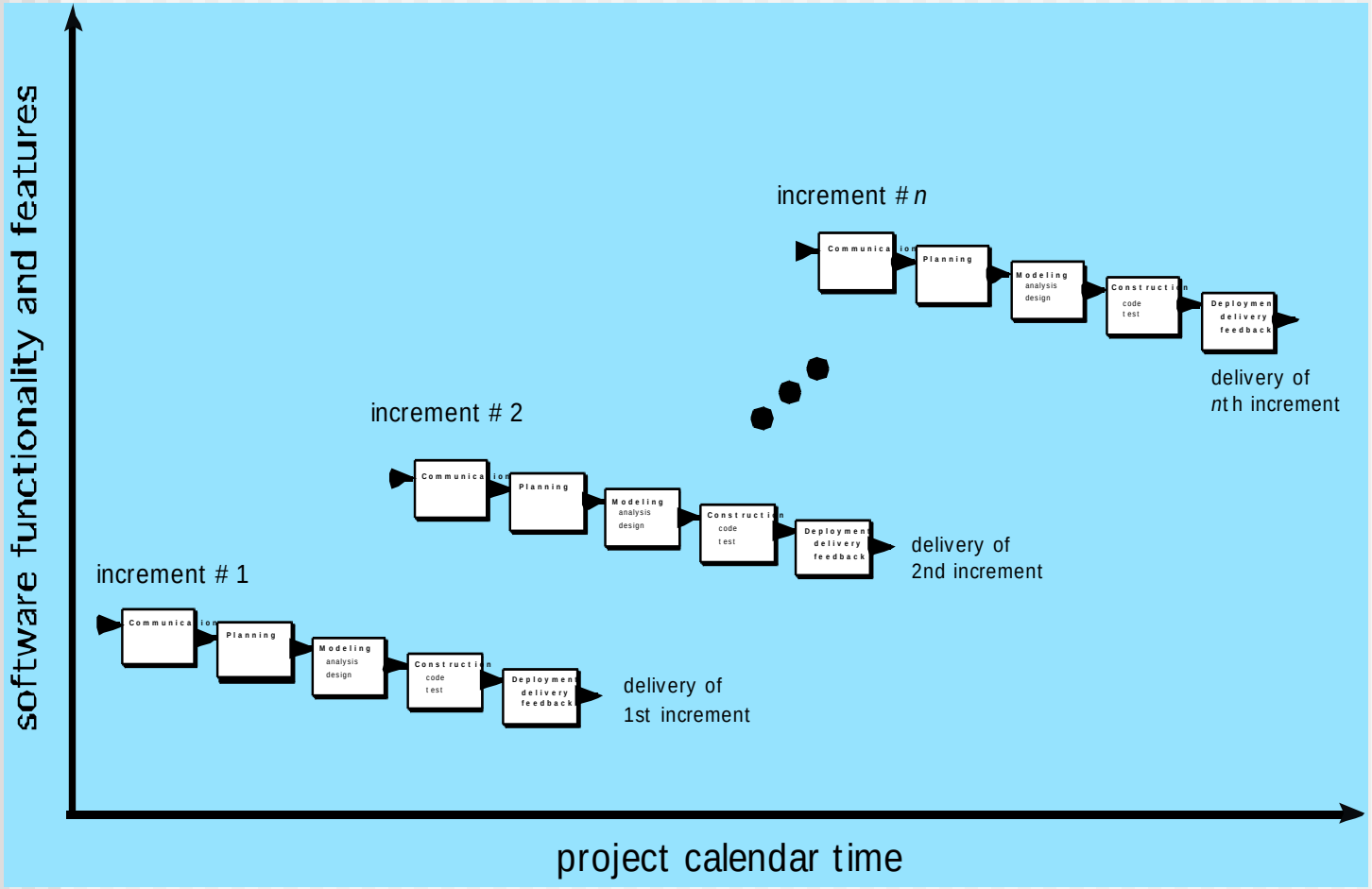
The Waterfall Model



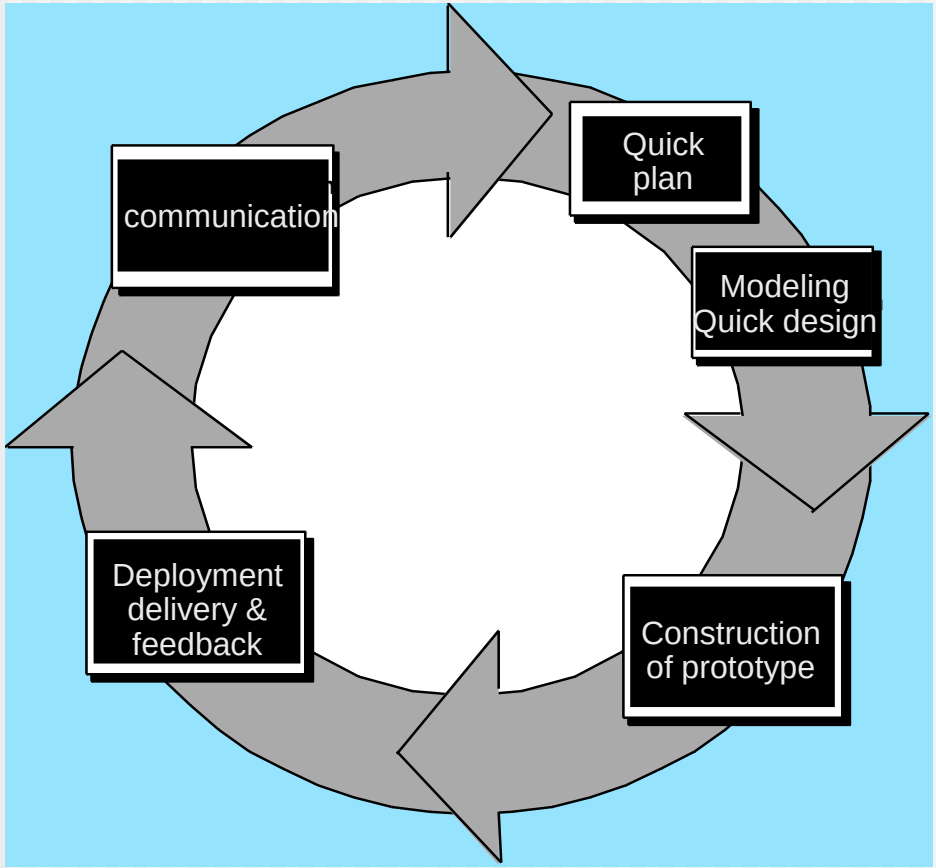
The V-Model



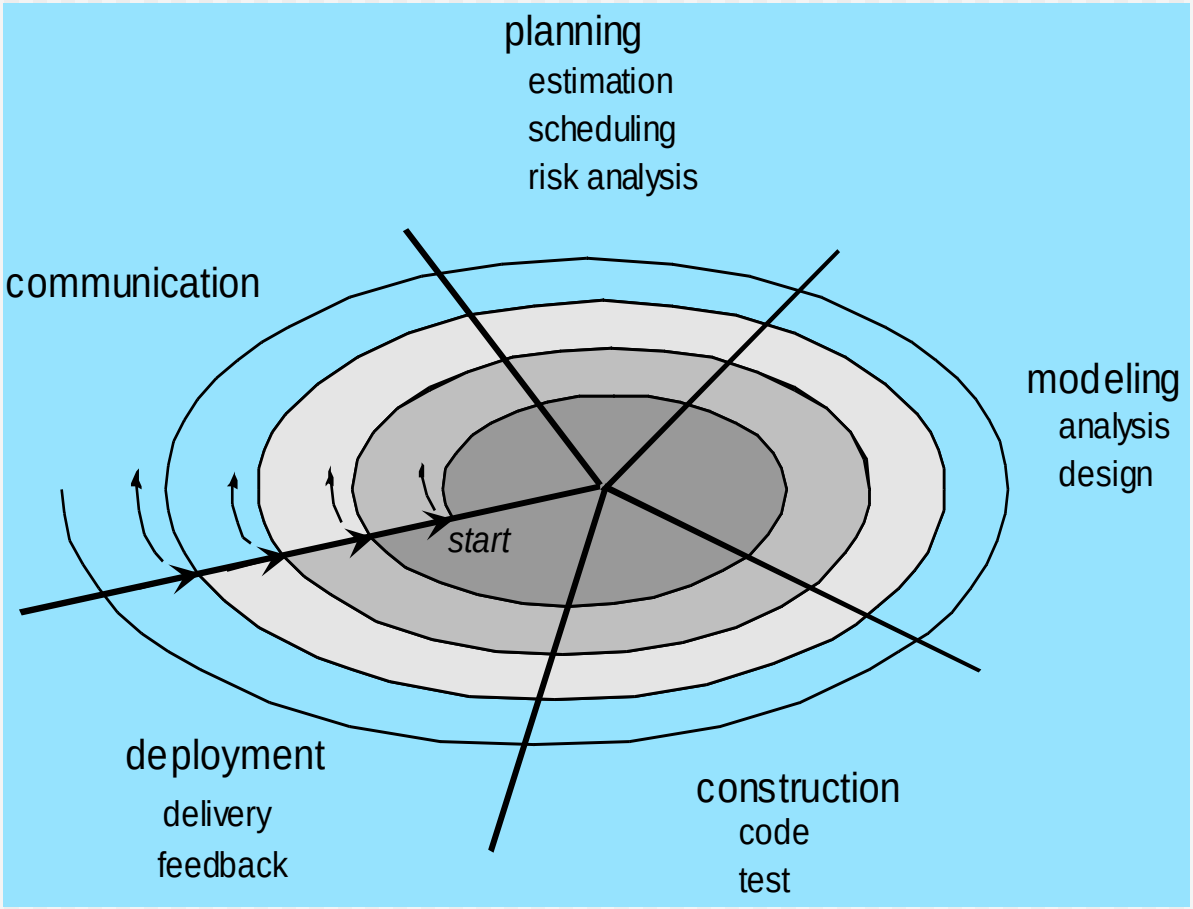
The Incremental Model



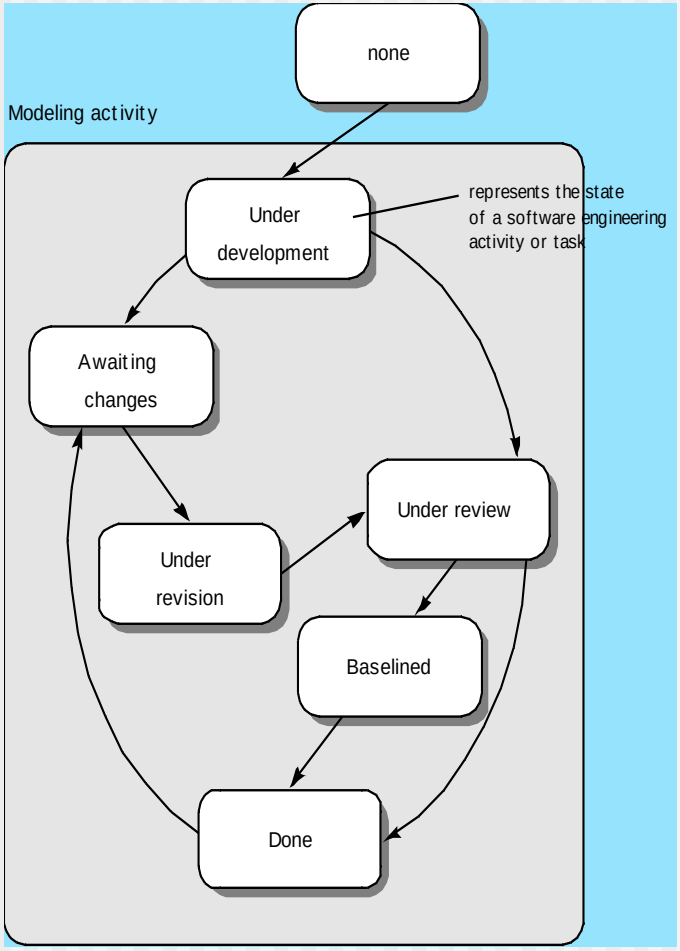
Evolutionary Models: Prototyping



Evolutionary Models: The Spiral



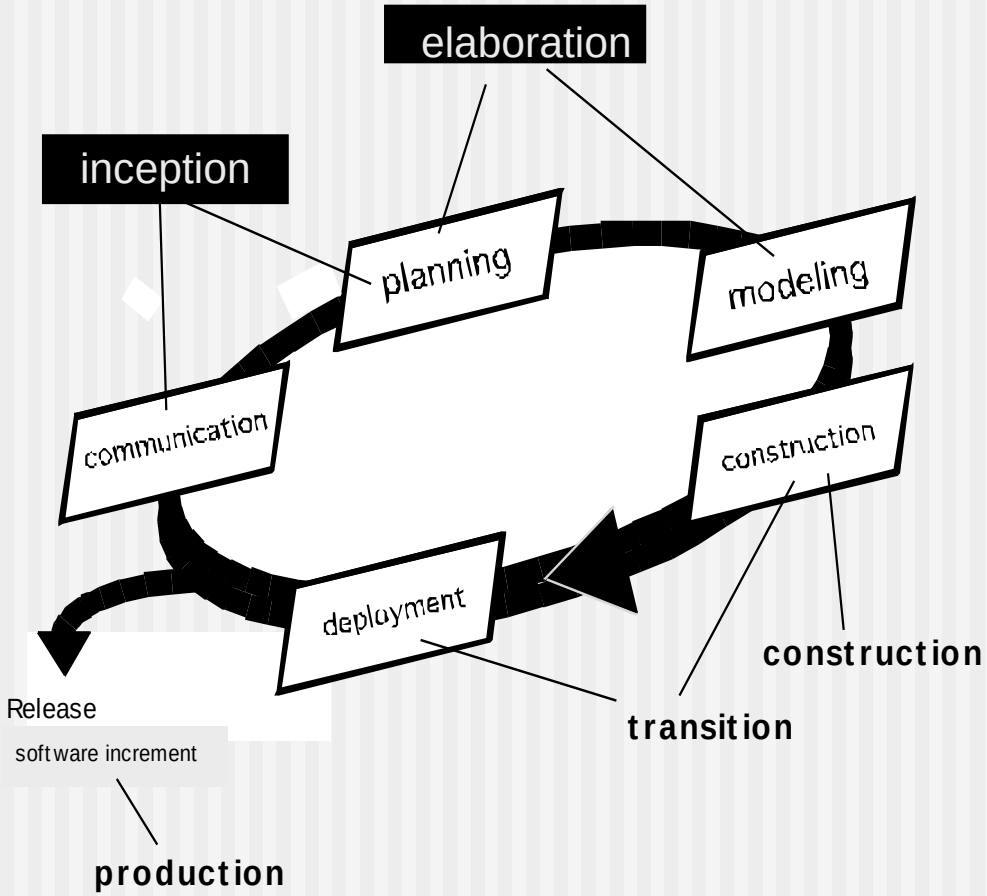
Evolutionary Models: Concurrent



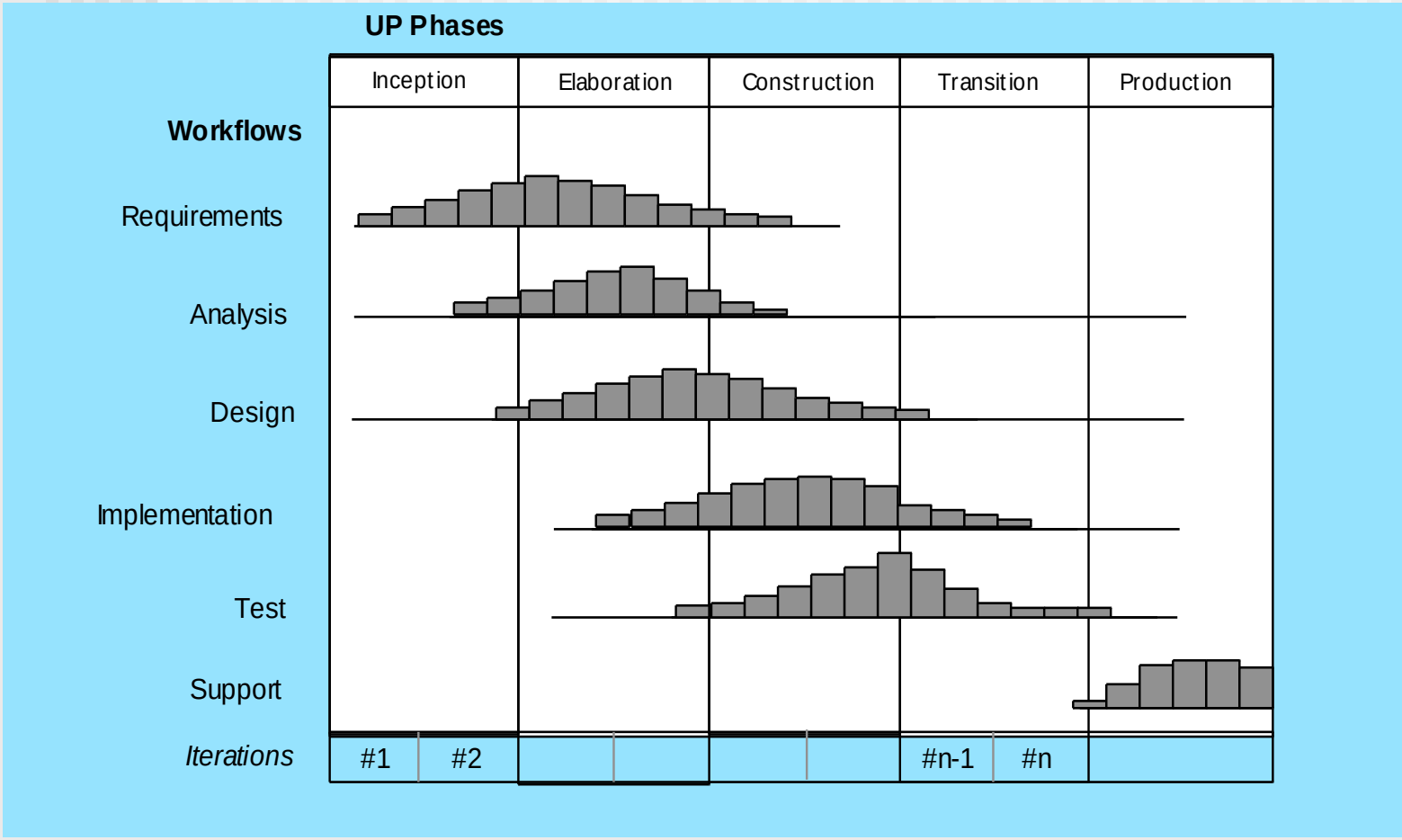
Still Other Process Models

- Component based development—the process to apply when reuse is a development objective
- Formal methods—emphasizes the mathematical specification of requirements
- AOSD—provides a process and methodological approach for defining, specifying, designing, and constructing *aspects*
- Unified Process—a "use-case driven, architecture-centric, iterative and incremental" software process closely aligned with the Unified Modeling Language (UML)

The Unified Process (UP)



UP Phases



UP Work Products

Inception phase

Vision document
Initial use-case model
Initial project glossary
Initial business case
Initial risk assessment.
Project plan,
  phases and iterations.
Business model,
  if necessary.
One or more prototypes

Elaboration phase

Use-case model
Supplementary requirements
  including non-functional
Analysis model
Software architecture
  Description.
Executable architectural
  prototype.
Preliminary design model
Revised risk list
Project plan including
  iteration plan
  adapted workflows
  milestones
  technical work products
Preliminary user manual

Construction phase

Design model
Software components
Integrated software
  increment
Test plan and procedure
Test cases
Support documentation
  user manuals
  installation manuals
  description of current
    increment

Transition phase

Delivered software increment
Beta test reports
General user feedback

Personal Software Process (PSP)

- **Planning.** This activity isolates requirements and develops both size and resource estimates. In addition, a defect estimate (the number of defects projected for the work) is made. All metrics are recorded on worksheets or templates. Finally, development tasks are identified and a project schedule is created.
- **High-level design.** An external specification is created for each component and a component design is created. Prototypes are built when uncertainty exists. All issues are recorded and tracked.
- **High-level design review.** Formal verification methods (Chapter 21) are applied to uncover errors in the design. Metrics are maintained for all important tasks and work results.
- **Development.** The component level design is refined and reviewed. Code is generated, reviewed, compiled, and tested. Metrics are maintained for all important tasks and work results.
- **Postmortem.** Using measures and metrics collected the effectiveness of the process is determined. If this is a large amount of data it should be analyzed statistically), Measures and metrics should provide guidance for modifying the process to improve its effectiveness.

Team Software Process (TSP)

- Build self-directed teams that plan and track their work, establish goals, and own their processes and plans. These can be pure software teams or integrated product teams (IPT) of three to about 20 engineers.
- Show managers how to coach and motivate their teams and how to help them sustain peak performance.
- Accelerate software process improvement by making CMM Level 5 behavior normal and expected.
  - The Capability Maturity Model (CMM), a measure of the effectiveness of a software process, is discussed in Chapter 30.
- Provide improvement guidance to high-maturity organizations.
- Facilitate university teaching of industrial-grade team skills.

Chapter 5

- **Agile Development**

Slide Set to accompany

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by Roger S. Pressman and Bruce R. Maxim

The Manifesto for Agile Software Development

"We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

- ***Individuals and interactions* over processes and tools**
- ***Working software* over comprehensive documentation**
- ***Customer collaboration* over contract negotiation**
- ***Responding to change* over following a plan**

That is, while there is value in the items on the right, we value the items on the left more."

Kent Beck et al

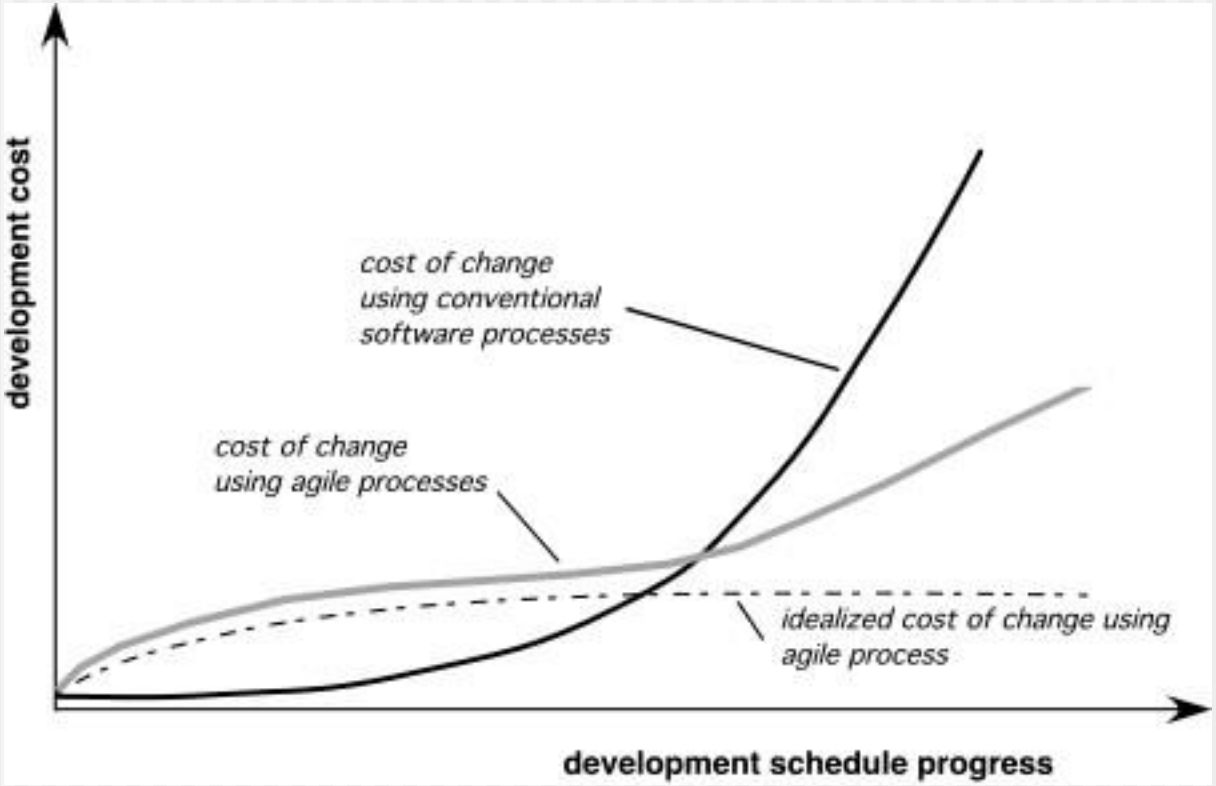
What is “Agility”?

- Effective (rapid and adaptive) response to change
- Effective communication among all stakeholders
- Drawing the customer onto the team
- Organizing a team so that it is in control of the work performed

Yielding …

- Rapid, incremental delivery of software

Agility and the Cost of Change



An Agile Process

- Is driven by customer descriptions of what is required (scenarios)
- Recognizes that plans are short-lived
- Develops software iteratively with a heavy emphasis on construction activities
- Delivers multiple ‘software increments’
- Adapts as changes occur

Agility Principles - I

1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.
2. Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.
3. Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.
4. Business people and developers must work together daily throughout the project.
5. Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.
6. The most efficient and effective method of conveying information to and within a development team is face–to–face conversation.

Agility Principles - II

7. Working software is the primary measure of progress.
8. Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.
9. Continuous attention to technical excellence and good design enhances agility.
10. Simplicity – the art of maximizing the amount of work not done – is essential.
11. The best architectures, requirements, and designs emerge from self–organizing teams.
12. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.

Human Factors

- *the process molds to the needs of the people and team,* not the other way around
- key traits must exist among the people on an agile team and the team itself:
  - **Competence.**
  - **Common focus.**
  - **Collaboration.**
  - **Decision-making ability.**
  - **Fuzzy problem-solving ability.**
  - **Mutual trust and respect.**
  - **Self-organization.**

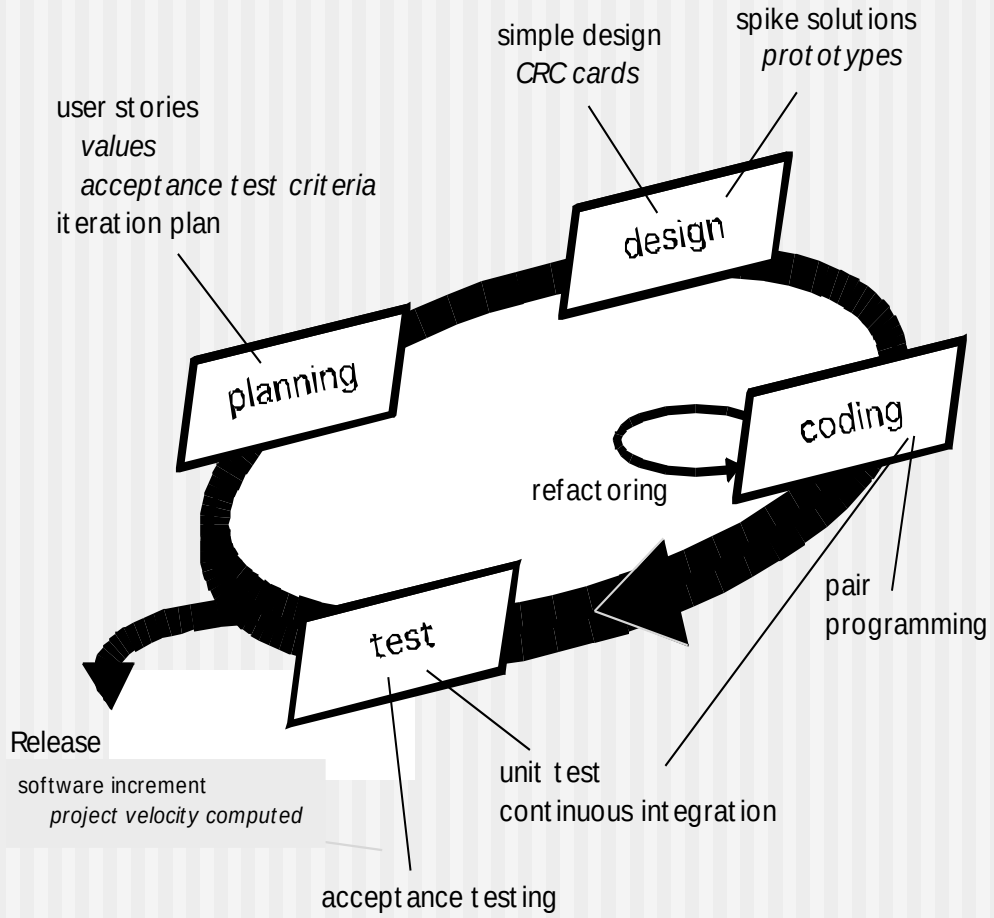
Extreme Programming (XP)

- The most widely used agile process, originally proposed by Kent Beck
- XP Planning
  - Begins with the creation of "user stories"
  - Agile team assesses each story and assigns a cost
  - Stories are grouped to for a deliverable increment
  - A commitment is made on delivery date
  - After the first increment "project velocity" is used to help define subsequent delivery dates for other increments

Extreme Programming (XP)

- XP Design
  - Follows the KIS principle
  - Encourage the use of CRC cards (see Chapter 8)
  - For difficult design problems, suggests the creation of "spike solutions"—a design prototype
  - Encourages "refactoring"—an iterative refinement of the internal program design
- XP Coding
  - Recommends the construction of a unit test for a store *before* coding commences
  - Encourages "pair programming"
- XP Testing
  - All unit tests are executed daily
  - "Acceptance tests" are defined by the customer and excuted to assess customer visible functionality

Extreme Programming (XP)



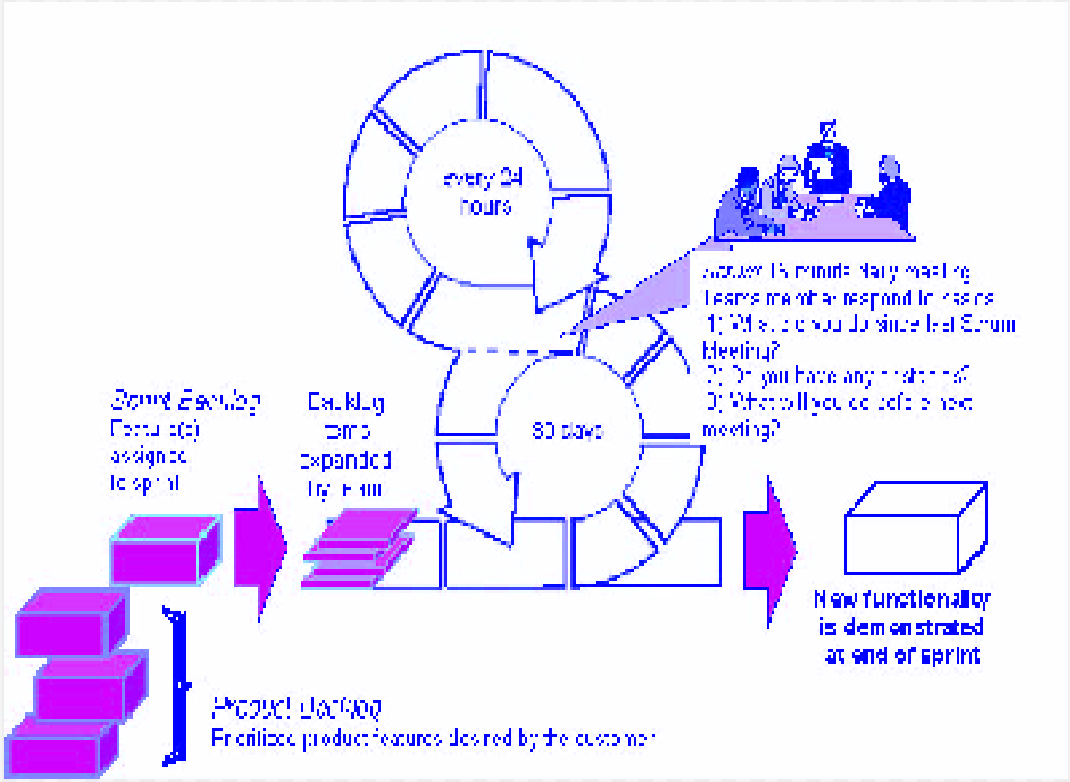
Industrial XP (IXP)

- IXP has greater inclusion od management, expanded customer roles, and upgraded technical practices
- IXP incorporates six new practices:
  - Readiness assessment
  - Project community
  - Project chartering
  - Test driven management
  - Retrospectives
  - Continuous learning

Scrum

- Originally proposed by Schwaber and Beedle
- Scrum—distinguishing features
  - Development work is partitioned into "packets"
  - Testing and documentation are on-going as the product is constructed
  - Work occurs in "sprints" and is derived from a "backlog" of existing requirements
  - Meetings are very short and sometimes conducted without chairs
  - "demos" are delivered to the customer with the time-box allocated

Scrum

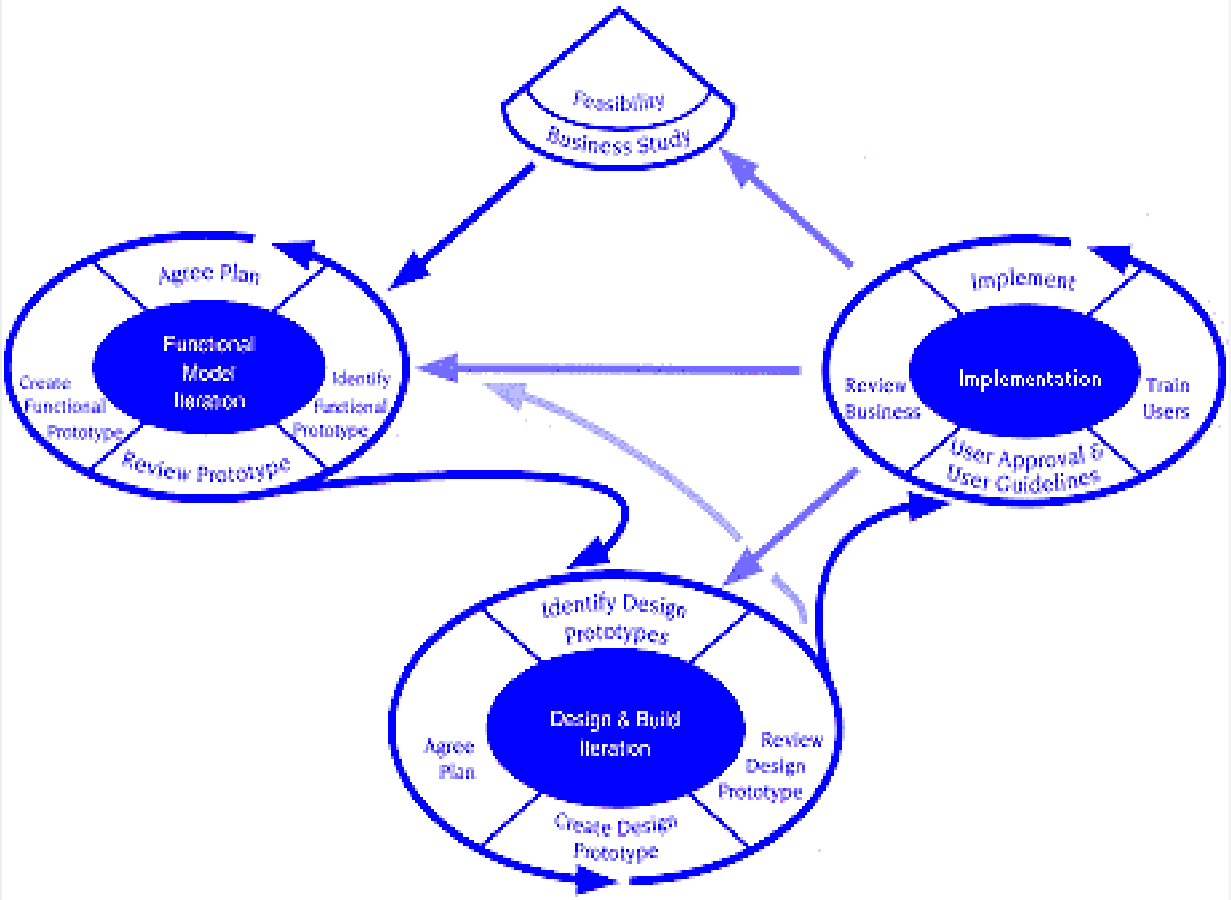


Scrum Process Flow (used with permission)

Dynamic Systems Development Method

- Promoted by the DSDM Consortium (www.dsdm.org)
- DSDM—distinguishing features
  - Similar in most respects to XP
  - Nine guiding principles
    - Active user involvement is imperative.
    - DSDM teams must be empowered to make decisions.
    - The focus is on frequent delivery of products.
    - Fitness for business purpose is the essential criterion for acceptance of deliverables.
    - Iterative and incremental development is necessary to converge on an accurate business solution.
    - All changes during development are reversible.
    - Requirements are baselined at a high level
    - Testing is integrated throughout the life-cycle.

Dynamic Systems Development Method



DSDM Life Cycle (with permission of the DSDM consortium)

Agile Modeling

- Originally proposed by Scott Ambler
- Suggests a set of agile modeling principles
  - Model with a purpose
  - Use multiple models
  - Travel light
  - Content is more important than representation
  - Know the models and the tools you use to create them
  - Adapt locally

Agile Unified Process

- Each AUP iteration addresses these activities:
  - Modeling
  - Implementation
  - Testing
  - Deployment
  - Configuration and project management
  - Environment management

Chapter 6

- **Human Aspects of Software Engineering**

Slide Set to accompany

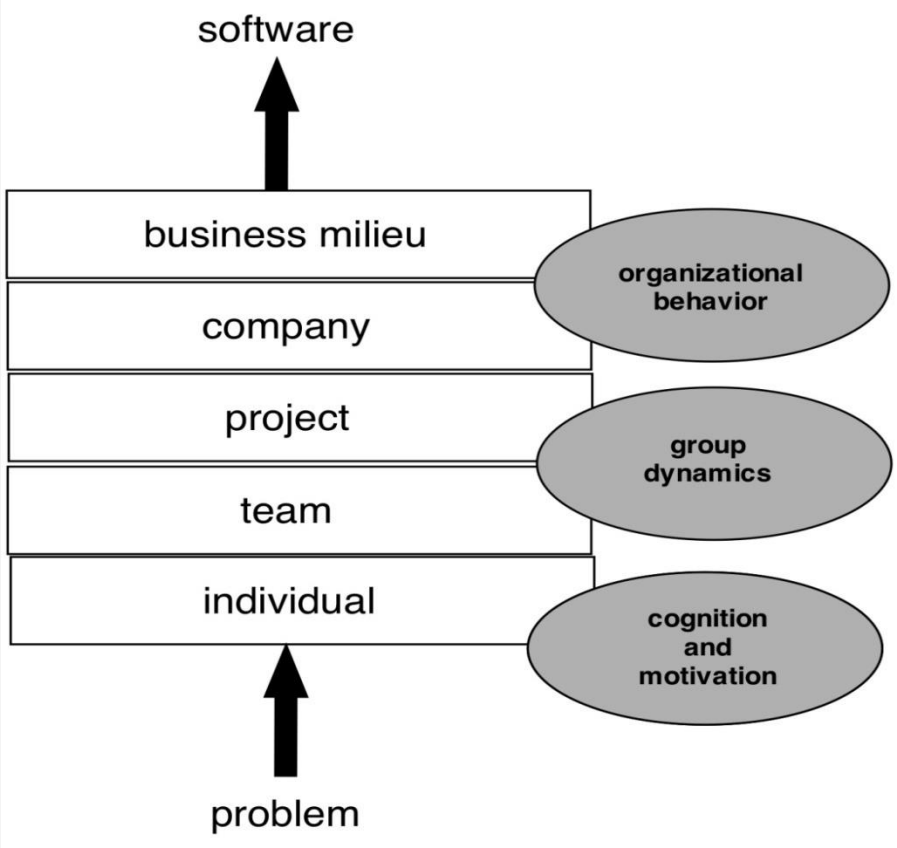
Software Engineering: A Practitioner's Approach, 8/e

by Roger S. Pressman and Bruce R. Maxim

Traits of Successful Software Engineers

- Sense of individual responsibility
- Acutely aware of the needs of team members and stakeholders
- Brutally honest about design flaws and offers constructive criticism
- Resilient under pressure
- Heightened sense of fairness
- Attention to detail
- Pragmatic

Behavioral Model for Software Engineering



Boundary Spanning Team Roles

- Ambassador – represents team to outside constituencies
- Scout – crosses team boundaries to collect information
- Guard – protects access to team work products
- Sentry – controls information sent by stakeholders
- Coordinator – communicates across the team and organization

Effective Software Team Attributes

- Sense of purpose
- Sense of involvement
- Sense of trust
- Sense of improvement
- Diversity of team member skill sets

Avoid Team "Toxicity"

- A frenzied work atmosphere in which team members waste energy and lose focus on the objectives of the work to be performed.
- High frustration caused by personal, business, or technological factors that cause friction among team members.
- "Fragmented or poorly coordinated procedures" or a poorly defined or improperly chosen process model that becomes a roadblock to accomplishment.
- Unclear definition of roles resulting in a lack of accountability and resultant finger-pointing.
- "Continuous and repeated exposure to failure" that leads to a loss of confidence and a lowering of morale.

Factors Affecting Team Structure

The following factors must be considered when selecting a software project team structure ...

- the difficulty of the problem to be solved
- the size of the resultant program(s) in lines of code or function points
- the time that the team will stay together (team lifetime)
- the degree to which the problem can be modularized
- the required quality and reliability of the system to be built
- the rigidity of the delivery date
- the degree of sociability (communication) required for the project

Organizational Paradigms

- closed paradigm—structures a team along a traditional hierarchy of authority
- random paradigm—structures a team loosely and depends on individual initiative of the team members
- open paradigm—attempts to structure a team in a manner that achieves some of the controls associated with the closed paradigm but also much of the innovation that occurs when using the random paradigm
- synchronous paradigm—relies on the natural compartmentalization of a problem and organizes team members to work on pieces of the problem with little active communication among themselves

suggested by Constantine [Con93]

Generic Agile Teams

- Stress individual competency coupled with group collaboration as critical success factors
- People trump process and politics can trump people
- Agile teams as self-organizing and have many structures
  - An adaptive team structure
  - Uses elements of Constantine's random, open, and synchronous structures
  - Significant autonomy
- Planning is kept to a minimum and constrained only by business requirements and organizational standards

XP Team Values

- Communication – close informal verbal communication among team members and stakeholders and establishing meaning for metaphors as part of continuous feedback
- Simplicity – design for immediate needs nor future needs
- Feedback – derives from the implemented software, the customer, and other team members
- Courage – the discipline to resist pressure to design for unspecified future requirements
- Respect – among team members and stakeholders

Impact of Social Media

- Blogs – can be used share information with team members and customers
- Microblogs (e.g. Twitter) – allow posting of real-time messages to individuals following the poster
- Targeted on-line forums – allow participants to post questions or opinions and collect answers
- Social networking sites (e.g. Facebook, LinkedIn) – allows connections among software developers for the purpose of sharing information
- Social book marking (e.g. Delicious, Stumble, CiteULike) – allow developers to keep track of and share web-based resources

Software Engineering using the Cloud

- Benefits
  - Provides access to all software engineering work products
  - Removes device dependencies and available every where
  - Provides avenues for distributing and testing software
  - Allows software engineering information developed by one member to be available to all team members
- Concerns
  - Dispersing cloud services outside the control of the software team may present reliability and security risks
  - Potential for interoperability problems becomes high with large number of services distributed on the cloud
  - Cloud services stress usability and performance which often conflicts with security, privacy, and reliability

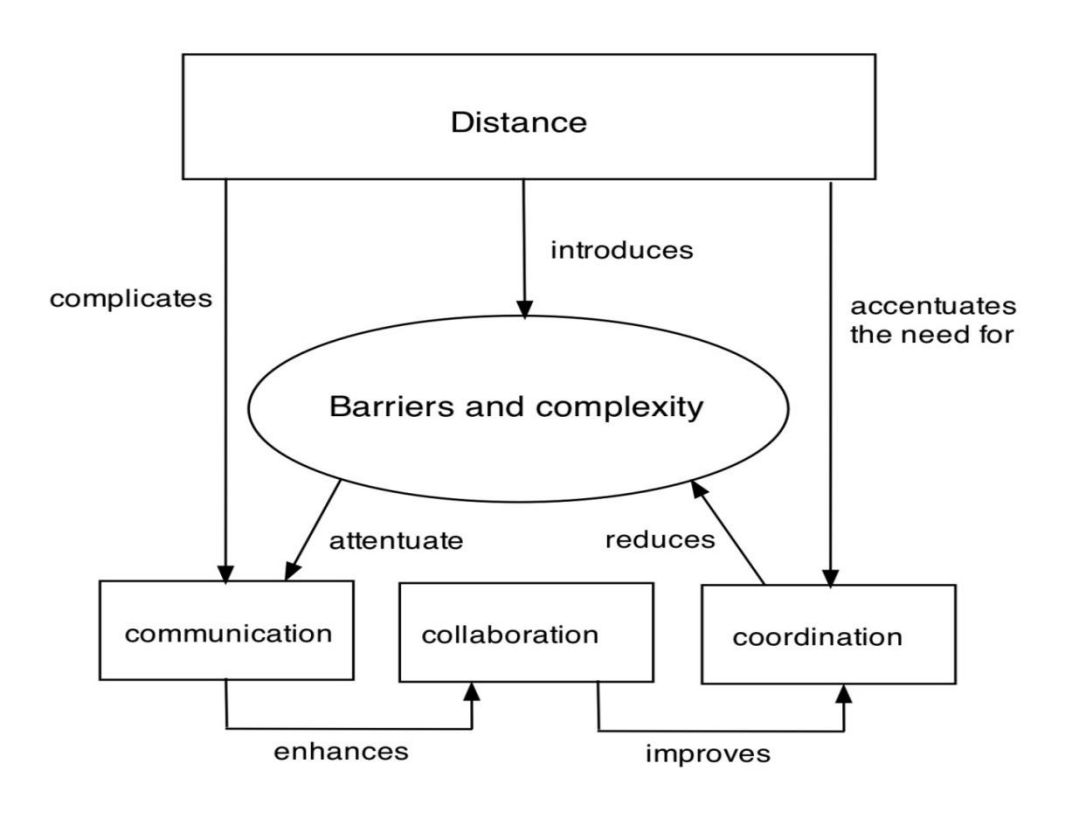
Collaboration Tools

- Namespace that allows secure, private storage or work products
- Calendar for coordinating project events
- Templates that allow team members to create artifacts that have common look and feel
- Metrics support to allow quantitative assessment of each team member's contributions
- Communication analysis to track messages and isolates patterns that may imply issues to resolve
- Artifact clustering showing work product dependencies

Team Decisions Making Complications

- Problem complexity
- Uncertainty and risk associated with the decision
- Work associated with decision has unintended effect on another project object (law of unintended consequences)
- Different views of the problem lead to different conclusions about the way forward
- Global software teams face additional challenges associated with collaboration, coordination, and coordination difficulties

Factors Affecting Global Software Development Team



Chapter 7

Principles that Guide Practice

Slide Set to accompany

Software Engineering: A Practitioner's Approach, 8/e

by Roger S. Pressman and Bruce R. Maxim

Software Engineering Knowledge

- *You often hear people say that software development knowledge has a 3-year half-life: half of what you need to know today will be obsolete within 3 years. In the domain of technology-related knowledge, that's probably about right. But there is another kind of software development knowledge—a kind that I think of as "software engineering principles"—that does not have a three-year half-life. These software engineering principles are likely to serve a professional programmer throughout his or her career.*

  Steve McConnell

Principles that Guide Process - I

- **Principle #1.** ***Be agile.*** Whether the process model you choose is prescriptive or agile, the basic tenets of agile development should govern your approach.
- **Principle #2.** ***Focus on quality at every step.*** The exit condition for every process activity, action, and task should focus on the quality of the work product that has been produced.
- **Principle #3.** ***Be ready to adapt.*** Process is not a religious experience and dogma has no place in it. When necessary, adapt your approach to constraints imposed by the problem, the people, and the project itself.
- **Principle #4.** ***Build an effective team.*** Software engineering process and practice are important, but the bottom line is people. Build a self-organizing team that has mutual trust and respect.

Principles that Guide Process - II

- **Principle #5.** ***Establish mechanisms for communication and coordination.*** Projects fail because important information falls into the cracks and/or stakeholders fail to coordinate their efforts to create a successful end product.
- **Principle #6.** ***Manage change.*** The approach may be either formal or informal, but mechanisms must be established to manage the way changes are requested, assessed, approved and implemented.
- **Principle #7.** ***Assess risk.*** Lots of things can go wrong as software is being developed. It's essential that you establish contingency plans.
- **Principle #8.** ***Create work products that provide value for others.*** Create only those work products that provide value for other process activities, actions or tasks.

Principles that Guide Practice

- **Principle #1.** ***Divide and conquer.*** Stated in a more technical manner, analysis and design should always emphasize *separation of concerns* (SoC).
- **Principle #2.** ***Understand the use of abstraction.*** At it core, an abstraction is a simplification of some complex element of a system used to communication meaning in a single phrase.
- **Principle #3. Strive for consistency.** A familiar context makes software easier to use.
- **Principle #4.** ***Focus on the transfer of information.*** Pay special attention to the analysis, design, construction, and testing of interfaces.

Principles that Guide Practice

- **Principle #5.** ***Build software that exhibits effective modularity.*** Separation of concerns (Principle #1) establishes a philosophy for software. *Modularity* provides a mechanism for realizing the philosophy.
- **Principle #6.** ***Look for patterns.*** Brad Appleton [App00] suggests that: "The goal of patterns within the software community is to create a body of literature to help software developers resolve recurring problems encountered throughout all of software development.
- **Principle #7.** ***When possible, represent the problem and its solution from a number of different perspectives.***
- **Principle #8.** ***Remember that someone will maintain the software.***

Communication Principles

- **Principle #1.** ***Listen.*** Try to focus on the speaker's words, rather than formulating your response to those words.
- **Principle # 2.** ***Prepare before you communicate.*** Spend the time to understand the problem before you meet with others.
- **Principle # 3.** ***Someone should facilitate the activity.*** Every communication meeting should have a leader (a facilitator) to keep the conversation moving in a productive direction; (2) to mediate any conflict that does occur, and (3) to ensure than other principles are followed.
- **Principle #4.** ***Face-to-face communication is best.*** But it usually works better when some other representation of the relevant information is present.

Communication Principles

- **Principle # 5.** ***Take notes and document decisions.*** Someone participating in the communication should serve as a "recorder" and write down all important points and decisions.
- **Principle # 6.** ***Strive for collaboration.*** Collaboration and consensus occur when the collective knowledge of members of the team is combined …
- **Principle # 7.** ***Stay focused, modularize your discussion.*** The more people involved in any communication, the more likely that discussion will bounce from one topic to the next.
- **Principle # 8.** ***If something is unclear, draw a picture.***
- **Principle # 9.** ***(a) Once you agree to something, move on; (b) If you can't agree to something, move on; (c) If a feature or function is unclear and cannot be clarified at the moment, move on.***
- **Principle # 10.** ***Negotiation is not a contest or a game. It works best when both parties win.***

Planning Principles

- **Principle #1.** ***Understand the scope of the project.*** It's impossible to use a roadmap if you don't know where you're going. Scope provides the software team with a destination.
- **Principle #2.** ***Involve the customer in the planning activity.*** The customer defines priorities and establishes project constraints.
- **Principle #3.** ***Recognize that planning is iterative.*** A project plan is never engraved in stone. As work begins, it very likely that things will change.
- **Principle #4.** ***Estimate based on what you know.*** The intent of estimation is to provide an indication of effort, cost, and task duration, based on the team's current understanding of the work to be done.

Planning Principles

- **Principle #5.** ***Consider risk as you define the plan.*** If you have identified risks that have high impact and high probability, contingency planning is necessary.
- **Principle #6.** ***Be realistic.*** People don't work 100 percent of every day.
- **Principle #7.** ***Adjust granularity as you define the plan.*** *Granularity* refers to the level of detail that is introduced as a project plan is developed.
- **Principle #8.** ***Define how you intend to ensure quality.*** The plan should identify how the software team intends to ensure quality.
- **Principle #9.** ***Describe how you intend to accommodate change.*** Even the best planning can be obviated by uncontrolled change.
- **Principle #10.** ***Track the plan frequently and make adjustments as required.*** Software projects fall behind schedule one day at a time.

Modeling Principles

- In software engineering work, two classes of models can be created:
  - *Requirements models* (also called *analysis models*) represent the customer requirements by depicting the software in three different domains: the information domain, the functional domain, and the behavioral domain.
  - *Design models* represent characteristics of the software that help practitioners to construct it effectively: the architecture, the user interface, and component-level detail.

Agile Modeling Principles

- **Principle #1.** ***The primary goal of the software team is to build software not create models.***
- **Principle #2.** ***Travel light – don't create more models than you need.***
- **Principle #3.** ***Strive to produce the simplest model that will describe the problem or the software.***
- **Principle #4.** ***Build models in a way that makies them amenable to change.***
- **Principle #5.** ***Be able to state an explicit purpose for each model that is created.***

Agile Modeling Principles

- **Principle #6. Adapt the models you create to the system at hand.**
- **Principle #7. Try to build useful models, forget abut building perfect models.**
- **Principle #8. Don't become dogmatic about model syntax. Successful communication is key.**
- **Principle #9. If your instincts tell you a paper model isn't right you may have a reason to be concerned.**
- **Principle #10. Get feedback as soon as you can.**

Requirements Modeling Principles

- **Principle #1.** ***The information domain of a problem must be represented and understood.***
- **Principle #2.** ***The functions that the software performs must be defined.***
- **Principle #3.** ***The behavior of the software (as a consequence of external events) must be represented.***
- **Principle #4.** ***The models that depict information, function, and behavior must be partitioned in a manner that uncovers detail in a layered (or hierarchical) fashion.***
- **Principle #5.** ***The analysis task should move from essential information toward implementation detail.***

Design Modeling Principles

- **Principle #1. Design should be traceable to the requirements model.**
- **Principle #2. Always consider the architecture of the system to be built.**
- **Principle #3. Design of data is as important as design of processing functions.**
- **Principle #4. Interfaces (both internal and external) must be designed with care.**
- **Principle #5. User interface design should be tuned to the needs of the end-user. Stress ease of use.**

Design Modeling Principles

- **Principle #6. Component-level design should be functionally independent.**
- **Principle #7. Components should be loosely coupled to each other than the environment.**
- **Principle #8. Design representations (models) should be easily understandable.**
- **Principle #9. The design should be developed iteratively.**
- **Principle #10. Creation of a design model does not preclude using an agile appraoch.**

Living Modeling Principles

- **Principle #1. Stakeholder-centric models should target specific stakeholders and their tasks.**
- **Principle #2. Models and code should be closely coupled.**
- **Principle #3. Bidirectional information flow should be established between models and code.**
- **Principle #4. A common system view should be created.**

Living Modeling Principles

- **Principle #5. Model information should be persistent to allow tracking system changes.**
- **Principle #6. Information consistency across all model levels must be verified.**
- **Principle #7. Each model element has assigned stakeholder rights and responsibilities.**
- **Principle #8. The states of various model elements should be represented.**

Construction Principles

- The construction activity encompasses a set of coding and testing tasks that lead to operational software that is ready for delivery to the customer or end-user.
- Coding principles and concepts are closely aligned programming style, programming languages, and programming methods.
- Testing principles and concepts lead to the design of tests that systematically uncover different classes of errors and to do so with a minimum amount of time and effort.

Preparation Principles

- ***Before you write one line of code, be sure you:***
  - Understand of the problem you're trying to solve.
  - Understand basic design principles and concepts.
  - Pick a programming language that meets the needs of the software to be built and the environment in which it will operate.
  - Select a programming environment that provides tools that will make your work easier.
  - Create a set of unit tests that will be applied once the component you code is completed.

Coding Principles

- ***As you begin writing code, be sure you:***
  - Constrain your algorithms by following structured programming [Boh00] practice.
  - Consider the use of pair programming
  - Select data structures that will meet the needs of the design.
  - Understand the software architecture and create interfaces that are consistent with it.
  - Keep conditional logic as simple as possible.
  - Create nested loops in a way that makes them easily testable.
  - Select meaningful variable names and follow other local coding standards.
  - Write code that is self-documenting.
  - Create a visual layout (e.g., indentation and blank lines) that aids understanding.

Validation Principles

- ***After you've completed your first coding pass, be sure you:***
  - Conduct a code walkthrough when appropriate.
  - Perform unit tests and correct errors you've uncovered.
  - Refactor the code.

Testing Principles

- Al Davis [Dav95] suggests the following:
  - **Principle #1.** ***All tests should be traceable to customer requirements.***
  - **Principle #2.** ***Tests should be planned long before testing begins.***
  - **Principle #3.** ***The Pareto principle applies to software testing.***
  - **Principle #4.** ***Testing should begin "in the small" and progress toward testing "in the large."***

Testing Principles

- **Principle #5.** ***Exhaustive testing is not possible.***
- **Principle #6.** ***Testing effort for each system module commensurate to expected fault density.***
- **Principle #7.** ***Static testing can yield high results.***
- **Principle #8.** ***Track defects and look for patterns in defects uncovered by testing.***
- **Principle #9.** ***Include test cases that demonstrate software is behaving correctly.***

Deployment Principles

- **Principle #1.** ***Customer expectations for the software must be managed.***
- **Principle #2.** ***A complete delivery package should be assembled and tested.***
- **Principle #3.** ***A support regime must be established before the software is delivered.***
- **Principle #4.** ***Appropriate instructional materials must be provided to end-users.***
- **Principle #5.** ***Buggy software should be fixed first, delivered later.***

Getting Agile with Scrum

Mike Cohn

6 June 2014

1

We're losing the relay race

"The… 'relay race' approach to product development…may conflict with the goals of maximum speed and flexibility. Instead a holistic or 'rugby' approach—where a team tries to go the distance as a unit, passing the ball back and forth—may better serve today's competitive requirements."

Hirotaka Takeuchi and Ikujiro Nonaka, "The New New Product Development Game", *Harvard Business Review*, January 1986.

2

"Apple employees talk incessantly about what they call 'deep collaboration' or 'cross-pollination' or 'concurrent engineering.'

"Essentially it means that products don't pass from team to team. There aren't discrete, sequential development stages. Instead, it's simultaneous and organic.

"Products get worked on in parallel by all departments at once—design, hardware, software—in endless rounds of interdisciplinary design reviews."

Source: "How Apple Does It," *Time Magazine*, October 24, 2005 by Lev Grossman

Scrum has been used by:

- Microsoft
- Yahoo
- Google
- Electronic Arts
- IBM
- Lockheed Martin
- Philips
- Siemens
- Nokia
- Capital One
- BBC
- Intuit
- Apple
- Nielsen Media
- First American Corelogic
- Qualcomm
- Texas Instruments
- Salesforce.com
- John Deere
- Lexis Nexis
- Sabre
- Salesforce.com
- Time Warner
- Turner Broadcasting
- Oce

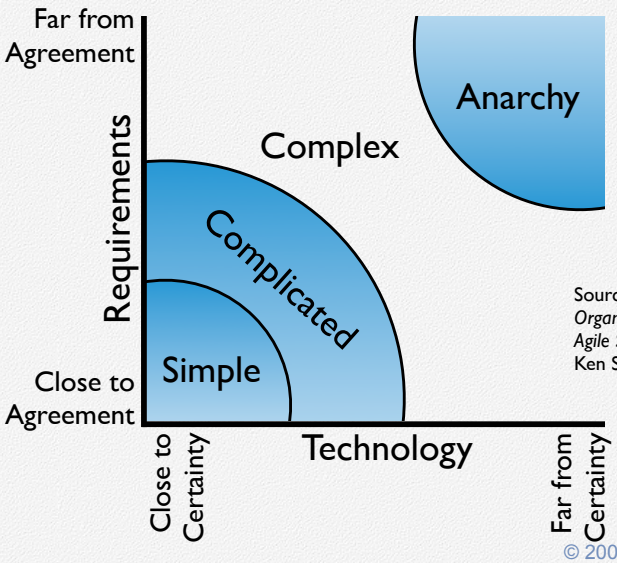
Scrum has been used for:

- Commercial software
- In-house development
- Contract development
- Fixed-price projects
- Financial applications
- ISO 9001-certified applications
- Embedded systems
- 24x7 systems with 99.999% uptime requirements
- the Joint Strike Fighter
- Video game development
- FDA-approved, life-critical systems
- Satellite-control software
- Websites
- Handheld software
- Mobile phones
- Network switching applications
- ISV applications
- Some of the largest applications in use

Characteristics

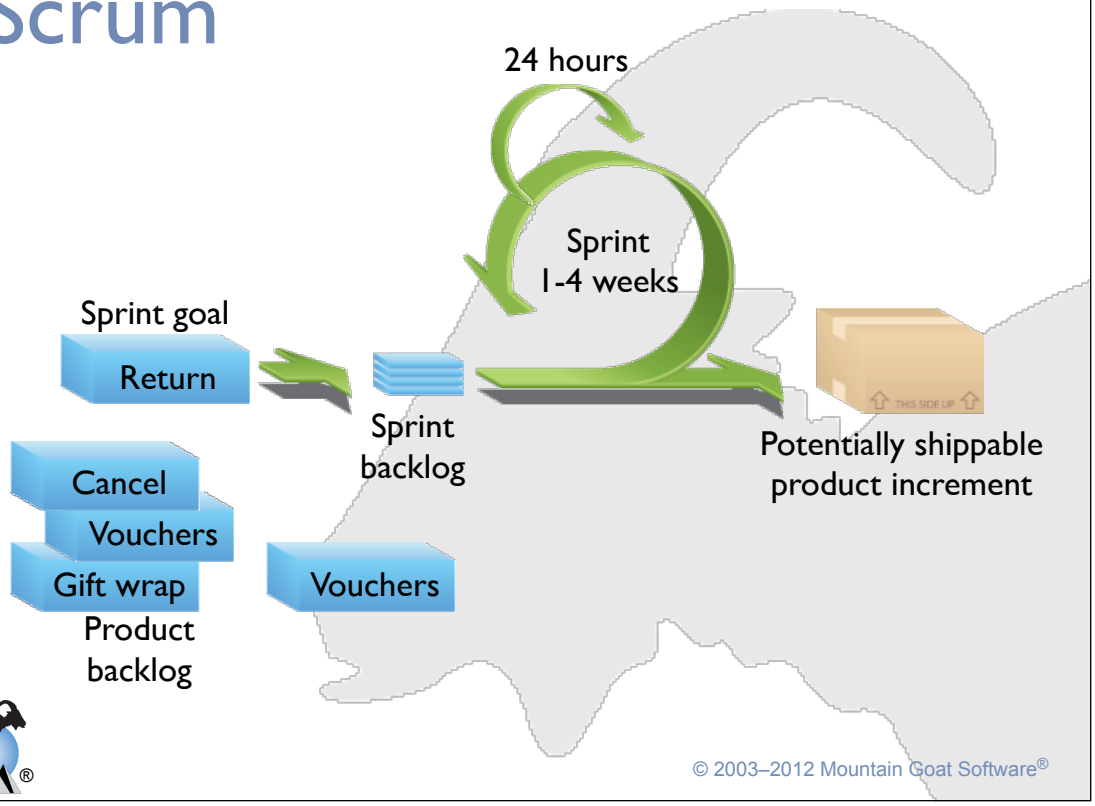
- Self-organizing teams
- Product progresses in a series of month-long "sprints"
- Requirements are captured as items in a list of "product backlog"
- No specific engineering practices prescribed
- Uses generative rules to create an agile environment for delivering projects
- One of the "agile processes"

Project noise level



Source: *Strategic Management and Organizational Dynamics* by Ralph Stacey in *Agile Software Development with Scrum* by Ken Schwaber and Mike Beedle.

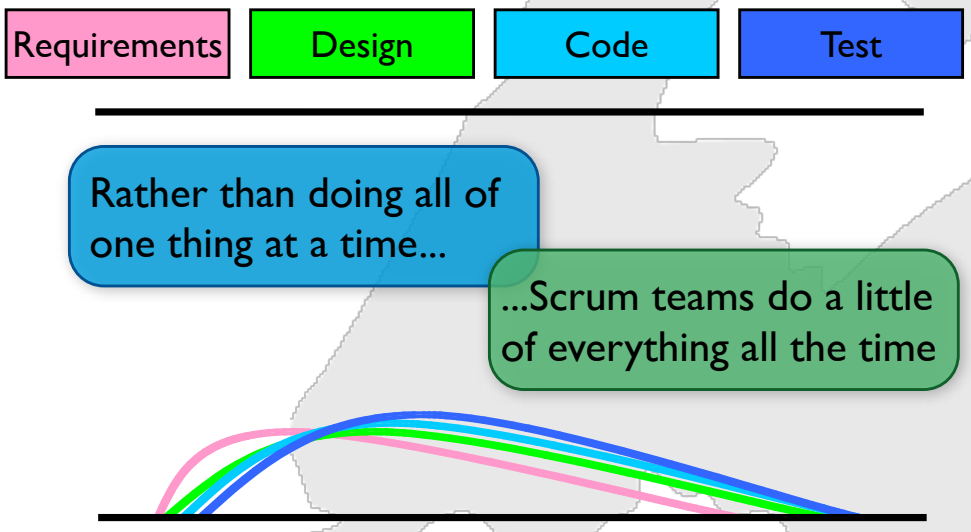
Scrum



Sprints

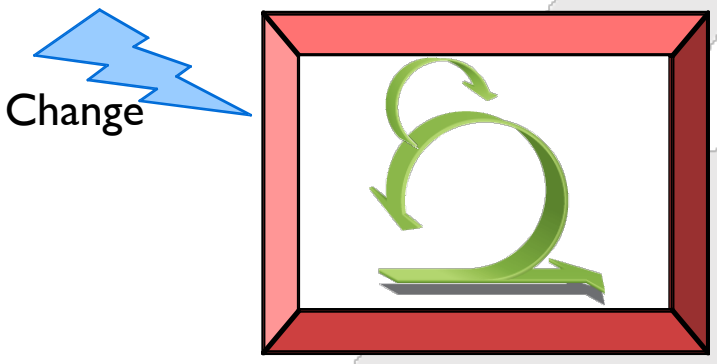
- Scrum projects make progress in a series of "sprints"
- Typical duration is 2–4 weeks or a calendar month at most
- A constant duration leads to a better rhythm
- Product is designed, coded, and tested during the sprint

Sequential vs. overlapping development



Source: "The New New Product Development Game" by Takeuchi and Nonaka. *Harvard Business Review*, January 1986.

No changes during a sprint



- Plan sprint durations around how long you can commit to keeping change out of the sprint

Scrum framework

Roles
- Product owner
- ScrumMaster
- Team

Ceremonies
- Sprint planning
- Sprint review
- Sprint retrospective
- Daily scrum meeting

Artifacts
- Product backlog
- Sprint backlog
- Burndown charts

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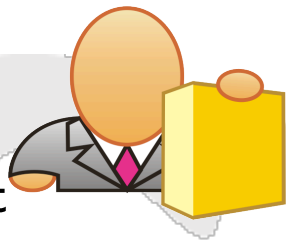
Product owner

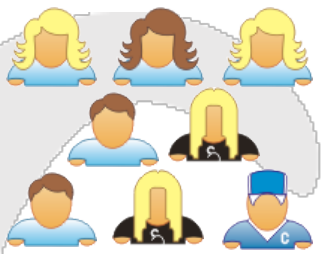


- Define the features of the product
- Makes scope vs. schedule decisions
- Responsible for achieving financial goals of the project
- Prioritize the product backlog
- Adjust features and priority every sprint, as needed
- Accept or reject work results

The ScrumMaster

- Responsible for enacting Scrum values and practices
- Removes impediments
- Coaches the team to their best possible performance
  - Helps improve team productivity in any way possible
- Enable close cooperation across all roles and functions
- Shield the team from external interference

The team



- Typically 5-9 people
- Cross-functional:
  - Programmers, testers, user experience designers, etc.
- Members should be full-time
  - May be exceptions (e.g., database administrator)
- Teams are self-organizing
  - Ideally, no titles but rarely a possibility
- Membership should change only between sprints

Scrum framework

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- ScrumMaster
- Team

Ceremonies

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- Product backlog
- Sprint backlog
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Sprint planning meeting

Who

- Team, ScrumMaster, & Product Owner

Agenda

- Discuss top priority product backlog items
- Team selects which to do

Why

- Know what will be worked on
- Understand it enough to do it

→ Sprint goal

→ Sprint backlog

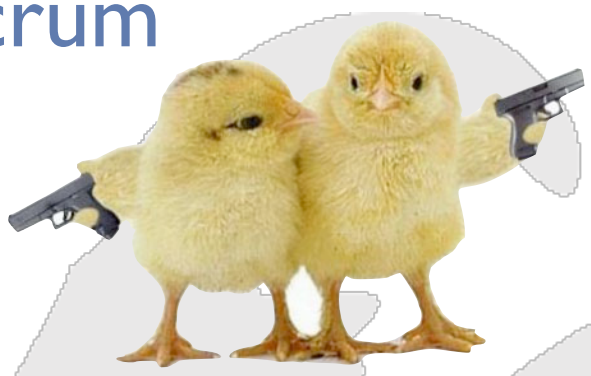
Sprint planning

- Team selects items from the product backlog they can commit to completing
- Sprint backlog is created
  - Tasks are identified and each is estimated (1-16 hours)
  - Collaboratively, not done alone by the ScrumMaster
- High-level design is considered

As a vacation planner, I want to see photos of the hotels.

Code the middle tier (8 hours)
Code the user interface (4)
Write test fixtures (4)
Code the foo class (6)
Update performance tests (4)

The daily scrum



- Parameters
  - Daily
  - 15-minutes
  - Stand-up
- Not for problem solving
  - Whole world is invited
  - Only team members, ScrumMaster, product owner, can talk
- Helps avoid other unnecessary meetings

Everyone answers 3 questions

1. What did you do yesterday?
2. What will you do today?
3. Is anything in your way?

- These are *not* status for the ScrumMaster
  - They are commitments in front of peers

The sprint review

- Team presents what it accomplished during the sprint
- Typically takes the form of a demo of new features or underlying architecture
- Informal
  - 2-hour prep time rule
  - No slides
- Whole team participates
- Invite the world

Sprint retrospective

- Periodically take a look at what is and is not working
- Typically around 30 minutes
- Done after every sprint
- Whole team participates
  - ScrumMaster
  - Product owner
  - Team
  - Possibly customers and others

Start / Stop / Continue

- Whole team gathers and discusses what they'd like to:

Start doing

Stop doing

Continue doing

This is just one of many ways to do a sprint retrospective.

Scrum framework

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- Burndown charts

Product backlog

This is the product backlog

- The requirements
- A list of all desired work on the project
- Ideally expressed such that each item has value to the users or customers of the product
- Prioritized by the product owner
- Reprioritized at the start of each sprint

A sample product backlog

Backlog item	Estimate
Allow a guest to make a reservation	3
As a guest, I want to cancel a reservation.	5
As a guest, I want to change the dates of a reservation.	3
As a hotel employee, I can run RevPAR reports (revenue-per-available-room)	8
Improve exception handling	8
...	30
...	50

Sprint goal

A short statement of what the work will be focused on during the sprint

Sprint 7

Implement basic shopping cart functionality including add, remove, and update.

Sprint 8

The checkout process—pay for an order, pick shipping, order gift wrapping, etc.

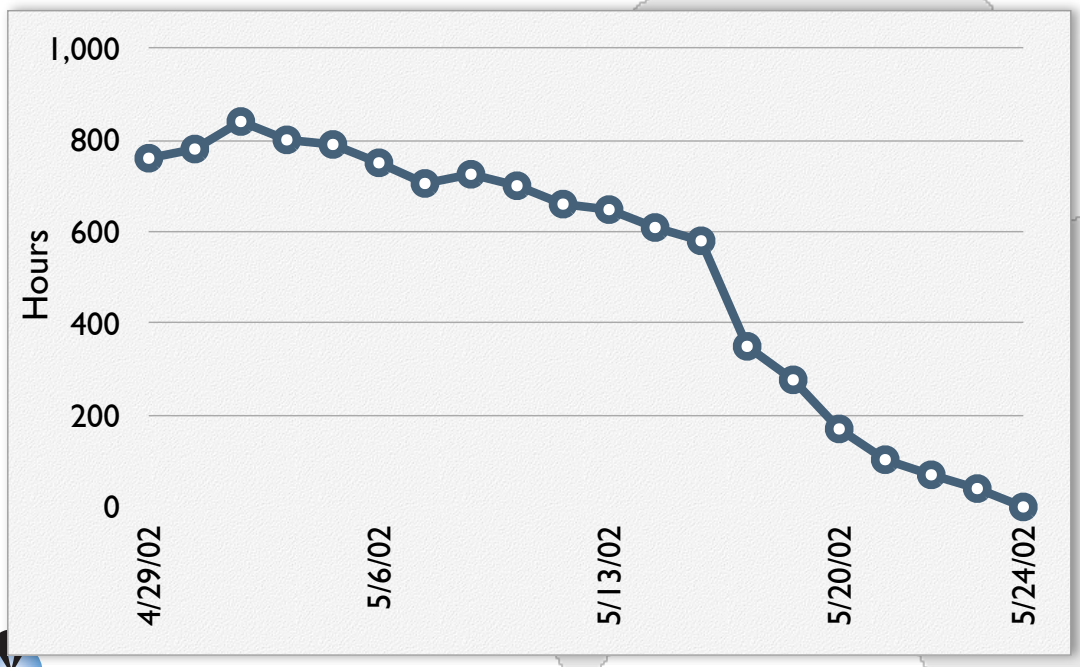
Managing the sprint backlog

- Individuals sign up for work of their own choosing
  - Work is never assigned
- Estimated work remaining is updated daily
- Any team member can add, delete or change the sprint backlog
- Work for the sprint emerges
- If work is unclear, define a sprint backlog item with a larger amount of time and break it down later
- Update work remaining as more becomes known

A sprint backlog

Tasks	Mon	Tues	Wed	Thur	Fri
Code the user interface	8	4	8		
Code the middle tier	16	12	10	4	
Test the middle tier	8	16	16	11	8
Write online help	12				
Write the foo class	8	8	8	8	8
Add error logging			8	4	

A sprint burndown chart



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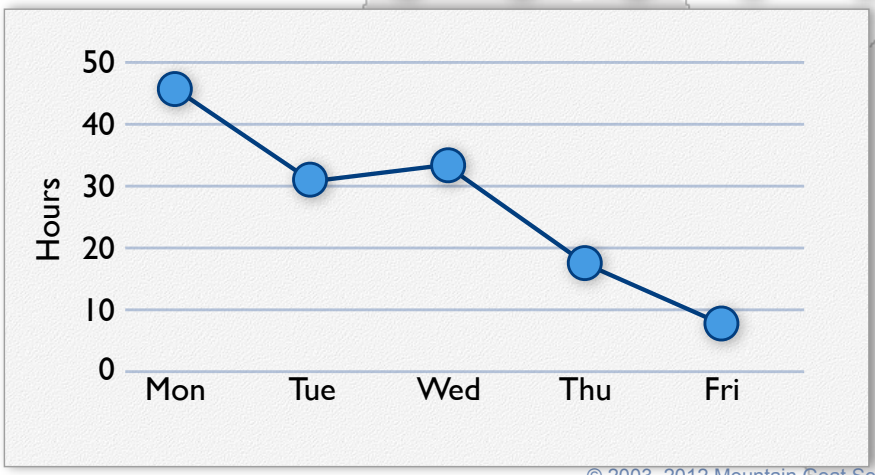
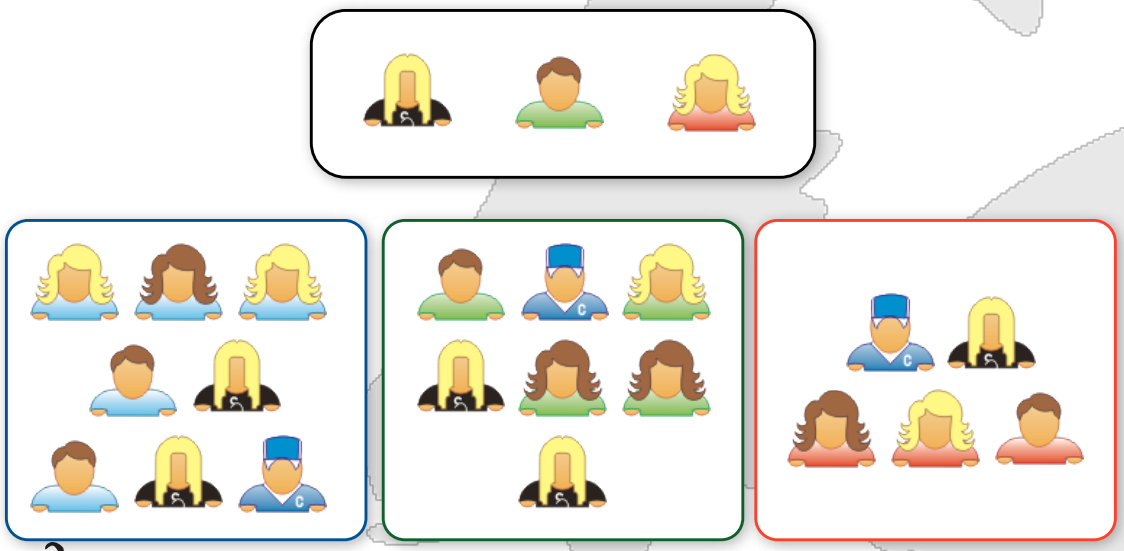
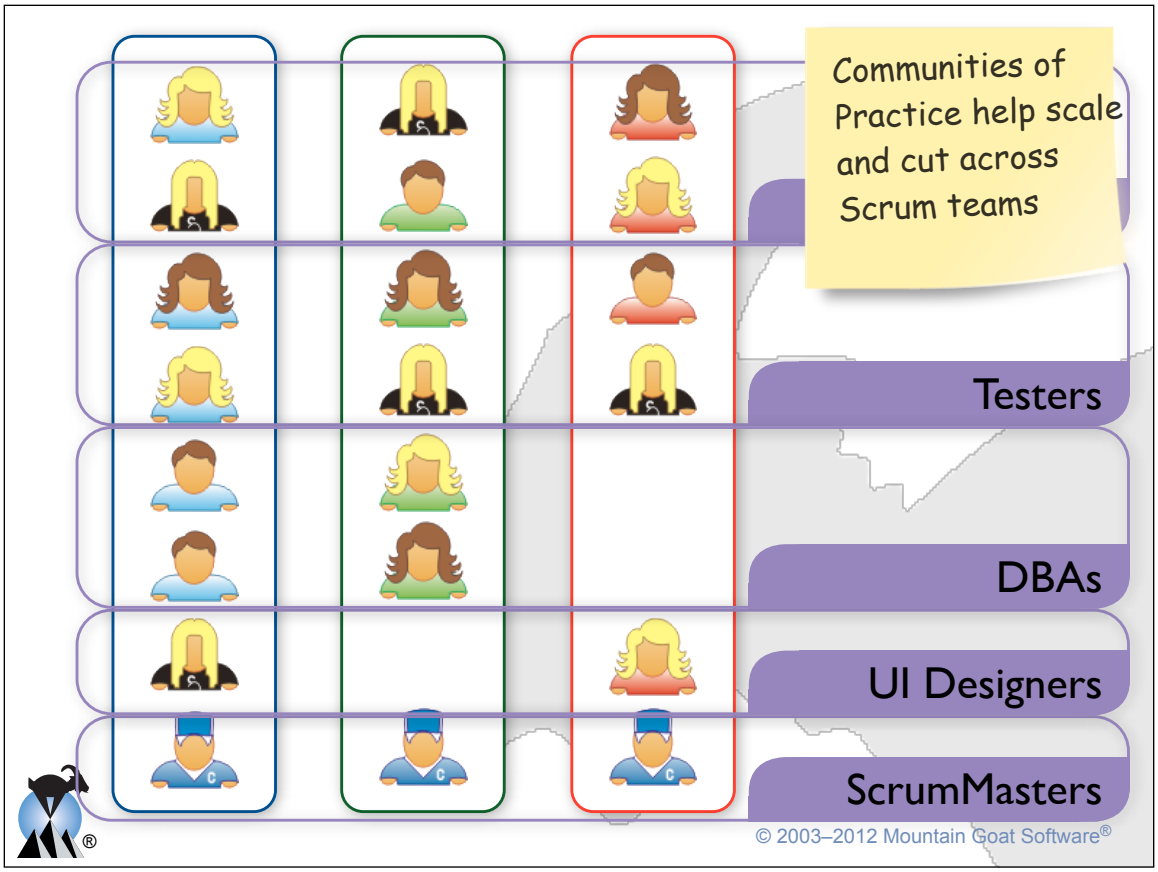


Scalability

- Typical individual team is 7 ± 2 people
  - Scalability comes from teams of teams
- Factors in scaling
  - Type of application
  - Team size
  - Team dispersion
  - Project duration
- Scrum has been used on projects of over 1,000 people

Scaling through the Scrum of scrums





A Scrum reading list

- *Agile Estimating and Planning* by Mike Cohn
- *Agile Game Development with Scrum* by Clinton Keith
- *Agile Product Ownership* by Roman Pichler
- *Agile Retrospectives* by Esther Derby and Diana Larsen
- *Agile Testing: A Practical Guide for Testers and Agile Teams* by Lisa Crispin and Janet Gregory
- *Coaching Agile Teams* by Lyssa Adkins
- *Essential Scrum* by Kenneth Rubin
- *Succeeding with Agile: Software Development using Scrum* by Mike Cohn
- *User Stories Applied for Agile Software Development* by Mike Cohn

About this presentation...

- A Creative Commons version of this presentation is available at:

  www.mountaingoatsoftware.com/scrum-a-presentation
- Available in Keynote and PowerPoint format
- Translated into 28 languages (so far!)

FrontRowAgile.com

Online video training

Mike Cohn

mike@mountaingoatsoftware.com
www.mountaingoatsoftware.com
twitter: mikewcohn

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