Chapter 3-4

- Process Models

*Slide Set to accompany*

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

*by Roger S. Pressman*


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A Generic Process Model

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Process Flow

- Describes how the framework activities and the actions and tasks that occur within each framework activity are organized with respect to sequence and time
Process Flow
Defining a Framework Activity

- A software team would need significantly more information before it could properly execute any one of framework activities.

- **What actions are appropriate for a framework activity given the following situation?**
  - the nature of the problem to be solved,
  - the characteristics of the people doing the work,
  - the stakeholders who are sponsoring the project.
Example: Communication Activity

- For a small software project requested by one person
  - Actions ➔ phone conversation
  - Work tasks (task set)
    - Make contact with stakeholder via telephone
    - Discuss requirements and develop notes
    - Organize notes into a brief written statement of requirements
    - Email to stakeholder for review and approval

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Example: Communication Activity

- For a complicated project with many stakeholders
  - Actions
    - Inception
    - Elicitation
    - Elaboration
    - Negotiation
    - Specification
    - Validation
Identifying a Task Set

- Each software engineering action can be represented by a number of different task sets.

- 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
Defining Framework Activity

- Different projects demand different task sets
- The software team chooses the task set based on problem and project characteristics
Process Patterns

- Proven solutions to the encountered problems which are readily available to the team

  ➔ The problems could be addressed and resolved quickly
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 Patterns [Ambler ’98]

- Pattern Name
- Forces
  - The environment in which the pattern is encountered and the issues that make the problem visible
- Type: Stage pattern, task pattern, phrase pattern
- Initial context
- Problem
- Solution
- Resulting context
- Related patterns
- Known Uses and Examples
Process Pattern Types

- **Stage patterns**—defines a problem associated with a framework activity for the process.
  - E.g.) EstablishingCommunication

- **Task patterns**—defines a problem associated with a software engineering action or work task and relevant to successful software engineering practice
  - E.g.) RequirementGathering

- **Phase patterns**—define the sequence of framework activities that occur with the process, even when the overall flow of activities is iterative in nature.
  - E.g.) SpiralModel or Prototyping
An Example Process Pattern

The following abbreviated process pattern describes an approach that may be applicable when stakeholders have a general idea of what must be done but are unsure of specific software requirements.

**Pattern name.** RequirementsUnclear

**Intent.** This pattern describes an approach for building a model (a prototype) that can be assessed iteratively by stakeholders in an effort to identify or solidify software requirements.

**Type.** Phase pattern.

**Initial context.** The following conditions must be met prior to the initiation of this pattern: (1) stakeholders have been identified; (2) a mode of communication between stakeholders and the software team has been established; (3) the overriding software problem to be solved has been identified by stakeholders; (4) an initial understanding of project scope, basic business requirements, and project constraints has been developed.

**Problem.** Requirements are hazy or nonexistent, yet there is clear recognition that there is a problem to be solved, and the problem must be addressed with a software solution. Stakeholders are unsure of what they want; that is, they cannot describe software requirements in any detail.

**Solution.** A description of the prototyping process would be presented here and is described later in Section 2.3.3.

**Resulting context.** A software prototype that identifies basic requirements (e.g., modes of interaction, computational features, processing functions) is approved by stakeholders. Following this, (1) the prototype may evolve through a series of increments to become the production software or (2) the prototype may be discarded and the production software built using some other process pattern.

**Related patterns.** The following patterns are related to this pattern: CustomerCommunication, IterativeDesign, IterativeDevelopment, CustomerAssessment, RequirementExtraction.

**Known uses and examples.** Prototyping is recommended when requirements are uncertain.
The existence of a software process is no guarantee that:

- The software will be delivered on time
- It will meet the customer’s needs
- It will exhibit the technical characteristics that will lead to long-term quality characteristics

Process can be assessed to ensure that it meets a set of basic process criteria:

- Process patterns must be coupled with solid software engineering
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 3: Summary

- A general process model for software engineering encompasses a set of framework and umbrella activities, actions, and work tasks.

- Each of a variety of process models can be described by a different process flow:
  - Process flow: A description of how the framework activities, actions, tasks are organized sequentially and chronologically.

- Process patterns can be used to solve common problems.
Process Model

- The purpose: to try to reduce the chaos present in developing new software products

- **Prescriptive** process models
  - Focuses on structure, order and project consistency in software development
Prescriptive Process Models

- A prescriptive process models strives for structure and an order in software development

_Few questions …_

- Are they appropriate for a software world that thrives on change?

- When we replace traditional process models (and the order they imply) with something less structured, do we make it impossible to achieve coordination and coherence in software work?

➡️ No easy answer. Alternatives available to software engineers.
Prescriptive Process Models

- Define a prescribed set of process elements and a predictable process work flow
  - Framework activities
  - Software engineering actions, tasks
  - Work products
  - Quality assurance
  - Change control mechanisms

- A process flow (work flow)
  - The manner in which the process elements are interrelated to one another
The Waterfall Model

- Communication
  - project initiation
  - requirement gathering
- Planning
  - estimating
  - scheduling
  - tracking
- Modeling
  - analysis
  - design
- Construction
  - code
test
- Deployment
  - delivery
  - support
  - feedback

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The Waterfall Model

- A classic life cycle which suggests a systemic, sequential approach to software development

- The V-model: The variation of the waterfall model

  - Depicts the relationship of quality assurance actions to the actions associated with some framework activities, such as communication, modeling, early construction activities
The V-Model
The V-Model

- A variation in the representation of the waterfall model

- Illustrates how verification and validation actions are associated with earlier engineering actions

- Depicts the relationship of quality assurance actions to the actions associated with communication, modeling, and early construction activities
The V-Model

- Moving down the left side of the V
  - Basic program requirements are refined into progressively more detailed and technical representations

- Moving up the right side of the V
  - Once code has been generated
  - Performing a series of tests (Quality assurance actions)
  - Validates each of the models created on the left side
The Waterfall Model: Criticism

- Real projects rarely follow the sequential flow
  - Changes can cause confusion

- It is often difficult for the customer to state all requirements explicitly

- The customer must have patience
  - A working version of the program will not be available until late in the project time span
  - A major blunder, if undetected until the working program is reviewed, can be disastrous
The Incremental Model

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The Incremental Model

**Motivation**
- Need to provide a limited set of software functionality to users quickly and then refine and expand on that functionality in later software releases

The incremental model applies *linear sequence in a staggered fashion* as calendar time progresses
- Each linear sequence produces deliverable “increments” of the software

Delivers a series of releases, called *increments*, that provide progressively more functionality for the customer as each increment is delivered
The Incremental Model: Example

- Example: Word-processing software
  - #1) Deliver basic file management, editing, and document production functions
  - #2) More sophisticated editing and document production capabilities
  - #3) Spelling and grammar checking
  - #4) Advanced page layout capability

- The process flow for any increment can incorporate the prototyping paradigm
The Incremental Model

- The first increment is often a **core product**
  - Only basic requirements are addressed
  - It is used by the customer, and he gives feedback

- The plan for the next increment addresses the modification of the core product to better meet the needs of the customer
Evolutionary Models: Motivation

- Software evolves over a period of time
- Business and product requirements often change as development proceeds
- Making a straight line path to an end product unrealistic
- A set of core product or system requirements is well understood, but the details of product or system extensions have yet to be defined
- We need a process model that has been explicitly designed to accommodate a product that grows and changes
Evolutionary Models

- Produce an increasingly more complete version of the software with each iteration

- What is the difference b/w incremental models and evolutionary models?
  - Incremental models ➔ each pass produces simply increments
  - Evolutionary models ➔ each pass produces more complete version of software
Evolutionary Models: Prototyping

- Unclear requirement (by Customer)
  - Often, a customer defines a set of general objectives for software, but does not identify detailed requirements for functions and features

- Not-convincing implementation issues (by Developer)
  - The developer may be unsure of implementation issues, such as the efficiency of an algorithm, the adaptability of an operating system, or the form that human-machine interaction should take
Evolutionary Models: Prototyping

Communication
Quick plan
Modeling Quick design
Construction of prototype
Deployment delivery & feedback
Quick design
Construction
Deployment & feedback
Communication
Quick plan
Modeling Quick design
Construction of prototype
Deployment delivery & feedback
Quick design
Construction
Deployment & feedback
Communication
Quick plan
Modeling Quick design
Construction of prototype
Deployment delivery & feedback
Quick design
Construction
Deployment & feedback

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Prototyping: Flow

- **Communication**
  - You meet with other stakeholders to define the overall objectives, identify known requirements, and outline areas where further definition are mandatory

- **Quick plan**
  - A prototyping iteration is planed quickly

- **Modeling**

- **Quick design**
  - Focuses on a representation of those aspects of the software that will be visible to end users

- **Construction of prototype**

- **Deployment, delivery & feedback**
  - The prototype is deployed and evaluated by stakeholders, who provide feedback that is used to further refine requirements
Prototyping

- Iteration occurs as the prototype is tuned to satisfy the needs of various stakeholders, while at the same time enabling you to better understand what needs to be done.

- The prototype serves as a mechanism for identifying software requirements.

- What do you do with the prototype?
  - The prototype serves as the first system.
  - Ideal case: Prototypes are built as throwaways
    - They are the ones that Brooks recommends you throw away.
  - But, some others are evolutionary in the sense that the prototype slowly evolves into the actual system.
Prototyping: Advantages

- Both stakeholders and software engineer can like the prototyping paradigm
  - User gets a feel for the actual system
  - Developers get to build something immediately
Prototyping: Limitations

- Stakeholders see what appears to be a working version of the software, but unaware of the inside process
  - they unaware that the prototype is held together haphazardly, unaware that in the rush to get it working
  - Overall software quality or long-term maintainability is not considered
- When informed that the product must be rebuilt for high quality, stakeholders will only demand “a few fixes” over “the prototype” due to the cost problem
- Software engineers make implementation compromises in order to get a prototype working quickly
  - An inappropriate operating system or programming language may be used simply; an inefficient algorithm many be implemented simply
  - They become comfortable with less-than-ideal choice, which becomes an integral part of the final system
  - The final system suffers from its low quality
Prototyping: Principle

- All stakeholder should agree the following:

- 1. The prototype is build to serve as a mechanism for defining requirements

- 2. The prototype is then discarded (at least in part)

- 3. The actual software is engineered with an eye toward quality
Evolutionary Models: The Spiral
The Spiral Model

- Characteristics
  - Couples the iterative nature of prototyping with the controlled and systematic aspects of the waterfall model
  - Provides the potential for rapid development of increasingly more complete versions of the software

- The spiral model can be adopted to apply throughout the entire life cycle of an application, from concept development to maintenance
The Spiral Model: Adaptation

- Adaptively represents whole development process throughout the life of the software

- **Stage 1)** *Concept development project* ➔
- **Stage 2)** *New product development project* ➔
- **Stage 3)** *Product enhancement project* ➔ …

- The spiral remains operative until the software is retired
The Spiral Model [Boehm ‘88]

- The spiral model is a risk-driven process model generator that is used to guide multi-stakeholder concurrent engineering of software intensive systems.

- Two main distinguishing features.
  - A cyclic approach for incrementally growing a system’s degree of definition and implementation while decreasing its degree of risk.
  - A set of anchor point milestones for ensuring stakeholder commitment to feasible and mutually satisfactory system solution.
The Spiral Model

- Software is developed in a series of evolutionary releases
- During early iterations, the release might be a model or prototype
- During later iterations, increasingly more complete versions of the engineered system are produced
The Spiral Model

- Each of the framework activities represent one segment of the spiral path

- Risk is considered as each revolution is made

- Anchor point milestones are noted for each evolutionary process
  - A combination of work products and conditions that are attained along the path of the spiral
The Spiral Model: Evolutionary process

- The first pass: Result in the development of a product specification
- Subsequent passes: Develop a prototype and then progressively more sophisticated versions of the software
- Each pass through the planning region: results in adjustments to the project plan
- Cost and schedule are adjusted based on feedback derived from the customer after delivery
- Project manager adjusts the planned number of iterations required to complete the software
The Spiral Model: Advantages

- A realistic approach to the development of large-scale systems and software
- The developer and customer better understand and react to risks at each evolutionary level
  - As a risk reduction mechanism, it applies the prototyping approach at any stage in the evolution
- Incorporates the classic life cycle into an iterative framework ➔ more realistically reflects the real world
- Demands a direct consideration of technical risks at all stages of the project ➔ reduce risks before they become problematic
The Spiral Model: Limitation

- It may be difficult to convince customers that the evolutionary approach is controllable.

- It **demands considerable risk assessment expertise** and relies on this expertise for success.

- If a major risk is not uncovered and managed, problems will undoubtedly occur.
Evolutionary Process: The Concurrent Models

- Allows a software team to represent iterative and concurrent elements of any of the process models

- E.g.: The modeling activity defined for the spiral model is accomplished by invoking one or more of the software engineering actions – prototyping, analysis, and design
The Concurrent Models: Example

Modeling activity

- Under development
- Awaiting changes
- Under revision
- Under review
- Baselined
- Done

represents the state of a software engineering activity or task.
The Concurrent Models: Example

- The communication activity has completed its first iteration ➔
- The modeling activity makes a transition from **inactive** (none) state into the **under development** ➔
- The customer indicates that changes in requirements must be made ➔
- the modeling activity moves from the **under development** state into the **awaiting changes** state.
The Concurrent Models: Event as Trigger

- Defines a series of events as a trigger for transitions from state to state for each of the software engineering activities, actions, or tasks
- E.g.) Event: **Analysis model correction**
  - Meaning: an inconsistency in the requirements model is uncovered
  - Trigger: Triggers the requirements analysis action from the **done** state into the **awaiting** changes state
The Concurrent Models: Summary

- Applicable to all types of software development and provides an accurate picture of the current state of a project.
- Defines a process network, rather than confining software engineering activities, actions, and tasks to a sequence of events.
- Each activity, action or task on the network exists simultaneously with other activities, actions or tasks.
- Events generated in the process network trigger transitions among the states of each activity.
Evolutionary Process Models: Weaknesses [Nogueira ‘00]

- Prototyping poses a problem of project planning because of the uncertain number of cycles required to construct the product.
- Evolutionary software processes do not establish the maximum speed of the evolution.
- Evolutionary software processes should be focused on flexibility and extensibility rather than high quality.
Specialized 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)
Component-Based Development

- Comprises applications from prepackaged software components
  - COTS (Commercial off-the-self) software components
    - Enables components to be integrated into the software that is to be built

- Sharing the characteristics of other models
  - The spiral model, the iterative model, the evolutionary model

- Modeling and construction activities begin with the identification of candidate components
The Formal Methods Model

- Consists of a set of activities that leads to **formal mathematical specification** of computer software
- Offers the promise of **defect-free** software
  - E.g.) aircraft avionics and medical devices
- Specify, develop and verify a computer-based system by applying a **rigorous mathematical notation**
- Ambiguity, incompleteness, and inconsistency can be discovered and corrected more easily through the application of mathematic analysis
The Formal Methods Model: Limitation

- The development of formal methods is quite time consuming and expensive
- Extensive training is required to apply formal methods
- It is difficult to use the models as a communication mechanism for technically unsophisticated customers
Aspect-Oriented Software Development

- In modern computer-based systems, certain **concerns** span the entire architecture
  - High-level properties of a system (E.g. security and fault tolerance)
  - Affect functions (e.g. the application of business rules)
  - Systemic (e.g. task synchronization or memory management)

- **Crosscutting concerns**
  - Concerns that cut cross multiple system functions, features, and information
Aspect-Oriented Software Development (AOSD)

- Aspect-oriented programming or aspect-oriented component engineering

- Defining, specifying, designing, and constructing **aspects**
  - Express **crosscutting concern**

- Aspect-oriented process
  - Likely adopt characteristics of both evolutionary and concurrent process models
    - Evolutionary model for identifying and constructing aspects
    - Concurrent model: Aspects are engineered independently of localized software components
The Unified Process (UP)

- Use case driven, architecture-centric, iterative and incremental software process

- Consider both traditional software process models and agile software development
  - Draw on the best features and characteristics of traditional software process models
  - Characterize them in a way that implements many of the best principles of agile software development
The Unified Process (UP)

- Recognizes the importance of customer communication and streamlined methods for describing the customer’s view of a system.
- Emphasizes the important role of software architecture.
- Helps the architect focus on the right goals, such as understandability, reliance to future changes, and reuse.
- Suggests a process flow that is iterative and incremental, providing the evolutionary feel that is essential in modern software development.

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The Unified Process (UP): History

- 90s: Working on a unified method
  - Combines the best features of each of their individual object-oriented analysis and design methods
  - Adopt additional features proposed by other experts in object oriented modeling

- UML (a unified modeling language)
  - Contains a robust notation for the modeling and development of object-oriented systems
  - By 1997, UML became a de facto industry standard for object-oriented software development
The Unified Process (UP)

- **UP phases** are similar in intent to the generic framework activities

  - **Inception phase**
    - Encompasses both customer communication and planning activities
    - Business requirements are described through a set of preliminary use case
      - Describe which features and functions each major class of users desires

  - **Elaboration phase**
    - Encompasses the planning and modeling activities
    - Refines and expands the preliminary use cases
    - Expands the architectural representation to include five different views of the software (the use case model, the analysis model, ...)

The Unified Process (UP)

- **Construction phase** = construction activity
- **Transition phase**
  - Encompasses the latter stages of the generic construction activity and the first part of generic deployment activity
  - Software is given to end uses for best testing
  - User feedback reports both defects and necessary changes
- **Production phase**
  - Coincides with the development activity of generic process
  - The ongoing use of the software is monitored
  - Defect reports and requests for changes are submitted and evaluated
The Unified Process (UP)
## UP Phases

### Workflows

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<thead>
<tr>
<th>Workflows</th>
<th>Inception</th>
<th>Elaboration</th>
<th>Construction</th>
<th>Transition</th>
<th>Production</th>
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### Iterations

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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

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At a corporate or organizational level, a software process model can be effective only if it is amenable to significant adaptation to meet the needs of the project team.

In an ideal setting, you would create a process that best fits your needs, and at the same time, meets the broader needs of the team and the organization.

Alternatively, the team itself can create its own process, at the same time meet the narrower needs of individuals and broader needs of the organization.

Personal software process / team software process
Personal Software Process (PSP)

- PSP emphasizes the need to record and analyze the types of errors you make, so that you can develop strategies to eliminate them.
Personal Software Process (PSP): Activities

- **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.** External specifications for each component to be constructed are developed and a component design is created. Prototypes are built when uncertainty exists. All issues are recorded and tracked.
Personal Software Process (PSP): Activities

- **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 the measures and metrics collected (this is a substantial amount of data that should be analyzed statistically), the effectiveness of the process is determined. Measures and metrics should provide guidance for modifying the process to improve its effectiveness.
Personal Software Process (PSP)

- PSP represents a disciplined, metrics-based approach to software engineering that may lead to culture shock for many practitioners.
- When PSP is properly introduced to software engineers, the resulting improvement in software engineering productivity and software quality are significant.
Team Software Process (TSP)

- The goal of TSP is to build a “self-directed” project team that organizes itself to produce high-quality software.

- TSP recognizes that the best software team is self-directed.
Team Software Process (TSP): Objectives

- **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.
Team Software Process (TSP): A self-directed team

- A self-directed team has a consistent understanding of its overall goals and objectives
  - Define roles
  - Responsibilities for each team member
  - Tracks quantitative project data
  - Identifies a team process that is appropriate for the project and a strategy for implementing the process
  - Defines local standards that are applicable to the team’s software engineering work
  - Continually assess risk and reacts to it
  - Tracks, manages, and reports project status
Team Software Process (TSP): Activity

- Project launch
- High-level design
- Implementation
- Integration and test
- Postmortem
Team Software Process (TSP): Scripts

- TSP makes use of a wide variety of scripts, forms and standards that serve to guide team members

- TSP scripts
  - Define specific process activities and other more detailed work functions that are part of the team process
  - Define elements of the team process and activities that occur within the process

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Process Technology Tools

- Help software organizations analyze current process, organize word tasks, control and monitor progress, and manage technical quality.

- Allow a software organization to build an automated model of the process framework, tasks sets, umbrella activities.
Product and Process

- If the process is weak, the end product will undoubtedly suffer
- But an obsessive overreliance on process is also dangerous
- A creative software professional should also derive as much satisfaction from the process as the end product
- The duality of product and process is one important element in keeping creative people engaged as software engineering continues to evolve
Chapter 4: Summary

- Prescriptive process models
  - Applied for many years to bring order and structure to software development
  - Each of these models suggest a somewhat different process flow, but all perform the same set of generic framework activities: communication, planning, modeling, construction, and deployment

- Sequential process models: The waterfall, and V-model
  - A linear process flow that is often inconsistent with modern realities
  - Applicable in situations where requirements are well defined and stable
Chapter 4: Summary

- **Incremental process models**
  - iterative in nature and produce working versions of software quite rapidly

- **Evolutionary process models**
  - Recognize the iterative, incremental nature of most software engineering projects and are designed to accommodate change
  - Produce incremental work products (or working versions of the software) quickly

- **Concurrent process model**
  - Allows a software team to represent iterative and concurrent elements of any process model
Chapter 4: Summary

- Specialized models
  - The component–based model
  - The formal methods
  - The aspect-oriented model
    - Accommodate crosscutting concerns

- The unified process
  - A “use case driven, architecture-centric, iterative and incremental” software process
  - Designed as a framework for UML methods and tools

- Personal and team models
  - Emphasize measurement, planning, and self-direction as key ingredients for successful SW process