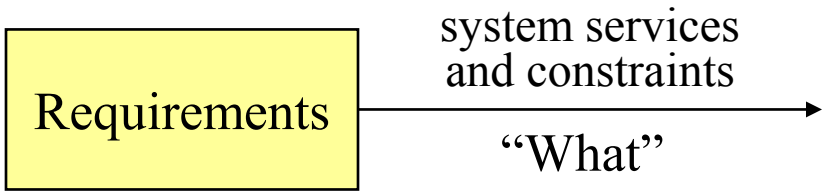
An Overview of Software Process

Objectives

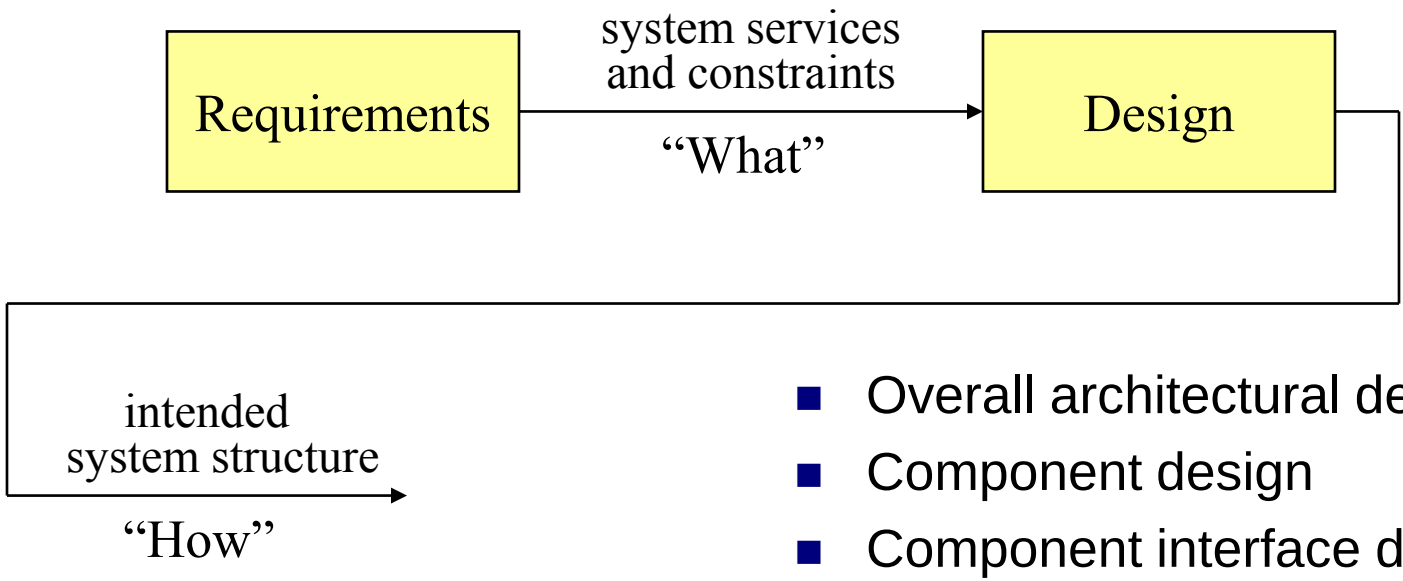
- To introduce the general phases of the **software development life cycle (SDLC)**
- To describe various generic **software process models** and discuss their pros and cons
- To introduce some specific **software processes**
- To discuss software process **assessment and improvement**

Generalizing the Software Development Life Cycle (SDLC)



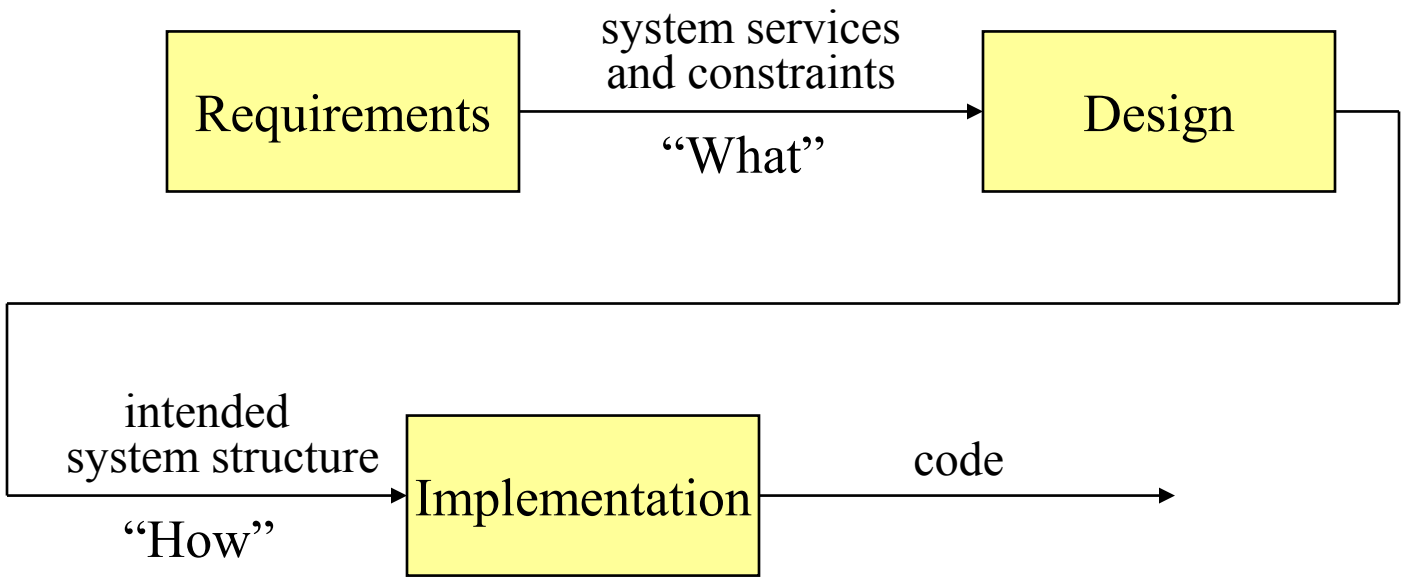
- Specify system scope
- Elicit and specify system services
- Elicit and specify system constraints
- Begin designing the user interface (isn't this design?!)
- Establish deliverables
- Discuss open issues
- Document
- Verify

Generalizing the Software Development Life Cycle (SDLC)



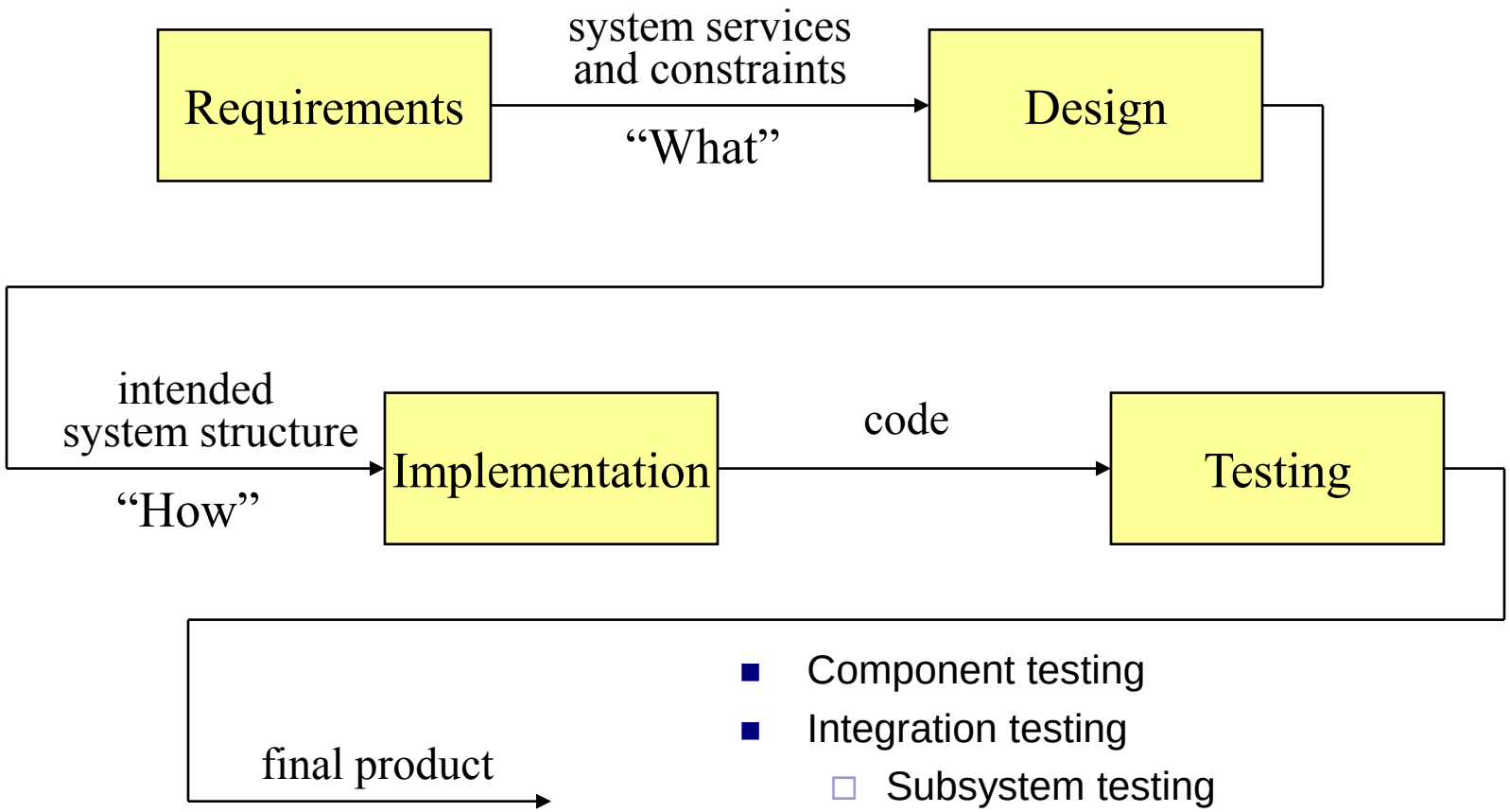
- Overall architectural design
- Component design
- Component interface design
- Algorithm design
- Data structure design
- Hardware and software decisions
- Discuss open issues
- Document
- Verify

Generalizing the Software Development Life Cycle (SDLC)



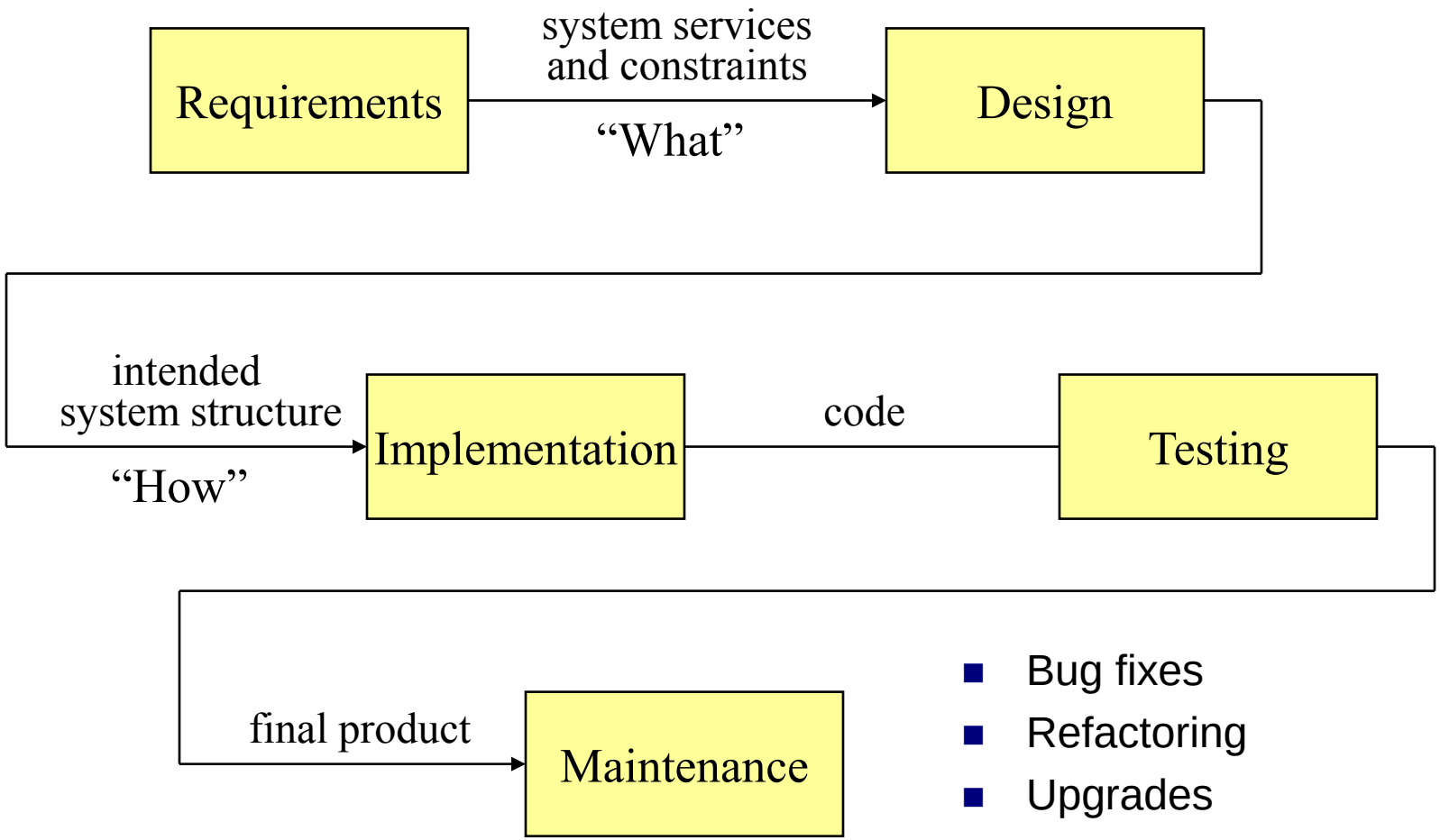
- Coding
- Successful compilation of code units
- Unit testing
- Code inspection
- Document

Generalizing the Software Development Life Cycle (SDLC)



- Component testing
- Integration testing
  - Subsystem testing
  - System testing
- Acceptance testing
- Document
- Deployment (actually its own phase)

Generalizing the Software Development Life Cycle (SDLC)

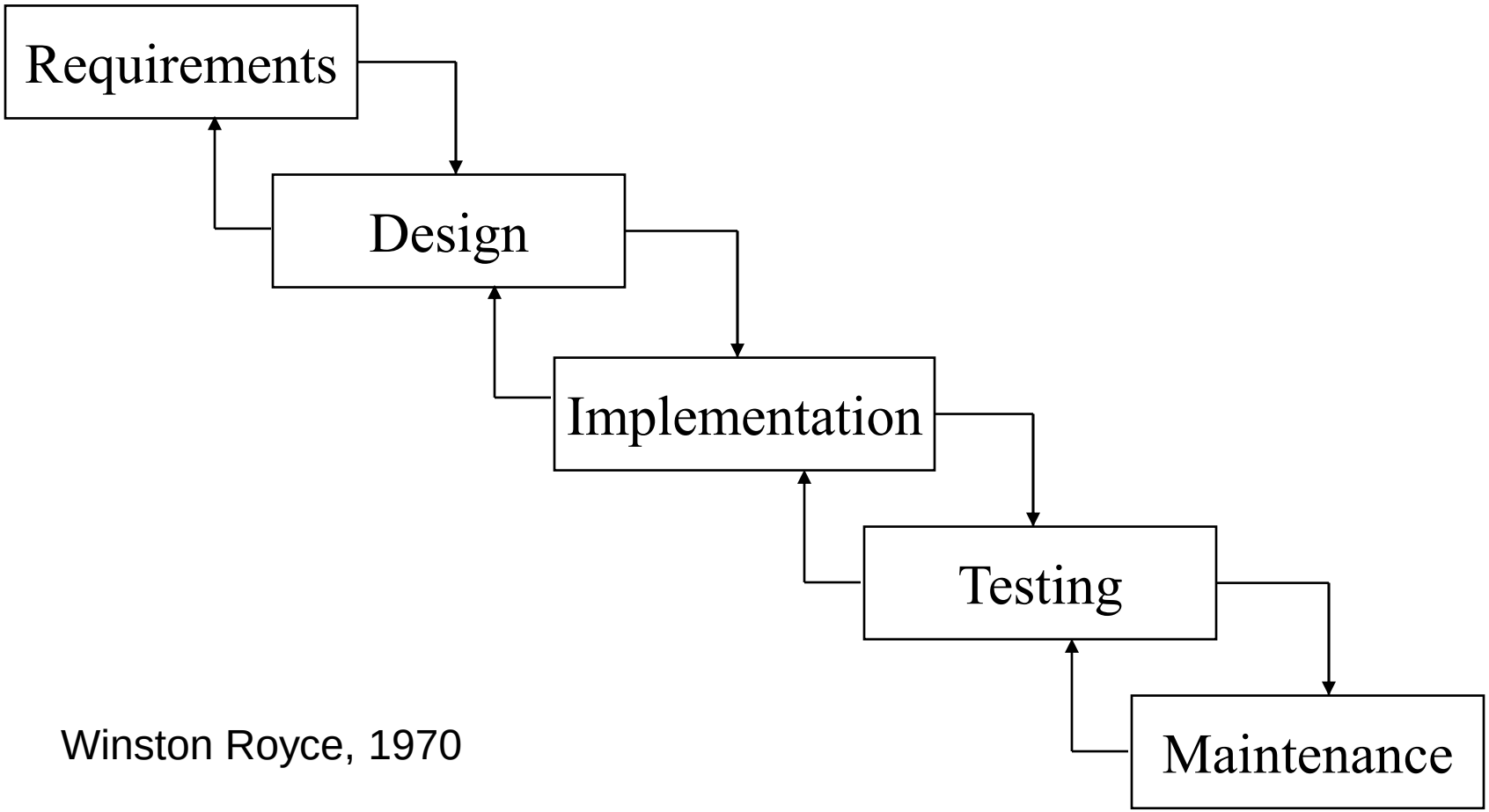


- Bug fixes
- Refactoring
- Upgrades
- Document

Software Process *Models*

- An abstract representation of how the SDLC phases can be addressed
- Major models:
  - Waterfall
  - Spiral
  - Iterative and Incremental Development (IID)
  - Prototyping
    - Evolutionary
    - Throwaway

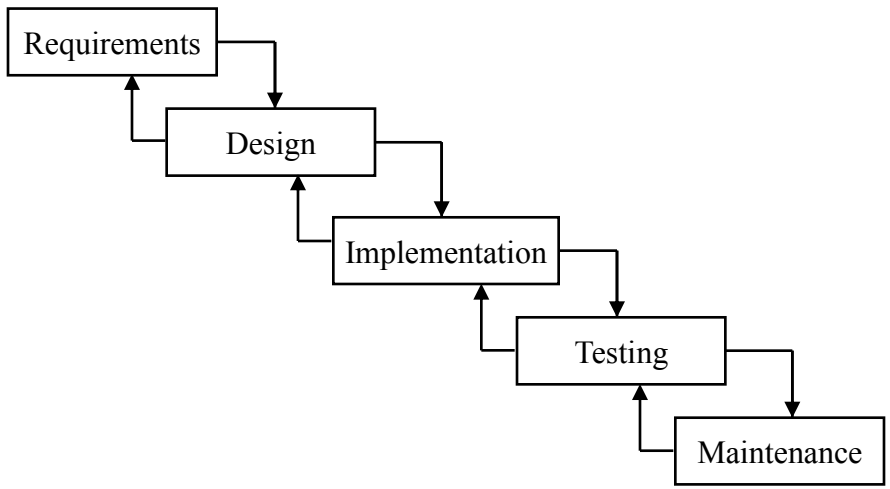
Waterfall Model



Winston Royce, 1970

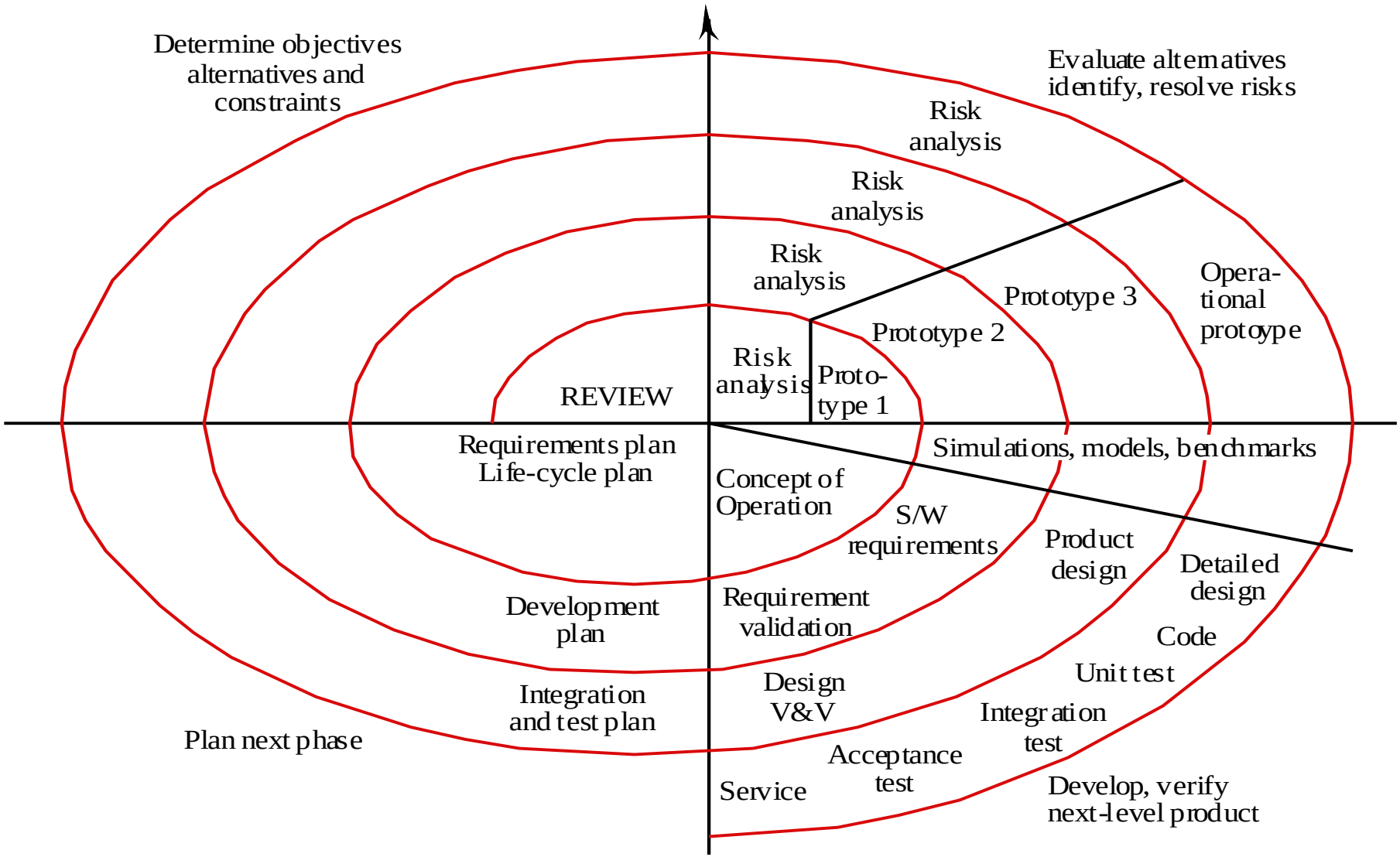
Observations

- Contains all phases of the SDLC
- May have to return to the previous phase
- Still widely used, especially on very large projects



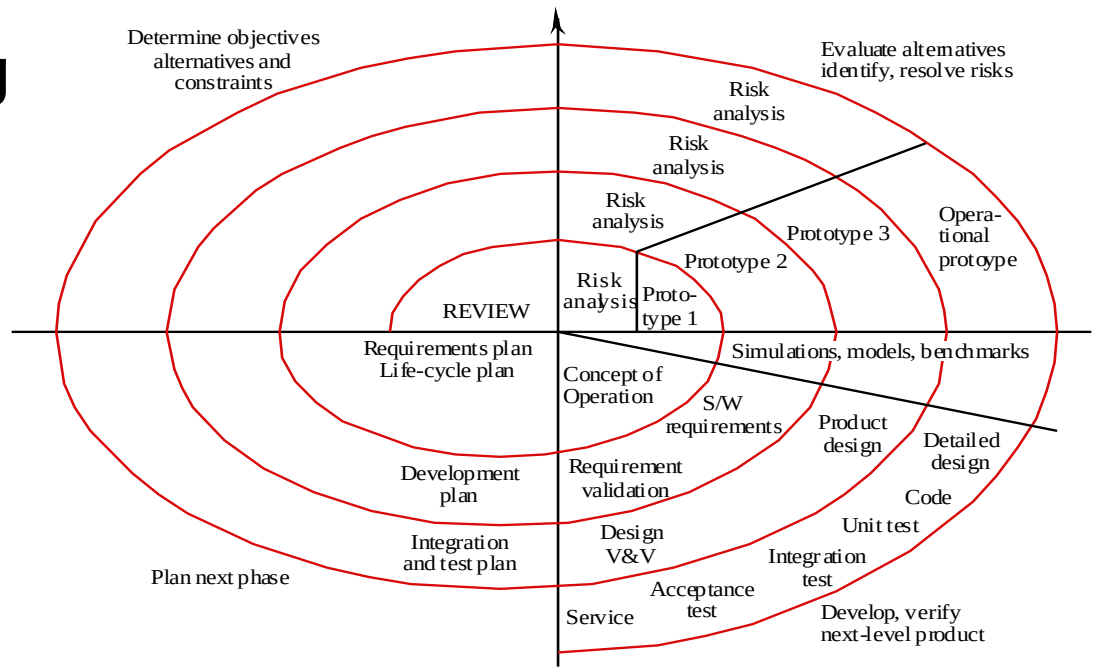
Spiral Model

Barry Boehm, 1988

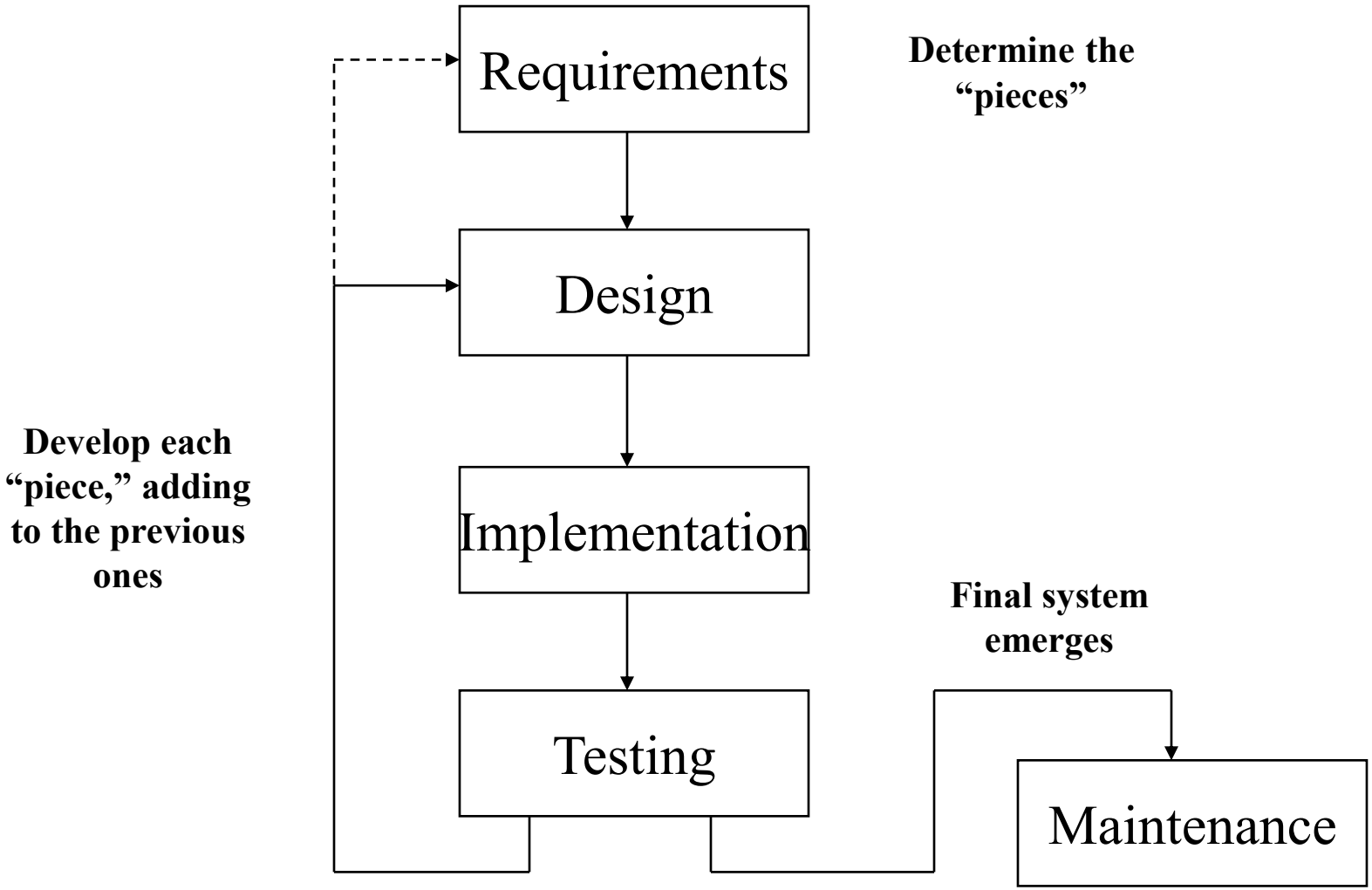


Observations

- Each loop in the spiral represents a phase in the process.
- Is **iterative**
- **Risks** are explicitly assessed and resolved throughout the process.
- Uses **prototyping**

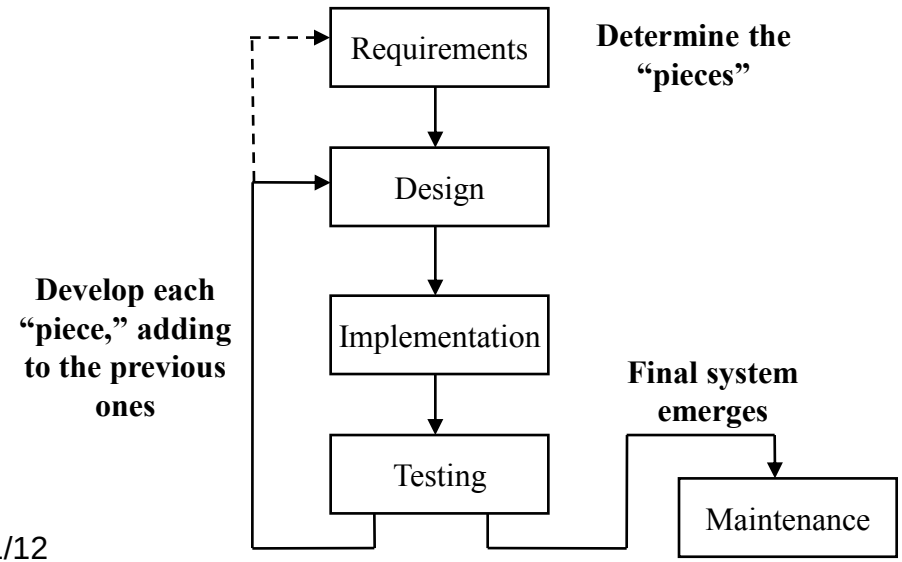


Iterative and Incremental Development (IID)

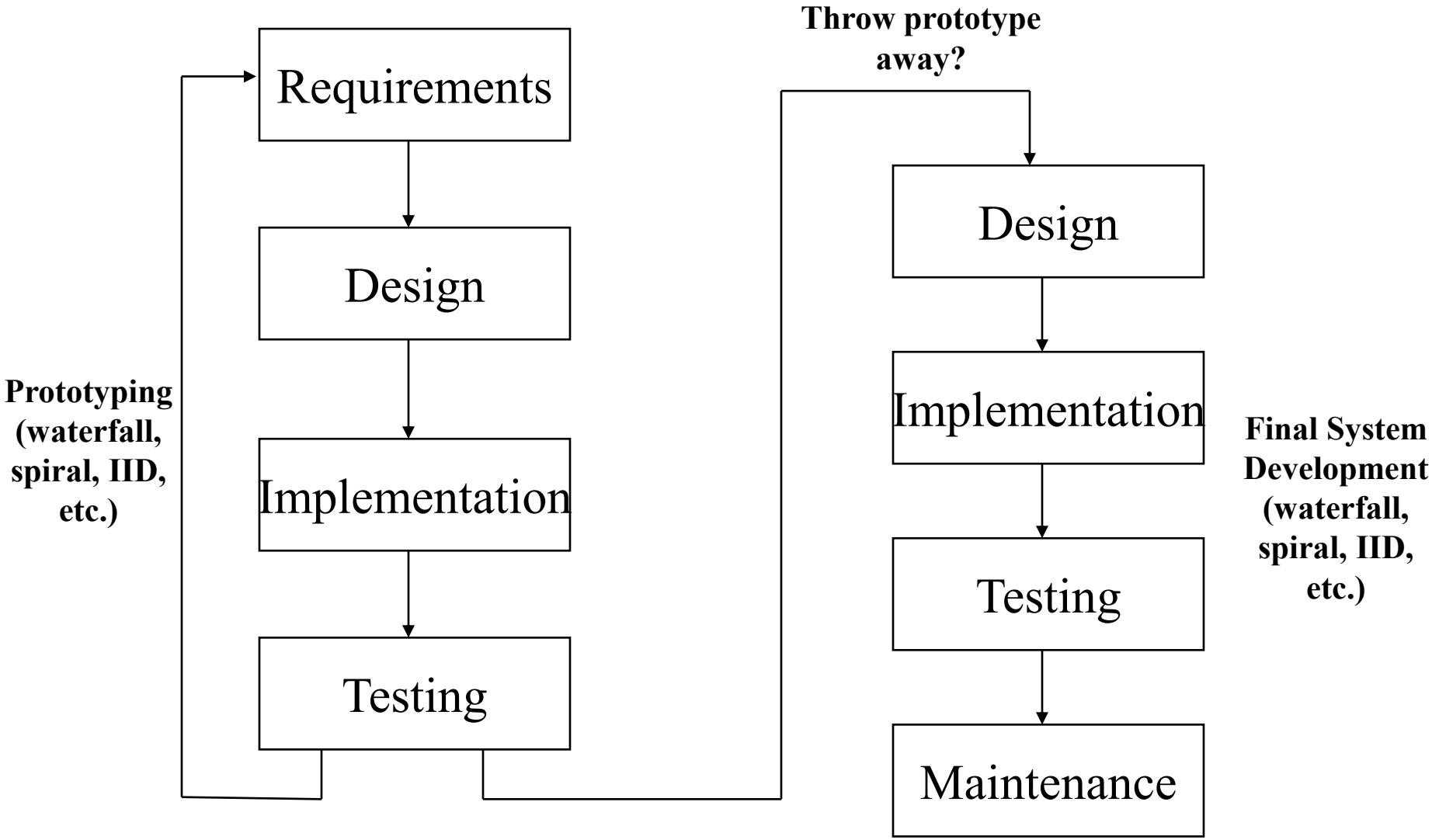


Observations

- Contains all phases of the SDLC
- Development and delivery is broken down into functional increments (“pieces”)
- The increments are prioritized
- Is an **iterative, incremental** process
- Common to deploy at the end of each iteration

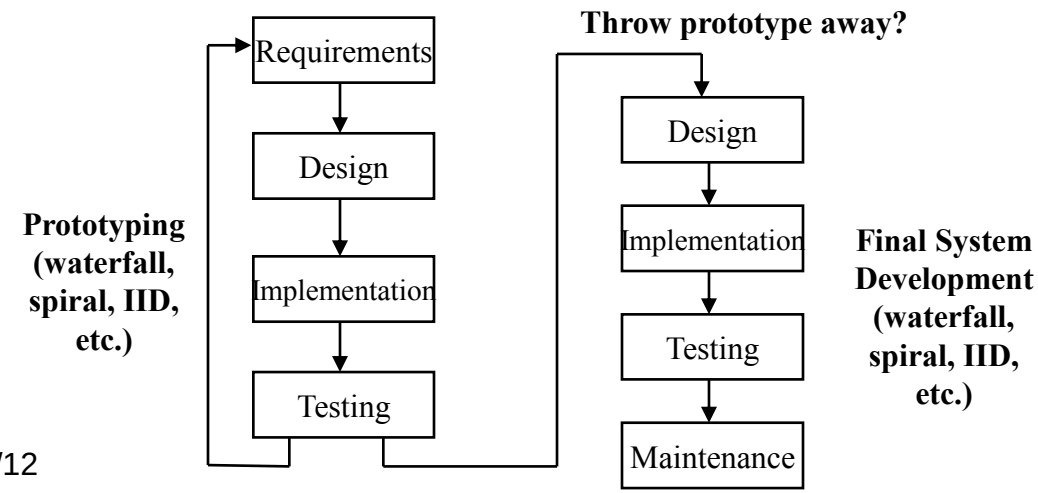


Prototyping



Observations

- Contains all phases of the SDLC
- Terrific requirements elicitation and validation technique
- There is always a “working” model (prototype) of the final system
- Is an **iterative** process
- Prototype can be thrown away (**throwaway prototyping**) or evolved into the final system (**evolutionary prototyping**)



Software Processes

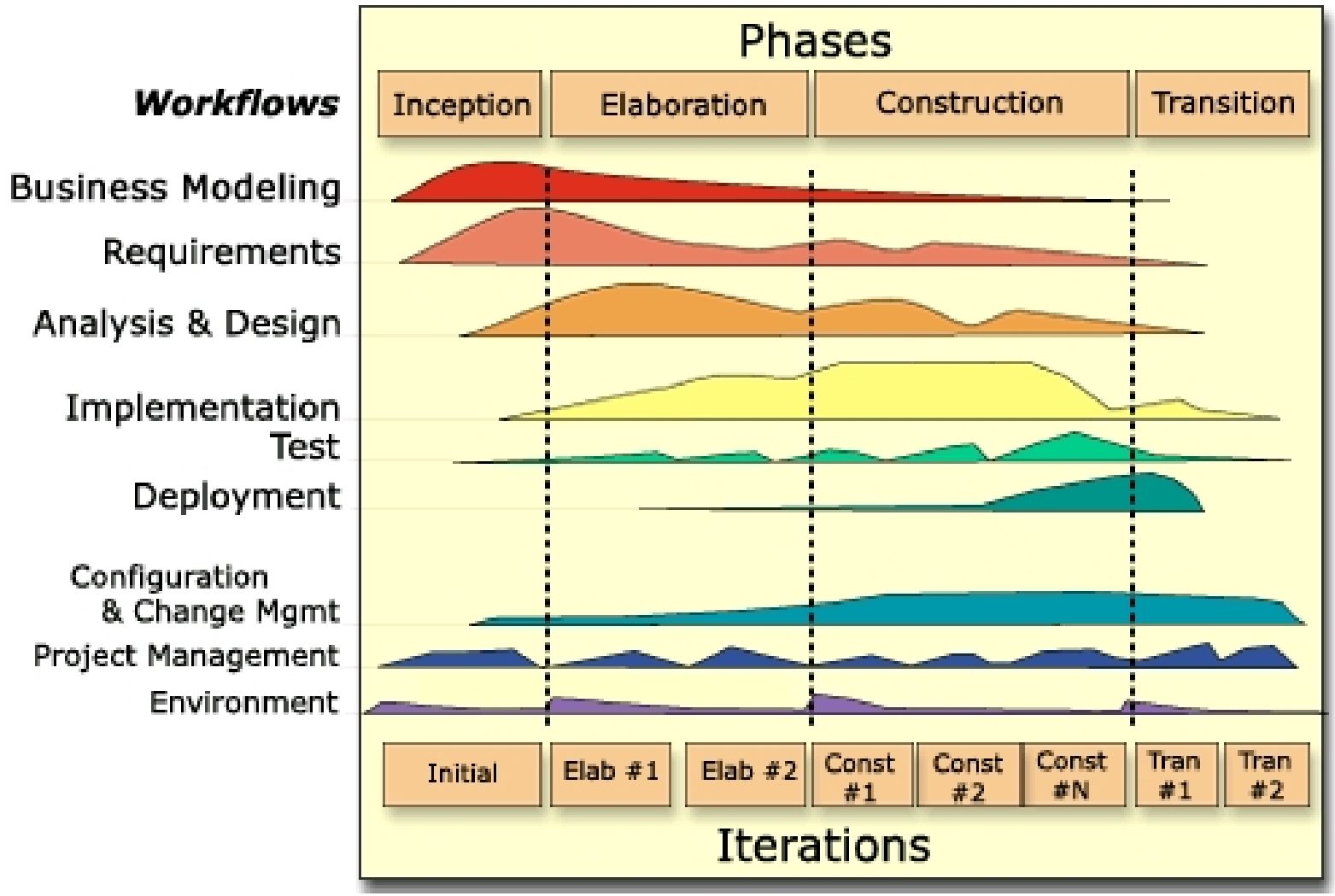
- Rational Unified Process (RUP) (’90’s)
- Agile processes (late ’90’s)
  - Scrum
  - Extreme Programming (XP)
- Customized

Rational Unified Process (3)

- Rational Unified Process (RUP)
  - Rational Software Corporation, now owned by IBM
    - "Three Amigos"
      - Grady Booch
      - James Rumbaugh
      - Ivar Jacobson
  - A popular type of Unified Process (UP)

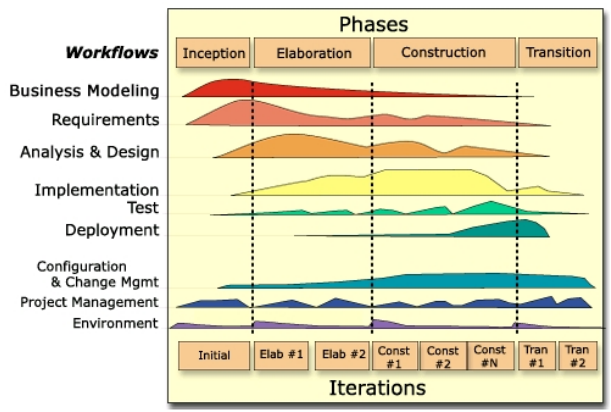
Rational Unified Process (1)

Rational Unified Process



Rational Unified Process (UP) (2)

- Set of activities (workflows), artifacts (e.g., documents, diagrams, code), and roles (e.g., architect, code reviewer, tester)
- Customizable generic process framework
- Characteristics
  - Use case driven (functional requirements)
  - Architecture-centric (system structure)
  - Iterative (cycles through “workflows”)
  - Incremental (incremental deliveries of a specified set of use cases)
- Makes extensive use of the Unified Modeling Language (UML)



Agile Processes

- Agile Manifesto (2001)
  - Emphasizes “lightweight” processes
  - Values
    - Individuals and interactions over processes and tools
    - Working software over comprehensive documentation
    - Customer collaboration over contract negotiation
    - Responding to change over following a plan
  - www.agilemanifesto.org
  - SD Magazine, *The Agile Manifesto*, August 2001
- Some agile processes
  - Scrum
  - Extreme Programming (XP) (Is it a process?)

Scrum (1)

Rugby – A way of restarting the game after an infringement or after the ball goes out of play

Scrum (2) [Reference: Schwaber & Beedle]

- "Scrum is superimposed on and encapsulates whatever engineering practices already exist."
- Roles
  - Scrum Master
    - Responsible for ensuring that Scrum values, practices, and rules are enacted and enforced
    - Represents management and the team to each other
    - Responsible for the success of the Scrum
  - Product Owner
    - Solely controls the Product Backlog
  - Scrum Team
    - Commits to achieving a Sprint goal
    - Accorded full authority to do whatever it decides is necessary to achieve the goal
    - Responsible for doing all of the analysis, design, coding, testing, and user documentation
    - Self-organizing, cross-functional
  - Stakeholders
    - Customers, vendors, others

Scrum (3)

- Some Tasks
  - Daily Scrums
    - What the team has accomplished since the last meeting
    - What it is going to do before the next meeting
    - What obstacles are in its way
  - 30-day Sprints
    - Sprint planning meeting
    - Sprint goal
    - End-of-Sprint review
- Some Artifacts
  - Product Backlog
    - An evolving, prioritized queue of business and technical functionality that needs to be developed into a system.
  - Release Backlog
    - The subset of the Product Backlog that is selected for a release.
  - Sprint Backlog
    - Tasks that the Scrum Team has devised for a Sprint.

Extreme Programming (XP) (1)

- Basic principles (Beck)
  - Rapid feedback
  - Assume simplicity
  - Incremental change
  - Embracing change
  - Quality work

Extreme Programming (XP) (2)

- Practices
  - The planning game
  - Small releases
  - Metaphor
  - Simple design
  - Testing
  - Refactoring
  - Pair programming
  - Collective ownership
  - Continuous integration
  - 40-hour week
  - On-site customer
  - Coding standards

Customized Processes

- Sometimes (usually?) it's best to "pick and choose"
- Questions to ask:
  - Is there a required process?
  - Are the requirements well-understood?
  - What else? (Think about this on your own.)

Assessing Process (1)

- Software “crisis” in the 1960’s, ’70’s, ’80’s
  - Over budget
  - Over schedule
  - Poor quality
- Software Engineering Institute (SEI)
  - Carnegie Mellon University
  - Federally-funded, non-profit research and development center
  - Consortium of academia, government, and industry
  - Mission: to “advance the practice of software engineering” (from www.sei.cmu.org)

Assessing Process (2)

- SEI Capability Maturity Model (CMM), 1991
  - Provides guidance for software process improvement
  - Also a method for assessing the maturity of an organization's software process
- Capability Maturity Model Integration (CMMI), 2002
  - Successor to CMM
  - Version 1.2, released August 2006
  - Five levels of process "maturity"
    - Incomplete
    1. Initial (ad hoc)
    2. Managed (can repeat earlier successes)
    3. Defined (standardized and documented process)
    4. Quantitatively Managed (software process metrics gathered)
    5. Optimizing (continuous process improvement)
  - Is not a specific process
  - Is process-independent

Assessing Process (3)

- Some government agencies and other organizations require contractors to have achieved a specific minimal CMMI level
- Other standards and certifications:
  - ISO 9000 (International Organization for Standardization)
    - A family of standards
    - Can be certified as “ISO 9000 compliant”
  - Six Sigma
    - Originally developed by Motorola
    - Origins in quality (defect) control in manufacturing
    - Various certifications

CMSC 345 Process (1)

- Linear process. Why?
  - First time through the entire life cycle
  - Semester is very short
  - I must give you hard deadlines
- Probably will have to integrate some iteration into the process
- Prototyping **strongly** recommended
  - For requirements elicitation
  - Keep your customer informed (and happy!)

References (1)

- Boehm, Barry, A Spiral Model of Software Development and Enhancement, *IEEE Computer*, 21(5):61-72, May 1988.
- Beck, K., *Extreme Programming Explained*. 2000, New York: Addison-Wesley.
- *Capability Maturity Model: Guidelines for Improving the Software Process*, ed. C.M.U. Software Engineering Institute. 1995, New York: Addison-Wesley.
- Fowler, M. and J. Highsmith, *The Agile Manifesto*, in *Software Development Magazine*, August 2001.
- International Organization for Standardization, http://www.iso.ch/iso/en/ISOOnline.frontpage
- Jacobson, I., G. Booch, and J. Rumbaugh, *The Unified Software Development Process* 1999, New York: Addison-Wesley.

References (2)

- Kruchten, P., *The Rational Unified Process: An Introduction*. 3rd ed. 2003, New York: Addison-Wesley.
- Manifesto for Agile Software Development**,** www.agilemanifesto.org
- Royce, Winston, Managing the Development of Large Software Systems: Concepts and Techniques, in *WESCON Technical Papers*, 1970, reprinted in *The Proceedings of the Ninth International Conference on Software Engineering*, 1987, pp. 328-338.
- Scott, K., *The Unified Process Explained* 2001, New York: Addison-Wesley.
- Schwaber, K. and M. Beedle, *Agile Software Development with SCRUM.* 2001, Prentice Hall.
- Software Engineering Institute (SEI), www.sei.cmu.edu
- Software Engineering Institute CMMI Website, http://www.sei.cmu.edu/cmmi/