Software Methodologies & Life Cycles

Software "Methodology"

HOW TO design and develop software

Historical Perspective

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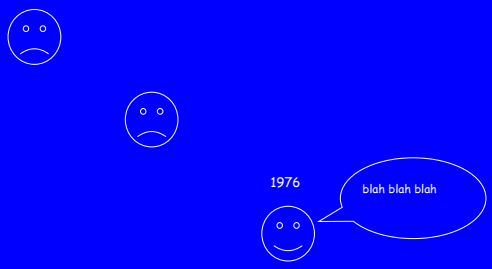


Last time

Software design/development is a "wicked problem"

Outline

- Methodologies
- Historical Perspective
- Essential processes of software development
- Life-cycle models
- Methodologies (NEXT TIME)

Essential Processes of Software Development

- Build the software

Essential Processes of Software Development

- **What is the software supposed to do?**
- **How should it do it?**
- Build the software
- **Does it work?**

Essential Processes of Software Development

- **Requirements Elicitation, Analysis, and Specification**
- **Design**
- **Implementation**
- **Test: Unit, Integration, System, Acceptance**

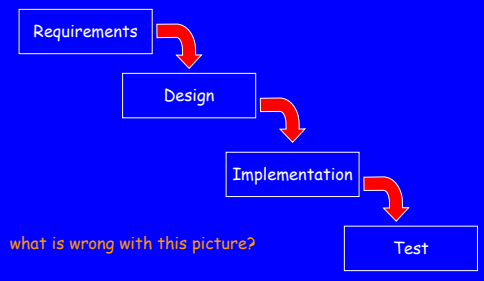
Processes of Software Development

- **Feasibility**
- **Requirements**
- **Design**
- **Implementation**
- **Test**
- **Deployment**
- **Maintenance**

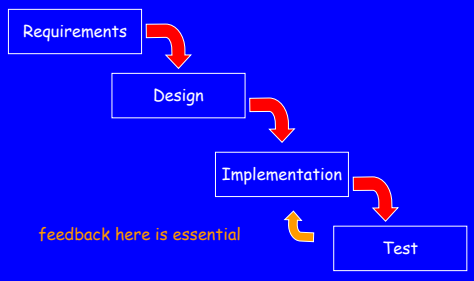
Life Cycle Models

A "Software Life-Cycle Model" specifies when the processes are conducted and how they feed into each other.

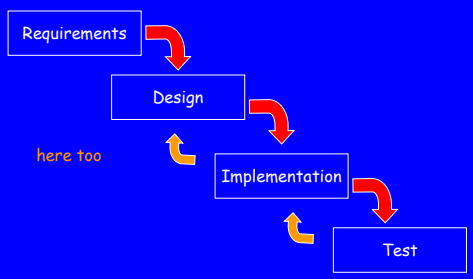
Waterfall Model



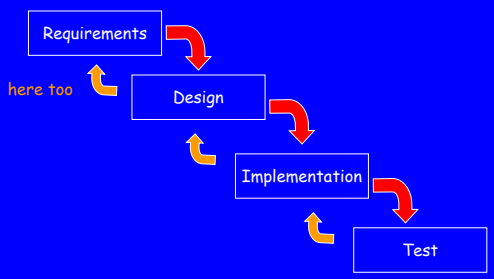
Waterfall Model



Waterfall Model



Waterfall Model with Backflow



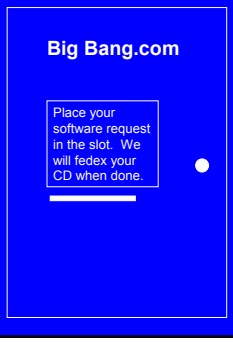
"Life-Cycle" Models

- Single-Version Models
- Multiple-Version Models

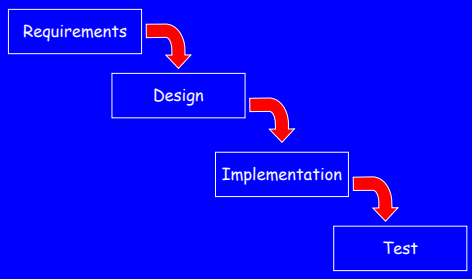
Single version models

- Big Bang
- Waterfall
- Waterfall with backflow
- V model

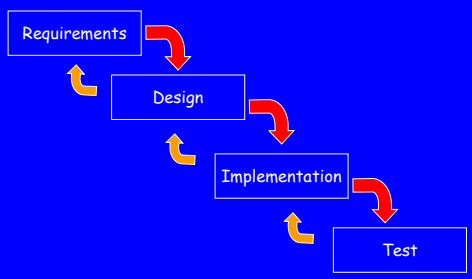
Big Bang Model



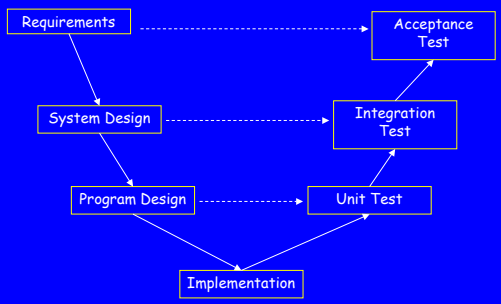
Waterfall Model



Waterfall Model with Backflow



"V" Model



"Life-Cycle" Models

- Single-Version Models
- Incremental/Iterative Models

Iterative vs. Incremental

- Iterative: re-do project in each stage
  more general
- Incremental: add to project in each stage

Iterative Development

- In each iteration:
  - Identify the largest risks of the project
  - Brainstorm on ways to reduce or eliminate these risks
  - Form a concrete plan with specific artifacts
  - Carry out the plan

Risk Driven Design/Development

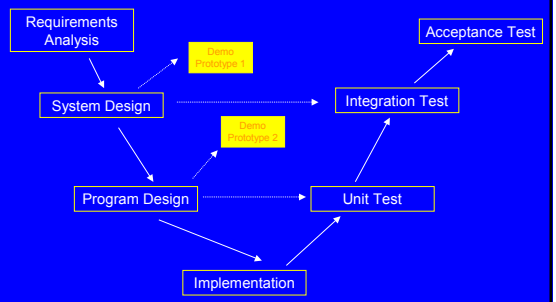
- Better to find out about infeasible, intractable, or very hard problems early.
- Better to discover flaws early.
- The easy parts will be worthless if the hard parts are impossible.

Iterative/incremental "Life-Cycle" Models

- Sawtooth Model
- Spiral Model & Variants
  - Controlled Iteration Model: Unified Process
  - Time Box Model
- Scrum

Sawtooth Model

(extension of V model)

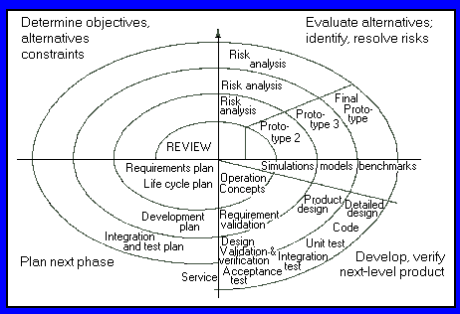


Boehm Spiral Model

Iterates cycles of these project phases:

1. Requirements definition
2. Risk analysis
3. Prototyping
4. Simulate and benchmark
5. Design, implement, and test
6. Plan next cycle (if any)

Boehm Spiral Model

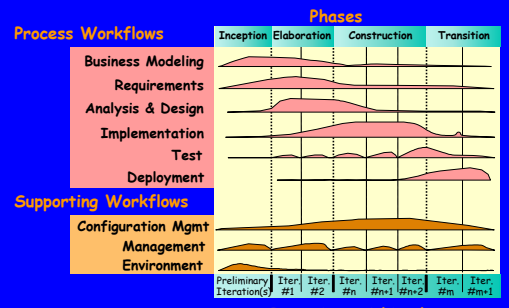


Controlled-Iteration Model

- Four phases per iteration
  - **Inception**: Negotiate and define product for this iteration
  - **Elaboration**: Design
  - **Construction**: Create fully functional product
  - **Transition**: Deliver product of phase as specified
- The next phase is started **before** the end of the previous phase (say at 80% point).

Rational Unified Process

(a form of controlled iteration)



Time-Box Requirement

- Requirements analysis
- Initial design
- while(not done)

  {
  Develop a *version* **within a bounded time**
  Deliver to customer
  Get feedback
  Plan next version
  }

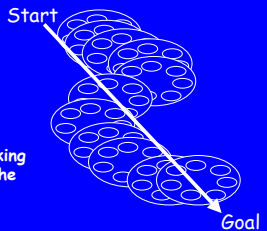
Scrum, A cure for Wicked?

Scrum first mentioned in
"The New New Product Development Game" (Harvard Business Review 86116:137-146, 1986)

Scrum Model

(incremental model,
includes some aspects of team structure, as well as process)

A small group is responsible for **picking up the ball and moving it toward the goal.**



Argument for the Scrum Model over other iterative models

- A software development project might not be compartmentalizable into nice clean phases as the Spiral models suggest.
- Scrum may be "just the thing" for wicked problems, because the team can quickly react to new information.

Some Principles of Scrum Model

- **Always have a product** that you can theoretically ship: "done" can be declared at any time.
- **Build early, build often**.
- **Continuously test** the product as you build it.
- **Assume requirements may change**; Have ablility to adapt to marketplace changes during development.
- **Small teams** work in parallel to maximize communication and minimize overhead.

Use of Iteration in Scrum

http://www.controlchaos.com/scrumwp.htm

- Each **iteration** consists of all of the standard Waterfall **phases**,
- *but* each iteration only addresses **one set of functionality**.
- Overall project deliverable has been **partitioned** into prioritized subsystems, each with clean interfaces.
- **Test the feasibility** of subsystems and technology in the initial iterations.
- Further iterations can **add resources** to the project while ramping up the speed of delivery.
- **Underlying development processes are still defined** and linear.

When to use single version?

- IMHO: For simple projects!

When not to use single version?

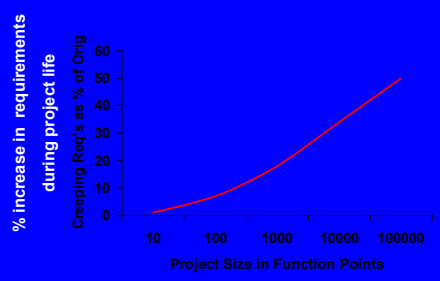
- IMHO: For everything else!

Note: some might disagree, e.g. Budgeon

Why not single-version?

- Initial requirements are *speculative*

Growth in requirements



Source: Applied Software Measurement, Capers Jones, 1997. Based on 6,700 systems.

Why not single-version?

- Initial requirements are *speculative*
- Initial designs are *speculative*

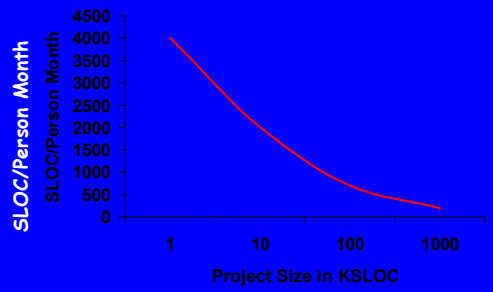
Software is "hard"

- Software is very "hard".
  Discover Magazine, 1999: Software characterized as the most complex "machine" humankind builds.

Why not single-version?

- Initial requirements are *speculative*
- Initial designs are *speculative*
- Speculative decisions compound in absence of feedback

Which may explain this: Decrease in Productivity



Source: Measures For Excellence, Putnam, 1992. Based on 1,600 systems.

Why not single-version?

- Initial requirements are *speculative*
- Initial designs are *speculative*
- Speculative decisions compound
- High complexity/low adaptability
- High risk issues identified/addressed late in the life cycle