# Software development activities

- Note “activities” – not “steps”
  - Often happening simultaneously
  - Not necessarily discrete

1. Planning: mostly study the requirements
2. Domain analysis: study the problem area
3. System design: devise computer solution
4. Implementation: write the code
5. Testing, documentation, maintenance, …

# Software engineering

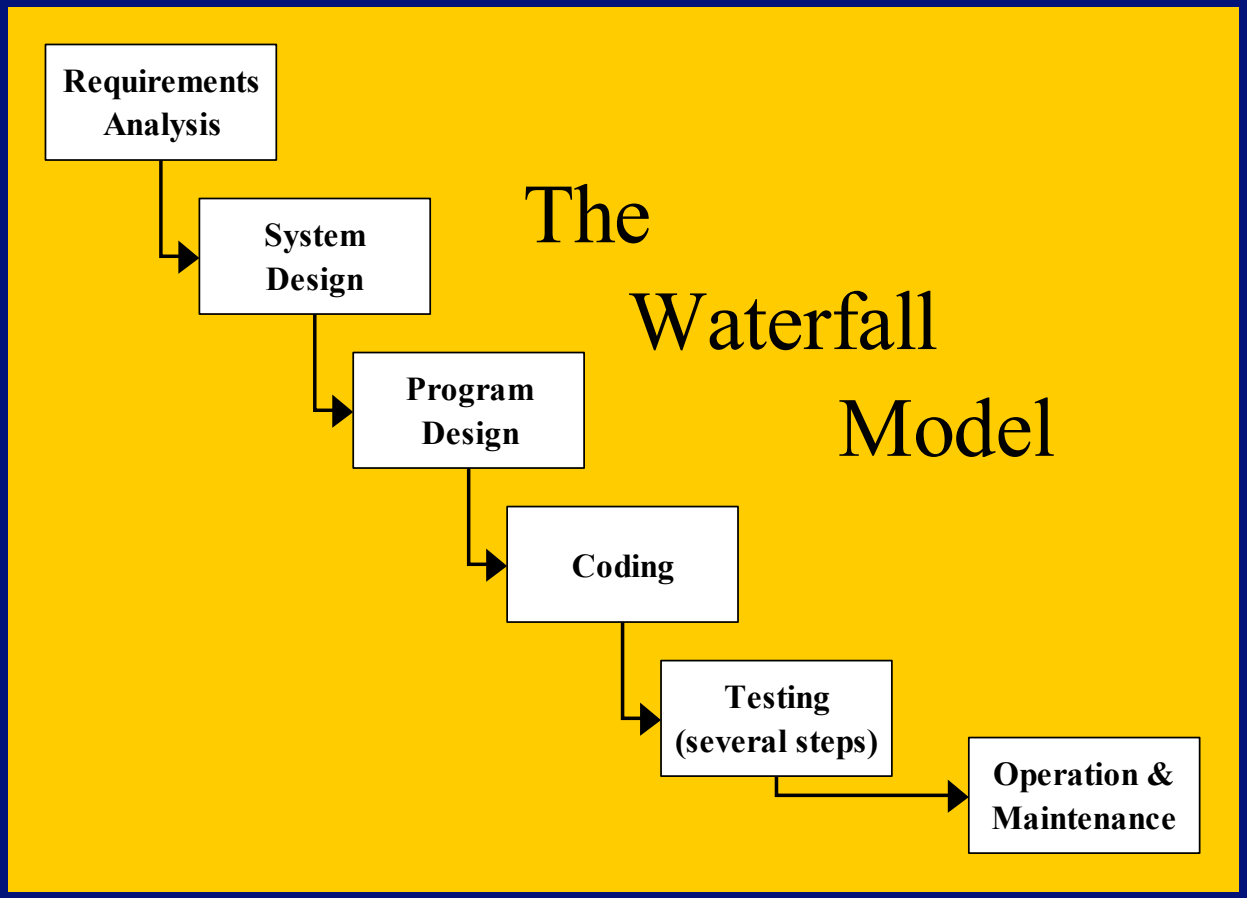
- A subset of system engineering
- Covers all software development activities, planning through maintenance
- Also includes various management tasks
  - Determine project roles, and assign personnel
  - Create and monitor development schedules
  - Some client relations and customer support
- Guided by CS theory
  - But really just heuristics, and often ad hoc

# Professional, ethical responsibility

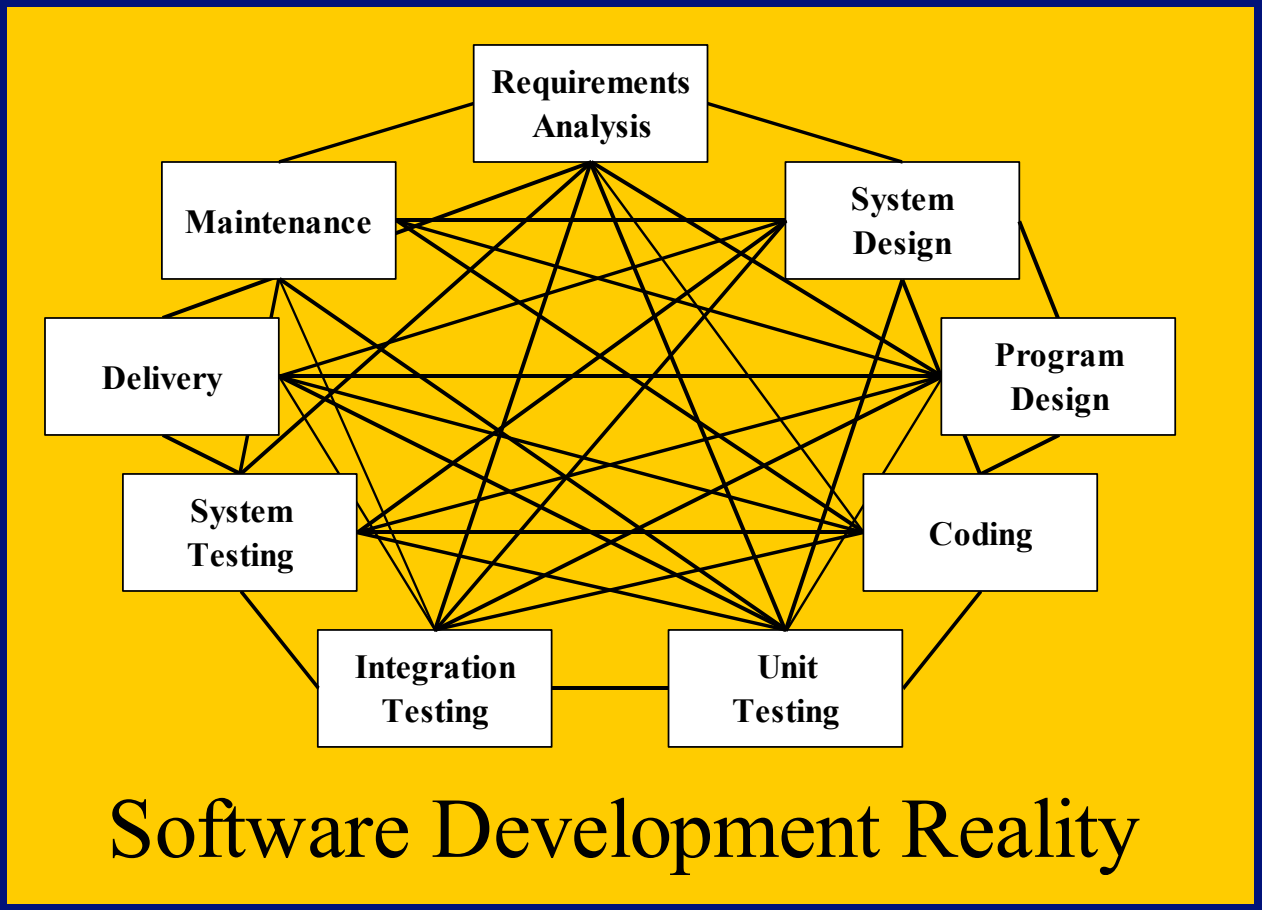
- Above all, do no harm! (Hippocratic Oath)
  - NO VIRUSES or other malicious programs
  - Avoid inventing "the bomb" or a plague, or …
- Basically demonstrate *loyalty* to employer, clients, co-workers, country, humanity, …
- See "Software Engineering Code of Ethics and Professional Practice" by ACM/IEEE-CS at https://www.acm.org/about-acm/code-of-ethics

# Development process modeling

- The classic:
- Step after step, after step, …
- Never back up

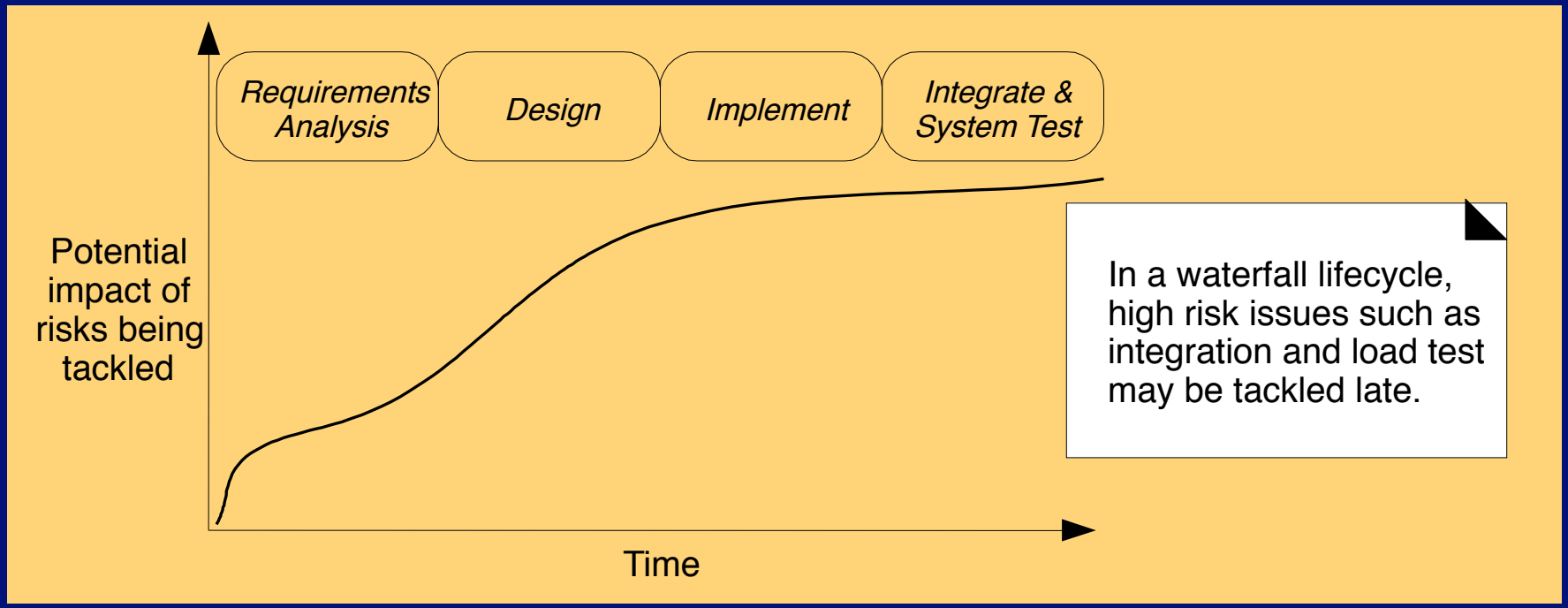


# Alternatives to waterfall model




- Okay, we all agree – this extreme doesn't work either
- Is there a middle ground?

# Considering risk




- Research conclusion: it is wise to do some implementing and testing early in the process

# Engineering the risk factor

- Spiral Model
  - Includes frequent risk analyses
- Frequent reevaluation during an extended planning stage

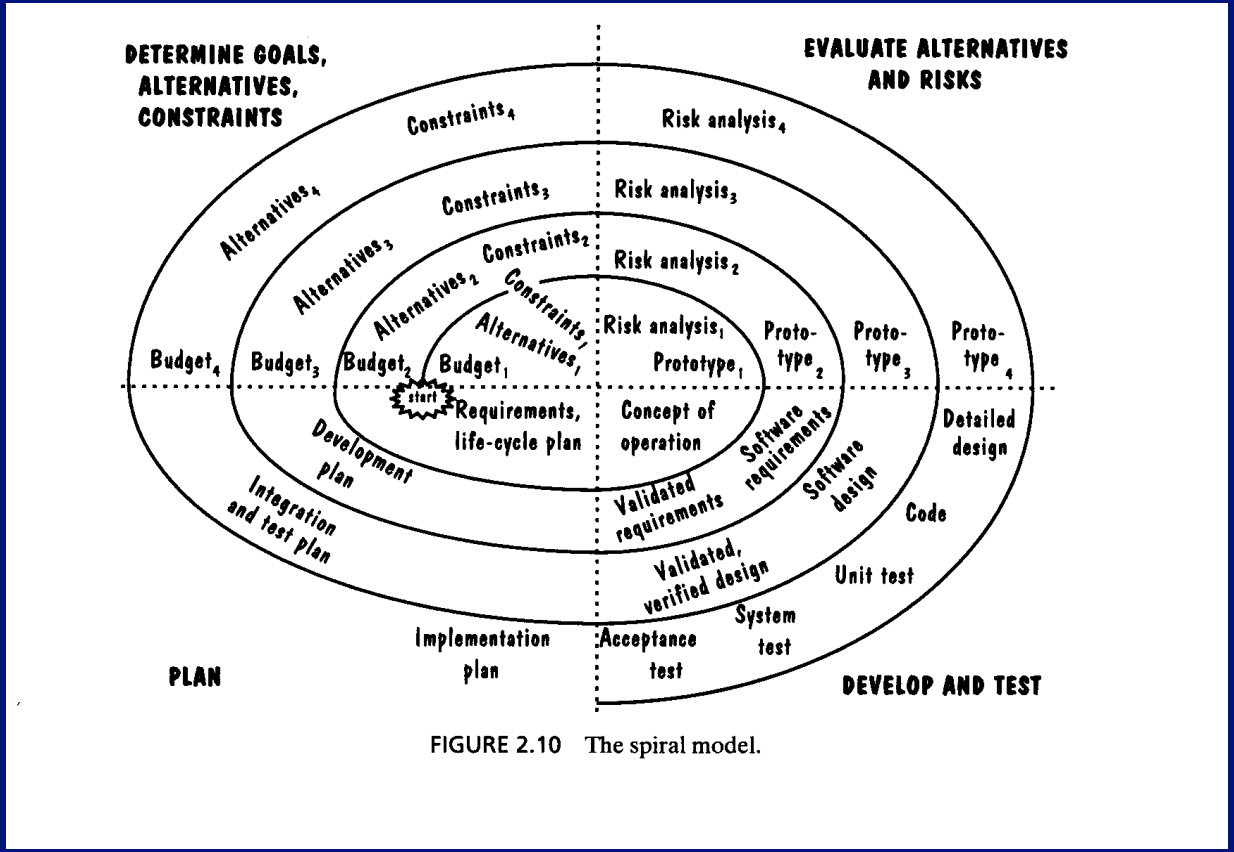
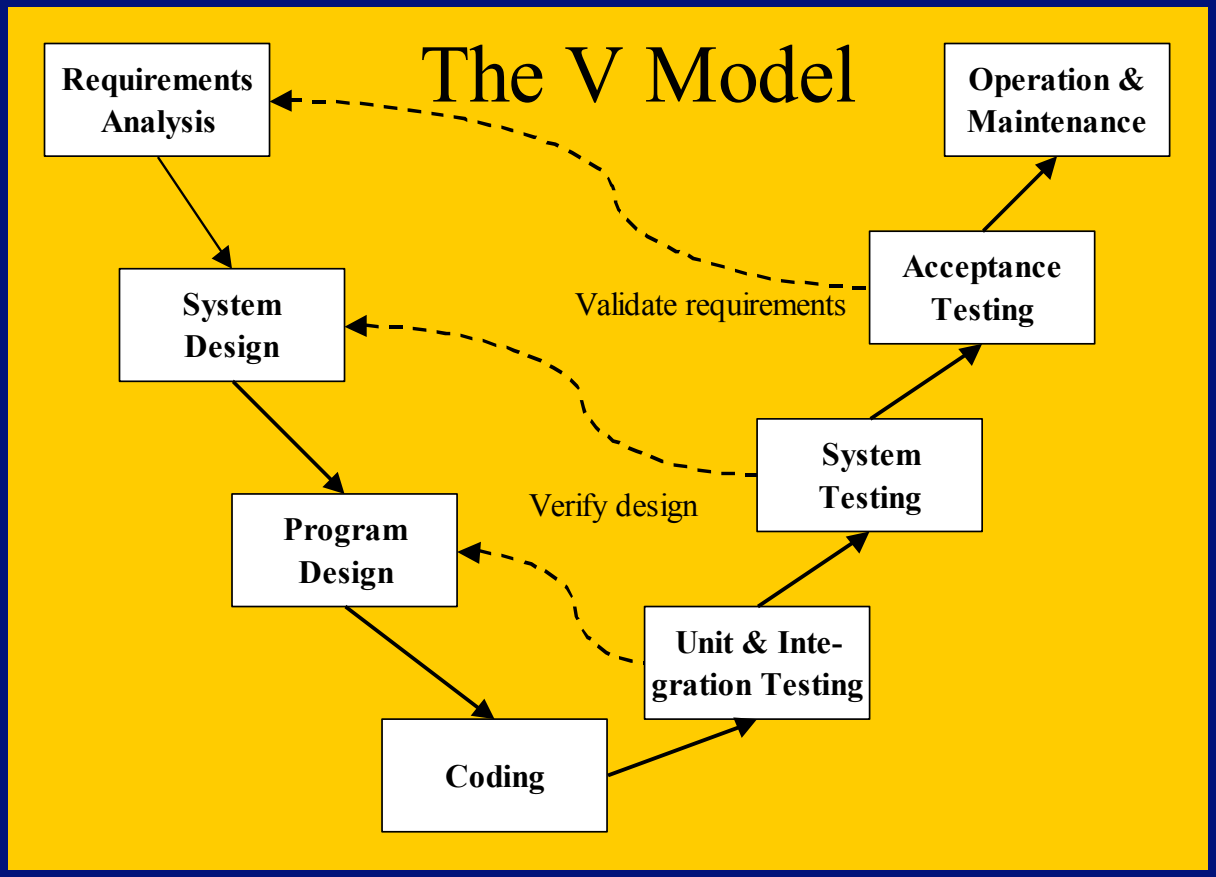



FIGURE 2.10 The spiral model.

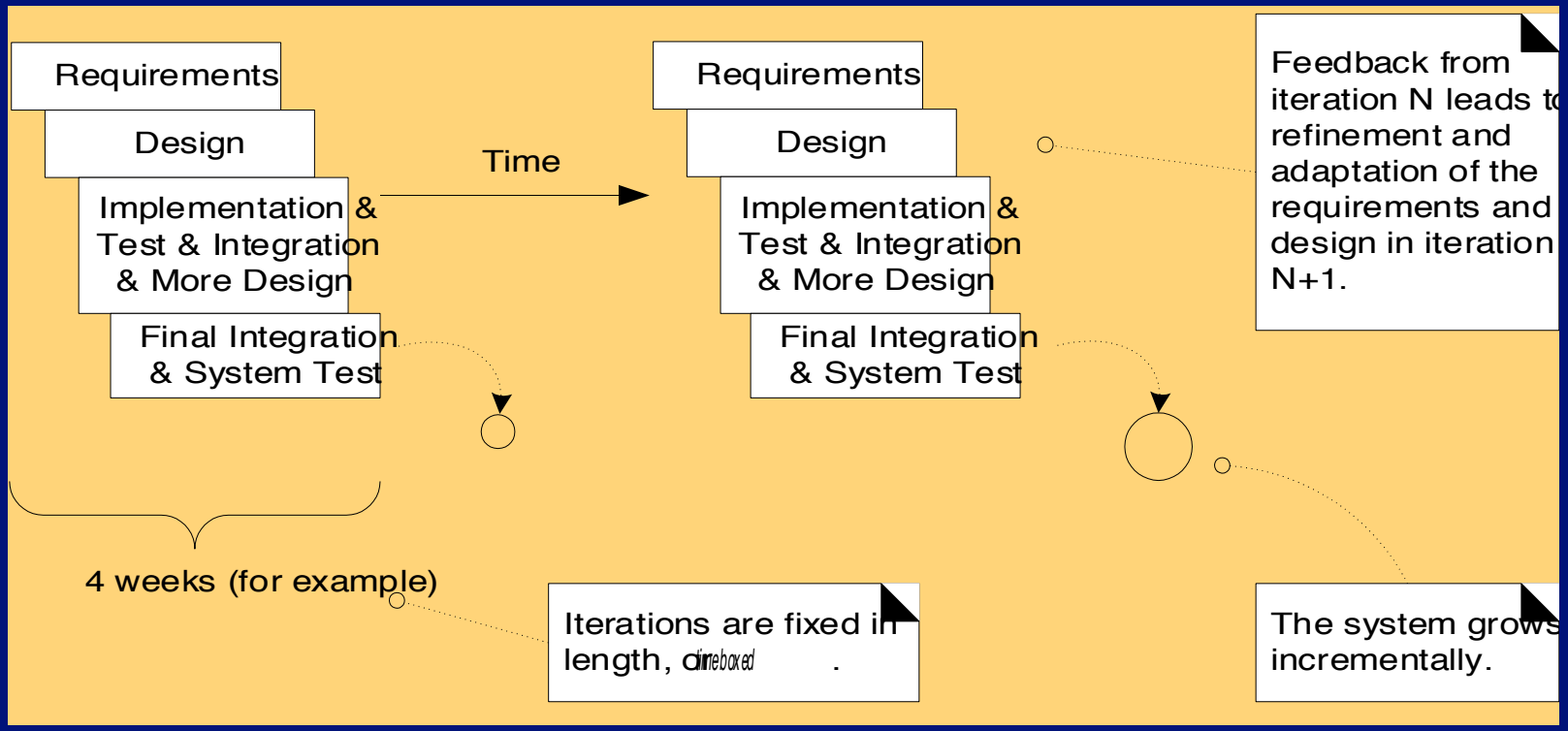
# Testing and iterating



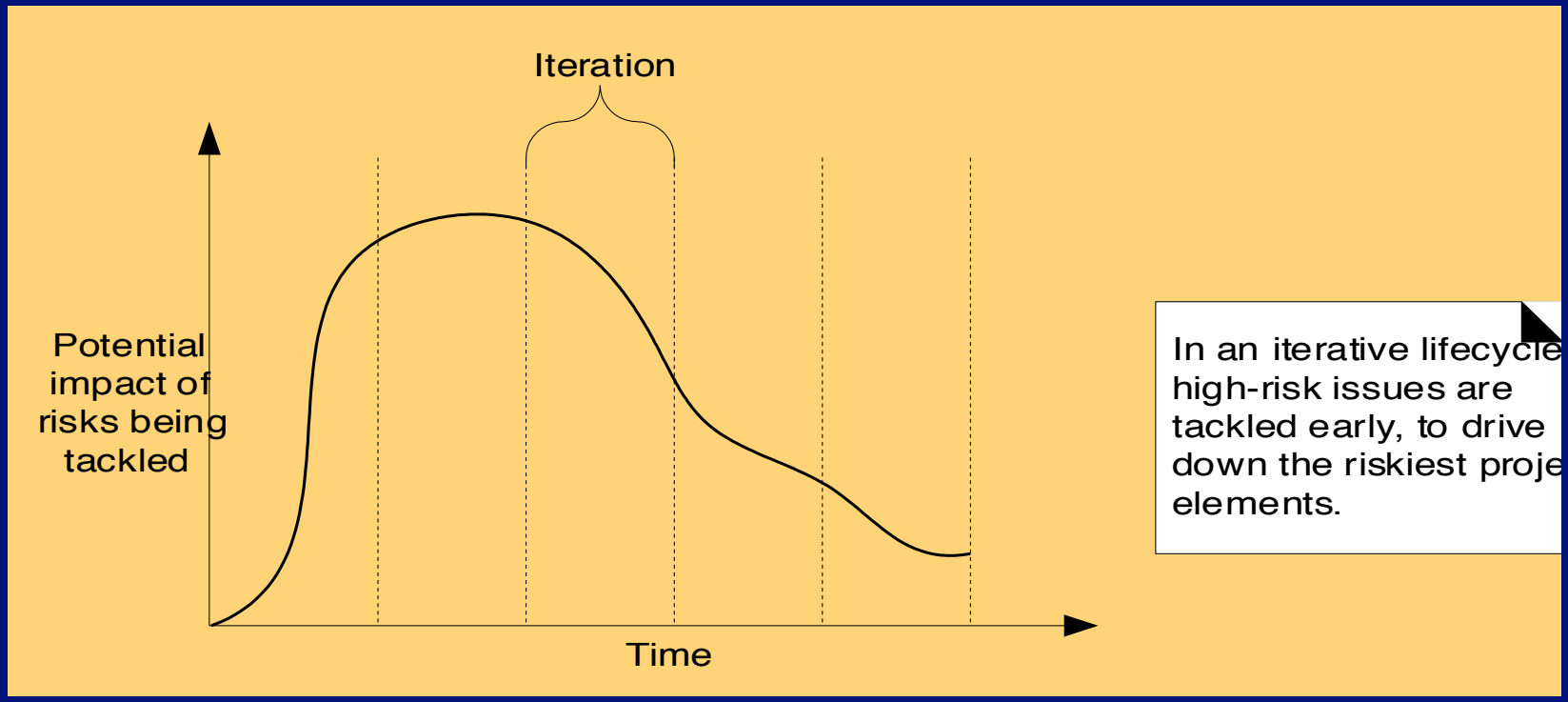

- Accounts for requirement changes and mistakes
- Key idea: plan to iterate
- But still a bit too rigid?

# Incremental / iterative process

- Hmmm … a hybrid that makes sense!



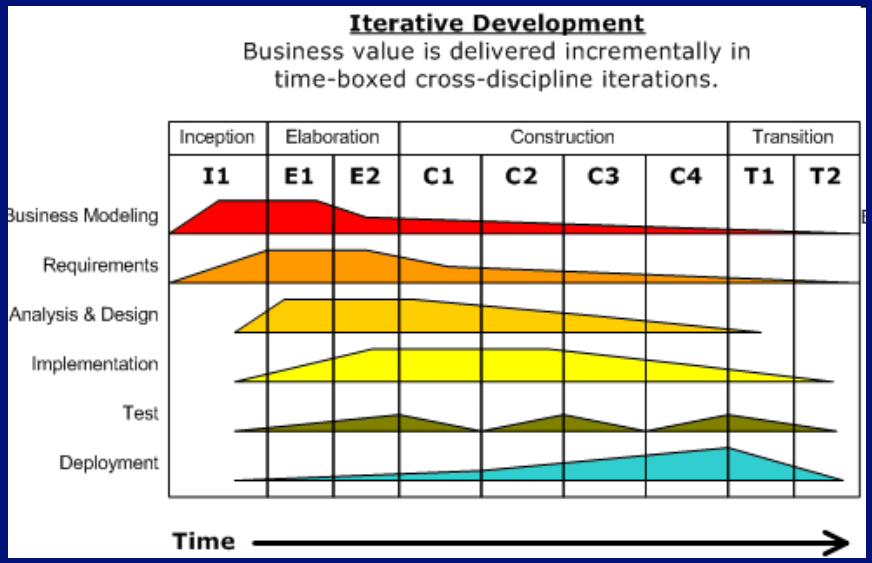
# Iterating reduces risk overall




- Especially if thorny issues are tackled early

# Unified Process (UP)

- By Rumbaugh, Jacobson, Booch, others
- Iterative and incremental through 4 phases
- Use case driven
- Architecture-centric
- Risk-focused
- UML-heavy
  - Static models
  - Dynamic models



# Agile Software Development

- Agility – observed to be a common feature of *successful* processes
- Different projects need different processes
- Generally better to focus on skills, communication, and community instead of processes
- Fruitful to consider it "a cooperative game of invention and communication" (Cockburn, 2002)
- See Agile Manifesto: http://agilemanifesto.org/
  - And related Principles of Agile Software

# Extreme Programming (XP)

- Very popular agile development process today
  - Started by Kent Beck, Agile Alliance member
- Mostly means adhering to some basic principles
  - Client representative on-site
  - Always practice pair programming
  - Perform constant, at least daily testing
  - Keep iterations short, and clearly time-boxed
  - Do frequent, incremental builds
- See www.extremeprogramming.org

# About OOA and OOD

- Means: analyzing and designing a system from an object perspective
  - System composed of objects or concepts
    - What things or ideas are involved?
    - How do objects/concepts interact?
- Means not: function-oriented
  - System composed of processes, functions
    - What to do, and how to do it?
    - Mostly worry about "flow of control"

**Catalog Library**
**Book Librarian**

- **Record loans**
- **Add resources**
- **Report fines**

# Doing OOA and OOD

- Not easy to do it well
  - But worth it for: big systems, big teams, long-term productivity (software reuse, etc.)
  - Takes skill: experience, practice, learning
- OOA – investigation of the problem
  - What must the system do?
  - Focus on learning the problem *domain*.
- OOD – find solution to the problem
  - How will system fulfill requirements?
  - Define logical software objects and associations to solve the problem.

# Tools for doing OOA and OOD

- UML – Unified Modeling Language
  - Standardized notation – now well accepted
- CASE tools – computer-aided software engineering tools (like "Rational Rose")
  - Getting highly sophisticated now
    - Can generate code from modeling diagrams
    - Can do reverse engineering, …
  - Not necessary for CS 48 (but could help with diagrams, and other requirements) – may cost $

# Start by not even thinking about programming

- *Try* to focus on domain concepts at first
  - Not software constructs (wait until design stage)
  - Avoids complexity overload
  - Design and eventual system will be better too!
- Create and maintain a steady stream of artifacts
  - Mostly pre-programming – diagrams, class specifications, glossary, …
  - Guides initial implementation, and aids subsequent modification, maintenance, and software reuse

# CS 48 development schedule

- Overview: a planning phase, followed by at least 2 complete development iterations – each iteration produces a working system
  - Call it "relaxed UP" reflecting agile principles
- Planning phase – Requirements Analysis
  - First be the client – describe the project
  - Then analyze the requirements
    - Itemize system functions and characteristics
    - Write use cases, and assign use cases to development iterations

# CS 48 schedule (cont.)

- Early iteration(s) –draft project (report and current system)
  - Analyze the domain pertinent to the iteration
    - Identify classes, class attributes, and associations
    - Identify system behavior (as a "black box")
  - Design the current system
    - Specify the way objects will behave and interact
    - Tie to other systems/tools as necessary
  - Implement and test
- Complete at least 1 more iteration – final project
  - Analyze/design/implement/test and update documents
    - Also demonstrate system to class during last week of quarter

# Next

Requirements Analysis