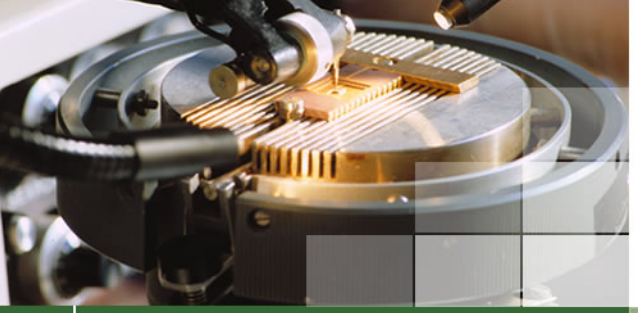


POLITECNICO DI MILANO

Dipartimento di
Elettronica e Informazione

Planning and Managing Software Projects 2014-15

Class 6

Planning Phase – Part 1

Project Phases and Lifecycle Planning

Emanuele Della Valle

http://emanueledellavalle.org

Credits

- This slides are largely based on Prof. John Musser class notes on “Principles of Software Project Management”
- Original slides are available at http://www.projectreference.com/
- Reuse and republish permission was granted

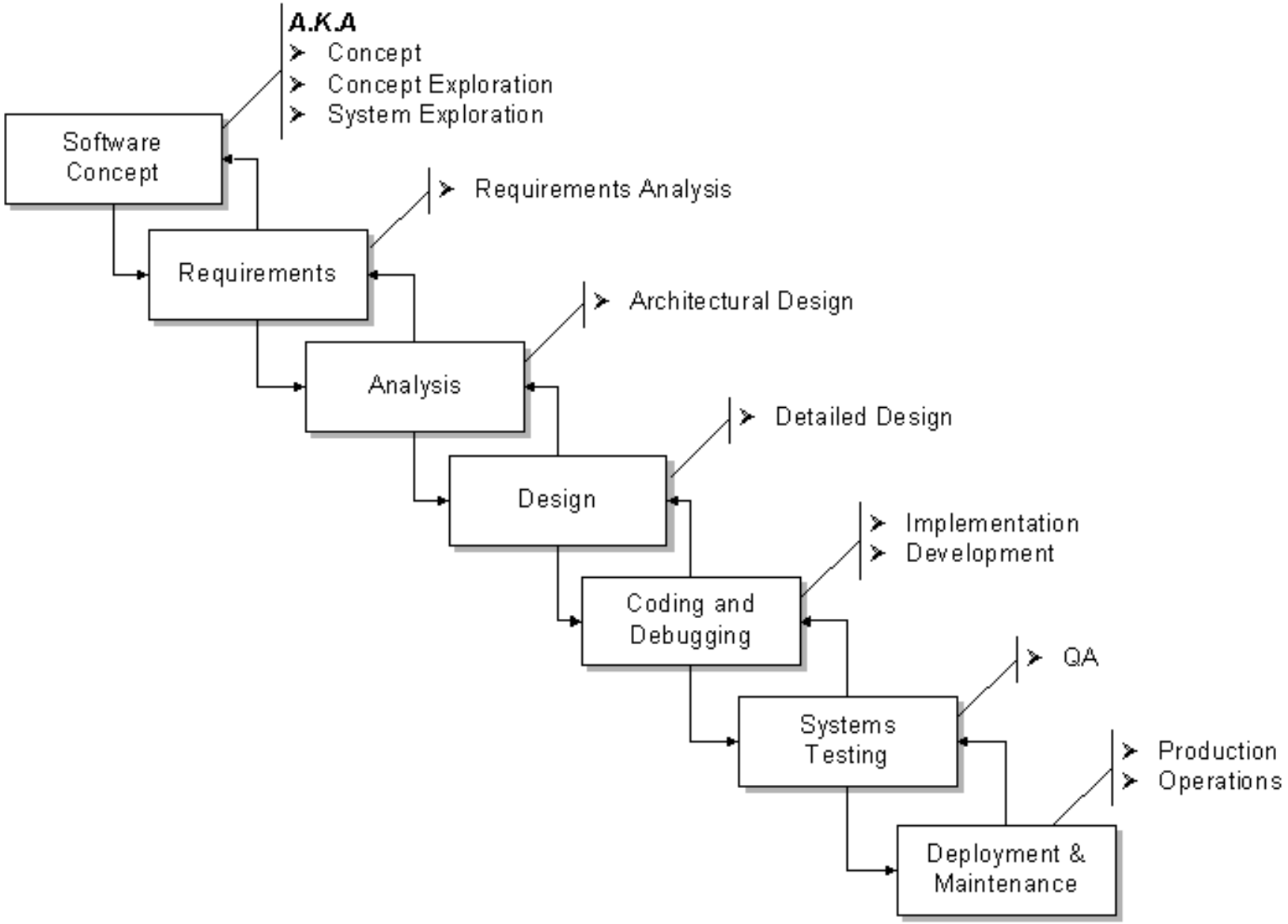
Today and Next Classes

- Today
  - Phases in Detail
    - Step-by-step of typical software project
  - Lifecycles
- Next Class
  - Matching Lifecycles to Project
  - Project plans
- Next Weeks:
  - Lots of Project-ish Details: WBS, PERT, CPM, Scheduling & Estimation

Class 3, 4 and 5 Review

- PMI Fundamentals
- PMI Processes
- Project and Organizations
  - Functional, Project, Matrix organizations
  - Role of PM in this type of organizations
- Project Selection
- Program Management (a.k.a., Project Portfolio Management)
- Procurement Management
- Initial documents
  - Statement of Work (SOW)
  - Project Charter

Project Phases



Time Allocation by Phase

- Remember the 40-20-40 Rule
  - Specification-Implementation-Test

	Planning	Code & Unit Test	Integration & Test
Commercial DP	25%	40%	35%
Internet Systems	55%	15%	30%
Real-time Systems	35%	25%	40%
Defense Systems	40%	20%	40%

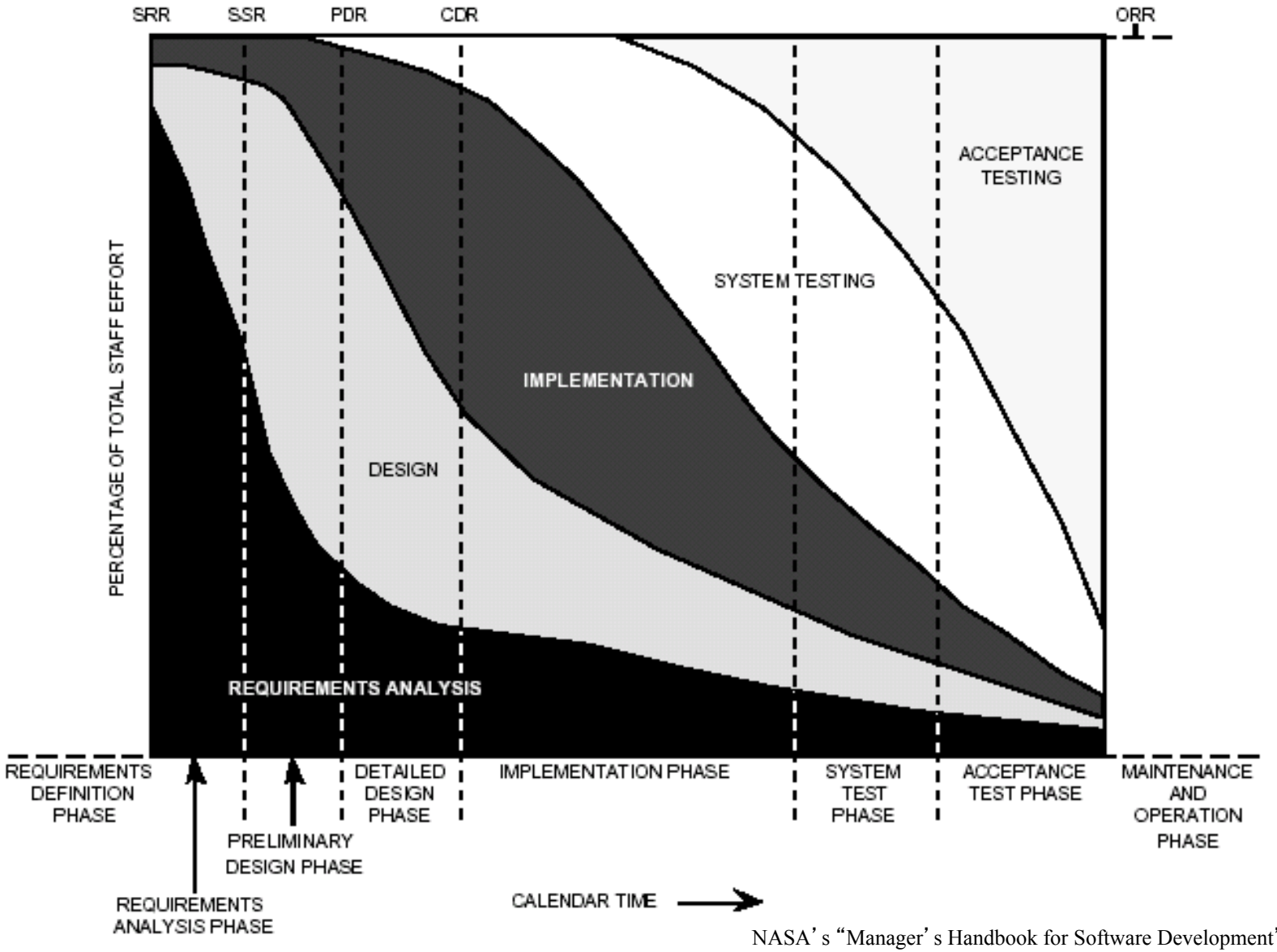
Bennatan, E.M, "On Time Within Budget"

Time Allocation by Phase

Activity	Small Project (2.5K LOC)	Large Project (500K LOC)
Analysis	10%	30%
Design	20%	20%
Code	25%	10%
Unit Test	20%	5%
Integration	15%	20%
System test	10%	15%

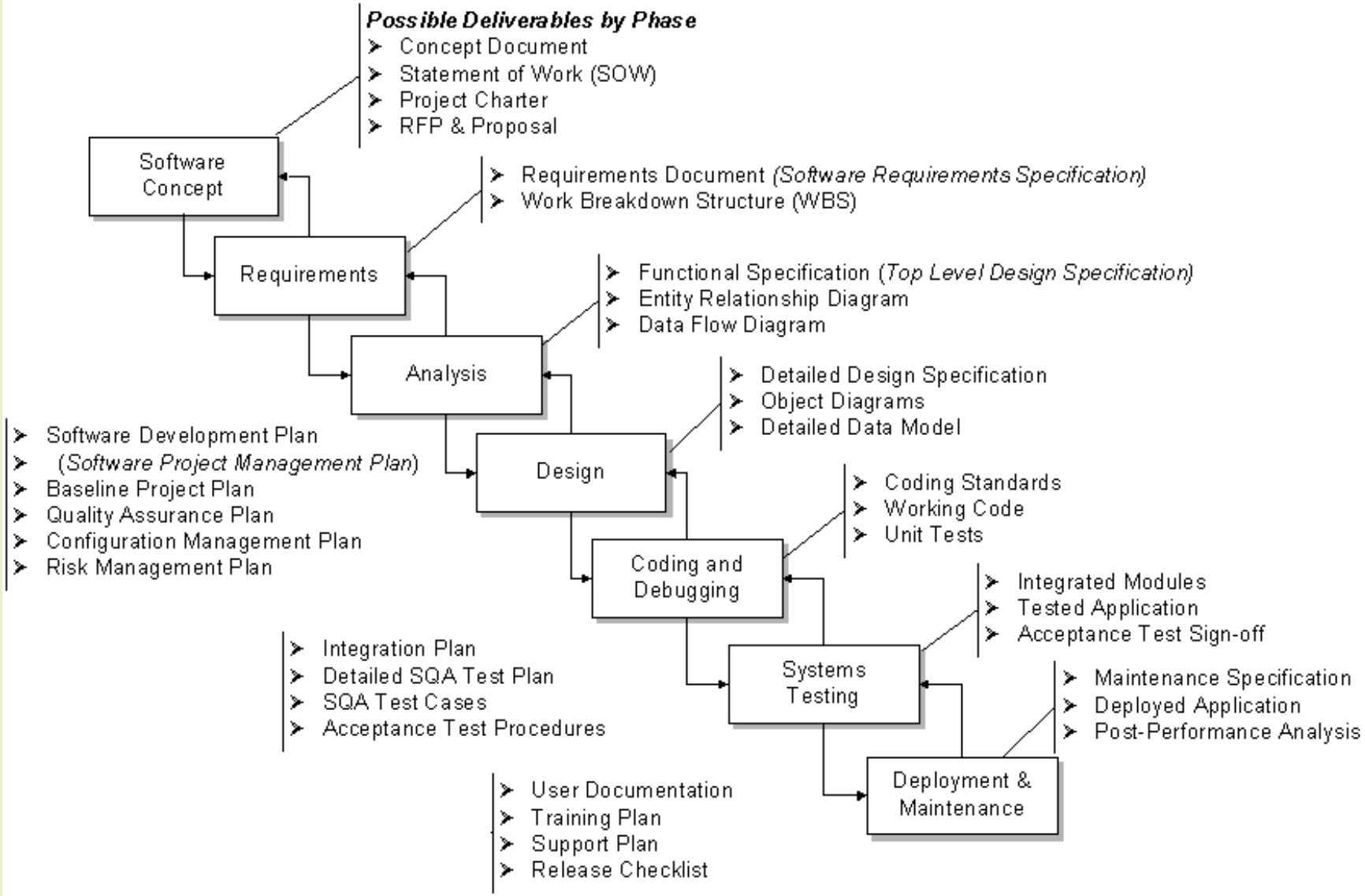
McConnell, Steve, "Rapid Development"

Activities by % of Total Effort



NASA's "Manager's Handbook for Software Development"

Potential Deliverables by Phase



Concept Exploration Phase 1/3

- The “Why” phase
- Not a “mandatory formal” phase
  - Sometimes called the “pre-project” phase
- Collecting project ideas
  - Then the “funneling” process
- Project Justification
  - Cost-benefit analysis
  - Project Portfolio Matrix
  - ROI
- Initial planning and estimates

Concept Exploration Phase 2/3

- Possibly includes Procurement Management:
  - RFP Process
  - Vendor selection
  - Contract management
- Gathering the initial team
  - Including PM if not already on-board
- Identify the project sponsor
  - Primary contact for approval and decision making
- Potential Phase Outputs:
  - Concept Document, Product Description, Proposal, SOW, Project Charter

Concept Exploration Phase 3/3

- Characteristics & Issues
  - Lack of full commitment and leadership
  - Some frustrations:
    - Management only getting rough estimates from development
    - Development not getting enough specifics from customer
    - Finding a balanced team
  - Budget sign-off may be your 1st major task as PM

- Achieved via:
  - Good concept document or equivalent
  - Demonstration of clear need (justification)
  - Initial estimates

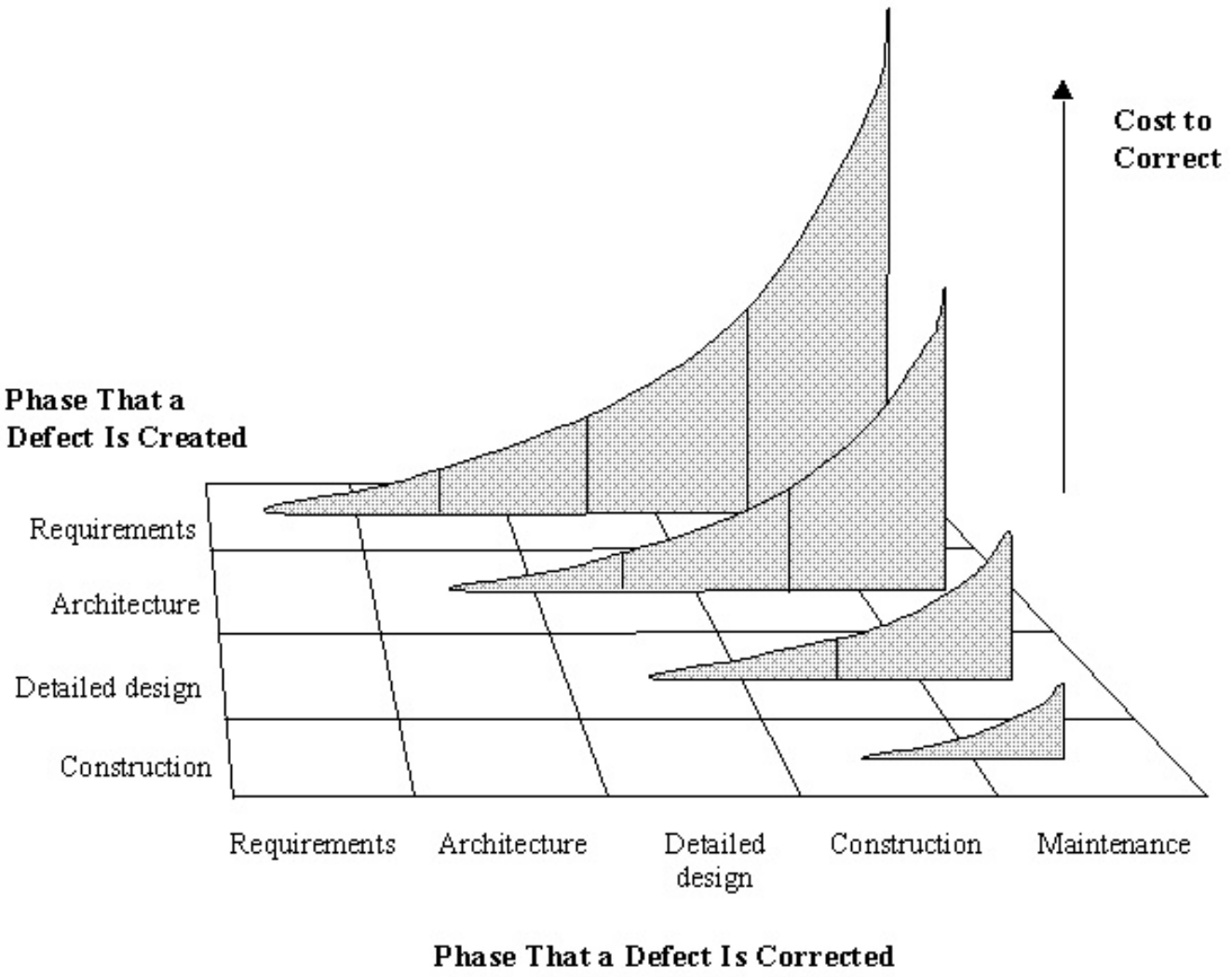
Requirements Phase

- The “What” phase
- Inputs: SOW, Proposal
- Outputs:
  - Requirements Document (RD)
    - a.k.a.Requirements Specification Document (RSD)
    - Software Requirements Specification (SRS)
  - 1st Project Baseline
  - Software Project Management Plan (SPMP)
  - Requirements Approval & Sign-Off
    - Your most difficult task in this phase

More on Requirements Phase

- Perhaps most important & difficult phase
- Shortchanging it is a ‘classic mistake’
- Can begin with a Project Kickoff Meeting
- Can end with a Software Requirements Review (SRR)
  - For Sponsor and/or customer(s) approval

Why are Requirements so Important?



Requirements - Characteristics & Issues

- Conflict of interest: developer vs. customer
- Potential tug-of-war:
  - Disagreement on Features & Estimates
  - Especially in fixed-price contracts
- Frequent requirements changes
- Achieving sign-off
- Project planning occurs in parallel

Requirements - Definition

- **Requirements are capabilities and condition to which the system** – more broadly, the project – **must conform**

2 Types of Requirements

- Functional (behavioral)
  - Features and capabilities
- Non-functional (a.k.a. “technical”) (everything else)
  - Usability
    - Human factors, help, documentation
  - Reliability
    - Failure rates, recoverability, availability
  - Performance
    - Response times, throughput, resource usage
  - Supportability
    - Maintainability, internationalization
  - Operations: systems management, installation
  - Interface: integration with other systems
  - Other: legal, packaging, hardware

Requirements

- Other ways of categorizing
  - Go-Ahead vs. Catch-up
    - Relative to competition
  - Backward-looking vs. Forward-looking
    - Backward: address issues with previous version
    - Forward: Anticipating future needs of customers
- Must be prioritized
  - Must-have
  - Should-have
  - Could-have (Nice-to-have: NTH)
- Must be approved
- An example I'm proud of
  - http://www.service-finder.eu/attachments/D1.1.pdf
    - You may find it a bit gold-plated, you may be right

Early Phases Meetings

- Project Kickoff Meeting
- Project Brainstorming Meeting
  - Clarify goals, scope, assumptions
  - Refine estimates
- WBS Meeting

Analysis & Design Phase

- The “How” Phases
- Inputs: Requirements Document
- Outputs:
  - Functional Specification
  - Detailed Design Document
  - User Interface Specification
  - Data Model
  - Prototype (can also be done with requirements)
  - Updated Plan (improved estimates; new baseline)

More on Analysis & Design Phase

- a.k.a. Top-level design & detailed design
- Continues process from requirement definition
- Ends with Critical Design Review (CDR)
  - Formal sign-off
  - Can also include earlier Preliminary Design Review (PDR) for high level design

Analysis & Design - Characteristics & Issues

- Enthusiasm via momentum
- Team structure and assignments finalized
- Delays due to requirements changes, new information or late ideas
- Issues around personnel responsibilities
- Unfeasible requirements (technical complexity)
- Resource Issues
  - Including inter-project contention

Development Phase

- The “Do It” phase
- Coding & Unit testing
- Often overlaps Design & Integration phases
  - To shorten the overall schedule
  - PM needs to coordinate this
- Other concurrent activities
  - Design completion
  - Integration begins
  - Unit testing of individual components
  - Test bed setup (environment and tools)
  - Project plans updated
  - Scope and Risk Management conducted

Development - Characteristics & Issues

- Characteristics
  - Pressure increases
  - Staffing at highest levels
  - Often a “heads-down” operation
- Issues
  - Last-minute changes
  - Team coordination (esp. in large projects)
  - Communication overhead
  - Management of sub-contractors

Integration & Test Phase

- Evolves from Development Phase
- Often done as 2 parallel phases
  - Partial integration & initial test
- Starts with integration of modules
- An initial, incomplete version constructed
- Progressively add more components

Integration & Test

- Integration primarily a programmer task
- Test primarily a QA team task
- Integration:
  - Top-down: Core functionality first, empty shells for incomplete routines (stubs)
  - Bottom up: gradually bind low-level modules
  - Prefer top-down generally
- Tests
  - Integration testing
  - Black & White-box testing
  - Load & Stress testing
  - Alpha & Beta testing
  - Acceptance testing

Integration & Test - Other activities

- final budgeting
- risk management
- training
- installation preparation
- team reduced

Integration & Test - Characteristics & Issues

- Increased pressure
- Overtime
- Customer conflicts over features
- Frustration over last-minute failures
- Budget overruns
- Motivation problems (such as burnout)
- Difficulty in customer acceptance
  - Especially true for fixed-price contracts

Deployment & Maintenance Phase

- Installation depends on system type
  - Web-based, CD-ROM, in-house, etc.
- Migration strategy
- How to get customers up on the system
  - Parallel operation
- Deployment typically in your project plan, **maintenance not**

More on Maintenance

- Maintenance
  - Fix defects
  - Add new features
  - Improve performance
- Configuration control is very important here
- Documents need to be maintained also
- Sometimes a single team maintains multiple products

Deployment & Maintenance

- Lack of enthusiasm
- Pressure for quick fixes
- Insufficient budget
- Too many patches
- Personnel turnover
- Regression testing is critical
  - Preferably through automated tools

Lifecycle Planning

- a.k.a. Lifecycle Management or Systems Development Life Cycle (SDLC)
- Greatly influences your chance of success
- Not choosing a lifecycle is a bad option
- Three primary lifecycle model components
  - Phases and their order
  - Intermediate products of each phase
  - Reviews used in each phase

Lifecycle Planning

- Different projects require different approaches
- You do not need to know all models by name
- You should know how that if given a certain scenario what sort of SDLC would be appropriate
- There are more than covered here
- A lifecycle is not a design, modeling or diagramming technique
  - The same technique (UML, DFD, etc) can be used with multiple lifecycles

Pure Waterfall

- The “granddaddy” of models
- Linear sequence of phases
  - “Pure” model: no phases overlap
- Document driven
- All planning done up-front

Waterfall Risk

- Why does the waterfall model “invite risk”?
- Integration and testing occur at the end
  - Often anyone’s 1st chance to “see” the program

Pure Waterfall

- Works well for projects with
  - Stable product definition
  - Well-understood technologies
  - Quality constraints stronger than cost & schedule
  - Technically weak staff
    - Provides structure
    - Good for overseas projects

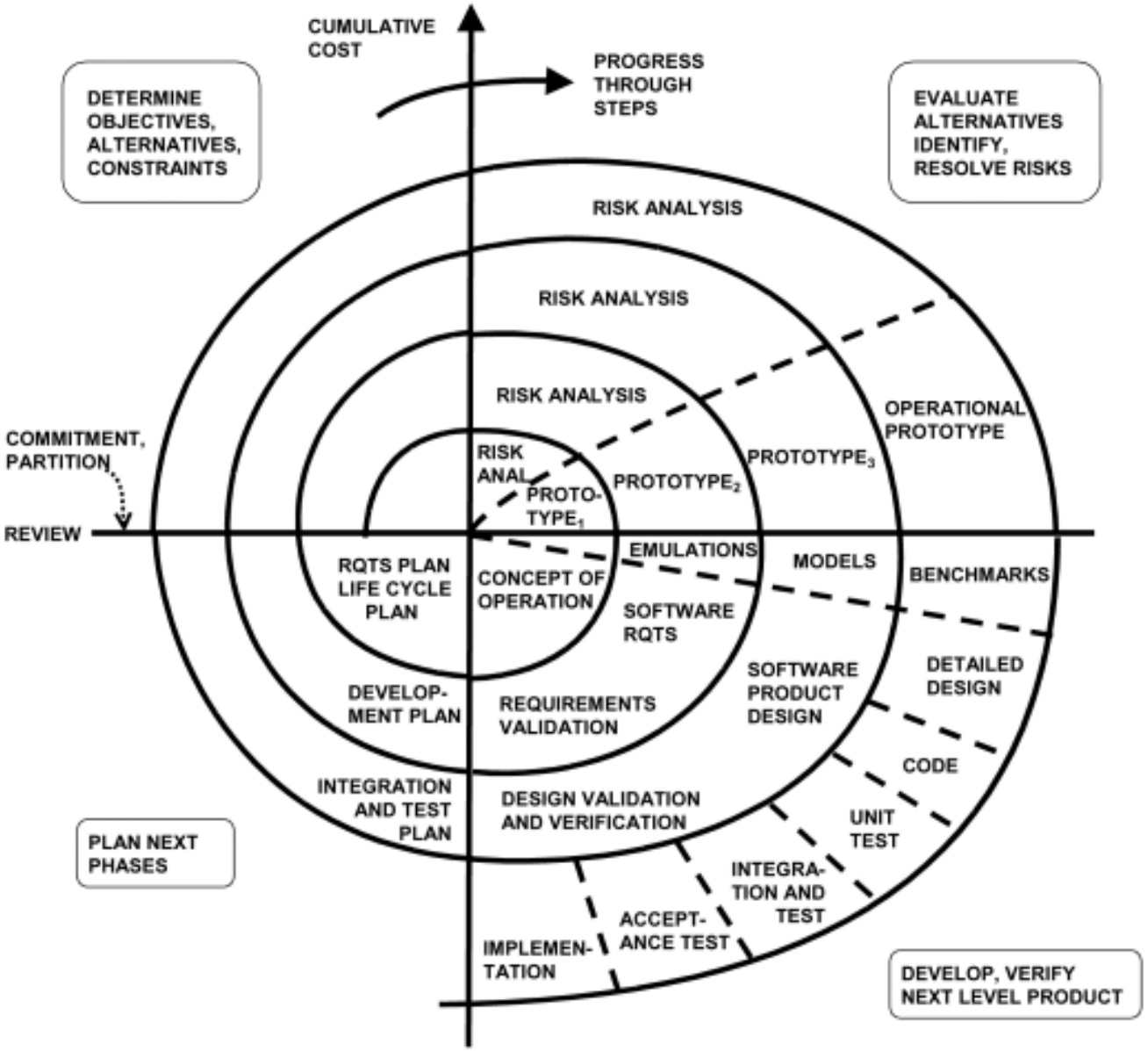
Pure Waterfall

- Disadvantages
  - Not flexible
    - Rigid march from start->finish
  - Difficult to fully define requirements up front
  - Can produce excessive documentation
  - Few visible signs of progress until the end

Code-and-Fix

- "Code-like-Hell"
- Specification (maybe), Code (yes), Release (maybe)
- Advantages
  - No overhead
  - Requires little expertise
- Disadvantages
  - No process, quality control, etc.
  - Highly risky
- Suitable for prototypes or throwaways

Spiral


CUMULATIVE COST
PROGRESS THROUGH STEPS
DETERMINE OBJECTIVES, ALTERNATIVES, CONSTRAINTS
EVALUATE ALTERNATIVES IDENTIFY, RESOLVE RISKS
RISK ANALYSIS
RISK ANALYSIS
RISK ANALYSIS
COMMITMENT, PARTITION
REVIEW
RISK ANAL
PROTO-TYPE1
PROTOTYPE2
PROTOTYPE3
OPERATIONAL PROTOTYPE
RQTS PLAN LIFE CYCLE PLAN
CONCEPT OF OPERATION
EMULATIONS
SOFTWARE RQTS
MODELS
BENCHMARKS
DEVELOP-MENT PLAN
REQUIREMENTS VALIDATION
SOFTWARE PRODUCT DESIGN
DETAILED DESIGN
CODE
INTEGRATION AND TEST PLAN
DESIGN VALIDATION AND VERIFICATION
UNIT TEST
INTEGRA-TION AND TEST
ACCEPT-ANCE TEST
IMPLEMEN-TATION
PLAN NEXT PHASES
DEVELOP, VERIFY NEXT LEVEL PRODUCT

Spiral

- Emphasizes risk analysis & mgmt. in each phase
- A Series of Mini-projects
- Each addresses a set of “risks”
  - Start small, explore risks, prototype, plan, repeat
- Early iterations are “cheapest”
- Number of spirals is variable
  - Last set of steps are waterfall-like

Spiral

- Advantages
  - Can be combined with other models
  - As costs increase, risks decrease
  - Risk orientation provides early warning
- Disadvantages
  - More complex
  - Requires more management

Modified Waterfall – Sashimi

- Overlapping phases
- Advantages
  - Reduces overall schedule
  - Reduces documentation
  - Works well if personnel continuity
- Disadvantages
  - Milestones more ambiguous
  - Progress tracking more difficult
  - Communication can be more difficult

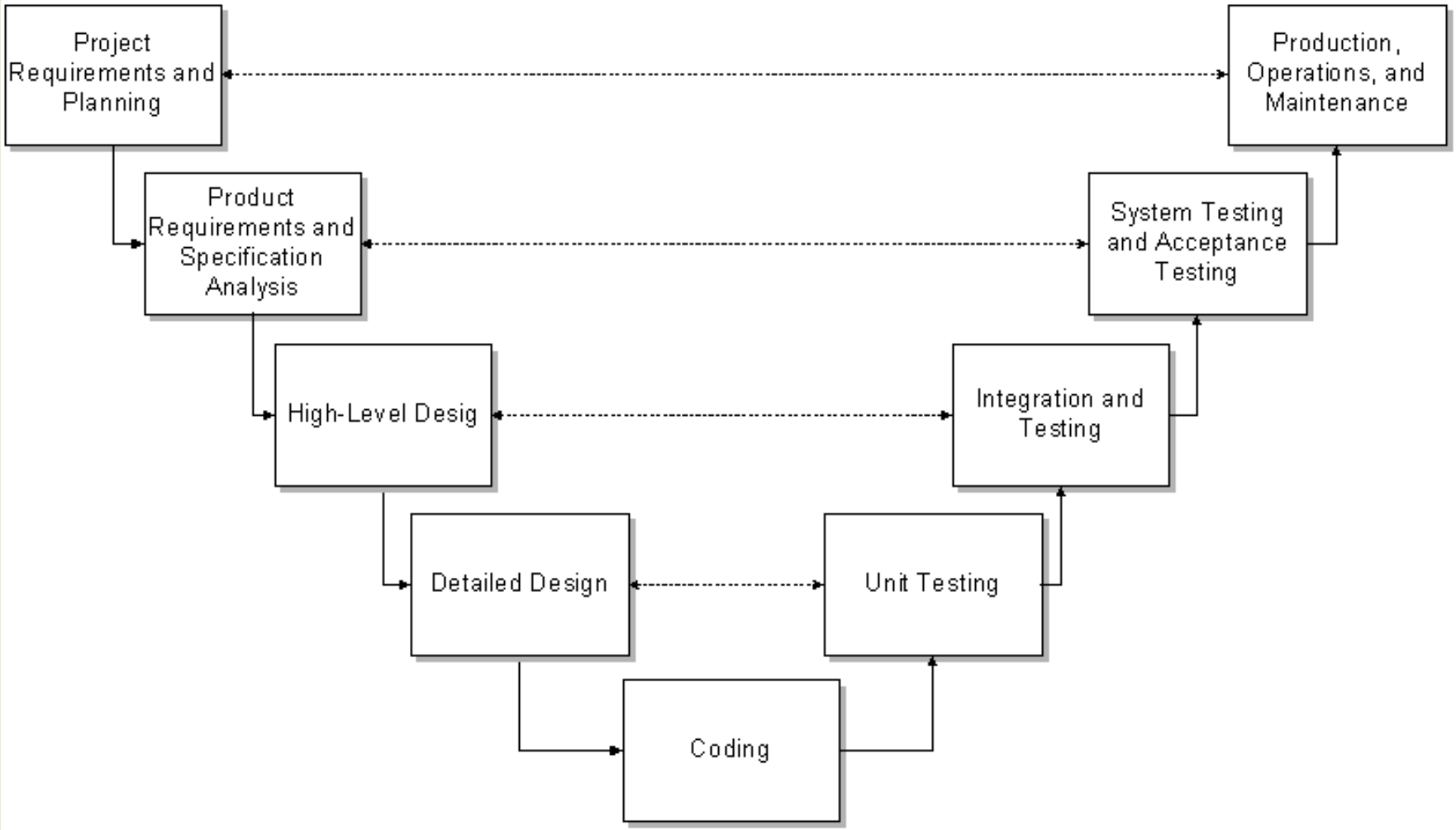
Evolutionary Prototyping

- Design most prominent parts first
  - Usually via a visual prototype
- Good for situations with:
  - Rapidly changing requirements
  - Non-committal customer
  - Vague problem domain
- Provides steady, visible progress
- Disadvantages
  - Time estimation is difficult
  - Project completion date may be unknown
  - An excuse to do “code-and-fix”

Staged Delivery

- Waterfall steps through architectural design
- Then detailed design, code, test, deliver in stages
- Advantages
  - Customers get product much sooner
  - Tangible signs of progress sooner
  - Problems discovered earlier
  - Increases flexibility
  - Reduces: status reporting overhead & estimation error
- Disadvantages
  - Requires more planning (for you the PM)
  - More releases increase effort (and possible feature creep)
- Similar to Evolutionary Prototyping, but guided by a strong architectural design

V Process Model



V Process Model

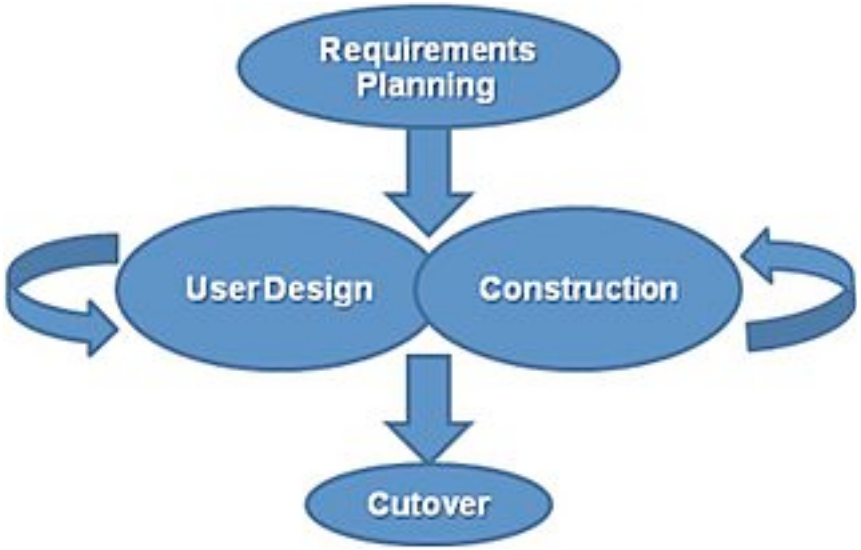
- Designed for testability
  - Emphasizes Verification & Validation (V&V)
- Variation of waterfall
- Strengths
  - Encourages V&V at all phases
- Weaknesses
  - Does not handle iterations
  - Changes can be more difficult to handle
- Good choice for systems that require high reliability such as patient control systems

Commercial Off-The-Shelf software (COTS)

- Build-vs.-buy decision
- Advantages
  - Available immediately
  - Potentially lower cost
- Disadvantages
  - Not as tailored to your requirements
- Remember: custom software rarely meets its ideal (so compare that reality to COTS option)

Rapid Application Development

- Phases
  1. Joint Requirements Planning (JRP)
  2. Joint Application Design (JAD)
  3. Construction
     - Heavy use of tools, code generators
     - Time-boxed, many prototypes
  4. Cutover



- Good for systems with extensive user input available

XP: eXtreme Programming

- Part of movement called “Agile Development”
- A “Lightweight” methodology
- A bit counter-culture
- Currently in vogue
- Motto: “Embrace Change”
- Highly Incremental / Iterative

eXtreme Programming

eXtreme Programming

- Suitable for small groups
- Attempts to minimize unnecessary work
- Uses an “on-site” customer
- Small releases
- Pair programming
- Refactoring
- Stories as requirements
- You want good developers if you use this

Other "Agile" Methodologies

- Agile here means "lite", reduced docs, highly iterative
- Agile Software Development
  - Alliance , http://www.agilealliance.org
  - their "manifesto", http://agilemanifesto.org/
  - their book http://www.amazon.com/exec/obidos/ASIN/0201699699/104-2402656-5403151
- SCRUM
  - Features 30-day "Sprint" cycles
  - See http://www.scruminc.com/
  - **Jeff Sutherland TEDx Talk**
  - Jeff Sutherland TEDx Talk
    - http://www.scruminc.com/jeff-sutherland-tedx-talk/
- Feature Driven Development (FDD)
  - XP with more emphasis on docs and process

"Agile" Methodologies

- Pros
  - can reduce process overhead
  - Responsive to user feedback
  - Amenable to change
- Cons
  - Requires close monitoring by PM
  - May not "scale" to large projects
  - Often requires better quality developers

Optional Reading

- "Iterative software development process" methods has to be "metabolise"
- If the team, the PM and all the stakeholders do not metabolize them, the project risks failing.
- Reading: "**How to Fail with the Rational Unified Process: Seven Steps to Pain and Suffering**"
  - http://www.ceng.metu.edu.tr/~gtumuklu/web/SE548/Reading%20Material/HowToFailWRational.pdf