Project Management

Session 3: Planning

Content

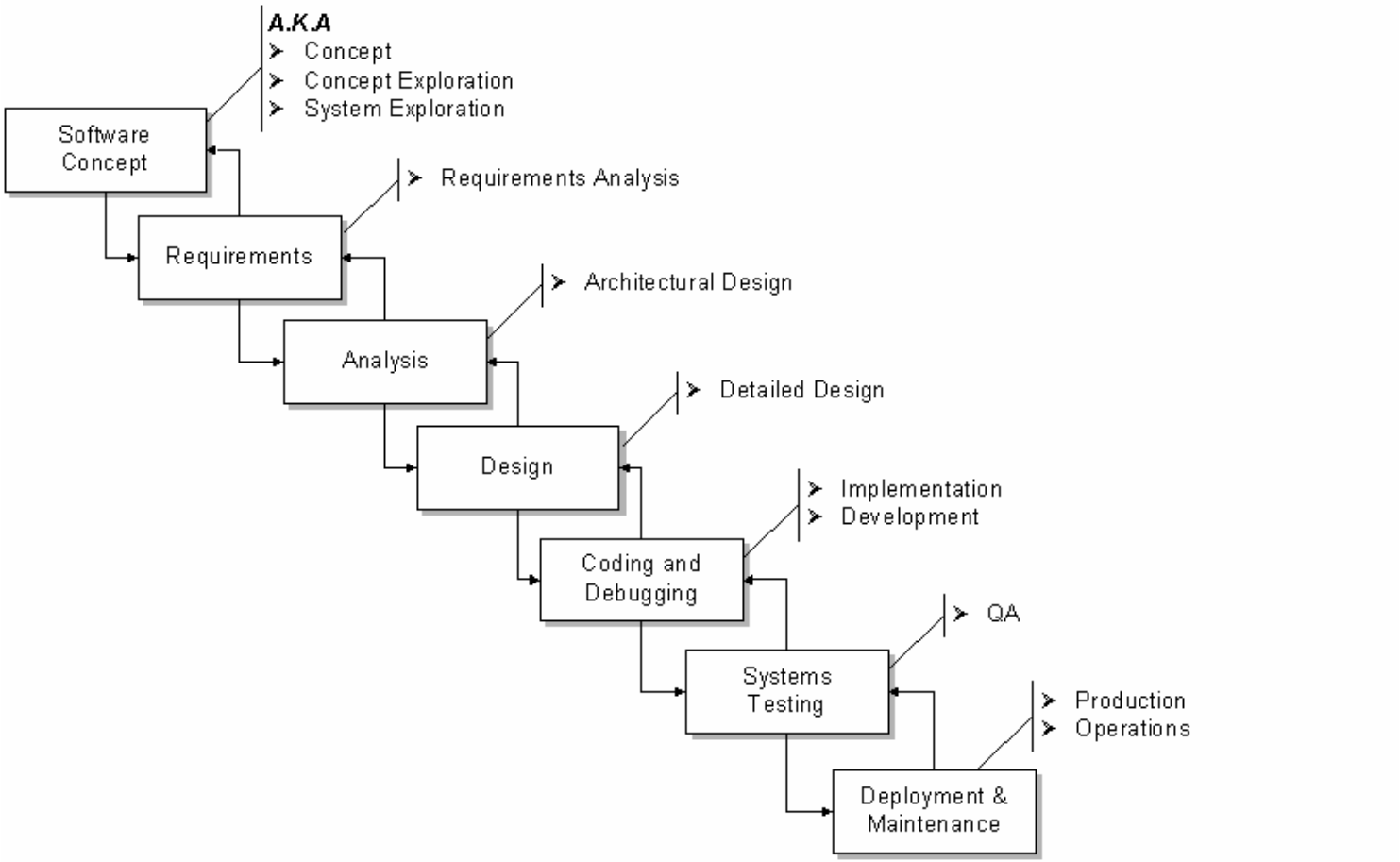
- 1. Phases in Detail
  - Step-by-step of typical software project
- 2. Lifecycle Planning
- 3. Project plans

- Next Week: Lots of Project-ish Details: WBS, PERT, CPM, Scheduling & Estimation

Session 2 Review

- PMI Fundamentals
- PMI Processes
- Project Organization
  - Functional, Project, Matrix Orgs.
- Initial documents
  - Statement of Work (SOW)
  - Project Charter
- Readings

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%

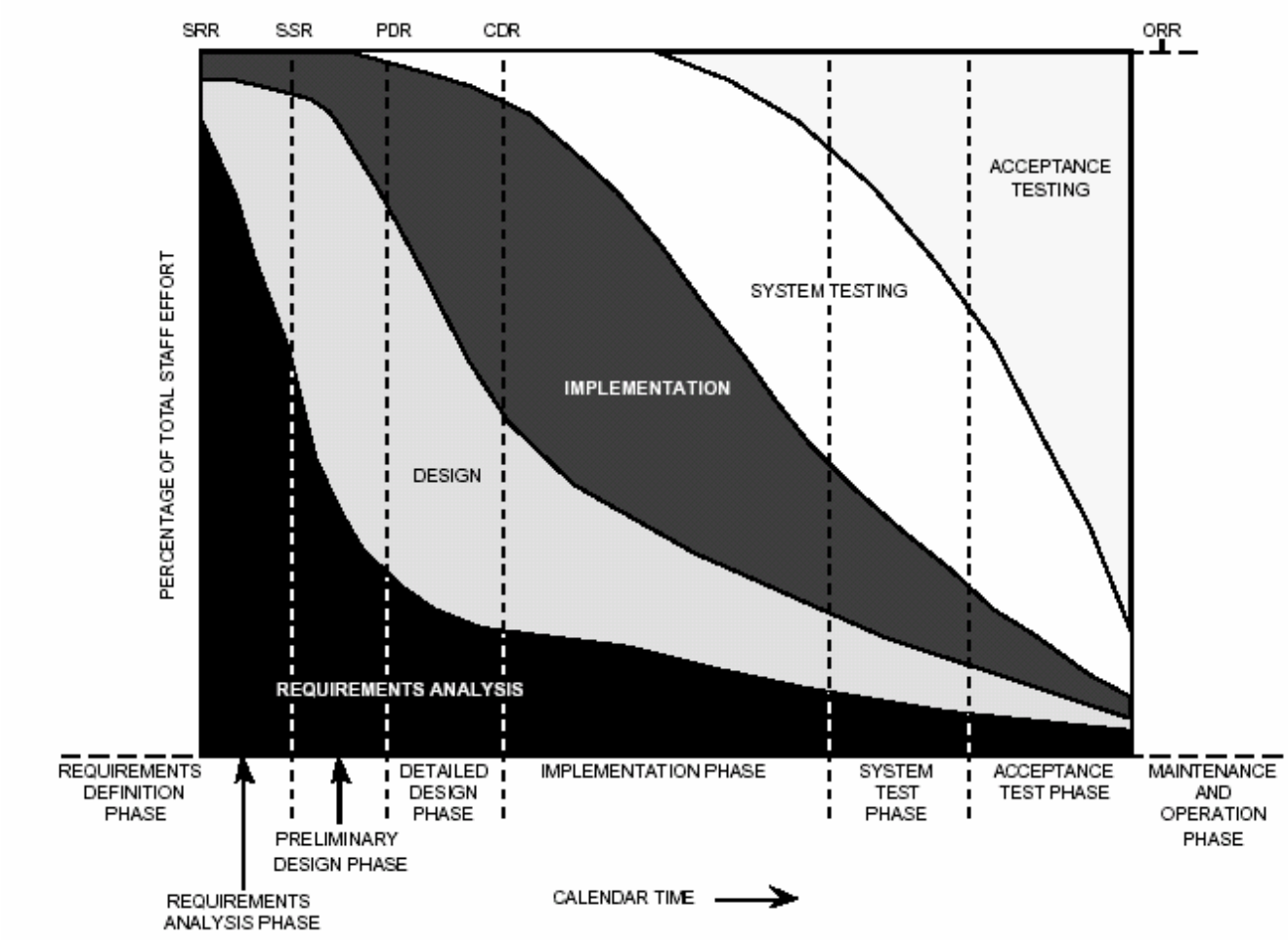
Bennatan, E.M, “On Time Within Budget”

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%

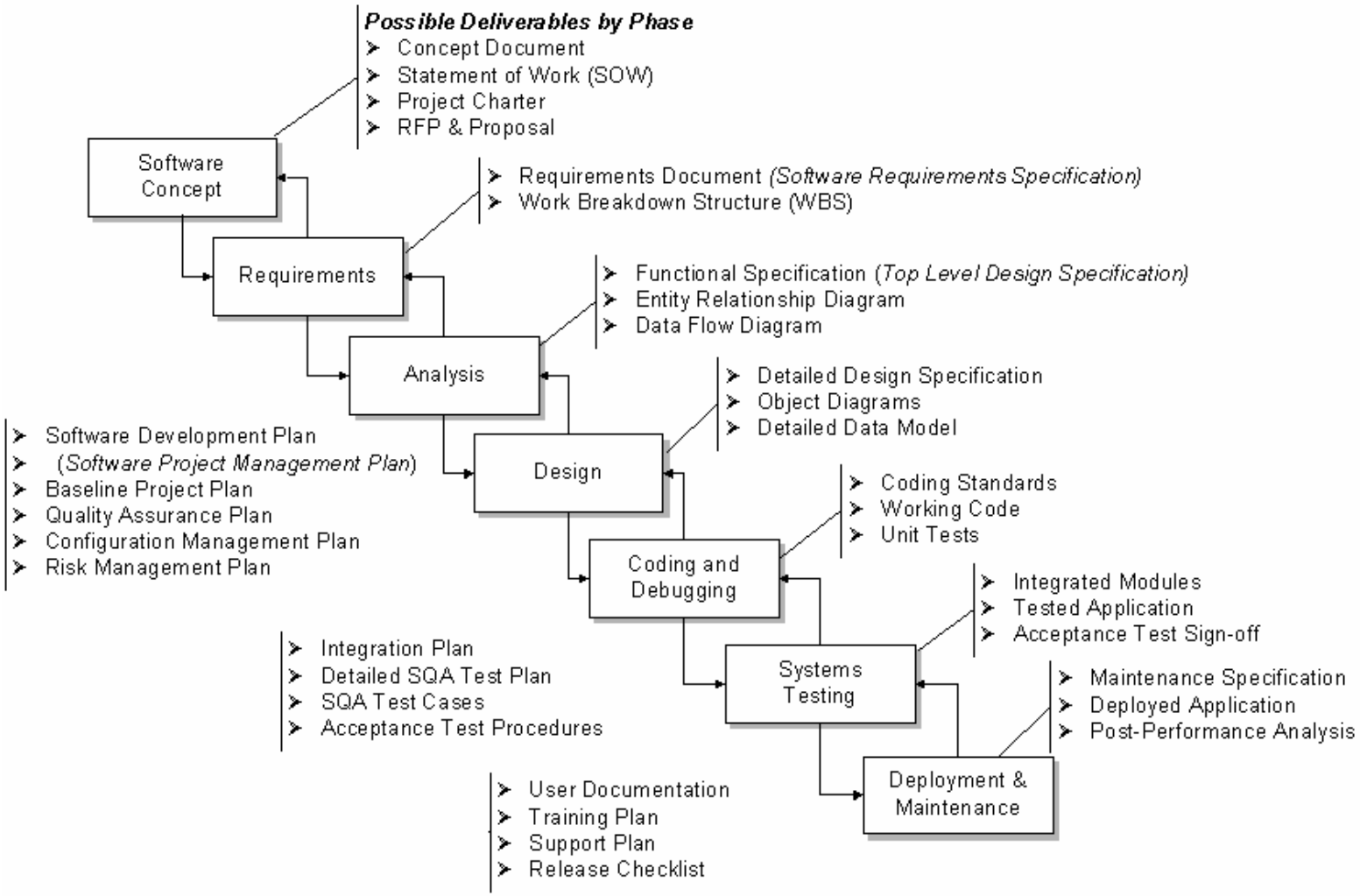
McConnell, Steve, “Rapid Development”

Activities by % of Total Effort



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

Potential Deliverables by Phase



Concept Exploration

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

Concept Exploration

- 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

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

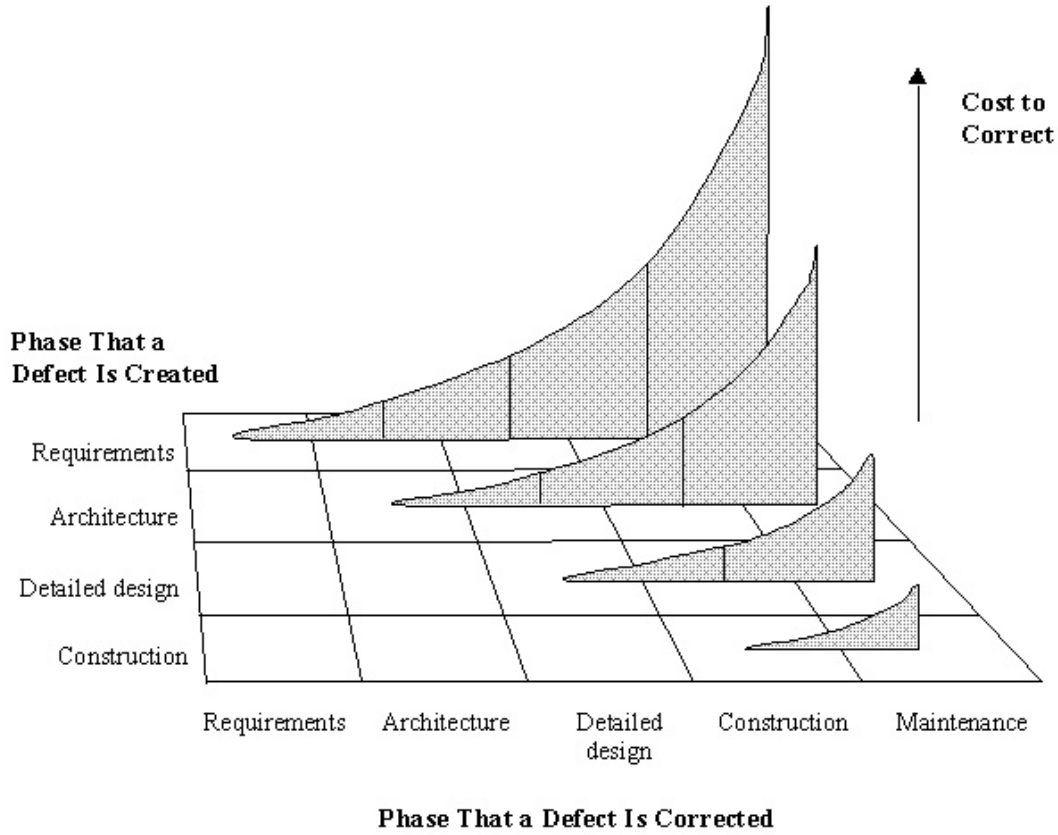
Requirements

- 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

Requirements

- 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

- 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

Early Phase Meetings

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

Analysis & Design

- 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)

Analysis & Design

- a.k.a. Top-level design & detailed design
- Continues process from RD
- 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

- The “Do It” phase
- Coding & Unit testing
- Often overlaps Design & Integration phases
  - To shorten the overall schedule
  - PM needs to coordinate this

Development

- 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
  - 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

- Evolves from Dev. 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

Integration & Test

- Tests
  - Integration testing
  - Black & White-box testing
  - Load & Stress testing
  - Alpha & Beta testing
  - Acceptance testing
- Other activities
  - Final budgeting; risk mgmt.; 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
    - Esp. true for fixed-price contracts

Deployment & Maintenance

- 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

Deployment & 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

- Characteristics & Issues
  - 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 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

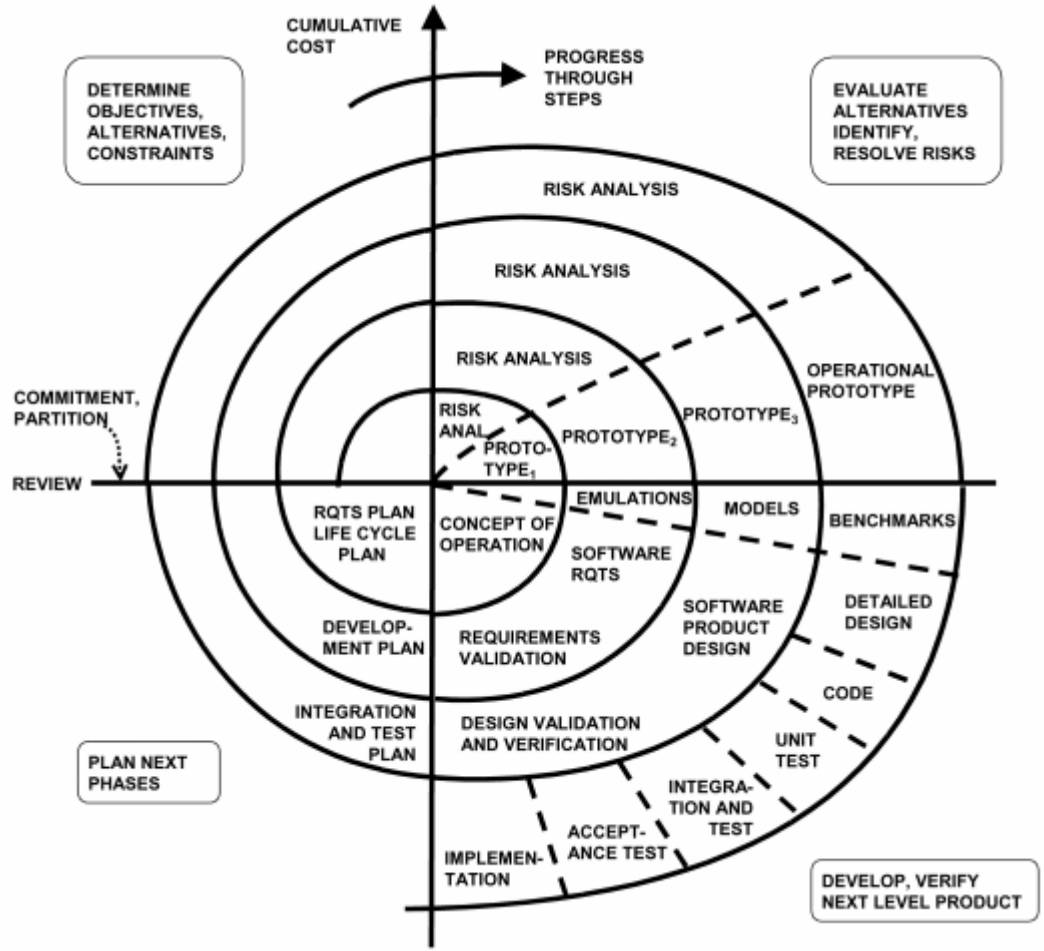
Pure Waterfall

- 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

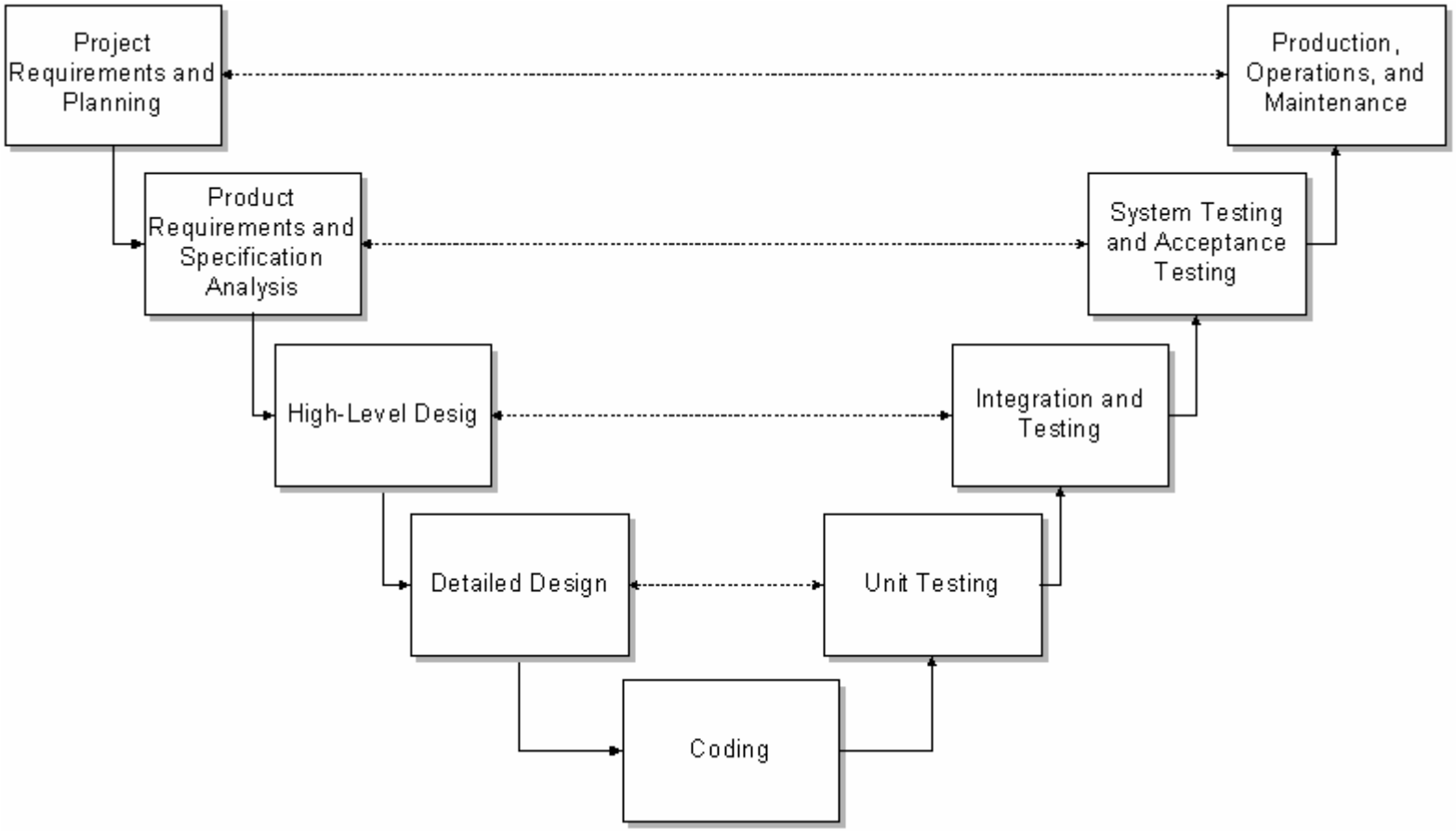
Evolutionary Prototyping

- 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)
- How's this differ from Evolutionary Prototyping?

V Process Model



V Process Model

- Designed for testability
  - Emphasizes Verification & Validation
- 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

RAD

- Rapid Application Development
- Popular in the 80’s
  - 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

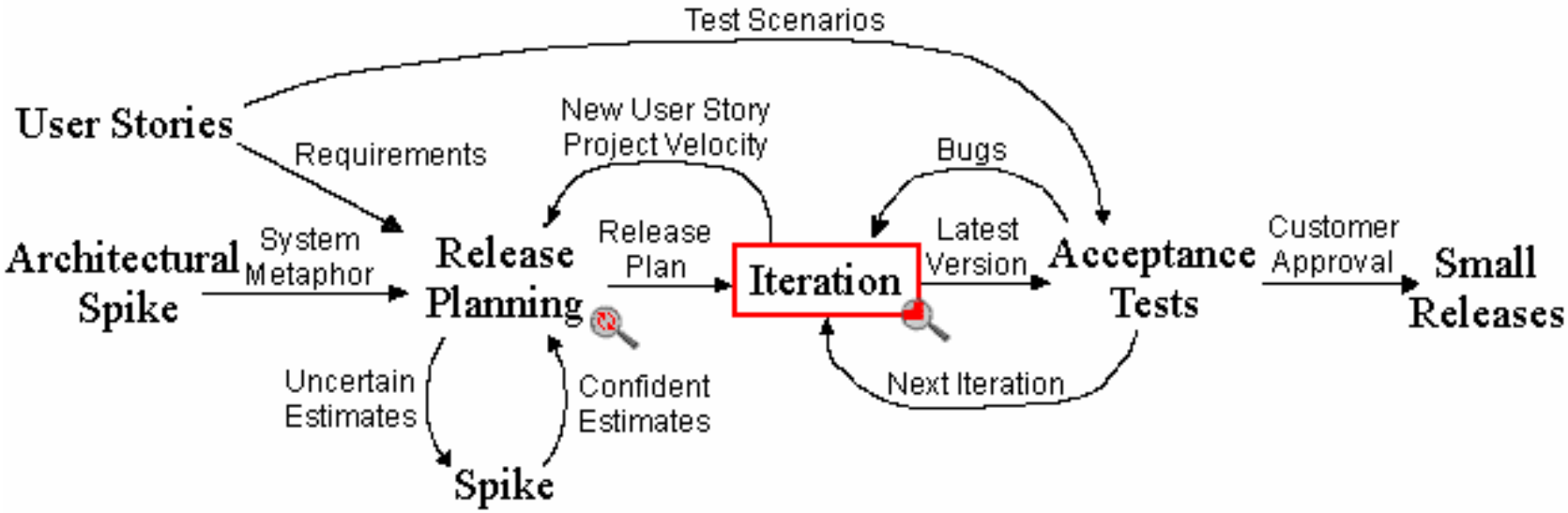
COTS

- Commercial Off-The-Shelf software
- 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)

XP: eXtreme Programming

- Not a Microsoft product
- 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 , their “manifesto”, their book
- SCRUM
  - Features 30-day “Sprint” cycles
- Feature Driven Development (FDD)
  - XP with more emphasis on docs and process

Other “Agile” Methodologies

- Adaptive Software Development (ASD)
  - Book, site
- Dynamic System Development Method (DSDM)
  - Popular in Europe
- Homegrown: developers often hide their “agile adventures” from management

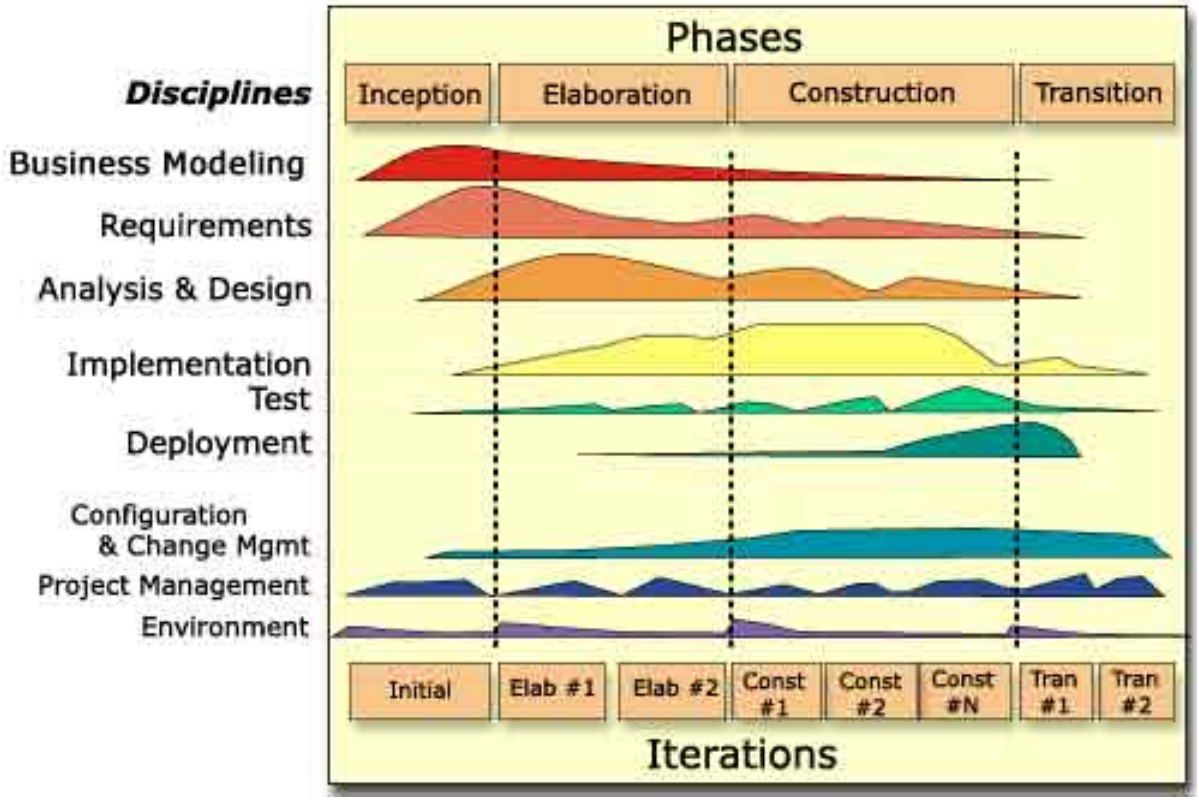
Other “Agile” Methodologies

- Pros
  - Similar to XP, 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

Rational Unified Process

- RUP
- From Rational Corporation
- “Generic” version is the Unified Process
- Commercial
- Extensive tool support (expensive)
- Object-oriented
- Incremental
- Newer

Rational Unified Process



Rational Unified Process

- Develop Iteratively
- Manage Requirements
- Uses UML (Unified Modeling Language)
- Produces “artifacts”
- Use component-based architecture
- Visually model software
- Complex process
- A “framework”
- Suitable for large scale systems

Choosing Your Lifecycle

- Varies by project
- Opt for “iterative” or “incremental”
- How well are requirements understood?
- What are the risks?
- Is there a fixed deadline?
- How experienced is the team or customer?
- See the table in McConnell

IEEE 1074

- A standard for developing software processes
  - Lifecycle model selection
  - Project management process
  - Predevelopment processes
  - Development processes
  - Post-development processes
  - Integral process

Planning

- “Plans are nothing. But planning is everything.” Gen. Dwight Eisenhower

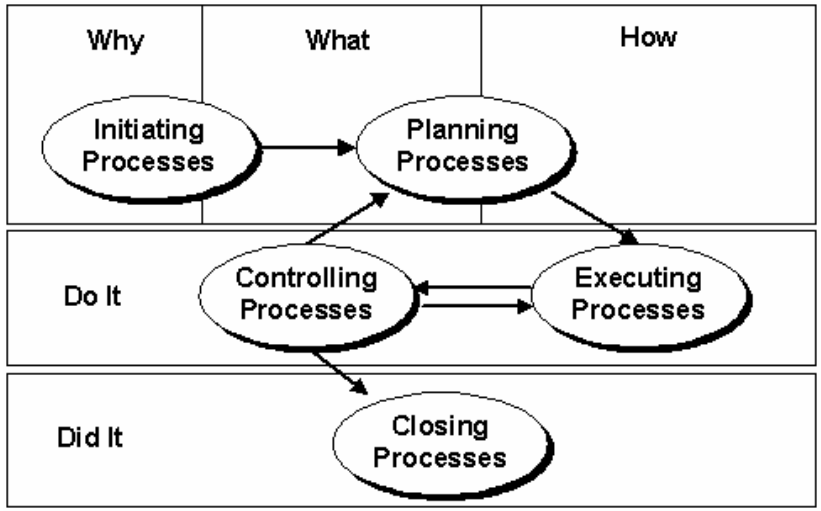
- “Aktualisieren”
- “Nachführen/Versionieren”
- “Kommunizieren/Verteilen”

Planning

- Preliminary planning starts on day one
- Even in the pre-project phase
- Should not be conducted “in secret”
- Need buy-in and approval
  - Very important step
  - Both from above and below

Your PM Process

- Why
  - Deliverable: ROI
- What
  - SOW, Requirements
- How
  - Design Specification, SDP, Lifecycle
- Do
  - Execution
- Done
  - PPR



Futrell, Shafer, Shafer, "Quality Software Project Management"

Primary Planning Steps

- Identify project scope and objectives
- Identify project organizational environment
- Analyze project characteristics
- Identify project products and activities
- Estimate effort for each activity
- Identify risk
- Allocate resources
- Review and communicate plan

Planning Documents

- Software Development Plan (SDP)
- Software Quality Assurance Plan (SQAP)
- Software Configuration Management Plan (SCMP)
- Risk Management Plan
- Software Process Improvement Plan
- Communications Management Plan
- Migration Plan
- Operations Plan

Planning Documents

- You (the PM) need to choose which documents are appropriate
- Docs do not *have* to be lengthy
- Small Set:
  - Software Development Plan
  - Risk Management Plan
  - Software Quality Assurance Plan
  - Software Configuration Management Plan

Planning Documents

- Project ROI Analysis
- Statement of Work (SOW)
- Project Charter
- Software Project Management Plan (SPMP)
- Budget
- Responsibility Assignment Matrix (RAM)
- Risk Management Plan

Product Documents

- Statement of Need
- System Interface Specification
- Software Requirements Specification
- Software Design Specification
- Software Validation & Verification Plan
- User Documentation
- Support Plan
- Maintenance Documentation

Planning

- How much will it cost?
- How long will it take?
- How many people will it take?
- What might go wrong?

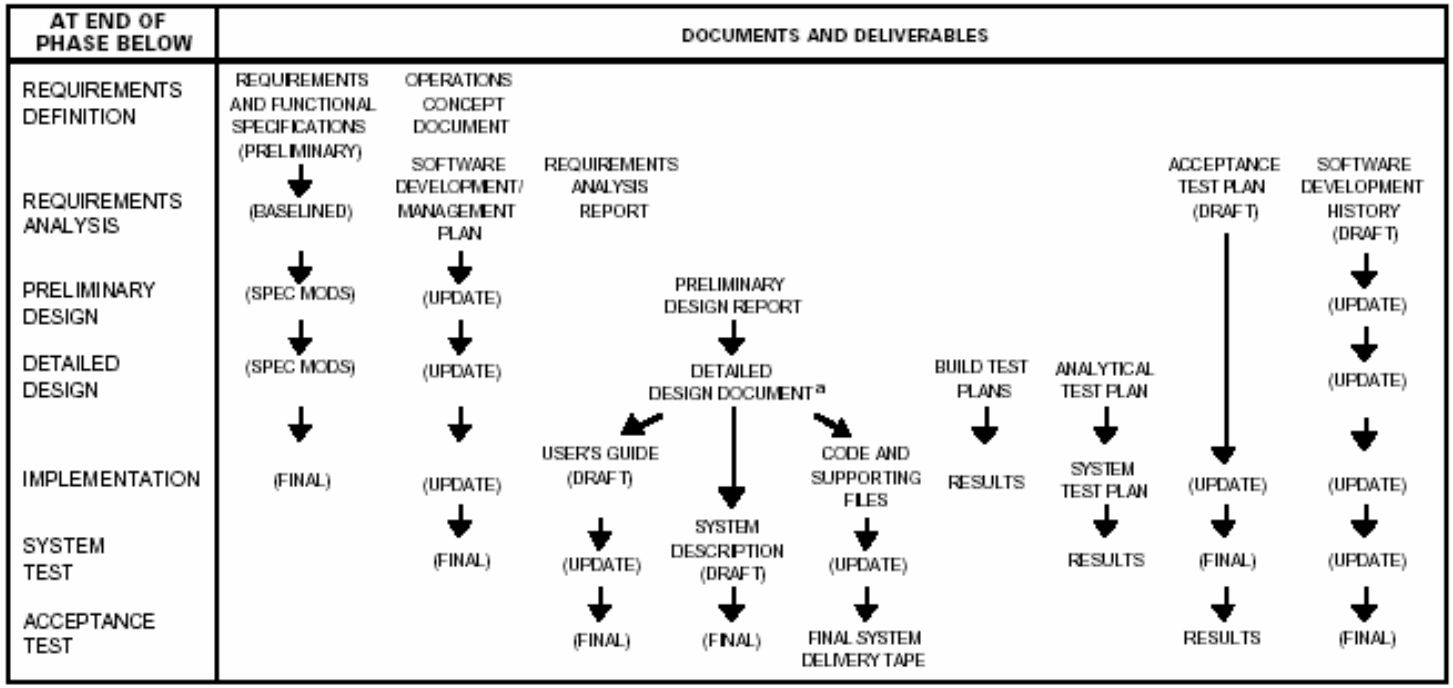
Planning

- Scoping
- Estimation
- Risk
- Schedule
- Control Strategy

Process Issues

- You want a fairly sophisticated process without incurring much overhead
- Remember, projects are often larger than they first appear
- Easier to loosen too much process than add later

Plans Evolve Over Time



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

Software Development Plan

- Software Project Management Plan (SPMP)
- Some consider it the most important document in the project (along with SRS)
  - Can be seen as an aggregation of other core documents
- Evolves over time as pieces come together
- McConnell's example

SDP / SPMP

- Fundamental Sections
  - Project overview
  - Deliverables
  - Project organization
  - Managerial processes
  - Technical processes
  - Budget
  - Schedule

Communications Management Plan

- Often a section of SPMP
- Describes information flow to all parties
  - Gathering and distributing information
- Status meetings
  - Monthly, Weekly, Daily?
  - Status reports are vital

Questions?