Software Development for Large Systems

ETSN05: Lecture 3
Alma Orucevic-Alagic, Fall 2016
Lecture 3: Overview

- Software Project Management (SPM)
- Process and Deliverables
- Meetings and Reviews
Lecture 3: Software Project Management (SPM)

- Historical Perspective: Hardware/Software Evolution
- Software Project Failures:
  - How large is a "large" IT project?
  - Does size actually matter in terms of success rates or failure probability for IT projects?
  - How do we classify a project as failure?
    » Time cost overruns vs. business case non-deliverables
  - What constitutes success? (IT vs. business failure)

Lecture 3: Why Software Fails: Factors

- Unrealistic or unarticulated project goal
- Inaccurate estimates of needed resources
- Badly defined system requirements
- Poor reporting of the project's status
- Unmanaged risks
- Poor communication among customers, developers, and users
- Use of immature technology
- Inability to handle the project's complexity
- Sloppy development practices
- Poor project management
- Stakeholder politics
- Commercial pressures

Lecture 3: Aspects of SPM

• Goals
• Risks
• Planning
• Staffing and organization
• Management
• Control and follow-up
Lecture 3: Goals of SPM

• Is this "the right" product?
• Does it have "needed" quality?
• Is it delivered at "the right" time?
• Is it within "a budget"?
Lecture 3: SPM – Risk Management

• Risk identification
• Risk analysis (including cause analysis)
• Risk prioritization
• Risk management action plan
Lecture 3: SPM – Risk Management

• Risk assessment:
  – Risk identification (checklist, decision driver analysis, assumption analysis, decomposition)
  – Risk analysis (performance, cost, network, decision, quality)
  – Risk prioritization (exposure, leverage, compound risk reduction)

• Risk control:
  – Risk management planning
  – Risk resolution
  – Risk monitoring

<table>
<thead>
<tr>
<th>Risk</th>
<th>Risk Management Technique</th>
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<tbody>
<tr>
<td>1) Personnel shortfalls</td>
<td>Staffing, team building, cross training.</td>
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<tr>
<td>2) Unrealistic schedules and budgets</td>
<td>Detailed cost &amp; schedule estimation, design to cost, incremental development, software reuse, requirements scrubbing</td>
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<td>3) Developing the wrong software functions</td>
<td>Organization &amp; mission analysis, prototyping, user surveys,…</td>
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<td>4) Developing the wrong user interface</td>
<td>Prototyping, scenarios, task analysis.</td>
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<td>5) Gold plating</td>
<td>Requirements scrubbing, prototyping, cost-benefit analysis, design to cost</td>
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<td>6) Continuing stream of requirement changes</td>
<td>High challenge threshold, information hiding, incremental development</td>
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<td>7) Shortfalls in externally furnished components</td>
<td>Benchmarking, inspections, compatibility analysis…</td>
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<td>8) Shortfalls in externally performed tasks.</td>
<td>Reference checking, teambuilding,…</td>
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<td>9) Real-time performance shortfalls</td>
<td>Simulation, benchmarking, modeling, prototyping</td>
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<tr>
<td>10) Straining computer science capabilities</td>
<td>Technical analysis, cost-benefit analysis, prototyping,…</td>
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Lecture 3: SPM - Planning

- Establish goals
- Define:
  - Organization
  - Standards and policies
  - Project milestones and deliverables
- Create project schedule
- Estimate costs and define budget
- Evaluate risks
- Document planning activities and monitoring
Lecture 3: SPM - Staffing and Organization

- Experience and education
- Motivation and commitment
- Team composition:
  - Line organization
  - Matrix organization
  - Functional sub-teams
Lecture 3: SPM-People Management

• Leadership
• Follow-up
• Delegate
• Motivate
• Support collaboration
• Facilitate coordination and communication
• Conflict management
• Audit trail
Lecture 3: SPM Project Control

• Establish reporting and follow up framework:
  – *Project Management*:
    » Baseline
    » Budget Review
    » Milestones
  – *Software Development*:
    » Process model
  – *Quality*
    » Verification and validation
    » Quality assurance
    » Configuration management

• Result Analysis
• Corrective Activities
• Documentation
Lecture 3: Process and Deliverables

• Requirements, Design and Test Documents
• "Contract" between customer and development team
• Reference for user manuals
• Product vs. project documentation
Lecture 3: Process and Deliverables

Chapter 3, PH book
Lecture 3: Process and Deliverables
Lecture 3: Process and Deliverables - Phases

• Phase 1 - Specification:
  » Requirements
  » Planning
  » Test

• Phase 2 - Design and Test:
  » High level design
  » Test design

• Phase 3 – Development:
  » Source code

• Phase 4: Software Product Delivery
Lecture 3: Process and Deliverables - Baseline

• First Review
• Subsequent changes are subject of control management
• Change Control Board (CCB)
Lecture 3: Process and Deliverables - Development Support

Diagram:
- Management
- Quality assurance
- Project management
- Technical development
- Configuration management
Lecture 3: Process and Deliverables - Development Support

- Techniques and tools
- Development environment
- Standards and rules
- Education
- Metrics, evaluation…
- Policies and strategies
Lecture 3: Process and Deliverables - Documents Management

- Follow PH:2
- Documents’ library
- Consistent format
- Include configuration item number on each document
- Reference SRS
- Identify and mark clearly deltas between new versions and base system
Lecture 3: Process and Deliverables - Phase 1: Specification

• WHO is the target group?
• WHAT is the message?
  – Clarity
  – Completeness
  – Ambiguity
  – Reference/Traceability/Auditing
Lecture 3: Process and Deliverables - Phase 1: Specification

- Formulate software development plan (SDP)
- Define and analyze product requirements (SRS)
- Plan reviews and test (SVVS)
- Phase 1 ends with formal review and baseline
Software Development Plan (SDP)
- Responsibility: Project Managers Group (PG)
  » Development plan:
    - Time/Resources per phase/week/activity/group
    - Time plan for phases/documents/reviews
    - Weekly calendar overview of tasks for each group
  » Define organization structure, and lines of responsibility
  » Describe support tools, methods, and standards
  » Formulate change management procedures
Lecture 3: Process and Deliverables - Phase 1: SRS

- Software Requirements Specification (SRS)
  - Responsibility: System Group and Development Group (SG, PG)
    » Identify and analyze customer’s needs
    » Define functional and quality requirements
    » Define terms used explicitly
    » Present at least two scenarios for each service identified
    » Create a new section for each service

- Correct, Consistent, Organized, Verifiable, Complete, Traceable, Unambiguous, Motivated
Lecture 3: Process and Deliverables - Phase 1: SVVS

- Software Verification and Validation Specification
  - Responsibility: Test Group (TG)
    » Decide how and when to hold reviews
    » Formulate tests:
      - Test type
      - Function test specification per service
      - System test specification
      - All requirements must be referenced
      - Quality/evaluation of non-functional requirements
Lecture 3: Process and Deliverables - Phase 2: High Level Design

- Produce high level design of the system
- Phase 2 ends with formal review and baseline
Lecture 3: Process and Deliverables - Phase 2: STLDD

- Software Top-Level Design Document (STLDD)
  - Responsible: SG and UG
    » Produce high level design, components, interfaces…
    » Describe functionality
    » Produce sequence diagrams, data store description…
    » Use UML and document appropriately
Lecture 3: Process and Deliverables - Phase 2: SVVI

- Software Verification and Validation Instructions
- Responsible: Test Group (TG)
  » Formulate test instructions for each test case in SVVS
  » Test execution:
    – Which test cases are run?
    – Target environment, simulator, phone?
  » Test case:
    – Pre-condition, Setup, Specification, Follow-up, Post-condition
Lecture 3: Process and Deliverables - Phase 4: Integration and System Test

- System test: Are all requirements satisfied
- Acceptance test: Does product fulfill customer’s needs
- Post-mortem review
- Phase ends with formal review (PDR) and formal baseline review
Lecture 3: Process and Deliverables - Phase 3: SDDD

- Software Detailed Design Document SDDD
- Responsibility SG and UG
  - Detailed/Implementation Level Design
Lecture 3: Process and Deliverables - Phase 4: SVVR

- Software Verification and Validation Report
  - Group responsible: Test Group (TG)
    » Include test results for:
      - Results of function tests for each service
      - Results of system tests
      - Number of errors and their types identified in each review, each dynamic test, different documents
      - Any unresolved errors
      - Comments on the test results
Lecture 3: Process and Deliverables - Phase 4: SSD

- System Specification Document
  - Group responsible: PG
    - Version (Delivered version, deltas)
    - Motivate possible differences in SRS
    - Installation instructions
Lecture 3: Process and Deliverables - Phase 4: PFR

- Project Final Report Responsible: PG
  - Summarize project experience
  - Provide overview of metrics
  - Analyze error costs
  - Reflect on what would you do differently if you were to run the project again/list project improvement suggestions.
# Lecture 3: Process and Deliverables - Document Timeline

<table>
<thead>
<tr>
<th>Week</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<tbody>
<tr>
<td>PG</td>
<td>SDP</td>
<td></td>
<td></td>
<td></td>
<td>SSD</td>
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<tr>
<td>SG</td>
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<td>STLDD</td>
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<tr>
<td>TG</td>
<td>SVVS</td>
<td>SVVI</td>
<td></td>
<td></td>
<td>SVVR</td>
<td></td>
<td>PFR</td>
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</table>

Review: SSR  
Baseline: Specification

Review: PDR  
Baseline: Design&Test

Review: PR  
Baseline: Product
Lecture 3: Process and Deliverables - Refinement
Lecture 4: Meetings and Reviews

• Opportunity to validate documents correctness/quality in a structured way
  – Informal reviews: Project’s internal quality control
  – Formal review: Auditors, reviewers, inspectors, quality assurance - the entire project group!

• Review documents in systematic and detail oriented fashion
  – Identify Errors
  – Spread Knowledge
  – Get inputs/basis for decision
Lecture 4: Meetings and Reviews

• What?
  – Requirements/design/code/user interface

• How?
  – Ad hoc
  – Checklist
  – Scenario-based

• Who?
  – Number of reviewers
  – Roles

• When?
  – Continuously
  – Before decision
## Lecture 4: Meetings and Reviews

<table>
<thead>
<tr>
<th>Role</th>
<th>Steps</th>
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</thead>
<tbody>
<tr>
<td>• Author</td>
<td>• Planning</td>
</tr>
<tr>
<td>• Moderator</td>
<td>• Overview</td>
</tr>
<tr>
<td>• Reader</td>
<td>• Preparation</td>
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<tr>
<td>• Recorder</td>
<td>• Meeting</td>
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<tr>
<td>• Inspector</td>
<td>• Rework</td>
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<tr>
<td>• Inspection process responsible</td>
<td>• Follow-up</td>
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</table>
Lecture 4: Meetings and Reviews

- Documents reviewed in order (SRS, SDDD)
Lecture 4: Meetings and Reviews - Errors

- Generic error types (see PH)
- Different specific error types for each document
  - SRS
  - SVVP & SVVR
  - STLDD & SDDD
- Error levels: A, B, C
  - A = system failure
  - B = function failure
  - C = minor issue/warning
Lecture 4: Review information collection

- Date for distribution
- Time for preparation
- Date of review meeting
- End date for rework
- First review or re-review
- Identity of review material (e.g. document number)
- Size of review material
- Names of participants
- Number of reviewers
- Duration of meeting
- Number of errors divided by type and severity
- Decisions (approved, corrected or re-review)
- Compare the review protocol and problem reports
Lecture 4: Course Project Reviews

• Informal reviews: customer not present, done before every formal review

• Formal reviews:
  – Software Specification Review (week 2)
    » SDP, SRS, SVVS
  – Preliminary Design Review (week 4)
    » STLDD, SVVI
  – Product Review (week 7)
    » Acceptance test
Lecture 4: TODO

• Prepare exercise session 3
• Exercise 2 and 3 serve as preparation for the computer exercises
• Sign up for computer exercises 1 & 2
• PG: schedule review 1, SDP
• SG: SRS
• UG: SRS
• TG: SVVS
• Review 1: Friday