Software Project Management using an Iterative Lifecycle Model

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Objectives of this Presentation

- To understand what the Unified Process is
- To understand the iterative lifecycle approach to software project management of the Unified Process
- To review case studies where the Unified Process was applied to implement an iterative lifecycle approach
References

- IBM Rational Unified Process (RUP) Version 7.0
- Eclipse Open Unified Process (OpenUP) Version 1.0
Agenda

1. What is the Unified Process?
2. What is Iterative development?
3. Iterative Development in the Unified Process
4. Case Studies
1. What is the Unified Process?

- Topics
  - Definition of a Software Development Process
  - Best Practices and the Unified Process
  - Characteristics of the Unified Process
  - Scope of the Unified Process
  - Structure of the Unified Process
  - Lifecycle of the Unified Process
  - Phases, Iterations and Milestones
Definition of a Software Development Process

- A software development process defines who does what, when and how to reach the goals of a software development project.

New or Changed Stakeholder Needs → Software Development Process → New or Changed Software System
Best Practices and the Unified Process

- Unified Process implements 6 best practices of software engineering

Unified Process

- Develop Iteratively
- Manage Requirements
- Use Component Architectures
- Model Visually
- Continuously Verify Quality
- Manage Change
Characteristics of the Unified Process

- **Use-case driven**
  - To drive process activities from functional requirements expressed using use case modeling techniques

- **Architecture-centric**
  - To build an executable architecture early in order to address important behavioral and structural system considerations

- **Iterative and incremental**
  - To partition the project lifecycle into multiple mini-waterfall projects each resulting in an executable release in order to mitigate risks
Scope of the Unified Process

- **In-scope**
  - Software development
  - Green-field development
  - Object-oriented paradigm
  - Project lifecycle

- **Out-of-Scope**
  - System development
  - Maintenance
  - Functional paradigm
  - Product lifecycle
Structure of the Unified Process
Lifecycle of the Unified Process

- 4 Phases and Major Milestones
  - Inception → Lifecycle Objective Milestone
    - Define project scope
  - Elaboration → Lifecycle Architecture Milestone
    - Build executable system architecture
  - Construction → Initial Operational Capability Milestone
    - Complete Beta version of the software system
  - Transition → Product Release Milestone
    - Complete GA version of the software system
Phases, Iterations and Milestones

- Inception
- Elaboration Iteration #1
- Elaboration Iteration #n
- Construction Iteration #1
- Construction Iteration #2
- Construction Iteration #n
- Transition Iteration #1
- Transition Iteration #n

- Lifecycle Objective Milestone (Major Milestone)
- Lifecycle Architecture Milestone (Major Milestone)
- Initial Operational Capability Milestone (Major Milestone)
- Product Release Milestone (Major Milestone)
2. What is Iterative Development?

- **Topics**
  - Best Practice: Develop Iteratively
  - Iterative Planning
  - Risk Definition
  - Risk and Iterative Development
  - Role
    - Project Manager
  - Artifact
    - Software Development Plan
    - Risk List
    - Iteration Plan
    - Iteration Assessment
Best Practice: Develop Iteratively

• Divide the lifecycle of your project into iterations where each iteration is a mini-project in itself that produces an incremental executable version of the system

• Realize high-priority and high-risk items in early iterations, and low-priority and low-risk items in late iterations
Iteration Definition

- Starts with planning and requirements, and ends with a release, internal or external
- Traverses all the discipline of the process: Requirements, Analysis & Design, Implementation, Test and Deployment
- Not a cycle of edit, compile, test, debug
Iterative Planning

- **Software Development Plan**
  - Entire project is planned at the macro level

- **Iteration Plan**
  - Each iteration is plan prior to starting its execution (PMBOK® Rolling-wave planning or progressive elaboration)
How Many Iterations are Necessary?

• Dependent on the nature of the project
• Typically between 4 and 9
• Typical iteration profiles
  – Low : 3 [0, 1, 1, 1]
  – Typical: 6 [1, 2, 2, 1]
  – High: 9 [1, 3, 3, 2]
  – Very high: 10 [2, 3, 3, 2]
How Long Should an Iteration Last?

- Dependent on the size of the project team
  - With 5 people → One week
  - With 20 people → 3 to 4 weeks
  - With 40 people → 3 months
Pragmatic Planning

- Project manager is concerned with only 3 plans at any given time
  - Software Development Plan
  - Current Iteration Plan
  - Next Iteration Plan
- The act of planning is more important than the plan itself
Risk Definition

- Uncertain event or condition that, if it occurs, has a positive or a negative effect on at least one project objective, such as time, cost, scope, or quality.

- Risk attributes
  - Probability
  - Impact

- Risk Strategies
  - Avoidance
  - Transfer
  - Mitigation
  - Acceptance
  - Contingency
Risk Management Definition

- A process takes care of the *known* aspects of software development
- Risk management takes care of the *unknown* aspects
Risk and Iterative Development

- Iterative development reduces risk early in the project lifecycle
Traditional Waterfall Software Project Lifecycle

1. Requirements Analysis
2. Design
3. Coding
4. Testing
5. Integration
Traditional Waterfall Project Progress Profile

- Requirements
- Design
- Coding
- Integration
- Testing
- Deployment

% Code Complete

0%

Integration begins

Late design breakage

Original Target Date

Actual Target Date

Time
Traditional Waterfall Project Risk Profile

- Risk Exploration Period
- Risk Elaboration Period
- Focused Risk Resolution Period
- Controlled Risk Management Period
Modern Iterative Project Progress Profile

- Modern Project Profile
- Traditional Project Profile

% Code Complete

Inception | Elaboration | Construction | Transition

Original Target Date | Actual Target Date

Time
Modern Iterative Project Risk Profile

- Inception
- Elaboration
- Construction – Transition

Modern Project Risk Profile

- Controlled Risk Management Period
- Conventional Project Risk Profile

Risk Exposure

- High
- Low

Risk Exploration Period
Risk Resolution Period

Risk Exposure
Unified Process Project Management Approach

• Engineering Stage (Inception and Elaboration Phases)
  – Realization of a few high-risk and high-priority use-cases and/or requirements
  – Driven by less predictable but smaller teams doing design and synthesis activities

• Production Stage (Construction and Transition Phases)
  – Realization of the remaining lower-risk and lower-priority use-cases and/or requirements
  – Driven by more predictable but larger teams doing construction, test, and deployment activities
## Focus of Lifecycle Stages

<table>
<thead>
<tr>
<th>Lifecycle Aspect</th>
<th>Engineering Stage</th>
<th>Production Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Reduction</td>
<td>Schedule, Technical Feasibility</td>
<td>Cost</td>
</tr>
<tr>
<td>Products</td>
<td><strong>Architecture Baseline</strong></td>
<td>Product Release Baselines</td>
</tr>
<tr>
<td>Activities</td>
<td>Analysis, Design, Planning</td>
<td>Implementation, Testing</td>
</tr>
<tr>
<td>Assessment</td>
<td>Demonstration, Inspection, Analysis</td>
<td>Testing</td>
</tr>
<tr>
<td>Economics</td>
<td>Resolving Diseconomies of Scale</td>
<td>Exploiting Economies of Scale</td>
</tr>
<tr>
<td>Management</td>
<td>Planning</td>
<td>Operations</td>
</tr>
</tbody>
</table>
## Effort and Schedule Profile per Phase

<table>
<thead>
<tr>
<th>Domain</th>
<th>Inception</th>
<th>Elaboration</th>
<th>Construction</th>
<th>Transition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effort</td>
<td>5%</td>
<td>20%</td>
<td>65%</td>
<td>10%</td>
</tr>
<tr>
<td>Schedule</td>
<td>10%</td>
<td>30%</td>
<td>50%</td>
<td>10%</td>
</tr>
</tbody>
</table>
Project Management Roles

• Project Manager
  – Responsible for managing the initiation, planning, execution, monitoring and control, and closure of the project, the phases and the iterations
Project Management Artifacts

- Project Manager
  - Business Case
  - Software Development Plan
  - Risk List
  - Iteration Plan
  - Iteration Assessment
Business Case

• Describes the business justification for the project
  – Product Description
  – Business Context
  – Product Overview
  – Financial Forecast
  – Constraints
Software Development Plan

- Describes the project plan at a macro level
  - Project purpose, scope and objectives
  - Assumptions and constraints
  - Work products
  - Organizational structure
  - External interfaces
  - Roles and responsibilities
  - Project Plan
    - Work breakdown structure (WBS), schedule, milestones
  - Other plans
Organizational Structure (Organizational Breakdown Structure – OBS)

- Project Organizational Breakdown Structure (OBS)
  - Management Team
    - Architecture Team
    - Development Team
    - Assessment Team
Work Breakdown Structure (WBS)

- Inception
  - Software Development Plan
  - Business Case
  - Vision
  - Use-Case Model (Outlined)

- Elaboration
  - Software Architecture Document
  - Use-Case Model (Partially Detailed)
  - Supplementary Specifications
  - Build (Executable Architecture)

- Construction
  - Design Model
  - Use-Case Model (Completely Detailed)
  - Build (Fully Detailed)

- Transition
  - Build (General Availability)
  - Build (Beta Version)
  - Test Cases
Risk List

- Describes known project risks with their magnitude (probability and impact)
  - For each risk identified
    - Risk magnitude or ranking
    - Description
    - Impact
    - Indicators
    - Mitigation strategy
    - Contingency Plan
### ATM Example: Use Cases and Risks Example

<table>
<thead>
<tr>
<th>Use Case</th>
<th>Bank System Interface</th>
<th>Card Reader Unit Interface</th>
<th>Cash Distribution Unit Interface</th>
<th>Graphical User Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Withdraw Cash</td>
<td>High Priority</td>
<td>High Priority</td>
<td>High Priority</td>
<td>High Priority</td>
</tr>
<tr>
<td></td>
<td>High Risk</td>
<td>High Risk</td>
<td>High Risk</td>
<td>High Risk</td>
</tr>
<tr>
<td>Deposit Funds</td>
<td>Medium Priority</td>
<td>Medium Priority</td>
<td>Medium Priority</td>
<td>Medium Priority</td>
</tr>
<tr>
<td></td>
<td>High Risk</td>
<td>High Risk</td>
<td>No Risk</td>
<td>High Risk</td>
</tr>
<tr>
<td>Transfer Funds</td>
<td>Medium Priority</td>
<td>Medium Priority</td>
<td>Medium Priority</td>
<td>Medium Priority</td>
</tr>
<tr>
<td></td>
<td>High Risk</td>
<td>High Risk</td>
<td>No Risk</td>
<td>High Risk</td>
</tr>
<tr>
<td>Pay Bill</td>
<td>Medium Priority</td>
<td>Medium Priority</td>
<td>Medium Priority</td>
<td>Medium Priority</td>
</tr>
<tr>
<td></td>
<td>High Risk</td>
<td>High Risk</td>
<td>No Risk</td>
<td>High Risk</td>
</tr>
<tr>
<td>Print Statement</td>
<td>Medium Priority</td>
<td>Medium Priority</td>
<td>Medium Priority</td>
<td>Medium Priority</td>
</tr>
<tr>
<td></td>
<td>High Risk</td>
<td>High Risk</td>
<td>No Risk</td>
<td>High Risk</td>
</tr>
</tbody>
</table>

**Question:** Which Use Case(s) should be realized in the Engineering Stage?
Iteration Plan

- Describes the scope (in terms of use cases/scenarios included in the scope) and plan for a specific iteration
  - Plan
  - Resources
  - Use Cases
  - Evaluation Criteria
ATM Examples: Iteration Plan for the First Iteration of Elaboration

• Use Cases/Scenarios
  – Withdraw Cash – Main Flow
  – Deposit Funds – Main Flow

• Why?
  – Because this will force the project team to mitigate the risks associated with interfaces to the Banking System and all ATM devices
Iteration Assessment

- Describes the assessment of the iteration in terms of whether or not objectives were achieved for a specific iteration
  - Iteration Objectives Reached
  - Adherence to Plan
  - Use Cases and Scenarios Implemented
  - Results Relative to Evaluation Criteria
  - Test Results
  - External Changes Occurred
  - Rework Required
ATM Example: Iteration Assessment

- Iteration objectives partially reached
  - Main flows of the Withdraw Cash and Deposit Funds use cases were implemented
  - All risks associated with interfaces to the Bank System and ATM devices were mitigated except for the envelop collector
  - An envelop collector from another vendor will need to be selected and integrated in a follow-on iteration
3. Iterative Development in the Unified Process

- **Topics**
  - **Inception Phase**
    - Inception Lifecycle Objectives Milestone
    - Inception Key Roles
    - Inception Key Artifacts
  - **Elaboration Phase**
    - Elaboration Lifecycle Architecture Milestone
    - Elaboration Key Roles
    - Elaboration Key Artifacts
  - **Construction Phase**
    - Construction Initial Operational Capability Milestone
    - Construction Key Roles
    - Construction Key Artifacts
  - **Transition Phase**
    - Transition Product Release Milestone
    - Transition Key Roles
    - Transition Key Artifacts
Inception Lifecycle Objective Milestone

- Objectives
  - Define scope of the project agreed-upon by all stakeholders
  - Identify risks on the project and plan response on these risks
  - Plan project
  - Secure budget for Elaboration
Inception Key Roles

- Requirements
  - System Analyst
- Project Management
  - Project Manager
- Environment
  - Process Engineer
  - Tools Specialist
Inception Key Artifacts

- **Requirements**
  - Vision
  - Use-Case Model (Outlined for all use cases)
  - Glossary

- **Project Management**
  - Business Case
  - Risk List
  - Software Development Plan (Elaboration phase planned in details)
  - Iteration Plan (Elaboration phase first iteration)

- **Environment**
  - Development Process
  - Development Infrastructure
Elaboration Architecture Objective Milestone

- Objectives
  - Baseline an executable architecture
  - Mitigate high-priority risks (high-probability and high-impact risks)
  - Secure budget for Construction
Elaboration Key Roles 1/2

• Requirements
  – System Analyst
  – Requirements Specifier

• Analysis & Design
  – Software Architect
  – Designer

• Implementation
  – Implementer
  – Integrator
Elaboration Key Roles 2/2

- Test
  - Test Manager
  - Test Analyst
  - Test Designer
  - Tester
- Project Management
  - Project Manager
- Environment
  - Process Engineer (Support)
  - Tools Specialist (Support)
Elaboration Key Artifacts

- **Requirements**
  - Use-Case Model (Detailed for architecturally-significant use cases only)
  - Supplementary Specifications
- **Analysis & Design**
  - Software Architecture Document
  - Design Model (Use-case realizations for architecturally-significant use cases only)
  - Data Model (if applicable)
- **Implementation**
  - Implementation Model (Implementation elements to support the realization of architecturally-significant use cases only)
  - Build (Executable architecture)
- **Test**
  - Test Cases (Partial)
- **Project Management**
  - Software Development Plan (Construction phase planned in details)
  - Iteration Plan (Construction first iteration)
Construction Initial Operational Capability Milestone

- Objectives
  - Complete development of all remaining capabilities
  - Ensure quality of the product
  - Prepare user support material
  - Secure budget for Transition
Construction Key Roles 1/2

- **Requirements**
  - System Analyst (Support)
  - Requirements Specifier

- **Analysis & Design**
  - Software Architect (Support)
  - Designer

- **Implementation**
  - Implementer
  - Integrator
Construction Key Roles 2/2

- Test
  - Test Manager
  - Test Analyst
  - Test Designer
  - Tester

- Deployment
  - Technical Writer

- Project Management
  - Project Manager

- Environment
  - Process Engineer (Support)
  - Tools Specialist (Support)
Construction Key Artifacts

- Requirements
  - Use Case Model (Fully detailed)
- Analysis & Design
  - Design Model (Complete)
  - Data Model (Complete if applicable)
- Implementation
  - Implementation Model (Complete)
  - Build (Complete)
- Test
  - Test Cases (All)
- Project Management
  - Software Development Plan (Transition phase planned in details)
  - Deployment Plan
  - Iteration Plan (Transition first iteration)
Transition Product Release Milestone

- Objectives
  - Ensure that the product is available for its end-users
  - Fine tuning the product based on user feedback
Transition Key Roles 1/2

- **Requirements**
  - System Analyst (Support)
  - Requirements Specifier (Support)

- **Analysis & Design**
  - Software Architect (Support)
  - Designer (Support)

- **Implementation**
  - Implementer (Support)
  - Integrator (Support)

- **Test**
  - Test Manager (Support)
  - Test Analyst (Support)
  - Test Designer (Support)
  - Tester (Support)
Transition Key Roles 2/2

- **Deployment**
  - Technical Writer (Support)
  - Deployment Manager
- **Project Management**
  - Project Manager
- **Environment**
  - Process Engineer (Support)
  - Tools Specialist (Support)
Transition Key Artifacts

- Implementation
  - Build (General availability version)
- Deployment
  - End-User Material
Line-of-Business Organization

- **Organization Manager**
  - Software Engineering Process Authority
    - Process definition
    - Process improvement
  - Software Engineering Environment Authority
    - Process automation
  - Project Review Authority
    - Project compliance
    - Periodic risk assessment
  - Infrastructure
    - Project administration
    - Engineering skill centers
    - Professional development

- **Project**
  - Project A Manager
  - Project B Manager
  - Project C Manager
  - Project N Manager
Project Organization

Software Management
- Business Case
- Vision
- Software Development Plan
- Work Breakdown Structure
- Status Assessments
- Requirements Set

Software Architecture
- Architecture Description
- Requirements Set
- Design Set
- Release Specifications

Software Development
- Design Set
- Implementation Set
- Deployment Set

Software Assessment
- Deployment Set
- User Manual
- Environment
- Release Specifications
- Release Descriptions
- Deployment Documents
Evolution of the Project Team

Inception
- Software Management 50%
- Software Architecture 20%
- Software Development 20%
- Software Assessment 10%

Elaboration
- Software Management 10%
- Software Architecture 50%
- Software Development 20%
- Software Assessment 20%

Transition
- Software Management 10%
- Software Architecture 5%
- Software Development 35%
- Software Assessment 50%

Construction
- Software Management 10%
- Software Architecture 10%
- Software Development 50%
- Software Assessment 30%
Human Resource Utilization

- Give each resource many roles and responsibilities to keep them utilized throughout the lifecycle of the project
- Business Analysts are usually good testers but are not good developers
- Architects and designers are usually good developers but are not good testers
4. Case Studies

- Topics
  - Ericsson Blue Ridge Labs, Lynchburg, VA
  - Rational Software, Boston, MA
  - Why so few Case Studies?
Ericsson (1999 to 2000)

- **Goal**
  - To build the embedded software for an Ericsson cellular phone

- **Iteration Duration**
  - 3 weeks

- **Other considerations**
  - Large team organized in silos
  - Not so successful model
Rational Software (2000 to 2002)

- **Goal**
  - To implement a Customer Relationship Management (CRM) system for the Marketing, Sales and Customer Support organizations of Rational Software

- **Iteration Duration**
  - 6 to 8 weeks

- **Other considerations**
  - Small collocated team
  - Implementation of a package application; not pure development
  - Analysts were also testers
  - Successful model

- **Reference**
  - Serge Charbonneau. Using RUP to Implement a Package Application, Rational Edge, April 2003
Why so few Case Studies?

• Because iterative model represents such a paradigm shift in the way software is being developed
• Other Unified Process best practices are being implemented a lost more than iterative development
• PMBOK does not provide a lot a guidance on iterative development (progressive elaboration)
Xelaration’s Mission

“To accelerate the success of our customers in improving their software engineering capabilities enabling them to achieve their business goals”