Chapter 1

Software Process

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Version 1.0
Topics

- The Nature of Software Development
- System Planning
- Software Lifecycle Phases
- Software Development Approaches
The nature of software (Brooks)

- **The software essence**
  - Complexity
  - Conformity
  - Changeability
  - Invisibility

- **The software accidents**
  - Stakeholders
  - Process
  - Modeling language and tools
Software development invariant

- Software production is an art
  - Software is developed, not manufactured
  - … but
    - OT & re-use
    - COTS
    - ERP
      - … but what about core business?
    - Component technology
      - CORBA
      - DCOM
      - EJB
Stakeholders

- Two groups
  - Customers
    - Users
    - System owners
  - Developers
    - Analysts
    - Designers
    - Programmers, etc.

- Main causes of software failures
- “Great designs come from great designers”
Process

- Process for:
  - Order of activities
  - Product delivery (what, when)
  - Assignment to developers
  - Monitoring → measuring → planning

- Cannot be codified or standardized
- Process and project size
- Iterative and incremental
CMM

Level 1
Initial

Unpredictable and undisciplined process that depends on the current staff.

Level 2
Repeatable

Repeatable project management; consistent time and effort predictions for similar projects.

Level 3
Defined

Both management and engineering processes are codified and followed.

Level 4
Managed

Metrics used to control the process.

Level 5
Optimizing

Continuous process improvement in place.

Improve process discipline

Improve process definition

Improve process metrics

Improve process change management

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Chapter 1

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ISO 9000

- Quality management
- Process
- ISO standards are about
  - What must be accomplished
  - Not about how
- Certification
  - Company must document and record its activities
  - On-site audit by an ISO registrar
Modeling Language and Tools

- **Language**
  - Visual
  - Declarative semantics

- **Tool**
  - CASE
  - Repository
  - Collaboration
  - Versions
  - Consistency and integrity of models
  - Report and code generation
UML

- Rational Software Corporation
- OMG
- Rational Unified Process
- OO
- Implementation independent
- Models
  - State
  - Behavior
  - State change
- CASE and process improvement
System Planning

- **Business strategy**
  - Small organizations
  - Large organizations

- **Approaches**
  - SWOT
  - VCM
  - BPR
  - ISA

- **Effectiveness vs. efficiency**
SWOT

- Mission statement
- Internal strengths and weaknesses
- External opportunities and threats
- Objectives
- Goals
- Strategies
- Policies
**Value chain** – from raw materials to final products sold and shipped to customers

*Primary activities*

*Support activities*
  * Incl. IS development

*IT can transform organization’s value chain*
**BPR**

- Organizations structured as *vertical* units
- Who is responsible for a business process
- Processes cut *horizontally* across the business and end at points of contact with customers
- Process redesign
- Workflow analysis
- BPI
- IT support
ISA

- Neutral architectural framework
- Does not include a system planning methodology
- Table of thirty cells
  - Five rows (perspectives)
    - Planner, owner, designer, builder, subcontractor
  - Six columns (descriptions, architectural models)
    - What, how, where, who, when, why
## Systems and management levels

<table>
<thead>
<tr>
<th>Level of decision making</th>
<th>Focus of decision making</th>
<th>Typical IS applications</th>
<th>Typical IT solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic</td>
<td>Strategies in support of organizational long-term objectives</td>
<td>Market and sales analysis, Product planning, Performance evaluation</td>
<td>Data mining, Knowledge management</td>
</tr>
<tr>
<td>Tactical</td>
<td>Policies in support of short-term goals and resource allocation</td>
<td>Budget analysis, Salary forecasting, Inventory scheduling, Customer service</td>
<td>Data warehouse, Analytical processing, Spreadsheets</td>
</tr>
<tr>
<td>Operational</td>
<td>Day-to-day staff activities and production support</td>
<td>Payroll, Invoicing, Purchasing, Accounting</td>
<td>Database, Transactional processing, Application generators</td>
</tr>
</tbody>
</table>
Software lifecycle phases

- Coarse granularity
  - Analysis
  - Design
  - Implementation

- Refined granularity
  - Requirements determination
  - Requirements specification
  - Architectural design
  - Detailed design
  - Implementation
  - Integration
  - Testing
Requirements phase

- Requirement – statement of a system service or constraint
- Service
  - Business rule
  - Computation
- Constraint
- Information gathering
- Requirements document
Specification phase

- Requirements document $\rightarrow$ specification document

- Visual modeling
  - Class diagrams
  - Use case models

- Implementation independent
Architectural design

- **Solution strategy**
  - Client
  - Server
  - Application logic layer

- **Modules (use cases)**

- **UML:**
  - Packages
  - Components
  - Deployment
**Detailed design**

- User interface (client)
- Database (server)
- Application logic
- **UML**
  - Class diagrams
  - Use cases
  - Activity diagrams
  - Sequence diagrams
  - Collaboration diagrams
  - Statecharts
Implementation

- Installation
- Coding
- Loading test and production databases
- Testing
- Performance tuning
- DBA
- User training
Integration

- Incremental integration
- Dependencies between modules (coupling)
  - Stubs
  - Drivers
- Uniform distribution of intelligence in modern OO systems
- Designing OO systems for integration
Maintenance

- Housekeeping
- Adaptive maintenance
- Perfective maintenance
- Software phasing-out
  - Perfective maintenance cannot help
  - Unpredictable effects of changes
  - Lack of documentation
  - Platform to be replaced
Project planning in lifecycle

- “Fixed” constraints
  - Time
  - Money
- Moving target
- Project feasibility
  - Operational
  - Economic
  - Technical
  - Schedule
- Project plan
Metrics in lifecycle

- Part of project and process management

- Metrics = measurements

- Measuring software products (quality and complexity)

- Measuring development products (process metrics)
Testing in lifecycle

- Spans the lifecycle
- Test plans and test cases
- Traceability to use cases
- SQA

Test types:

- Formal reviews (walkthroughs, inspections)
- Execution-based
- Incremental (regression) testing
- Capture-playback tools
Software development approaches

- The past
  - Procedural programs
  - Deterministic execution
  - Program in control

- The present
  - Interactive program
  - Event-driven execution
  - Objects

- Structured vs. Object-Oriented
Structured approach

- Modeling techniques
  - DFD
  - ERD

- Problems
  - Sequential and transformational
  - Inflexible solutions
  - No reuse
Object-Oriented approach

- Data-centric
- Event-driven
- Addresses emerging applications
- Addresses application backlog
- Follows iterative and incremental process

Problems

- Semantic gap in case of relational database implementation
- Project management
- Solution complexity
Summary

- **Nature** of software development – *craft* or even *art*
- **The triangle for success** – stakeholders, process, modeling language and tools
- **System planning** – SWOT, VCM, BPR, ISA
- **The software development lifecycle**
- **Structured development approach**
- **Object-oriented development approach**