Chapter 1

Software Process

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.
  - Improve process definition

- **Level 4: Managed**
  - Metrics used to control the process.
  - Improve process metrics

- **Level 5: Optimizing**
  - Continuous process improvement in place.
  - Improve process change management

### 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
**VCM**

- **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>Strategy 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 generation</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 → 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