Model-Integrated Software System Engineering (MISSE)

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MISSE Tutorial Outline

8:15-9:00 Boehm - MISSE Overview and Motivation
   - Model clash taxonomy and examples

9:00-10:00 Boehm - MISSE Framework
   - Relations to Objectory, AT&T/Lucent ARB’s
   - Application to Digital Library projects
   - CCPDS-R example

10:00-10:30 Break

10:30-11:30 Port - Product Model Integration
   - Digital Library examples

11:30-12:00 Boehm, Port - Questions, general discussion
How Does it Fit Together?

**Success Models**
- Win-Win: Business Case Analysis
- Software Warranties: COTS
- 10x: Six Sigma
- Award Fees
- JAD: RAD

**Product Models**
- OML
- CORBA
- COM
- Architecture
- Product Lines
- OO Analysis & Design
- Domain Ontologies
- COTS: GOTS

**Process Models**
- Spiral
- Waterfall
- Risk Management
- Business Process Reengineering
- CMM’s: Peopleware
- IPT’s: Objectory
- Groupware

**Property Models**
- COCOMO
- COTS: Checkpoint
- System Dynamics
- Metrics: Lifelines
- Simulation & Modeling

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**MiSSE Integration Framework**

**Success Models**
Win-Win; IKWISI; Business Case; Mission Models;

**Process Models**
- Life-Cycle
- Waterfall
- Evolutionary
- Incremental
- WW Spiral
- Anchor Points
- Risk Mgmt.
- Activities
- CMM KPA’s

**Property Models**
Cost & Schedule; Performance; Assurance; Usability;...
Examples of Model Clashes

- Product Model Clashes: structure clashes, traceability clashes, architectural style clashes
- COTS-driven product and Waterfall process
- Risk-based process and spec-based progress payments
- Design-to-cost process and tightly-coupled architecture
- Incremental process and Rayleigh-curve staffing model
- Evolutionary development without life-cycle architecture
- Golden Rule and stakeholder win-win
- Spec-based process and IKIWIISI success model
  - I'll know it when I see it

The Golden Rule as Software Success Model

- Do unto others
- As you would have others
- Assuming users and operators like to write programs, and know computer science
- Better to use Modified Golden Rule
- Do unto others as you would have others do unto you
  - If you were like them

- Build computer systems to serve users and operators
- Users love powerful, obscure, UNIX-like commands
- Users are pilots, doctors, tellers: Keep it simple
Where do Models (and Clashes) Come From?
- Childhood training
  - Golden Rule, easiest - first
- Past experience
  - Waterfall, Rayleigh curve
- Exaggerating for effect
  - Quality is free, COTS marketing
- Government/Corporate policy
  - Use waterfall, use COTS, use Ada, use 4GL’s, Cost as Independent Variable

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MISSE Conceptual Framework

Success Models Impose Metrics of Space of Operating Points
Elements of Critical Front End Milestones

<table>
<thead>
<tr>
<th>Milestone Element</th>
<th>Life Cycle Objectives (LCO)</th>
<th>Life Cycle Architecture (LCA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition of Operational Concept</td>
<td>Operations, policies and procedures</td>
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</tr>
<tr>
<td>Initial Operational Capability</td>
<td>Software preparation</td>
<td>Operational and support software</td>
</tr>
<tr>
<td>Software preparation</td>
<td>Operational readiness testing</td>
<td>COTS licenses</td>
</tr>
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<td>Software preparation</td>
<td>Site preparation</td>
<td>Site preparation</td>
</tr>
<tr>
<td>Facility, equipment, supplies, vendor support</td>
<td>User, operator, and maintainer preparation</td>
<td>Selection, teambuilding, training</td>
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Initial Operational Capability (IOC)

- Software preparation
  - Operational and support software
  - Data preparation, COTS licenses
  - Operational readiness testing

- Site preparation
  - Facilities, equipment, supplies, vendor support

- User, operator, and maintainer preparation
  - Selection, teambuilding, training
Architecture in a Project's Life Cycle

It encompasses the requirements, architecture and high level design phases of the typical waterfall diagram. It also continues throughout the life of the project (someone continues to wear the architect's hat).

Architecture Review (LCA)

Architecture in a Project's Life Cycle:

Planning and Architecture Phase

Iterative process until consensus is reached

Carries through the life of the project

Architecture Review (LCA)

Chairperson meets with the project to determine technical focus and required expertise for review

Chairperson assembles review team of stakeholders and subject matter architecture experts; project sends out review material

A 2 or 3 day review is conducted. Detailed talks are presented on key technical areas. Issues raised during discussions are recorded on cards

Immediate readout is given to the team at the end of the review. Cards are grouped by: Things Done Right, Issues, and Recommendations

Chairperson follow up with a written report and presentation to the project's management if requested

Used regularly since 1988, with over 10% project savings
MISSE Example I - Digital Library Applications

• The Challenge
• MISSE Approach
• 1996-97 Results
• 1997-98 Results to Date

The Challenge

• 15 Digital Library Applications
  – 2 sentence problem statements
  – Librarian clients
• 86 Graduate Students
  – 30% with industry experience
  – Largely unfamiliar with each other, Library ops.
  * Develop LCA packages in 11 weeks
• Re-form teams from 30 continuing students
  * Develop IOC packages in 12 more weeks
    – Including 1-week beta test
Domain Model: Block Diagram

- Users
- System Boundary
- Multimedia Asset Access
- Multimedia Assets
- Multimedia Asset Managers
- Existing Asset Managers
- Existing System
- IA System Infrastructure
- IA System
- IA System Operations and Maintenance (O&M)
- IA: Information Archive
Specified Product Views

- System Block Diagrams
- Requirements Templates
- Usage Scenarios
- Physical Architecture
- Objects and Classes
- Object Interaction Diagrams
- Dataflow Diagrams
- State Transition Diagrams
- Event Sequence Diagrams
- Data Descriptions
- Requirements Traceability

Synthesized from Booch, Rumbaugh, Sommerville, J-STD-016

Box-and-Arrow Representation
Project Results: Development

- All products completed on schedule
- Librarians generally enthusiastic about products
  
  3-Committed to implementation
    - Cinema-TV, Business School, Tech. Reports
  
  2-Investing in further effort
    - Latin American Pamphlets, Medieval Manuscripts
  
  1-Awkward synthesis of 3 applications
    - 3 photo archives not equivalent

- Continuing in 1997-98
  - 20 candidate Library projects; mostly new

Librarians' Views of WinWin

- Recognized that everyone's win conditions were essential for project success
- Developed stronger awareness of software developers' issues
- Thought more critically about our own measure of success
- Made us more likely to look for others' win conditions
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Case Study: CCPDS-R Project Overview

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>CCPDS-R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain</td>
<td>Ground based C3 development</td>
</tr>
<tr>
<td>Size/language</td>
<td>119M SLOC Ada</td>
</tr>
<tr>
<td>Average number of people</td>
<td>75</td>
</tr>
<tr>
<td>Schedule</td>
<td>75 months</td>
</tr>
<tr>
<td>Process/standards</td>
<td>DOD-STD-2167A iterative development</td>
</tr>
<tr>
<td>Environment</td>
<td>Rational host</td>
</tr>
<tr>
<td></td>
<td>DEC host</td>
</tr>
<tr>
<td></td>
<td>DEC VMS targets</td>
</tr>
<tr>
<td>Contractor</td>
<td>TRW</td>
</tr>
<tr>
<td>Customer</td>
<td>USAF</td>
</tr>
<tr>
<td>Current status</td>
<td>Delivered On-budget, On-schedule</td>
</tr>
</tbody>
</table>
Common Subsystem Macroprocess

Development Life Cycle

Inception

Elaboration

Construction

Architecture iterations

Release iterations

Contract award

Architecture baseline

Early delivery of "alpha" capability to use

Competitive design phase:
- Architectural prototypes
- Planning
- Requirements analysis

Contract award (LCO)

Architecture baseline under change control (LCA)

Baseline under change control

Negligible

Formal test

0% 12%

Performance assessment

Modeling

80% of operational software demonstrated

Common Subsystem Progress

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<thead>
<tr>
<th>CDR progress</th>
<th>Traditional Approach</th>
<th>CCPS-R Approach</th>
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<tbody>
<tr>
<td>Software design</td>
<td>Complete</td>
<td>Complete</td>
</tr>
<tr>
<td>Code development</td>
<td>10%</td>
<td>15%</td>
</tr>
<tr>
<td>Baseline under change control</td>
<td>Negligible</td>
<td>47%</td>
</tr>
<tr>
<td>Formal test</td>
<td>0%</td>
<td>2%</td>
</tr>
<tr>
<td>Performance assessment</td>
<td>Modeling</td>
<td>80% of operational software demonstrated</td>
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RATIONAL
References

(Boehm et al. papers available at http://sunset.usc.edu)

