Composable Process Elements for COTS-Based Applications

Ye Yang, USC
yangy@sunset.usc.edu

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Outline

• Introduction
• Motivation
• CBA Process Decision Framework
• CBA Process Elements
• Elaborated Win Win Spiral Model
• Example
• Conclusion
Introduction

- Increasing COTS-composing Trend
- Traditional sequential processes do not work for COTS-Based Applications (CBA’s)
- COTS solutions driven primarily by the systems objectives, constraints & priorities (OC&P’s)
  - Effort distributed among COTS assessment, tailoring, and glue code development
Key Definition and Context

• COTS Based Applications
  – as a system for which
    • at least \textbf{10\%} of the development effort is devoted to COTS considerations
    • at least \textbf{30\%} of the end-user functionality is provided by COTS products

• Different from new code applications on COTS platforms
Increase in CBA projects

- CBA Growth Trend
  - USC e-services project data shows: from 28% in 1997 to 60% in 2001

- Major Implications for education, staffing, processes, research
Need Stronger CBA Process Guidance

• Problems with current CBA process models
  – Overly sequential; waterfall-based
  – Insufficiently specific

• New model based on CBA sources of effort
  – Process happens where the effort happens
Example Waterfall-based Model

- **UMD COTS Process**
More Realistic But Nonspecific Model

- SEI EPIC
CBA Effort Distributions

- USC e-Service project data
  - 5 person teams
  - 24 weeks fixed schedule

- COCOTS Calibration Data
  - Small to large business mgmt., analysis, and control applications
CBA Effort Sequences

• An Observation from USC e-service project processes

<table>
<thead>
<tr>
<th>Sample</th>
<th>Effort Sequences</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AC; ATG; C</td>
<td>Non-COTS solution first, then introduced COTS, finally follow non-COTS solution.</td>
</tr>
<tr>
<td>2</td>
<td>AT; A(TG)</td>
<td>The second A was performed because the client introduced new candidates; and assessment done by performing T and G.</td>
</tr>
<tr>
<td>3</td>
<td>A(TG); AG</td>
<td>Insufficient first A: the COTS didn’t work as expected. Stakeholders’ renegotiation based on the results provided by the second A.</td>
</tr>
<tr>
<td>4</td>
<td>A(TG); A(TG)</td>
<td>The second A was inserted because new COTS candidates were introduced by the client.</td>
</tr>
<tr>
<td>5</td>
<td>AT; AT</td>
<td>Insufficient first A.</td>
</tr>
<tr>
<td>6</td>
<td>ATG</td>
<td>A basic COTS integration process.</td>
</tr>
<tr>
<td>7</td>
<td>AT</td>
<td>Tailoring a content management tool selected by the client.</td>
</tr>
<tr>
<td>8</td>
<td>AT; (AA); A(TG); (TGC)</td>
<td>See my example project: Oversized Image Viewer later.</td>
</tr>
</tbody>
</table>

A: Assessment T: Tailoring G: Glue code development D: Custom Development
CBA Decision Framework(1)

• A recursive and reentrant process
  – to accommodate concurrent CBA activities
  – to adapt to frequent go-backs based on new and evolving OC&P’s and COTS considerations

• 3 Critical development process elements:
  – COTS assessment
  – COTS tailoring
  – COTS glue code development
CBA Decision Framework (2)

P1: Identify OC & P's: Evaluation Criteria, Weights and Scenarios

P2: Identify alternatives: Candidate COTS products

P3: Assess Candidate COTS products

P4: Tailoring Required?

P5: Multiple COTS cover all OC & P's?

P6: Can Adjust OC & P's?

P7: Custom Development

P8: Coordinate Application Code development and Glue Code effort

P9: Develop Custom Code

P10: Develop Glue Code

P11: Tailor COTS products

P12: Productize, Transition Application

Start

Yes

No

Deploy
Assessment Process Elements

A1: Initial filtering of candidates with respect to criteria

A2: Need tailoring or glue code for evaluation

A3: Evaluate remaining COTS candidates

P4: Tailoring Required?

P5: Multiple COTS cover OC & P’s?

P6: Can Adjust the OC & P’s?

Tailoring or Glue Code uncertainties

Yes, Glue Code

None Acceptable

None

Yes, Tailor

Acceptable

Full-COTS solution best

Partial-COTS solution best

None

Acceptable

Candidates remaining

None
Tailoring Process Elements

T1: Identify Tailoring Options

T2: Clear best tailoring choice?

A

Yes

No

Evaluate remaining COTS candidates

T3: Perform Tailoring

Develop and Integrate

Productize, Transition, Solution
GlueCode Process Elements

G1: Best Choice?
- Yes
  - G2: Tailoring?
    - No
      - G4: Develop and Integrate
    - Yes
      - Several Options
        - G5: Best Option?
          - No, Out of Options
            - G6: Solution Satisfactory?
              - Yes
                - P12: Productize, Transition Application
              - No
                - P8: Coordinate Application Code development and Glue Code effort
  - Yes
    - P2: Identify alternatives: Candidates COTS products

G3: Identify Remaining Valid Combinations
- No Valid Combinations
- Yes
  - G4: Develop and Integrate
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  ➢ Elaborated Win Win Spiral Model
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Elaborated Win Win Win Spiral Model

1a. Identify Success-Critical Stakeholders
1b. Stakeholders Identify System Objectives, Constraints, & Priorities (OC & P’s) Alternatives Solution Elements

Progress Through Steps
Cumulative Cost

2a. Evaluate Alternatives with respect to OC & P’s
2b. Assess, Address Risks

3. Elaborated Product and Process Definitions
4. Verify and Validate Product and Process Definitions

Stakeholders' Review and Commitment

LCO: Life Cycle Objectives
LCA: Life Cycle Architecture
CCD: Core Capability Demo
IOC: Initial Operational Capability
Example CBA: Oversize Image Viewer

- **Client:**
  - A librarian at USC

- **Developers:**
  - A development team of 5 graduates at USC

- **Main tasks**
  - Development of a viewing capability for oversized images, including features such as
    - Image navigation, cataloging, search, archive, and access administration

- **Application of CBA decision framework**
  - First three win-win spiral cycles
  - Sequencing of tasks driven by stakeholders’ win conditions and projects major risk items
# Spiral Model Application to Oversize Image Viewer

## Cycle 1
- **Stakeholders**: Developer, customer, library-user client, COTS vendors
- **OC&P’s**: Image navigation, cataloguing, search, archive and access administration
  - COTS cost ≤ $25K, ≥ 5 user organizations
  - IOC developed, transitioned in 24 weeks
- **Alternatives**: ER Mapper, Mr SID, Systems ABC, XYZ
- **Evaluation; Risks**: XYZ > $25K; ABC < 5 user org’s
  - ER Mapper, Mr SID acceptable
  - Risk: picking wrong product without exercise
- **Risk Addressed**: Exercise ER Mapper, Mr SID
- **Risk Resolution**: ER Mapper image navigation, display stronger
- **Product Elaboration**: Use ER Mapper for image navigation, display
- **Process Elaboration**: Tailor ER Mapper for library-user Windows client
- **Product Process**: Customer: want campus-wide usage, support of Unix, Mac platforms
  - ER Mapper runs only on Windows
- **Commitment**: Customer will find Unix, Mac user community representatives

## Cycle 2 (LCO)
- **Stakeholders**: Additional user representatives (Unix, Mac communities)
- **OC&P’s**: System usable on Windows, Unix, and Mac platforms
- **Alternatives**: ER Mapper, Mr SID
- **Evaluation; Risks**: ER Mapper Windows-only, plans to support Unix, Mac; schedule unclear
  - Mr SID supports all 3 platforms
  - Risk: Unix, Mac non-support
- **Risk Addressed**: Ask ER Mapper for guaranteed Unix, Mac support in 9 months
- **Risk Resolution**: ER Mapper: no guaranteed Unix, Mac support even in 18 months
- **Product Elaboration**: Use Mr SID for image navigation, MySQL for catalog support, Java for admin/GUI support
- **Process Elaboration**: Prepare to tailor Mr SID, MySQL to support all 3 platforms
- **Product Process**: Need to address Mr SID/MySQL/Java interoperability, glue code issues; GUI usability issues
- **Commitment**: Customer will buy Mr SID

## Cycle 3 (LCA)
- **Stakeholders**: Additional end-users (staff, students) for usability evaluation
- **OC&P’s**: Detailed GUI’s satisfy representative users
- **Alternatives**: Many GUI alternatives
- **Evaluation; Risks**: Risk of developing wrong GUI without end-user prototyping
  - Mr SID/MySQL/Java interoperability risks
- **Risk Addressed**: Prototype full range of system GUI’s, Mr SID/MySQL interfaces
determined
- **Risk Resolution**: Acceptable GUI’s, Mr SID/MySQL/Java interfaces determined
- **Product Elaboration**: Develop production Mr SID/MySQL/Java glue code
- **Process Elaboration**: Use Schedule as Independent Variable (SAIV) process to ensure acceptable IOC in 24 weeks
- **Product Process**: Need to prioritize desired capabilities to support SAIV process
- **Commitment**: Customer will commit to post-deployment support of software
  - Users will commit to support training, installation, operations
Use of the CBA Decision Framework in Cycle 1

Assessing COTS’s for image viewing capabilities
Composing the Assessment Element in Cycle 1

A1: Initial filtering of candidates with respect to criteria

A2: Need tailoring or glue code for evaluation

A3: Evaluate remaining COTS candidates

P4: Tailoring Required?

P5: Multiple COTS cover OC & P’s?

P6: Can Adjust the OC & P’s?

Candidates remaining

Yes, Glue Code

Yes, Tailor

None Acceptable

Partial-COTS solution best

Full-COTS solution best

Tailoring or Glue Code uncertainties

None Acceptable

Yes, Glue Code
Assessing COTS’s for additional objectives

Use of the CBA Decision Framework in Cycle 2

1. Identify OC & P’s: Evaluation Criteria, Weights and Scenarios
2. Identify alternatives: Candidate COTS products
3. Assess Candidate COTS products
4. Tailoring Required?
5. Multiple COTS cover all OC & P’s?
6. Can Adjust OC & P’s?
7. Custom Development
8. Coordinate Application Code development and Glue Code effort
9. Develop Custom Code
10. Develop Glue Code
11. Tailor COTS products
12. Productize, Transition Application

Yes

No

None Acceptable

Partial COTS Solution Best

Full COTS solution best
No Application Code or Glue Code Required

Deplo y

Start

Assessing COTS’s for other features
Use of the CBA Decision Framework in Cycle 3

Detailed assessment; tailoring and glue coding to help assessing interoperability
Conclusions

• Incidence of CBA’s increasing
  – Major implication for education, staffing, processes, and research

• Current software process guidelines don’t fit CBA’s well
  – Overly sequential; non-specific

• CBA process framework presented here working well for e-services projects
  – Addresses major sources of effort on general CBA’s: assessment, tailoring, glue code
Questions?