CSE Annual Research Review

Large-Project Research
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Goals of Presentation

Introduce some of the technical challenges facing CSE through the large-project assistance to

- FAA Large system builds:
  - Early and evolving estimates: Function Points to SLOC
  - Roll-up of effort estimates for systems of systems

- FCS: YalSoS
  - “True” Spiral Development (Models and processes)
  - Applying MBASE/RUP concepts
    - Spiraled IECT
    - Feasibility Rationale Documents
    - Architecture Review Boards
  - to integration of incrementally delivered
    - models
    - simulations
    - software
Estimation for En Route Systems Acquisition

Presented at SIS Conf ‘03

En Route System Components

Characterization: Systems of Systems with COTS, Reuse, and system interdependencies

Estimation techniques & Challenges
Enroute System

Domestic Air Traffic Control

Stakeholders

~ 500 FAA Managed Air Traffic Control Towers
~ 180 Terminal Radar Control Centers

~ 60 Flight Service Stations
~ 40,000 Radars, NAVAIDs, Radios, etc.

Flight Data Specialists
Quality Assurance
Weather Service
Traffic Flow Management
Airspace & Procedures
System Operators
System Maintainers

Airlines, Pilots, GA, Military

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Characterizations of ERAM

Systems of Systems with COTS, Reuse, and system interdependencies

Cost and Schedule estimation requires
- Good, independent size estimate(s)
- Valid historical data from comparable systems
Estimation Techniques & Challenges

Function Point Methodology for early sizing

Historical Database for reasonable backfiring

Multiple estimates and comparisons with rationales for differences

- Sizing: Function Points by FAA; SLOC (by ?) vendor(s)
- Effort: Function Point (using productivity data); COCOMO

Re-estimation Reasons

- Size Estimate changes: more detailed
- Functionality changes => size changes
- Environment changes => driver changes
- Milestones

Roll-up for system of systems
Future Combat Systems (FCS)
CeBASE Assisting DoD SIS & Darpa PMO

“True” Spiral Development (Models and processes)
Applying MBASE/RUP concepts

- Spiraled IECT
- Feasibility Rationales
- Architecture Review Boards

To integration of incrementally delivered
- models
- simulations
- software
1a. Identify Success-Critical Stakeholders

1b. Stakeholders Identify System Objectives, Constrains, & Priorities (OC & Ps) Alternatives Solutions Elements

2a. Evaluate Alternatives with respect to OC & Ps

2b. Assess, Address Risks

3. Elaborate Product and Process Definition

4. Verify and Validate Product and Process Definitions

5. Stakeholders’ Review

6. LCA DPR after SDD

7. Stakeholders’ Commitment

8. LCO DPR after CTD
The WinWin Spiral Model's "Significant Accomplishments"

Each spiral segment has associated prose and links to documents with "evidence" [Accomplishment Criteria]

1. Stakeholders: Project Identifies Success-Critical Stakeholders; Offer prototypical set [list of stakeholders for the round]

2. Stakeholders Identify System Objectives, Constraints & Priorities (OC&Ps), and Alternative Solution Elements
   - Objectives, Constraints and Priorities:
     Elaborate and list the system or subsystem's product and process Objectives, Constraints and Priorities of the round
   - Alternatives: Elaborate and list the system or subsystem's product and process alternatives of the round

3. Evaluate Alternatives with Respect to OC&Ps
   - Prototypes
   - Models & Sims
   - Analyses

4. Assess and Address Risks
   - Evaluate & list alternatives with respect to the objectives, constraints & priorities of the round
   - Identify and list major source of product and process risks of the round
   - List mitigation plans for risks
The WinWin Spiral Model's "Significant Accomplishments" (cont.)

5. Make/mature definitions of Products and Processes

- Build the "Product(s)" for this sub-step
- Define/Build the "Process(s)" for this sub-step
- Examples of artifacts include
- Document sets (for Inception and Elaboration) including generic content (like IEEE Std J-016)
- Sw Ops Concept;
- Requirements;
- Design (to appropriate level of detail);
- Feasibility Rationale [new; management control]
- Detailed design, code, integration and system-level tests (for "Construction" phase) generic content...
- Increment Plan
- ...

6. Verify and Validate Product and Process "Definitions"
Examples include ("depending on phase")

- Developmental Progress Review (DPR) [a Boeing system engineering term being used for USC/AT&T's Architecture Review Boards (ARBs) with Architecture Tradeoff Analysis Method (ATAMs) and Feasibility Rationales [at LCO and LCA]
- Sw Integration Test
- Sw Acceptance Test (for functionality of the current build)
- Transition Readiness Review
- Product "Release" Review [Transition Complete]
- FQT [Final Transition Phase of multiple builds]

7. & 8. Stakeholders' Review and Commitment

- Review (Preview) the next spiral cycle and commit to proceed as planned.
MBASE/RUP Activity/Process Model
FCS Program Acquisition Spiral

FCS CTD [I and part E]
(Sim & Modeling; Prototyping Only)

SDD
[rI E C T]
Integration and Test Facility

System Development (primes)

System Models
(LoFi System Sims)
(HiFi System Models)

Model s & Sim. Devel.
(by M&S and T&E of LSI)

Model & Sim. Evolution
Recommended Three (MINIMUM) Overlapping Development Spirals for Primes

Evolve After Architecture Complete

<table>
<thead>
<tr>
<th>Inception</th>
<th>Elaboration with Evol. Req.</th>
<th>Construction</th>
<th>Transition</th>
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^ with FQT Dry Run

Inc. Elaboration Construction Transition^