Early Software Discipline for Ground Systems: The Incremental Commitment Model

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What is the Incremental Commitment Model (ICM)?

• System development model to respond to the challenges to future projects
  – Adapting with agility to emergent and rapidly changing requirements
  – Concurrently providing high assurance to all of the system’s success-critical stakeholders

• Achieves goals through
  – Involvement of stakeholders in a series of incremental commitment milestone events
  – Stabilizing each increment’s development while accommodating most change in future increments
  – Providing continuous verification and validation
ICM Principles

1. Success-critical stakeholder satisficing
2. Incremental growth of system definition and stakeholder commitment
3,4. Concurrent, iterative system definition and development cycles
   Cycles can be viewed as sequential concurrently-performed phases or spiral growth of system definition
5. Risk-based activity levels and anchor point commitment milestones
Incremental Commitment in Gambling

• **Total Commitment: Roulette**
  – Put your chips on a number
  • Build a single ground control system for 6 diverse satellite systems
  – Wait and see if you win or lose

• **Incremental Commitment: Poker, Blackjack**
  – Put some chips in
  – See your cards, some of others’ cards
  – Decide whether, how much to commit to proceed
Incremental Commitment In Life: Anchor Point Milestones

- Common System/Software stakeholder commitment points
  - Defined in concert with Government, industry organizations
  - Initially coordinated with Rational’s Unified Software Development Process
- Exploration Commitment Review (ECR)
  - Stakeholders’ commitment to support initial system scoping
  - Like dating
- Validation Commitment Review (VCR)
  - Stakeholders’ commitment to support system concept definition and investment analysis
  - Like going steady
- Architecting Commitment Review (ACR)
  - Stakeholders’ commitment to support system architecting
  - Like getting engaged
- Development Commitment Review (DCR)
  - Stakeholders’ commitment to support system development
  - Like getting married
- Incremental Operational Capabilities (OCs)
  - Stakeholders’ commitment to support operations
  - Like having children
The ICM Life Cycle Process: Overview

DoD, General/DoD Milestones

Beginning of Phases (EVADO)

Activities

Phases (EVADO)

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<tr>
<th>Phases (EVADO)</th>
<th>Exploration</th>
<th>Valuation</th>
<th>Architecture</th>
<th>Development 1</th>
<th>Development 2</th>
<th>Development 3</th>
<th>Development 4</th>
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<tr>
<td>Initial Scoping</td>
<td>Concept Definition, Investment Analysis</td>
<td>System Architecting</td>
<td>Increment 1 Development</td>
<td>Increment 2 Architecting Rebaseline</td>
<td>Increment 1 Operations</td>
<td>Increment 2 Development</td>
<td>Increment 3 Architecting Rebaseline</td>
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Evaluation of Evidence of Feasibility to Proceed

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Stakeholder Review and Commitment

Adjust Scope, Priorities, or Discontinue
Pass/Fail Feasibility Rationales

• Evidence provided by developer and validated by independent experts that:
  • If the system is built to the specified architecture, it will
    – Satisfy the requirements: capability, interfaces, level of service, and evolution
    – Support the operational concept
    – Be buildable within the budgets and schedules in the plan
    – Generate a viable return on investment
    – Generate satisfactory outcomes for all of the success-critical stakeholders
  • All major risks resolved or covered by risk management plans
  • Serves as basis for stakeholders’ commitment to proceed
Risk-Driven Scalable Spiral Model: Increment View

- Rapid Change
  - Short Development Increments
  - Foreseeable Change (Plan)
  - Increment N Baseline
- High Assurance
  - Stable Development Increments
- Short, Stabilized Development of Increment N
  - Increment N Transition/O&M
Risk-Driven Scalable Spiral Model: Increment View

- **Rapid Change**
  - Unforeseeable Change (Adapt)
  - Short Development Increments
- **High Assurance**
  - Foreseeable Change (Plan)
  - Stable Development Increments
  - Current V&V Resources
  - Continuous V&V
- **Agile Rebaselining for Future Increments**
  - Future Increment Baselines
- **Short, Stabilized Development of Increment N**
  - Increment N Transition/O&M
  - Deferrals
  - Artifacts
  - Concerns
- **V&V of Increment N**
  - Future V&V Resources
Conclusions

• Current processes not well matched to future challenges
  – Emergent, rapidly changing requirements
  – High assurance of scalable performance and qualities
• Incremental Commitment Model addresses challenges
  – Assurance via evidence-based milestone commitment reviews, stabilized incremental builds with concurrent V&V
    • Evidence shortfalls treated as risks
  – Adaptability via concurrent agile team handling change traffic and providing evidence-based rebaselining of next-increment specifications and plans
  – Use of critical success factor principles: stakeholder satisficing, incremental growth, concurrent engineering, iterative development, risk-based activities and milestones
• Major implications for funding, contracting, career paths