Adaptive Mission Assurance (AMA)
A Class Agnostic, Value Driven Approach

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Adaptive Mission Assurance (AMA)

Background

• Aerospace has supported DoD and IC agile mission developments for two decades (supporting PM, SE & MA)
  – Class C/D missions with Life Cycles of 24-36 months
  – Risk tolerant S&T and operational demonstrations
  – Cost and Schedule are heavily constrained
  – Challenged to optimize probability of mission success by trading technical performance and risk for cost and schedule

• Aerospace has productized an approach for Class D (~$250M) and sub-Class D missions ($1M to $20M)
  – Approach has evolved over the past 20 years
  – Draws on the “Agile” mindset, principles, and frameworks
  – >95% success rate for meeting mission objectives
  – Optimized for limited MA Resources per mission
The Challenge

Risk Tolerant, Class Ambiguous, Constraints-driven missions

• Space community is acquainted with and skilled in Class A Mission Assurance
  – Accustomed to ultra-low risk tolerance for requirements-driven missions
  – 1st priority is to eliminate risk to achieving highly specified system performance
  – 2nd priority is good enough cost and schedule
  – Must trade cost and schedule to ensure lowest risk and near 100% performance

• Risk Tolerant, Class Ambiguous, Constraints-driven missions
  – Typified by uncertainty, change, evolving outcomes, limited resources, and directed schedules
  – They are risk tolerant, yet they do not fit cleanly into any single risk class (A/B/C/D)
  – 1st priority is the constraint on cost and schedule and a willingness to accept risk
  – 2nd priority is good enough performance that still achieves mission goals and objectives
  – Must trade on performance and risk for meeting cost and schedule constraints

• The Challenge:
  – How to optimize mission assurance to “gracefully” accept risk within cost & schedule constraints while still achieving an agreeable expectation of mission success

AMA provides a risk class agnostic, value driven approach that incorporates the “Agile” mindset for quickly delivering the highest value mission assurance activities first within project constraints (e.g., cost and schedule)
Meeting the Challenge
Adaptive Mission Assurance (AMA)

- A **Value-driven** approach that **Tailors up**
  - Incorporates an “Agile” mindset, principles, and frameworks
  - Begins with the minimum “prescriptive” requirements for **Safety & Do-No-Harm**
  - **Tailors up** discretionary mission assurance requirements based on best value for the unique mission context
  - Then, it dynamically “adapts” for delivering **Highest value first** as the mission “evolves” and “stuff happens”
  - Prefers activities with the most bang-for-the-buck; i.e., **Not always the highest risk**

Optimizes MA within constraints by favoring the best value responses while burning down risk to a targeted residual that is agreeable and understood by stakeholders for a more realistic expectation of mission success
The Backlog

A Dynamic MA Plan of Prioritized Activities based on Mission Value

Mission Value is not based on the value of the requirement but the activity that achieves the requirement
The Backlog
Establishing Mission Context and the Initial Backlog

Establish Mission Context

Identify Risks within Mission Context

Constraints

“Dynamic Plan”

“Dynamic Risk Picture”

Subsequent Sprints

Discretionary

MA Requirements ranked by the Value of corresponding activity within Mission Context

“Pull”

Do-No-Harm Requirements

“Push”

Human Safety Requirements

Institutionally Driven

Mission Context Driven
Valuation
Grooming the Backlog

• Rank in order of VALUE
  – “Bang for the buck” NOT simply “highest risk”
  – Delivers more value earlier within constraints
  – Relative Value = Mission Impact Points / Program Impact Points
  – “Low hanging fruit” may fall higher on the list than more serious
    risks that are difficult or impossible to mitigate within constraints

• Draw the “Cut Line”
  – Starting with the most valued activities, make rough order resource
    estimations; rough order estimations on activities are good enough
  – Continue until the “cut line” for activities is reached
  – Items above the cut line are executed in their time within the phase
  – Update the Risk Picture
  – Supports a better narrative for requesting additional resources

<table>
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<tr>
<th>Action</th>
<th>Risk Reduction</th>
<th>Confidence in Risk Reduction</th>
<th>Cost (story points)</th>
<th>Confidence in Cost</th>
<th>Ratio</th>
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</thead>
<tbody>
<tr>
<td>Add software review</td>
<td>5 High</td>
<td></td>
<td>3 Medium</td>
<td></td>
<td>1.7</td>
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<tr>
<td>Add extra time for testing</td>
<td>8 High</td>
<td></td>
<td>13 High</td>
<td></td>
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<tr>
<td>Add modal survey test</td>
<td>20 Medium</td>
<td></td>
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<td></td>
<td>1.0</td>
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<tr>
<td>Add extra accelerometers to sine vibe test</td>
<td>3 Medium</td>
<td></td>
<td>2 High</td>
<td></td>
<td>1.5</td>
</tr>
</tbody>
</table>
Valuation
Planning Poker

• Offers an informal less structured game-like format

• Favors relative predictions over “perfect estimations” by scoring competing activities with “story points”

• Avoids bogging down while leveraging full team knowledge

• Format
  – Cards represent “story points”
  – Discuss each item before voting
  – Seek consensus on a story point value for each item
  – Team discusses (and re-votes until consensus is achieved)
  – Great way to pool the team’s thoughts and insights

• The real benefit of planning poker is the discussion and mutual understanding of value
AMA Sprints

Anatomy of a Sprint

• Plan
  – “Groom” the Backlog
  – Valuations using Planning Poker; Re-prioritize by value as necessary
  – Confirm Cut Line for lifecycle phase(s) cost and schedule thresholds
  – Update Risk Picture

• Backlog Execution
  – Execute tasks above the cut line as appropriate in their time
  – Backlog authorizes planned or active activities as of current sprint

• Review
  – Review activity outcomes, divergences, and emergent risks & issues
  – Update Risk Picture

• Dynamic Risk Picture
  – Continually maintains the “As Is” and “To Be” risk picture
  – Update with emerging risks, issues, and outcomes
  – Use Planning Poker as needed

• Retrospective (at Milestones)
  – Focus on method and communications
  – What worked and what didn’t work
  – Collect Lessons Learned
AMA Sprints
AMA Operates in Short Sprints

- Driven by team’s communication tempo (~2-4 weeks)
- Each lifecycle phase will contain multiple sprints
- Evolves the Backlog as the mission development progresses
- Evolves and maintains the Risk Picture as the backlog responds to emergences

Sprints evolve the Backlog and Risk Picture thus managing stakeholder expectation across full mission lifecycle
AMA Sprints
Optimizes Activity within Constraints while responding to Emergent Developments

With changes in Mission Context or Emergences:

- Activities may change from sprint to sprint as the Backlog evolves and is reordered based on changing valuations
- Could abandon already initiated activities shifting to higher value activities based on changing valuations
- Future phase plans can change as higher value activities are selected based on the current sprint mission context
- Risk Picture changes as the Backlog evolves thus managing stakeholder expectation through readiness certification
Adaptive Mission Assurance

Summary

• Optimizes mission assurance to “gracefully” accept risk within resource constraints while achieving an agreeable expectation of mission success

• Tailors up discretionary mission assurance requirements based on best value for the unique mission context and emergences

• Incorporates the “Agile” mindset for delivering the highest value mission assurance activities first within project constraints

• “Adapts” for favoring the highest value activities as mission developments “evolve” and “stuff happens”

• Burns down risk to a targeted residual that is agreeable and understood by stakeholders for a more realistic expectation of the probability of mission success supporting certification of flight readiness (CoFR)
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Landscape

• Active AMA Support:
  – DoD Space Test Program (STP)
  – DoD Space Rapid Capacities Office (SpRCO)
  – Air Force Research Laboratory (AFRL)
  – NASA Office of Safety and Mission Assurance (NASA OSMA)

• In Discussions / Task Development:
  – NASA Cryogenic Fluid Management Large Demonstration (LCD) Mission
  – NASA Space Research Projects Division (ST-10)
  – NASA Technology Demonstration Missions (TDM)
  – NASA Game Changing Development (GCD)
  – NASA Commercial Lunar Payload Services (CLPS)
  – NASA Human Landing System (HLS)
  – NASA Planetary Missions Program Office (PMPO)
  – NASA Space Launch System (SLS)
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Back-Up
Agile Mindset
Manifesto

The Agile Manifesto*

We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

- **Individuals and interactions** over processes and tools
- **Working software** over comprehensive documentation
- **Customer collaboration** over contract negotiation
- **Responding to change** over following a plan

That is, while there is value in the items on the right, we value the items on the left more.

An Agile Manifesto for Mission Assurance

We are committed to understanding how best to improve our chances of mission success. Through this work we have come to value:

- **Individuals and interactions** over processes and tools
- **Mission Success** over comprehensive documentation
- **Stakeholder collaboration** over requirements and checklists
- **Responding to change** over following a plan

That is, while there is value in the items on the right, we value the items on the left more.

*Agile Alliance, https://www.agilealliance.org

An Agile Mindset enables the ability to create and respond to change in an uncertain or turbulent environment
Adaptive Mission Assurance

Essential Agile Elements

• Small cohesive mission teams
  – Mutual understand of what constitutes mission success and a shared willingness to accept some probability of failure
  – Lean heavily on frequent collaboration while representing unique program and institutional accountabilities
  – Delegate institutional authority to the team to innovate mission assurance; keep stakeholders apprised
  – Innovation and flexibility are essential for constraints-driven responses to inevitable change and emergences
  – Mission Assurance representation should be tightly integrated with the decision making of the mission team

• Keep it simple
  – Mission assurance is anything that contributes to mission success
  – Leverage developer processes that already support the value chain; minimize duplication
  – Favor documentation that leverages operative artifacts that already support the value chain

• Readily Available “Knowledge”
  – Systems Engineering savvy MA representation is ideal
  – Diverse subject matter experts for agile application where and when needed by the mission team
  – Knowledge base consisting of Institutional (Center) command media, lessons learned, and tools