



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

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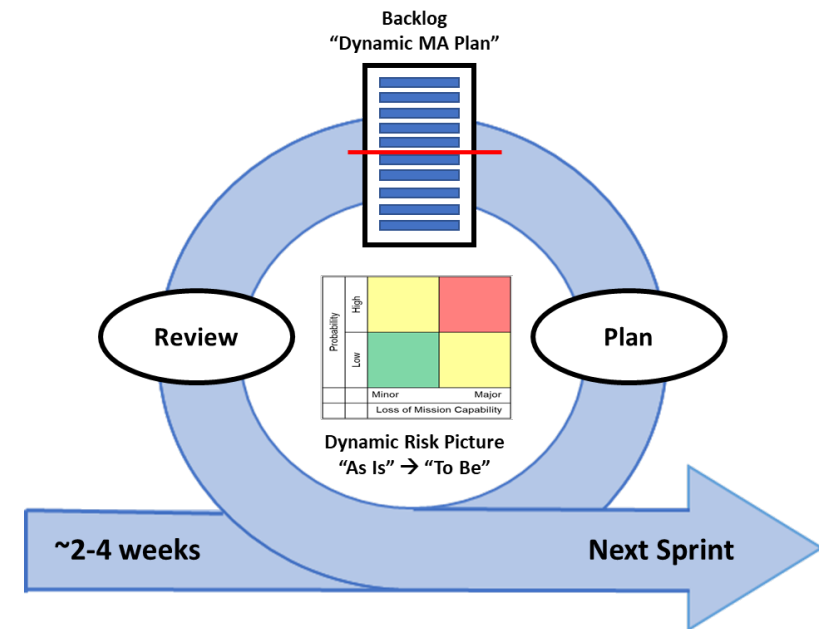
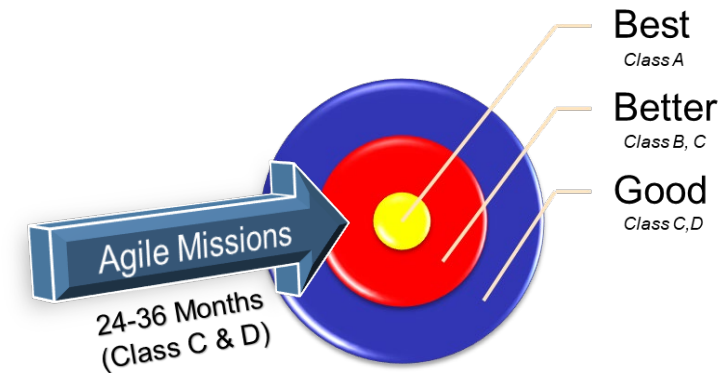
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Adaptive Mission Assurance (AMA)

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*

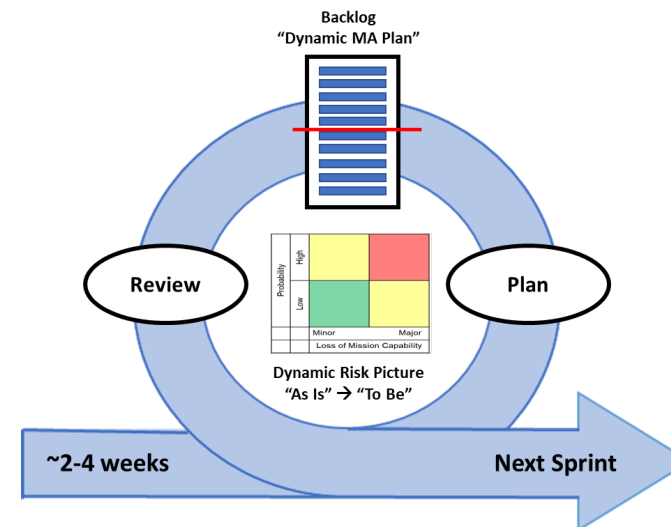
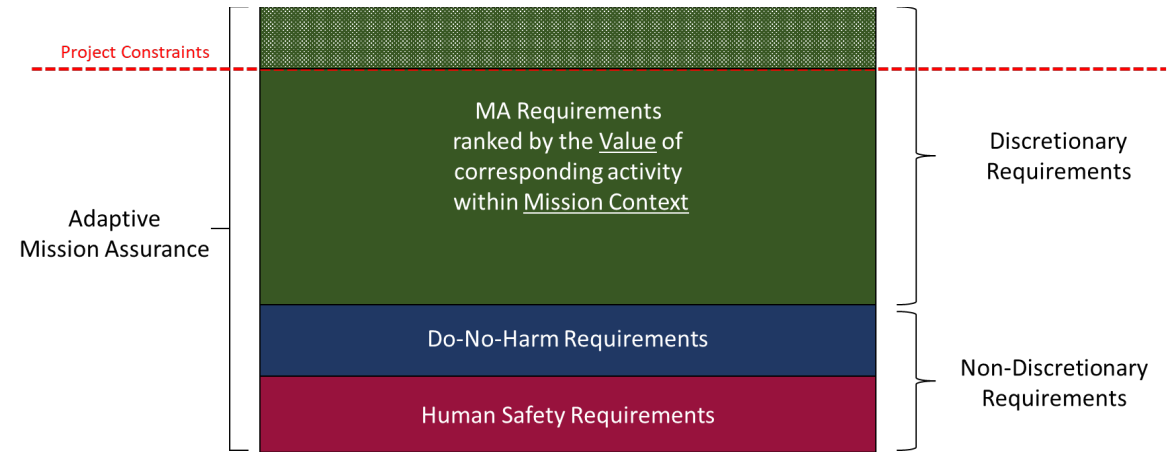
AMA provides a risk class agnostic, value driven approach that incorporates the “Agile” mindset for quickly delivering the highest value mission assurance activities first within project constraints (e.g., cost and schedule)



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



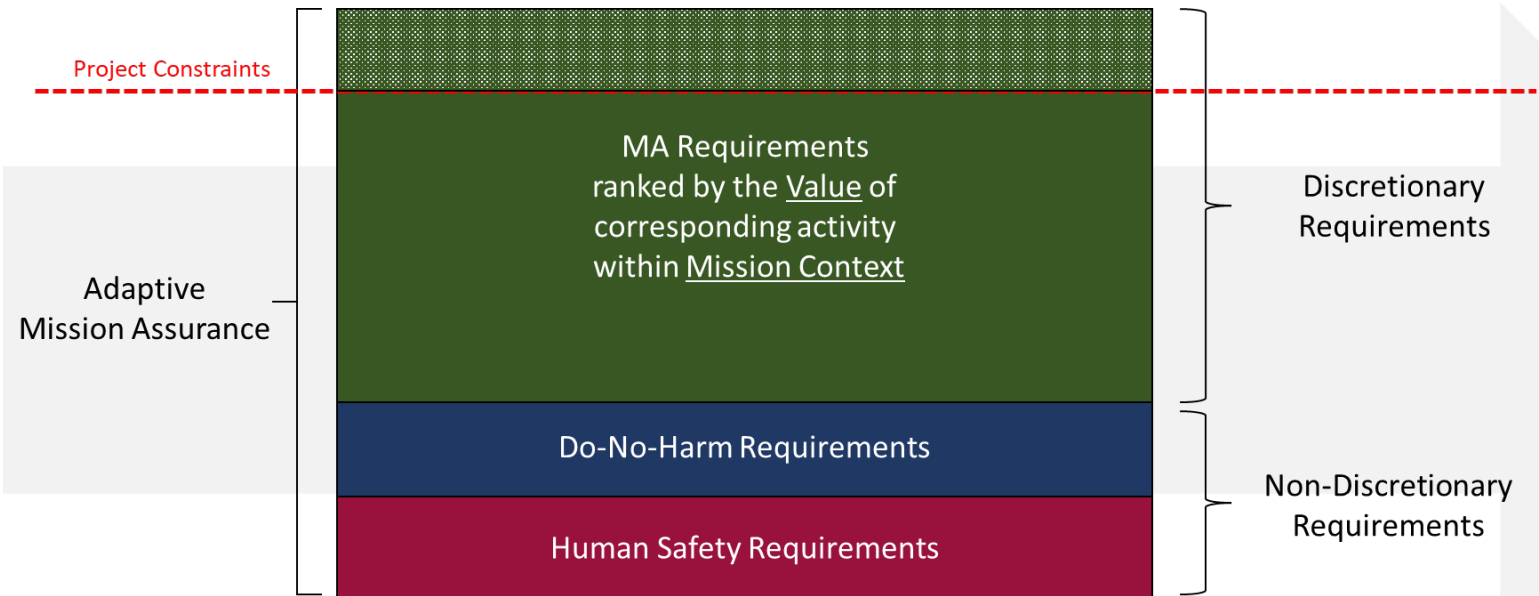
Optimizes MA within constraints by favoring the best value responses while burning down risk to a targeted residual that is agreeable and understood by stakeholders for a more realistic expectation of mission success



The Backlog

A Dynamic MA Plan of Prioritized Activities based on Mission Value

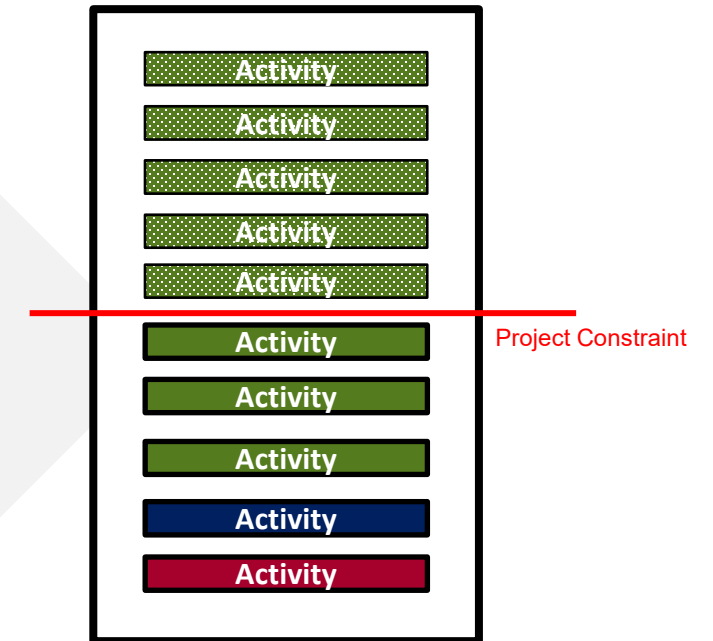
Requirements



“Tailored”

Mission Assurance Requirements (MAR)
Varies by Institution (e.g., GSFC, SMD, etc.)

Activities



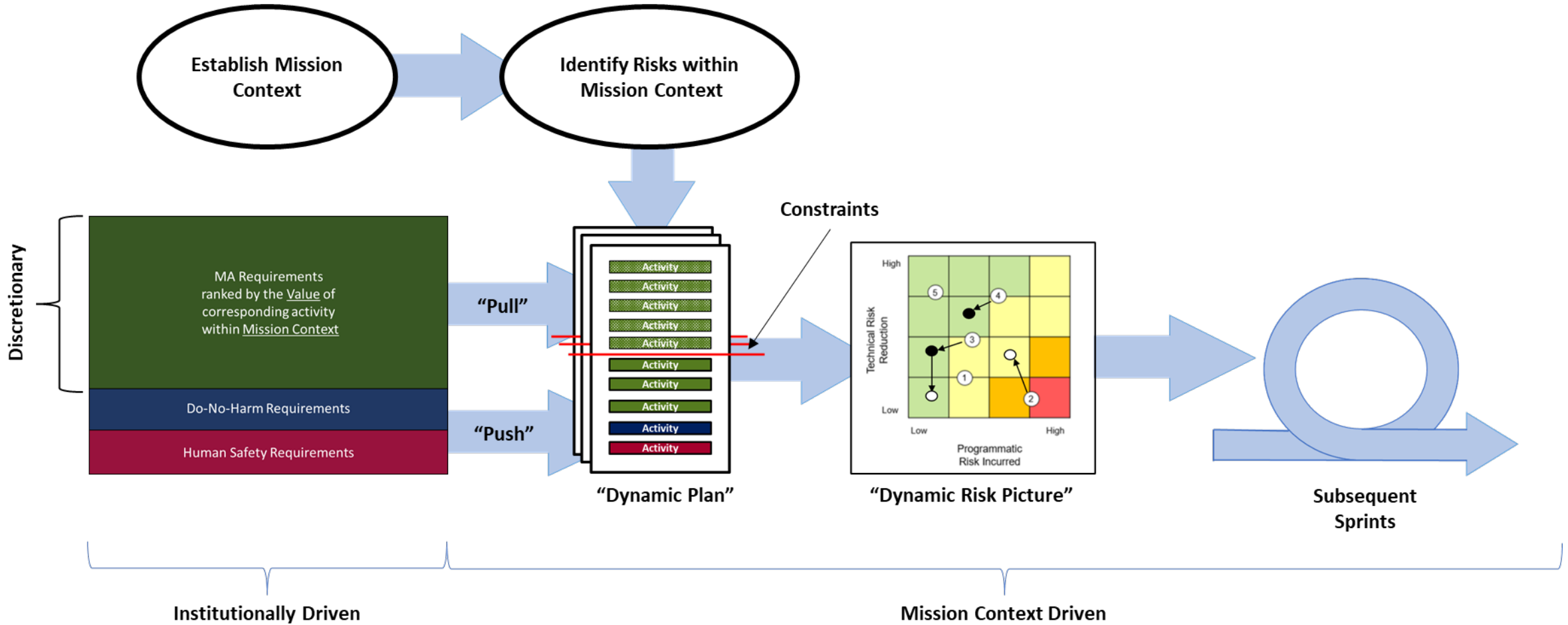
“Backlog”

Prioritized MA Activities
This is your “Dynamic MA Plan”

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



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

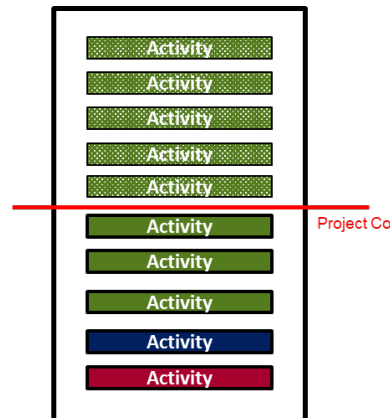
- Draw the “Cut Line”

- 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

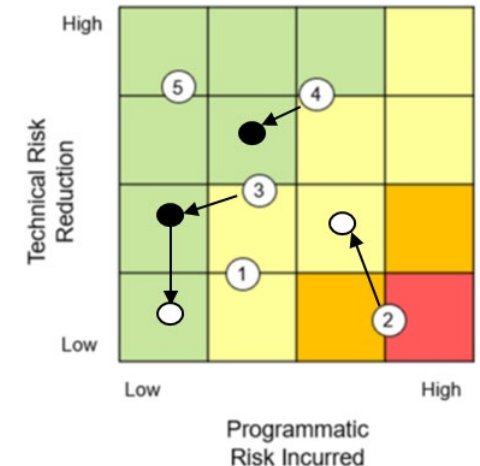
Valuation Table

Action	Risk Reduction (story points)	Confidence in Risk Reduction	Cost (story points)	Confidence in Cost	Ratio
Add software review	5	High	3	Medium	1.7
Add extra time for testing	8	High	13	High	0.6
Add modal survey test	20	Medium	20	High	1.0
Add extra accelerometers to sine vbe test	3	Medium	2	High	1.5

Backlog
“Dynamic MA Plan”



Dynamic Risk Picture
“As Is” → “To Be”

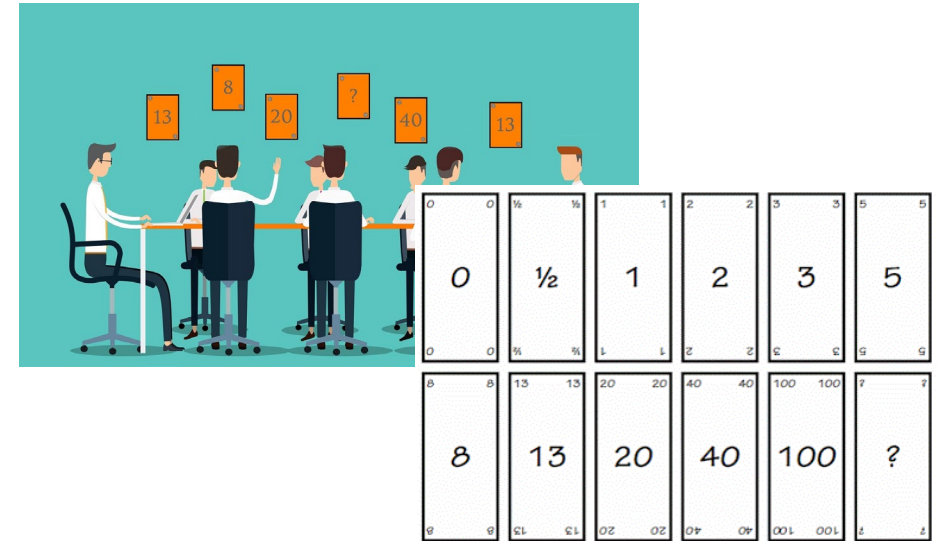




Valuation

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



Action	Risk Reduction (story points)	Confidence in Risk Reduction	Cost (story points)	Confidence in Cost	Ratio	Implement?
Add software review	5	High	3	Medium	1.7	Yes
Add extra time for testing	8	High	13	High	0.6	No
Add modal survey test	20	Medium	20	High	1.0	No
Add extra accelerometers to sine vibe test	3	Medium	2	High	1.5	Yes

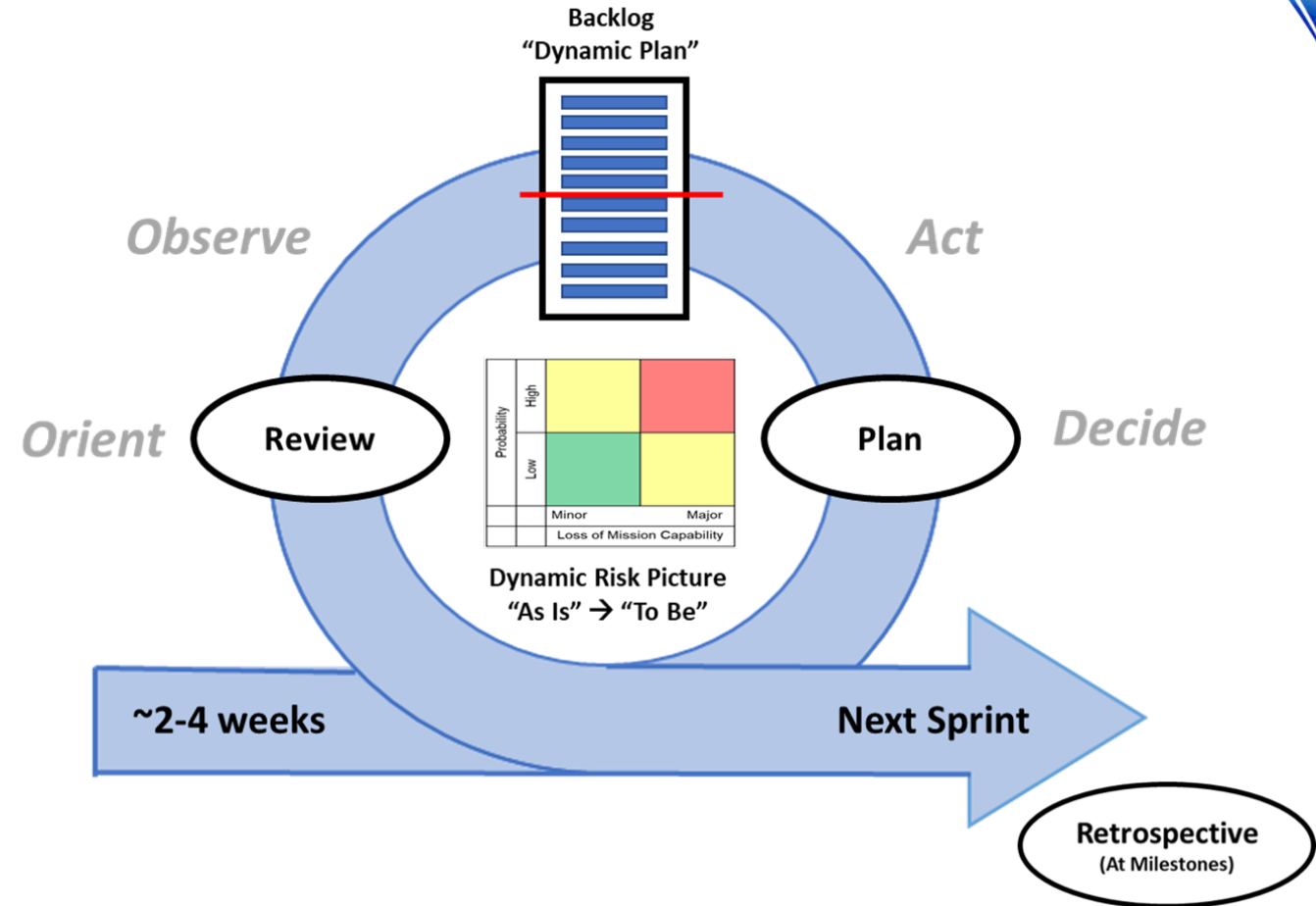
Item	Technical Risk Reduction	Programmatic Risk Incurred
1	Low	Low
2	Low	High
3	High	Low
4	High	High



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

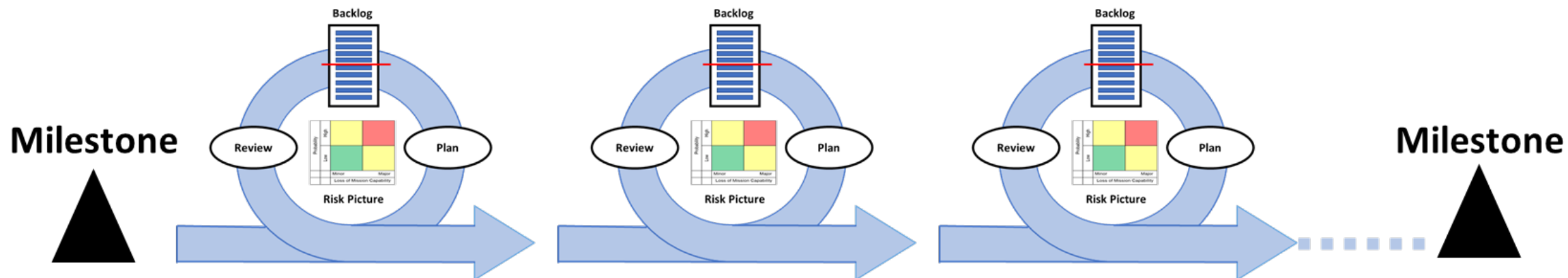




AMA Sprints

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 emergencies

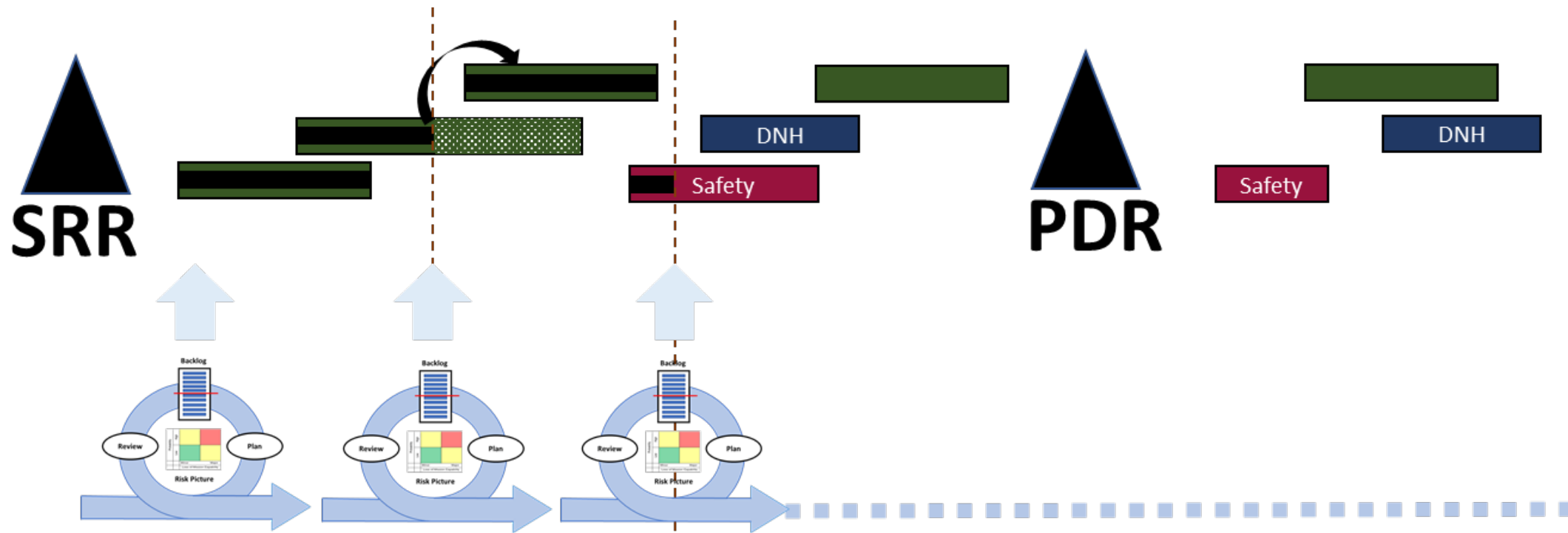


Sprints evolve the Backlog and Risk Picture thus managing stakeholder expectation across full mission lifecycle



AMA Sprints

Optimizes Activity within Constraints while responding to Emergent Developments



With changes in Mission Context or Emergences:

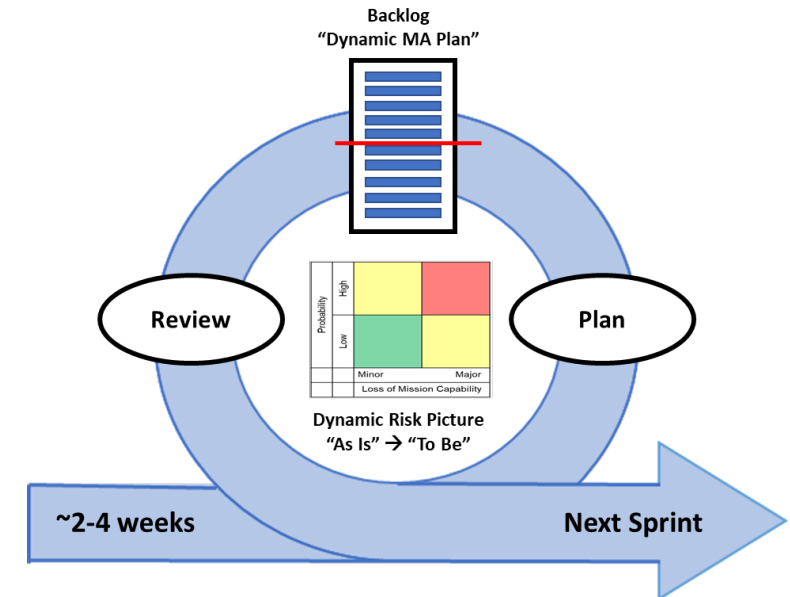
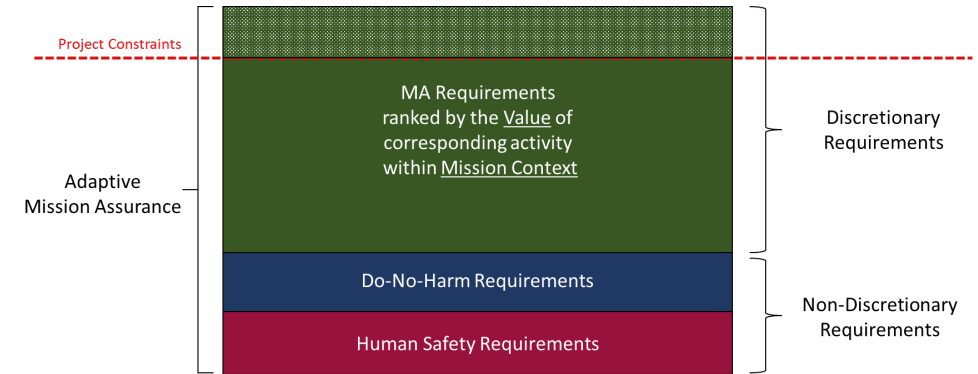
- Activities may change from sprint to sprint as the Backlog evolves and is reordered based on changing valuations
- Could abandon already initiated activities shifting to higher value activities based on changing valuations
- Future phase plans can change as higher value activities are selected based 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)





Adaptive Mission Assurance

Landscape

- Active AMA Support:
 - *DoD Space Test Program (STP)*
 - *DoD Space Rapid Capabilities 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)*



Adaptive Mission Assurance (AMA)

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 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.

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

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



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 emergencies*
- *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*