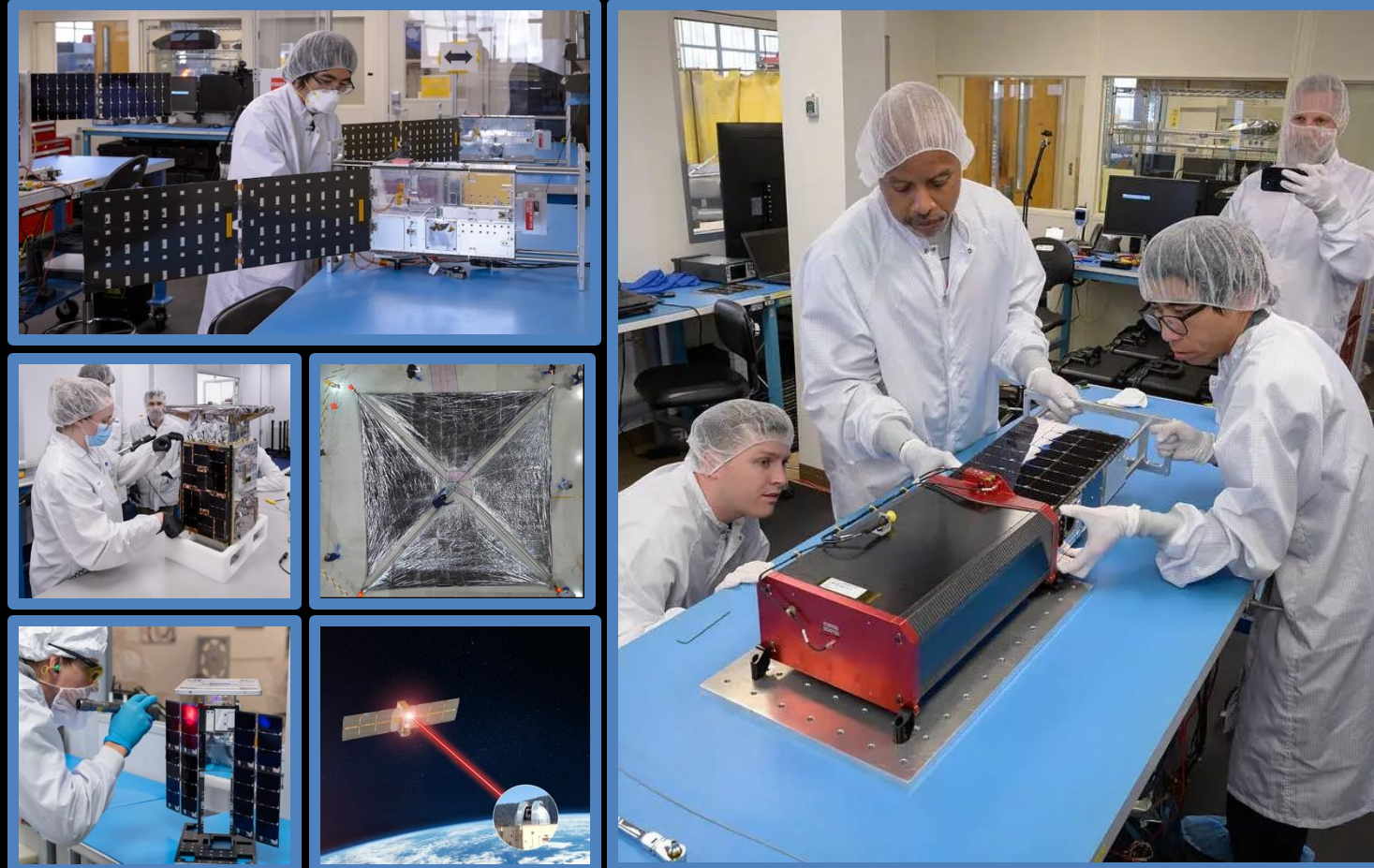




Model Based Systems Engineering (MBSE)

January 22, 2025

Access to Space for All
Systems Engineering Webinar Series



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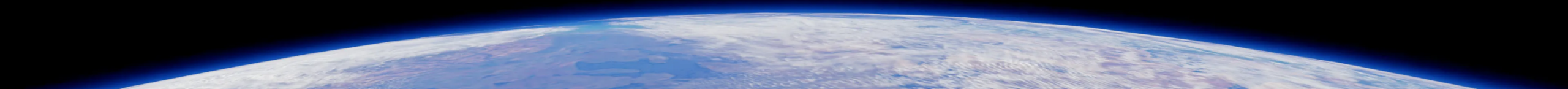
Webinar Overview:



This webinar will cover an introduction to Model Based Systems Engineering (MBSE). This overview includes:

- What is MBSE and why is it important to NASA missions?
- How do you begin using MBSE to develop a small spacecraft project?
- What examples of missions that utilized MBSE?
- How do you relate mission requirements to MBSE?

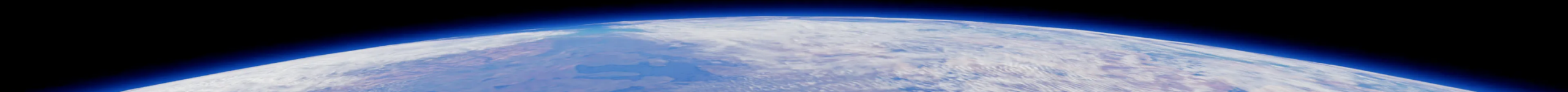
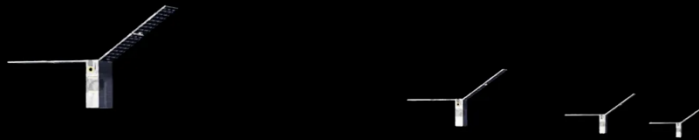
Purpose:
To provide attendees with information and knowledge of Model Based Systems Engineering and how it plays a vital roll in developing small spacecraft projects.



What is Model Based Systems Engineering (MBSE) ?



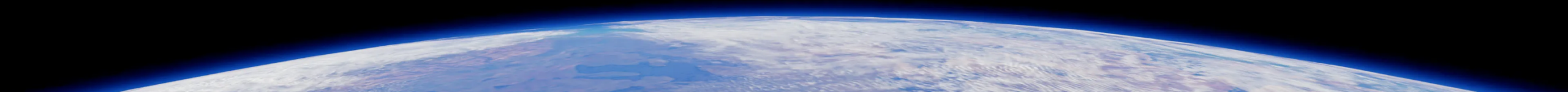
- Transition from document to integrated models
- Enables end-to-end traceability and systems thinking



Why is MBSE Important to NASA Missions?

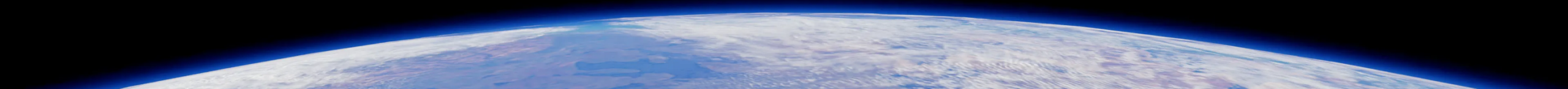


- Speeds up design integration cycles
- Enhances accuracy in requirements tracking
- Facilitates multidisciplinary collaborations



Enhancing Collaboration with MBSE

- Multidisciplinary Collaborations:
 - Shared models provide a common language for engineers, designers, and stakeholders.
 - Improved communications reduces misinterpretations and errors.
- Example:
 - How MBSE facilitated alignment between thermal engineers and system architects during habitat design?



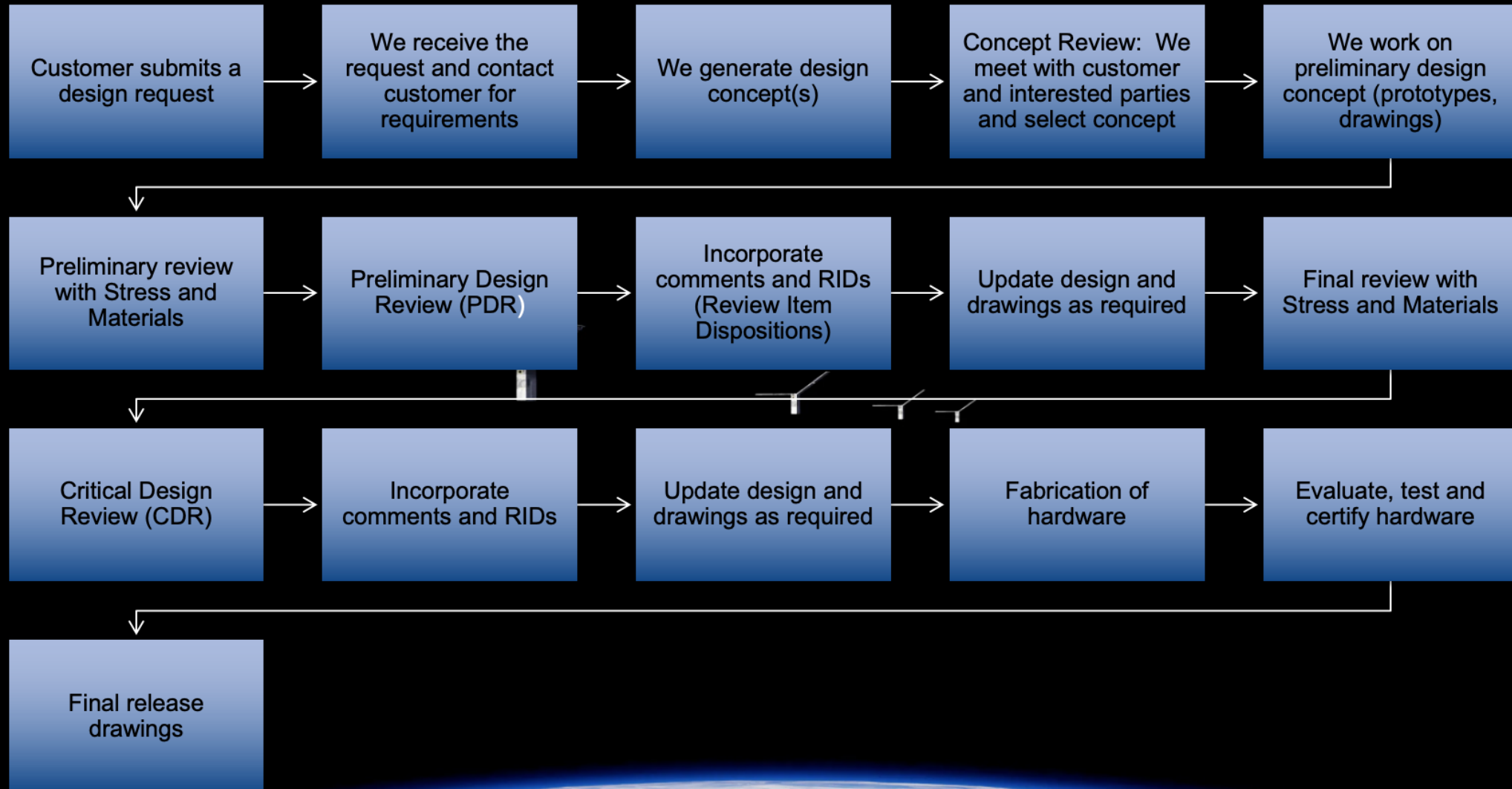
How do you begin using MBSE to develop a small spacecraft project?



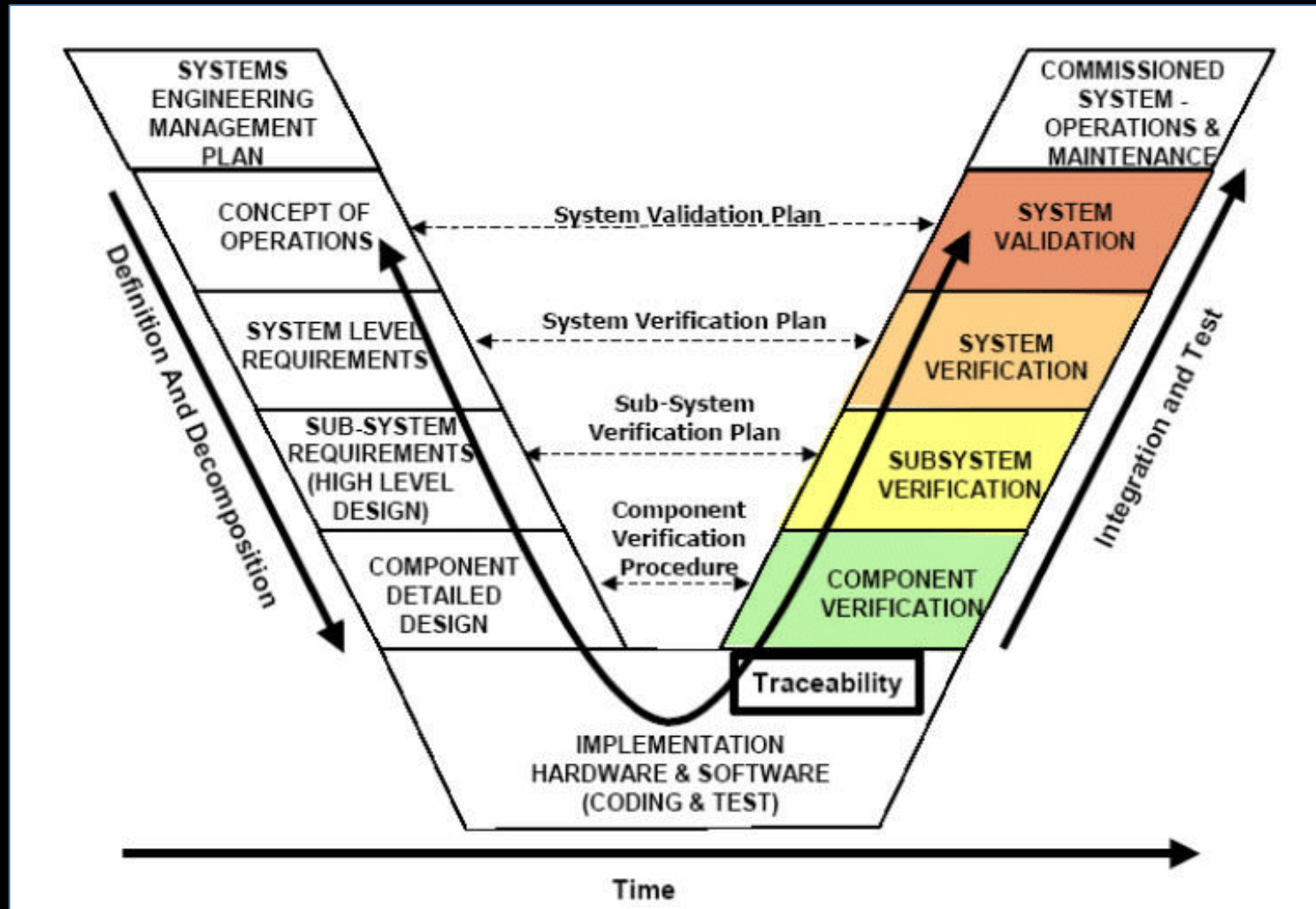
MBSE Tools and Workflows

- **Core tools:**
 - Jama: Requirements management and traceability.
 - MagicDraw: System modeling and visualization.
 - SysML: Standardized language and systems modeling.
 - Flow: New tool integrating requirements and system models in one
- **Workflow examples:**
 - Capture requirements in Jama.
 - Develop system architecture in MagicDraw using SysML.
 - Link models to Computer Aided Design (CAD)/Finite Element Analysis (FEA) for detailed design validation.

How do you begin using MBSE to develop a small spacecraft project?



How do you begin using MBSE to develop a small spacecraft project?



What examples of missions that utilized MBSE?



Real-world applications

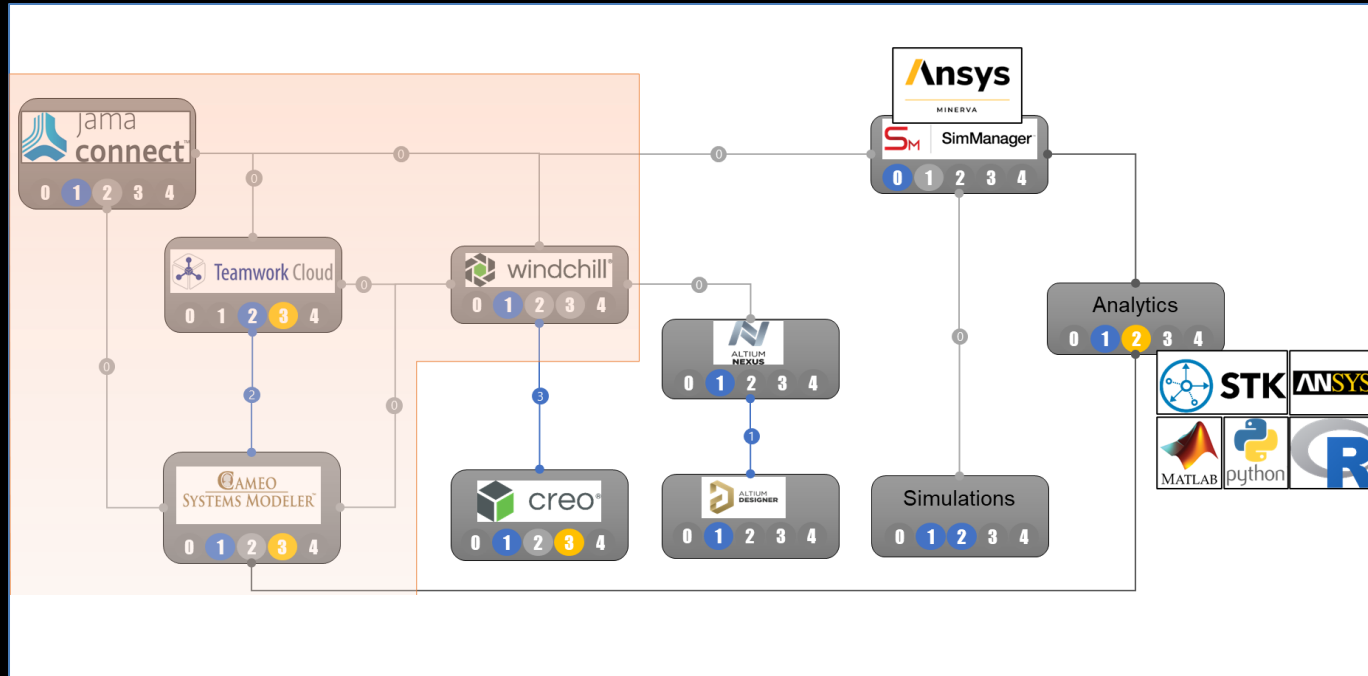
- R5 CubeSat: MBSE streamlined design validation

- Augmented Reality: Human-centered design through systems modeling.



What examples of missions that utilized MBSE?

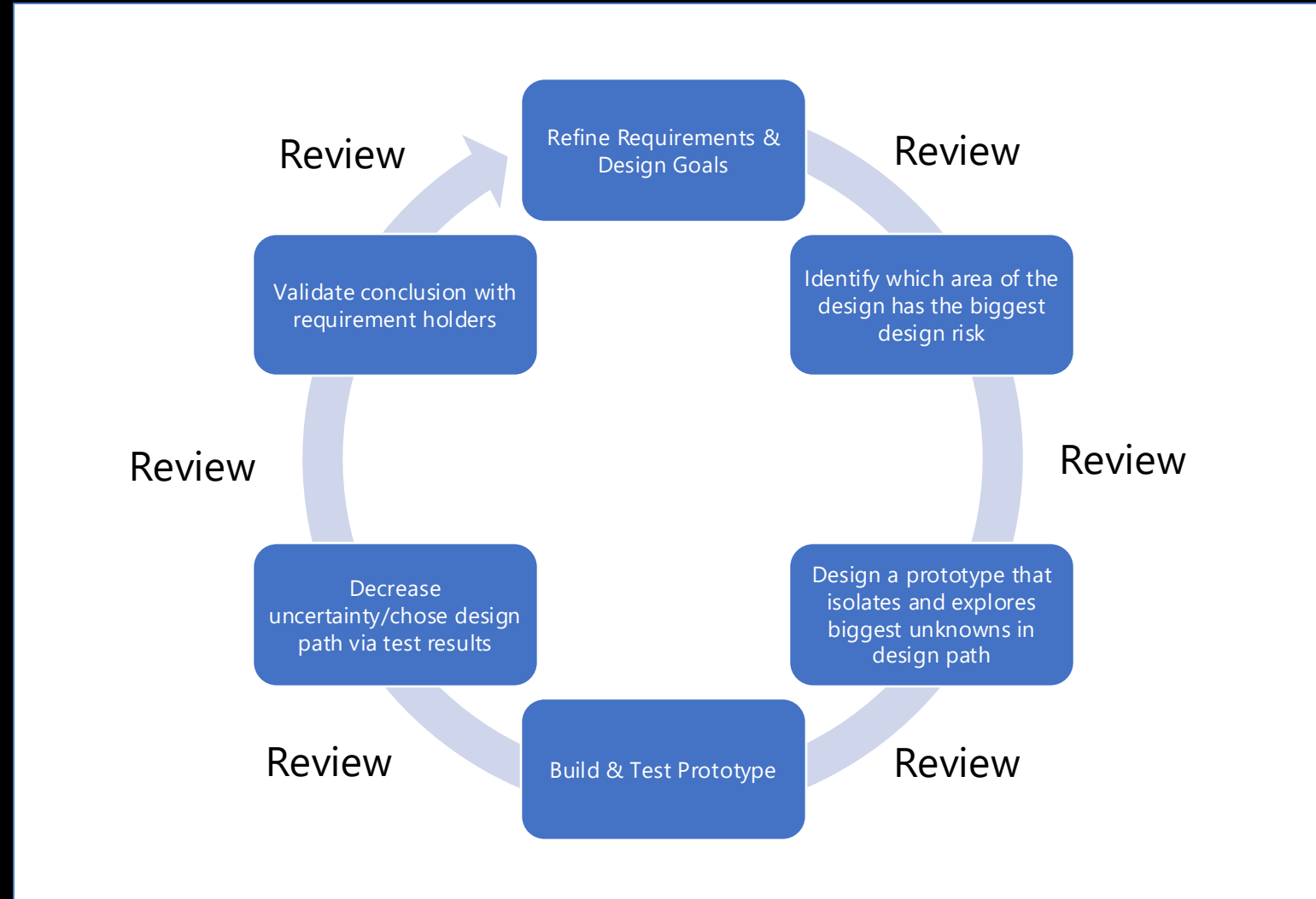
- MBSE in Action at NASA:
 - Tools: Jama for requirements, MagicDraw for modeling.



- Case Study: R5 CubeSat
 - Results: Reduced design integration time and improved cross-functional alignment.

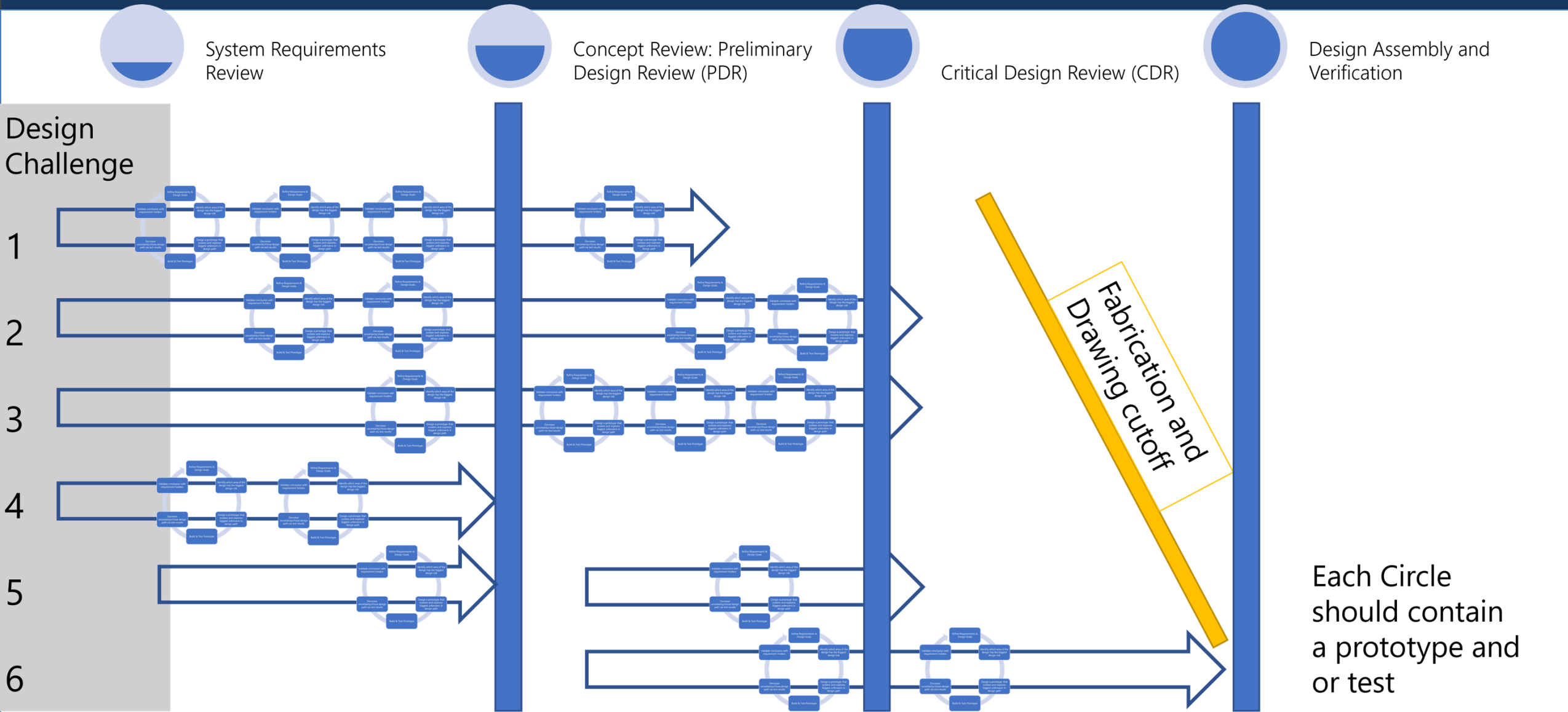
How do you relate mission requirements to MBSE?

- Cycle exists because of unknown or less confident design solutions/design path.
- Goal is to identify why there's less confident, quantify it, and prototype to increase confidence.





How do you relate mission requirements to MBSE?



Challenges and Lessons Learned



Challenges:

- **Tool Familiarity:** Initial learning curve for engineers adapting to Jama/MagicDraw.
- **Data Integration:** Ensuring consistency between MBSE models and traditional tools like CAD/FEA.
- **Stakeholder Buy-In:** Convincing teams to shift from document-driven processes to model-driven ones.

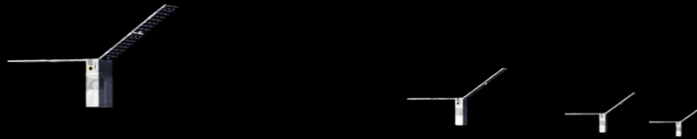
Lessons learned:

- **Start Small:** Pilot MBSE on smaller subsystems before scaling.
- **Training:** Invest in team-wide training to build confidence in tools and workflows.
- **Continuous Feedback:** Regularly refine processes based on team input and project outcomes.

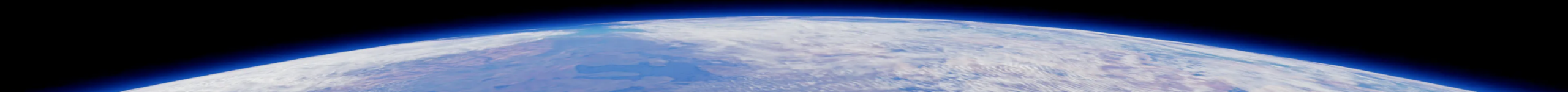
STEPS for ADOPTION:

- Start with small, well-defined projects.
- Provide comprehensive training for teams.
- Pilot workflows and refine based on feedback.

Success Factors:

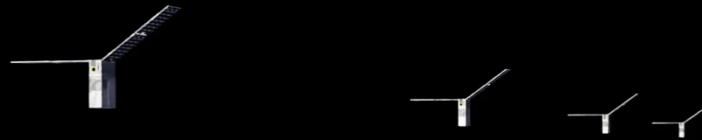


- Leadership buy-in and support.
- Clear communication of MBSE value to stakeholder.



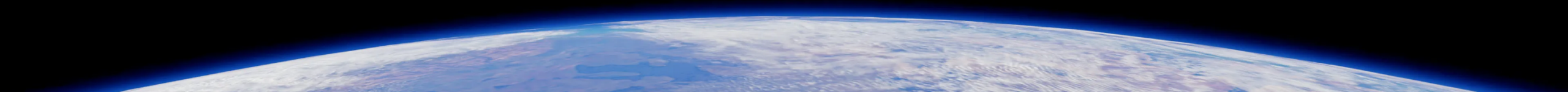
Trends:

- AI-assisted modeling to predict design outcomes.
- Digital twins for real-time system monitoring.
- Advanced simulations for systems-of-systems engineering.



Opportunities:

- Expanding MBSE to autonomy and scalable designs.



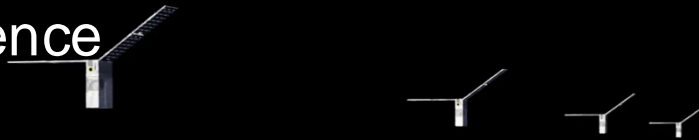
Upcoming Webinar: Design and Develop Science Missions



This webinar will conclude by providing an overview to design a concept mission applying various processes and tools described over the course of this series.

This overview includes:

- What is defined as a science mission?
- What segments make up a science mission?
- What steps and processes are taken to design and develop a science mission?
- What are examples of a science mission design?



Purpose:
To provide attendees with information and knowledge of how to design and develop science missions.

Questions?



www.nasa.gov/smallsat-institute/