



# Model Based Systems Engineering (MBSE)

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Access to Space for All  
Systems Engineering Webinar Series

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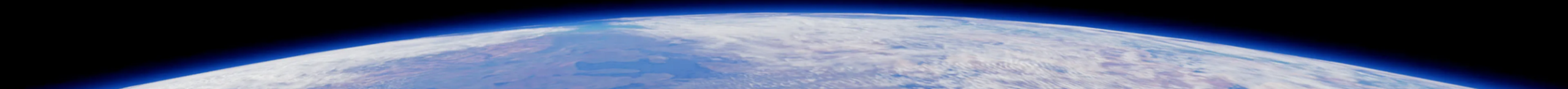
# Webinar Overview:



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?

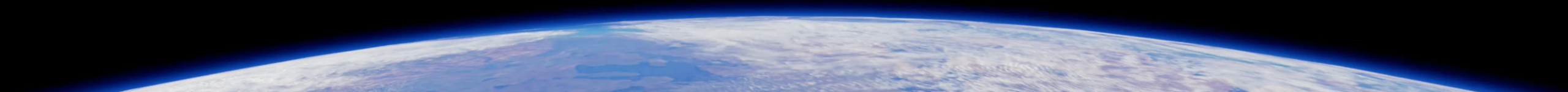
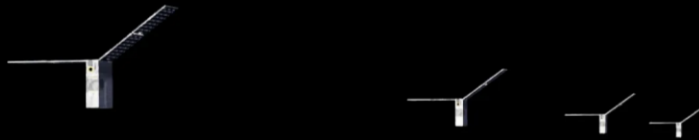
**Purpose:**  
To provide attendees with information and knowledge of Model Based Systems Engineering and how it plays a vital roll in developing small spacecraft projects.



# What is Model Based Systems Engineering (MBSE) ?



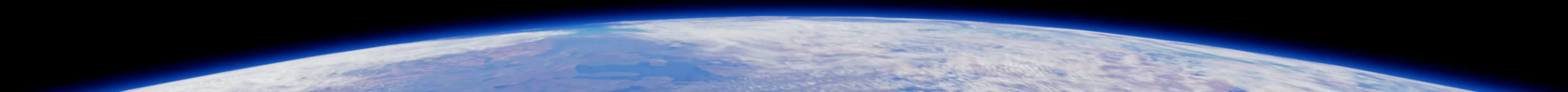
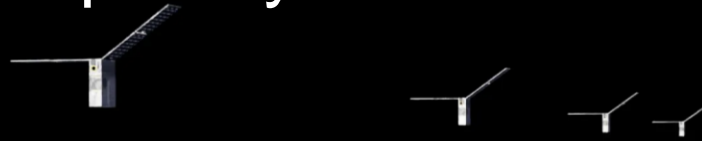
- Transition from document to integrated models
- Enables end-to-end traceability and systems thinking



# Why is MBSE Important to NASA Missions?

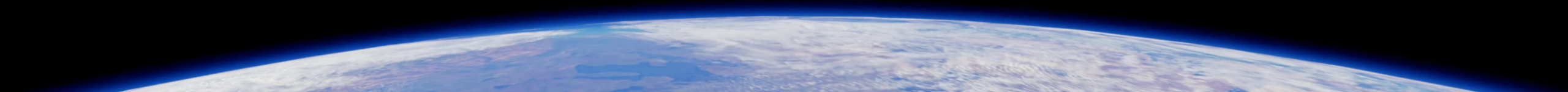


- Speeds up design integration cycles
- Enhances accuracy in requirements tracking
- Facilitates multidisciplinary collaborations



## 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?



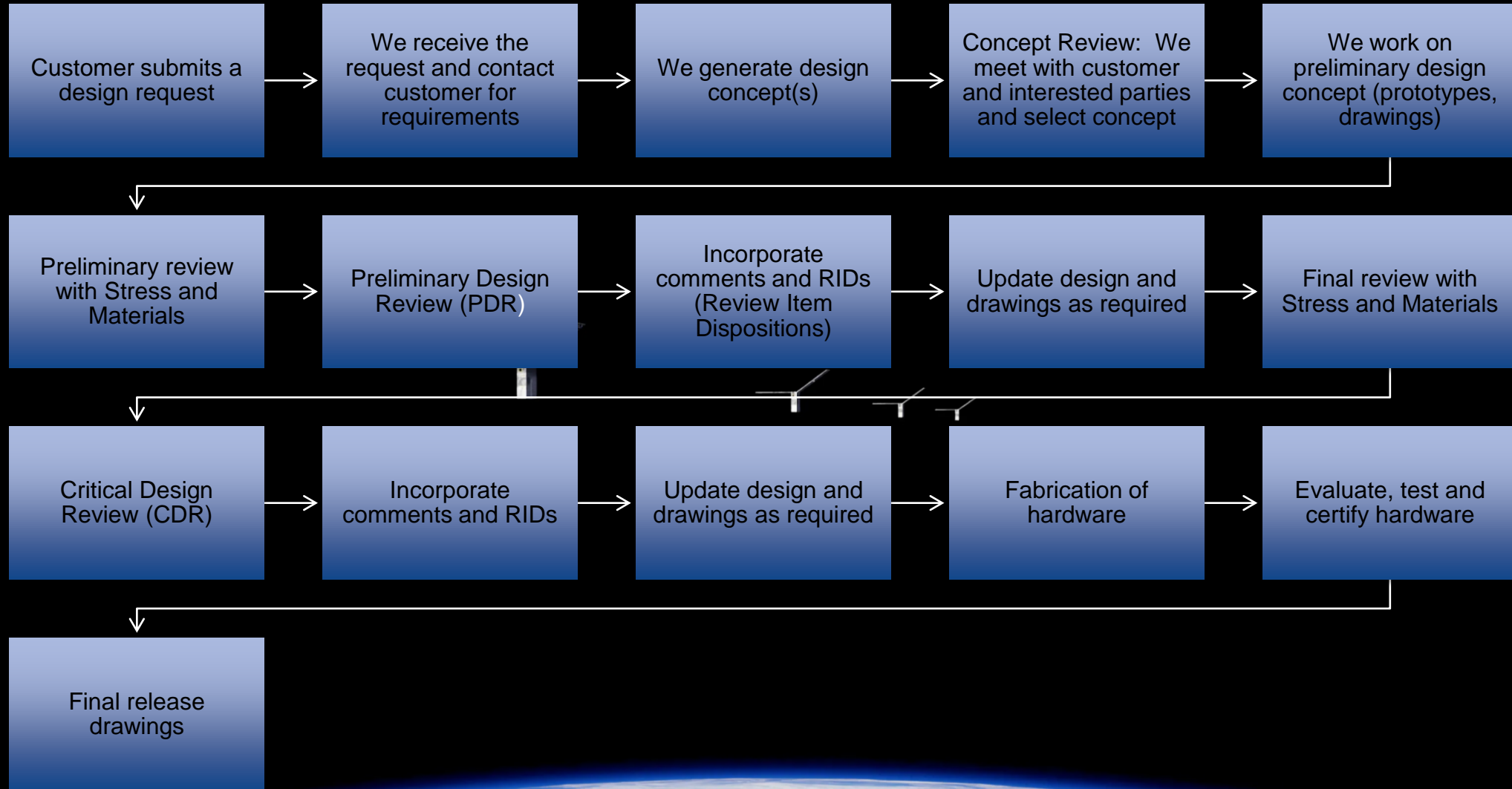
# How do you begin using MBSE to develop a small spacecraft project?



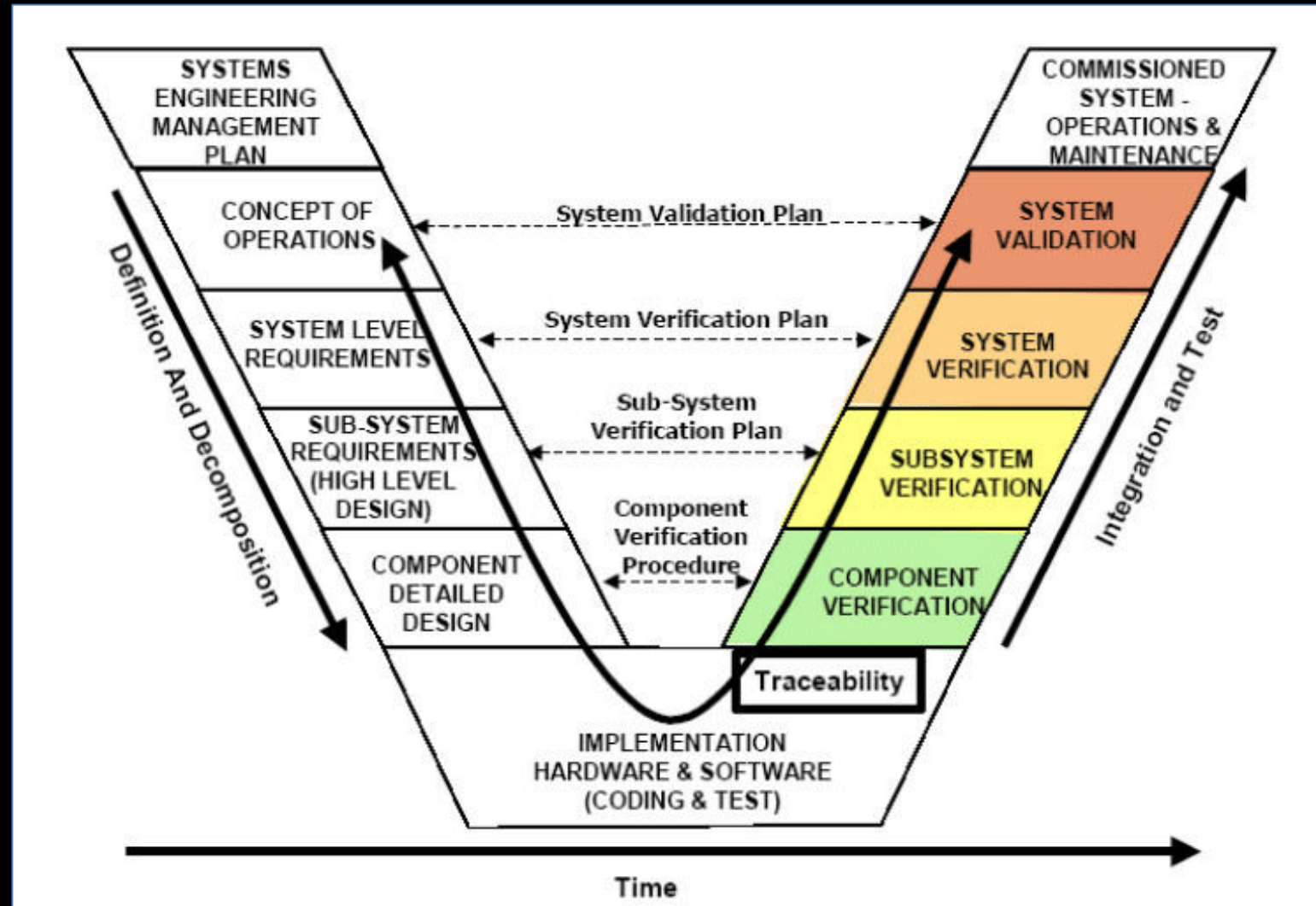
## MBSE Tools and Workflows

- **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

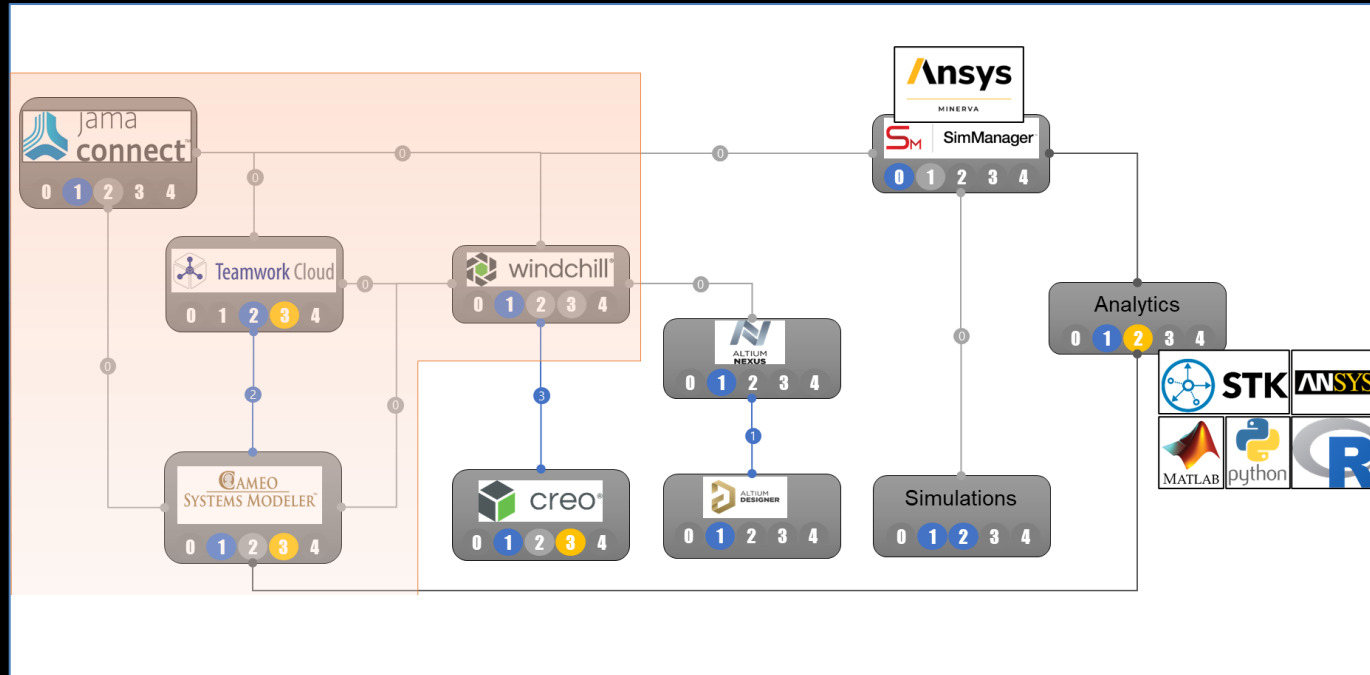
- R5 CubeSat: MBSE streamlined design validation

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



# What examples of missions that utilized MBSE?

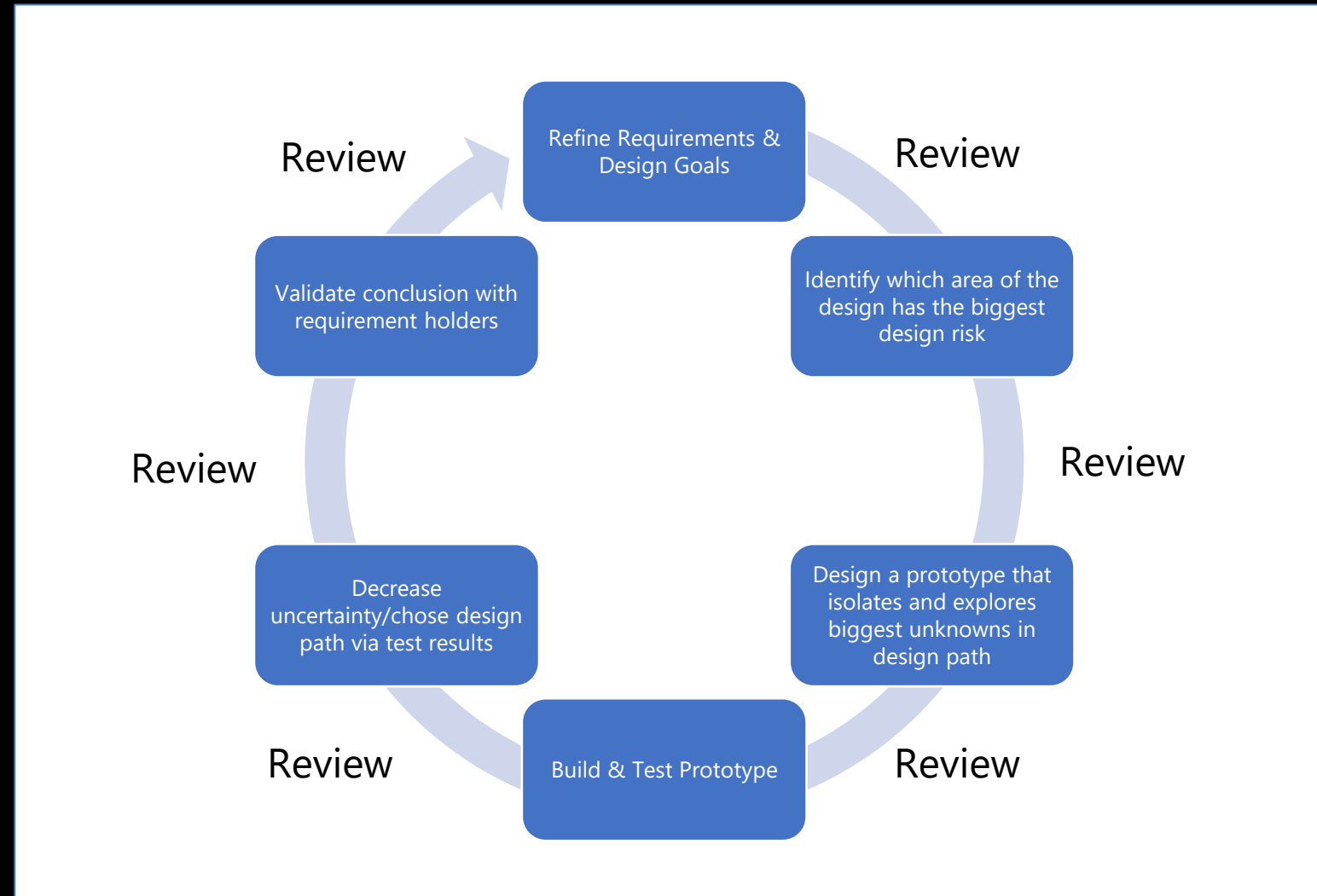
- MBSE in Action at NASA:
  - Tools: Jama for requirements, MagicDraw for modeling.



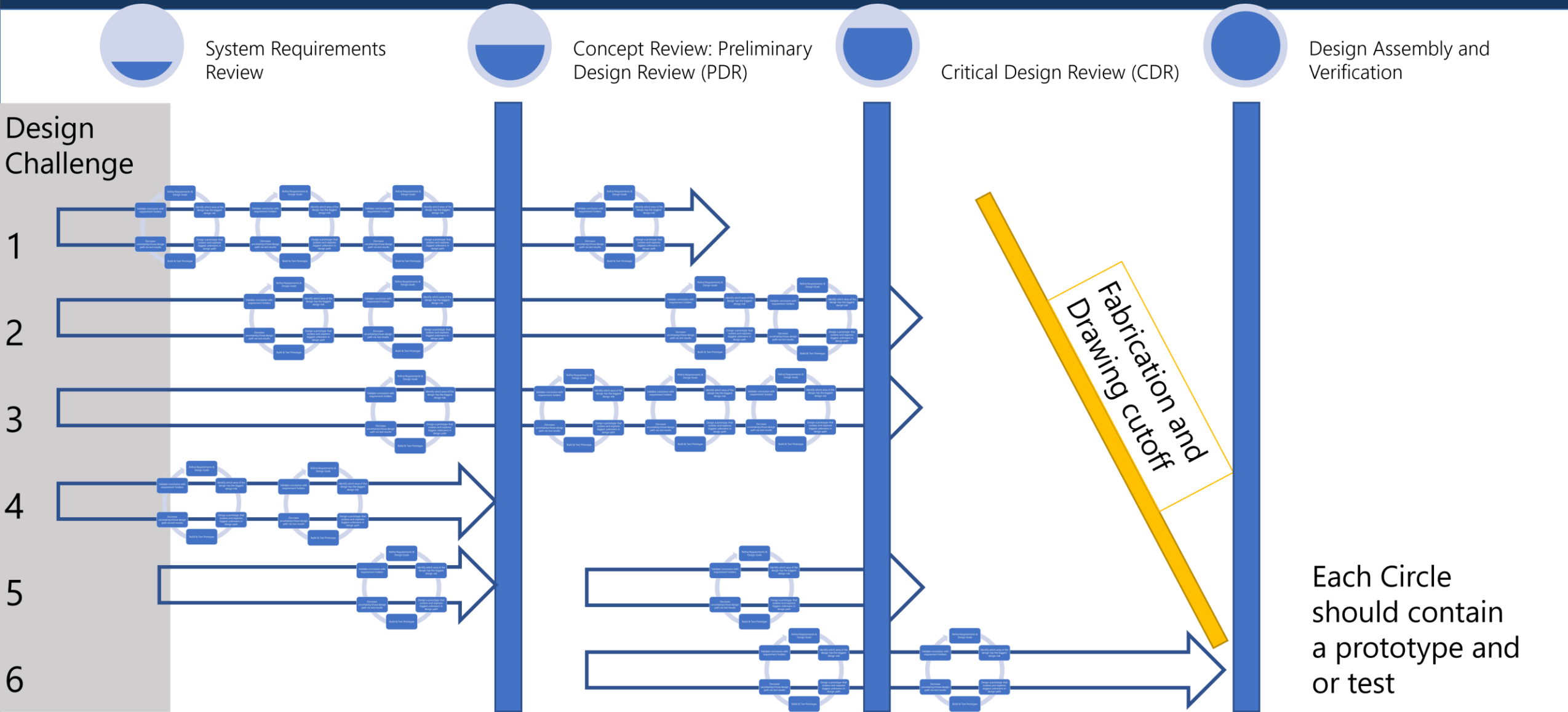
- Case Study: R5 CubeSat
  - Results: Reduced design integration time and improved cross-functional alignment.

# 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:

- 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.

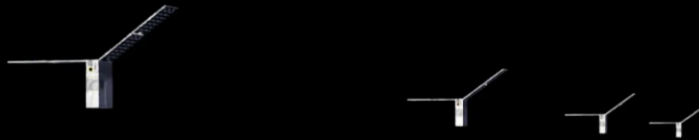
## Lessons learned:

- 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.

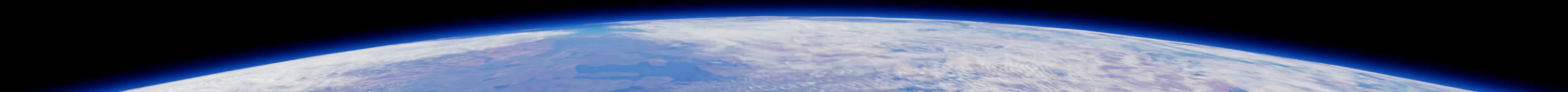
## STEPS for ADOPTION:

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

## Success Factors:

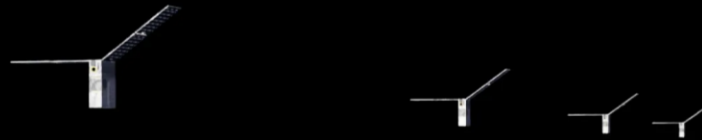


- Leadership buy-in and support.
- Clear communication of MBSE value to stakeholder.



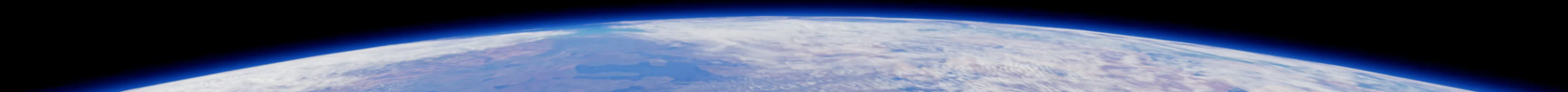
## Trends:

- 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.



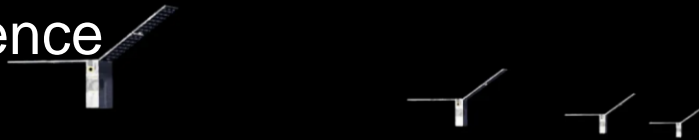
# Upcoming Webinar: Design and Develop Science Missions



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/](http://www.nasa.gov/smallsat-institute/)