



Status of NEPP Model-Based Mission Assurance Efforts

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Acronyms



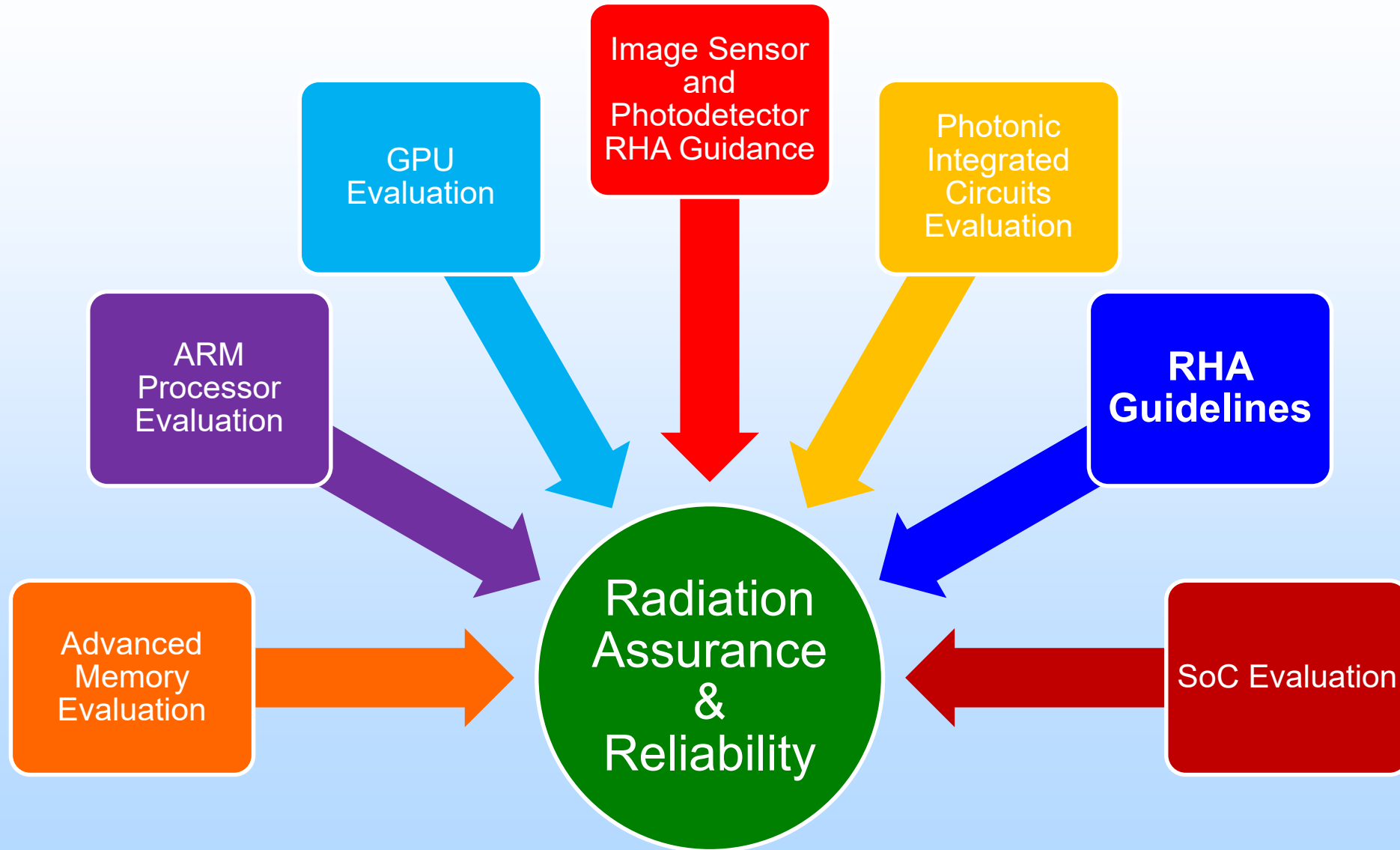
- **ARM: Architecture Reference Manual**
- **AWS: Amazon Web Services**
- **COTS: Commercial Off The Shelf**
- **DT: Digital Transformation**
- **GPU: Graphical Processing Unit**
- **GSN: Goal Structuring Notation**
- **H4D: Hacking For Defense**
- **MBMA: Model-Based Mission Assurance**
- **MBSE: Model-Based System Engineering**
- **NEPP: NASA Electronics and Packaging Program**
- **OSMA: Office of Safety and Mission Assurance**
- **OSU: Ohio State University**
- **R&M: Reliability & Maintainability**
- **R-GENTIC: Radiation Guidelines for Notional Threat Identification and Classification**
- **RHA: Radiation Hardness Assurance**
- **SEAM: System Engineering and Assurance Modeling**
- **SEE: Single Event Effects**
- **SoC: System-on-Chip**

Outline

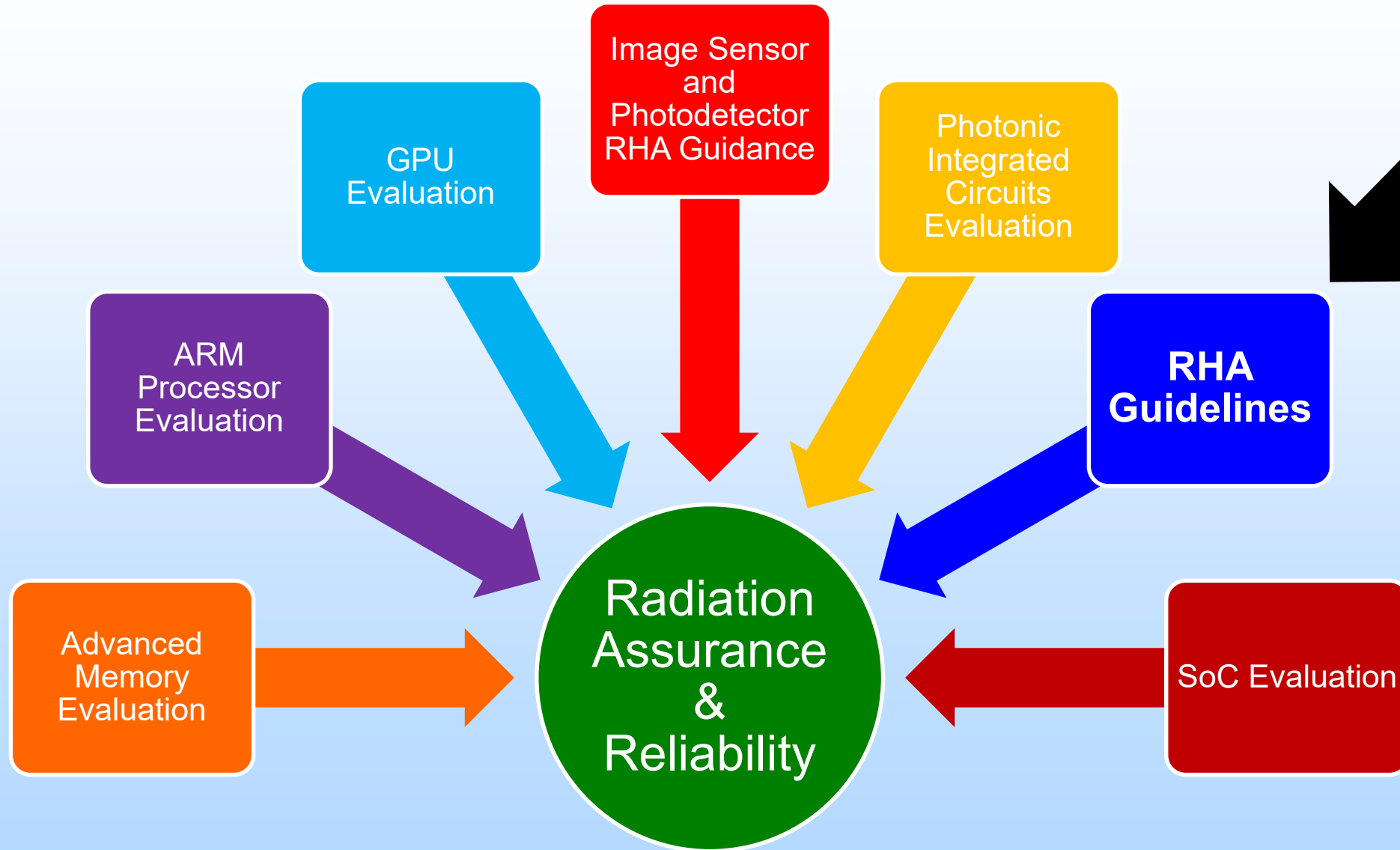


- **NEPP Focus**
- **History of NEPP and MBMA**
- **FY21 Update**

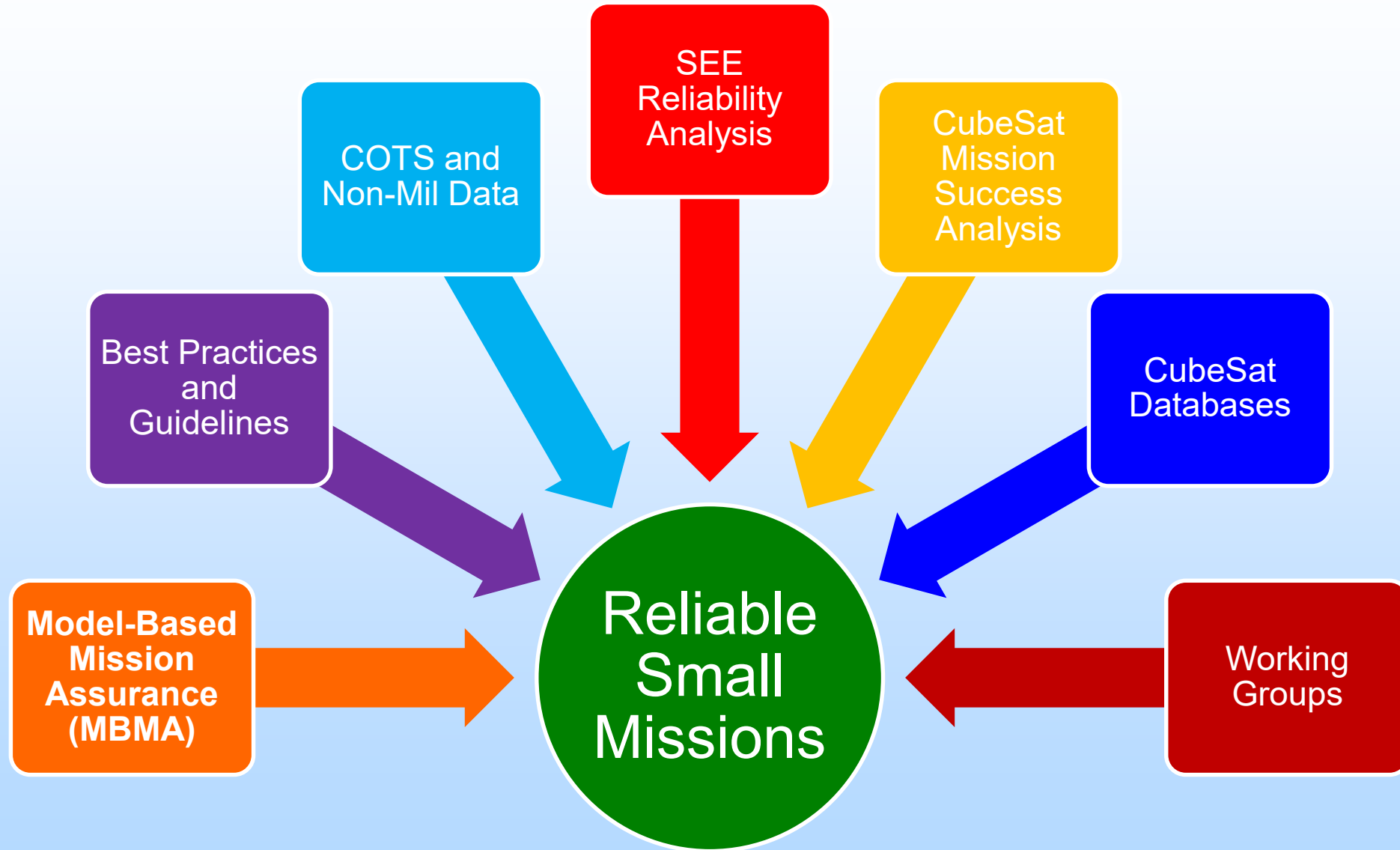
NEPP Program (OSMA) – Radiation Work



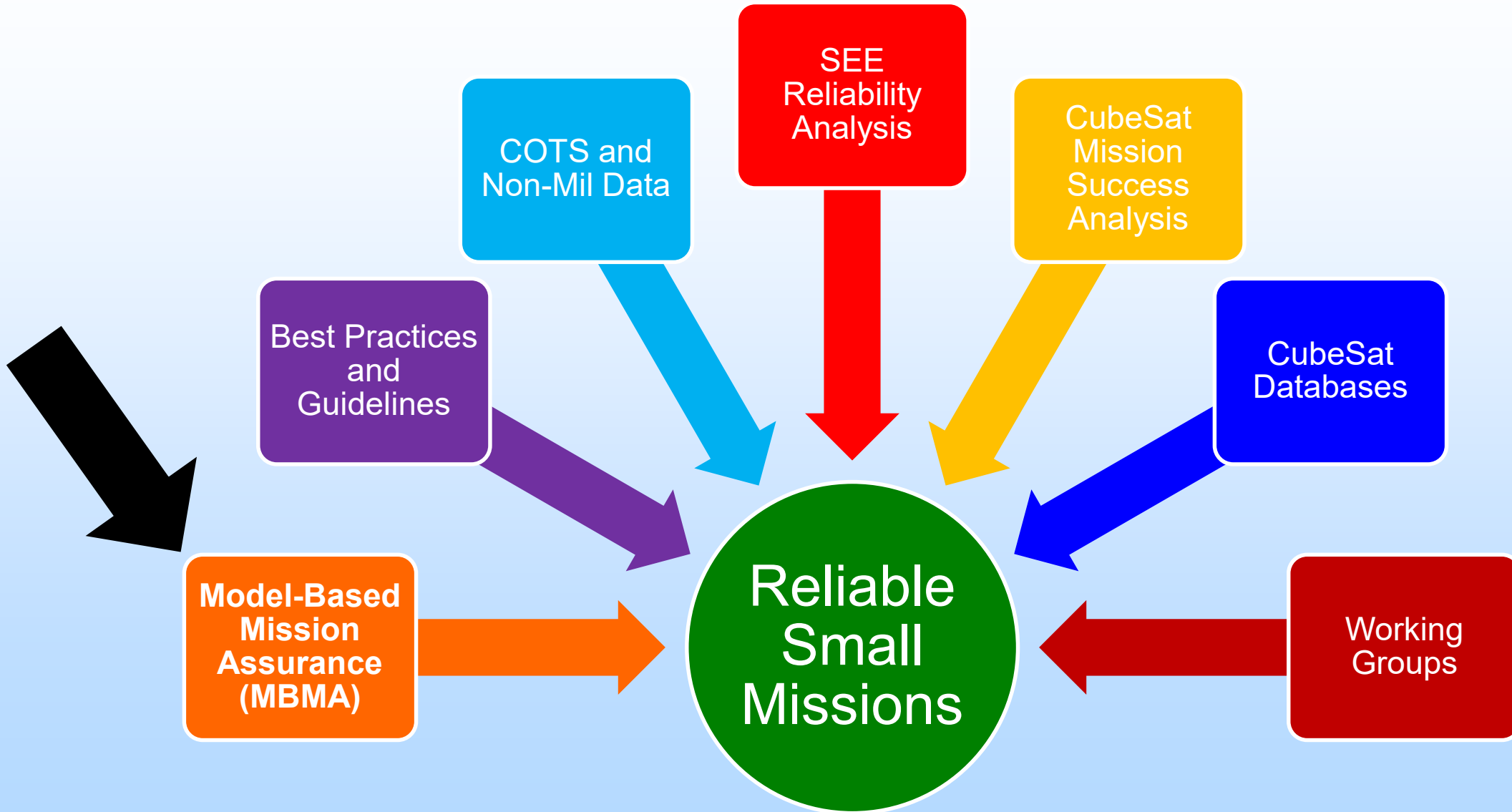
NEPP Program (OSMA) – Radiation Work



NEPP Program (OSMA) – Small Mission Efforts

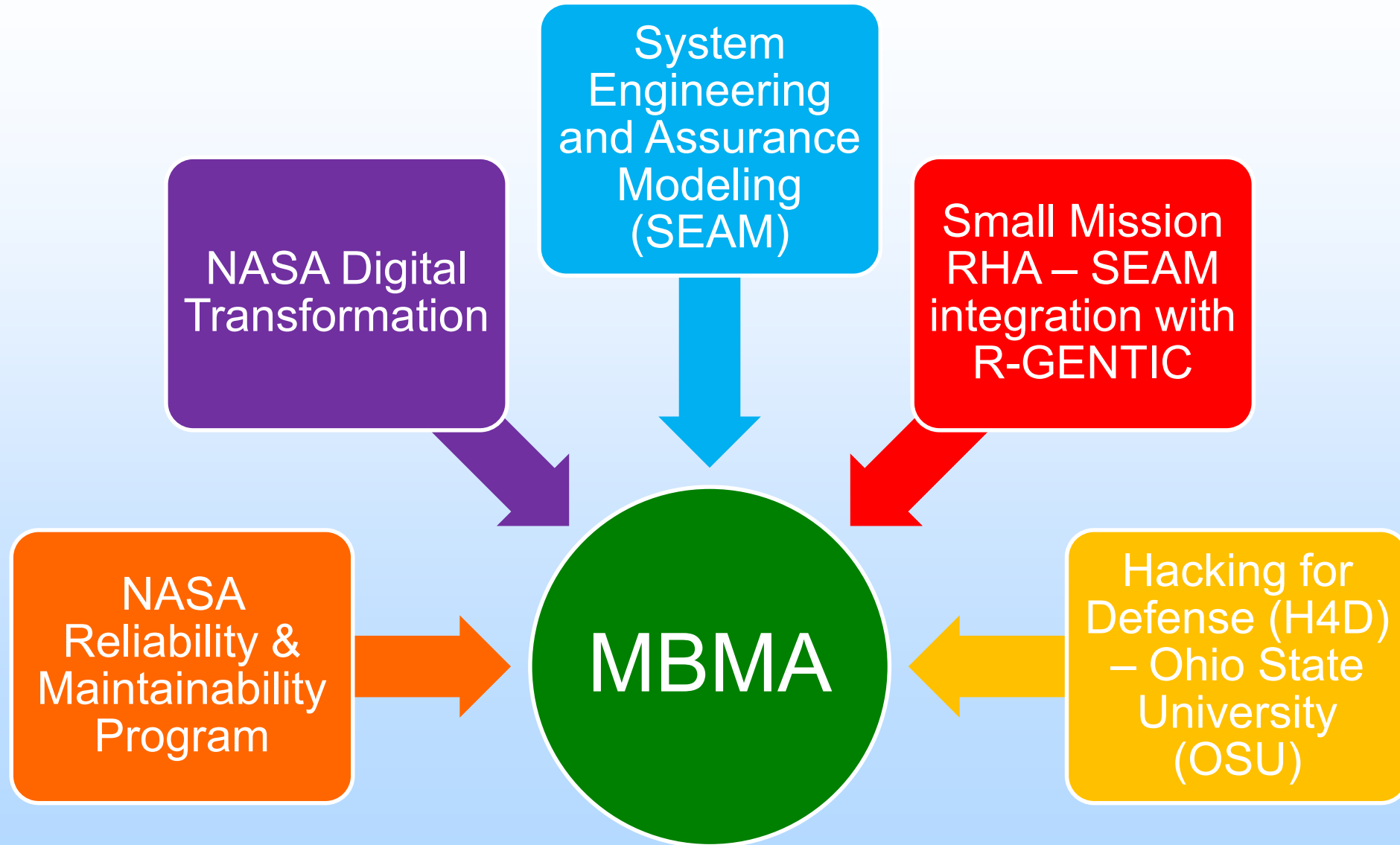


NEPP Program (OSMA) – Small Mission Efforts





NEPP Program (OSMA) – MBMA

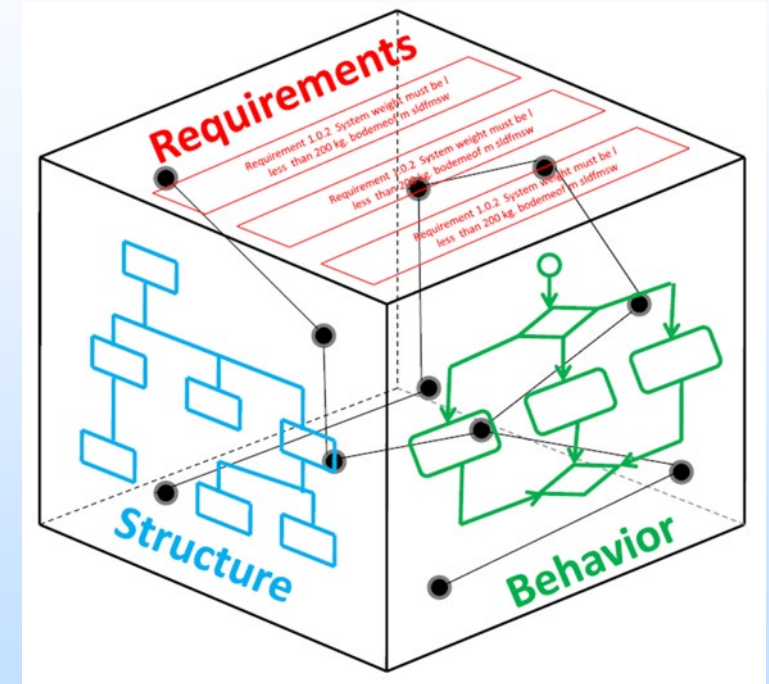


What is a Model?

- The Department of Defense defines a model as “A physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, or process”.

Modeling and Simulation Coordination Office, Ed., Modeling and Simulation (M&S) Glossary. 1901 N. Beauregard St., Suite 500 Alexandria, VA 22311: Department of Defense, Oct. 2011. <https://www.msco.mil/MSReferences/Glossary/TermsDefinitionsI-M.aspx>

- We are used to working with mathematical representations of systems, entities, phenomenon, or processes
- Model-Based Mission Assurance (MBMA) is adding logical representations of our systems and processes to enhance and improve Radiation Hardness Assurance (RHA)



M. Bajaj, B. Cole, and D. Zwemer, “Architecture to geometry - integrating system models with mechanical design,” in *Proc. AIAA SPACE*, 2016.

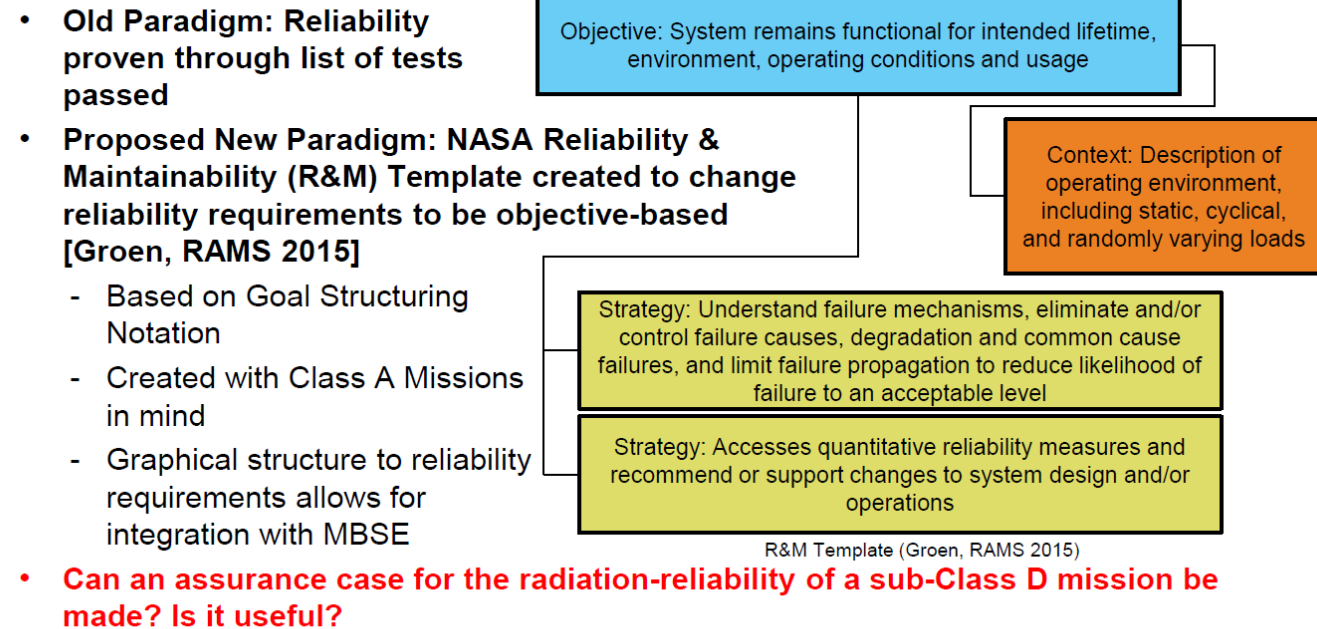
2016: NASA Reliability & Maintainability Template



NASA Reliability & Maintainability (R&M) Template



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2017: Model-Based Assurance Case (MBAC+) (MBAAC+)

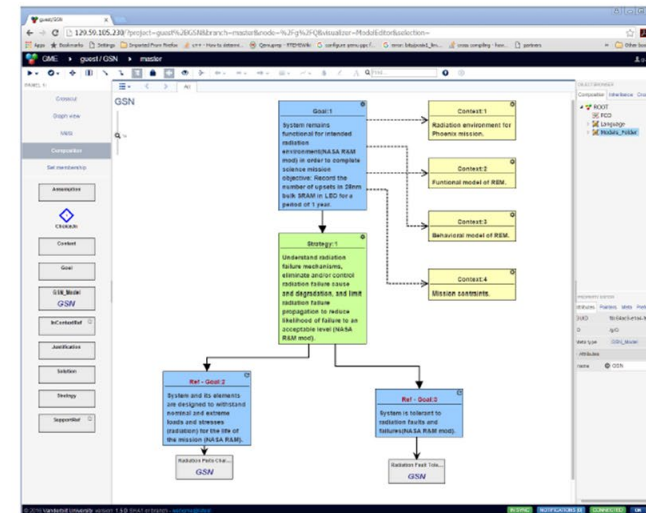


Model-Based Assurance Case (MBAAC+ (=WebGME)) for Radiation Hardness Assurance Activities



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- Tutorial at NSREC 2017 Tuesday, July 18th, during lunch
- Learn how to use NASA's Reliability and Maintainability Template to construct a radiation reliability assurance case
- Modeling environment also supports SysML Block Diagram modeling with fault propagation (no Bayesian nets yet)
- Browser based
- Free non-proprietary site hosted on Amazon (AWS) (like Crème)
- Free images of site for proprietary or export controlled modelling for hosting on Amazon GovCloud or internal servers



2018: System Engineering and Assurance Modeling



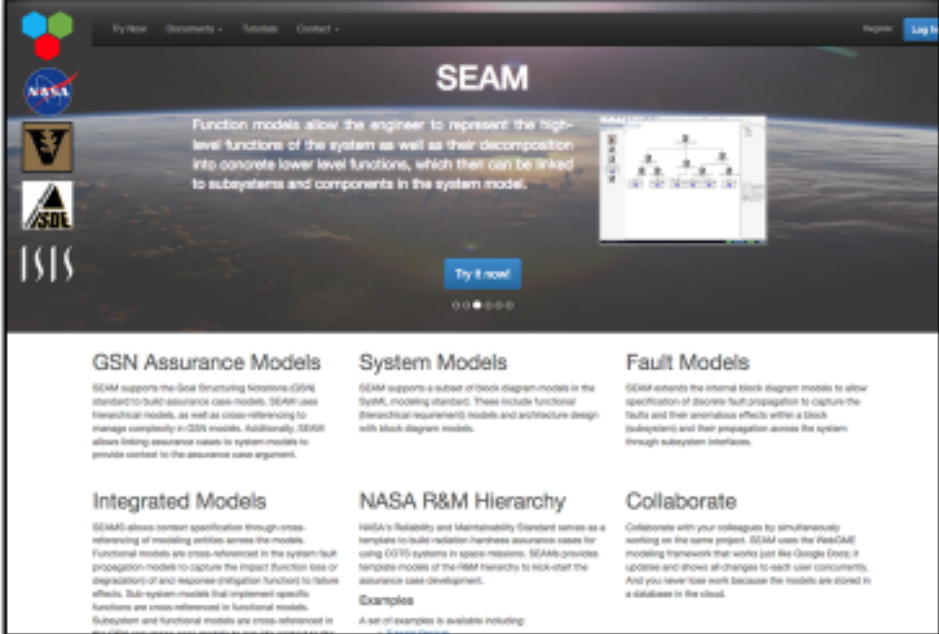
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System Engineering and Assurance Modeling (SEAM) Platform



- Web-browser based
- GSN implementation
- SysML+fault propagation models
- Functional Models
- Integration of GSN+SysML
- Export to Bayes Net software tools
- Examples based on CubeSat expmt.

<https://modelbasedassurance.org/>



The screenshot shows the SEAM website interface. At the top, there is a navigation bar with 'Try Now', 'Documents', 'Status', and 'Contact'. Below this is the SEAM logo and a main heading 'SEAM'. A paragraph of text explains that function models allow engineers to represent high-level functions and their decomposition into lower-level functions. To the right, there is a diagram showing a hierarchical structure of functions. Below the main heading, there are several sections: 'GSN Assurance Models', 'System Models', 'Fault Models', 'Integrated Models', 'NASA R&M Hierarchy', and 'Collaborate'. Each section contains a brief description of the model type and its application. A 'Try it now!' button is visible in the center of the page.

NEPP ETW 2018

13

2019: Model-Based Mission Assurance



Conclusions

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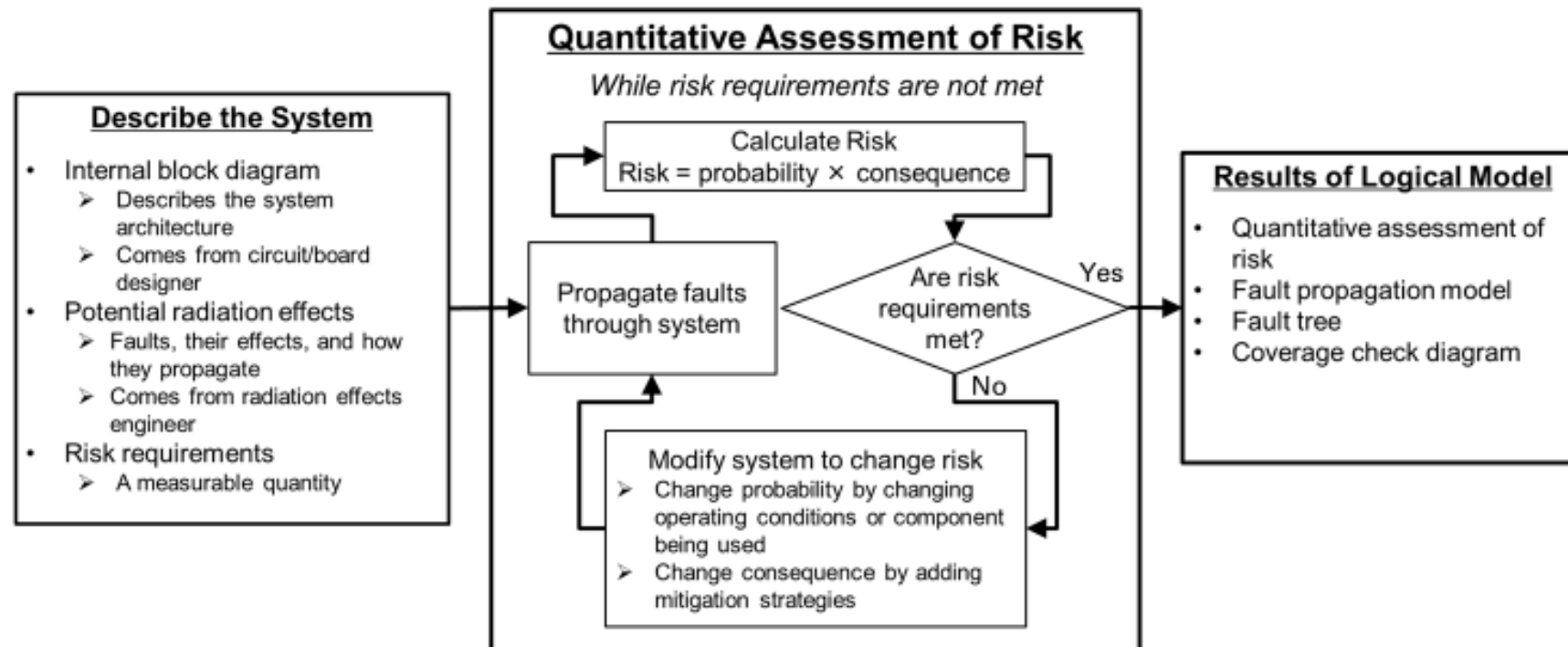
- **MBMA is a function of time**
 - Captures the evolution of mission assurance as the system is developed
- **MBMA enables concurrent engineering of reliability and design engineering**
 - Argument structure show how a requirement is verified and how it is derived
- **MBMA enables intelligent mission-specific requirements**
 - Illustrates the creation of reliability requirements as more about the mission is known



2020: Model-Based Risk Assessment



Model-Based Quantitative Risk Assessment



To be presented by R. A. Austin at the NASA Electronics Parts and Packaging (NEPP) Electronics Technology Workshop (ETW) virtually June 15-18, 2020

Quantitative Assessment of Risk for Modeling Radiation Impact on System Functions

5

2021: RHA and the Digital Transformation



- **R-GENTIC integration with SEAM**
 - Lower barrier to entry
 - Standardize radiation fault propagation models
- **SEAM on the AWS GovCloud**
 - Enable use on NASA flight projects
- **SEAM and Hacking 4 Defense**
 - Market research on what the barriers to entry on using model-based engineering for RHA

