AEROSPACE REPORT NO.
TOR-2017-01696

# Mission Assurance Considerations in Model-Based Engineering for Space Systems Product Overview

May 4, 2017

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Contract No. FA8802-14-C-0001

Authorized by: Space Systems Group

**Developed in conjunction with Government and Industry contributors as part of the U.S. Space Programs Mission Assurance Improvement Workshop.**



## Acknowledgments

This document has been produced as a collaborative effort of the Mission Assurance Improvement Workshop. The forum was organized to enhance mission assurance processes and supporting disciplines through collaboration between industry and government across the U.S. Space Program community utilizing an issue-based approach. The process is to engage the appropriate subject matter experts to share best practices across the community in order to produce valuable mission assurance guidance documentation.

The document was created by multiple authors throughout the government and the aerospace industry. For their content contributions, the following contributing authors are acknowledged for making this collaborative effort possible:

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A special thank you for co-leading this team and efforts to ensure completeness and quality of this document are extended to:

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*Product Overview*

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May 4, 2017

# Agenda

- Motivation for this Mission Assurance Improvement Workshop (MAIW) topic
- Process areas selected
- Product development approach
- Example section development: Independent reviews
- Topic follow-on recommendations
- Workshop objectives
- Breakout session results
- Team membership and recognition

# Motivation for Mission Assurance Considerations in Model-Based Engineering for Space Systems

## Motivation

- Persistent trend in industry:
  - *Doc-based work → Model-based work*
- How can we retain all the mission assurance "goodness" during this transition?
- What opportunities exist to enhance mission assurance here?

## Product

- Detailed treatment of six mission assurance process areas:
  - *Transition expected*
  - *Recommendations*
  - *Lessons learned*
- Summary recommendations for mission assurance leaders
  - *Focus on PM, SE, MA lead perspective*

PM = project management; SE = systems engineering; MA = mission assurance

**Product motivated by industry trends toward model-based work**

# Mission Assurance Program Framework

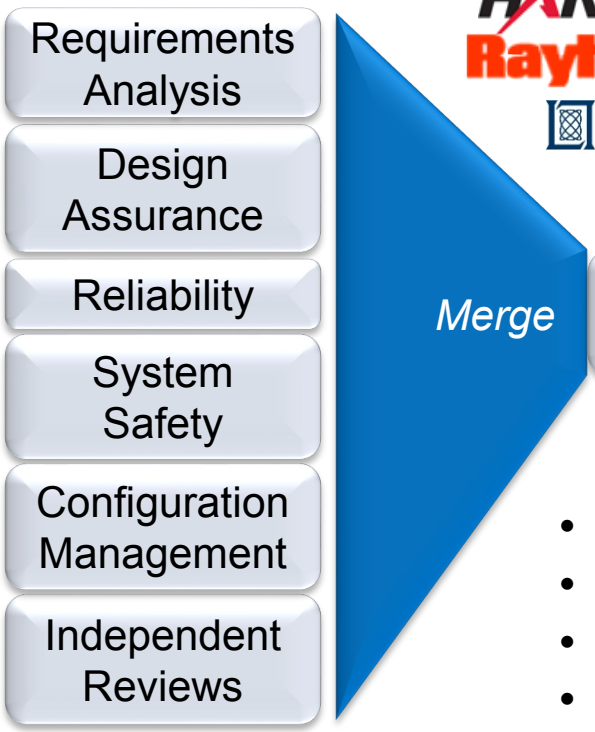
| No. | Recommended Mission Assurance Process | Process Group |
|---|---|---|
| 1 | Requirements Analysis and Validation | 1. Program Execution |
| 2 | Design Assurance | |
| 3 | Parts, Materials and Processes | |
| 4 | Environmental Compatibility | |
| 5 | Reliability Engineering | |
| 6 | System Safety | |
| 7 | Configuration/Change Management | |
| 8 | Integration, Test and Evaluation | |
| 9 | Risk Assessment and Management | 2. Risk, Oversight, and Assurance |
| 10 | Independent Reviews | |
| 11 | Hardware Quality Assurance | |
| 12 | Software Assurance | |
| 13 | Supplier Quality Assurance | |
| 14 | Failure Review Board | 3. Triage, Information and Lessons Learned |
| 15 | Corrective/Preventative Action Board | |
| 16 | Alerts, Information Bulletins | |

Proposed follow-on

Source: Bjorndahl, W. D., *Mission Assurance Program Framework*, Aerospace Report No. TOR-2010(8591)-18, The Aerospace Corporation, El Segundo, CA, 2010.

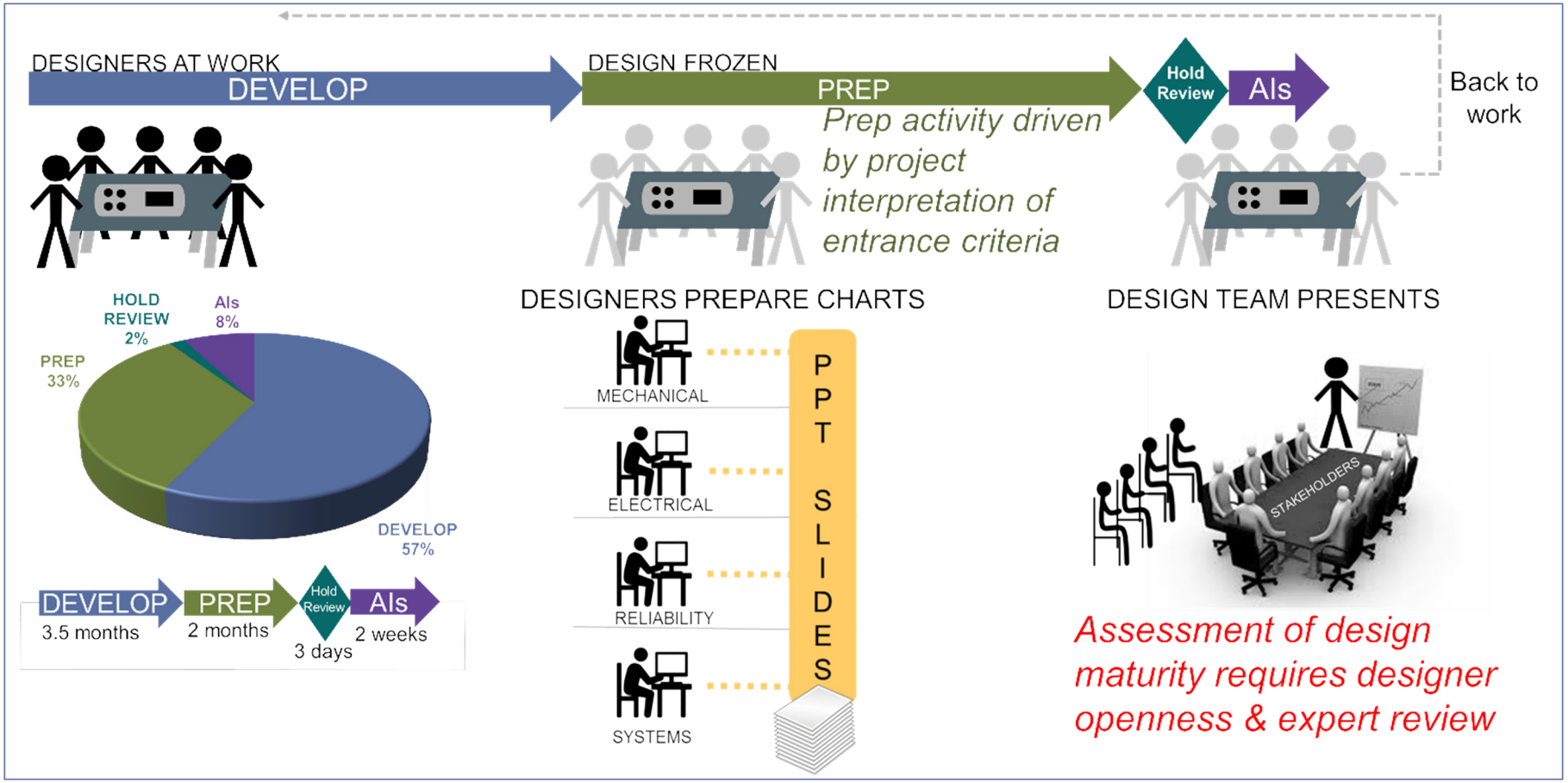
# Product Development Approach

- Work divided by MA area
- One section lead per area
- Common outline per section:
  - *As-is/to-be transition graphic*
  - *Guidance, background*
  - *Benefits, opportunities*
  - *Recommendations*



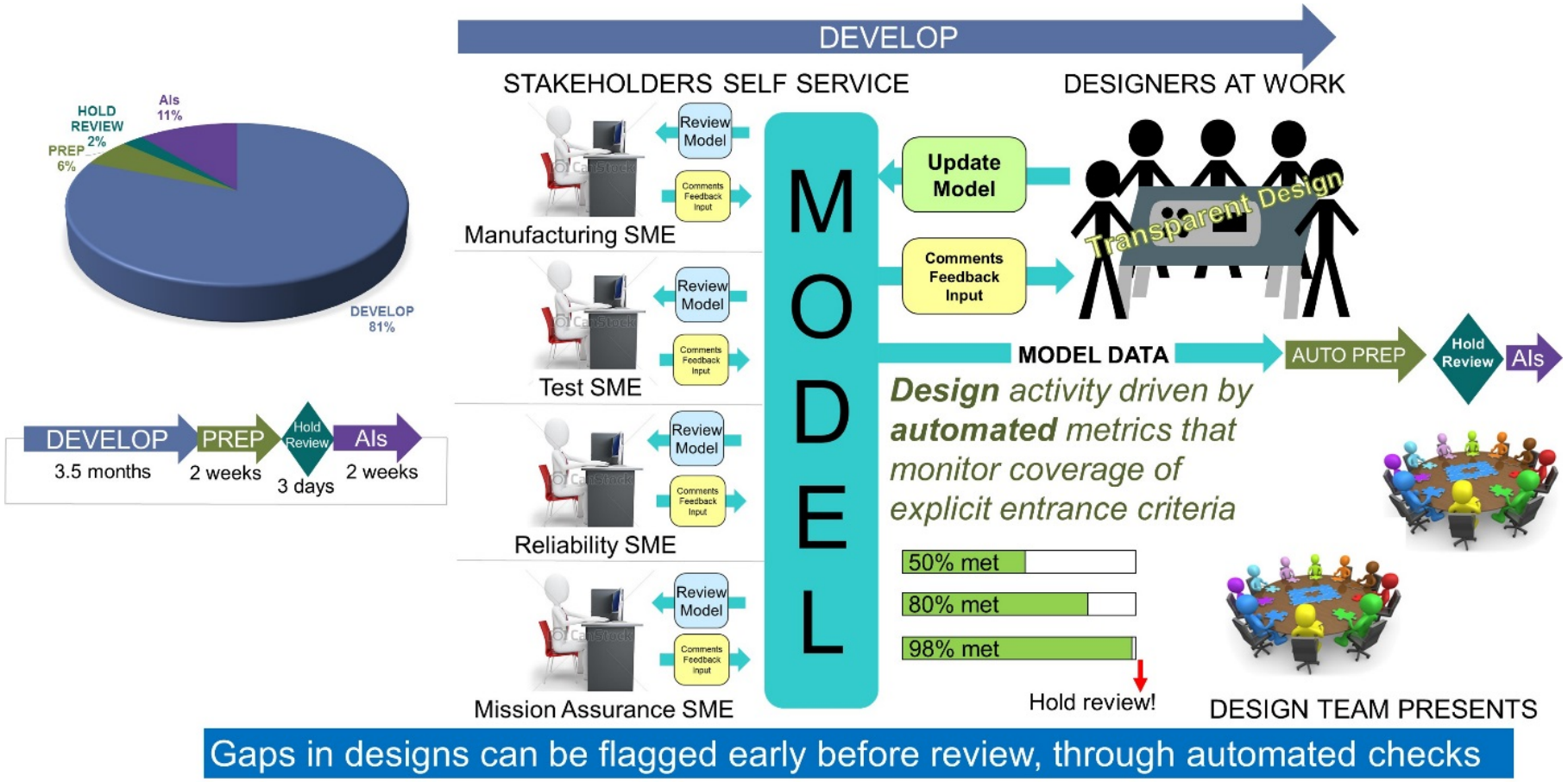

- Role impacts
- MA recommendations
- Guidance
- General recommendations
- Lessons learned

# Section Example: Independent Reviews Current State

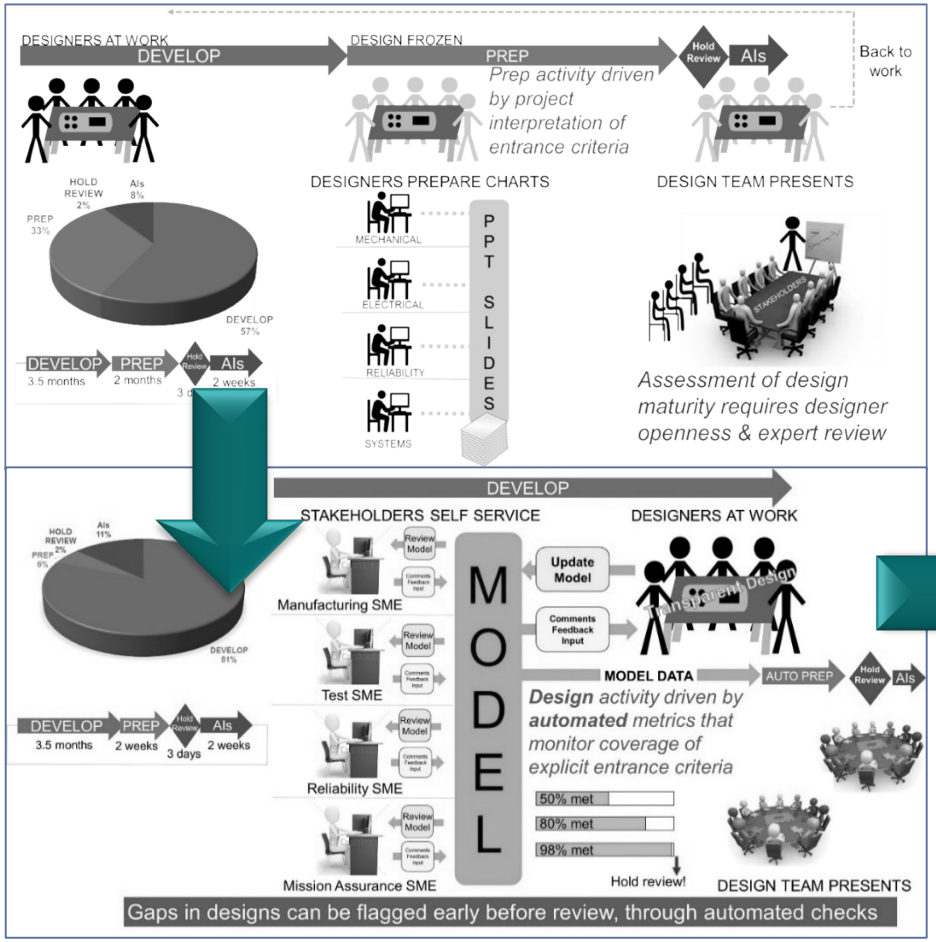



PREP = preparation; PPT = PowerPoint™; AI = action item

# Section Example: Independent Reviews Future State



# Example Development of One Section




*Sample recommendations*

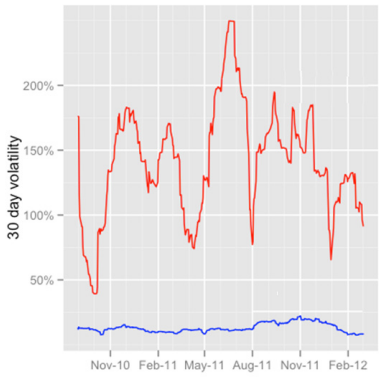
Themes for front matter

- Review completeness and maturity of model
- Ensure model checkers are validated
- Review configuration control approach of model
- Consider volatility of model in addition to technical data

Implementation details

- Recommend model-based deliverables over documents
- Common reference IT infrastructure can help reduce risks
- Automated work sequence records can help flag behavior/culture problems
- Consider slow approach to adoption to reduce rejection risk

# Example Implementation-Agnostic Recommendations for Reviews




Programs implementing model-based reviews should:

- extend these reviews beyond the review of technical content to the completeness and validity of the model itself, versus what is expected for the current milestone.
- verify that model checkers have been validated and are as effective as claimed, especially if manual review is reduced according to model checker maturity.
- review model volatility as a risk indicator as well as the volatility of changes to model checkers. If models and checkers are continually changing, version misalignment and errors are likely to occur and thus undermine the value of model checking.

# Example General Recommendations

1. Ensure program decision making is based on authoritative model data.
2. Reduce mission assurance risks through engaging reliability, safety, design assurance analysis early and often as the model evolves.
3. Reviews should cover both the technical content and the validity of the model itself.
4. Capture rationale behind changes to the technical baseline within the model and ensure decision making accountability and understanding through the lifecycle.
5. Need a clear configuration management strategy for maintaining an authoritative model that accounts for distributed tools and databases.
6. Monitor process rigor and compliance through model-use profiling and constraints.
7. Feedback operational experience (failures, behaviors) into design models to inform next-generation use cases.

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## External Distribution

REPORT TITLE

Mission Assurance Considerations in Model-Based Engineering for Space Systems Product Overview

| REPORT NO. | PUBLICATION DATE | SECURITY CLASSIFICATION |
|---|---|---|
| TOR-2017-01696 | August 31, 2017 | UNCLASSIFIED |


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TOR-2017-01696

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