

# Deploying MBSE to the Boeing Enterprise – A Fresh Perspective

(Challenges Faced & Lessons Learned)

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GLOBAL PRODUCT DATA  
INTEROPERABILITY  
**S U M M I T**  
2019



# Presenter Biographies

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## A Fresh Perspective:

- Nabeel has had a distinguished 6 month career at Boeing and was hired into the 2CES MBSE development group as a result of experience obtained during undergraduate studies
- Nabeel is on the System Test team where his primary responsibilities include testing the application and all additional profiles/plugins for quality, ensuring new capabilities meet the Boeing spec, and documenting all lessons learned in the development cycle.
- Graduated 2018 with BS AE from Georgia Tech, and started an online MS AE also at Georgia Tech in mid-August specializing in aerospace systems engineering



## A Seasoned Guide:

- John Herrold is currently one of the lead engineering architects for the 2<sup>nd</sup> Century Enterprise Systems Model Based Systems Engineering Activity that provides a service ready model based systems engineering solution (process, tool and training) for systems and design engineers.
- John has been a Boeing employee for 39 years and has worked mostly in the engineering analysis domain, supporting many of the Boeing Commercial and Military Airplane Products.
- John is a designated Boeing Technical Lead Engineer and a member of the International Council on Systems Engineering (INCOSE). John has a BSEE from the University of Washington.

# MBSE at Boeing - Overview

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## Starting off - What was I able to find out about the history of MBSE at Boeing?

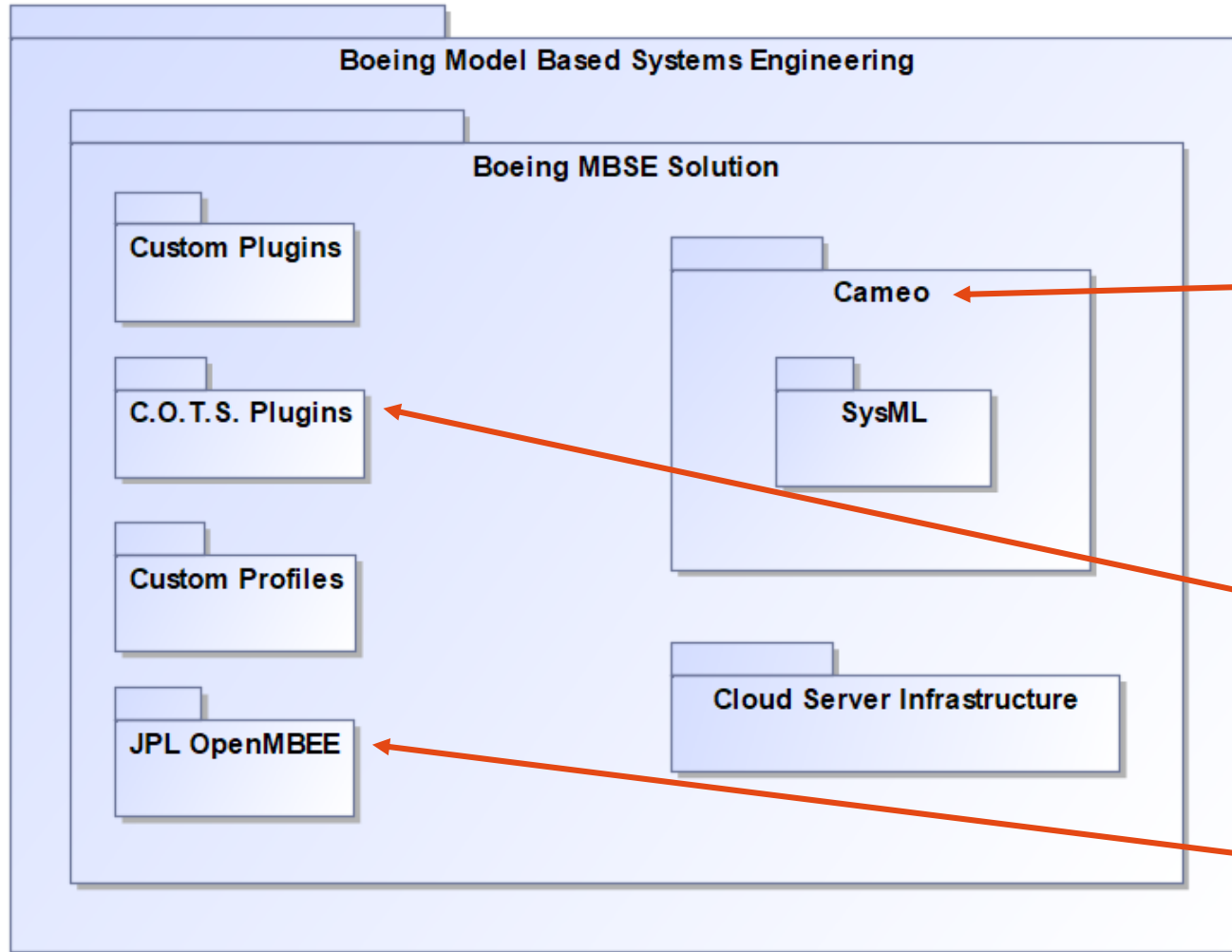
- Boeing has been in the process of developing MBSE tools and processes since ~2005 with tools such as SLATE, TcSE, Rational Rose, Vitech Core, and Rhapsody/Jazz
  - Pockets within Boeing are path finding MBSE implementations that lead the way to an enterprise-wide success
- **The first MBSE implementation with enterprise wide engineering awareness and understanding started in ~2016 with the Boeing 2<sup>nd</sup> Century Enterprise Systems (2CES) initiative, which is the term for Boeing's enterprise digital transformation efforts.**



Image credit: [Boeing](#) (public)

# MBSE at Boeing - Overview

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## Boeing MBSE Schematic

The foundation of the Boeing MBSE Solution is Cameo Enterprise Architecture

But we also conduct trade studies to find the best additions to Cameo that meet our needs

# MBSE at Boeing – Team Structure

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## How is the MBSE Development Team Structured at Boeing?

How do these teams fit together? And how are they managed for the purpose of deploying the correct SE tool and architectural guidelines for Boeing?

- Two teams lead the development of the Boeing MBSE solution:
  - Engineering team focused on capability definition, release, testing, program implementation/support, and training
  - IT team focusing on tool capability development, tool deployment and defining and managing the MBSE physical infrastructure
- The engineering team is broken down into numerous subteams:
  - Training
  - Program Engagement
  - Quality
  - SE MBSE Capabilities (Reuse, Modeling Patterns, Query, Configuration Management/Product Line Engineering)
  - Architecture

# MBSE Development Teams - Utilizing Agile

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The MBSE Development Team has operated on the Scaled Agile Framework for just over a year now

## Let's talk about Agile!

Has it helped our MBSE deployment efforts?

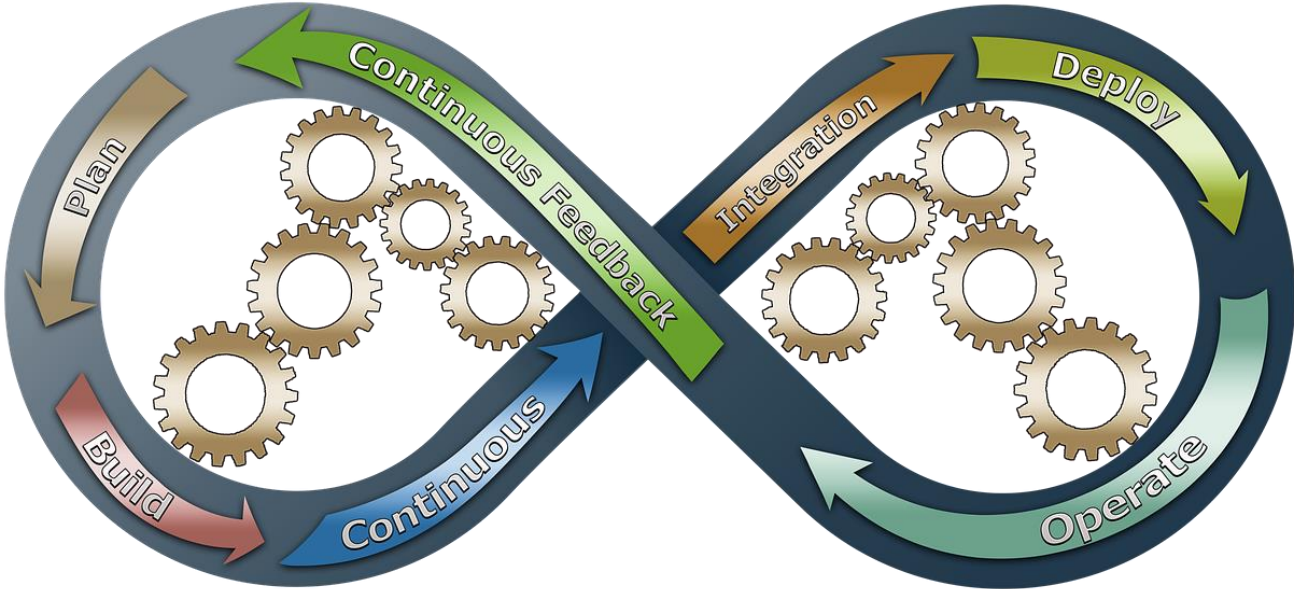


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# Perceived Agile Benefits

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1. A clear framework set in place for the purposes of iterative software development: Scaled Agile Framework for Lean Enterprises - SAFe
  2. Usage of a specific tool to facilitate Agile (e.g. Microsoft Visual Studio Team Foundation Server – TFS)
    3. Much easier to track progress, map out dependencies, triage bugs, and to plan out work in sprints

# Perceived Agile Improvement Opportunities

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1. A sense of the overarching team mission needs to be maintained among the individual work items that developers get assigned
2. Is there a way to adapt Agile to suit the needs of different teams without losing the core framework?
3. Boeing as an enterprise should keep determining how to scale the Agile framework appropriately for its needs



# Embracing Agile – From the Developers’ Perspective

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“Agile has been a good change overall for the group, but it definitely feels like we’ve lost that overarching development mission in favor of individual team objectives”

“I like Agile because it gives me a concrete work statement for 2 weeks and I think TFS is a pretty strong tool for tracking work.”

“It could be better! It’s good on paper but difficult to properly implement.”

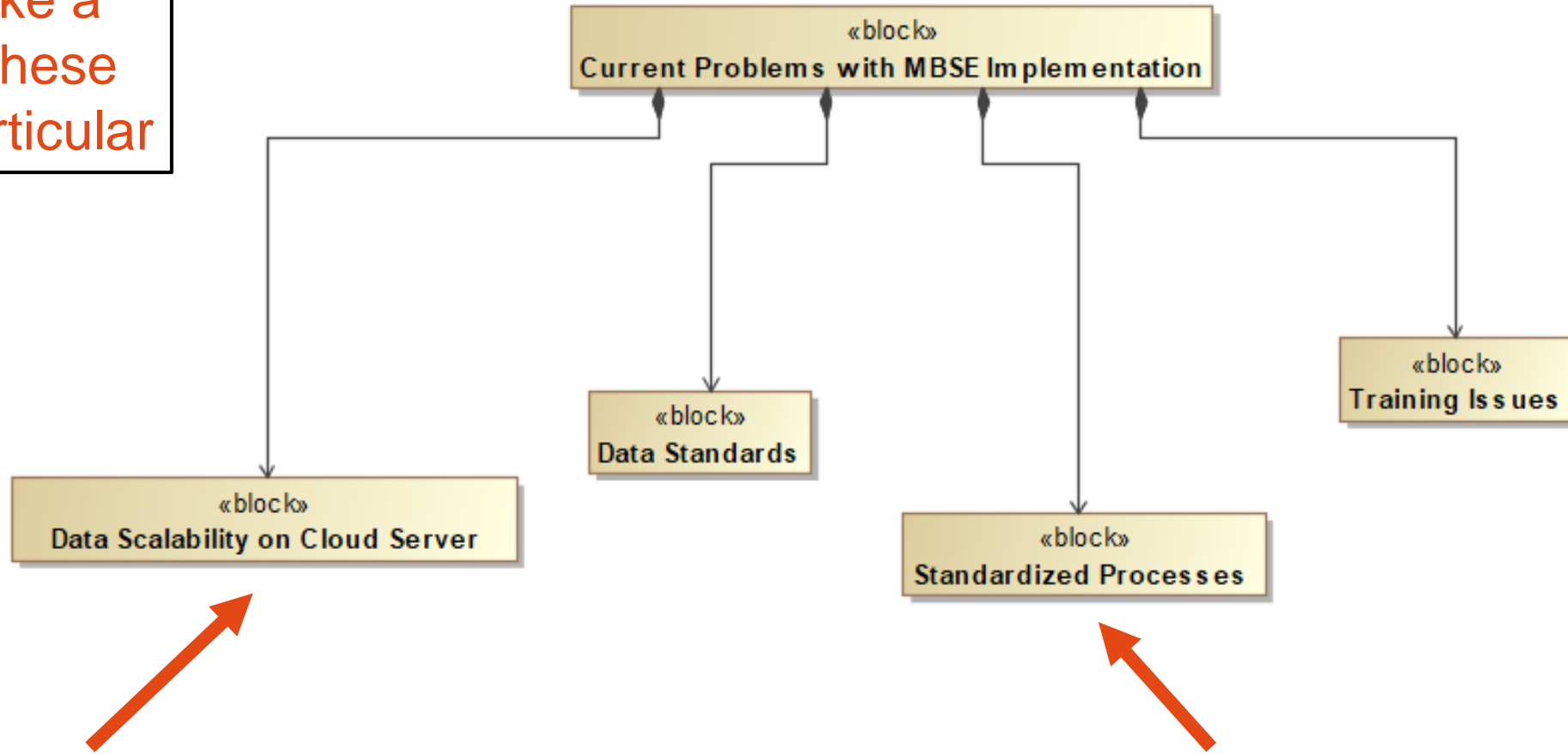
“It’s ok! Though it took time to understand the agile planning process we seem to understand it well now.”

**Takeaway: Continue to be Agile in MBSE tool and process development and improve our Agile processes with time!**

# Observed Growing Pains with MBSE at Boeing

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Let's take a look at these two in particular



# Growing Pains – Data Scalability

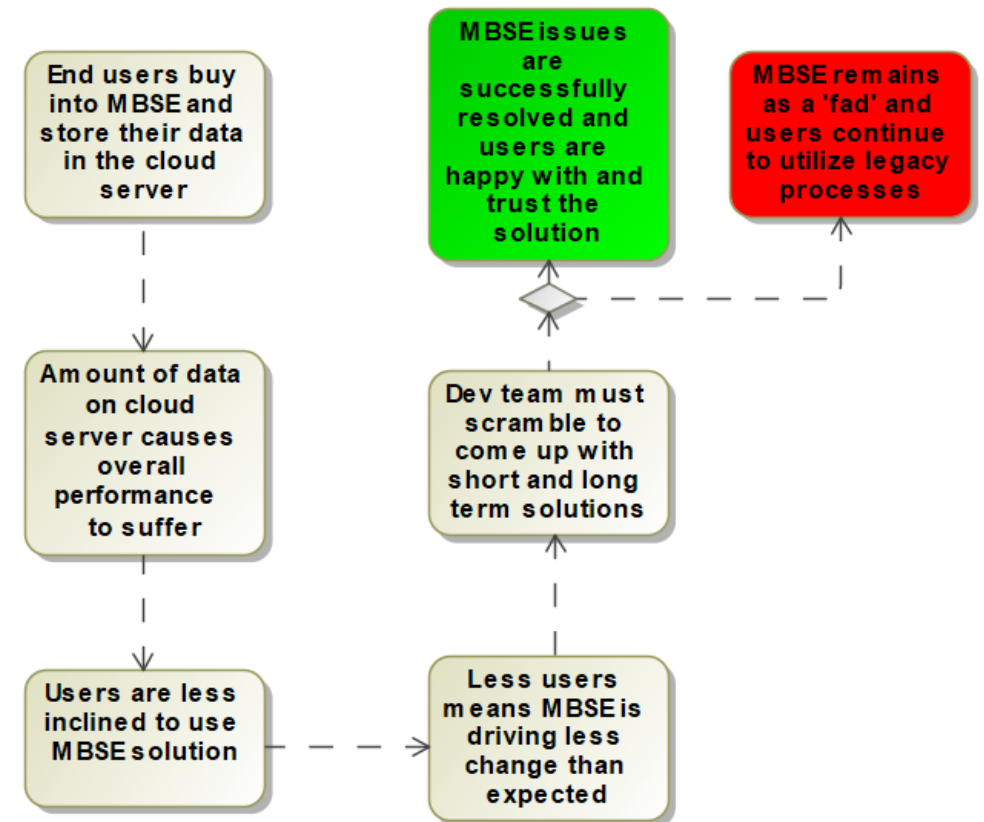
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## Data scalability for the MBSE cloud server is necessary and often overlooked

- Very large amount of data stored in the MBSE cloud as a result of many different teams choosing to implement MBSE into their projects
- The overall performance of the data servers relates inversely with the size of the project and the number of concurrent users on the server.

### Key opportunities:

- Explore ways to decrease the time spent migrating between server environments
- Address performance issues in the production environment due to project sizes



# Growing Pains – Standard Development Processes

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**Standard Development Processes is the next most immediate issue observed with the Boeing MBSE solution. Key questions to answer include:**



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- How do we standardize and/or modernize the systems engineering architecting and deployment process at a large company filled with legacy practices and ideas?
  - What should we keep, and what should we reconsider? Are we *allowed* to reconsider certain things?
- How do we keep **documentation** for end users and developers both intricate yet up-to-date?
  - Cameo models can help, and MMS
- How can we develop **documentation** (and processes) to benefit both developers and end users who'd like to introduce a new capability to Boeing MBSE?

**Takeaway:** Yes, we still have a long way to go, and need to focus on the answers to the questions above in order to implement MBSE and make it more efficient.

# My Discussions with Experienced Teammates: Near Term MBSE Deployment Challenges (Top 6)

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## (Not exhaustive, but currently resonate with the dev team)

1. Tool Integrations & interoperability including data transformations vs. linking (OSLC) between data repositories
2. Configuration management within a diverse set of tools and data repositories
3. Scalability and performance as models grow. IT infrastructure "chasing" end user expectations.
4. Data complexity/detail incorporating other engineering domain data (EE, ECS, Mech/Hyd, Structures, Production, Physical Design, Specialty Engineering) into the solution space to perform early architecture assessments
5. Diligence on IP design methods and models vs. industry sharing
6. Adoption (and influencing!) of standard tools, methods and processes for modeling, data transformations and data linking

# The Future of MBSE at Boeing – The Fresh Perspective

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- The most important lesson we keep coming back to is **thorough** and **living** documentation of all new capability development processes.
  - Standardization of best practices can **only** be achieved through documentation and **buy-off** from all parties in the development life cycle.
- It is important to build **trust** between the development team and end user teams above all else
  - When important parts of the infrastructure fail, end users must have confidence that they will be fixed.
- The largest challenge facing MBSE at the moment is interoperability between different platforms. This is an ongoing issue.

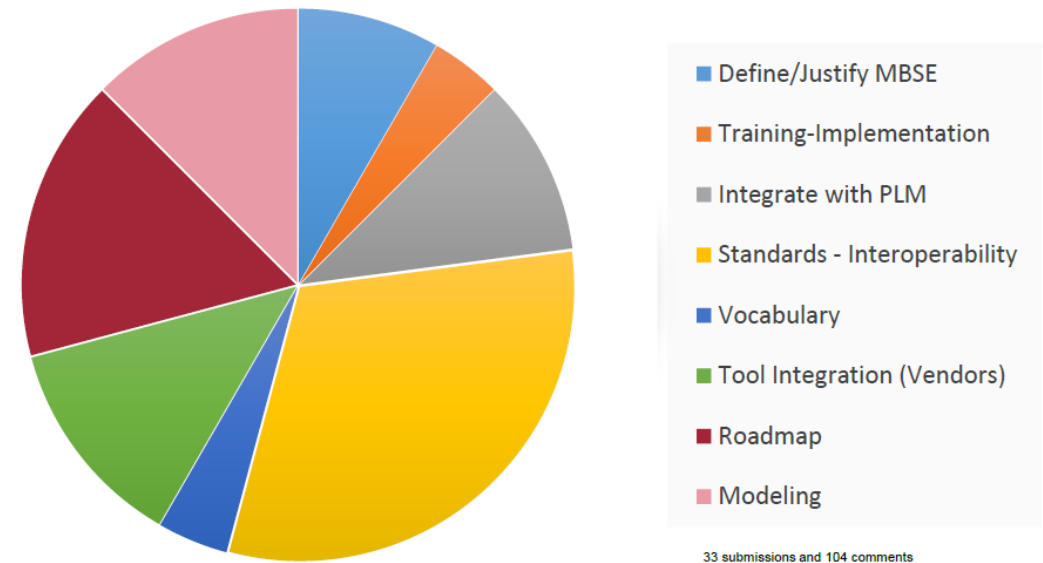


Image taken from 2017 GPDIS presentation by Mark Williams and Greg Pollari

# Conclusion – What do These Different Perspectives Enable?

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- **Gathering different perspectives promotes a diverse pool for improvements**
  - We are not drawing solely on the perspectives and experiences of managers and technical experts – the new user perspective is important to consider as well!
- **Continuous tool improvements, process improvements, and deployment improvements are critical to ensure the future of MBSE in the industry**
  - This means being constantly open to new ideas and doing things differently than before
  - All while maintaining adherence to long standing required processes and mindset – A delicate balance to strike
- **MBSE deployment, not just at Boeing, faces continued challenges both near and long term**
  - The solutions lie in continued technical improvements, building trust, and considering all perspectives when implementing change

# Questions?

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MBSE?

The future?

Agile?

Boeing?