MBEasy: Tenets for Making MBSE Easy Again

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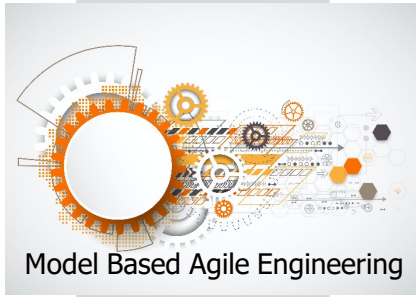
NOTE: The content in this presentation is derived from The accompanying paper titled "MBEasy: Tenets for Making MBSE Easy Again"

Presenter Bio



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  - Global Engineering Fellow (Agile EaSA, Offensive Cyber Technology)
  - OSWP, OSCP OSCE, OSEE, CEH/CNDA, CISSP, Safe Agilest, Certified Enterprise Architect
- Background & Experience
  - 29 years at BAE Systems
    - Algorithm Developer
    - Chief Engineer, Advanced Programs
    - Business Development
    - Strategic Program Capture
    - I&S University Founder
    - Cyber Resilience Capability Group
    - Deputy Director, FAST LABS Cyber Technology
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- Offensive & Defensive Cyber Security

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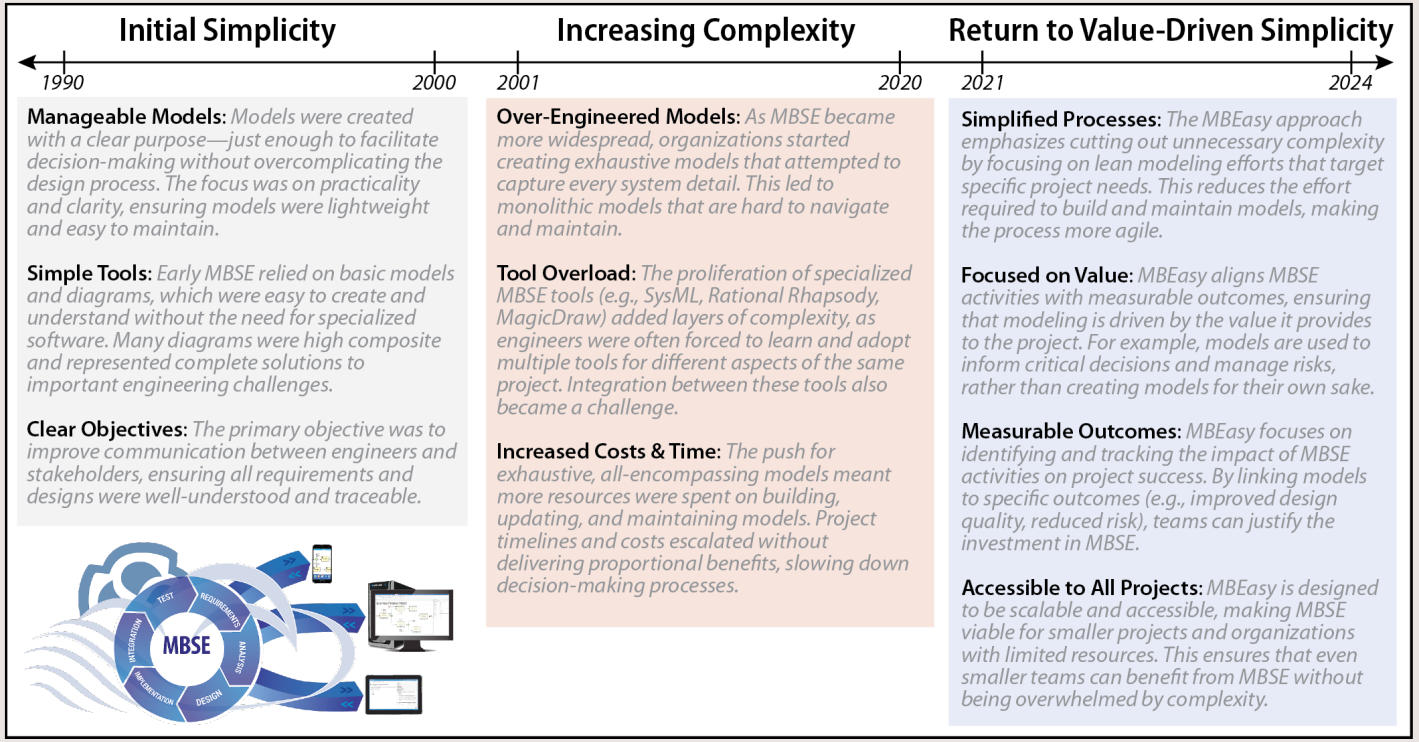
Today's MBSE Appears Complex

- Model-Based Systems Engineering (MBSE) has emerged as a transformational methodology for designing, analyzing, and managing complex systems.
  - It moves us away from traditional document-heavy approaches into a digital engineering environment
- However, as MBSE has gained widespread adoption, its processes have become increasingly complex.



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Initial Simplicity

1990 – 2000

Manageable Models: *Models were created with a clear purpose—just enough to facilitate decision-making without overcomplicating the design process. The focus was on practicality and clarity, ensuring models were lightweight and easy to maintain.*

Simple Tools: *Early MBSE relied on basic models and diagrams, which were easy to create and understand without the need for specialized software. Many diagrams were high composite and represented complete solutions to important engineering challenges.*

Clear Objectives: *The primary objective was to improve communication between engineers and stakeholders, ensuring all requirements and designs were well-understood and traceable.*

Increasing Complexity

2001 – 2020

Over-Engineered Models: *As MBSE became more widespread, organizations started creating exhaustive models that attempted to capture every system detail. This led to monolithic models that are hard to navigate and maintain.*

Tool Overload: *The proliferation of specialized MBSE tools (e.g., SysML, Rational Rhapsody, MagicDraw) added layers of complexity, as engineers were often forced to learn and adopt multiple tools for different aspects of the same project. Integration between these tools also became a challenge.*

Increased Costs & Time: *The push for exhaustive, all-encompassing models meant more resources were spent on building, updating, and maintaining models. Project timelines and costs escalated without delivering proportional benefits, slowing down decision-making processes.*

Return to Value-Driven Simplicity

2021 – 2024

Simplified Processes: *The MBEasy approach emphasizes cutting out unnecessary complexity by focusing on lean modeling efforts that target specific project needs. This reduces the effort required to build and maintain models, making the process more agile.*

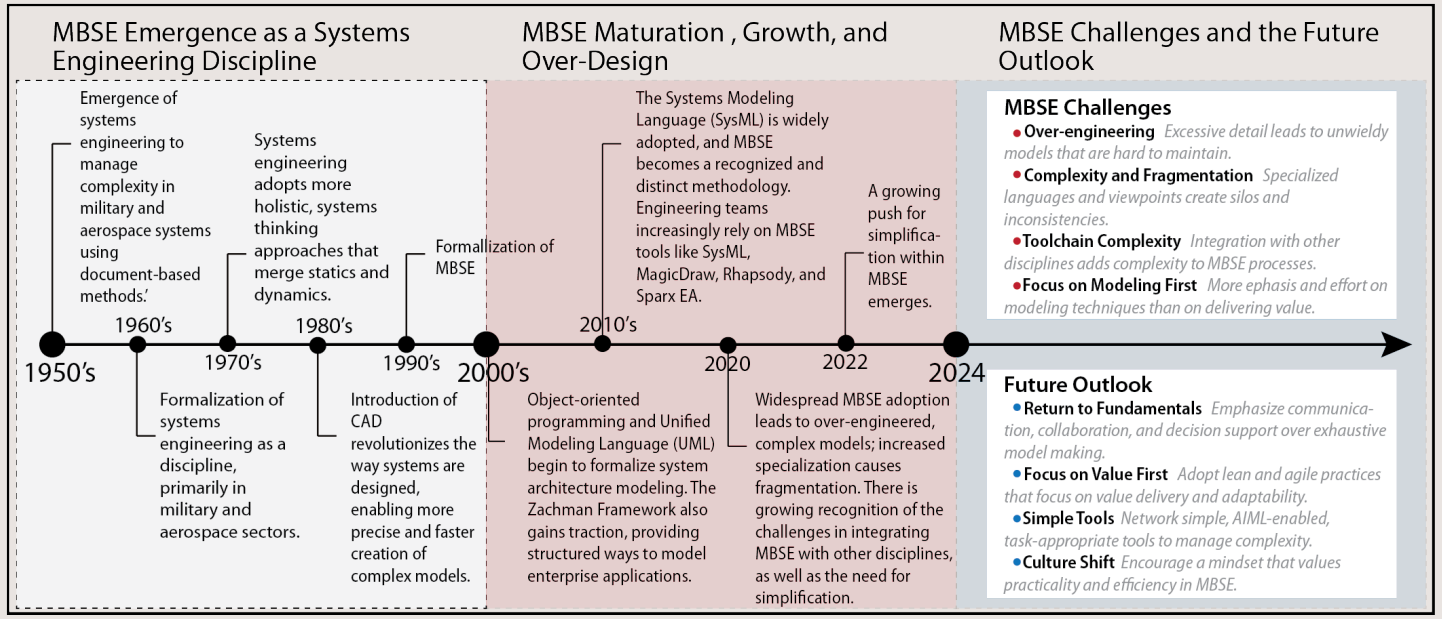
Focused on Value: *MBEasy aligns MBSE activities with measurable outcomes, ensuring that modeling is driven by the value it provides to the project. For example, models are used to inform critical decisions and manage risks, rather than creating models for their own sake.*

Measurable Outcomes: *MBEasy focuses on identifying and tracking the impact of MBSE activities on project success. By linking models to specific outcomes (e.g., improved design quality, reduced risk), teams can justify the investment in MBSE.*

Accessible to All Projects: *MBEasy is designed to be scalable and accessible, making MBSE viable for smaller projects and organizations with limited resources. This ensures that even smaller teams can benefit from MBSE without being overwhelmed by complexity.*

History of Agile Principles in Systems Engineering

- MBSE rapidly evolved since Wayne Wymore formalized it in 1993.
- Initially, MBSE involved simple, purpose-driven models documented as paper-based artifacts.
- Over time, it became a sophisticated discipline using detailed models captured as digital artifacts.
- This complexity arose as MBSE became an industry involving universities, government think tanks, and commercial tool vendors.



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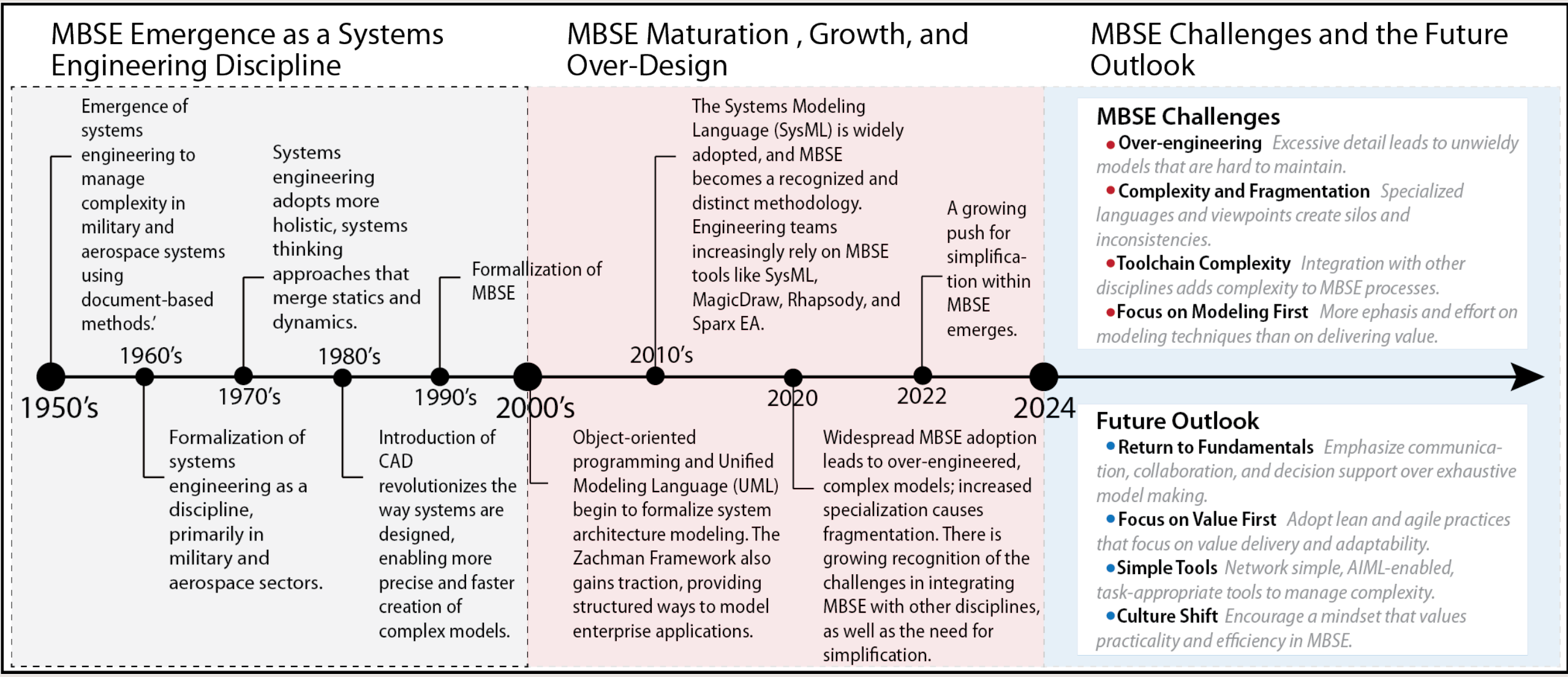

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Tenets for Making MBSE Easy Again

- To address the challenges faced by modern MBSE, we surveyed projects within our business to identify adoption and value creation issues.
- This survey led to the MBEasy tenets, offering a practical solution to enhance MBSE effectiveness.
- While the survey results reflect our internal findings, we encourage other organizations to evaluate the MBEasy concepts and tailor them to the specific needs of their projects.

Today's MBSE Trends	Tomorrow's MBSE Outlook
Focus on Model Making *Many MBSE efforts treat the 'system model' as the primary deliverable, dedicating excessive time and budget to perfecting diagrams, often beyond their intended value.*	**Focus on Value Creation** *Tomorrow's MBSE efforts will focus on a value-first approach, developing diagrams in the system model only to the extent necessary to achieve the intended value.*
Ad-Hoc MBSE Processes *Many companies lack a formal MBSE methodology, leading to inconsistent execution of MBSE activities, widely varying work quality, and reduced buy-in from project teams.*	**Lean/Agile MBSE Process** *Tomorrow's formalized MBSE methods provide clarity on how to execute MBSE activities effectively, ensuring value creation without over-engineering the models.*
MBSE Model Breakdown *As projects add more information to the MBSE model, it often becomes complex, eventually collapsing under its own weight and requiring significant costs to clean up and maintain.*	**"Just-Enough" MBSE Model** *Tomorrow's MBSE method includes clear criteria for deciding what should be included in the model and what should not, enabling controlled growth in the model's scale.*
Ad-Hoc Model Structure *Many companies lack a standard model structure or template, making project start-up difficult and hindering the reuse of models as an accelerator for future projects.*	**"Best-Practice" Model Structure** *Tomorrow's MBSE models leverage a common model structure leveraging best practices to sustain modeling activities and to promote project-wide model use.*
Modeling-Driven Analysis *Many projects dive straight into using MBSE tools, which often distracts engineers from focusing on the core analysis tasks as they spend more time struggling with the tool itself.*	**Analysis -Driven Modeling** *In tomorrow's MBSE environment, simple tools will be used to accelerate early-stage analysis, while MBSE tools will be reserved for the final analysis activities.*
MBSE Mega-Tools *Today's MBSE toolsets focus heavily on software integration, resulting in mega-tools that attempt to cover the entire systems engineering lifecycle but deliver marginal performance.*	**MBSE App Store** *Tomorrow's MBSE toolset prioritizes data integration and best-of-breed apps tailored to specific systems engineering tasks ensuring higher performance and efficiency.*
SysML Mega-Language *Today's MBSE environment relies on SysML as the single modeling language, which limits the ability of other engineering disciplines (e.g., requirements, hardware, software, database, UI/UX) to effectively consume and utilize the models.*	**Domain Specific Modeling Languages** Tomorrow's MBSE environment uses modeling languages designed for model consumers ensuring greater accessibility and use across various engineering disciplines
"Gold Plating" of Analysis *Today's MBSE teams often continue working on the 'system model' until time or budget runs out, leading to overspecification of the model beyond its intended value.*	**Lean/Agile Doneness Criteria** Tomorrow's MBSE teams will establish a "doneness" criteria that measures value and determines completeness; analysis cannot begin until this criteria is clearly defined.

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Tenets for Making MBSE Easy Again

Favor Value Creation over Model Making

- Problem:
  - Many MBSE activities create models with the hope, rather than certainty, that these efforts will create value for the project team.
    - This often results in underutilized modeling results and inadvertently increasing project costs.
  - The crux of the issue is not modeling itself but the preliminary step of defining its purpose and value.

> *Analysis creates value; Model making documents conclusions*

- Solution:
  - We must prioritize identifying the value that MBSE activities bring before beginning detailed analysis, modeling, and documentation work on a project.

Tenets for Making MBSE Easy Again

Use a Standard, Repeatable MBSE Process

- Problem:
  - Ad hoc processes across projects characterize many MBSE efforts and are heavily influenced by the modelers' individual experiences and preferences.
  - This approach results in consistent, complete, and unfamiliar models for those who need to use them.
    - This lack of consistency is a root cause of the project teams' never using many MBSE models, which relegates MBSE to a documentation activity.

- Solution:
  - We must adopt a standardized process to ensure that modeling results are predictable, reliable, and easily integrated into the larger project context.

> *Repeatable MBSE processs are the rails for adoption and consistent value creation*

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Tenets for Making MBSE Easy Again

Use a Minimal Artifact Set to Promote Model Understanding

- Problem:
  - Information fragmentation occurs when a single product's architecture is dissected across numerous viewpoints, defined by various modeling levels and technology views.
  - This dispersal of data forces model consumers to mentally piece together these disparate views to understand the product design comprehensively.
    - Slows model adoption and reduces model utility across the project team.

- Solution:
  - Modeling teams must curate a minimal set of core artifacts that are directly beneficial to the project team and pertinent to mitigating project risks.

> *MBSE Model understanding is inversely proportional to the size of the framework and the number of diagrams*

Tenets for Making MBSE Easy Again

Use a Standard Template to Streamline Model Development and Management

- Problem:
  - The organization of MBSE models presents a considerable challenge and often leads to significant issues regarding model use, maintenance, and integrity.
    - Models are frequently organized based on the personal preferences of the MBSE SME.
  - The diversity in organizing principles and implementations across models hampers model utility, inadvertently inflating the workload and project costs.

> *Improperly designed MBSE Models collapse under their own weight; only model what is important*

- Solution:
  - This challenge underscores the necessity for modeling teams to adopt a standardized, well-defined, and proven model template as a foundational step in their MBSE practice.

Tenets for Making MBSE Easy Again

Analysis First, Documentation Last

- Problem:
  - A common failure of MBSE teams is the disproportionate emphasis on the model, which overshadows the crucial analysis and design work.
  - It's important to acknowledge that, in most modeling activities, analysis and design constitute 90% of the actual work, leaving modeling and documentation to account for merely 10%.
  - This misalignment often leads to inefficient practices and diminished project outcomes.

- Solution:
  - Modeling teams must prioritize analysis activities and judiciously use MBSE tools to document the results afterward.

> *90% of MBSE is analysis and design, 10% is documenting decisions as models*

Tenets for Making MBSE Easy Again

Right Tool, Right Job

- Problem:
  - A common misconception among many MBSE teams is the belief that all systems engineering analysis results need to be encapsulated within a single MBSE tool.
  - This viewpoint overlooks the reality that diverse analysis activities often necessitate a suite of tools to accurately represent the full spectrum of analysis results.

> *MBSE Models produced, but not consumed, have little value to the project*

- Solution:
  - Embracing the "right tool, right job" approach provides a more efficient problem-solving environment while allowing a single source of truth.
    - MBSE does not require a single orchestrating SysML tool

Tenets for Making MBSE Easy Again

Right Language, Right Job

- Problem:
  - A common misconception within many systems engineering teams is the belief that SysML, or any single modeling language, is universally sufficient for documenting all analysis results.
  - This assumption fails to acknowledge that SysML has inherent limitations and is not perfectly expressive of all systems engineering solutions.
    - It is constructed on a finite ontology tailored to address specific systems engineering problems.

> *SysML is not universally expressive; it cannot document the total system architecture or design*

- Solution:
  - Adhering to the principle of "Right Language, Right Job" ensures that analysis results are accurately captured and presented in a manner that is accessible and understandable to project engineers.

Tenets for Making MBSE Easy Again
Avoid Gold Plating

- Problem:
  - In pursuing comprehensive MBSE solutions, teams often fall into the trap of overengineering—affectionately known in the industry as "gold plating."
  - This tendency to push analysis and modeling beyond the scope necessary to resolve the original analytic problem not only introduces delays in the MBSE value stream but also escalates project costs without proportional benefits.

- Solution:
  - Modeling teams must adopt an agile, value-driven methodology to counteract the inclination toward gold plating.
  - Such an approach prioritizes efficiency, relevance, and iterative value delivery to the project team, ensuring the most significant impact.

> *Use an Agile approach to plan, manage, and measure value created by MBSE activities*

Application of MBEasy Tenets

- At BAE Systems, Mission Systems, we recently integrated the tenets of MBEasy into our Agile Enterprise and Systems Architecting (Agile EaSA) project implementations.

- Agile EaSA has been developed over the past decade, making it a proven approach for addressing the complexities of modern systems engineering.

- This methodology is successfully applied across many DoD and IC projects, from advanced research projects to internal innovation programs and high-profile government contracts.

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Agile EaSA: A Methodology for Agile Systems Engineering

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ABSTRACT

The challenges associated with delivering modern intelligence and combat systems to market are multiplying exponentially and expanding in multiple dimensions. First, product complexity is growing due to the increasing use of networked microcontrollers, embedded software, micro-packaging, and restrictive size, weight, and power (SWAP) constraints. Second, cost reductions are significant factors in engineering, manufacturing, and operating costs that significantly shape the product design space. Third, product design, development, and delivery schedules steadily decrease as customers demand products on shorter timelines to keep pace with adversarial advances. These three trends go against conventional product manager wisdom, saying, "better, faster, or cheaper, but not all three."

We must rethink our system analysis and design approach to address these challenges. The current methodology, steeped in 20 years of historical practices and lessons learned, is optimized for yesterday's economy. Today's economy expects complex products to be more affordably delivered and on an agile cadence. This new economy requires new thinking about how we perform systems architecture and engineering.

This paper presents principles and best practices associated with BAE Systems' proven ***Agile Enterprise and Systems Architecture (Agile EaSA)*** methodology. Agile EaSA is a value-driven, 'just enough' systems engineering approach to affordably manage product complexity using an agile delivery cadence. Best practices and procedures from agile EaSA are transferrable to other methodologies and provide a basis for designing the next generation of agile systems engineering practices.

Summary

- This presentation introduces the MBEasy tenets and its integration with current and future MBSE processes and tool environments.
- MBEasy streamlines MBSE by emphasizing value creation, lean modeling, and adaptability to meet project needs effectively.
- We explore how MBEasy principles—such as avoiding over-specification and focusing on actionable insights—can enhance efficiency and improve project outcomes.
- Agile EaSA is a real-world application of these principles, demonstrating successful deployment in large-scale programs, including initiatives within the Intelligence Community.

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MBEasy: Tenets for Making MBSE Easy Again

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ABSTRACT

Model-based systems engineering (MBSE) is rapidly evolving into a specialized field with its experts, tools, and methodologies. However, the increasing complexity within the MBSE ecosystem often makes it difficult for organizations to implement effectively, especially on projects with limited budgets, tight deadlines, and intricate designs. This complexity has led to confusion about MBSE's true value in practical applications, resulting in hesitancy and inefficiencies in its adoption.

This paper seeks to simplify MBSE by addressing common misconceptions that hinder its effective use in development projects. For each misconception, we present an alternative approach that helps clarify objectives, accelerate workflows, and maximize the value of MBSE activities when integrated into an organization's engineering processes.

We introduce MBEasy, a set of MBSE tenets that significantly reduce complexity while emphasizing value creation. MBEasy facilitates faster adoption and practical application by focusing on the core aspects that drive results. This user-friendly methodology reduces costs, enhances team collaboration, shortens project timelines, improves design quality, and fosters innovation. Organizations implementing MBEasy can expect measurable improvements in project outcomes, operational efficiency, and the overall impact of their systems engineering efforts.

Keywords: Systems Engineering, Model-Based Systems Engineering, Agile Development

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Questions?

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