Carnegie Mellon University
Software Engineering Institute

Report on the First MBSynergy Workshop

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Abstract

On November 19, 2024, the Software Engineering Institute (SEI) sponsored the MBSynergy Workshop, a one-day, invitation-only event where 25 subject matter experts from key Department of Defense (DoD) programs and organizations, as well as the intelligence community (IC), gathered to discuss how model-based system engineering (MBSE) affects their work.

This report summarizes the participants' discussions of the government's equities (i.e., its interests, responsibilities, and concerns) and how MBSE improves their programs' performance and efficiency.

1 About The MBSynergy Workshop

On November 19, 2024, the Software Engineering Institute (SEI) sponsored the MBSynergy Workshop, a one-day, invitation-only event where 25 subject matter experts who serve as engineers or program managers in major software-intensive programs and commands attended. These experts gathered from key Department of Defense (DoD) programs and organizations, as well as the intelligence community (IC), to discuss how model-based system engineering (MBSE) affects their work.

In this report, we, the SEI team that led and facilitated the workshop, summarize the participants' discussions of the government's equities (i.e., its interests, responsibilities, and concerns) and how MBSE improves their programs' performance and efficiency.

1.1 Purpose and Vision

Our vision statement for the workshop was, "Turning DoD/IC vision for MBSE and digital engineering (DE) into reproducible practice."

DoD 5000.97, *Digital Engineering*, mentions that MBSE and DE should "enable faster, smarter, data-driven decisions throughout the system life cycle" [OUSD 2023]. The successful practice of MBSE in the DoD/IC context has drivers for strategy development, budgeting, scheduling, and resourcing programs. Yet, achieving an increased velocity of decision making remains an open challenge across programs.

In this workshop, we created a forum where practitioners and subject matter experts could exchange ideas, concerns, challenges, and solutions on how to improve the value delivered by MBSE and DE. The workshop was built on two objectives:

1. By interacting with peers and thought leaders from the DoD/IC, participants gained perspective on the scenarios depicting DoD/IC implementations in other programs and enterprises.
2. Focusing on the art of the feasible and the art of the possible, we improved our ability to observe the everyday practice of critical software engineering methods and concepts.

We organized the workshop around alternating group discussions and breakout discussions. All of these discussions inform current SEI research and engagements between the DoD/IC and SEI.

1.2 Agenda

We used the agenda, shown in Table 1, to set participants' expectations for the day's activities.

Table 1: Workshop Agenda

When	What	How	Why
0800–0830	Welcome & Coffee	Informal coffee setup	Buffer for late arrival
0830–0915	Vision & Introduction	Stage-setting presentation	Set the scope & agree on the method of operation (MO)
0915–1000	Implementation Patterns	Present examples & explain approach	Establish a simple approach to capturing patterns
1000–1015	Break	Refresh coffee	Information interaction
1015–1100	Current Practice	Implementation patterns, key questions, and polls	Gather/share perspectives
1100–1200	Archetypes	Identify key implementation patterns for focus	Knowledge capture
1200–1300	Lunch		
1300–1400	Adoption	Polls and discussions	Gather/share perspectives
1400–1430	Deferred Topics	Review the running list	Address important topics that participants brought up
1430–1530	Call for Action	Nominate topics, courses of action (COAs), and stakeholders for focus	Guide SEI direction for maximum benefit
1530–1600	Closing & Next Steps	Group conversation or breakouts	Informal follow-on conversation if you don't have to catch a flight

Participants were highly engaged throughout the day. We extended the time allocated to work in small teams to promote continuing and emerging discussions, since many were spontaneous and rich in content.

1.3 Participants

At this invitation-only event, our goal was to engage 25–30 DoD/IC personnel members who serve as engineers or program managers in major software-intensive programs and commands. The daily work of all invited participants involved pursuing warfighter equities in complex government enterprises and frequently engaging a lead system integrator or well-known provider in the Defense Industrial Base (DIB).

The workshop group included mostly civilian contract personnel working for the Army, Navy, Air Force, and the IC. Participants related easily to one another's contexts and shared many relevant insights. We conducted the workshop using the Chatham House Rule [Wikipedia 2024]:

> *Under the **Chatham House Rule**, anyone who comes to a meeting is free to use information from the discussion but is not allowed to reveal who made any particular comment. It is designed to increase openness of discussion. The rule is a system for holding debates and discussion panels on controversial topics, named after the London headquarters of the Royal Institute of International Affairs, where the rule originated in June 1927.*

Therefore, participants did not disclose their identities at the event, nor do we reveal their identities in this report. We expect to hold future workshops to explore MBSE-related topics

relevant to the U.S. government. We also may design an industry-centric workshop or consider an integrated workshop that includes government and industry teams working together.

1.4 Approach

Using brief presentations, large-group facilitation, and small-group working sessions, we guided workshop participants through a range of topics that the SEI-research team selected. We used slides to provide the backdrop for level-setting conversations early in the workshop. We also used an interactive polling tool to gather anonymous input via participants' smartphones, which displayed the group's results in a summary chart as the participants' responses accumulated.

The workshop was designed to heavily favor engagement and interaction among the participants. As we had hoped, our role as facilitator was challenging because throughout the large conference room, participants were eager to contribute to the wide range of compelling topics. We provided an on-site graphic artist who captured the sentiment in the room about key topics in the form of drawings. We include some of these drawings in this report.

2 Workshop Outcomes

In Section 2.1, Five Major Lessons, and Section 2.2, Real-Time Anonymous Polling, we present the workshop's key findings.

2.1 Five Major Lessons

The following lessons help describe and prioritize the topics of greatest importance to the communities represented in the workshop.

2.1.1 Systems Engineering and Architecture

Well-established systems engineering and architecture processes and practices are prerequisites to the practitioner's useful application of MBSE concepts. The scope of responsibilities assigned to program office personnel often fails to reinforce the level of systems engineering rigor that MBSE can build on. A wide range of practices exists, and organizations often report that they are understaffed and have major difficulties attracting personnel who have the needed training and experience. Also, the success of acquisition personnel is often evaluated through a program management lens rather than a systems engineering performance lens. Finally, program office personnel often force MBSE tools to mimic traditional artifacts of the oversight process. This forced use of MBSE may tend to distort core systems engineering processes and diminish the intended benefits of MBSE.

2.1.2 Enterprise Value of MBSE

Early adopters of innovative technology may reap its benefits more rapidly when they clearly understand "what correct looks like" as defined by their respective settings. Many DoD/IC organizations lack a compelling example of *correct* that is well suited for the setting where they operate. Vague ambitions for "better, faster, cheaper" are difficult to reconcile in diverse enterprise settings where complex capabilities are delivered to the warfighter. During early adoption, many fail to understand the nature of the contributions that MBSE can make, much less the magnitude of those contributions.

Integrating MBSE into the value stream that an enterprise delivering warfighter capability uses requires a good fit for the people, process, and performance systems of the organizations involved. Adhering to an arbitrary framework or tool by rote can be counterproductive when that framework or tool uses terminology and an approach that implies engineering rigor that doesn't exist.

2.1.3 Community Building

The proof of concept for MBSE efficacy is best illustrated by a peer program that involves practitioners who must navigate similar conditions using MBSE. Many practitioners prefer sharing their experience directly with others rather than learning from sanitized case studies or academic explanations. Rather than deriving prescriptive actions that others can replicate, peer programs teach their participants particular needs derived from other participants' settings that

must be adequately addressed for any new approach to take hold. Benchmarking across organizations to identify these leverage points provides opportunities to accelerate progress across organizations and among practitioners.

2.1.4 Tools, Training, and Policy

Absent a sufficiently common approach to MBSE—or even a common understanding of it—it is difficult to mature its use with common tools, training, and policy. Many organizations that use bespoke MBSE implementations still struggle to achieve success. A request by an external authority adds risk to misaligned implementations used by practitioners who are unduly influenced by the wording of a policy, the advocacy of a methodologist, or the advanced interface standards of a tool.

The starting point for training organizations to integrate MBSE into their operations should not rely on the procedural knowledge of organizations experienced in successfully operating MBSE and achieving maximal benefit. The adopting organization's core mission and the nature of the capability being delivered should drive the systems engineering implementation approach required. The procedures followed by roles in any particular organization have less to do with MBSE than they do with the technology the organization uses and the nature of the value the organization delivers to its customers. When the interface to a tool, the steps in a methodology, or the obligations of a policy become the main drivers of implementation decisions, the focus on the value to customers is easily lost.

2.1.5 Ownership of the MBSE Approach

As with many engineering advances, it is important to understand the adopting population. Asking questions, such as the following, can clarify who implements MBSE:

- Can the responsibilities associated with MBSE reside in a role filled by a government employee? Or must some core set of MBSE responsibilities reside in a role filled by a contractor? Either way, how should the program office engage with MBSE processes appropriately?
- Can issues related to data rights and intellectual property feasibly be isolated from the MBSE implementation?
- How can the enterprise architecture align with an MBSE approach?
- What is the interplay among training, tools, policies (technical or acquisition), and program execution?
- Does the practice of MBSE change substantially as more perspectives are included (e.g., threat modeling, manufacturing readiness levels, long-term sustainment models, other facets of the larger systems engineering trade space)?

2.2 Real-Time Anonymous Polling

At the MBSynergy Workshop, the software we used to engage participants enabled us to direct the conversation, in part, based on the sentiments reflected in group polls. Rather than asking focused survey questions designed to yield analytical results, we used the conversation starters that had limited utility in a retrospective summary and analysis, such as what we include in this

report. However, in this section, we highlight several important discussion topics and include graphics drawn by the SEI's on-site artist.

2.2.1 Perspectives Included

Participants were free to respond to questions or ignore a poll as they wished. The first question posed was answered by 25 of the 35 workshop participants. We, as members of the SEI team, did not respond to polls. Instead, we focused on inputs from DoD/IC participants.

Only one program manager attended the workshop, and the participants voiced a preference to have a greater balance of perspectives in the room, especially since many program management topics surfaced in the discussion of how MBSE is practiced in the participants' home organizations.

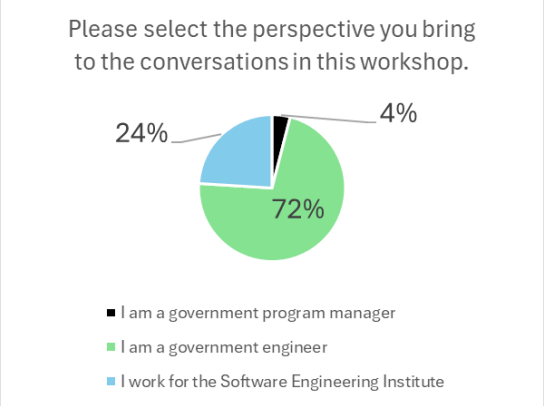


Figure 1: Workshop Participant Breakdown

2.2.2 Who Implements MBSE?

We asked workshop participants to name the roles in their program office that include responsibilities related to how the program uses MBSE. The participants' responses included the following role and team names:

- Chief Engineer
- Architect
- Systems Engineer
- Program Manager
- Certification
- Test Engineer
- Airworthiness Certification/Engineer
- Test and Evaluation
- Modeler
- Test
- Mission Architect
- Solution Design Engineer
- Capability Verification Engineer
- Product Office
- Engineer
- Integrator
- Cybersecurity
- Pipeline Lead
- Safety
- Configuration Management

Responsibilities for MBSE are found among many different roles in government organizations. Each role balances its new responsibilities with its traditional workload.

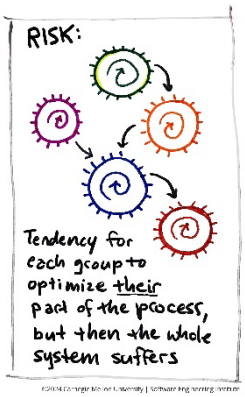
Figure 2: Roles and Responsibilities for MBSE

The above list includes familiar organizational teams and roles as well as specialists in a variety of areas. We argue that effectively implementing MBSE involves many functions in a program office, so a shared vision of what defines MBSE is essential. The successful implementation of MBSE is not accomplished in isolation to support one given goal (e.g., perform one activity) but across multiple goals. This multi-goal approach calls for a robust MBSE strategy that answers a large variety of concerns across the program office as shown in Section 2.2.3.

2.2.3 Focus of MBSE

Workshop participants shared a wide range of stories about how MBSE works in practice. When we polled participants for priorities in their organization with respect to MBSE, they replied with the following responses:

- Include systems engineering in IT decision making
- Facilitate better requirements elicitation with users
- Is it helping me identify issues early to mitigate?
- Staff your organization
- Accept the new world
- Reduced effort down the road
- Objective metrics
- Relation to warfighter delivery
- Common view across teams
- Did we understand what we asked for?
- Get a small win
- Mission impact
- Cost savings
- Get everyone trained
- Strategy or roadmap to implement MBSE for the program



Optimizing the enterprise that contributes to the system is a systems engineering challenge.

Figure 3: Enterprise Optimization

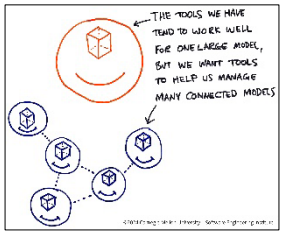
This list of priorities represents a heterogeneous set of concerns. Some pertain to the efficiency of an organization in conducting its mission (e.g., mission impact, cost savings), and others pertain to the organization structure itself (e.g., training, staffing). Others focus on identifying where the MBSE wins are. These responses reflect different levels of maturity across the participants' organizations, which also illustrates a more general pattern across the DoD and IC communities.

2.2.4 Tools for MBSE

Participants agreed that providing better tools will not alone address the chief concerns summarized in the major findings we listed above; however, they had much experience to offer about tools.

The modeling tools used in DoD/IC settings do not always enable the system-of-systems modeling envisioned by the engineers attending the workshop. Having observed this shortcoming, however, they agreed that tooling is not the highest priority.

Tools should support engineering activities and enable the production of artifacts prescribed by a program. Hence, it is the responsibility of the DoD and IC to define tool requirements.



An integrated warfighter capability requires an integrated modeling capability to effectively apply MBSE.

Figure 4: Many Connected Models

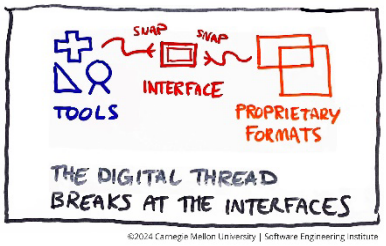
2.2.5 Digital Threads

The concept of digital threads has received favorable welcome in different parts of the DIB, and that welcome has culminated with the recent release of DoDI 5000.97, *Digital Engineering* [OUSD 2023]. Stories about the lack of access to proprietary data or contractors reverse engineering some part of a competitor's system so they can deliver the capability to integrate on a platform are familiar among acquisition personnel.

Some experiences that participants shared emphasized the complexity of building and using digital threads when contributors' proprietary data rights are a concern and when the tool environments are used for the DoD or IC. Engineering a digital thread adds complexity to engineering models to ensure that data can be accessed. In addition to technical concerns, other issues are involved, including access control and (more generally) cybersecurity.

2.2.6 Integrating Documentation

While the image of a completely digital world appeals to many, the realities of a DoD or IC environment imply that being able to trace key acquisition documents and artifacts in various formats will continue to be of interest to stakeholders.



Challenges of major DoD/IC programs often stem from the constraints of the DIB's market environment.

Figure 5: Broken Digital Threads

Workshop participants agreed that electronically tracing sources of truth (e.g., stakeholder agreements, design decisions, product standards) is a common need.

Documents produced from models or the synchronization between documents and models is a critical need that organizations must address as digital environments are deployed.

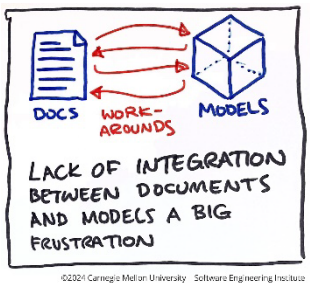


Figure 6: Interoperability and MBSE

3 Calls for Action

At the conclusion of the workshop, we asked participants which MBSE-related topics the SEI should pursue. In this section, we sort these topics by category and provide an answer for each.

3.1 MBSE Community at Large

Workshop participants expressed an interest in getting feedback about MBSE from the overall community.

Call for Action: Engage with the National Defense Industrial Association (NDIA) and DIB to gather their feedback.

The SEI identified several working groups across the NDIA, the American Institute of Aeronautics and Astronautics (AIAA), and the International Council on Systems Engineering (INCOSE). These groups work at a Distro-A level[1] to discuss many topics related to MBSE (e.g., DE, digital twins).

In addition to these open groups, restricted meetings, such as the Federal Digital Engineering Forum[2] (FED DEF), are held to enable the DoD/IC to engage with the DIB at the CUI[3] level.

Each group has an intersection of interests related to developing a better understanding of the separation of concerns among the communities of practice. They also have interest in how teams working in isolation may later integrate their models in a coherent way in a large-scale project environment. By bringing affected communities together, we can develop better approaches, common definitions, shared understandings of intentions and model scope, and so on to support more productive outcomes for efforts expended in MBSE.

3.2 "Hot" Topics in MBSE Technologies

MBSE and DE are ever-evolving topics, and new "hot" topics are continually emerging. Workshop participants were curious about SysMLv2 and AI in particular.

Call for Action: Investigate SysMLv2 transition.

The finalization of SysMLv2 and the migration from SysML1.x to SysMLv2 is a major concern in the DIB, DoD, and IC. The prevalence of the Unified Architecture Framework (UAF) and SysML1.x identified shortcomings in language and tool support. The first evaluations of SysMLv2 also show the importance of this topic for major programs.

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1 Documents labeled as Distribution A are approved for public release and have unlimited distribution.

2 For more information about FED-DEF, refer to its website (http://fed-def.org) [FED DEF 2025].

3 CUI stands for controlled unclassified information.

For context, the Object Management Group (OMG) is finalizing SysMLv2 and is planning to submit the final draft in March 2025. SysMLv2 is a complete rewrite of SysML to clarify the language and add capabilities to ease model exchange and interoperability. Tool vendors are currently working on their editing capabilities. Dassault, ANSYS, Siemens, MathWorks, and others shared their roadmap for releasing new tools to support SysMLv2. In fact, SysMLv2 is a major topic discussed in recent editions of INCOSE's International Workshop (IW), NDIA's Systems & Mission Engineering Conference (SMEC), and AIAA's SciTech Forum and Exposition.

Also, the OMG hosts a wiki that lists some of the current work around SysMLv2 and the transition from SysML1.x [OMG 2024]. It is sponsored by the Office of the Secretary of Defense's (OSD's) DEM&S office. The transition from SysML1.x to SysMLv2 will require significant resources to migrate relevant models while maintaining models built using legacy standards.

Call for Action: Explore using AI to support MBSE.

Some workshop participants were curious to learn how AI might help support MBSE applications in modeling. They expect a new and revolutionary user experience for development environments.

One participant observed that MBSE is an area "ripe for the application of AI." The opportunity to employ AI with MBSE opens up a number of use cases, including the following:

- AI-driven testing tools to quantify assurance and aid in certification
- engineering AI solutions using MBSE

Several tool vendors are already utilizing the JavaScript Object Notation (JSON) serialization of SysMLv2 to evaluate large language models (LLMs) for model generation [Ludovic 2024]. The outcomes of this evaluation are satisfactory for small-scale models and initial model creation. A genuine advantage would be to utilize intricate models for complex analyses to understand emergent properties of the system. Tools such as Imandra.AI[4] and Celedon Davinci[5] are already demonstrating some of these promising capabilities. However, there are numerous challenges to ensuring the scalability and deployment of these tools within a DoD/IC environment.

3.3 DoD/IC Policies

MBSE in the DoD/IC requires dealing with policy, deployment, and sustainment. Workshop participants mentioned topics related to these aspects of implementing MBSE in DoD/IC departments and agencies.

[4] For more information about Imandra.AI, see the Imandra website (https://www.imandra.ai/sysml) [Imandra 2025].

[5] For more information about Celedon Davinci, see the Celedon website (https://celedon.solutions/davinci/) [Celedon 2025].

Call for Action: Influence OSD and policymakers to provide a program objective memorandum (POM) for MBSE within the DoD/IC enterprise.

Call for Action: Address the diversity in MBSE deployment across the branches of the military, and audit best practices for MBSE.

Call for Action: Define a common platform for model exchange.

Call for Action: Create a lifecycle sustainment plan for models and data.

There is a common technological baseline across the DoD or IC. Similar tools are used for requirement capture and modeling in UAF or SysML, etc. However, participants reported that they each deploy and maintain their own DE environments separately. These unique environments create myriad operational issues that projects must deal with in addition to their daily operations.

Defining a common baseline for DE environments across organizations would help achieve the following:

- Disseminate good practices.
- Reduce the cost to operate these platforms.
- Address common issues (e.g., access control, configuration management).

Policies for sustaining models and data are also required to address updates in modeling standards and the tools they rely on.

Acquisition policies are another key element to consider. In multiple forums, workshop participants shared that there is a lack of guidance for defining deliverables. This insufficient guidance starts with the media to be delivered:

- Is it a SysML model?
- Which version of SysML?
- Is it a Cameo model?
- Is it an .mdzip file?

The lack of common terminology is not just detrimental, it also shows a lack of precision in naming artifacts to be delivered. By extension, it also denotes a lack of precision about what is expected from a delivered model and ultimately defies ease of integration.

3.4 DE Environment

Workshop participants asked about MBSE-related environments, their risks, and security.

Call for Action: Define the relationships among MBSE, DevSecOps, Agile, DE, and others.

DevSecOps, Agile, DE, and a Modular Open Systems Approach (MOSA) are potentially equally transformative for DoD/IC engineering practices. Responding to trends such as these with bespoke approaches devised in isolation leads to an arduous and frustrating journey. Instead, programs across the DoD and IC could benefit from the following approach:

- Understand the potential that these approaches have in aggregate.
- Dig deeply into each source for insight with a common concept of operations in mind.

OSD DEM&S,[6] OMG, AIAA,[7] NDIA, and INCOSE[8] (to name a few) have exchange forums where users can discuss these topics focusing on DE. Properly defining an ontology of DE terms would help establish a common vocabulary that acts as a foundation for program execution. Defining an ontology was started by the INCOSE Digital Engineering Interchange Working Group, has been discussed at the AIAA SciTech 2025 conference, and will continue to be discussed at INCOSE International Workshop 2025. The SEI is currently tracking some of this work. This topic echoes the recommendation listed in Section 3.1 to engage with the NDIA and the DIB at large.

Call for Action: Evaluate the cyber risks associated with DE and model sharing.

Call for Action: Create a model-based security classification guide.

Deploying MBSE at scale through a common digital environment creates new access control challenges. Because models can change rapidly, we can imagine threat scenarios that range from unauthorized read access that would result in unauthorized information dissemination to unauthorized write access that would taint digital assets with malicious or corrupted information. Further, data theft could help identify exploitable cyber threats to an existing system. This concern is similar to securing software development environments in general. Because a model shows more aspects of a system than source code, attack vectors can evolve as progress is made on the system under development. A specific cyber threat analysis is necessary to fully evaluate this issue.

3.5 Training

Workshop participants mentioned topics related to training content about the MBSE methodology, the role of models, and MBSE implementation.

Call for Action: Apply the MBSE methodology to specific acquisition pathways.

Call for Action: Help practitioners articulate the role of models and understand how to leverage modeling for a particular situation.

Call for Action: Provide guidance about applying MBSE to legacy versus new systems.

Training is a crucial component of technology transition. The skills that practitioners acquire from training or education are paramount. The Defense Acquisition University, Air Force Institute of

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6 For more information about the DEM&S Community of Practice, see the Office of The Under Secretary of Defense for Research and Engineering website (https://www.cto.mil/sea/dems_cop/) [OUSD 2025].

7 For more information about the AIAA-DEIC Committee, see the AIAA-DEIC website (https://aiaadeic.org [AIAA-DEIC 2025]).

8 For more information about the INCOSE Digital Engineering Information Exchange, see the INCOSE website (https://www.incose.org/communities/working-groups-initiatives/digital-engineering-information-exchange [INCOSE 2025]).

Technology, and other DoD/IC components support training various aspects of MBSE and DE. AIAA is about to release a report on workforce development for DE.

Workshop participants unanimously agreed that training for a specific language (e.g., SysML or UAF) or tool (e.g., Cameo) is not their primary concern. Rather, the focus of training should be on how tools can help U.S. Government personnel achieve greater effectiveness. Training will need to address the workflows where MBSE will contribute, considering that highly regulated settings where engineering work occurs are prerequisites to adopting new approaches. Major differences in scope and application are likely when programs consider using MBSE for the following:

- new "greenfield" systems
- modernization programs for fielded systems
- long-term sustainment of legacy systems

3.6 MBSE Processes

Workshop participants mentioned topics directly related to MBSE itself, including models, processes, and templates.

Call for Action: Improve model interoperability.

Call for Action: Avoid models becoming shelfware by maintaining current and relevant data.

Call for Action: Define criteria for determining the sufficiency of a model. Ask, "How do I evaluate models to determine whether they are good or can answer the questions I need answers to?"

Call for Action: Guide auditing MBSE processes with associated metrics to evaluate the maturity of MBSE adoption.

Call for Action: Use an MBSE starter kit that includes a collection of templates.

Call for Action: Optimize the MBSE approach by increasing model complexity and team/organization complexity (e.g., geography, skills, career paths).

One workshop participant mentioned that "of the three pillars (tools, language, methodology), the latter is the weakest [and] must be tailored and adapted for each program." Defining a methodology and its associated processes is crucial for the success of a program; however, they are often overlooked. Practitioners sometimes learn to use Cameo to model in SysML1.x, but they often lack the foundational concepts of systems engineering required for success (e.g., guidance found in the *INCOSE Systems Engineering Handbook* or International Organization for Standardization [ISO] 15288) [Walden 2023]. Nevertheless, it is critical to understand the goals of systems engineering, its roles, and how to tailor it to a specific program.

Participants had specific questions related to MBSE:

- Some questions focused on the short-term use of MBSE and were specific to a use case, such as how to improve model interoperability, define a minimum viable model for a specific evaluation goal, or understand the model lifecycle.

- Other questions focused on the longer term use of MBSE, such as how to consider models an integral part of a system development lifecycle, how to update models regularly, how to audit MBSE processes to improve quality metrics, and how to define those quality metrics.
- Finally, participants asked about an MBSE starter kit to help programs start their modeling journey.

These inquiries share a common focus: determining the appropriate methodology, if any, for utilizing MBSE. MBSE methodologies frequently cannot adapt to DoD/IC requirements for supporting activities mandated by acquisition policies. Whether to modify the existing MBSE methodology and processes or develop specific processes that align with an organization's objectives is a topic that SEI researchers are currently addressing in the MBSynergy project. This topic will be the subject of a subsequent workshop.

4 Conclusion

The SEI sponsored the MBSynergy workshop in November 2024. At this one-day event, 25 subject matter experts from the DoD and IC discussed MBSE and how it affects their work.

As SEI researchers, we led and facilitated the workshop. In this report, we summarized the participants' discussions of the government's equities, focusing on the improvements MBSE can make to their programs' performance and efficiency.

The workshop discussions led to the following five major lessons:

- **Systems Engineering and Architecture**. Workshop participants agreed that systems engineering and architecture are essential enablers to the beneficial use of MBSE. Participants attributed many failed MBSE implementations to failures in these fundamental disciplines.
- **Enterprise Value of MBSE**. A concrete expression of what a successful MBSE approach yields was not apparent in many settings. The motivations for implementing MBSE were often disconnected from the day-to-day performance criteria that define program success.
- **Community Building**. The socio-technical nature of the challenges that practitioners face when using MBSE requires that they learn from their early experiences to accelerate beneficial change. Building on the experience of others in a forum for establishing a shared history and track record can accelerate this process.
- **Tools, Training, and Policy**. All the challenges to successfully using MBSE are not easily solved by introducing training or new tools. Workshop participants helped us understand that these external drivers to adopting MBSE do not suffice.
- **Ownership of the MBSE Approach**. Many participants described their experiences implementing MBSE as spanning the contractual boundaries and proprietary technologies that define the Defense Industrial Base (DIB). However, shared ownership of an authoritative source of truth across boundaries, especially at a more detailed level, can be contentious.

The workshop format allowed us to capture key observations from participants using real-time anonymous polling and a graphical recording of the spirited discussions. The feedback we gathered also helps us identify productive avenues for future SEI work in service of the DoD and IC.

Appendix Anonymous Brainstorming with Electronic Polls

We presented the following questions to workshop participants via an app on their smartphones. Their responses were summarized and displayed on screens throughout the conference room where the workshop was held. We used this anonymous brainstorming method to feed the conversation with an evolving set of topics driven by workshop participants.

1. Please select the perspective you bring to the conversations in this workshop.
   - I am a government program manager.
   - I am a government engineer.
   - I work for the Software Engineering Institute.
2. Why is your leadership interested in MBSE? (Assign 5 votes among the options.)
   - lower the cost of requirements engineering
   - increase confidence in completeness of product delivery
   - improve quality of delivered product
   - increase schedule confidence
   - shorten schedule
   - lower overall cost
   - comply to a mandate
3. What does it mean for the government to use MBSE? (Check all that apply.)
   - Include digital models of system functionality as contract deliverables to the government.
   - Include digital models of program performance as an element of government oversight.
   - Maintain correspondence between digital representations and implement capabilities.
   - Perform analyses with digital models to assess attributes of the capabilities to be delivered.
   - Integrate models from different parties to perform system-level analysis.
4. I have seen MBSE models that include information about the following (Check all that apply.)
   - requirements
   - capabilities
   - enterprise architecture
   - system architecture
   - system-of-systems architecture
   - technical performance measures (TPMs)
   - sub-system requirements allocations

- component designs
- verification design/planning
- product lifecycle management (PLM)

5. How do you evaluate the effectiveness or value of MBSE in making things “better?”

6. Please rate the extent to which you agree with this statement: With the introduction of MBSE, we will still build the same engineering artifacts; they will just take on a new form.
   - strongly agree
   - agree
   - neutral
   - disagree
   - strongly disagree
   - not applicable

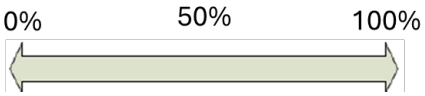
7. CDRLs have changed in my organization to make best use of MBSE.
   - yes
   - no
   - not applicable

8. Please name the roles in the program office that include responsibilities related to the program’s use of MBSE.

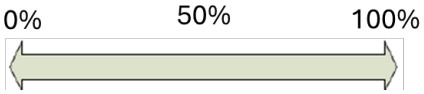
9. I believe my team’s stance on adoption of MBSE most closely resembles the description of this stage: (Click the location on the image.)

10. I believe the DoD’s adoption status for MBSE most closely resembles the description of this stage: (Click the location on the image.)

11. Among the programs you engage with, what percentage are using MBSE? (Click the image.)



12. What percentage of the programs you engage with are making good use of MBSE (have practices worth sharing)? (Click the image.)



13. Please rate the extent to which you agree with this statement: I would prefer that leadership understood a different definition of "MBSE" than they appear to have adopted.
    - strongly agree
    - agree
    - neutral
    - disagree
    - strongly disagree
    - not applicable
14. What are the most challenging limiting factors for the beneficial use of MBSE in your organization? (Enter 1 to 5 words max.)
15. What do you see as the #1 priority focus for your organization to evaluate the value you get in using MBSE? (Enter a short phrase.)

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13. ABSTRACT (MAXIMUM 200 WORDS)

On November 19, 2024, the Software Engineering Institute (SEI) sponsored the MBSynergy Workshop, a one-day, invitation-only event where 25 subject matter experts from key Department of Defense (DoD) programs and organizations, as well as the intelligence community (IC), gathered to discuss how model-based system engineering (MBSE) affects their work.

This report summarizes the participants' discussions of the government's equities (i.e., its interests, responsibilities, and concerns) and how MBSE improves their programs' performance and efficiency.

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