Benchmarking the Benefits of MBSE

An industry collaboration on the value and effectiveness of MBSE across the life cycle

Tom McDermott
Stevens Institute, Systems Engineering Research Center

Geoff Draper
L3Harris Technologies

MBSE Benchmarking Survey

Objective	• Assess **value and effectiveness** of MBSE adoption for improving business outcomes (gov't, industry) – benefits vs. traditional methods. Develop a profile of MBSE use and meeting expectations across the life cycle. • Where are we as organizations, and as an industry? Building models, or <u>using</u> models? Applying what we learn. • Enable adopters to conduct a qualitative or quantitative assessment of their progress against MBSE best practices and guidance on developing an improvement roadmap
Method	• Conduct an industry survey of MBSE capability. Align with **INCOSE draft DE Capabilities Definition matrix.** • **Characterizing MBSE practices, capability, value, benefits**. • Probe alignment and integration with other adopter initiatives (e.g., PLM, DevOps, cross-discipline) • Collect and share best practices and assets on MBSE benefits/value from community
Organizational Involvement	• Participation call through industry associations: INCOSE (lead), NDIA, … • Government sponsorship and support: DoD (OUSD R&E), FFRDCs (SERC) • Survey administration by DoD SERC (Stevens Institute) - "honest broker" to protect proprietary data.
Schedule	• Survey: define (Sep-Oct); instrument (Oct-Nov); distribute (Dec-Jan); analyze (Feb-Mar)
Core Team	• INCOSE: Garry Roedler; Troy Peterson • NDIA: M&S Committee (Chris Schreiber); SE Division (Joe Elm, Geoff Draper; Garry Roedler) • SERC: Tom McDermott, Nicole Hutchinson

This is an interactive session to collect initial feedback on MBSE effectiveness and to pilot an upcoming industry survey

Draft INCOSE DE Capabilities Definition

Basis from The Aerospace Corporation MBSE Community Roadmap and the NASA MSFC MBSE Maturity Matrix

Developed through a series of workshops with INCOSE and NDIA to form a proposed comprehensive Model-Based Enterprise Capability Matrix

WG in place to complete and release as an INCOSE DE Capabilities Document

| Model-Based Capability Stages	Stage 0	Stage 1	Stage 2	Stage 3	Stage 4
Tools & IT Infrastructure					
Collaboration	E-mail, telecom.	System Model File Exchange.	Various organizations working on different parts of model. Full model integrated by a single organizations.	Partial On-line, real-time collaboration amongst distributed teams	On-line, real-time collaboration amongst distributed teams
Disparate Database/Tool interoperability	None	Tool-to-Tool, ad hoc interoperability	Partial Federated Database Management System (FDBMS)	Main tools interoperable. Supporting tools interact through file transfer.	Fully Federated w/ standard "plug-and-play" interfaces. Data is interchanged among tools
Inter-Database/Tool Data Item Associations	Databases/tools are independent	Inter-Database/Tool Data Item associations defined	Inter-Database/Tool Data Item associations defined, captured, managed	Inter-Database/Tool Data Item associations among all data items defined, captured, managed, and traceable	Inter-Database/Tool Data Item associations among all data items defined, captured, managed, and traceable where changes in one data source alerts owners of other data sources of intended updates
User IF, Viewpoint/Views	N/A	Doc Gen	UI draws from Model app	UI draws from multiple models/DBs	UI supports Interrogation; multiple configs

MBSE Survey Overview

Topics	Summary of Survey Questions
1. MBSE Usage	1. MBSE strategy documented at enterprise level 2. MBSE processes & tools integrated, inform enterprise staff *3. Q: Primary value of cross-functional MBSE integration?*
2. Model Management	4. Taxonomy for modeling across organization 5. Well-defined processes/tools for model management. 6. Standard org guidance for model management/tools *7. Q: Business value from consistent model management?*
3. Technical Management	8. Modeling basis for enterprise org processes 9. MBSE process support for technical reviews *10. Q: Value of MBSE (or digital engrg) in technical reviews?*
4. Metrics	11. Modeling provides measurable improvement across projects 12. Consistent metrics across programs/enterprise? *13. Q: Most useful metrics?*
5. Model Quality	14. Defined processes/tools for V&V of models 15. Defined processes/tools for data/model quality assurance
6. Data Management	16. Org approach for data interface between tools 17. Data managed independent of tools for portability *18. Q: Data management roles/processes?*

Topics	Summary of Survey Questions
7. Model Sharing and Reuse	19. Teams establish, share, reuse org model libraries 20. Org interface around models for stakeholder use 21. Shared models used to consistently manage programs across lifecycle *22. Q: org implementation for data/model discovery, reuse?*
8. Modeling Environments	23. Modeling environment security 24. Modeling environment protects IP 25. Cross-discipline processes for tools, data interoperability *26. Q: value from collaborating on models across disciplines*
9. Organizational Implementation	*27. Q: most challenging org obstacles for MBSE?* *28. Q: Best organizational enablers for MBSE?* *29. Q: Biggest changes our org needs forMBSE?*
10. Workforce	30. Organization defined critical roles to support MBSE *31. Q: Top MBSE roles in your organization?* 32. Org staffing adequate to fill MBSE-related roles?
11. MBSE Skills	33. Defined critical skills for MBSE *34. Q: The most critical skills for MBSE?*
12. Demographics	Organizational size, domain, MBSE experience

Survey content is derived from the draft INCOSE Digital Engineering Capabilities Definition

How would you best characterize your organization?

1. **U.S. Government (DoD, agency)**

2. **U.S. Defense Industry**

3. **Academia / FFRDC**

4. **Commercial Industry**

5. **Other**

0% 0% 0% 0% 0%

U.S. Government (D... U.S. Defense Industry Academia / FFRDC Commercial Industry Other

Response Counter
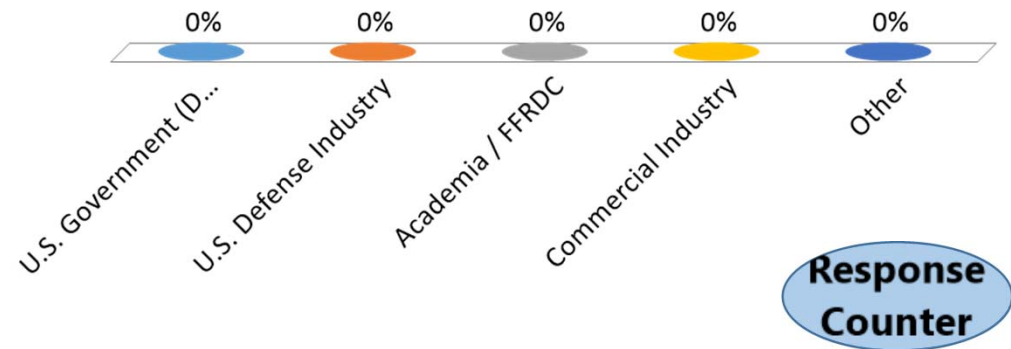
How long has your organization been working toward MBSE?

1. **Less than 1 year**

2. **1-3 years**

3. **4-6 years**

4. **More than 6 years**

| 0% | 0% | 0% | 0% |
| Less than 1 year | 1-3 years | 4-6 years | More than 6 years |

Response Counter
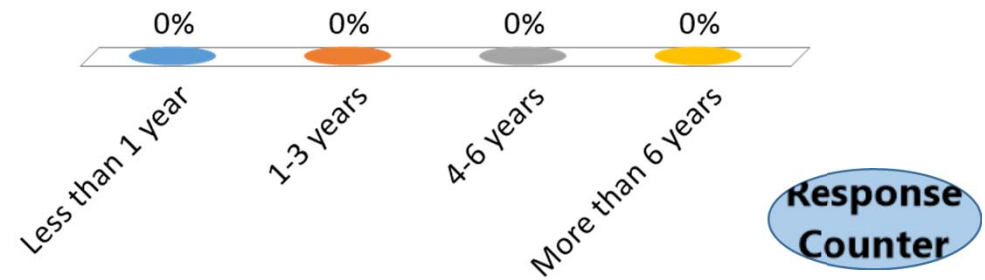
Q1. Our organization's MBSE use strategy is documented as part of the organization's overall strategy at the enterprise level.
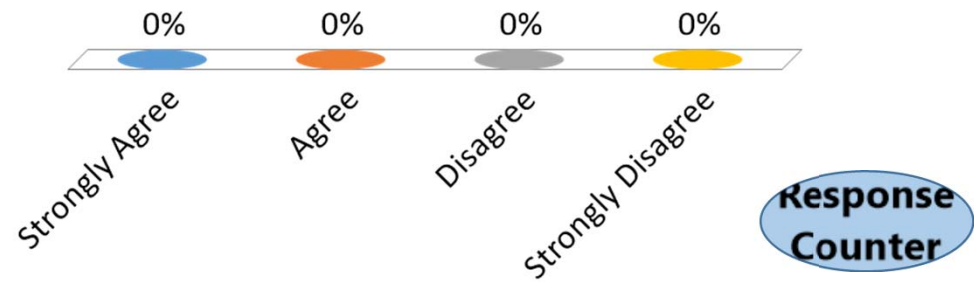
1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

| 0% | 0% | 0% | 0% |
| Strongly Agree | Agree | Disagree | Strongly Disagree |

Response Counter
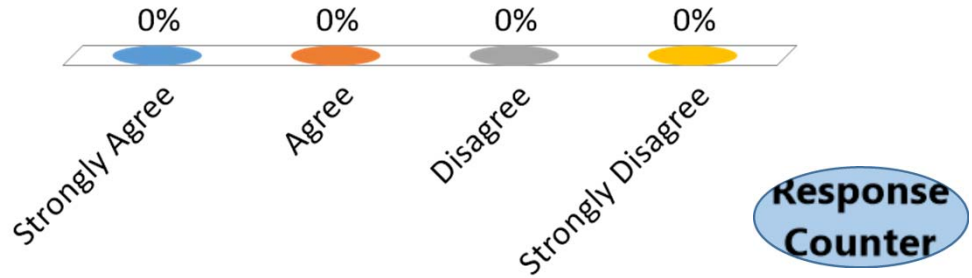
Q2: Our MBSE processes and tools are integrated with business information tools and results are used to inform systems engineers, program management, and all staff across the enterprise.
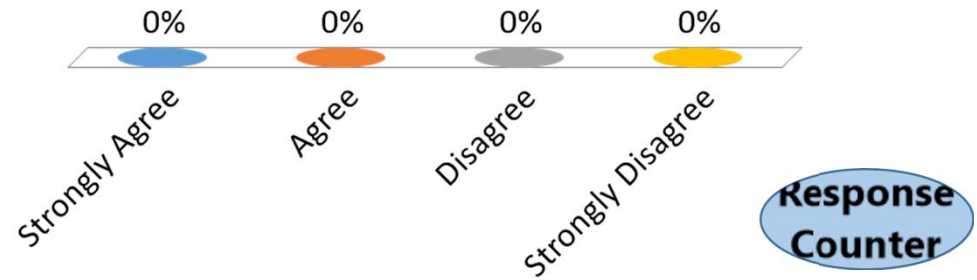
1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

0%   0%   0%   0%

Strongly Agree   Agree   Disagree   Strongly Disagree

Response Counter

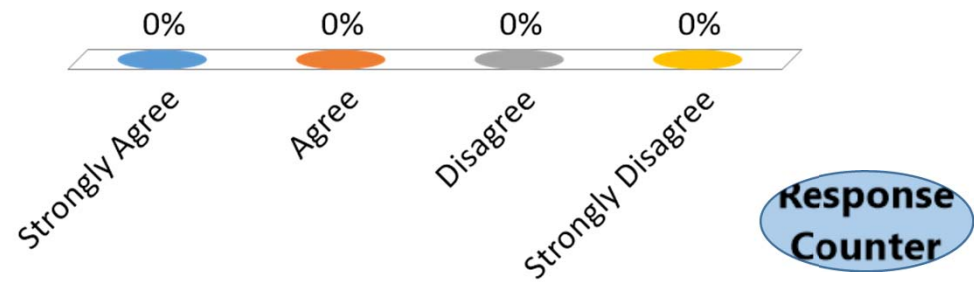**Q4: We have a clear taxonomy that we use consistently for modeling across our organization.**

1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

0%   0%   0%   0%

Strongly Agree   Agree   Disagree   Strongly Disagree

Response Counter

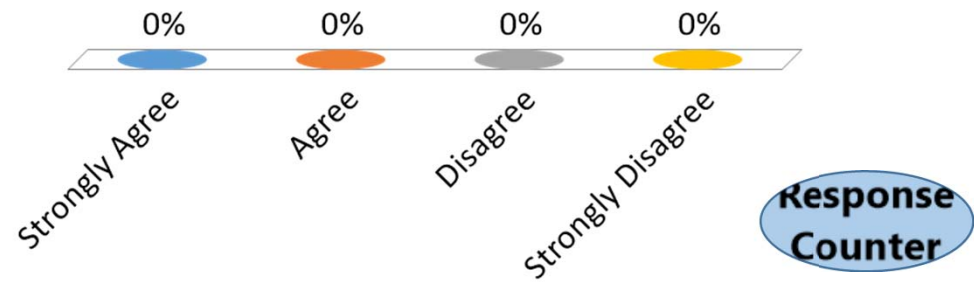**Q5: Our organization has well-defined processes and tools for model management.**

1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

0%	0%	0%	0%
Strongly Agree	Agree	Disagree	Strongly Disagree

Response Counter

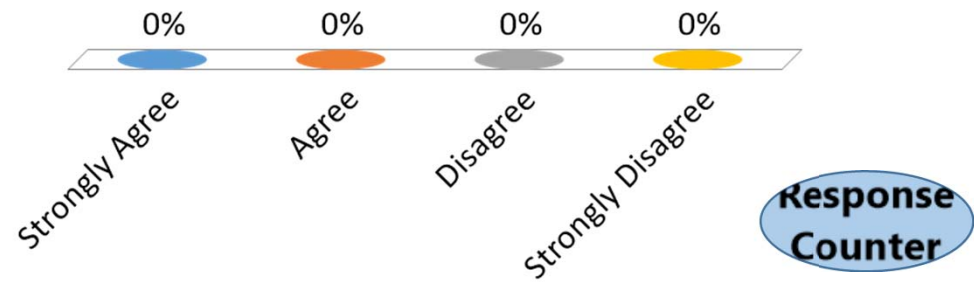**Q6: Our organization has standard business and program guidance driving our model management processes and tools.**

1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

0%	0%	0%	0%
Strongly Agree	Agree	Disagree	Strongly Disagree

Response Counter

Q8: My organization uses modeling as the basis for our technical processes consistently across the enterprise.
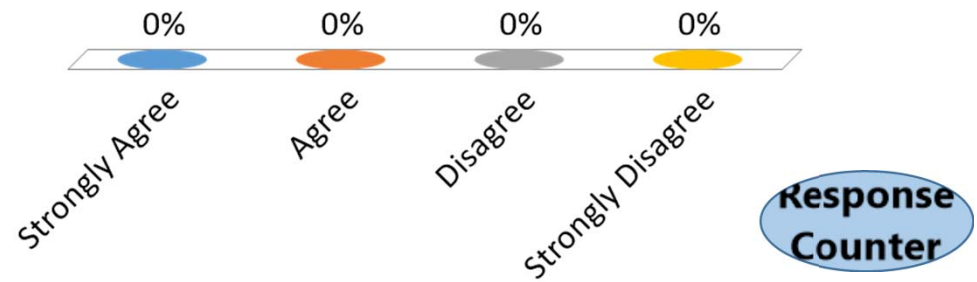
1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

0%   0%   0%   0%

Strongly Agree   Agree   Disagree   Strongly Disagree

Response Counter

MBSE Benchmarking Survey

Q9: Our MBSE process fully supports our technical review process.

1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

0%	0%	0%	0%
Strongly Agree	Agree	Disagree	Strongly Disagree

Response Counter

**Q11: Modeling activities in our organization provide measurable improvements within and across projects.**

1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

| 0% | 0% | 0% | 0% |

Strongly Agree   Agree   Disagree   Strongly Disagree

Response Counter

Q12: We have consistent metrics across our program(s)/enterprise.

1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

| 0% | 0% | 0% | 0% |

Strongly Agree   Agree   Disagree   Strongly Disagree

Response Counter

Model Quality
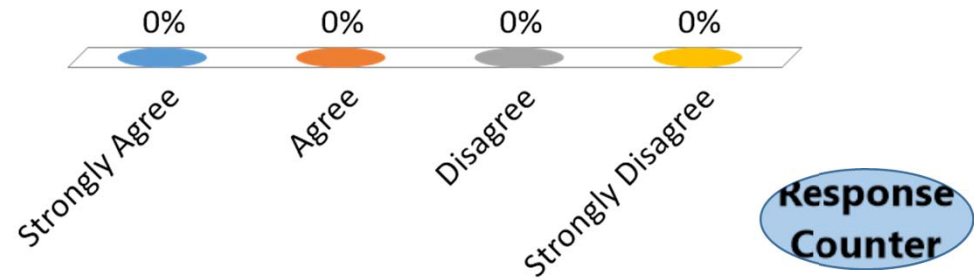
Q14: Our organization has defined processes and tools for verification and validation of models at appropriate levels and program phases.
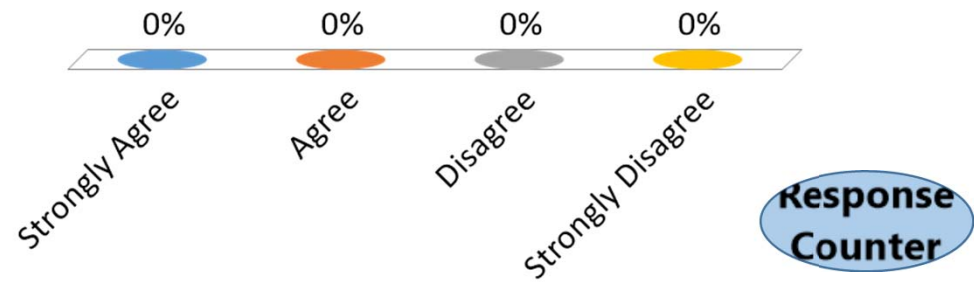
1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

0%	0%	0%	0%
Strongly Agree	Agree	Disagree	Strongly Disagree

Response Counter
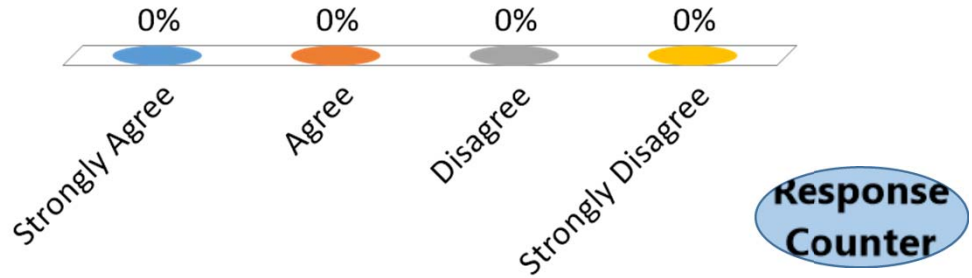
Q15: Our organization has defined processes and tools for data and model quality assurance.

1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**
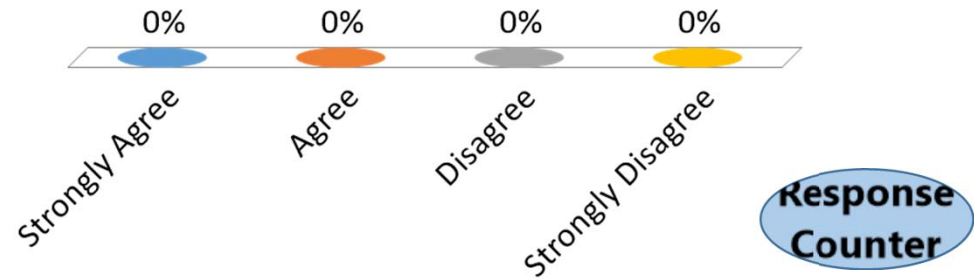
0%   0%   0%   0%

Strongly Agree   Agree   Disagree   Strongly Disagree

Response Counter

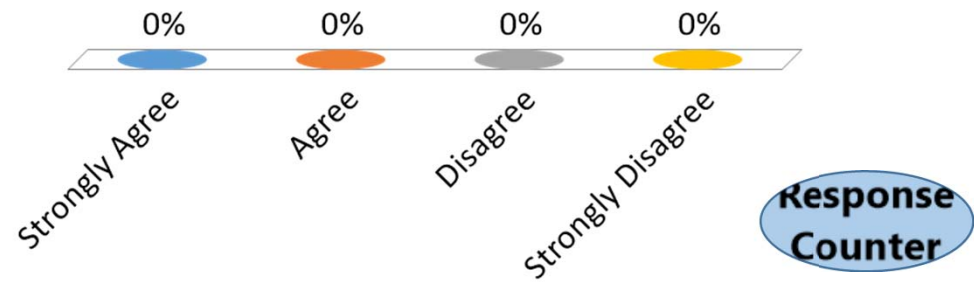**Q16: Our organization has identified appropriate approaches for data interface between tools.**

1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

| 0% | 0% | 0% | 0% |
| Strongly Agree | Agree | Disagree | Strongly Disagree |

Response Counter

Data Management

Q17: Data is managed independent of tools and allows for portability across disciplines.

1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

0%	0%	0%	0%
Strongly Agree	Agree	Disagree	Strongly Disagree

Response Counter

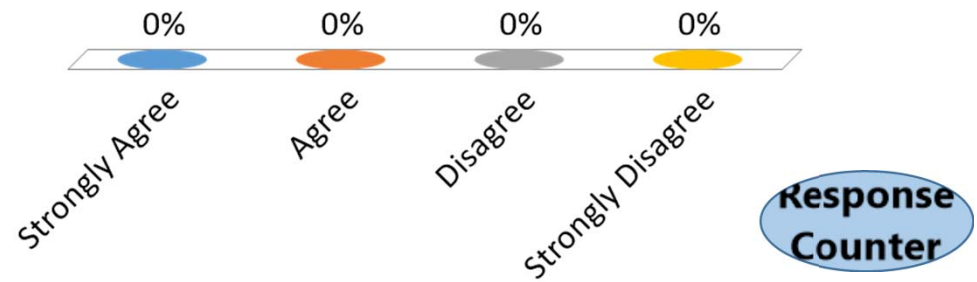**Q19: Teams in my organization establish model libraries, share them as appropriate, and reuse when applicable.**

1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

Strongly Agree	Agree	Disagree	Strongly Disagree
0%	0%	0%	0%

Response Counter

Model Sharing and Reuse

Q20: Our organization has implemented an interface around our models that can be used and understood by a variety of stakeholders.
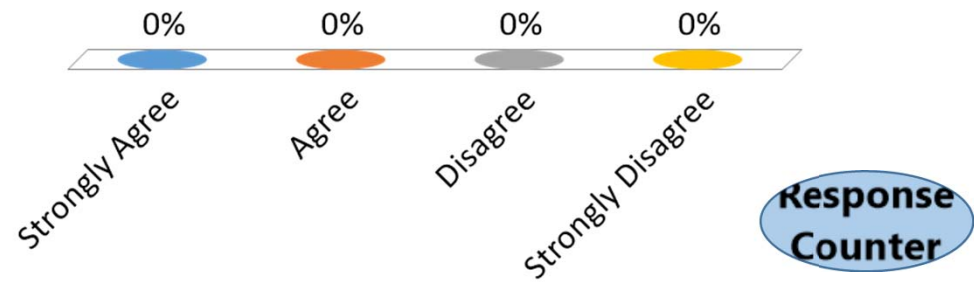
1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

0% 0% 0% 0%

Strongly Agree   Agree   Disagree   Strongly Disagree

Response Counter

**Q21: Shared models are being used to consistently manage systems across the lifecycle.**

1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

0%   0%   0%   0%

Strongly Agree   Agree   Disagree   Strongly Disagree

Response Counter

Q23: I am comfortable that our modeling environment is secure.

1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

| 0% | 0% | 0% | 0% |

Strongly Agree   Agree   Disagree   Strongly Disagree
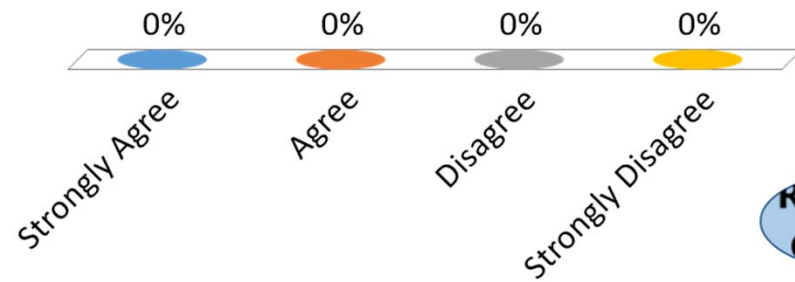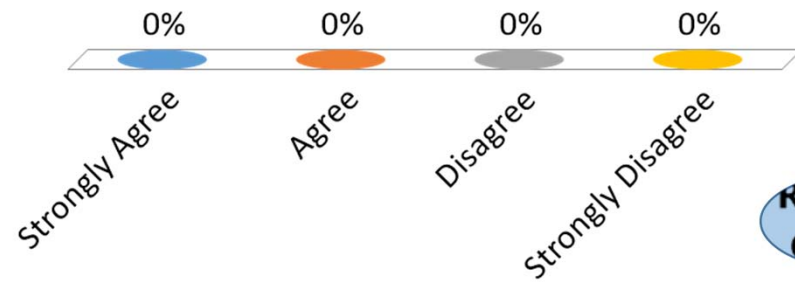
Response Counter

Q24: I am comfortable that our modeling environment protects our intellectual property.

1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

0% 0% 0% 0%

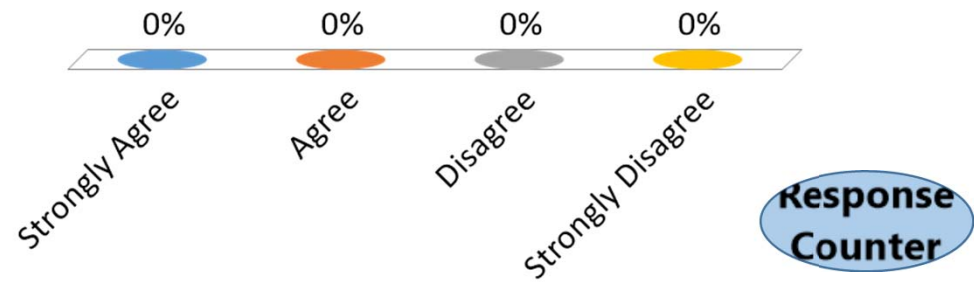Strongly Agree   Agree   Disagree   Strongly Disagree

Response Counter

Q25: Our organization has defined processes and work instructions across multiple disciplines that cover tool use and related data interoperability concerns.
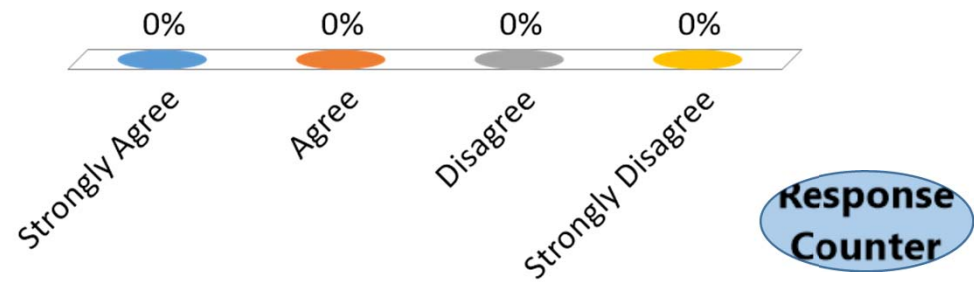
1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

0% 0% 0% 0%

Strongly Agree   Agree   Disagree   Strongly Disagree

Response Counter

Q30: My organization has clearly defined the critical roles to support MBSE.

1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

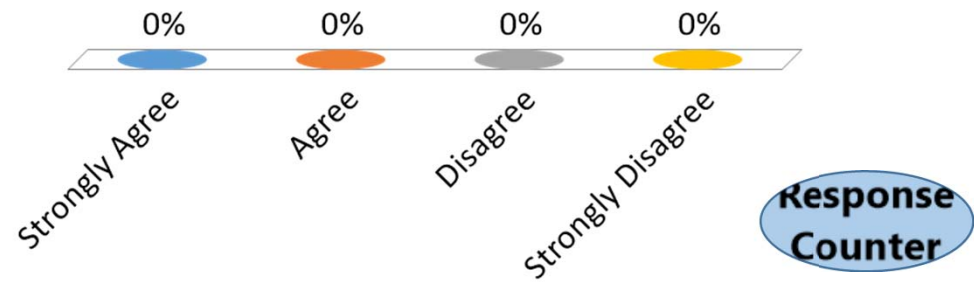0%   0%   0%   0%

Strongly Agree   Agree   Disagree   Strongly Disagree

Response Counter

Q32: We have sufficient staffing in our organization to fill all MBSE-related roles.
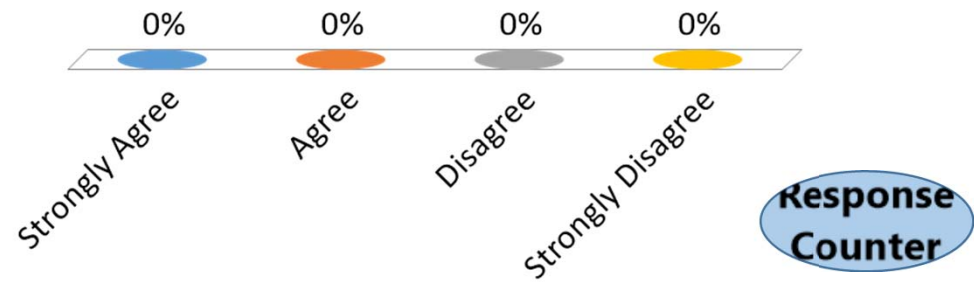
1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

0%	0%	0%	0%
Strongly Agree	Agree	Disagree	Strongly Disagree

Response Counter

Q33: Our organization has clearly defined critical skills for MBSE.

1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**
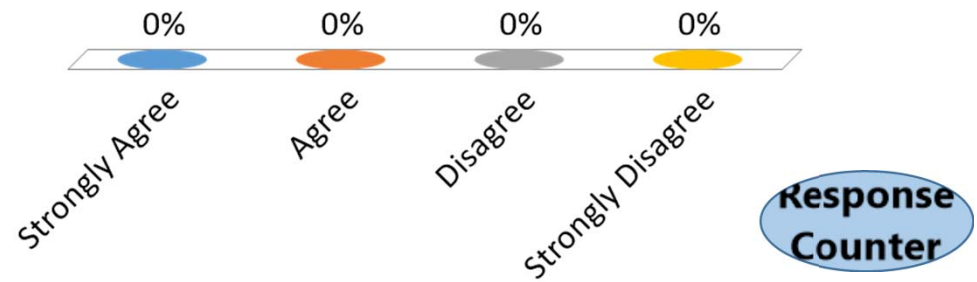

0%   0%   0%   0%

Strongly Agree   Agree   Disagree   Strongly Disagree

Response Counter

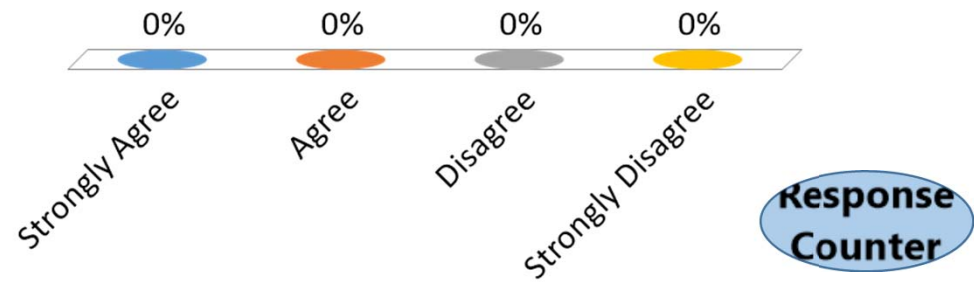**Q35: Our MBSE training is linked to the critical skills identified for MBSE.**

1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

Is this pilot survey effective in assessing MBSE capability? Is it sufficient for community deployment?

1. **Strongly Agree**

2. **Agree**

3. **Disagree**

4. **Strongly Disagree**

Open Discussion

MBSE Usage	**Q3: What do you see as the primary value of integrating MBSE processes with program and business management processes?**	
Model Management	**Q7: List any statements that describe the business value you are realizing from consistent model management processes and tools.**	
Technical Management	**Q10: What are the most valuable benefits of MBSE (or "digital engineering") in the technical review process?**	
Metrics	**Q13: List the metrics that have proven to be the most useful:**	
Data Management	**Q18: List any new data management roles and processes you have created.**	
Model Sharing and Reuse	**Q22: How has your organization implemented improved data and model discovery and reuse, either within or between teams?**	

Additional comments on best practices or challenges for MBSE adoption and effectiveness across our industry?

Open Discussion

Modeling Environment	Q26: List any additional value you find from collaborating on models across disciplines.	
Organizational Implementation	Q27: The most challenging obstacles to implementing MBSE in our organization are:	
	Q28: The best enablers to for MBSE in our organization are:	
	Q29: Going forward, the biggest changes our organization needs to make to improve our implementation of MBSE are:	
Workforce	Q31: The top MBSE role(s) in my organization are:	
MBSE Skills	Q34: The most critical skills for MBSE are:	

Additional comments on best practices or challenges for MBSE adoption and effectiveness across our industry?

Thank you for your input!

Thank you for helping us pilot and improve our MBSE survey.

Watch for opportunities soon to provide further survey input through NDIA, INCOSE, or other organizations.

Survey results are expected to be published in Q1 2020.

Contact info:

Tom McDermott
Stevens Institute
tamcdermott42@gmail.com

Geoff Draper
L3Harris Technologies
Vice-Chair, NDIA Systems Engineering Division
geoff.draper@l3harris.com