Benchmarking the Benefits and Current Maturity of Digital Engineering/Model-Based SE

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Frameworks for Evaluating DE Value

- DoD Digital Engineering Strategy
  - —Vision, mission, and goals can be generalized to any organization
- INCOSE Model-Based Enterprise Capability Matrix
  - —Benchmark for Organizational and Industry-wide DE Maturity, published January 2020
- DE/MBSE Value, Benefits, and Metrics Framework
  - —Developed by the SERC, four categories for DE value/benefits: Quality, Velocity/Agility, User Experience, Knowledge Transfer
- DE/MBSE Enterprise Adoption Framework
  - —Developed by the SERC from the Baldrige CPE Framework: Adoption

DoD Digital Engineering Strategy

STRATEGIC MANAGEMENT SYSTEM

Digital Engineering (DE) Vision: Modernize how the Department designs, develops, delivers, operates, and sustains systems.

DE Mission: Securely and safely connect people, processes, data, and capabilities across an end-to-end digital enterprise.

ENDS	Models are used to inform enterprise and program decision making	An enduring, authoritative source of truth is used over the lifecycle	Use technological innovation to improve engineering practices	Infrastructure and environments support improved communication and collaboration	Transform culture and workforce engineering across the lifecycle
WAYS / INITIATIVES	Formalize the planning for models to support engineering activities and decision making across the lifecycle	Plan and develop the authoritative source of truth	Infuse technological innovations to enable the end-to-end digital enterprise	Develop, mature, and use digital engineering IT infrastructures	Improve the digital engineering knowledge base
WAYS / INITIATIVES	Formally develop, integrate, and curate models	Govern the authoritative source of truth	Make use of data to improve awareness, insights, and decision making	Develop, mature, and use digital engineering methodologies	Lead and support digital engineering transformation efforts
WAYS / INITIATIVES	Use models to support engineering activities and decision making across the lifecycle	Use the authoritative source of truth across the lifecycle	Advance human-machine interactions	Secure IT infrastructure and protect intellectual property	Build and prepare the workforce
MEANS	Process, Methods, Tools, Technology, People				

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Focus: Enterprise Transformation Measures

- Gartner: "*Select just 5 to 9 metrics to track, report and act on. The value of a metric lies in its ability to influence business decision making*."
- The best metrics:
  - Have a defined and defensible causal relationship to a business outcome
  - Work as a leading, not lagging, indicator
  - Address a specific defined audience – in a way they can understand
  - Drive action when they change from green to yellow to red

https://www.gartner.com/smarterwithgartner/how-to-measure-digital-transformation-progress/

- There are no universal metrics – must be enterprise specific
- Good Digital Transformation metrics have some traits
  - Measure people **adoption**, and enterprise process **adoption**
  - Analyze breadth of **usability**, and issues with **usability**
  - Measure **productivity** indicators
  - Generate **new value** to the enterprise (revenue, operational efficiency, etc.)

Summary DE Success Measures Framework

Models are used to inform enterprise and program decision making	An enduring, authoritative source of truth is used over the lifecycle	Use technological innovation to improve engineering practices	Infrastructure and environments support improved communication and collaboration	Transform culture and workforce engineering across the lifecycle

Quality:
- Reduce Errors/Defects
- Improve System Quality
- Improve Traceability
- Reduce Cost

Knowledge Transfer:
- Better access to information
- Better communication/ info sharing
- Collaboration

Velocity/Agility:
- More Reuse
- Improve Consistency
- Increase Efficiency
- Support Integration
- Reduce Time

User Experience:
- Manage Complexity
- Improved System Understanding
- Automation

Adoption:
- Methods/Processes
- Roles/Skills
- Training/Tools
- Leadership support
- Change Mgmt Process
- Resources

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MBSE Benefits: Literature Review Results

- Searched papers that mention a benefit of MBSE and what the source of that benefit was: measured gains, observed gains, perceived gains (no source for benefit), reference.
  - Total Papers that mention MBSE: 847
    - Papers that mention benefits: 360
      - Measured gains: **2**
      - Observed gains: 27
      - Perceived gains: **236**
- Identified 48 categories of benefits linked to the metrics framework across the areas of Quality, Velocity/Agility, User Experience, and Knowledge Transfer.

*Kaitlin Henderson (VT) PhD studies

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Literature Review Benefit Categories (48)

Category	List of Benefits		
Quality	Reduce errors/ defects	Improved risk analysis	Improved capability
	Improved traceability	Improved system design	More stakeholder involvement
	Improved system quality	Better requirements generation	Strengthened testing
	Reduce risk	Increased accuracy of estimates	Reduce cost
	Increased rigor	Improved predictive ability	Better analysis capability
	Increased effectiveness	Improved deliverable quality	
Velocity/ Agility	Improved consistency	Increased productivity	Higher level support for integration
	Increased capacity for reuse	Increased transparency	Increased uniformity
	Increased efficiency	Increased confidence	Increased precision
	Reduce rework	Increased flexibility	Early V&V
	Reduce time	Better requirements management	Reduce ambiguity
	Reduce waste	Ease of design customization	Easy to make changes
User Experience	Higher level support for automation	Improved system understanding	Reduce effort
	Reduce burden of SE tasks	Better data management/capture	
	Better manage complexity	Better decision making	
Knowledge Transfer	Better accessibility of info	Improved architecture	Better communication/ info sharing
	Better knowledge management/ capture	Multiple viewpoints of model	Improved collaboration

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Literature Review Quantitative Results

(sorted by measured, 21 most cited)

Category	Perceived	Observed	Measured
Quality	Reduce Errors/Defects (16)	Reduce Errors/Defects (26)	Reduce Errors/Defects (2)
	Improve Traceability (61)	Improve Traceability (9)	Improve Traceability (1)
	Improve System Quality (21)	Improve System Quality (0)	Improve System Quality (1)
	Reduce Risk (22)	Reduce Risk (2)	Reduce Risk (1)
	Increased Rigor (0)	Increased Rigor (0)	Increased Rigor (1)
	Reduce Cost (33)	Reduce Cost (4)	Reduce Cost (0)
Velocity/ Agility	Consistency (44)	Consistency (6)	Consistency (1)
	Reuse (37)	Reuse (5)	Reuse (1)
	Efficiency (13)	Efficiency (2)	Efficiency (0)
	Improve Standardization	Improve Standardization	Improve Standardization (0)
	Collaboration/Info Sharing (68)	Collaboration/Info Sharing (11)	Collaboration/Info Sharing (0)
	Integration/V&V (11)	Integration/V&V (3)	Integration/V&V (1)
	Reduce Time (24)	Reduce Time (8)	Reduce Time (1)
User Experience	Automation (0)	Automation (0)	Automation (2)
	Reduce SE Task Burden (0)	Reduce SE Task Burden (0)	Reduce SE Task Burden (1)
	Manage Complexity (48)	Manage Complexity (2)	Manage Complexity (0)
	Productivity (14)	Productivity (0)	Productivity (0)
	System Understanding (24)	System Understanding (2)	System Understanding (0)
Knowledge Transfer	Information Access (27)	Information Access (5)	Information Access (2)
	Knowledge Capture/Sharing (13)	Knowledge Capture/Sharing (0)	Knowledge Capture/Sharing (2)
	Architecture/Sys Understanding (23)	Architecture/Sys Understanding (2)	Architecture/Sys Understanding (1)

mbsematuritysurvey.sercuarc.org

Final Survey data as of February 1, 2020.
Quantitative metrics reflect “effective” participants. Information derived from text responses reflects “all” participants

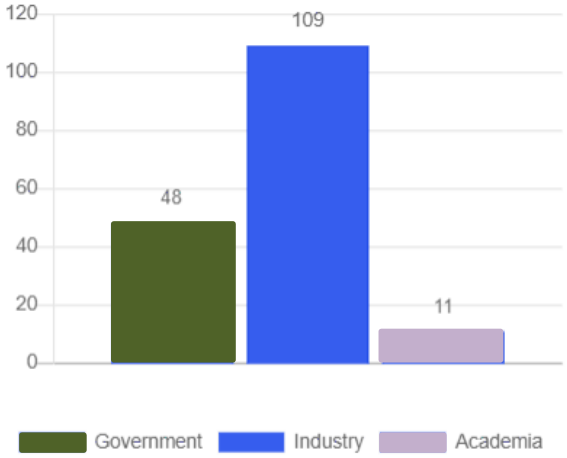
MBSE Survey Overview

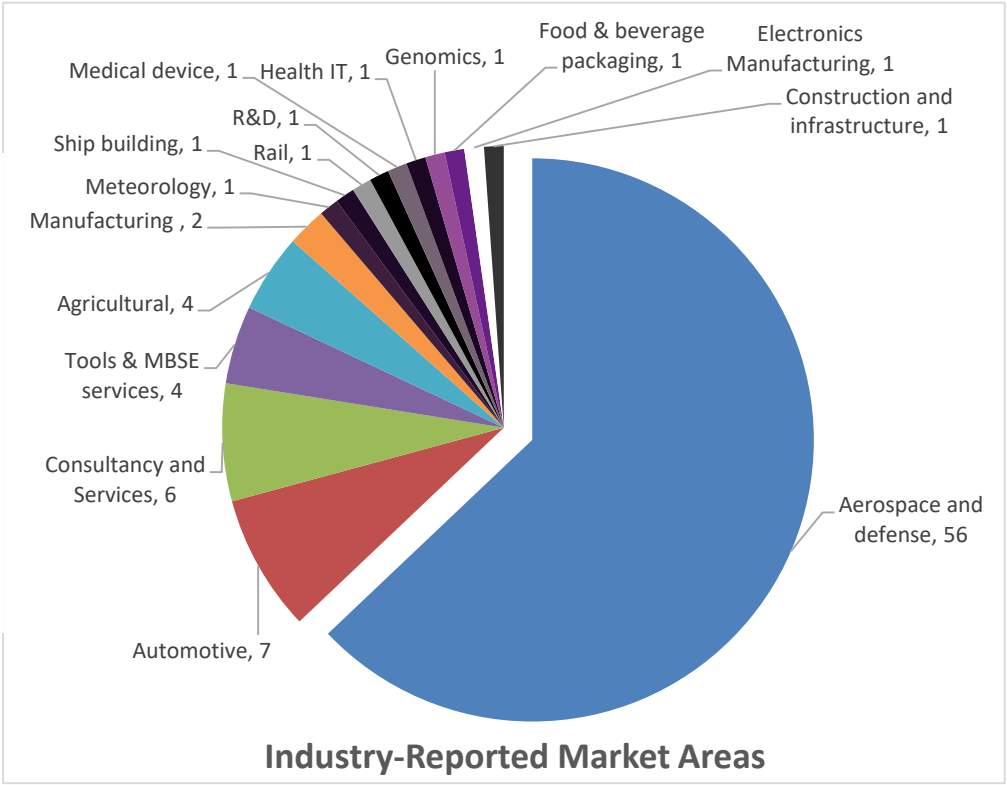
Topics	Summary of Survey Questions
1. MBSE Usage	1. MBSE strategy is integrated with product strategy at the enterprise level 2. MBSE processes & tools are integrated with product-level processes and tools *3. Most important reasons for integrating MBSE*
2. Model Management	4. Have a taxonomy for modeling across organization 5. Have defined processes/tools for model management 6. Have standard guidance for model management/tools *7. Identify business value from consistent model management*
3. Technical Management	8. Use modeling as the basis for technical processes 9. MBSE process supports our technical review process *10. Identify benefits or challenges of MBSE in technical reviews*
4. Metrics	11. Modeling provides measurable improvement across projects 12. Have consistent metrics across programs/enterprise *13. Identify any metrics that have proven useful*
5. Model Quality	14. Have defined processes/tools for V&V of models 15. Have defined processes/tools for data/model quality assurance
6. Data Management	16. Have effective approaches for managing the data interface between tools 17. Data is managed independent of tools for portability *18. Identify new data management roles/processes*
7. Model Sharing and Reuse	19. Support model libraries for reuse 20. Have interfaces around models for stakeholder use 21. Shared models are used to consistently manage programs across lifecycle *22. Identify practices for data/model discovery, reuse?*
8. Modeling Environments	23. Our modeling environment is secure 24. Our modeling environment protects IP 25. Have defined processes for tools, data interoperability *26. Identify benefits from collaborating on models across disciplines*
9. Organizational Implementation	*27. Identify most challenging org obstacles for MBSE* *28. Identify best organizational enablers for MBSE* *29. Identify biggest changes our org needs for MBSE*
10. Workforce	30. Have defined critical roles to support MBSE *31. Identify top MBSE roles in your organization* 32. Have sufficient staffing to fill MBSE-related roles
11. MBSE Skills	33. Have defined critical skills for MBSE *34. Identify the most critical skills for MBSE*
12. Demographics	Organizational size, domain, MBSE experience, role

**Questions in italics elicit free text responses*

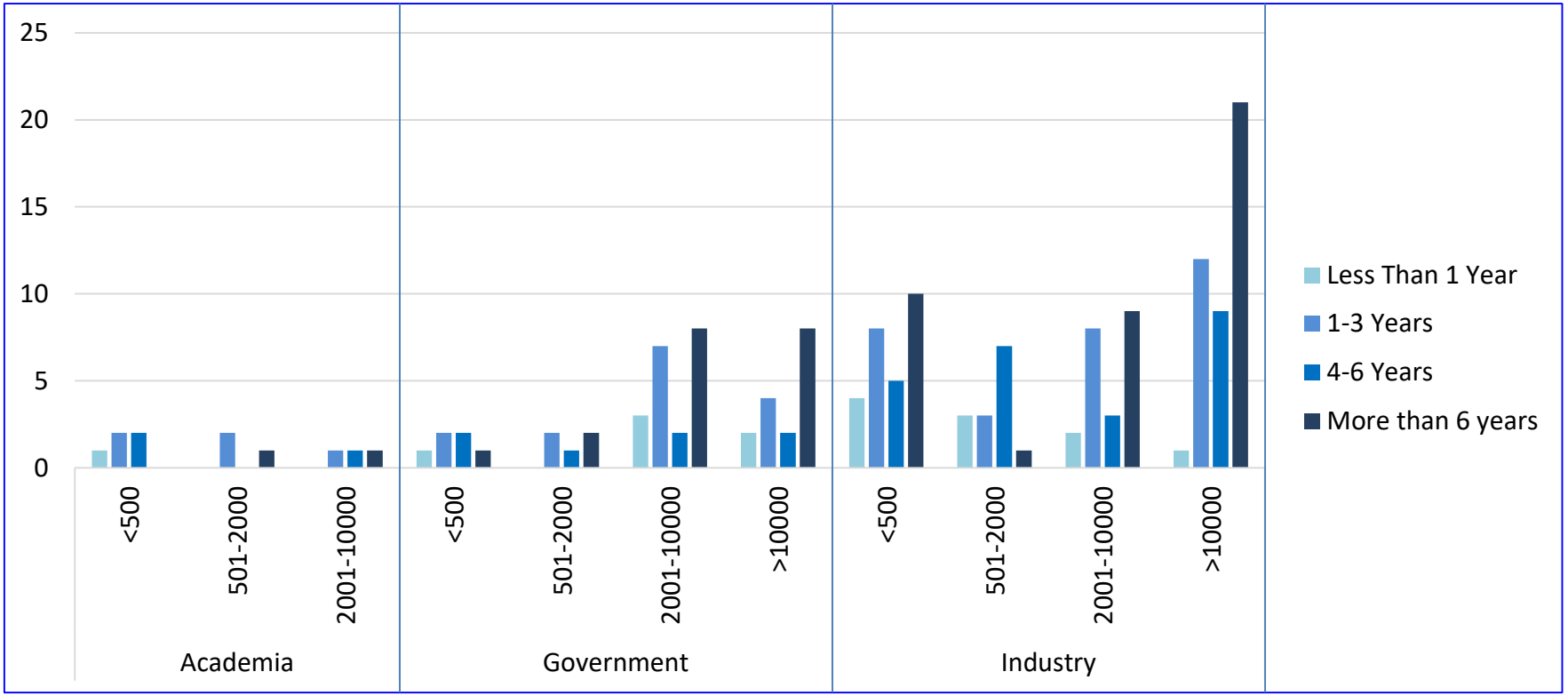
Survey content is derived from the draft INCOSE Digital Engineering Capabilities Definition

Demographics - Organization type:

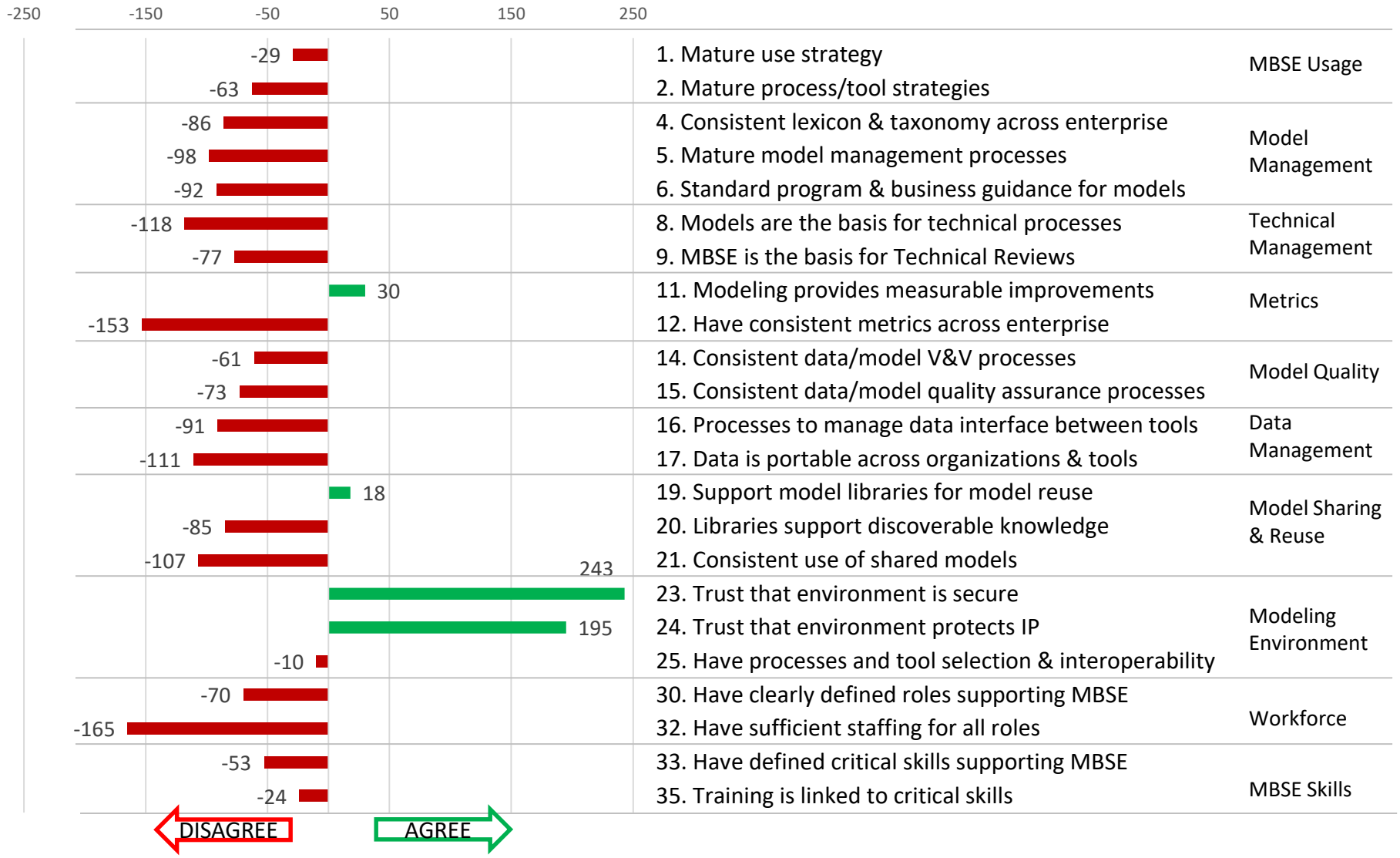




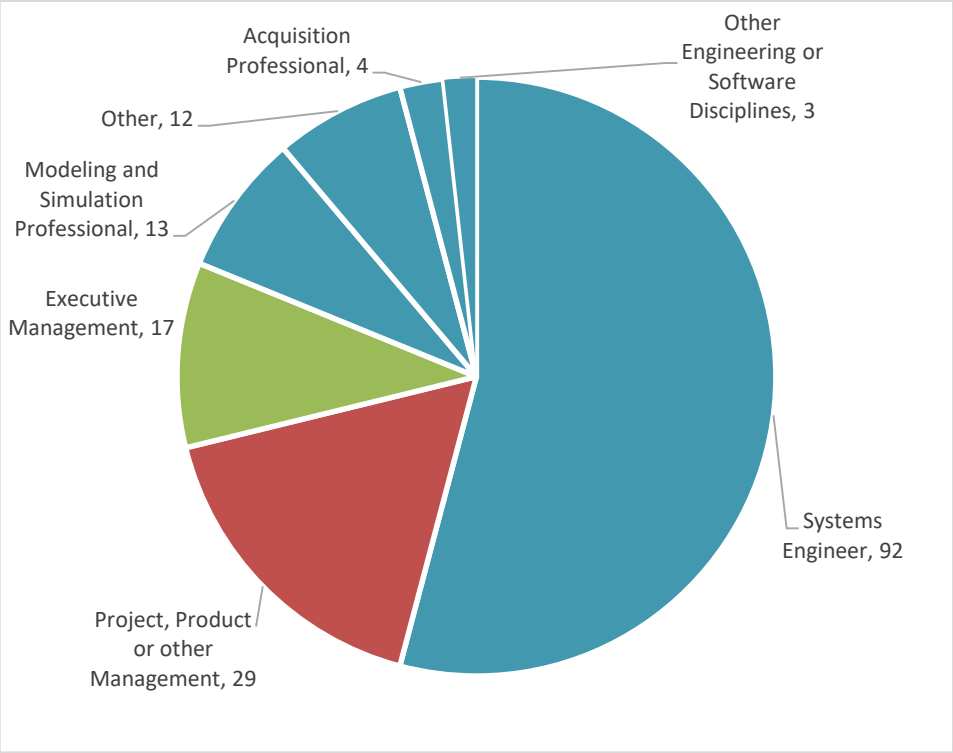
Demographic – type, size, experience



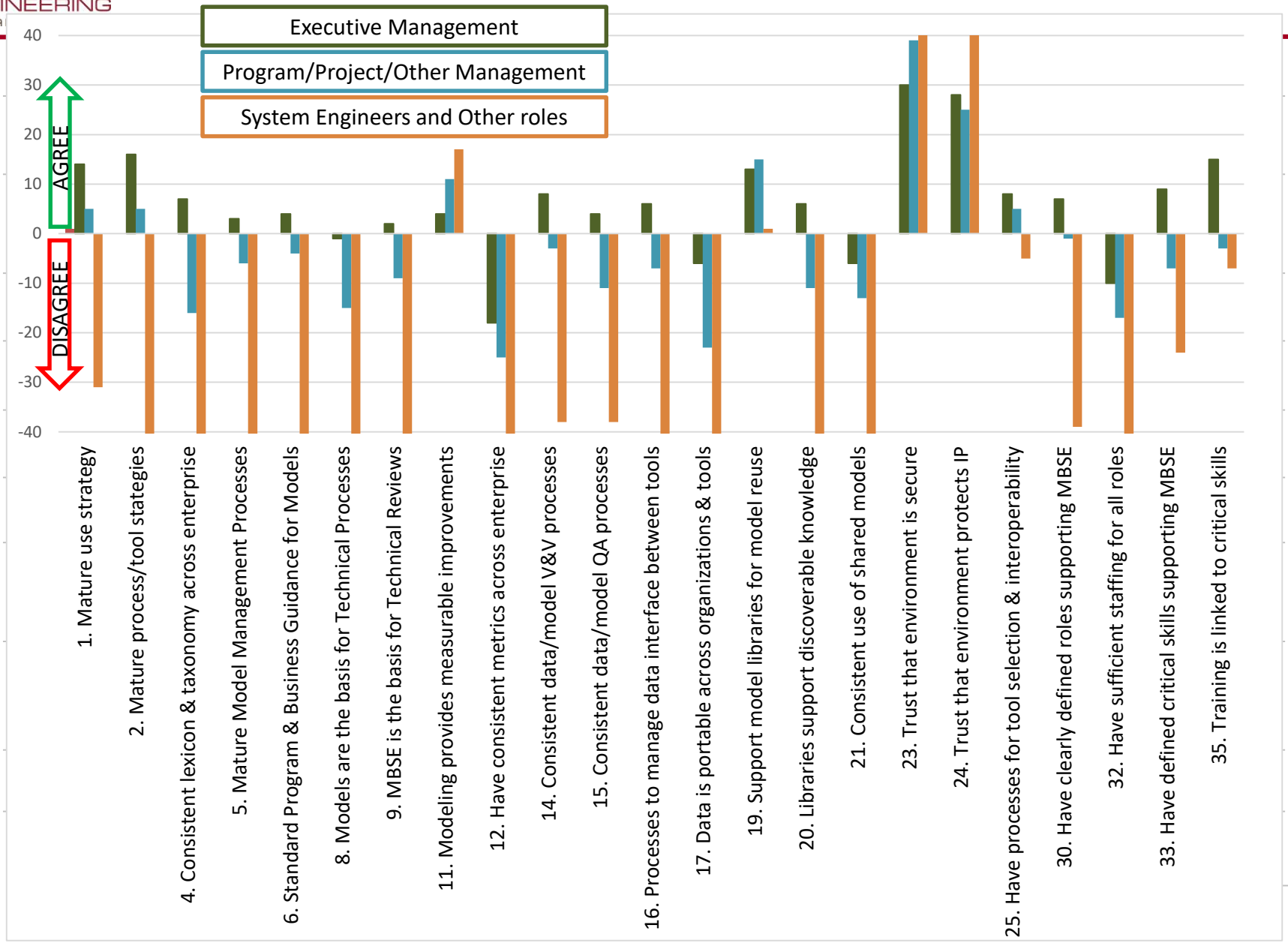
Overall Survey Scores



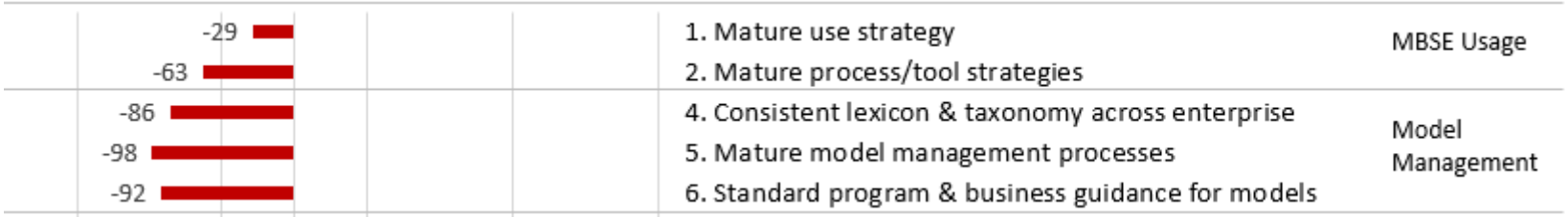
Demographics – Participant roles



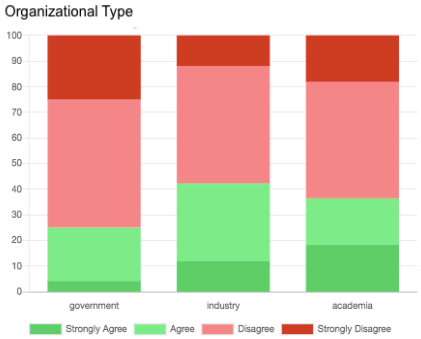
Overall Survey Scores by Role

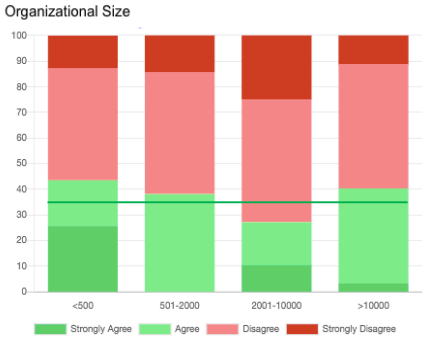


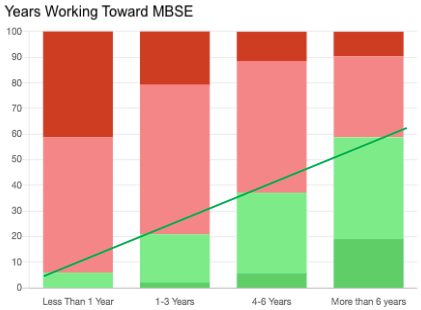
MBSE Usage and Model Management Survey Results

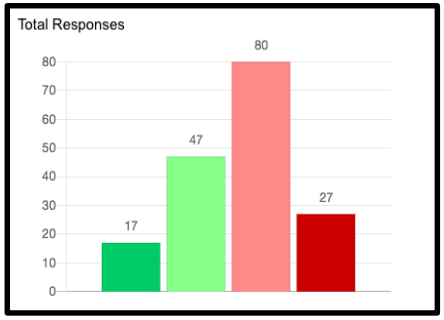


Our MBSE processes and tools are integrated with our overall product-level processes and tools.

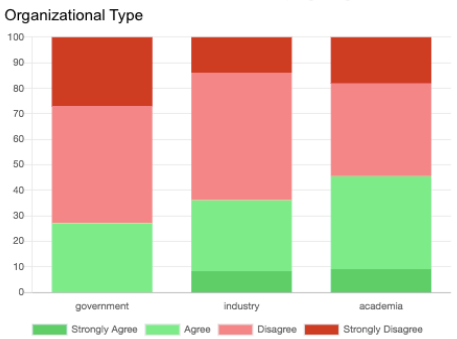


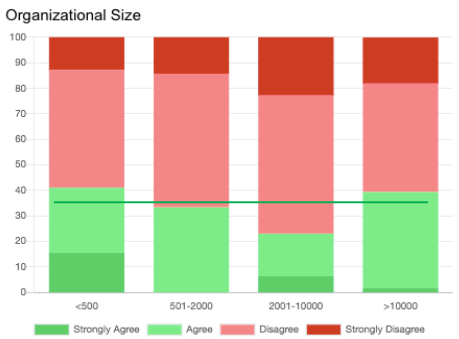


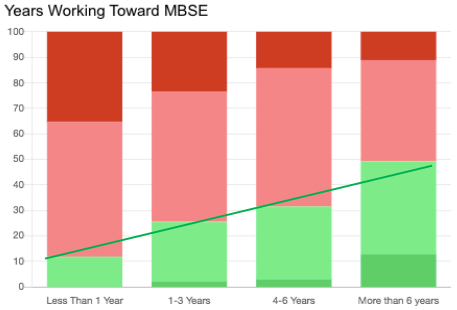


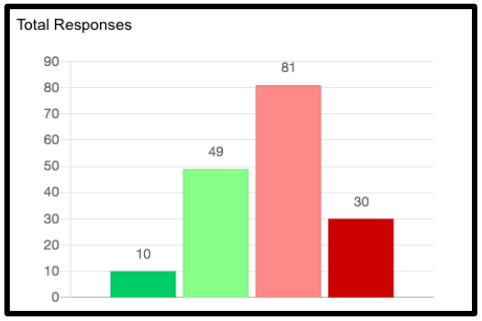


Our organization has standard business and program guidance that defines our model management processes and tools.

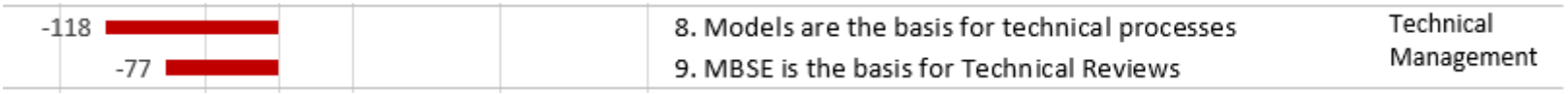




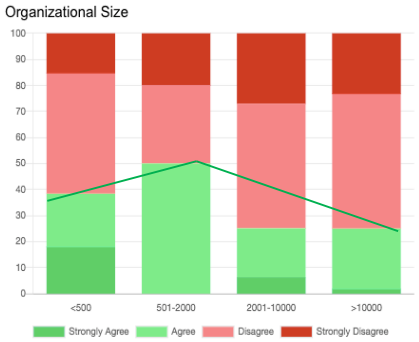


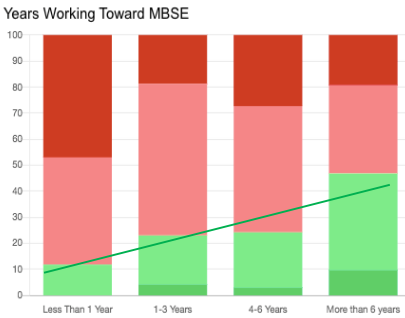


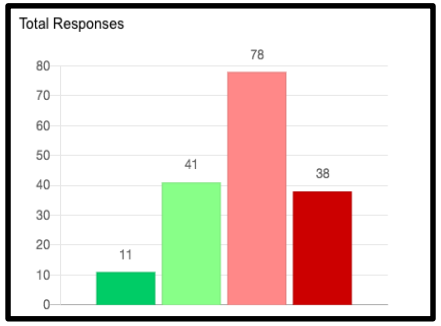
Technical Management Survey Results



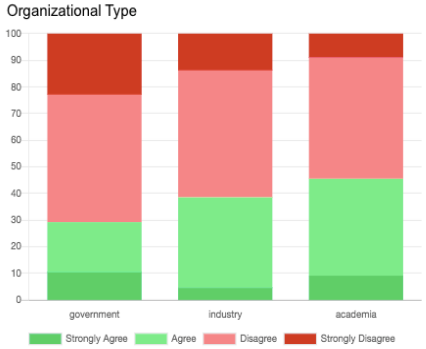
Our organization uses modeling as the basis for our technical processes consistently across the enterprise.

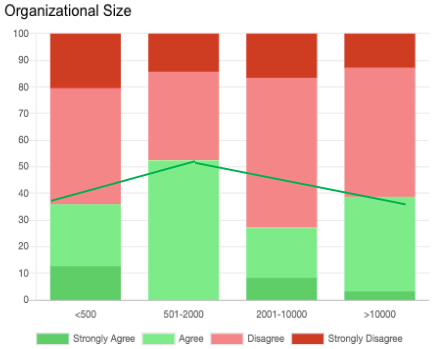


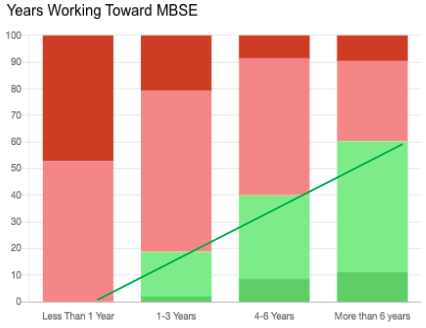


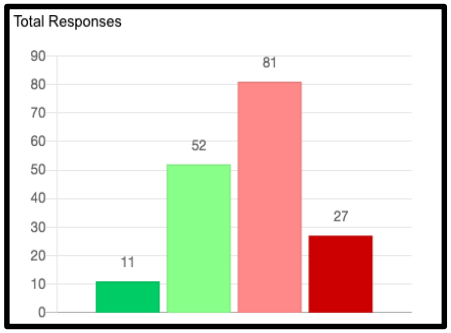


Our MBSE process fully supports our technical review process.





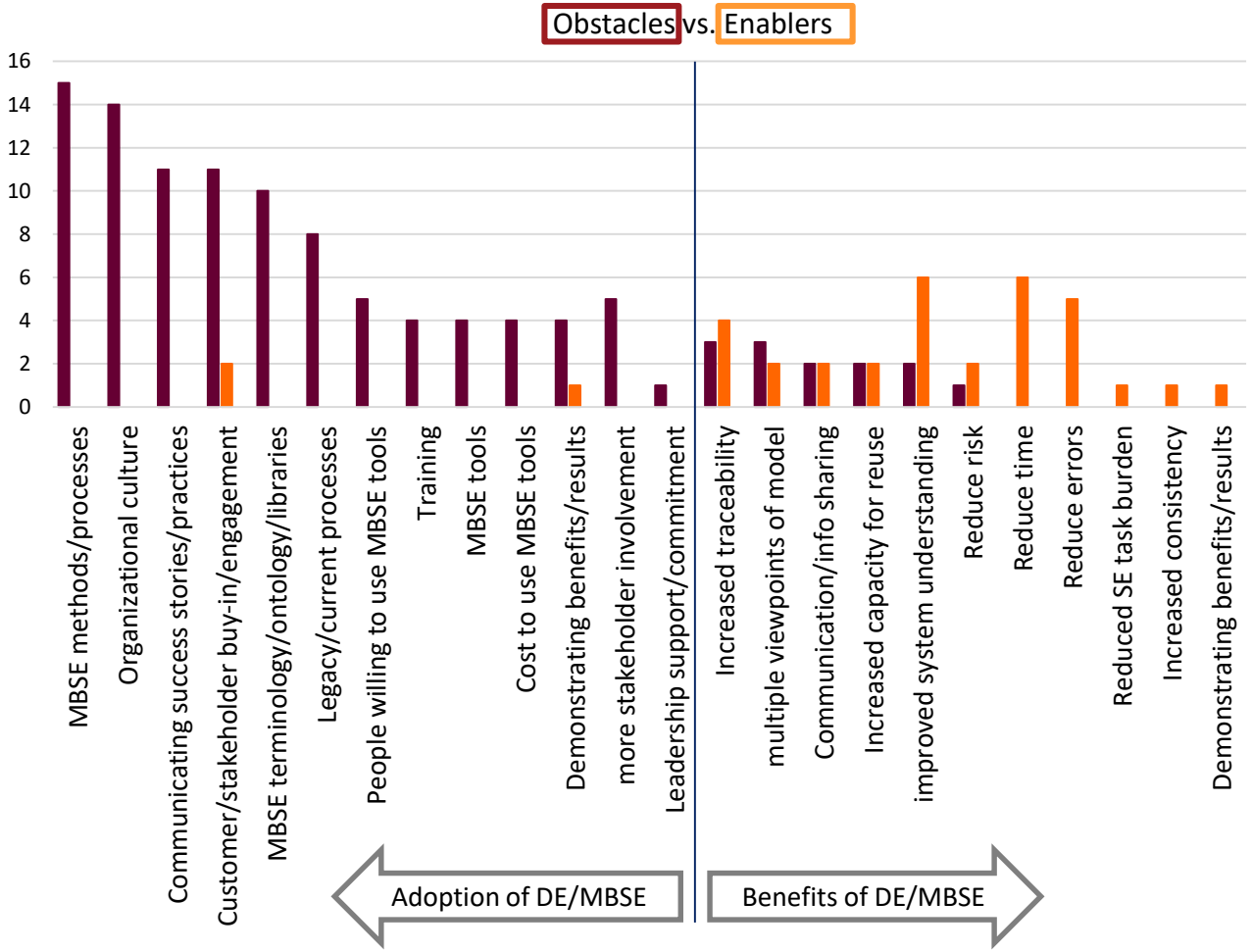




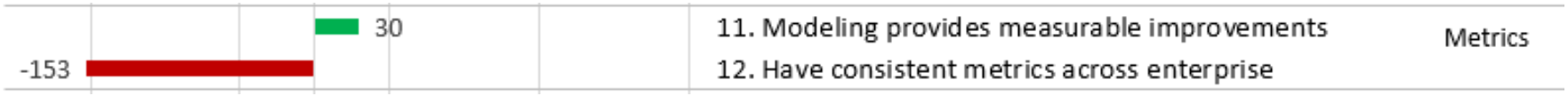
Free-text question: ***Please identify any benefits or challenges your organization has found in the use of MBSE (or 'digital engineering') in the technical review process.***

Comparing Obstacles vs. Enablers in Tech Review Processes

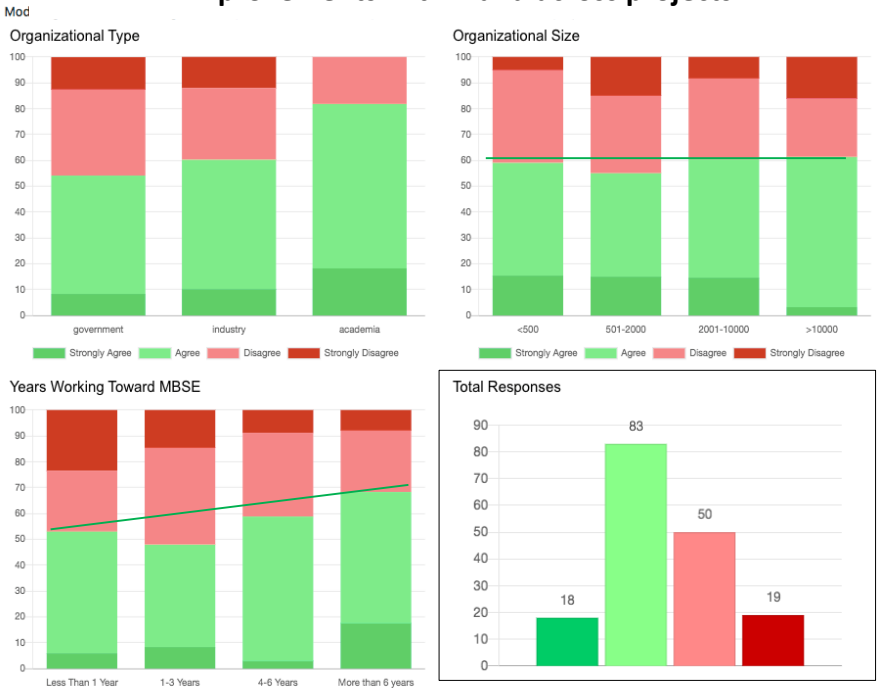
Participants were asked to respond to the prompt, "*Please identify any benefits or challenges your organization has found in the use of MBSE (or 'digital engineering') in the technical review process.*"



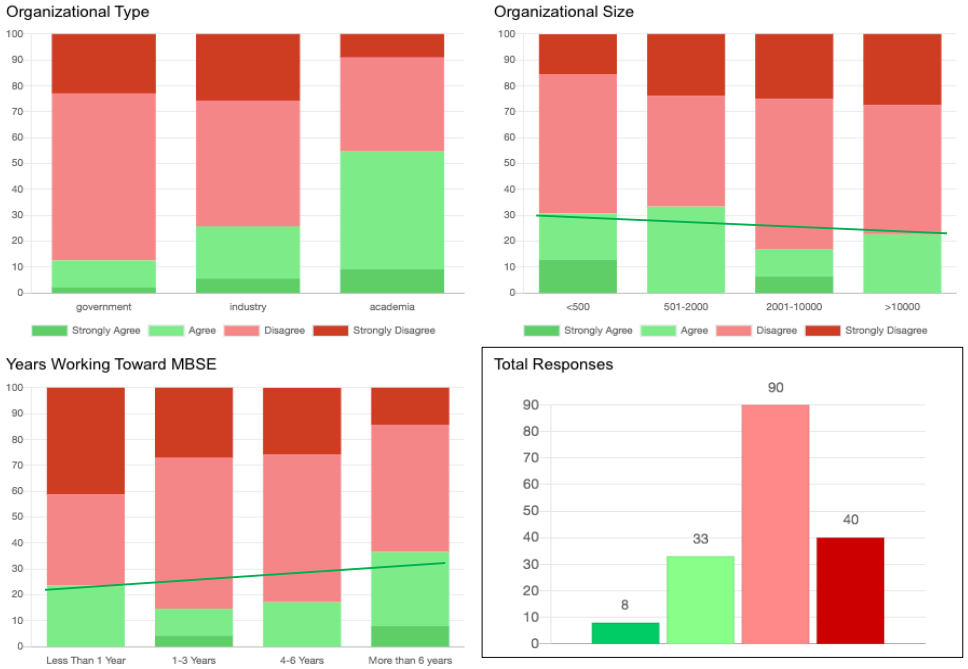
DE/MBSE Metrics Survey Result



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

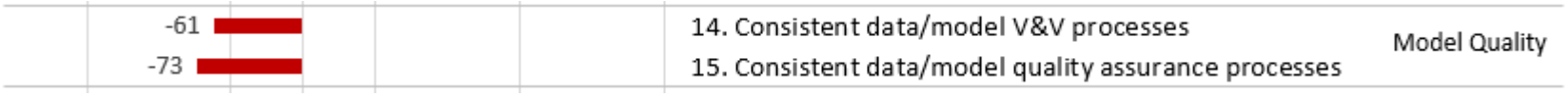


We have consistent metrics across our program(s)/enterprise that include our modeling activities.

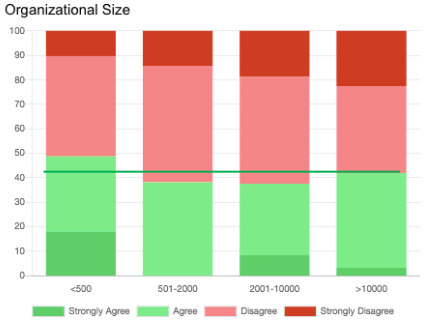


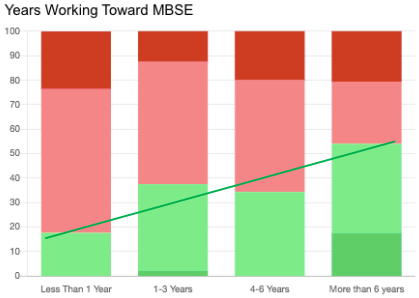
Free-text question: ***Please identify any metrics that have proven to be useful for measuring the performance of your MBSE activities*****.**

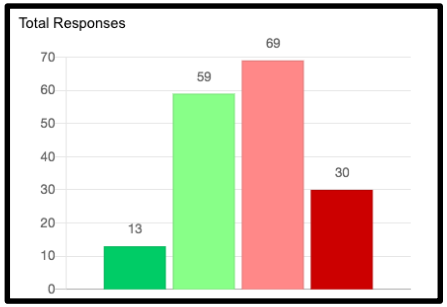
Model Quality Survey Results



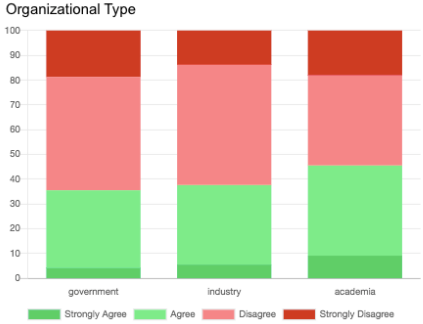
Our organization has defined processes and tools for V&V of models at appropriate levels and program phases.

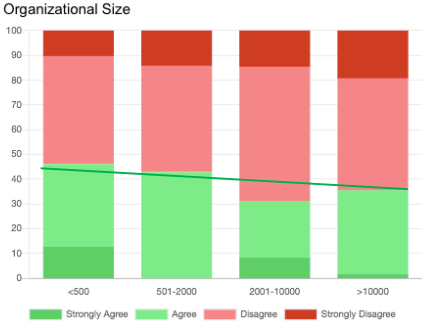


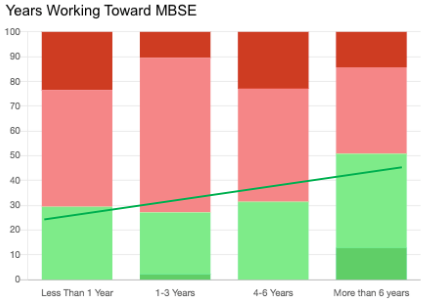


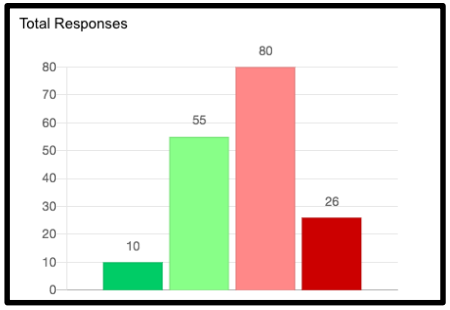


Our organization has defined processes and tools for data and model quality assurance.

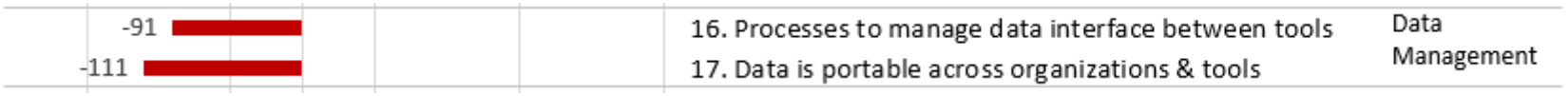




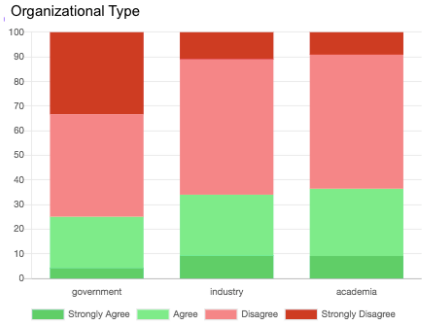


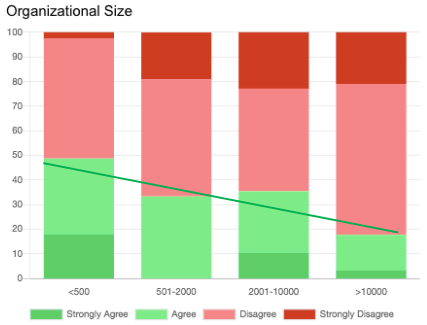


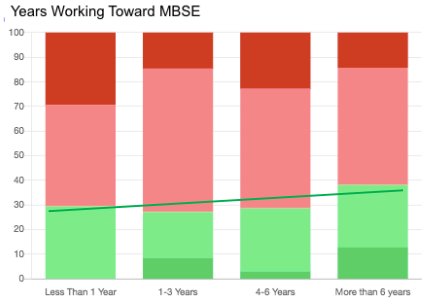
Data Management Survey Results

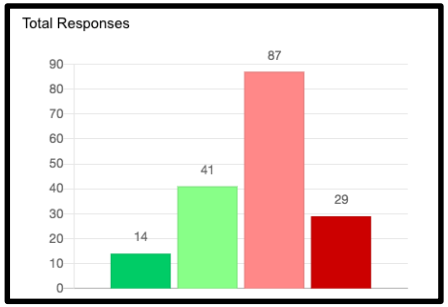


Our organization has effective approaches for managing the data interface between tools.

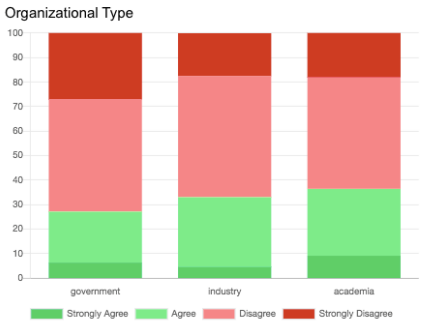


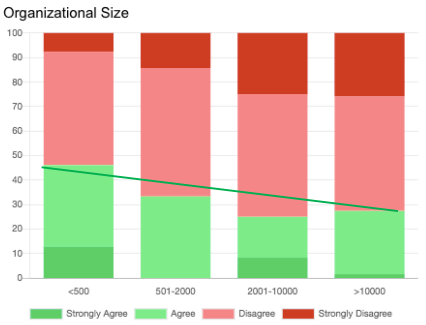


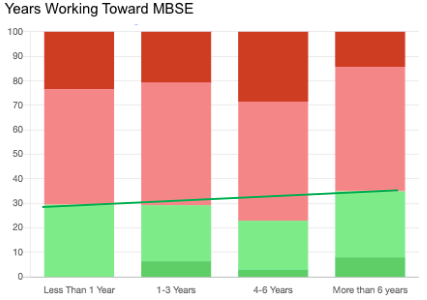


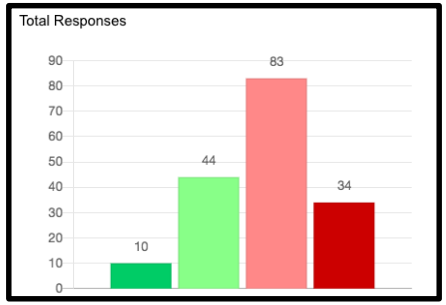


Data is managed independent of tools and allows for portability across different organizational structures and related disciplines.

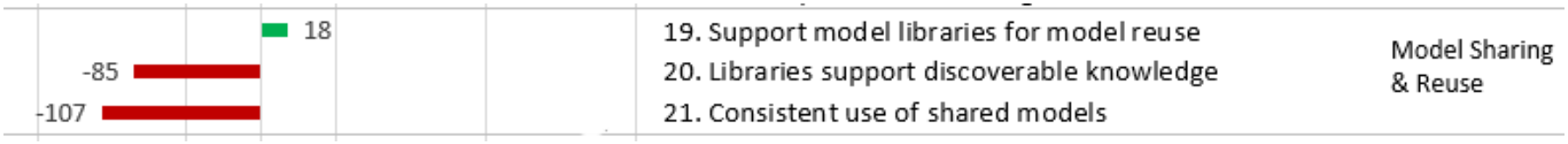




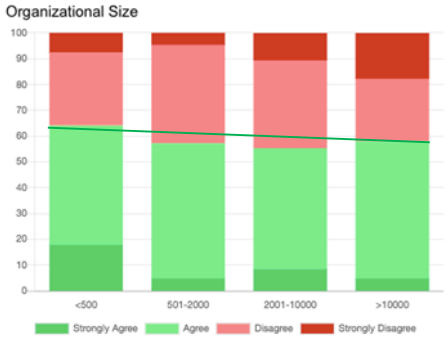


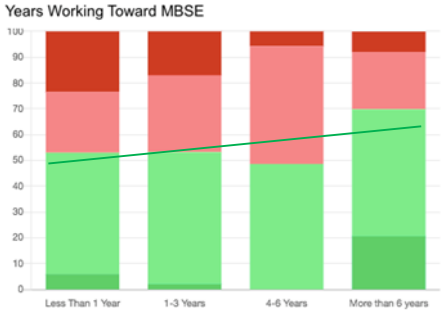


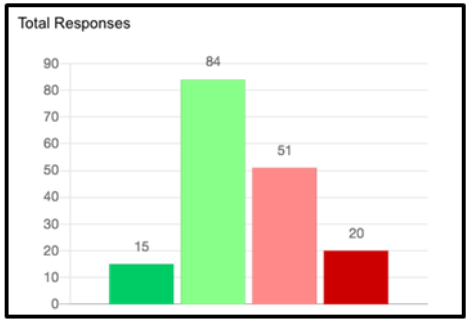
Model Sharing & Reuse Survey Result



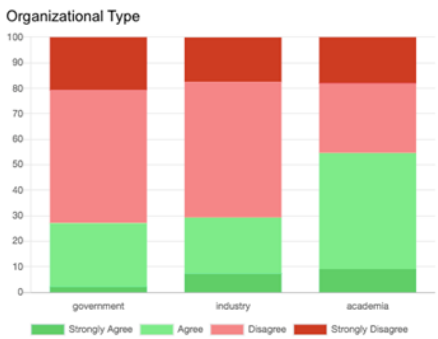
Our organization supports model libraries for the purpose of model reuse.

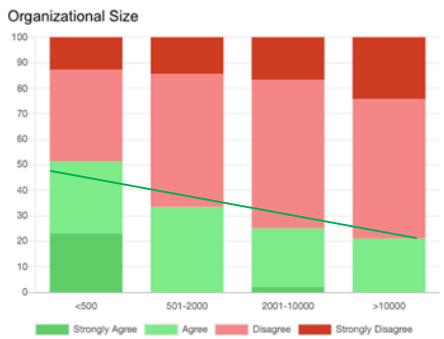


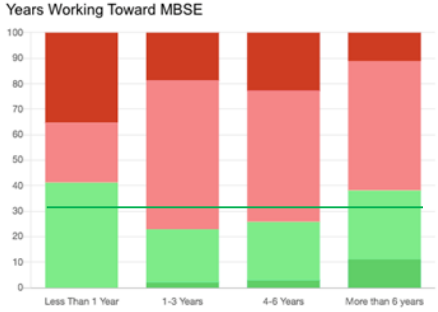


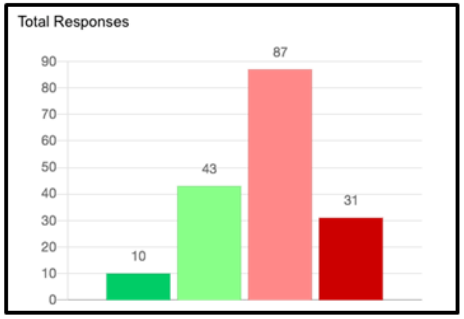


Shared models are being used to consistently manage systems across the lifecycle.







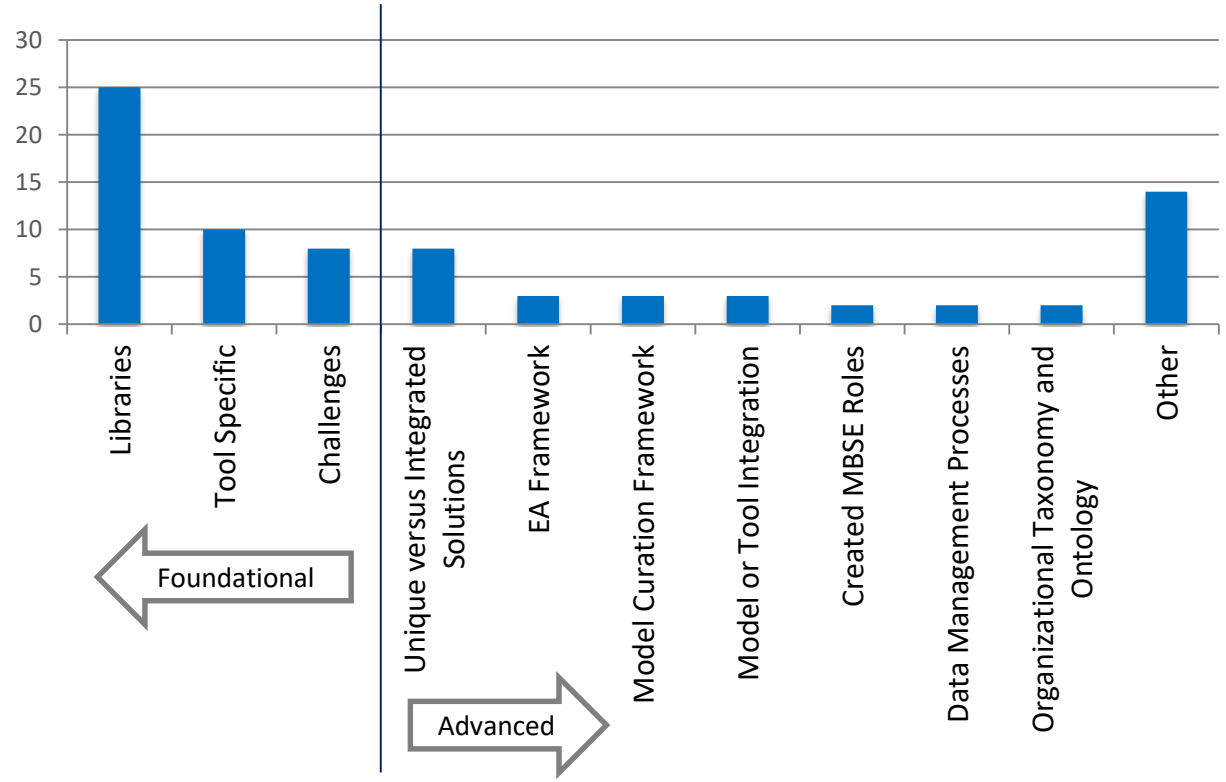


Free-text question: ***Please identify any practices your organization has implemented to improve data and model discovery and reuse, either within or between teams. Include examples of appropriate model reuse if possible*.**

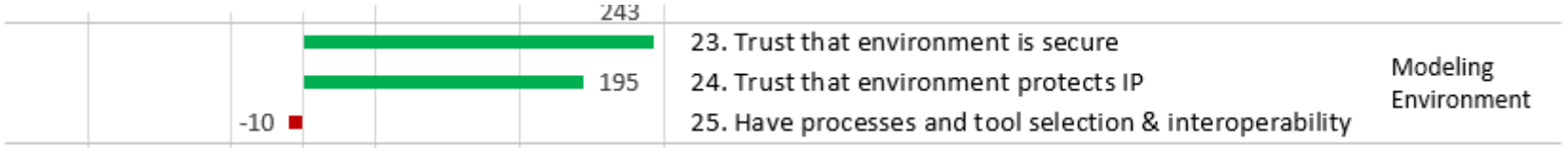
Data/Model Discovery & Reuse

Participants were asked to respond to the prompt, "*Please identify any practices your organization has implemented to improve data and model discovery and reuse, either within or between teams. Include examples of appropriate model reuse if possible.*"

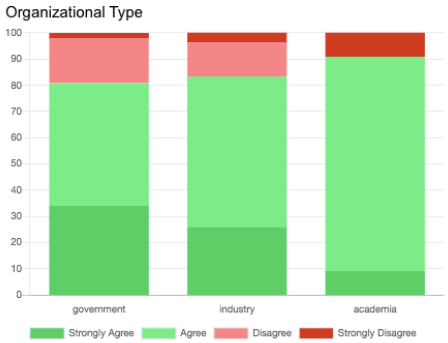
	Total Responses	None or NA	TBD or Too Immature	Analyzable responses
Q10 Data and Model Discovery and Reuse	97	13	26	58

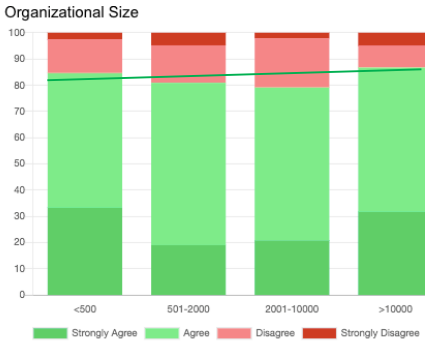


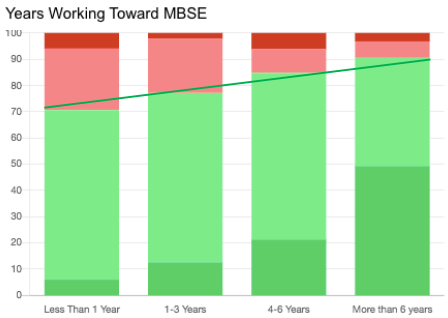
Modeling Environment Survey Results

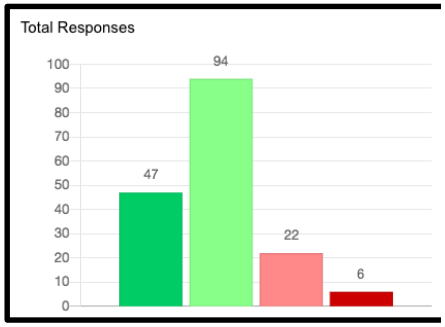


Our organization takes steps to make sure that our modeling environment protects our intellectual property.

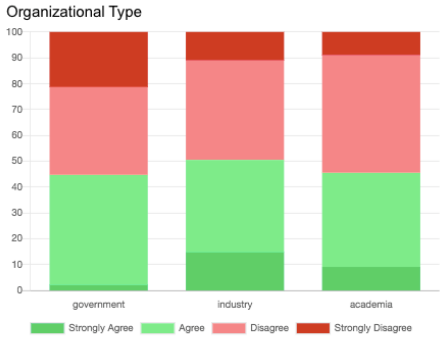


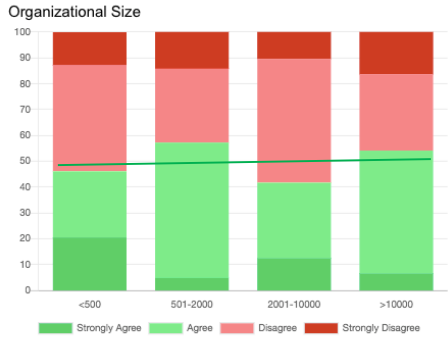


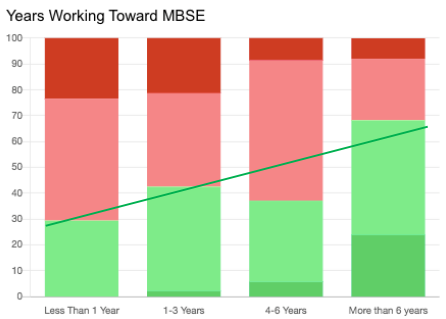


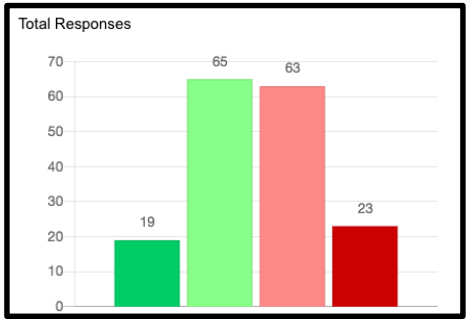


Our organization has defined processes and work instructions that cover tool selection, use, and related data interoperability concerns.





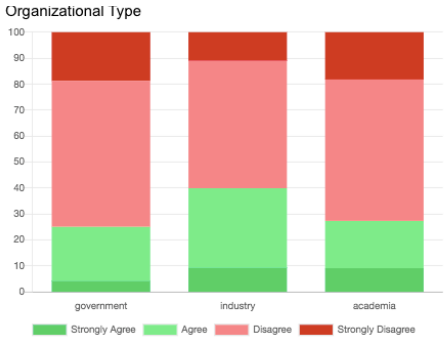


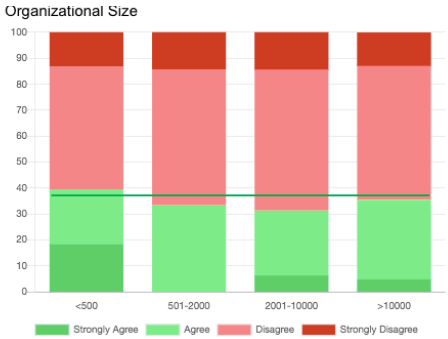


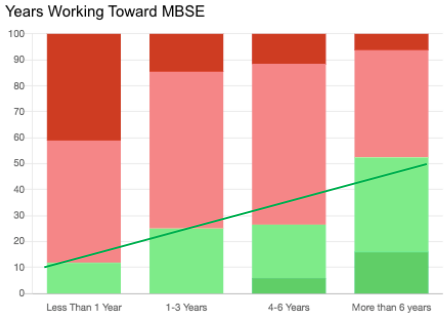
Workforce and Skills Survey Results

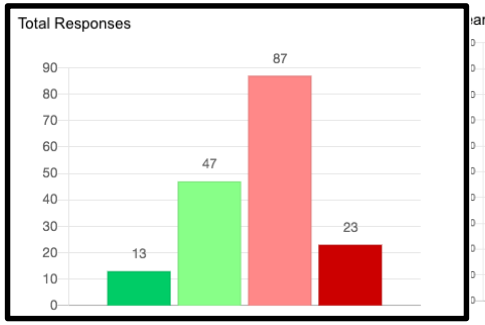
-70	30. Have clearly defined roles supporting MBSE	Workforce
-165	32. Have sufficient staffing for all roles	
-53	33. Have defined critical skills supporting MBSE	MBSE Skills
-24	35. Training is linked to critical skills	

Our organization has clearly defined the critical roles to support MBSE.

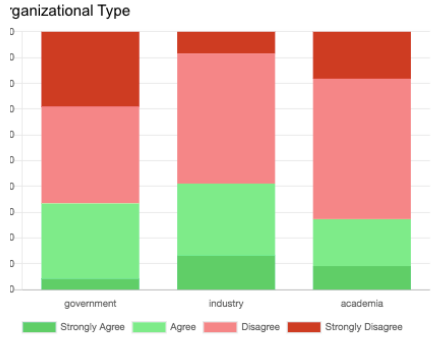


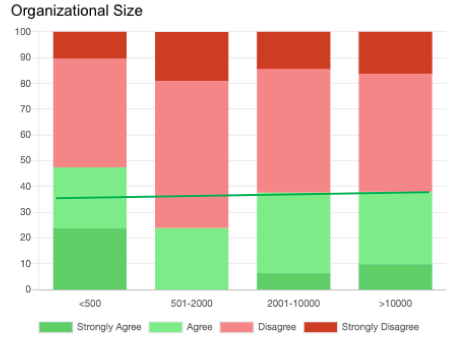


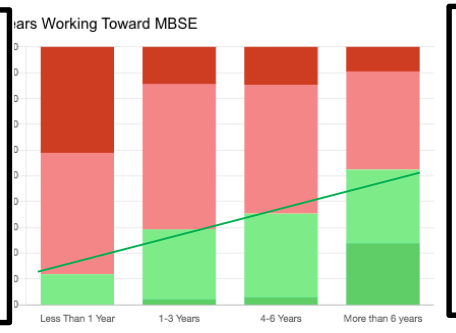


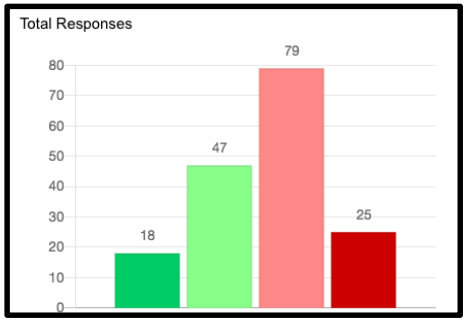


Our organization has clearly defined critical skills for MBSE.

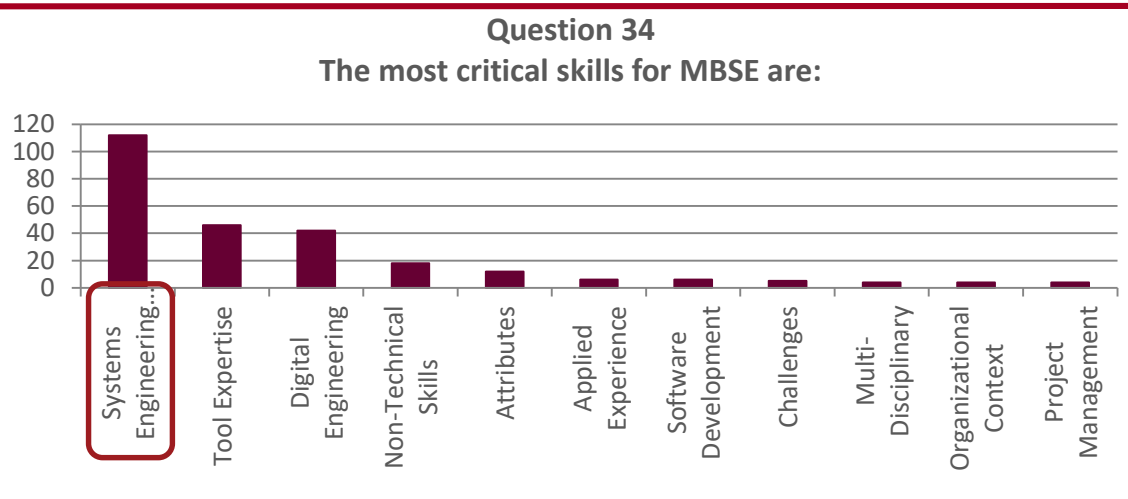


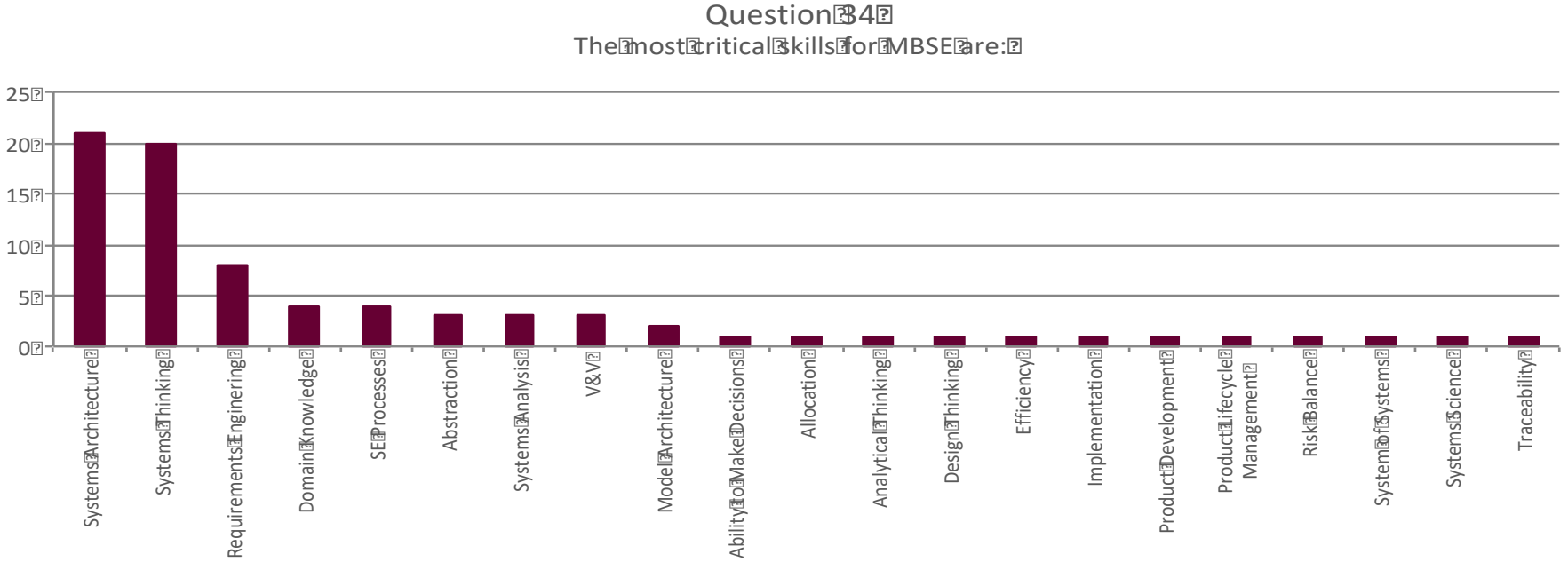




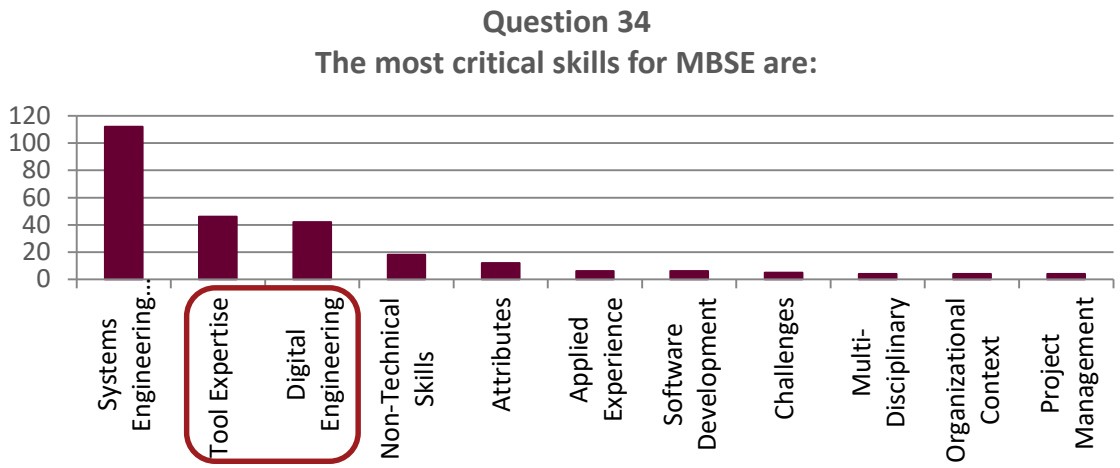


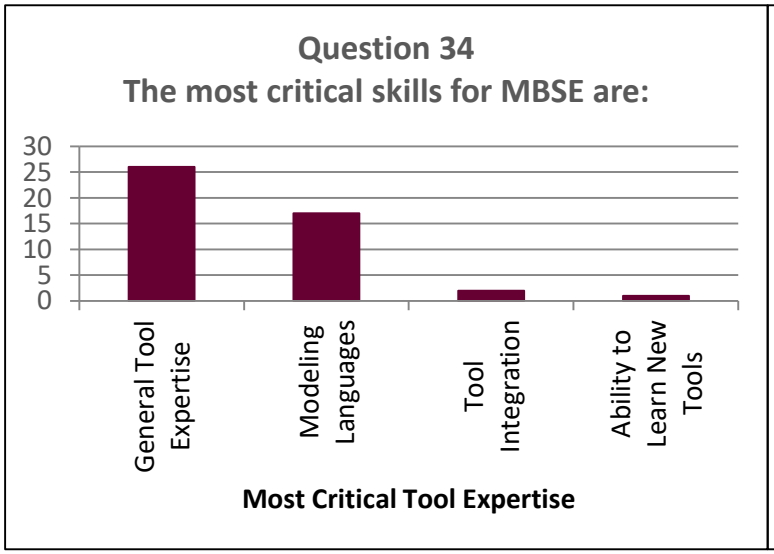
Survey Results of Critical Skills

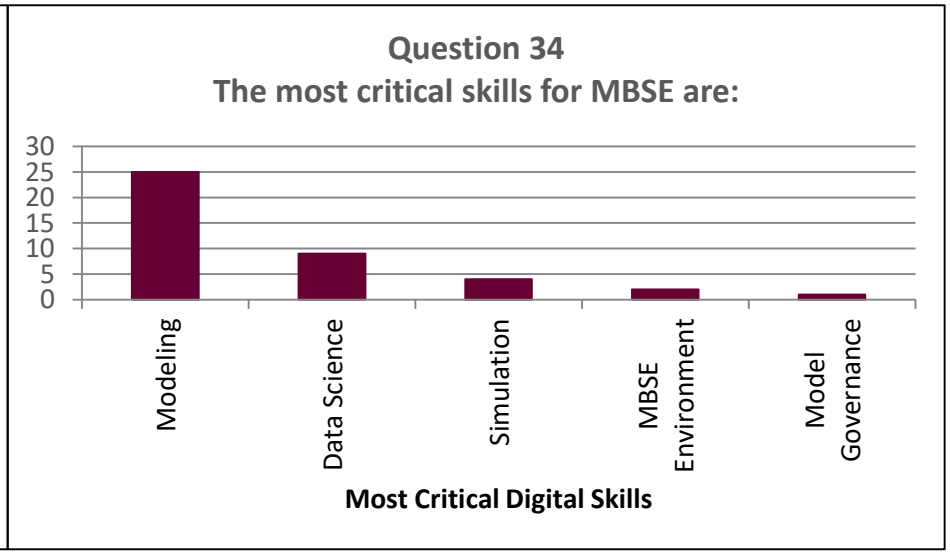




Survey Results of Critical Skills







Survey Free-Response Analysis - Benefits

- Survey questions related to benefits are:
  - *Q3. What do you see as the most important reasons for integrating MBSE processes with program and business management processes?*
  - *Q7. Please provide one or more descriptions of the business value you are realizing from consistent model management processes and tools.*
  - *Q26. Please identify any additional benefits you find from collaborating on models across disciplines.*

	Non-response	No value achieved	Response containing benefits
Q3 Reason for integrating MBSE	41	N/A	104
Q7 Value from consistent model mgt.	23	18	70
Q26 Benefit from collaboration	24	6	52
Totals	88	24	226

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List of DE/MBSE Benefit Categories (Literature Review)

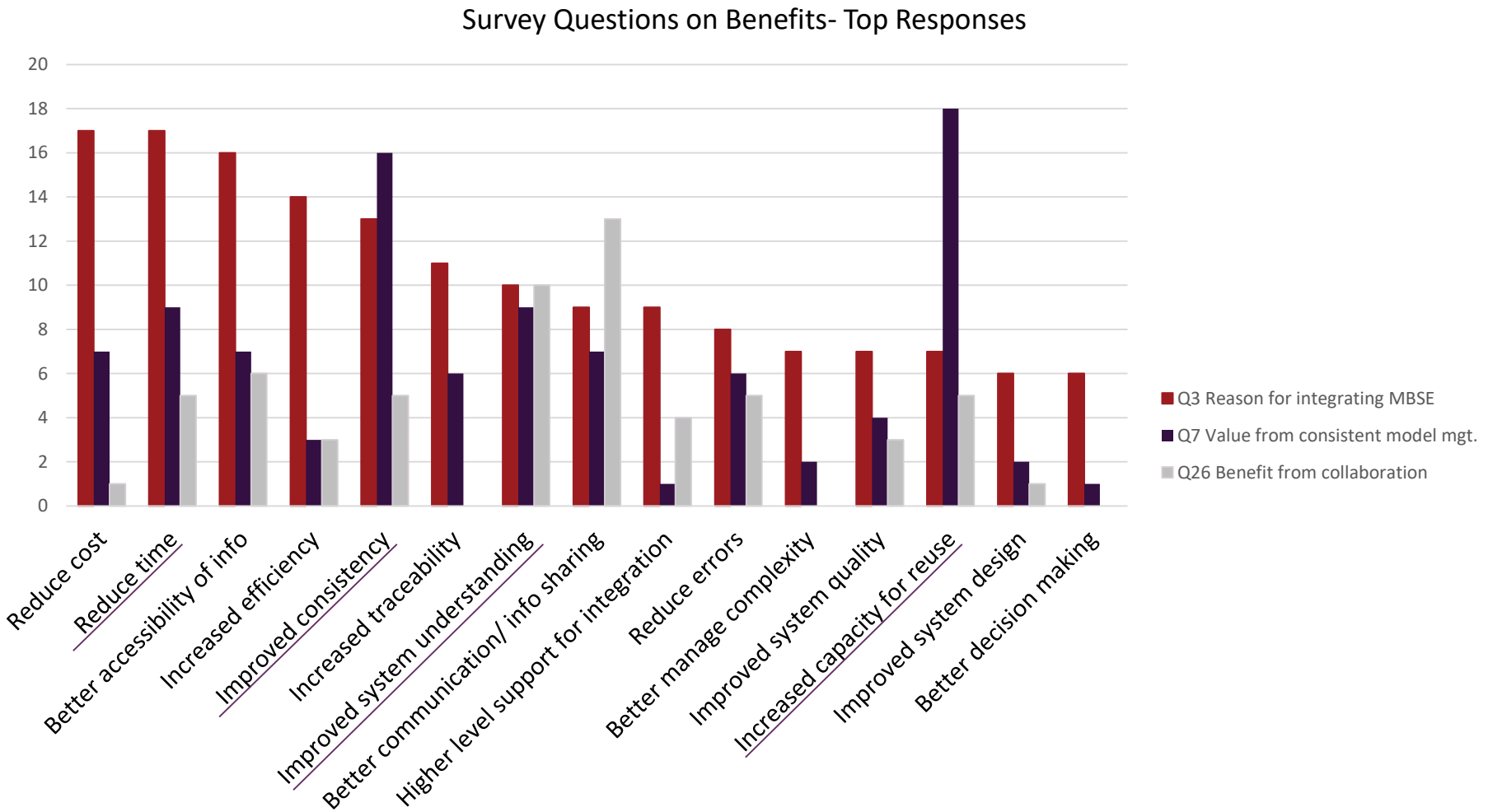
Category	List of Benefits		
Quality	Reduce errors/ defects	Improved risk analysis	Improved capability
	Improved traceability	Improved system design	More stakeholder involvement
	Improved system quality	Better requirements generation	Strengthened testing
	Reduce risk	Increased accuracy of estimates	Reduce cost
	Increased rigor	Improved predictive ability	Better analysis capability
	Increased effectiveness	Improved deliverable quality	
Velocity/ Agility	Improved consistency	Increased productivity	Higher level support for integration
	Increased capacity for reuse	Increased transparency	Increased uniformity
	Increased efficiency	Increased confidence	Increased precision
	Reduce rework	Increased flexibility	Early V&V
	Reduce time	Better requirements management	Reduce ambiguity
	Reduce waste	Ease of design customization	Easy to make changes
User Experience	Higher level support for automation	Improved system understanding	Reduce effort
	Reduce burden of SE tasks	Better data management/capture	
	Better manage complexity	Better decision making	
Knowledge Transfer	Better accessibility of info	Improved architecture	Improved collaboration
	Better knowledge management/ capture	Better communication/ info sharing	Multiple viewpoints of model

Most Frequently-Reported Benefits from Survey Analysis by Question

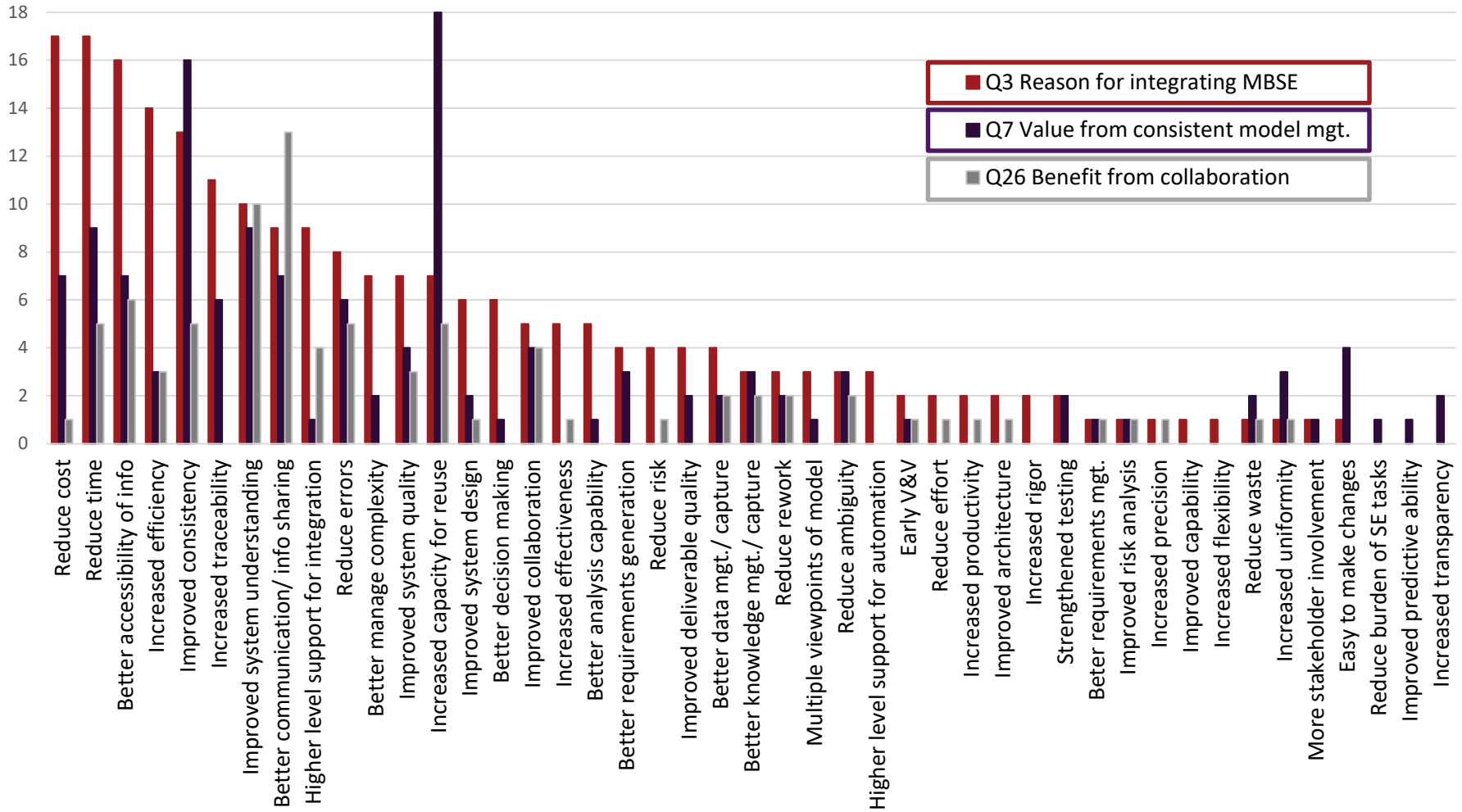
- **Integration Benefits**
- **Model Mgmt. Benefits**
- **Collaboration Benefits**

Q3 Reason for integrating MBSE	Q7 Value from consistent model mgt.	Q26 Benefit from collaboration
Reduce cost (17)	Increased capacity for reuse (18)	Better communication/ information sharing (13)
Reduce time (17)	Improved consistency (16)	Improved system understanding (10)
Better accessibility of info (16)	Improved system understanding (9)	Better accessibility of info (6)
Increased efficiency (14)	Reduce time (9)	Improved consistency (5)
Improved consistency (13)	Better communication/ information sharing (7)	Reduce errors (5)
Increased traceability (11)	Better accessibility of info (7)	Reduce time (5)
Improved system understanding (10)	Reduce cost (7)	Increased capacity for reuse (5)

Top Benefits Reported from Survey Questions



All Benefit Categories Reported from Survey Questions



Analysis of Survey Question on Metrics

- *Question 13 Please identify any metrics that have proven to be useful for measuring the performance of your MBSE activities* was also analyzed against the literature review benefit categories

	Non-response	No metrics	Response containing metrics
Q13 Metrics for MBSE	19	33	44

Number of complete responses

	Adoption metrics	Lit review benefit metrics	Unable to categorize
Q13 Metrics for MBSE	17	72	11

Number of unique comments

Adoption metrics: metrics related to the successful adoption and implementation of MBSE instead of measuring the value of MBSE itself

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Most cited benefits and metrics categories from survey data

Top survey response metrics (Q13 only)		Survey response benefits (Q3, Q7, and Q26)	
Better requirements generation	7	Better requirements generation	7
Reduce errors	7	Reduce errors	19
Increased traceability	6	Increased traceability	17
Better requirements mgt.	6	Better requirements mgt.	3
Improved system design	5	Improved system design	9
Reduce cost	5	Reduce cost	25
Reduce time	5	Reduce time	31
Increased capacity for reuse	5	Increased capacity for reuse	30
Better analysis capability	4	Better analysis capability	6
Improved system quality	2	Improved system quality	14
Increased effectiveness	2	Increased effectiveness	6
Higher level support for automation	2	Higher level support for automation	3
Higher level support for integration	2	Higher level support for integration	14

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Most cited benefits and metrics categories from survey data

Remaining survey response metrics (Q13 only)		Top Survey response benefits (Q3, Q7, and Q26)	
(not cited)	0	Improved consistency	34
(not cited)	0	Increased capacity for reuse	30
Better accessibility of info	1	Better accessibility of info	29
Improved system understanding	1	Improved system understanding	29
(not cited)	0	Better communication/ info sharing	29
(not cited)	0	Increased efficiency	20
(not cited)	0	Improved collaboration	13
Better knowledge mgt./ capture	1	Better knowledge mgt./ capture	8
Reduce ambiguity	1	Reduce ambiguity	8
Better manage complexity	1	Better manage complexity	7
Better decision making	1	Better decision making	7
(not cited)	0	Reduce rework	7
Improved deliverable quality	1	Improved deliverable quality	6
Better data mgt./ capture	1	Better data mgt./ capture	6
Reduce risk	1	Reduce risk	5
Increased uniformity	1	Increased uniformity	5
Multiple viewpoints of model	1	Multiple viewpoints of model	4
Strengthened testing	1	Strengthened testing	4
Reduce effort	1	Reduce effort	3
Improved capability	1	Improved capability	1

Challenges in Enterprise Adoption of MBSE

- Successful adoption of Model-based Systems Engineering (MBSE), like many other large-scale enterprise change initiatives, can present significant challenges - requires intentional focus on many aspects within an organization -*not just the technical details of processes and tools*.
  - The Digital Engineering Work Group pain points relate to technical aspects such as tools, reference models, standards, and data, as well as other organization-level challenges such as implementation/deployment approach, IT infrastructure, and training/skills of the workforce.
  - Cloutier (2019) reported the top five inhibitors to successful adoption of MBSE were: *cultural and general resistance to change*, *availability of skills*, the *MBSE learning curve*, *lack of perceived value of MBSE*, and *lack of management support*.
- This breadth of factors demonstrates the importance of a holistic, enterprise-wide perspective in designing and implementing the approach to adopt MBSE.
- Examining MBSE adoption from the lens of the Baldrige Criteria for Performance Excellence (CPE) can generate insight and more complete understanding of MBSE adoption.

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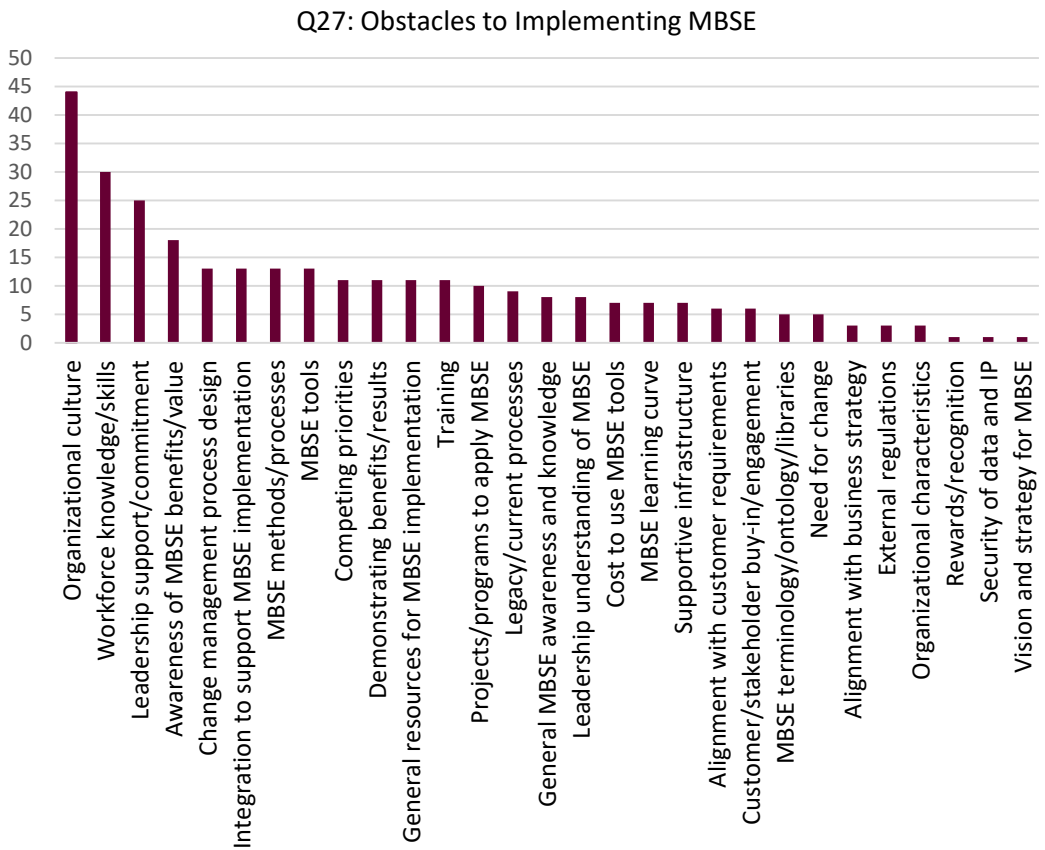
List of enterprise success factors from the survey analysis

Category	List of Success Factors		
Leadership	Leadership support/commitment	Leadership understanding of MBSE	
Communication	Awareness of MBSE benefits/value	Communicating success stories/practices	Need for change
Resources	Cost to use MBSE tools	General resources for MBSE implementation	
Workforce	General MBSE awareness and knowledge	People willing to use MBSE tools	Teamwork
	MBSE learning curve	People in SE roles	Training
	Workforce knowledge/skills		
Change Processes	Champions	Competing priorities	Legacy/current processes
	Change management process design	Integration to support MBSE implementation	Vision and strategy for MBSE
	Community of practice	Demonstrating benefits/results	
MBSE Processes	MBSE methods/processes	MBSE tools	Security of data and IP
	MBSE terminology/ontology/libraries	Projects/programs to apply MBSE	
Organizational Environment	Alignment with business strategy	Organizational culture	Success metrics
	Organizational characteristics	Rewards/recognition	Supportive infrastructure
External Environment	Alignment with customer requirements	Customer/stakeholder buy-in/engagement	
	External regulations	Use in SE community	

Analysis of Survey Responses: *Obstacles*

- There were 166 respondents providing comments to the question on obstacles, parsed into 303 unique response comments.

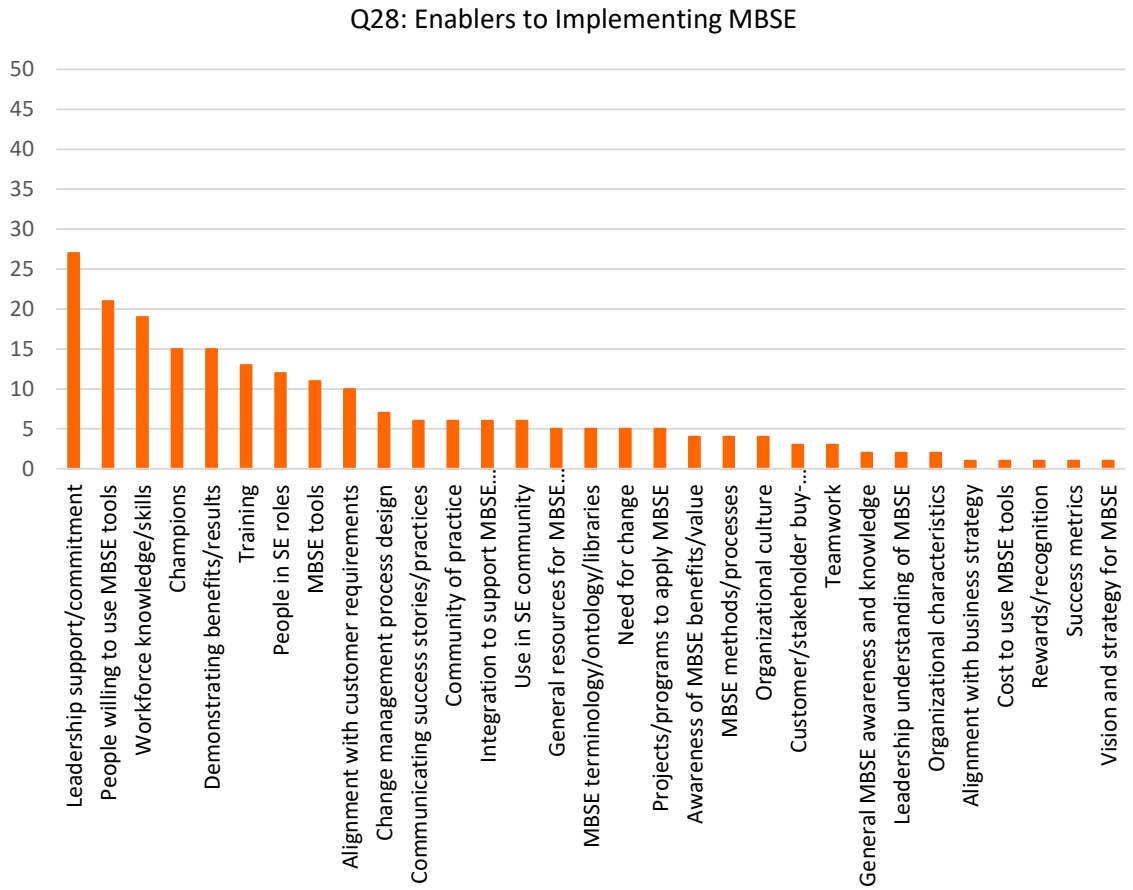
Code	# Comments Obstacles
Organizational culture	44
Workforce knowledge/skills	30
Leadership support/commitment	25
Awareness of MBSE benefits/value	18
Change management process design	13
Integration to support MBSE implementation	13
MBSE methods/processes	13
MBSE tools	13
Competing priorities	11
Demonstrating benefits/results	11
General resources for MBSE implementation	11
Training	11
Projects/programs to apply MBSE	10
Legacy/current processes	9
General MBSE awareness and knowledge	8
Leadership understanding of MBSE	8



Analysis of Survey Responses: *Enablers*

- There were 156 respondents providing comments to the question on enablers, parsed into 223 unique response comments.

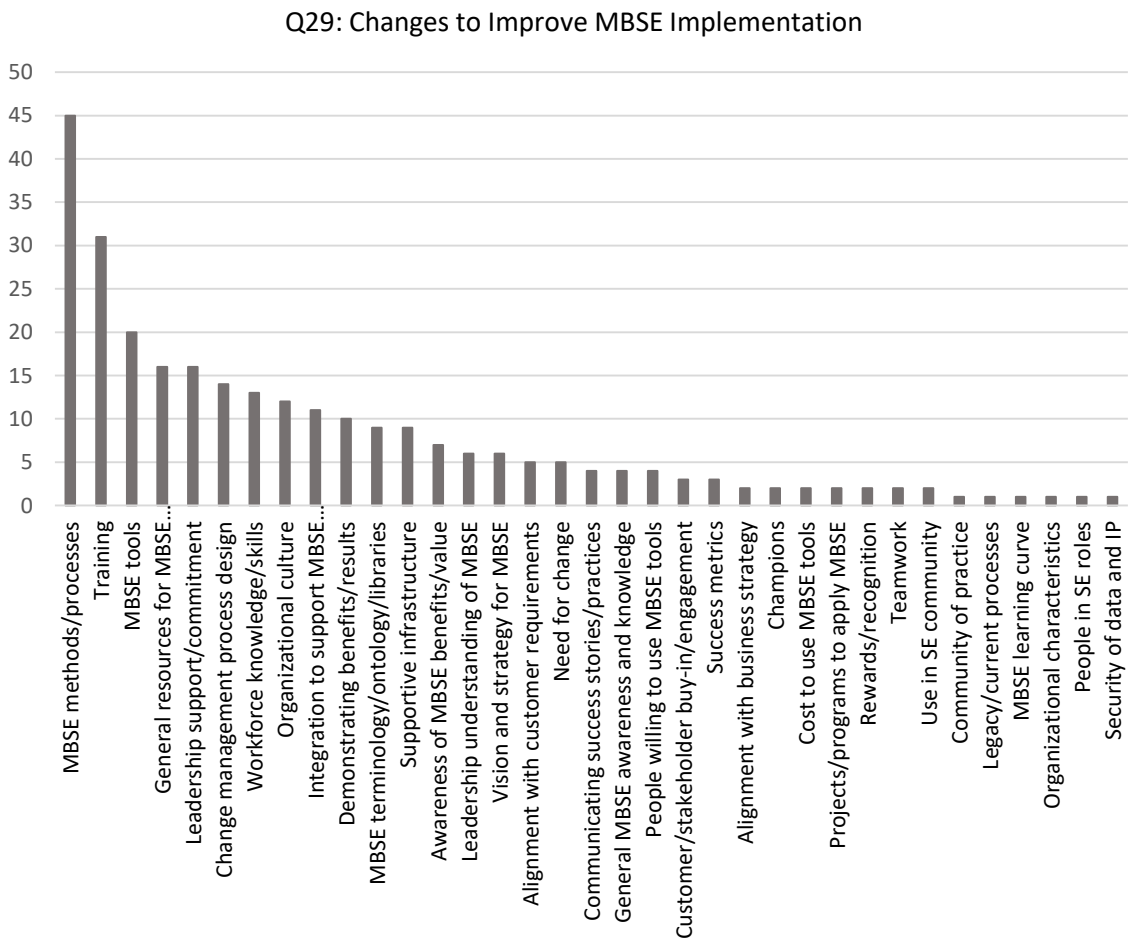
Code	# Comments Enablers
Leadership support/commitment	27
People willing to use MBSE tools	21
Workforce knowledge/skills	19
Champions	15
Demonstrating benefits/results	15
Training	13
People in SE roles	12
MBSE tools	11
Alignment with customer requirements	10
Change management process design	7
Communicating success stories/practices	6
Community of practice	6
Integration to support MBSE implementation	6
Use in SE community	6



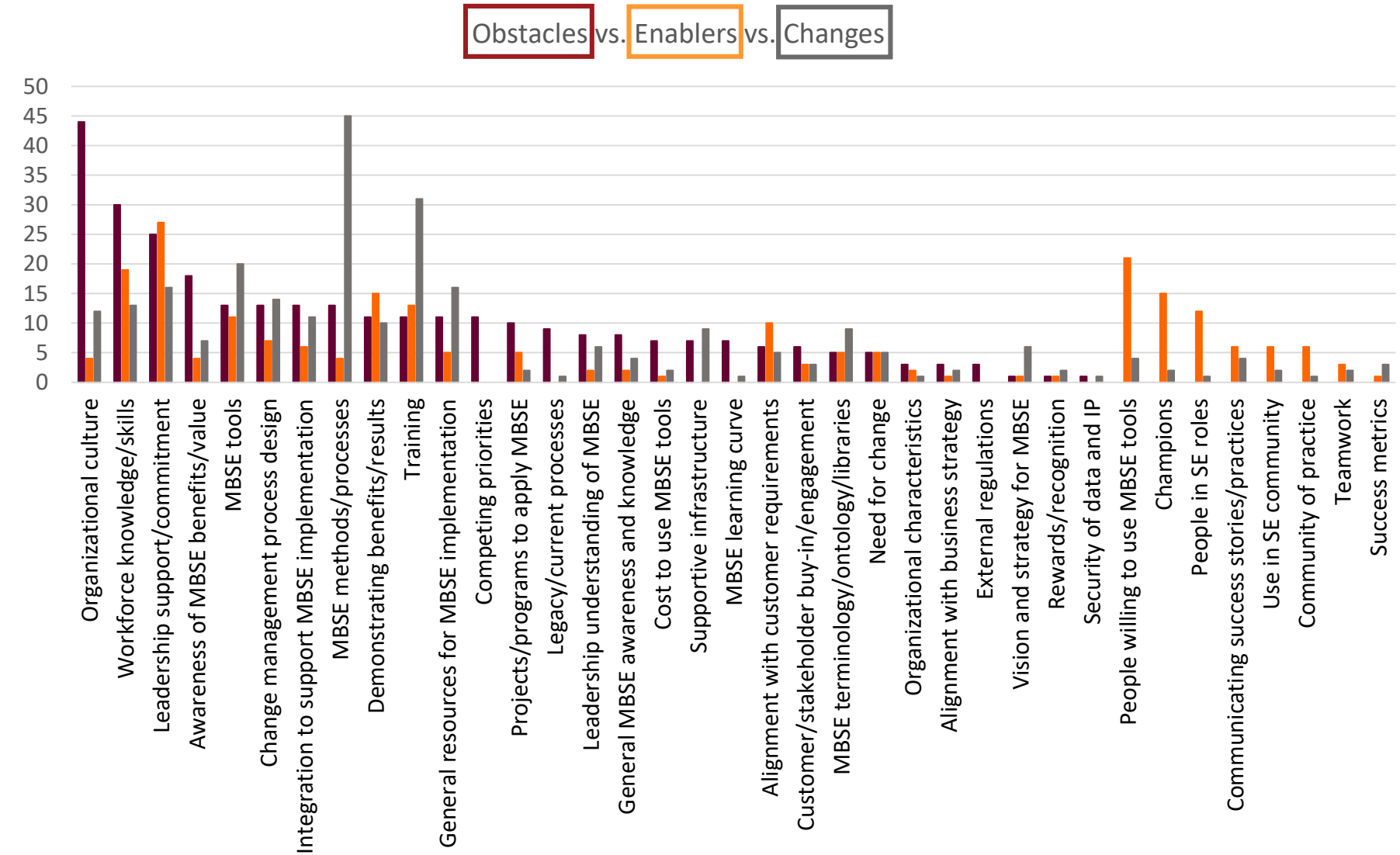
Analysis of Survey Responses: *Changes*

- There were 153 respondents providing comments to the question on changes, parsed into 273 unique response comments.

Code	# Comments Changes
MBSE methods/processes	45
Training	31
MBSE tools	20
General resources for MBSE implementation	16
Leadership support/commitment	16
Change management process design	14
Workforce knowledge/skills	13
Organizational culture	12
Integration to support MBSE implementation	11
Demonstrating benefits/results	10
MBSE terminology/ontology/libraries	9
Supportive infrastructure	9
Awareness of MBSE benefits/value	7
Leadership understanding of MBSE	6
Vision and strategy for MBSE	6



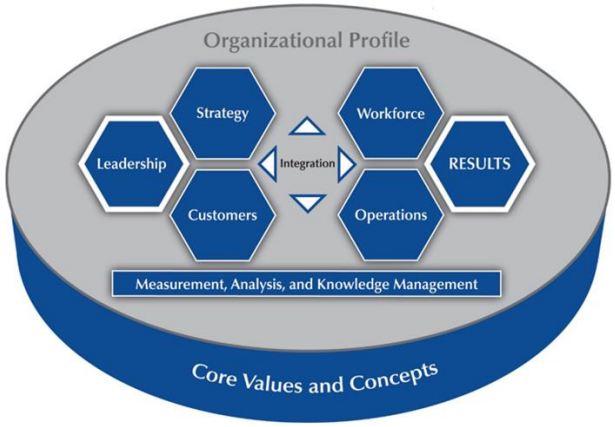
Comparing Obstacles vs. Enablers vs. Changes



Framework for MBSE Adoption

- Insight from analysis of both obstacles and enablers, mapped to the Baldrige CPE, can be used to define a more comprehensive set of adoption practices for maturity in MBSE – e.g.:
  - Leaders communicate a clear reason and need for MBSE adoption
  - Leaders understand MBSE
  - Leaders support and are committed to MBSE
  - People understand the benefits of MBSE
  - MBSE is aligned with the overall business strategy
  - MBSE is used for the right projects/programs
  - MBSE adoption is aligned with what customers need
  - Customers and stakeholders buy-in to MBSE
  - Data management processes support MBSE
  - The IT infrastructure supports MBSE use
  - Clear metrics are defined to track results & progress of MBSE
  - Systems engineers have skills needed to support MBSE use
  - Training is provided to develop needed skills
  - People are rewarded/recognized for using MBSE
  - The organizational culture is aligned with MBSE use

Baldrige CPE Framework



1. Leadership: *How do you share your vision and lead your organization? How do you ensure good governance?*
2. Strategy: *How do you prepare for the future?*
3. Customers: *How do you listen to, satisfy, and engage your customers?*
4. Measurement, analysis, and knowledge mgt: *How do you use reliable data and information to make decisions?*
5. Workforce: *How do you engage and empower your people?*
6. Operations: *How do you ensure efficient and effective operations that deliver customer value?*
7. Results: *How well are you doing?*

What is your culture and environment?

http://www.nist.gov/baldrige

SYSTEMS ENGINEERING RESEARCH CENTER

Summary: Top DE Metrics Areas

(>10 citations)

Category	Most Cited Benefits	Survey	Lit Review
Quality	Reduce Cost	5.5%	5.5%
	Reduce Defects/Errors/Rework	4.2%	1.3%
	Increased Traceability	3.7%	8.4%
	Higher Level of Support for Integration	3.1%	1.2%
	Improved System Quality	3.1%	4.6%
Velocity/Agility	Improved Consistency	7.5%	6.0%
	Reduce Time	6.8%	4.8%
	Improved Capacity for Reuse	6.6%	5.5%
	Increased Efficiency	4.4%	1.8%
	Improved Collaboration	2.9%	0.8%
User Experience	Improved System Understanding	6.4%	3.7%
	Better Manage Complexity	2.0%	5.6%
Knowledge Transfer	Better Accessibility of Information	6.4%	3.6%
	Better Communication/ Information Sharing	6.4%	10.9%
Adoption	Methods/Processes	8.0%	*
	Roles/Skills, People Willing to Use	6.8%	*
	Leadership support/Commitment	5.5%	*
	Training/Tools, People Willing to Use	4.4%	*
	Change Management Process Design	3.1%	*

*not assessed in lit review

Questions?

Thank you!

Summary: Top DE Metrics Areas

(percent citation, >10 citations)