



MBSE Benefits: Evidence from the Literature and Insights from Practitioners

Kaitlin Henderson

RESEARCH OVERVIEW / GOALS

Literature Review

There is an **absence of agreement in the literature** as to whether MBSE benefits are demonstrated and well known, or there is a lack of perceived value of MBSE

Objective: Assess quality of the evidence used to support claims of MBSE benefits in literature

Research Questions:

- **What benefits are claimed to be associated with using MBSE in the literature?**
- **What type of evidence supports such MBSE benefits claims?**

MBSE Maturity Benchmark Survey

Objective: Assess the value and effectiveness of MBSE adoption, develop profile of current MBSE use and expectations

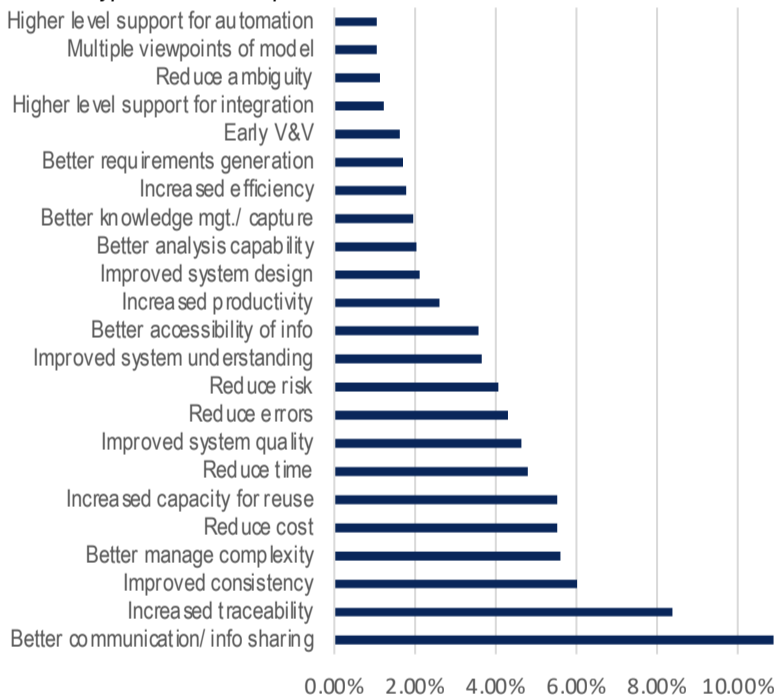
Results from three survey questions will be used to provide a practitioner's perspective on benefits

DATA & ANALYSIS

Total papers evaluated: **847**
 Total papers citing benefits: **360**
 Total individual benefits: **1233**

Claim Type	Number of Papers Containing Benefits	Percentage
Measured	2	0.6%
Observed	36	10.0%
Perceived	240	66.7%
Reference	109	30.3%
Misc.	4	1.1%

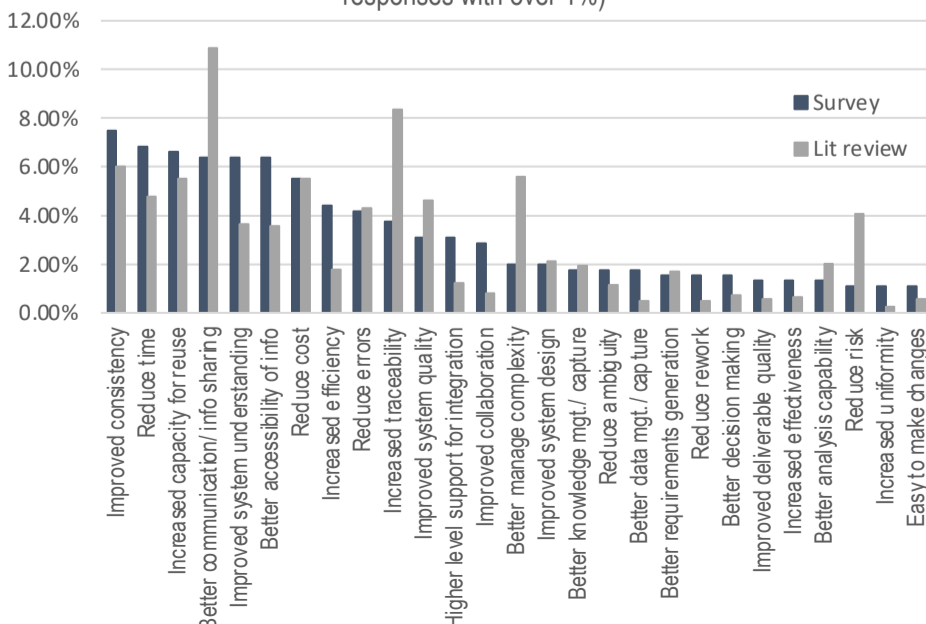
Total benefit types that make up at least 1.00% of the total benefits cited across all papers



Excerpt of results of qualitative analysis of measured benefits papers

Criteria	(Maurandy, Helm et al. 2012)	(Bayer 2018)
Defined process for measuring benefits.	A measurement process is described.	A measurement process is described.
Extent to which the assessment was driven by specific metrics	Metrics seem to be chosen based on experience, but no formal approach for selecting metrics is provided.	Metrics were selected based on challenges encountered in prior projects.
Measurement instrument	Measurement is based on personal, qualitative scoring and estimations of individuals.	Measurement is based on personal, qualitative scoring of individuals.

Survey v. Lit review benefit occurrence in percentage (Survey responses with over 1%)



METHODOLOGY

This review used an adapted systematic literature review approach:

1. Formulation of research questions
2. Selection of data sources
3. Selections of keywords and Literature search
4. Selection and evaluation of literature
5. Data recording based on types of evidence
6. Data formatting into aggregated benefit categories
7. Data analysis

Types of evidence claims:

Measured: The benefit is measured through a defined measurement methodology.

Observed: The benefit is noticed by the authors over the course of implementation of MBSE but is not measured through any defined system of measurement.

Perceived: The benefit is expected, predicted, or perceived to be evident by the author(s) of the paper.

Reference to another source: The benefit is cited from another paper(s).

48 benefit categories emerged inductively from a consolidation of the results. Benefits are positive consequences stemming from the use of MBSE when compared to a document-based systems engineering approach

Data analysis included a qualitative assessment of the methodological soundness of the papers which were classified as including measured benefits

SURVEY OUTCOMES

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.

- Results from questions aligned with benefit categories from the literature- providing support for the literature review results
- Results were broadly distributed across the benefit categories
- Results from questions had little alignment with results from Q13 referencing metrics, which indicates the participants were most likely basing their citation of benefits on perception or observation as opposed to measurement (Q13. Please identify any metrics that have proven to be useful for measuring the performance of your MBSE activities)

CONCLUSIONS / IMPLICATIONS

- There is not significant empirical evidence of benefits of MBSE in the literature
 - Only 2 of 360 papers used measurement to support their claims, and these have several methodological weaknesses
 - Majority of benefits are based on perceptions and expectations
- There is little agreement on what the benefits are across literature and amongst practitioners
 - The occurrence of benefits are widely distributed across benefit categories in the literature and survey results
 - The most frequently cited benefit in the literature makes up just over 10% of all total benefits

CONTACTS / REFERENCES

Bayer, T. (2018). Is MBSE helping? Measuring value on Europa Clipper. 2018 IEEE Aerospace Conference, IEEE

Maurandy, J., et al. (2012). 11.5. 3 Cost-Benefit Analysis of SysML Modelling for the Atomic Clock Ensemble in Space (ACES) Simulator. INCOSE International Symposium, Wiley Online Library.

McDermott T, Van Aken E, Hutchison N, Salado A, Henderson K, and Clifford M. (2020), Technical Report SERC-2020-SR-001, Benchmarking the Benefits and Current Maturity of Model-Based Systems Engineering Across the Enterprise: Results of the MBSE Maturity Survey, March 19, 2020.

Contacts: Kaitlin Henderson (kari1@vt.edu)
 Alejandro Salado (asalado@vt.edu)