OMG issued a Request for Information on SysML and MBSE

INCOSE conducted survey for IW in Jacksonville, FL

INCOSE UK conducted MBSE Survey

INCOSE conducted follow-on MBSE Survey

Demographic Data

- There were 192 surveys as of 12/22/2014 and are incorporated in this data (2012 had 134 responses)
- Of the 192 responses, 136 provided demographic information
- Responses came from 19 countries (2012 had 14 countries)
- 99 unique companies/divisions represented
  - Umptiscrunch Automotive and Umtiscrunch Defense counted as 2 different companies
Question 2

To what extent have you participated in MBSE activities during the last 5 years?

- Not involved in MBSE: 0.44
- MBSE Tool Vendor: 1.30
- Researching MBSE: 3.14
- Teaching MBSE: 2.43
- Developing internal MBSE methods, tools,...: 3.29
- Practicing MBSE on projects: 3.34
To what extent in the last 3 years has your company/organization:

- Adopted MBSE on programs/projects: 3.04
- Applied MBSE on Pilots and studies: 3.25
- Increased MBSE awareness: 3.64

To what extent have you participated in MBSE activities during the last 5 years?

- Not involved in MBSE
- MBSE Tool Vendor: 1.30
- Researching MBSE: 3.14
- Teaching MBSE: 2.43
- Developing internal MBSE methods, tools, & training: 3.29
- Practicing MBSE on projects: 3.34
What type(s) of industry and/or product(s) does your company represent? If your industry is not represented, do not check a box, simply type your answer in the "Other" field provided.

- Aircraft: 28.6%
- Automotive: 17.7%
- Space: 27.1%
- Medical: 15.6%
- IT: 9.4%
- Defense: 49.5%
- Other: 25.0%
What type(s) of industry and/or product(s) does your company represent? If your industry is not represented, do not check a box, simply type your answer in the "Other" field provided.

- **Space Systems**: 30.2% (2012), 27.1% (2014)
- **Medical**: 14.6% (2012), 9.4% (2014)
- **IT**: 31.3% (2012), 15.6% (2014)
- **Defense**: 59.4% (2012), 49.5% (2014)
- **Automotive**: 13.5% (2012), 17.7% (2014)
- **Aircraft**: 28.1% (2012), 28.6% (2014)
Question 3: 2014 “Other” Responses

Created from 52 responses
2012, 45% of the respondents had 1,000 or fewer engineers
2014, 34% of the respondents had 1,000 or fewer engineers
To what extent in the last 3 years has your company/organization:

- Adopted MBSE on programs/projects: 3.31
- Applied MBSE on Pilots and studies: 3.40
- Increased MBSE awareness: 3.72
Question 5:

Comparing 2012 responses with 2014 responses

- **Adopted MBSE on programs/projects**
  - 2012: 3.03
  - 2015: 3.31

- **Applied MBSE on Pilots and studies**
  - 2012: 3.25
  - 2015: 3.40

- **Increased MBSE awareness**
  - 2012: 3.65
  - 2015: 3.72

The responses are scaled from 1.0 (Not at all) to 5.0 (Almost Always).
What is the relative focus of the MBSE effort in your organization to support each of the following?

- Verification planning and execution: Some Focus (3)
- Detailed design and analysis: Almost All (5)
- Requirements flowdown and traceability: Almost All (5)
- Trade studies: Some Focus (3)
- Architecture modeling: Almost All (5)
- Conceptual design: Almost All (5)
- Other: Some Focus (3)
What is the relative focus of the MBSE effort in your organization to support each of the following?

- **Other**
  - 2012: 2.22
  - 2015: 2.40

- **Verification planning and execution**
  - 2012: 2.83
  - 2015: 2.88

- **Detailed design and analysis**
  - 2012: 3.08
  - 2015: 3.23

- **Requirements flowdown and traceability**
  - 2012: 3.22
  - 2015: 3.33

- **Trade studies**
  - 2012: 2.76
  - 2015: 2.61

- **Architecture modeling**
  - 2012: 3.39
  - 2015: 3.77

- **Conceptual design**
  - 2012: 3.23
  - 2015: 3.36

No Focus (1)  Some Focus (3)  Almost All (5)
INCOSE UK MBSE 'State of the Nation'*
Q2.4 - In which SE activities do you use modelling?

- Synthesising Allocated Architecture(s): 26%
- RAMS Analysis: 26%
- Life Cycle Cost Analysis: 39%
- Trade-off Studies: 49%
- Verification & Validation: 59%
- Capturing Stakeholder Needs: 67%
- Analysing Stakeholder Needs: 67%
- Scenario Modelling: 69%
- Defining Logical Architecture(s): 69%
- Defining System Requirements: 76%
- Analysing System Requirements: 81%

### Question 7

To what extent are the following modeling languages used for system architecture modeling as part of your MBSE effort?

<table>
<thead>
<tr>
<th>Modeling Language</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SysML</td>
<td>3.69</td>
</tr>
<tr>
<td>UML</td>
<td>3.16</td>
</tr>
<tr>
<td>Simulink</td>
<td>2.93</td>
</tr>
<tr>
<td>Home grown modeling...</td>
<td>2.46</td>
</tr>
<tr>
<td>Other COTS modeling...</td>
<td>2.41</td>
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<tr>
<td>UPDM</td>
<td>1.99</td>
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<tr>
<td>IDEF0</td>
<td>1.83</td>
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<tr>
<td>Modelica</td>
<td>1.81</td>
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<td>FFBD</td>
<td>1.77</td>
</tr>
<tr>
<td>AADL</td>
<td>1.43</td>
</tr>
<tr>
<td>EAST-ADL</td>
<td>1.39</td>
</tr>
<tr>
<td>OPM</td>
<td>1.31</td>
</tr>
</tbody>
</table>

- **No Value (1)**
- **Some Value (3)**
- **High Value (5)**
INCOSE UK MBSE 'State of the Nation’*
Q2.5 Most widely used languages

- Modelling Language (UML) - 67%
- Flowcharts - 64%
- Context Diagrams - 61%
- System Modelling Language (SysML) - 60%
- Natural Language (Text) - 30%
- Data Flow Diagrams (DFDs) - 39%
- Fault Trees - 40%
- Business Process Modelling Notation (BPMN) - 20%
- Entity Relationship Diagrams (ERDs) - 29%
- State Charts / Finite State Machines - 29%
- Rich Pictures - 34%
- IDEF - 19%
- Goal Structuring Notation (GSN) - 17%
- Behaviour Trees - 13%

How much formal training is typically offered, in number of days, to the team members involved in the modeling effort?

- Other training: 3.53 days
- MBSE tools: 3.89 days
- MBSE method: 3.80 days
- Modeling language: 3.88 days
What is the perceived value of the modeling effort by each of the following?

- Systems engineers: 4.26
- Software engineers: 3.80
- Customer: 3.37
- Test engineers: 3.09
- Hardware engineers: 2.84
- Project management: 2.83
Rank each item below in terms of the extent that it currently inhibits successful adoption of the MBSE within your organization/company.

Not an Inhibitor (0) | Somewhat Inhibiting (2) | High Inhibitor (4)

1. Cultural and general resistance to change - 3.91
2. MBSE learning curve - 3.64
3. Availability of skills - 3.54
4. Lack of perceived value of MBSE - 3.47
5. Lack of management support - 3.32
6. Risk associated with the adoption of MBSE - 3.10
7. Method maturity - 2.98
8. Other - 2.93
9. Tool maturity - 2.90
10. MBSE training - 2.71
11. Availability of tools - 2.60
Rank each item below in terms of the extent that it currently inhibits successful adoption of the MBSE within your organization/company.

### MBSE 2012

- Cultural and general... 3.82
- Other 3.71
- MBSE learning curve 3.48
- Availability of skills 3.45
- Lack of perceived value... 3.37
- Lack of management... 3.29
- Method maturity 3.13
- Tool maturity 3.01
- MBSE training 2.95
- Risk associated with the... 2.93
- Availability of tools 2.84

### MBSE 2014

- Cultural and general... 3.91
- MBSE learning curve 3.64
- Availability of skills 3.54
- Lack of perceived value... 3.47
- Lack of management... 3.32
- Risk associated with the... 3.10
- Method maturity 2.98
- Other 2.93
- Tool maturity 2.90
- MBSE training 2.71
- Availability of tools 2.60

**Not An Inhibitor (1)** **Somewhat Inhibiting (3)** **High Inhibitor (5)**
What is the relative importance that your system model integrates with the following models and/or tools?

- Project management: 3.10
- Product lifecycle management: 3.63
- Product data management: 3.37
- Simulation and analysis: 4.11
- Electrical design: 3.25
- Mechanical design: 3.32
- Software design: 4.05
- Requirements management: 4.34
SURVEY INITIAL FINDINGS
Quick word on Bias of this Survey

• The data is biased in that we asked the MBSE and INCOSE community to tell us what they think of MBSE to date
  – Seems plausible that the most responses will be those with high interest

• IMPORTANT THAT WE DO NOT JUMP TO CONCLUSIONS NOT SUPPORTED BY THE DATA
Systems Engineering, and MBSE, are somewhere on their way up their own technology adoption curve.
Q2 seems to indicate that:

There is an increase in the number of companies Practicing MBSE & Developing internal MBSE methods, tools, and training
To what extent in the last 3 years has your company/organization:

- Increased MBSE awareness: 3.64
- Applied MBSE on pilots and studies: 3.25
- Adopted MBSE on programs/projects: 3.04

We see that since the last survey, there is an increase in the number of companies practicing MBSE & Developing internal MBSE methods, tools, and training.

To what extent have you participated in MBSE activities during the last 5 years?

- Not involved in MBSE: 1.30
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Finding 2...

Q3 seems to point to:

**MBSE is migrating into more “main stream” industries**
What type(s) of industry and/or product(s) does your company represent? If your industry is not represented, do not check a box, simply type your answer in the "Other" field provided.

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- **Defense responses decreased**
- **While Auto and Aircraft Increased**
From Q9, it appears that

Among the systems engineering survey participants, there is a high perceived value (4.26)

– But remember, this is a biased survey
Perceived value increasing

2012 Survey

- Systems engineers: 4.05
- Software engineers: 3.97
- Customer: 3.14
- Hardware engineers: 3.00
- Test engineers: 2.93
- Project management: 2.77

2014 Survey

- Systems engineers: 4.26
- Software engineers: 3.80
- Customer: 3.37
- Test engineers: 3.09
- Hardware engineers: 2.84
- Project management: 2.83
Finding 5…

• Q6 and UK Q2.4 seems to indicate

Today, MBSE is most useful in Requirements management & Systems Architecture modeling
What is the relative focus of the MBSE effort in your organization to support each of the following?

- **Other**: 2.40
- **Verification planning and execution**: 2.88
- **Detailed design and analysis**: 3.23
- **Requirements flowdown and traceability**: 3.33
- **Trade studies**: 3.61
- **Architecture modeling**: 3.77
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**INCOSE UK MBSE 'State of the Nation'*

Q2.4 - In which SE activities do you use modelling?

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Finding 4...

- The top 5 barriers have not changed much

  Cultural and general resistance to change
  MBSE Learning curve
  Availability of Skills
  Lack of Perceived value
  Lack of management support
Question 10

Rank each item below in terms of the extent that it currently inhibits successful adoption of the MBSE within your organization/company.

Created from 33 comments to this question.
Next Steps

• Perform a full longitudinal analysis of the past surveys
• Issue an “open” technical report