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Benefits and challenges of MBSE – I know an old lady

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Overview

1. Realising MBSE
2. I know an Old Lady
3. Conclusions
1: Realising MBSE

- Person
- Process
- Tool

1..* «block» MBSE

- Enables 1..* «block» Person
- Drives 1..* «block» Process
- 1..* «block» Tool
2: I Know an Old Lady ...
... Who Swallowed a Fly .....
... I Don’t Know Why She Swallowed a Fly

• Knowing ‘why’ is essential
• ‘Why’ will depend on context
  – Different stakeholders have different needs
  – Different stakeholders want different benefits
Realising MBSE Benefits

```
<table>
<thead>
<tr>
<th>Stakeholder Role</th>
<th>MBSE</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1..*</td>
<td></td>
<td>1..*</td>
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</tbody>
</table>

«block»
Person
1..*

«block»
Process
1..*

«block»
Tool
1..*

enables

drives

must realise

1..*

1..*
Typical MBSE Stakeholder Roles

- **Customer**
  - **User**
  - **Operator**

- **External**
  - **System Sponsor**

- **Supplier**
  - **Manager**
  - **Engineer**

- **Standard**
  - **Manager**
  - **Engineer**

- **Stakeholder Role**
  - **Benefit**

Relationship:
- **Stakeholder Role** must realise **Benefit**

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Engineer Context

- Improve system development
- Improve consistency
- Improve automation
- Make approach more efficient
- Improve communication
- Manage complexity
- Increase understanding
- Improve tool interoperability

- ... for testing
- ... for artefact generation
- ... for model checking

MBSE Sponsor

Manager

«include»
«constrain»
«constrain»
«constrain»
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MBSE Sponsor Context

Increase value of business

- Increase sales
- Increase quality

Demonstrate ROI

Invest in MBSE

Operator
User
Engineer
Identified Benefits of MBSE

- **Time**
- **Resource**
- **Money**
- **Quality Attribute**
  - **Safety**
  - **Compliance**
  - **Security**
- **Efficiency**
- **Consistency**
- **Complexity Management**

- **Communication**
- **Re-use**
- **Tool Interoperability**
- **Automation**
- **Return on Investment**

This diagram illustrates the benefits of Model-Based Systems Engineering (MBSE) with connections to various aspects such as time, resources, money, quality attributes, efficiency, consistency, complexity management, communication, re-use, tool interoperability, and automation. The connections show how these aspects are integrated within the MBSE framework.
I Know an Old Lady Who Swallowed a Spider ...
... That Wriggled and Jiggled About Inside Her

- Look for tried and tested solutions
- For flies, this is a spider
- For MBSE, this is:
  - Standards
  - Architecture frameworks
  - Modelling notations
  - Processes
  - Methodologies
  - More staff
  - Etc.
Example Solutions – Architectures

• Consider the following examples:
  – MODAF/DoDAF/NAF
  – Zachman
  – ISO 42010 (‘Systems and software Engineering - Architecture description’)

• What are you trying to do:
  – Development?
  – Acquisition?
  – Enterprise Architecture?
Visualising Architecture
I Know an Old Lady Who Swallowed a Bird/Cat/Dog ...
... How Absurd ... Imagine That ... What a Hog

• Need to understand and control use of techniques
  – Shows no understanding of systems engineering
  – Shows no understanding of own competence

• Need common language:
  – In terms of spoken language (e.g. SysML)
  – In terms of domain-specific language (e.g. an Ontology)
Example of Common Spoken Language
- SysML
Example of Common Domain Language – The MBSE Ontology
Focus on Architecture
Focus on Need

- Rule
- Need Description
- Source Element
- Need
- Capability
- Requirement
- Concern
- Goal
- Context
- Use Case
- Stakeholder Context
- Project Context
- Organisational Context
- Process Context
- System Context
- Scenario
- Semi-formal Scenario
- Formal Scenario

- is related to
- constrains
- traces to
- describes
- describes the context of
- validates
- is needed to deliver
- meets
- is elicited from

{incomplete}
I Know an Old Lady Who Swallowed a Goat/Cow ...
... She Opened Her Throat ... I Don’t Know How

- Complete chaos!
  - Lost sight of original goals
  - No concept of relationships between techniques
- The MBSE Ontology drives the implementation of MBSE
  - Basis for framework and associated views
  - Defines how views may be visualised (informs notation)
  - Allows understanding and definition of associated processes
  - Allows understanding and definition of associated competence
  - Provides valuable input into tool assessment
Example View Based on the MBSE Ontology

- Each Source Element in the Source Element View must be traceable to one or more Need Description in the Requirement Description View.
- Each Need Description in the Requirement Description View must be traceable to one or more Source Elements in the Source Element View.
- Rules, when they exist, must apply to a Need Description.
- Each Need Description must be related to at least one Use Case.
- Each Need Description may be constrained by zero or more Rules.
- Each Requirement Context View must have a related element on a Context Definition View that defines the Context.
- Each Use Case must be related to either another Use Case or a Stakeholder Role.
- Each Use Case must have at least one Validation View associated with it.
- Each element on a Stakeholder Context Definition View, such as a Stakeholder Role or System Element, may appear as a Stakeholder Role on a Requirement Context View.
Example View Based on the MBSE Ontology
I know an old lady who swallowed a horse ...
... She’s Dead, of Course!...
2. Conclusions

- MBSE requires:
  - People, process and tools

- Essential concerns:
  - Understand why and the benefits
  - Do not apply techniques blindly

- Getting it right includes:
  - Have a solid basis for MBSE – use of MBSE Ontology

- Getting it wrong results in:
  - Dead bodies
  - Horse dung
Want to know more?

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