



34th Annual **INCOSE**
international symposium

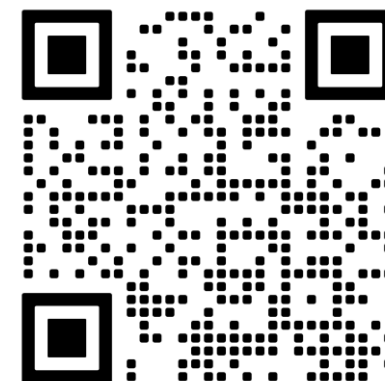
hybrid event

Dublin, Ireland
July 2 - 6, 2024



Revolutionize Digital Engineering with MBSE

Engineering in the Digital Age



Lydia Kaiser

We live in the digital age



Engineering Challenges



New
Technologies



Huge Solution
Space



Internal and
external interfaces



Rising
Interdisciplinarity

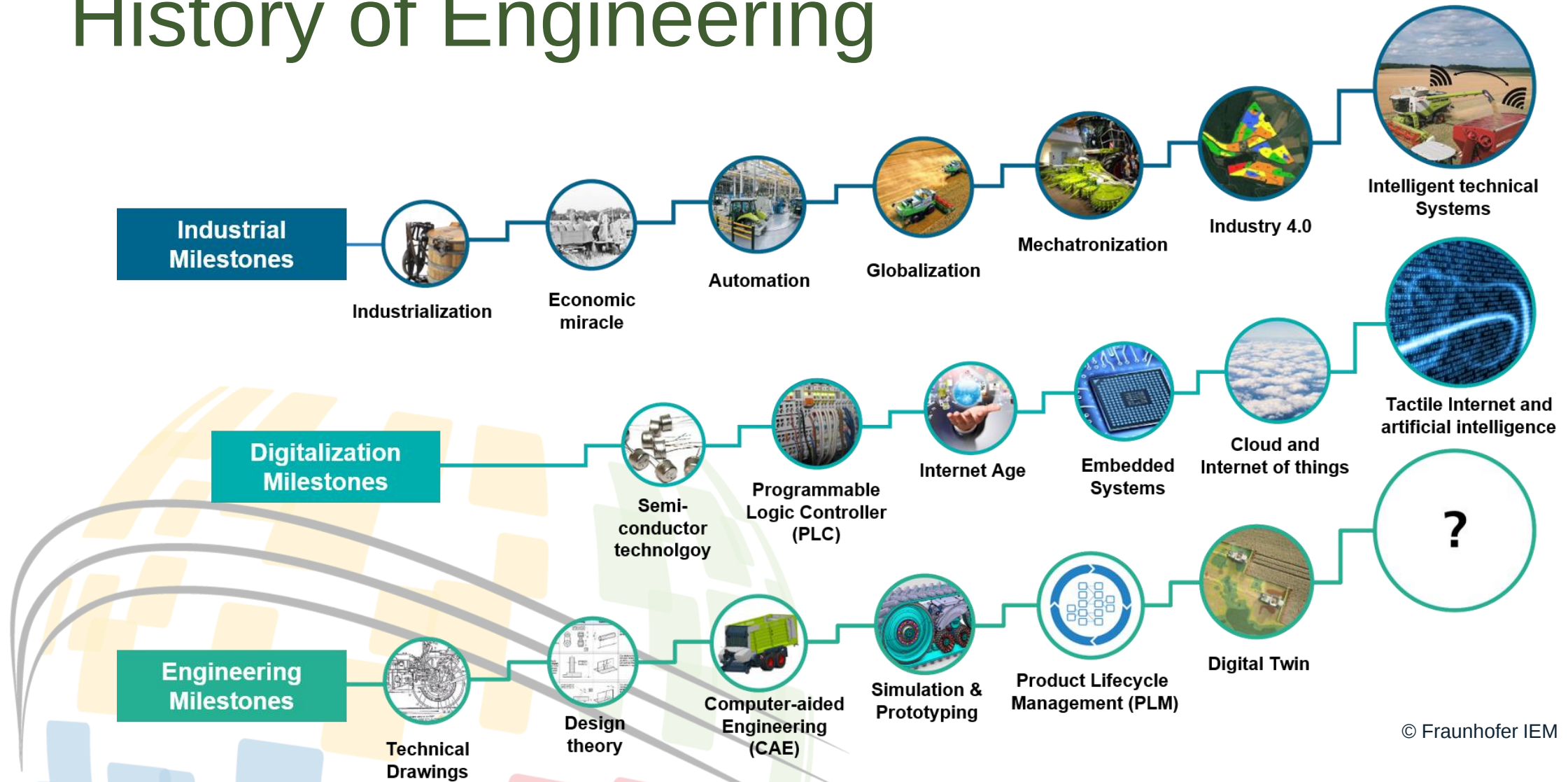


Unclear
Requirements



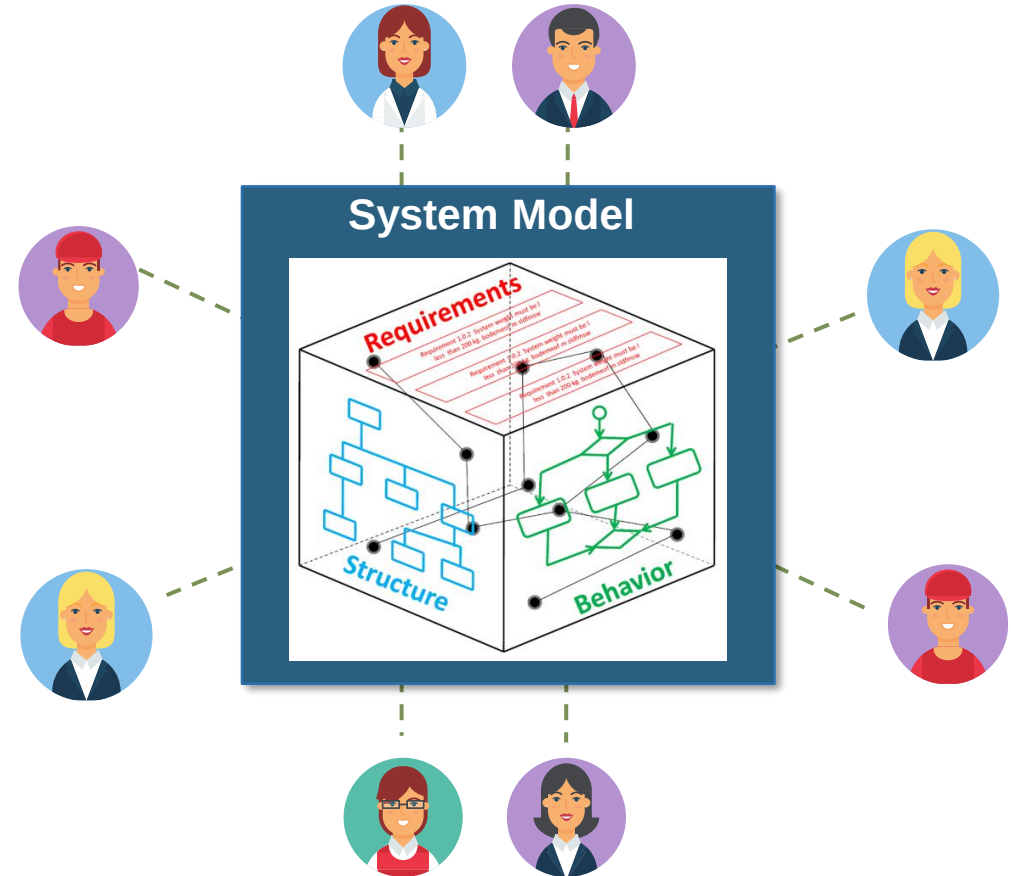
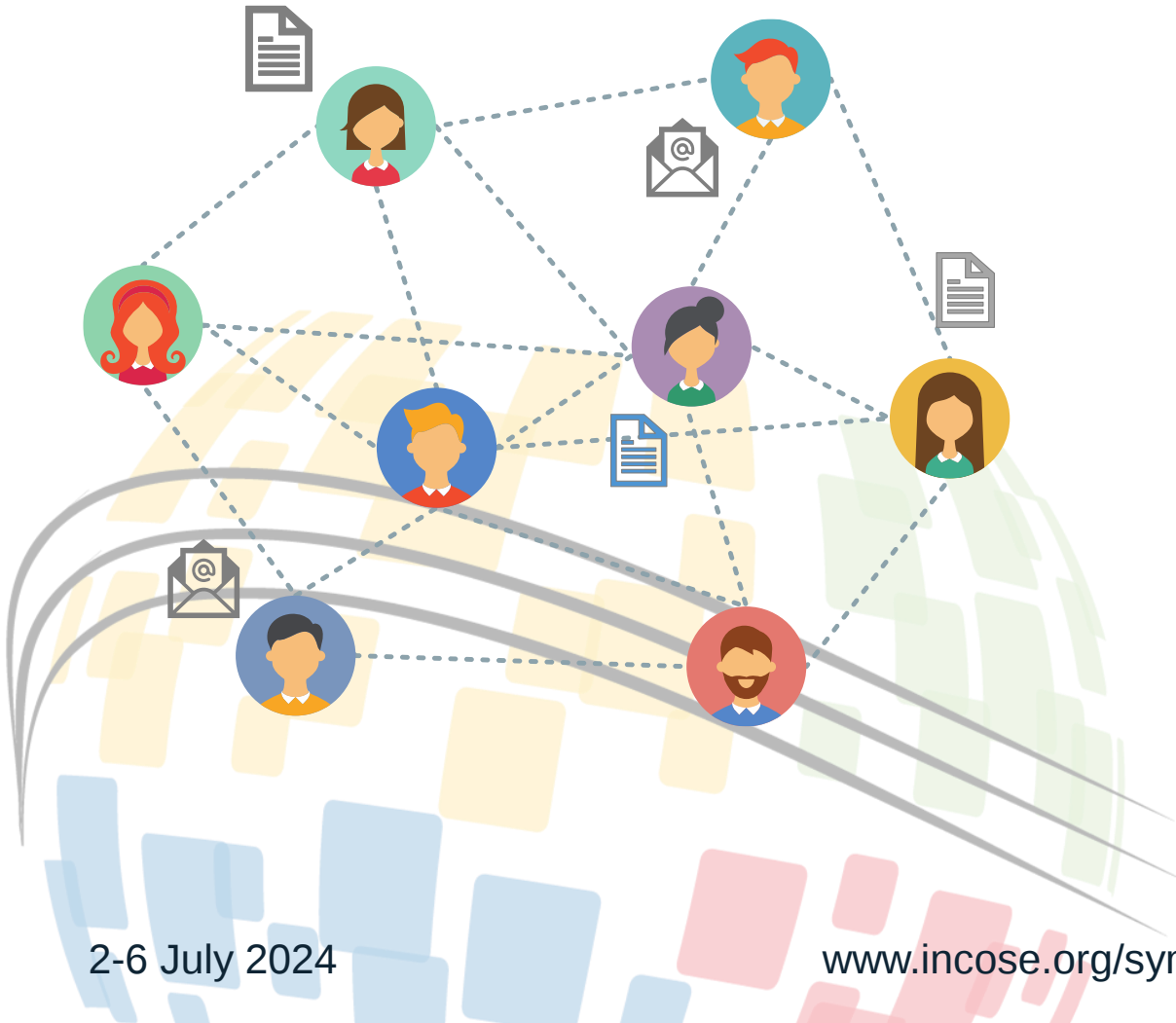
Uncertainty

History of Engineering

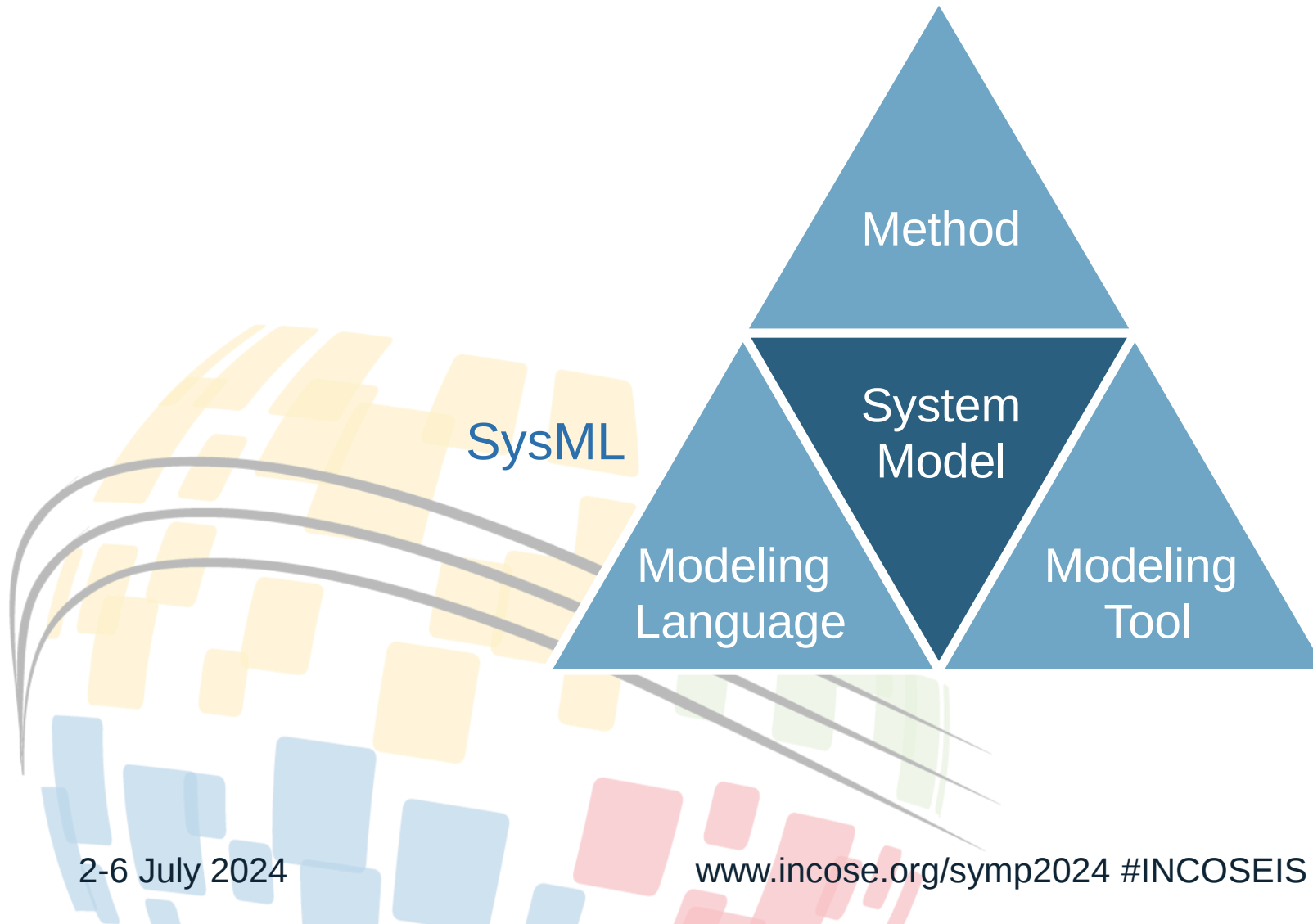


© Fraunhofer IEM

From SE to MBSE



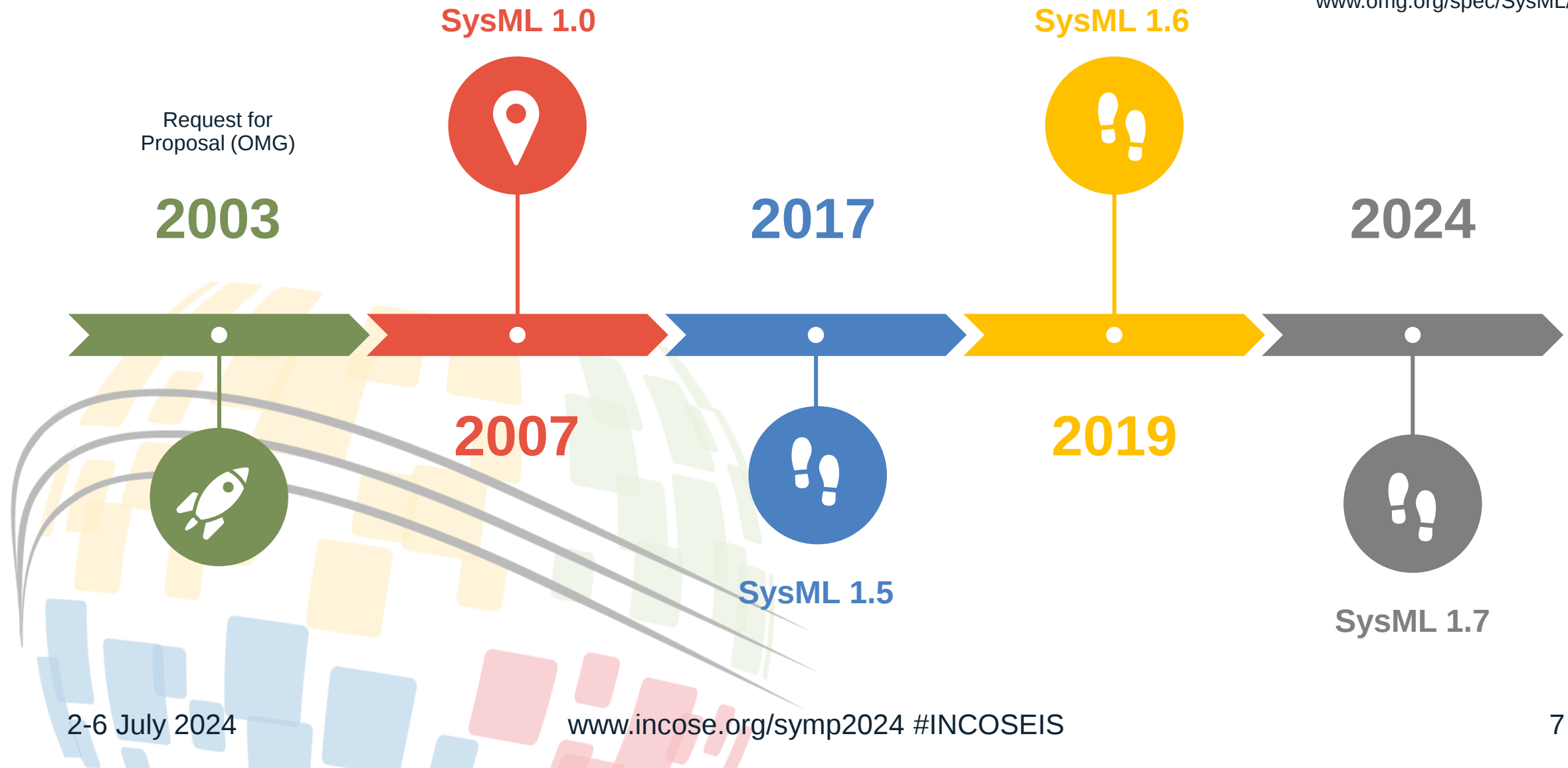
MBSE - Triangle



Once Upon a Time...



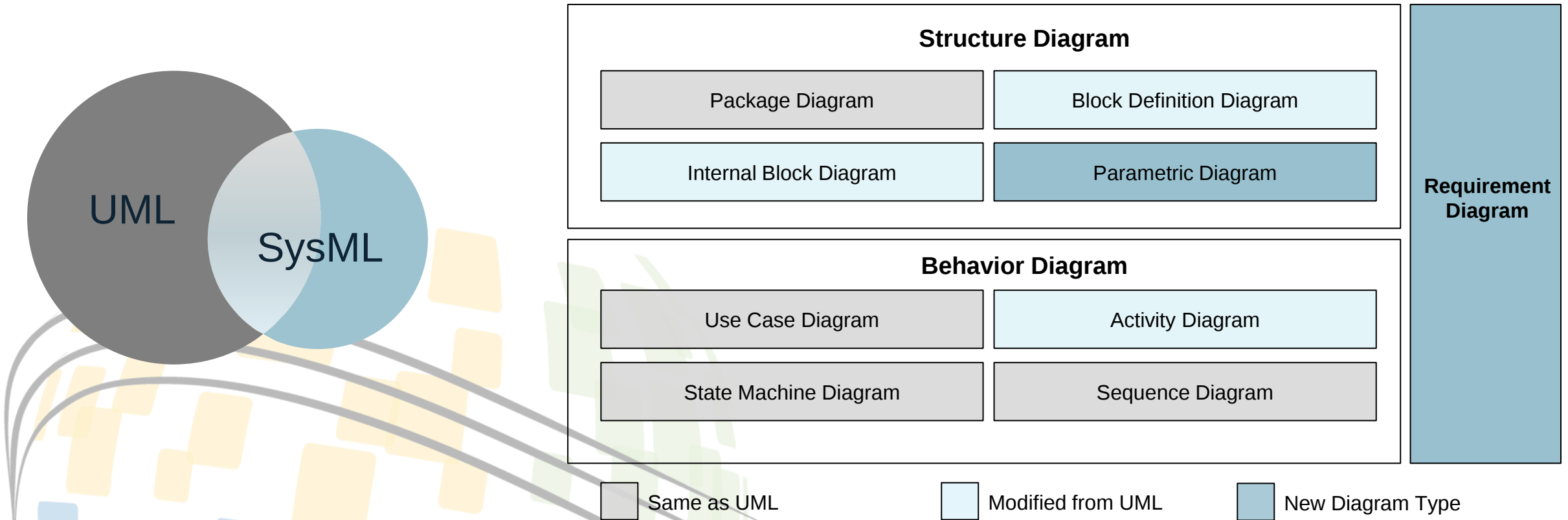
www.omg.org/spec/SysML/



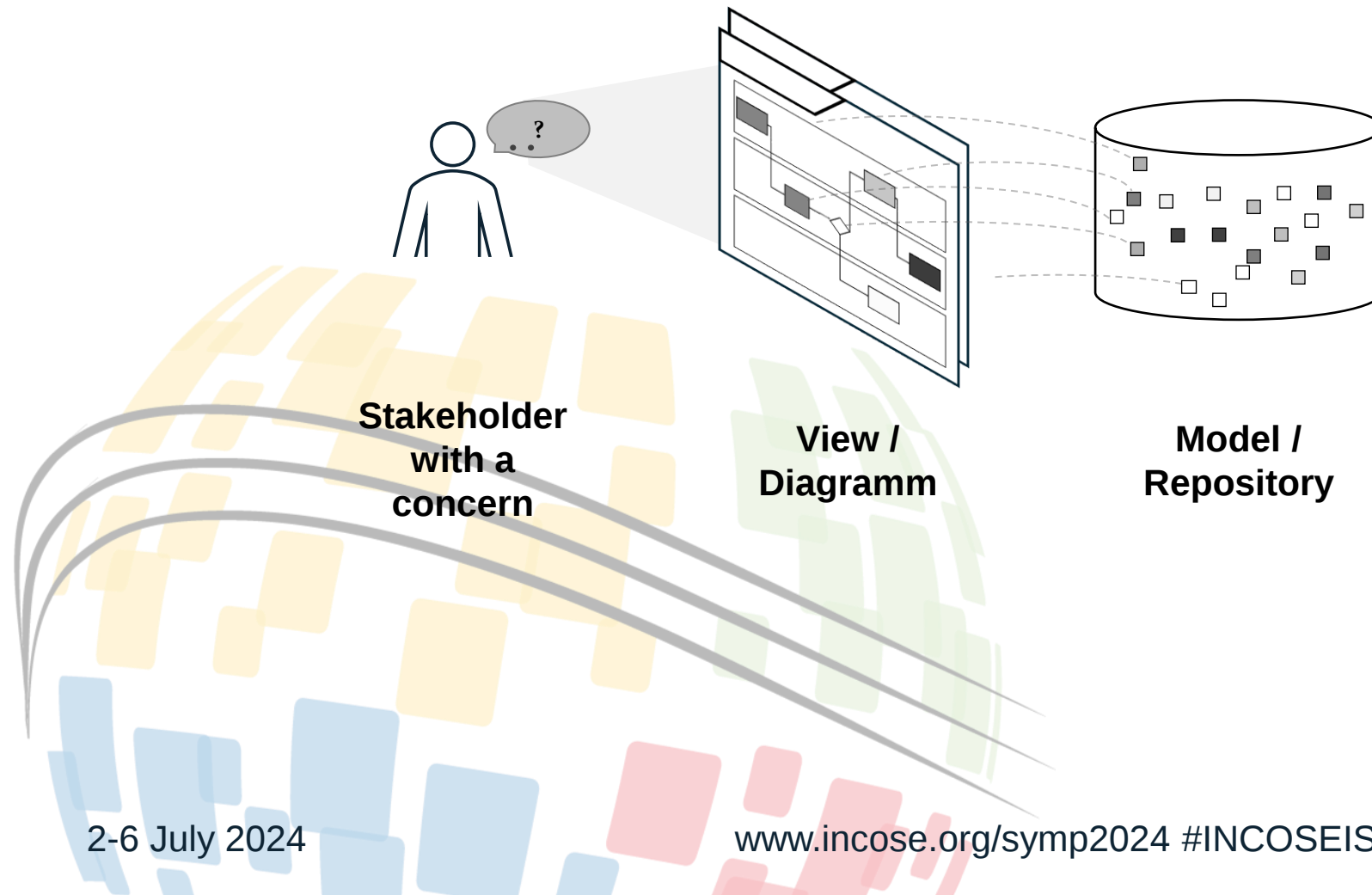
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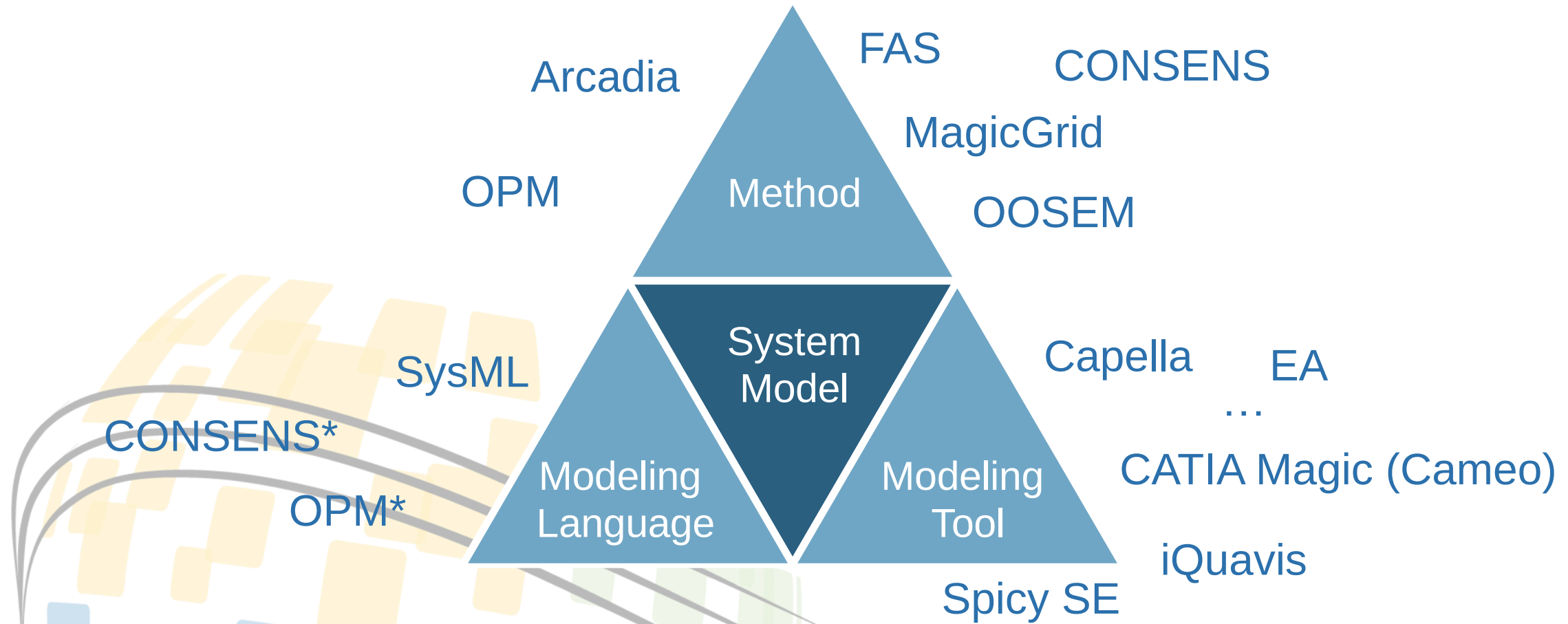
Good to know ...



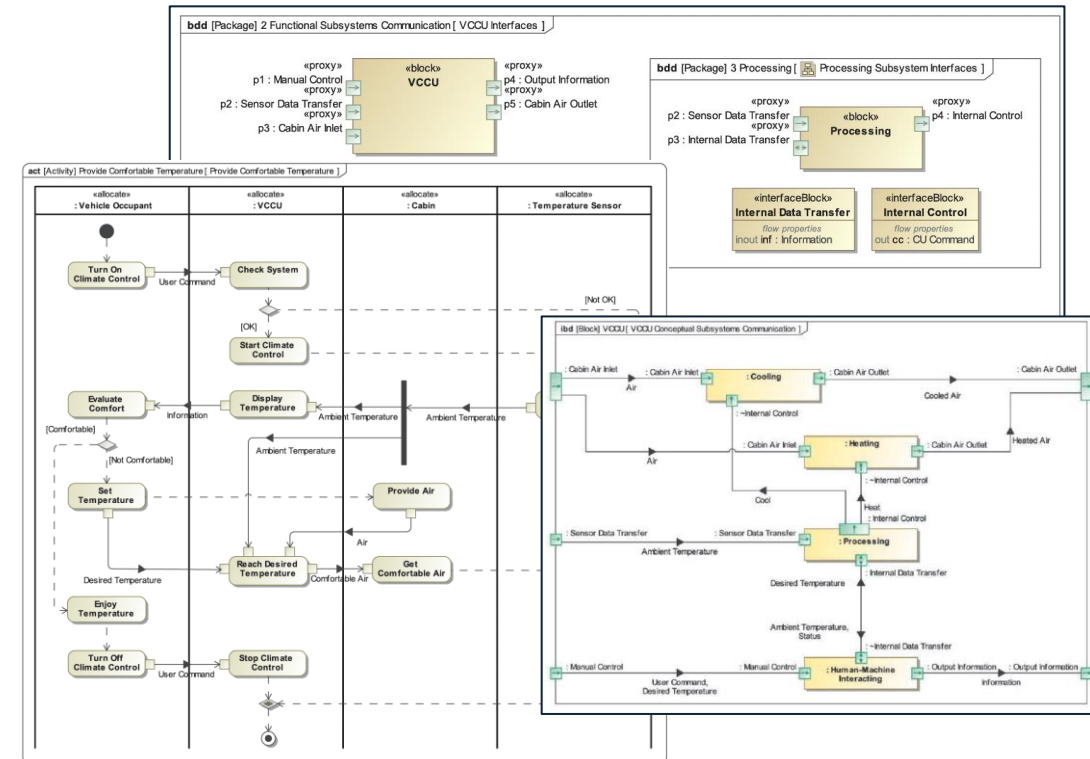
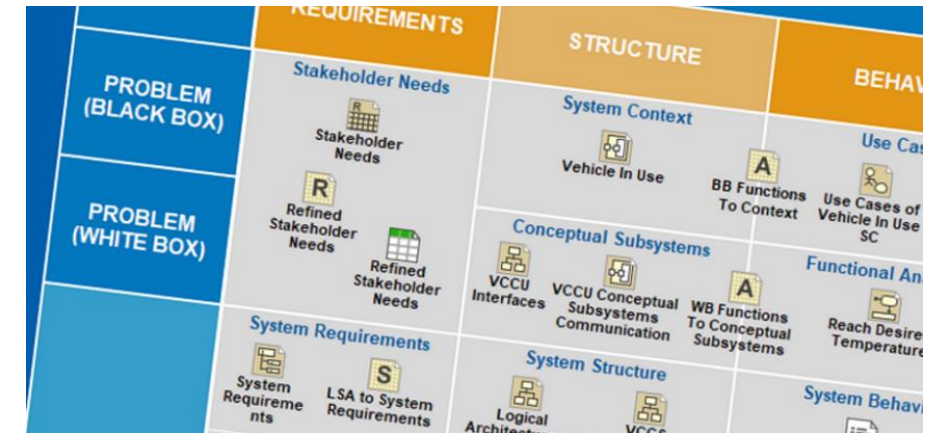
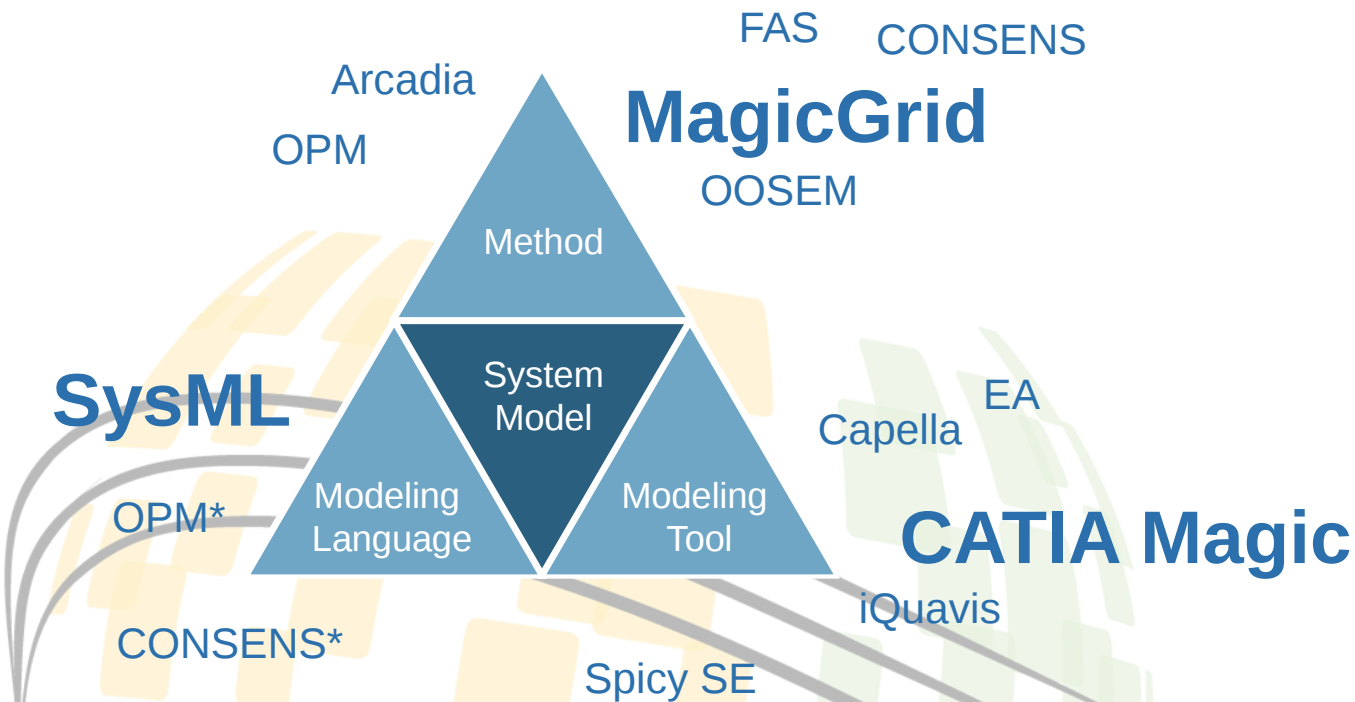
Good to know ...



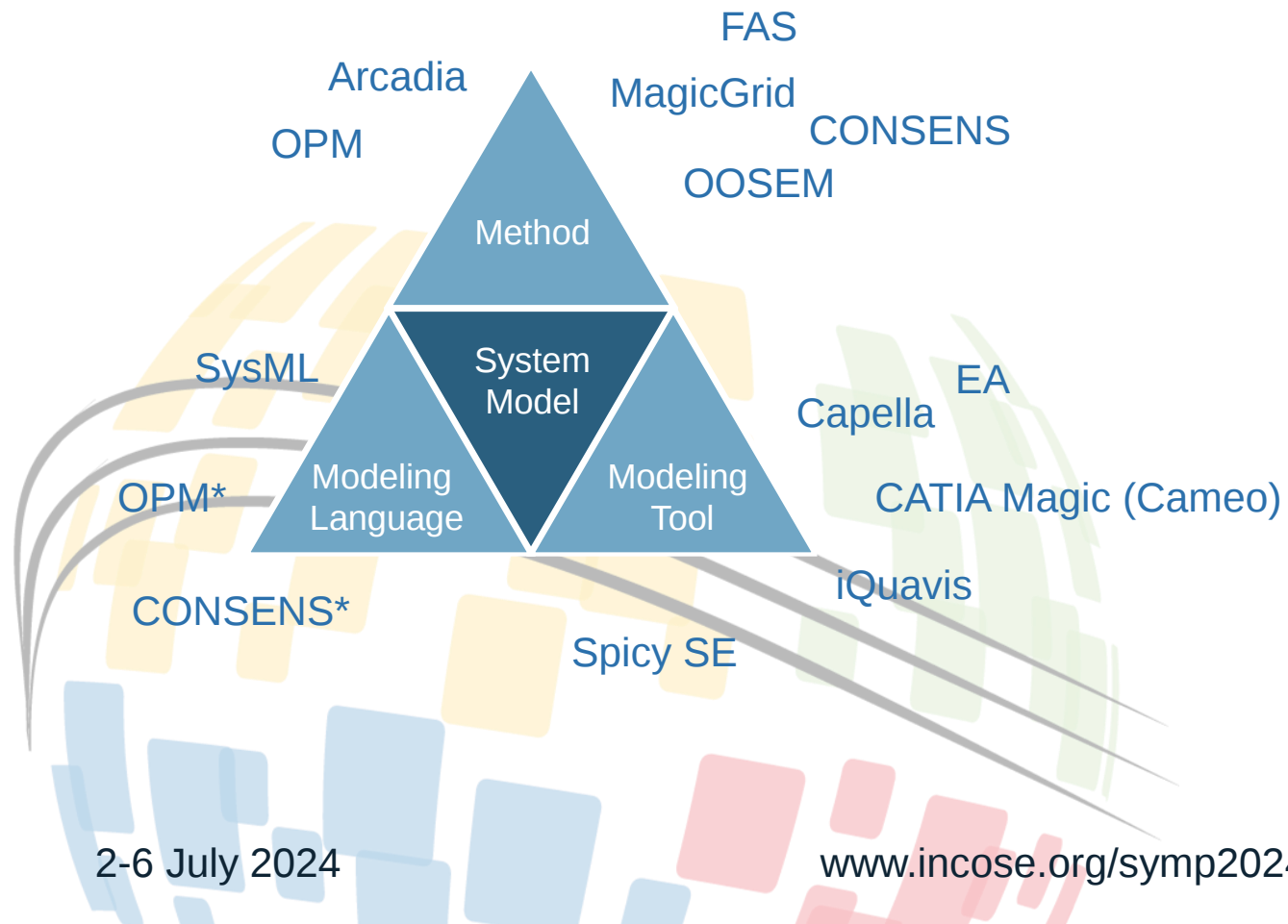
MBSE - Triangle



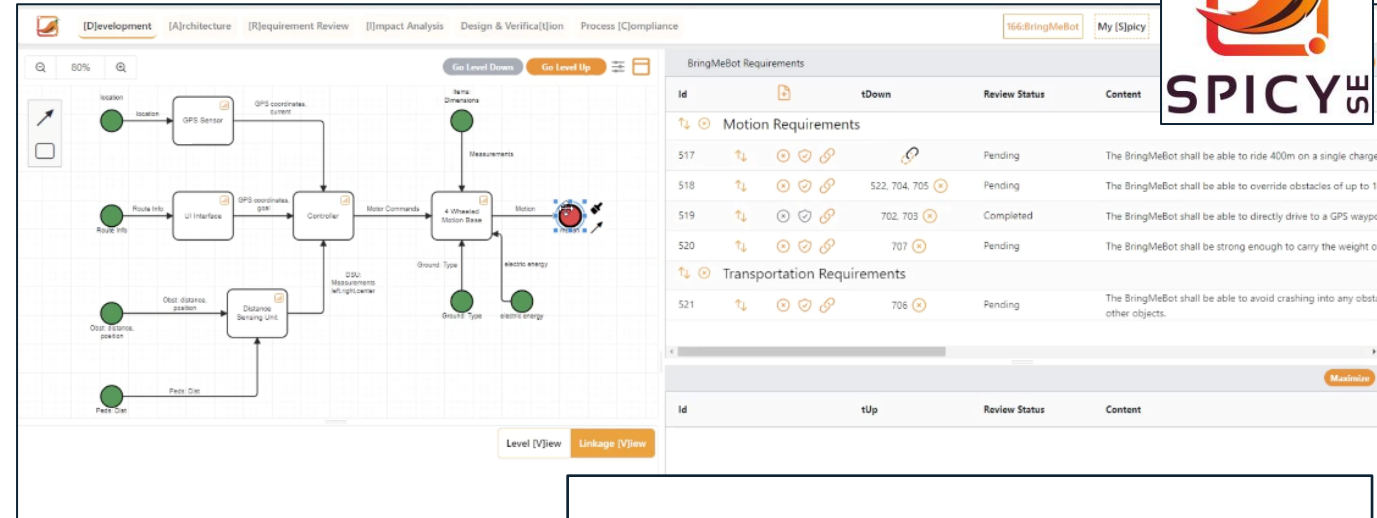
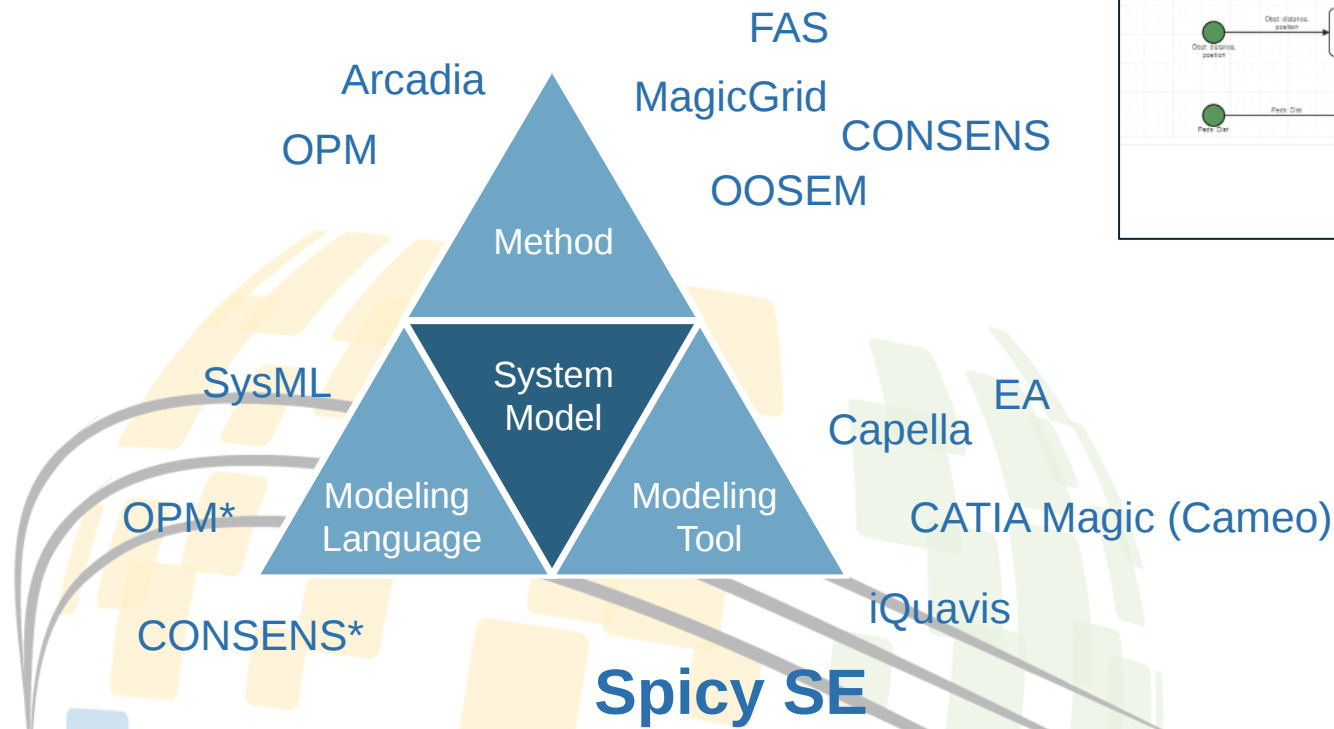
MBSE - Triangle



MBSE - Triangle

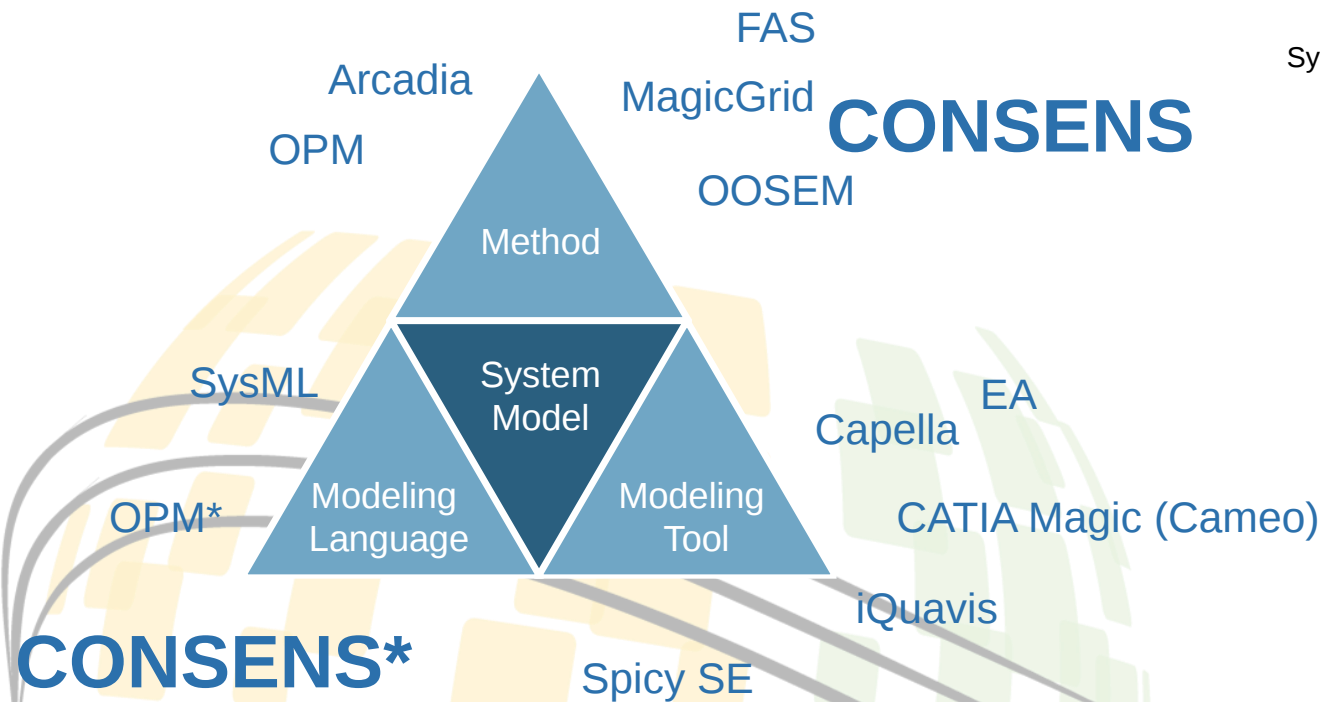


MBSE - Triangle



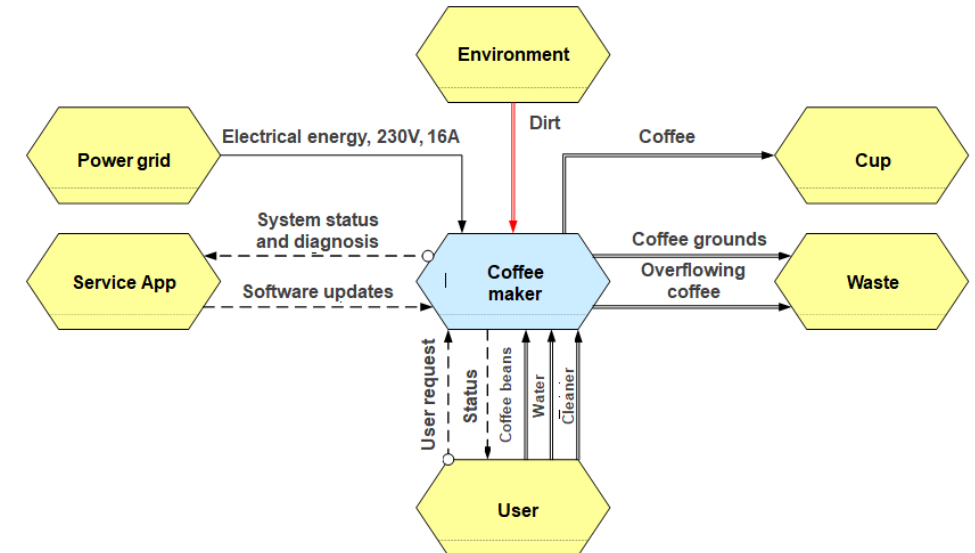
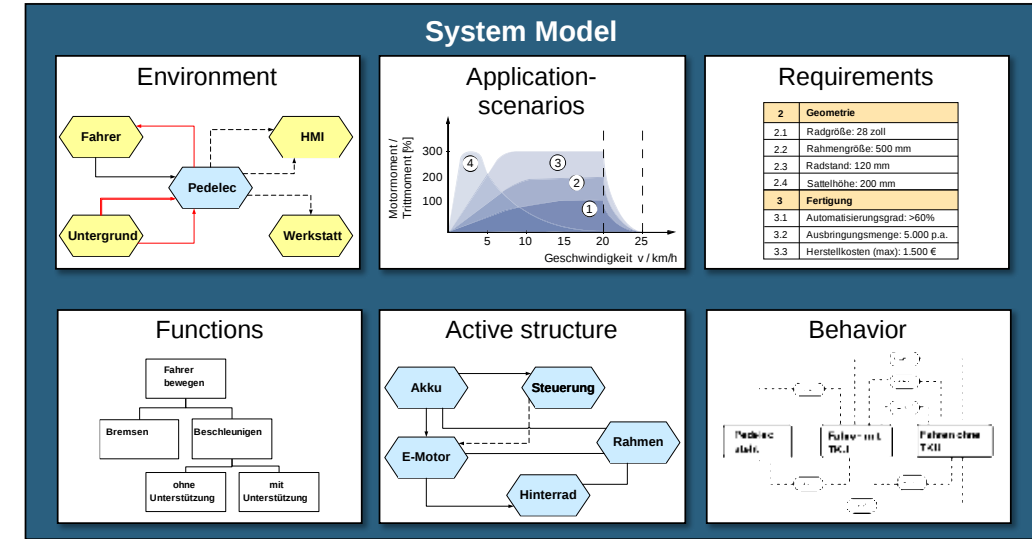
- Browser based platform
- Architecture and Interfaces
- Requirements and Linkages
- Testcase Specification

MBSE - Triangle

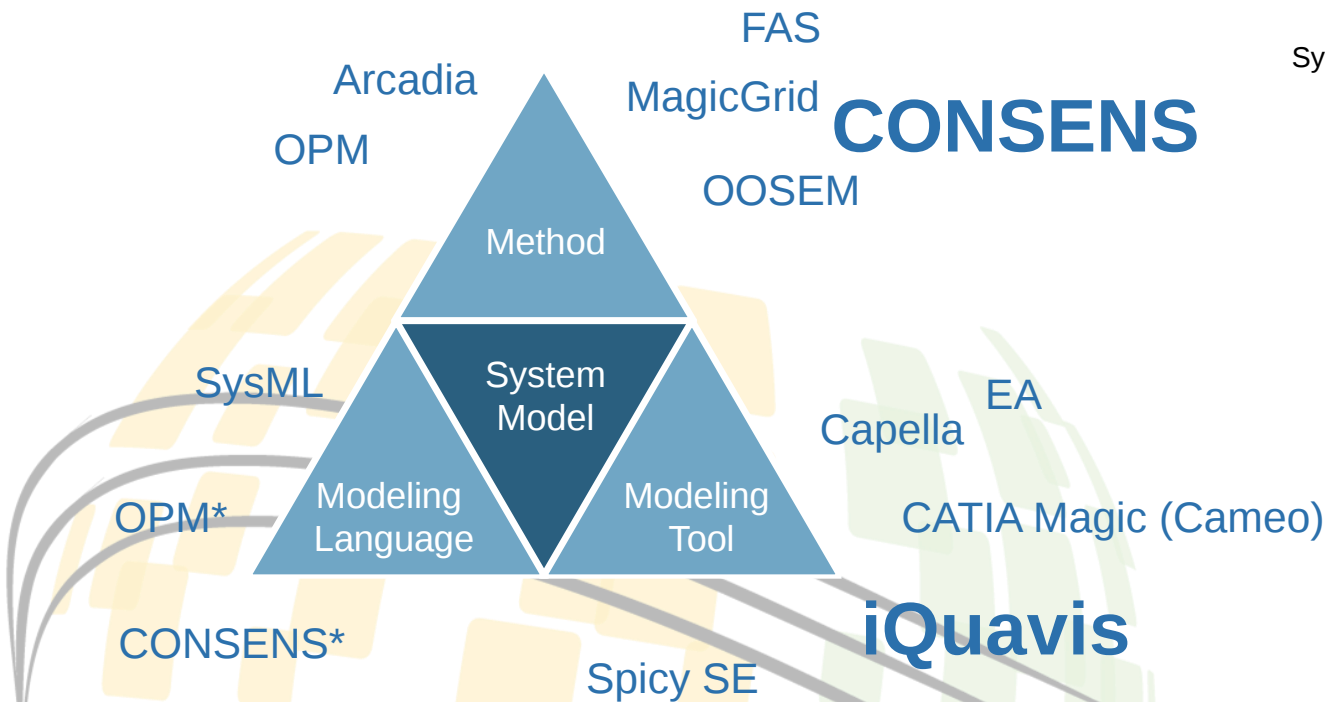


Analysis

Synthesis

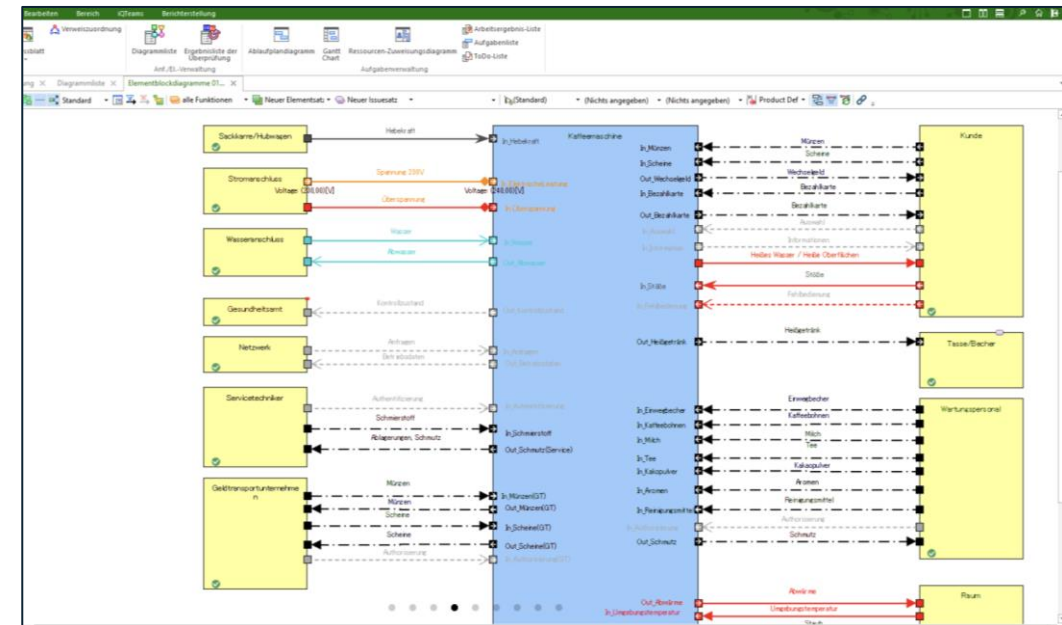
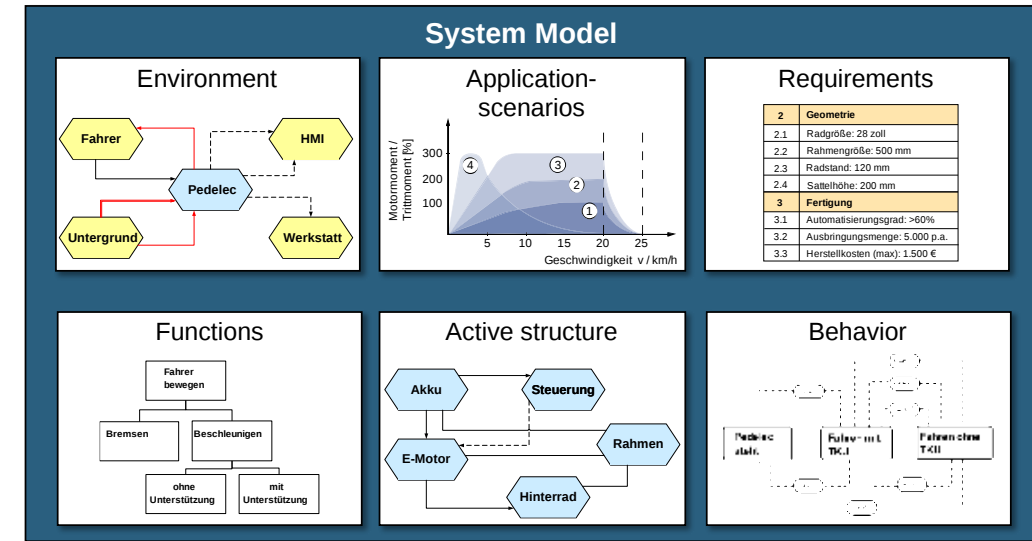


MBSE - Triangle



Analysis

Synthesis



Challenges on the Way



High learning effort and training needs for the modeling methods, language and tools



Complexity of systems and related models



High manual effort for modeling and model maintenance



Rare reusability of models



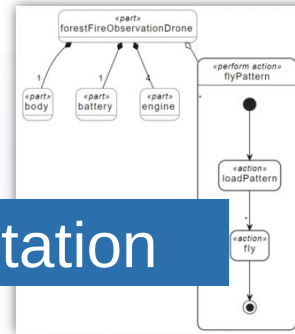
Low acceptance among employees due to isolated solutions

...

SysML v2

```
part forestFireObservationDrone {  
  part body;  
  part battery;  
  part engine[4];  
  perform action flyPattern {  
    first start;  
    then action loadPattern;  
    then action fly;  
    then done;  
  }  
}  
part def Engine;
```

Textual Notation



Graphical Notation

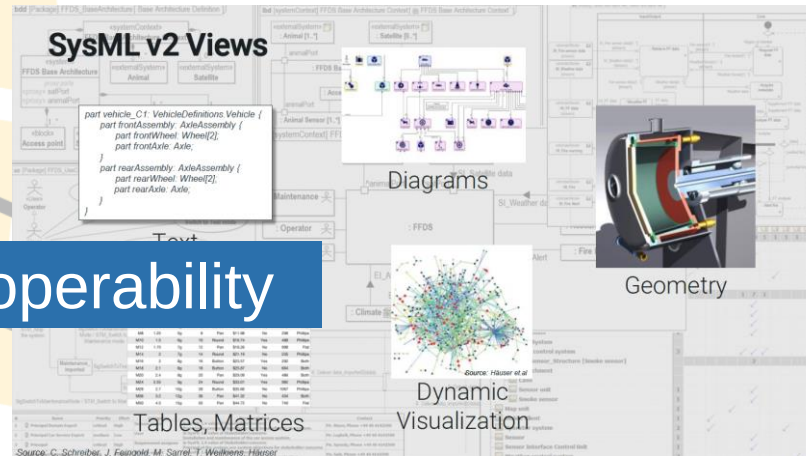
Oose, Tim Weilkiens 2023

new Metamodel

UML

SysML

Interoperability



Oose, Tim Weilkiens 2023

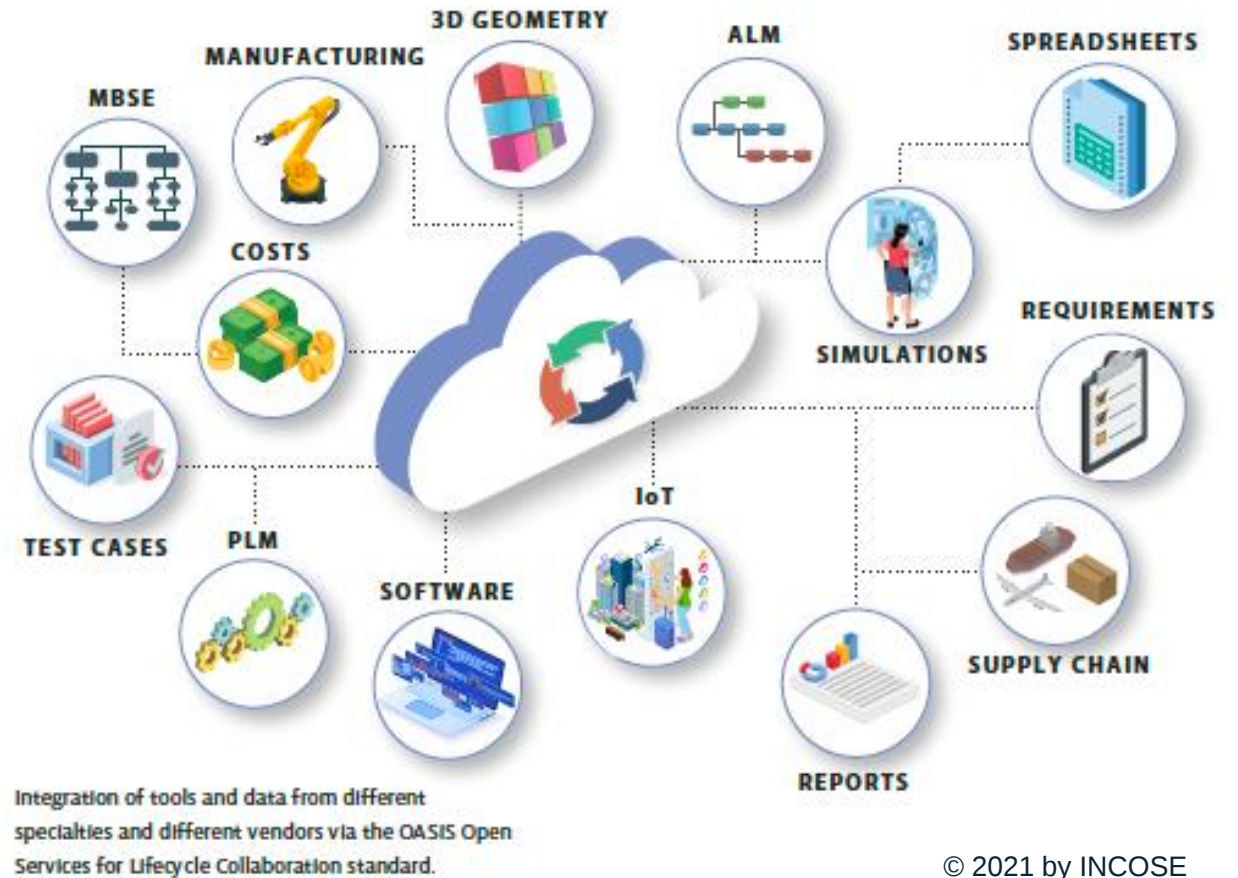
Modeling of Variants

2-6 July 2024

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SE Vision 2035

Digital Engineering –
connected models and
data across the entire
Lifecycle



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Start a Learning Journey



Understand the WHY

Take first steps in HOW

Become great at WHAT

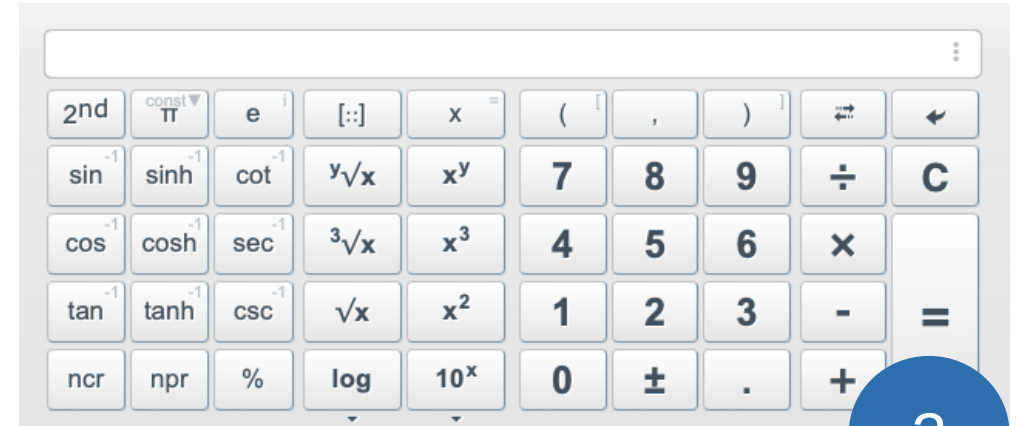
Like using a calculator ...



1

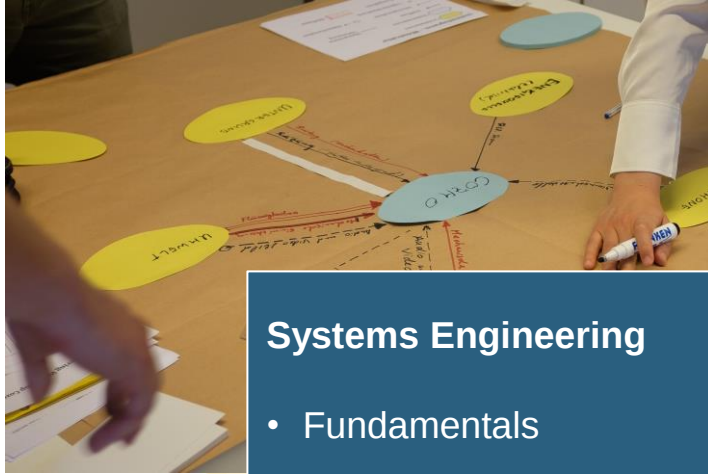


2



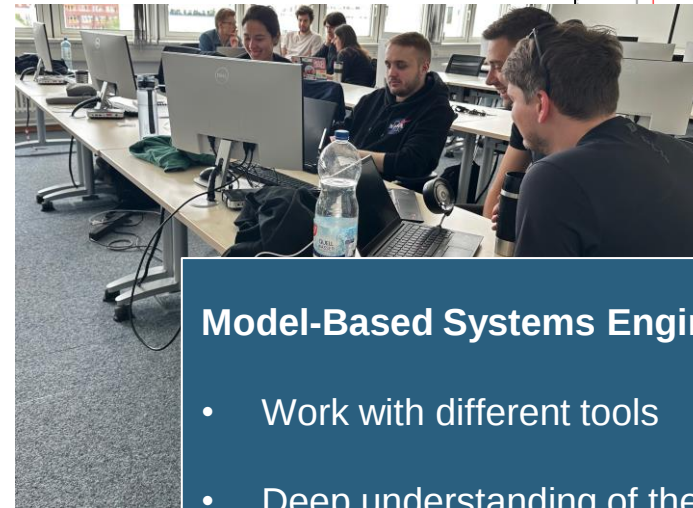
3

My teaching approach



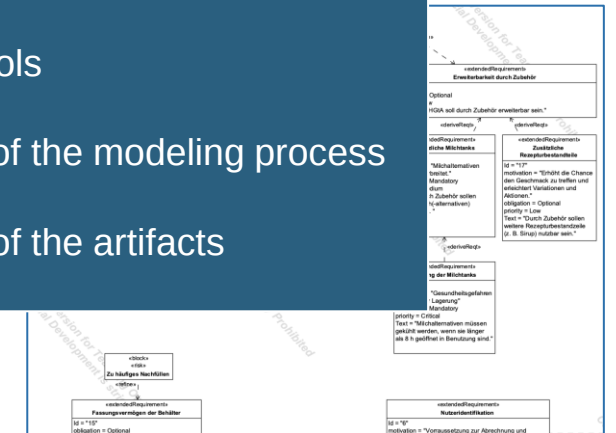
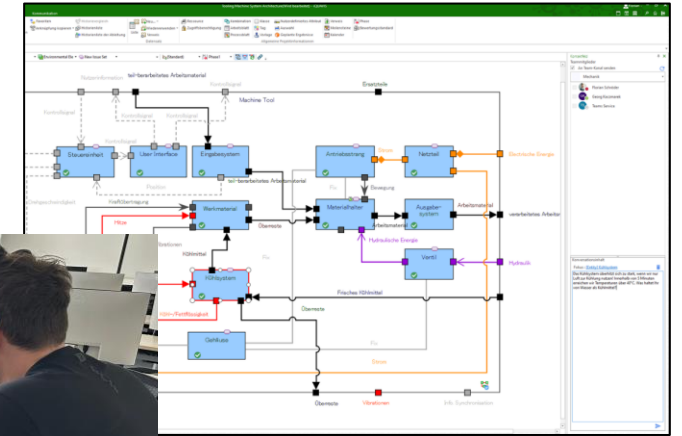
Systems Engineering

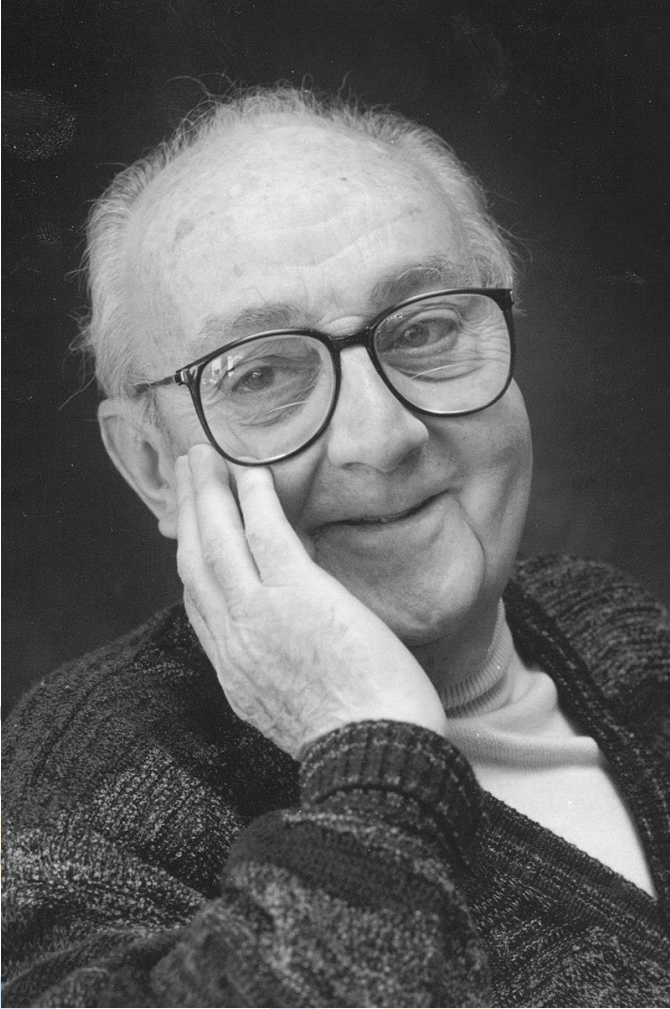
- Fundamentals
- Training in Systems Thinking
- Awareness of the integrated approach
- Awareness of interdisciplinary work



Model-Based Systems Engineering

- Work with different tools
- Deep understanding of the modeling process
- Deep understanding of the artifacts





” *All models are wrong,
but some are useful.*

George E. P. Box



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What is a Model?

General Model Theory by Stachowiak

Mapping

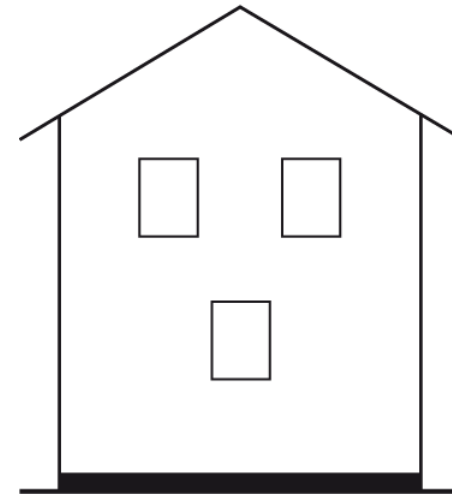
Models are always representations of something

Reduction

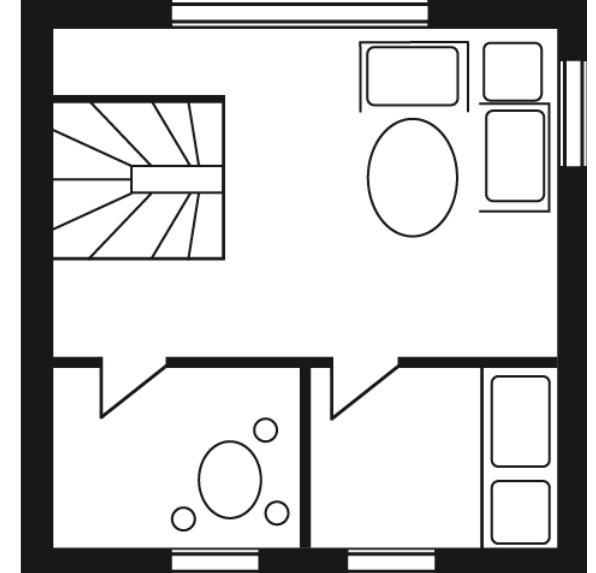
Models do not capture all attributes

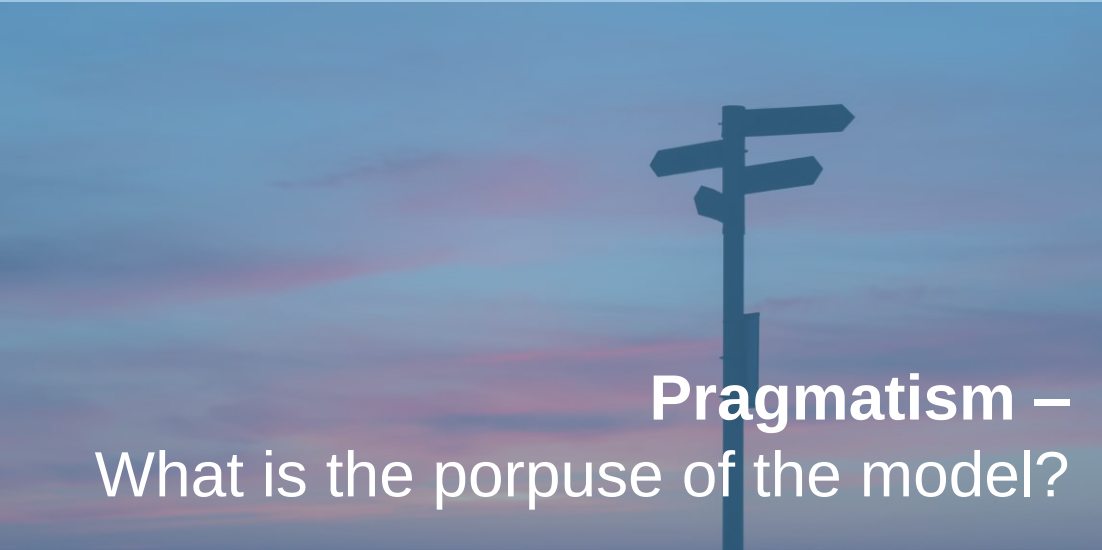
Pragmatism

Models are created for a specific purpose



Oliver Alt, 2012





Pragmatism –
What is the purpose of the model?



Reduction – What aspects need to be described to achieve the purpose?



Mapping –
Describe your System in a Model



Use the model and learn from your experience!

Further Informations

- SPicy SE: <https://spicy-se.com>
- iQuaivis: <https://www.two-pillars.de>
- MagicGrid: <https://discover.3ds.com/sites/default/files/2021-12/magicgrid-book-of-knowledge-ebook.pdf>
- Exhaustiveness of Systems Structures in Model-based Systems Engineering for Mechatronic Systems; <https://doi.org/10.1016/j.protcy.2016.08.055>
- OPM: <https://esml.technion.ac.il/opm/overview/>
- Capelle/Arcadia: <https://mbse-capella.org/arcadia.html>
- INCOSE SE Lab: <https://www.incose.org/inet/discover-community-initiatives/incose-se-laboratory>