32nd Annual INCOSE international symposium
hybrid event
Detroit, MI, USA
June 25 - 30, 2022

Artificial Intelligence Capabilities for Effective Model-Based Systems Engineering: A Vision Paper

www.incose.org/symp2022

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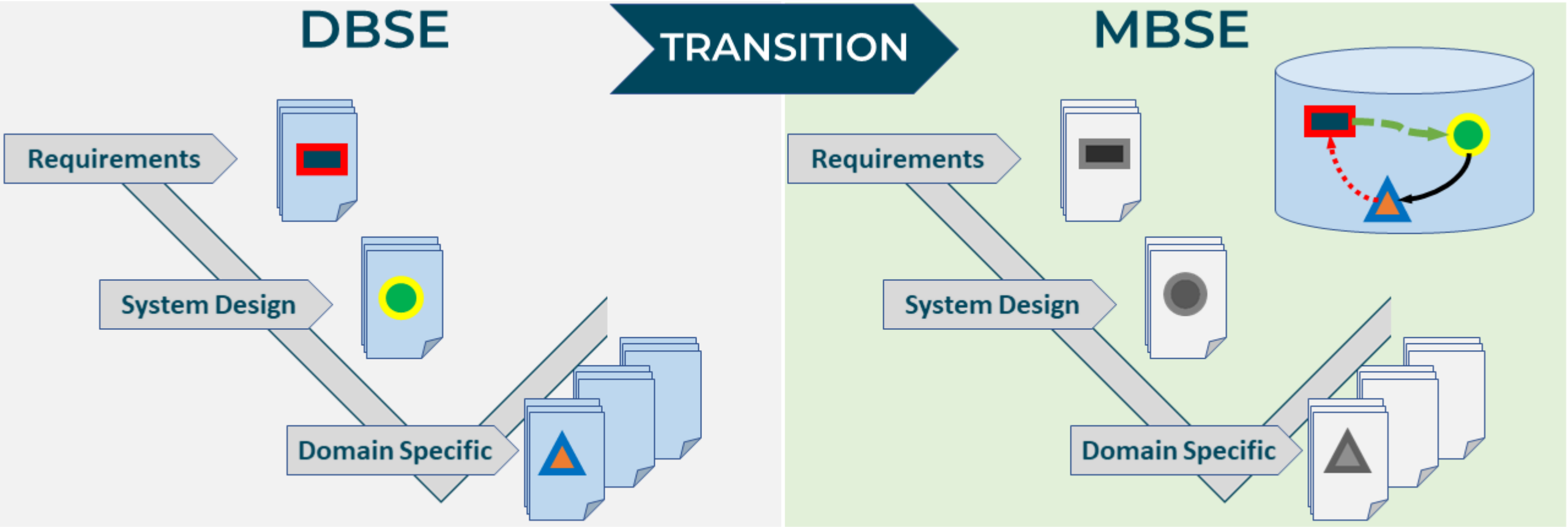
SysDICE
KNOWLEDGE FOR IMPACT

IRIT
Institut de Recherche
en Informatique de Toulouse
CNRS - INP - UT3 - UT1 - UT2J

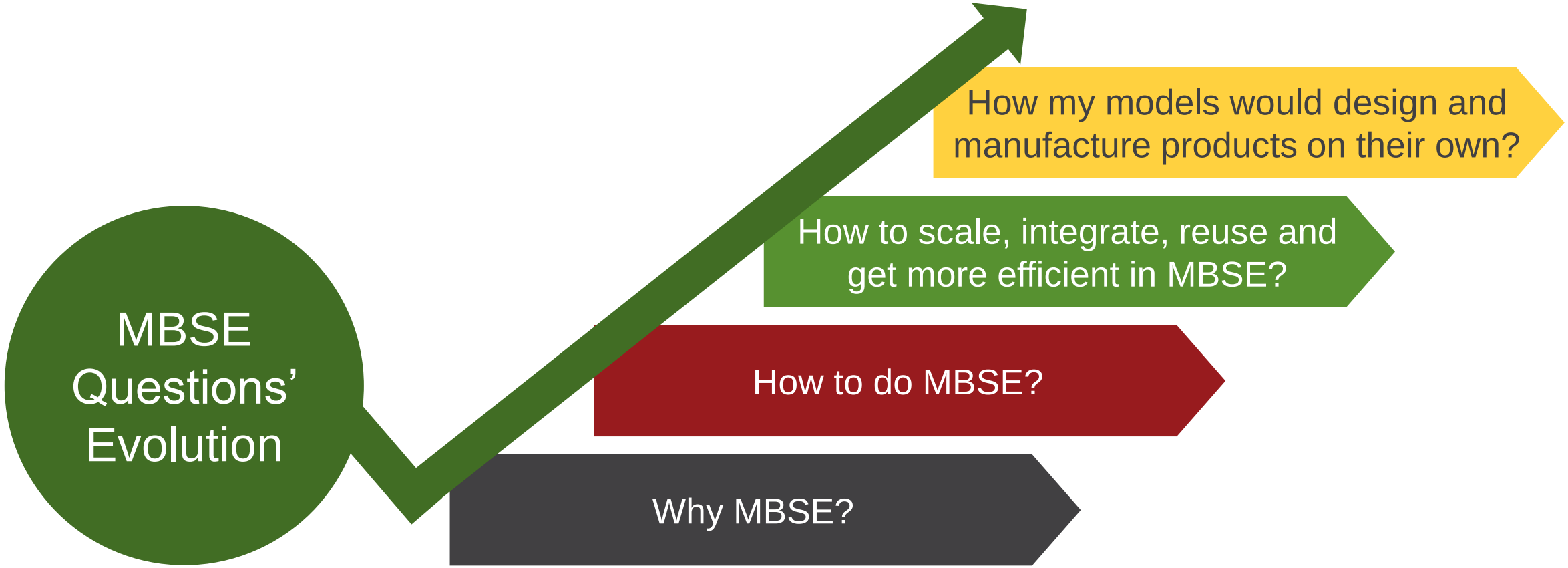
Context: DBSE to MBSE Transition



Documents As Primary Artefacts

Models As Primary Artefacts

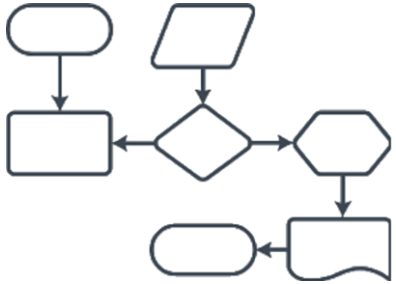
10 Years of Observations on Most Common Questions Asked related to MBSE:



MBSE Adoption Components

Personnel

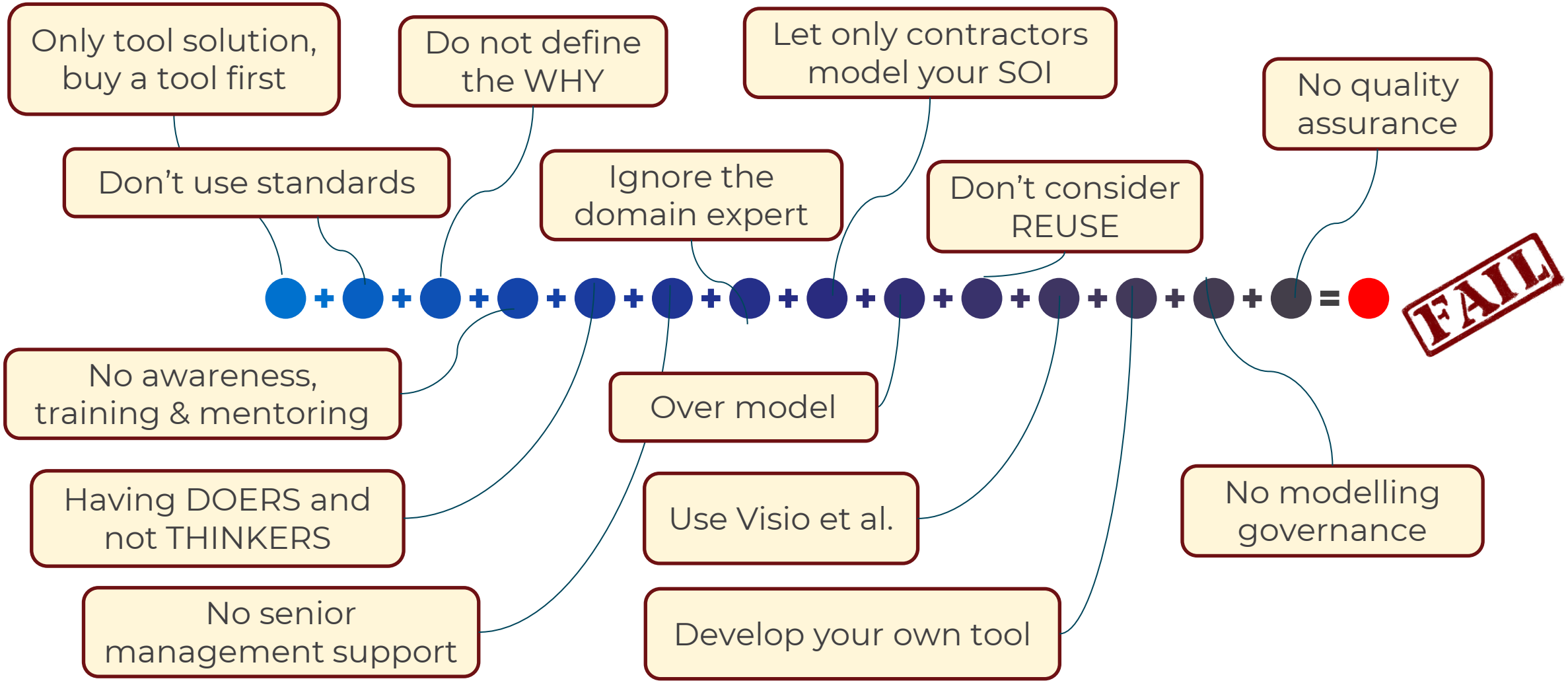
Modeling Language
Modeling Method
Modeling Tool



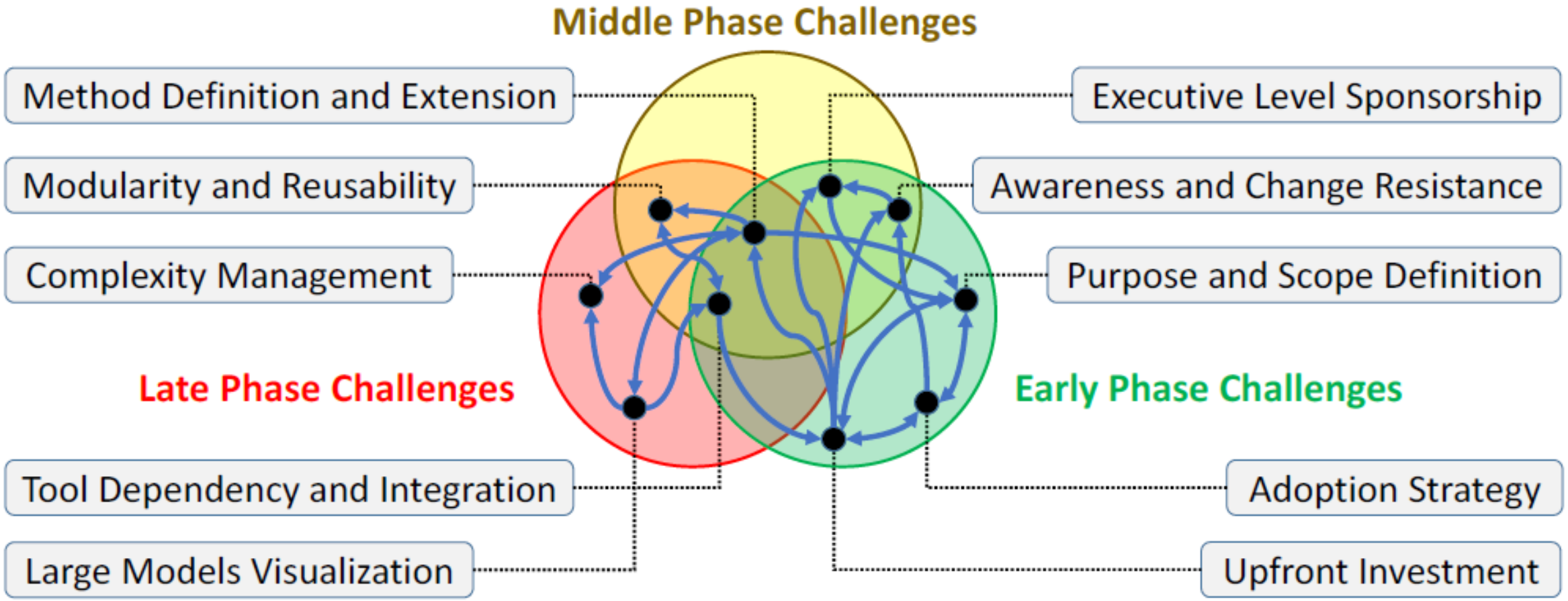
Process

Source: *Chami et al. Towards Solving MBSE Adoption Challenges: The D3 MBSE Adoption Toolbox, INCOSE IS 2018*

An Equation for MBSE Adoption ~~SUCCESS~~ FAILURE



Results of A Survey on MBSE Adoption Challenges



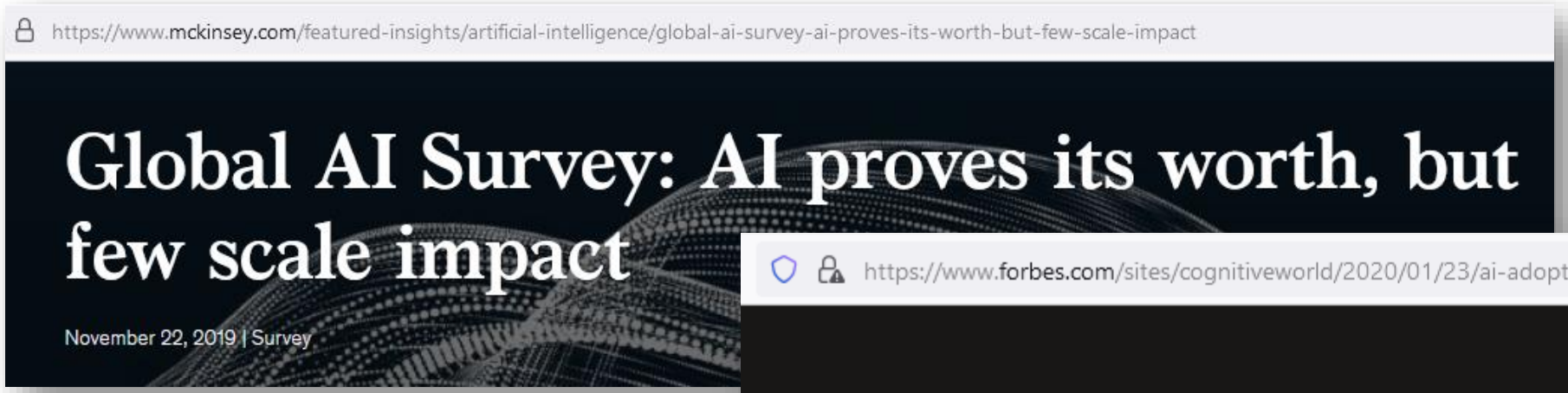
Source: *Chami & Bruel, A Survey on MBSE adoption challenges. The Systems Engineering Conference of the Europe, Middle-East and Africa (EMEA) Sector of INCOSE*

Source: https://www.pinterest.de/pin/563018681245269/

Instead of focusing solely on **delivering intelligent products**,

Why not **supporting as well designing and developing** the products with the help of some intelligent framework.

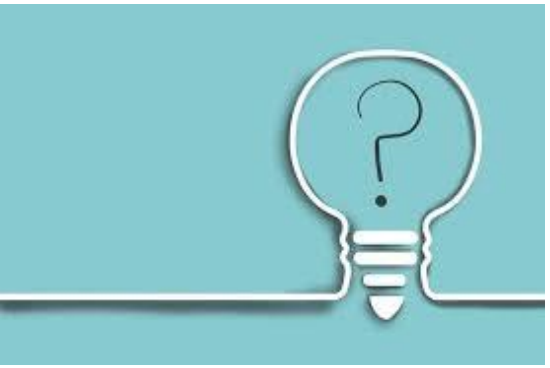
AI Adoption Can't be Ignored any more…



Why not matching the context of existing **MBSE challenges** with **successful AI applications** in other domains?

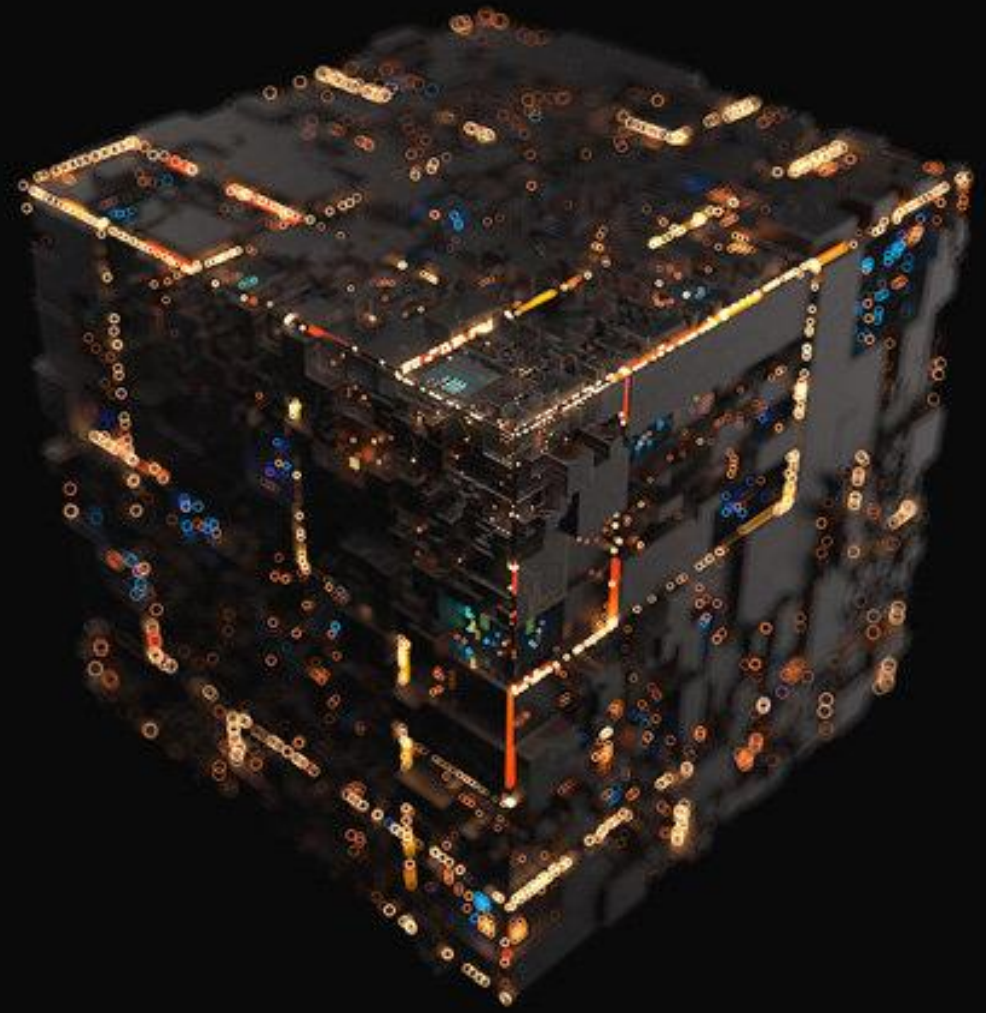
Objective: Support the system design using the **combination** of MBSE & AI

Which AI applications are useful for the identified MBSE challenges?



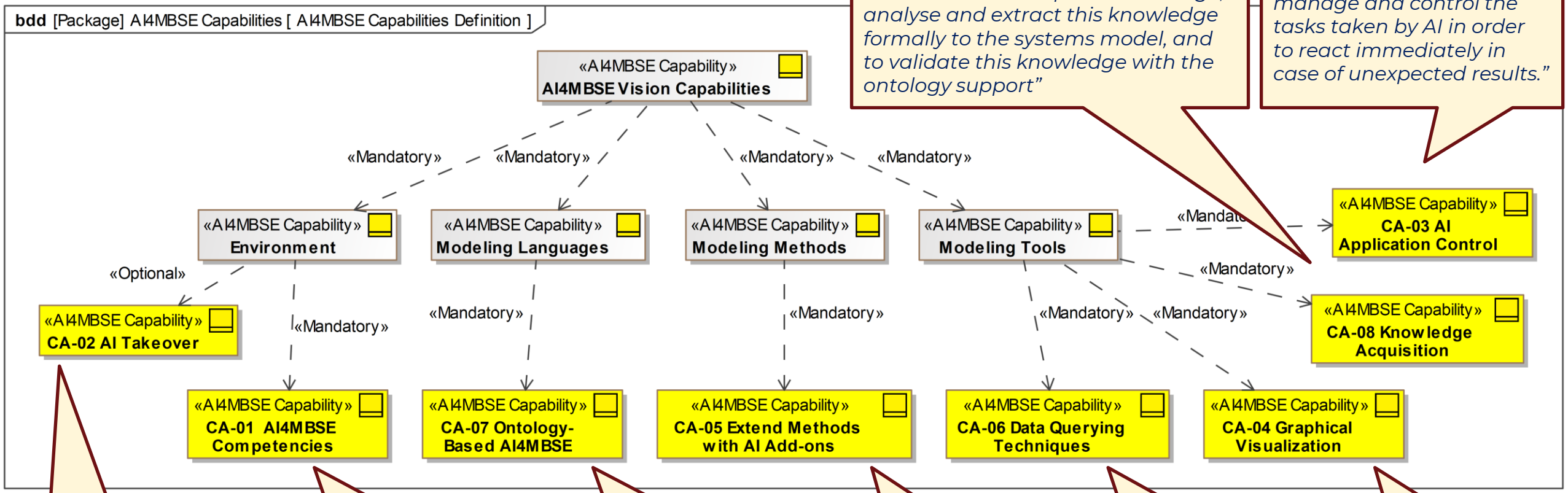
How the AI applications could be implemented & what limitations are there?

What Capabilities would an **AI4MBSE** Solution require?



Source: https://singularityhub.com

AI4MBSE CAPABILITIES



"AI4MBSE should be compatible with knowledge acquisition techniques to elicitate domain experts knowledge, analyse and extract this knowledge formally to the systems model, and to validate this knowledge with the ontology support"

"AI4MBSE tools must provide the capability to manage and control the tasks taken by AI in order to react immediately in case of unexpected results."

"AI4MBSE should accommodate an optional AI takeover of a defined systems engineers' tasks. This must be tested and validated consistently before deployment."

"MBSE universities, training centers, and universities lecturers or researchers shall include related AI techniques and foundations on the existing MBSE curriculum."

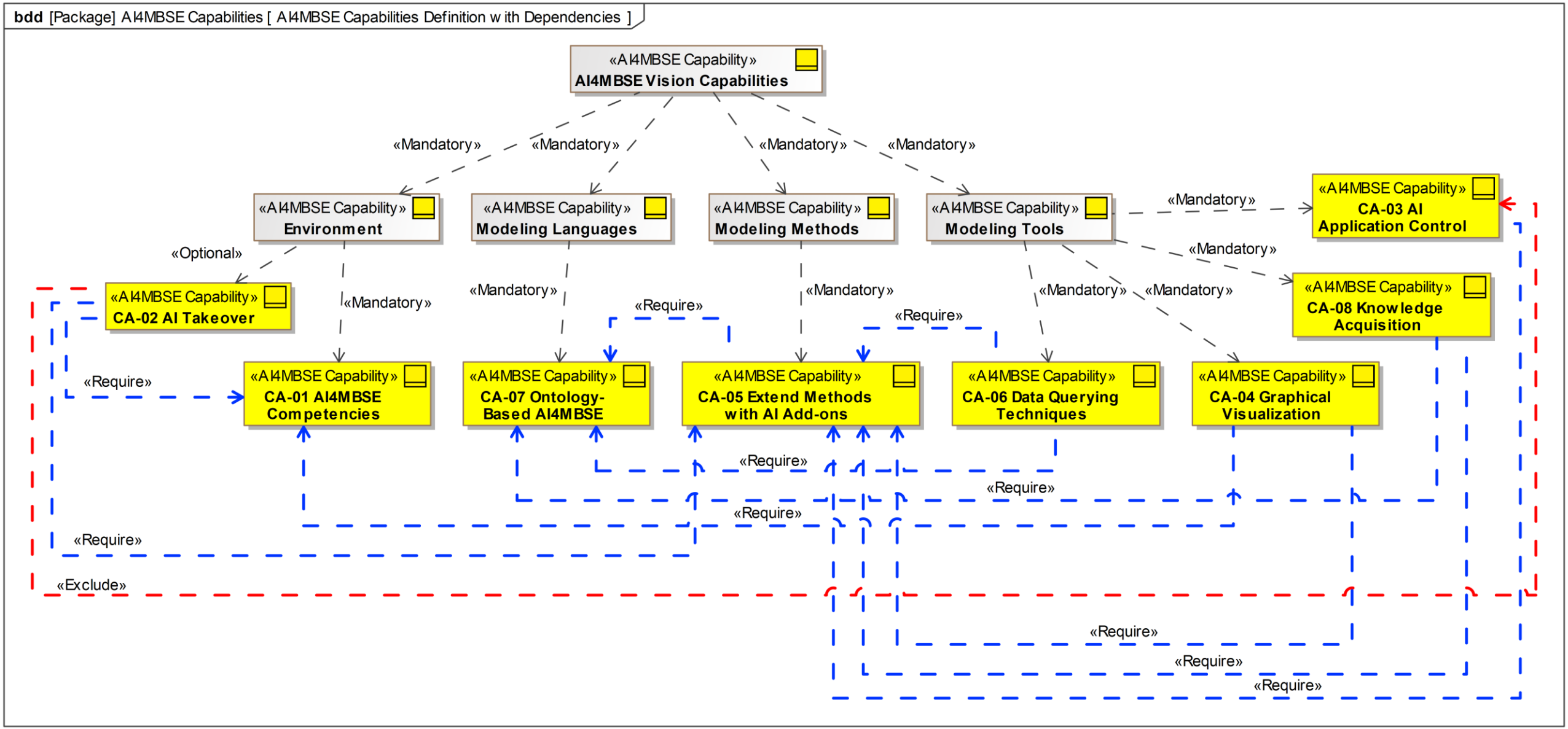
"AI4MBSE should be supported by an ontology for elements of modeling language, AI and their mapping for the sake of achieving effective application of AI."

"MBSE applied modeling methods shall be extended with the related AI development and deployment steps."

"AI4MBSE shall be supported with a productive semantic querying technique to answer typical systems engineers questions about the model content."

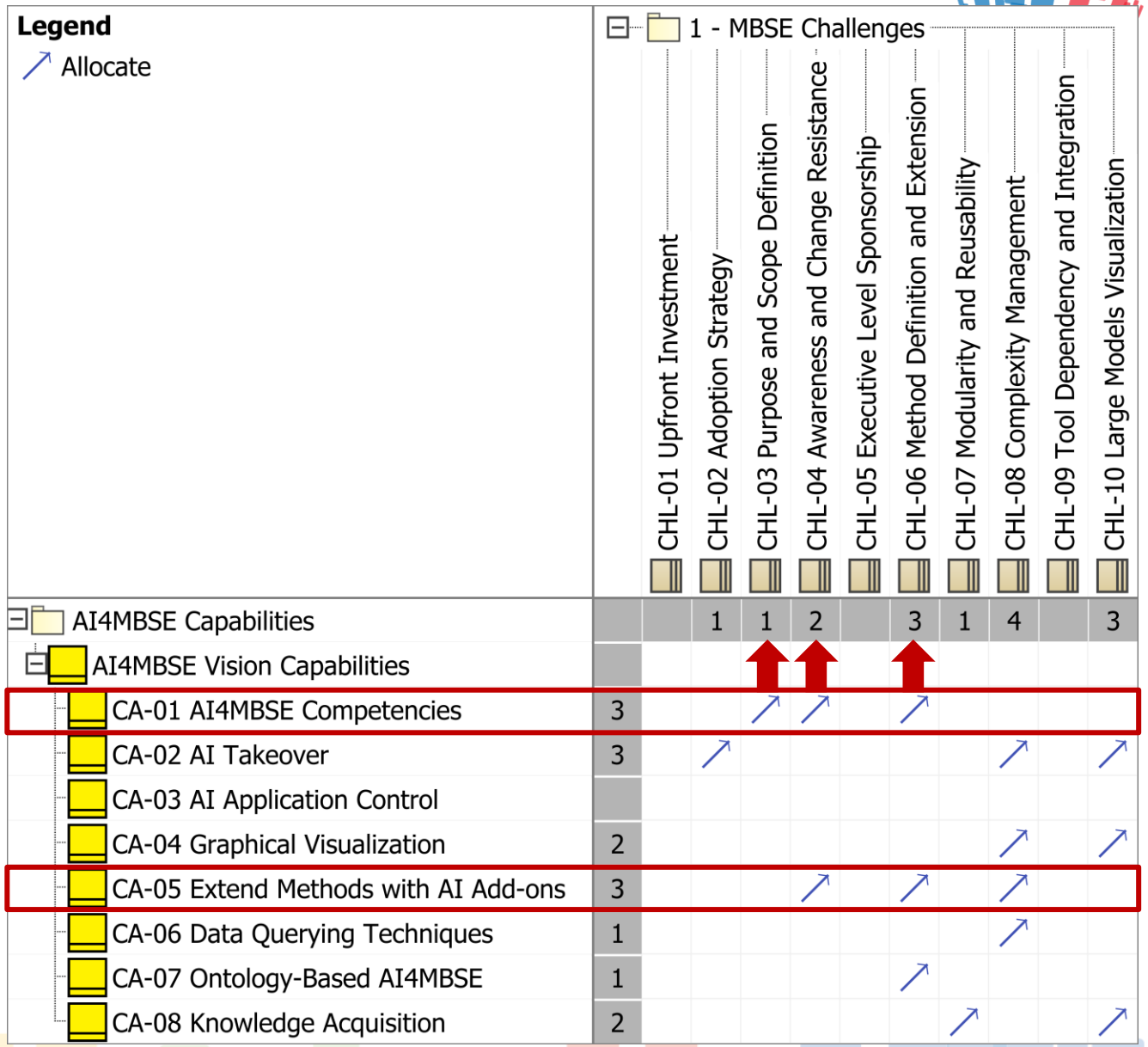
"AI4MBSE tools shall provide the means of visualizing models in a graphical manner with the defined methods"

AI4MBSE CAPABILITIES DEPENDENCIES



ALLOCATION BETWEEN CAPABILITIES & CHALLENGES

- MBSE alone is not enough for SE problems
- AI4MBSE capabilities might not be able to solve all MBSE challenges
- Early AI4MBSE experience explored the allocation of the AI4MBSE capabilities to the MBSE challenges



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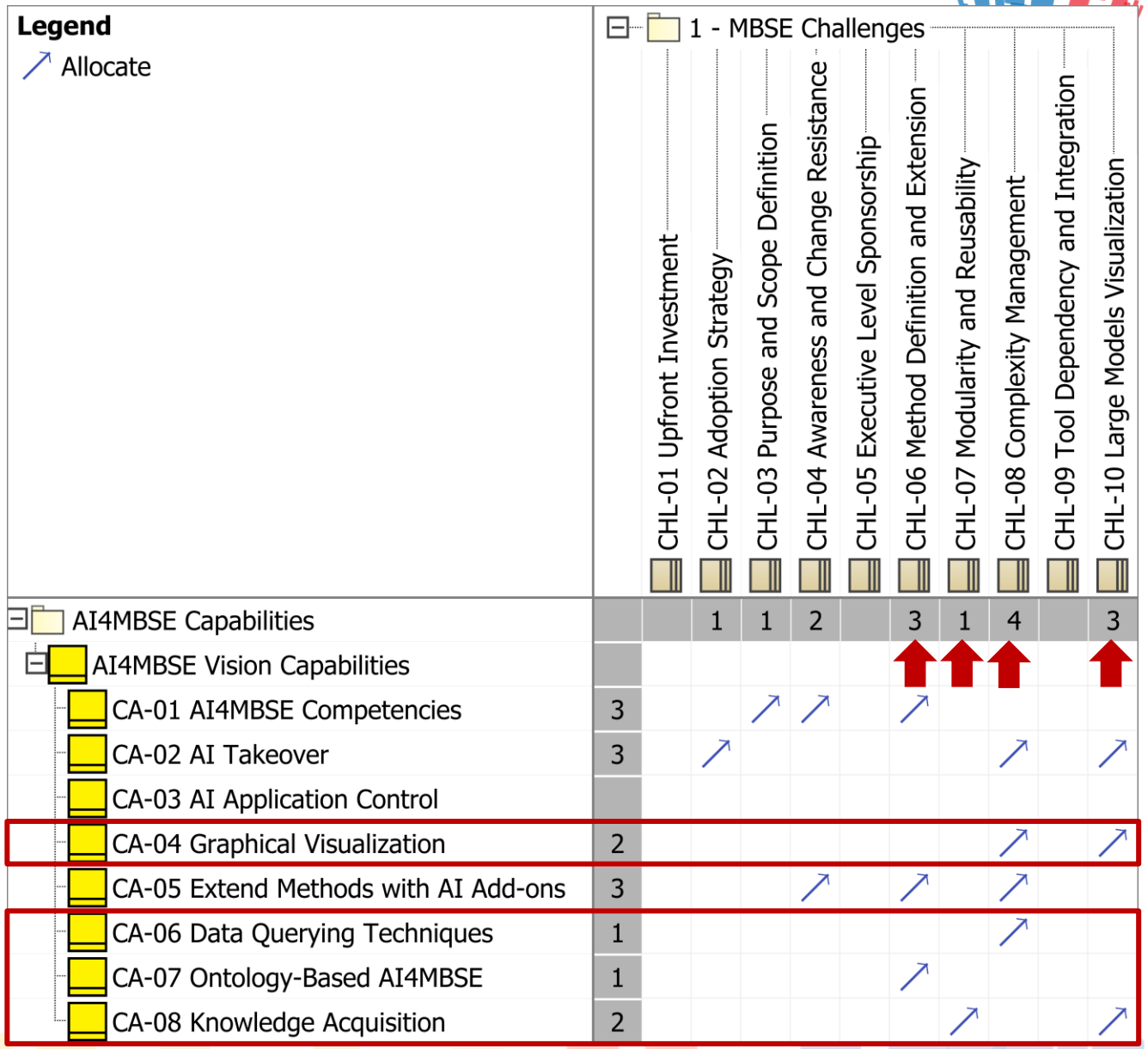

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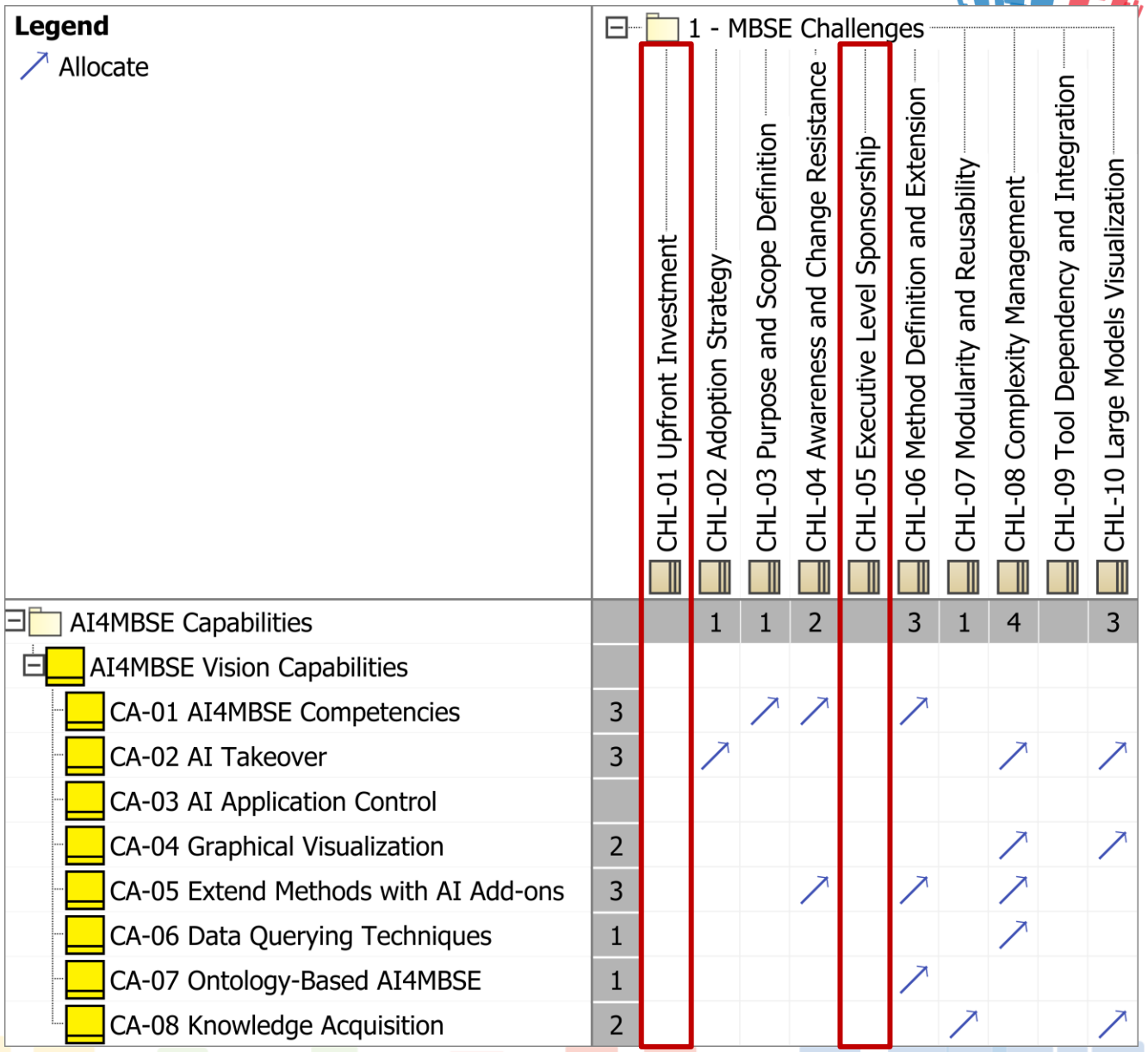
- *Although challenge 1 & 5 are not yet allocated by any capabilities, solving the other challenges might reflect with a positive influence toward them.*



Any doubt about AI4MBSE?

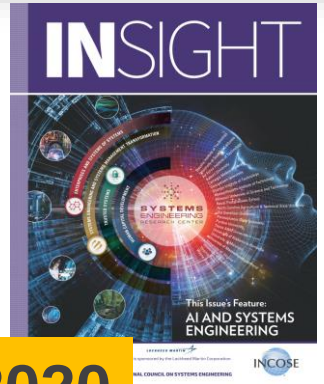
Artificial Intelligence and Systems Engineering

Ian Sommerville,
Computing Department, Lancaster University, LANCASTER LA1 4YR, UK.

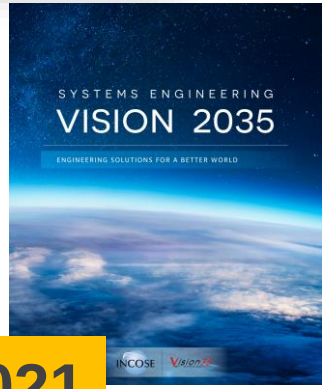
1993

Why then, in a recent seminar attended by many leading software engineering researchers to discuss the future of software engineering [1] was AI never mentioned? Why is there a perceptible hostility between many systems engineering practitioners and AI researchers? Why do some engineering disciplines embrace AI enthusiastically but software and systems engineers ignore the possibilities of this technology? What of the future - can AI make a contribution to systems engineering?

2019



2020



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