



HTSC Research Meet “Systems Engineering and Beyond”

Digital Engineering

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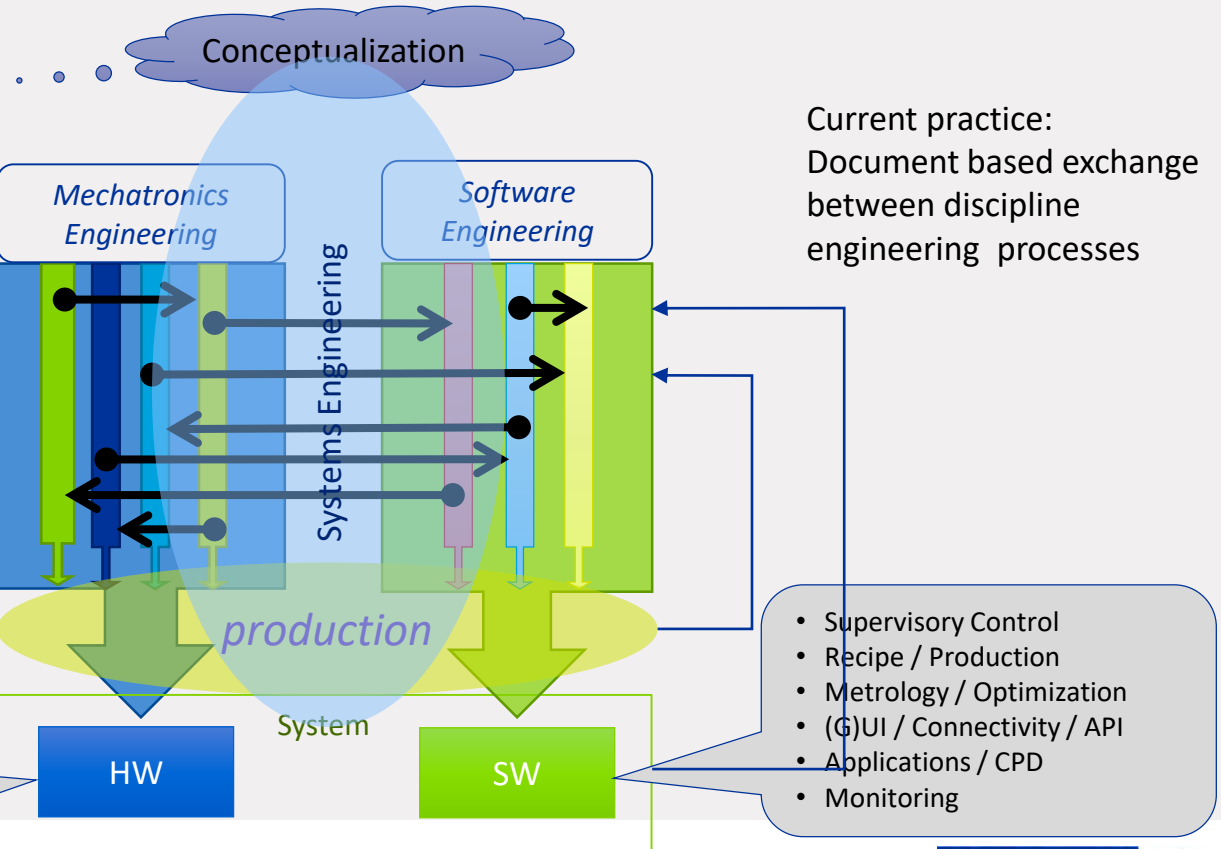
HTSC

HIGH TECH
SYSTEMS
CENTER

TU/e

Thursday, 2 July 2020

Engineering...



Digital Engineering

- Improve computerized support for systems engineering processes
- Integrate models from various disciplines to analyze and balance engineering decisions at all semantic levels
- Synthesize models to system contributions or to next level system models
- Focus on multi-disciplinary interactions

Digital Twinning

Automated Reasoning

*Engineering **Economics***

*Cross Discipline **Software** Contributions*

Artificial Intelligence in Engineering

Visualization

Model and knowledge management

Re-use

SERC Research INSIGHT 23/1

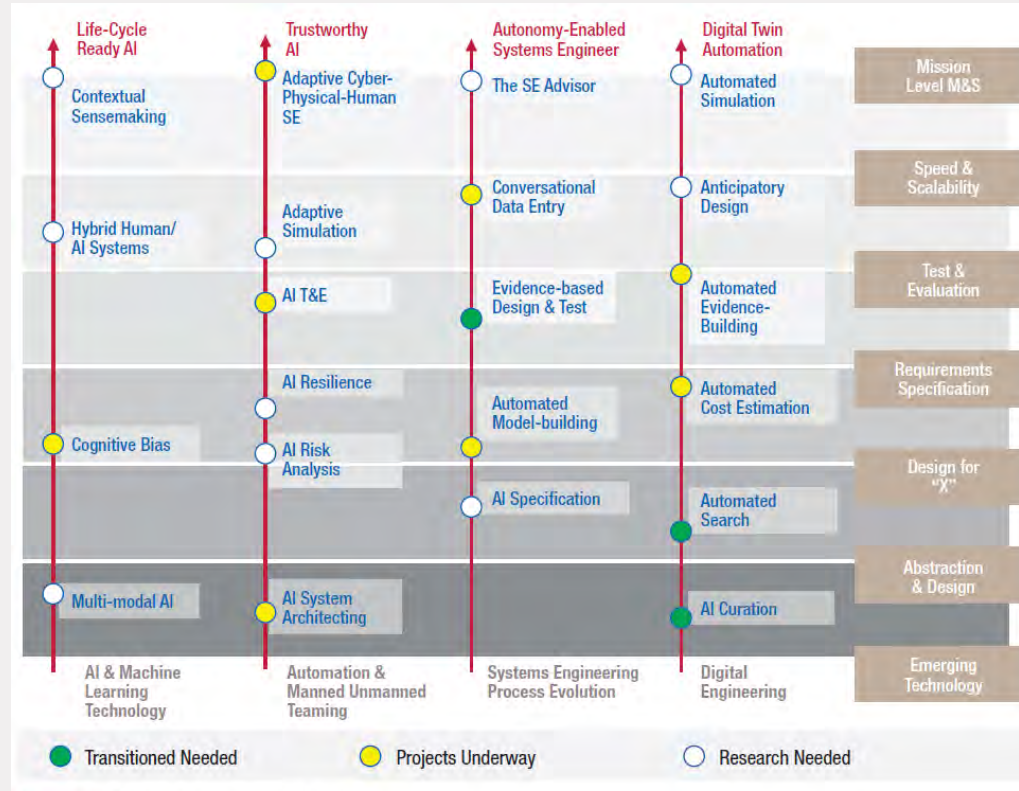


Figure 4. SERC AI and autonomy roadmap



SERC Research

INSIGHT 23/1

“Systems Engineering Process Evolution through Digital Engineering – the evolution of systems engineering process to learning technologies and automation and the transition to a digital engineering data driven basis for engineering which allows automation and learning.”

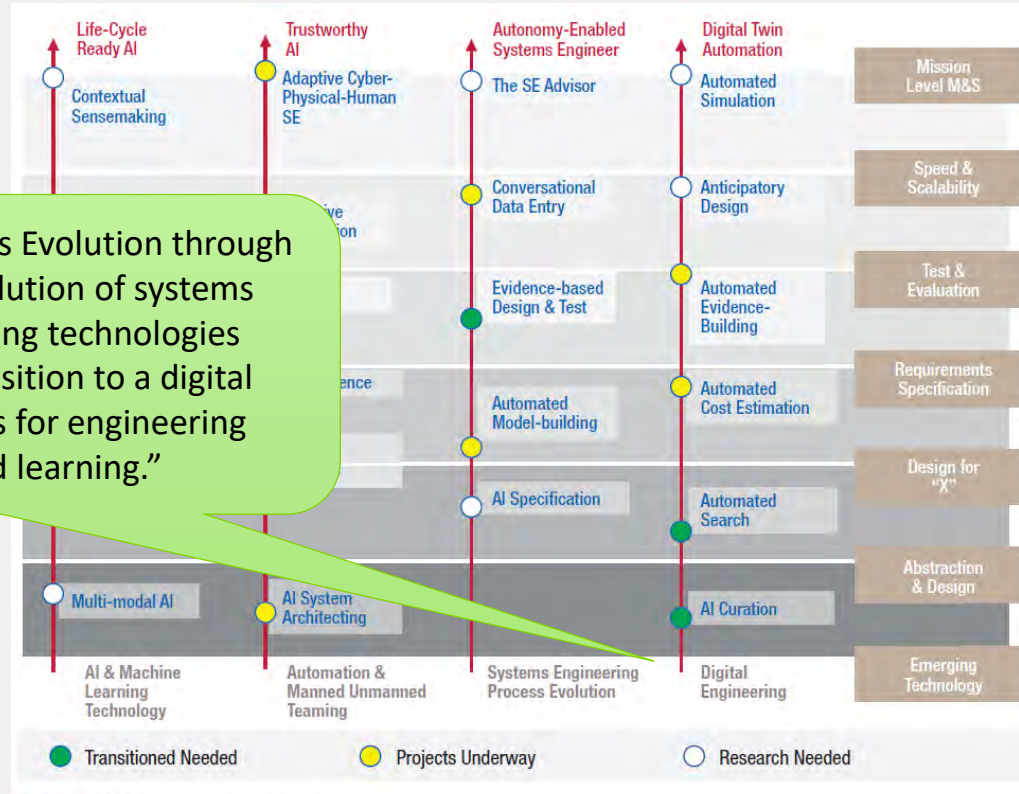
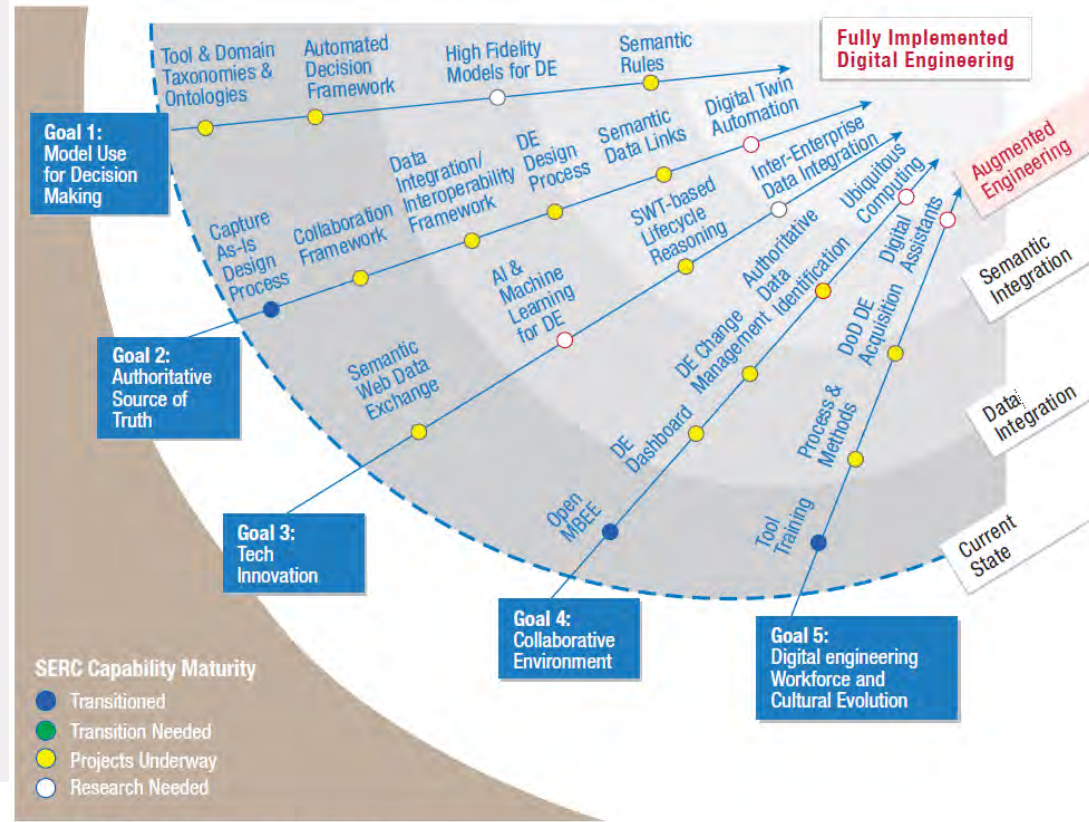


Figure 4. SERC AI and autonomy roadmap



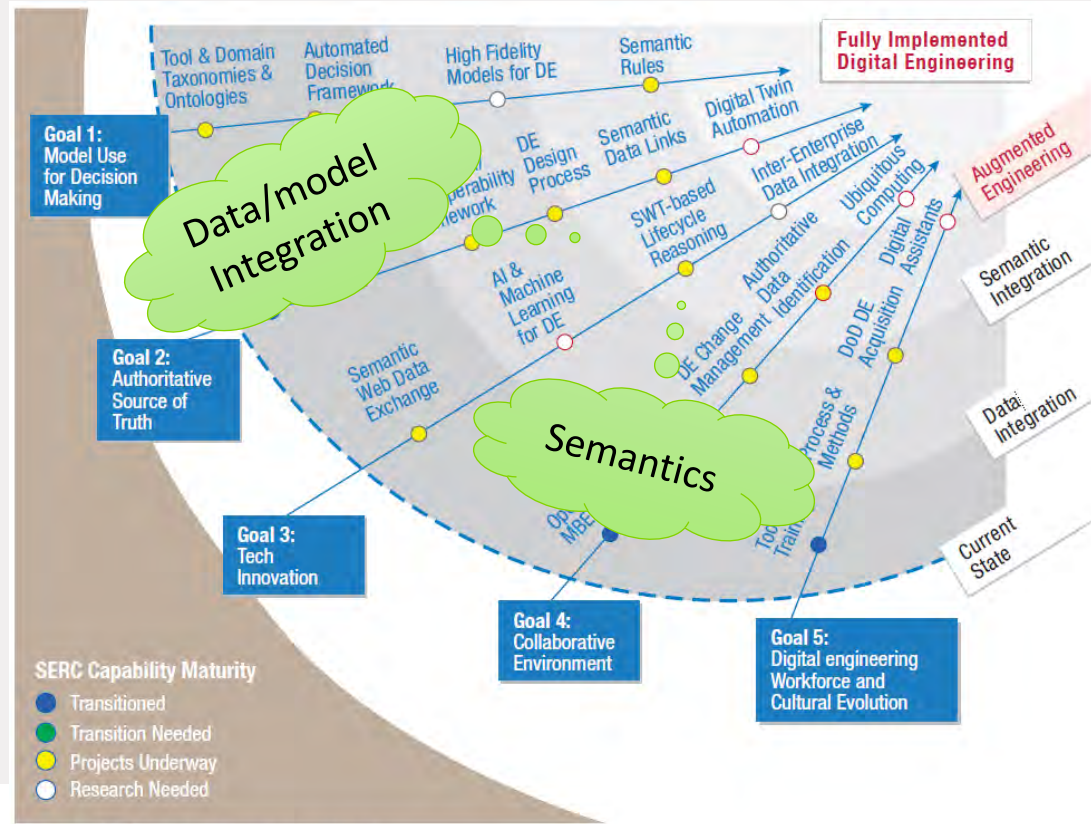
SERC Research

INSIGHT 23/1



SERC Research

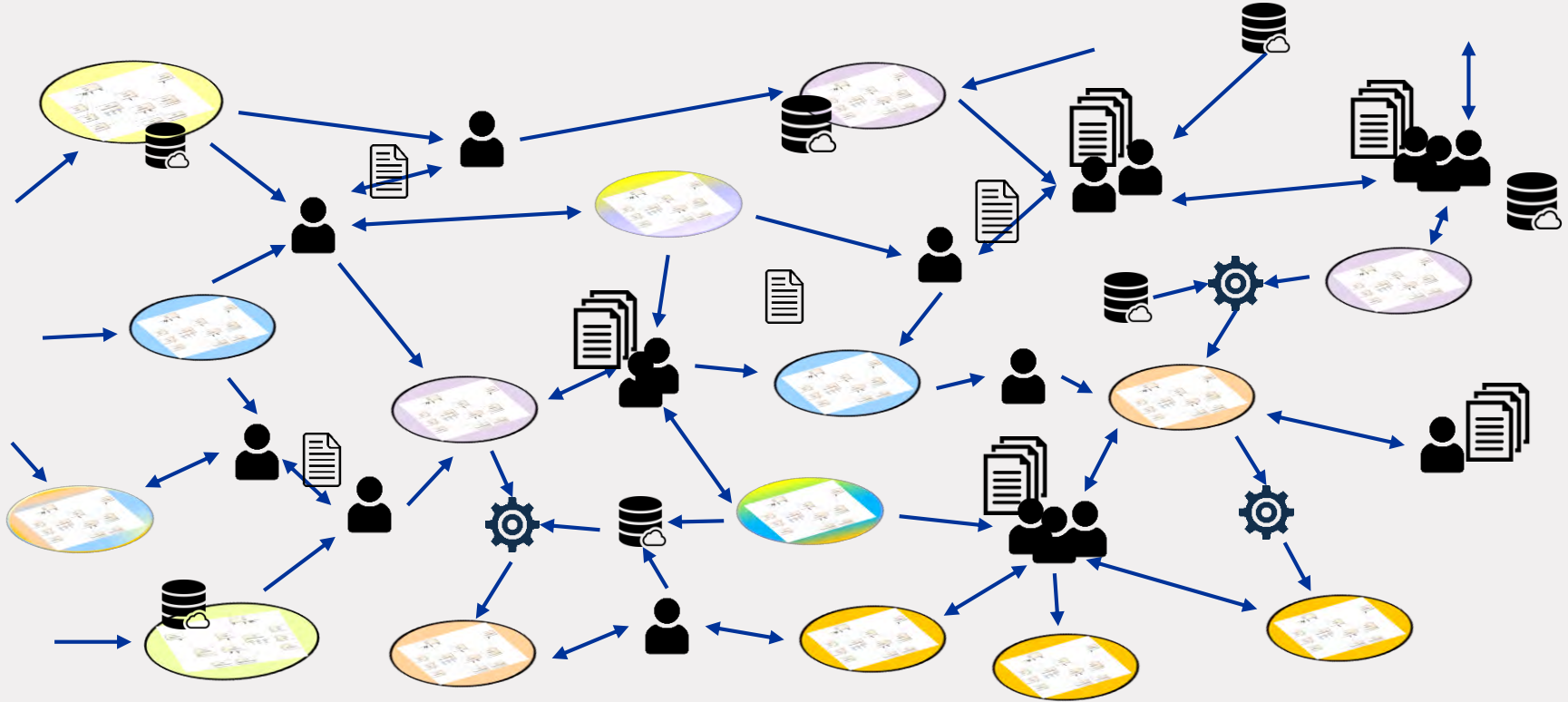
INSIGHT 23/1



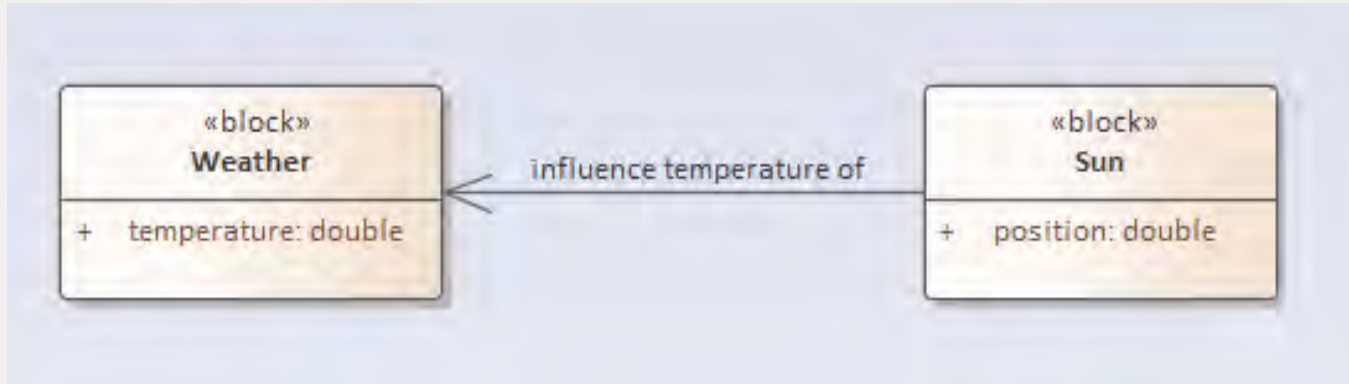
The Challenge

What Digital Engineering needs to solve

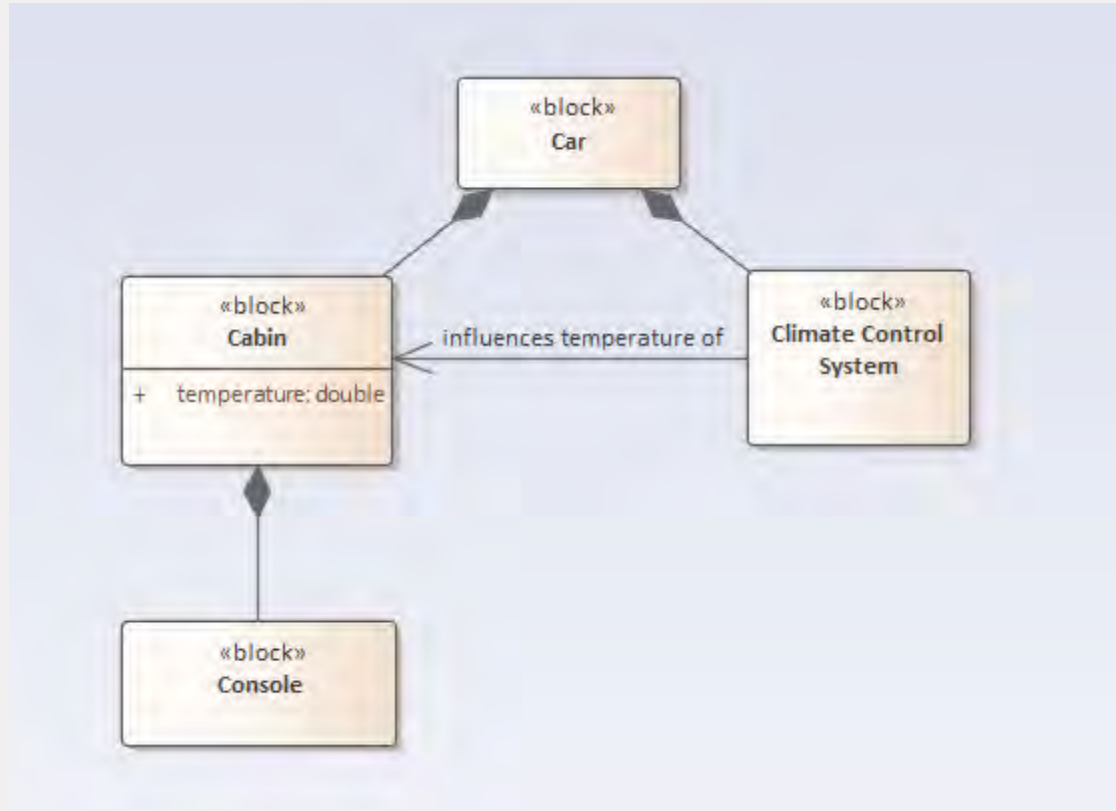
Islands Of Automation



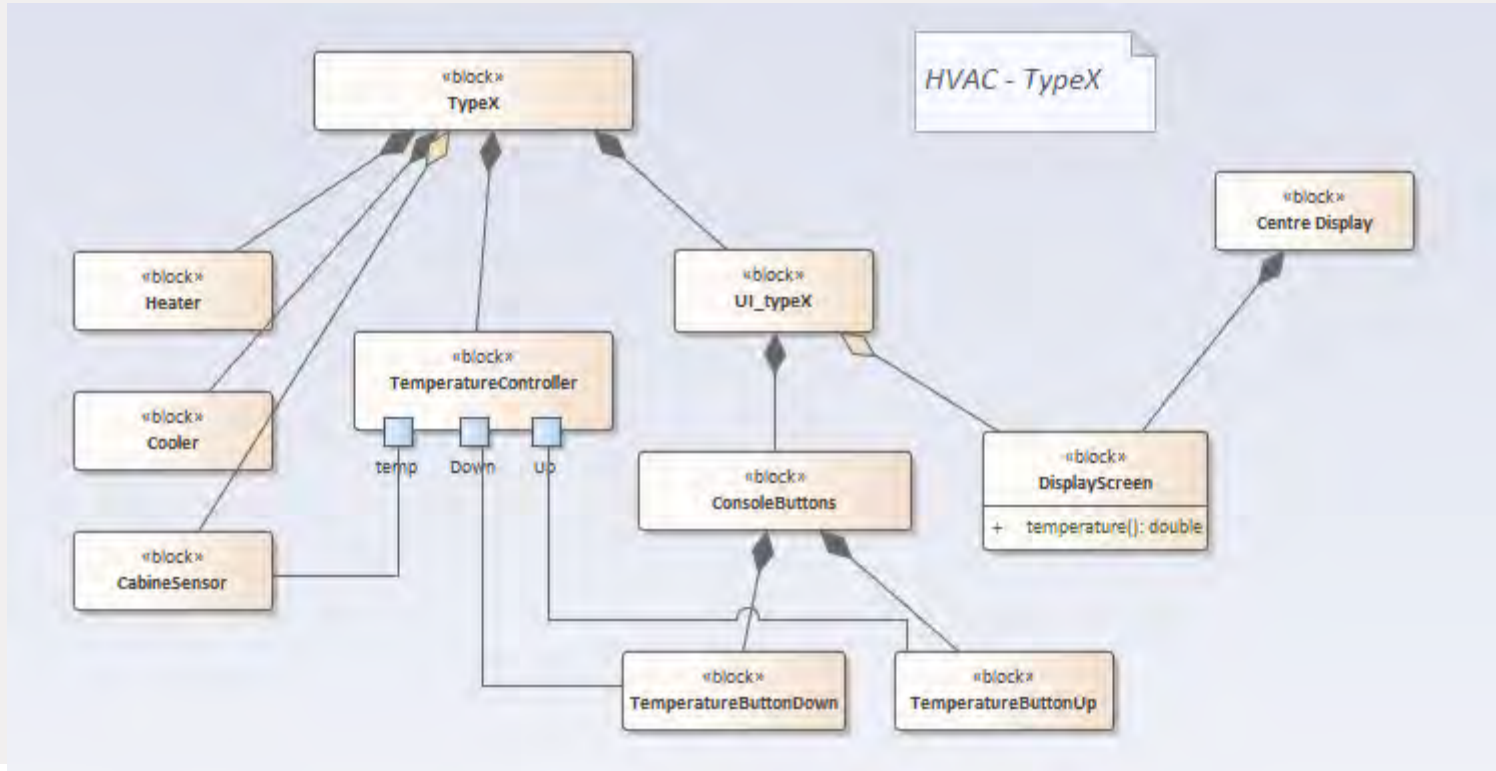
MBSE: e.g. SysML



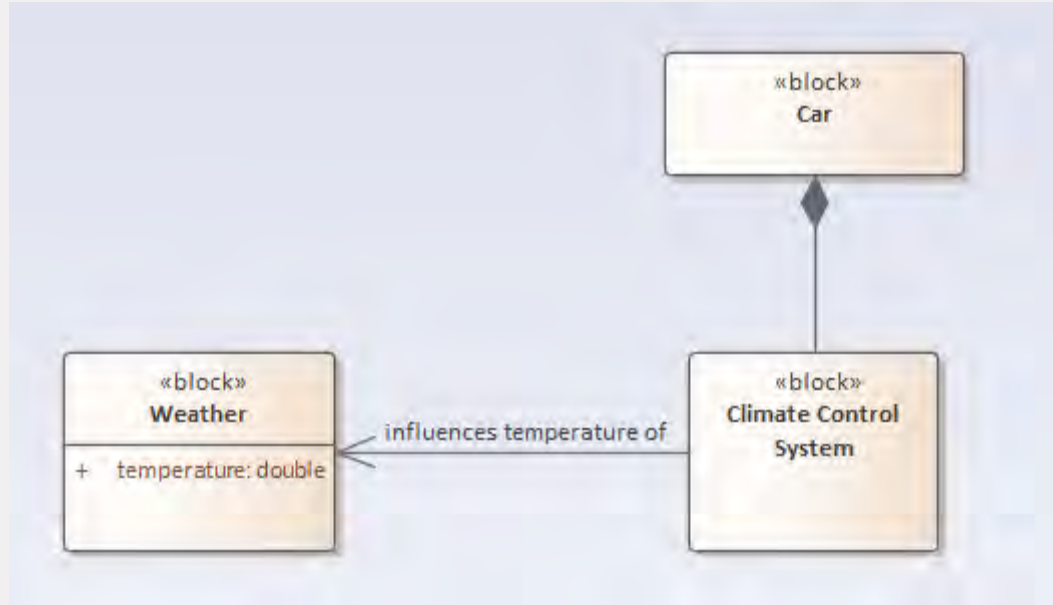
SysML



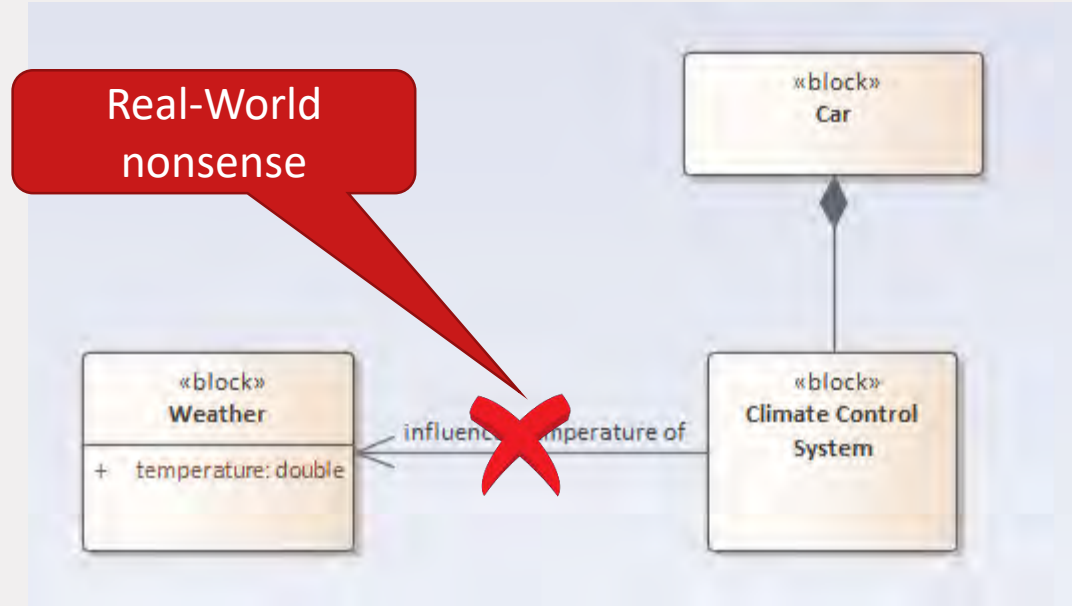
SysML



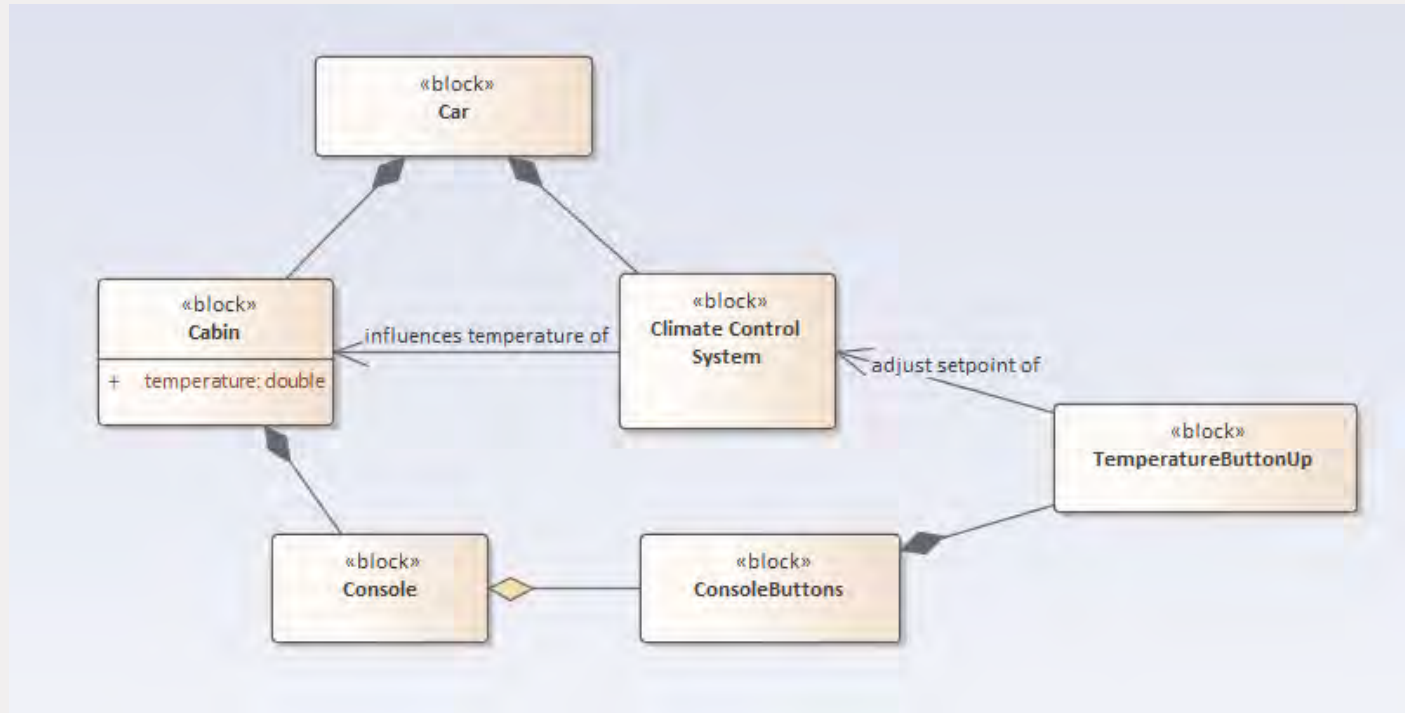
SysML?



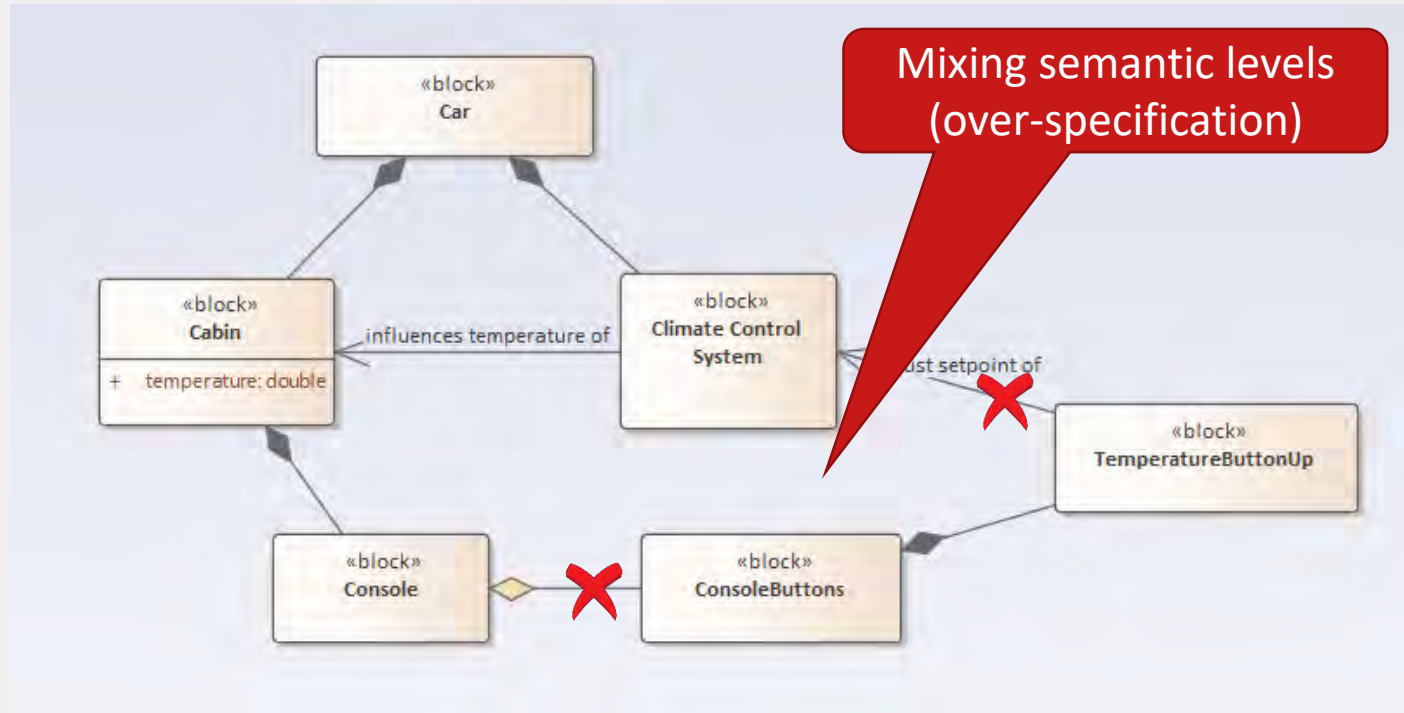
SysML?



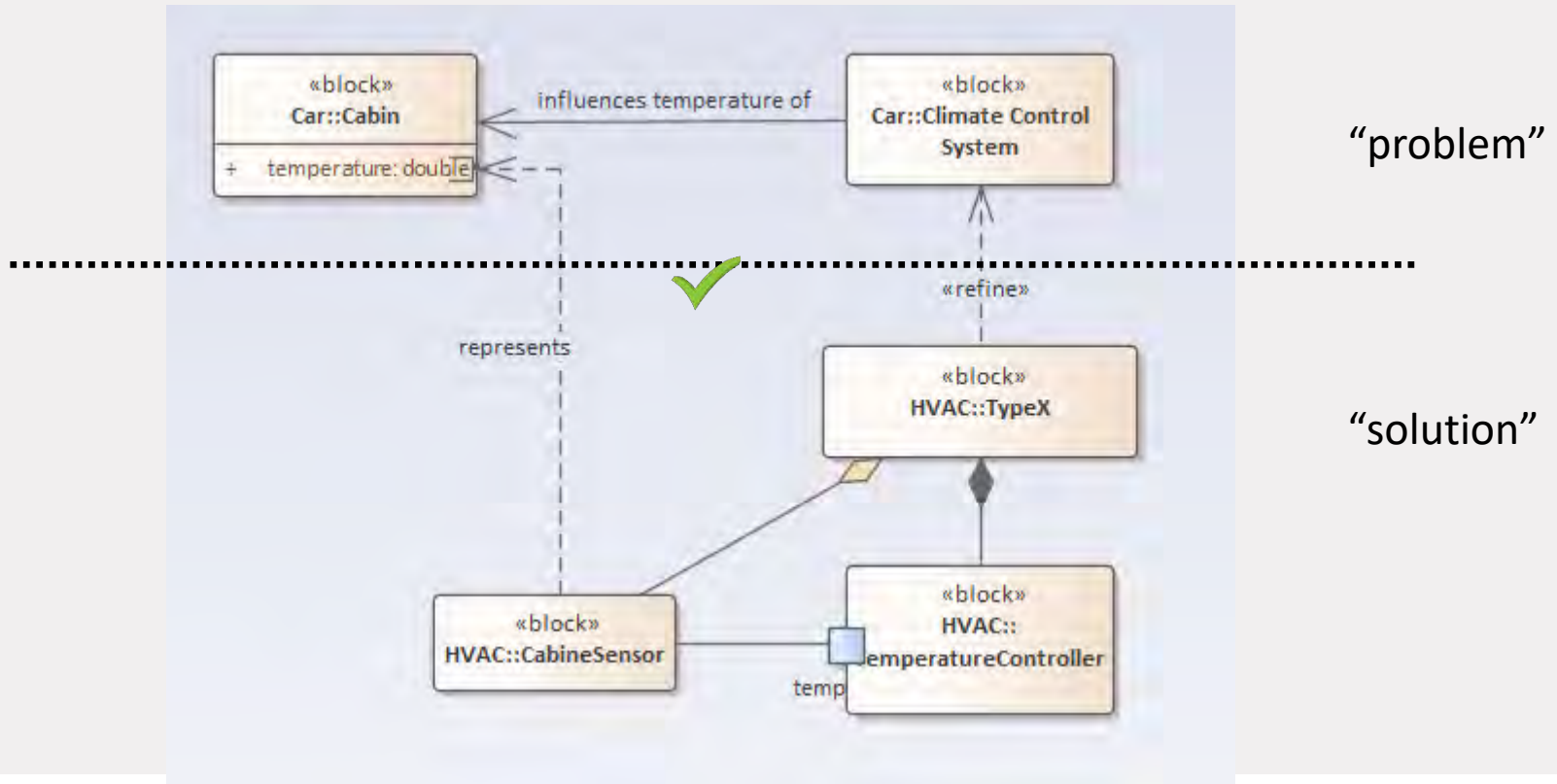
SysML?



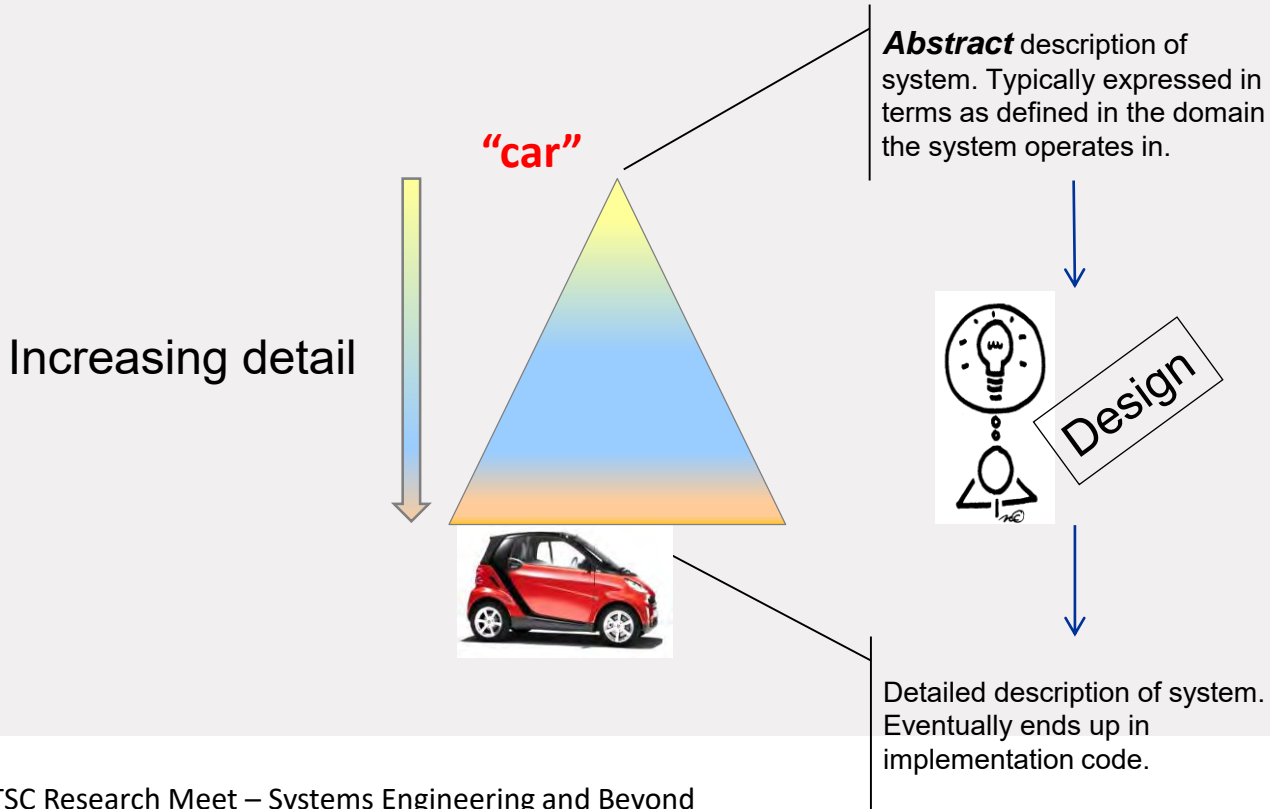
SysML?



SysML

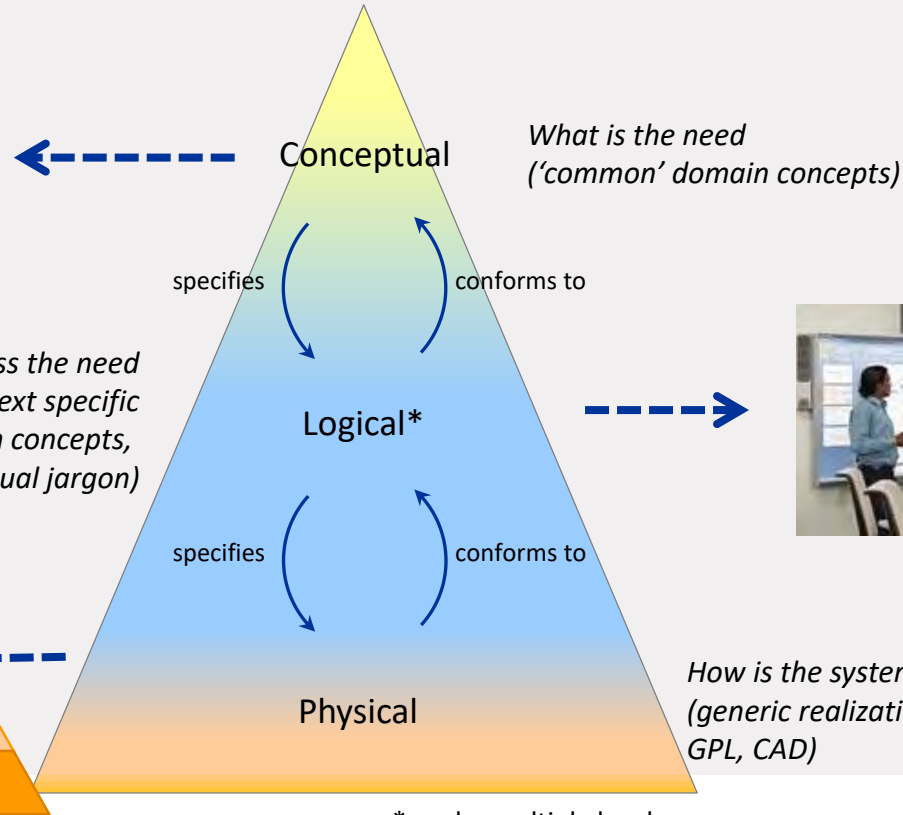


The Engineering Pyramid



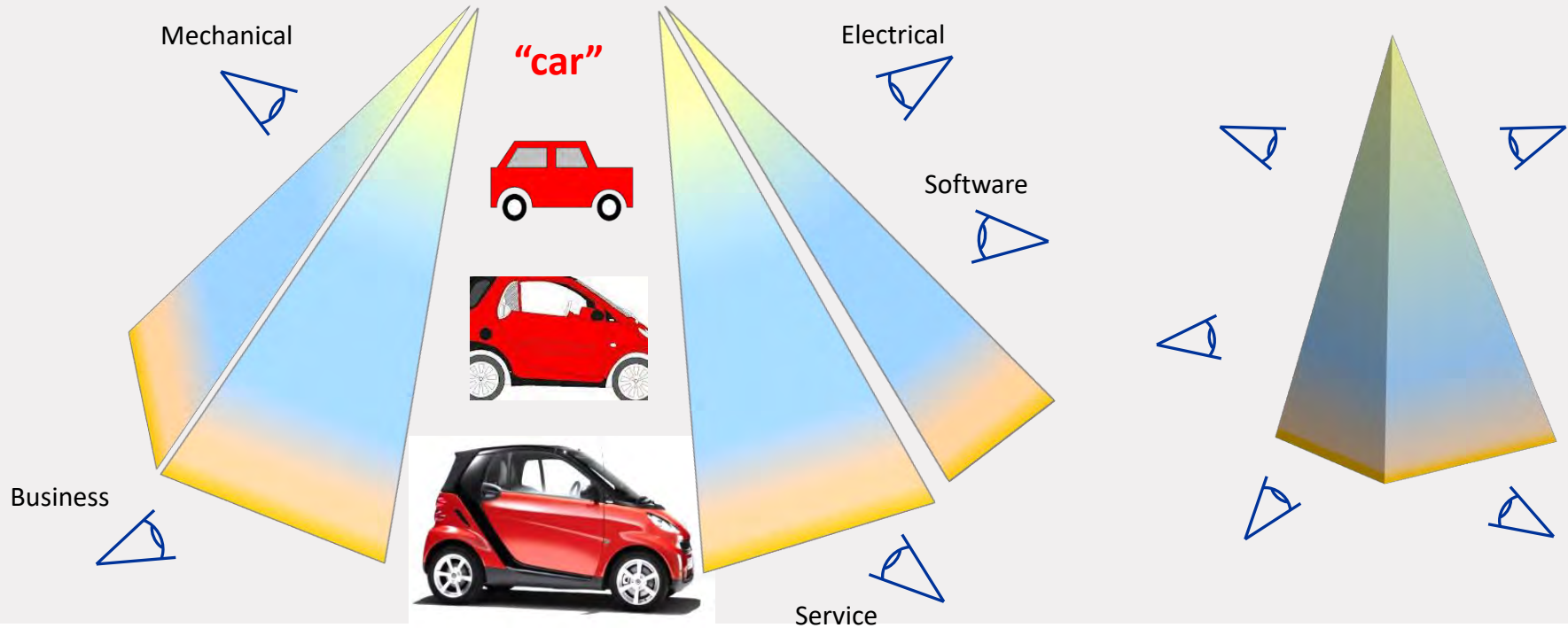
Engineering Abstractions

car
brakes
doors
engine
ADAS
HVAC



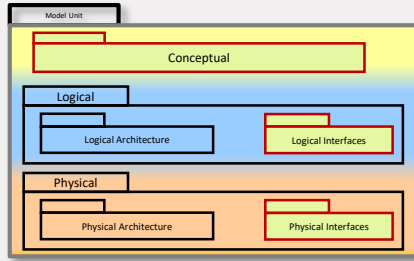
*can be multiple levels

Engineering Pyramid – Combined Viewpoints

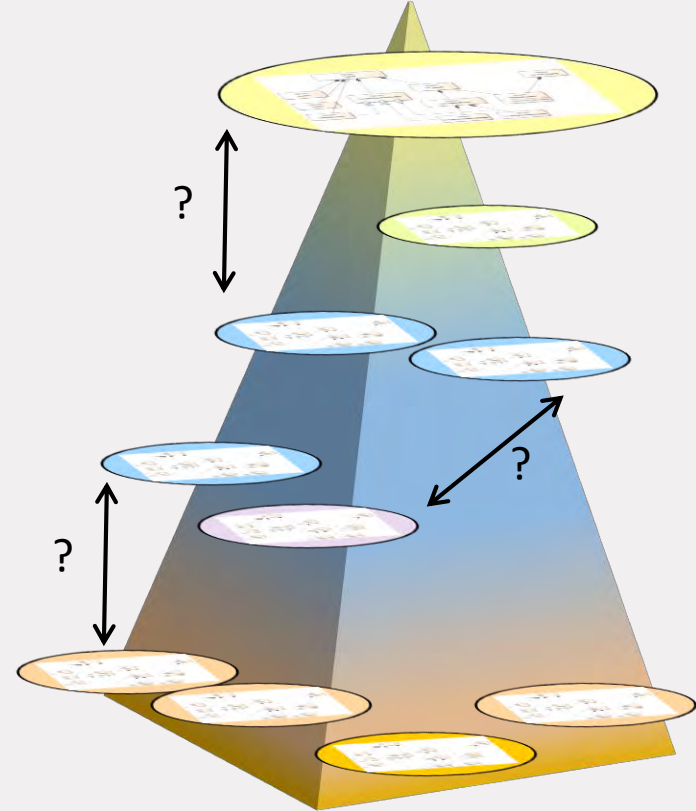
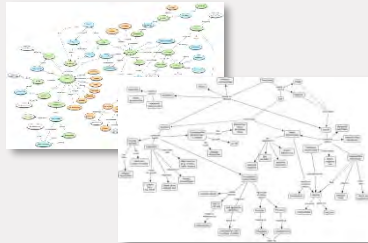


Organizing the Islands

Defined
Levels

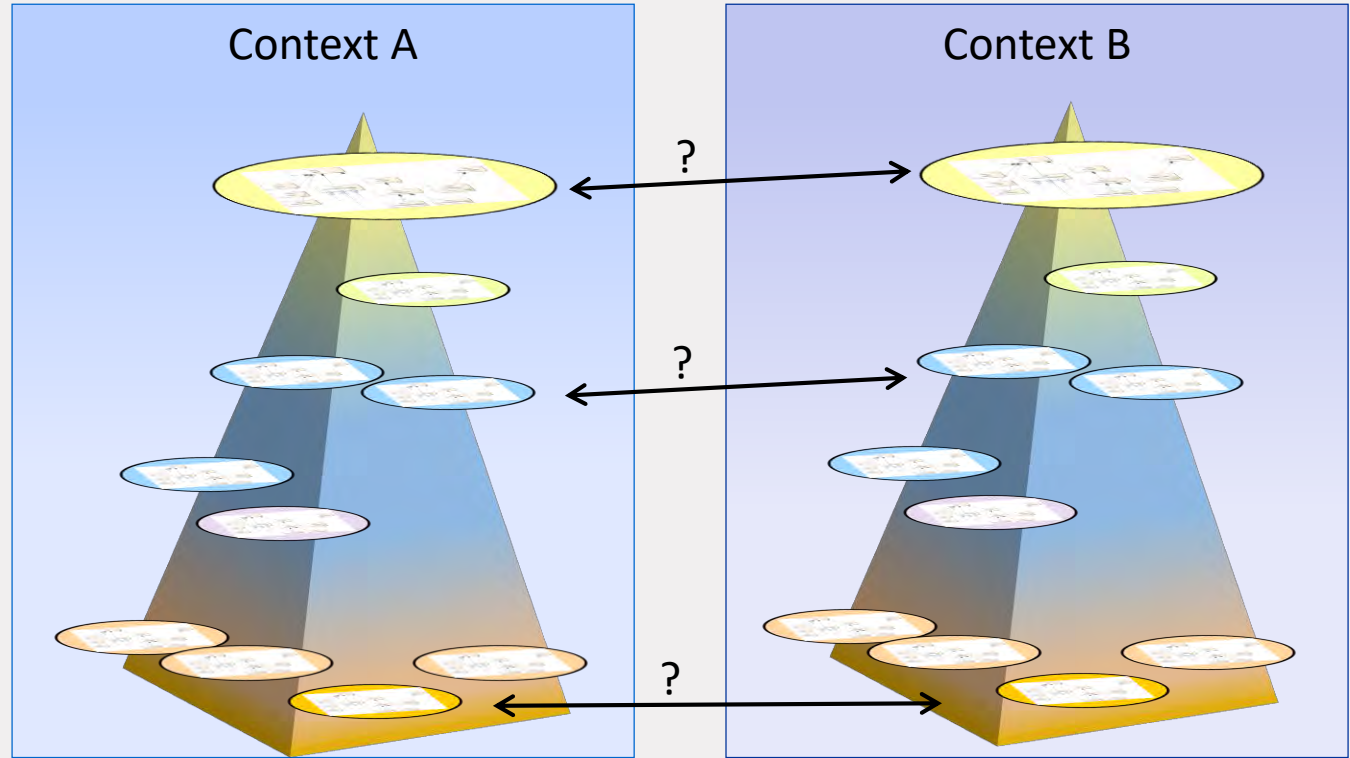
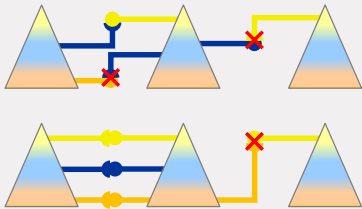


Ontologies



Ontologies Context

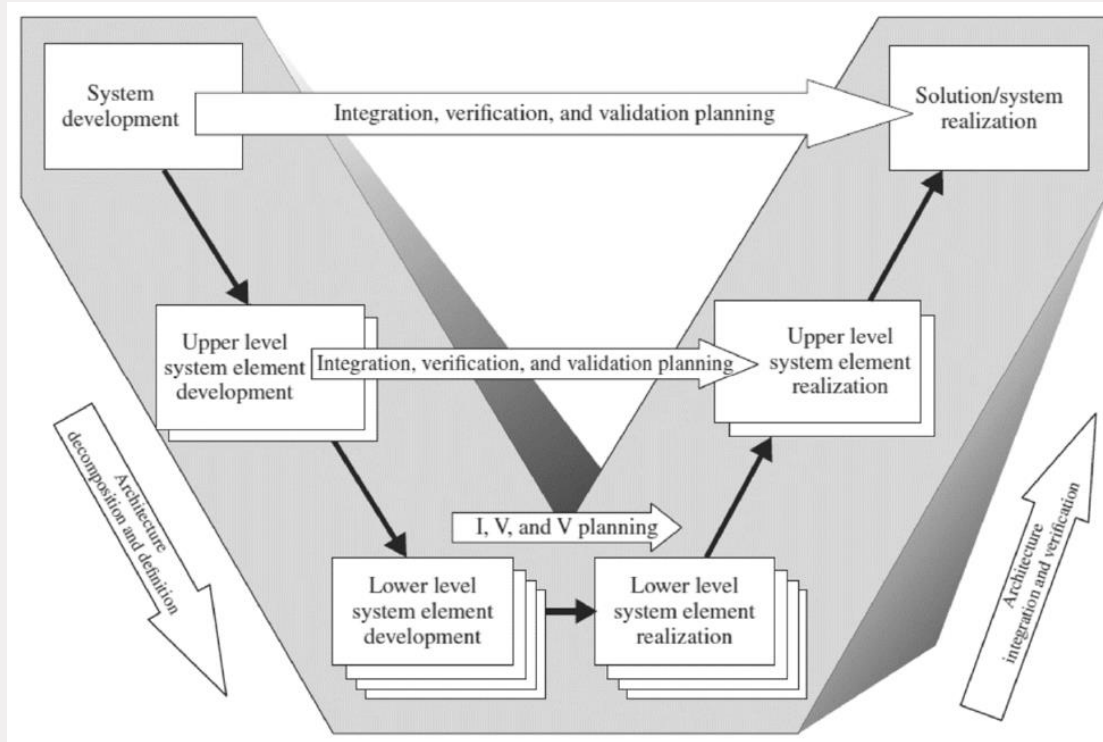
- Companies
- Departments
- Subsystems
- Disciplines
- ...



Engineering

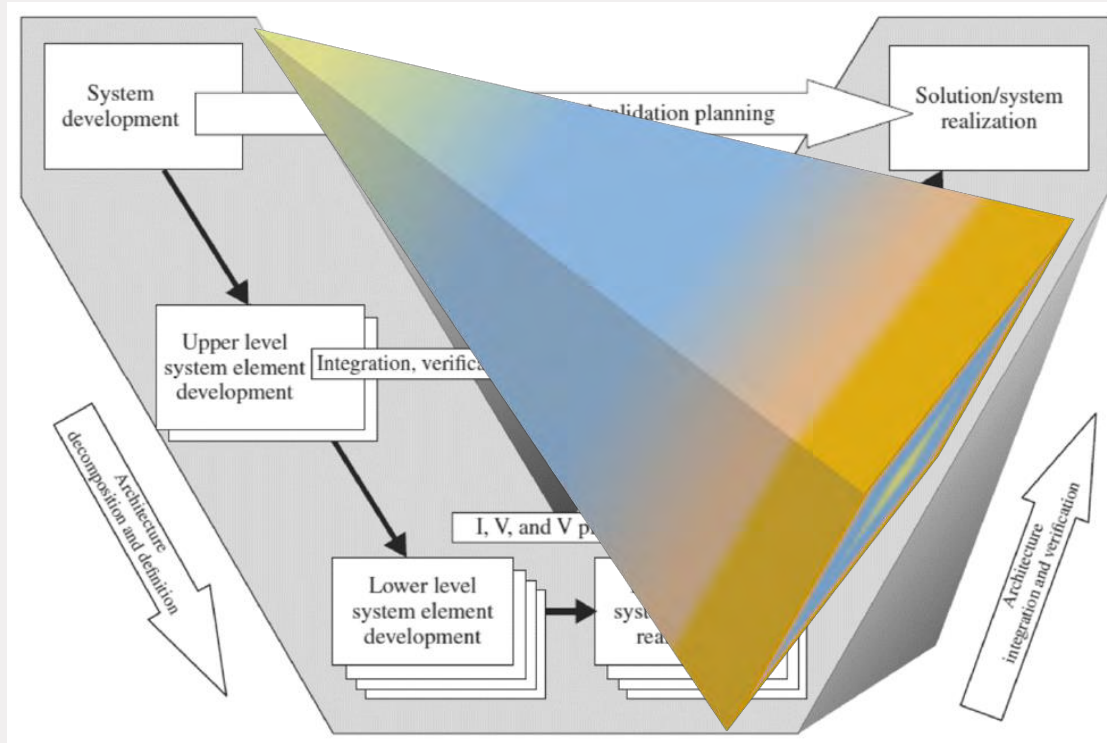
Engineering Pyramids and the V-Model

V-Model



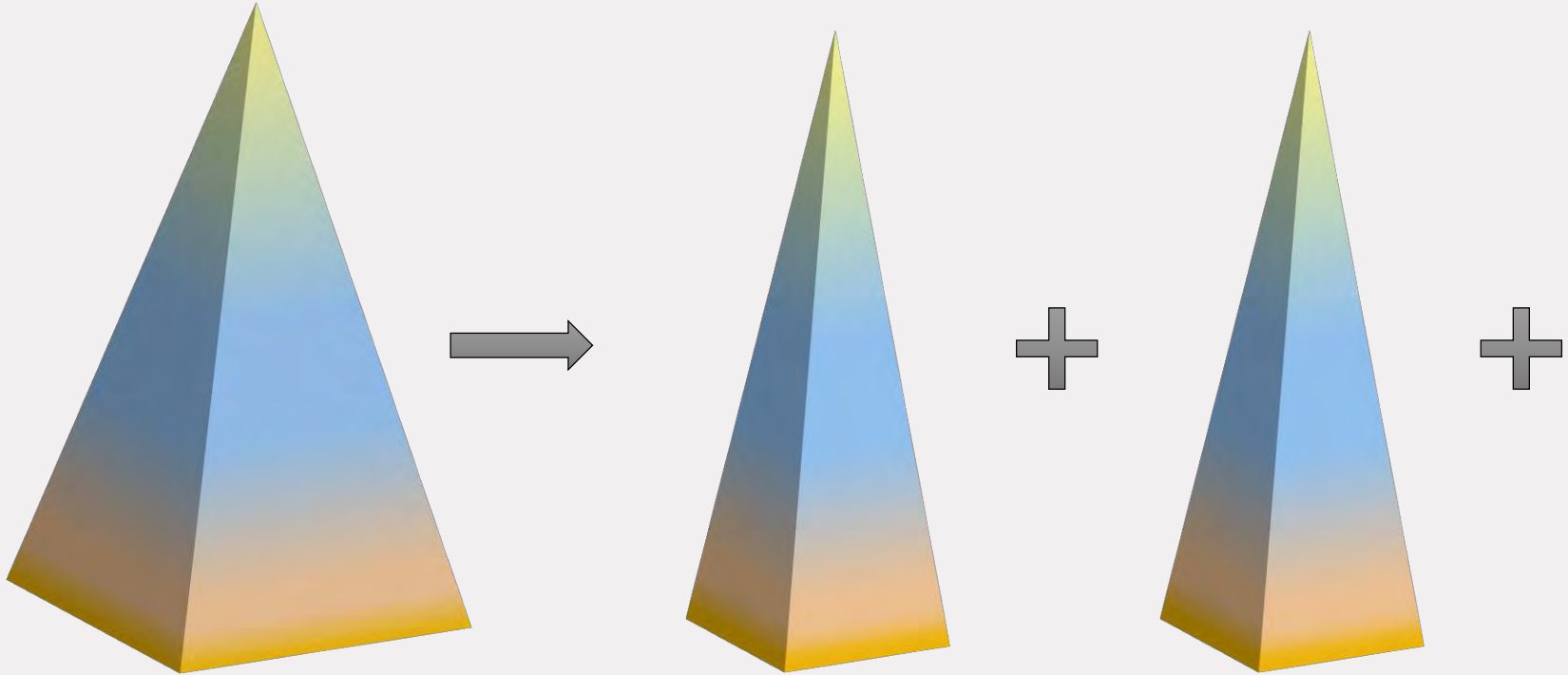
INCOSE
"Vee Model"
(2015)

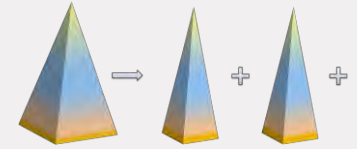
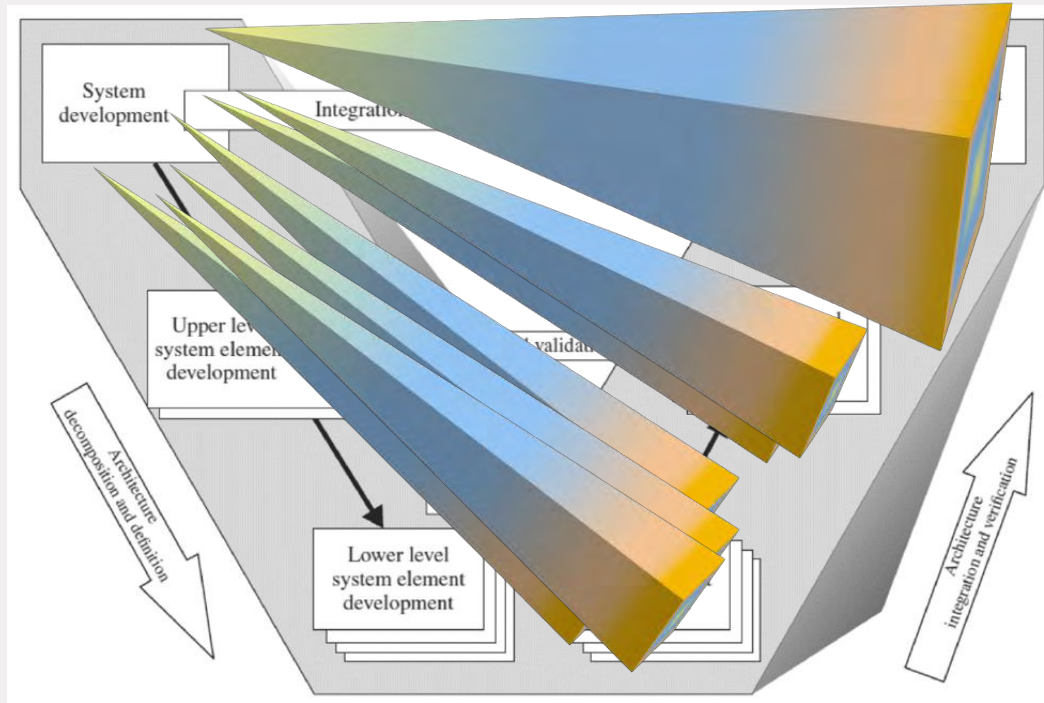
Pyramid and V-Model



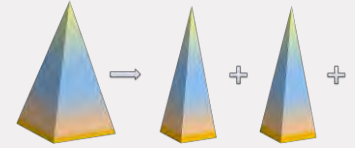
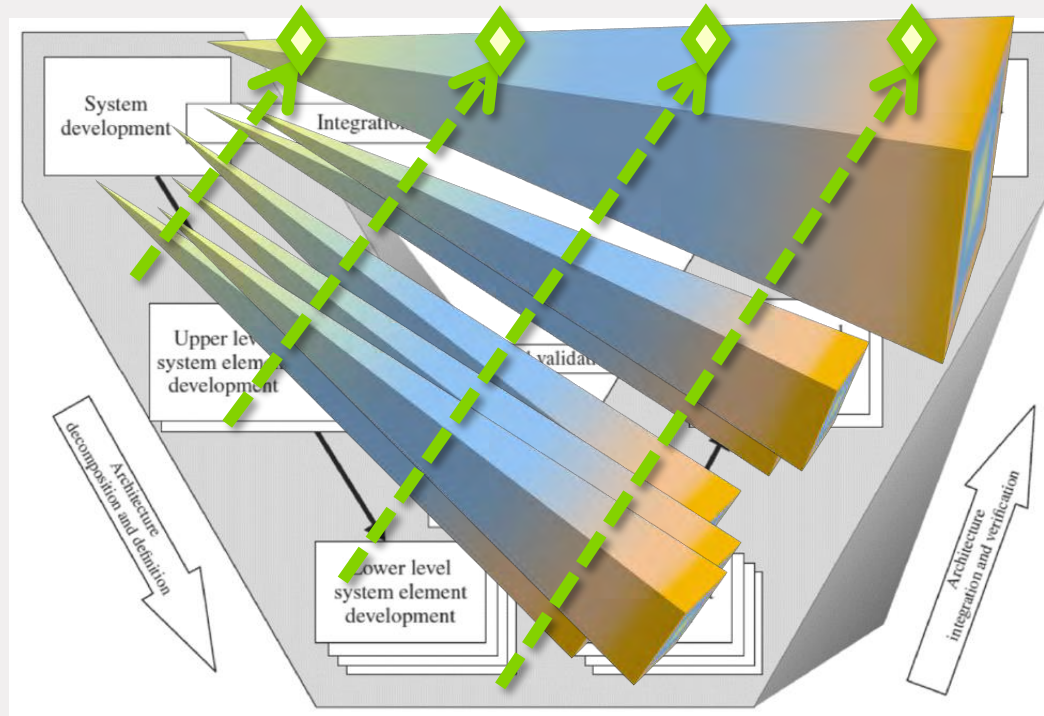
INCOSE
“Vee Model”
(2015)

Decomposition / Delegation

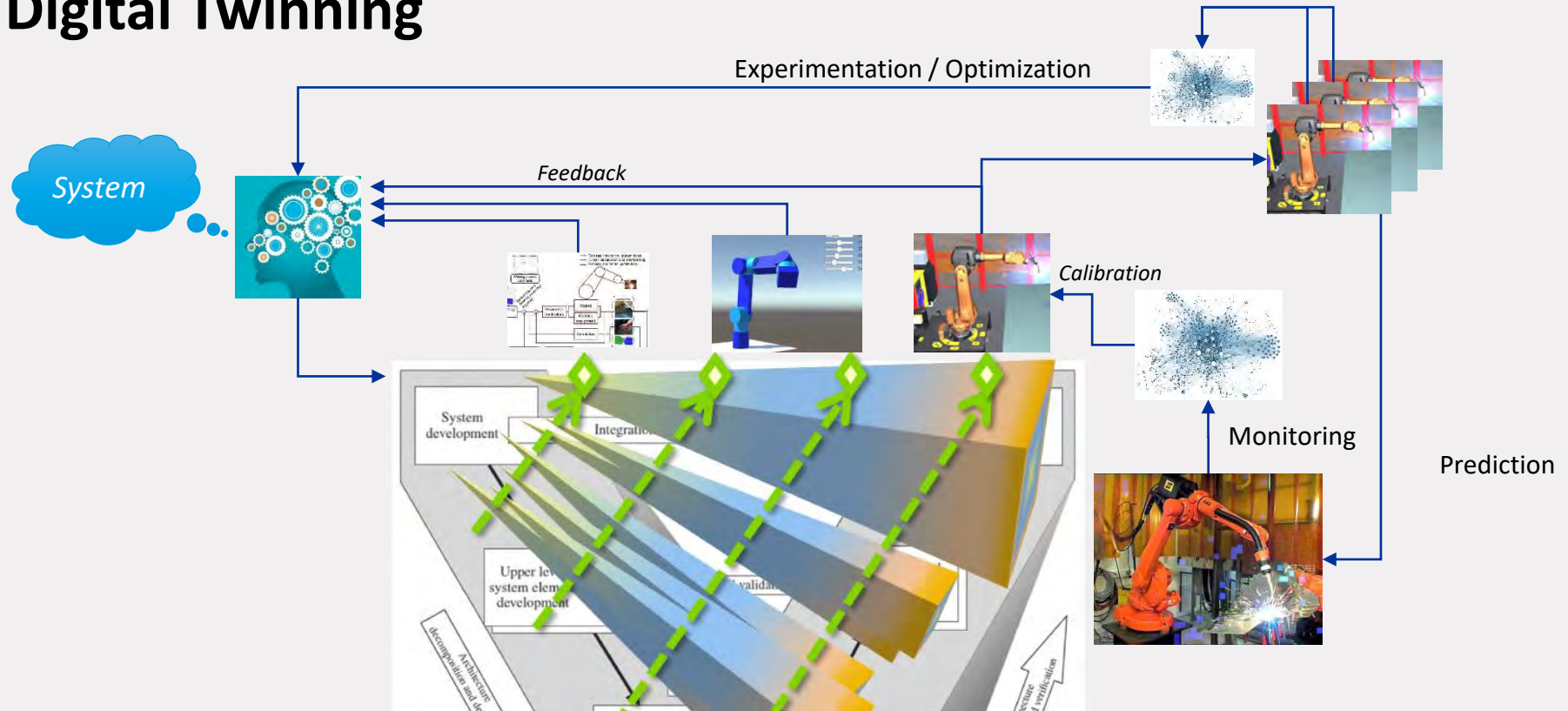




Early Analysis/V&V



Digital Twinning



(con)FuSE

The Future of Systems Engineering

Role of the System Engineer

System concepts

- Develop / standardize in system domain ontologies

Manage the Model/Data Integration process

- Identify the relevant domains
- Define the relations between models/data

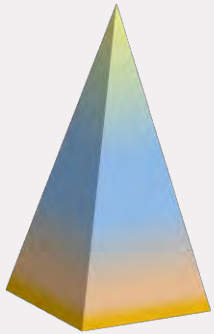
Integration is a continuous process

- Virtual integration -> Digital Twinning
- Analysis and V&V in early stages on integrated models

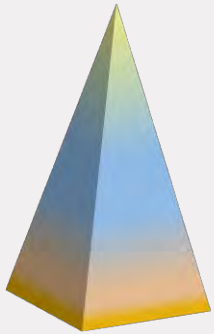
Digitization: *Systems engineering requires Engineering systems*

- The System Engineer becomes the Orchestrator

Systems Engineering?



Systems Engineering?



Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management

<http://www.keod.ic3k.org/>

Thank you!

Questions?