WHAT ROLE CAN MBSE PLAY IN THE HIGH-TECH EQUIPMENT INDUSTRY?

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MBSE – adoption and added value

October 6, 2020

An initiative of industry, academia and TNO

ESI

THE HIGH-TECH INDUSTRY

Semiconductor manufacturing equipment

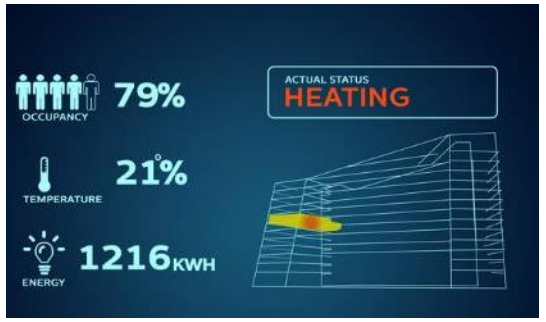
Medical systems

Food processing

Agricultural robots

Traffic management

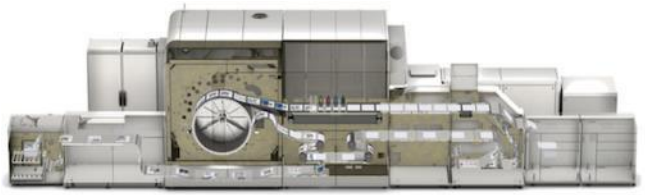
Electron microscopes



Building control

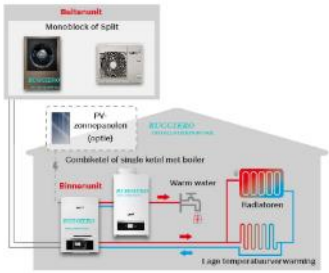
Robotized warehousing

Combat management systems



Industrial printers

Automotive

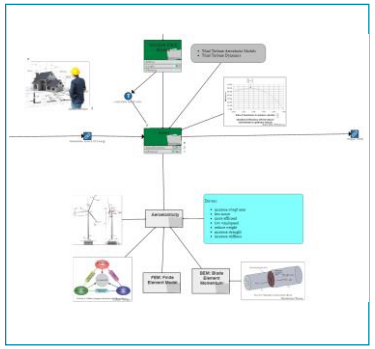


Residential heating/cooling

MBSE

Document-centric
Presentations and
Documents

Model-centric
Multi-user, tool-based,
Connected information



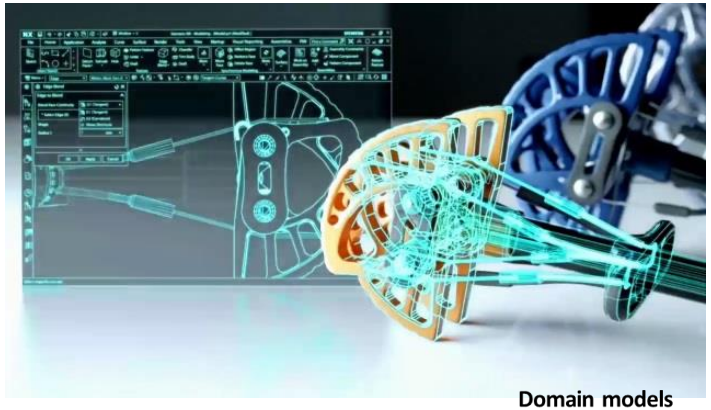
MBSE = Model-based Systems Engineering

The System Engineering methodology that focuses on creating and exploiting domain models as primary means of information exchange, analysis, simulation to design and manage effective systems over their full life cycles.

the interdisciplinary field of **engineering** and **engineering management** on how

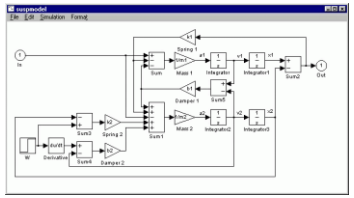
- Models are the authoritative, single source of Systems Engineering information for everyone.
- Models are not add-ons to documents.
  Documents (if used at all) are generated from the models.
- MBSE covers the full System Life Cycle (SLC)

MODELS ARE WIDELY USED IN SYSTEMS ENGINEERING



Domain models

Automated transformations



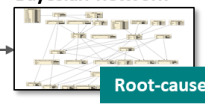
Causal graph

Expert knowledge exchange

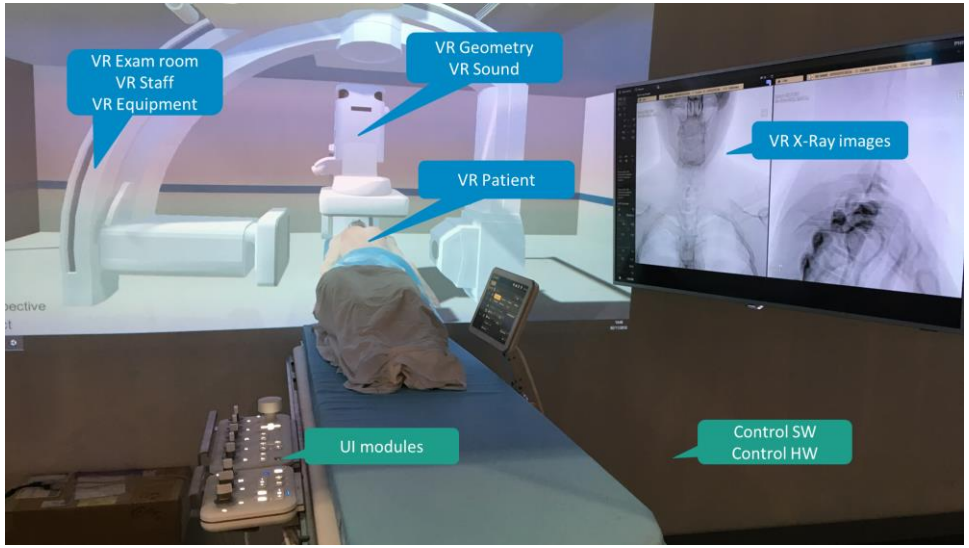
Fishbone

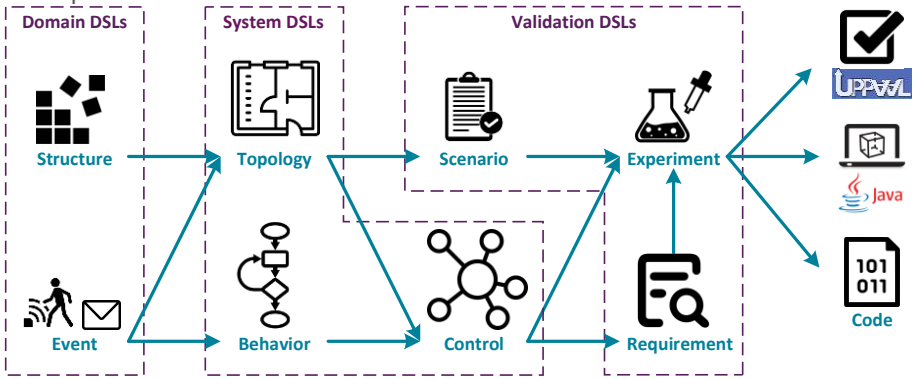
Root-cause analysis

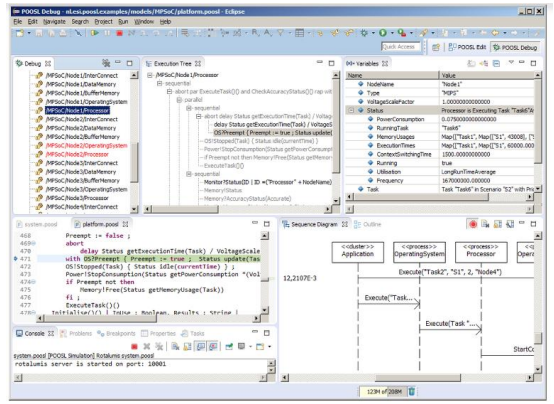
Bayesian network



Root-cause analysis

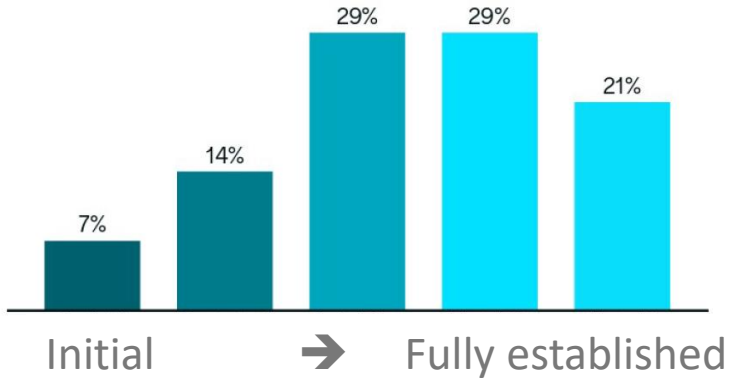




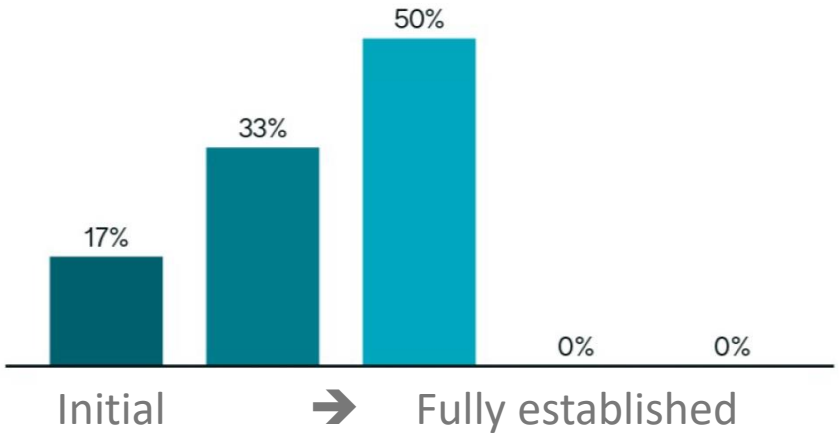


SE IS ESTABLISHED – HIGH TECH EQUIPMENT INDUSTRY IS EXPLORING MBSE

Where is your organisation with respect to SE in general?



Where is your organisation with respect to MBSE?



Missing: the cookbook to achieve value and RoI

DEMYSTIFYING MBSE – A STUDY BY ESI AND PARTNERS

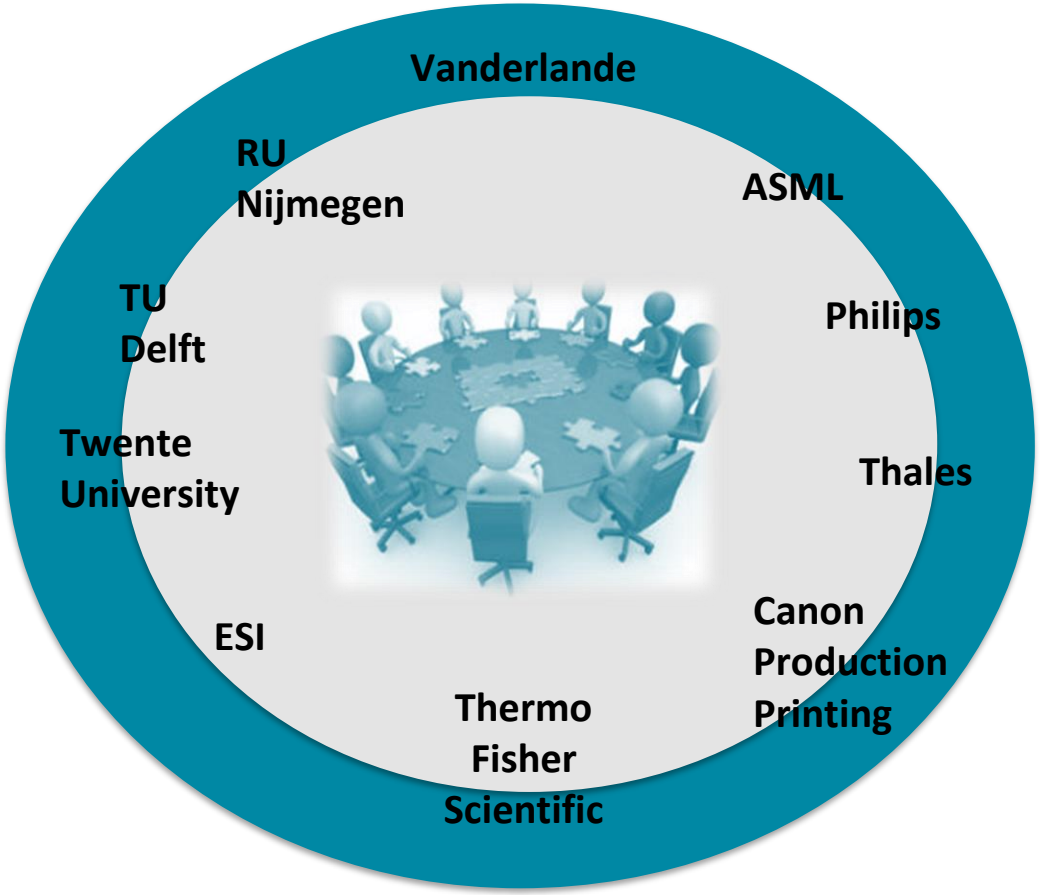
"MBSE tools are developing fast.
It is necessary to keep up-to-date experience."

MBSE study objective

- **Assess and learn together** whether and how MBSE provides a handle towards increasing system complexity

Today

Initial report on needs and investigation topics



MOTIVATION FOR INVESTIGATION MBSE IN HIGH-TECH EQUIPMENT INDUSTRY

- Cope with increasing complexity
- Knowledge management, transfer, and personnel know-how
- Communication
- Re-use and platform development
- Process and quality improvement

“Current solutions are made so complex over the lifecycle we are an enemy to ourselves”

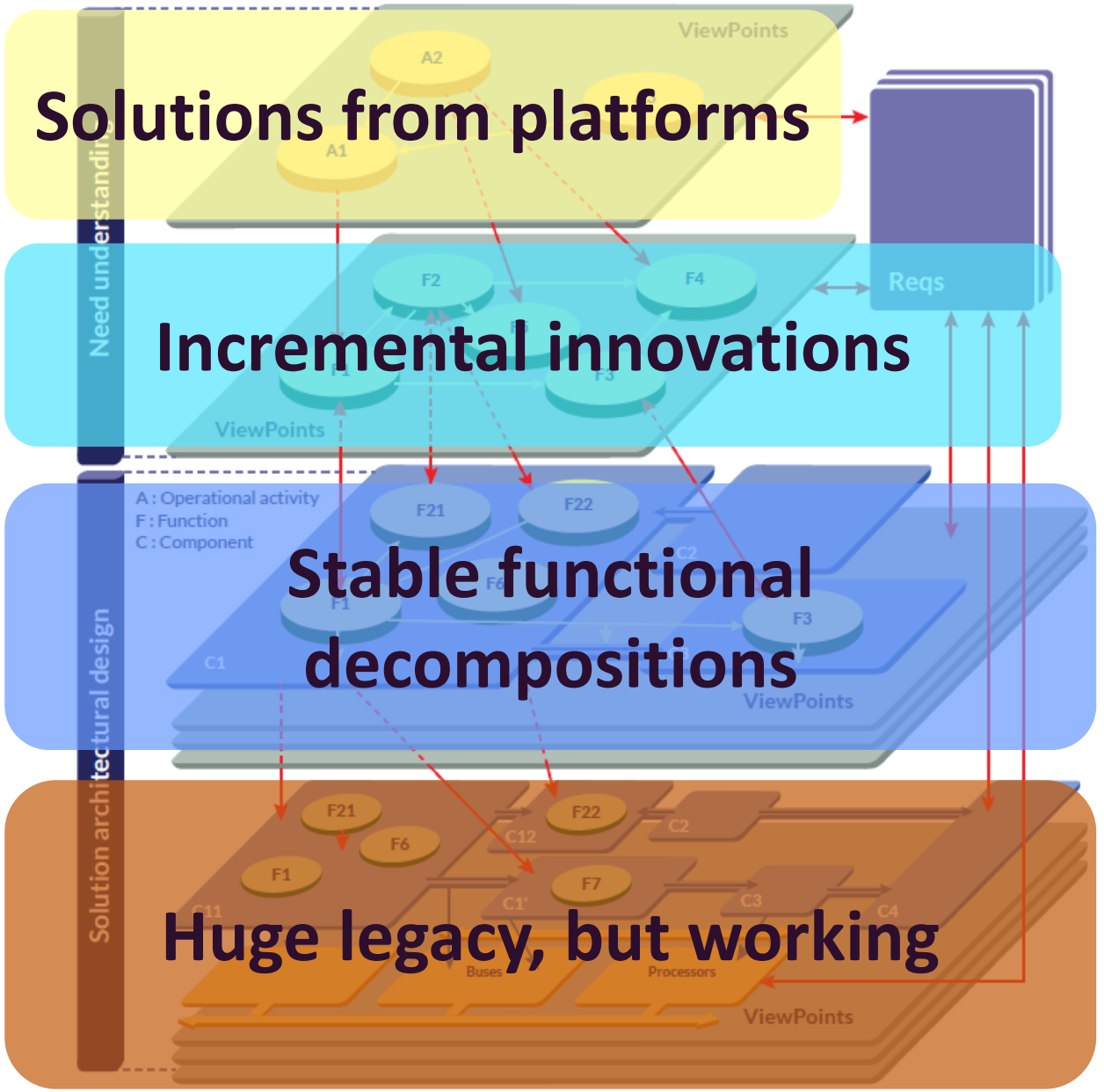
HIGH-TECH R&D

VERSUS

MBSE

(ARCADIA)

Large and growing SW content



Operational Analysis
What the users of the system need to accomplish

Functional & Non Functional Need
What the system has to accomplish for the users

Logical Architecture
How the system will work to fulfill expectations

Physical Architecture
How the system will be developed and built

INVESTIGATION TOPICS FOR MBSE IN THE HIGH-TECH EQUIPMENT INDUSTRY

1. Support incremental, brown field development
2. Address large need for knowledge management and knowledge transfer
3. Connect SW to Systems Engineering
4. “Configure-to-Order” solutions from platforms

1955

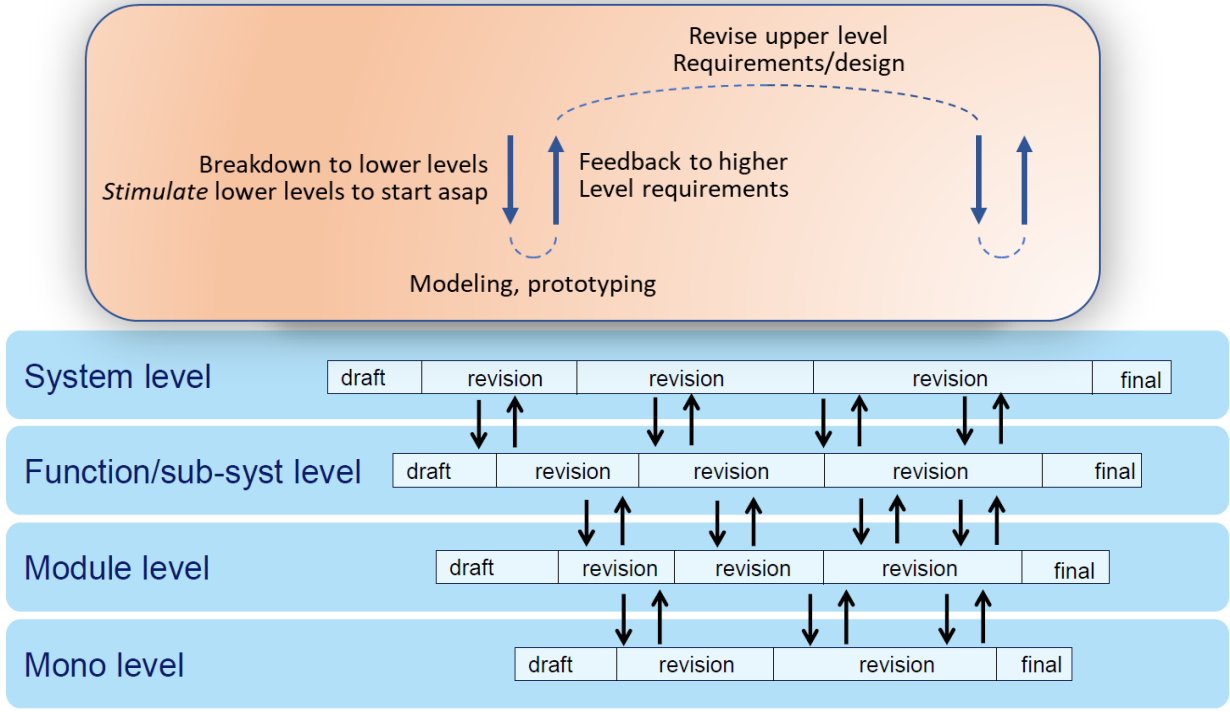
Over many generations

2020

INVESTIGATION TOPIC 1.
CAN MBSE BE EFFECTIVE IN INCREMENTAL AND CONCURRENT ENGINEERING?

MBSE with long living systems and assets

- Fast development cycles
- Increments are less than 10% new , over 90% stays the same
- The previous system is available
- Many legacy assets without models



"High-Tech industry vs MBSE: risk-hungry vs risk-averse"

Concurrent engineering (ASML)

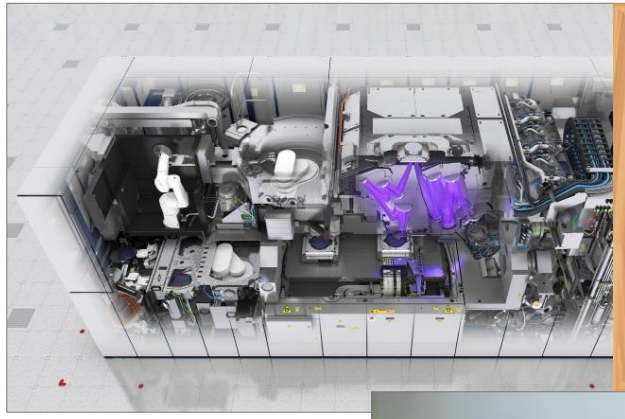
INVESTIGATION TOPIC 2.
CAN MBSE SUPPORT KNOWLEDGE MANAGEMENT & KNOWLEDGE TRANSFER?

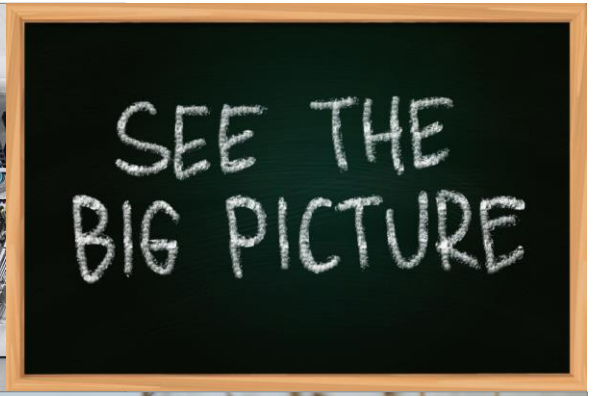
Reduce dependency on experienced people

How to apply MBSE to:

- Provide overview/oversight system
- Capture knowledge in a transferable way for systems with long lifetimes
- Enable impact assessment of change requests
- Reduce learning curve for new people, attractive to new talent and recruiting

“Improve quality and accelerate time-to-market by really understanding your product over generations”





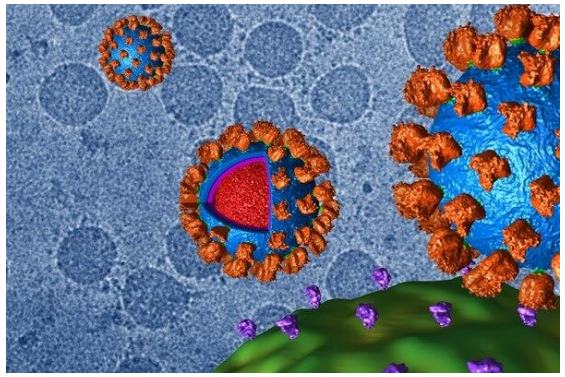
INVESTIGATION TOPIC 3.
HOW TO CONNECT SW TO (MODEL-BASED) SYSTEMS ENGINEERING?

SW sees the most rapid innovation

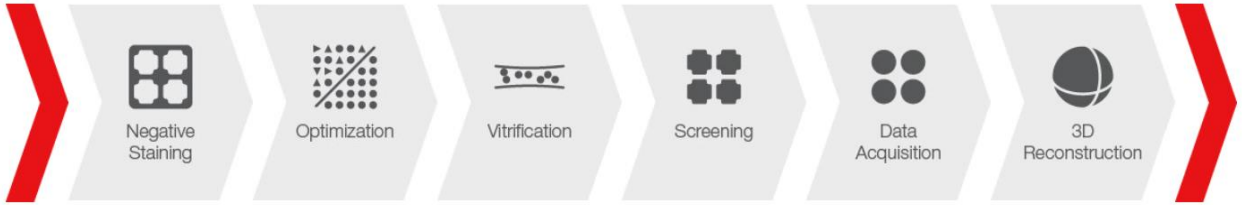
How to mix SW into Systems Engineering with MBSE

- How to link SE and SW models
- How to prove that SW services deliver the solution
- Integration of cloud and data analytics

"Terabytes of data from tens of thousands of particle views must be processed to achieve 3D reconstruction"



3D reconstruction



TFS Electron Microscopy: data and SW intensive workflow

INVESTIGATION TOPIC 4.
MBSE FOR CONFIGURE-TO-ORDER SOLUTIONS OUT OF PLATFORMS

“Configure to order” requires two MBSE approaches

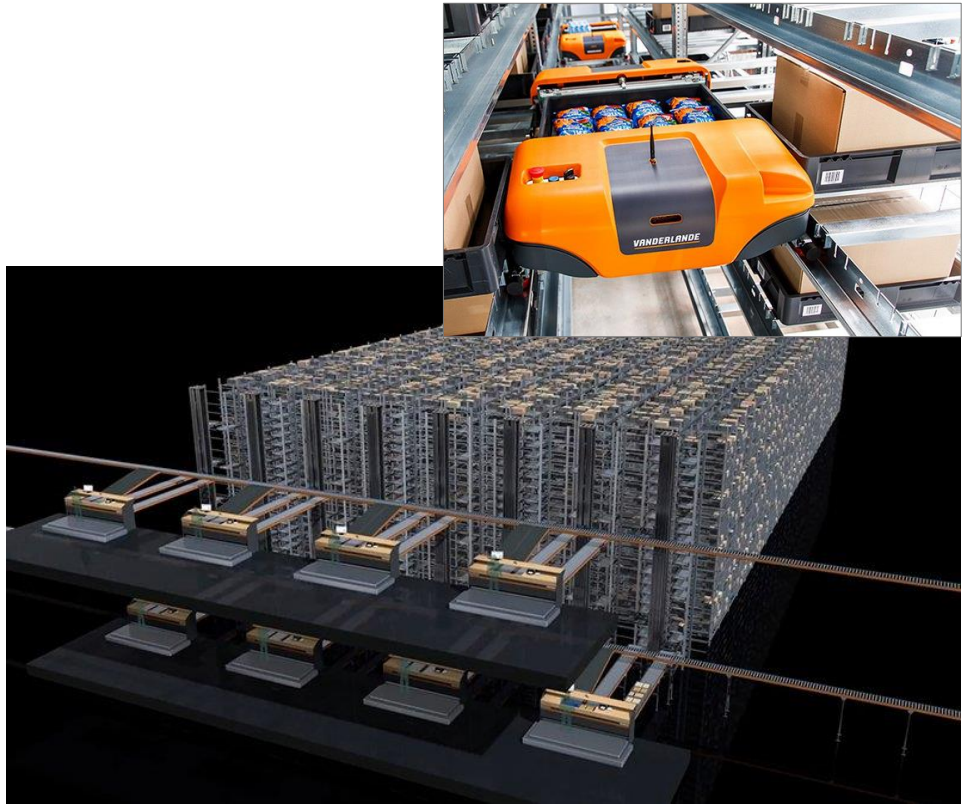
MBSE for a platform:

- Modelling a configurable, modular and reusable asset repository with enablers

MBSE for a solution:

- Modelling a system with user needs/requirements, an integrated behavior & structure, and additional emergent behavior

“MBSE to manage complexity vs MBSE to hide complexity”



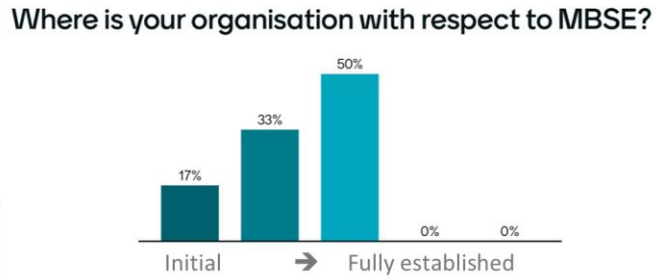
Scalable robotised warehouses

SUMMARY

*"Improving **system oversight,** and improving **legacy / diversity management** are what makes MBSE interesting"*

Key MBSE investigation topics identified

- MBSE for incremental, brown field development
- Support knowledge management and transfer
- Connect SW, data to Systems Engineering
- "Configure-to-Order" solutions from platforms



Join us in April 2021 at the ESI symposium where we will share an update

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