



Enhancing Industrial Equipment Reengineering with Model-Based Systems Engineering

Capella Days 2024



Jesko Drewes



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Speakers



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Agenda

	Topic	Presenter
1	Introduction	Jesko
2	Quality Test Machine (QTM)	Cedric
3	Reengineering of Industrial Machinery	Jesko
4	Actual State of QTM	Cedric
5	Target State of QTM	Jesko
6	Solution Exploration and Decision	Cedric
7	Transfer to Industrial Machinery	Jesko

SIEMENS

Industrial Business

Digital Industries



Smart Infrastructure



Mobility



Siemens Healthineers¹



Portfolio Companies



Siemens Advanta



Siemens Financial Services



Services

Siemens Real Estate



Global Business Services



¹ Publicly listed subsidiary of Siemens; Siemens' share in Siemens Healthineers: 75%

Digital Industries



77,000 employees¹



€ 21,9 billion in revenue²



Software (industrial)
#1 market position



Factory Automation
#1 market position



Motion Control
#1 market position



Process Automation
#2 market position



Customer Services

¹ As of September 30, 2023 | ² For fiscal 2023

Digital Enterprise Experience Center – Our Showroom



Munich

Workshops

Host internal and external workshops

Experience

Experience the Software Portfolio of Siemens Digital Industries Software

Discuss solutions

Discuss Siemens solutions across the life cycle



Broadcasting

Virtual conferences and video shoots

Tour

Book a tour to experience the Digital Universe of Siemens

Demonstrate

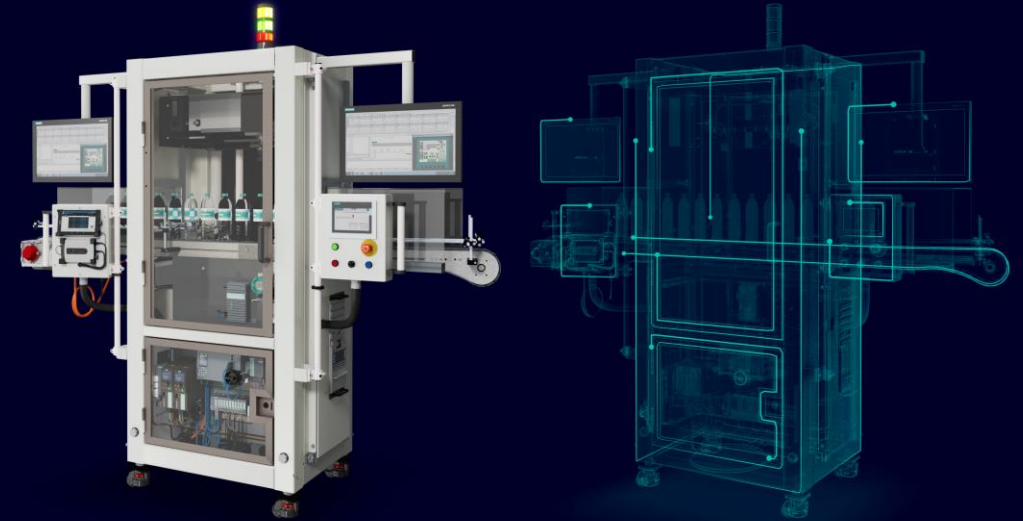
Demonstrate the Digital Industries of tomorrow

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Quality Test Machine

- Main exhibit in Digital Enterprise Experience Center
- manufactured for fair by industrial machinery partner
- build out of Siemens components
- used for 5 years in our showroom
- Key Functionality: testing if bottles are leak-proof



Currently under update to show state-of-the-art solutions for Engineering, Manufacturing and Service

Missing functions of the Quality Test Machine



Missing production data



Missing connectivity



Error in automation

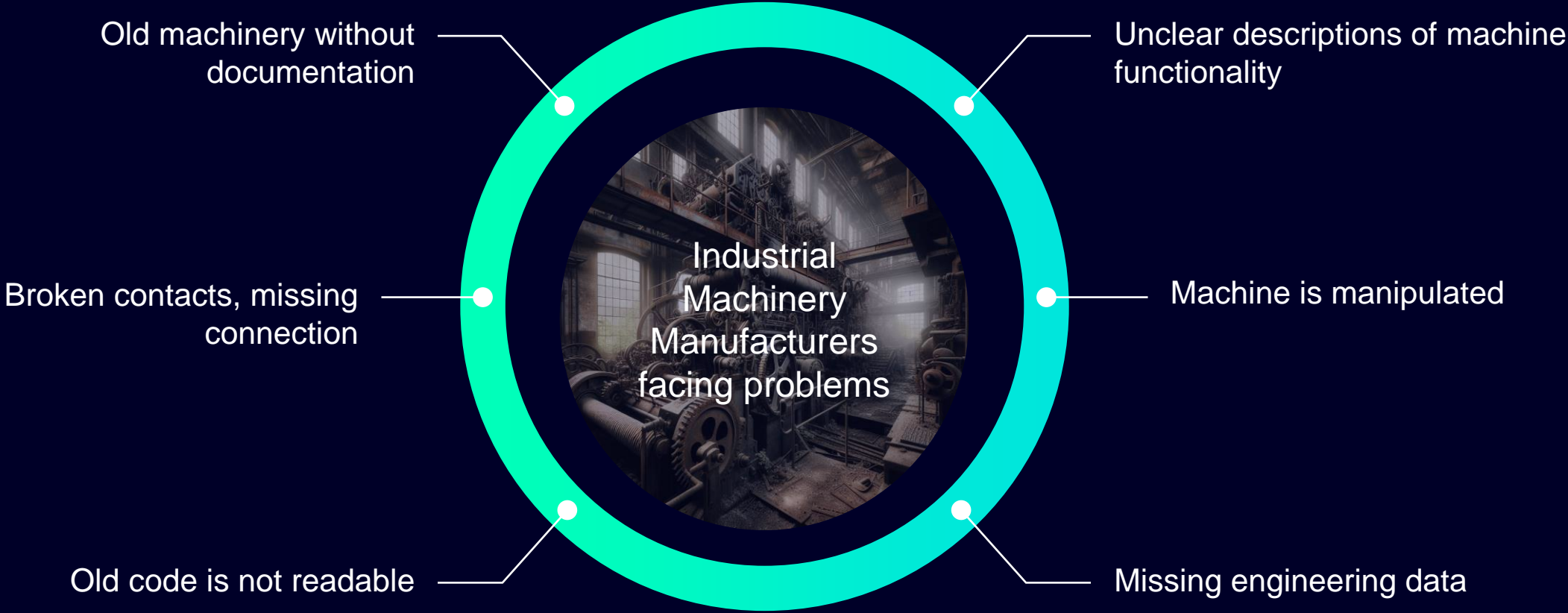


No maintenance possible

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Problems in Reengineering



How can model-based Systems Engineering support Reengineering?



Connect the status quo with the machine update



Clear description of the system functions



Better understanding of the problem



Clear responsibilities for the reengineering process



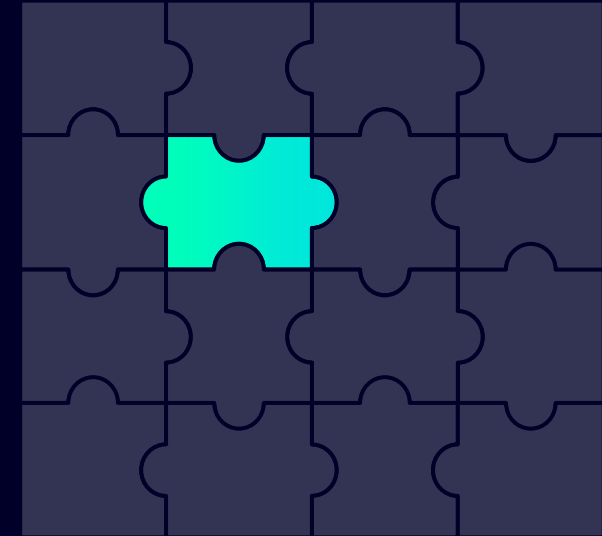
Document decisions



Enhance System Quality and Performance



Risk reduction for the Reengineering Project



Reengineering with model-based Systems Engineering



- Create system understanding
- Create a standardized picture of the system

- Define needed functionalities
- Adopt actual system state
- Develop a holistic view of the system

- Organize system logically
- Orient the system towards the solution

- Implement specific solutions in the structure
- Checking the holistic solution approach

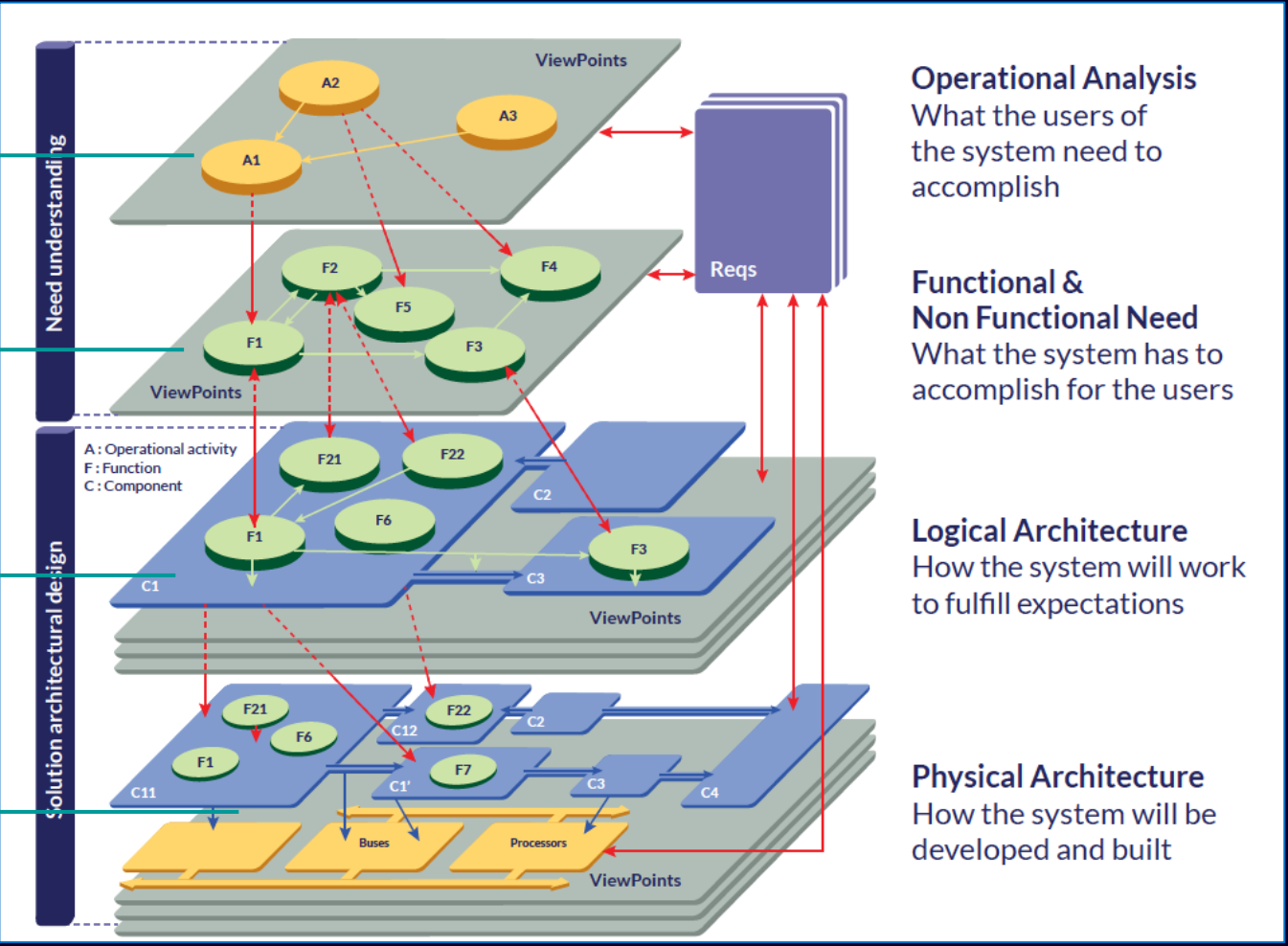
Adapting ACARDIA for Reengineering

Model the current state of the machine including functions and components

Model the target functions of the system adopting current functions

Model the target logical components reusing current components

Model the target physical components



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

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Modeling the actual state with Model-Based Systems Engineering

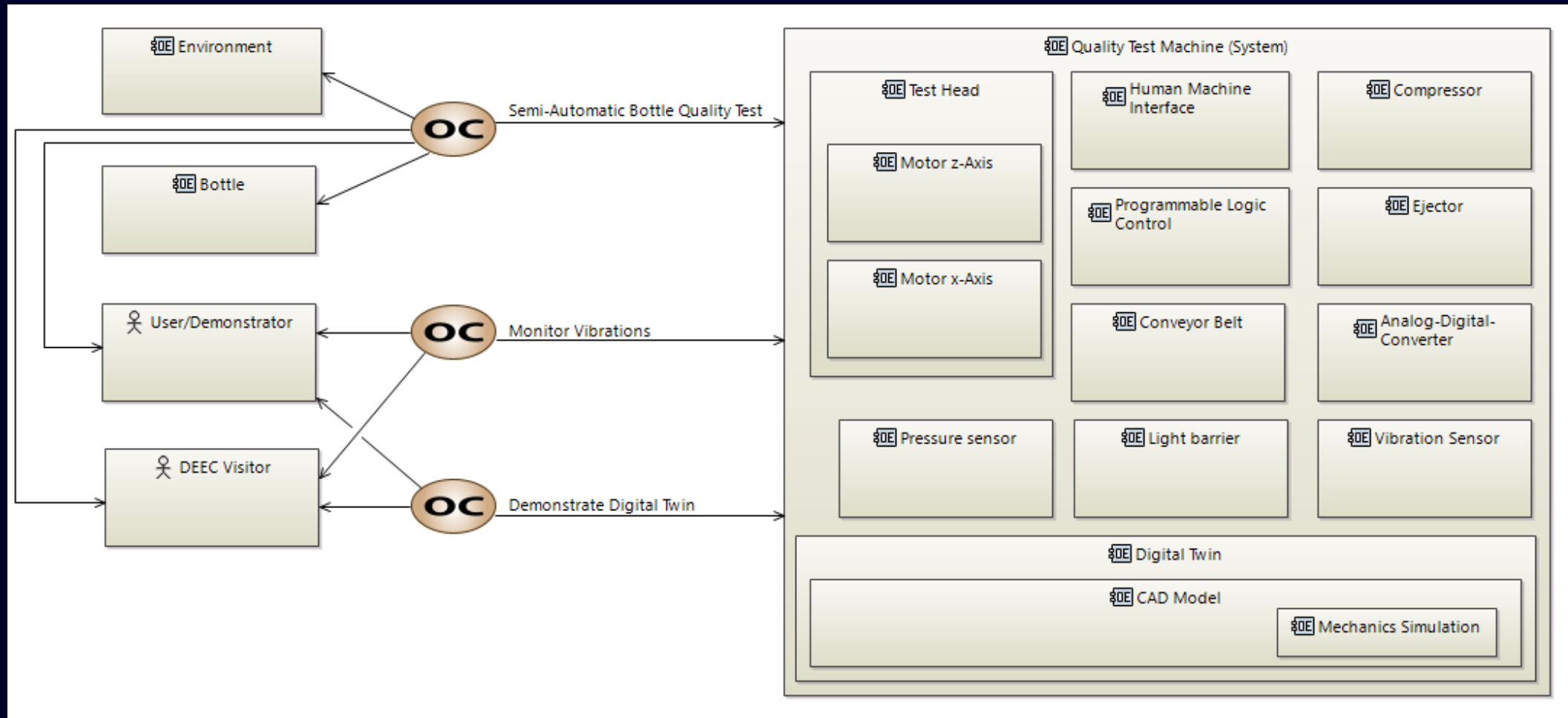


- Develop a general understanding, what current machine is doing
- Understand who is involved in the project
- Define known system components
- Assign functions to the known system components
- Find missing components



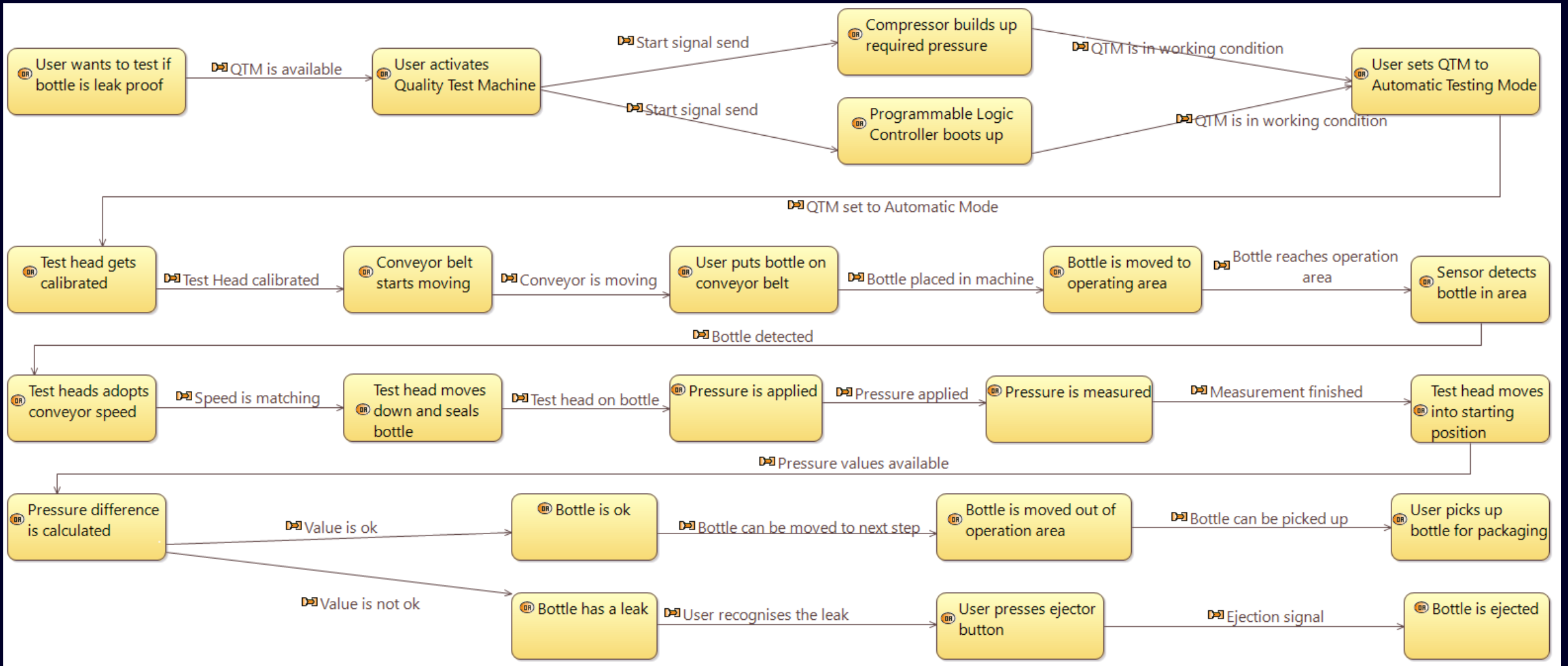


Modeling the actual state with MBSE – Capabilities, Actors, Entities



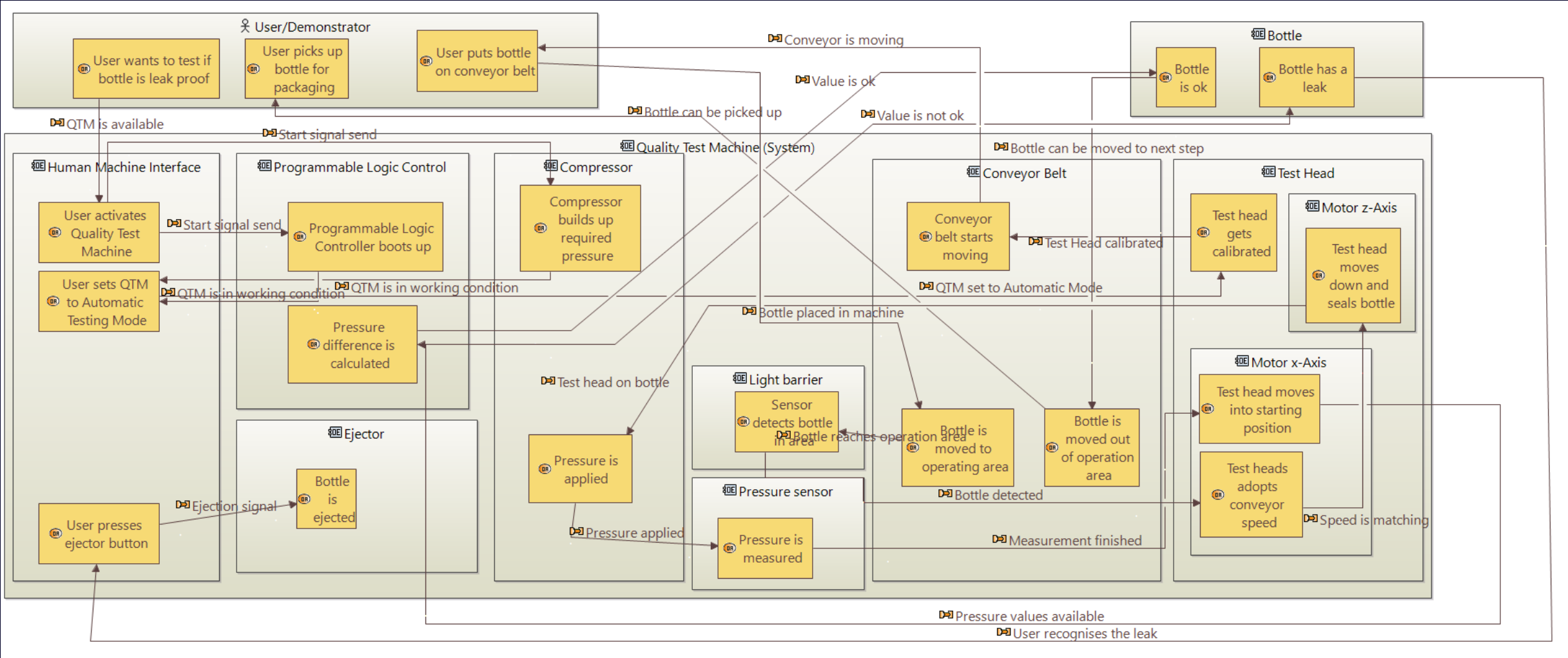


Modeling the actual state with MBSE – Activities for Semi-Automatic Bottle Testing





Modeling the actual state with MBSE – Architecture for Semi-Automatic Bottle Testing



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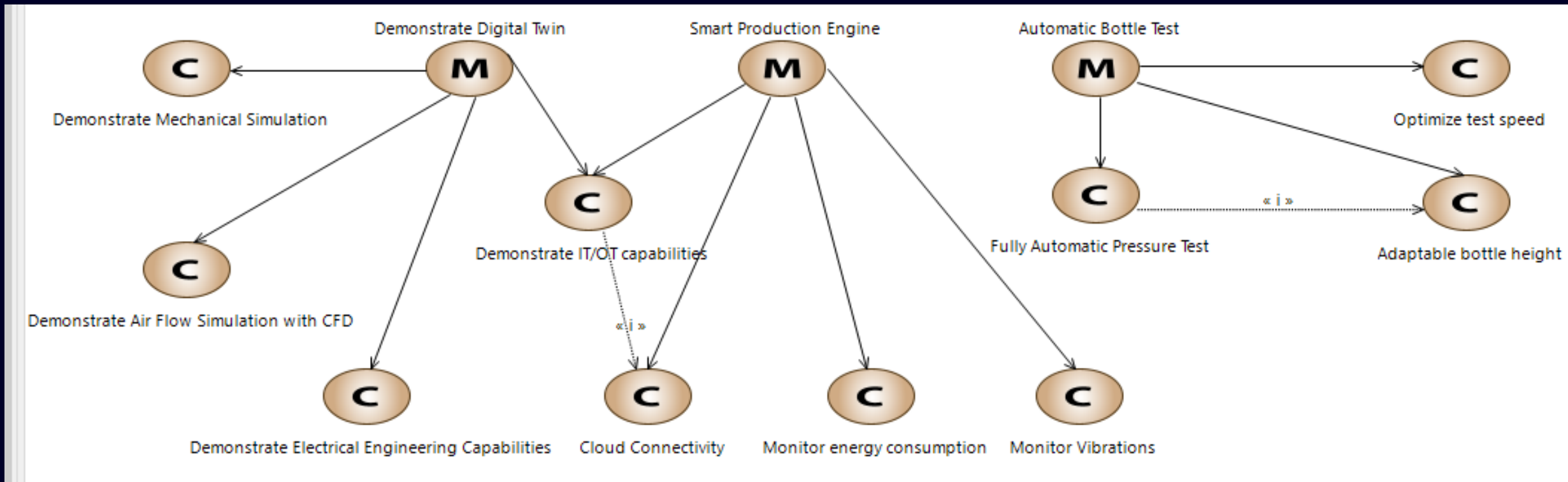
Modeling the target state with MBSE

- Adapt functions and system components used in the actual state
- Model needed functionalities for the improvement
- Define needed new components
- Optimize links, exchanges and information flows
- Differences are automatically highlighted with color
- Build a clear holistic overview early in the reengineering process
- Assign responsibilities for specific system elements
- Document changes and differences to the old system



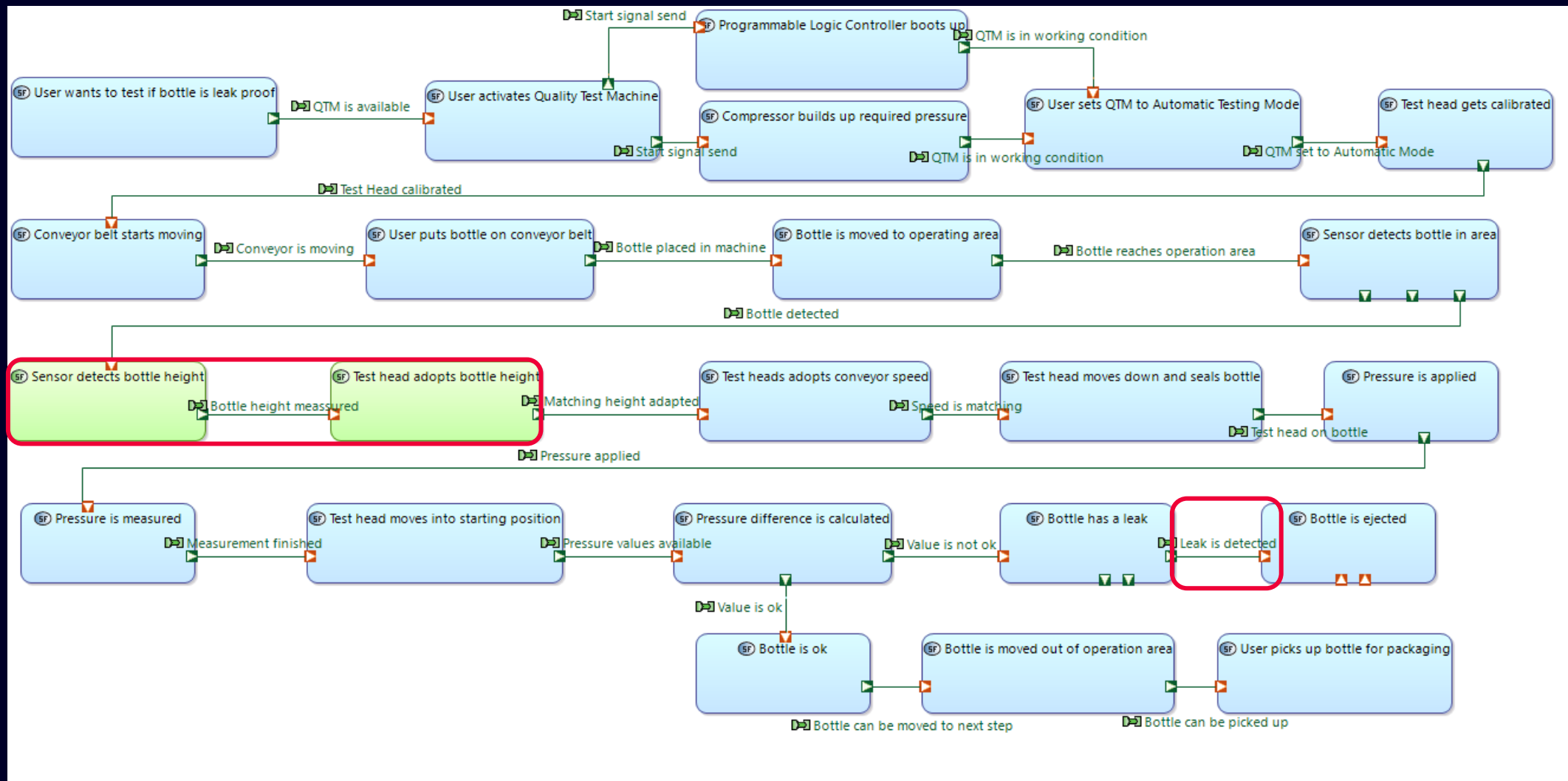


Capabilities



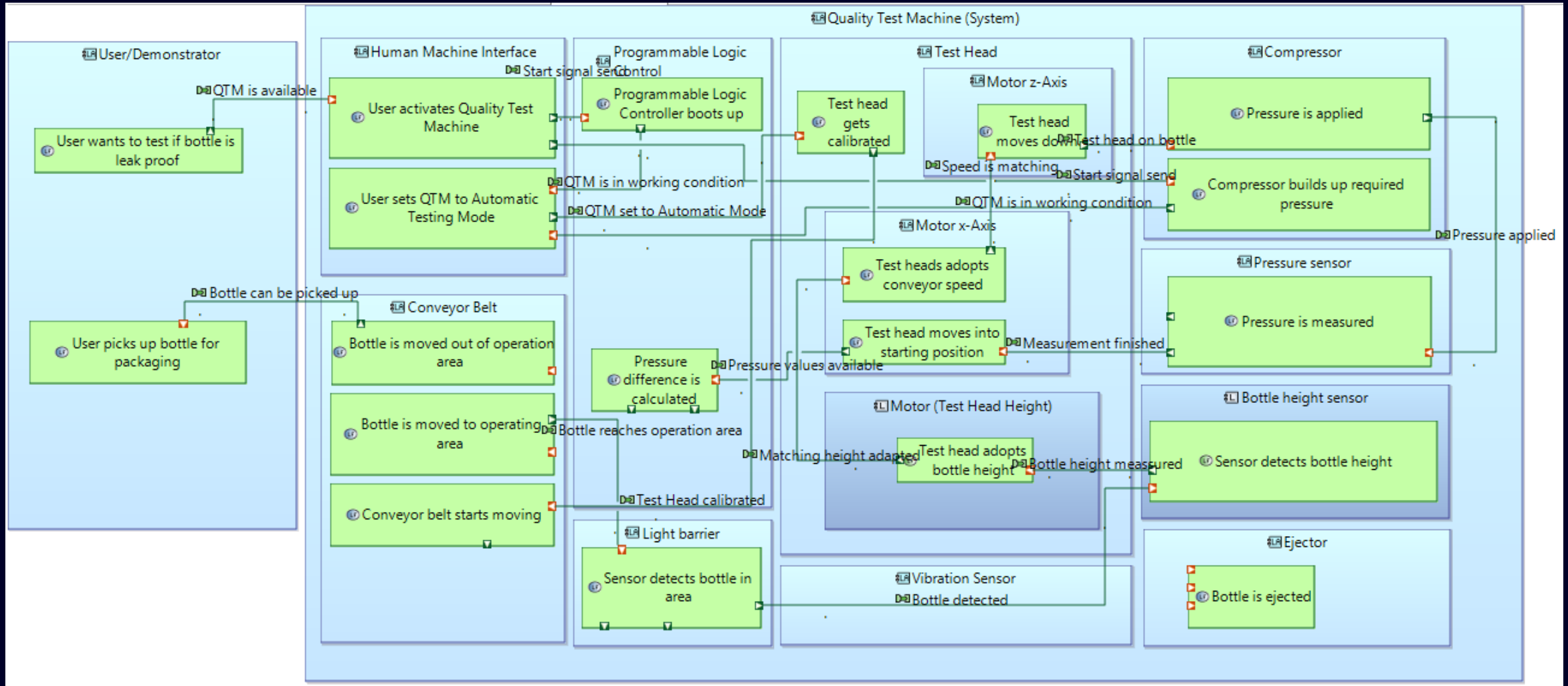


Modeling the target state with MBSE – Functions for Fully Automatic Bottle Testing



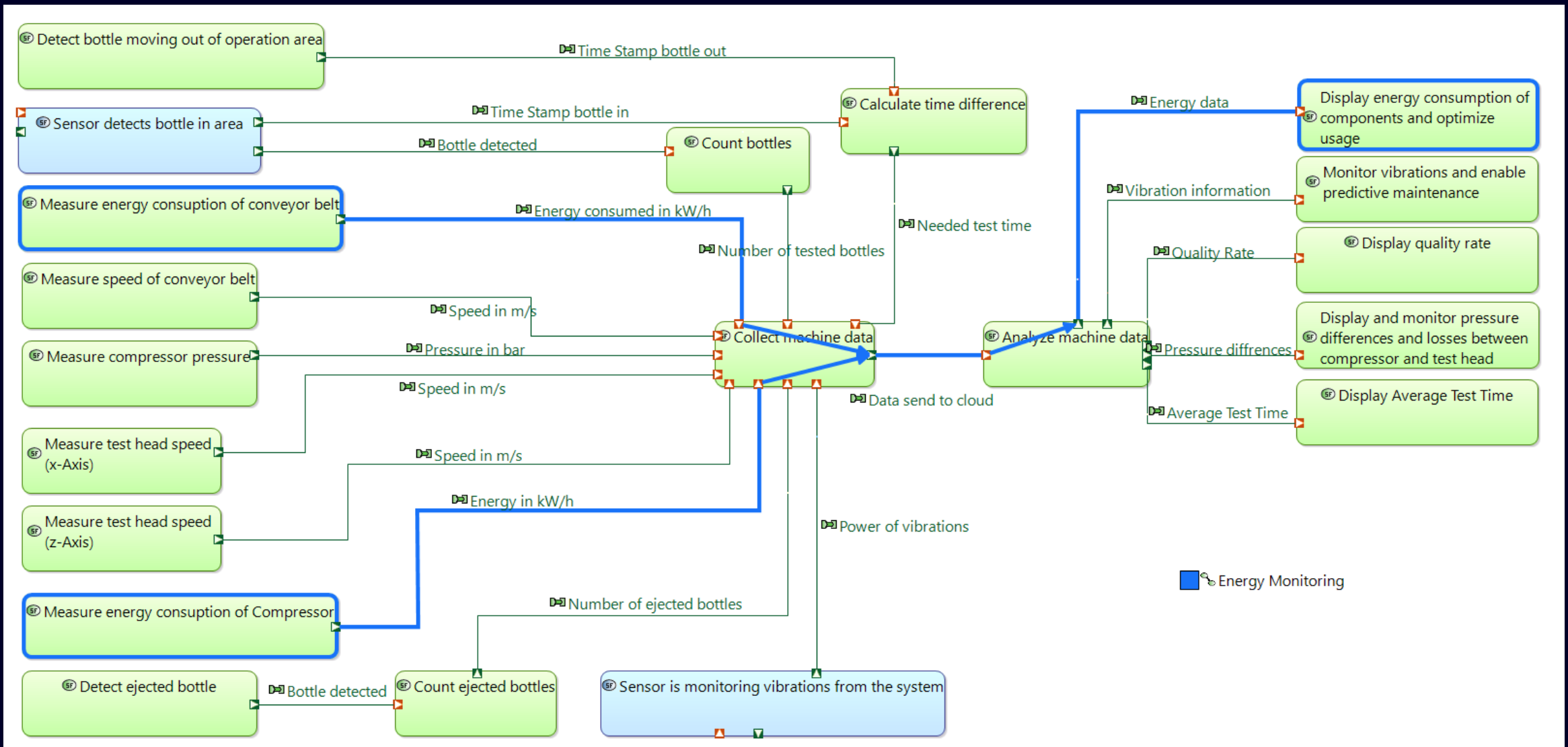


Modeling the target state with MBSE – Architecture for Fully Automatic Bottle Testing



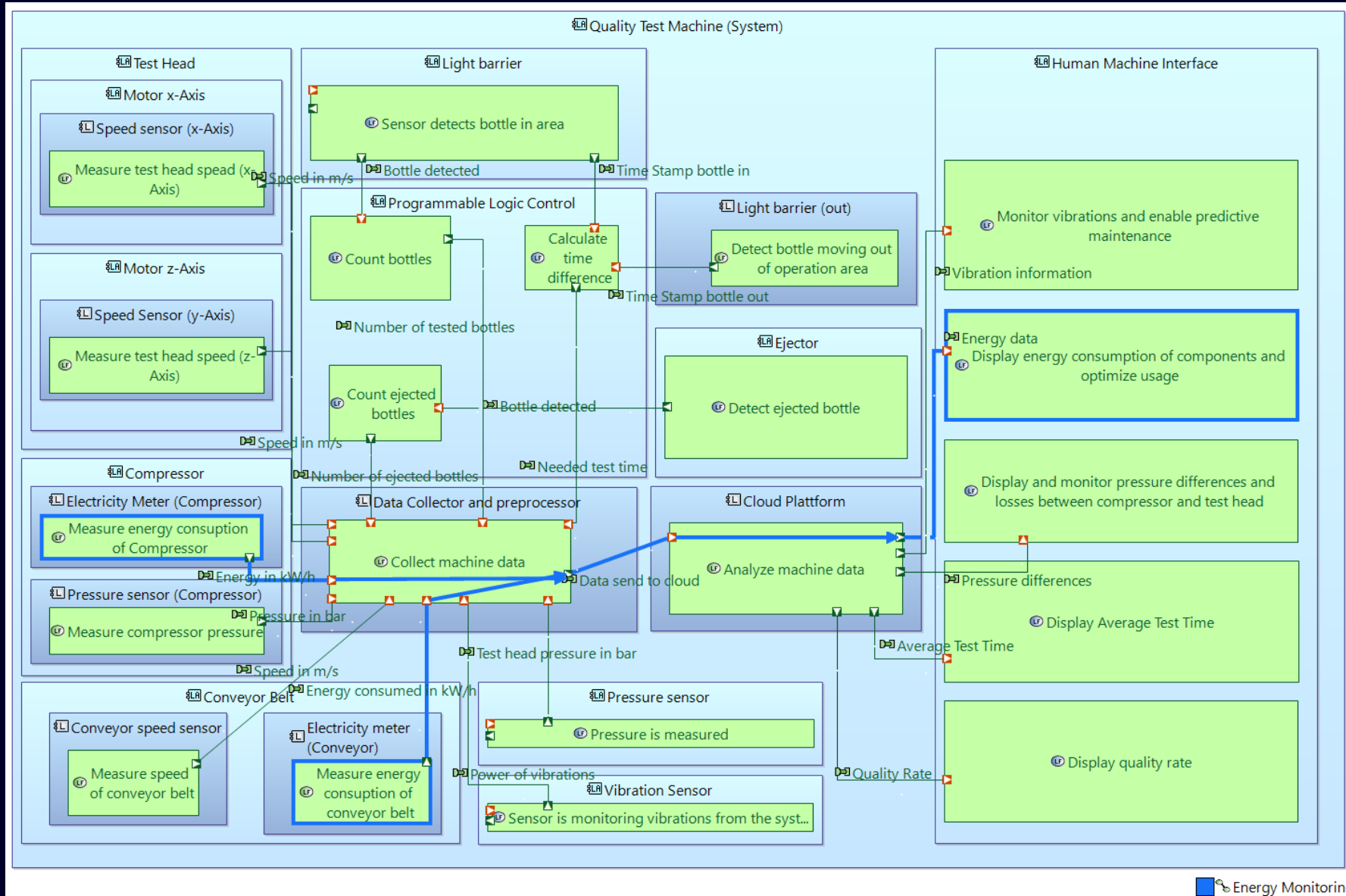


Modeling the target state with MBSE – Functions for Smart Production Engine





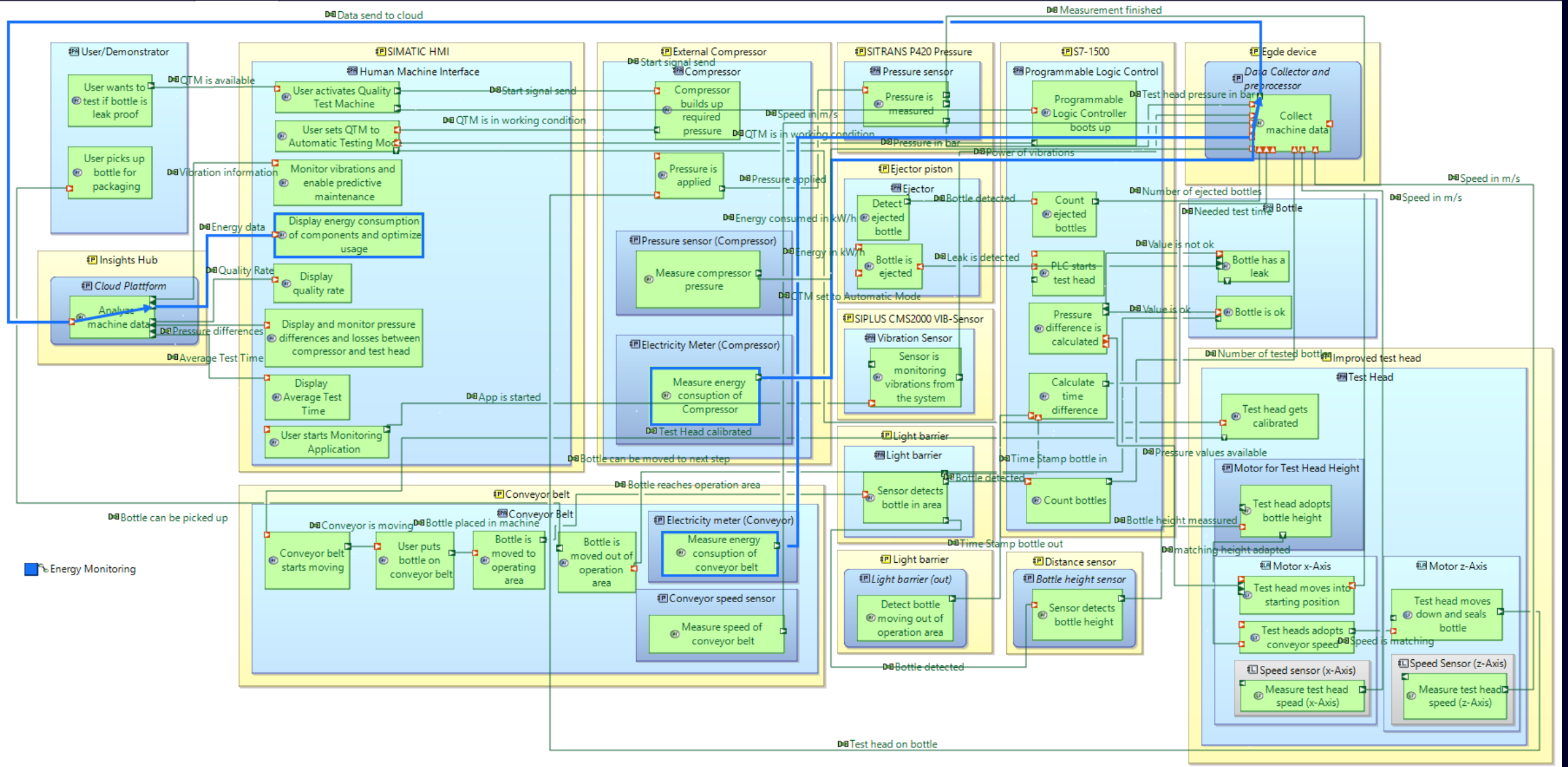
Modeling the target state with MBSE – Architecture for Smart Production Engine



Energy Monitoring



Modeling the target state with MBSE – Physical Architecture



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IT/OT – Smart Production Engine



Insights Hub 

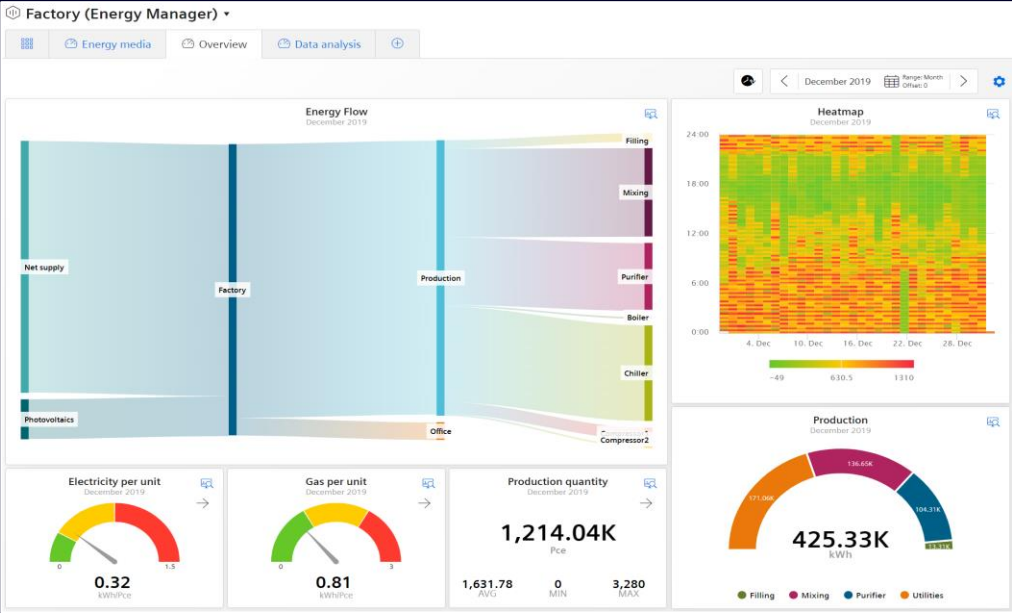
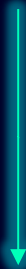


Insights Hub Monitor

Monitor your energy consumption



Energy Manager



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New challenges across all industries

Future industrial machinery needs to make production more sustainable and traceable.

“Digital” is the new standard for Systems like products, machinery or factories.

Smart Systems are supporting production processes.



1. Sustainability



2. Interdependent World



3. Digital Transformation



4. Industry 4.0/
Society 5.0



5. Smart Systems

All megatrends have in common, that they add to the already high complexity of Systems as well as their Engineering.



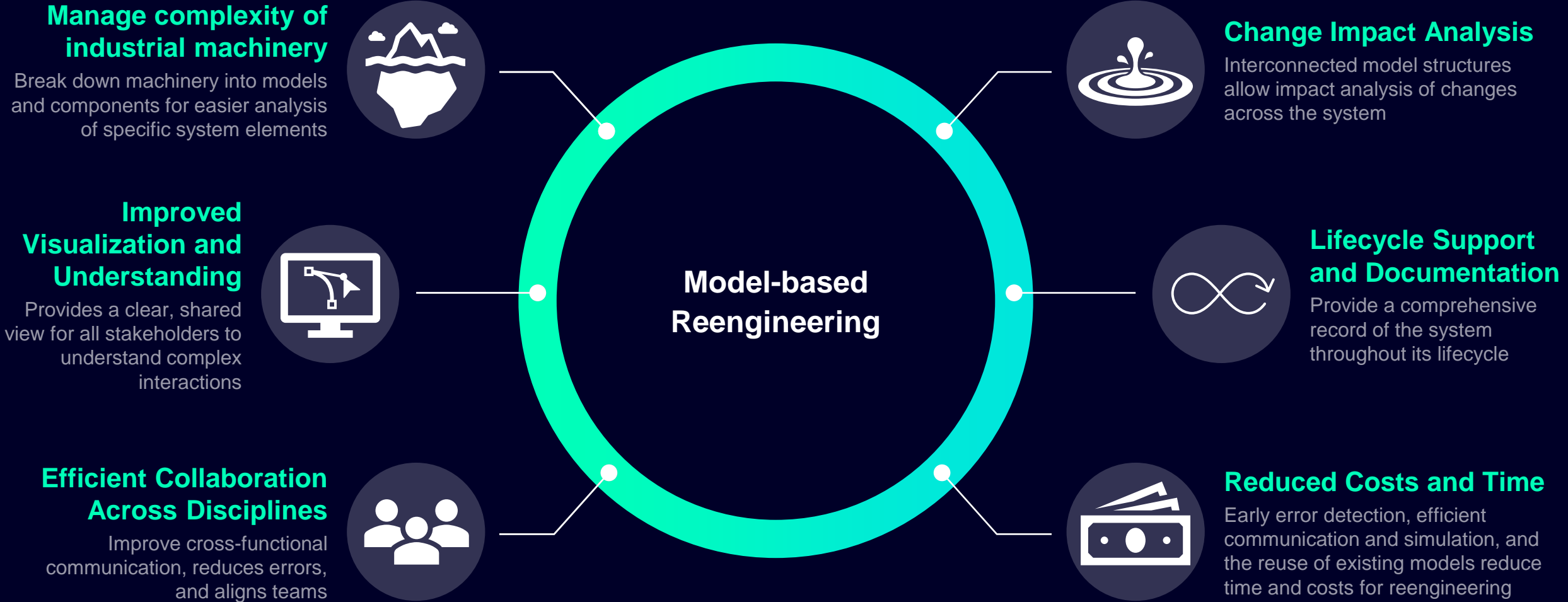
6. Complexity Growth

Industrial machinery becomes more connected in IT/OT systems.

Manufacturing and Lifecycle Engineering aspects become more important during the development of industrial machinery .

Adapted from INCOSE Systems Engineering Vision 2035, p. 3

Why should you use MBSE for Reengineering Industrial Machinery ?



Thank you for your attention!

Q&A



Speakers



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