Applying UAF for SoS Modelling

OMG UAF Summit | 20-Mar-24 | Dr. C. von Holst

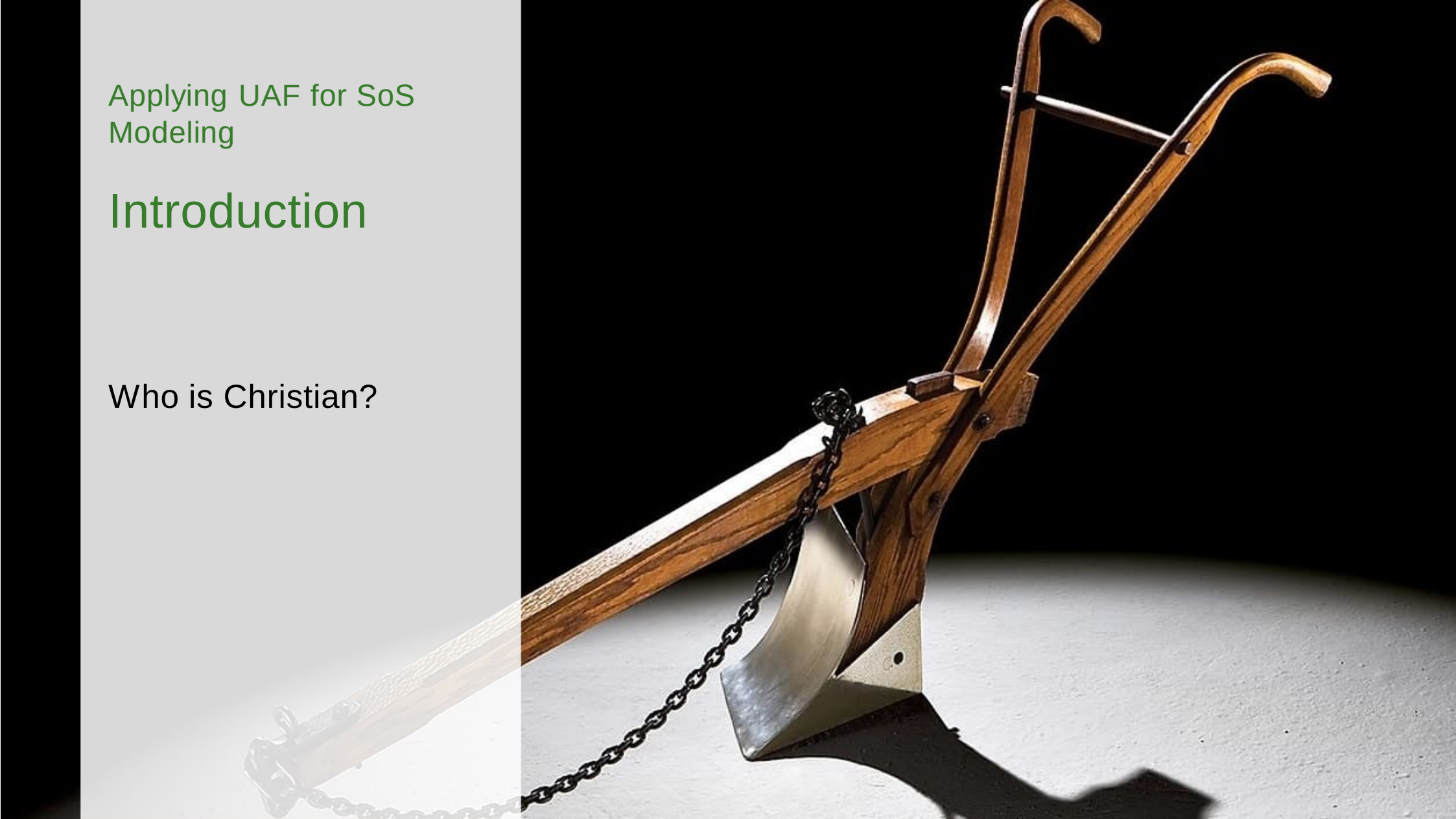
Agenda

- Introduction
- John Deere's SE Implementation
- Why System of Systems Modeling?
- Example & 1st Results
- Summary & Conclusion
- Q&A

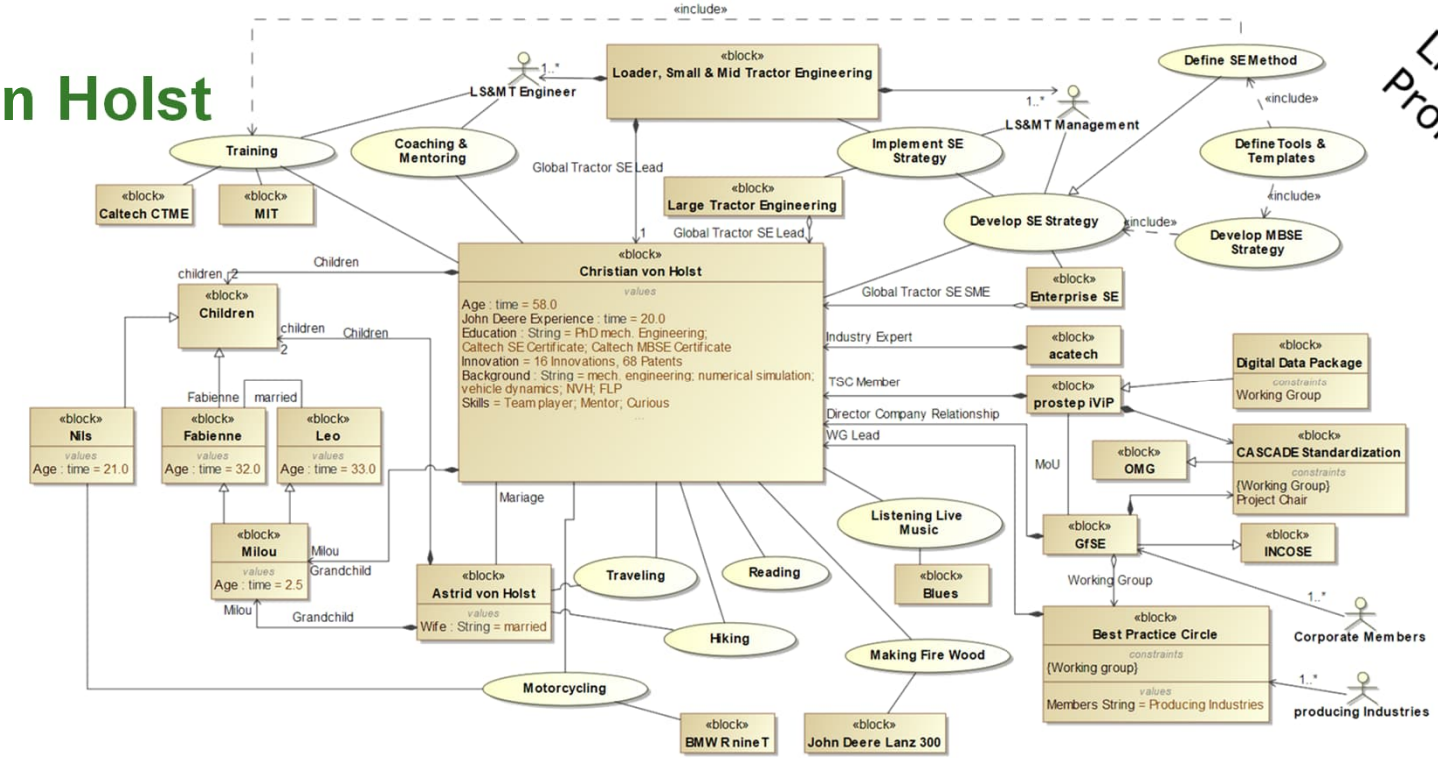
Applying UAF for SoS Modeling

Introduction

Who is Christian?



Christian von Holst



Applying UAF for SoS Modeling

John Deere's SE Implementation

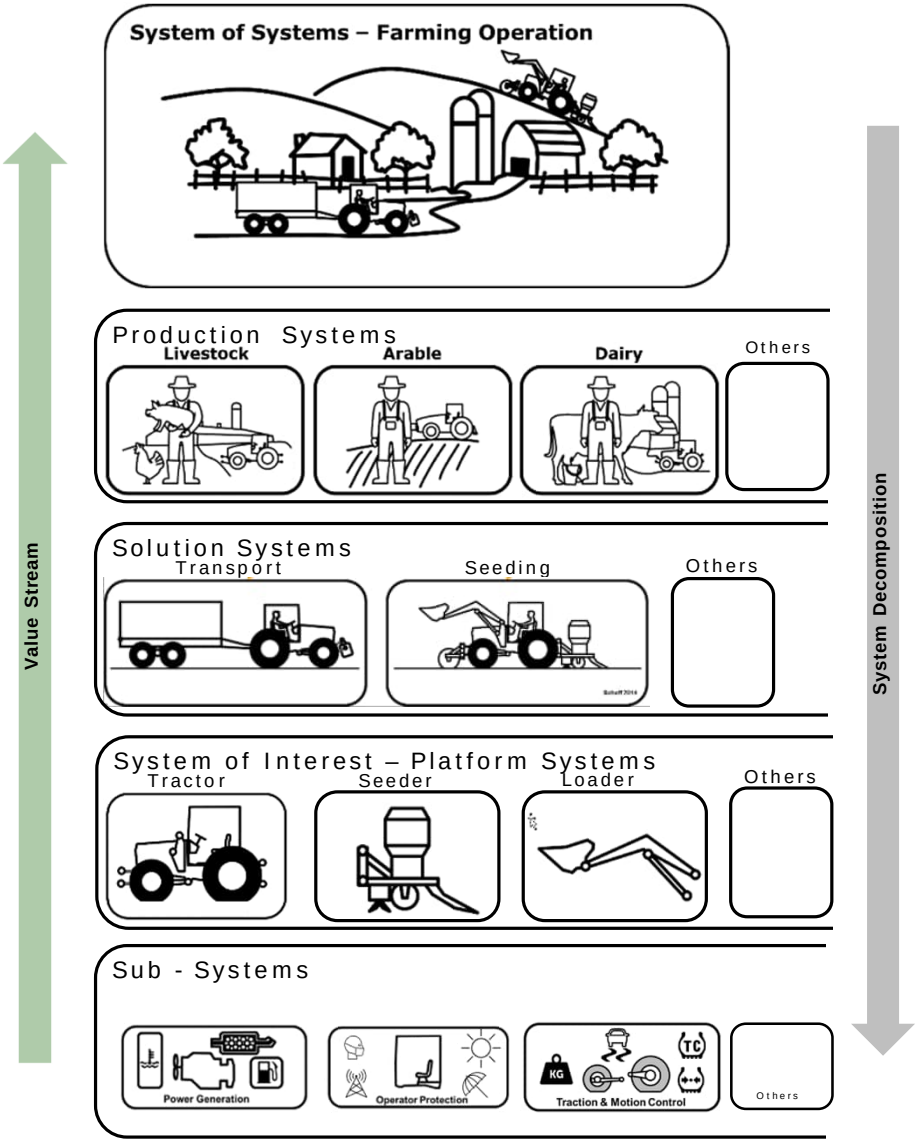
Systems Decomposition & Production Systems

John Deere's System Decomposition

Customer Focus

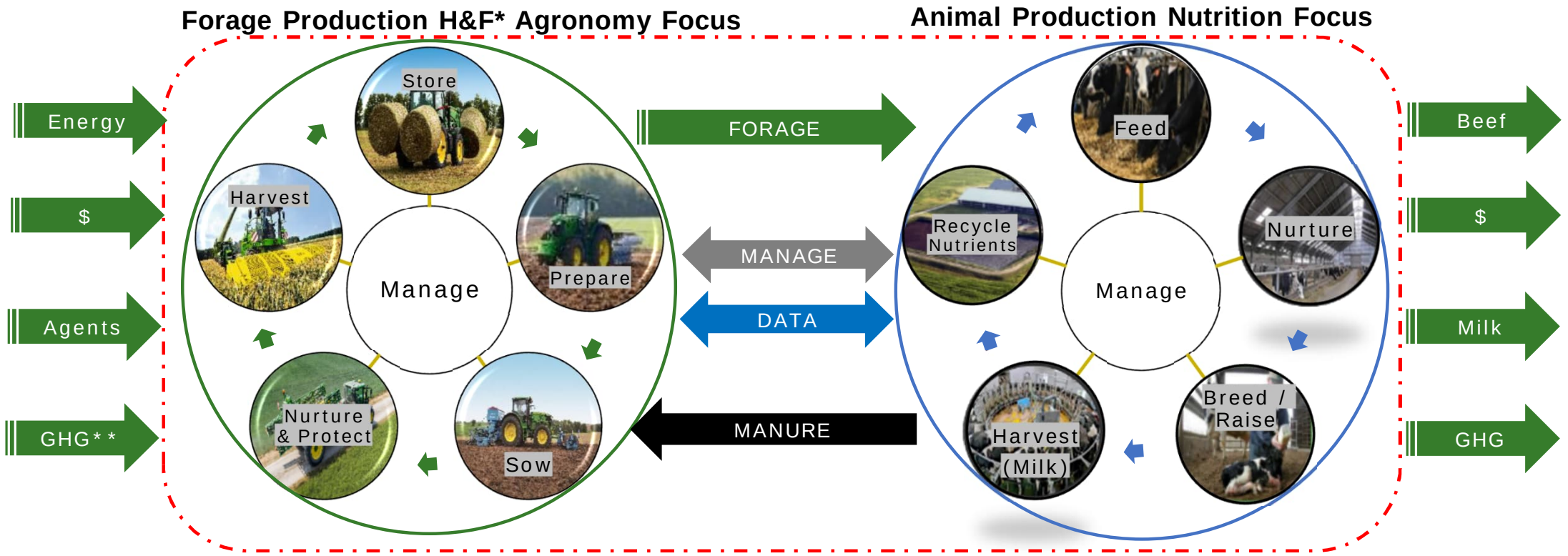
John Deere's customer operate farms. That's, where their money is made.

- To serve our customers needs, we have to understand farming operations
- Farm sites are our System-of-Systems (SoS). Here is the value stream to be understood to generate customers business opportunities
- The platform systems are a decomposition of the SoS. They receive its requirements out of the higher-level systems
- Modeling the platform systems (Systems-of-Interest or SoI) benefits from modeling the higher-level systems, up to the SoS.



Production steps – derived from ConOps

Have the Value Flows in Focus – Example: Dairy & Livestock Farm



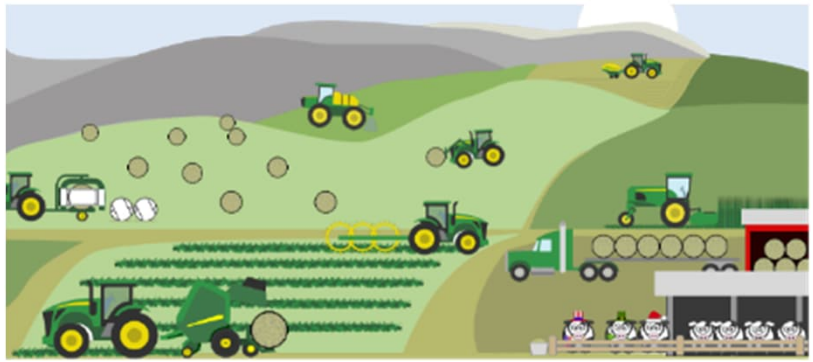
* H&F: Hay & Forage
** GHG: Greenhouse Gas

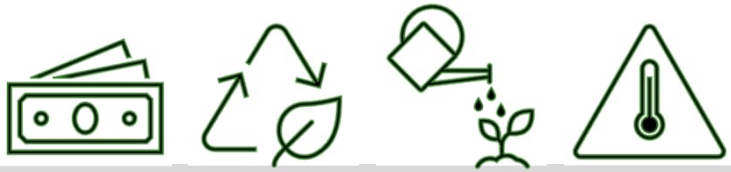
Complex SoS: What if?

Execute Case Studies to Find Improvements

What if?

What if?





Applying UAF for SoS Modeling

System of Systems Modeling

Why applying UAF?

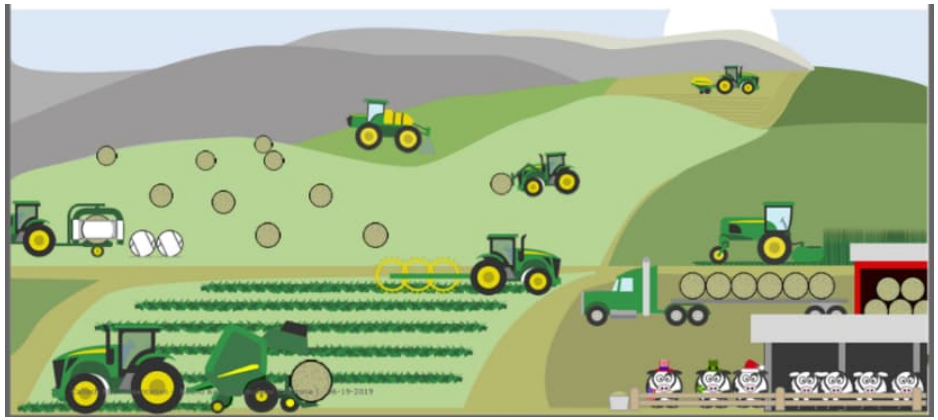
The Idea!

Why building a Digital Twin of a D&L* Farm?

A detailed MBSE Model of a Dairy or Livestock (D&L) farm would serve several core needs:

- Execute case and sensitivity studies and immediately generate requirements downstream for the platform system
- Interconnect with other Digital Twins (other platform systems or other Production Systems)
- Fact based decision making and advanced simulation means.

But SysML comes easily to limits when modelling such complex SoS!

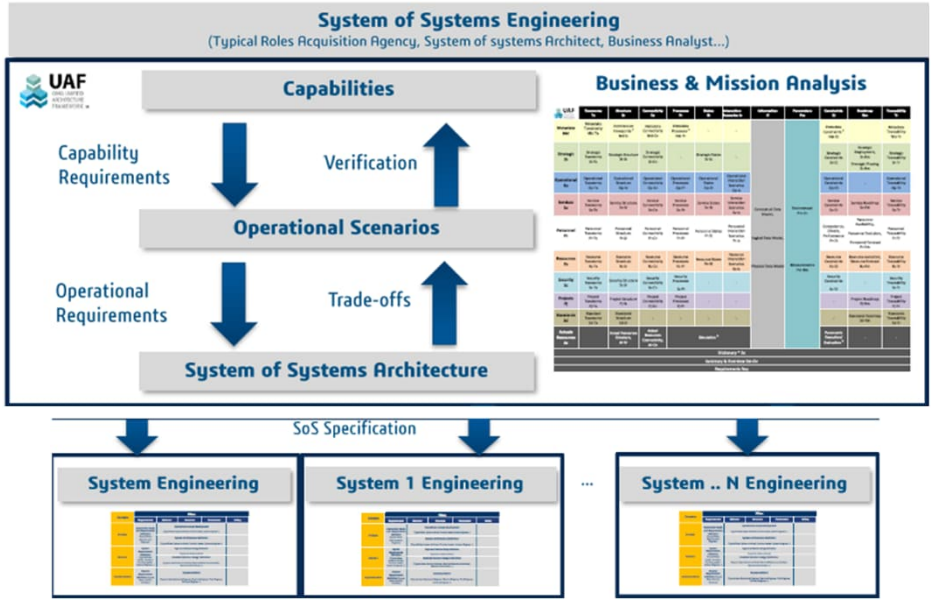


* D&L: Dairy & Livestock

Unified Architecture Framework Summary

Why Choosing UAF?

- SE Industry standard and managed by OMG
- Commercial Tool Packages available
- **Focused on Systems of Systems** or Enterprise Architecting
- Higher Enterprise Goals
  - Capabilities
  - Operational scenarios
  - Resource configurations
- Provides multiple viewpoints for SoS
- Plugin is pre-populated for diagrams and analysis
- Plugin is SysML based, so compatibility JD system
- Comprehensive documentation, trainings and experts available

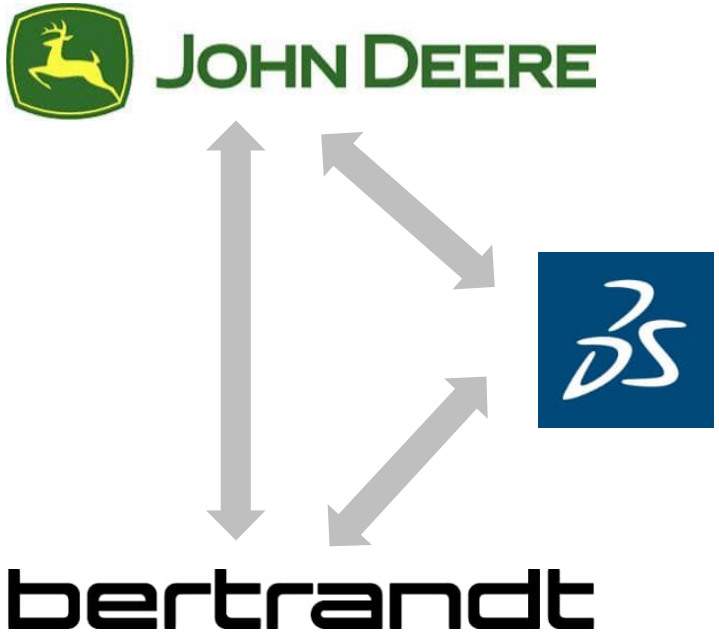


Partnering for Steeper Learning Curve

How Should be Modelled in Detail?

Modelling a Dairy or Livestock Farm in CSM*

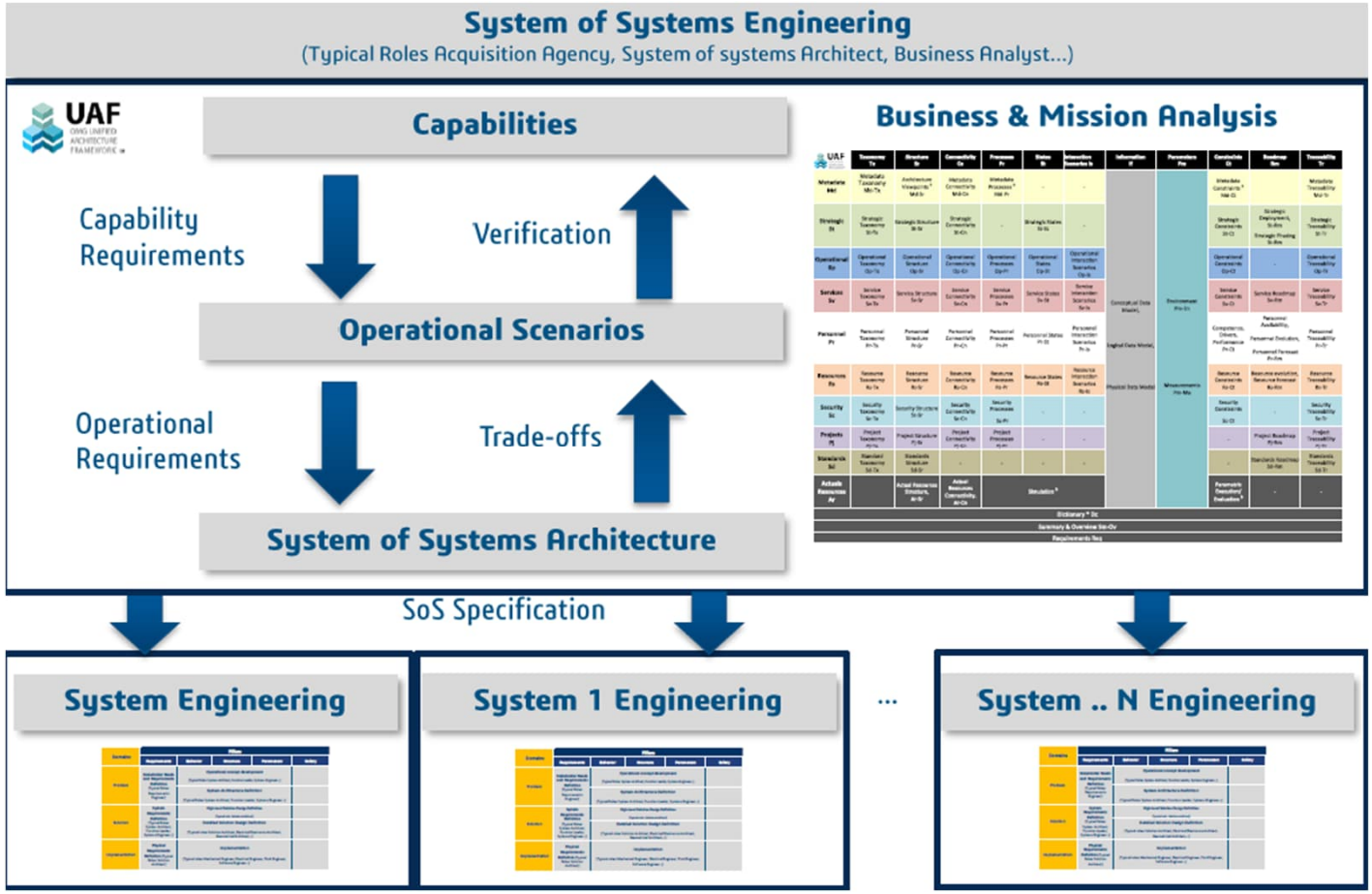
- John Deere provides the detailed agronomical and agricultural engineering knowledge for the modelling task
- John Deere also provides SysML Modeling Framework
- Bertrand provides the workforce and SysML and MBSE modeling competencies
- Dassault provides the training and tool competencies
- Dassault furthermore provides competency in the frameworks like MagicGrid or Unified Architecture Framework (UAF)



* CSM: Cameo Systems Modeler

UAF Grid in a Nutshell

Pick What's Needed



Core Viewpoints → Different Abstraction Levels

Focus on Operational Scenarios

Why: strategies of enterprise, goals, capabilities

What: what to do to achieve the strategies?

How & Who: how and who implements the scenarios? → Resources etc.

Applying UAF for SoS Modeling

Example

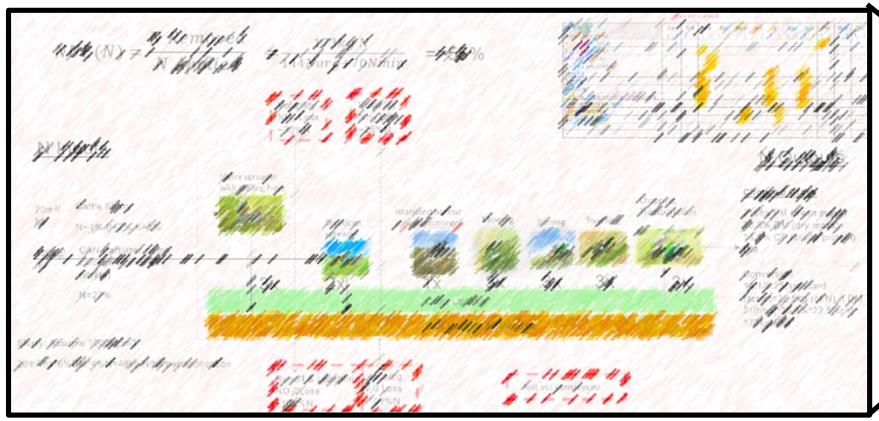
UAF model of a D&L Farm

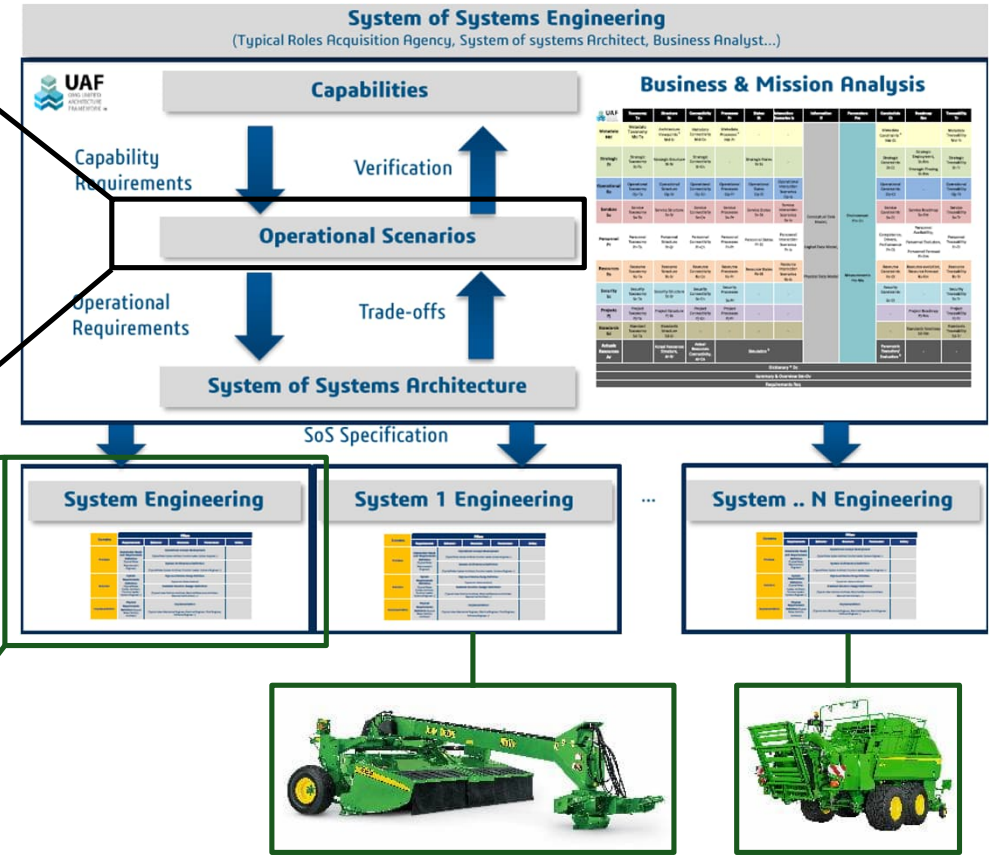
UAF for D&L Farm Modeling

And Connecting to Tractor MBSE Model

Production System Operations

Platform System Architecture



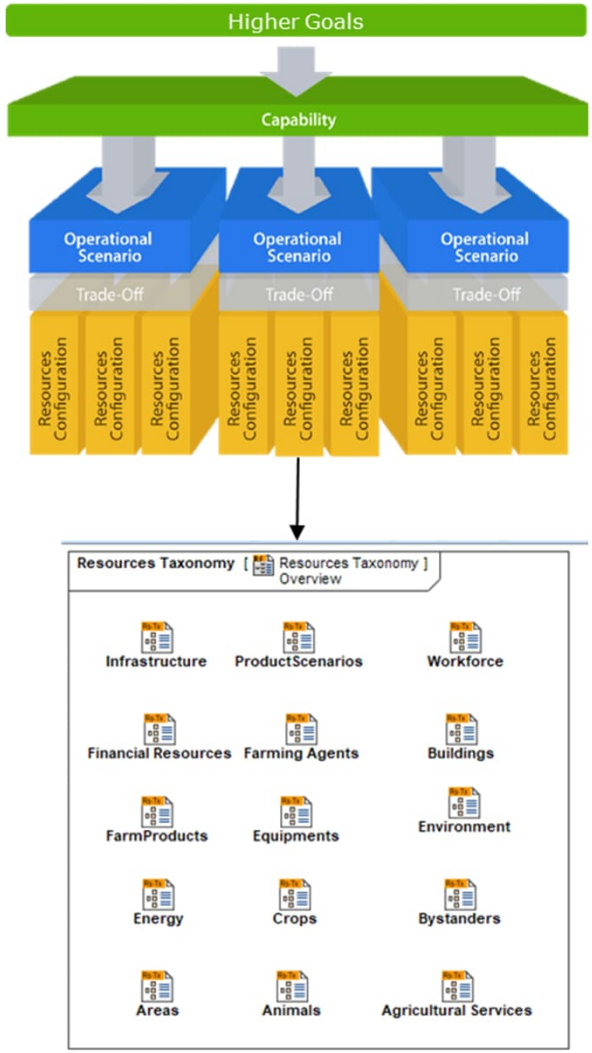


The UAF Model of the D&L Farm

SoS Model

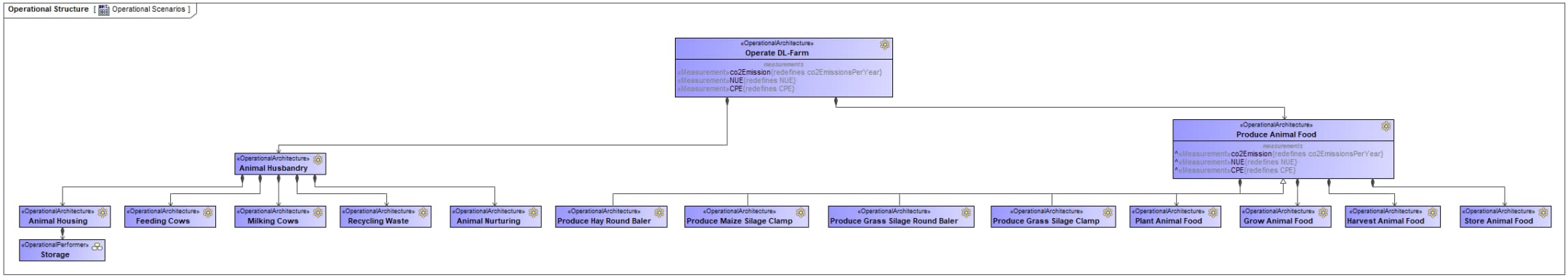
UAF offers all we need for our Farm modelling:

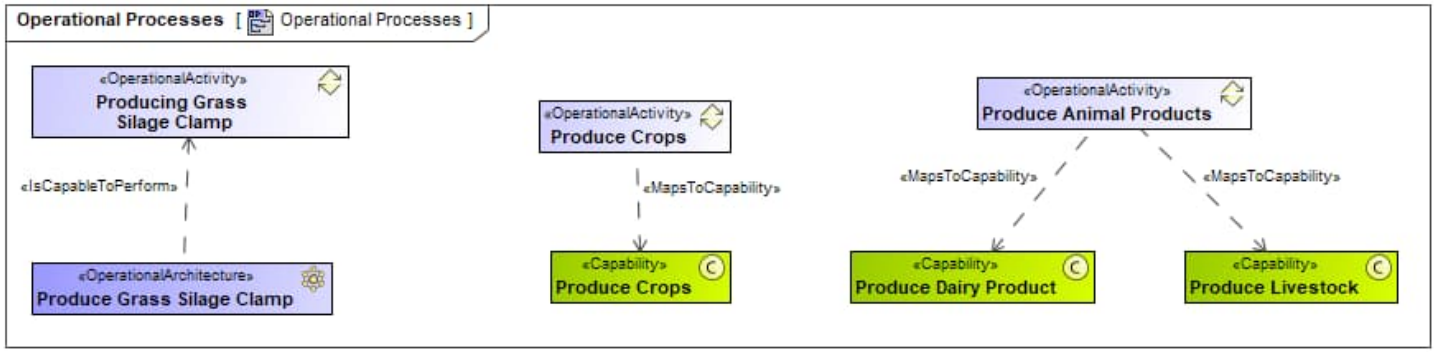
- Farm Goal & Capabilities → e. g. Sustainability Goal(s)
- Operational Activities → e. g. Farm Operations
- Resources → e. g. Land, Labor, etc.
- Farm Products → e. g. Grass Silage
- Operational Scenarios → e. g. Jobs, Production Steps
- Resource configurations → e. g. Solutions
- Measures → e. g. Performance, CO2E, etc.
- Simulation
- Traceability



D&L Operational Scenarios

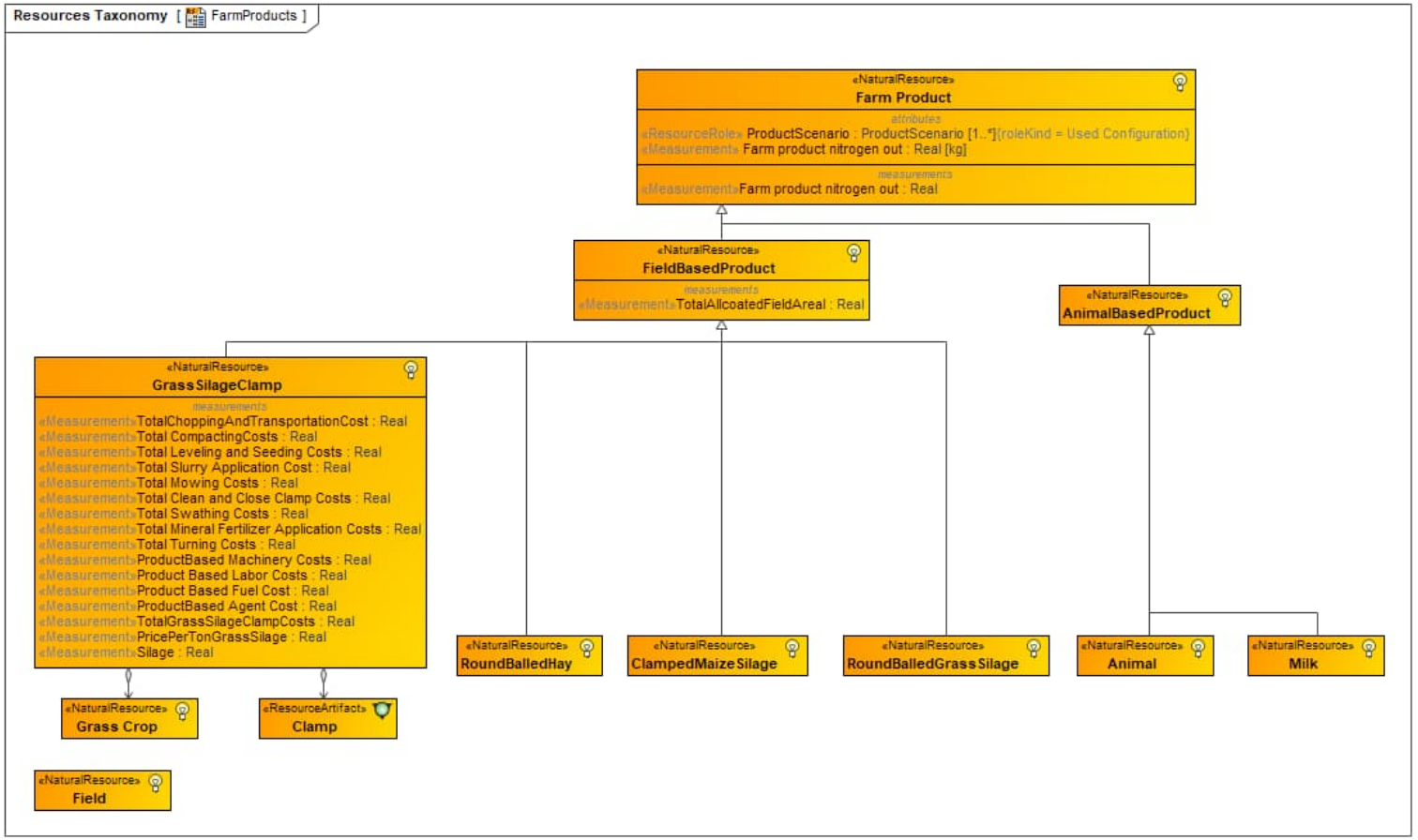
High & Mid Level Models - Example





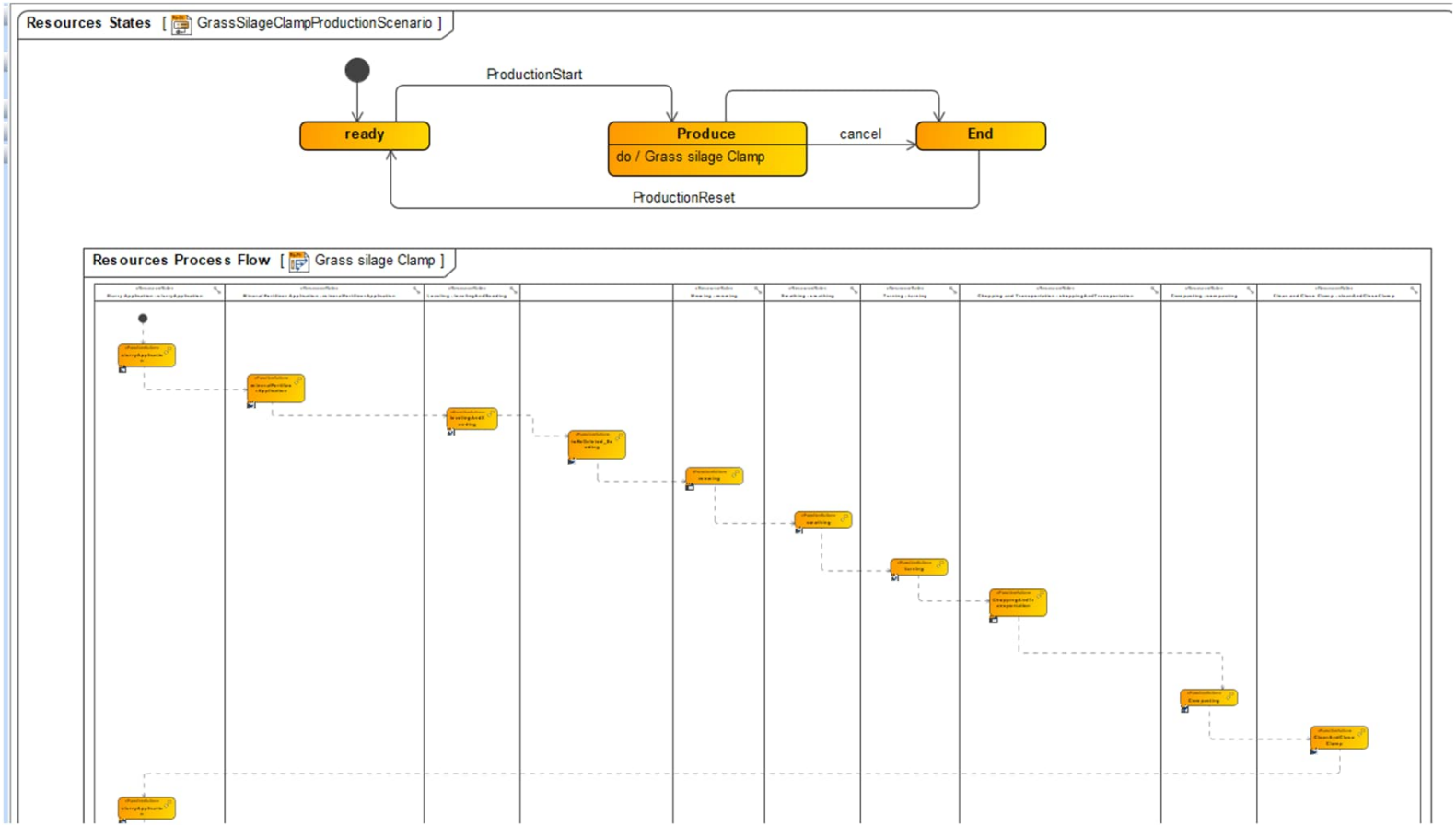
D&L Resources

Farm Products - Example



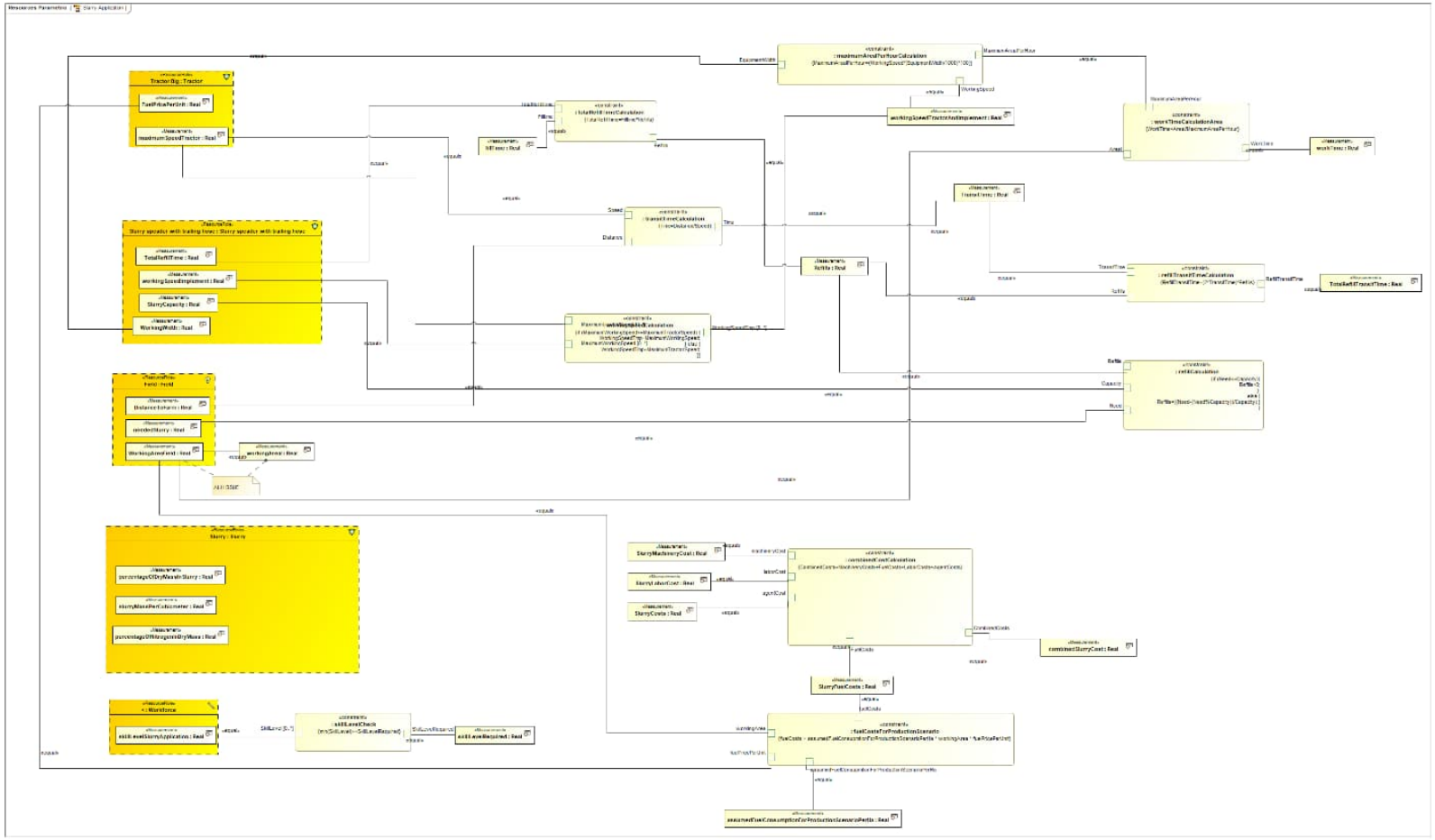
D&L Process Flow

Grass Silage Clamp - Example



D&L Job Calculation

Slurry Application - Example



D&L Production System Needs to Platform Systems

Produce Grass Silage Clamp - Example

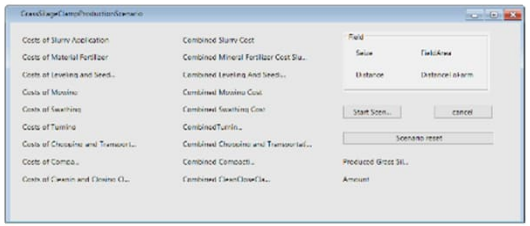
D&L Farm

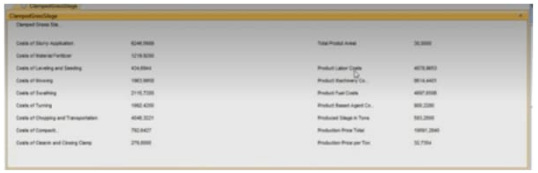
Simulation Capabilities - Example

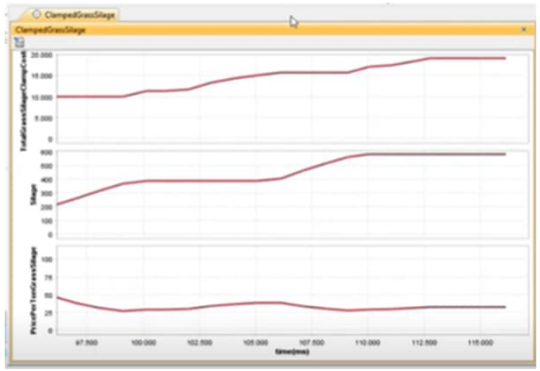
Input → **MBSE Simulation** → **Output**

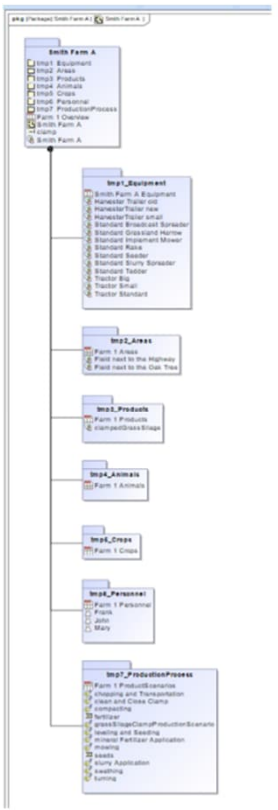
- **GUI**
- **Excel**

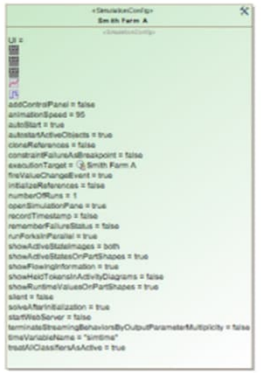
- **GUI**
- **Excel**
- **Other**

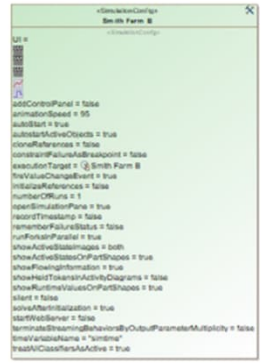


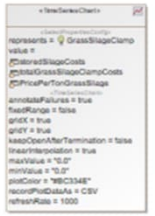






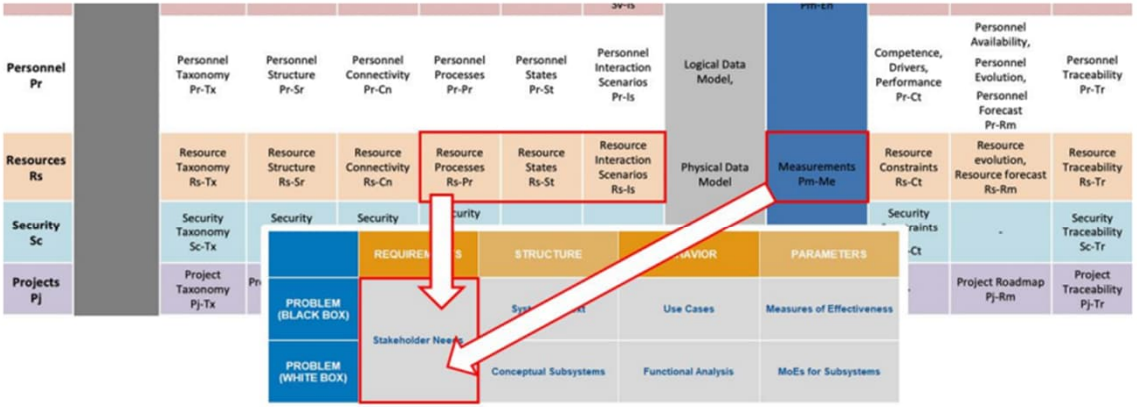


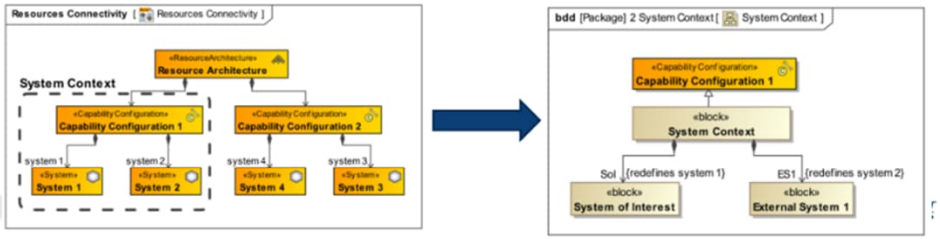


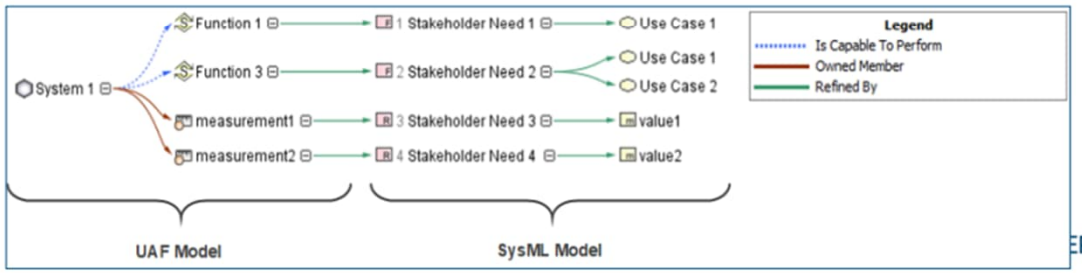


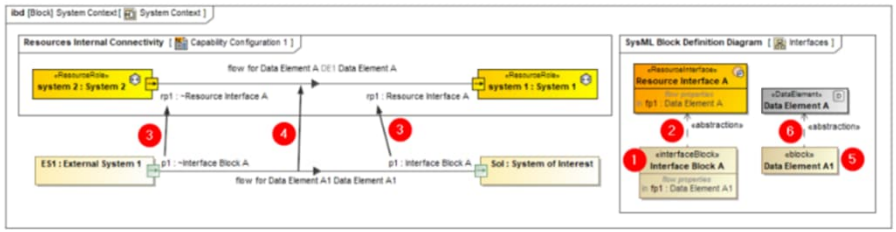
Connecting D&L Model to Platform Model

Traceability and Connectivity UAF ↔ SysML









Applying UAF for SoS Modeling

Summary

And conclusion

Summary

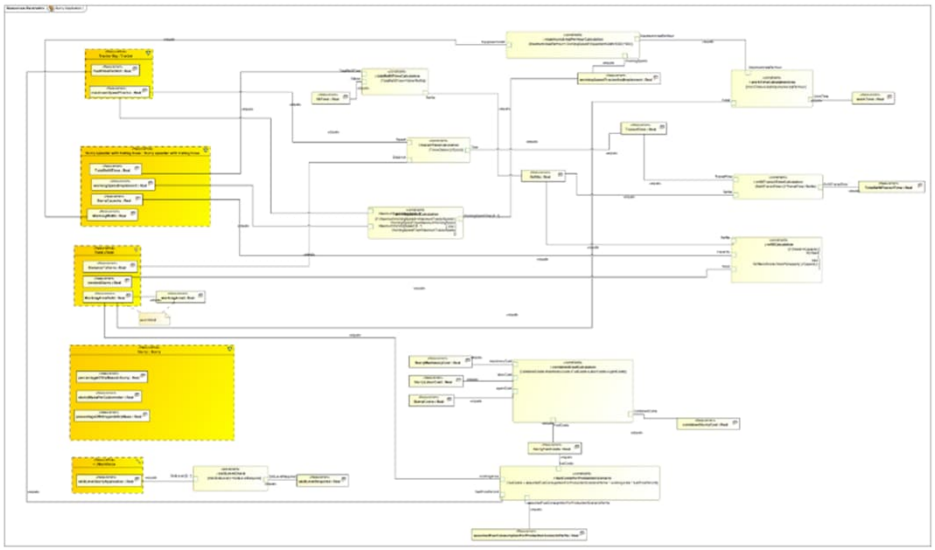
Achievements so far

System of Systems Modeling delivers several significant advantages:

- Enhancing capabilities of Digital Thread & Digital Twin
- Direct connection to Platform Models possible
- Simulation means allow case studies
- Many more

But there is further work to do:

- User Interface and usability for non-experts
- Two modeling languages
- SysML v2
- Some more



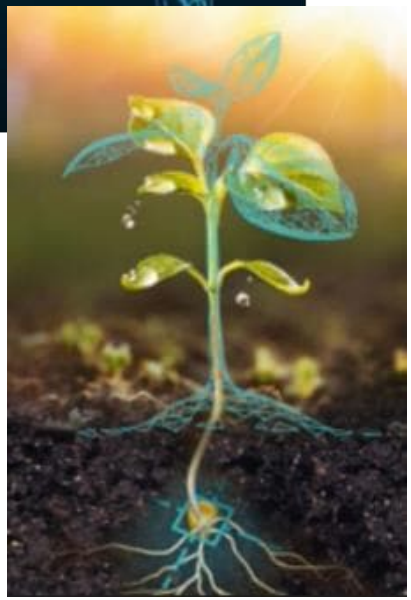
Conclusion

And next steps

Strong focus towards Model-based Systems Engineering delivers competitive advantage

- The Proof-of-Concept (PoC) will be continued into a pilot
- Especially the user interface to non-experts needs improvements (competing w/ MS Excel ©)
- Partnering with Experts accelerated learning curve significantly and delivered quickly exciting results

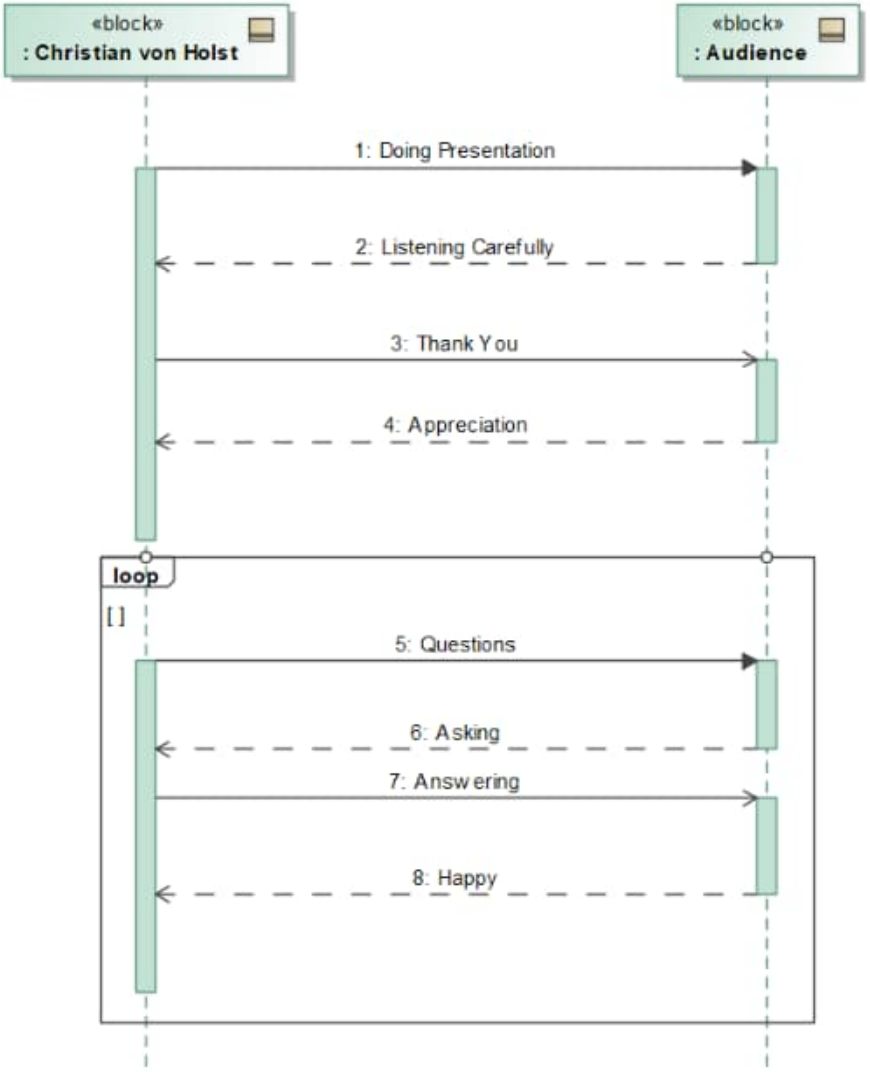
The journey towards MBSoSE* just started



* MBSoSE:Model-based System of Systems Engineering Cameo Systems Modeler

Q & A

… Thank You!

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