34th Annual INCOSE international symposium

hybrid event

Dublin, Ireland
July 2 - 6, 2024

Practice to Adapt MBSE as Agility Enabler to the Agile Software Development for Mobility Platforms

Introduction of Authors

Daisuke Hashimoto

- Head of Systems Engineering in Woven by Toyota in Japan from Apr. 2023 to present
- Before he joined Woven by Toyota, practicing MBSE for open-source-based autonomous driving systems in TIER IV
- Even before that, he developed military systems of systems for the Ministry of Defense in Japan for over 10 years in Mitsubishi Electric Corp.

Yutaro Ito

- A steering committee member of the JCOSE
- Systems Engineer in Woven by Toyota in Japan from Jul. 2021 to present
- Before he joined Woven by Toyota, he had rich experience in in-vehicle ECU system software development for more than 10 years

Agenda

- Summary
- Background
- SE Challenges in Our Context
- Our Approaches
- Results
- Conclusion

Summary

This presentation will share MBSE practices that have been tried and tested in mobility platform development at Woven by Toyota, the mobility technology subsidiary of Toyota Motor Corporation.

Our SE challenges are:

1. Integrating SE into modern agile software development
2. Determine ontology for different development cultures

Our approaches:

1. Changed the perception of the V-model in MBSE by introducing & tailoring Boeing MBE Diamond [1]
2. Developed metamodels to identify terms and relationships

Results: Started adapting MBSE into the agile SW development without sacrificing agility

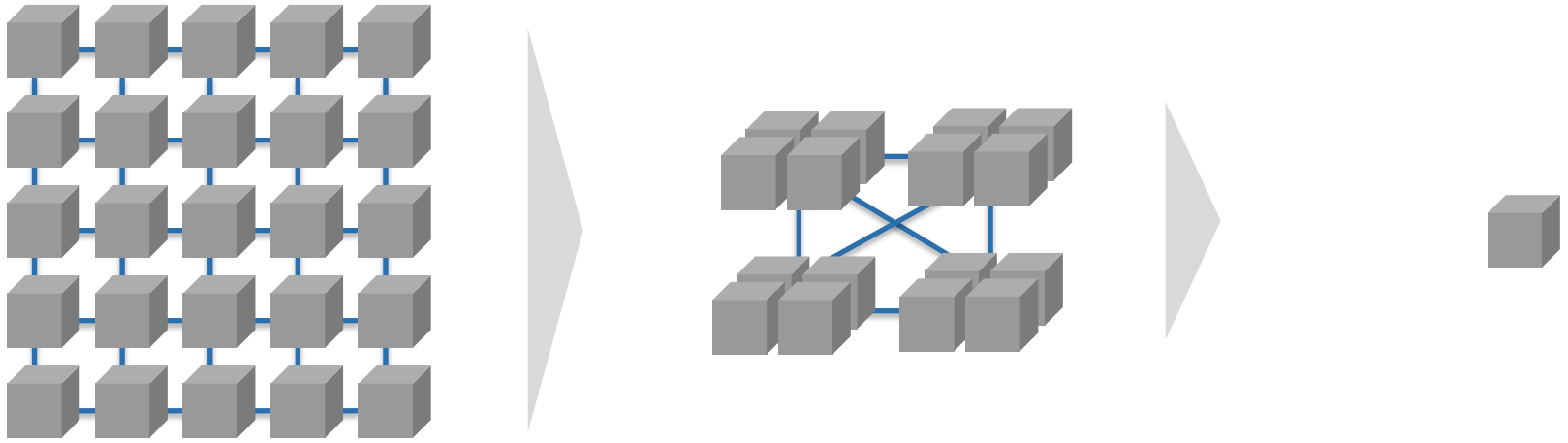
[1] Boeing MBE Diamond

Background

Transition to SW-centric Vehicles

In-vehicle E/E* architectures become more centralized, the weight of functions implemented by SWs increases (*Electrical/Electronic)

The automotive industry is struggling to develop software-defined vehicles (SDVs), changing from hardware-centric vehicles to software-centric ones



Distributed E/E Architecture

Domain E/E Architecture

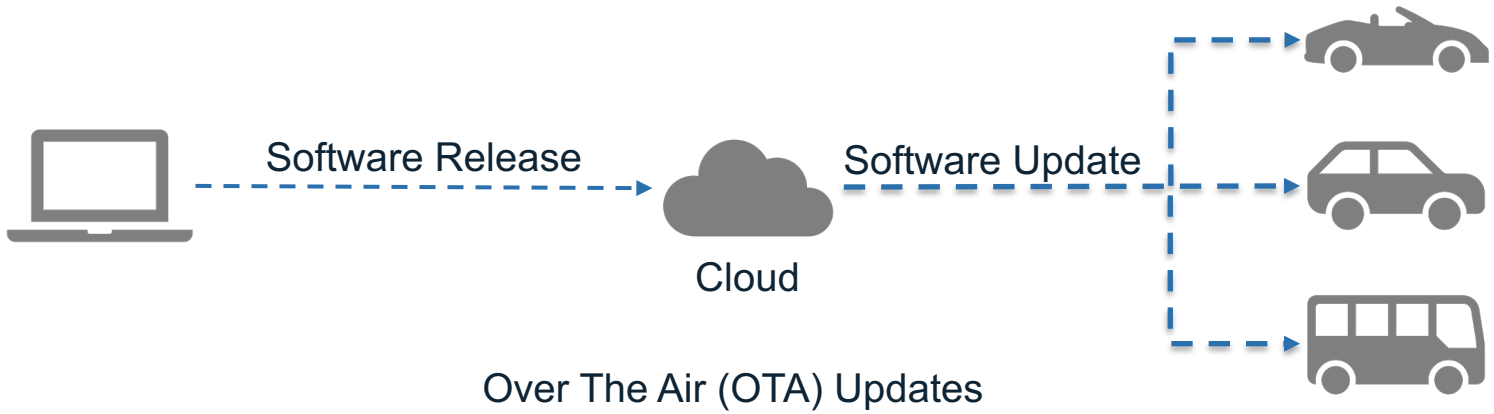
Centralized E/E Architecture

High Demand for Early Adoption of R&D Technologies into Products

Demands for enhancing functionalities through OTA updates and changes in the market environment

Increased demand for early adoption of R&D technologies and agile SW development

The difficulty in ensuring quality and harmonizing R&D technologies and production-level systems is increasing more and more



Company History

TRI-AD

Founded in March 2018

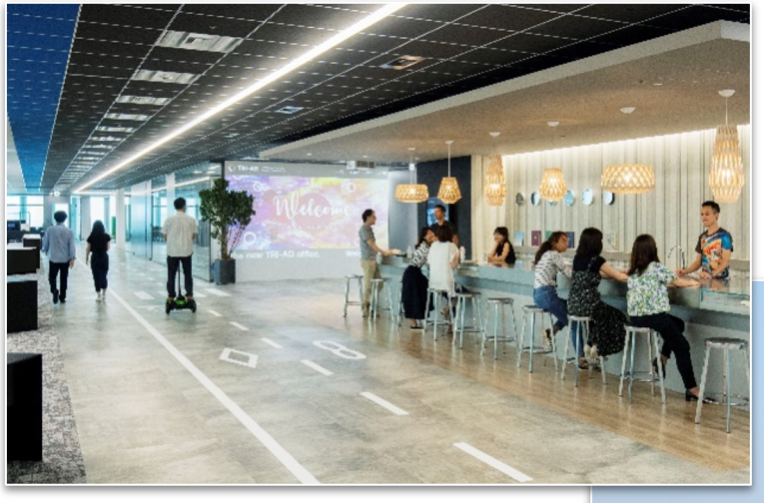
woven planet

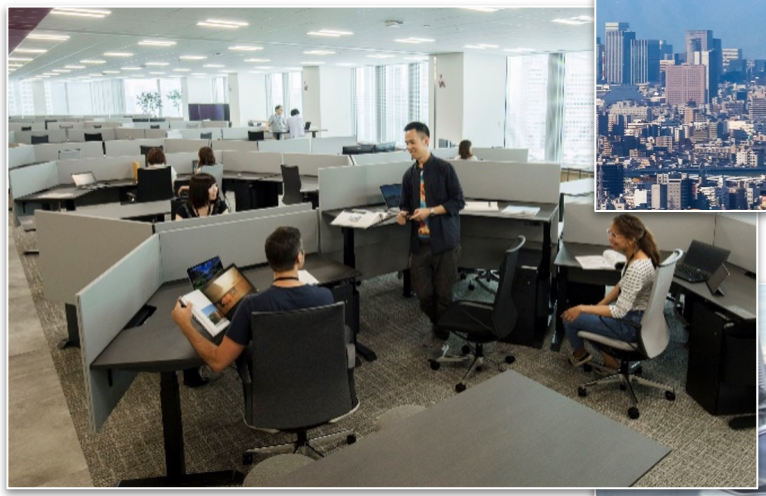
woven core

woven alpha

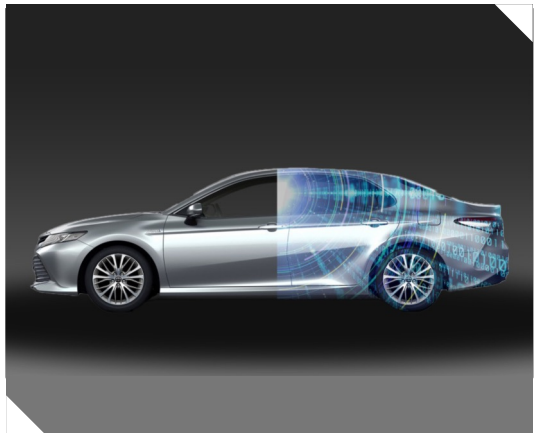
woven by TOYOTA

Since April 2023





Focus Area



Arene OS

- Software Platform and Operating System
- New customer value through software

Woven City

- Test course for mobility
- Build the future fabric of life.

AD/ADAS

- Safe and reliable AD/ADAS systems
- Geospatial intelligence
- Human-centered mobility

Woven Capital

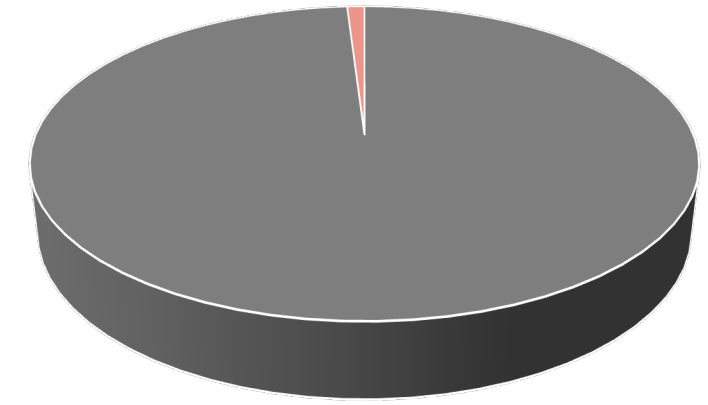
- A growth-stage venture fund
- Investing in the future of Mobility and driving innovation

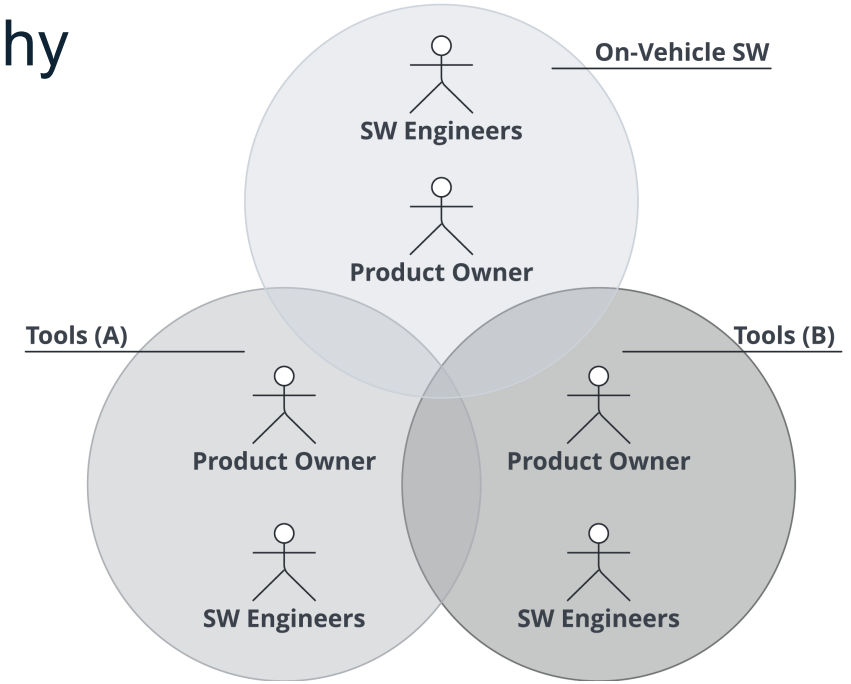
SW-First Culture in Arene Development

Arene is a combination of build tools and on-vehicle SW services

Most engineers are SW engineers who have a background in cloud system development and prefer Agile development (e.g., Scrum)

They have their terms, cultures, and philosophy





SE Challenges in Our Context

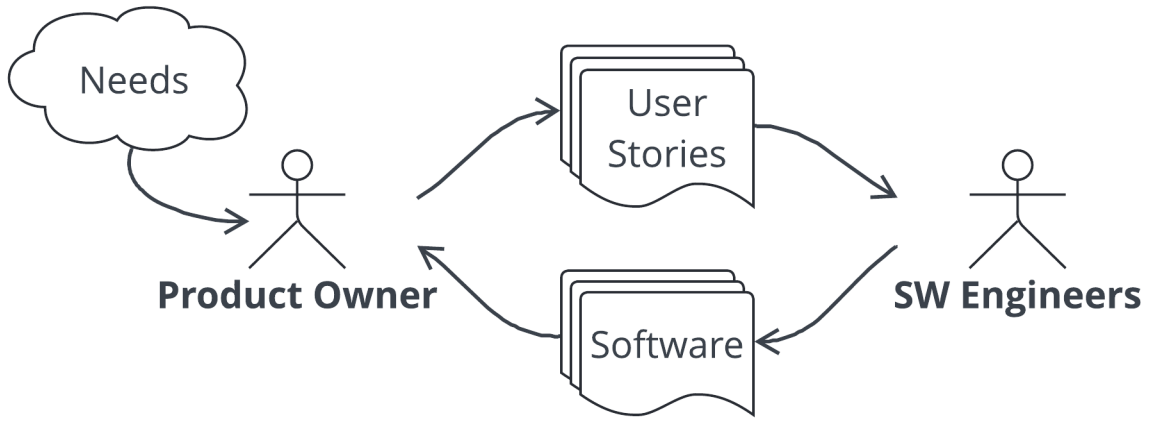
SE Challenges in Our context

1. Integrate SE into modern agile software development
2. Determine ontology for different development cultures

1. Integrating SE into Modern Agile Software Development

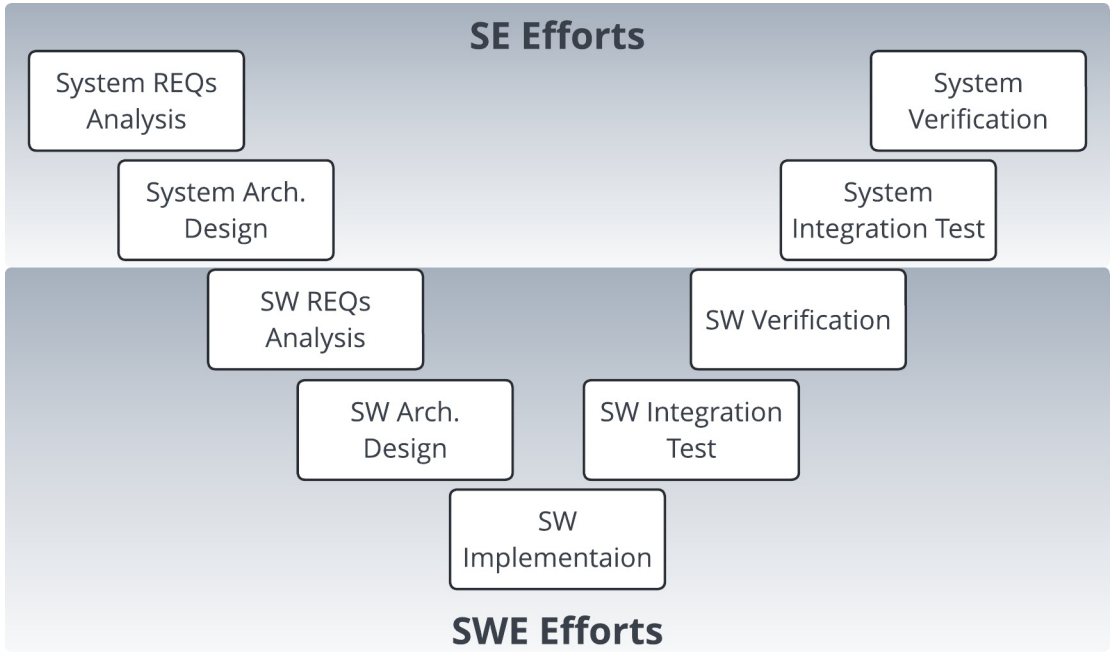
Agile SW Development

- Seems to be light and/or rapid



Perception of SE

- Seems to be heavy and/or slow



1. Integrating SE into Modern Agile Software Development

Gaps between agile software development and traditional SE

A valley of death b/w R&D and SE caused by engineering cultural differences or misconception that SE is a heavy process [2]

To transform the organization from the R&D to the production phase, integrating SE and agile software development to harmonize different teams' activities while overcoming the gaps and valley of death between SE and agile software development

[2] INCOSE INSIGHT volume 26, Issue 3

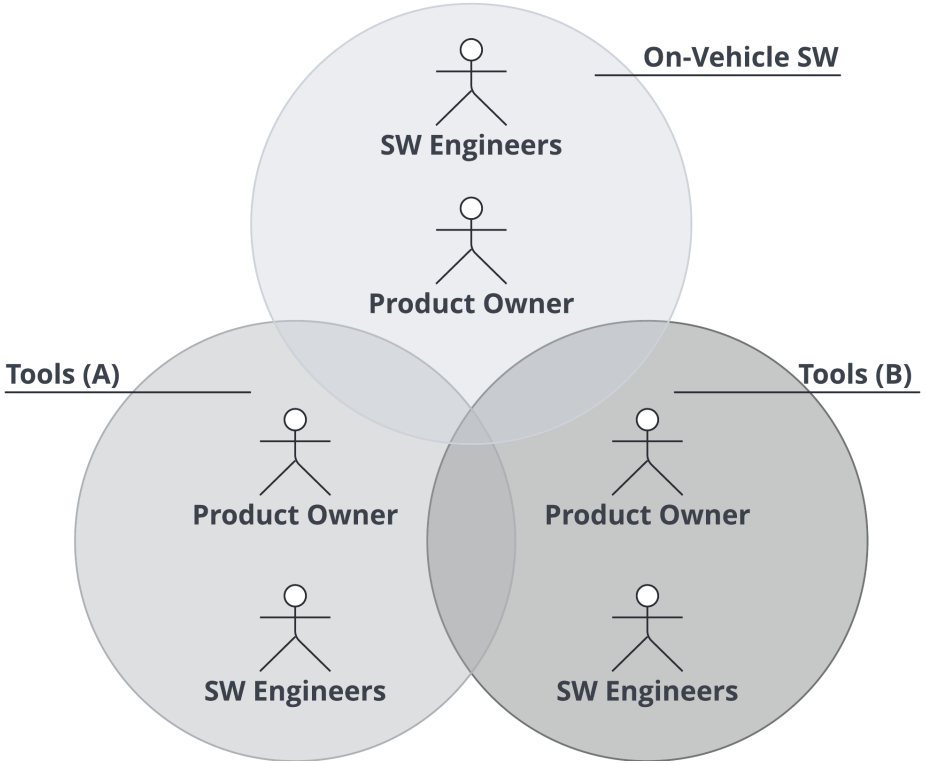
2. Determine ontology for different development cultures

Different software engineering teams have different cultures in the organization

The following crucial words are frequently used with ambiguous terminology and relationships:

- Product
- System
- Software
- Feature
- Function

To get rid of different understandings from engineers, determine ontology for the above conceptual words



Our Approaches

Our Approaches

SE Challenges

1. Integrating SE into modern agile software development

2. Determine ontology for different development cultures

Our Approaches

1. Changed the perception of the V-model in MBSE by introducing & tailoring Boeing MBE Diamond [1]

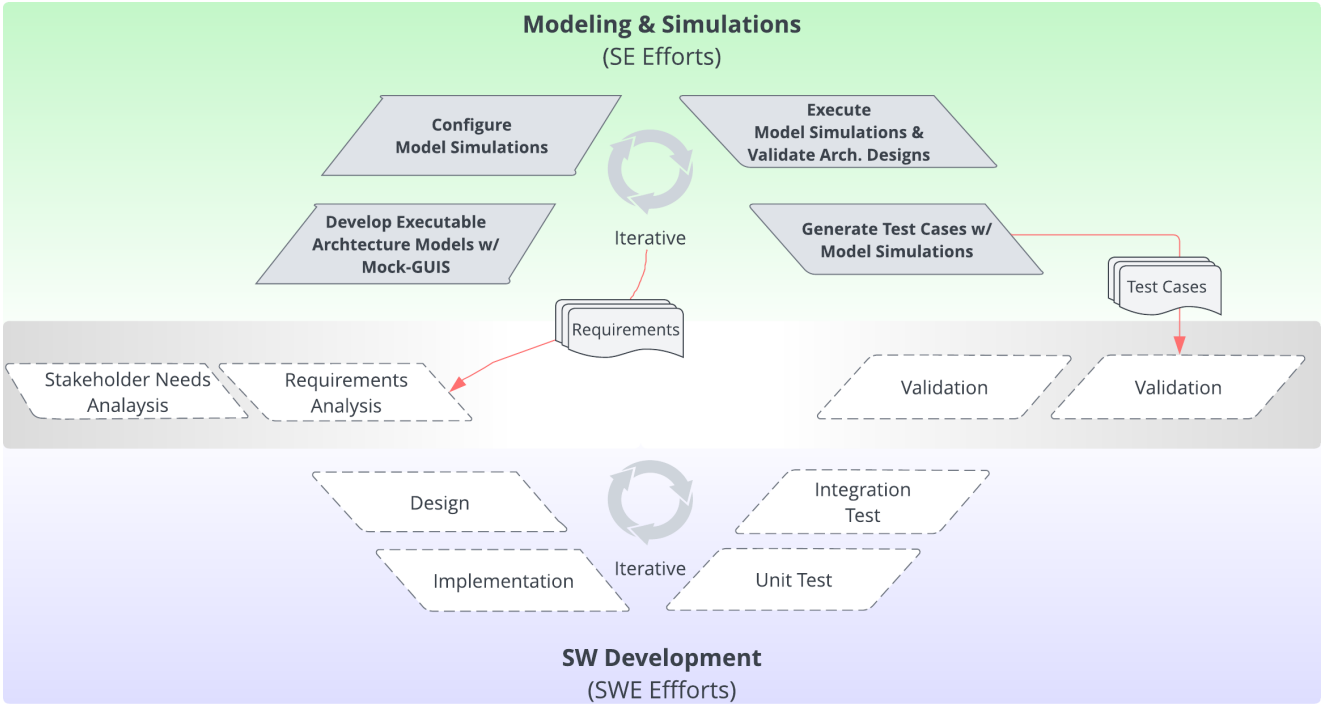
2. Developed metamodels to identify terms and relationships

[1] Boeing MBE Diamond

1. Changed the perception of the V-model in MBSE by introducing & tailoring Boeing MBE Diamond [1]

Motivations:

- To avoid creating psychological resistance to introducing SE approaches
- To minimize the impact of introducing a new discipline (MBSE) into SW engineering teams
- To provide value to developments that have been already in progress while concurrently working alongside them



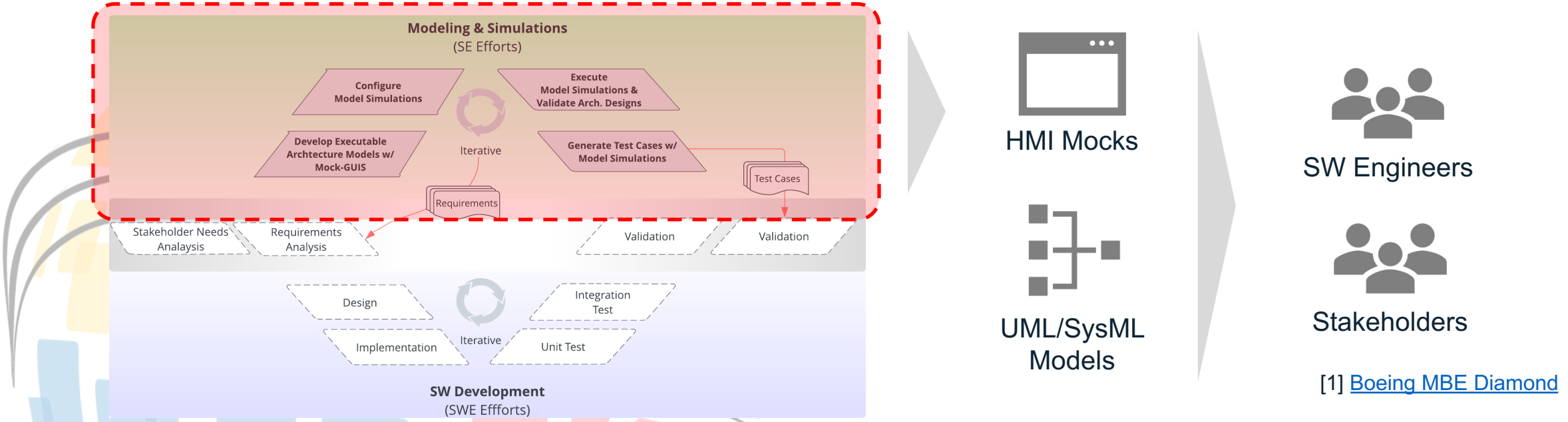
Tailored & modified diamond

[1] Boeing MBE Diamond

1. Changed the perception of the V-model in MBSE by introducing & tailoring Boeing MBE Diamond [1]

Immerse the concept into the organization

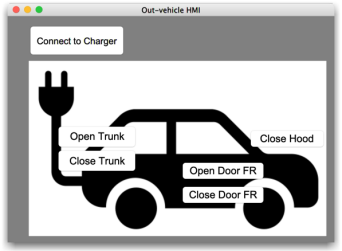
- Develop executable models to provide SW engineers with intuitive specifications
- Integrate the models with HMI mocks to share end-to-end overviews of the SOI
- Drive cross-functions/domains/stakeholders in the discussion

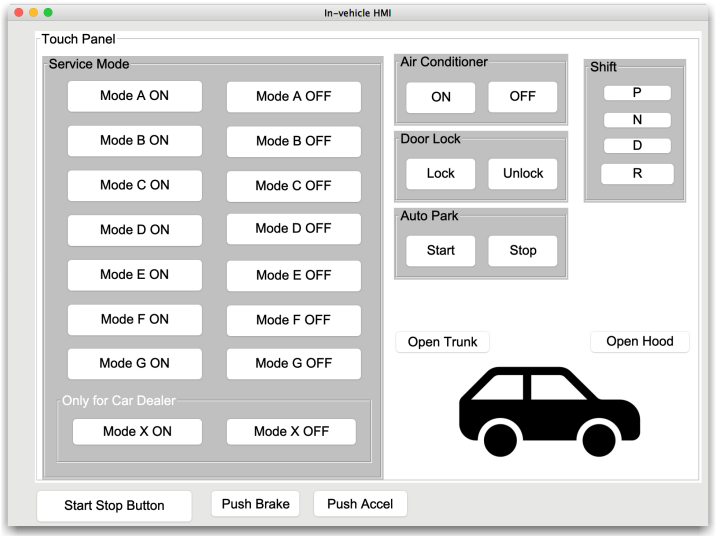


[1] Boeing MBE Diamond

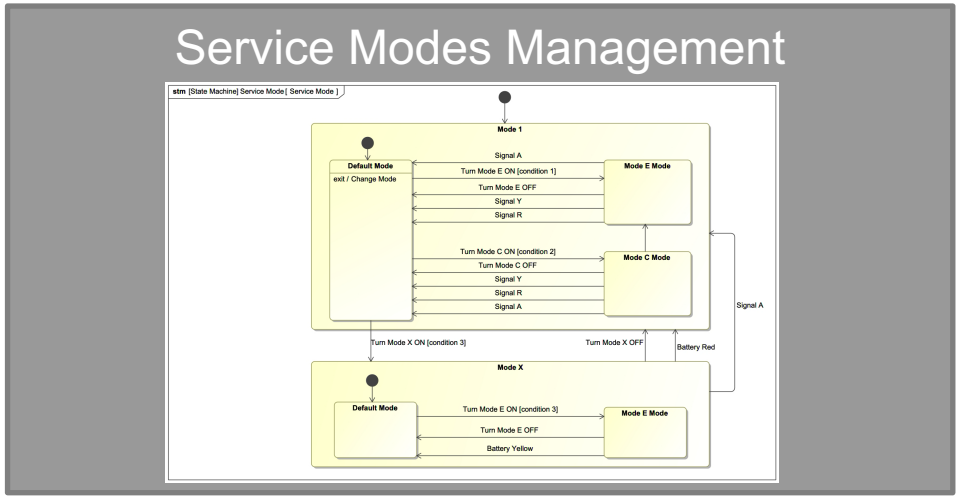
1. Changed the perception of the V-model in MBSE by introducing & tailoring Boeing MBE Diamond [1]

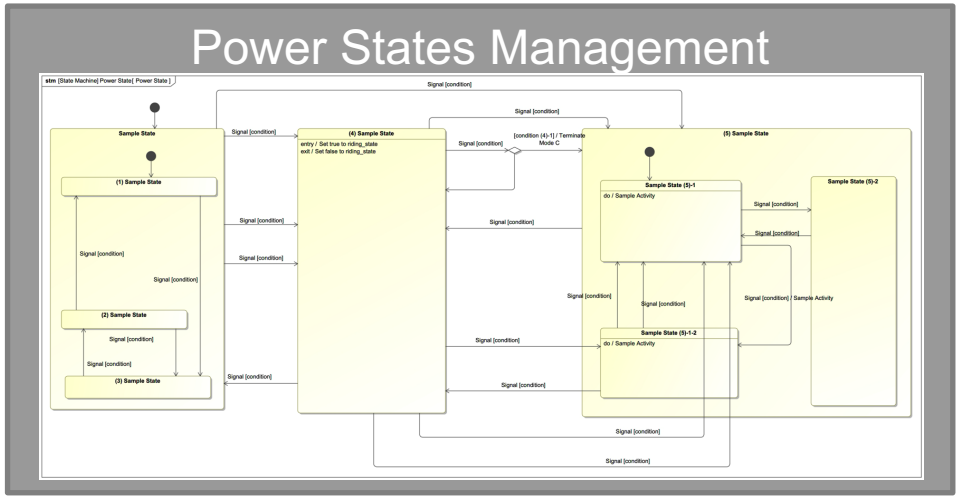
Example*





Out/In-vehicle HMI Mocks



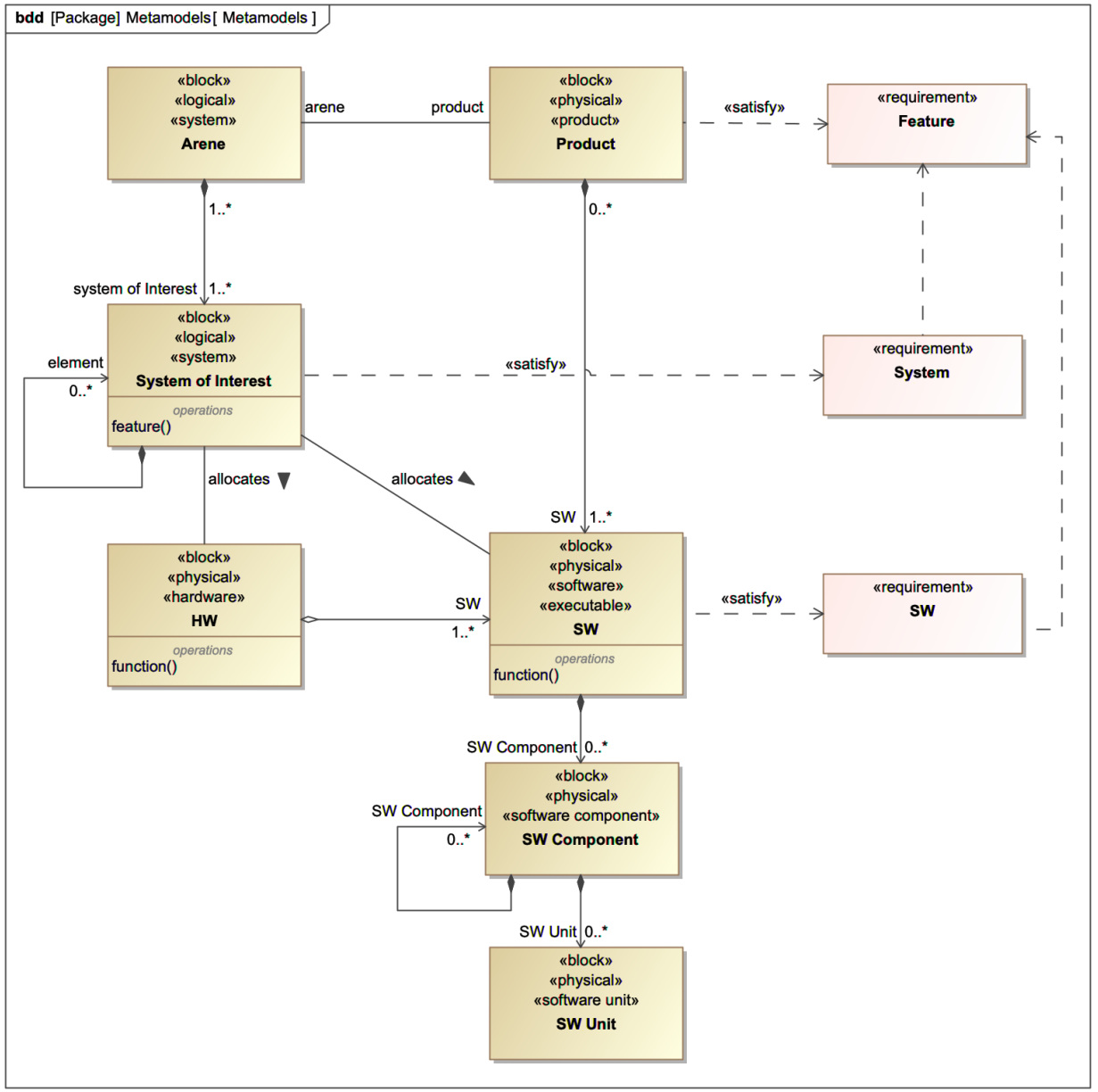


*This example was tailored and modified from the original ones for the presentation purpose

2. Developed metamodels to identify terms and relationships

Ambiguous words:

- Product
- System
- Software
- Feature
- Function



Results

Results

Arene OS development are still ongoing, but the following outcomes are beginning to emerge:

- The value of MBSE is beginning to be understood by SW developers in the organization while providing modeling and simulations alongside software developments
- The metamodels organized the relationship between buzzwords that are used in the agile SW development custom in the organization

As a starting point, succeeded in integrating MBSE and agile SW development without sacrificing agility

Conclusion

Conclusion

In the automotive industry, there is a transition into SW-centric vehicles and a high demand for early adoption of R&D SW Technologies into Products

There is a difficulty factored by a valley of death b/w R&D and SE caused by engineering cultural differences or misconceptions [2]

Our approaches:

1. Changed the perception of the V-model in MBSE by introducing & tailoring Boeing MBE Diamond [1] with executable models
2. Developed metamodels to identify terms and relationships

Results: Started adapting MBSE into the agile SW development without sacrificing agility

[1] Boeing MBE Diamond, [2] INCOSE INSIGHT volume 26, Issue 3

34th Annual INCOSE international symposium

hybrid event

Dublin, Ireland
July 2 - 6, 2024

www.incose.org/symp2024
#INCOSEIS