How Ansys supports and enables Model-based Systems Engineering in the context of Digital Transformation

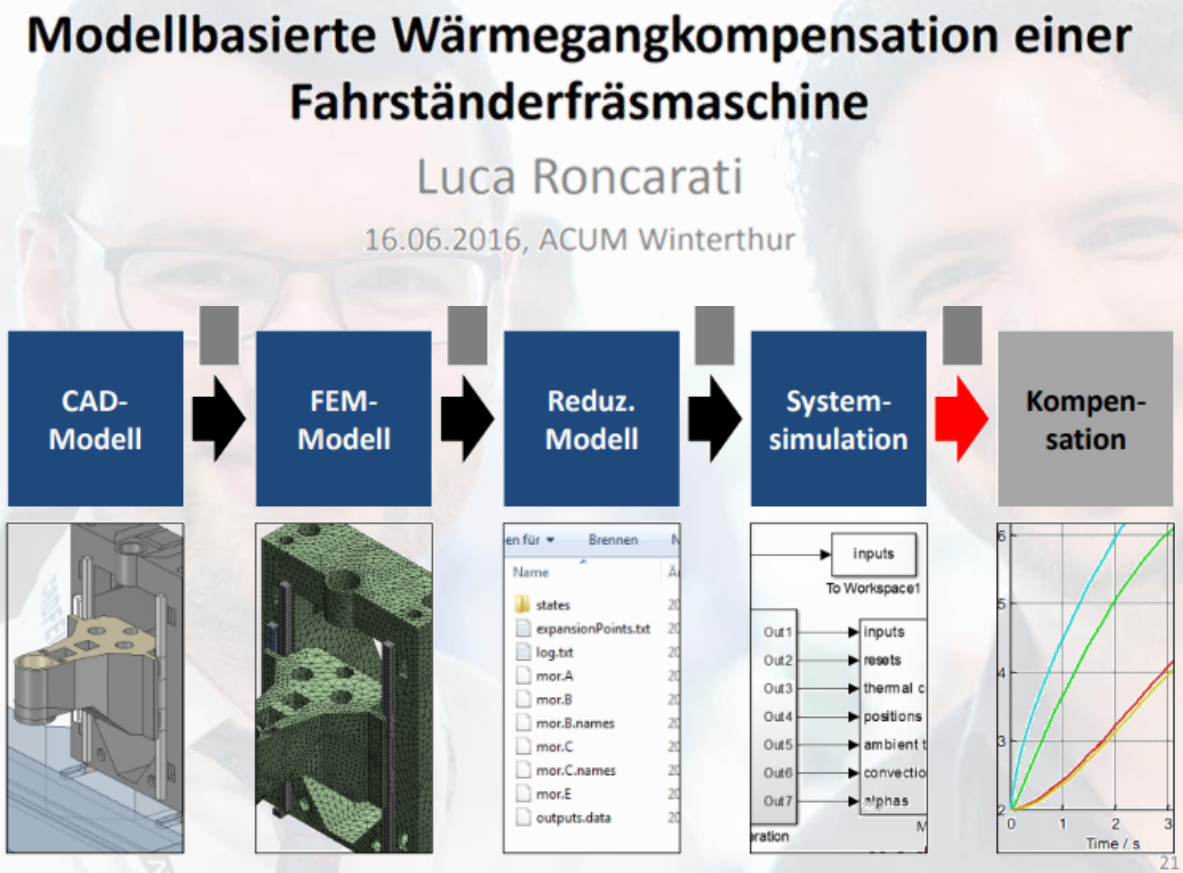
SIMULATION CONFERENCE

CADFEM Ansys Simulation Conference 2023
Rapperswil

Martin Meiler, CADFEM Germany GmbH

CADFEM Ansys / ELITE CHANNEL PARTNER

Inspiration treibt Innovation



Systemsimulation, 15.06.2023 >> ganze Session

CADFEM

Werkzeugmaschinen

Raum 4.112

Simulation von Trenn- und Fügeprozessen mit netzfreien Methoden

Raphael Heiniger, DYNAmore Swiss GmbH

Kompensation des Wärmegangs im Produktionsprozess durch Verwendung reduzierter FE-Modelle

Frank Bratschi, Ingenieurbüro Bratschi GmbH
Eric Gutmann, mcs und Roy Frieden, Innovateam Engineering

Performance- und Kostenziele von Werkzeugmaschinen durch Simulation erreichen

Daniel Spescha, Inspire AG

Werkstück-Formfehlerprognose mittels virtuellem Prototypen beim Koordinatenschleifen

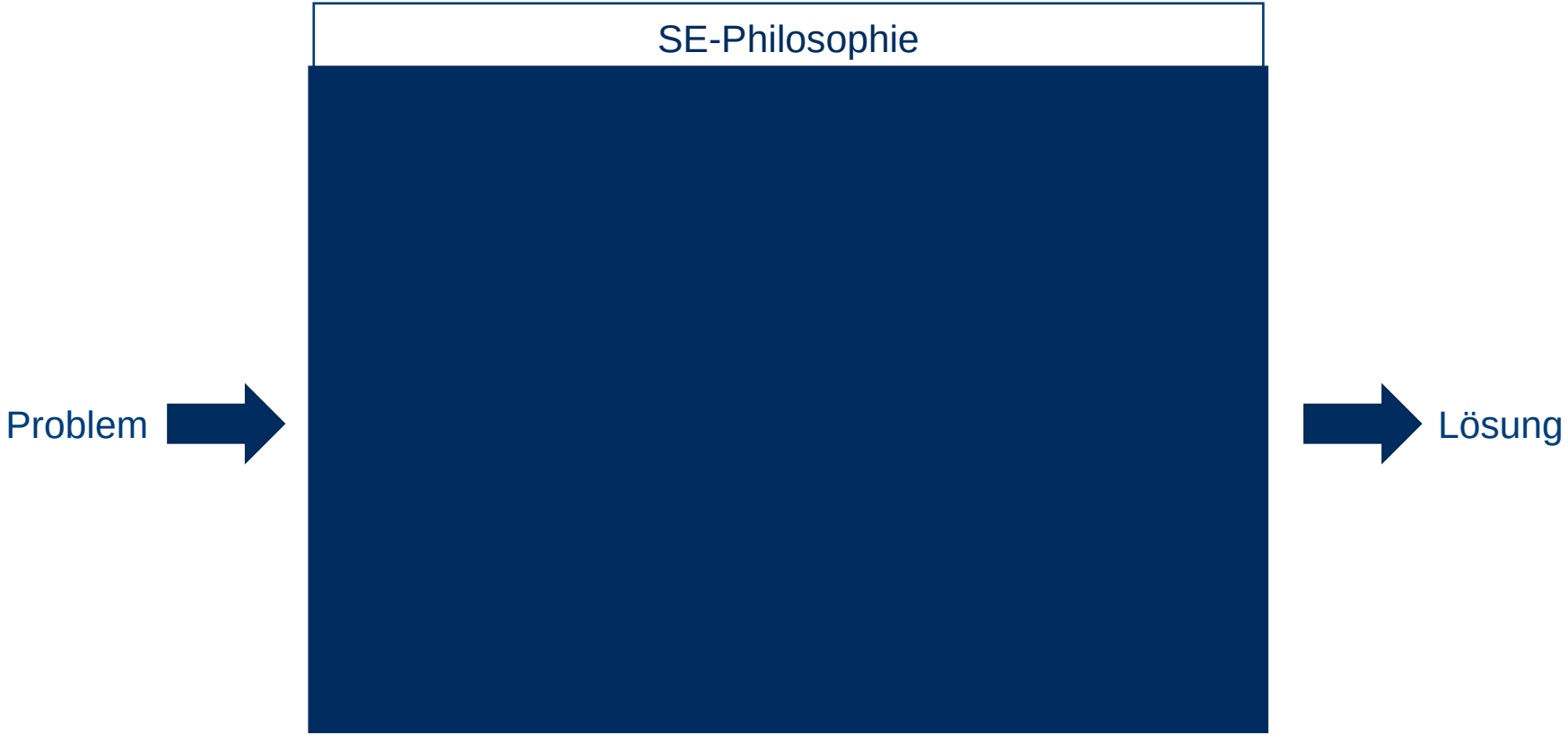
Michael Egeter, L.Kellenberger & Co. AG (Hardinge Inc.) und Mayra Hoppstädter, inspire AG

Inspiration treibt Innovation

1. Systemsimulation
2. **Systems Engineering**

Systems Engineering

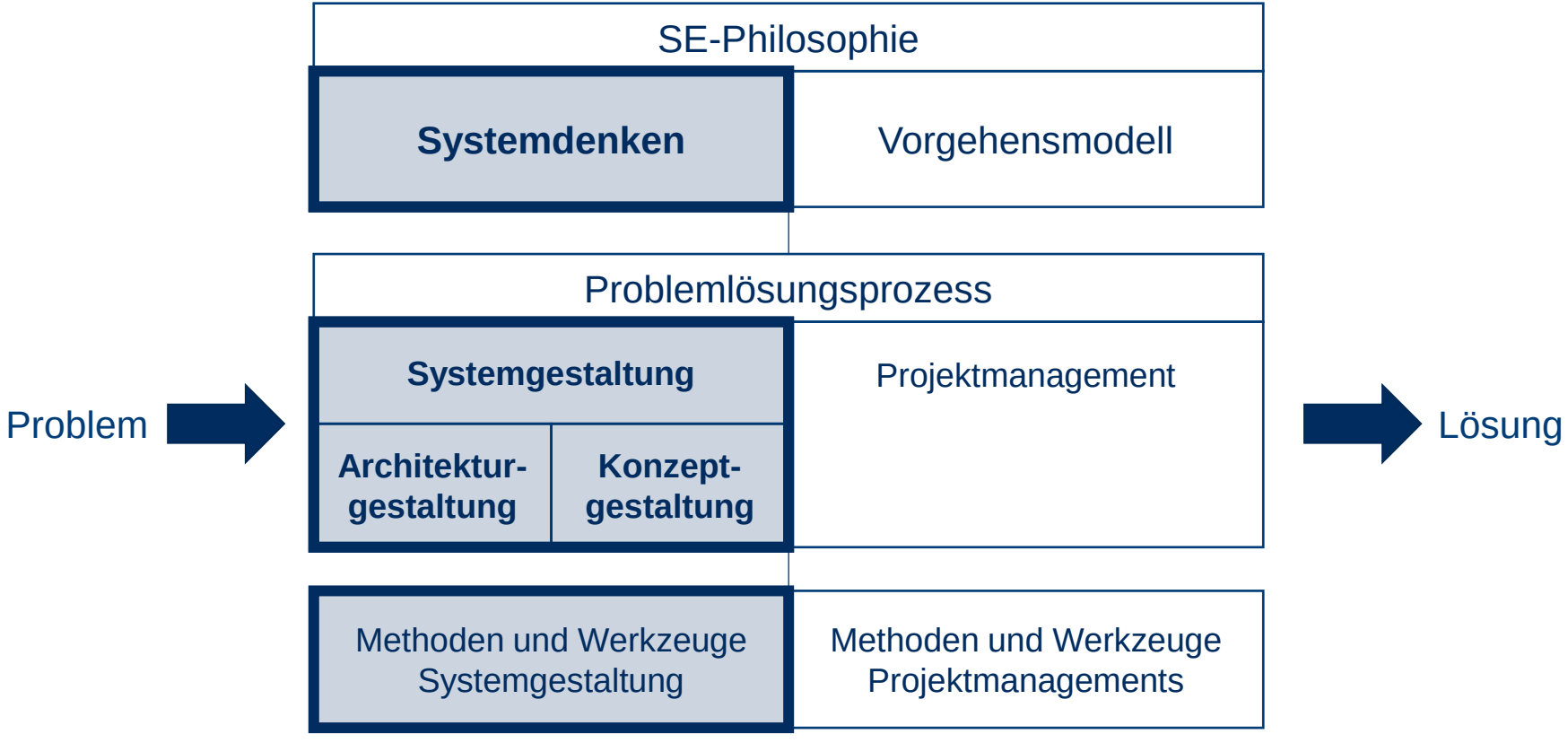
Modellbildung und Simulation als integraler Bestandteil der Systemgestaltung



Systems Engineering; Reinhard Haberfellner, Oliver de Weck, Ernst Fricke; 2013

Systems Engineering

Modellbildung und Simulation als integraler Bestandteil der Systemgestaltung



Systems Engineering; Reinhard Haberfellner, Oliver de Weck, Ernst Fricke; 2013

Inspiration treibt Innovation

1. Systemsimulation
2. Systems Engineering
3. **Modellbasierter und durchlässiger Workflow**

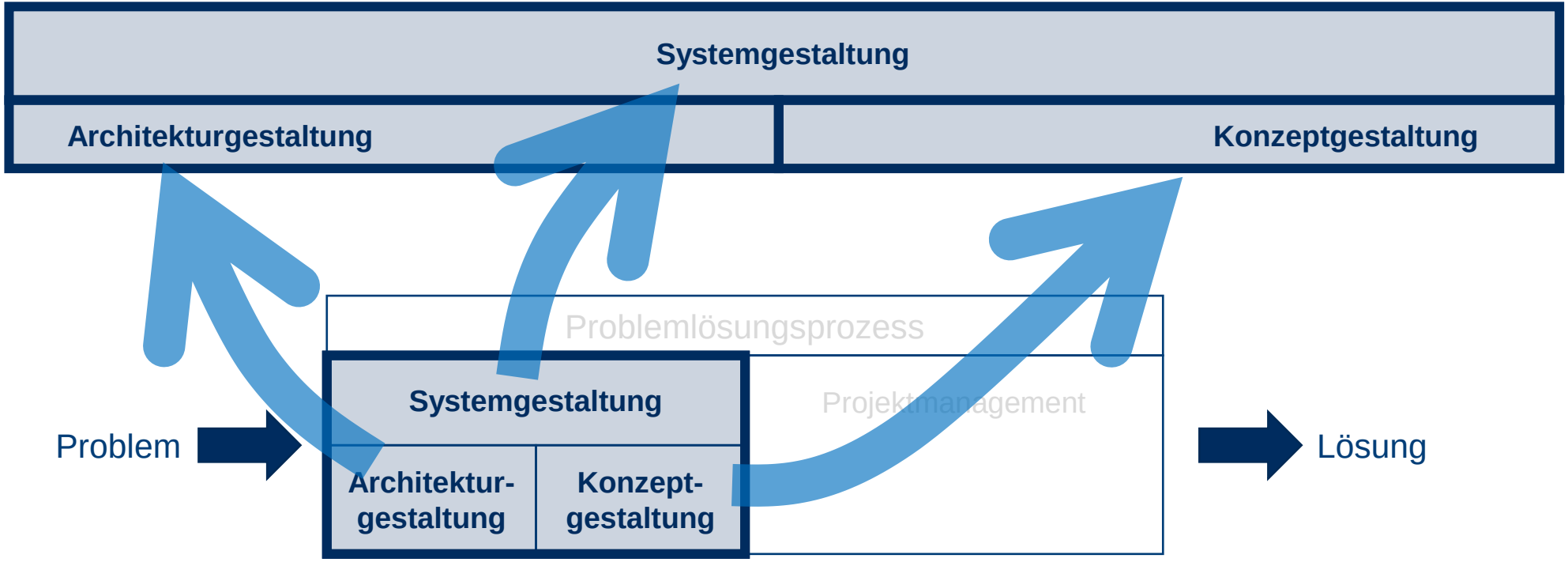
Systems Engineering

Modellbildung und Simulation als integraler Bestandteil der Systemgestaltung

Systems Engineering; Reinhard Haberfellner, Oliver de Weck, Ernst Fricke; 2013

Systems Engineering

Modellbildung und Simulation als integraler Bestandteil der Systemgestaltung



MBSE, Modellbasierter und durchlässiger Workflow

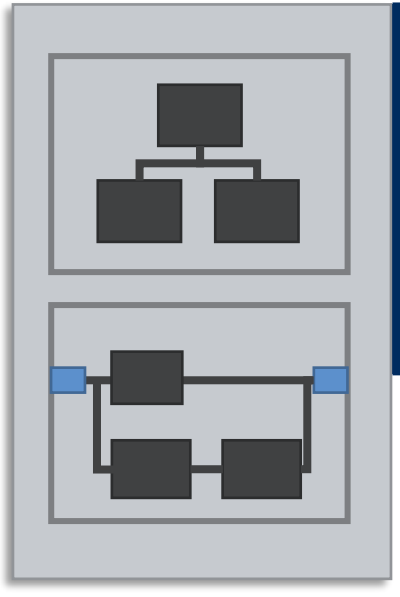
Modellbildung und Simulation als integraler Bestandteil der Systemgestaltung

Systemgestaltung

Architekturgestaltung | **Konzeptgestaltung**

System Architecture Model (SAM)

Physics based Engineering Workflows



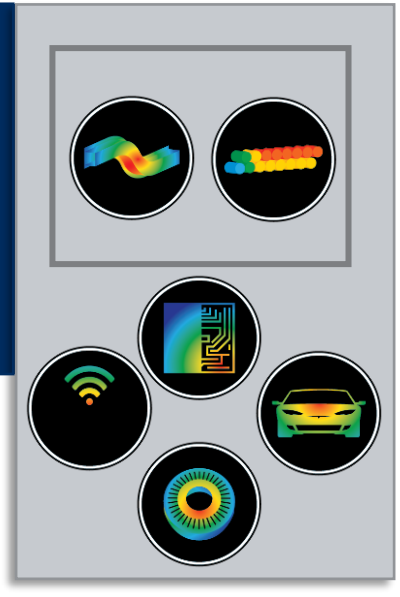
Beschreibendes Modell

Modellbasierter und durchlässiger Workflow

Austausche der relevanten Informationen
Steigerung der Effektivität und Effizienz

Architecture Design → Update Analysis Models

Requirements ← Analysis Results



Physikbasiertes Modell

Inspiration treibt Innovation

1. Systemsimulation
2. Systems Engineering
3. Modellbasierter und durchlässiger Workflow

Mehrwert durch MBSE

Model-based Systems Engineering

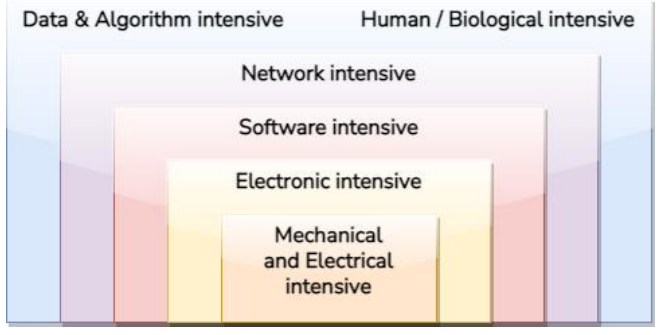
Challenges in product development

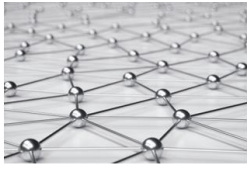
Time to Market

Costs

Quality

Complexity

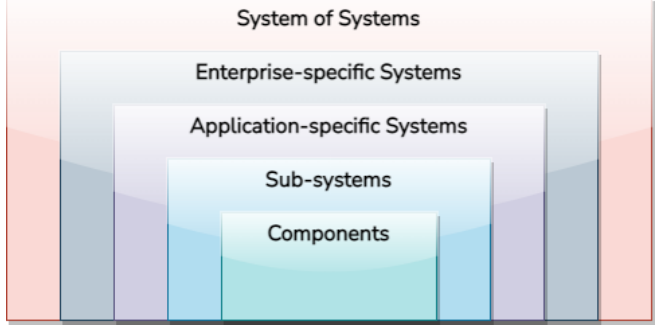




Interdependent Systems

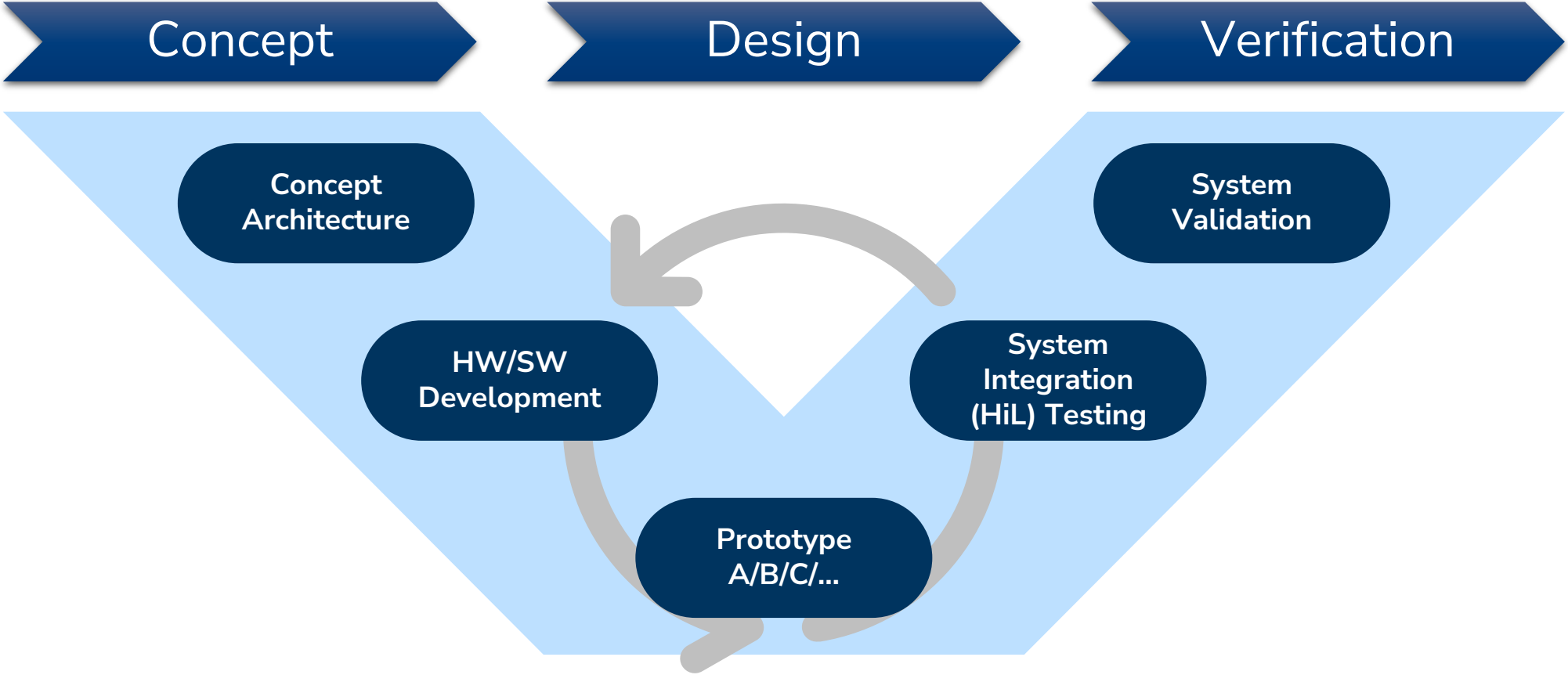
Distributed Systems

Safety and Security

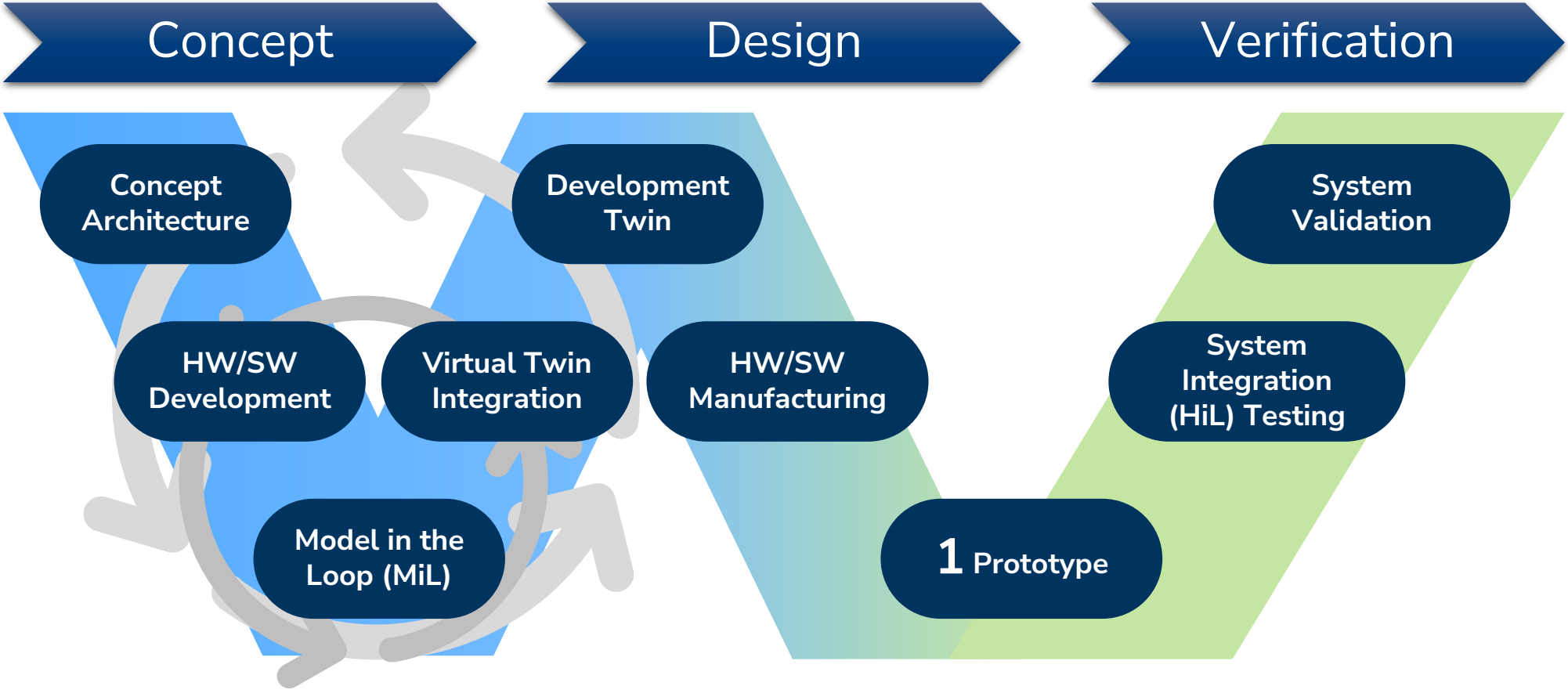


Source: INCOSE – Vision 2035

System development up to today



System development in future



How Ansys supports and enables Model-based Systems Engineering in the context of Digital Transformation

SIMULATION CONFERENCE

CADFEM Ansys Simulation Conference 2023
Rapperswil

Martin Meiler, CADFEM Germany GmbH

CADFEM Ansys / ELITE CHANNEL PARTNER

System development in future requires …

CADFEM

01 Collaboration

between Systems and CAE Engineering
due to

- lack of physical prototypes
- lack of measurement / validation / training data
- enable a holistic and sustainable product development

02 Process Integration

of engineering tasks
for

- gaining insight into product development from concept, via preliminary to detailed designs
- understanding process complexity and interactions
- optimization / design of experiments
- setting up traceable and reproducable development artefacts

03 Central Data Storage

of domain specific single sources of information
for

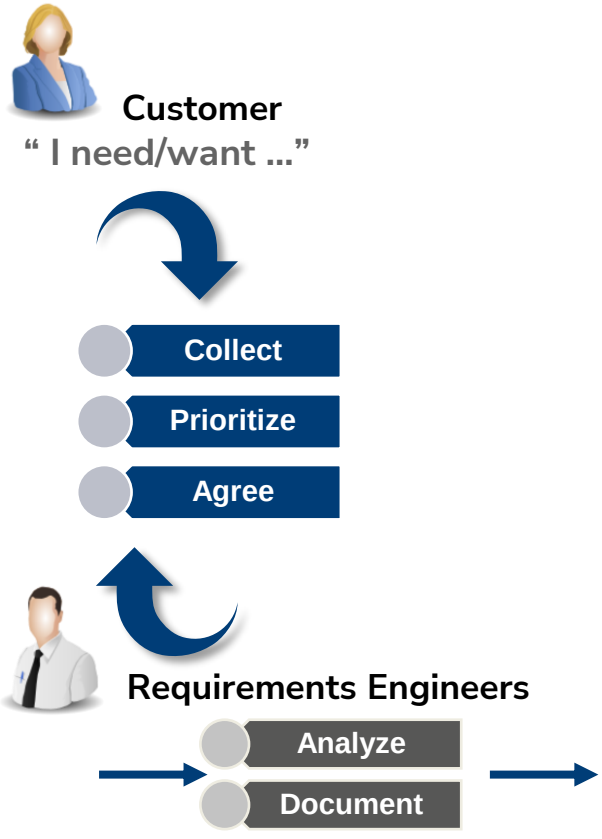
- PLM/ALM, CAD models, requirements
- CAE simulation and process data
- Material data
- Embedded Software and Architecture

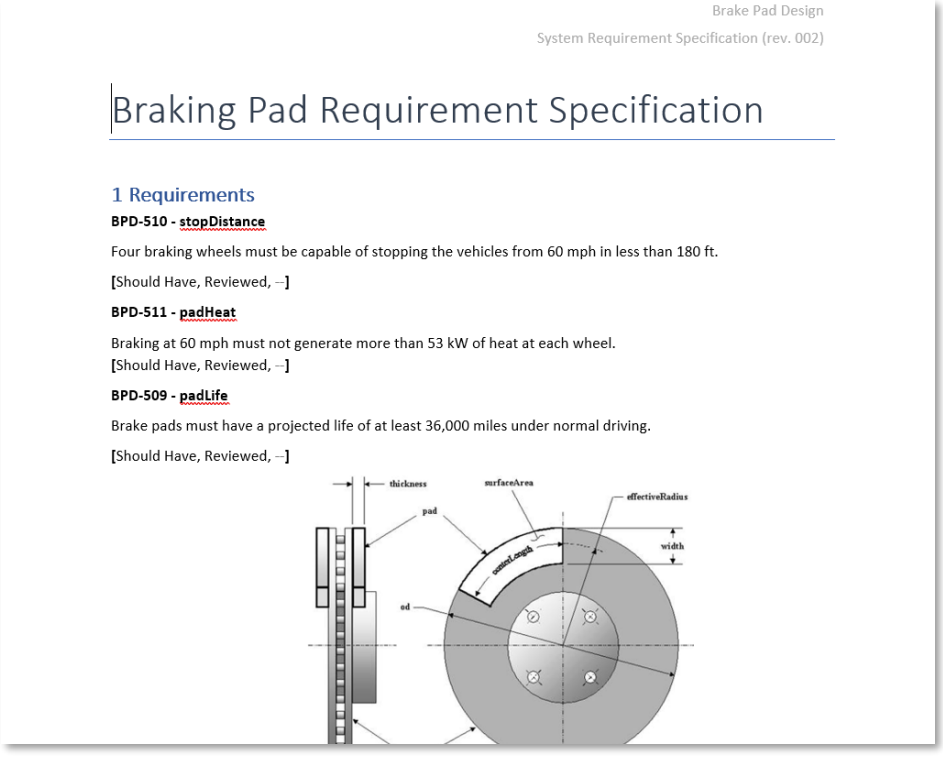
04 Open Interfaces

in order to easily exchange data between

- different tools and vendors
- customer, OEM, and supplier

Model-Based …
demonstrated on Requirements Management





Brake Pad Design

System Requirement Specification (rev. 002)

Braking Pad Requirement Specification

1 Requirements

BPD-510 - stopDistance

Four braking wheels must be capable of stopping the vehicles from 60 mph in less than 180 ft.

[Should Have, Reviewed, --]

BPD-511 - padHeat

Braking at 60 mph must not generate more than 53 kW of heat at each wheel.
[Should Have, Reviewed, --]

BPD-509 - padLife

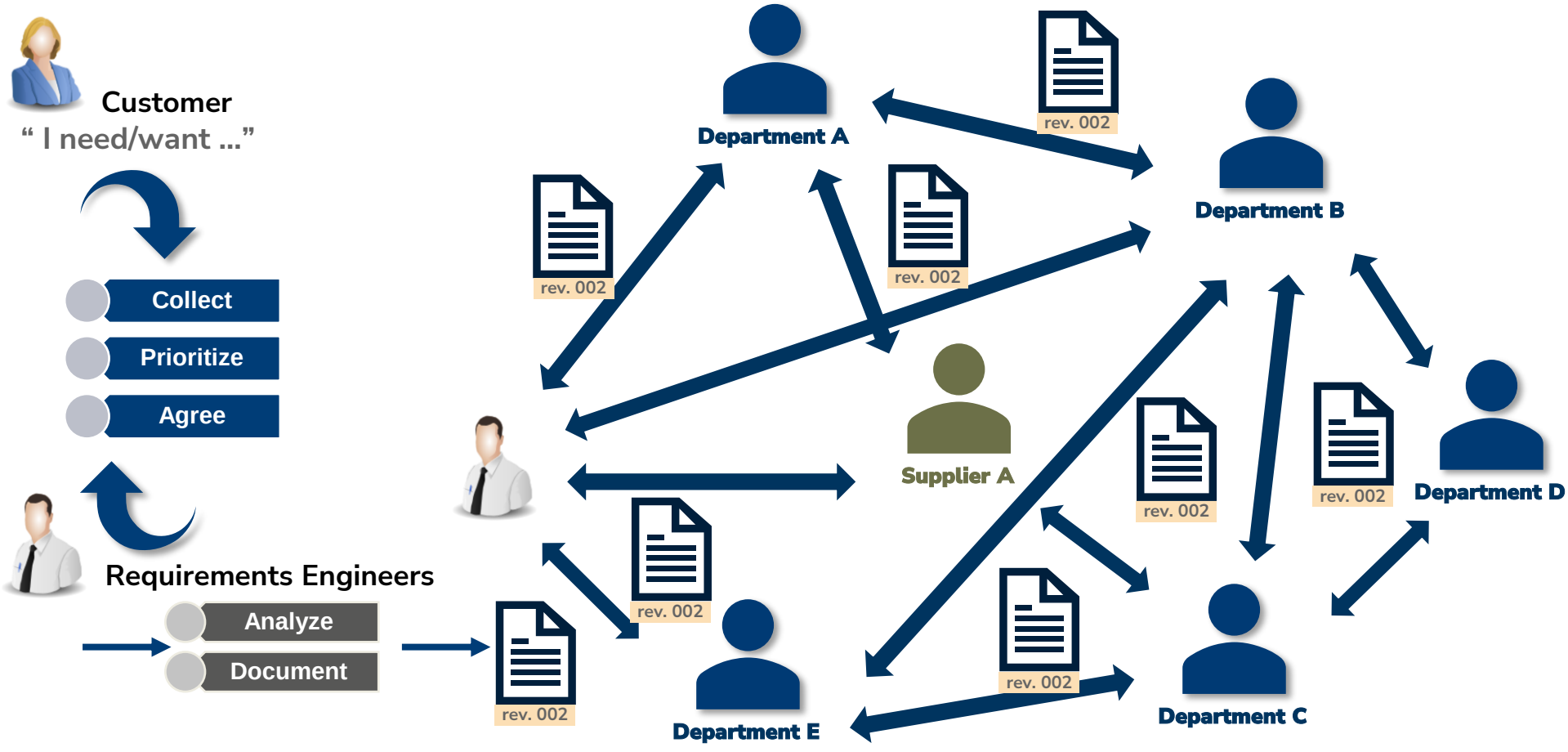
Brake pads must have a projected life of at least 36,000 miles under normal driving.

[Should Have, Reviewed, --]

rev. 002

Document-centric approach

Model-Based …
demonstrated on Requirements Management



Model-Based …
demonstrated on Requirements Management

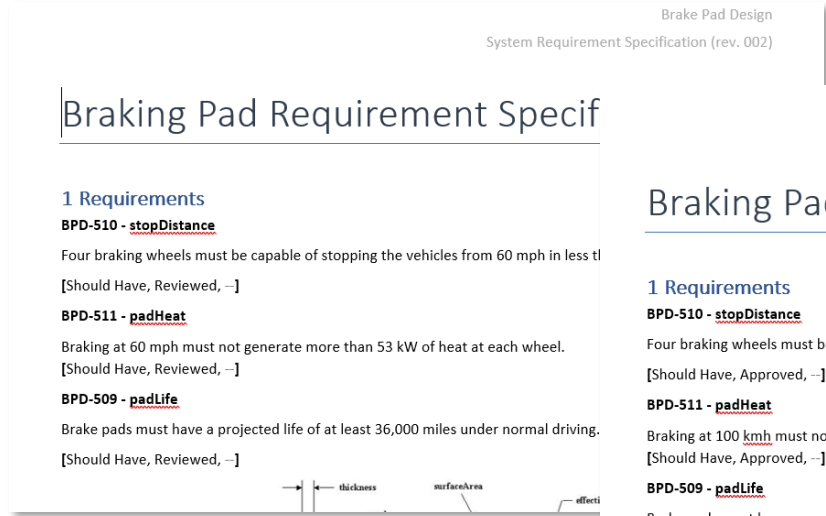
Customer

“ I need/want …”

- Collect
- Prioritize
- Agree

Requirements Engineers

- Analyze
- Document



Brake Pad Design

System Requirement Specification (rev. 002)

Braking Pad Requirement Specif

1 Requirements

BPD-510 - stopDistance

Four braking wheels must be capable of stopping the vehicles from 60 mph in less tl

[Should Have, Reviewed, --]

BPD-511 - padHeat

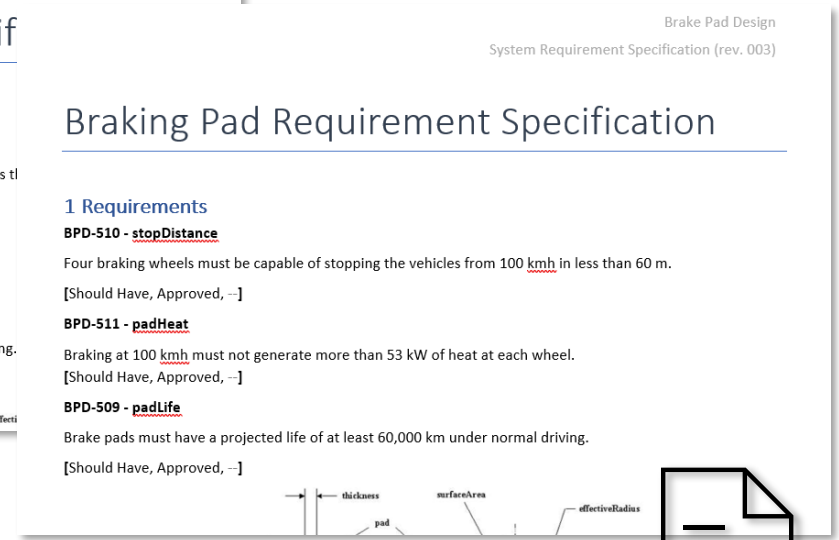
Braking at 60 mph must not generate more than 53 kW of heat at each wheel.
[Should Have, Reviewed, --]

BPD-509 - padLife

Brake pads must have a projected life of at least 36,000 miles under normal driving.

[Should Have, Reviewed, --]

rev. 002



Brake Pad Design

System Requirement Specification (rev. 003)

Braking Pad Requirement Specification

1 Requirements

BPD-510 - stopDistance

Four braking wheels must be capable of stopping the vehicles from 100 kmh in less than 60 m.

[Should Have, Approved, --]

BPD-511 - padHeat

Braking at 100 kmh must not generate more than 53 kW of heat at each wheel.
[Should Have, Approved, --]

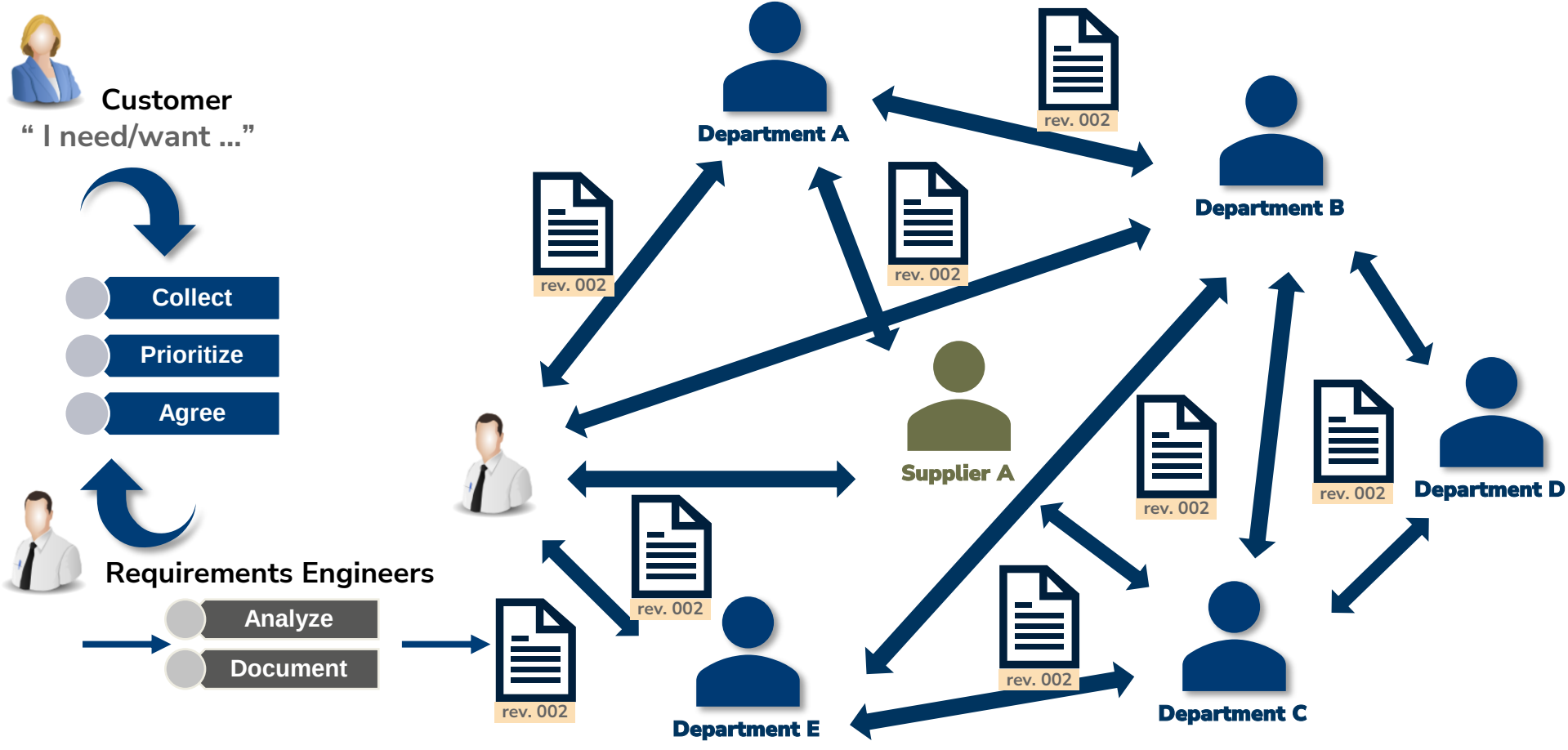
BPD-509 - padLife

Brake pads must have a projected life of at least 60,000 km under normal driving.

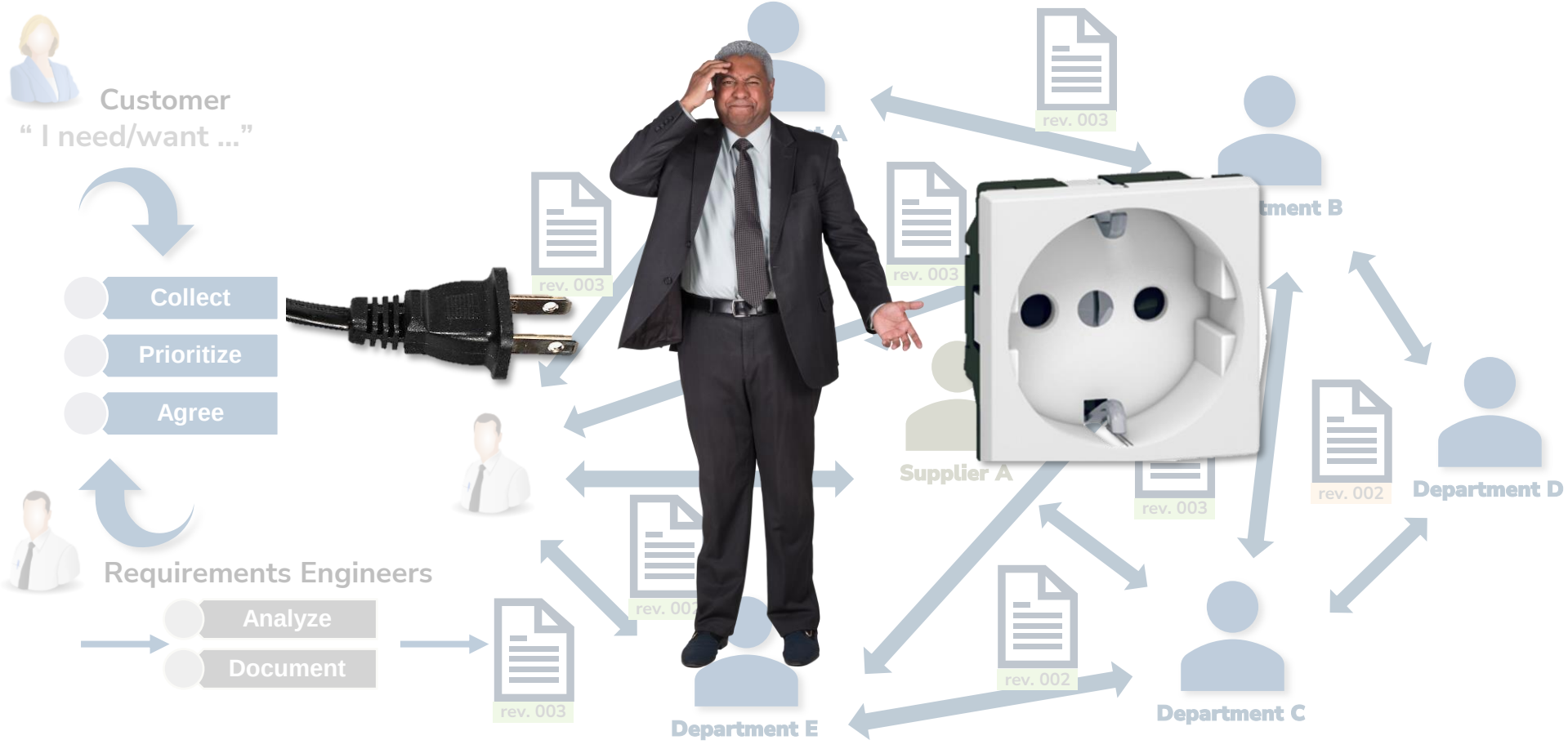
[Should Have, Approved, --]

rev. 003

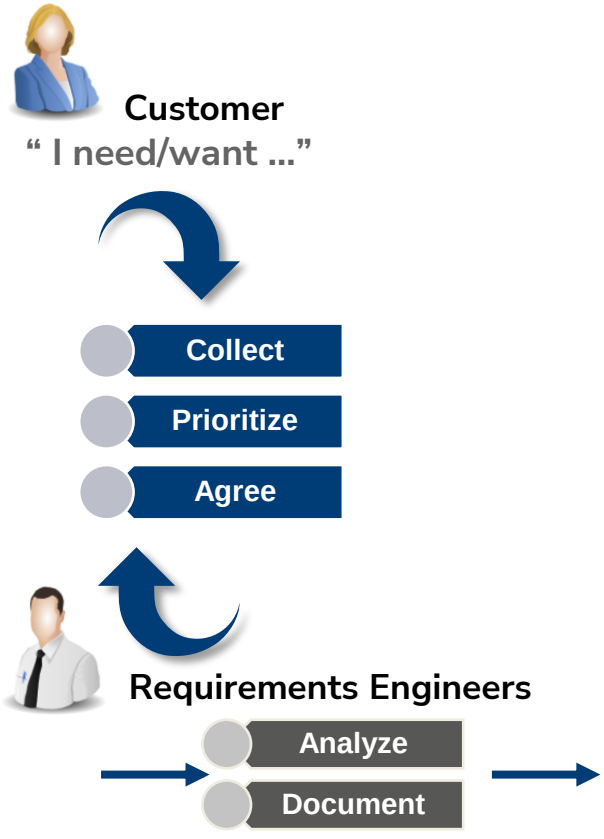
Model-Based …
demonstrated on Requirements Management

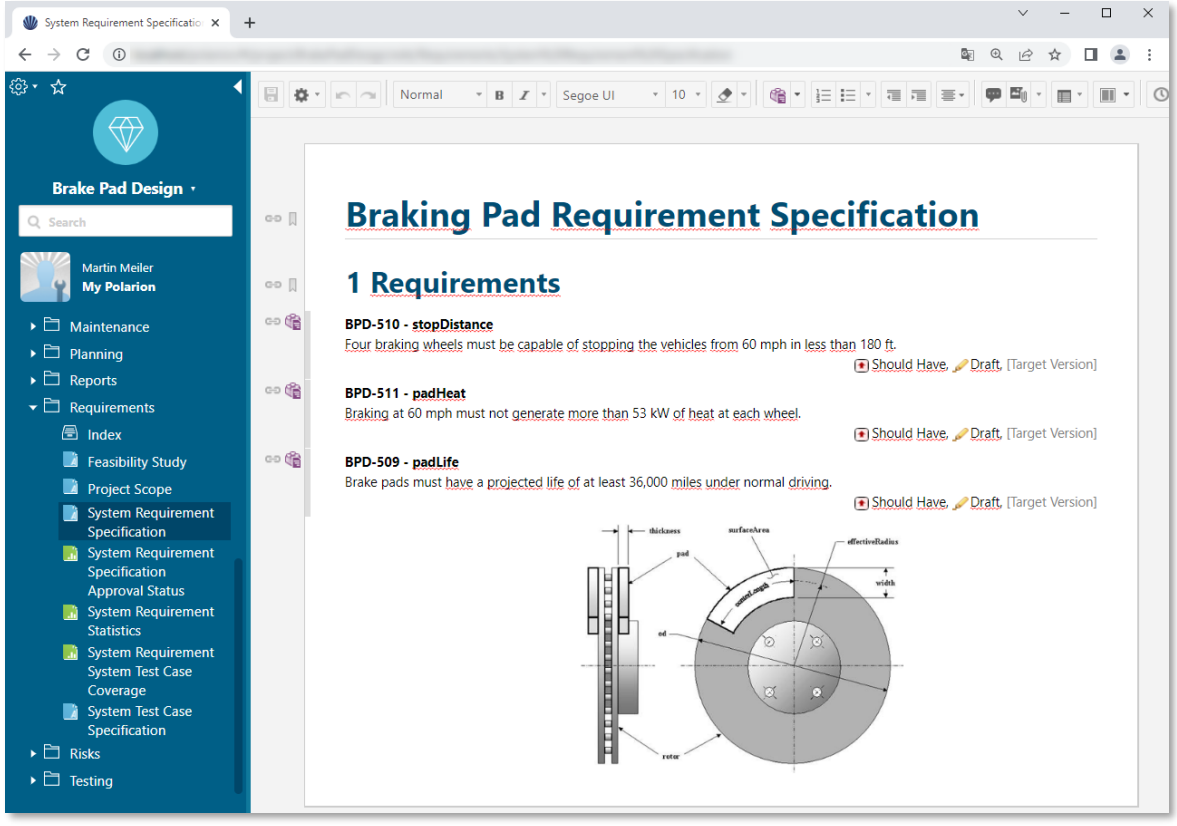


Model-Based …
demonstrated on Requirements Management



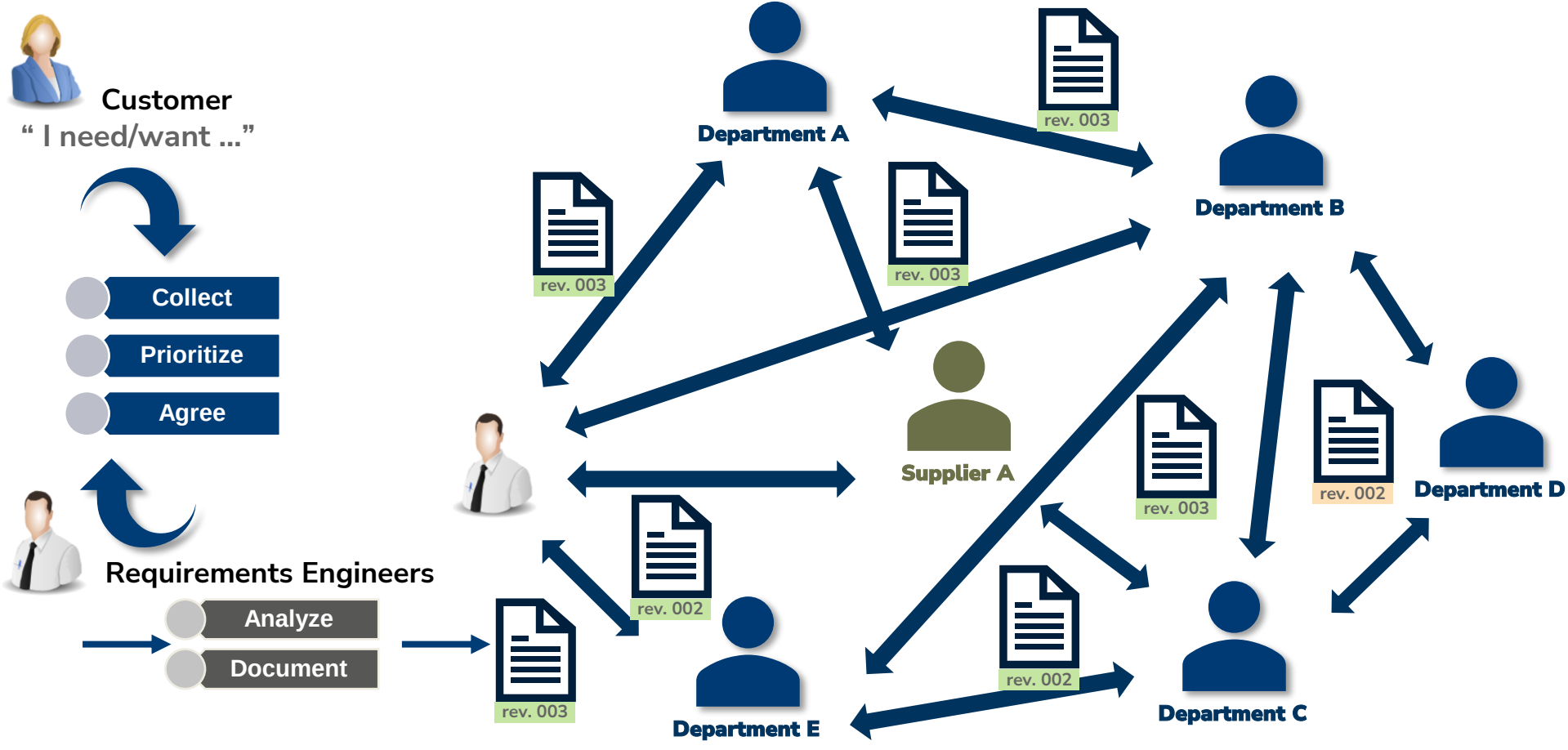
Model-Based …
demonstrated on Requirements Management



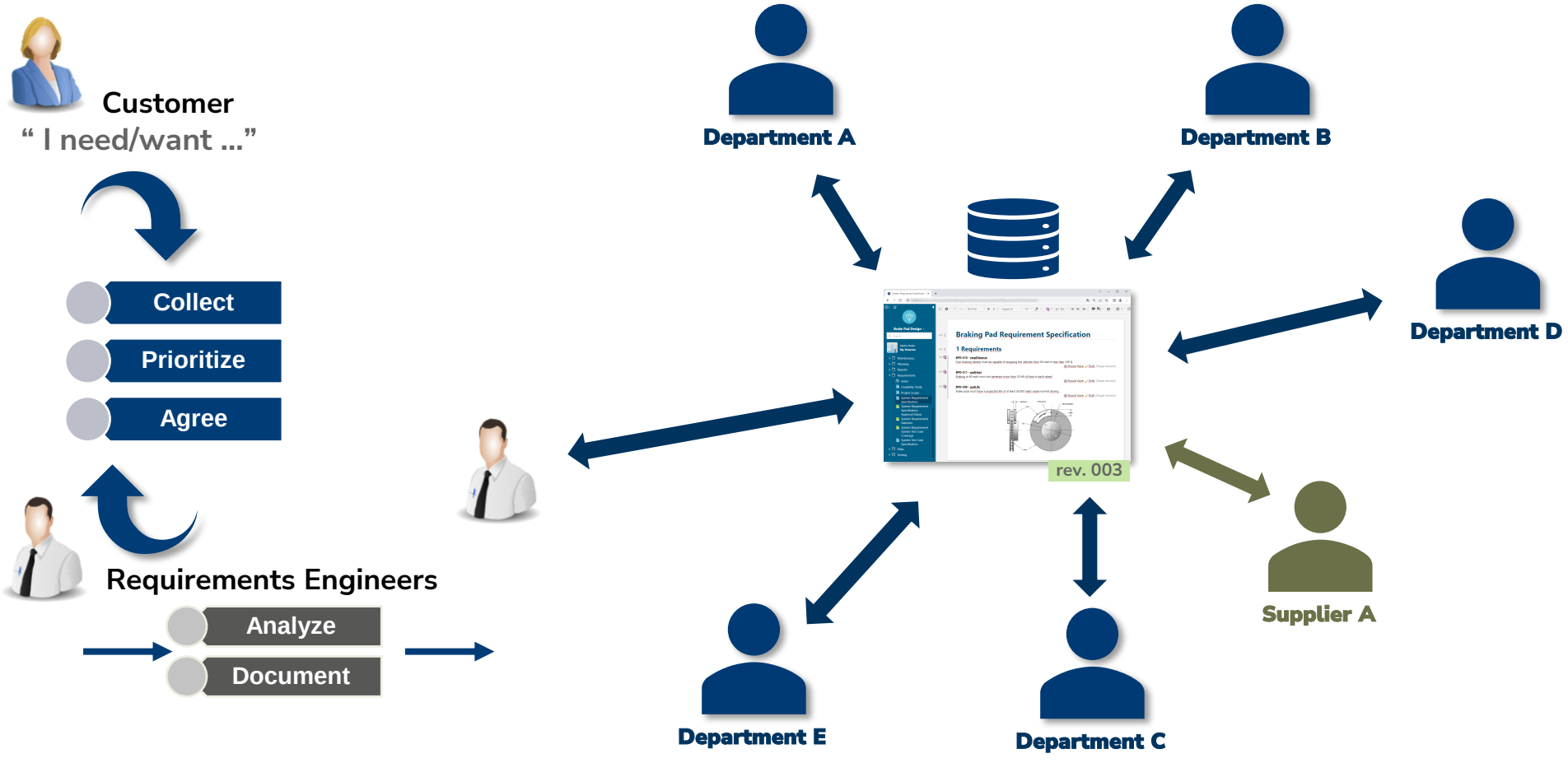


Model-based approach

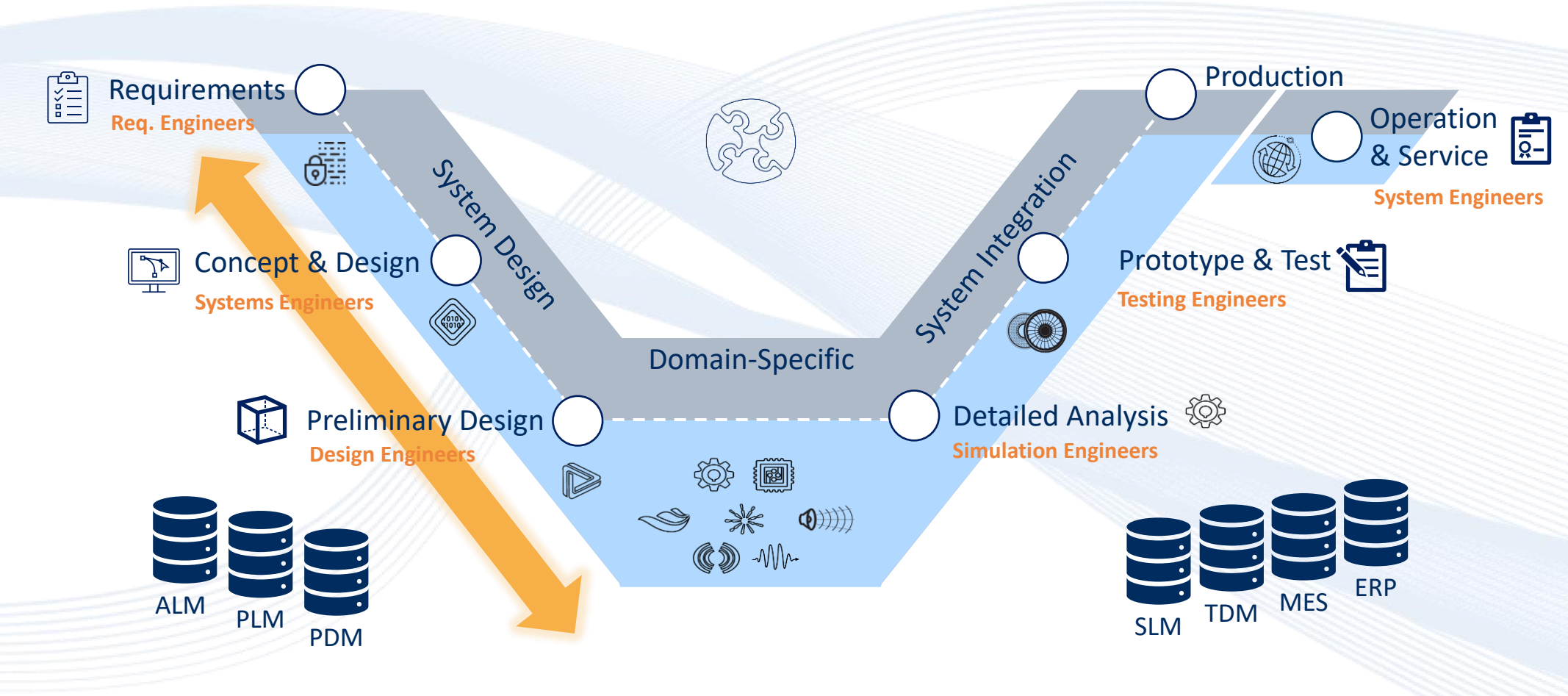
Model-Based …
demonstrated on Requirements Management



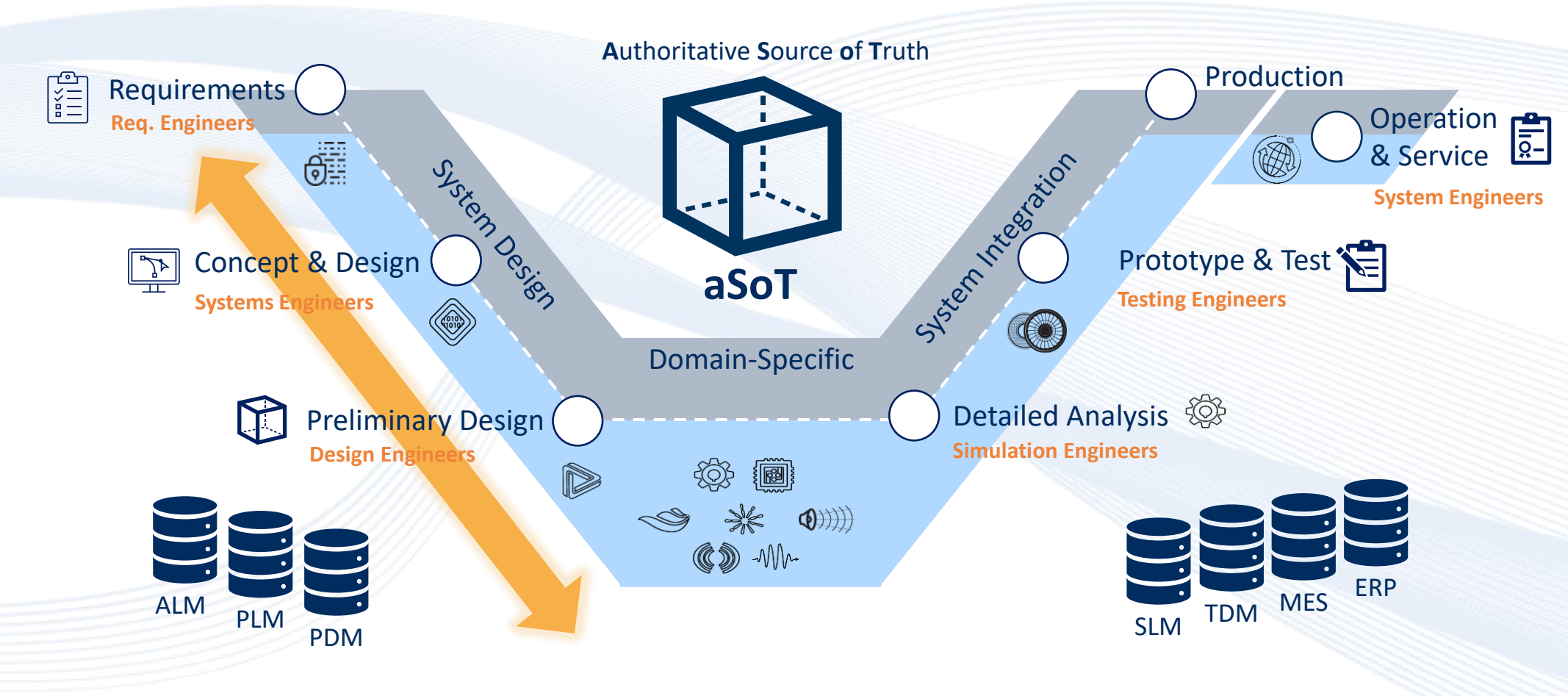
Model-Based …
demonstrated on Requirements Management



Digital Thread

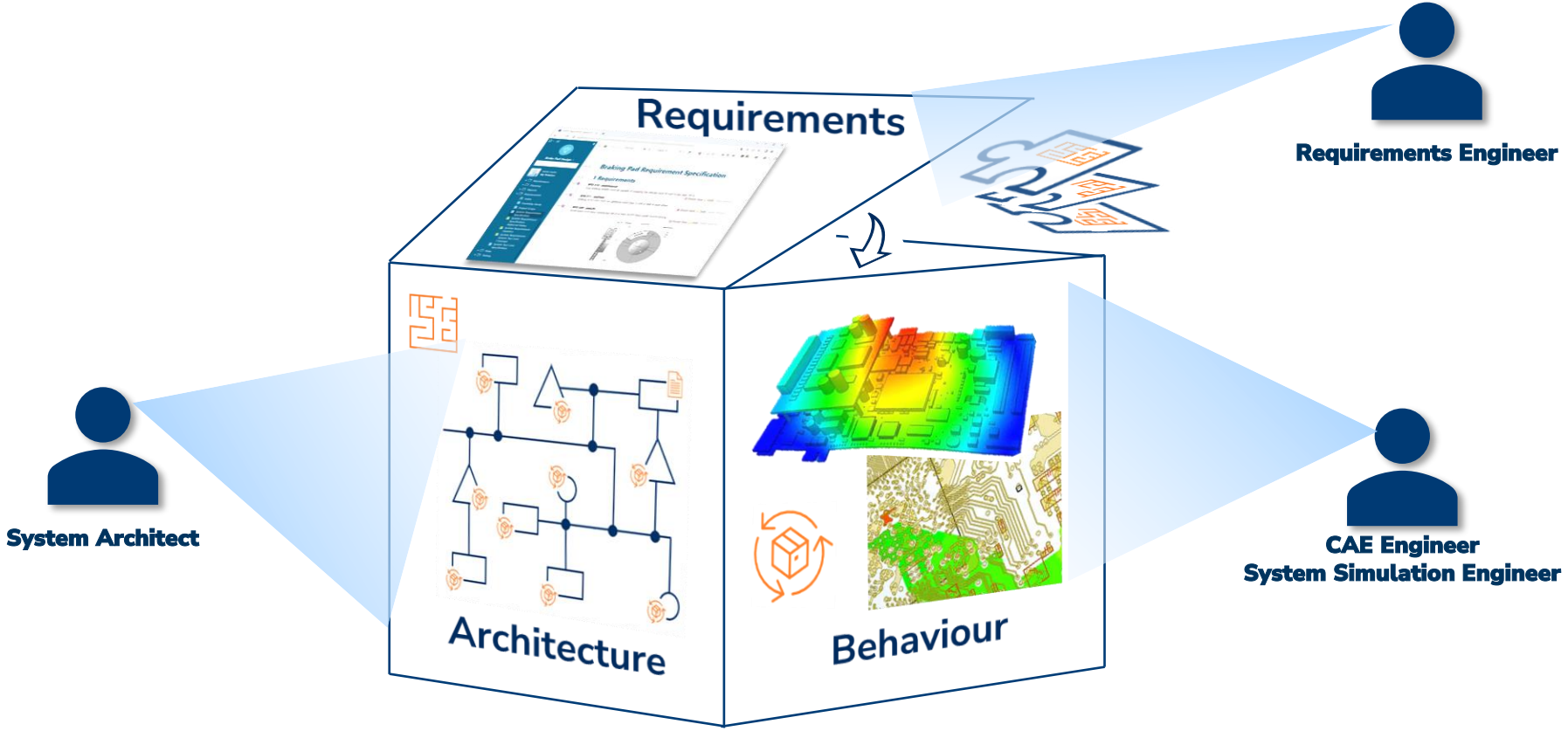


Digital Thread



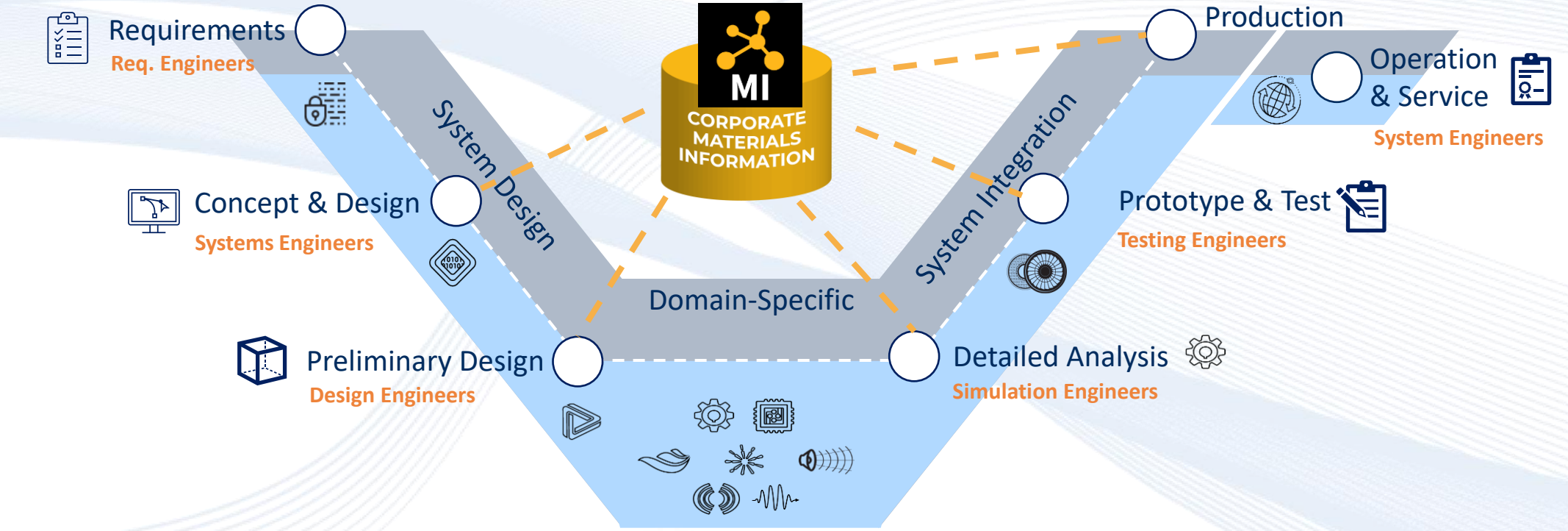
Model-Based …

One model and different views



Material Information Management (MIM)

CADFEM



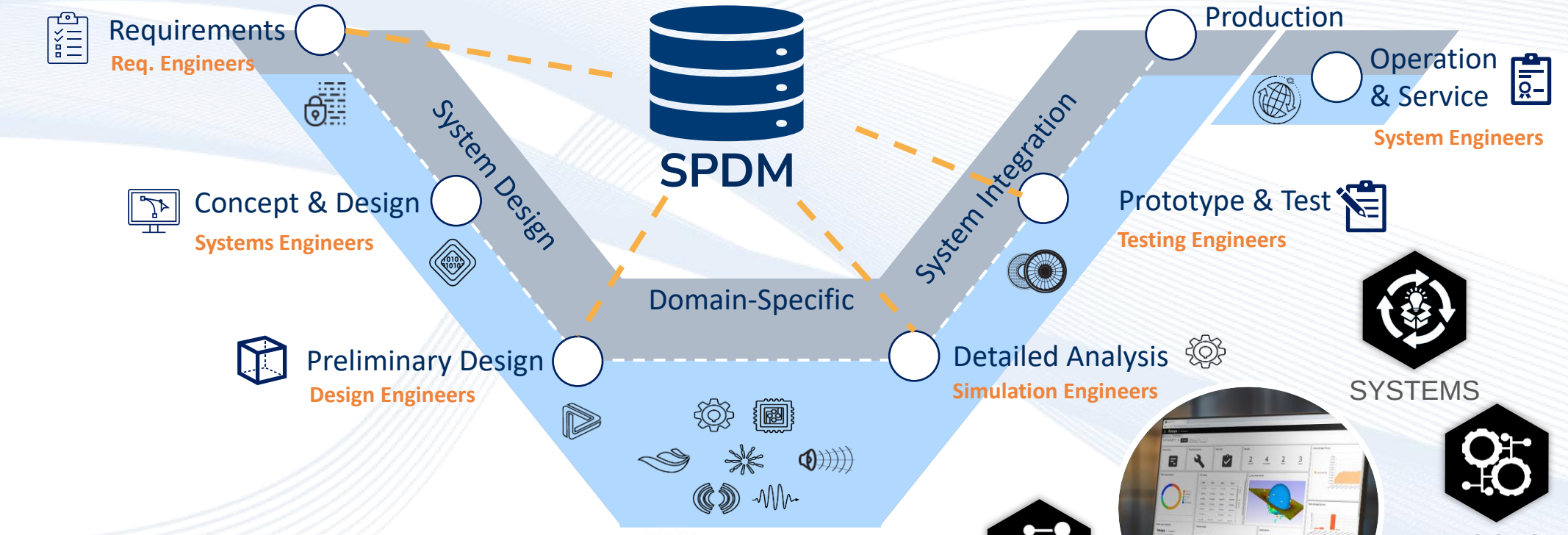
Ansys

GRANTA MI

CADFEM

Simulation and Process Data Management

CADFEM



Ansys

MINERVA

SYSTEMS

TOOLS

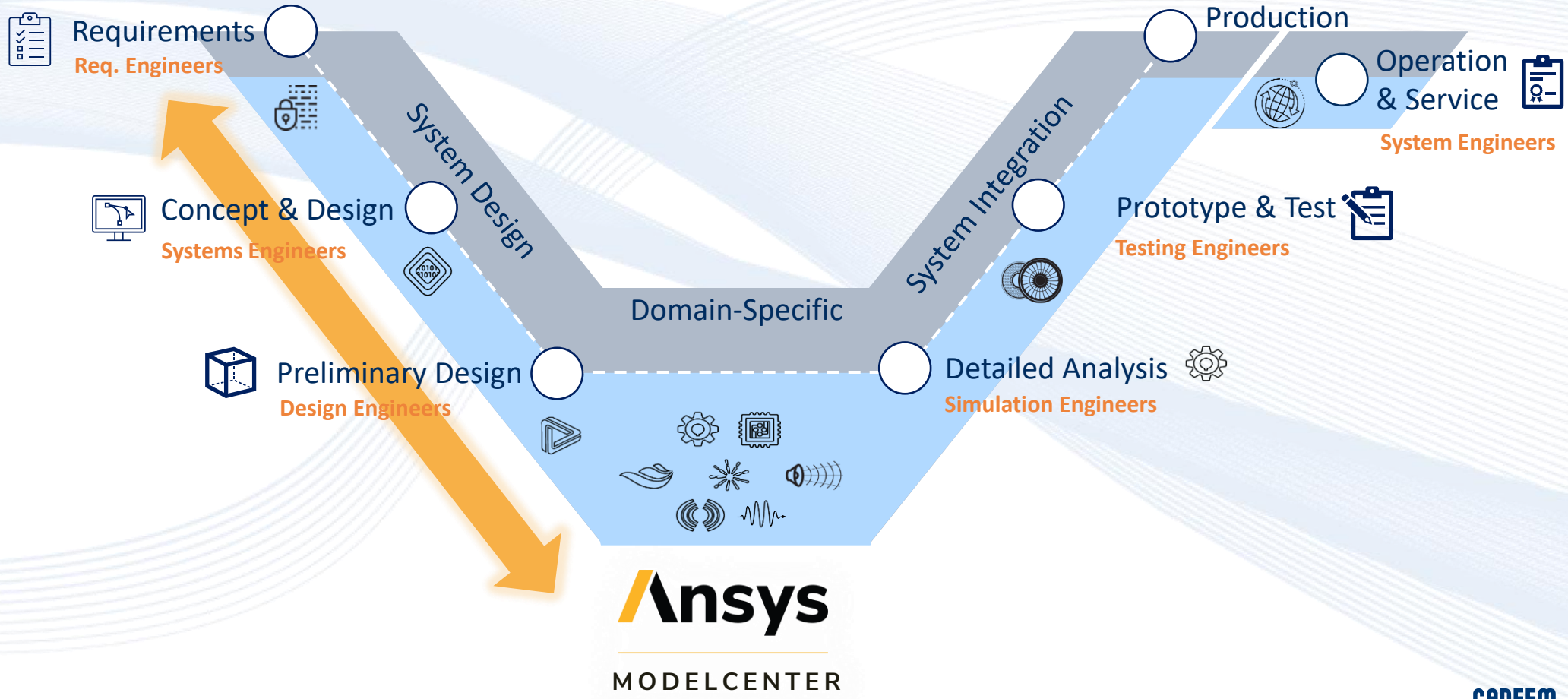
DATA

TEAMS

CADFEM

Model Based Systems Engineering (MBSE)

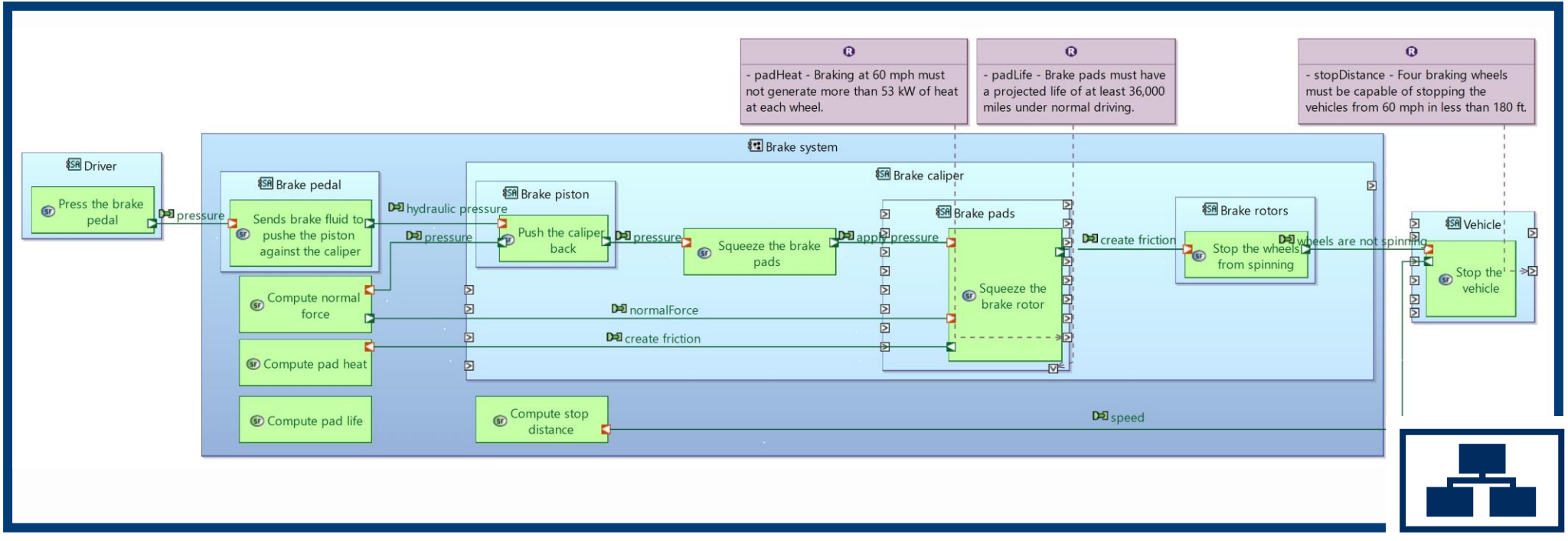
CADFEM



CADFEM

System Architecture Model (SAM)

System Architect



ModelCenter Integrated Workflow

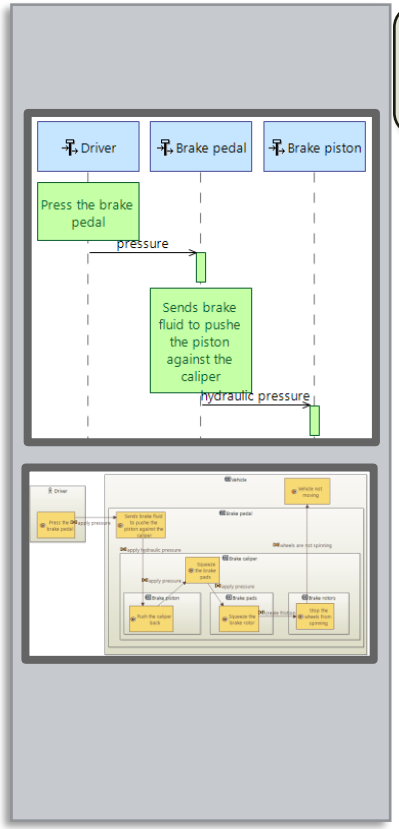
Performance Engineer

Model Based Systems Engineering (MBSE)

Requirements, Concept Design, Detailed Analysis

CADFEM

Systems Architecture Model



Part 1
Define the System Architecture Model

Part 2
Create "Black Boxes" to encapsulate Simulations

ModelCenter MBSE

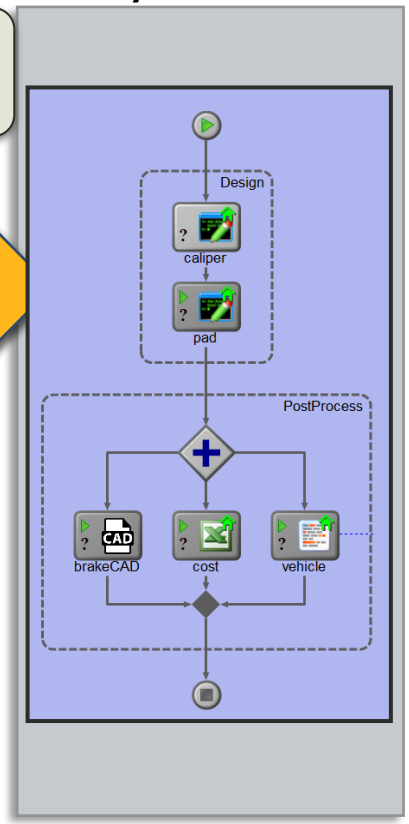
Part 3
Connect Simulations to System Model

Part 4
Run Trade Studies on the System Level

IBM Rational

Capella

Orchestrator Analytical Models



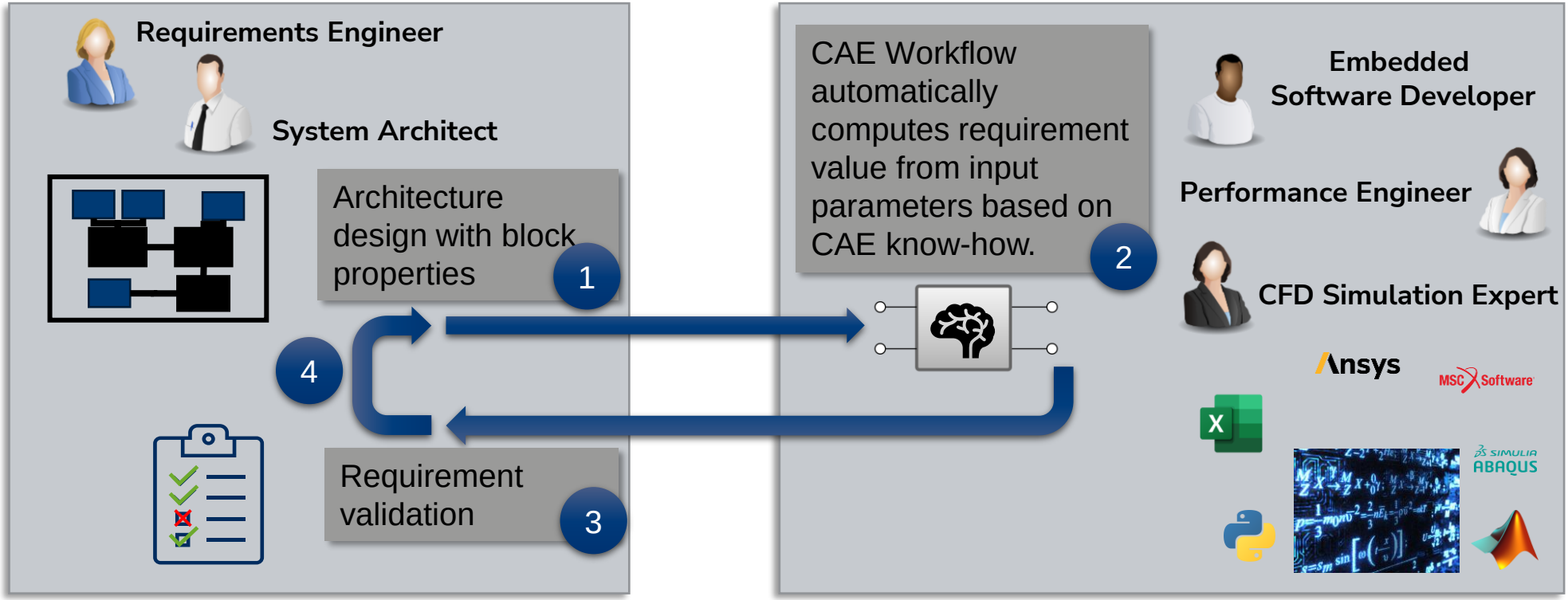
Model Based Systems Engineering (MBSE)

Requirements, Concept Design, Detailed Analysis

CADFEM

System Engineering

CAE Engineering



Digital Thread

Contact

In case of any questions regarding
model-based systems engineering or digital thread …

Martin Meiler

Business Development Manager
Embedded Software
mmeiler@cadfem.de