Model-Based Engineering mit Industriesteuerungen

Lars Mikelsons
Bosch Rexroth AG, Germany

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Gliederung

- **Was ist Model-Based Engineering?**
- Durchgängiges Engineering
- Beispiel: Virtuelle Inbetriebnahme
- Beispiel: Model-Based Engineering

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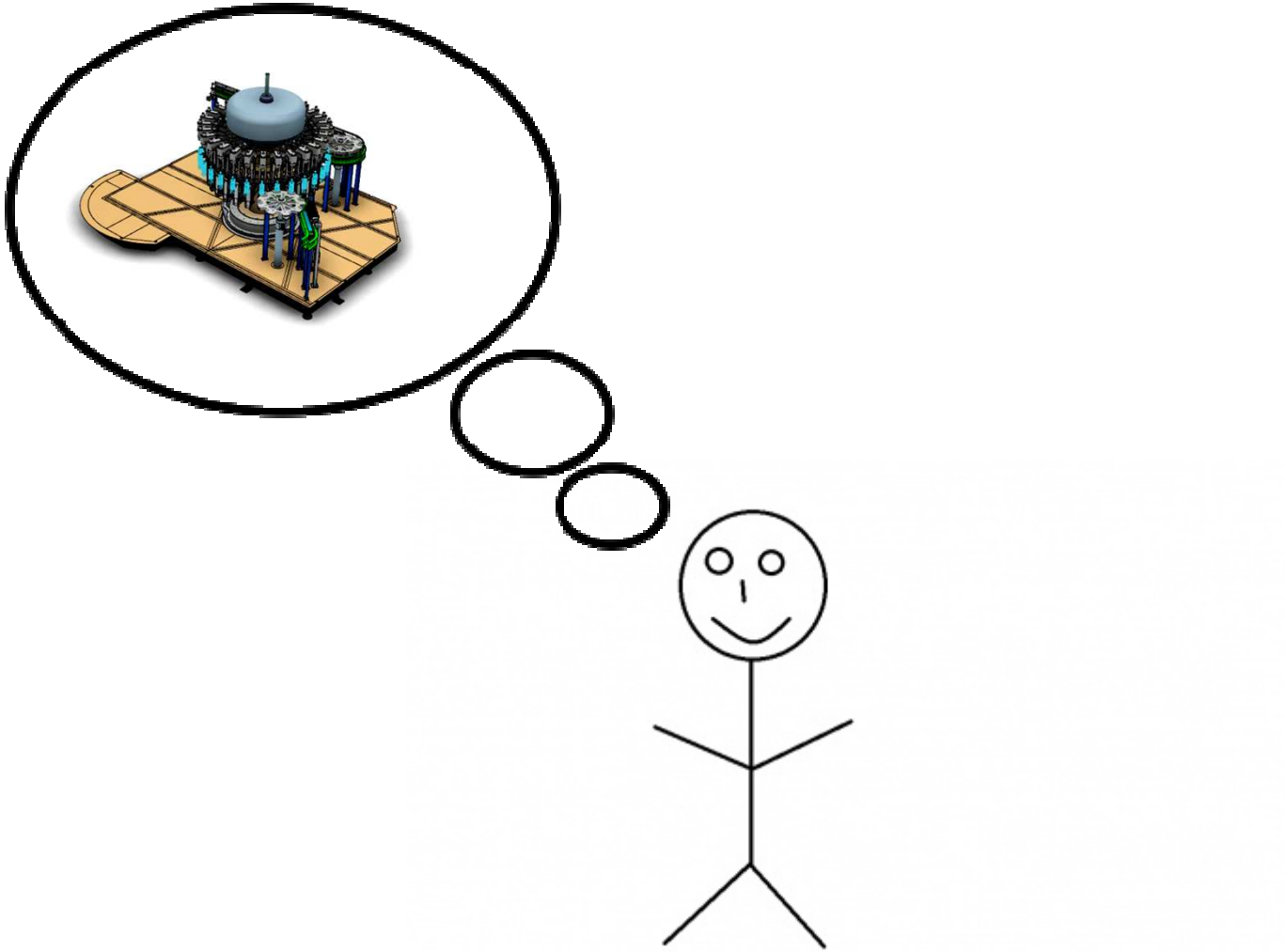
Was ist Model-Based Engineering?



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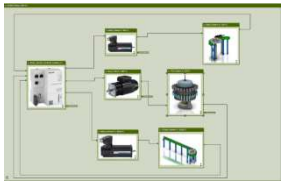
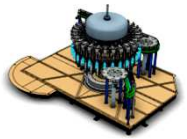
Durchgängigkeit im Entwicklungszyklus

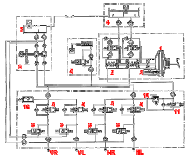
Produktmanager



Mechanikingenieur

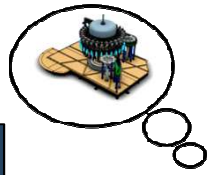


Hydraulikingenieur



Elektroingenieur

Applikateur



Fazit

- Simulation wird als Mehraufwand empfunden
- Systemwissen wird weggeworfen
- Kein multidisziplinäres Denken

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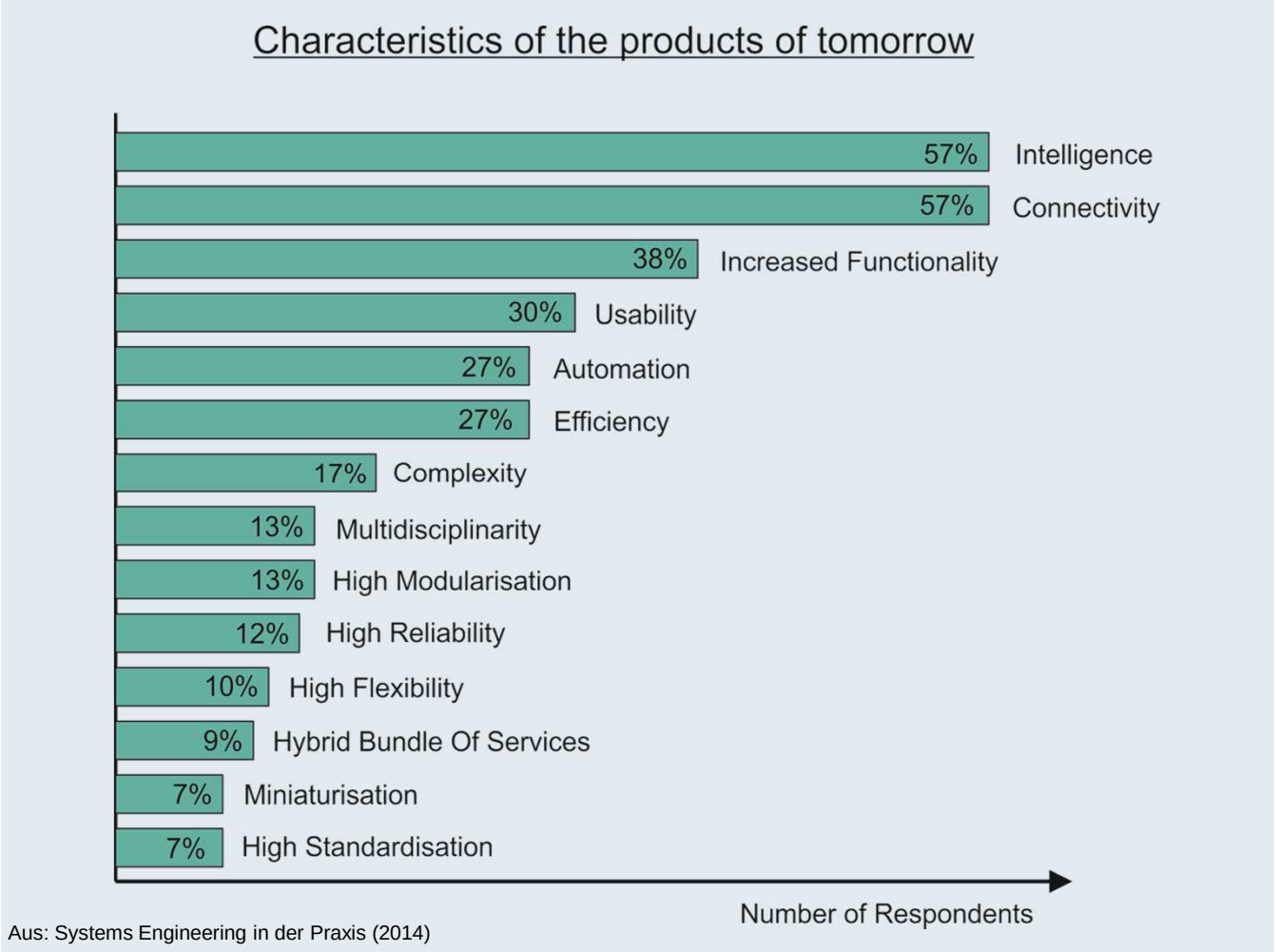
Was ist Model-Based Engineering?



Aus: Systems Engineering in der Praxis (2014)

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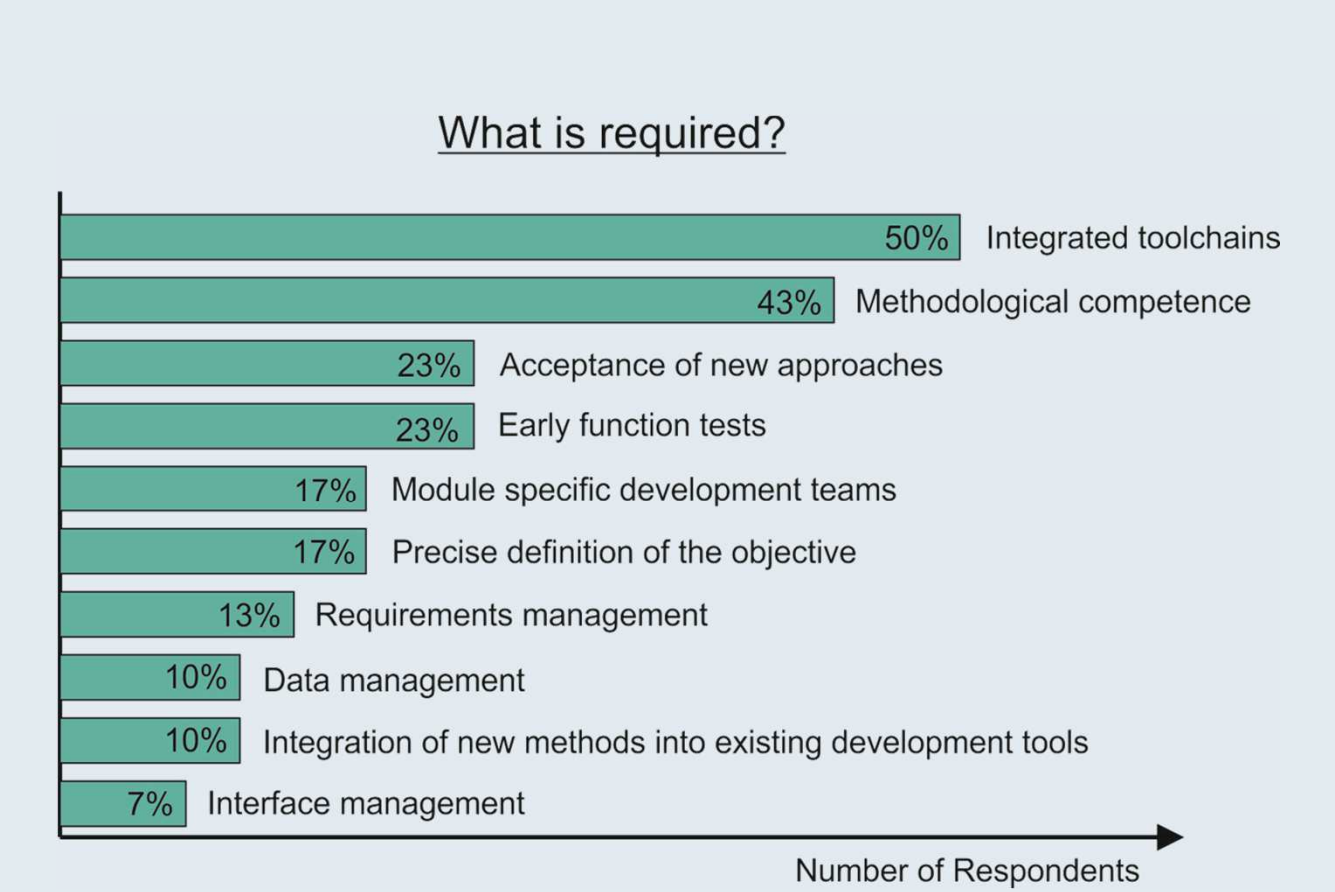
Was ist Model-Based Engineering?



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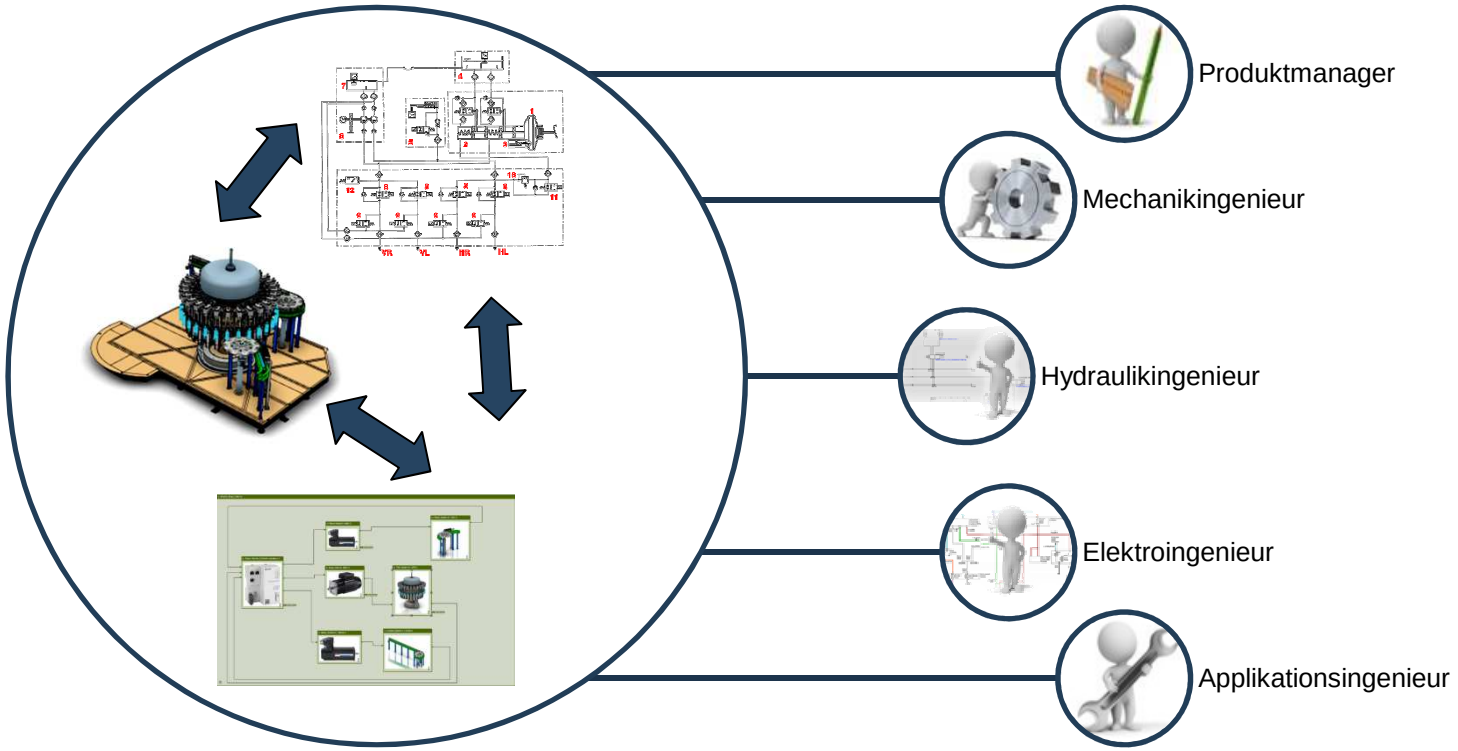
Durchgängigkeit im Entwicklungszyklus



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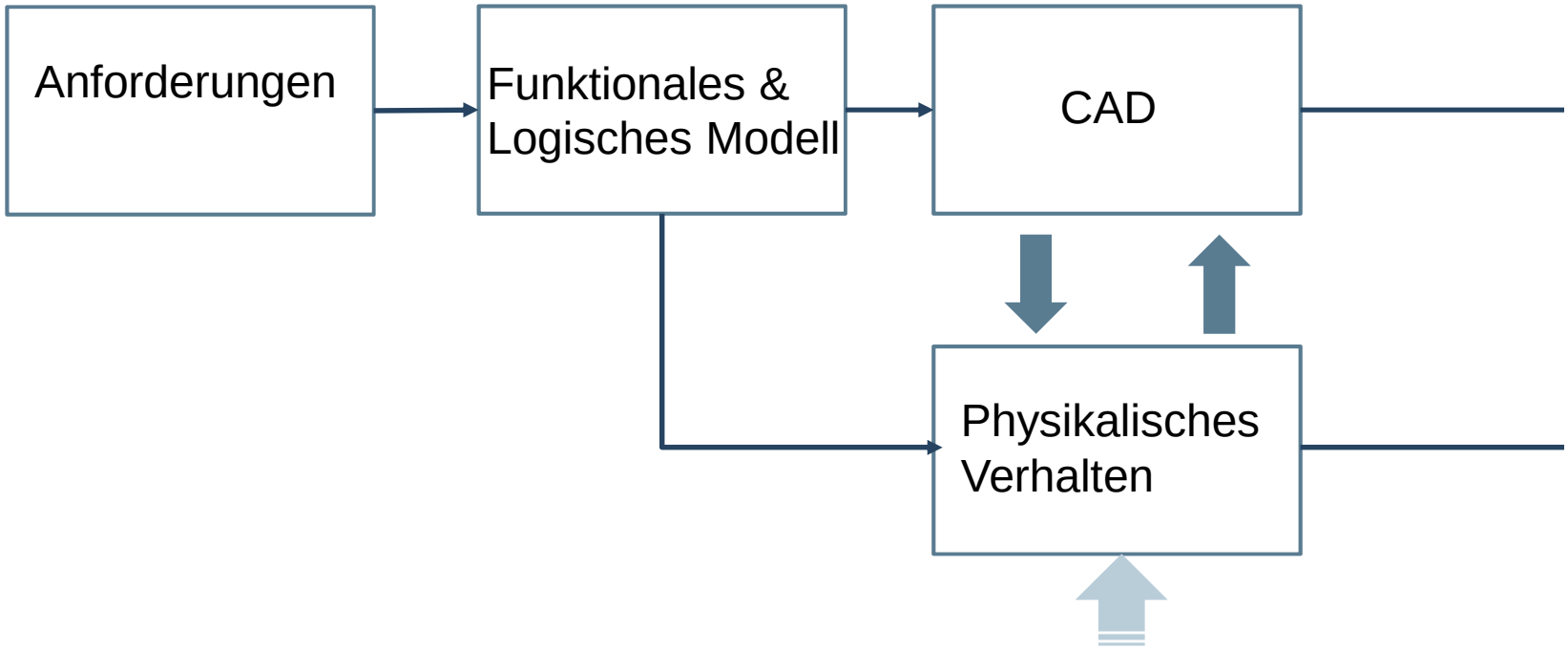
Durchgängiges Engineering



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Modelle

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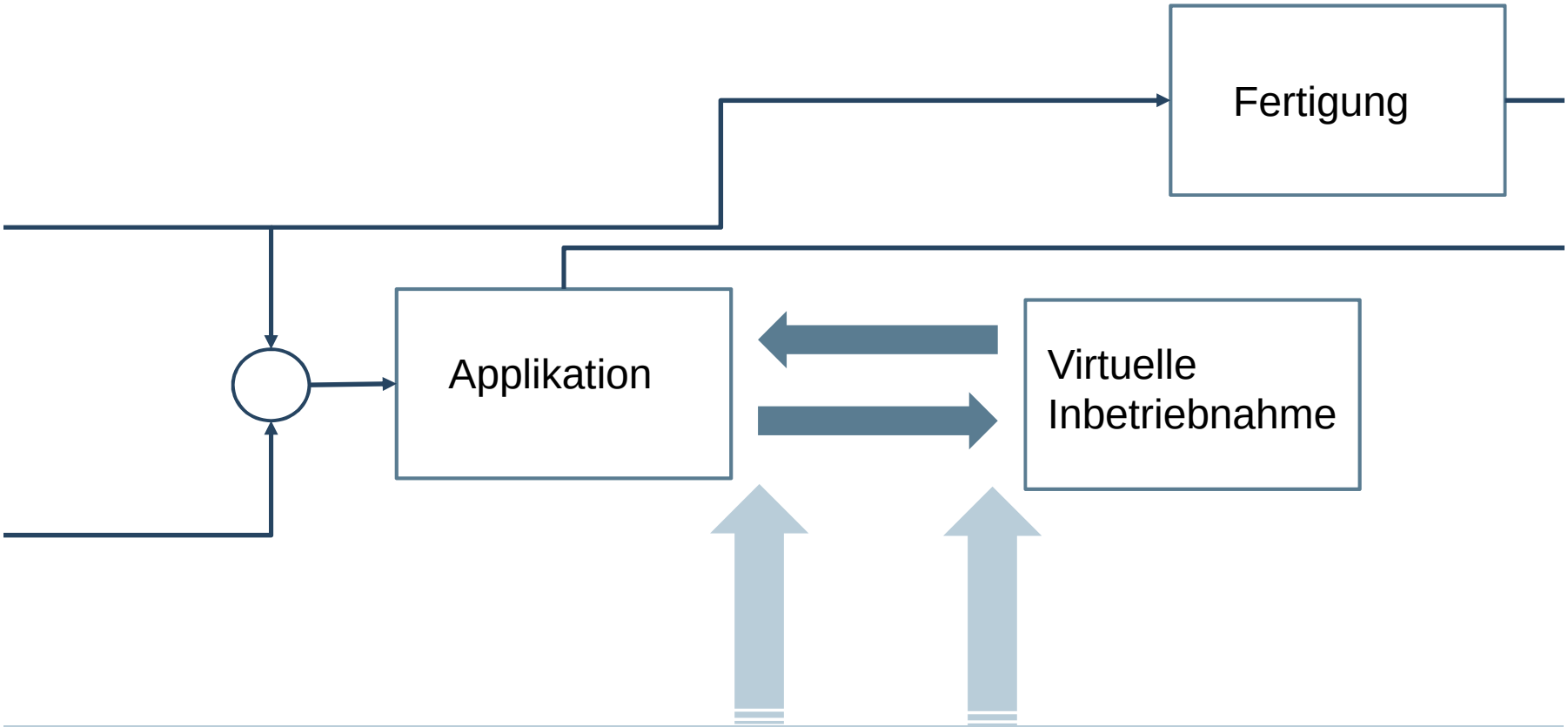
Durchgängiges Engineering



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Schnittstellen **Modelle**

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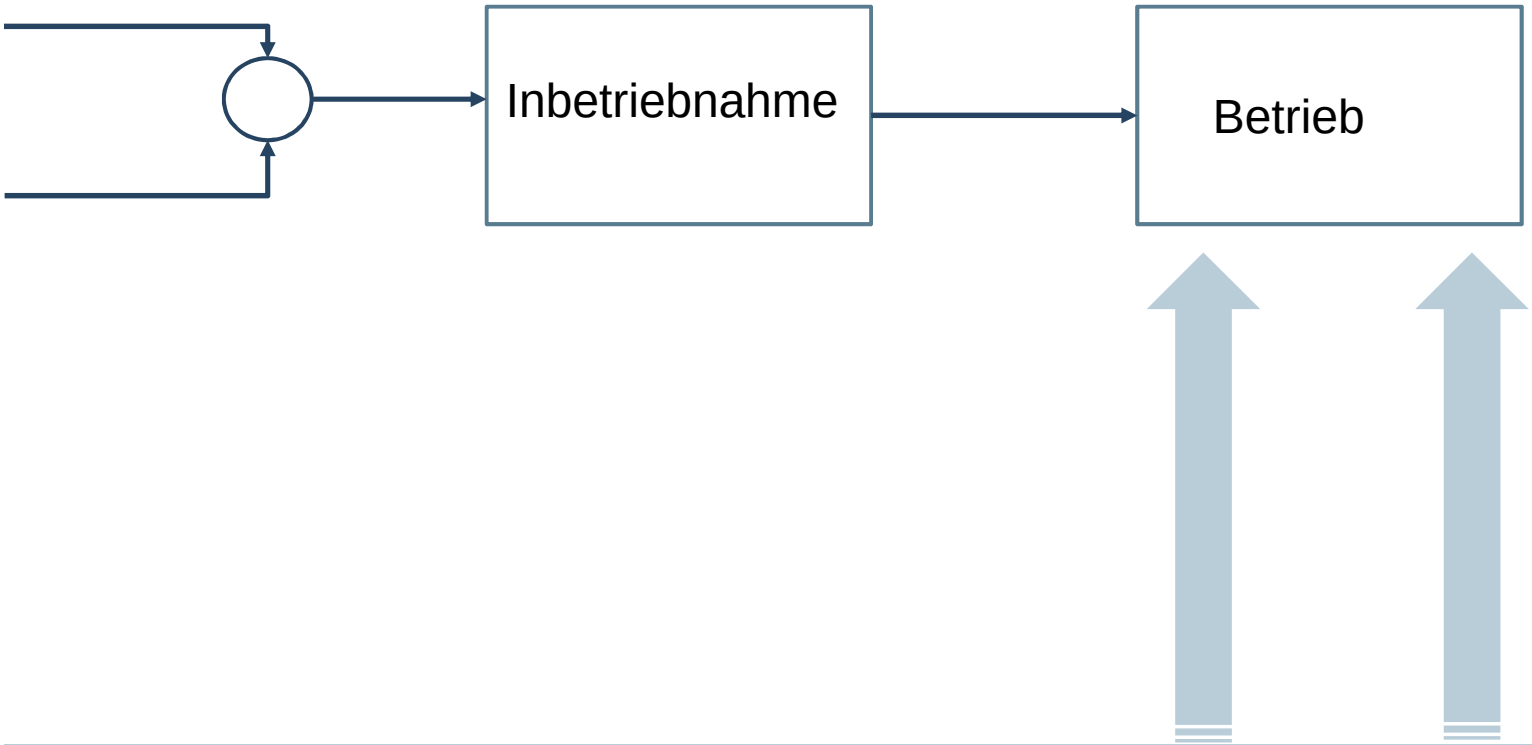
Durchgängiges Engineering



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Schnittstellen **Modelle**

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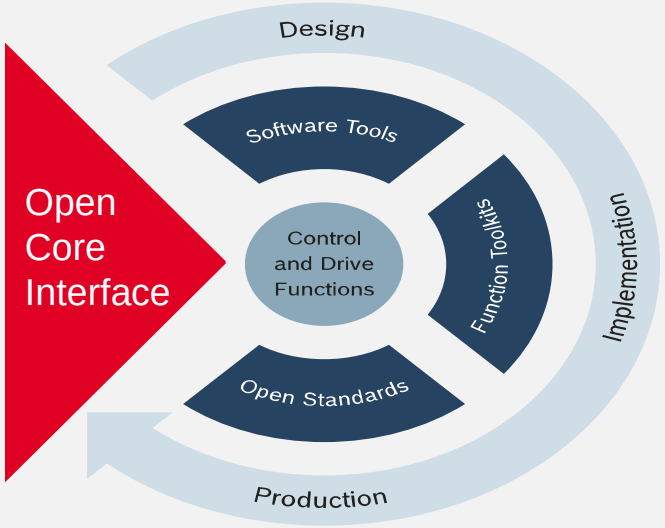
Open Core Interface

- **Brückenschlag** zwischen IT und SPS-basierter Automatisierung
- **Direkter Zugang** zu allen Kernfunktionalitätem der Steuerung über Hochsprachen
- **Realisierung** von OEM spezifischen Lösungen und innovativen Automationskonzepten



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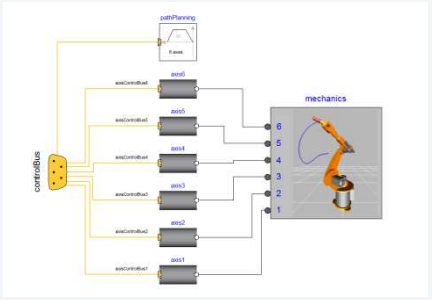
Durchgängiges Engineering



- **Modelica**
  - Offener industriegetriebener Standard
  - Lego-like Modellierung
  - Objektorientierte Modellierungssprache
  - Home of FMI
- **FMI**
  - Standardisierte Modellschnittstelle
  - Unterstützt von > 50 Tools

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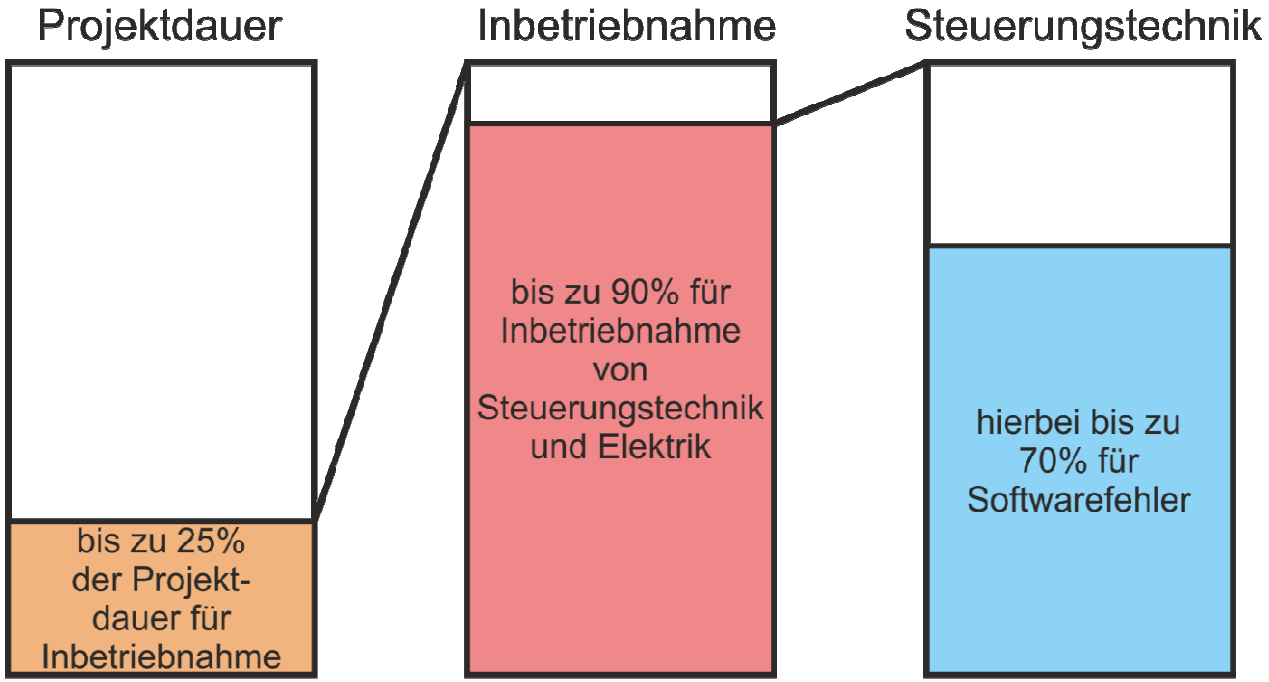
Virtuelle Inbetriebnahme



Nach:*VDW: Abteilungsübergreifende Projektierung komplexer Maschinen und Anlagen*

Fazit

- Teile des Engineerings erst an realer Maschine möglich
- Debugging an realer Maschine ist zeitaufwändig
- Engineering ist ortsgebunden

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Virtuelle Inbetriebnahme

Motion Logic Control

Reales System

Virtuelles System

IEC 61131
C/C++
Java
Matlab
Modelica

OPEN CORE ENGINEERING

Modellbasierte Entwicklung

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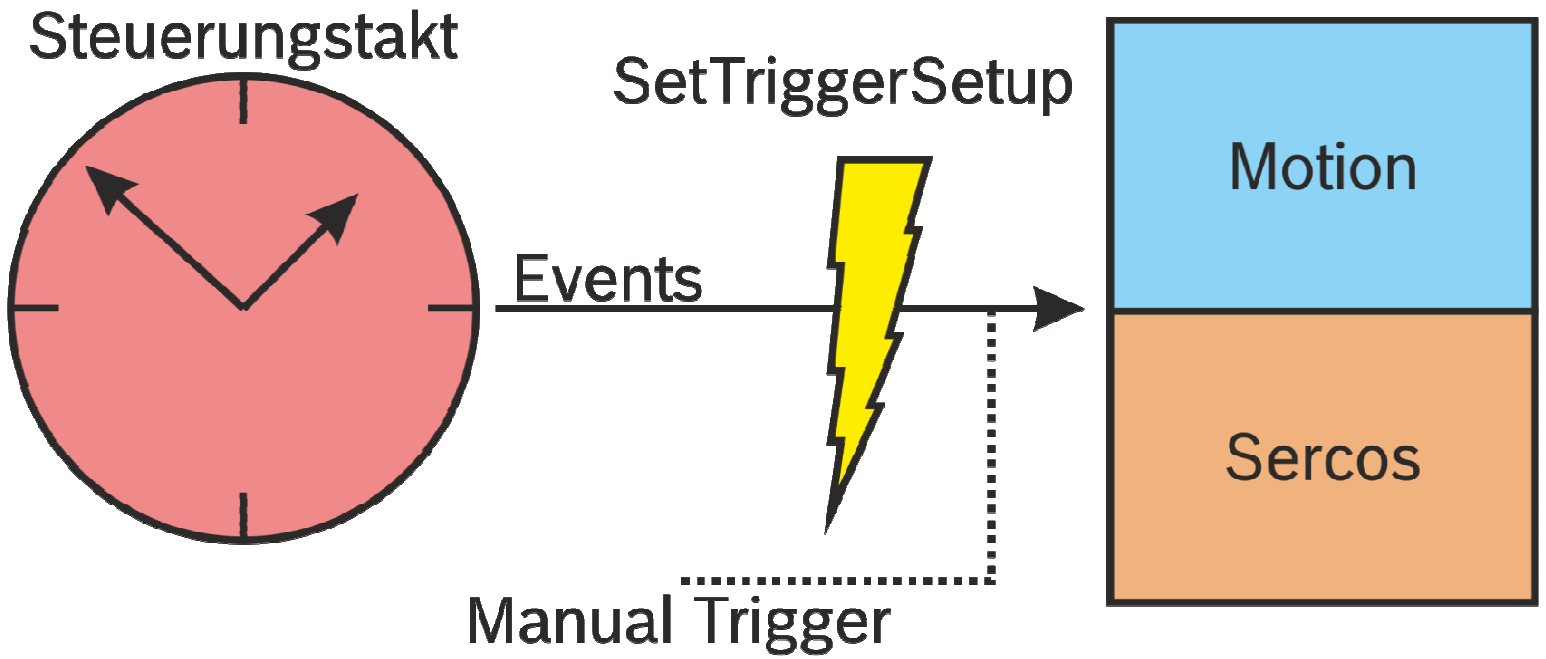
Virtuelle Inbetriebnahme



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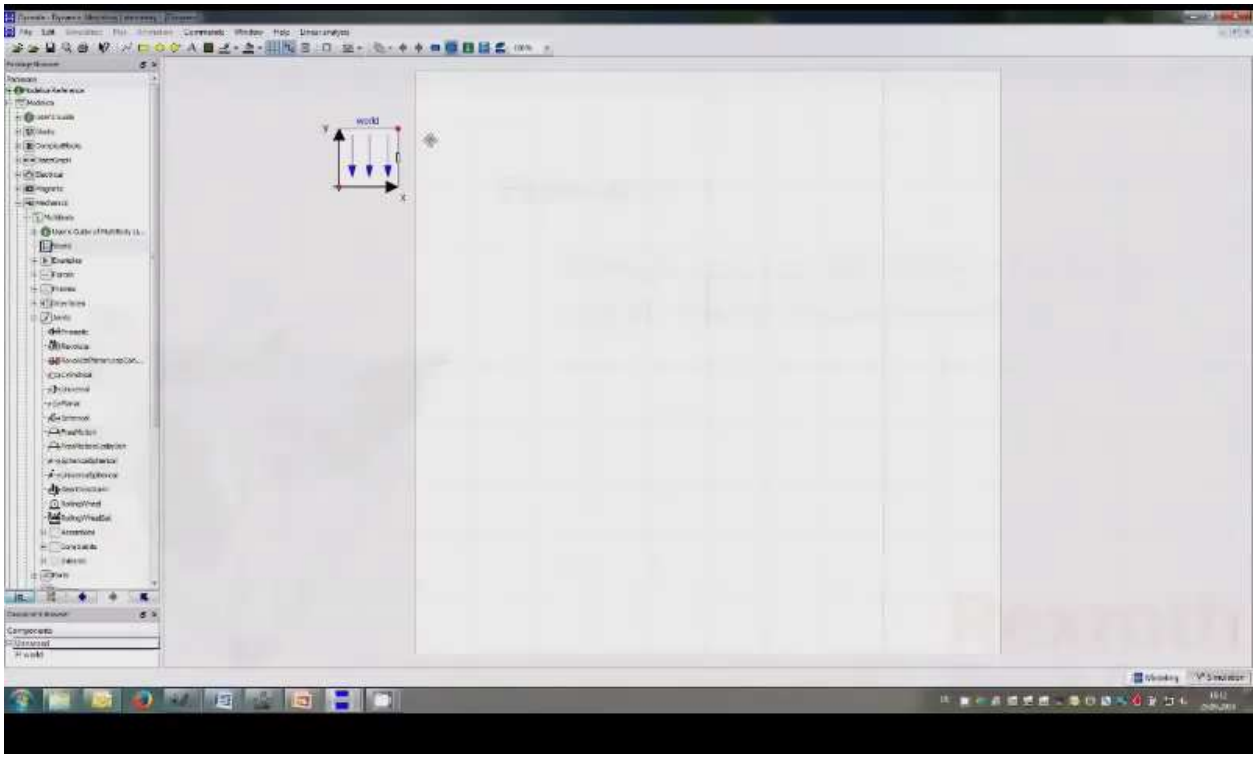
Virtuelle Inbetriebnahme



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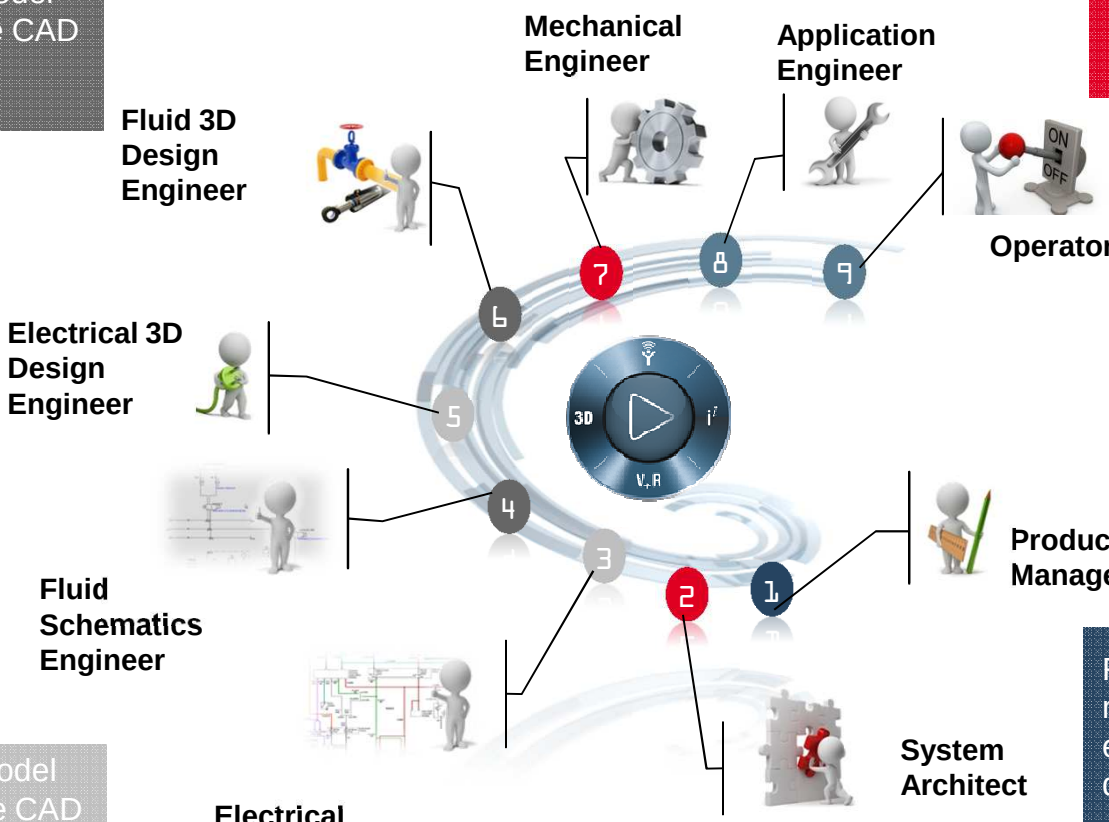
Model-Based Engineering

A Consistent model thanks to unique CAD for Fluid & Mechanical

Realistic simulation for system validation and optimization



Connecting the real and the virtual world

Reduce the risk in machine design early in the development cycle

A Consistent model thanks to unique CAD for Electrical & Mechanical

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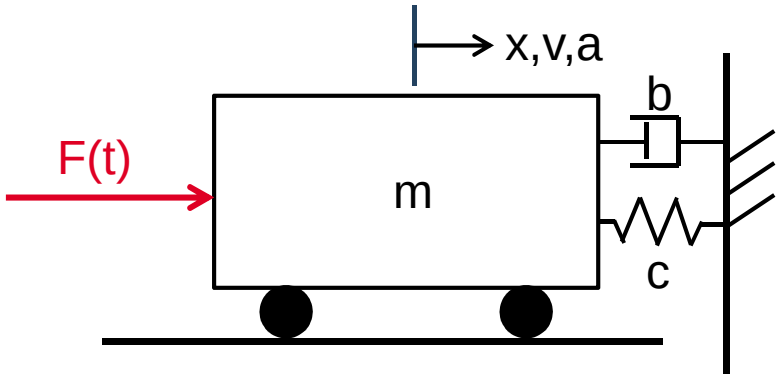
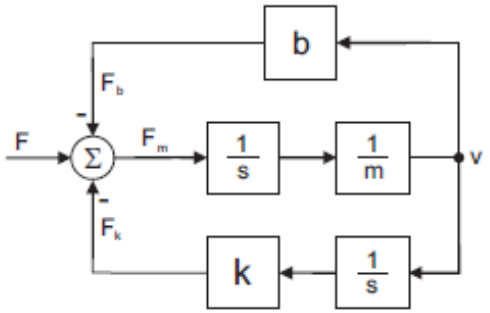
Conventional workflow

- Sketch of the system
- Equations of motion
- Implemenation
- Choice of the solver
- Evaluation of the simulation results



$$F = m \cdot a + d \cdot v + c \cdot x$$



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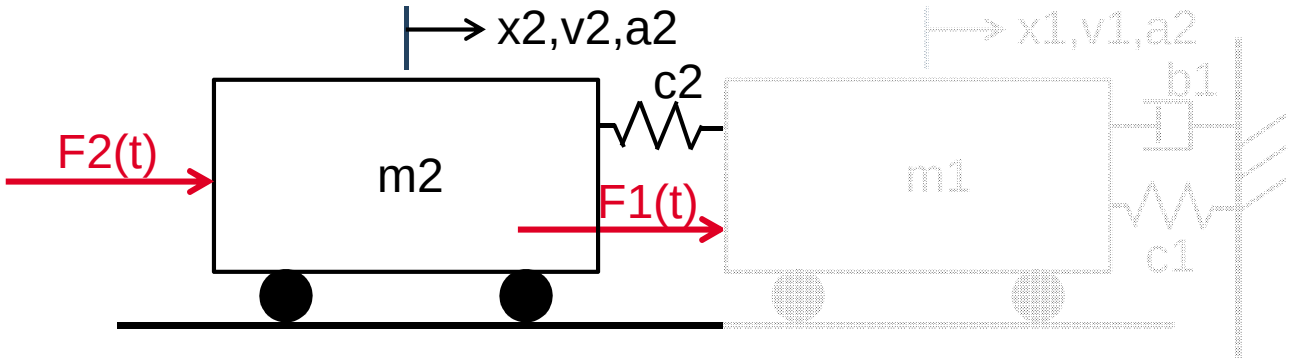
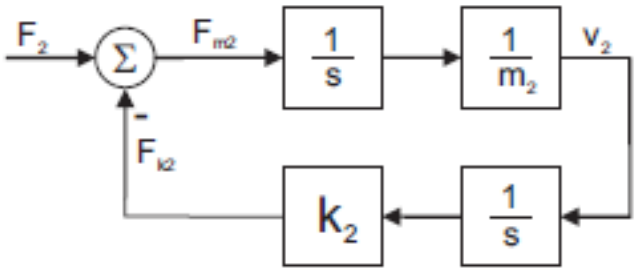
Extension of the model



- Sketch of the system
- Equation of motion
- …



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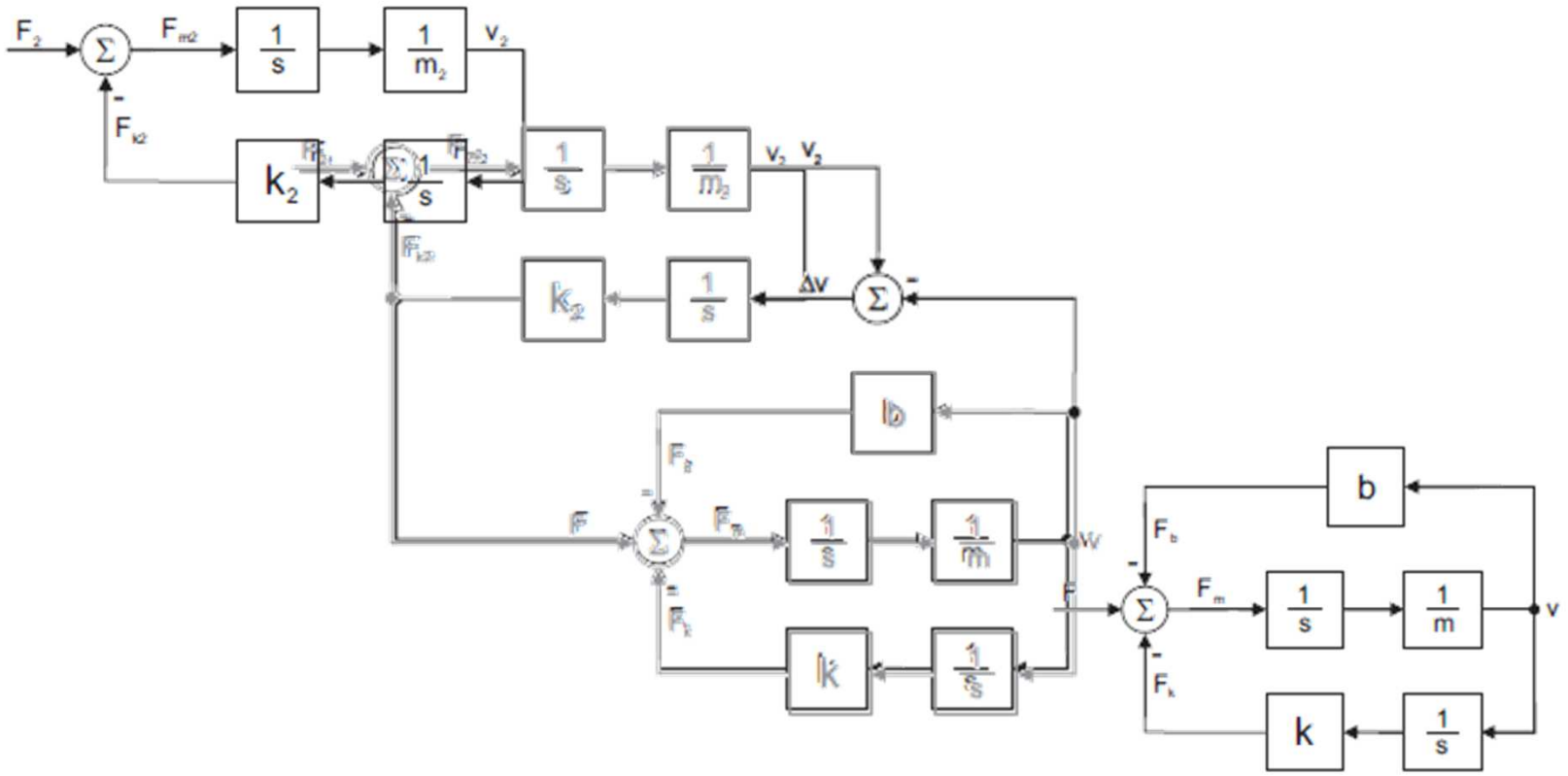
Two-mass oscillator



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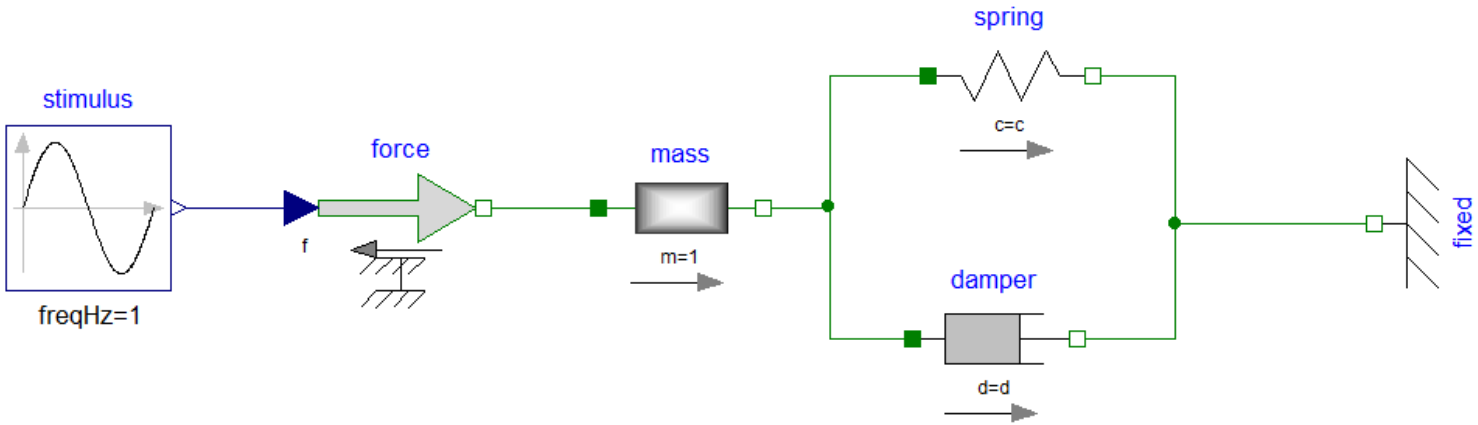
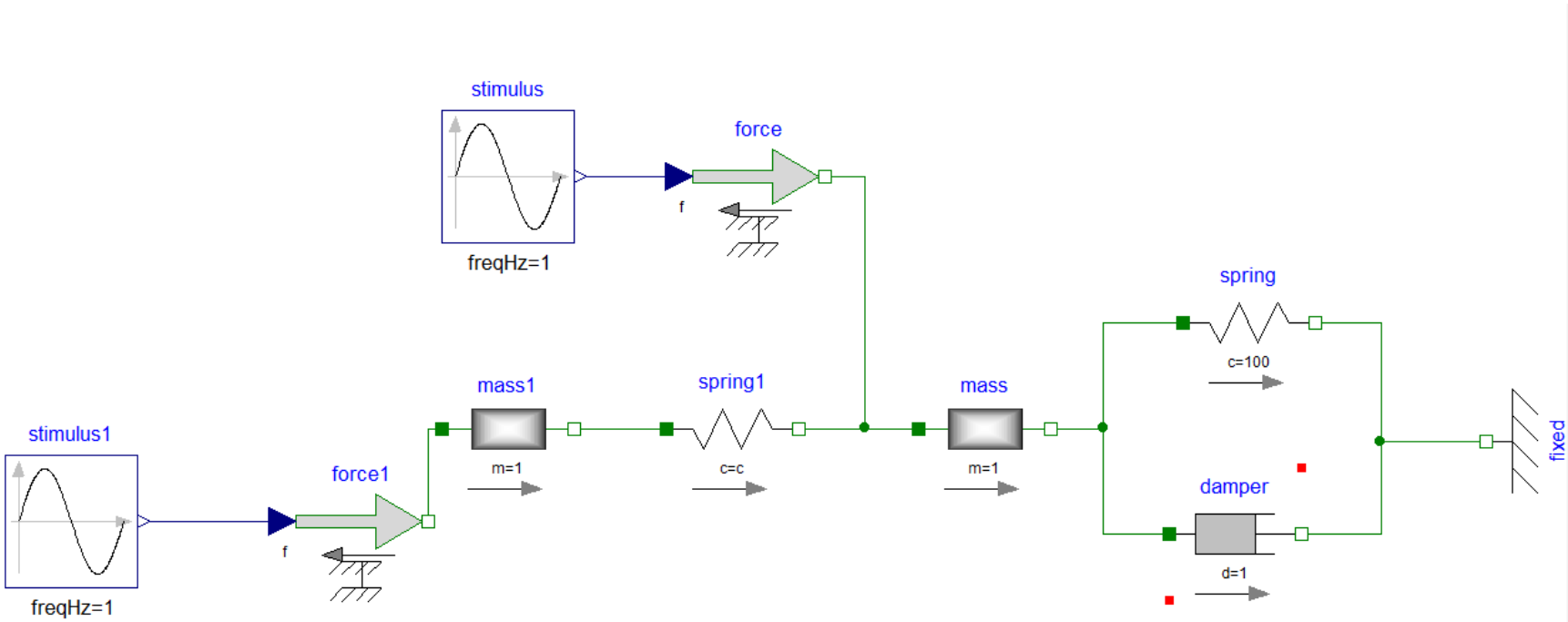
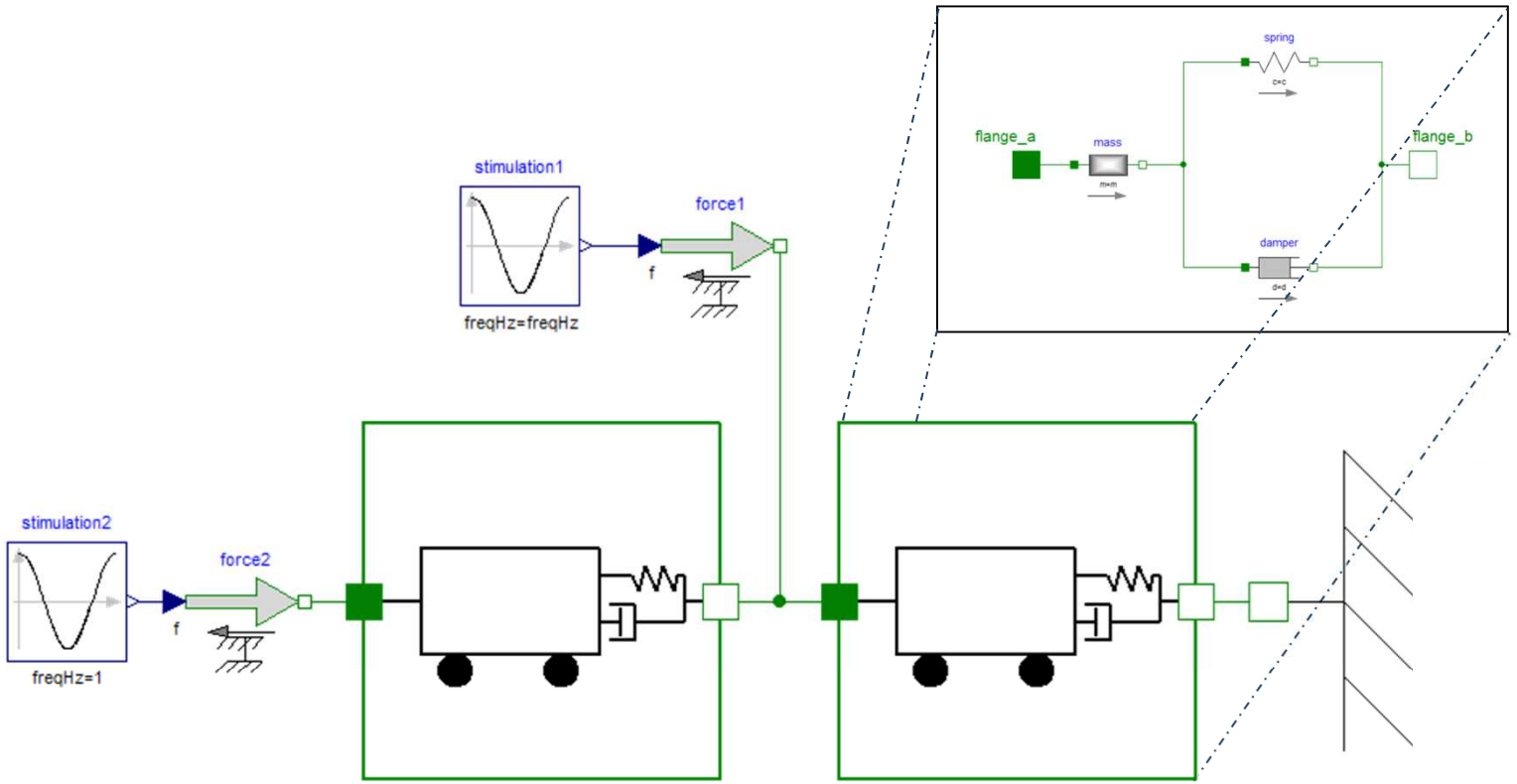
Single-mass oscillator revisited



Two-mass oscillator revisited



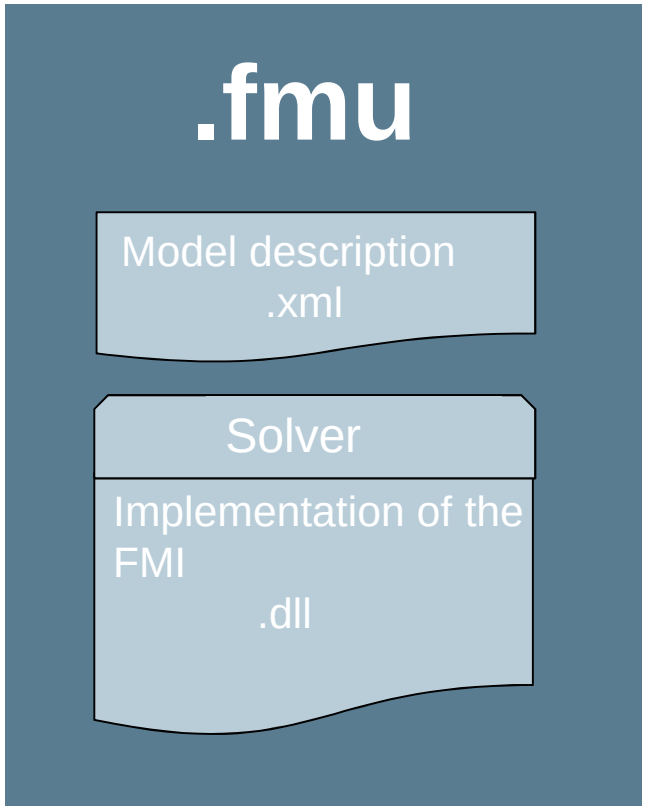
Two-mass oscillator revisited



Structure of the interface

- FMU is exchanged in a .zip format
  - Model description in a .xml file
  - Implementation as C-source or .dll

- Two interfaces
  - Model exchange
  - Co-Simulation



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