THE INTERNET OF SYSTEMS ENGINEERING: Next Generation of Development and Quality Assurance Environments

Siemens Product Configuration Symposium 2015

Ina Schieferdecker, October 28, 2015

making cities smart

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WHAT IF YOUR APPLICATIONS FAIL YOU?

- Software-based systems in safety-, security- and mission-critical environments
- Their dependability, safety and security are essential
- “Software horror picture show”

- Quality engineering of software-based systems continues to be a growing market
- Also driven by new regulations for security and safety

OUTLINE

1. Context
2. The Internet of Systems Engineering
3. Supporting Technologies
4. Summary

ABOUT ME

Director ... in applied research

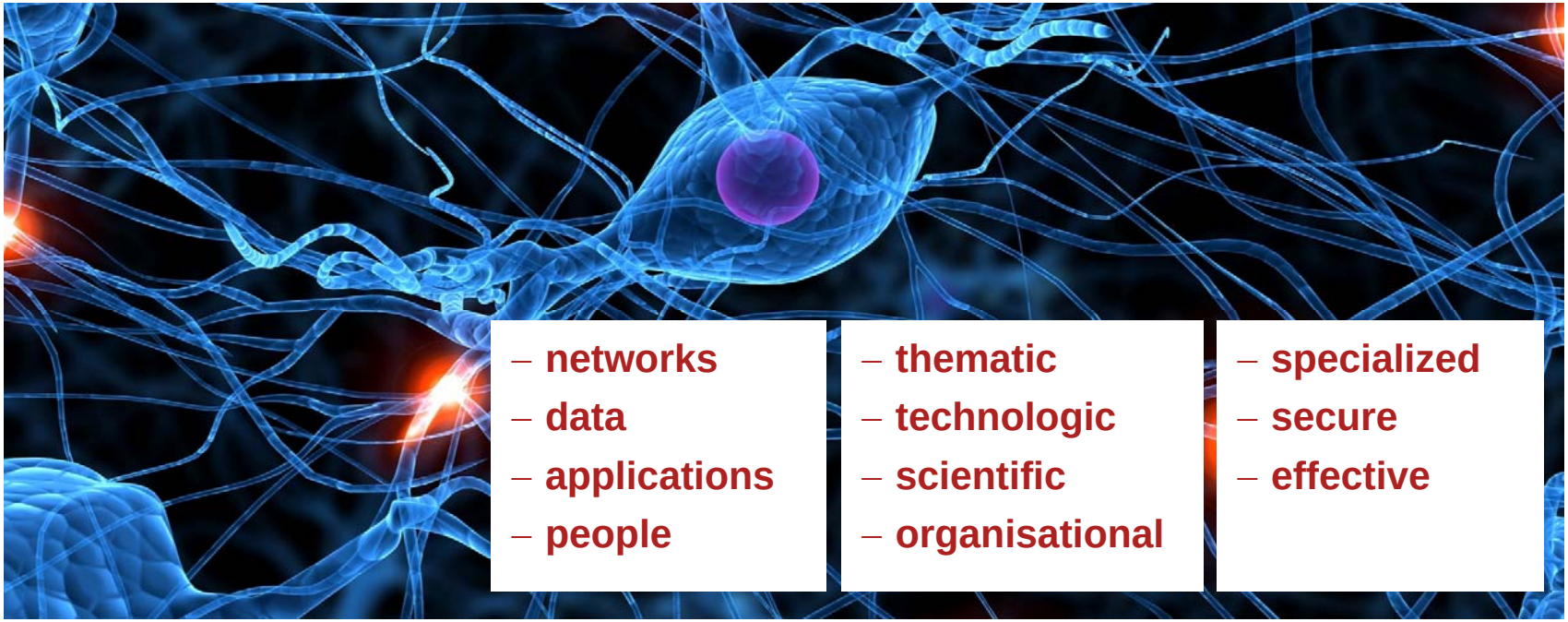
Professor … in education

Member of academy … for scientific recommendations

President … for high-quality software-based systems

Entrepreneur … for high-tech IT

ABOUT FOKUS: THE NETWORKING INSTITUTE



Expertise

- Internet of Things, 5G, M2M, Web of Things
- Critical Infrastructures, Energy Networks, Industry 4.0
- Identity Management
- Model-Driven Engineering, Testing and Certification
- Linking Legislation and Technology

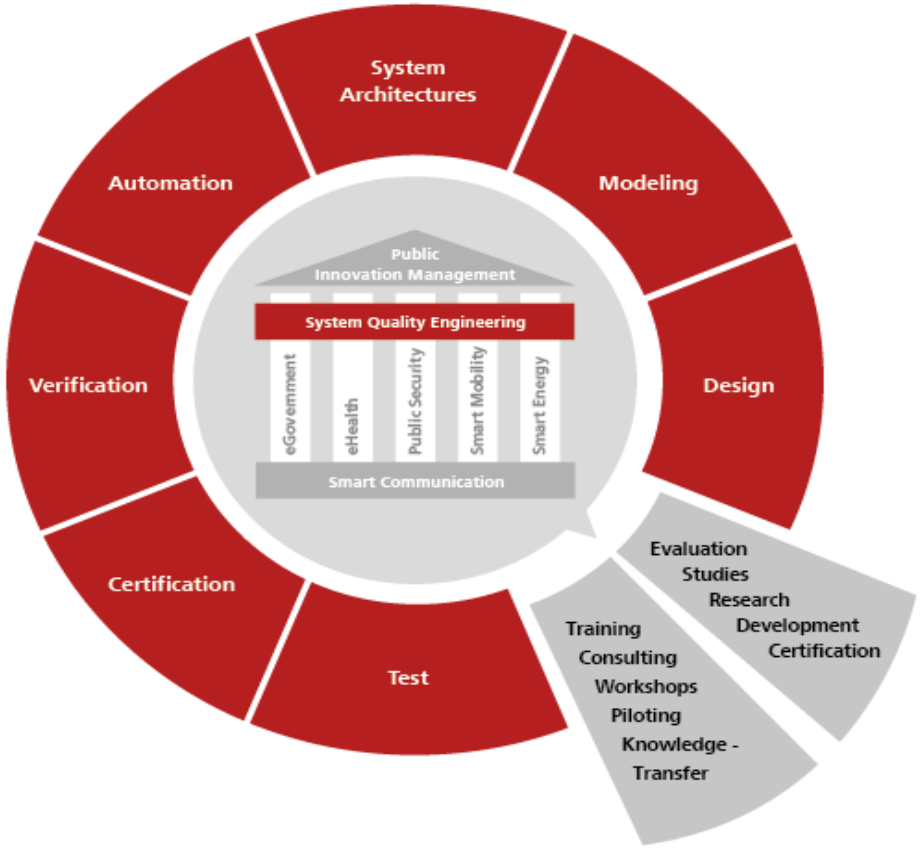
ABOUT SYSTEM QUALITY ENGINEERING @ FOKUS

Vision

- Safe, secure, and robust ICT technologies are the basis of any ICT-based solution
- All actors – whether it be people, machines, or systems – are interconnected and can exchange information anywhere and anytime as necessary

Mission

- The System Quality Center provides expertise and methodologies for cost efficient quality and software engineering



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KEY CHALLENGES IN SYSTEMS ENGINEERING

In the times of the Internet of Everything:

1. Safety
2. Security
3. Compliance
4. Interoperability
5. Collaboration

SIMPLIFICATION OF ENGINEERING TOOLS LANDSCAPE

From 

To 

Today's engineering environments are far away from being open and collaborative environments

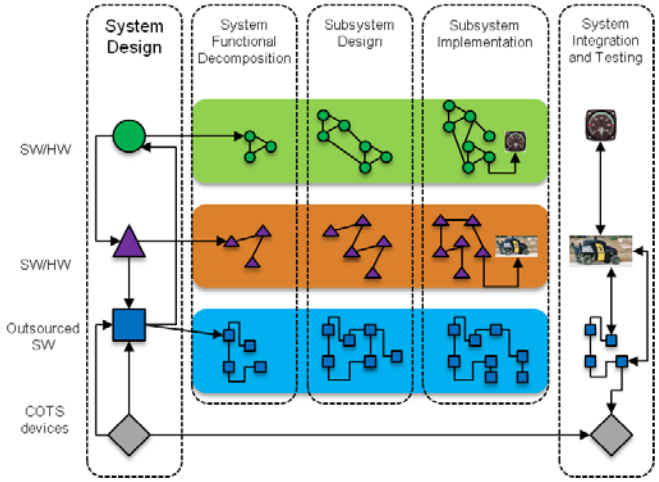
Proprietary solutions of tool integration and interoperability block efficient collaboration over team, company boarders or not to mention regional boarders

→ The engineering environments of the future will based on efficient and scalable Internet technologies, in order to allow

- Seamless transition from development to operation and other business units
- Close collaboration between engineers, customers and suppliers

OVERCOME SILO'ED 3RD PARTY DEVELOPMENTS

From



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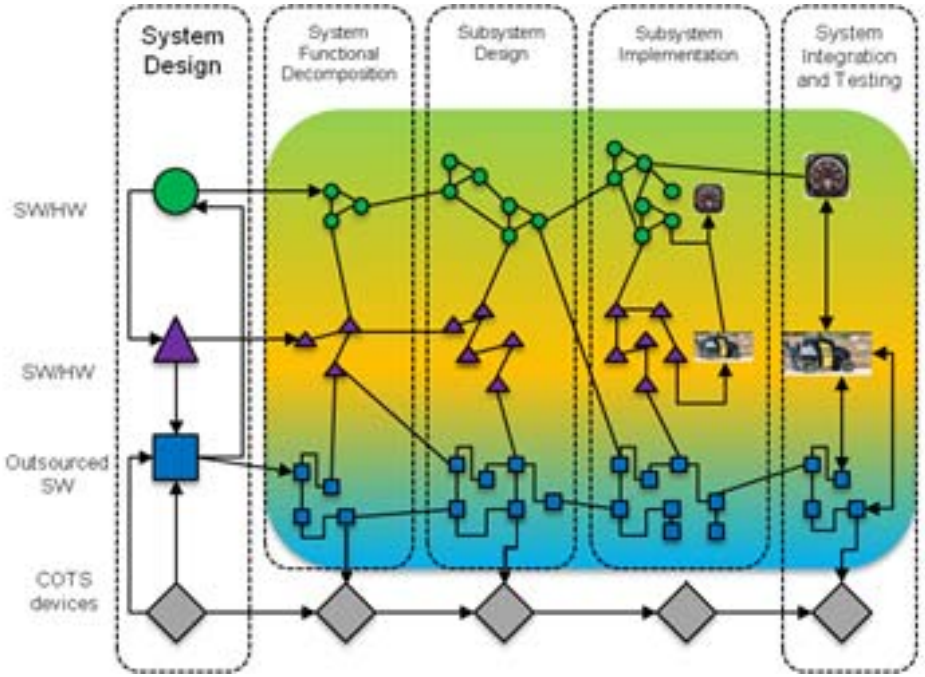


EC PROJECT SPRINT-IOT

Software Platform for Integration of Engineering and Things

– So far, silo'ed approach, where the actual integration and testing of the various components is only possible once the system can be completely assembled

– Integration of tools and information (IBM Rational's System Architect for design, Team Center for testing, DOORS for requirements engineering, MathCore's MathModelica, HP's Quality Center, Elvior's TestCast)

– Semantic information mediation

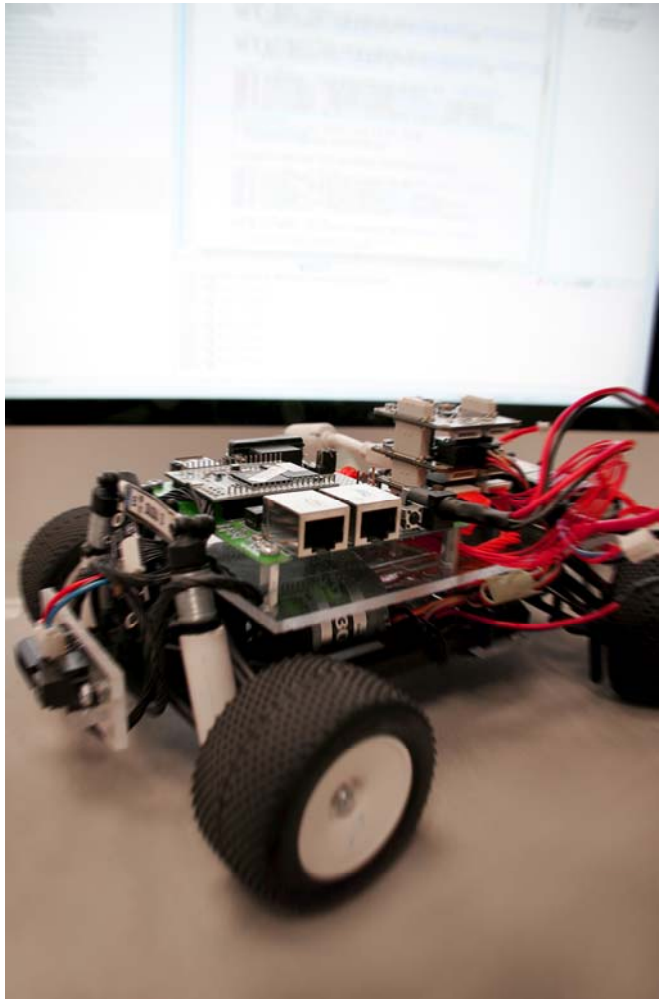
– Internet-based platform – Internet of Engineering Things

Further information

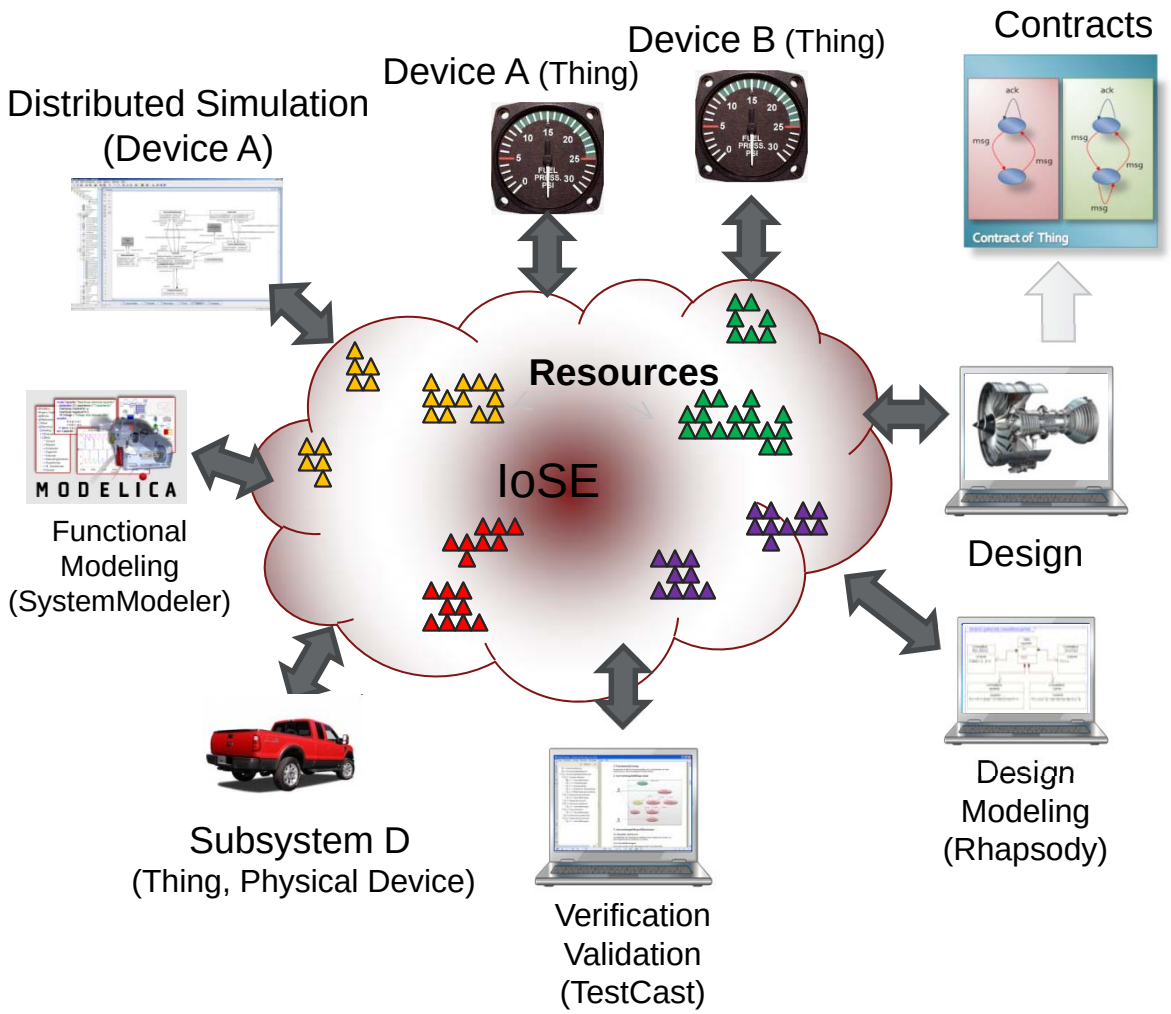
http://www.sprint-iot.eu

Partner

LET US HAVE A LOOK



DISTRIBUTED ENGINEERING CAPABILITIES



Documents (Specifications)
Requirements
Work Items
Tasks
Defects
Contracts
Change Requests
People and their Roles
Resources (time and money)
Systems and Sub-Systems
Architecture models
Design models
Simulation Data
Test Data (Input, Output, Pre, Post)
Test Cases
System under Test (SUT)
Physical Devices
Interfaces and Ports
Relationships (Associations)
Parameters
And much more…

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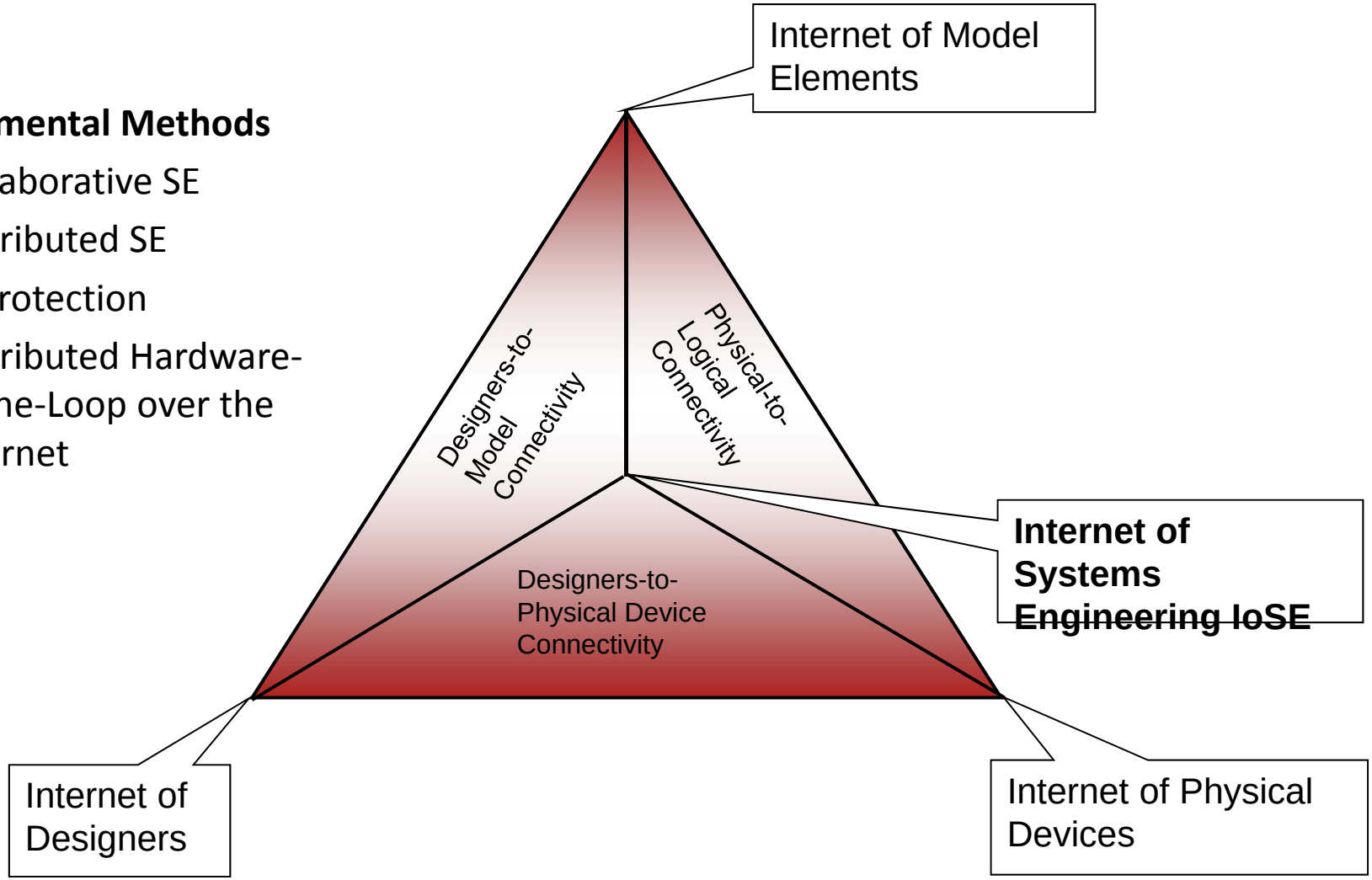
THE INTERNET OF SYSTEMS ENGINEERING – IOSE

Fundamental Methods

- Collaborative SE
- Distributed SE
- IP Protection
- Distributed Hardware-in-the-Loop over the Internet



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IOSE: RESOURCES AND LINKED DATA

Adopting semantic Web technologies and standards

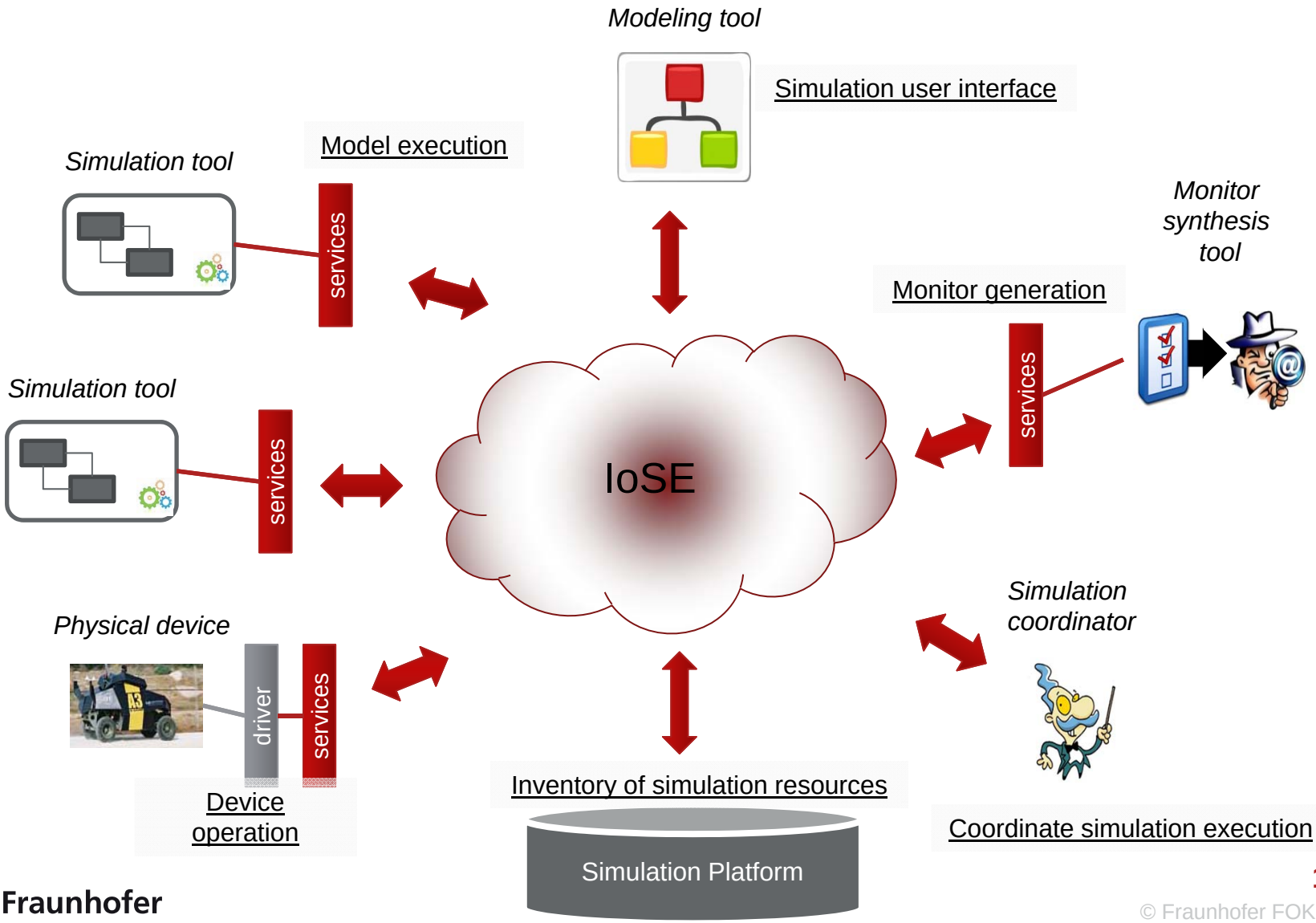
- Adopting OWA (open world assumption) on models and resources
  - Inventing the semantic mediation to bridge between models
- RDF (Resource Definition Framework) models
- OWL (Web Ontology Language) ontologies describing these models
- RESTful interaction among modeling tools and applications
  - With Oauth authentication
- Compliant with OSLC for resource sharing via linked data

Modeling elements are Web resources – “things” of the IoSE

Major advantage: Models as well as their ontology descriptions are

- Searchable (i.e. linked data)
- Querable
- Actionable

IOSE: HYBRID SIMULATION PLATFORM



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TOOL INTEROPERABILITY

The platform view

- Importer/Exporter based
  - Many tools do have some import or export mechanisms for foreign formats
  - Manual work and partially scripts for exchanging models
  - Fragile and hard to maintain for complex environments

- Eclipse
  - New tools (in particular MDE oriented tools) are likely to be created as Eclipse tools
  - Eclipse and EMF are en vogue and receive direct and indirect funding from industry and public authorities
  - Management of Eclipse instances is not trivial

TOOL INTEROPERABILITY

The platform view

- Family of tools
  - A family of (semi) integrated tools (e.g. Rational Suite, Enovia)
  - Exchange of information is handled in more or less integrated way
  - Inflexible, vendor lock-in

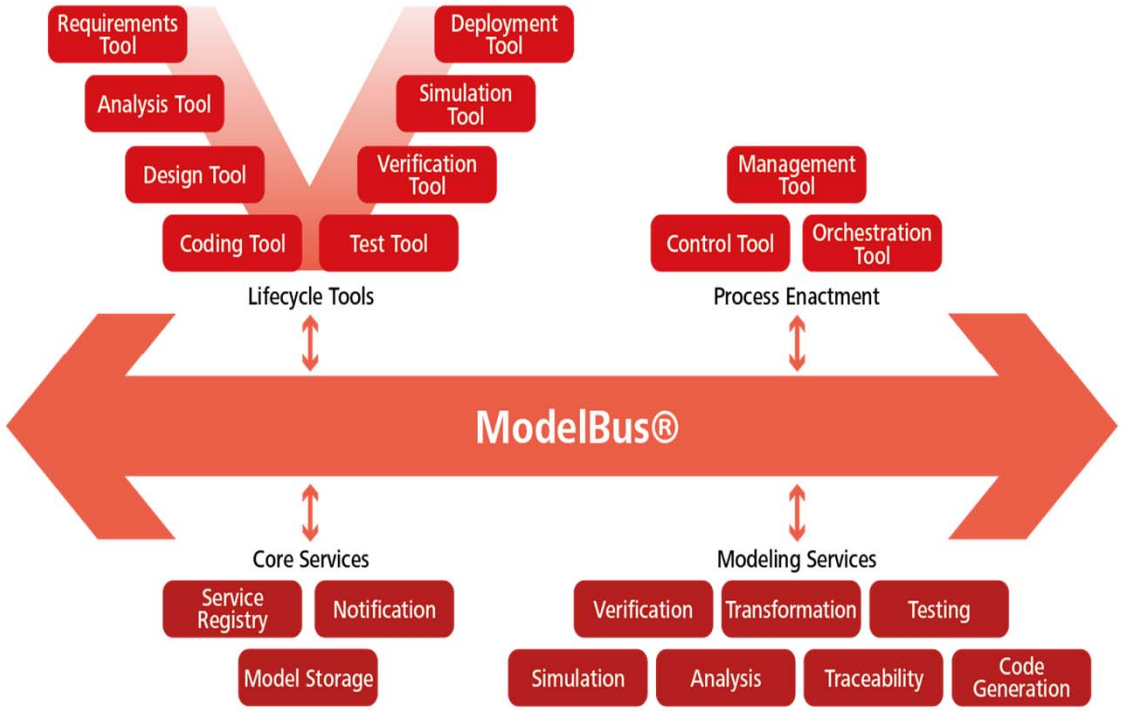
- Platform - Jazz
  - Based on RESTful services (http)
  - Linking of data as fundamental concept
  - Mainly driven by IBM, IBM tools support this approach

- Platform - ModelBus®
  - Service based approach and RESTful services
  - Model repository
  - Flexibility in integration paradigm

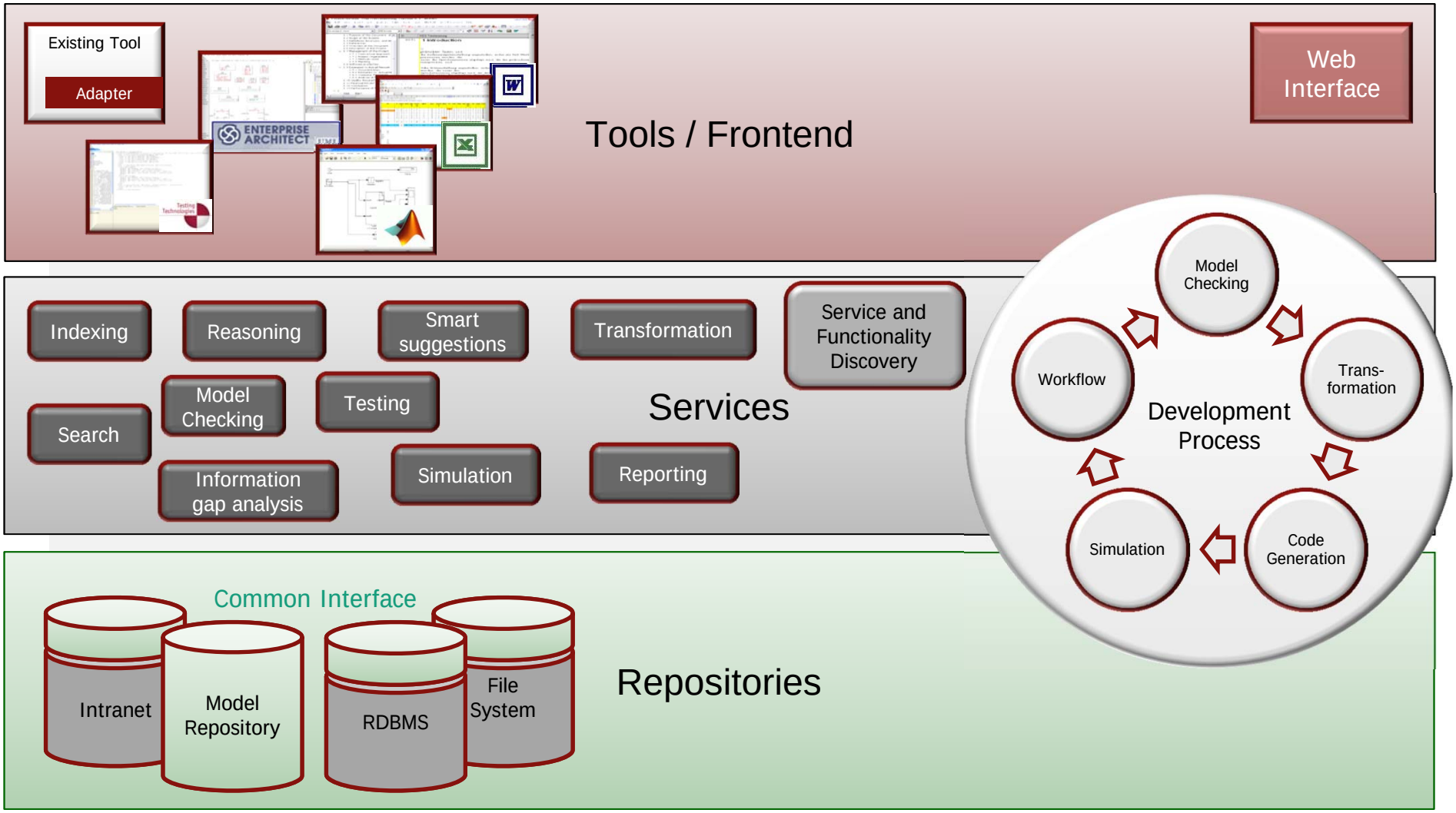
MODELBUS®

General Concept

- Lifecycle service support for creative, collaborative work
- Process Enactment guides and controls the development processes
- Core services for the operation via ModelBus
- ModelBus services provides back-end functionality for automation



MODELBUS® ARCHITECTURE



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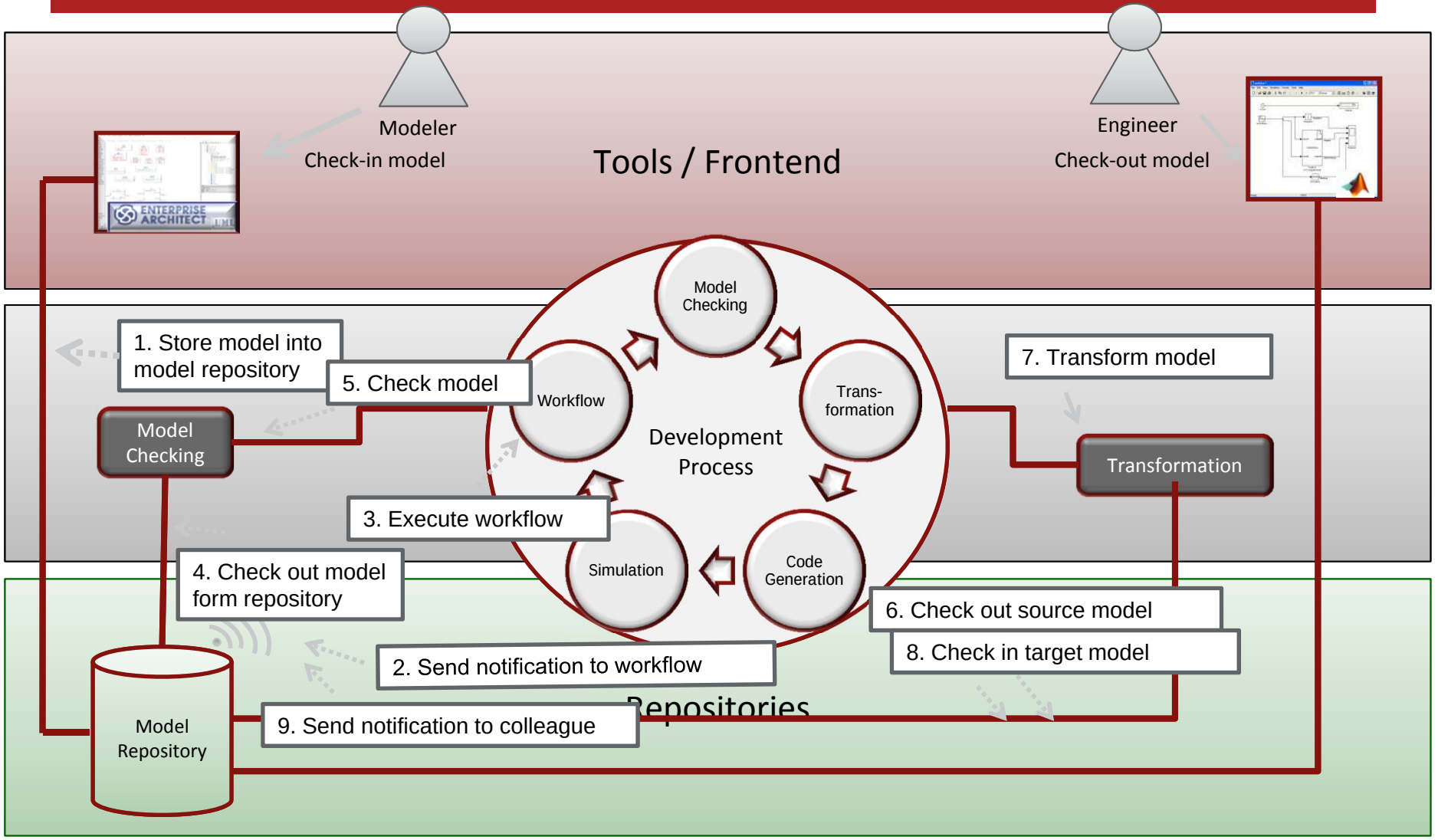
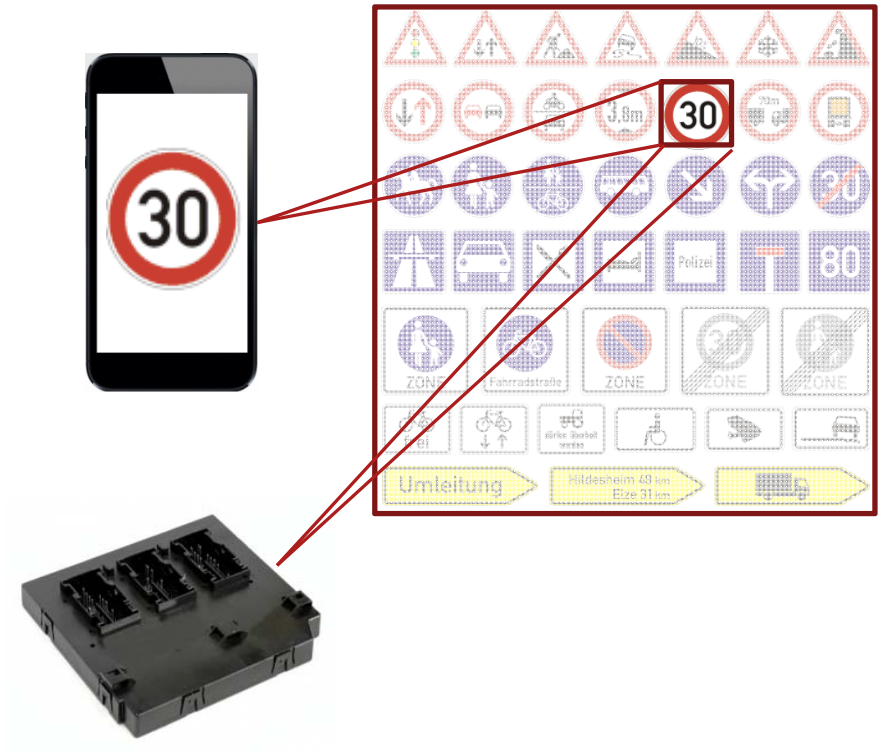


EC PROJECT VARIES

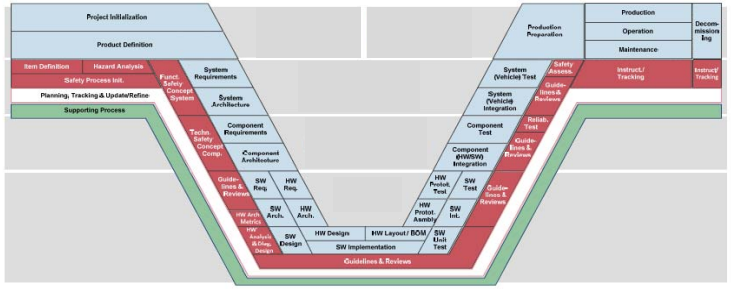
Case Study

As product and consulting company for the automotive domain B&M is specialized in systems engineering, development and testing of complex electronic and mechanical systems. Within the case study B&M will appear as developer of automotive driver assistance software.



Traffic Sign Recognition System

- Different hardware and operating systems
- Different countries with variety of laws and regulations
- Different directions of traffic
- Different sets of customer specific functionalities



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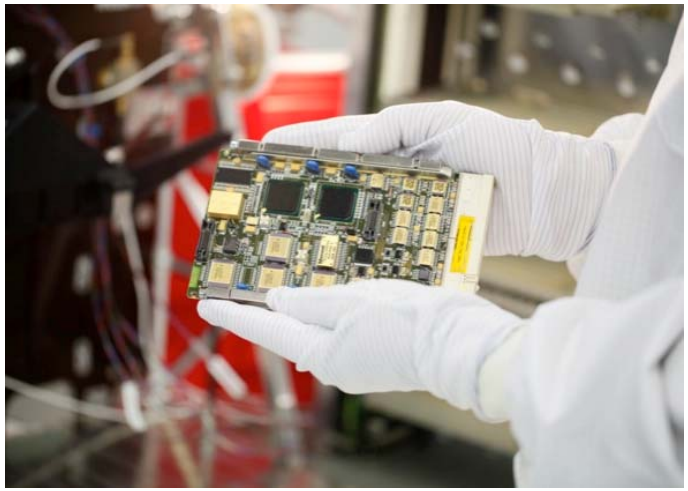
GOALS

- The existing normal development process needs to be supported
- Support for variability management needs to be added over all process phases
- Traceability needs to be supported
- Help for maintaining and assessing consistency needs to be supported
- Support safety aspects and certification

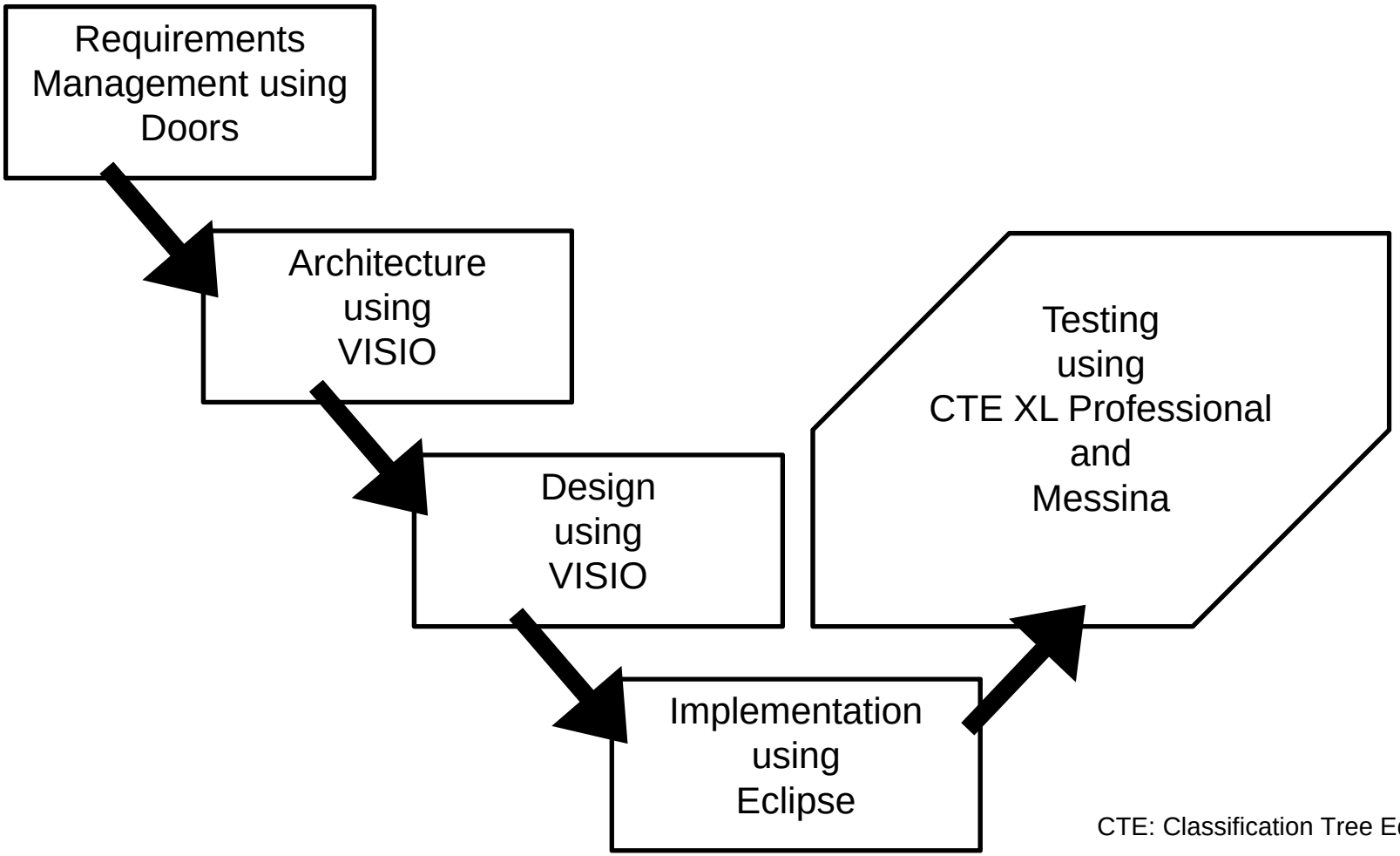
SAFETY AND CERTIFICATION RELATED ASPECTS

Specific goals

- On the framework (support for functional safety management)
  - Centralized and protected Automation: avoid errors through incorrect repetition (human error) and manipulation
  - Process support
  - Traceability support: coverage, consistency, correlation and tracking
  - Access rights, Authentication and Logging/Versioning: tracking
- On the tooling
  - Support for Analysis (e.g. QFD, FMEA, FTA): supporting methods and assessment
  - Checking for completeness and changes

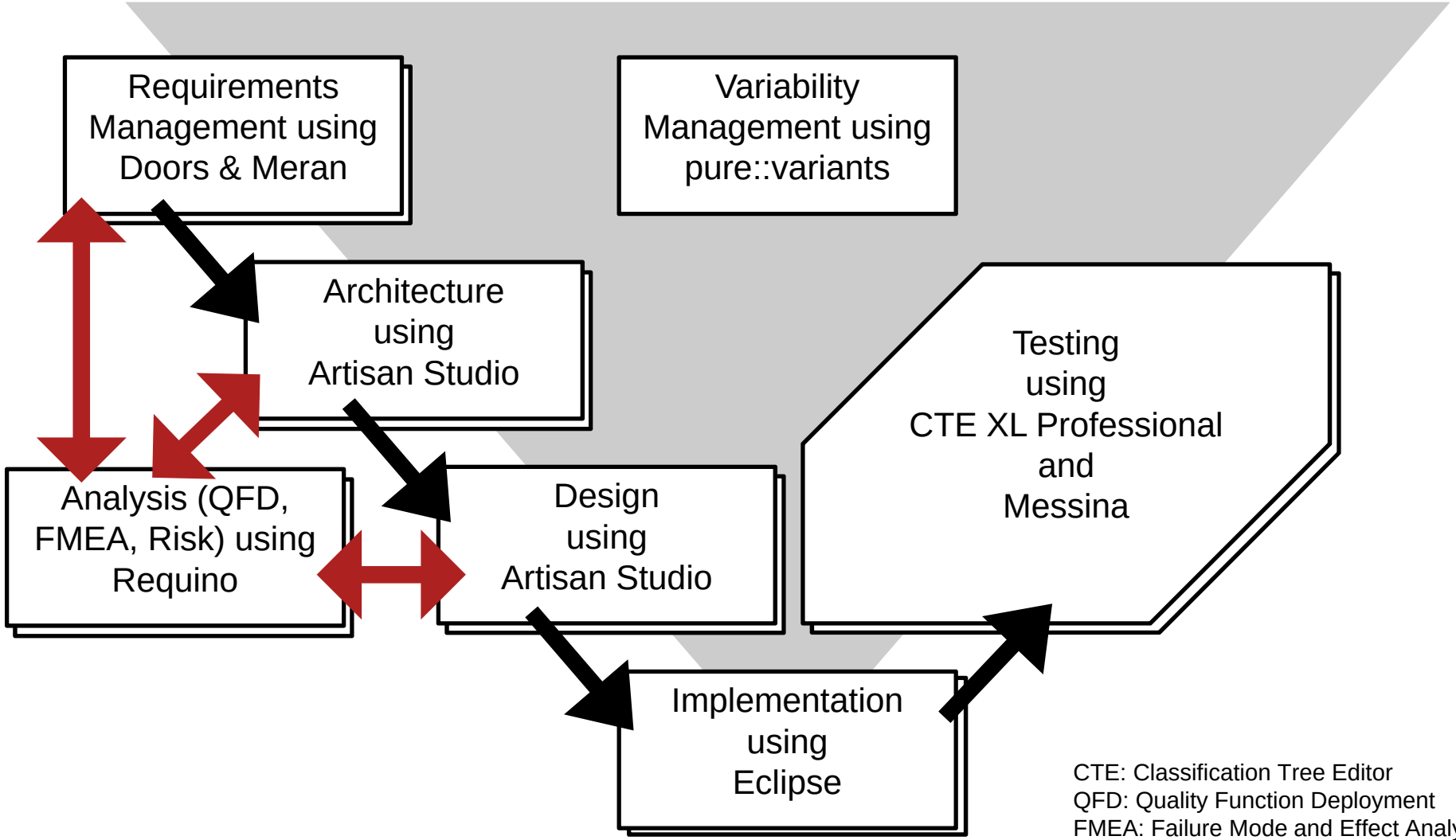


THE ESTABLISHED PROCESS



CTE: Classification Tree Editor

THE ENVISAGED PROCESS



CTE: Classification Tree Editor
QFD: Quality Function Deployment
FMEA: Failure Mode and Effect Analysis

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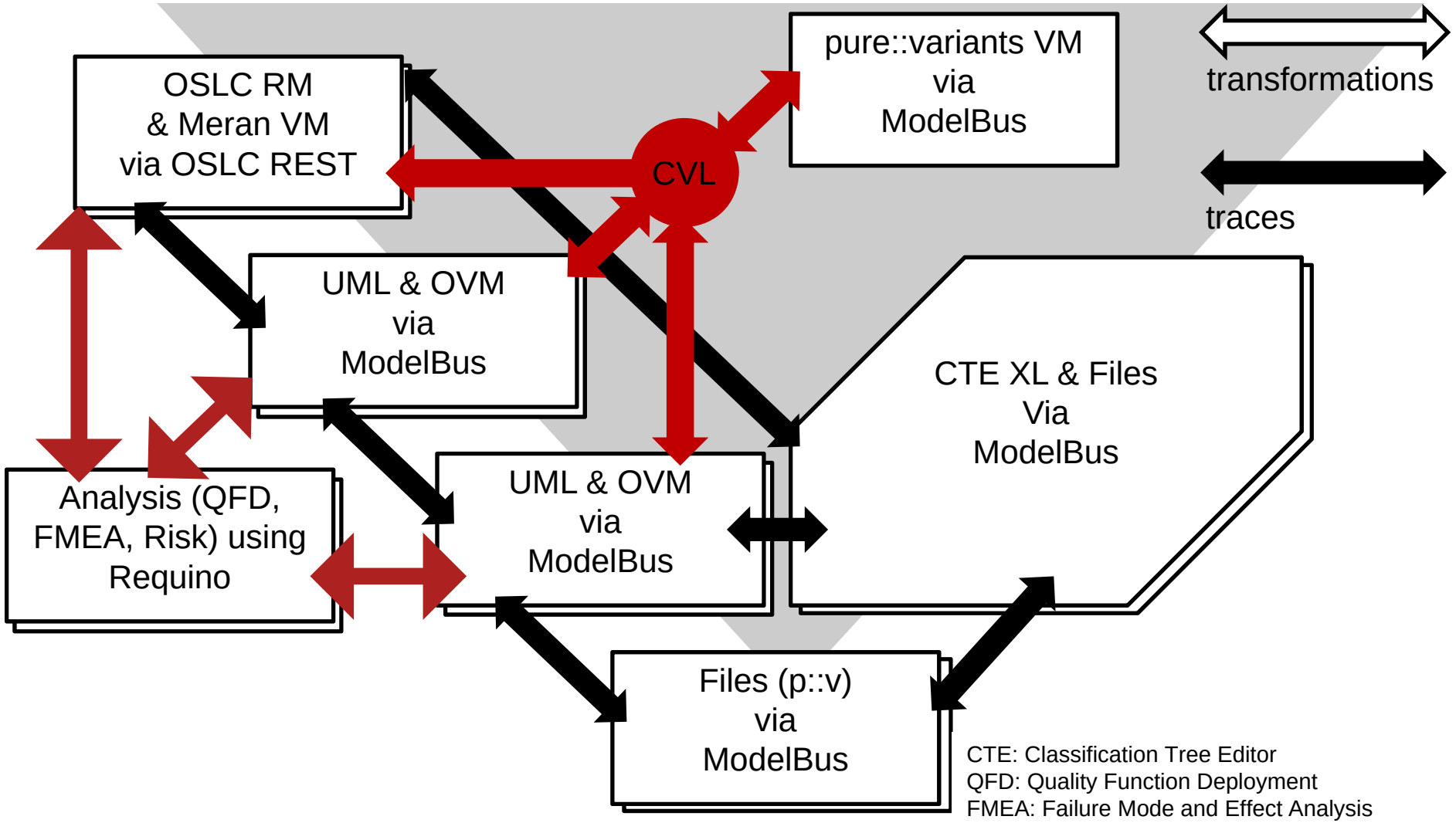
REALIZATION
CONSISTENT VARIABILTY MANAGEMENT HANDLING



CTE: Classification Tree Editor
QFD: Quality Function Deployment
FMEA: Failure Mode and Effect Analysis
OSLC: Open Services for Lifecycle Collaboration
UML: Unified Modeling Language
OVM: Open Verification Methodology
CVL: Common Variability Language

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TRACEINO

Model-Driven Traceability

Challenge

- Linking model elements of models that are conform to different meta models
- Linking model elements across tool borders
- Type safe, case specific traceability links
- Generic characteristics of traceability links necessary for analysis
- Tracing solution which is customizable to a high degree

Solution

- Easily modelling traceability meta models with the aid of EMF modelling tools
- Linking a tool's model elements with model elements managed by other tools
- Exploring traceability links within the tools themselves
- Querying traceability information

TRACEINO

METRINO

Model-Driven Measurements

Challenge

- Estimate the cost & schedule of future projects
- Evaluate the productivity impacts of new tools and techniques
- Establish productivity trends over time
- Improve process and systems quality

Solution

- Model-driven handling of quality attributes and properties
- Definition of metric generation rules
- Front-end for the definition and management of metrics incl. thresholds, grouping of metrics, etc.
- Visualization of metric computation results in different forms

METRINO

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SUMMARY

1. Engineering is getting more and more complex

→ In order to meet time-to-market and quality requirements, distributed, collaborative, cross-domain engineering approaches are needed

2. Engineering Environments are networked IT-Systems: networked models, networked devices, networked engineers

→ The Internet of Systems engineering paradigms supports networked engineering approaches by use of model-driven methods

3. Quality Assurance needs a holistic view on the systems and processes and access to the recent, complete, and synchronized knowledge

→ ModelBus and its tools like Metrino and Traceino enable the efficient development and maintenance of software-based systems in heterogenous tool landscapes

THANK YOU FOR YOUR ATTENTION

CONTACT

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