



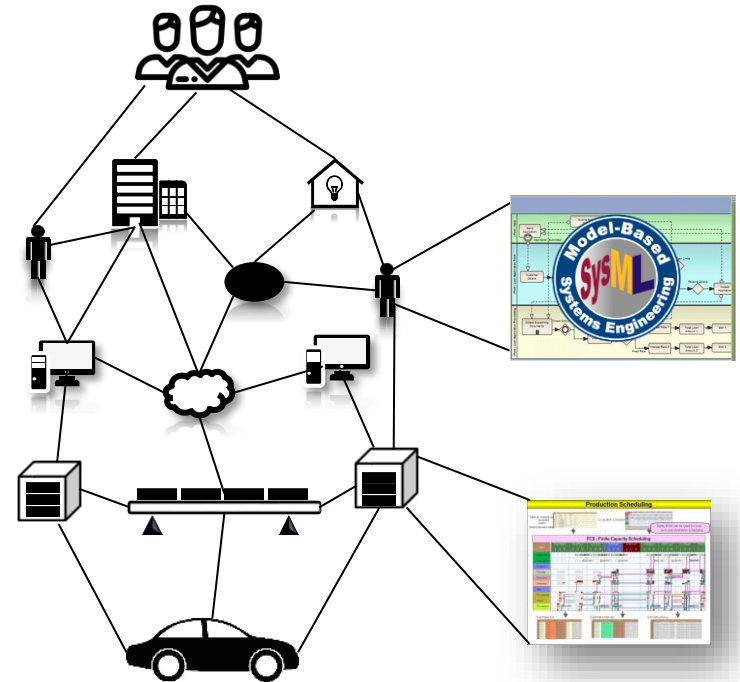
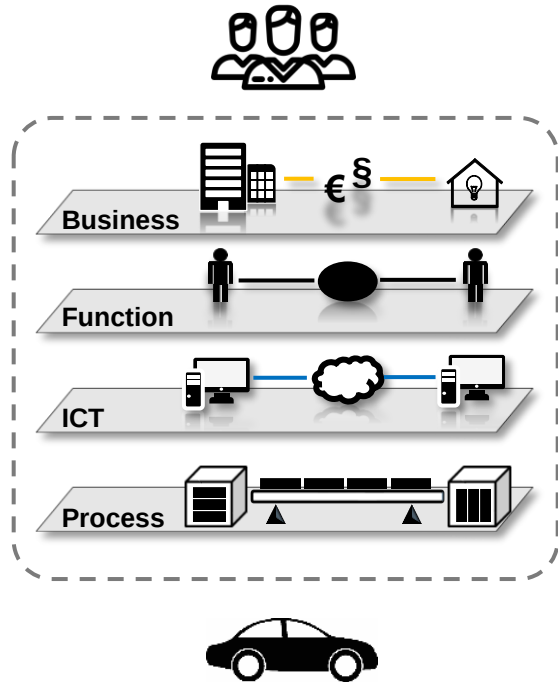
FH Salzburg

RAMI Toolbox

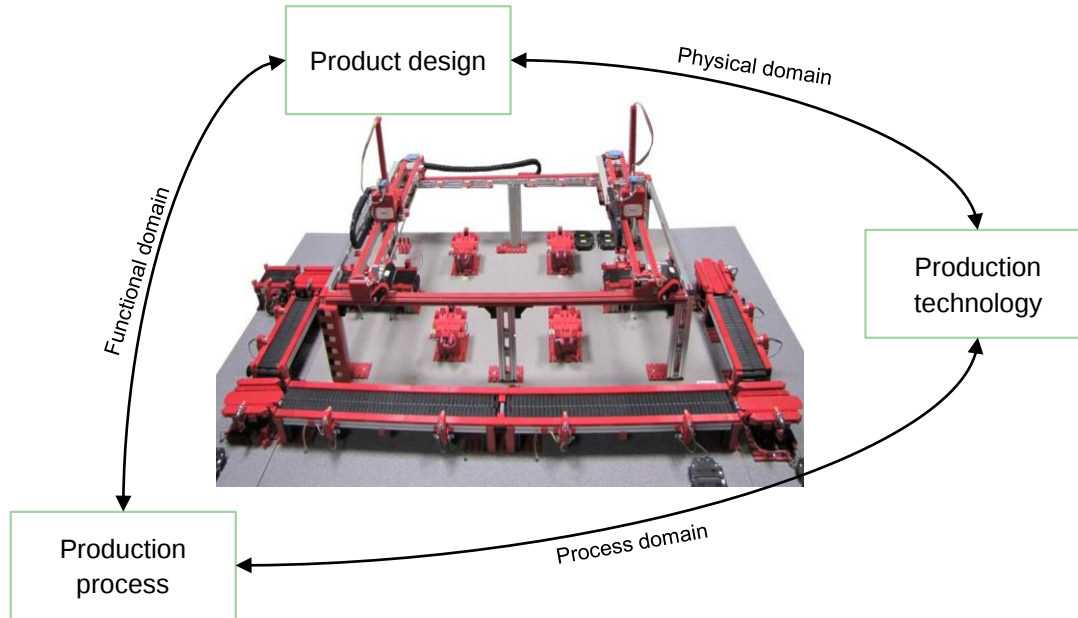
A Framework enabling Model-based Systems Engineering of
complex Flexible Production Systems

**Christoph Binder, Ambra Calà, Jan Vollmar, Christian
Neureiter and Arndt Lüder**

Industry 4.0: Increasing Complexity

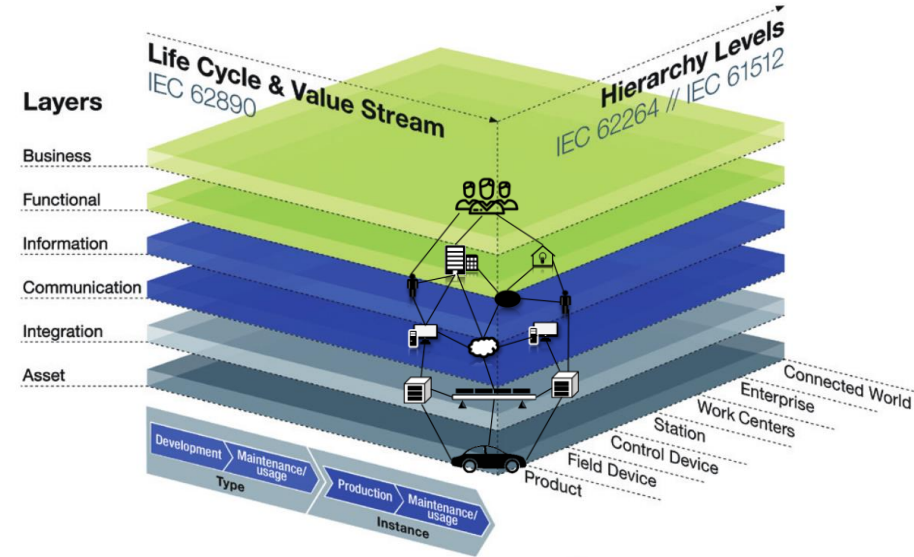
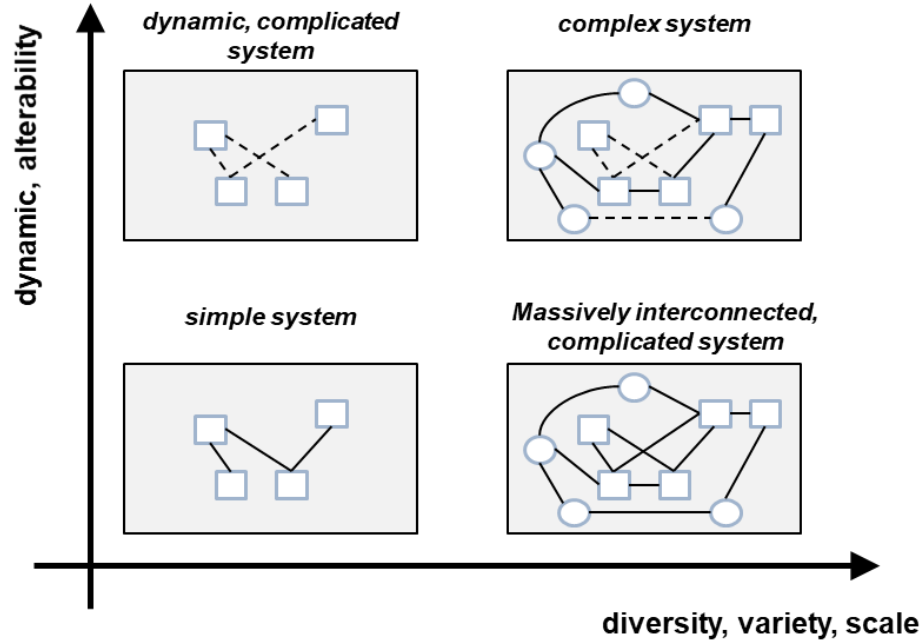


Flexible Production Systems



- *Multi-discipline collaboration and early verification are very important*
- *No available modeling methodology to track and handle intelligent manufacturing systems*
- *A consistent and unambiguous system representation is necessary to ensure integrity*

Complex Systems



RAMI Toolbox

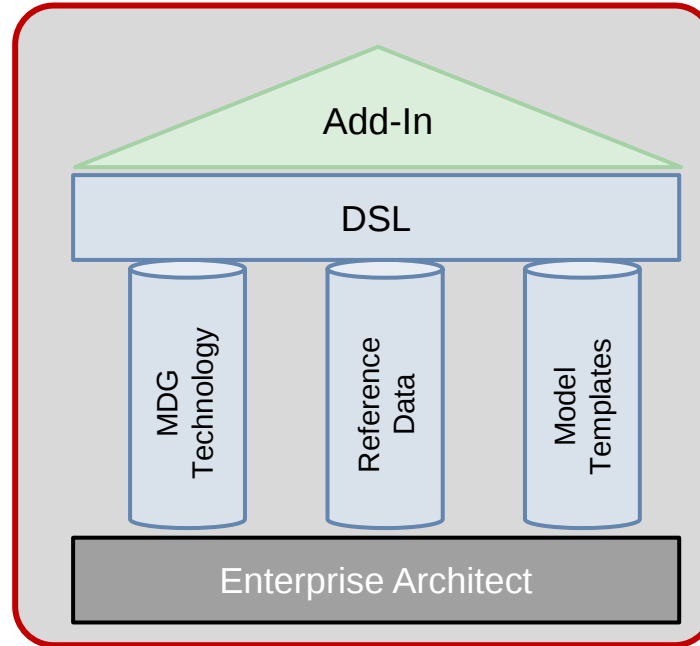


Goal

- *Create a development environment for interdisciplinary, domain specific and model-based Systems Engineering for Industry 4.0 architectures*

Obstacles

- (1) *Applicability*
- (2) *Architecture Definition*
- (3) *Process Model*
- (4) *Tool-Support*



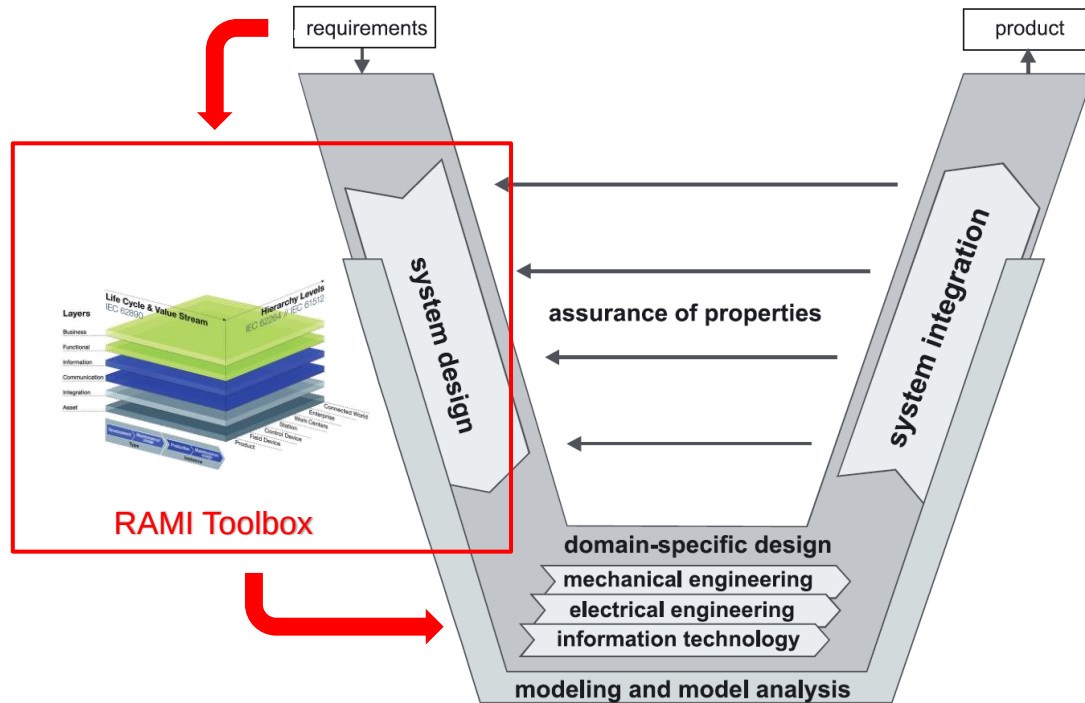
Add-In

- Model Transformations
- Model Evaluation
- Matrix and Layout functionality
- ...

DSL / MDG Technology

- UML Profile
- Diagram Profile
- Toolbox Profile

Systems Engineering – VDI 2206

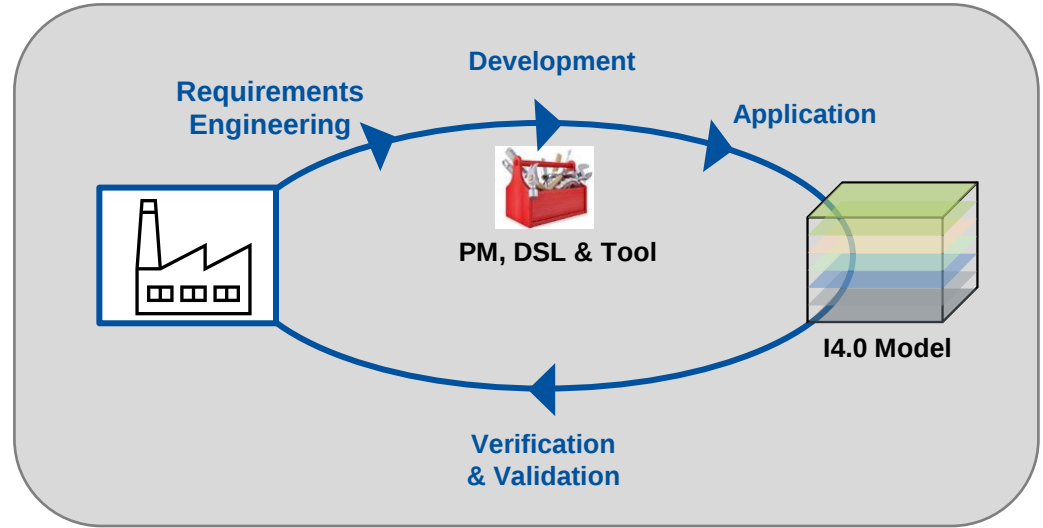


Approach



Agile Design Science Research Methodology

- (1) *Specification of Case Study*
- (2) *Requirements Engineering*
- (3) *Development of Process Model, DSL & Modeling Environment*
- (4) *Application*
- (5) *Verification & Validation*
- (6) *Return to (1)*

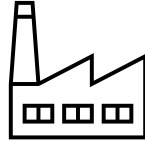
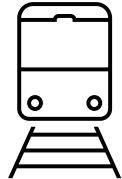


Case Studies



Real-World Scenarios

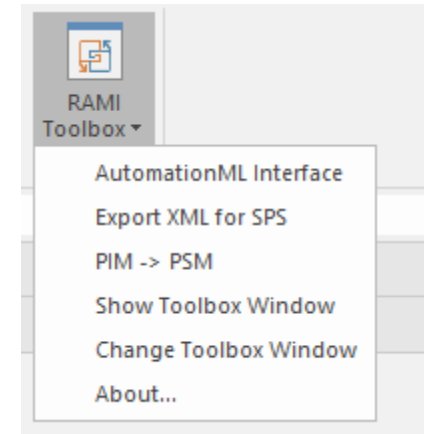
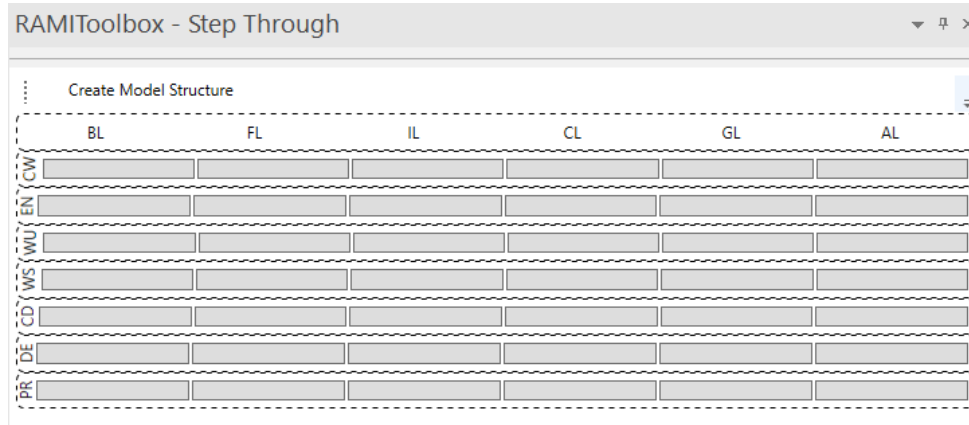
- *Metal Profiles for Subway Tracks*
- *Car Manufacturing*
- *Siemens Fischertechnik Smart Factory*



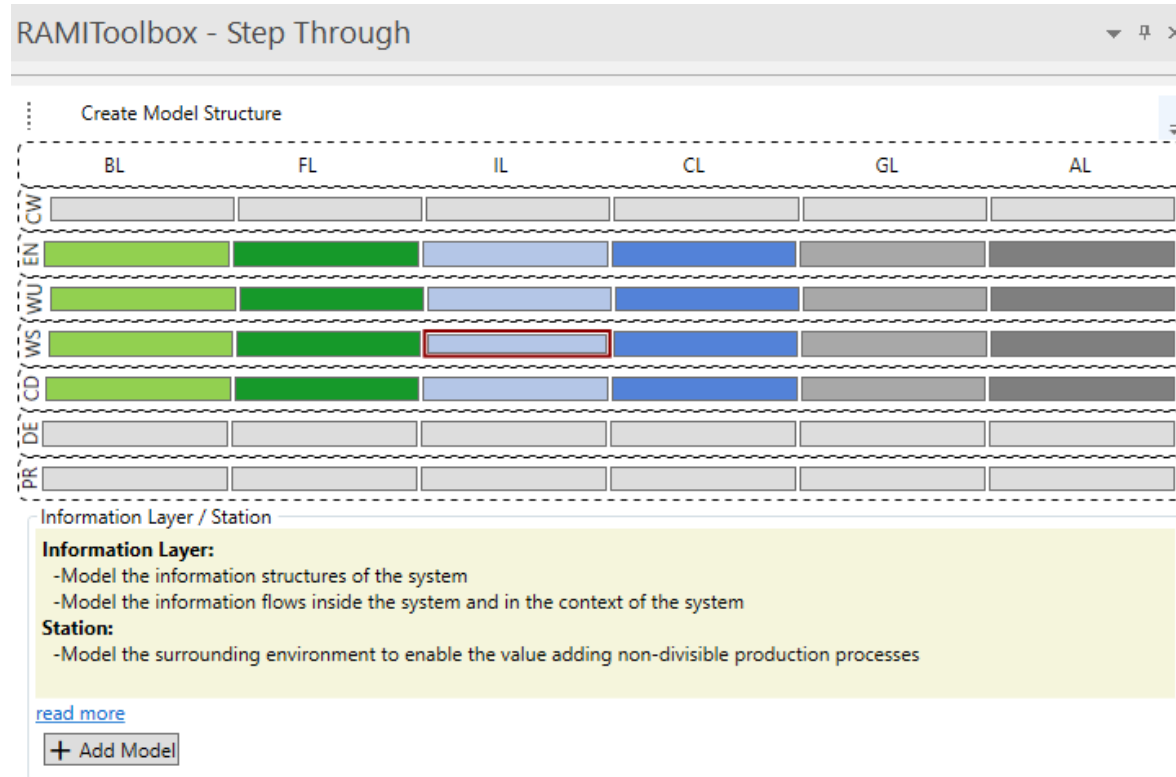
Industry 4.0 Approach / Requirements

- *Increase effectivity*
 - Customized Profiles: Information exchange with customer
 - Sample size „1“
 - State-based maintenance
- *Special Focus on Systems Engineering*
 - Requirements on different abstraction levels
 - Black- and White-Box Functions
 - Logical Architecture
 - Technical Elements

Implementation



Main Window



Functionality - Structure



Create Model Structure

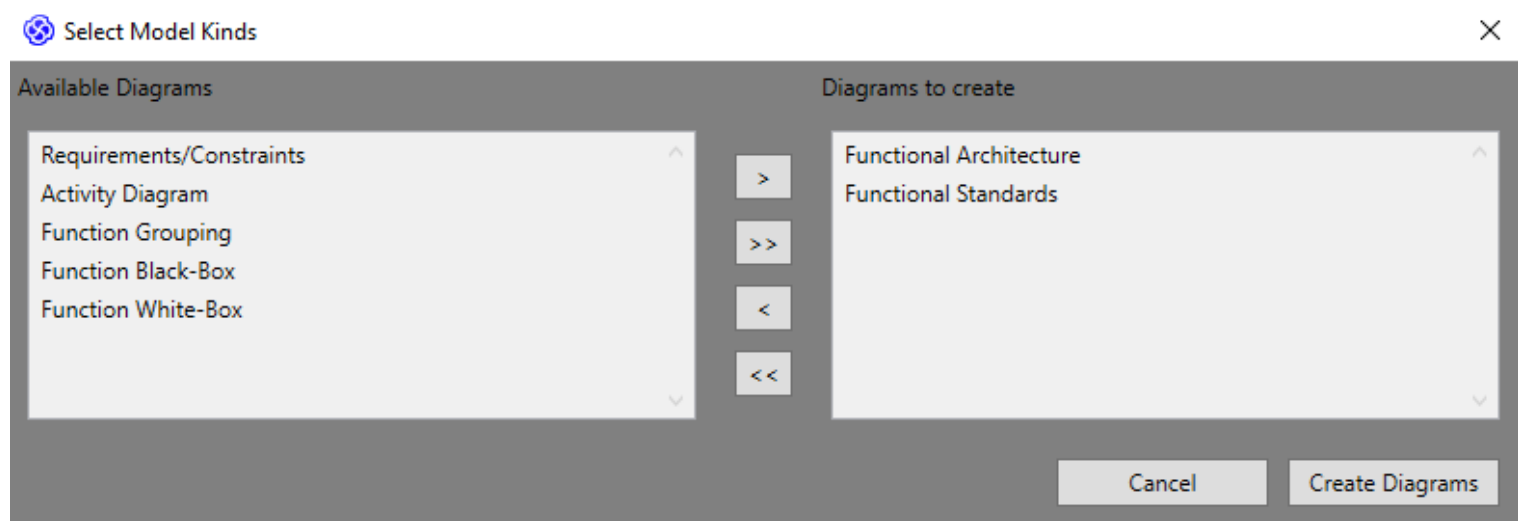
Choose Models to Create:

- ☐ Create CW Structure
- ☒ Create EN Structure
- ☒ Create WU Structure
- ☒ Create WS Structure
- ☒ Create CD Structure
- ☐ Create DE Structure
- ☐ Create PR Structure
- ☐ Create * Structure 8

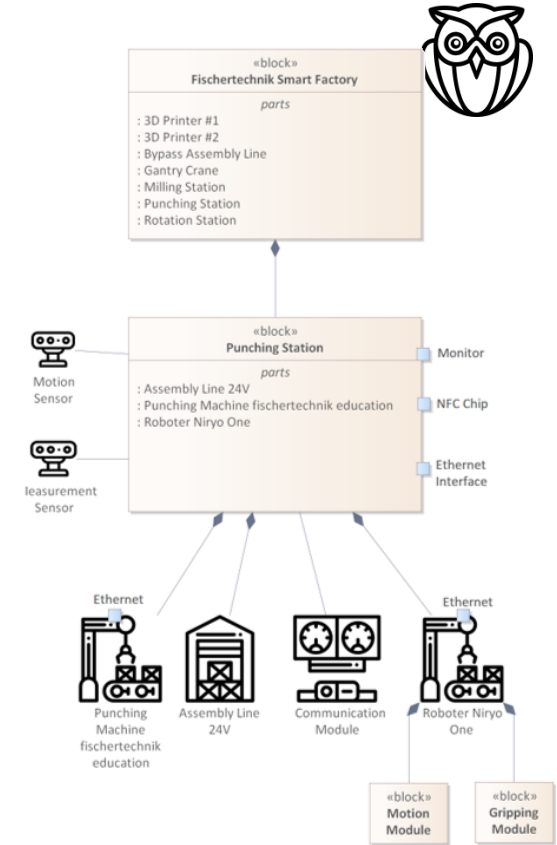
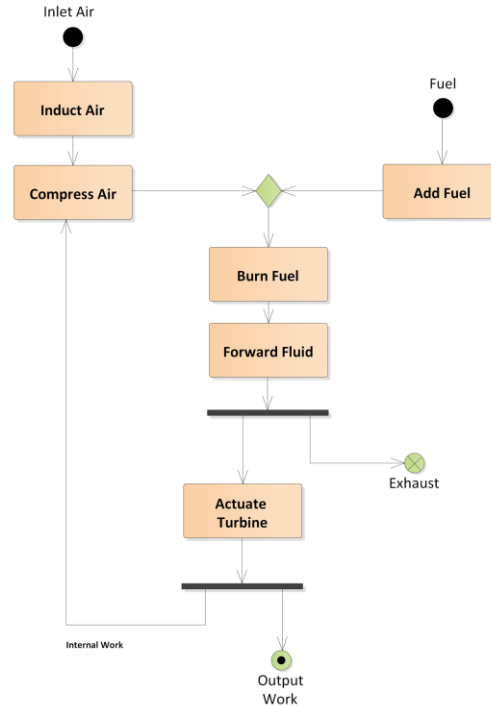
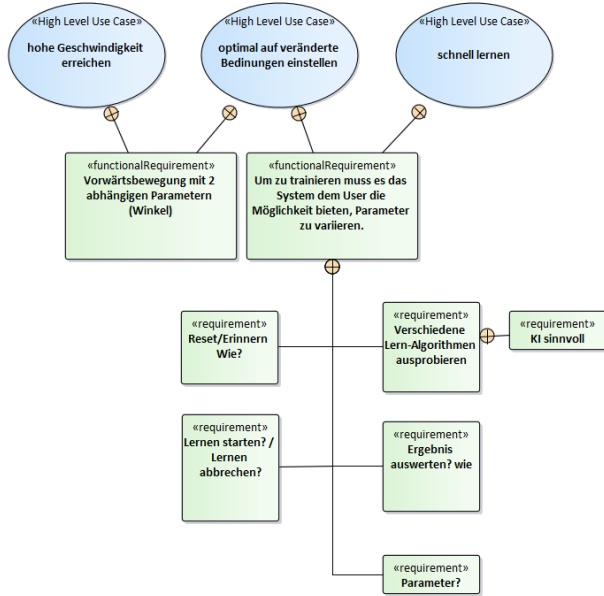
Select All Deselect All Cancel OK

Project	Context	Diagram	Element
EN			
	«view»	Business Layer	
	«view»	Function Layer	
	«view»	Information Layer	
	«view»	Communication Layer	
	«view»	Integration Layer	
	«view»	Asset Layer	
WU			
	«view»	Business Layer	
	«view»	Function Layer	
	«view»	Information Layer	
	«view»	Communication Layer	
	«view»	Integration Layer	
	«view»	Asset Layer	
WS			
	«view»	Business Layer	
	«view»	Function Layer	
	«view»	Information Layer	
	«view»	Communication Layer	
	«view»	Integration Layer	
	«view»	Asset Layer	
CD			
	«view»	Business Layer	
	«view»	Function Layer	
	«view»	Information Layer	
	«view»	Communication Layer	
	«view»	Integration Layer	
	«view»	Asset Layer	

Functionality – Model Kinds



Exemplary Models



State, Outcomes & Findings so far



State

- *Toolbox adopted in first version*
 - Free accessible
 - Click-through Models available
- *ADSRM in fourth iteration*

Findings so far

- *Availability of RAMI 4.0 architecture modeling framework*
- *Evaluated towards usability amongst other attributes*
- *Different flaws in RAMI 4.0 already identified*
 - Especially: misfitting on „left side“
- *Interconnection between models of*
 - Product – Process - Production

Current / Future work

- *Refinements with engineering tool-chain*
- *Interfaces to domain-specific design*
- *Concepts for adoption of RAMI 4.0*
- *Review with domain-stakeholders*

Further information

- www.en-trust.at
- <https://rami-toolbox.org/>
 - Publications
 - Toolboxes for download
 - Tutorials



Contact

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