

## 50. Software Factories - Metamodelling in Heterogeneous Technical Spaces

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1) Heterogeneous technical spaces

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  - [http://www.springer.com/computer/swe/book/978-3-642-00281-6?cm\\_mmc=Google-\\_-Book%20Search-\\_-Springer-\\_-0](http://www.springer.com/computer/swe/book/978-3-642-00281-6?cm_mmc=Google-_-Book%20Search-_-Springer-_-0)
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# Literature

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<http://nbn-resolving.de/urn:nbn:de:bsz:14-qucosa-63986>
  - This PhD thesis lays the ground for component models and composition technology for modeling languages.
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# The Book of the MOST Project for Multi-TS Development



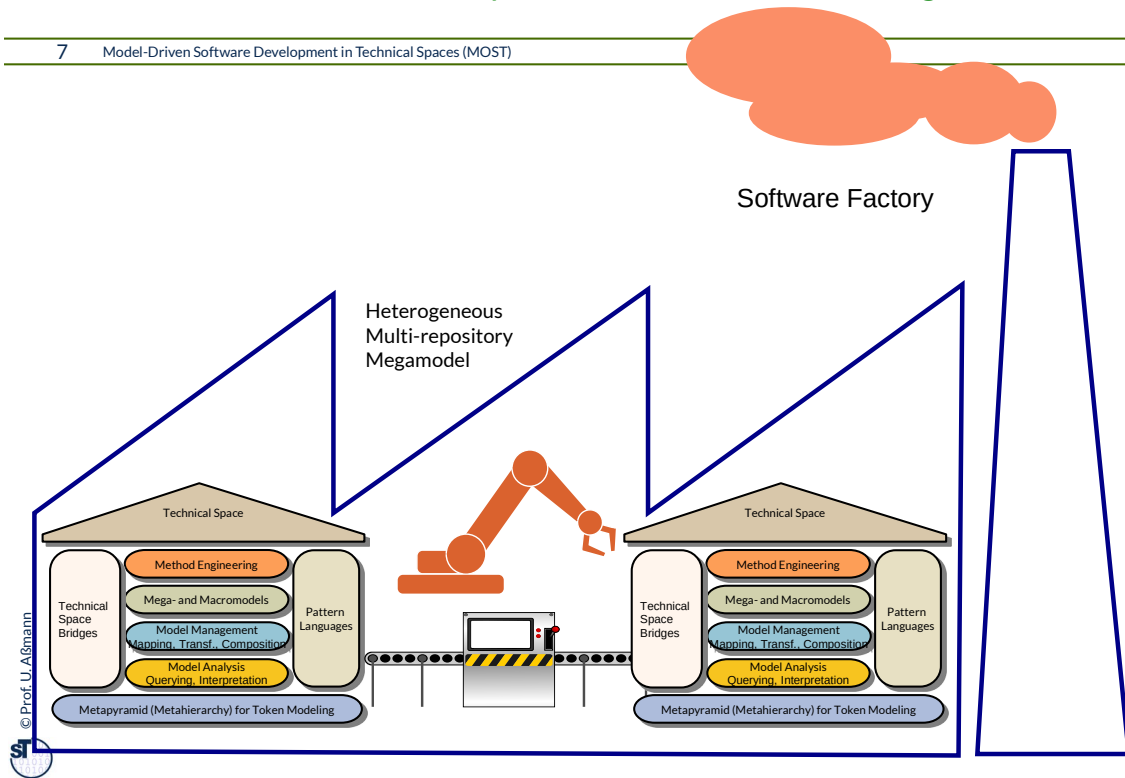
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## 50.1 MDSD in Multiple Technical Spaces (Multi-TS Development)

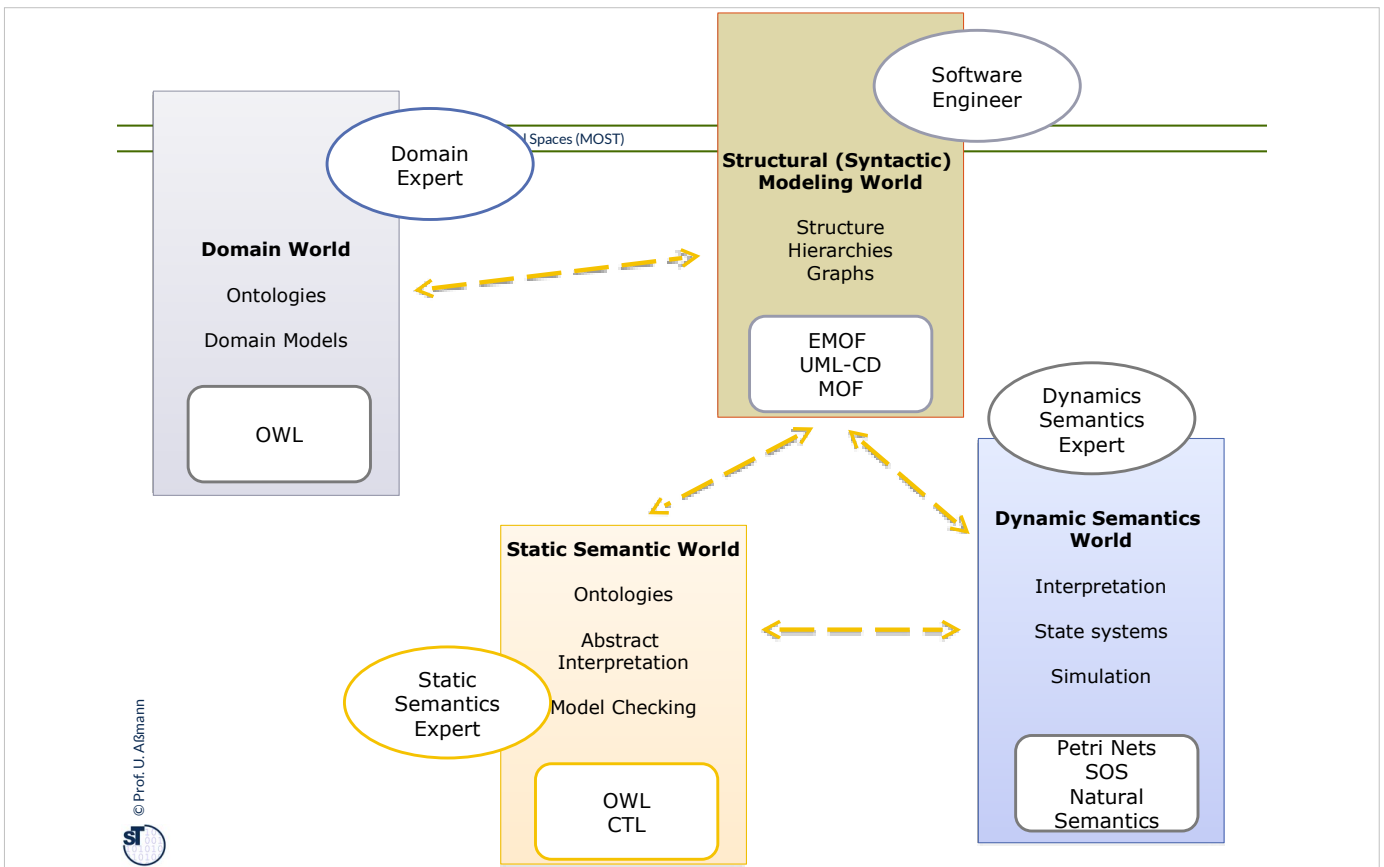
# Q13: A Software Factory's Heart: the Multi-TS Megamodel



# The Problem: Heterogeneous Software Lives in **Several** Technical Spaces

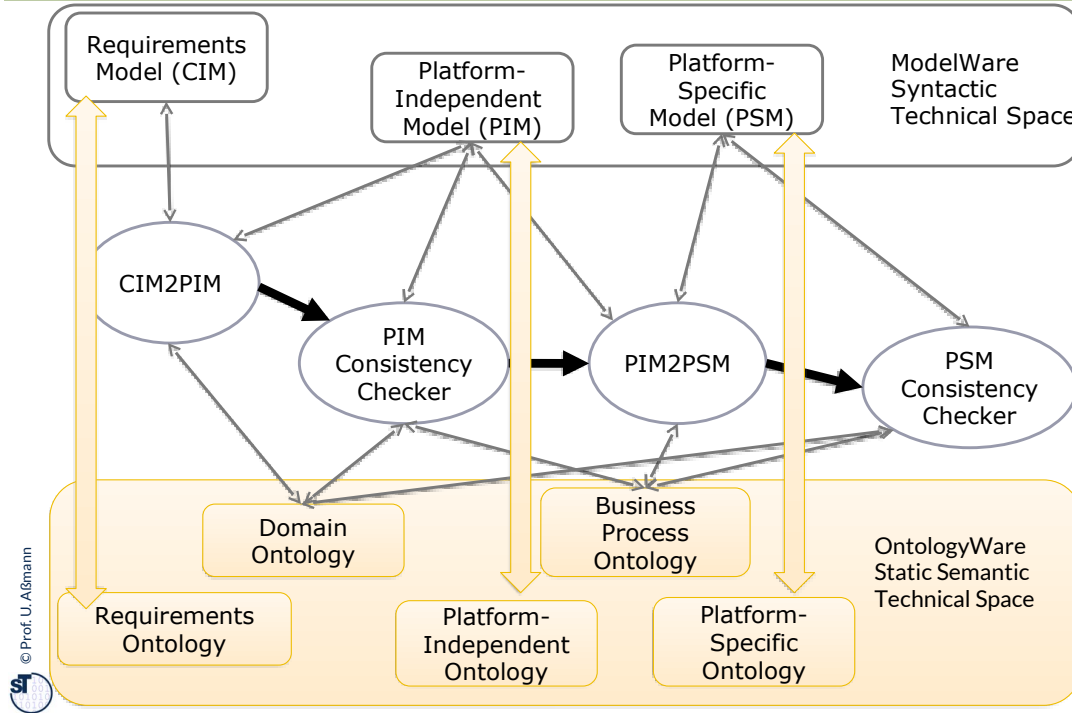
- ▶ Modern cars, cloud robots (Kiva robots), and other CPS live in several technical spaces:
  - Syntactic technical space
  - Static semantic technical spaces
  - Dynamic semantic technical space (usually one)
  - Domain world technical space





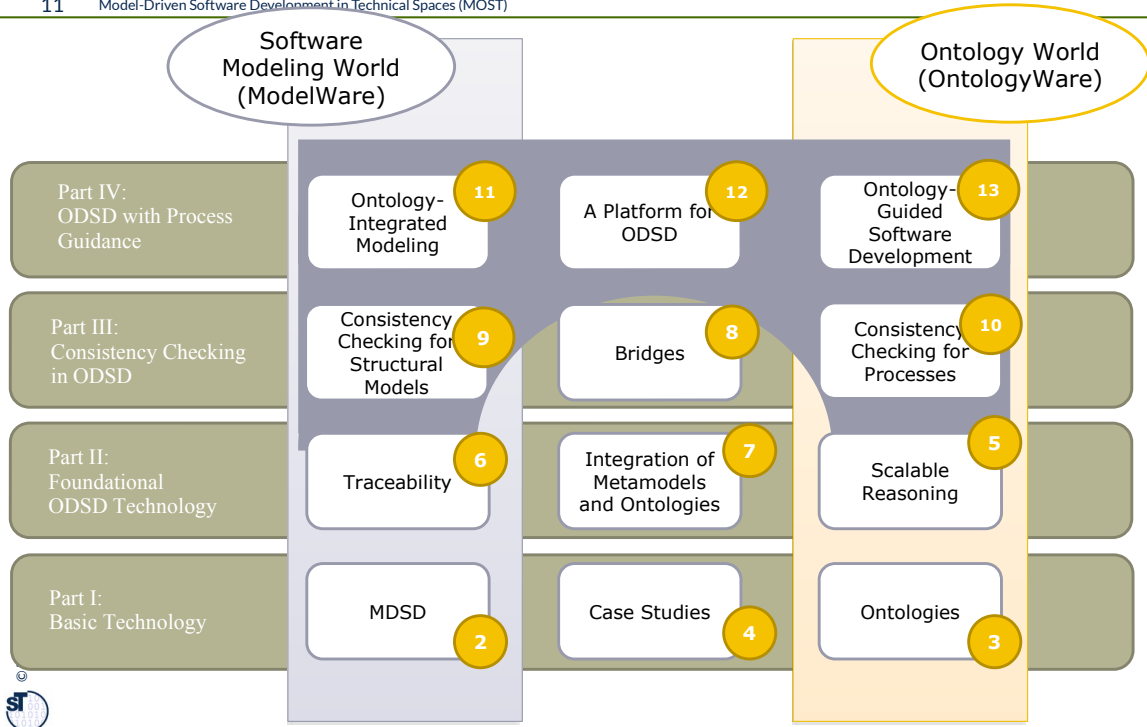
Bridging.all-the-technical-spaces

## Example: A Heterogeneous MDA (From MOST Project)



## MDSD-Integrated-Services

# MOST: Tasks for Bridging between Syntactic and Semantic TS

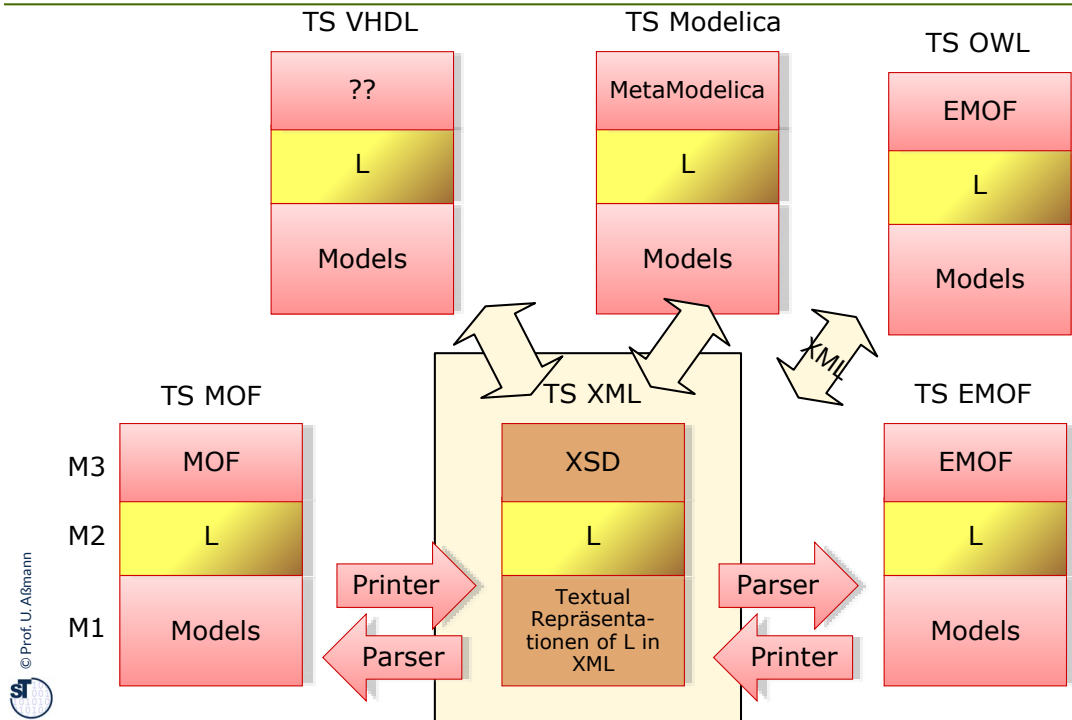


## BookRoadmap



## 50.2 Applications Working in Multiple Technical Spaces

# Language Mapping between Several TS via XML Data Exchange via Link Trees



# Multi-Technical-Space MDSD Tools (Software Factories)

A **heterogeneous software factory** is a multi-TS IDE using several technical spaces at the same time.

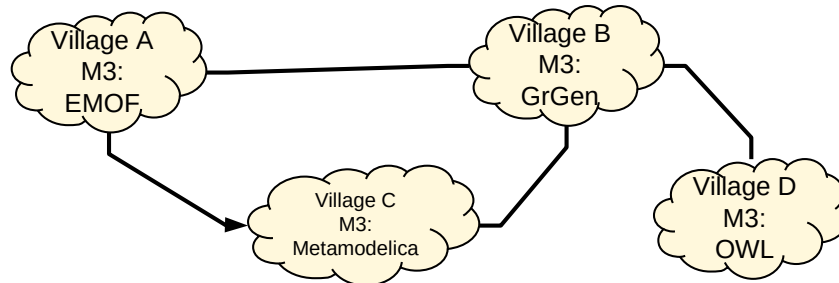
- ▶ Today, most MDSD toolkits work in one technical space.
- ▶ However, industrial software development usually is heterogeneous and several technical spaces must be used (XML, Java, C++, UML, csv, ...)
- ▶ PreeVision, ASCET are software factories

A **software factory produces heterogeneous software product lines in several technical spaces.**

A **software factory benefits from a multi-TS macromodel.**

# Multi-Technical-Space MDSD Toolkits (Software Factories)

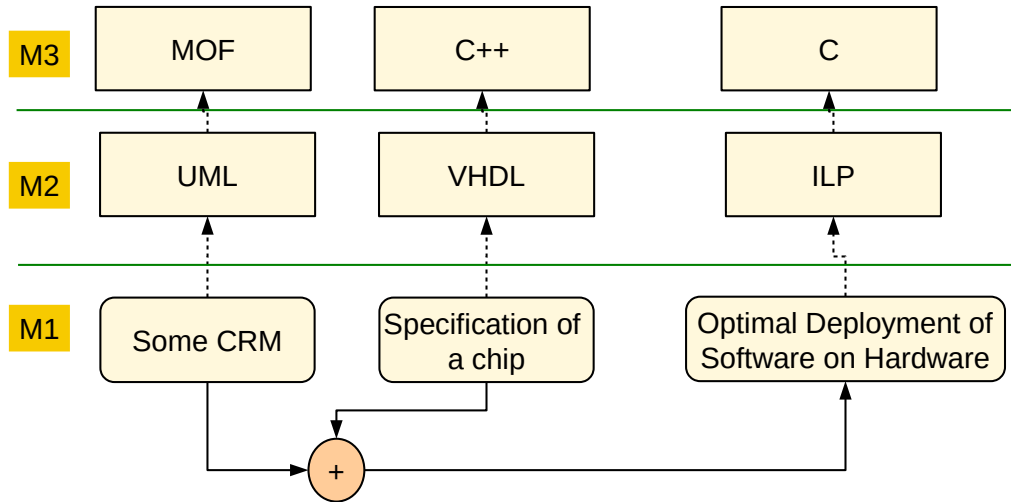
- ▶ Jean Bezivin's *Model Engineering Metapher*:
- ▶ “The world of Model Engineering consists of different villages connected by streets. Every sort of engineer maintains one or several “model villages” (technical spaces) or “model towns” (or technological spaces)”
- ▶ The task of model engineering is to build bridges and streets in the modeling landscape



**Model Engineering** is the engineering of software factories – the engineering with several technical spaces in multiple technological spaces

## Example: Hardware Design

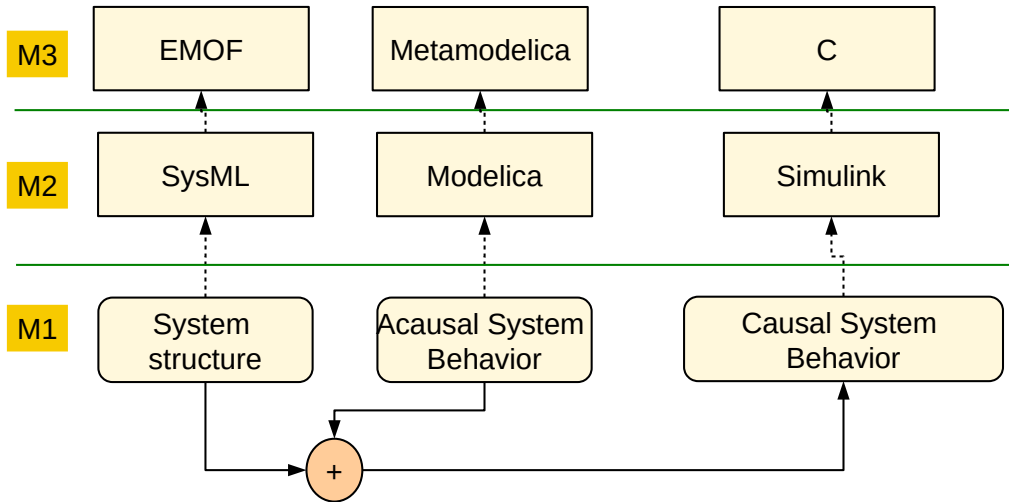
- ▶ To automate the optimization of software systems you need
  - A language to describe software systems (e.g., UML in MOF)
  - A language to describe hardware (e.g., VHDL in C++)
  - A language to express the optimization problem (e.g., ILP in C)





## Example: Simulation

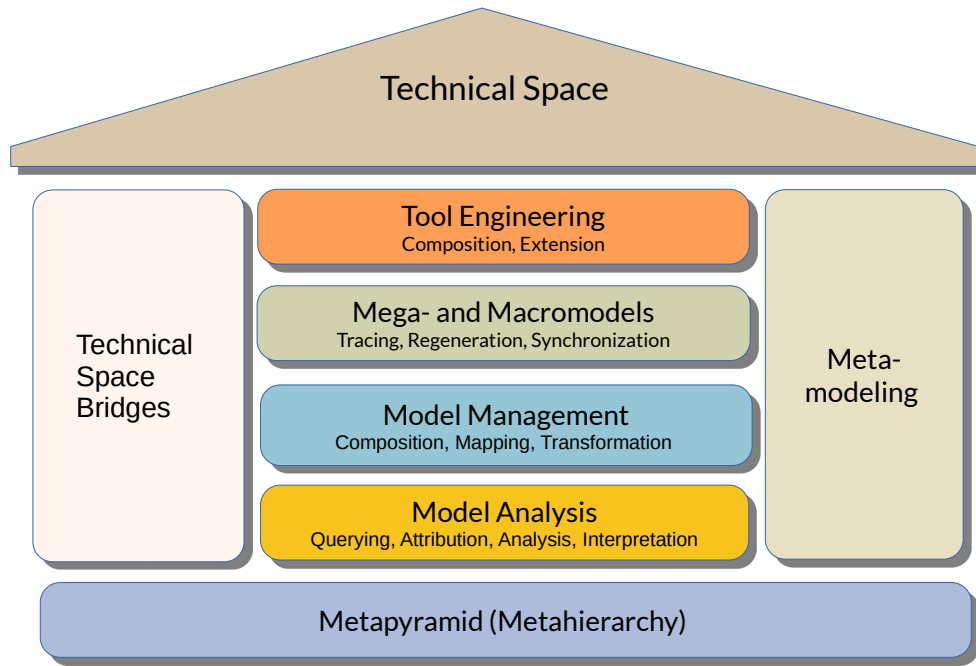
- ▶ To model advanced simulation software systems you need
  - A language to describe software structures (e.g., SysML in EMOF)
  - A language to describe simulations (e.g., Modelica in Metamodelica)
  - A language to express the optimization problem (e.g., Simulink in C)



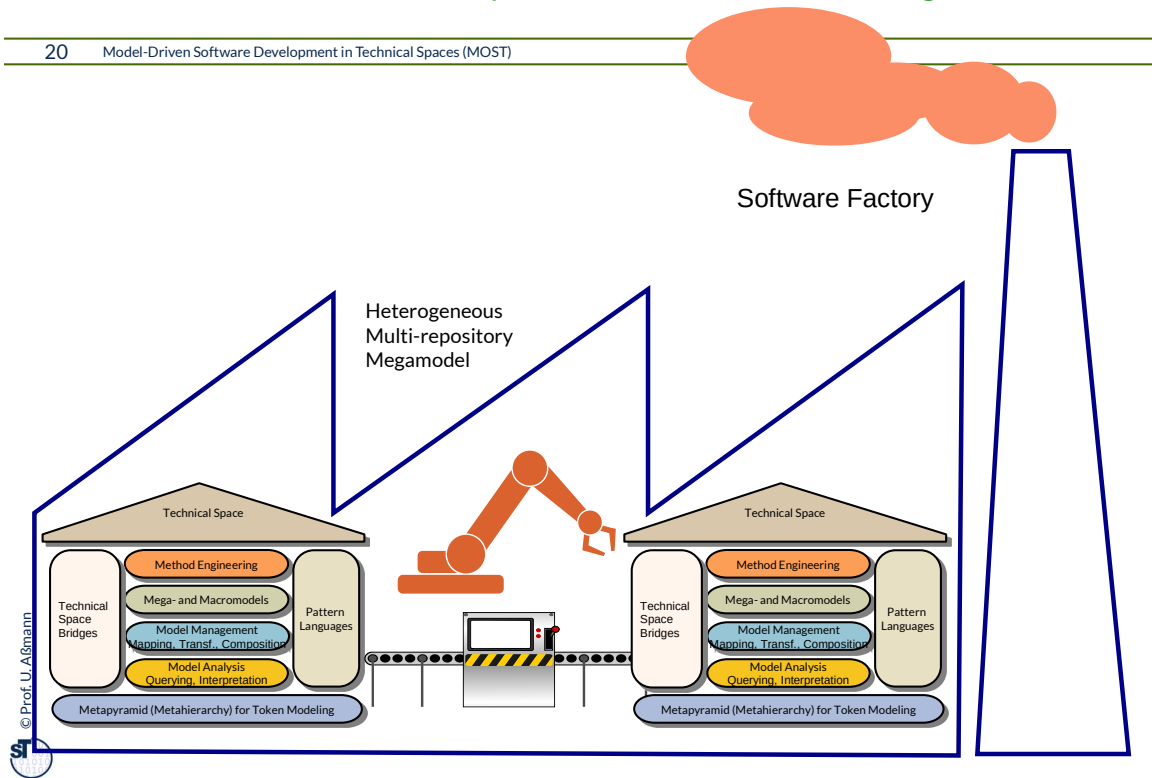


## 50.2 Software Factories (Wrapup)

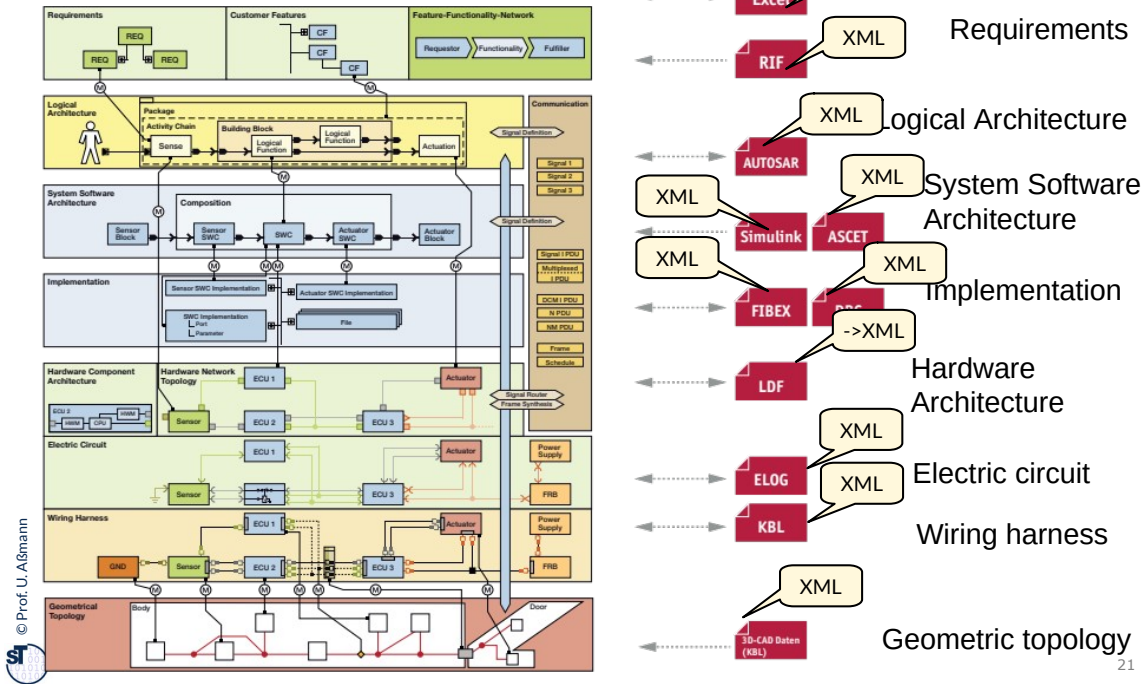
# Q10: The House of a Technical Space



# Q13: A Software Factory's Heart: the Multi-TS Megamodel



# Remember the Big Example: Car Design with PREEvision (Vector): Interoperability with XML Link Trees



# Engineering of Multi-Technical Space Macromodels

- ▶ Engineering of Technical Spaces and Macromodels is one of the most important topics of the future of software development
- ▶ Dresden has modern technologies and tools
  - Analysis tools (such as Relational RAG)
  - Transformation tools (such as RACR)
  - Invasive composition (of snippets), with metacomposition tools (Reuseware)
  - CROM (Role-based metalanguages)
  - Round-Trip Engineering protocols

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# The End

- ▶ Explain why future toolkits to design complex things will be multi-TS software factories
- ▶ What is different in the handling of a multi-TS megamodel compared to a 1-TS megamodel?
- ▶ Which technical space would you choose to exchange data in a software factory? Why?
- ▶ Why will all engineering disciplines do software factories in 50 years from now?