

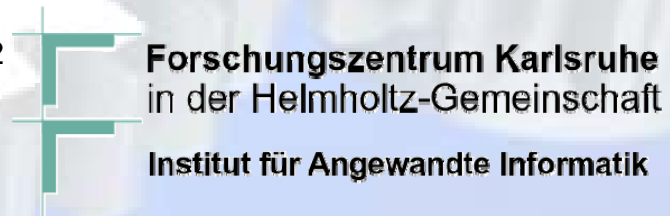
Towards an Integrated Design Approach for Si+NonSi MEMS Methodology

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Bridging the gap between SI and Non SI MST Modelling...

- **University of Siegen**
 - Institute of Micro System Technology (IMT) covering research and teaching in design and processing of **SI backend technologies** (e.g. image sensors, Application Specific Lab-on-Microchip (ALM))
 - Micro System Engineering group with experience in methods and tools for MEMS design
 - Focus on process knowledge management for SI surface micromachining
 - Recent Project in this context: EU FP6 Project PROMENADE (Process Management and Design Environment)
- **Forschungszentrum Karlsruhe**
 - One of the largest Nano Micro research centers in Germany with focus on development of **Non SI technologies**
 - “Process Information Systems“ - Group at Institute for Applied Computer Science (IAI) with experience in organisational & knowledge management aspects of Microsystems
 - Focus in this context on development of Knowledge environments for Non SI SME networks
 - Recent Project in this Context: National Project MicroWebFab

Idea: Joining methodologies to overcome present boundaries between SI and Non SI World



MST Knowledge Management for a Knowledge Based Development and Fabrication

Continuous *customer driven* invention of products and with that the improvement of technologies (SI+Non SI) is a characteristic feature of MST as a cross sectional technology

=> Result: Parallel further development of products and processes required

=> Requires a continuous adjustment of process capabilities to product requirements by structuring, modeling and simulation of technological and economical parameters

Especially in SME (SME networks) an organizational approach to control the adaptive product development process on business process level is still missing.



MST Knowledge Management for a Knowledge Based Development and Fabrication (II)

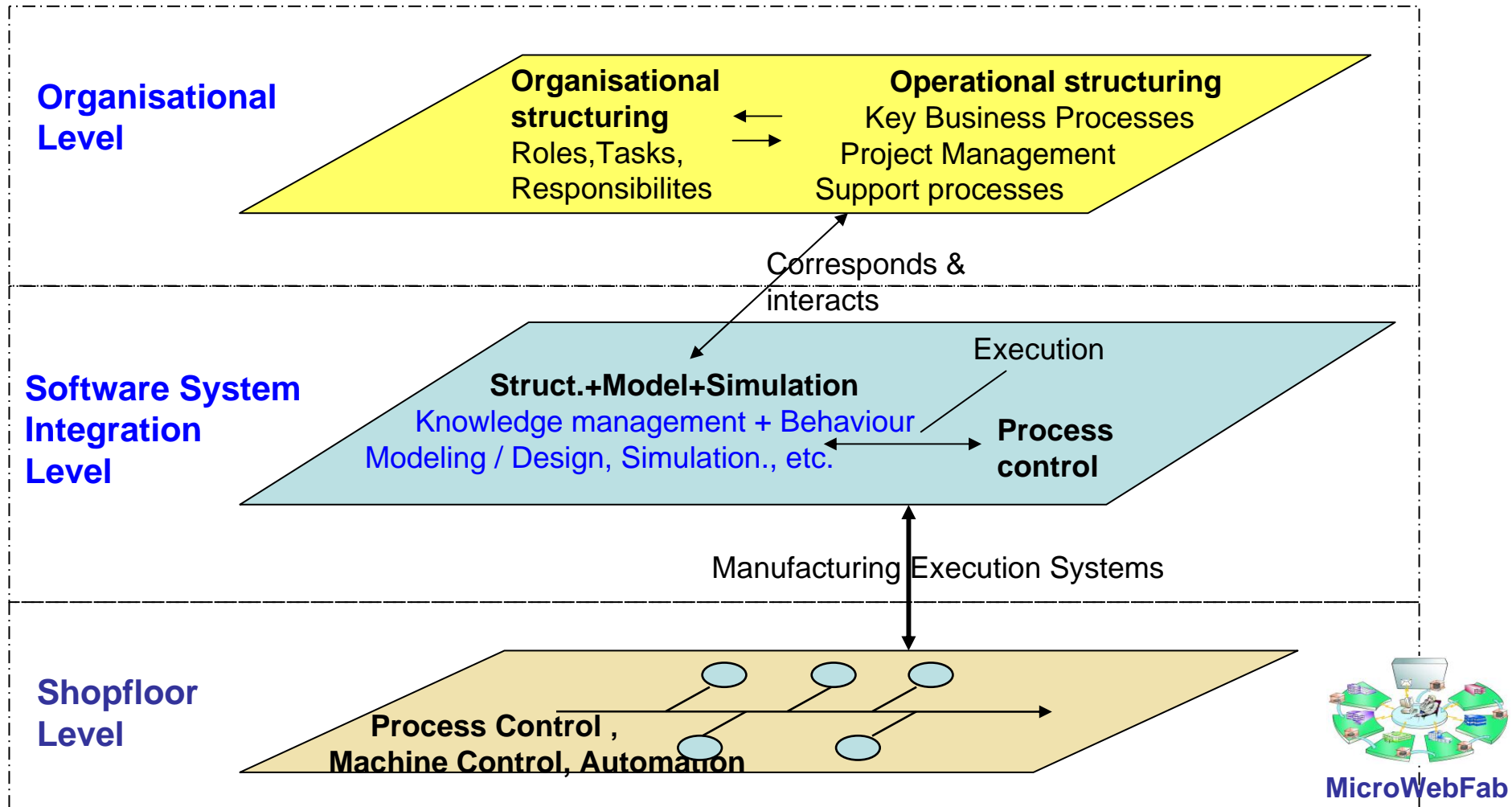
Microsystem specifications usually are not bound to specific technologies
Distinction between SI- and Non SI-technologies is irrelevant for the customers

An established „standardized“ approach for product development and technology selection across the SI/Non-SI-boundary is not available so far

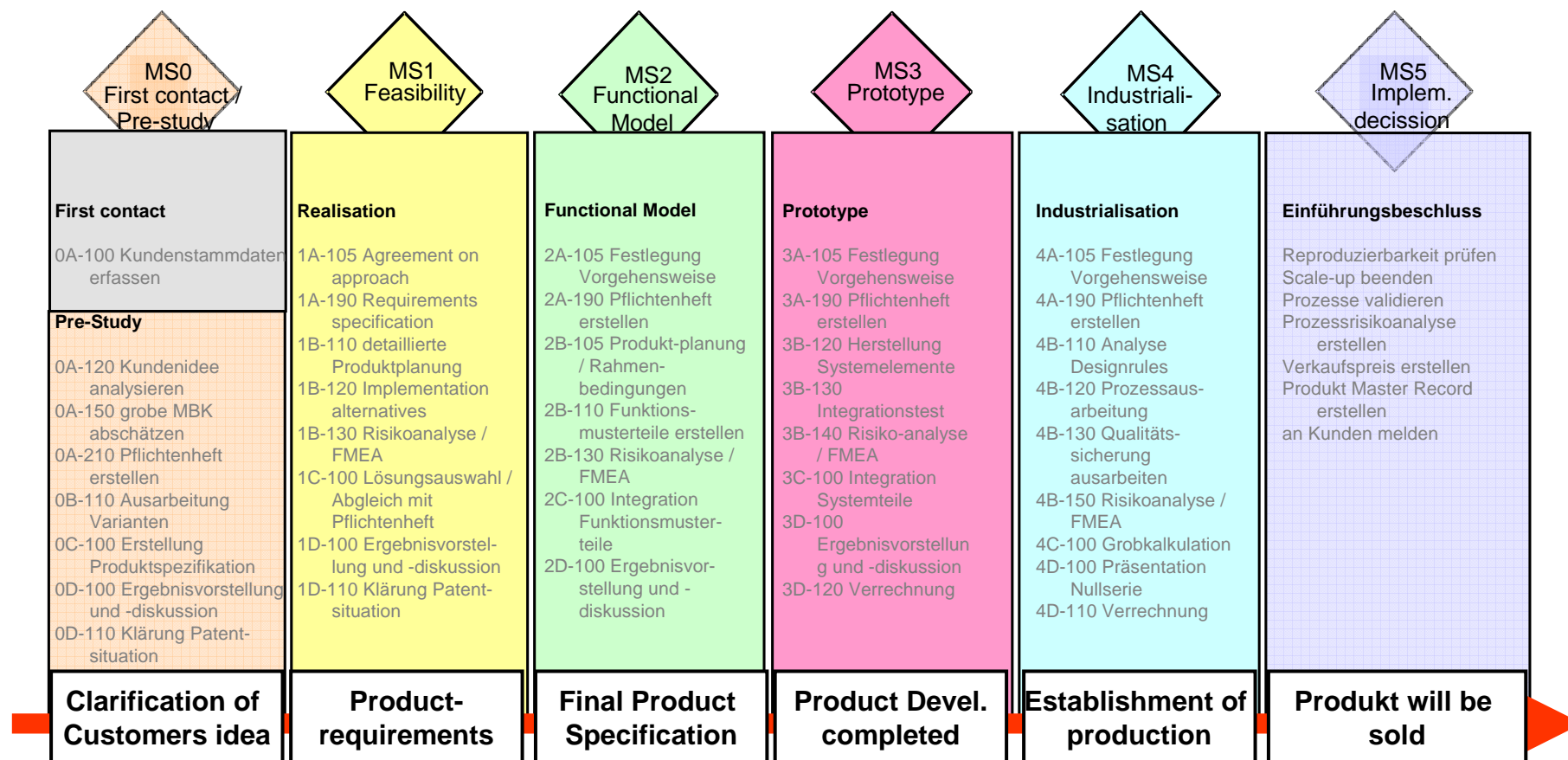
⇒ To overcome present limitations, an integrated Knowledge Management approach for Microsystems Technology is required, which includes relations between product, production, technologies, economic issues and allows for a better comparability of technologies



From Business Process to Shopfloor - Vertical Levels of a Company's Product Development Process



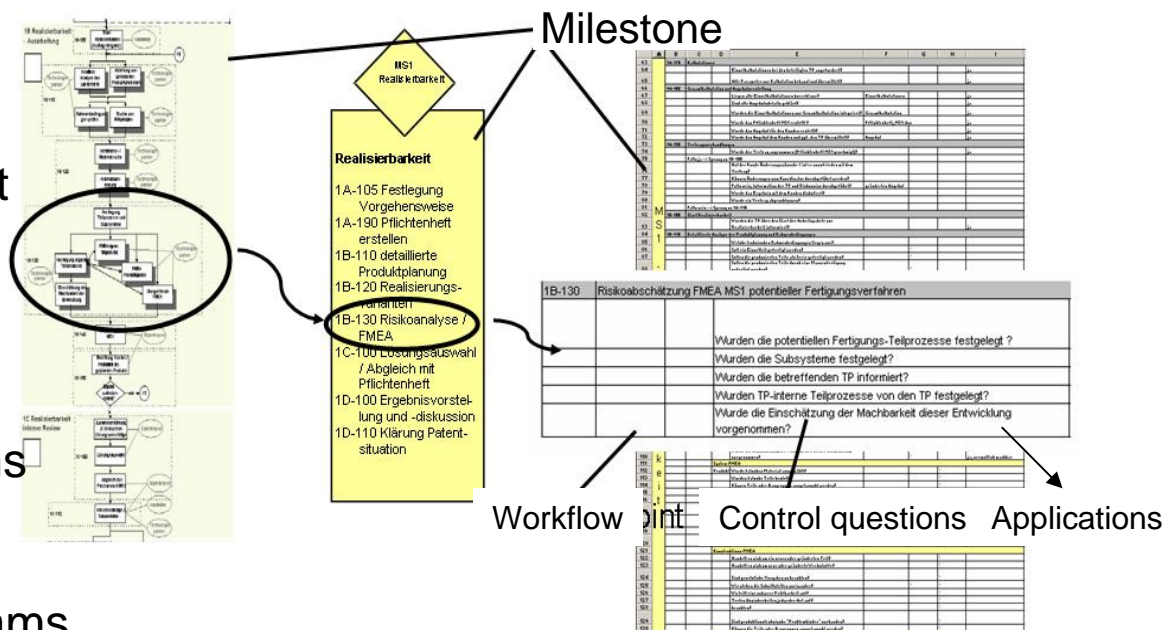
Design Control and Commercialisation Guidelines as basis for a development and industrialisation



Development Process at Business Process Level

- Process oriented Knowledge management
- Supporting project management

- Procedure Models
- Information Systems
- Design Rules
- Project tracking for heterogeneous Teams



Derivation and documentation of Business Rules
 Design & Industrialisation Guidelines
 for the product development process

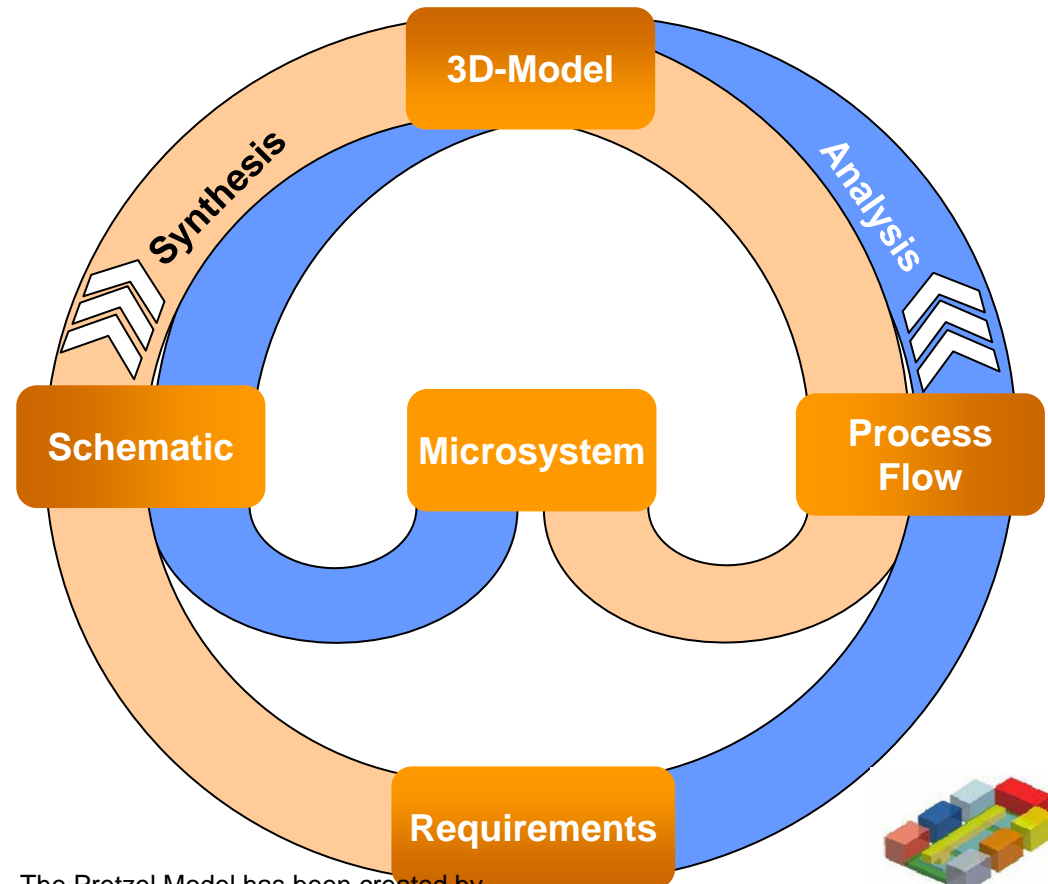


MicroWebFab



Project Management on technological level: The Pretzel Model for MST-Design

- Concurrent top-down and bottom-up-flows
- **Blue flow:** bottom up
 - Design of process (step) sequences
 - Building micro/nano structures taking technological constraints into account
- **Pink flow:** top-down
 - Creating schematics and layouts (making use of mixed-domain models)
 - To be checked against the process constraints



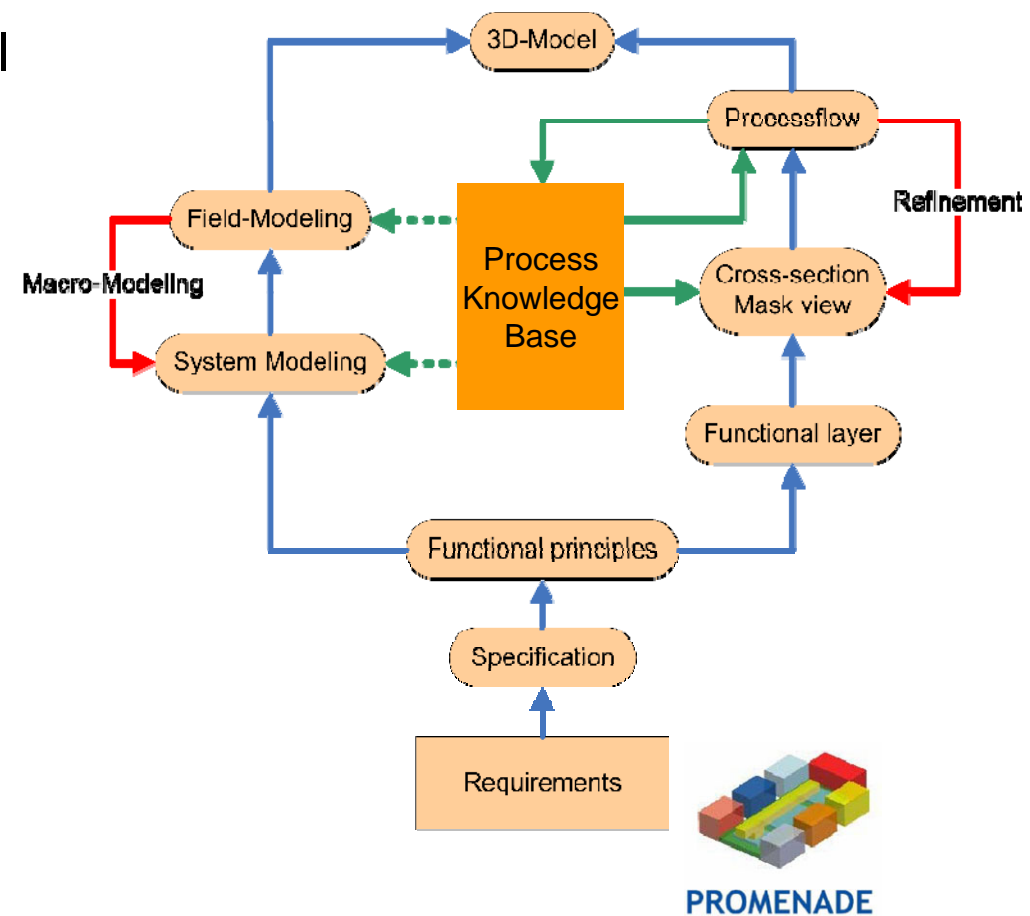
The Pretzel Model has been created by
Dr. Kai Hahn and Dr. Andreas Wagener
at University of Siegen, Germany



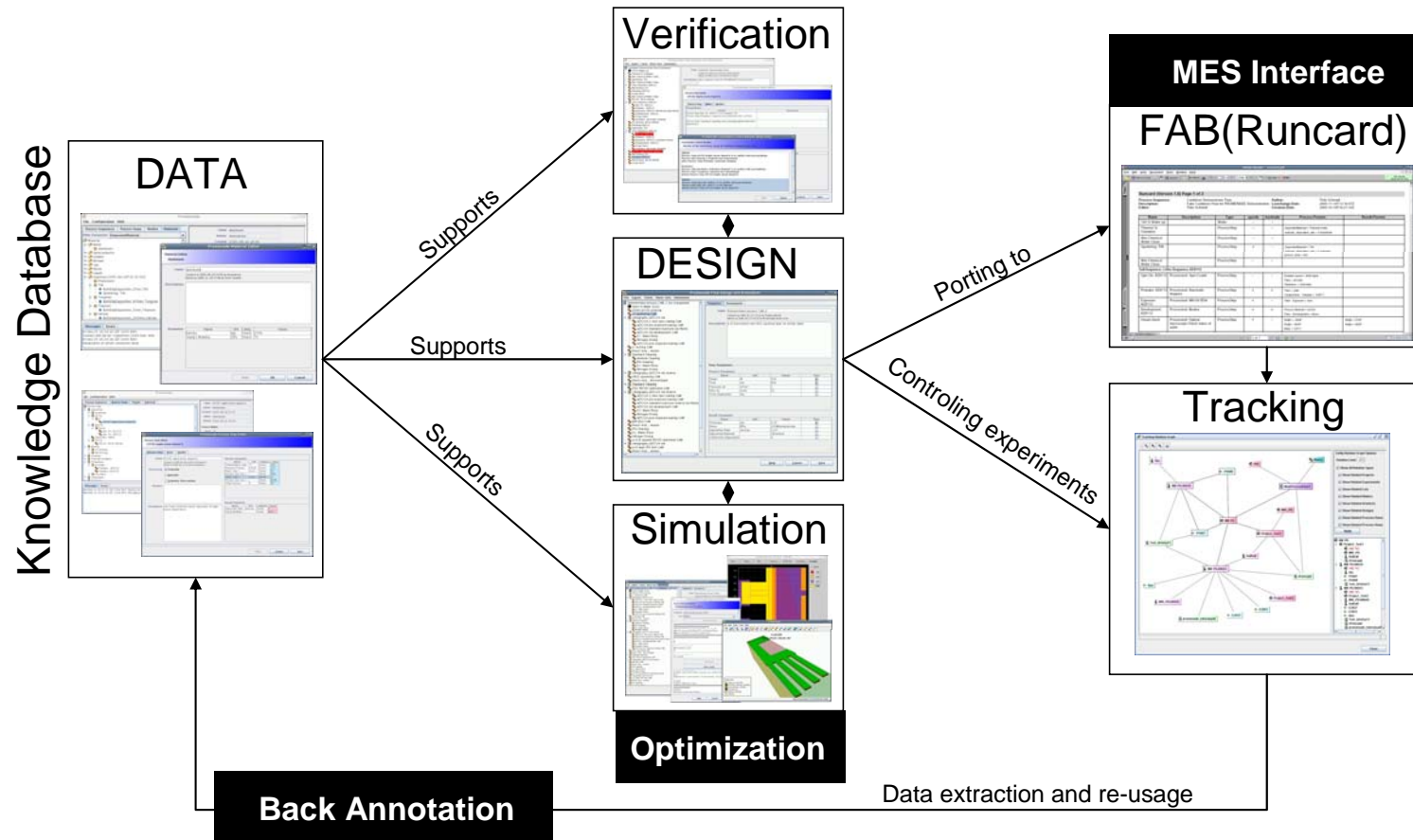
PROMENADE

Process Management Flow

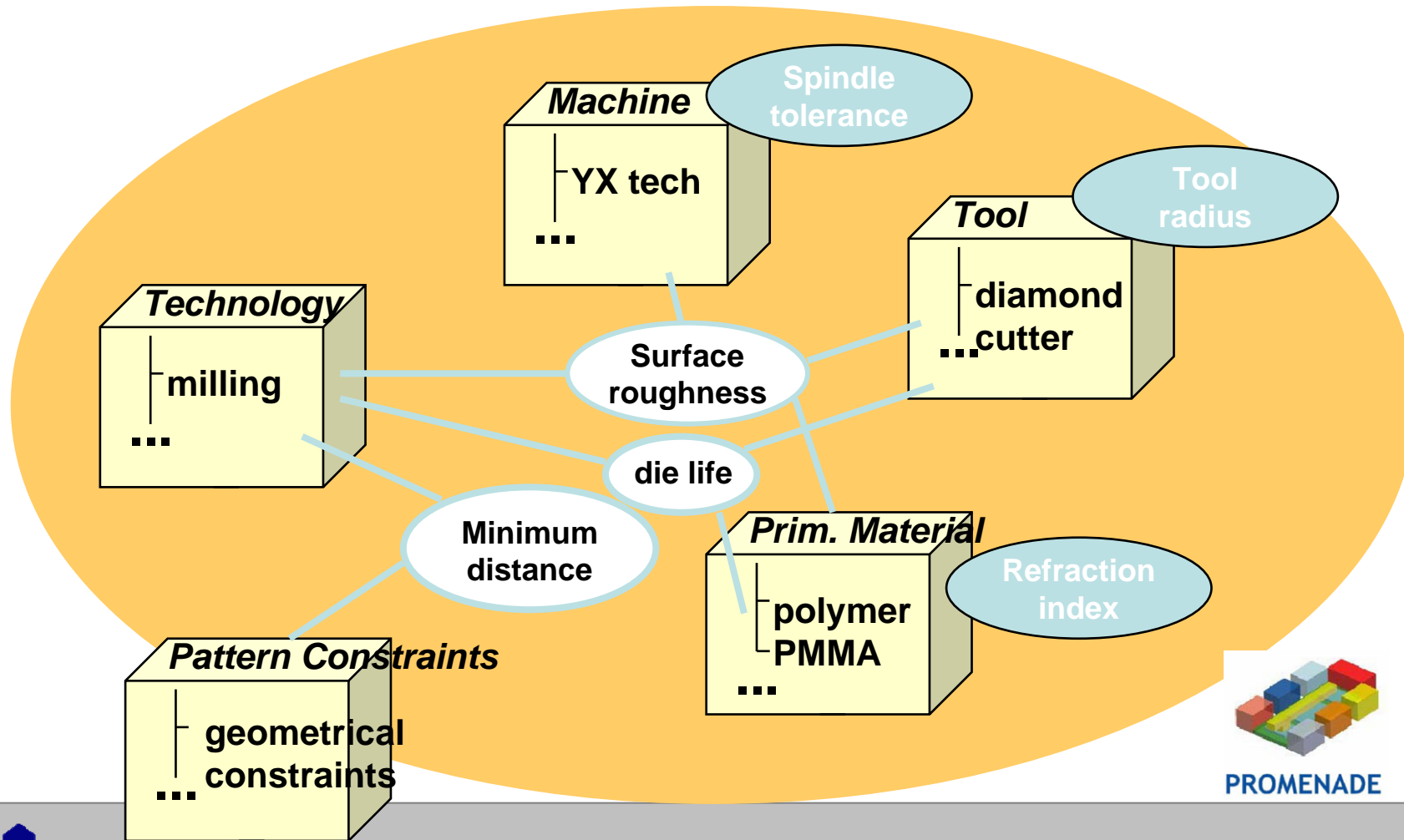
- Implementing the bottom-up flow of the Pretzel model
- Keeping all relevant process data in a comprehensive Process Knowledge Base
- Addressing
 - micro/nano product designers and design tools
 - process designers and design tools
- Offering tools to handle process data



Example: Process Management Flow using PROMENADE



Structuring Approach “Competences” and “Process steps”

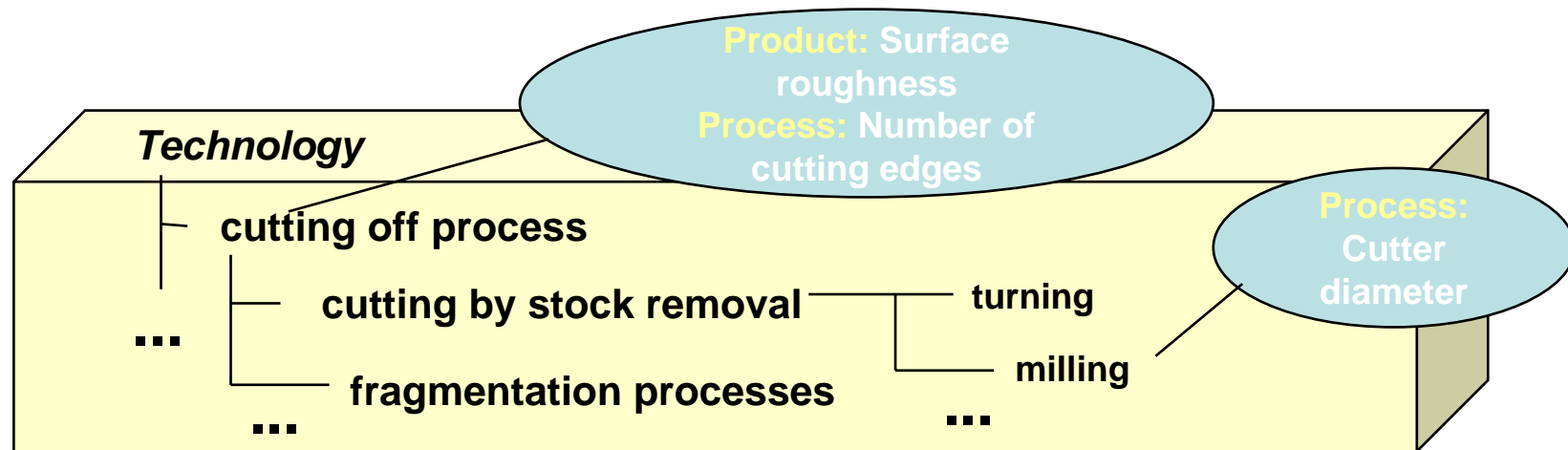


ProWiDa

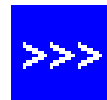


Structuring Approach Process Knowledge Base

Process step = a combination of relevant technological aspects representing a company's competence



Hierarchical tree:
inheritance, specification of parameters' values and definition
of new parameters for every technical aspect.



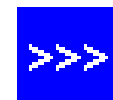
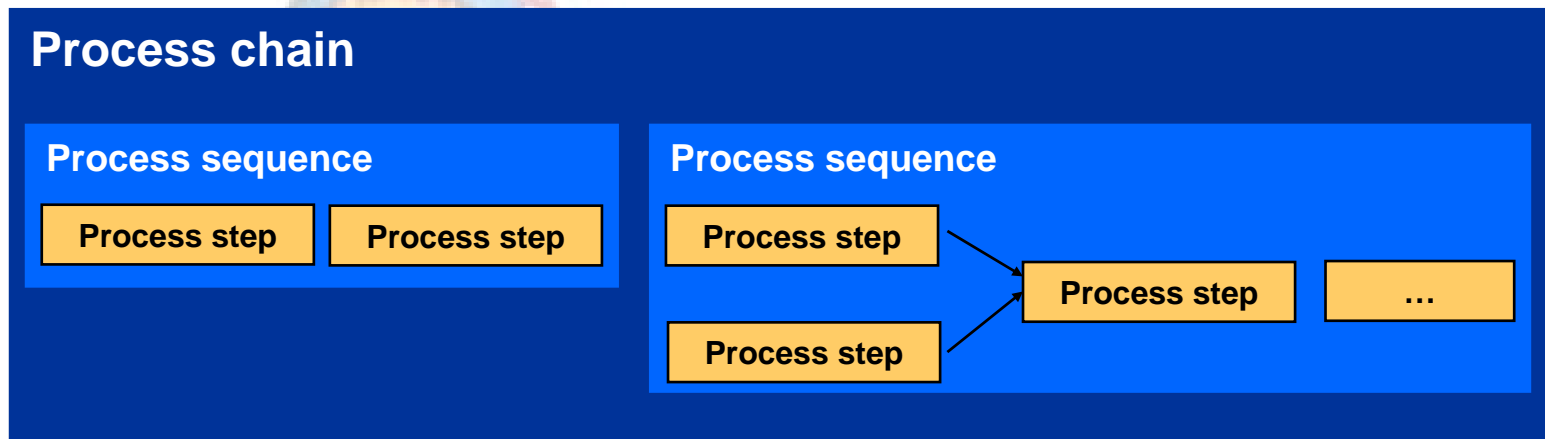
ProWiDa



Process Modelling Approach

Process - Modularisation

The Matruschka Principle: Process steps are combined to process sequences, that additionally can be linked to form a process chain.



PROMENADE

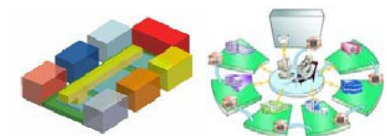
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Product and Process Simulation

Fabrication-Simulation

- **Simulation as a virtual fabrication scenario**
 - **Available today**
 - Off-the-shelf simulation tools as a basis
 - e.g. device simulation, process step simulation, FEM, FDM, ...
 - **Challenge**
 - Simulating a complete process chain
 - Combining various simulation modes and various levels of abstraction related to different technological and business domains
 - Problem: Interfacing of given simulators as appropriate
 - Integration of economical and technological aspects

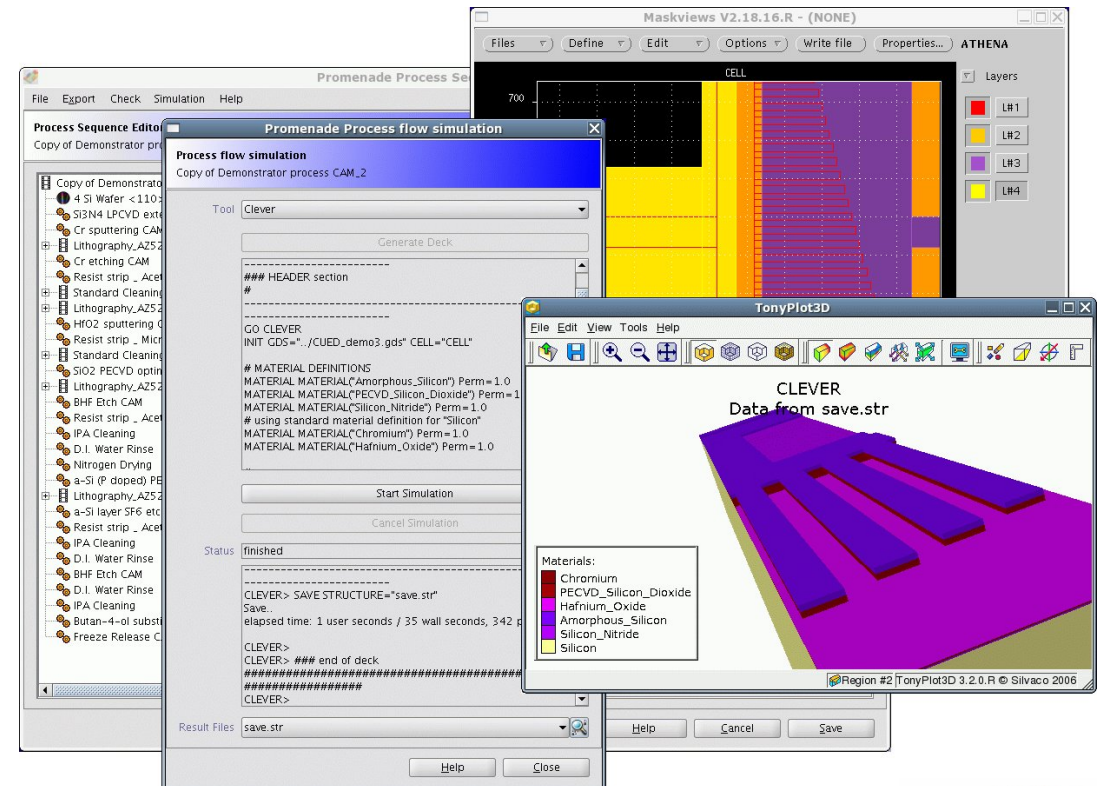


PROMENADE MicroWebFab



Example I: Integration in a (technological) product modelling and design environment

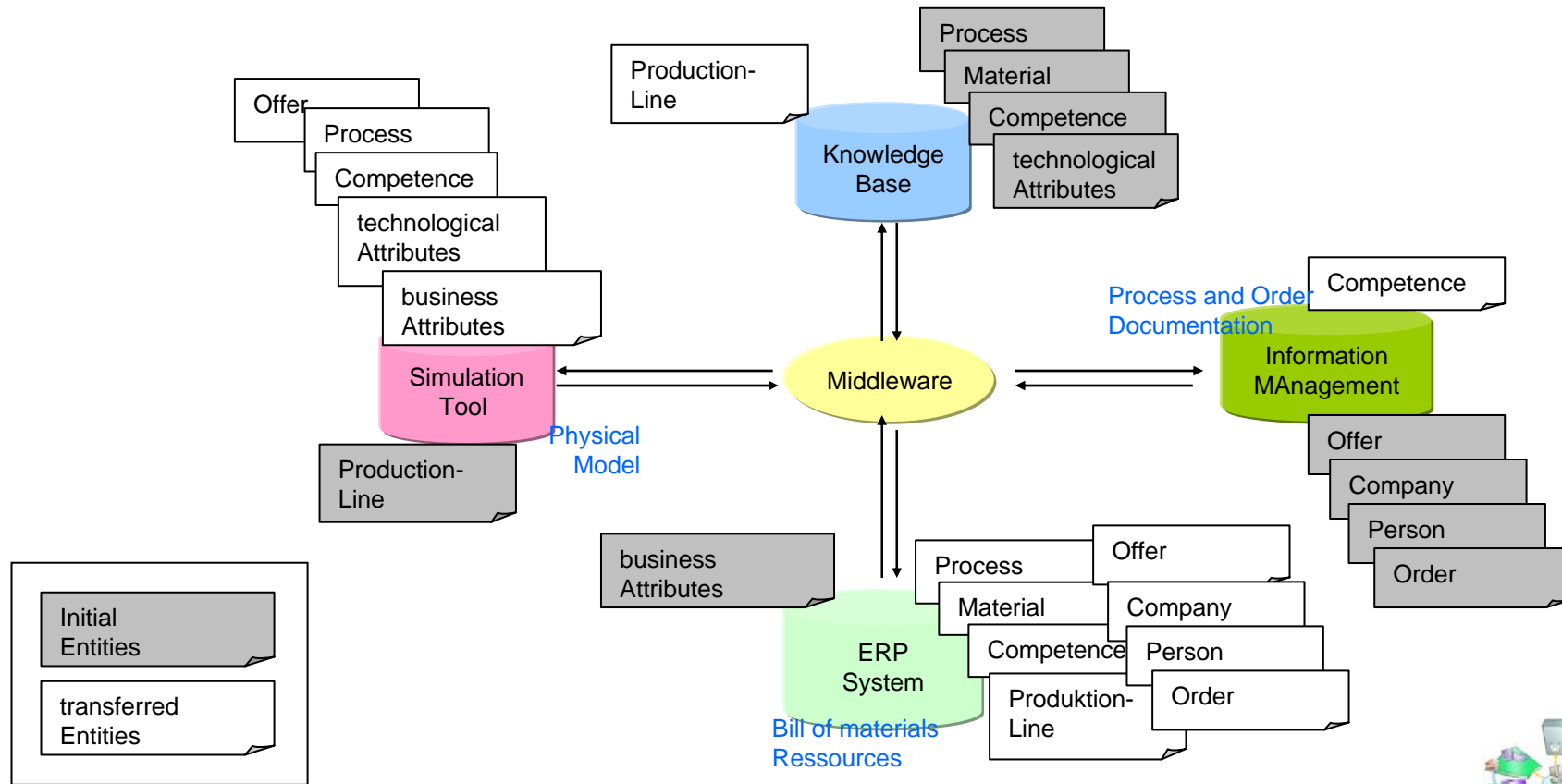
- PROMENADE knowledge base
 - Complete process knowledge covering
 - Process steps
 - Process step sequences
 - Materials
 - Machines
 - Effects
 - **Models**
 - Interfacing and control of simulation tools
 - e.g. SILVACO tools
 - TU Vienna tools



PROMENADE



Example II: Integration in a company's cooperation environment - The ProWiDa Scenario



Relation between costs and technological competences



Summary

- Integrated organisational and technological Approach is mandatory to overcome present limitations in MEMS Design & Simulation
 - Joint Approach for knowledge management of SI+NonSI is overdue
 - Interaction between product requirements and technological capabilities
 - Integration into a company's business environment
- Highly relevant for SMEs (networks) as an adequate solution to provide knowledge based support for product and production planning as a basis for new business models in European MST
- First solutions available by ProWiDa and PROMENADE (XperiDesk by Process Relations GmbH)
- Much more work still net to be done!



Thank you very much for
your kind attention!

