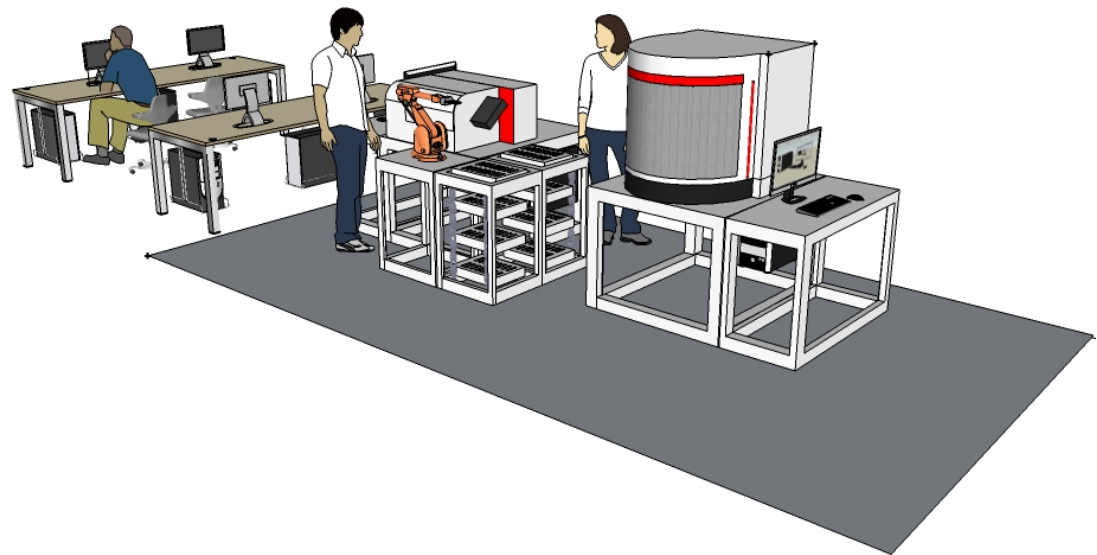

Integrated, scalable Concept of a Learning Factory

at the Faculty of Mechanical and Industrial Engineering,
Vienna University of Technology



Prof. Wilfried Sihm (Institute of Management Science/Fraunhofer Austria)

Vienna University of Technology – Faculty of Mechanical and Industrial Engineering

Vienna University of Technology (TU Vienna)

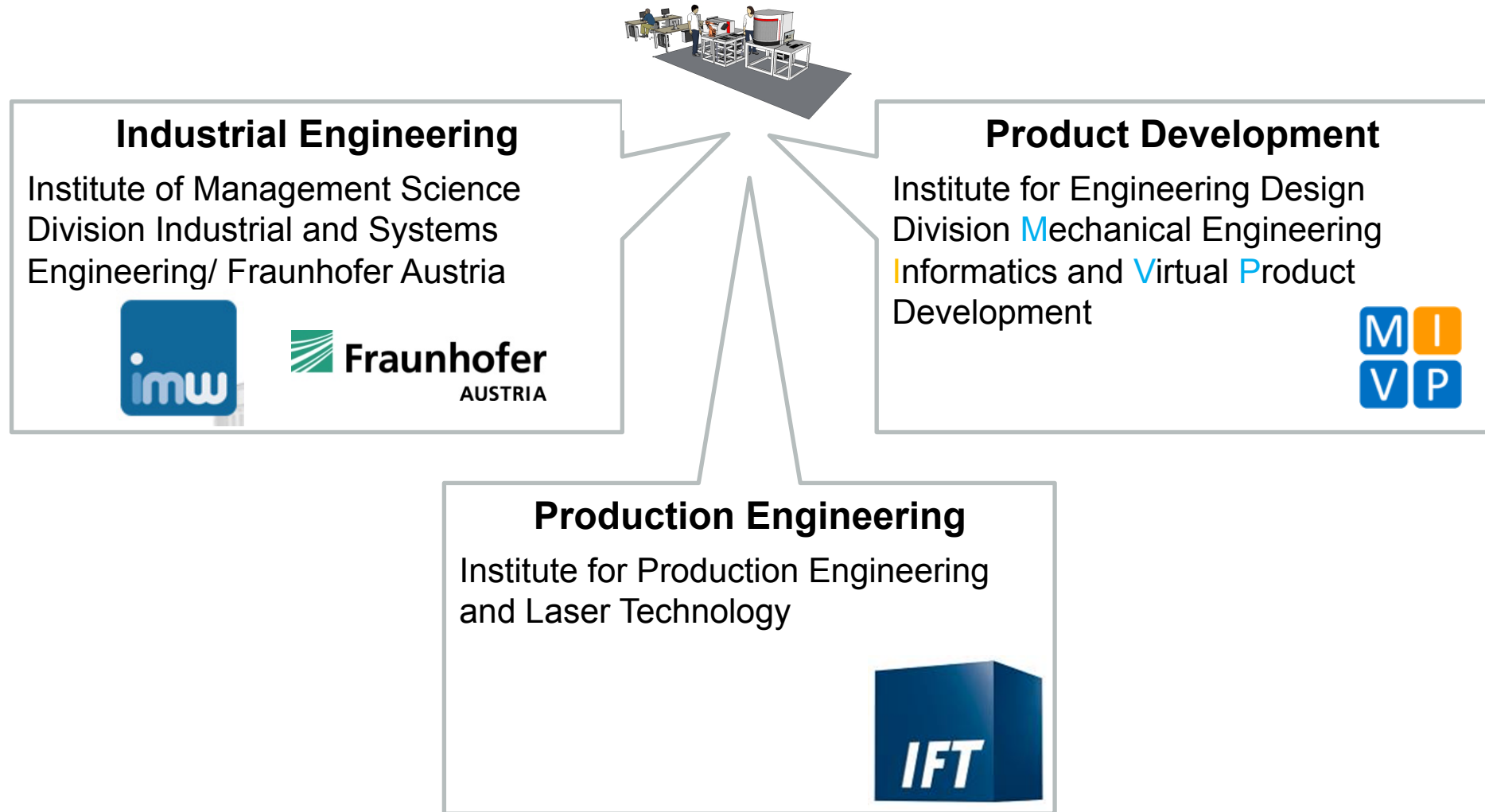
- Rector: O.Univ.-Prof. Dr. Peter Skalicky
- Founded in 1815
- 8 faculties, 4.105 employees
- Students: ca. 23.000 (23% international)
- Budget: >260 Mio. € (2009)
- Degree programs: 21 Bachelor, 43 Master



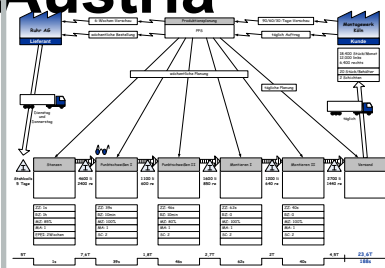
Faculty of Mechanical and Industrial Engineering

- 9 Institutes
- approx. 600 first enrolments in Mechanical Engineering and Industrial Engineering (2009)

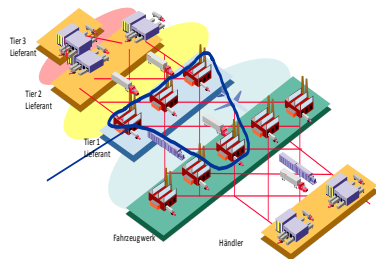
Faculty-wide learning factory through cooperation of:



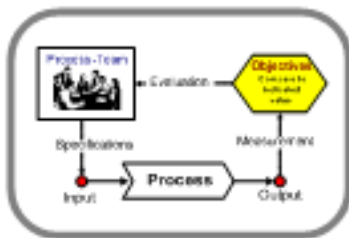
Austria



- Lean Management/Value Stream Mapping
- Production Networks, Factory Planning, Energy efficient production
- Optimization of Production & Assembly, Maintenance
- Holistic planning and controlling procedures



- Lean Logistics, Sustainable Logistics
- Material flow planning, Build-to-order strategies
- Transport Logistics, Cooperative logistics models
- Supplier Parks, Supplier Management, Agile Supply Chains



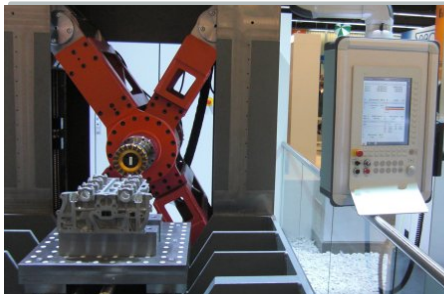
- Lean Administration, Lean Process
- Process management, Process evaluation and -controlling
- Order processing optimization, Simulation-based Process Analysis
- Performance enhancement in administrative functions

Institute for Production Engineering and High Efficiency Laser Technology



Technology and processes

- research in cutting technologies from micro to macro scale
- chemical and physical processes, like electrochemical milling
- research in innovative technologies for surface treatment



Production systems and control technologies

- research in new machine tool structures and components for high performance manufacturing
- innovations in versatile machine and control concepts



IT-supported production management and quality

- research in new concepts and implementation of manufacturing execution systems
- research in high precision metrology and quality assurance

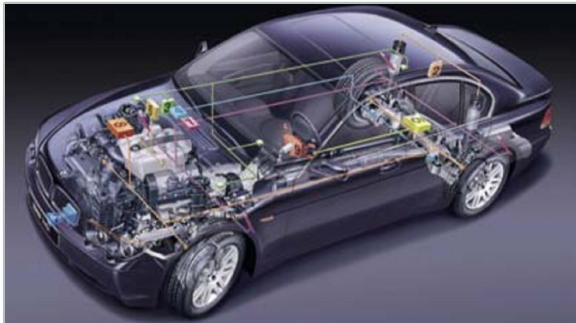
Institute for Engineering Design

M. Engineering Informatics and Virtual Product Development



IT- Tools for tasks and processes

- Engineering IT Applications e.g.: CAx, Calculation, Analysis, Simulation, Visualization/VR
- Industrial Information Systems e.g.: PDM, ERP



IT integrated in innovative products

- Mechatronic Products and Systems
- Product-Service-Systems (PSS)
- Methods for Integrative Product Development/ Systems Engineering

Research Focus

- Closed-Loop Product Data Management (PDM)
- Semantic Web Technology und Knowledge Management
- Software Usability and Visualization Technology

Integrated Scalable Learning Factory

Target and Unique selling proposition?

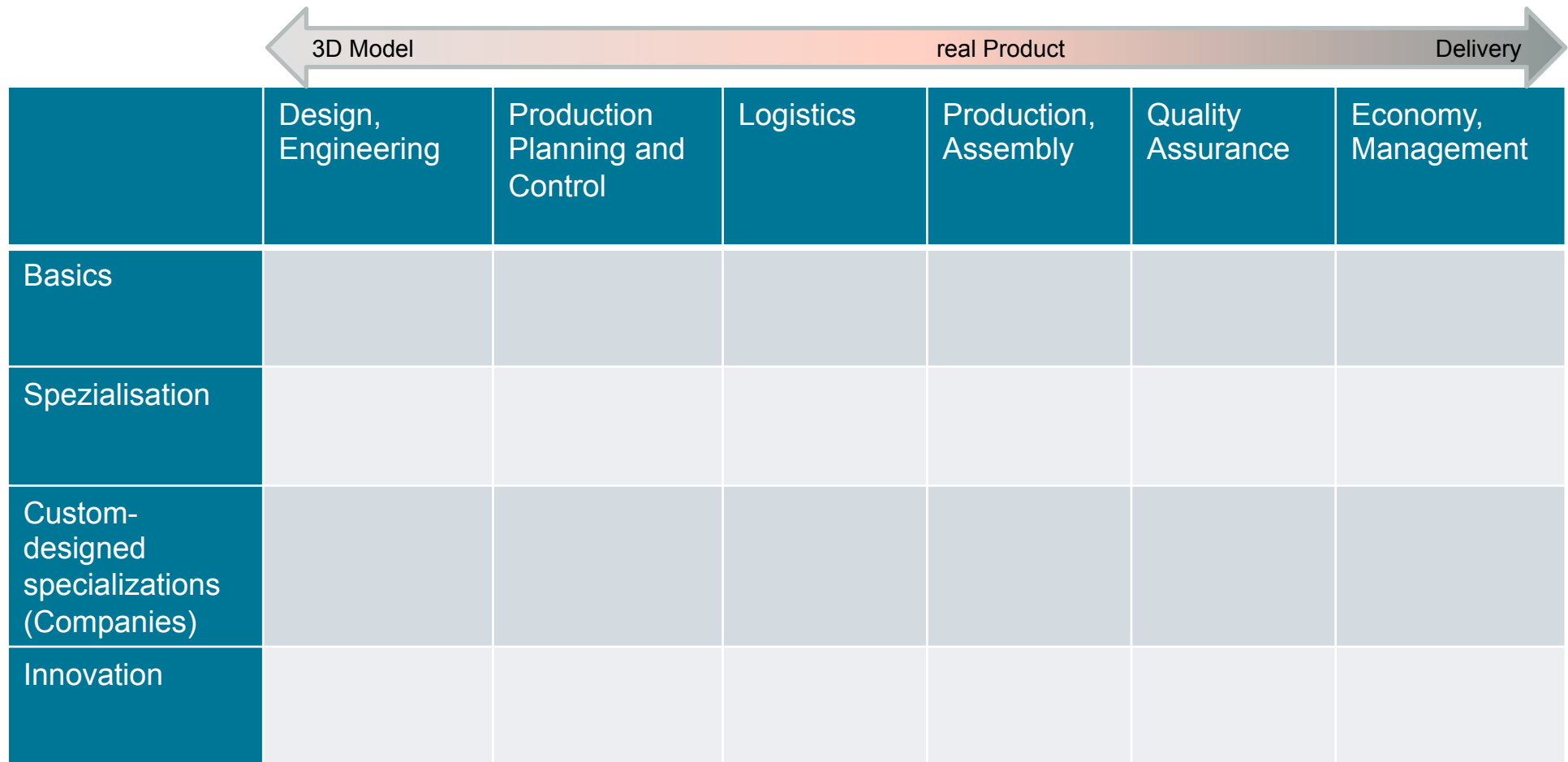
INTEGRATED Concept

- Competence of 3 Institutes
- In the integrated learning factory knowledge, skills and competences of participants (students and industry representatives) are increased in product management, design engineering, production management, project management and cost accounting for a certain project. They work in a team and deepen their knowledge.

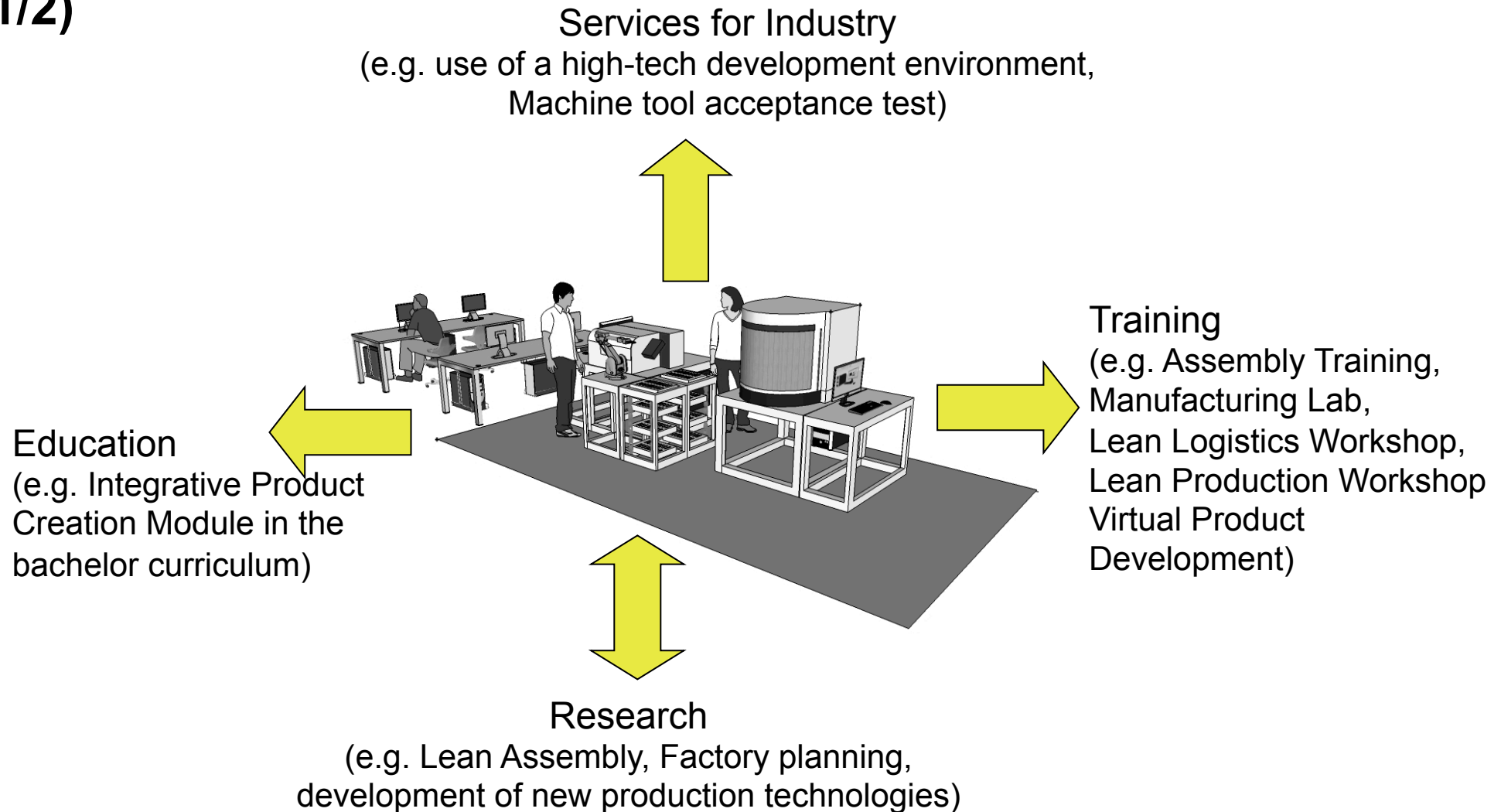
SCALABLE

- Different Depths of Training possible
- Basics – Specialization – Custom designed specialization for companies - Innovation

Order Fulfillment from Design to Product



Benefits in Research, Education and Industry Cooperation (1/2)



Benefits in Research, Education and Industry Cooperation (2/2)

- Platform for further education and trainings in industry, e.g. for postgraduate studies or in cooperation with companies
- Research and practical trial of new technologies and methods
- Communication interface between research and industries
- Testing field for students for checking and presenting results
- Continuous Support of the students in their education in various programs
- Continuous improvement and renewal of technologies

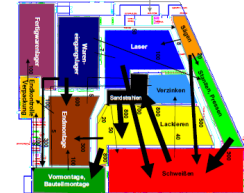
Existing education modules in Industrial Engineering

Assembly Training Cell

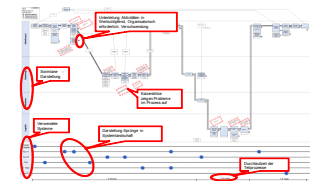


- Lean Basics
- Job Engineering
- Time Management tools

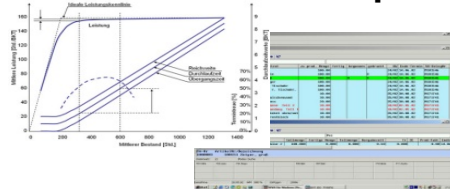
Lean Layout



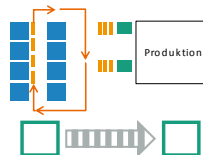
Lean Administration



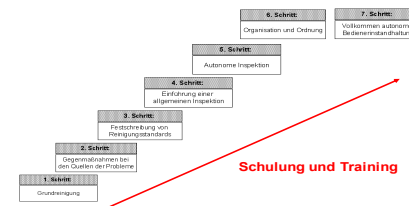
Production Planning and -control Workshop



Lean Logistics Workshop



TPM Workshop



	Design, Engineering	Production Planning and Control	Logistics	Production, Assembly	Quality Assurance	Economy, Management
Basics						
Spezialisierung						
Custom-designed specializations (Companies)						
Innovation						

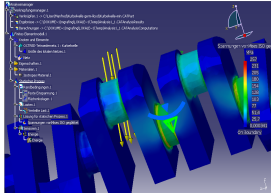
3D Model

real Product

Delivery

Existing education modules in Product Development

Engineering Design



- CAD
- CAE/FEM
- Parametric Design

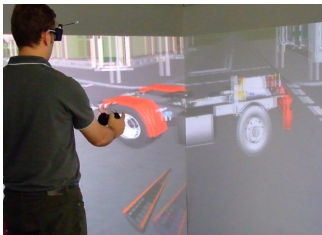
3D Model

real Product

Delivery

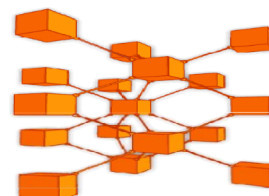
	Design, Engineering	Production Planning and Control	Logistics	Production, Assembly	Quality Assurance	Economy, Management
Basics						
Spezialisation						
Custom-designed specializations (Companies)						
Innovation						

Virtual Product Development



- Simulation
- Digital Mock-Up
- Virtual Reality
- Knowledge Based Design

Product Lifecycle Management



- Requirements
- Configuration
- Knowledge Management
- Life Cycle Analysis

Existing education modules in Production Engineering

NC-Technology



- NC-control
- Programming
- Simulation

Machine tool acceptance test



- Accuracy
- Metrology
- Acceptance test
- Compensation

	Design, Engineering	Production Planning and Control	Logistics	Production Assembly	Assurance	Management
Basics						
Spezialisation						
Custom-designed specializations (Companies)						
Innovation						

Manufacturing execution systems



- Master data
- Data acquisition
- Functionality
- Bill of material
- Implementation

Production automation

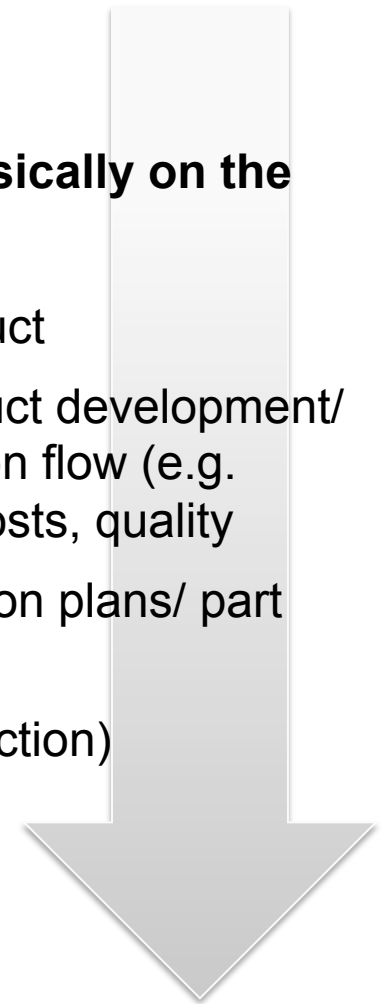


- Control systems
- Actuators
- Sensors
- NC-control
- Control concepts

Actual situation

Merge of the existing initiatives of the three institutes (partly physically on the existing laboratory location, partly in terms of information)

- Development of an integrated teaching concept with a certain product
- Regard of dependences in the product development process: product development/ design, simulation, production planning, production steps, production flow (e.g. lathing, milling, sawing, laser cutting), material supply, assembly, costs, quality
- Refining, adjusting and merging of existing systems (CAD, production plans/ part lists)
- Introduction of new technologies: (e.g. 3D-printer, generative production)



Further Steps of Development

- Integration of in-depth topics e.g. ECO DESIGN
- Concentration of activities in the newly build Vienna University of Technology Science Center
- Integration of further faculties with adjoining emphasis (e.g. informatics, construction engineering, electronics)

- Establishment of a modern high-tech innovation and application center as a „green field“ plan
- This should create a high-tech research environment that provides space for industry and university to develop innovative results
- Beside training and joint research projects, companies should have the possibility to create value in this high-tech environment

Initiative on European Learning Factories

- International exchange of knowledge and collaborative development of training content
- Synergies in the physical establishment of learning factories
- Leadership through innovative enhancements
- Main focus of the Learning Factory Vienna:
Integrated Product- and Production Engineering



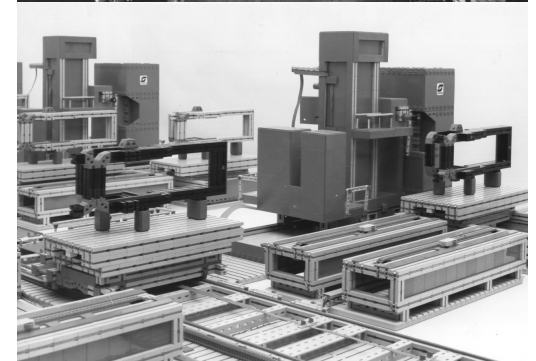
Initiative on European Learning Factories

■ Founding Members, Darmstadt, May 20th 2011

	Institute of Production Management, Technology and Machine Tools (PTW) Technische Universität Darmstadt		Institute of Management Science Vienna University of Technology
	ESB Business School Reutlingen-University		Institute of Production Engineering and Laser Technology Vienna University of Technology
	Royal Institute of Technology		Institute for Machine Tools and Industrial Management Technische Universität München
	Laboratory for Manufacturing Systems & Automation Department of Mechanical Engineering and Aeronautics		Center for Integration and process Innovation
	Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture		The Computer and Automation Research Institute, Hungarian Academy of Sciences In cooperation with Budapest University of Technology and Economics

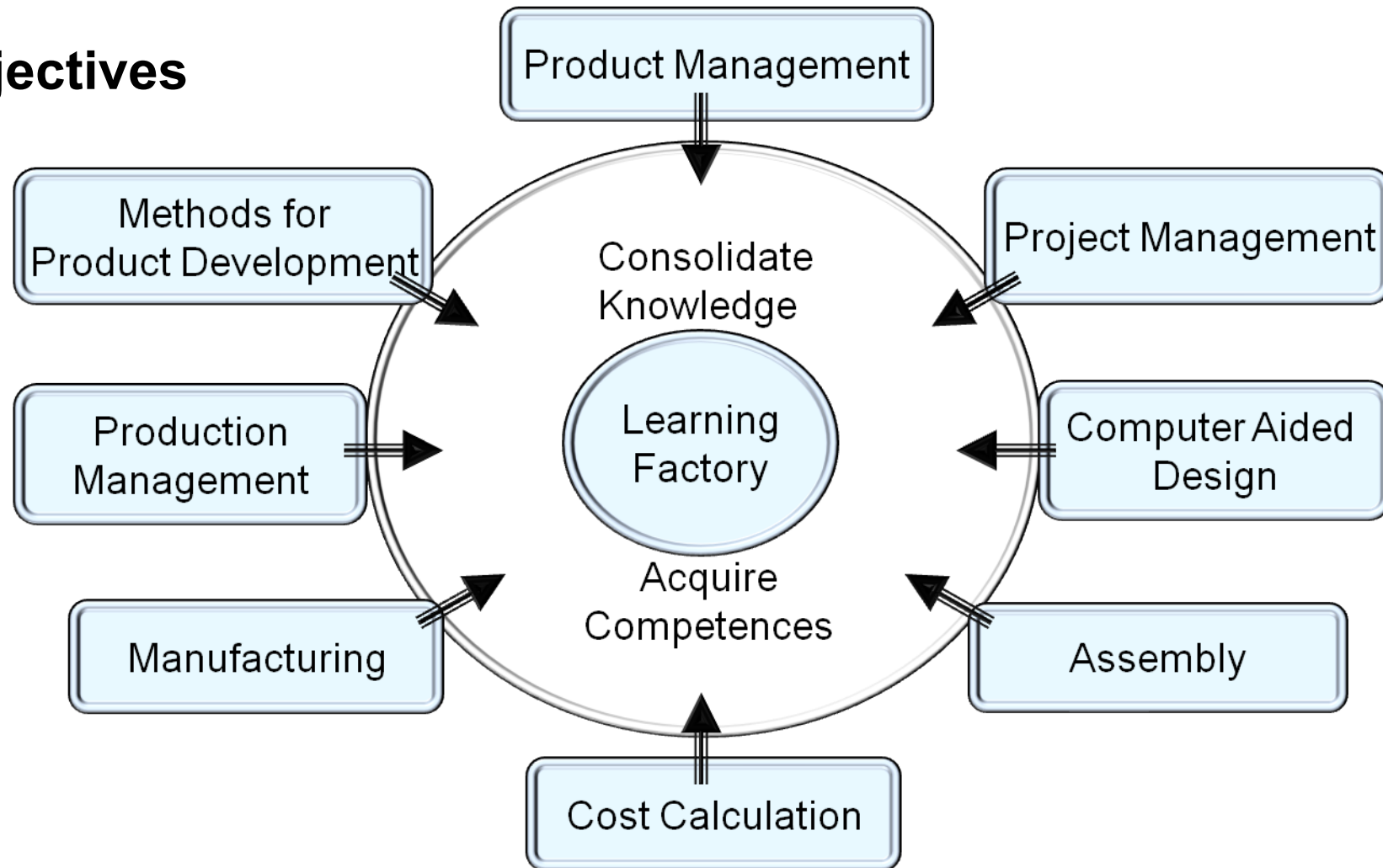
Motivation for a new Learning Factory

- Design of new curricula for bachelor studies "Mechanical Engineering" and "Industrial Engineering"
- Demand for occupational qualification
- Requirements specified by Industry (collected prior to curriculum design) lead to project- and problem based learning
 - By working together in groups, students learn communication skills, share knowledge and develop a sense of responsibility towards others
 - Knowledge integration between courses will improve. Students acquire an integrated view on the design and manufacturing process (due dates, costs, availability of resources)
 - Makes learning more enjoyable



Learning Factory in the new bachelor curriculum

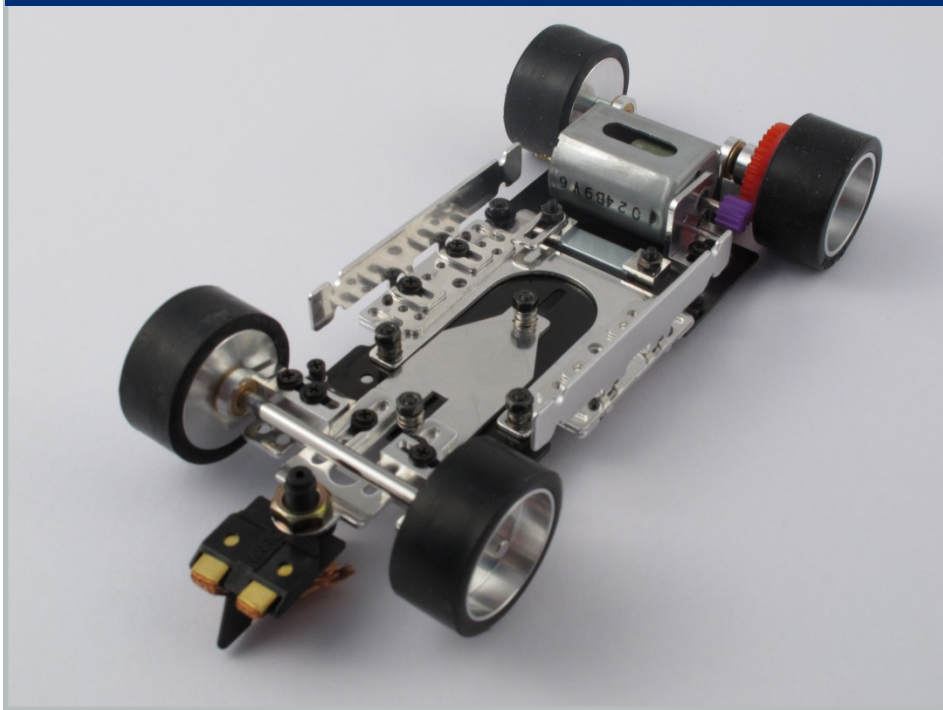
Objectives



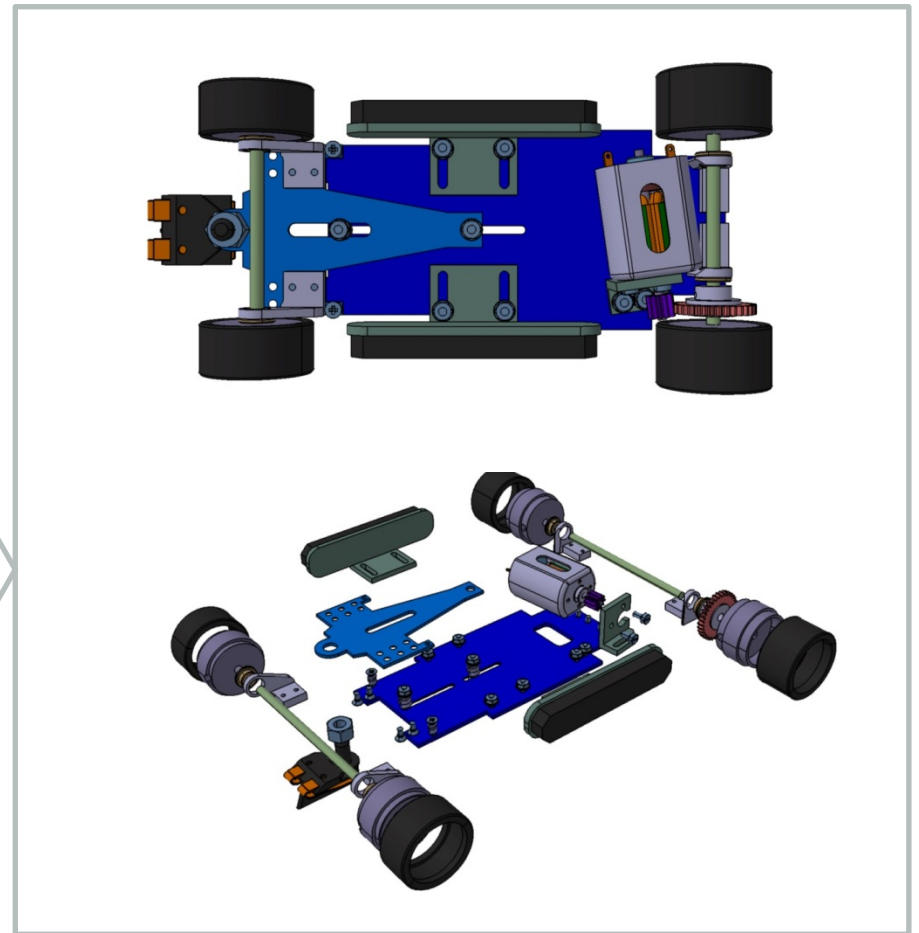
Learning Factory in the new bachelor curriculum

Product

real slotcar as initial point of work



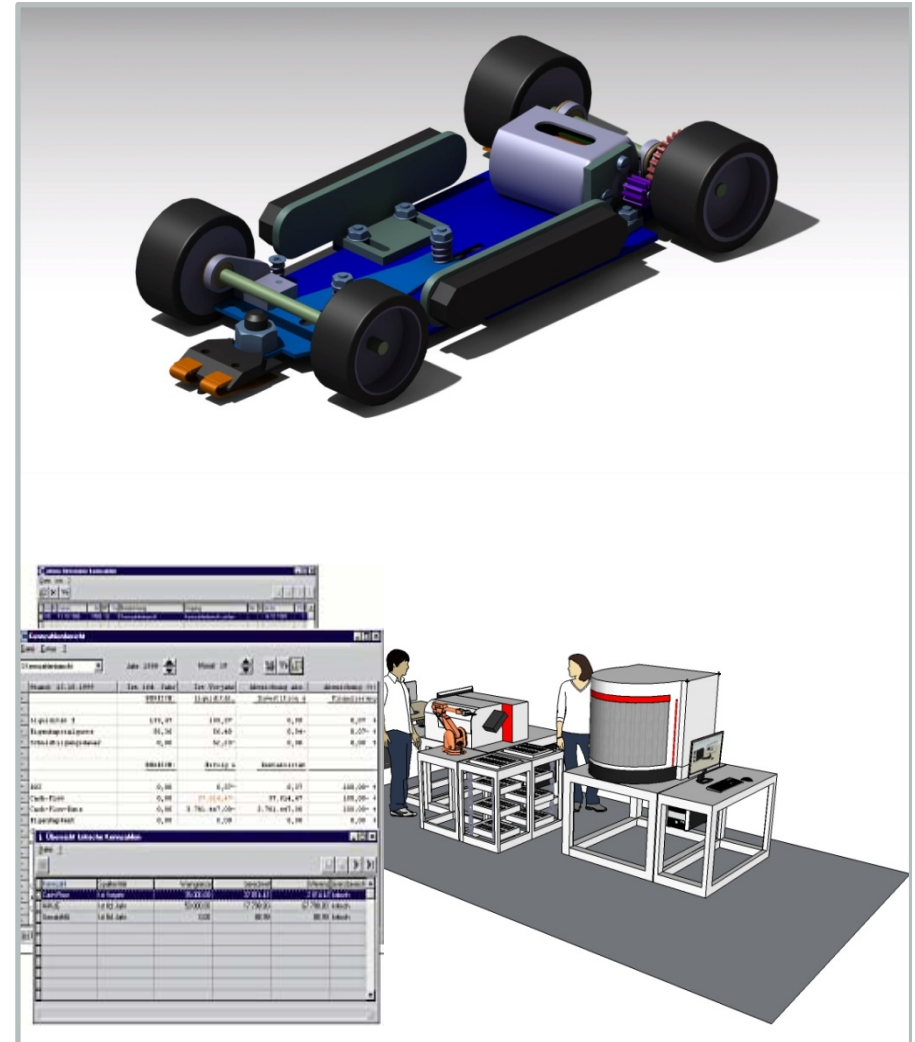
Re-designed slotcar



Learning Factory in the new bachelor curriculum

Project work

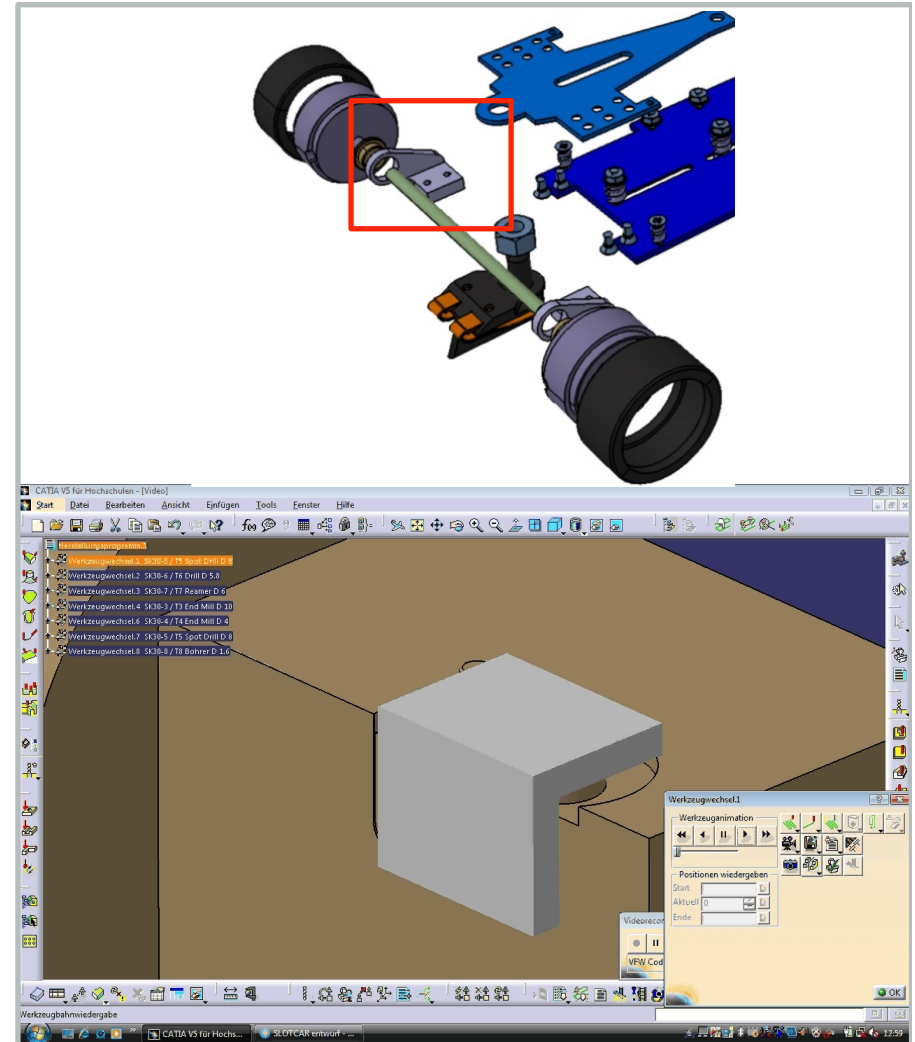
- An existing product (slot car) has to be improved by the students
 - Target: e.g. reduction of manufacturing costs
- Product analysis, definition of measures (make-or-buy decisions, reduction of parts, reduction of assembly operations, improvement of manufacturing methods etc.)
- Design of modified parts according to given constraints and CAD assembly including purchased parts



Learning Factory in the new bachelor curriculum

Project work

- Fabrication planning (selection of machine tools, operations, tools, fixtures), NC-programming and simulation using CAM
- Assembly planning (subassembly, final assembly, operations, fixtures, tools etc.)
- Preliminary calculation
- Manufacturing of parts, assembly (provision of tools and fixtures, set up of machine tools)
- Product costing analysis



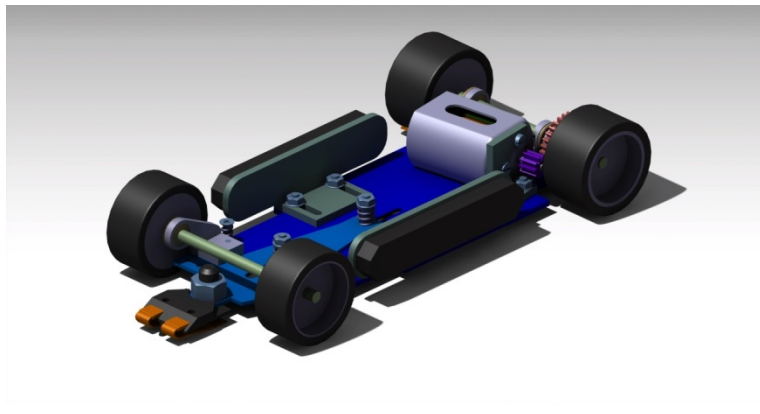
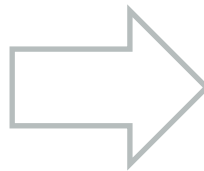
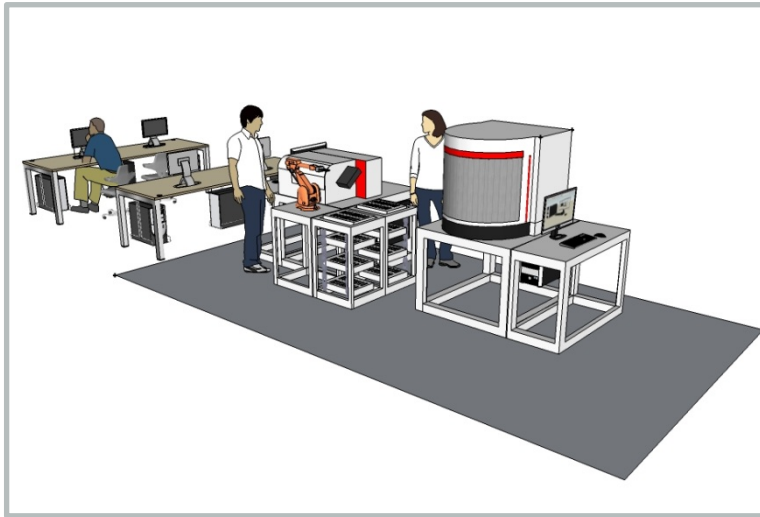
Learning Factory in the new bachelor curriculum

Project work

- Software tools: CAD, PDM, CAM, simulation
- Technologies:
 - NC Turning, Milling, Drilling and Laser Cutting
 - Rapid Prototyping
 - Concept models
 - Functional and visional prototypes
 - Fixtures
 - Product mockups

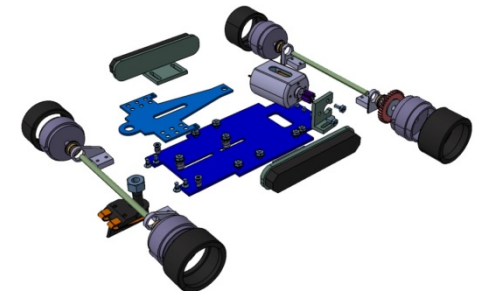
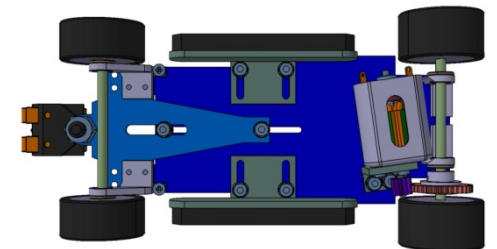
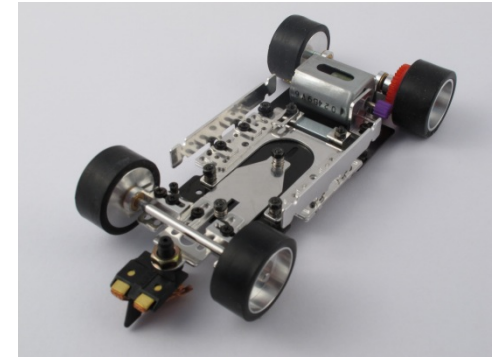


Learning Factory – Production Engineering Equipment



Learning Factory in the new bachelor curriculum

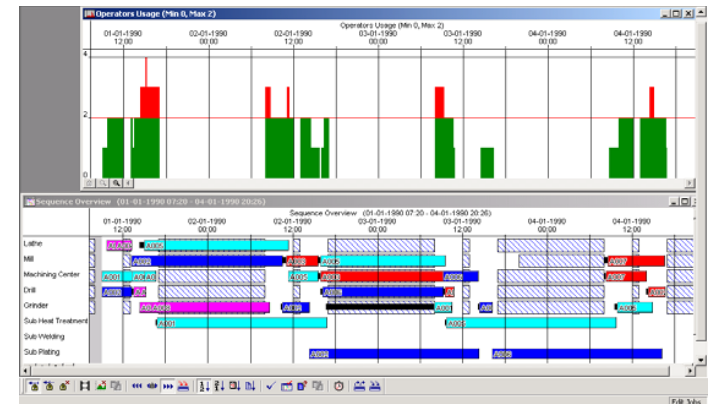
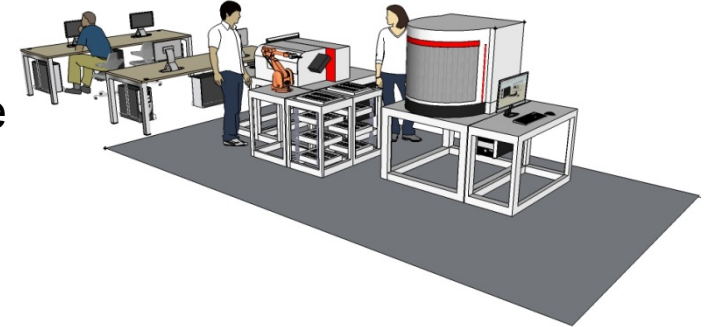
Field test



Learning Factory in the New Bachelor Curriculum

Future topics

- Further integration of Design and Manufacture (Feature Based Modeling)
- Support of design and manufacturing processes by integrated business software
 - Master Data
 - Bill of Material
 - Operations
 - Demand and Requirements Management
 - Purchasing
 - Production
 - Costing
- Adaptable automated manufacturing systems
- **Second level learning factory:** Pilot Factory for Innovation and Application in Production Engineering (real production company)



2nd Conference on Learning Factories May 10th 2012 Vienna University of Technology, Austria

First Announcement

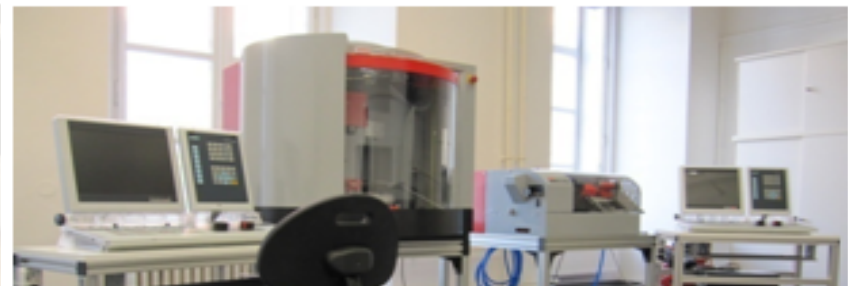
Competitive Production in Europe through innovation and training

Invitation and Scope

We cordially invite you to participate in the 2nd Conference on Learning Factories, held in Vienna, Austria. This Conference offers you the opportunity to visit Vienna, the "City of Culture" in the heart of Europe!

The objective of this conference is to show, how companies can be supported by Learning Factories in educating their staff and in creating high-tech research environments that provide space for industry and research institutions to develop innovative results.

With the support of Learning Factories the efficiency and the competitiveness of the European production companies can be increased.



Contact Persons

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Institute of Construction Science and Technical Logistics

Univ.-Prof. Dipl.-Ing. Dr.-Ing Detlef Gerhard

detlef.gerhard@tuwien.ac.at Tel: +43 1 58801 30722