2nd Conference on Learning Factories

Competitive production in Europe through education and training

May 10th 2012
Vienna University of Technology

Content

Hosting Institutes

Institute for Management Science
Industrial and Systems Engineering
Fraunhofer Austria Research GmbH
Prof. Dr. Wilfried Sihn

Institute for Production Engineering and Laser Technology
Prof. Dr. Friedrich Bleicher

Institute for Engineering Design and Logistics Engineering
Prof. Dr. Detlef Gerhard

Univ.-Prof. Prof. eh. Dr.-Ing. Dr.h.c.Dipl.-Wirtsch.-Ing. Wilfried Sihn

Univ.-Prof. Prof. eh. Dr.-Ing. Dr. h.c.
Dipl.-Wirtsch.-Ing. Wilfried Sihn
Conference Chairman

Head
Fraunhofer Austria Research GmbH
Division Production and Logistics Management

Vienna University of Technology
Institute for Management Science
Division for Industrial and Systems Engineering

DEAR LADIES and GENTLEMEN,
DEAR COLLEAGUES,

How can competitive production be secured in Europe?
Which role does education or training play in this context?

The 2nd conference on Learning Factories helps to answer these questions. It provides the possibility to exchange experiences and to discuss individual criteria as well as potential and outcomes of Learning Factories.

Therefore, it is a great pleasure welcoming you to Vienna!

Kind regards

Agenda

09:00	Opening of the conference Rector of the Vienna University of Technology, Prof. Sabine Seidler Chairman: Vice president of the "Initiative on European Learning Factories" Prof. Wilfried Sihn (Vienna University of Technology)		
Block I	**Universities**		
09:15	Session 1:	Potential of Learning Factories as education and innovation centres for universities and the production industry Speaker: Prof. Kurt Matyas (TU Vienna)	
09:45	Session 2:	Hands-on Training Center for Industrial Engineering in Higher Education Speaker: Prof. Jochen Deuse (TU Dortmund)	
10:15	Session 3:	5 years Process Learning Factory CiP at TU Darmstadt - Concept, Results,Experiences and still new Challenges Speaker: President of the "Initiative on European Learning Factories" Prof. Eberhard Abele (TU Darmstadt)	
10:45	Coffee break		
11:15	Session 4:	Green Factories Bavaria Speaker: Prof. Gunther Reinhart (TU Munich)	
Block II	**Industry**		
11:45	Session 5:	Multi-Dimensional Networked Learning within the ESB Logistics Learning Factory – Innovative approach, teaching-learning concept and engineering project games Speaker: Prof. Vera Hummel, Prof. Harald Augustin (Reutlingen University)	
12:15	Lunch		
13:15	Session 6:	Learning shopfloor – continuous improvement Speaker: DI Rudolf Hamp (Opel Wien GmbH)	
13:45	Session 7:	Excellent Qualified and Trained Employees - The Key for the successfull implementation of Lean Production Speaker: DI (FH) Frank Werz, MBA	
14:15	Coffee break		
14:45	Session 8:	Sometimes cold or wide, sometimes fast or dark - boosting changeability by learning factories Speaker: Klaus Zimmermann (Festo Didactic GmbH)	
Block III	**TU Vienna Learning Factory**		
15:15	Session 9:	Education for the 21st century - impacts for teaching and learning Speaker:Dr. Markus Tomaschitz (Magna International Europe AG)	
15:45	Session 10:	Vision and implementation of the Learning and Innovation Factory of the Vienna University of Technology Speaker: Prof. Wilfried Sihn, Prof. Friedrich Bleicher, Prof. Detlef Gerhard (TU Vienna)	
16:10	Closing of the conference		
16:20	Transport to the Institute for Production Engineering and Laser Technology		
17:00	Visit and inspection of the Learning and Innovation Factory of the TU Vienna		
18:00	Transport back to the Vienna University of Technology		
19:30	Dinner event at the Vienna city hall		

O.Univ.Prof. Dipl.-Ing
Dr.techn. Sabine Seidler

TECHNISCHE UNIVERSITÄT WIEN
Vienna University of Technology

About TU Vienna
Our mission is "technology for people". Through our research we "develop scientific excellence", through our teaching we "enhance comprehensive competence". TU Vienna has eight faculties lead by deans: Architecture and Planning, Civil Engineering, Electrical Engineering and Information Technology, Informatics, Mathematics and Geoinformation, Mechanical and Industrial Engineering, Physics and Technical Chemistry. The University is led by the Rector and four Vice Rectors (responsible for Research, Academic Affairs, Finances and Controlling as well as Human Resources and Gender). The Senate has 26 members. The University Council, consisting of seven members, acts as a supervisory board.

Opening of the Conference

Block I
Universities

Block I I
Industry

Block I I I
Learning and Innovation Factory of the Vienna University of Technology

Ao.Univ.Prof. Dipl.-Ing. Dr.techn. Kurt Matyas

Univ.-Prof. Dipl.-Ing. Dr. Kurt Matyas, born in 1963 is professor at the Institute of Management Science – Division of Industrial- and Systems Engineering of the Vienna University of Technology since 2001. His research and teaching topics cover production management, logistics and maintenance. Kurt Matyas published more than 60 scientific articles and 4 books.

In addition to his teaching and research activities, Prof. Matyas is managing numerous research projects at the Vienna University of Technology and together with Fraunhofer Austria, he supervised applied research projects and consultancy projects with manufacturing companies.

He is dean for academic affairs at the Faculty of Mechanical and Industrial Engineering since 2008. He is also Vice President of the Austrian Association of Industrial Engineering & Management since 2006.

Fraunhofer Austria Research GmbH is performing applied and industry oriented research. Projects are dealing with the planning and optimization of the structure, organization and management of industrial and service enterprises or their logistics networks and is specialised in structuring and optimisation of production and logistics processes in a high-tech and highly automated environment. Special emphasis is given to the matching of IT systems with the requirements of operational domains in particular with respect to the organisation of socio-technological systems. FhA is co-operating with the Institute of Management Science of the Vienna University of Technology and maintains numerous contacts to industry, academia and research institutions in Western, Eastern and South-Eastern Europe.

Founded in 1815, the Vienna University of Technology is renowned for its long tradition. It finds high international and domestic recognition in teaching and research and as partner of innovation oriented enterprises. The Institute of Management Science / Department for Industrial Engineering and System Design (IMW) can offer expertise in the main areas such as Production Management & Logistics Management as well as Quality-, Process- and Product Management. Research concentrates on the processing of scientific findings for practical applications. Numerous positive results both in application-oriented research projects as well as industry projects proof the reliable methodological background of the department and form a broad basis of satisfied partners and customers.

Potential of Learning Factories as education and innovation centres for universities and the production industry

Potential of Learning Factories as education and innovation centers for universities and production industry

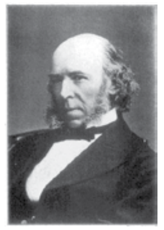
Prof. Dr. Kurt Matyas

Vienna University of Technology
Institute of Management Science
Industrial and Systems Engineering

Fraunhofer Austria Research GmbH
Division Production and Logistics Management

April 12

The great aim of education
is not knowledge
but action.



Herbert Spencer
(1820-1903)
British philosopher and sociologist

April 12

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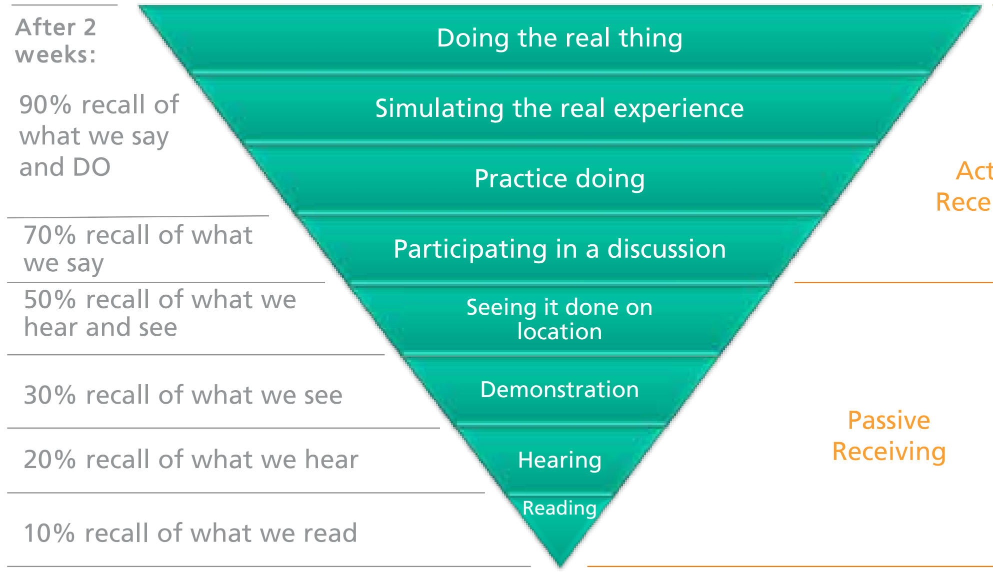
Potential of Learning Factories as education and innovation centers for universities and production industry

CURRENT REQUIREMENTS TO HIGHER AND ADVANCED EDUCATION

Higher and Advanced Education
Requirements

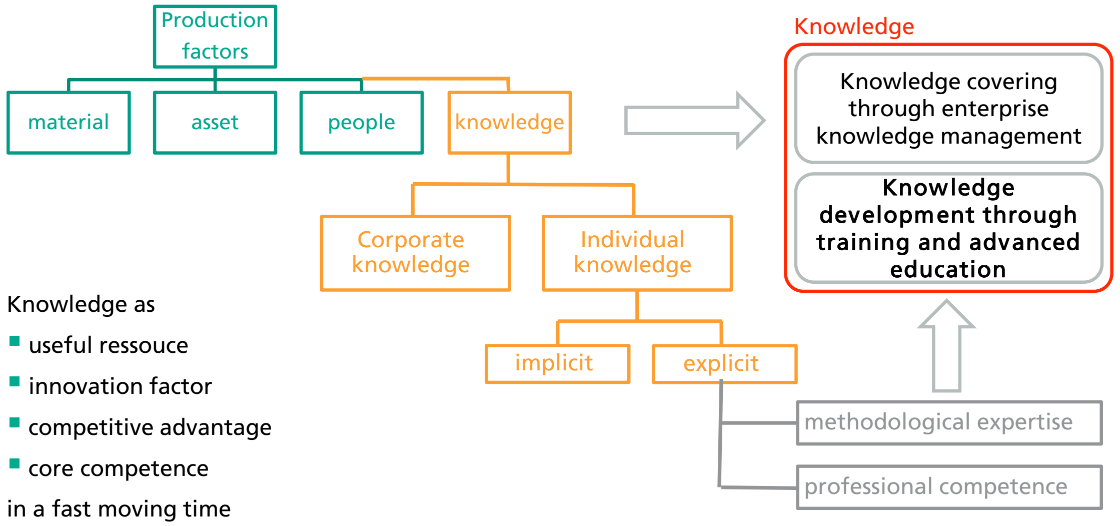
from scientific point of view



Higher and Advanced Education
Requirements

from economic point of view

KNOWLEDGE as 4th production factor



Knowledge as
- useful ressouce
- innovation factor
- competitive advantage
- core competence

in a fast moving time

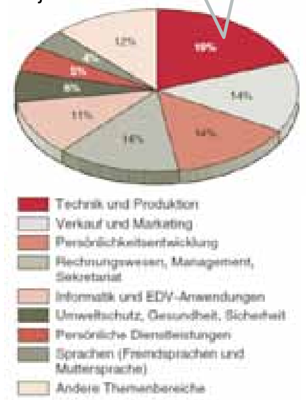
Higher and Advanced Education
Requirements

from economic point of view

Current trends
- Working & Learning as origin for ability to innovate
- Qualification related to a specific field instead of diversified education
- Location:
  - Workers: in-house training
  - Management: extern via experts
- Production industry:
  - Practical training already during the advanced education
  - Mapping of real production processes

Almost 20% of consumed classes concern subjects of technics and production

Classes and subjects



Statistik Austria 2007

Potential of Learning Factories as education and innovation centers for universities and production industry

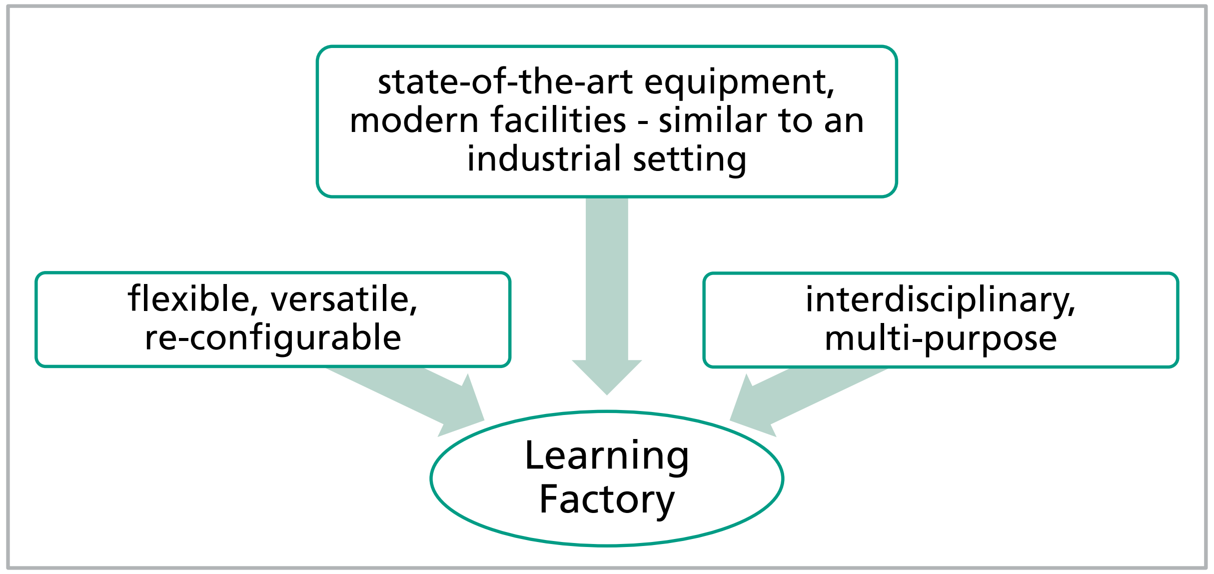
COMMON UNDERSTANDING OF A LEARNING FACTORY

Learning Factory
Common Understanding

contemporary manufacturing demonstration center
competence
application test center
leading education tool
continuous improvement
labour situation
alternative training methods

innovation
research
discover
technical, analytic, planning skills
Interpersonal ability
training for industry
interactive participation
hands-on training
real experience
education for students

Learning Factory
Best-Case Characteristics



Potential of Learning Factories as education and innovation centers for universities and production industry

OPPORTUNITIES OF LEARNING FACTORIES

University - Industry Partnership
Win-Win Situation

Universities
- Higher Education
- Industry Projects
- Technology
- Financial Support
- Potential Employer

Cooperation

Industry
- Advanced Education
- Access to Science
- Science Center
- Science Marketing
- Recruiting

University - Industry Partnership
Win-Win Situation

Universities
- Higher Education
- Industry Projects
- Technology
- Financial Support
- Potential Employer

- Curriculum based on direct linkage of theoretical studies with practice-based project for students
- Learning Factory as an integral part of the syllabus
- Targets:
  - Strong foundation in engineering science fundamentals
  - Manufacturing and project related design process and business realities
  - Knowledge of latest technologies or methods
  - Management and application to solve problems
  - Creativity, Communication, ability to work in a team
- Practice-oriented through cooperation projects with companies

University - Industry Partnership
Win-Win Situation

- Holistic approach instead of limited perspective
- Exploitation of employee's methods expertise
- Practice in an ideal training infrastructure
- Ability to implement learned tasks in the own company
- Increase of innovation potential
- Motivation of employees

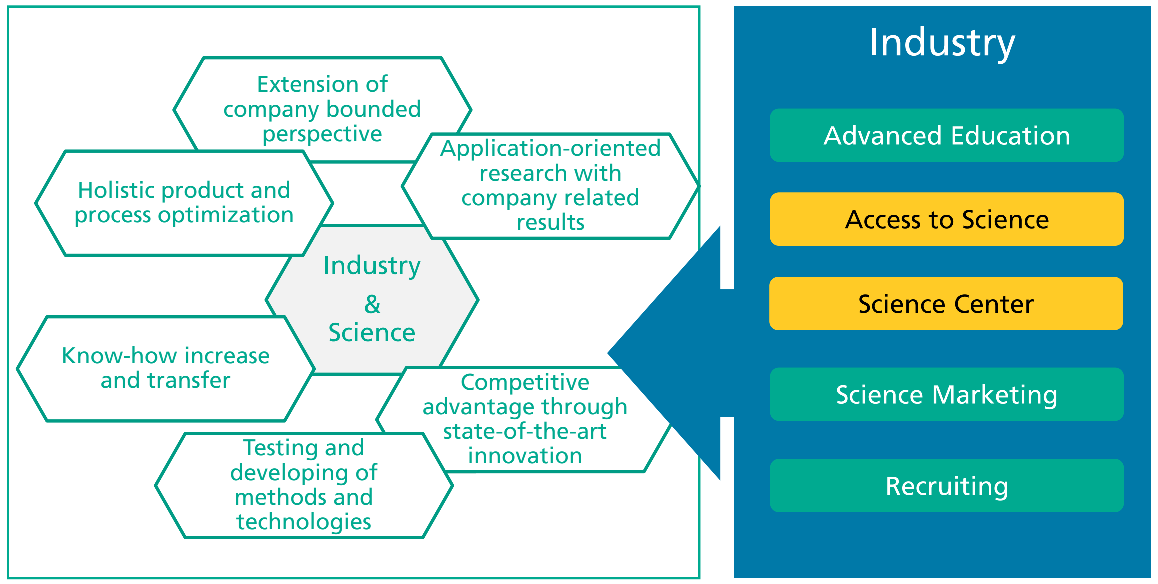
Industry
- Advanced Education
- Access to Science
- Science Center
- Science Marketing
- Recruiting

University - Industry Partnership
Win-Win Situation

Universities
- Higher Education
- Industry Projects
- Technology
- Financial Support
- Potential Employer

- Infrastructure for involving industry activly in the educational process
- Technology transfer between universities and companies
- Common technology development
- Aspiration to technology leadership


University - Industry Partnership
Win-Win Situation



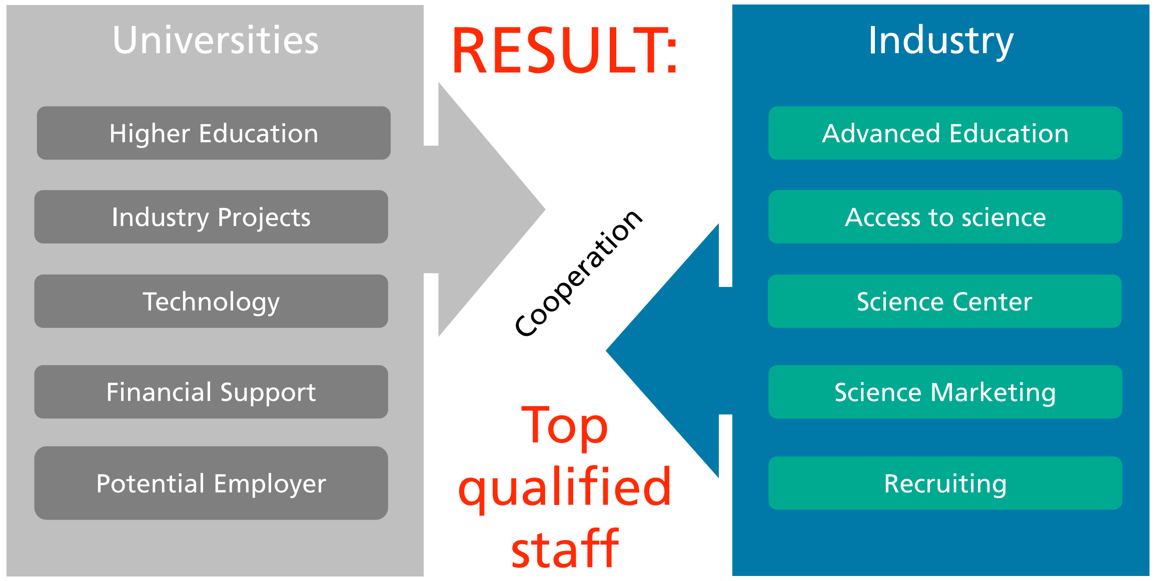
University - Industry Partnership
Win-Win Situation

Marketing
- High presence of the company's brand and research activities
- Common appearance with universities or research institutes
- Mutual image transfer

Recruiting
- Collaboration with prospective alumni
- Influence on key areas of training
- High exposure as attractive employer
- Winning of potenial job candidates

Industry
- Advanced Education
- Access to science
- Science Center
- Science Marketing
- Recruiting

University - Industry Partnership
Win-Win Situation



Potential of Learning Factories as education and innovation centers for universities and production industry

Prof. Dr. Kurt Matyas

Univ.-Prof. Dr.-Ing. Jochen Deuse

Univ.-Prof. Dr.-Ing. Jochen Deuse was born in 1967 and studied Mechanical Engineering at the University of Dortmund.

Jochen Deuse received his doctoral degree at RWTH Aachen University, Laboratory for Machine Tools and Production Engineering (WZL), in 1998.

For seven years, he has held senior management positions in the Bosch Group in Germany and Australia.
Since 2005, Jochen Deuse is head of Chair of Industrial Engineering, TU Dortmund University, Germany.

The Chair of Industrial Engineering is concerned in teachings and research with planning and organisation of enterprise processes in production, logistics and service with the main focus on:

- *Work System Design*
- *Digital Manufacturing*
- *Production Systems*
- *Group Technology*
- *Time and Motion Studies*

Hands-on Training Center for Industrial Engineering in Higher Education

technische universität dortmund

“Hands-on Training Centre for Industrial Engineering in Higher Education”

2nd Conference on Learning Factories - Vienna, May 10th 2012

“Competitive production in Europe through education and training”

Univ.-Prof. Dr.-Ing. Jochen Deuse

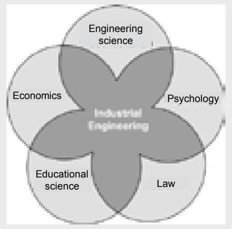
Dipl.-Wirt.-Ing. Marlies Steffen

Hands-on Training Centre for Industrial Engineering
What is Industrial Engineering (IE)?

F. W. Taylor

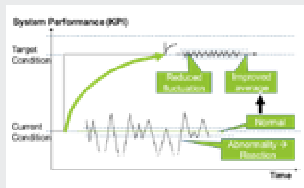
“Replacement of rules of thumb by precise procedures developed after careful time and motion studies”

Interdisciplinary work



Work in the area of human, organisation and technology

Design of industrialised processes



Stable processes as prerequisite for efficient use of resources

Professional IE competences

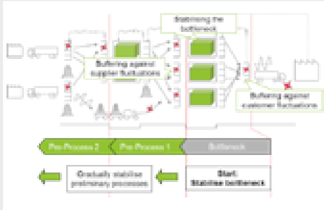
[IfaA]

IE combines

- System,
- Methodological and
- Problem solving competence

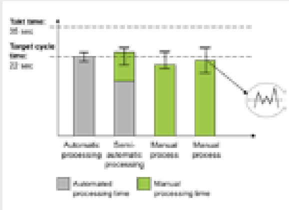
Hands-on Training Centre for Industrial Engineering
IE Competence Profile

System competence



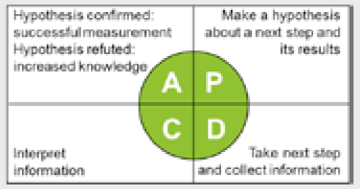
Understanding „what do we need to do“

Methodological competence



Mastering state of the art methods
- Line balancing
- Time studies
- Lean tools
- …

Problem solving competence



[Suzaki]

Systematic problem solving w/ the Scientific Method

Additional key competences

Enhancing professional acting
- Personal
- Activity
- Social and communication competence

Hands-on Training Centre for Industrial Engineering
Environment for Experiential Learning

Two shift gearbox

- Bolted connections
- Tight joints, undercuts
- Complex precedence graph
- Heavy parts > 1kg
- Likelihood of confusion
- Different product variants

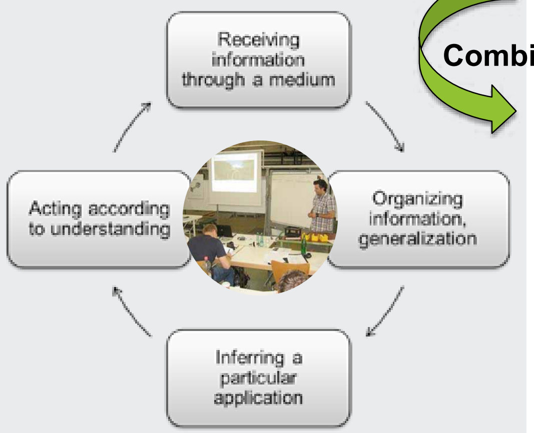
Materials for fixtures

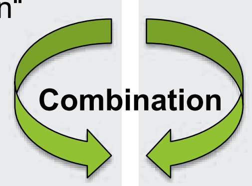
Flexible work places

Different containers

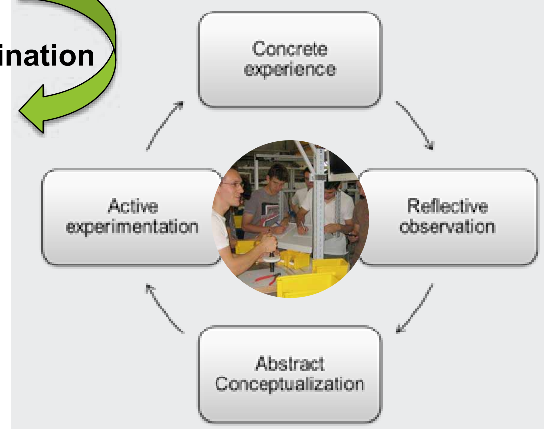
Hands-on Training Centre for Industrial Engineering
Theories of Learning and Competence Development

„Information assimilation“





„Experiential learning“



- Low time consuming
- Easy to give knowledge a structure
- Low taxonomy level
- Low learning retention

[Coleman]

- High taxonomy level
- High learning retention
- Time consuming
- Knowledge needs a structure

[Kolb]

Hands-on Training Centre for Industrial Engineering
“Work System Design”

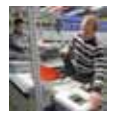
Students of:
- Industrial Engineering,
- Mechanical Engineering and
- Logistics

Learning environment:
- 1 week theoretical knowledge
- **1 week practice in IE Training Centre**
- Groups of 6-8 students

Contents:
- Product, operating sequence analysis
- Time and motion study
- Calculation of customer takt and pc/t
- Line balancing
- Ergonomic work place design
- Work system design
- Principles of Lean Production
- …

Step 1: Screen documents, set up project plan

Step 2: Design work system



Group A: Experiments w/ PDCA

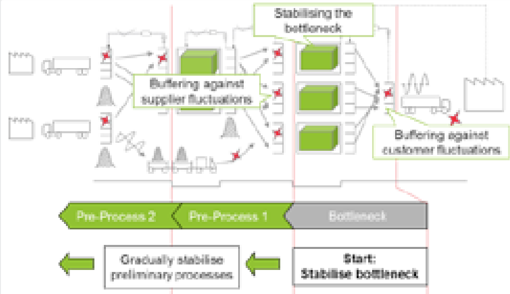
Group B: Planning w/ sheet and pencil

Step 3: Tests, detailed planning

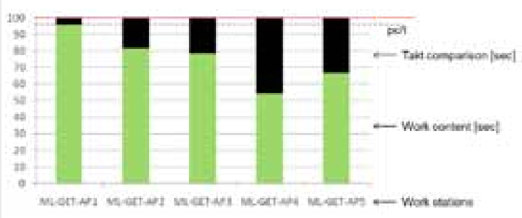
Step 4: Presentation and feedback

Hands-on Training Centre for Industrial Engineering
Development of “System and Methodological Competence”

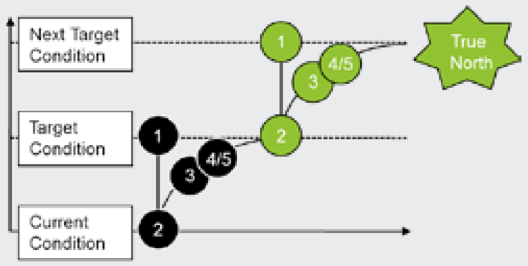
System competence



Methodological competence

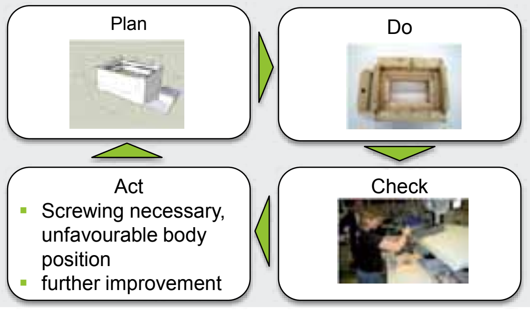


Hands-on Training Centre for Industrial Engineering
Development of “Problem Solving Competence”



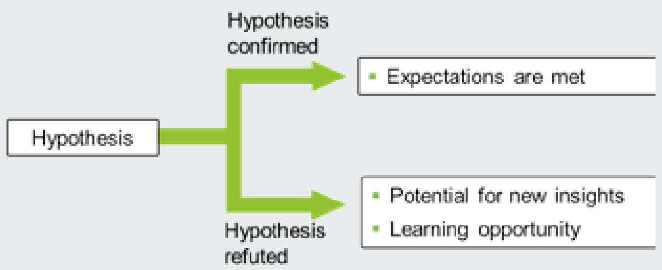
(1) Orientation towards the True North and specification of a Target Condition
(2) Understanding the Current Condition
(3) Systematically identifying problems and obstacles
(4) Definition of a next step in order to solve problem or overcome obstacle
(5) Interpreting and evaluating results

[Suzaki]

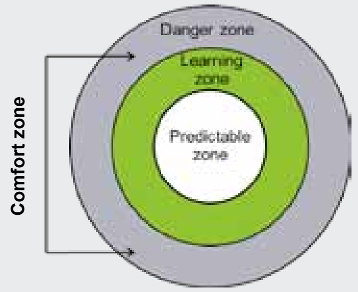


Hands-on Training Centre for Industrial Engineering
PDCA Enables Experimental Learning

- Hypotheses need to be falsifiable in order to enable the Scientific Method and to generate new learning opportunities
- It is commonly accepted that suggested solutions to problems might fail
- Experimenting via „Trial and Error“



[according to Popper]



[Rother]

Hands-on Training Centre for Industrial Engineering
Experiments conducted in the Training Centre

Experiments w/ apportionment of an order

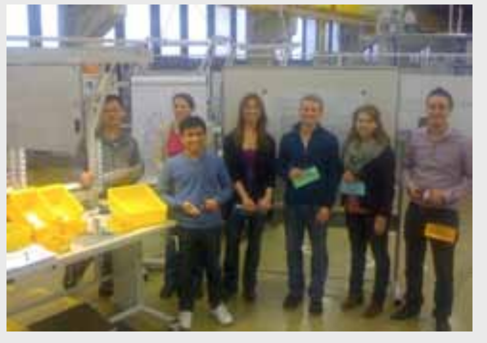
Experiments w/ division of work by type

Experiments w/ milk run

Experiments w/ fixtures

Hands-on Training Centre for Industrial Engineering Students' Feedback

- "The high practical relevance of the course was the main reason to choose the subject Industrial Engineering."
- "I like the combination of professional competence development and Soft Skills."
- "I feel better prepared to start my professional life and gained more insight into the working methods of IEs."
- "I had plenty of fun and knowledge will sustain much longer than knowledge gained in lectures."



Univ.-Prof. Dr.-Ing. Jochen Deuse | 10 May 2012 11

Thank You for Your Kind Attention!

Univ.-Prof. Dr.-Ing. Jochen Deuse | 10 May 2012 12

**Prof. Dr.-Ing.
Eberhard Abele**

The Institute Director Professor Dr.Ing. Eberhard Abele studied mechanical engineering at the Stuttgart University of Technology. He was a researcher and department leader at the Fraunhofer Institute for manufacturing engineering and automation (IPA) in Stuttgart, Germany. In the past he was holding several management functions in a German automotive supply company as head of production planning and head of special purpose machine tool. In the same company he was head of production technology and a technical director. Since 2000 he is director of the Institute for Production Management, Technology and Machine Tools (PTW) at the Technische Universität Darmstadt. Professor Abele is chairman of the team "production research 2020" (Produktionsforschung 2020) of the German Ministry of Education and Research, fellow of the International Academy for Production Engineering (CIRP) and a member of the German Academy of Science and Engineering (acatech). He published about 200 international research publications in the fields of cutting, automation, robotics, machine tools, and production management.

TU DARMSTADT

The Institute of Production Management, Technology and Machine Tools (PTW) is one of the leading research institutes in production technology. Currently about 35 research associates work with different focuses along the machining process chain. This includes the development of machine-components and energy efficient machine tools, technologies for high speed machining and production management. In the last mentioned area the PTW achieved a pioneering role in 2007 with opening the process learning factory CiP, a nationwide, industry oriented facility for education and advanced training, which conduces as a pilot factory in the context of mediating methodological skills for production optimization. Since the opening of the process learning factory "CiP" continuous development has been reached by the research group, at the moment consisting of eight engineers. The CiP displays on about 500 square meters the entire value stream from order intake to the final product.

5 years Process Learning Factory CiP at TU Darmstadt - Concept,Results,Experiences and still new Challenges

Dipl.-Ing. Sven Bechtloff

Sven Bechtloff studied Mechanical Engineering at Technische Universität Darmstadt and gained work experience in that period by internships at EvoBus Portugal S.A., Siemens VDO Automotive AG or Deutz Power Systems GmbH & Co. KG. Since 2008 he works as a research associate at Center for industrial Productivity (CiP) at PTW where he became Team Leader in 2011. At process learning factory CiP he is trainer for lean production and concentrates his activities on a comprehensive expansion of the machining area with focus on cellular manufacturing. In 2012 Sven Bechtloff became chief engineer.

The Institute of Production Management, Technology and Machine Tools (PTW) is one of the leading research institutes in production technology. Currently about 35 research associates work with different focuses along the machining process chain. This includes the development of machine-components and energy efficient machine tools, technologies for high speed machining and production management. In the last mentioned area the PTW achieved a pioneering role in 2007 with opening the process learning factory CiP, a nationwide, industry oriented facility for education and advanced training, which conduces as a pilot factory in the context of mediating methodological skills for production optimization. Since the opening of the process learning factory "CiP" continuous development has been reached by the research group, at the moment consisting of eight engineers. The CiP displays on about 500 square meters the entire value stream from order intake to the final product.

5 years Process Learning Factory CiP at TU Darmstadt - Concept, Results, Experiences and still new Challenges

Vienna, Austria | 10.05.2012

TECHNISCHE UNIVERSITÄT DARMSTADT

5 years Process Learning Factory CiP at Technische Universität Darmstadt

Concept, Results, Experiences and still new Challenges

Prof. Dr.-Ing. E. Abele
Dipl.-Ing. S. Bechtloff

Institute of Production Management, Technology and Machine Tools
Technische Universität Darmstadt

Centre for industrial Productivity

www.prozesslernfabrik.de

Content

- Future challenges require new approaches for efficient learning
- Process learning factory CiP – Our former vision became reality
- Education of students
- Vocational training of industry employees
- Statistical flashback
- Current research topics
- Next steps, new challenges and our vision

Initial situation for a new approach

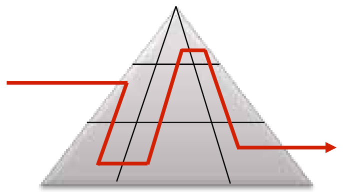
Survey among 50 staff managers and directors:
- In what are alumni of Technische Universität Darmstadt good at?
- Where is a need for improvements?

Results

- 70% of the students are going to work within the departments of production, development or quality assurance
- As future employees in production, the alumni lack of:
  - Knowledge about processes and Lean methods
  - Skills in the establishment and adaption of production systems
  - Perception of ideal workflows in manufacturing and enthusiasm for continuous improvement

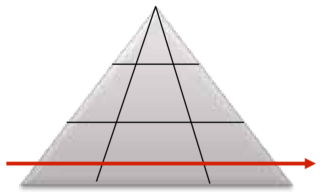
Future capabilities have to be geared to process-oriented organisations

function-oriented



Organisation manages itself autonomously in vertical processes
- Knowledge
- Careers
- Abilities
- Perceptions

process-oriented



Value add as a result of horizontal processes
- Short innovation cycles
- Clear competences
- Short lead times
- High adherence to delivery dates

Growing innovation speed and decreasing period of employment are future challenges in production techniques

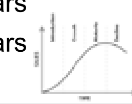
Period of employment

Average period of employment in production planning
- 1980: 8 years
- 2000: 6 years
- 2010: 4 years

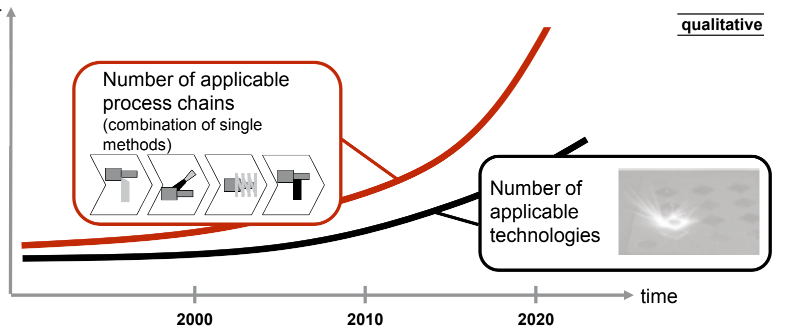
Challenge competence oriented lifelong learning approaches

Product life cycle

example of a high-pressure cleaner
- 1980: 7 years
- 2000: 5 years
- 2010: 3 years

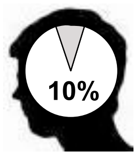


Production engineering variants

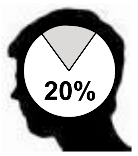


Learning by experience on the shopfloor gains lasting knowledge and skills

We keep in mind only a part of the things we perceive:

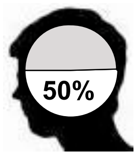


10% of what we read

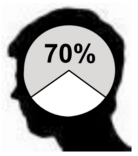


20% of what we hear

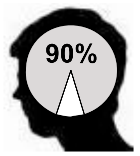
30% of what we see



50% of what we hear & see



70% of what we say



90% of what we do

Our former vision became reality: A learning factory on the campus

PTW TU DARMSTADT CiP

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Properties and probable application ranges of learning factories

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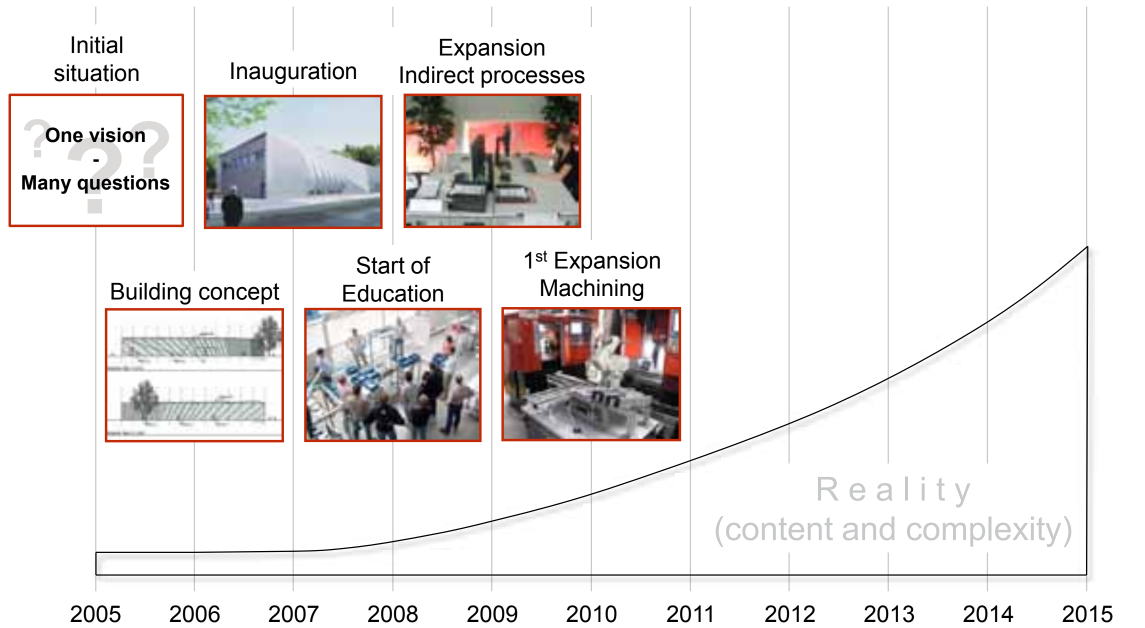
Process learning factory CiP at TU Darmstadt: Current milestones

PTW TU DARMSTADT CiP



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First steps: Questions considered from idea to realisation

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CiP – A learning company at Technische Universität Darmstadt: Production and assembly of industrial products

Mass product

- Realization of complete value tream including machining, assembly and indirect processes (order fulfillment)
- No sale but disassembly

➢Pneumatic cylinder

Assembly with high variance

- About 4.000 different variants are possible

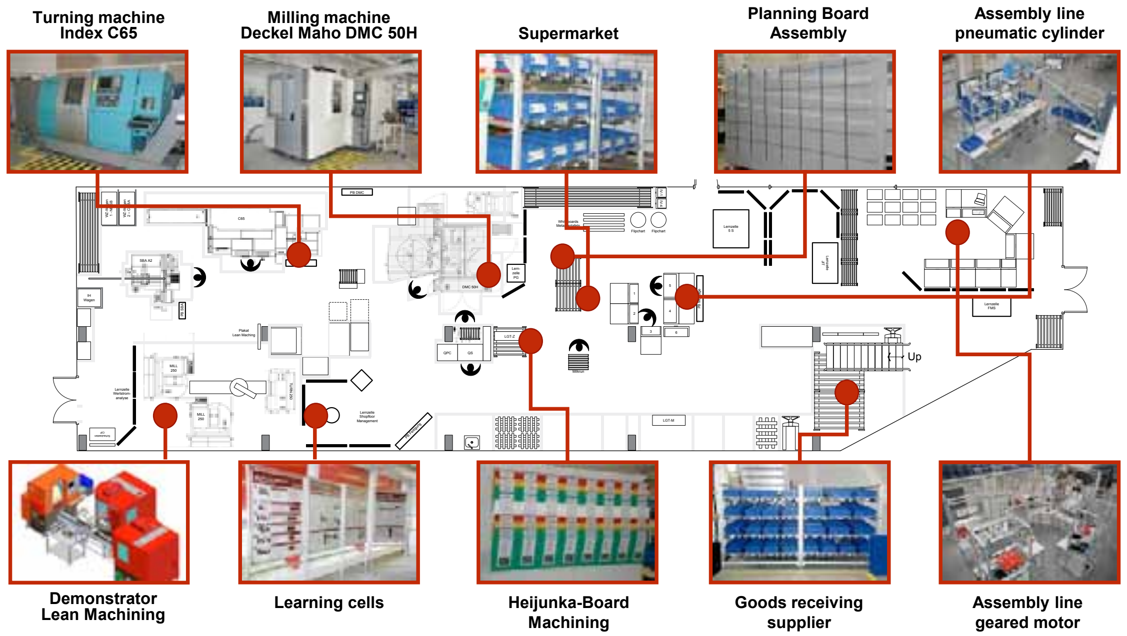
➢Electric engine

Give-away for participants

- Flexible Organisation des Fertigungssystems möglich

➢Schlüsselanhänger

The hardware in the learning factory represents a midsize factory in series production



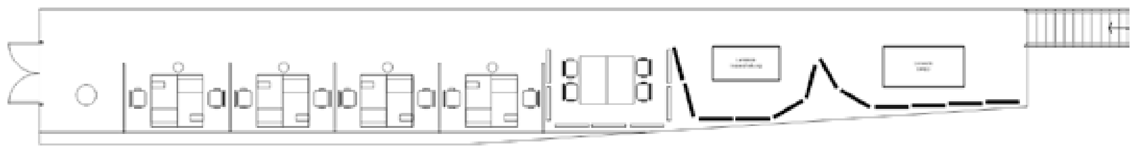
The integration of indirect processes enables the transfer at interfaces of production and planning

Realised departments with indirect processes:

- Sales
- Purchase
- Development
- Production planning and control
- Idea management

Questions regarded in workshops:

- Lean Office with 5S
- Integration of administrative and technical IT-Systems
- Integration of parameter-changes in planning processes to consider early production innovation stages

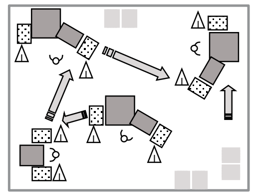


By various configurations of a flexible machining cell an economic valuation of several production setups is possible

Batch Production*

3 employees (operator)
Change over time: 10 min.

Fixed costs / year: 39.028,95 €
Var. costs / hour: 112,39 €

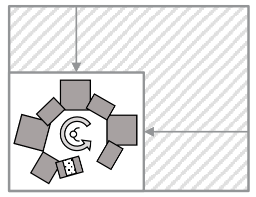


11,30 € / piece (Lot size 150)

Chaku Chaku cell

1 employee (operator)
Change over time: 10 min.

Fixed costs / year: 36.615,00 €
Var. costs / hour: 50,39 €

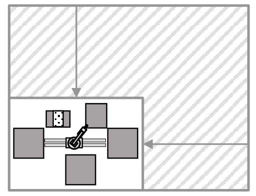


8,50 € / piece (Lot size 40)

Automatic handling system

0,25 employee (technician, pro rata)
Change over time: 4 hrs.

Fixed costs / year: 52.302,08 €
Var. costs / hour: 30,98 €



8,20 € / piece (Lot size 230)

Economic valuation

* at maximum workload; free capacities have been sold to other products for machine-hour rate

Video Experience Tour

Integration of the process learning factory in the education of mechanical engineering students

Master thesis

Tutorial / Advanced Design Projects (ADP)

Lectures: Management of industrial production, Machine Tools and robots, Automation

Bachelor thesis

Lecture: Technology of manufacturing processes

Master

Bachelor

Student workforce, Research assistant (HiWi)

The CiP curriculum addresses employees who are involved in the implementation of Lean methods

Phase 1: Lean understanding

Lean Basics

Basics and diagnosis**
- The need for Lean
- 7 types of waste
- Value stream mapping
- OEE

Value stream design**
- Pull principle
- Flow production
- In-takt production
- Value stream design

Quality techniques**
- Lean quality assurance
- Poka Yoke
- Problem solving
- Jidoka

* 1-day-Workshop
** 2-day-Workshop

Phase 2: Lean core elements

Lean Material Flow

Just-in-Time**
- Pull systems, Kanban, supermarket

Production control**
- Heijunka, Levelling

Flexible manpower systems**
- Yamazumi, flexible line design

Lean Machining

Quick change-over (SMED)**
- Change-over time optimisation

Maintenance**
- Strategies, TPM

Cellular Manufacturing*
- Line balancing and layout

Lean Quality

Measuring system analysis**
- Capability of measuring systems

Machine capability**
- Machine acceptance test

Process capability and SPC**
- SPC, control charts

Phase 3: Lean culture

Lean Thinking

Leadership for continuous improvement processes*
- Improvement and leadership routines
- Coaching principles

Value added excellence in indirect processes**
- Lean Office with 5S
- Job structure analysis
- Value stream analysis and design

Methods- and transfer- competence for Lean trainers*
- Sensitisation for Lean
- Moderation techniques
- Workshop development

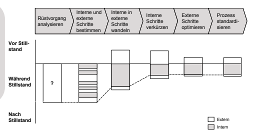
Ability to develop operational excellence in the individual environment

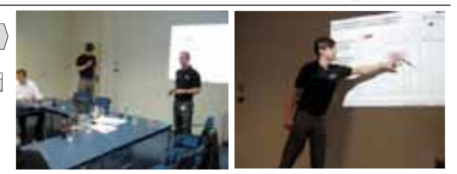
Transformation of CiP to a Lean best practice enterprise

Examples for the structure of learning modules: Workshop Quick change-over (SMED)

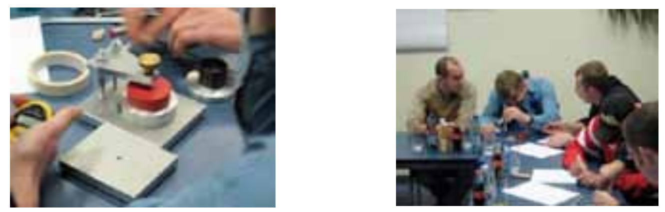
Day 1

Theory — Theory imparted





Simulation Game — Optimisation process understood



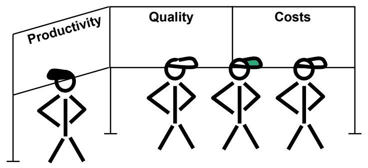
Day 2

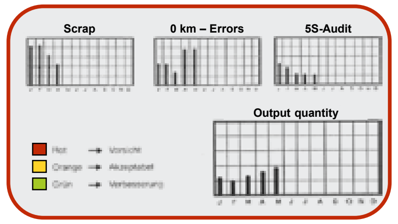
Practical Application — Method applied in practice

60% Shopfloor ratio

Examples for the structure of learning modules: Workshop Lean Basics – Shopfloor Management

Daily performance dialogue

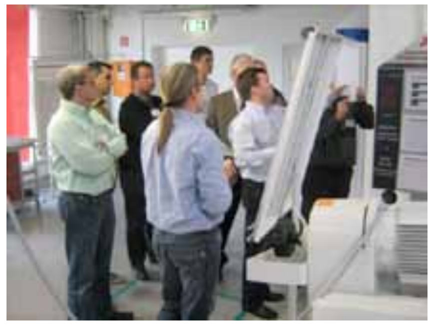




- Which key performance indicators (KPI) are necessary?
- How can these KPI be determined and visualised?
- Which actions can be taken immediately?

Development of a shopfloor management board

Realisation of a performance dialogue



Previous cooperation partners in research and education

Research and vocational education with partner companies

Rexroth Bosch Group, Continental, ALSTOM, Hirschvogel Automotive Group, KEIPER, mpdv, BorgWarner, HBM, habasit, Q-DAS, reis robotics, DAW, KÄRCHER, MERCK, schweizer, Generator Technologies, PWG, ixetic, CONTTEK, SEW EURODRIVE, PIV, B/S/H/, BMK Group, Mahr, Linde, woco

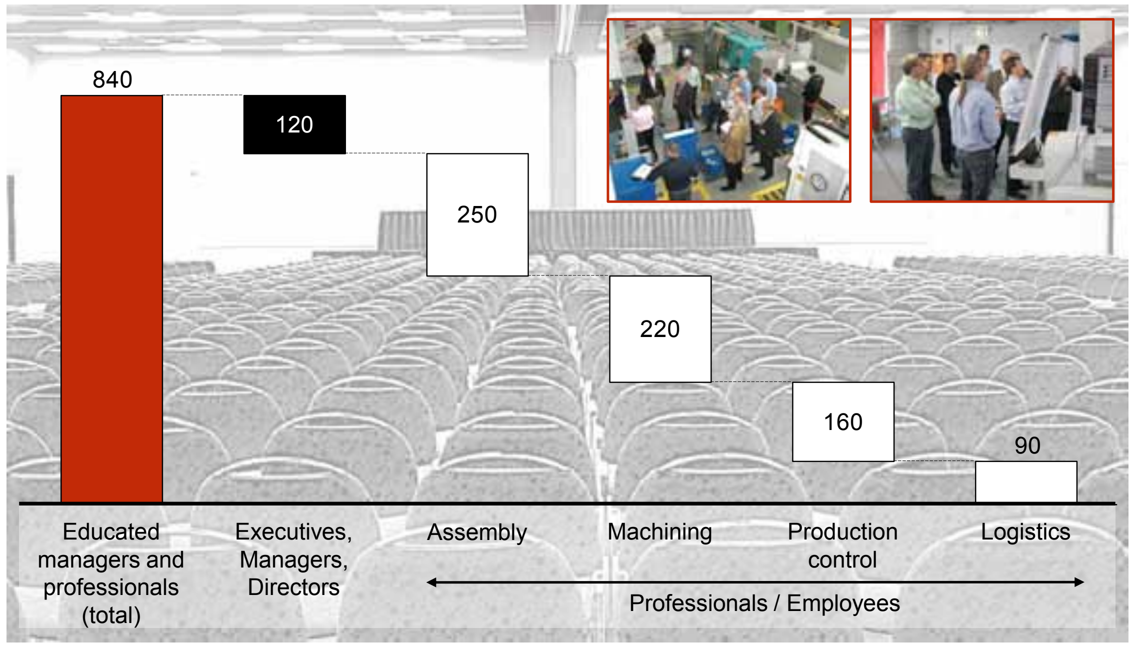
Management Training

DAIMLER, SANDVIK, EADS, BMW, SEAT, alba, vodafone, VW

Vocational education with regional SME

fertigungstechnik, SETON, ELB, Erb, BRÜNING, SMC, SECON, LYNX, MARTIN, QUAX, UELZENER, BOIDA, BUSALT & CO, SchuFF, FETTEROLF

In the past 4 years a range of managers and professionals have been educated at process learning factory CiP



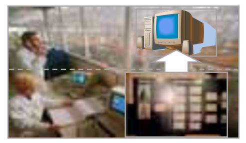
Current research topics of the CiP staff

Competence Development for Continuous Improvement Processes

- Methods for the institutionalization of continuous improvement processes at the shopfloor
- Capability building for the staff's empowerment in improvement processes

Flexible Parts Productions

- Holistic approach for flexible parts productions in Germany, especially by Cellular Manufacturing
- Increase of productivity in machining by Low-Cost-Automation gadgets



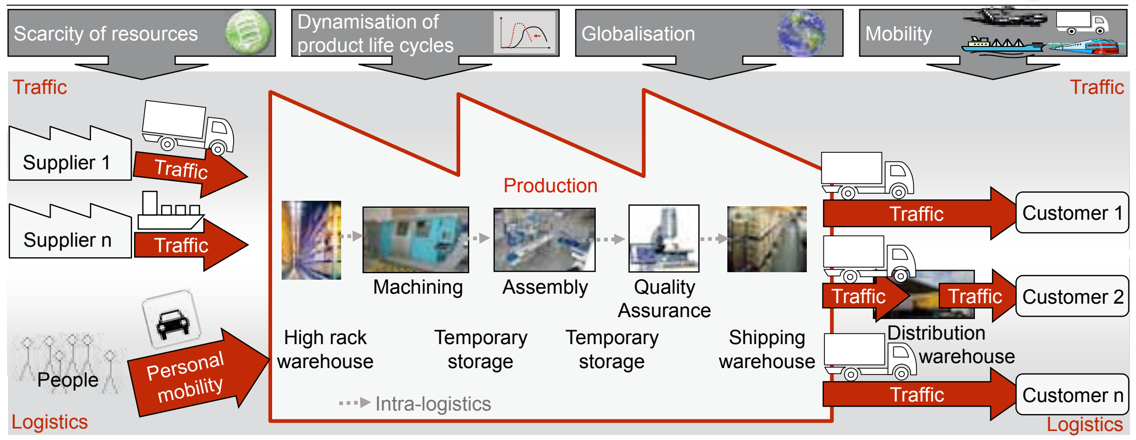
Lean-IT: Supporting Lean Production with IT-Solutions

- Simulation-based planning of lean material and information flows
- Dynamic adjustment of Kanban-loops based on leveled Production

Production Logistics for Lean Production

- Flexible assembly and logistics systems
- Configuration of optimized value streams under consideration of logistics and traffic

Target of the research project Dynamo PLV is to consider the interactions between production, logistics and traffic



Procurement logistics	Intra-logistics / Production	Distribution logistics
Global sourcing / Traffic • Local vs. global procurement? • Influence of traffic for supplier selection? • …	Production / Intra-logistics • Flexibilisation strategies? • Choice of location? • One-piece-flow or batch production? • …	Demand Fulfillment / Distribution / Traffic • Influence of traffic for delivery date? • …

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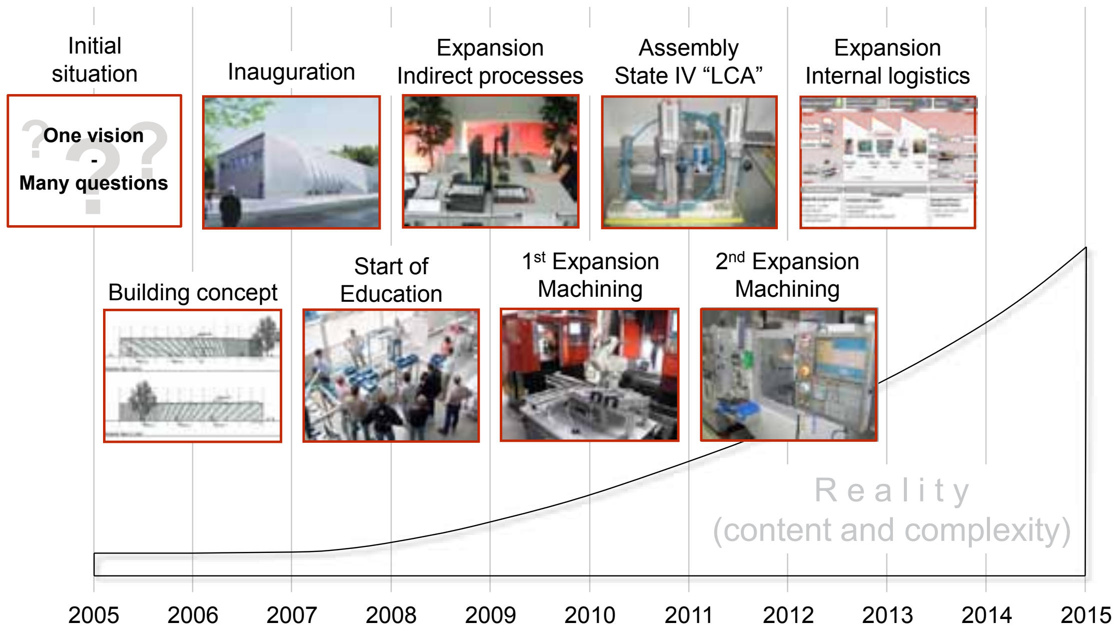
Process learning factory CiP at TU Darmstadt: Our next steps



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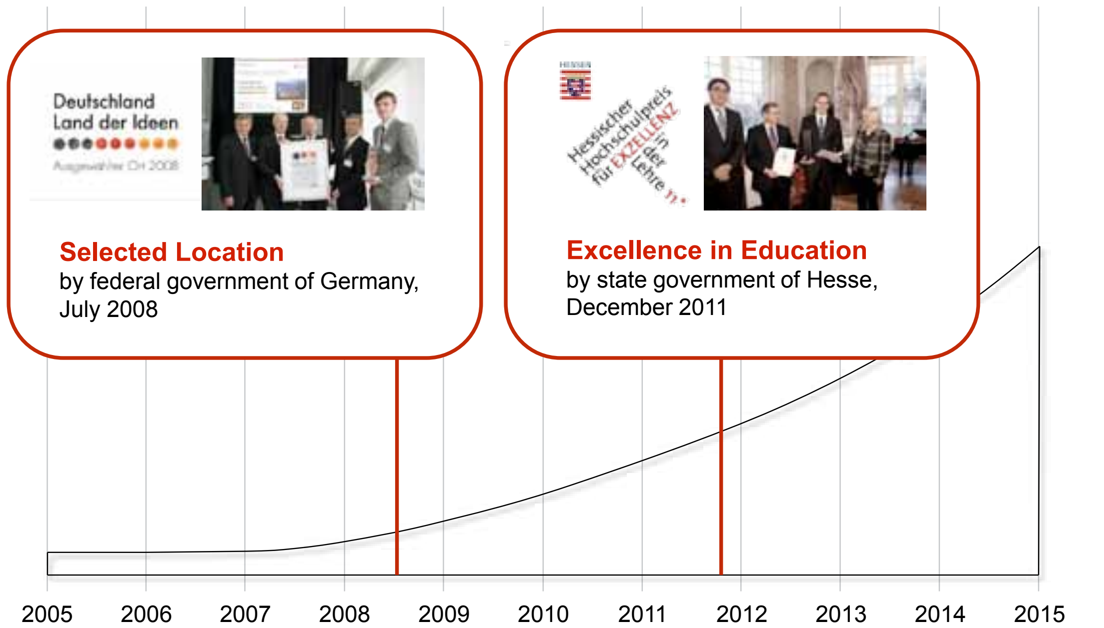
Process learning factory CiP at TU Darmstadt: Awards



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5 years Process Learning factory CiP… and still new challenges!

- "Right-sized" Learning Factory? (theory, simulation, shopfloor vs. budget)
- Generalization vs. Specialization? (industries, products, processes)
- Business model (costs and continuity of partners and staff: research associates, student workforce, technical support)

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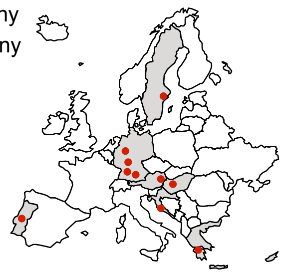
Establishment of the initiative on European Learning Factories under the aegis of TU Darmstadt / PTW on May 20th 2011

European universities in cooperation with PTW/CiP within the initiative (extract)

- Technical University Munich, Germany
- Business School Reutlingen, Germany
- University Bochum, Germany
- Technical University Vienna, Austria
- KTH Stockholm, Sweden
- University of Split, Croatia
- Hungarian Academy of Science
- University of Patras, Greece
- IPS, Setubal, Portugal



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Targets of the initiative on European Learning Factories

- Establishment of an European cooperation between universities / institutes working being pioneers in this field
- Exchange of knowledge and learning modules between partners
- Training of students, industry experts and managers
- Setting standards for trainings to gain efficiency in training
- Building competence centers for specific topics

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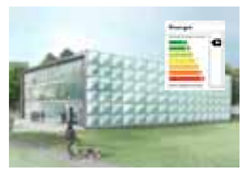
Our vision for the year 2020: „Research Campus" with focus on „Urban Value Added"

„Research Campus"
Technische Universität Darmstadt

Process Learning Factory „CiP"

established in 2007

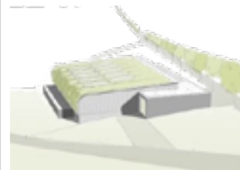


Energy Efficiency Factory „Eta"

planned and requested

Logistics Learning Factory

planned and requested



Center of methodological competencies

planned

Ongoing expansion by network activities and collaborative research

Targets:
- Enlargement of current education offer for students and industry employees
- Research in comprehensive processes
- Integration and cooperation of several departments in a common object
- Motivation for multidisciplinary research activities

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Lessons learned so far: How to build up a Learning Factory

Be sure to have…

- a clear focus on **target groups** (industries, students,…)
- enough **resources** (money, staff, building, infrastructure, machine shop for daily improvement)
- **experience**, know-how
- **partners**, networking

and finally…

- **good luck!** (support, "business angels")

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Prof. Dr. Gunther Reinhart

Prof. Dr. Gunther Reinhart is full professor for Industrial Management and Assembly Technology and director of iwb (Institute for Machine Tools and Industrial Management) at Technische Universitaet Muenchen (TUM). After studying mechanical engineering, he was research assistant at iwb from 1982 to 1988 with Prof. Dr. Joachim Milberg. After receiving the Ph.D. from TUM he started his industrial career with BMW Group, initially as head of the handling and welding engineering department and subsequently as director of the body paint shop. In 1993 he turned back to university to become professor and director of iwb.

From 2002 to 2007 Professor Reinhart took a sabbatical from university to become a member of the executive board of IWKA Corporation, a large German supplier with 13,000 employees worldwide. There he was in charge of Technology and Marketing. 2007 Professor Reinhart turned back to university and has served with Professor Michael F. Zaeh as co-director of iwb with more than 100 employees.

He is also the chairman of the Bavarian Cluster for Mechatronics and Automation and since 2009 head of the Fraunhofer IWU research-department for Resource-Efficient Converting Machines (RMV). Gunther Reinhart is member of multiple scientific societies and associations like acatech, WGP, WLT, CIRP and AIM. He has approximately 300 publications to his credit and is author or editor of ten books and two series. He has supervised doctoral theses of some 100 research associates.

The Institute for Machine Tools and Industrial Management (iwb) of Technische Universitaet Muenchen is one of the major production technological institutes in Germany and consists of two chairs of the Faculty of Mechanical Engineering in Garching near Munich as well as a user centre in the area of production engineering in Augsburg. The two ordinariates, Institute for Industrial Management and Assembly Technologies and Institute for Machine Tools and Manufacturing Technology, define the focus of the research topics of iwb.
These are manufacturing processes, machine tools, handling, assembling and joining technology, control technology, robotics as well as industrial management, factory planning and logistics.
The staff of iwb dedicates itself to those fields in its research, teaching, and industrial exchange.

Green Factories Bavaria

Institute for Machine Tools
and Industrial Management
Prof. Dr.-Ing. M. Zäh
Prof. Dr.-Ing. G. Reinhart

GREEN FACTORY BAVARIA

VIENNA, MAY 10, 2012
2ND CONFERENCE ON LEARNING FACTORIES

DIPL.-ING. F. KARL
PROF. DR.-ING. G. REINHART

Institute for Machine Tools
and Industrial Management
Prof. Dr.-Ing. M. Zäh
Prof. Dr.-Ing. G. Reinhart

Agenda

- Introduction to *iwb*
- Initial Situation
- Green Factory Bavaria
- Enhancement of “Training Factory for Energy Productivity” (LEP)
- Conclusion and Outlook

Institute for Machine Tools
and Industrial Management
Prof. Dr.-Ing. M. Zäh
Prof. Dr.-Ing. G. Reinhart

Agenda

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Introduction to *iwb*

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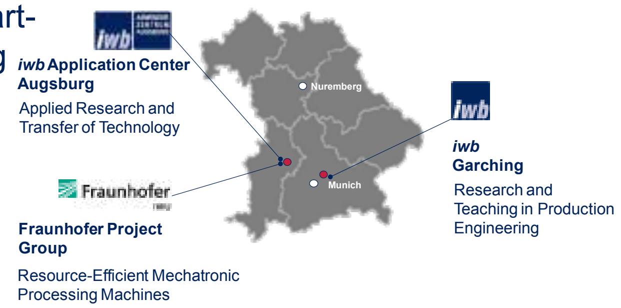
Prof. Dr.-Ing. G. Reinhart

Infrastructure

- Largest institute within the Department of Mechanical Engineering
- 5.100 m² office space
- 3.650 m² laboratory
- Approx. 130 employees
- Approx. 10 Mio. € budget



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Introduction to *iwb*

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Research Areas of *iwb*

Production Organization and Logistics

Mechatronic Manufacturing Systems

Manufacturing and Assembly Technologies

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Prof. Dr.-Ing. G. Reinhart

Agenda

- Introduction to *iwb*
- **Initial Situation**
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Initial Situation

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Prof. Dr.-Ing. G. Reinhart

Situation in Bavaria

High Share of Nuclear Energy in Bavaria

Nuclear power plants will be shut down by 2022, though it covers 2/3 of Ba-varian energy consumption

Intentions to Increase E-Mobility

Growing number of electric vehicles will increase the demand for electric power.

Bavaria as a Popular Holiday Destination

Tourism accounts for approx. 8 % of Bavarian GDP (turnover: 27 bn €).

Bavaria needs to fill the gap caused by the pull out from nuclear energy and to maintain its environment and landscape.

Sources: Bayerisches Landesamt für Statistik und Datenverarbeitung 2011, Bayerisches Wirtschaftsministerium 2010, Striebich 2003
Pictures: dpa, BMW, bayern.tourismus.de

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Initial Situation

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Reduction of Energy Consumption in Manufacturing

Bavaria as a Strong Industrial Site

Manufacturing sector ac-counts for approx. 28 % of gross value and 35 % of energy consumption.

SIEMENS Audi KAESER KOMPRESSOREN …

Reduction of Energy Consumption

Reduction of energy con-sumption is a powerful possibility to fill the gap caused by the pull out. A reduction of 30% (10 TWh/a) could obsolete an average plant.

Further Advantages for Companies and Bavaria

- Reduction of production costs
- Increase of competitiveness
- Securing of jobs
- Protection of the region
- …

Knowledge about energy saving potentials and possibilities needs to be trans-ferred to Bavarian companies, especially to small and medium-sized enterprises.

Sources: Bayerisches Landesamt für Statistik und Datenverarbeitung 2011, Bayerisches Wirtschaftsministerium 2010
Pictures: BMW, Kuka, Audi, Siemens, Kaeser, wikipedia, bayern-online.com

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Initial Situation

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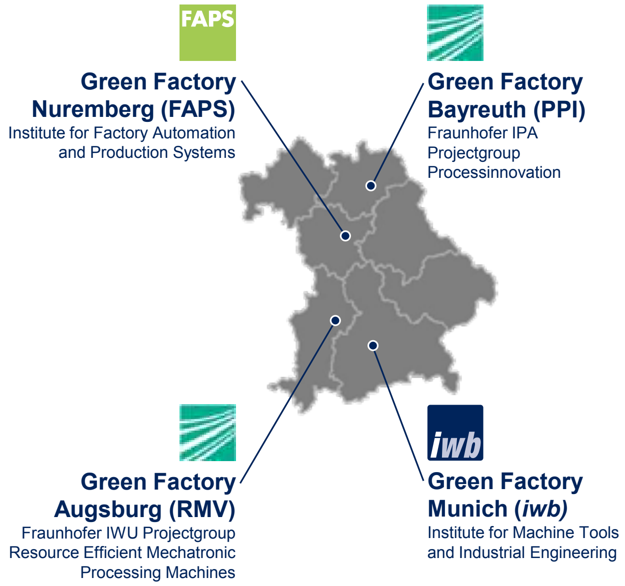
Prof. Dr.-Ing. G. Reinhart

Shop Floor of Green Factories Bavaria

Four Green Factories Will Be Built Up in Bavaria at Different Sites, e.g.

- Training, demonstration, laboratory and research factories
- Transfer of knowledge to companies
  - Methodological approaches
  - Technical solutions (e.g. best practices)
- Support of small and medium companies
  - Measurement
  - Green services
  - Trainings
  - Seminars



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Prof. Dr.-Ing. M. Zäh
Prof. Dr.-Ing. G. Reinhart

Agenda

- Introduction to *iwb*
- Initial Situation
- **Green Factory Bavaria**
- Enhancement of “Training Factory for Energy Productivity” (LEP)
- Conclusion and Outlook

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Green Factory Bavaria

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One common platform, many distinguished research cases

Foci of Green Factories

RMV Augsburg
- Factory building and equipment
- Company organization and order processing
- Joining and handling processes

***iwb* München**
- Additive manufacturing processes
- Machining processes (e.g. machine tools)
- Laser cutting and welding

PPI Bayreuth
- Production logistics and service engineering
- Primary shaping
- Disassembling and cleaning

FAPS Erlangen
- Technical planning and control of production systems
- El. Engineering
- Electronic and mechatronic production

Interdisciplinary Topics

Measuring technology	Simulation	Standardization	Energy monitoring
Indices	Certification	Technology transfer	Etc.

Corporate Activities

Green Services	Conferences	Workshops	Etc.

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Green Factory Bavaria

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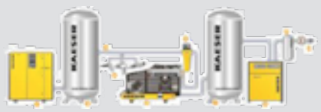
Green Factory at Augsburg (RMV)

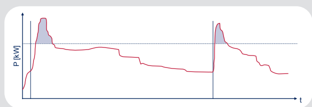
Green Processes
- Assembly processes
- Painting processes
- Handling of flexible parts (e.g. CFK)
- …

→Combination to an coherent production process

Green Factory Building
- Depiction of an energy-efficient factory building and infrastructure
- Construction of a sustainable factory building
- Implementation of building equipment (e.g. compressed air, air conditioning)



Green PPC
- Long term planning aspects (e.g. green and brown-field planning, interactions with LEAN)
- Short term planning aspects (e.g. smoothing of energy pikes, energy flexibility to react to energy fluctuations)



Combination to a new demonstration platform to show interactions between machines, planning, factory building and infrastructure

 5/10/2012 Pictures: Mazda, Kaeser PPC: Production Planning and Control

Green Factory Bavaria

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Green Factory at Bayreuth (PPI)

Consideration of Different Manufacturing Processes and Forms of Energy
- Processes
  - Primary shaping
  - Separating
    - Disassembly
    - Cleaning
- Different forms of energy (electric, potential, thermal)

Installation of Different Demonstration Platforms
- Primary shaping (CFK in an autoclave)
- Disassembly of forms / CFK-parts
- Cleaning of forms
- Intra-logistics and warehouse
- Green Services (e.g. retrofitting, measuring of energy consumption, energy recovery)

Build up of an integrated production process from the demonstrators considering a CFK-product (bicycle brake)

 5/10/2012 Pictures: radsport-libber.de, BMW, lang-werkzeugmaschinen.de

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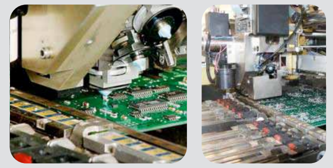
Green Factory at Nuremberg (FAPS)

Technical Planning and Control of Production Systems
- Reduction of energy consumption of IT-systems in production
- Integration of local intelligence in sensors and actors
- Decreasing of tact times in not fully loaded phases
- Adapted controls

Engineering of Electrical Systems
- Integration of new materials and connecting technologies in power electronics
- Design of illumination systems

Manufacturing of Electronic and Mechatronic Products
- Analysis and demonstration of processes with minimal energy expenses (e.g. brazing and soldering, handling)



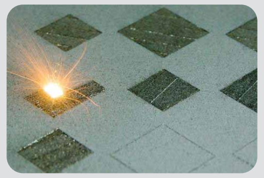
Integration of the topics into a demonstration line along the value adding chain of mechatronic products or engines

 5/10/2012 Pictures: discountfiresupplies.co.uk, tme.eu, bossert-elektronic.de, pcb-elektronik.de, de.hirscher.com

Green Factory at Munich (*iwb*)

Displaying of Various Manufacturing Processes

- Additive manufacturing processes
- Metal-cutting manufacturing processes
- Laser cutting and welding
- Processes at the existing Training Factory for Energy Productivity (LEP)




Existing Training Factory for Energy Productivity (LEP)*

- Displaying various manufacturing processes
- Manufacturing of a gear box
- Methodological improvement over the training



Enhancement of the existing Training Factory for Energy Productivity (LEP, “Lernfabrik für Energieproduktivität”, see www.energielernfabrik.de).

*LEP was build up in cooperation between *iwb* and McKinsey&Company Inc., but is used separately
Pictures: Kubinska & Hofmann

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- **Enhancement of “Training Factory for Energy Productivity” (LEP)**
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Integration of Further Aspects in LEP

Displaying of PPC Aspects (Production Planning and Control)

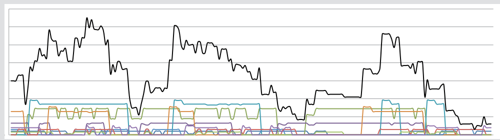
- Potentials to reduce energy consumption through planning
- Possibilities for energy flexibility (energy consumption depending on availability)

Integration of Additional Machines and Infrastructure, e.g.

- Energy storages to buffer energy
- Redundant and alternative machines and processes to display interactions between lead time and energy consumption


Enlargement of Measurement and Visualization Equipment

- Installation of additional measuring points
- Extension of visualization devices (e.g. on machine level)
- Implementation of energy forecasting



Picture: Heller

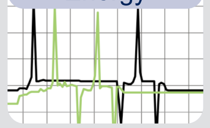
Build up of a Machine Tool Laboratory

Build up of a Competence Center for Energy Efficiency at Machine Tools

- Demonstration, research, teaching and laboratory platform to holistically examine machine tool behavior (interactions between dynamics, temperature and energy consumption)

Dynamics

Energy



Temperature

Transfer of Measures

- Possibilities to increase energy efficiency at new and existing machines
- Direct experience and visualization of effects of single measures on machine behavior

Analysis of Energy Efficiency

- Potential of low weight materials in components (e.g. CFK)
- Influences on energy consumption
- Interactions between energy efficiency and dynamic as well as thermal behavior

Picture: aerostruktur, CADCON

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Conclusion and Outlook

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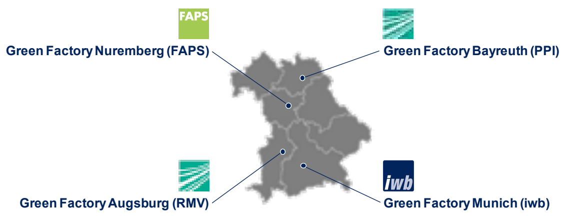
Conclusion

- Arising gap in Bavarian's energy supply due to German pull out from nuclear power
- Need for Bavarian companies to reduce energy consumption in production
- Technical and methodological knowledge has to be transferred to companies

Outlook

- Build up of four Green Factories in Bavaria at different sites
- Demonstration of different topics at each location
- Transfer of knowledge through seminars, green services, trainings, …

Green Factory BAVARIA



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Prof. Dr.-Ing. Vera Hummel

ESB Business School, Reutlingen University
We are one of Germany's leading international business schools, and one of the first state institutions to offer integrated international degrees, which ESB Business School has awarded for almost 40 years now. ESB Business School is part of Reutlingen University, a state-owned university in Baden-Württemberg. With nearly 60 professors and around 2,200 students, ESB Business School is one of the biggest business schools in Germany. For many years, ESB Business School has consistently been at the top of all league tables in the university rankings carried out by specialist journals and rating agencies. Reutlingen University offers international academic programmes with close ties to industry and commerce. Thanks to its living international dimension, values-based teaching and close collaboration with the business world, we enjoy an excellent reputation both within Germany and abroad.

Vera Hummel, Prof. Dr. Dipl.-Ing., is a professor at the ESB Business School, Reutlingen University since 2010 for logistic network design and planning.
Before she worked for Mercedes-Benz in Switzerland and in South Africa as well as for Fraunhofer IPA and the University of Stuttgart.
Currently she is leading the expert group of logistics at HSRT.
She also is the initiator - Construction of a „ESB logistics learning factory„ on the campus for education, research and training.
Her research, consulting and trainings topics cover process management, logistics, industrial engineering, quality management and business excellence.

Multi-Dimensional Networked Learning within the ESB Logistics Learning Factory – Innovative approach, teaching-learning concept and engineering project games

Prof. Dr.-Ing. Harald Augustin

Prof. Dr.-Ing. Harald Augustin, Deputy Dean at the ESB Business School at the Reutlingen University, studied mechanical engineering at the Technical University Karlsruhe, Germany, in France, Australia and Canada and finalized his PhD (Dr.-Ing.) at the Technical University Kaiserslautern.
His fields of research, teaching and training are factory and logistics systems, specialised in factory and warehouse planning, Digital Factory, Green Warehousing and Lean Warehousing. A main field of expertise are information and communication systems for the Virtual Collaborative Engineering.
In this subject he is head of the Virtual Engineering and Training Center VETC at the ESB Business School.

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Multi-Dimensional Networked Learning within the ESB Logistics Learning Factory – Innovative approach, teaching-learning concept and engineering project games

Multi-Dimensional Networked Learning within the ESB Logistics Learning Factory

2nd CONFERENCE ON LEARNING FACTORIES
Competitive production in Europe through education and training

May 10th 2012
Vienna University of Technology

Prof. Dr.-Ing. Vera Hummel
Prof. Dr.-Ing. Harald Augustin
ESB Business School
Reutlingen University

Hochschule Reutlingen
Reutlingen University

ESB Logistik Lern Fabrik

Overview

- Initial situation
- ESB Logistics Learning Factory Structure
- Innovative approach
- Teaching-learning concept
- Engineering project games
- Conclusion

ESB Logistik Lern Fabrik

ESB Logistics Learning Factory
Initial Situation

- **Change of the job profile** -> beside the classic tasks focused on logistics functions, more and more problem-oriented projects appear across the whole value chain
- Shortly after getting their bachelor and master certificates, graduates are already positioned in the **role of a project engineer**
- **Provision of connected learning contents** of the logistics from theory and practice - **on the scale of the project-, factory- and the network planning and design** - are, according to industrial partners and advisory board, necessary for the accomplishment of future challenges
- **Via professional business competence,** knowledge and action can be linked with regards to technical competence, method competence, social competence and individual competence, to ensure top rankings for ESB and to increase the attractiveness of the study programs
- **Requirement of an integrated factory** to cover an innovative learning environment for students, a training infrastructure for the industry, as well as a research centre for the advancement of technology, management and workflow in logistics to extent research activities

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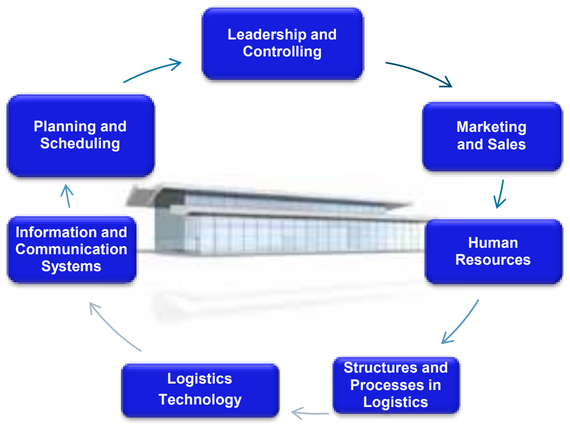
ESB Logistics Learning Factory
Integrated content

Factory areas:

- Marketing and Sales
- Product / Service Development
- Procurement
- Information Systems
- Process Engineering and Material Flow
- Industrial Engineering / Work Science
- Intake
- Storage
- Planning and Scheduling
- (light) Assembly
- Picking up the consignments
- Packing Area
- Distribution
- Yard Management
- Human Resource
- Finance and Controlling



Hochschule Reutlingen
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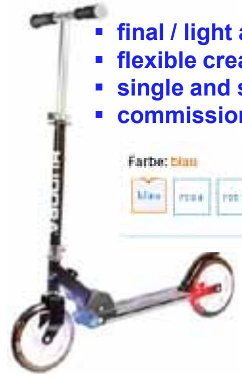
ESB Logistics Learning Factory
1. Products and Spectrum of Goods
2. Services: Support for logistics services (ramp up)

Cityroller Scooter HUDORA L205 with light(14599)



- **final / light assembly**
- **flexible creation of different models**
- **single and small batch series**
- **commissioning, packaging and distribution**

Spectrum of Goods

protective helmet

protective gloves

protective accessories

Logistics services (ramp up)

Conceptualization of:

- Consignment stock
- Replacement part logistics with 24/7 service
- Recall Logistics
- Packaging logistics
- Assembly and installation
- Product finalization
- Supply warehouse
- Reprocessing treatment

Source: http://www.lgi.de/branchen/electronics.html

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ESB Logistics Learning Factory
Process and Infrastructure Maturity modell

Extract

Procurement

RG	Beschreibung	Infrastruktur
1	Arbeitsplatz keine elektronische Beschaffungsinformationen	Arbeitplatz mit Dokumenten
		Liefeantenkataloge
2	Arbeitsplatz mit elektronischer Beschaffungsinformationen, automatsiche Bestandsführung, manuelle Bestellung	Arbeitplatz mit I&K
		Systeme zur Bestandführung
3	Arbeitsplatz mit elektronischer Beschaffungsinformationen, automatsiche Bestandsführung, workflow Bestellung	Arbeitplatz mit I&K
		Systeme zur Bestandführung
		Workflow-Management-System
4	n.v.	

Intake

RG	Beschreibung	Infrastruktur
1	wenig Info, Bestellinfo liegt nicht vor, Ware kann keinem Vorgang zugeordnet werden; MA sucht Info.	Arbeitplatz mit Dokumenten
		Fördermittel Hubwagen
2	Bestellinfo liegt vor, Ware kann identifiziert und zugeordnet werden, Einbuchung ins System	Arbeitplatz mit I&K
		ERP System
		Fördermittel s.o.
3	Bestellinfo liegt vor, Ware wird automatisch identifiziert und eingebucht	Arbeitplatz mit I&K s.o.
		RFID System
4	Bestellinfo liegt vor, Ware wird automatisch identifiziert und eingebucht sowie zum Lager befördert	Arbeitplatz mit I&K s.o.
		RFID System s.o
		Fördermittel automatisiert od FTS

Storage

RG	Beschreibung	Infrastruktur
1	manuelles ein- und auslagern, manuelle Bestandsführung, keine Lagerprinzipien	Arbeitsplatz, manuelle Dokumente
		Festplatzlagersysteme: Regallager, Blocklager,
2	Manuelles ein- und auslagern, Bestandsführung mit EDV , Verwaltung der Lagerplätze, chaotische	Arbeitsplatz, mit I&K
		Festplatzlagersysteme: Regallager, Blocklager,
3	teilautomatisches ein- und auslagern, Bestandsführung mit EDV , Verwaltung der Lagerplätze, chaotische Lagerplatzzuweisung, FiFo Proinzipien	Arbeitsplatz, mit I&K
		Festplatzlagersysteme: Regallager, Blocklager,
		RFID System
		Automatisches Lager (z.b: AKL)
4	Automatisiertes Ein- und Auslagern	Arbeitsplatz, mit I&K
		RFID System s.o
		Automatisches Lager (z.B Palettenregal mit RBG)

Maturity Model

ML 1 old fashioned, chaotic
ML 2 partial optimized
ML 3 lean, robust und sustainable
ML 4 automated (were applicable)

- **Input**
- **Learning goals**
- **Processes**
- **Instruments**
- **Know-How**
- **Output**

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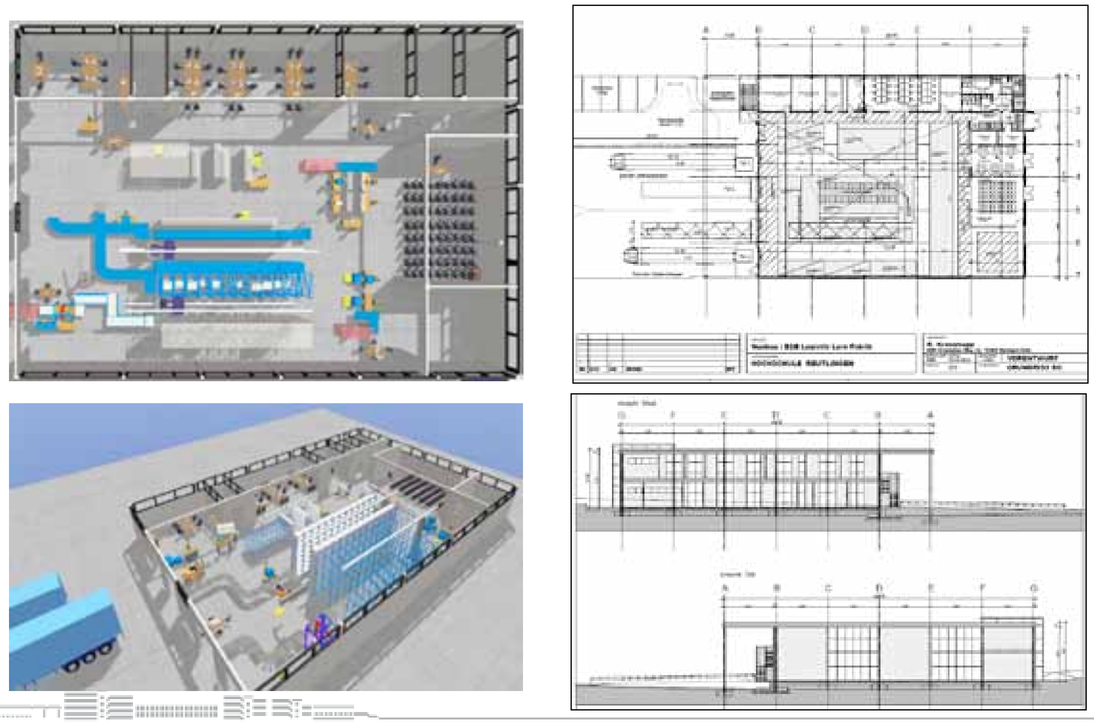
ESB Logistics Learning Factory
Processes, Infrastructure and Building



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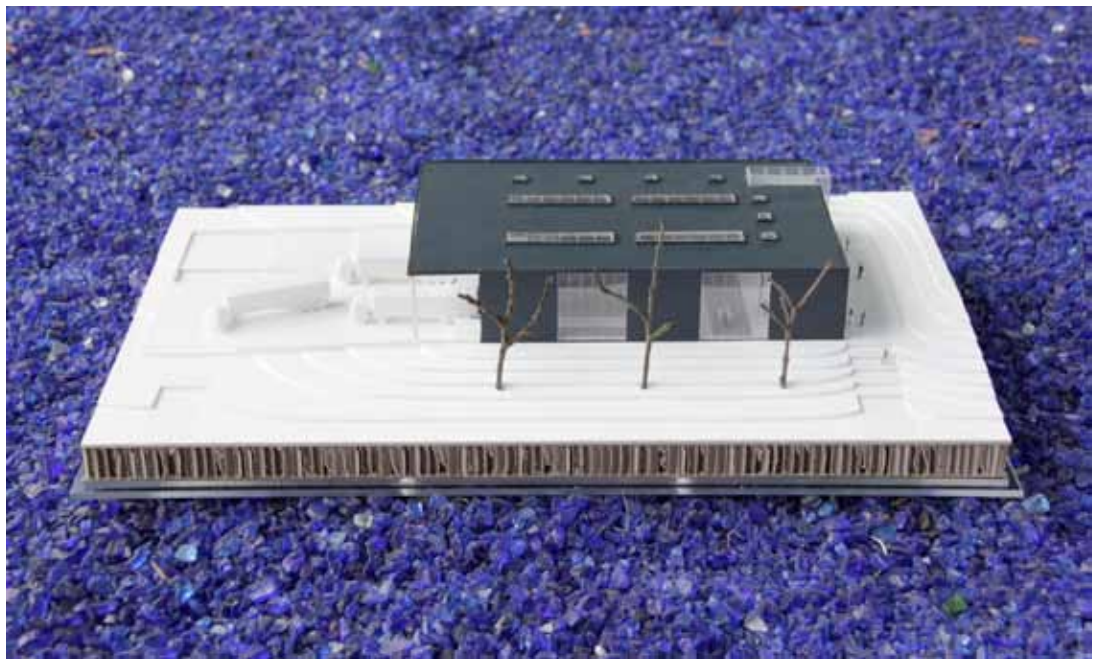
ESB Logistics Learning Factory
Factory Building- Architecture Model



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ESB Logistics Learning Factory
Factory Building- Architecture Model

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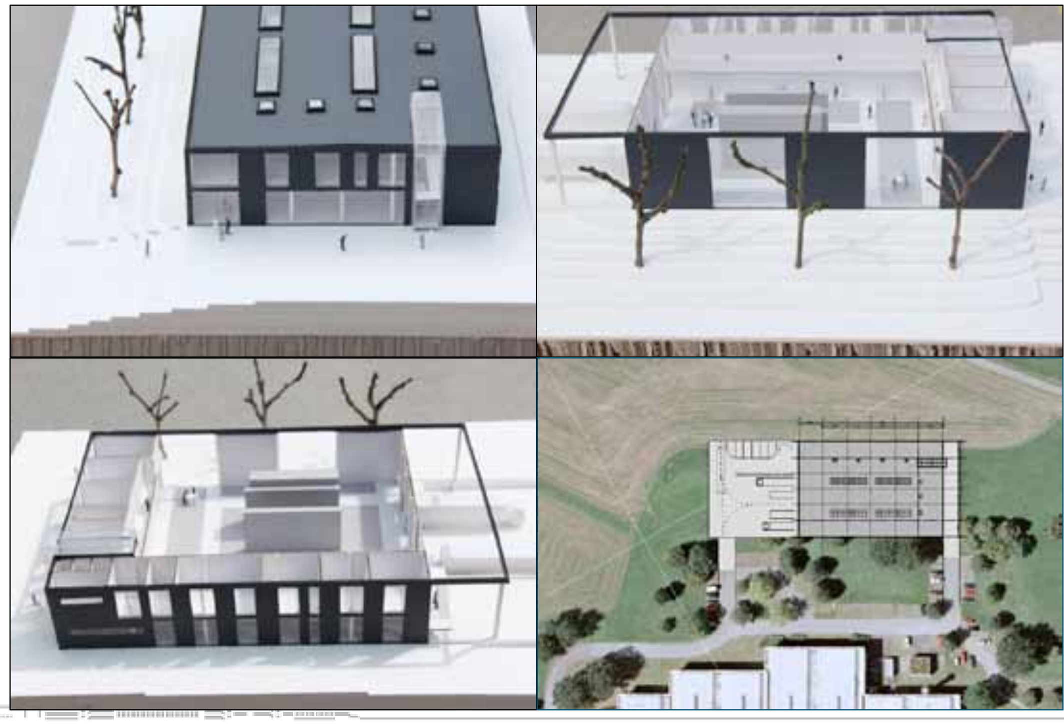
ESB Logistics Learning Factory
Factory Building- Architecture Model and Area Plan



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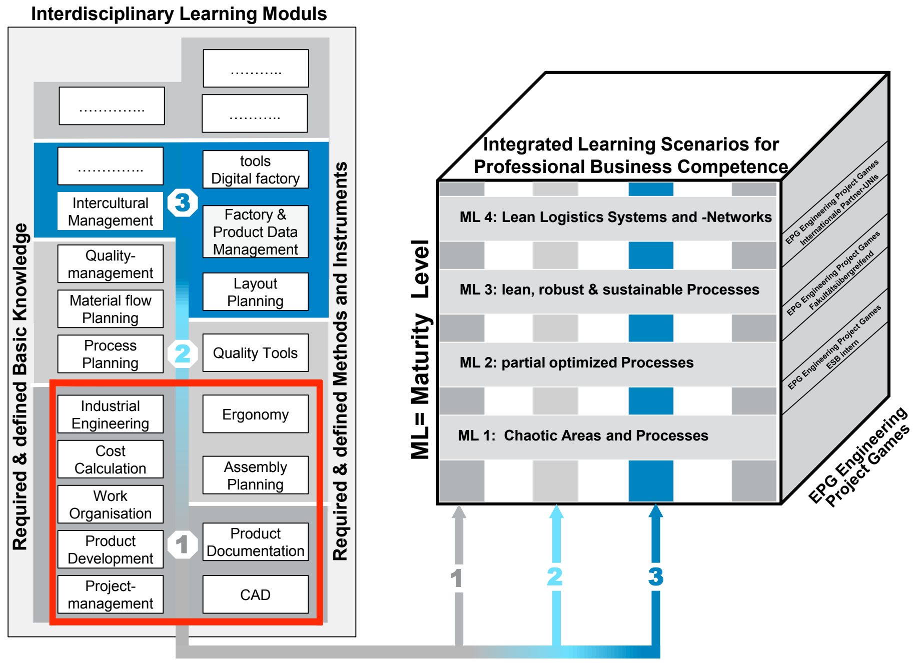
ESB Logistics Learning Factory
Multidimensional Networked Studying in the ESB LLF



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ESB Logistics Learning Factory
Interdisciplinary Learning Moduls

2.1 Theoretical knowledge	2.2 Best practice examples
Lecturing, presentation	Presentation
2.4 Self-Application	2.3 Self-Application on pre-defined examples
Engineering projects	

3 Engineering Project Games
Self applying in groups
- for a defined group of parts of the city scooter

2 Knowledge transfer for required methods and instruments
- Project management
- CAD & product documentation
- Part lists & working plan
- Time determination
- Costing

1 Basic Knowledge:
Lecturing, online-learning, self studying
- Product development
- Industrial engineering
- Work sciene,
- Cost calculation

Qualification Strategy

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ESB Logistics Learning Factory
EPG Engineering Project Games – Expertise and History

EPG Engineering Project Games

VLC Virtual Logistics Company

"When plans come to life"

VPC Virtual Production Company

	MinePlan	MINT	ViKoP (FIT 2011)	ViEECO ViPPER	ViEECO ViSLER I	ViEECO ViSLER II	EPG VLC / VPC
Implemen-tation	1994	1995-1998	1998-2003	2004	2004	2009	2011
Products	Truck axles	Truck axles	Truck axles	Pneumatic Valve	Printers & Plotters	Laptops	Laptops
Content	Factory planning	Factory planning	Factory planning	Product change management, factory planning	warehouse and factory planning	Transpor-tation, ware-house & factory planning, QM	International SC Design, warehouse & factory planning, QM
Location	local	international	international	international	international	international	international

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ESB Logistics Learning Factory
EPG Engineering Project Games – Planning Tasks

- Development of an European logistics strategy
- Transportation planning (pallets and parcels)
- Site planning with evaluation and site(s) selection
- Warehouse(s) planning
- Quality management / Risk management
- Factory / Assembly planning for several production lines
- Total cost and efficiency calculation
- Presentation of group results to the company managing board

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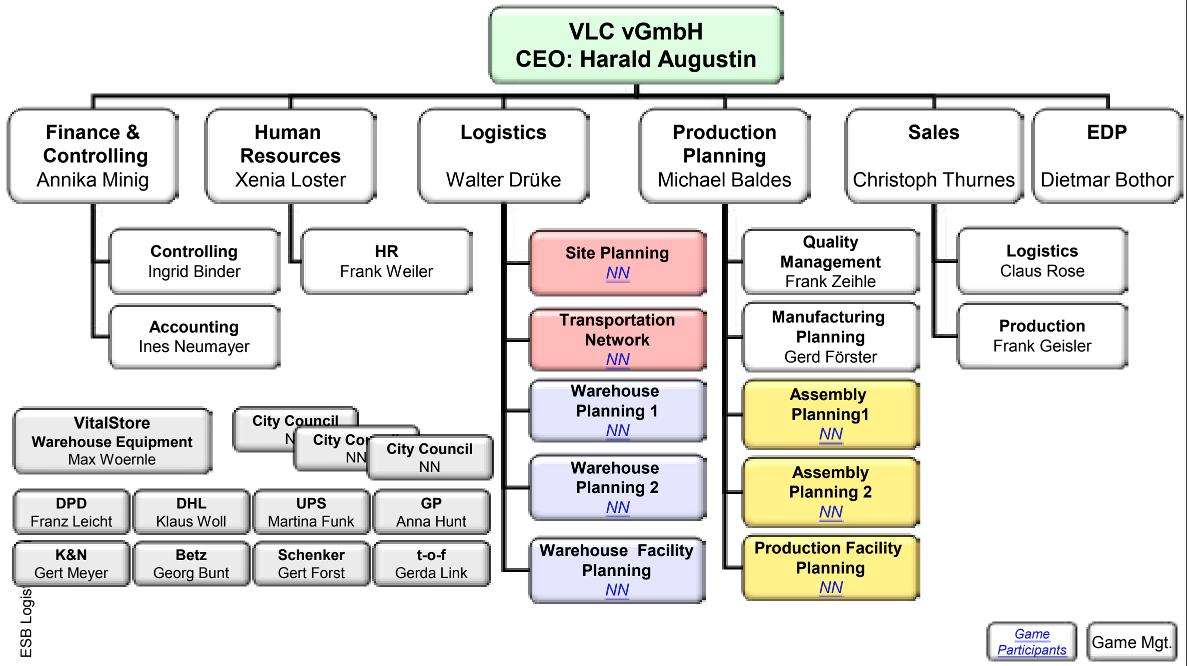
ESB Logistics Learning Factory
EPG Engineering Project Games – Virtual and Real Roles



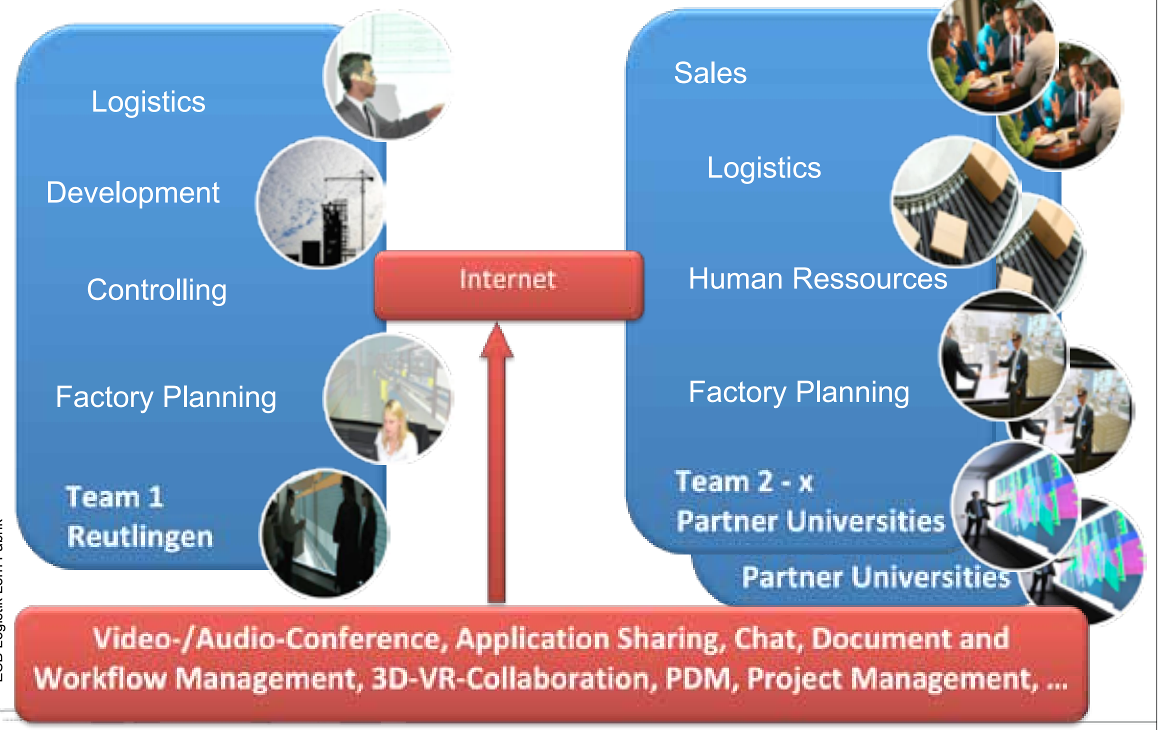
ESB Logistics Learning Factory
EPG Engineering Project Games – Virtual Organisation

Company intranet

Personalized Planning Data / Company Details and Management Announcements	Planner Handbooks and General Compendiums (Process description how to plan a factory and a warehouse)	Mediathek Factory, Production, Warehouse, Material Flow Technologies (Picture and video material for further explanation and planning support)

Information change during runtime

ESB Logistics Learning Factory
EPG Engineering Project Games – International communication via high-end internet technologies



ESB Logistics Learning Factory
EPG Engineering Project Games – applied technologies in EPG virtual teams

ESB VETC Virtual Engineering and Training Center

Communication Systems

Communication and Collaboration
- Polycom Multipoint Video-Conferencing with MCU (max. 25 participants)
- Daviko Video-Conferencing
- VisTable Collaboration Suite

Office Systems

Office and Project Management
- MS-Project
- ViFlow (process mapping)
- MS-Office (Visio, Powerpoint, Excel, Word)

Planning Systems

Product Development
- CatiaV6
- PTC ProductView (3D viewer)
- Powerwall: ICIDO

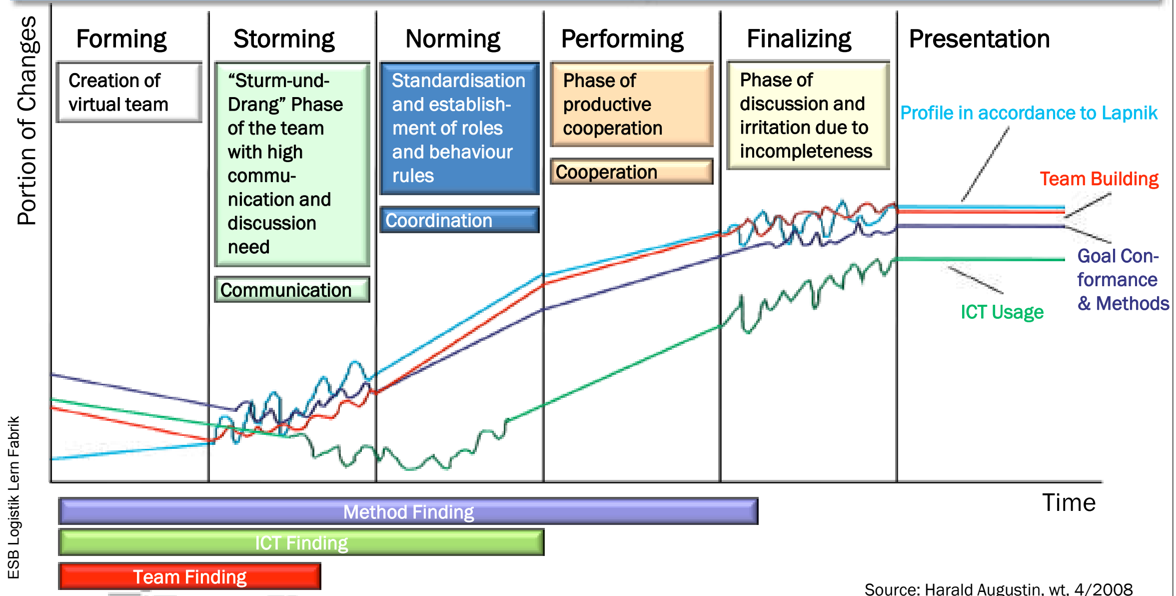
Product / Project Data Management
- Delmia V6 / Enovia
- BSCW

3D-Concept and Planning
- VisTable 3D Layout Planning
- 2 Planning Tables 50" Plasma Touch Screens
- Tarakos 3D Logistics System Planning
- Delmia V6 3D Factory Planning
- Powerwall ICIDO immersive VR Powerwall 6x3m
- A.R.T. Tracking System
- Digital Smartboard

ESB Logistics Learning Factory
EPG Engineering Project Games – Experiences

ESB LOGISTIK-LERN-FABRIK

Experience the 4th dimension of international Factory / Warehouse Planning



Source: Harald Augustin, wt, 4/2008

Conclusion

ESB LOGISTIK-LERN-FABRIK

- ESB LLL is an initiative of 10 Professors (Fachgruppe Logistik)
- Core team of 3 Professors: lead **Prof. V. Hummel, Prof. H. Augustin**, Prof. W. Echelmeyer, ESB LLF is integrated in the SEP (strategy development plan)
  → Vision: the **New Factory will be established by 2014** on the campus
- Building, infrastructure and business modell are worked out. **Financial requirements are identified.**
- **Sponsoring concept** for the factory building is available (Platin, Gold and Silver sponsor)
- **Different sources for financing** the infrastructur as well as for the development of learning modules and scenarios **are identified** and are applied for.
- The **master study programms will be from 2013 a „project oriented programm**" (3 semesters) Projects will be run with industry & necessary theoretical and methodological Know-How will be provided by the professors
- The **bachelor study programms** are **under investigation** and will be project oriented as from 2014 onwards

ESB Logistik Lern Fabrik

Block I
Universities

Block I I
Industry

Block I I I
Learning and Innovation Factory of the Vienna University of Technology

Dipl.Ing. Rudolf Hamp

Rudolf Hamp studied mechanical engineering in Vienna and after his graduation he worked as teacher and consultant.
In 1981 he started his career in the engine and transmission plant in Vienna-Aspern and soon he managed the material and production control. In 1988 he took an assignment in Rüsselsheim. Hamp returned to Vienna as manager manufacturing services and in this function – and later on as plant manager – he implemented the lean manufacturing concept. Aspern took over a leading role in lean manufacturing and thus he founded the reputation of the plant as a benchmark powertrain plant of the world. During his direction the first important plant expansion of the 5-speed transmission plant and the cylinder head production was carried out.
In 2000 Rudolf Hamp was assigned as plant manager in Szentgotthard, Hungary, and developed the plant to a measure of production processes to increase quality and productivity. The plant was honored with the JIPM Award of the Japan Institute for Plant Maintenance in 2004 and the Quality Award of the European Foundation for Quality Management in 2006.
From October 2005 to August 2011 Rudolf Hamp was general manager of Opel Wien. He led the ramp-up of the newly built 6-speed transmission and the start of production of the third generation of the ECOTEC engines (in 2009) and the turbo engines (2010).
As of December 2011 Hamp is member of the Advisory Board of Opel Wien GmbH.

Every second powertrain, the heart of Opel or Vauxhall vehicles, comes from Vienna. In the three decades since start of production, Opel Vienna has continuously set standards in quality, reliability and productivity and, through its consistent implementation of downsizing technology, shows that its product portfolio is more than trendy. Opel Wien GmbH has 1,950 employees and with its annual production of 1.55 million units, it is the largest General Motors Powertrain plant in the world. From start of production in 1982 up to now about 32 million engines and transmissions were produced. The main customers are still the Opel plants in Europe. However, because globalization is ever progressing, customers now are situated in Brazil, Mexico, the USA, China, South Korea and Australia and, as of 2012, also in South Africa and India.

Wir leben Autos.

Learning shopfloor – continuous improvement

Welcome to the learning shopfloor of Opel Wien

Wir leben Autos.

Plant Aspern

Home of a strong team

Learning Factories – Learning Shopfloor

Content

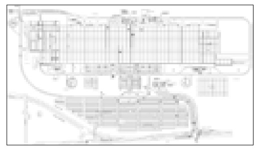
1. Introduction of Opel Wien GmbH
2. Importance of People to be competitive
3. Living examples at Opel Wien
4. Summary

2 R. Hamp - Opel Wien GmbH

Introduction of Opel Wien GmbH

Opel Wien GmbH

Plant Aspern



Facts & Figures 2011

Currently ~ 2000 employees work at plant Aspern

Production	
Engines	603.188
5-gear transmissions	514.549
6-gear transmissions	432.421
Total	1.552.003

Production cumulative (1982 – 2011)	
Engines	11,8 Mill.
Transmissions	21,0 Mill.
Total	32,8 Mill. engines and transmissions

Products 2012

	M20/32 transmission 6– gear manual + MTA	F17 transmission 5- gear manual + MTA	TWINPORT ECOTEC engine 1.0 / 1.2 / 1.4 / Eflex / 1.4 Turbo
Variants	74	51	47
Customers			
GME	Opel/Vauxhall Saab	Opel/Vauxhall	Opel/Vauxhall
GMIO	Opel, Chevrolet, Buick, Holden	Opel, Chevrolet	Opel, Chevrolet
GMNA	Chevrolet	Chevrolet	Chevrolet
GMSA	Chevrolet	Chevrolet	

Global customers

Volums distribution: 30% GME: 70%

Importance of People to be competitive

Opel Wien

Importance of people to be competitive

A production plant

– In a very competitive global business

– In a high cost country, without strong home market

– Manufacturing factors

- Machine, Material } no competitive advantage, accessible to everybody, everywhere
- Method, Man } competitive strength, must be developed in the plant

Our strength are our people

Learning Factories – Learning Shopfloor

Importance of people to be competitive

Applying the Power of people in all areas and levels

– There is no factory without people

– All new methods, technologies and systems are developed and applied by people

– Sustained execution and improvement of processes based on people

Skills, competences, continuous improvement, people involvement and development are key to be competitive

Developing people and organization

A never ending Process

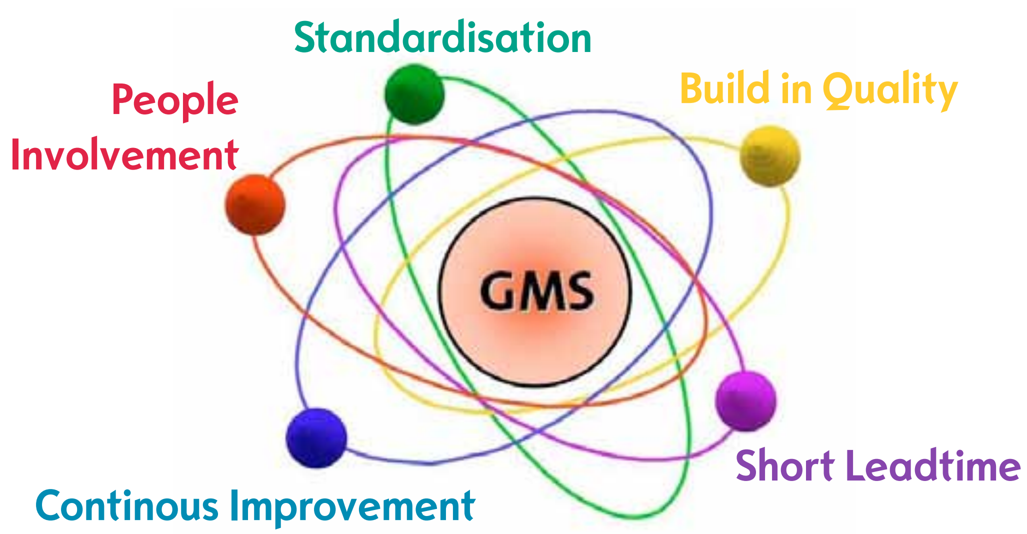
Our Evolution:

- Teamorganisation since 1981
- Strong suggestion system
- Systematic CIP since 1989
- Policy deployment (Hoshin Kanri) since 1993
- A strong set of improvement tools
- One integrated production system – GMS
- Consequently executed in daily live

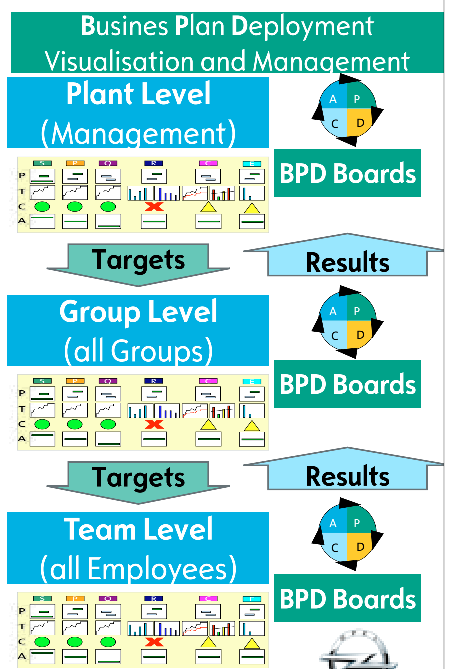
Many setbacks and Lessons Learned

Living examples at Opel Wien

Global Manufacturing System

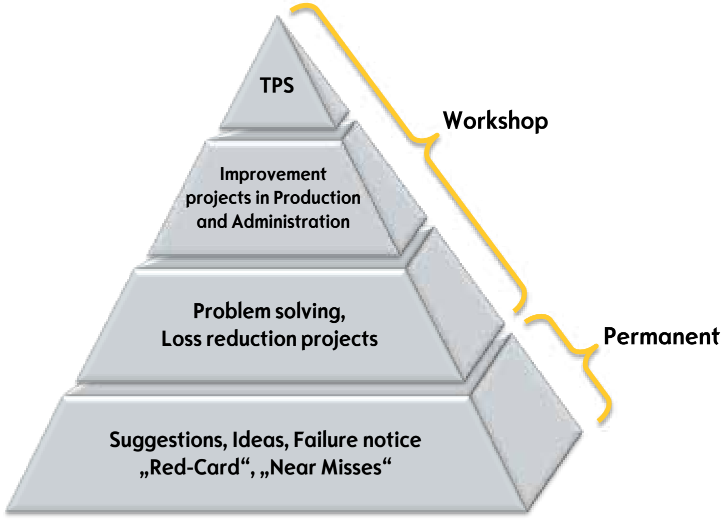


Business Plan Deployment



Continuous Improvement

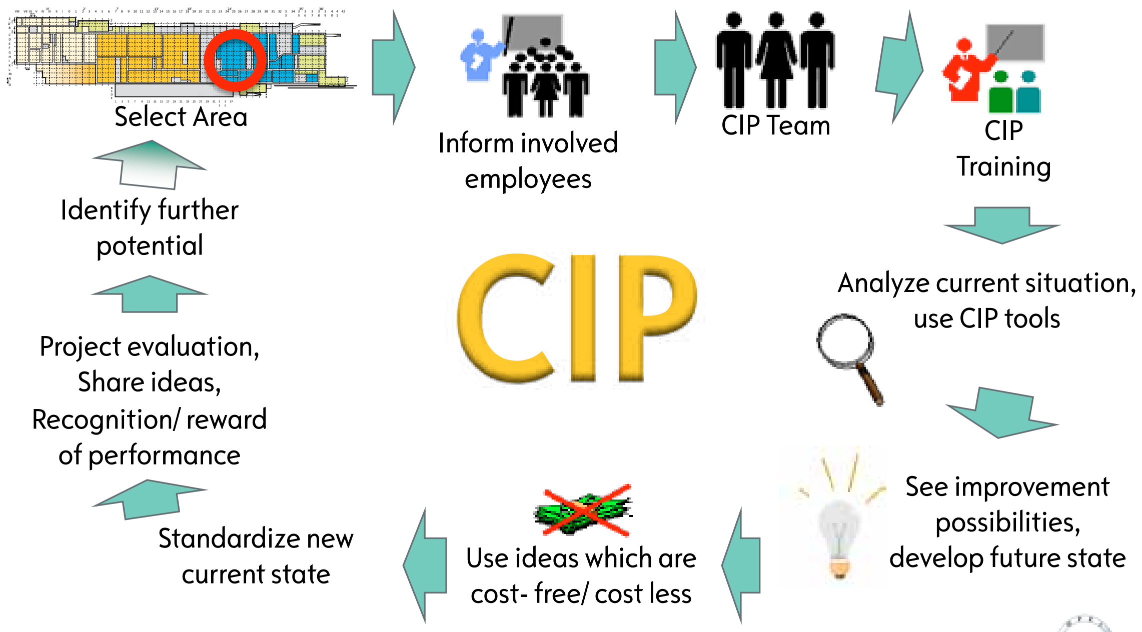
Implementation and Tools



EVERY EMPLOYEE IS PART OF THE CONTINUOUS IMPROVEMENT PROCESS

15 R. Hamp - Opel Wien GmbH

Continuous Improvement Process(CIP)



16 R. Hamp - Opel Wien GmbH

CIP – Creativity and Innovation

Standardized process and frame conditions

- Clear roles and responsibilities
- Well defined process (content and time wise)
- Clear definition of rewards (Bonuses etc.)
- Support and coaching by specialists from service areas

17 R. Hamp - Opel Wien GmbH

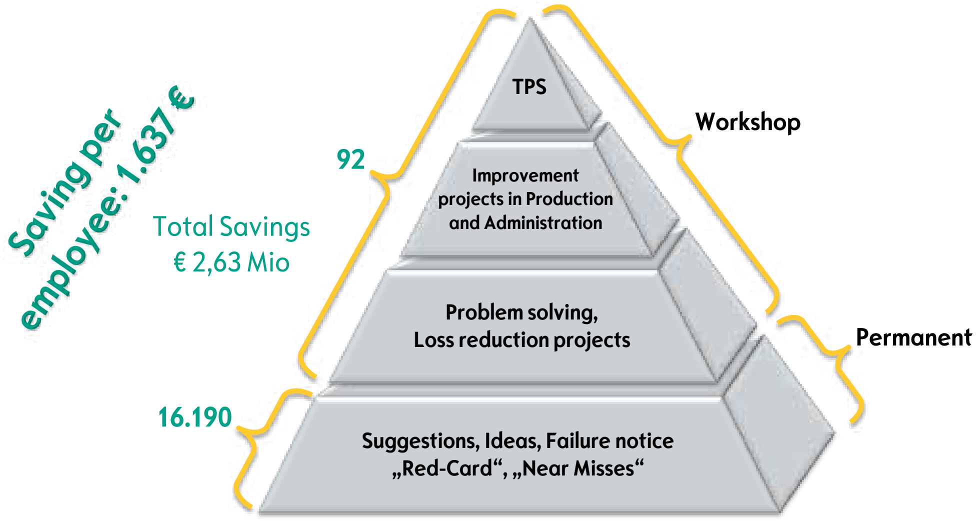
Value Stream Mapping Workshops

18 R. Hamp - Opel Wien GmbH

CIP Example

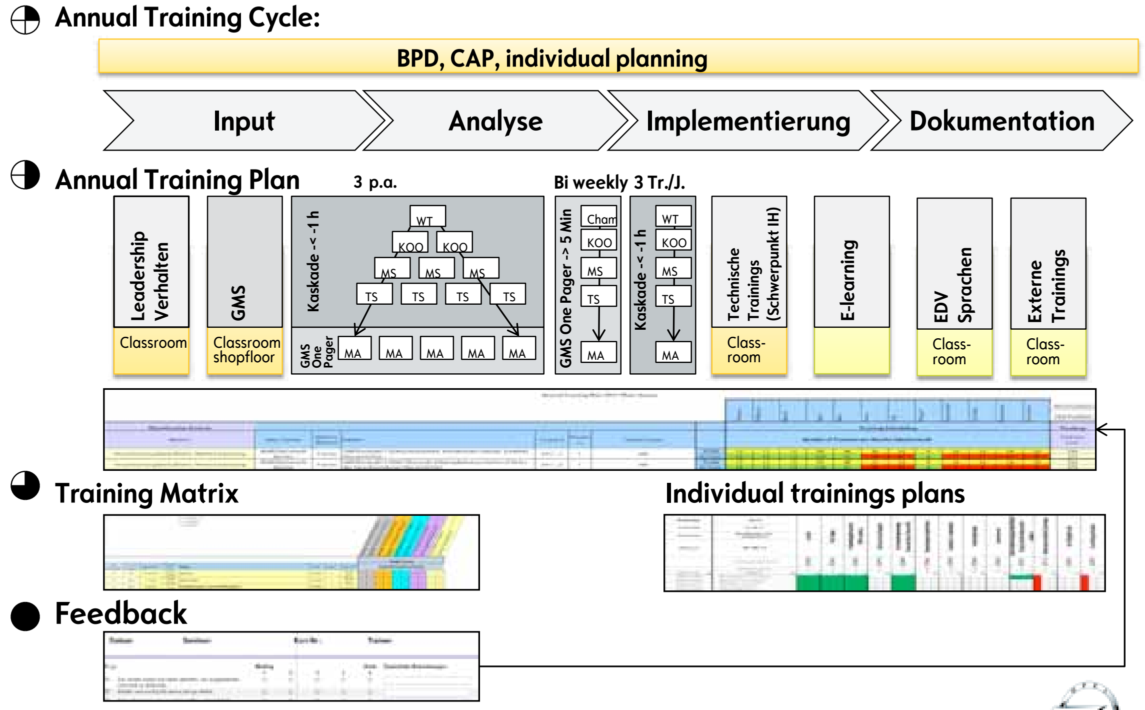
Continuous Improvement

Tools and Results 2011



EVERY EMPLOYEE IS PART OF THE CONTINUOUS IMPROVEMENT PROCESS

Training concept



Summary

Learning Factories – Learning Shopfloor

Summary

- Continuous improvement requires continuous learning and development of people - this is a must to be competitive.
- It needs to be lived by everybody, everyday.
- It is a „FITNESS PROGRAM“ for the company, to be ready for future challenges.
- It is like the personal fitness – **you can't buy it** – you have to work on it personally and in the team. So you have to develop it in the company.
- Partnerships with universities and other organizations can provide a strong support and access to new methods and processes.

The company can never be better than its people!

23 R. Hamp - Opel Wien GmbH

Thank you - for your attention

Wir leben Autos.

DI (FH) Frank Werz, MBA

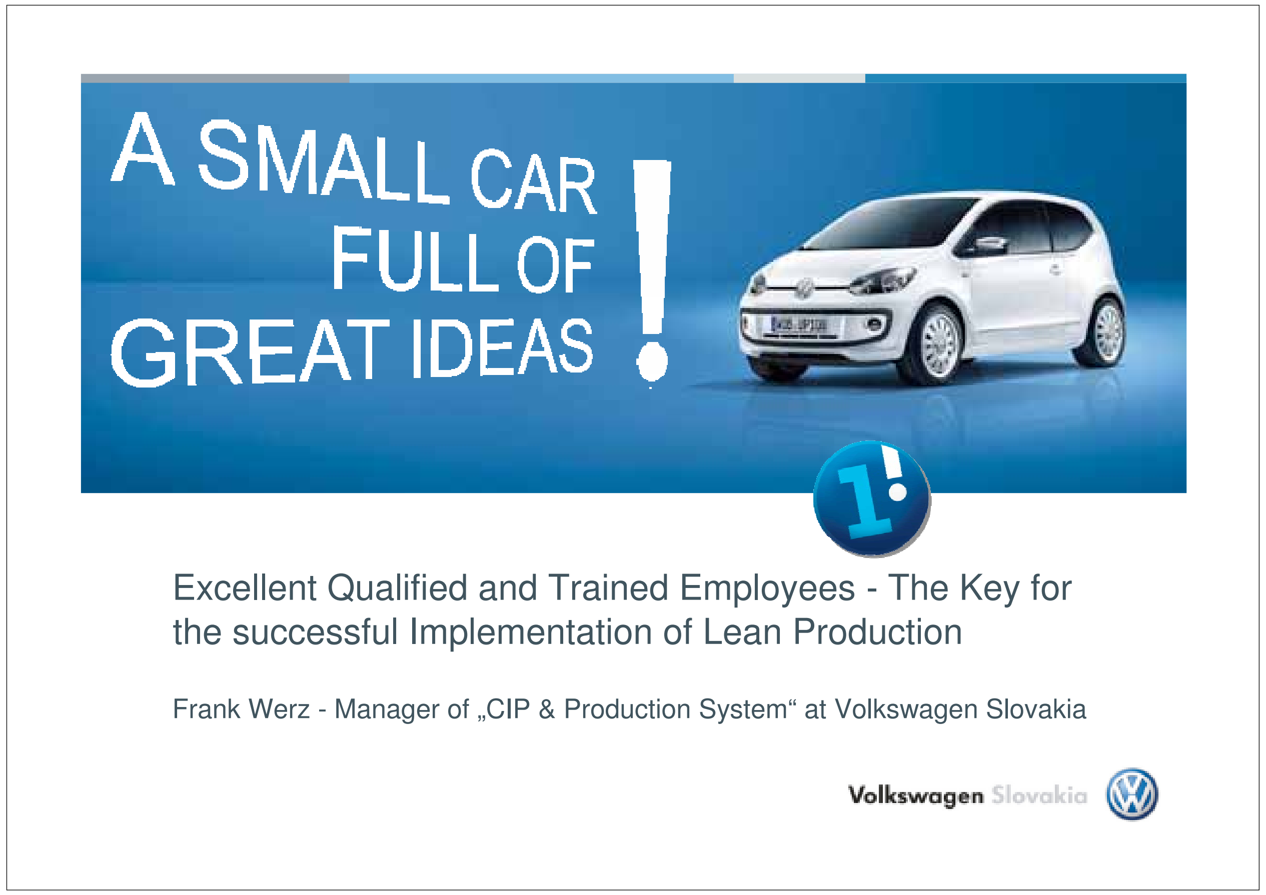
Head of CIP and Production System Volkswagen Slovakia a.s., Bratislava

After completing his studies as a graduate engineer for production technology at the University of Applied Science in Ulm / Germany he continued as a postgraduate with the Master of Business Administration. While being abroad he has gained a great knowledge and international experience in Mexico, USA and in Japan. Which he is applying at his current position. After graduating he worked as logistics planner at AUDI AG headquarter in Ingolstadt. His responsibilties included logistic-planning and calculation as well as establising and developing logistic and optimization activities. In 2004 he invented the new improved method to realize a lean production in Audi, it was a great achievement and based on this success these methods are used in each and every plant of Volkswagen Group worldwide.

In June 2008 he joined the team of Volkswagen Slovakia a.s. as a head of “CIP and production system”. Since then he is in charge of leading and extending this organizational unit through the establishment and further development of the continuous improvement process in all areas. Thanks to Frank Werz and his dedicated and hard working team Volkswagen Slovakia have won the Automotive Lean Production Award for the year 2011 – for the best car-manufactoring plant in Europe. This is the first and only award for the Volkswagen brand ever in the history.

Volkswagen Slovakia was founded in 1991. In 1992 the production of the Volkswagen Passat Variant was established and the story of a successful and exemplary company began. In the plants in Bratislava and Martin, cars, gearboxes and components are made. Currently the production of the SUV class, such as the Volkswagen Touareg, Audi Q7 and the body of the Porsche Cayenne take place in Bratislava. Since 2011, this plant has also been used for the production of the New Small Family featuring the Volkswagen up!, Škoda Citigo and SEAT Mii. With a total production capacity to 400,000 vehicles a year and 8400 employees, Volkswagen Slovakia is one of the biggest employers in Slovakia as well as one of the biggest exporters.Last year Volkswagen Slovakia won the prestigious “Automotive-Lean-Production-Award” in the category “OEM”.

Excellent Qualified and Trained Employees - The Key for the successful Implementation of Lean Production


A SMALL CAR
FULL OF
GREAT IDEAS!
Excellent Qualified and Trained Employees - The Key for the successful Implementation of Lean Production
Frank Werz - Manager of „CIP & Production System“ at Volkswagen Slovakia
Volkswagen Slovakia


What is necessary to prepare a country or a team
to win a football championship?
number one.
Volkswagen Slovakia

Agenda

1 Volkswagen Group and Volkswagen Slovakia
2 Internationally Standardised Group Production System (GPS)
3 The Way for Qualified and Trained Employees – Training Centers
4 The successful Result

number one. Volkswagen Slovakia

Production plants

62 production plants worldwide

number one. Volkswagen Slovakia

1 Volkswagen Group and Volkswagen Slovakia

number one. Volkswagen Slovakia

From Volkswagen Brand to Volkswagen Group

number one. Volkswagen Slovakia

Volkswagen Group

Volkswagen Company is with its 10 brands the biggest car producer in Europe.

Global market share	12,3 %	(11,3 %)
Profit after tax	15.799 mil. €	(7.226 mil. €)

Year 2011, year 2010 in brackets

number one.

Volkswagen Slovakia

Volkswagen Group
Year 2011

501.956
employees

number one.

Volkswagen Slovakia

Volkswagen Group
Year 2011

8.494.280
produced cars

number one.

Volkswagen Slovakia

Volkswagen Group
Year 2011

34.500
vehicles produced per day

number one.

Volkswagen Slovakia

Volkswagen Group
Year 2011

240+
models

Volkswagen Slovakia
Year 2011

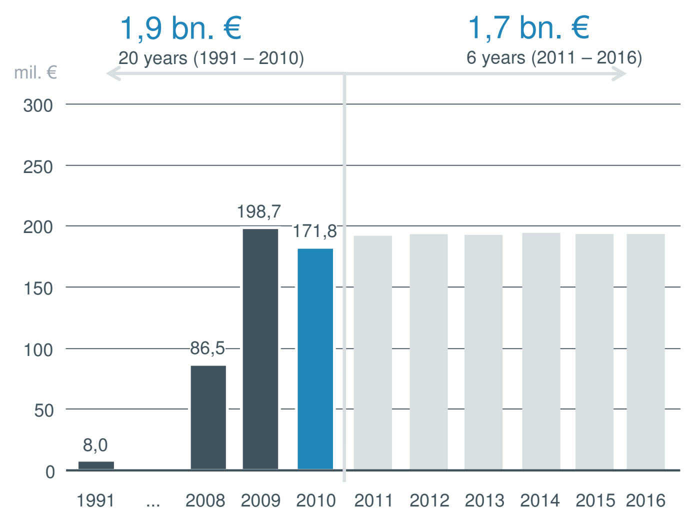
8.400 employees *	210.441 vehicles	401.000 gear boxes	34.000.000 components

*Status of 31st December 2011

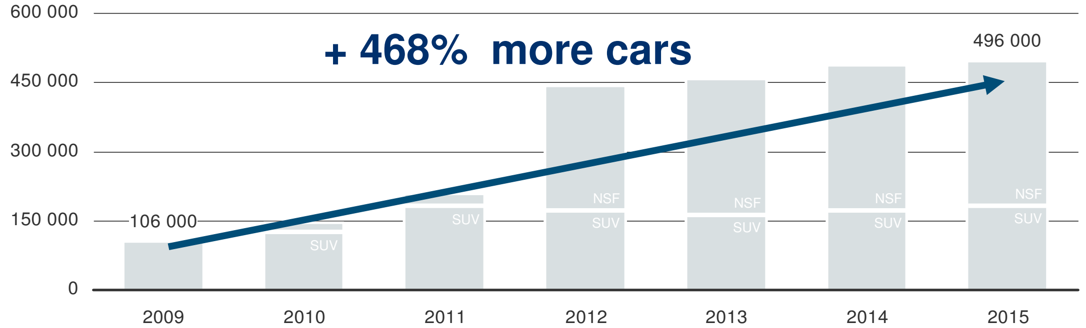
Products produced in Slovakia

Volkswagen Touareg	New Small Family	Audi Q7	Porsche Cayenne	Gear boxes and components

Investment
Outlook until 2016



Challenges – Production volume



Increasing number of employees

number one. 1

Volkswagen Slovakia

2 Internationally Standardised Group Production System (GPS)

number one. 1

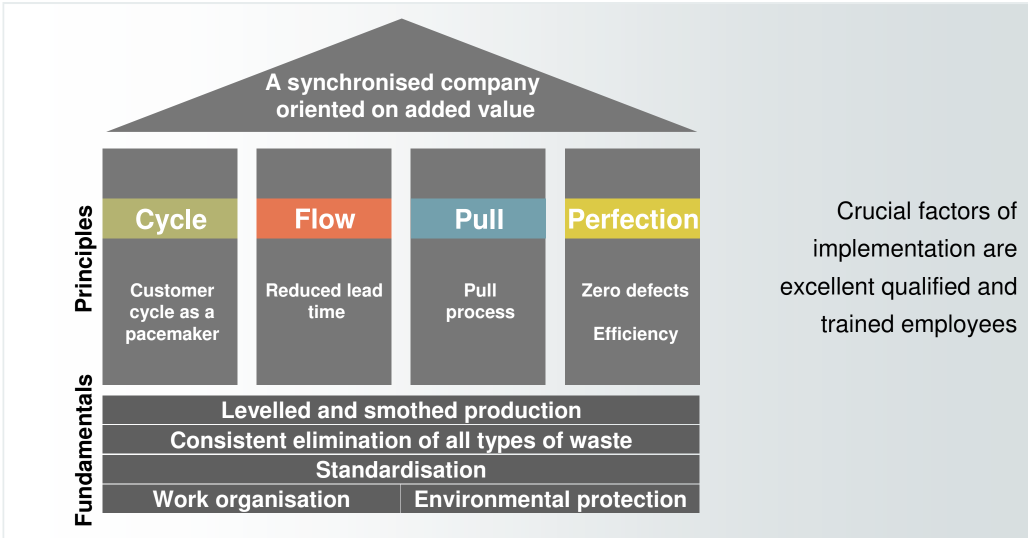
Volkswagen Slovakia

number one. 1

Volkswagen Slovakia

Group Production System (GPS)

Realisation of a lean, value-orientated production



...by the implementation of the concern production systems!

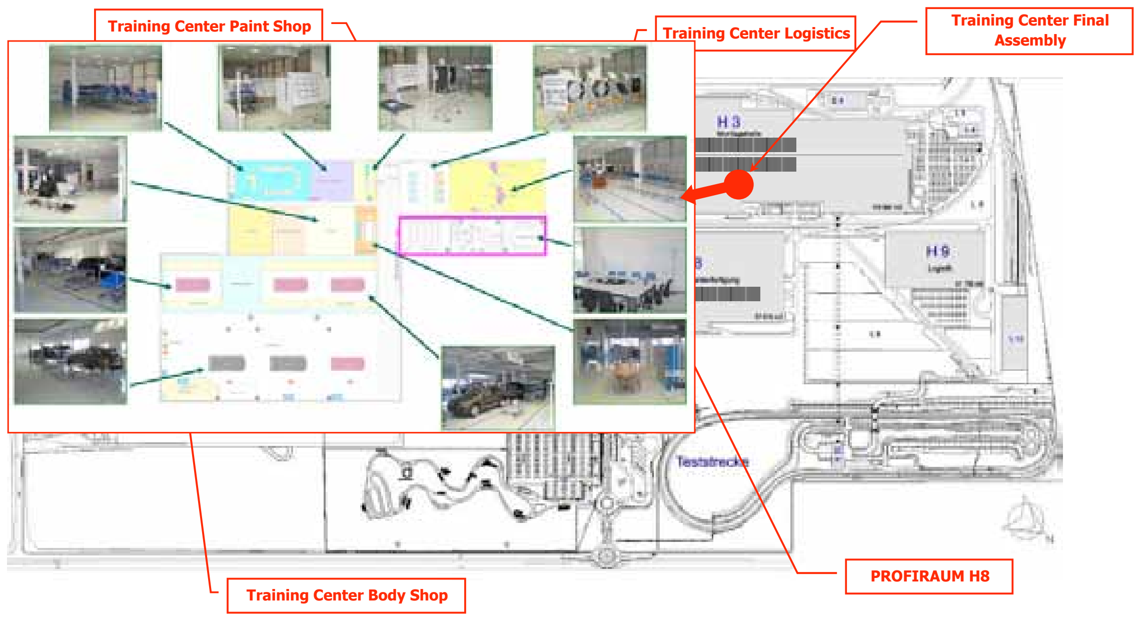
number one. 1

Volkswagen Slovakia

3 The Way for Qualified and Trained Employees – Training Centers

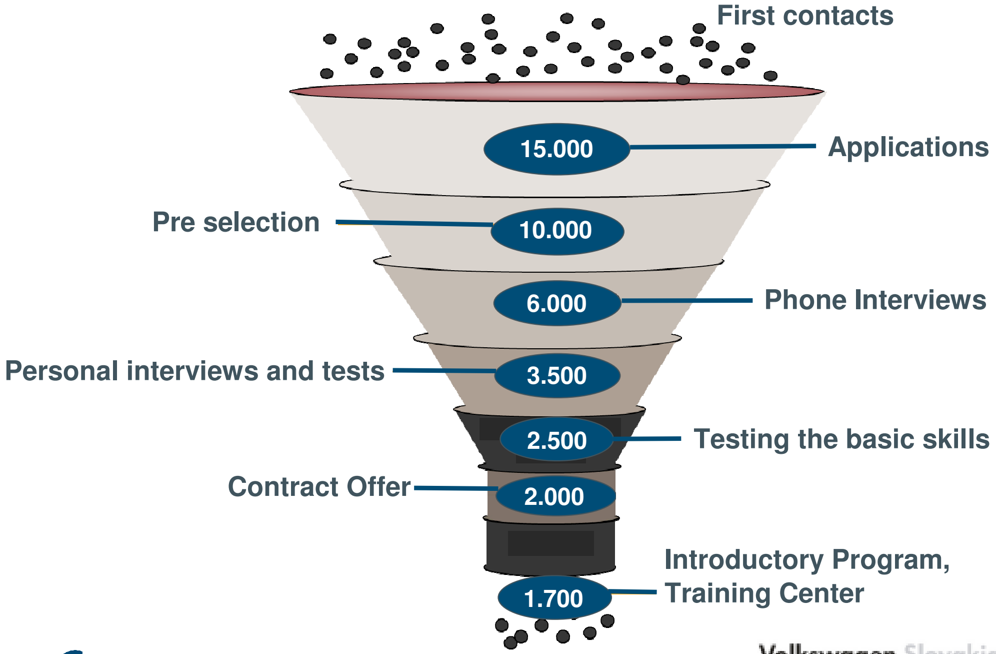
number one. Volkswagen Slovakia

Training Centers VW Slovakia - Location



number one. Volkswagen Slovakia

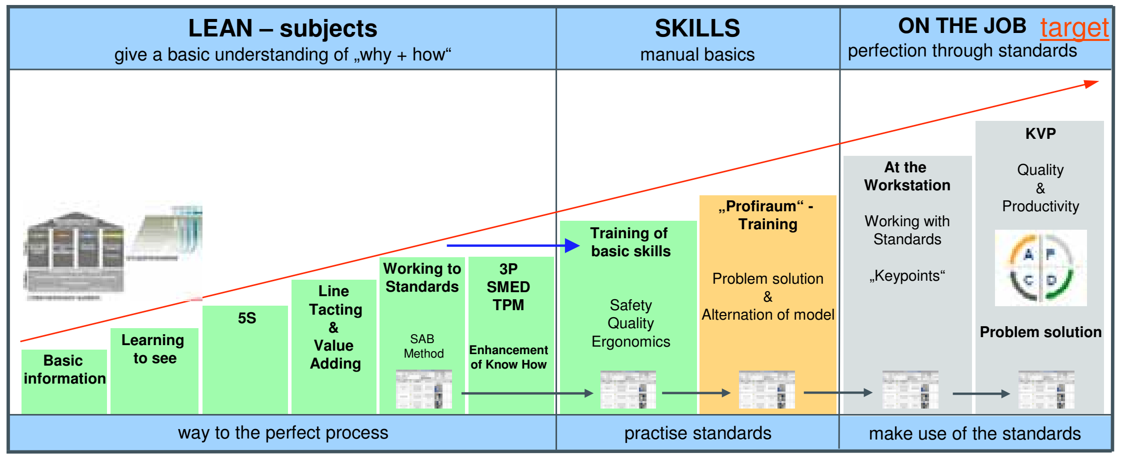
Selection Process



number one. Volkswagen Slovakia

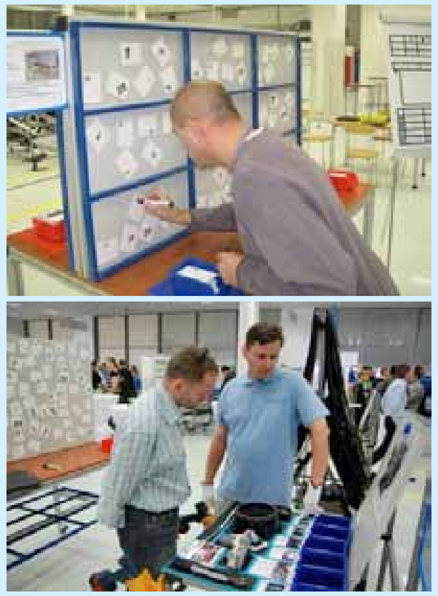
Modules of Training & Objective Target
Systematic Procedure for New Employees

„The focus on a target is measurable through positive results at the shopfloor“



number one. Volkswagen Slovakia

Lean Subject

Lorry Game	5S Game
	

number one. 1

Volkswagen Slovakia

On The Job

number one. 1

Volkswagen Slovakia

Fundamental Skills

Warm-Up	Screwdriver	Aspects
		Ergonomics Quality Safety at work

number one. 1

Volkswagen Slovakia

Enhancing Qualification of Consisting Employees..

…through several additional qualifications

- Raise consciousness for quality – passion for detail
- Training of difficult and challenging operations
- Issue-specific training (surface, quality-approval, EC-screwdriver)
- Problem-solving-strategies

number one. 1

Volkswagen Slovakia

The Key Points for the Successful Implementation of Lean Production

- Selection and testing
- Training of each employee
- Specific Training Centers of each Area
- Intensive Education
- Standardised Education for everbody

number one. 1!

Volkswagen Slovakia

4 The successful Result

number one. 1!

Volkswagen Slovakia

Lean Award 2011

Category OEM

AUTOMOTIVE LEAN PRODUCTION

Volkswagen Slovakia as winner

in the category OEM

number one. 1!

Volkswagen Slovakia

Thank you for your attention!

Volkswagen Slovakia

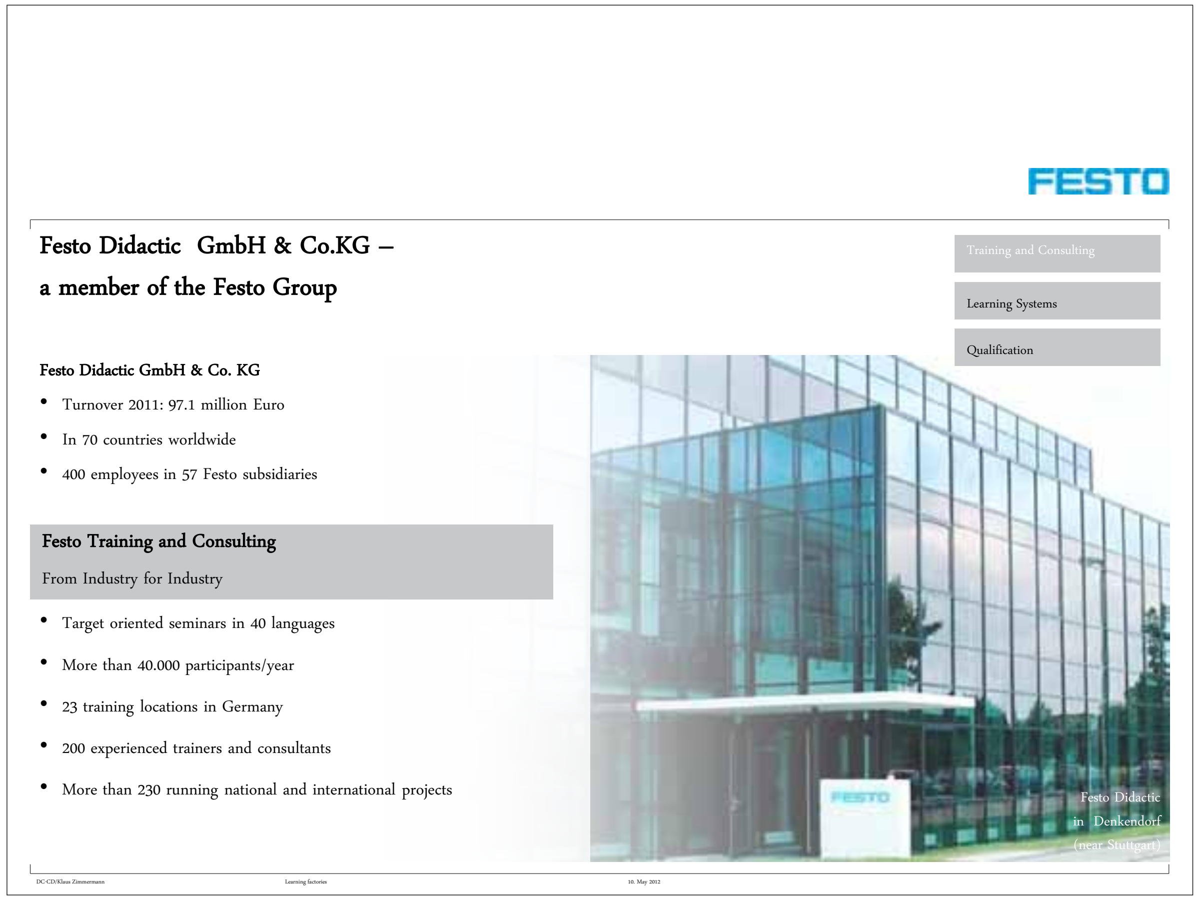
Klaus Zimmermann

Klaus Zimmermann has held the position of Head of Training and Consulting with Festo Didactic GmbH & Co. KG since 1998. In this position he is responsible for all of Festo Germany's training and consulting activities. With more than 50 trainers and consultants, both employed and freelance, Festo has been an important player in the field of consulting, expert monitoring and competency development for almost 50 years. Klaus Zimmermann favours a holistic approach, attributing equal importance to the factors people, technology and organisation in order to develop successful and sustainable solutions for the customer.Following technical vocational training, Klaus Zimmermann studied Company and Management pedagogics. He is co-author of the book "Change Management in Production"(MI publishing).

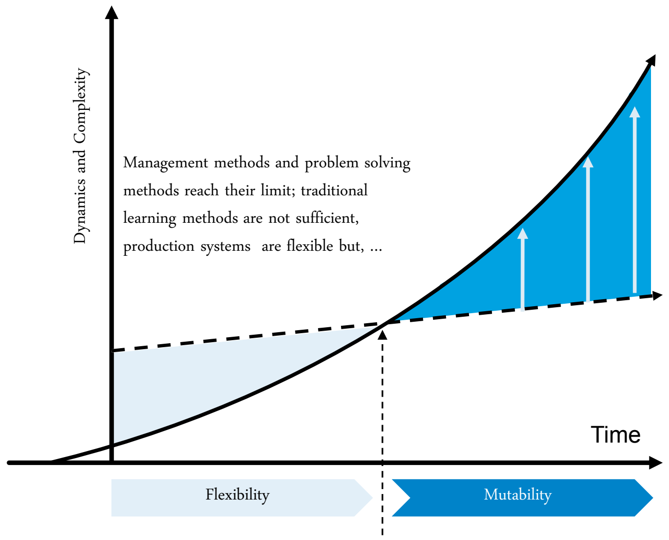
Festo stands for technology, innovation, efficiency, and reliability in 176 countries throughout the world. This is true for both Festo products and its portfolio of services.Festo Didactic is a worldwide leading provider of professional, industry-oriented qualification solutions for process and factory automation.Learning Systems:From technology-oriented training packages to learning factories, software, teachware and fully equipped turnkey learning centres for schools and universities. Training and Consulting:Approx. 42,000 course participants per year attend more than 2,900 courses.Modular and quality-assured training content in 40 languages.Industrial consulting projects in the areas of product development, Lean production, procurement and logistics. From industry, for industry: Festo Training and Consulting combines many years of experience and recognised competency in manufacturing with didactic know-how to support its customers in developing value added systems of peak efficiency.

Sometimes cold or wide, sometimes fast or dark - boosting changeability by learning factories


Sometimes cold or wide, sometimes fast or
dark – boosting changeability by learning factories
„I don't know if it will be better if it's different.
But it must be different if it is to be better.“
Georg Christoph Lichtenberg
Klaus Zimmermann
Head of Training and Consulting
Festo Didactic GmbH & Co. KG, Denkendorf
Represented results based on the research project of WaProTek.
Promoting Versatility of Process Architecture.
Project was supported by the ministry of Education and Research.


FESTO
Festo Didactic GmbH & Co.KG –
a member of the Festo Group
Training and Consulting
Learning Systems
Qualification
Festo Didactic GmbH & Co. KG
• Turnover 2011: 97.1 million Euro
• In 70 countries worldwide
• 400 employees in 57 Festo subsidiaries
Festo Training and Consulting
From Industry for Industry
• Target oriented seminars in 40 languages
• More than 40.000 participants/year
• 23 training locations in Germany
• 200 experienced trainers and consultants
• More than 230 running national and international projects
Festo Didactic
in Denkendorf

Increased dynamics and complexity as a future challenge for enterprises

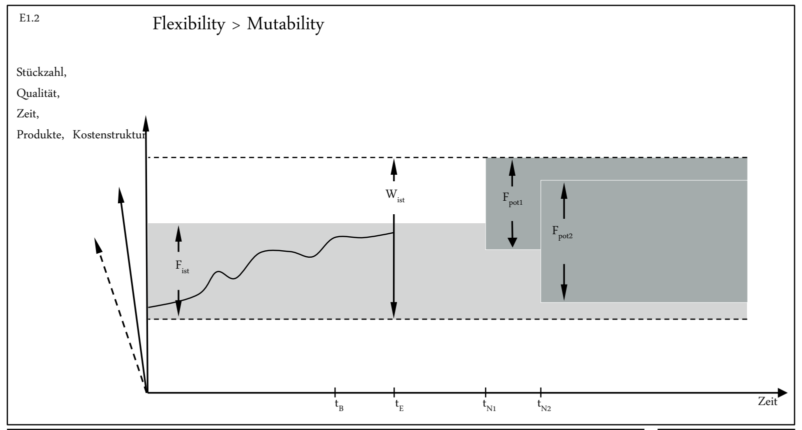


Mutability driver

- **Climate & Environment:** Increasing importance of natural ressources and energy efficiency
- **Economy:** Globalisation, higher and increasing variations in demand, new technologies, ...
- **Society:** Demographic change, change in social strcuture, changing customer behaviour
- **Learning:** Lack of ability to cope with increased complexity and dynamism

DC-CD/Klaus Zimmermann Learning factories 10. May 2012

To be flexible is not enough . ..



F_{ist}: Ist-Flexibilitätskorridor	F_{pot}: Potenzieller Flexibilitätskorridor
W_{ist}: Wandlungskorridor	t_N: Beginn der geplanten Wirkung einer Maßnahme
A: Aktivierungsaufwand	t_E: Entscheidung über Wandlungsmaßnahmen
E: Systemebene	t_B: Erkennen des Wandlungsbedarfs

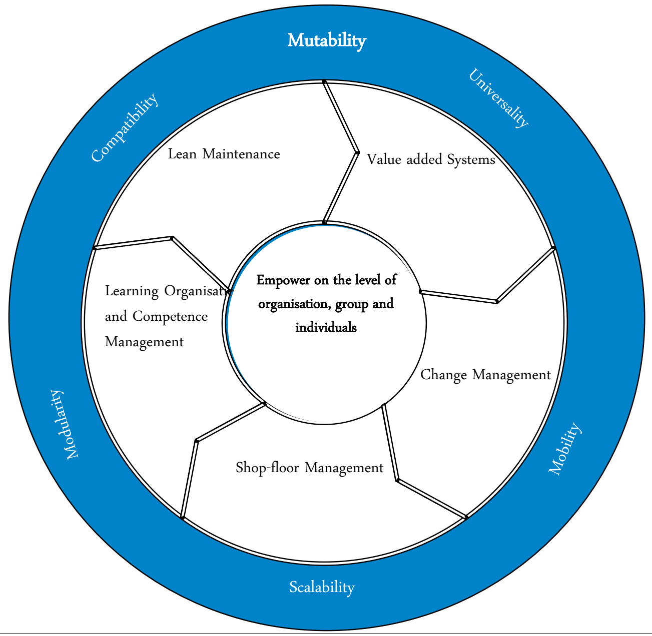
WF = f(W,A)

Didactic GmbH & Co. KG

DC-CD/Klaus Zimmermann Learning factories 10. May 2012

Capabilities to develop Mutability

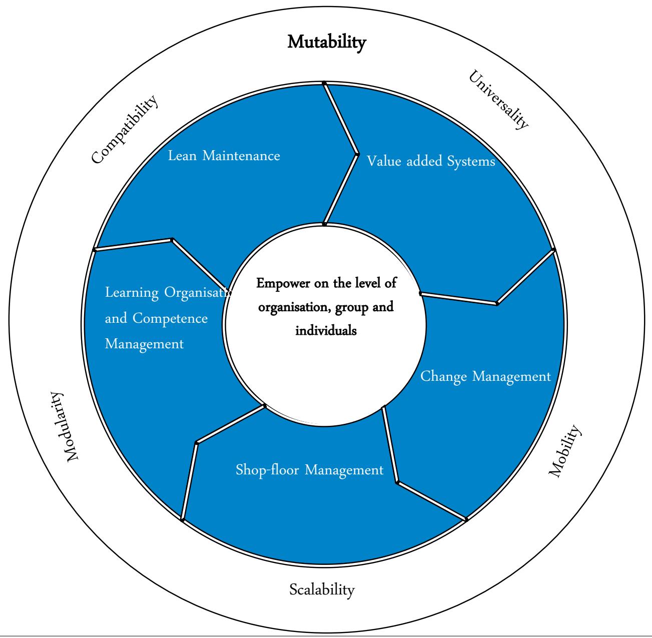
- **Universality**
  Ability to satisfy various requirements in terms of products and technologies
- **Mobility**
  Locally unrestricted movement of objects
- **Scalability**
  Technical, spatial and personal extensibility and reducibility
- **Modularity**
  Ability to exchange standardised units of elements easily
- **Compatibility**
  Interconnectivity of material, information and energy



DC-CD/Klaus Zimmermann Learning factories 10. May 2012

Festo model to build up Mutability

- **Holistic Value Added Systems**
  Increase value added in all business processes
- **Lean Maintenance Systems**
  Combine machine effectiveness maintenance efficiency
- **Shop-floor Management**
  Develop an efficient communication and management culture that aims at problems
- **Change Management**
  Address cultural obstacles to change and generate more awareness for improvements – apart from obsolete tool-driven improvement philosophies
- **Learning organisation and development of competence**
  Enable organisations,to identify the next step after „Lean" and discover new potential within both the organisation and management level ,
  as well as among employees.



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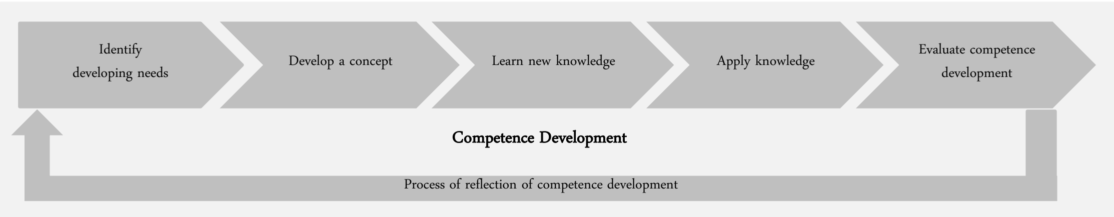
FESTO

Competences: a central factor for mutable companies



Typical competences regarding Mutability

- Readiness to assume risk, strength of strength of purpose, insistence insistence
- Systemic, complex thinking
- Assertiveness
- Readiness to learn

FESTO

Learning factories are multifaced like the structures and the processes in a company

FESTO

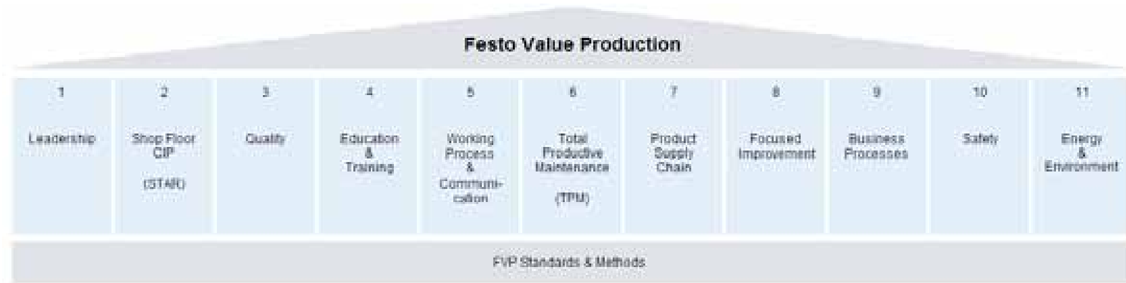
Learning factories are a didacitc approach to develop competencies

Learning factories are didactical and simplified models of real processes.
They promote open minded learning and combine theoretical learning with practical application.
Therefore they facilitate the development of **operational competence**

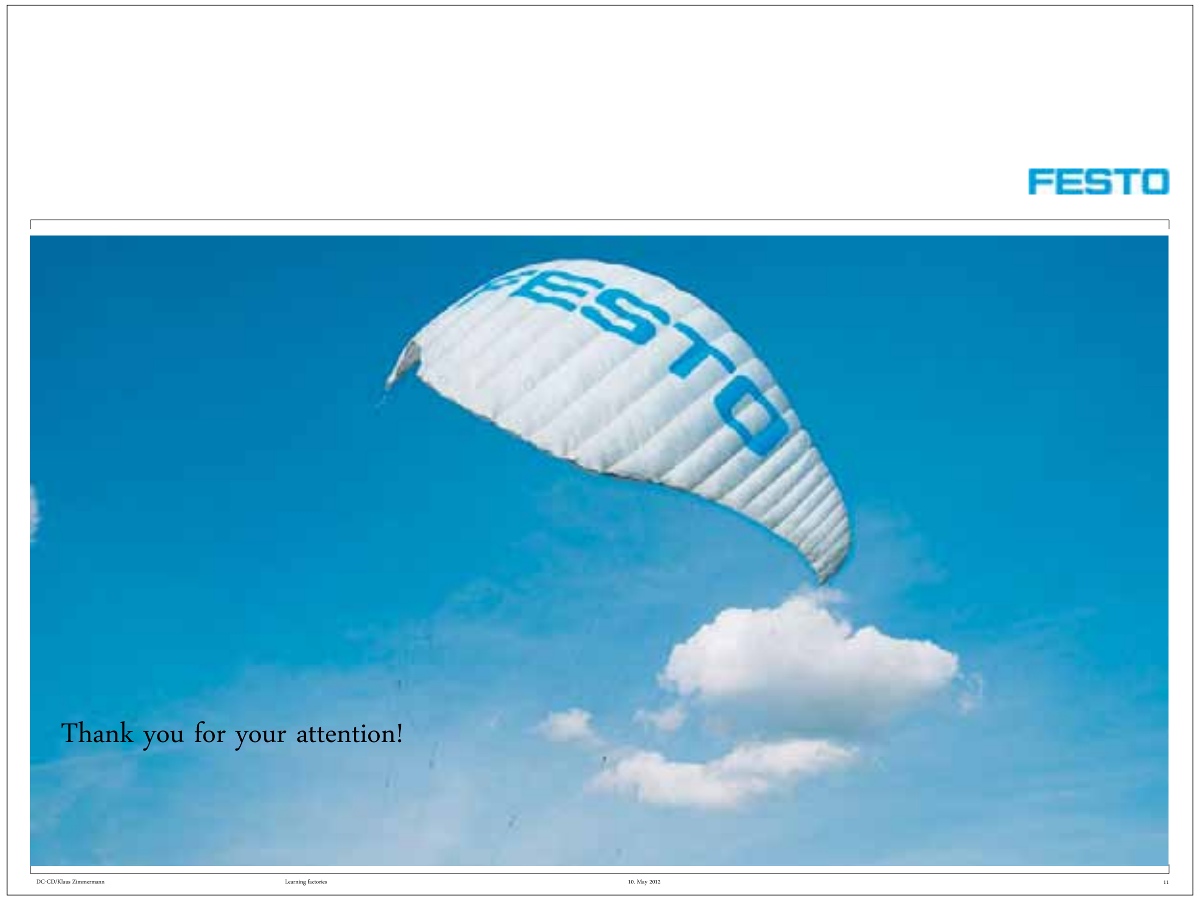
FESTO

Festo Value Production System (FVP)

Festo Value Production (FVP) is a holistic value added system



With the continuous and sustainable improvement of our capabilities we support the target processes of all subsidiaries.


FESTO
Thank you for your attention!
DC-CD/Klaus Zimmermann
Learning factories
10. May 2012
11

Dr. Markus Tomaschitz

Dr. Markus Alexander Tomaschitz, born 1970 in Graz, Austria, studied Business Administration at California University of Hayward, U.S.A and Karl-Franzens-Universität/GRAZ/Austria. Several publications and articles on management, leadership, entrepreneurship, education and human resource management. As of 10/2006 Magna Int. Europe AG as Executive Director Magna Education & Research GmbH. & CO. KG, before Executive Director and CEO of FH JOANNEUM GmbH. - University of Applied Sciences, Graz, Austria; Senior Partner and CEO of EUROPE – MPO; Industrial experiences at Continentale AG and Oracle Inc. as project manager in the USA, Germany and Steirische Volkswirtschaftliche Gesellschaft;Graz/Austria.

Magna International Inc., is a global automotive supplier headquartered in Aurora, Ontario, Canada. It is North America's largest automobile parts manufacturer, and one of Canada's largest companies. Its operating groups include Magna Steyr, Magna Powertrain, Magna Exteriors and Interiors, Magna Seating, Magna Closures, Magna Mirrors, Magna Electronics and Cosma International. Magna manufactures auto parts that are primarily supplied to General Motors, Ford Motor Company, and Chrysler LLC. In addition to the Big 3 U.S. automakers, Magna's major customers include Volkswagen, BMW and Toyota. In Europe, Magna Steyr holds contracts for the assembly of the Peugeot RCZ, Aston Martin Rapide and Mini Countryman. Magna has approximately 108,000 employees in 286 manufacturing operations and 88 product development, engineering and sales centres in 26 countries. Revenue $28.7 billion USD (year end 2011), Operating income: $291 million USD (4th quarter 2011), Net income: $312 million USD (4th quarter 2011).

MAGNA

Education for the 21st century - impacts for teaching and learning

Education for the 21st century - impacts for teaching and learning

Dr.Markus Tomaschitz, Executive Director Magna Education & Research

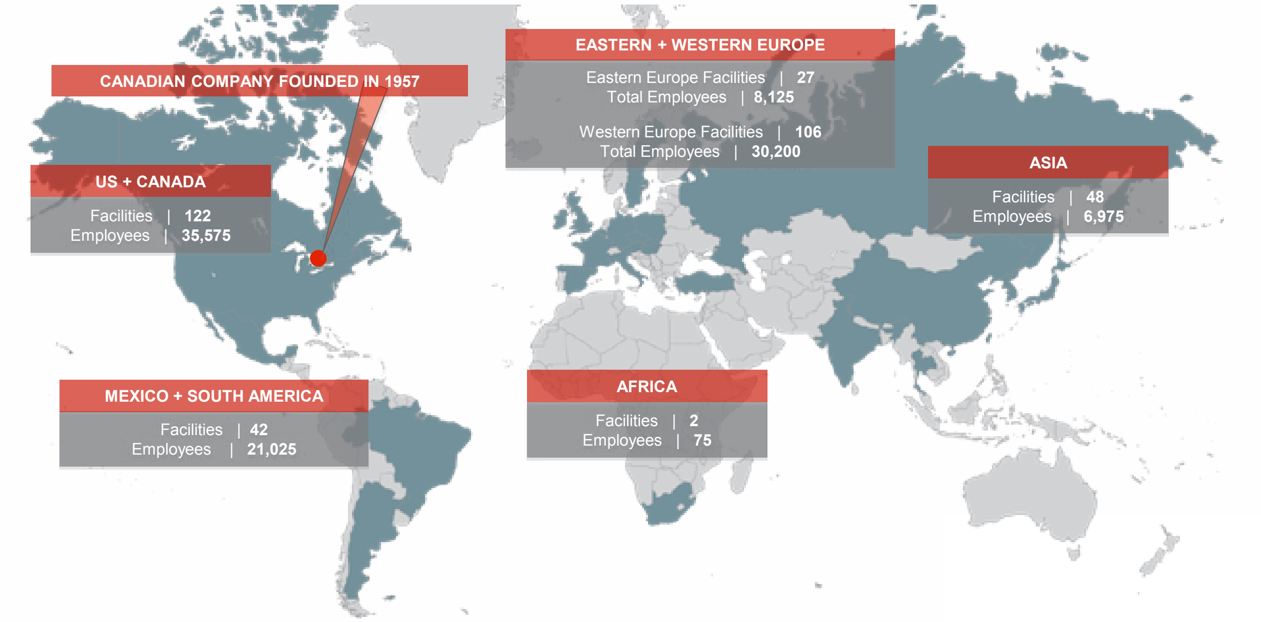
TOPICS

- Skills needed for students to excel in the twenty-first century
- Three main categories of 21st Century Skills: learning and innovations skills; digital literacy skills; and life and career skills
- Timely issues such as the rapid advance of technology and increased economic competition
- Economic disruptions to come due to offshoring and automation
- Need for Skills not just Knowledge, and Creativity in particular
- Science/Technology/Engineering/Math for innovation agendas

May 2011 2

Global Presence

MAGNA



~ 107,000 People | 26 Countries | Global Facilities 347 | $28.7 Billion (2011 Sales)

(As of April 2012)

May 2011 Markus Tomaschitz - Disclosure or duplication without consent is prohibited 3

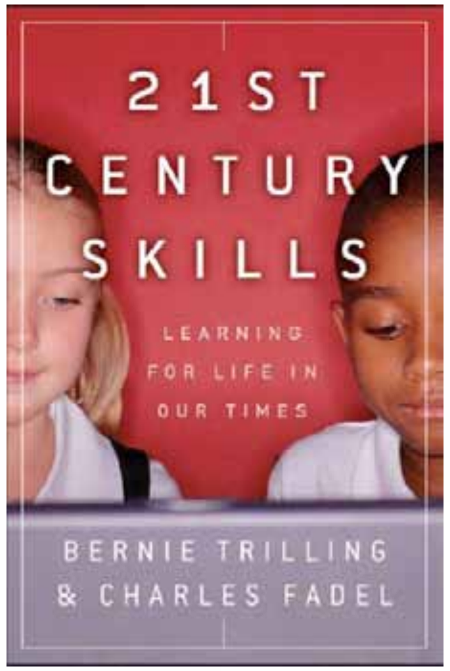
The importance of Education

MAGNA

There is a lot of knowledge and information about the huge role and importance of Education.

It didn't find it's way to boardrooms of companies.

But there is no alternative to education and research for European companies trying to stay competitive.



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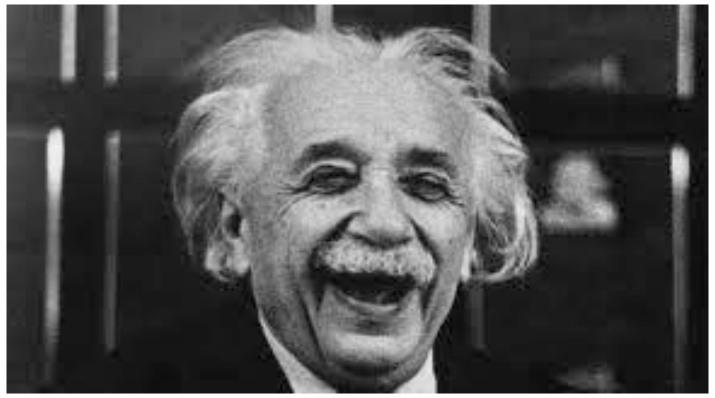
"The clearest form of lunacy is to keep on doing what you always did and hoping that something will change."



Albert Einstein 1897 - 1955

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Asking why?

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- Many countries have seen rapidly rising numbers of people with higher qualifications. But in a fast-changing world, producing more of the same education will not suffice to address the challenges of the future.
- Students need to be capable not only of constantly adapting but also of constantly learning and growing, of positioning themselves and repositioning themselves in a fast changing world.
- These changes have profound implications for teachers, teaching and learning as well as for the leadership of schools and universities.

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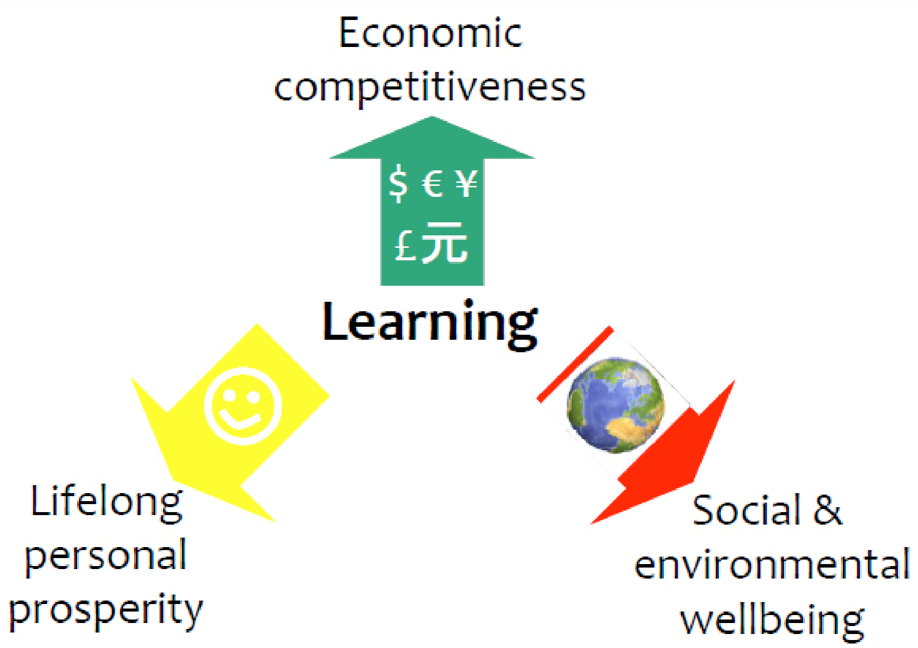
Benefits of learning



Source: Charles Fadel, Speech in Vienna, Oct.2011

TOP 10 breakthroughs

Transforming life over the next 20-30 years

1. Alternative energy
2. Desalination of water
3. Precision farming
4. Biometrics
5. Quantum computers
6. Entertainment on demand
7. Global access
8. ***Virtual education***
9. Nanotechnology
10. Smart Robots

Source: World Future Society

Displacement due to technology

Ox → Harvester

Horse → Automobile

Lab Mice → Assays (not soon enough…)

Humans:
- Scribes → printing press
- Washers → washing machine
- Cashiers/Attendants → bar code scanner
- Healthcare/Finance/Services/Jeopardy champions → Watson

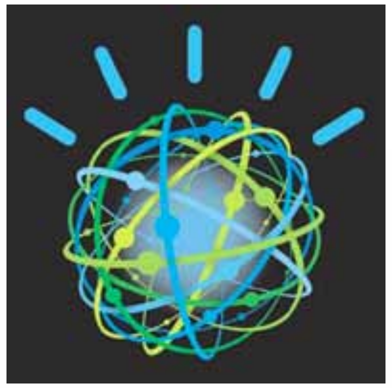
etc

IBM WATSON

New Threshold

“…in medical education we’re still a very memory-based curriculum… Watson-like tools will cause us to reconsider what students do”

Dr Herbert Chase
Columbia University
New York Times, Feb. 17, 2011



“We are currently preparing students for jobs and technologies that don’t yet exist… in order to solve problems that we don’t even know are problems yet.”

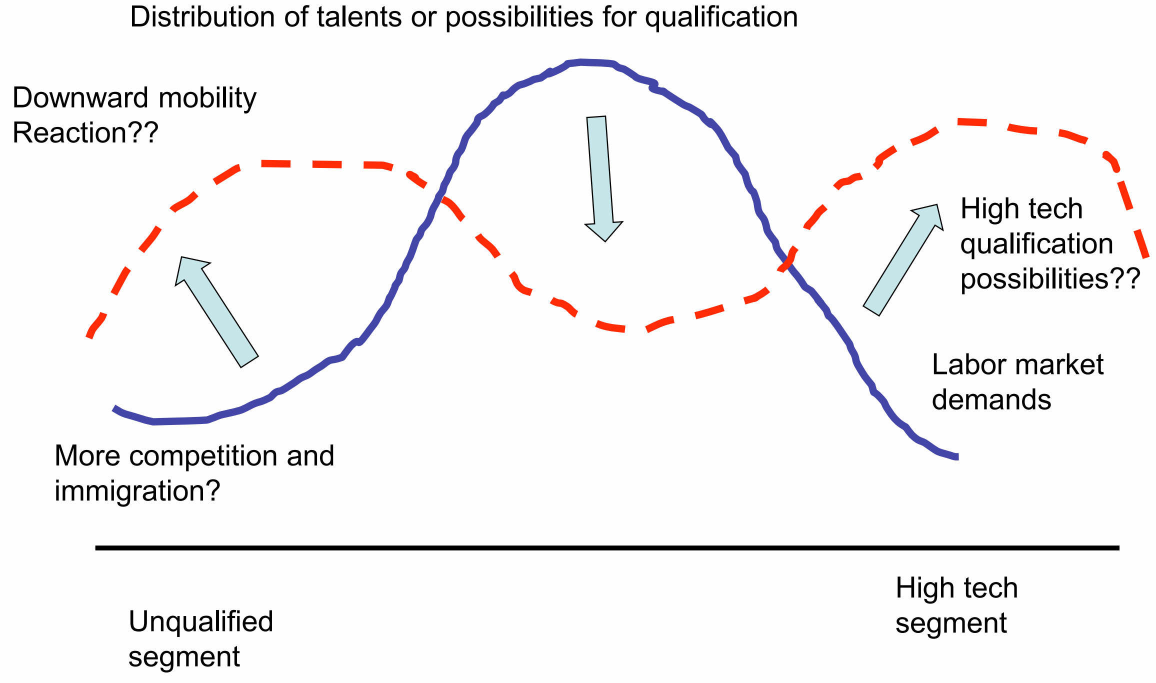
Richard Riley
Former U.S. Secretary of Education

So what do we teach for

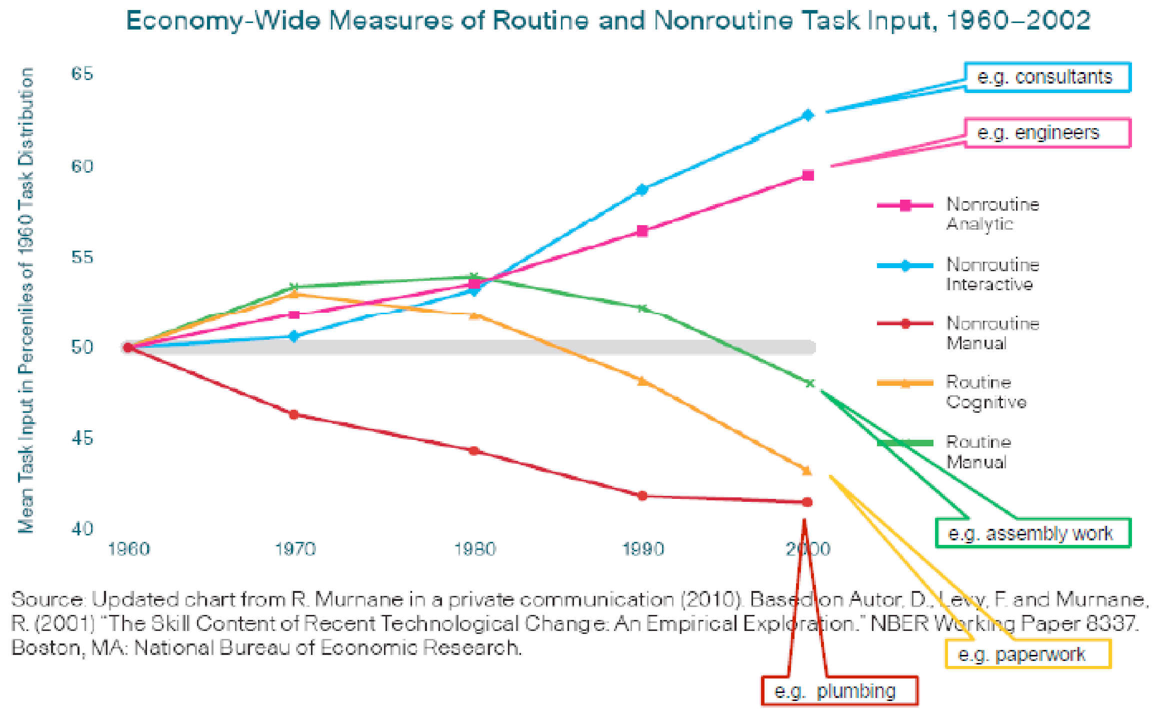
- **Possibly:**

- **Better Engineering**
- **Asking the right questions**
- **Synthesizing/integrating**
- **Creating**
- **Ways of thinking.** Creativity, critical thinking, problem-solving, decision-making and learning
- **Ways of working.** Communication and collaboration
- **Tools for working.** Information and communications technology (ICT) and information literacy
- **Skills for living in the world.** Citizenship, life and career, and personal and social responsibility

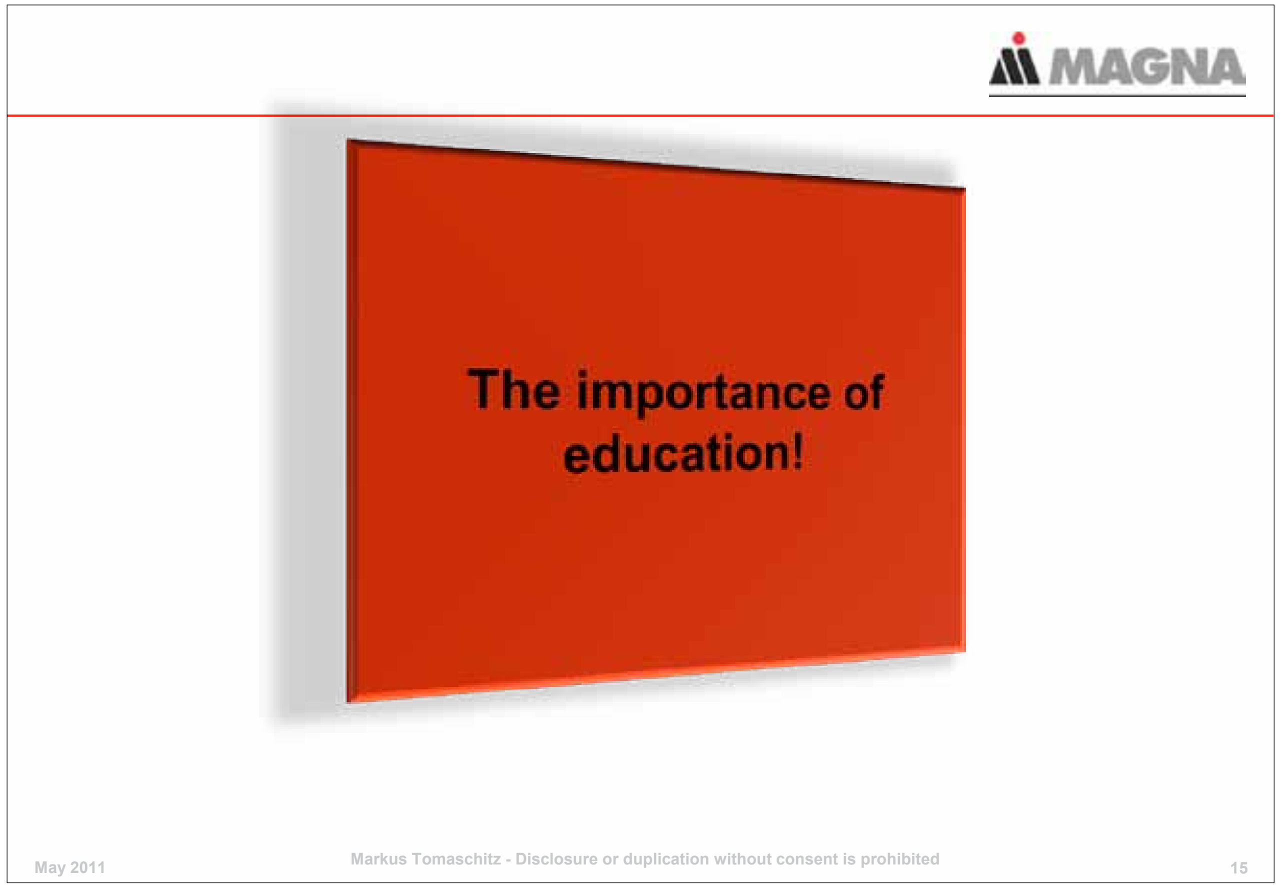
Qualification Shift



Accelerating change demands different skills



Source: Updated chart from R. Murnane in a private communication (2010). Based on Autor, D., Levy, F. and Murnane, R. (2001) “The Skill Content of Recent Technological Change: An Empirical Exploration.” NBER Working Paper 8337. Boston, MA: National Bureau of Economic Research.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The importance of education!
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„The only lasting, inimitating competitive advantage an organization has is the quality of people.“
Michael Porter, in a speech given at Columbus University 2010
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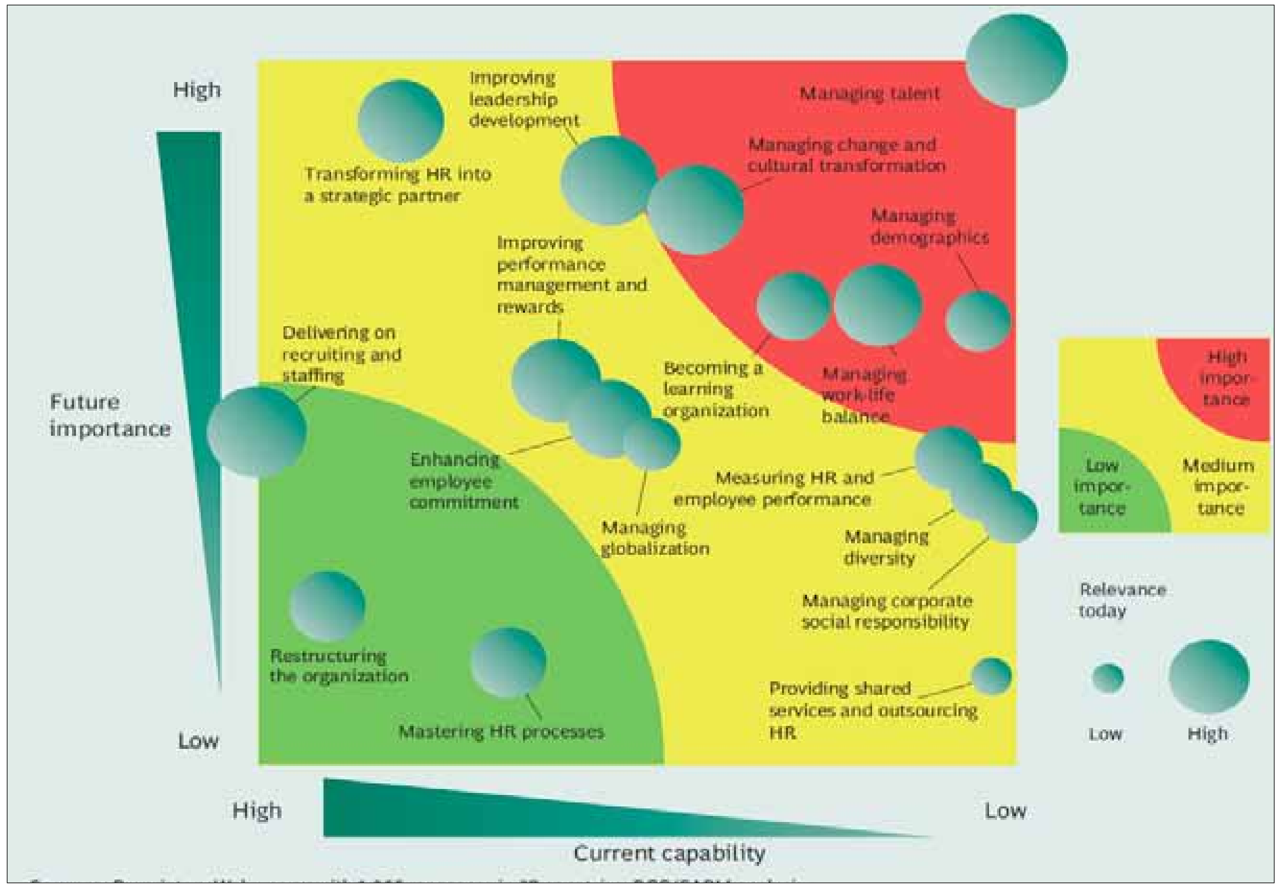
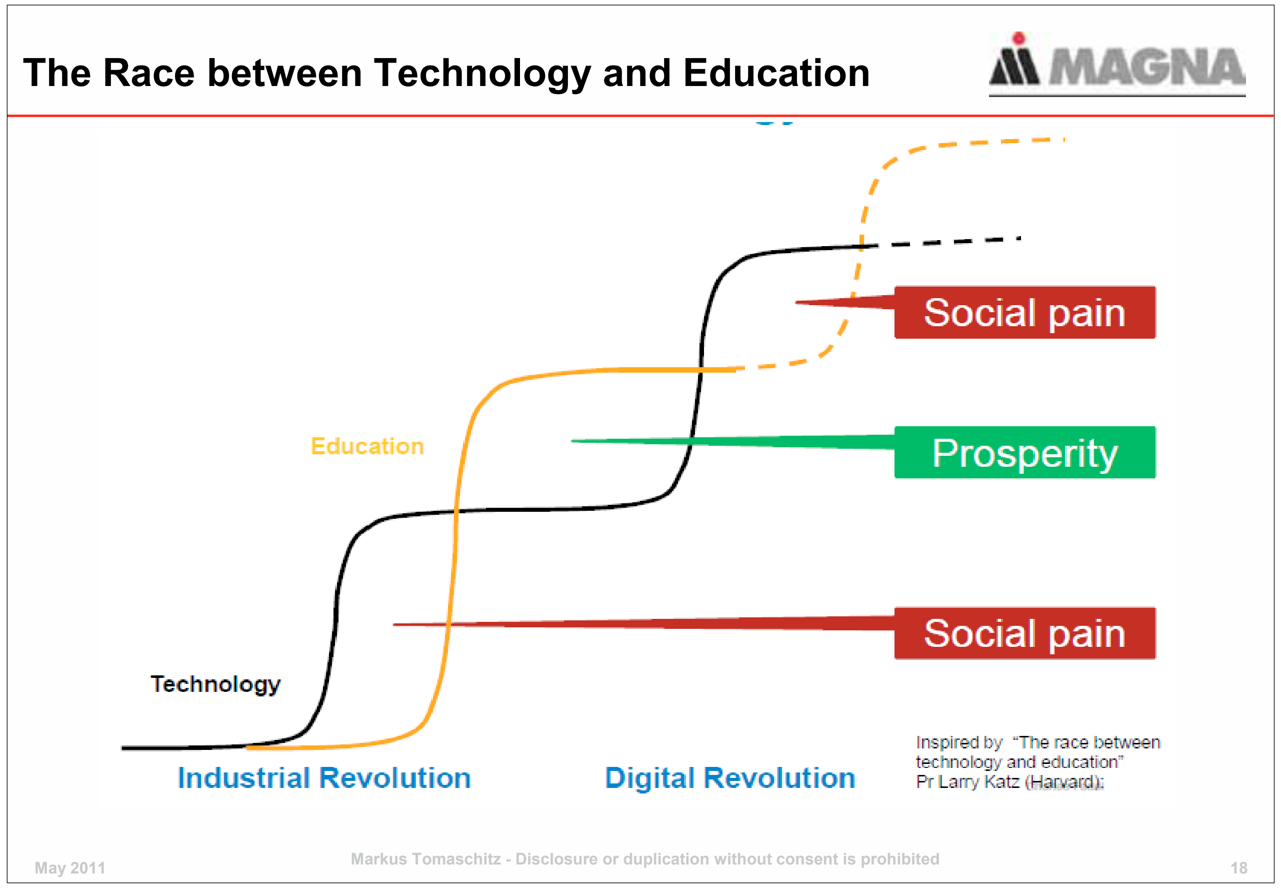

High
Low
Future importance
Improving leadership development
Managing talent
Transforming HR into a strategic partner
Managing change and cultural transformation
Managing demographics
Improving performance management and rewards
Delivering on recruiting and staffing
Becoming a learning organization
Managing work-life balance
Enhancing employee commitment
Measuring HR and employee performance
Managing globalization
Managing diversity
Managing corporate social responsibility
Restructuring the organization
Providing shared services and outsourcing HR
Mastering HR processes
High importance
Low importance
Medium importance
Relevance today
Low
High
High
Low
Current capability


The Race between Technology and Education
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Social pain
Education
Prosperity
Social pain
Technology
Industrial Revolution
Digital Revolution
Inspired by "The race between technology and education" Pr Larry Katz (Harvard);
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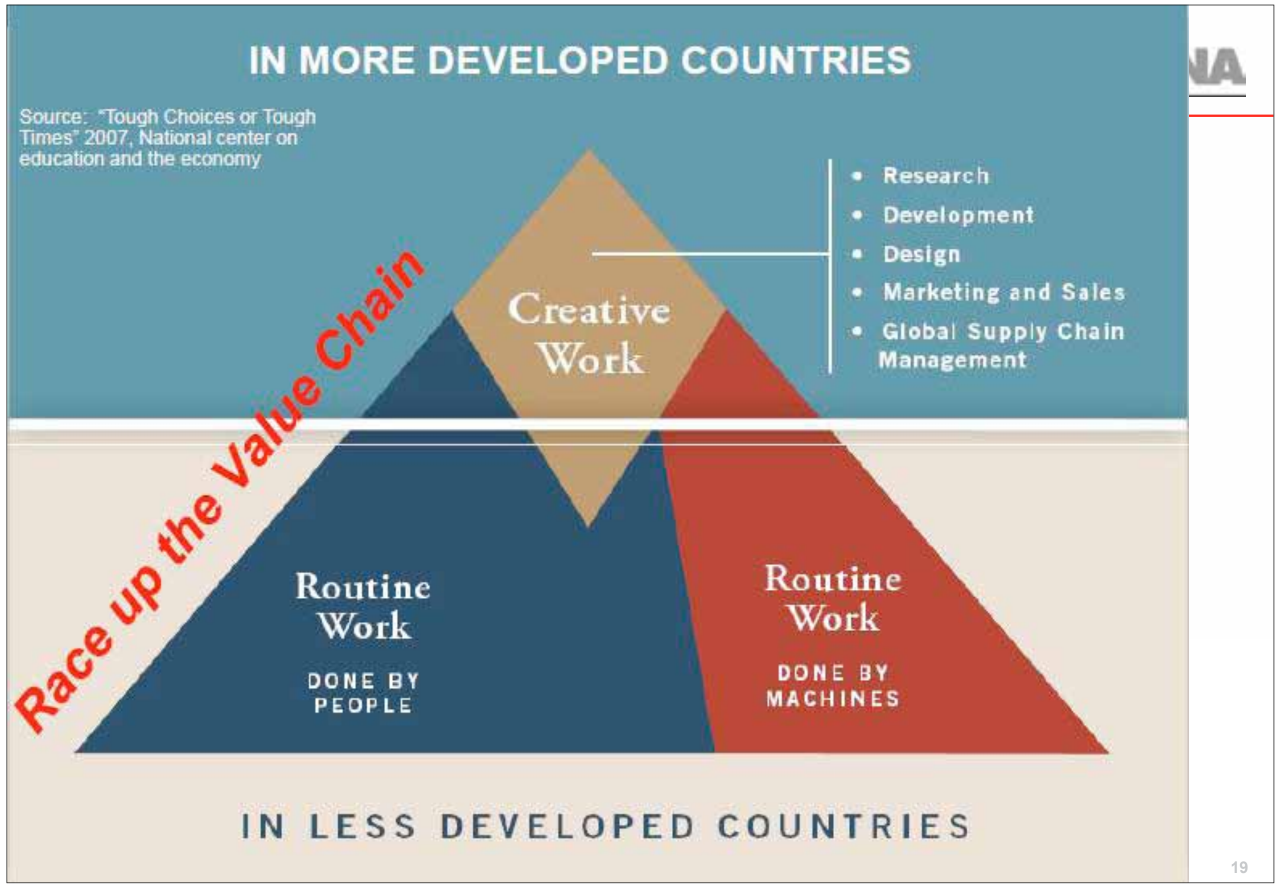
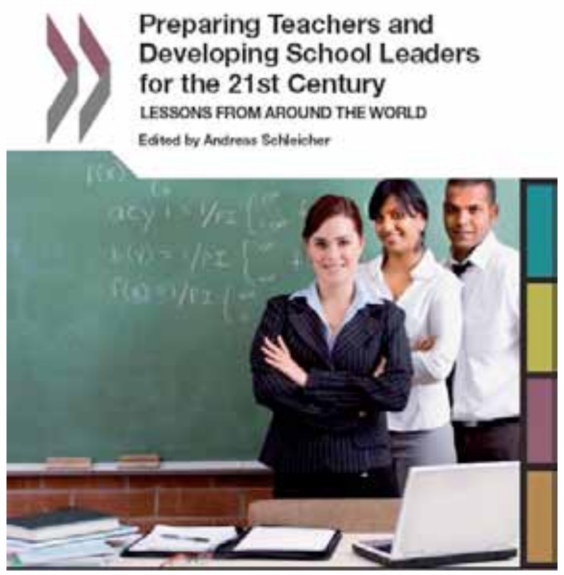


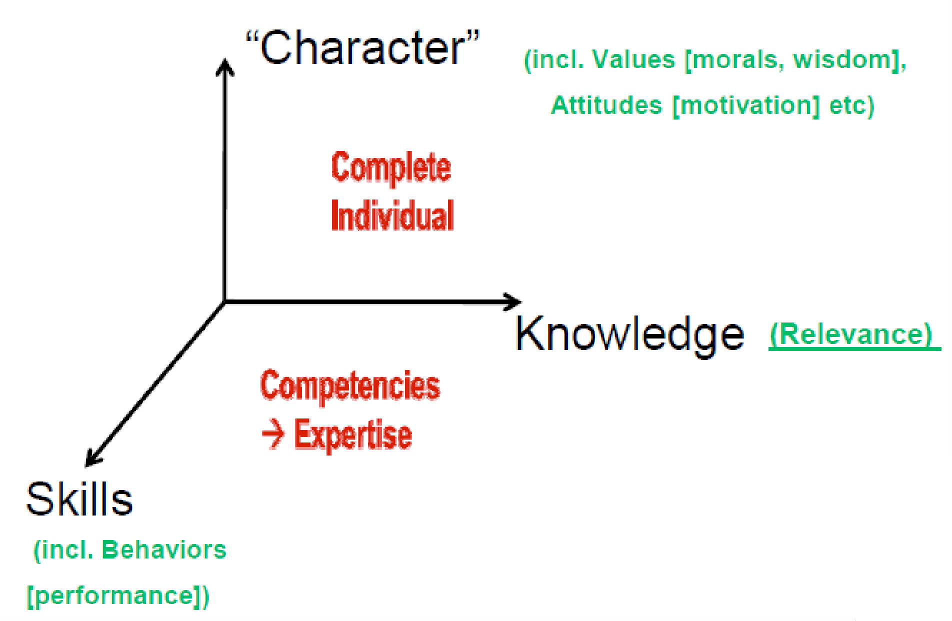
Schooling vs. the real world



"...school learning is abstract, theoretical and organized by disciplines while work is concrete, specific to the task, and organized by problems and projects..."

Source: OECD, "Learning for Jobs" 2009

Rethinking – what is taught?



Skills of Effective Managers – One Study

1. Verbal communication (including listening)
2. Managing time and stress
3. Managing individual decisions
4. Recognizing, defining, and solving problems
5. Motivating and influencing others
6. Delegating
7. Setting goals and articulating a vision
8. Self-awareness
9. Team building
10. Managing conflict

21st Century Skills Framework

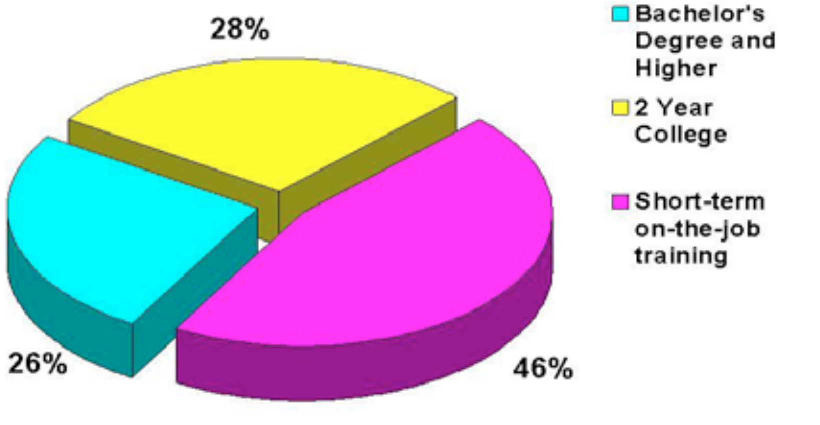
- **Learning & Innovation Skills**
  - Critical Thinking & Problem Solving
  - Creativity & Innovation
  - Communication & Collaboration
- **Information, Media & Technology Skills**
  - Information Literacy
  - Media Literacy
  - ICT (Information, Communications & Technology) Literacy
- **Life & Career Skills**
  - Flexibility & Adaptability
  - Initiative & Self-Direction
  - Social & Cross-Cultural Skills
  - Productivity & Accountability
  - Leadership & Responsibility

The Challenge

… place the right people in the right spot on the team …

The implications on education! Some examples

2014 Projected Education Requirements for Jobs



Source: U.S. Department of Labor

Subject evolution

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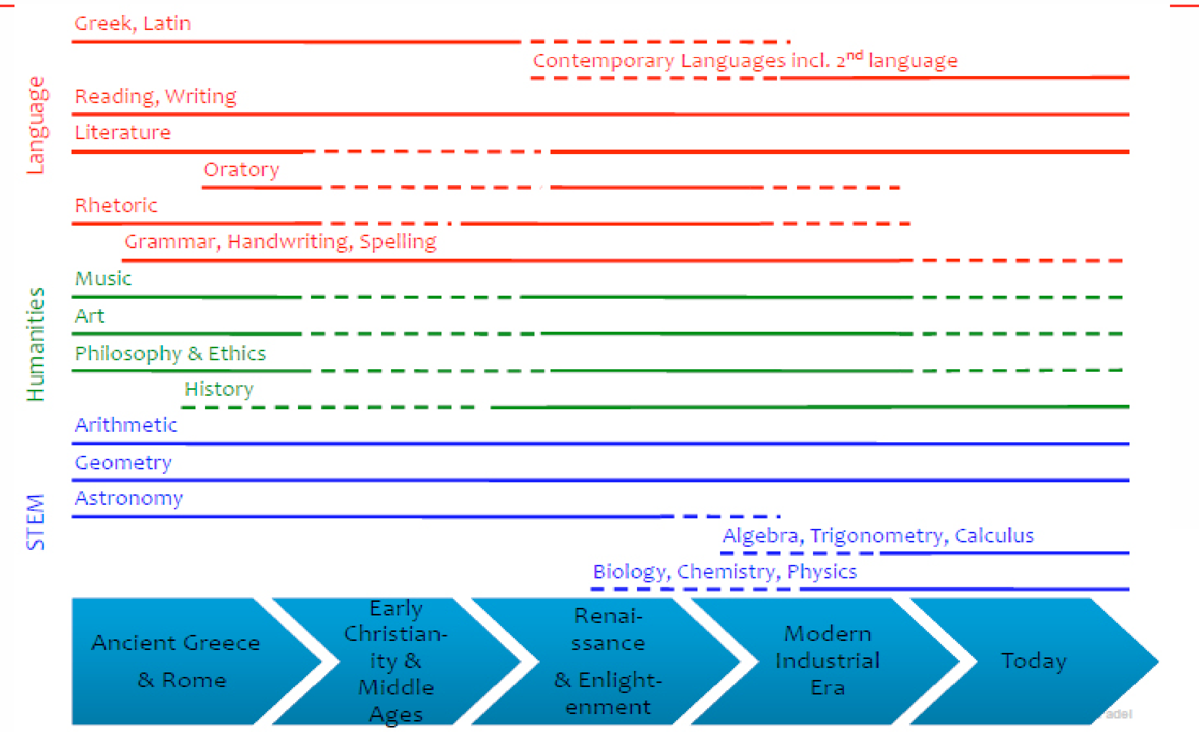

Example: Literacy

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- **In the 21st century literacy is about reading for learning, the capacity and motivation to identify, understand, interpret, create and communicate knowledge, using written materials associated with varying situations in continuously changing contexts.**
- **In the past it was sufficient to direct students to an encyclopedia to find the answer to a question, and they could generally rely on what they found to be true.**
- **Today literacy is about curiosity and self-direction, managing non-linear information structures, building one's own mental representation and synthesis of information as one finds one's own way through hypertext on the Internet, about dealing with ambiguity, developing healthy skepticism, an inquiring mindset, and interpreting and resolving conflicting pieces of information.**

- Source: OECD, Preparing teachers and developing school leaders for the 21st century – LESSONS FROM AROUND THE WORLD

Begging for relevance

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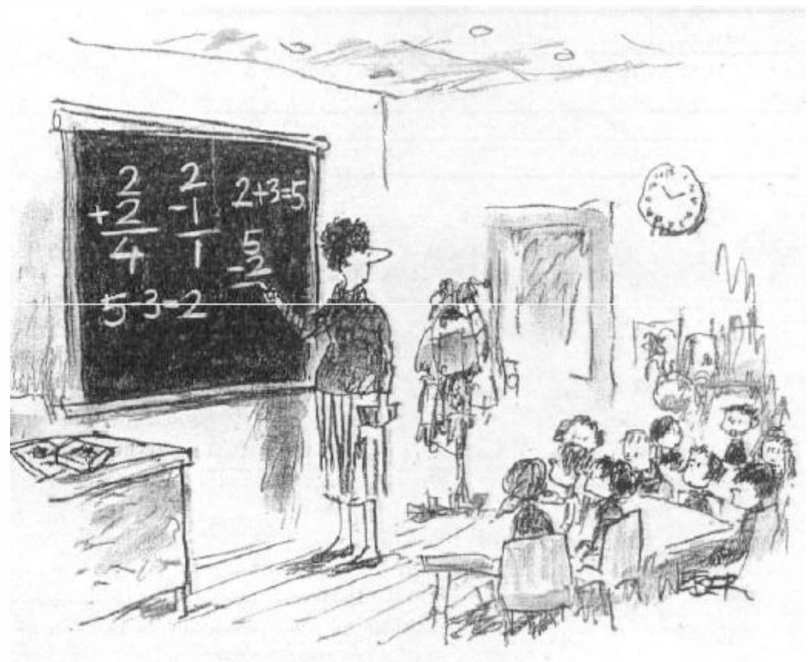

"Please, Ms. Sweeney, may I ask where you're going with all this?"

Ratio of subjects – OECD average

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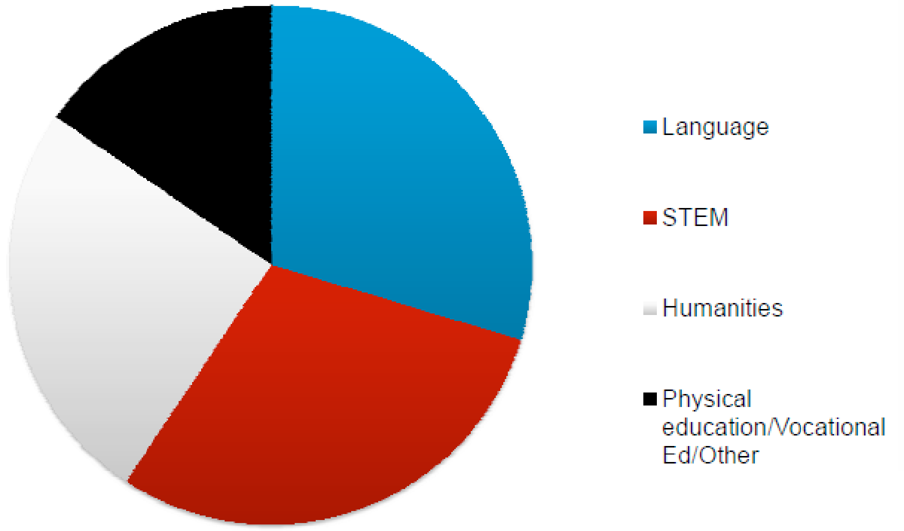

What should be the ratio??

Knowledge

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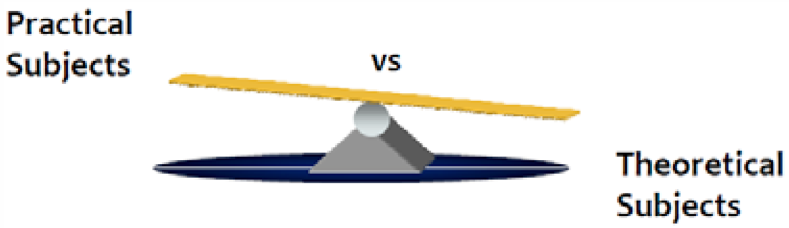
- **Knowledge – relevance required: students' lack of motivation, and often disengagement, reflects the inability of education systems to connect the content to real-world relevance. Need to rethink the significance and applicability of what is taught, and in concert to strike a better balance between the conceptual and the practical.**



Economic argument vs Psychosocial argument

STEM Education – OECD average

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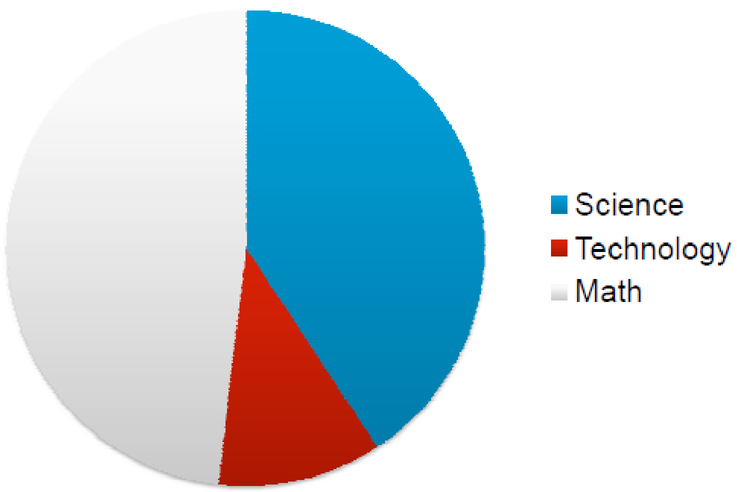

Why so little technology?
Why is engineering only a college discipline?

STEM Professors have a positive impact

MAGNA

"Our evidence shows that countries with a higher concentration of engineering college majors grow faster, whereas countries with a higher proportion of law concentrators grow slower."

"If an extra 10% of enrollment was engineering, the growth rate would rise 0.5% per year; if an extra 10% enrollment were in law, growth would fall by 0.3% per year".

Source: "Allocation of Talent, Implications for growth"
1990 National Bureau of Economic Research, Murphy et al

Expanding the mindset

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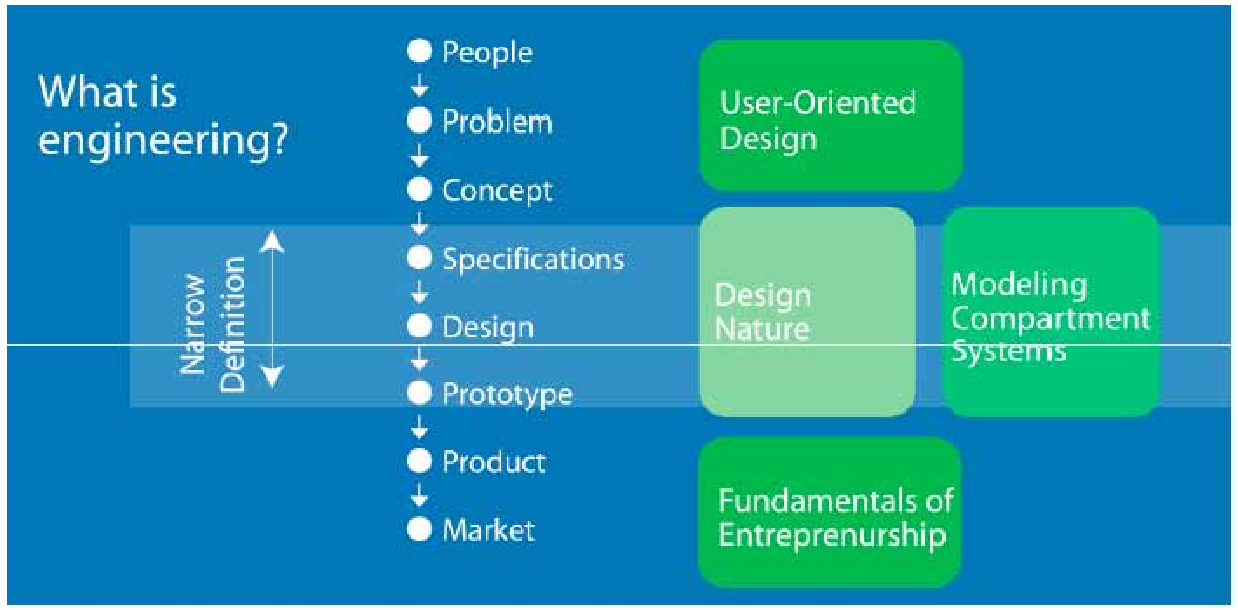
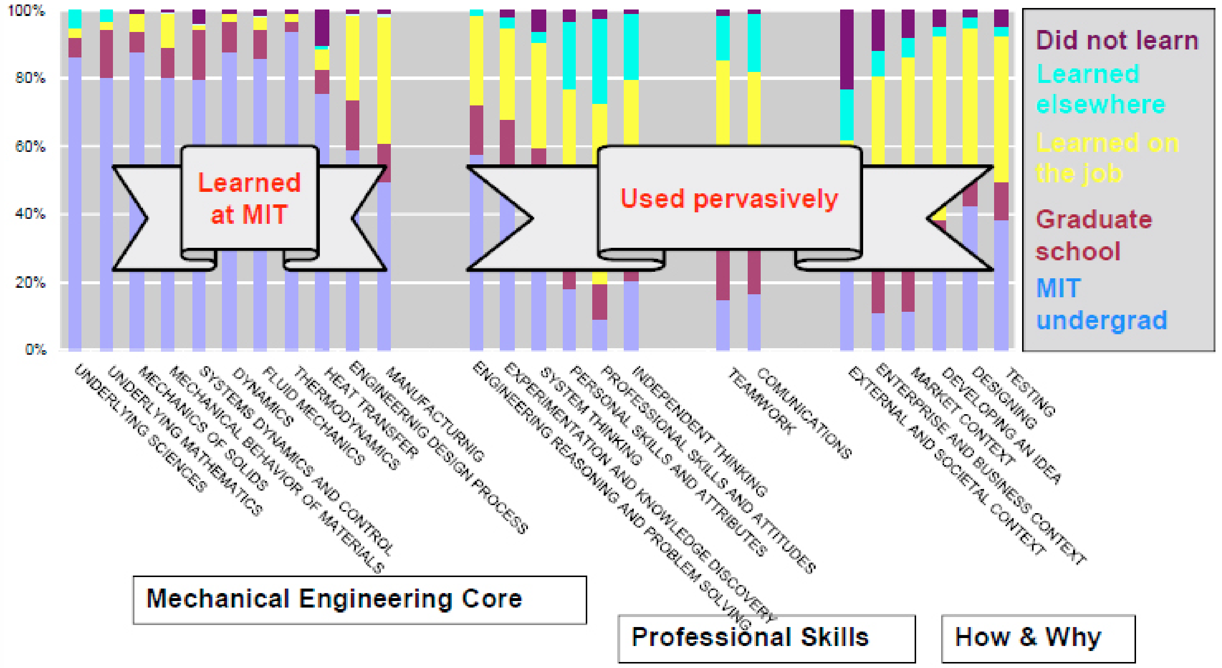


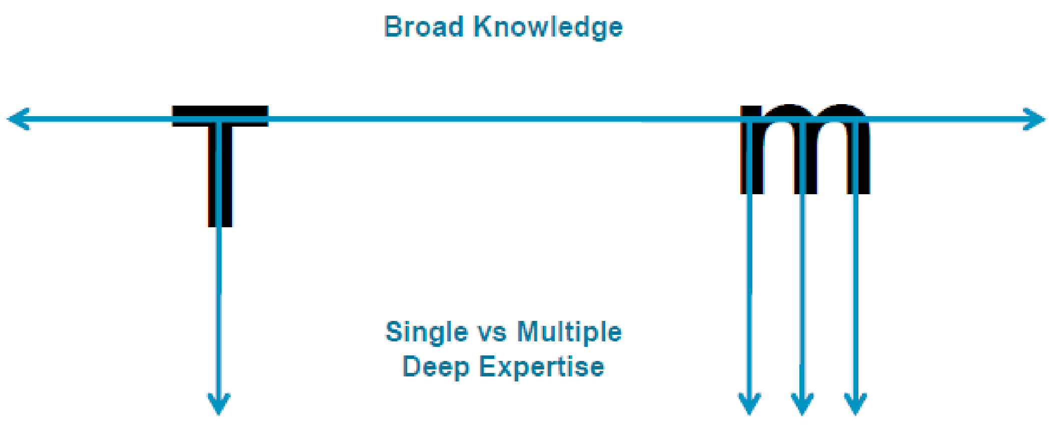
Source: Richard Miller, President Franklin Olin College

MIT – New understanding of education



Source: Kristen Wolfe June,2004 S.B. Thesis & Professor Warren Seering. Courtesy Professor Woodie Flowers

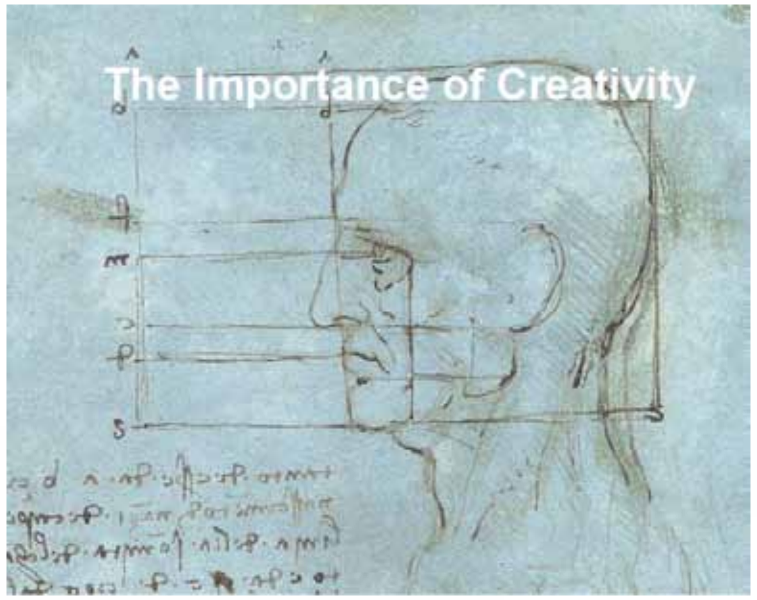
M-shaped individual, not just t-shaped

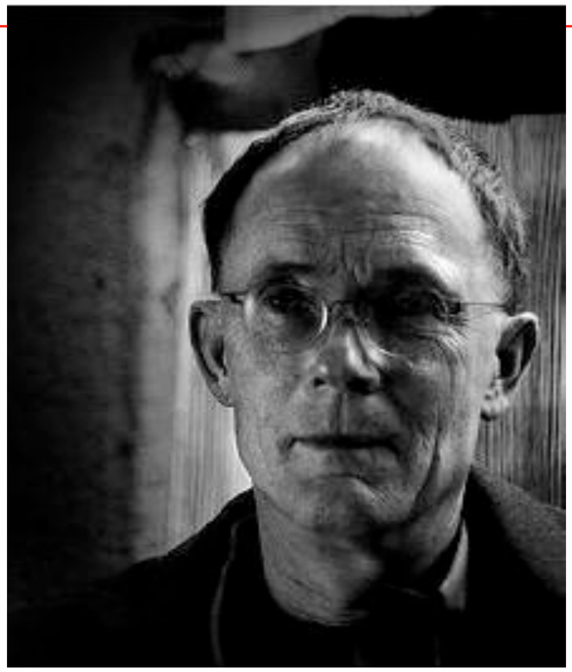


We need both!!

"STEM for Employability…

…Humanities for Excellence"





„The future is already here – it's just not very evenly distributed"

Science-Fiction author William Gibson,
quoted in *The Economist*,
December 4, 2003


MAGNA

Block I
Universities

Block I I
Industry

Block I I I
Learning and Innovation Factory of the Vienna University of Technology

Univ.-Prof. Prof. eh. Dr.-Ing. Dr.h.c.Dipl.-Wirtsch.-Ing. Wilfried Sihn

Wilfried Sihn, Univ.-Prof. Prof. eh. Dr.-Ing. Dr. h.c. Dipl.-Wirtsch.-Ing., is Professor at the IMW since 2004 and Head of the Institute since March 2009. Before starting his career at the TU Wien, he was Deputy Director of the Fraunhofer Institute for Manufacturing Engineering and Automation (IPA) in Stuttgart, and is Director of Fraunhofer Austria since December 2008. He has been active in the field of applied research and consulting services for more than 25 years now. His areas of expertise include production management, corporate organization, enterprise logistics, factory planning, order management, and business process reengineering. Prof. Sihn was instrumental in developing concepts as the Fractal Company. As well, he is Vice-President of the "International Society of Agile Manufacturing" and International Editor of the journal „Agility and Global Competition", as well as Guest Editor of the „International Journal of Technology Management (IJTM)". He holds lectures on the above-mentioned topics at national and international conferences. His more than 200 publications also include several books, making him an active player in scientific and practice-related discussions.

Fraunhofer Austria Research GmbH is performing applied and industry oriented research. Projects are dealing with the planning and optimization of the structure, organization and management of industrial and service enterprises or their logistics networks and is specialised in structuring and optimisation of production and logistics processes in a high-tech and highly automated environment. Special emphasis is given to the matching of IT systems with the requirements of operational domains in particular with respect to the organisation of socio-technological systems. FhA is co-operating with the Institute of Management Science of the Vienna University of Technology and maintains numerous contacts to industry, academia and research institutions in Western, Eastern and South-Eastern Europe.

Founded in 1815, the Vienna University of Technology is renowned for its long tradition. It finds high international and domestic recognition in teaching and research and as partner of innovation oriented enterprises. The Institute of Management Science / Department for Industrial Engineering and System Design (IMW) can offer expertise in the main areas such as Production Management & Logistics Management as well as Quality-, Process- and Product Management. Research concentrates on the processing of scientific findings for practical applications. Numerous positive results both in application-oriented research projects as well as industry projects proof the reliable methodological background of the department and form a broad basis of satisfied partners and customers.

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imw INSTITUTE OF MANAGEMENT SCIENCE

Vision and implementation of the Learning and Innovation Factory of the Vienna University of Technology

Univ.-Prof Dr.-Ing.
Detlef Gerhard

Univ.-Prof Dr.-Ing. Detlef Gerhard (born 1969) studied mechanical engineering with a focus on Computer Integrated Manufacturing at the University of Paderborn (Germany). He received his PhD in 2000 after five years as a research assistant at the Department of Information Technology in Mechanical Engineering at the Ruhr-University Bochum (Germany). In February 2006 he was appointed professor at the Vienna University of Technology (Austria) and leads the Mechanical engineering Informatics and Virtual Product development (MIVP) research group at the Institute of Engineering Design and Logistics Engineering. Previously, he was in industry in senior positions in the field of IT consulting, project leading and development of enterprise-wide software solutions. In his latest industry position, he served as overall responsible for the technical and business IT at a worldwide operating manufacturer of conveyor systems and special purpose machinery. Prof Gerhard is elected member of the WiGeP (Wissenschaftliche Gesellschaft für Produktentwicklung) Scientific Society for Product Development based in Germany. His main research interests are methods and IT tools for information management in product creation processes with special focus on semantics.

Our Research group is part of the institute of Engineering Design and Logistics Engineering at Vienna University of Technology and focusses on Virtual Product Development which in our understanding can be defined as complete description and illustration of real products and their characteristics in form of computer models with the aim to validate and verify designs and characteristics by simulation and digital prototyping. This is our core competence area and comprises management of data, processes and IT tools within the complete product lifecycle (PLM). Our research focusses on the application of information technologies and informatics methods in the creation processes of machinery, vehicles and equipment. The central objective is to explore new technologies, processes and methods with a significant added value for applications in the context of co-operation and multi-disciplinary engineering processes in industrial environments. Within all research projects which are preferably conducted with partners from industry aspects of process and organisation are looked at alongside the modelling and software implementation.

Vision and implementation of the Learning and Innovation Factory of the Vienna University of Technology

Univ. Prof. Dipl.-Ing.
Dr.techn. Friedrich Bleicher

After studying Mechanical Engineering he started as a scientific assistant at the Institute of Production Engineering, Vienna University of Technology.
"Doktor technicae" in Mechanical Engineering in 1996 and habilitation for Production Engineering in 2001; since 2001 Associate Professor at the Institute for Production Engineering. In 2009 he gets the professorship for Machining Technology and is head of the Institute of Production Engineering and Laser Technology at Vienna University of Technology.
The main topics of research are covering machining processes with geometrically defined and undefined cutting edges, process automation, development and optimization of machine tools,ECM-technologies and rapid manufacturing.

Institute of Production Engineering and Laser Technology

The Institute of Production Engineering and Laser Technology (IFT) of the Vienna University of Technology covers a wide range of production processes, machine tool techniques and automation in the field of production engineering.

The spectrum of working activities is covering production planning and manufacturing execution systems, process automation and NC-control technology, development and optimization of machine tools including innovative machine tool concepts like parallel kinematics, machining processes, particularly cutting with geometrically defined and undefined cutting edges or laser technology as well as ECM-technologies and rapid manufacturing.

Results of research work are directly fed into academic education, which allows a practically orientated training and guarantees a comprehensive insight into production engineering.

Vision and implementation of the Learning and Innovation Factory of the Vienna University of Technology

VIENNA UNIVERSITY OF TECHNOLOGY

Vision and implementation of the Learning and Innovation Factory of the Vienna University of Technology

Department for Management Science / Fraunhofer Austria
Univ.-Prof. Dipl.-Wirtsch.-Ing. Dr.-Ing. Prof. eh. Dr. h.c. Wilfried Sihn

Department for Production Engineering and Laser Technology
Univ.-Prof. Dipl.-Ing. Dr. techn. Friedrich Bleicher

Department for Engineering Design and Logistics Engineering
Univ.-Prof. Dipl.-Ing. Dr.-Ing Detlef Gerhard

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Introduction

Learning & Innovation Factory for Integrative Production Education

Learning and Innovation Factory of the Vienna University of Technology

Learning Factory | Innovation Factory | Vision

Higher education	Advanced training	Innovation	Service
"Integrative product manufacturing" Lecture, practical course (Bachelor Mechanical Engineering - Management	Methods focus: Lean Assembly, Lean Production & Logistics Technology focus: RFID and pick-by-voice assembly support	e.g. process evaluation and optimization of Lean Assembly, development of innovative factory planning methods, etc.	e.g. use of innovative research and development facilities as high application and demo center

Students | Industry

 2

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Vision and implementation of the Learning and Innovation Factory of the Vienna University of Technology

FACULTY-WIDE LEARNING FACTORY AS PART OF THE CURRICULUM

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Higher Education „Integrative Product Creation“

- Lecture name: Integrative Product Creation
- Parts: Engineering Design – Manufacturing - Assembly
- Students: Bachelor Program (Mechanical Engineering - Management)
- Lecture: Theoretical preperation
  2 ECTS (5 days a 3 hours + exam)
- Practical course: Project implementation (analysis, planning and manufacturing)
  5 ECTS (10 days a 8 hours + final presentation)
- Targets: Holistic consideration of product creation process
  Understanding of inter-divisional coherences
  Impact of design based decisions for the production process

Integrated knowledge transfer and practice by the Factulty of Mechanical and Industrial Engineering

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Faculty-wide learning factory through cooperation of:

Learning & Innovation Factory for Integrative Production Education

Industrial Engineering
Industrial and Systems Engineering in cooperation with Fraunhofer Austria

Product Development
Institute for Engineering Design and Logistics Engineering

Production Technology
Institute for Production Engineering and Laser Technology

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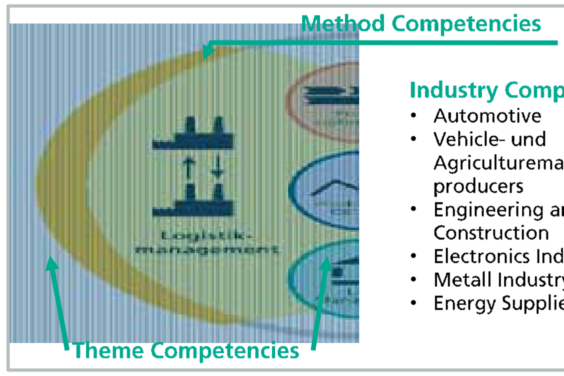
Institute for Management Science/Industrial and Systems Engineering & Fraunhofer Austria Research GmbH Business area Production- und Logistics Management

- Production Management
- Logistics/SCM
- Quality- and Process Mgmt
- Project Management
- Plant Design
- Maintenance/Reliability
- System Planning
- Product-Management
- Business-Games



Industry Competences
- Automotive
- Vehicle- und Agriculturemachinery producers
- Engineering and Plant Construction
- Electronics Industry
- Metall Industry
- Energy Suppliers

Commerce and Industry

Higher education → Research → Development → Realization → Application

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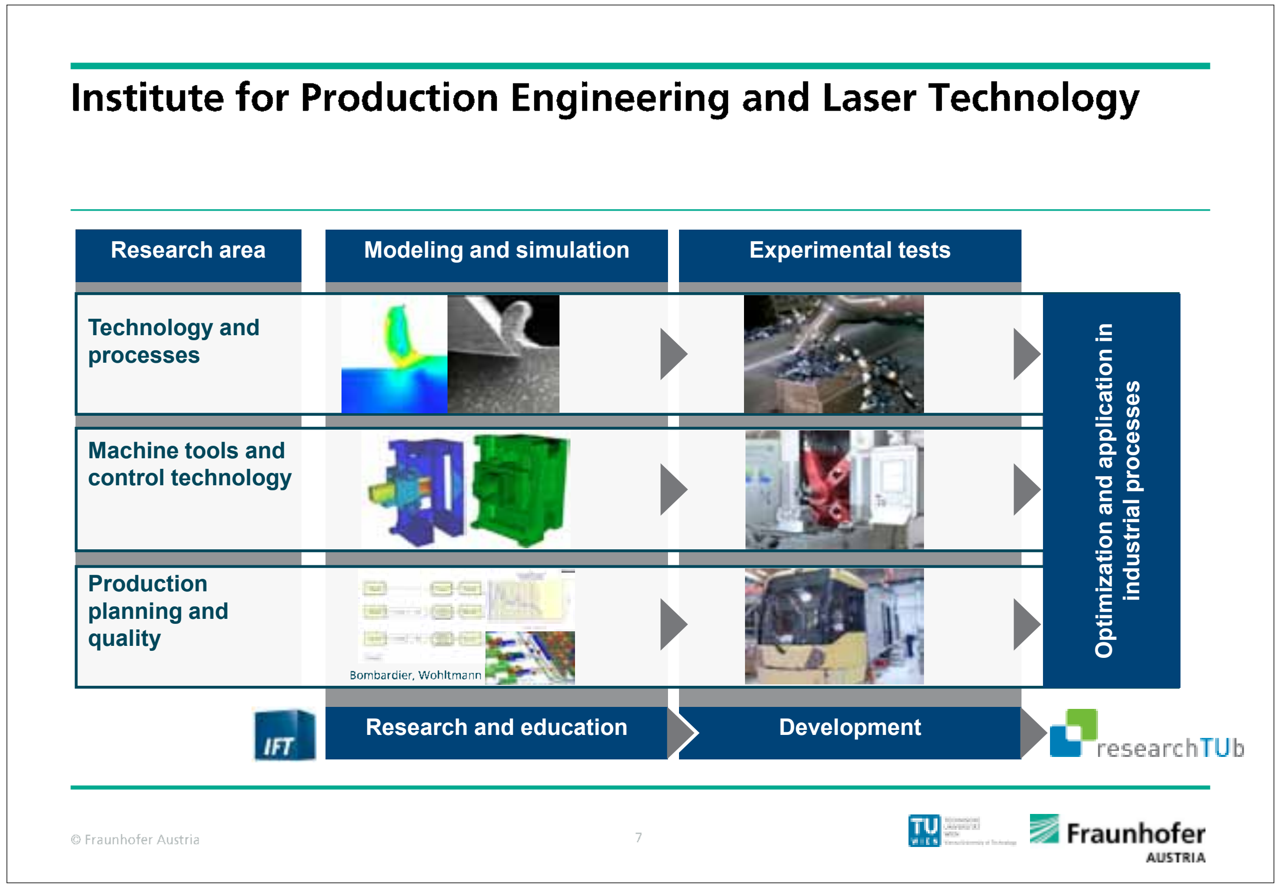
Institute for Production Engineering and Laser Technology
Research area
Modeling and simulation
Experimental tests
Technology and processes
Machine tools and control technology
Production planning and quality
Bombardier, Wohltmann
Optimization and application in industrial processes
IFT
Research and education
Development
researchTUb
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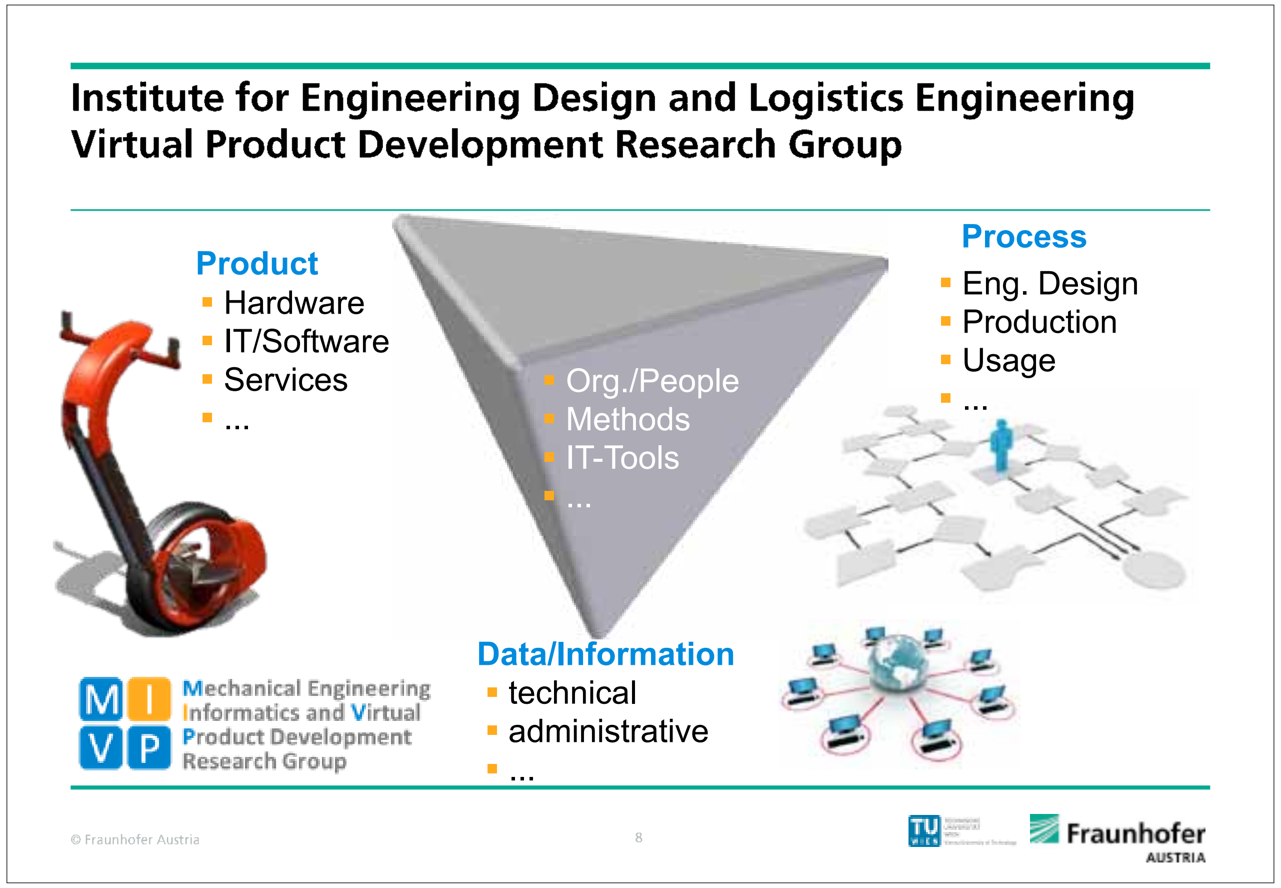
Institute for Engineering Design and Logistics Engineering
Virtual Product Development Research Group
Product
Hardware
IT/Software
Services
...
Org./People
Methods
IT-Tools
...
Process
Eng. Design
Production
Usage
...
Data/Information
technical
administrative
...
Mechanical Engineering Informatics and Virtual Product Development Research Group
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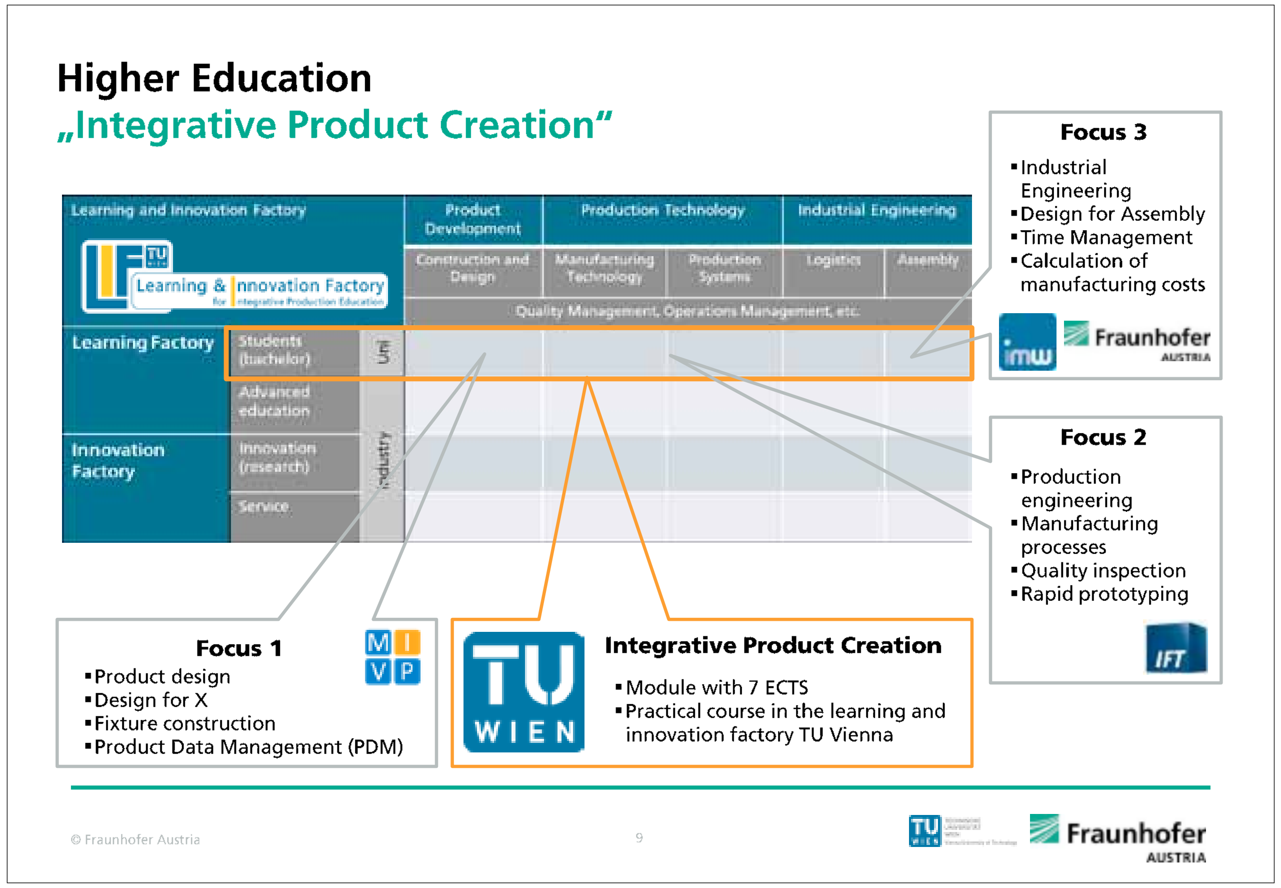
Higher Education
„Integrative Product Creation“
Learning and Innovation Factory
Product Development
Production Technology
Industrial Engineering
Construction and Design
Manufacturing Technology
Production Systems
Logistics
Assembly
Learning & Innovation Factory
Quality Management, Operations Management, etc.
Learning Factory
Students (bachelor)
Advanced education
Uni
Innovation Factory
Innovation (research)
Service
Industry
Focus 3
Industrial Engineering
Design for Assembly
Time Management
Calculation of manufacturing costs
imw
Fraunhofer AUSTRIA
Focus 2
Production engineering
Manufacturing processes
Quality inspection
Rapid prototyping
IFT
Focus 1
Product design
Design for X
Fixture construction
Product Data Management (PDM)
TU WIEN
Integrative Product Creation
Module with 7 ECTS
Practical course in the learning and innovation factory TU Vienna
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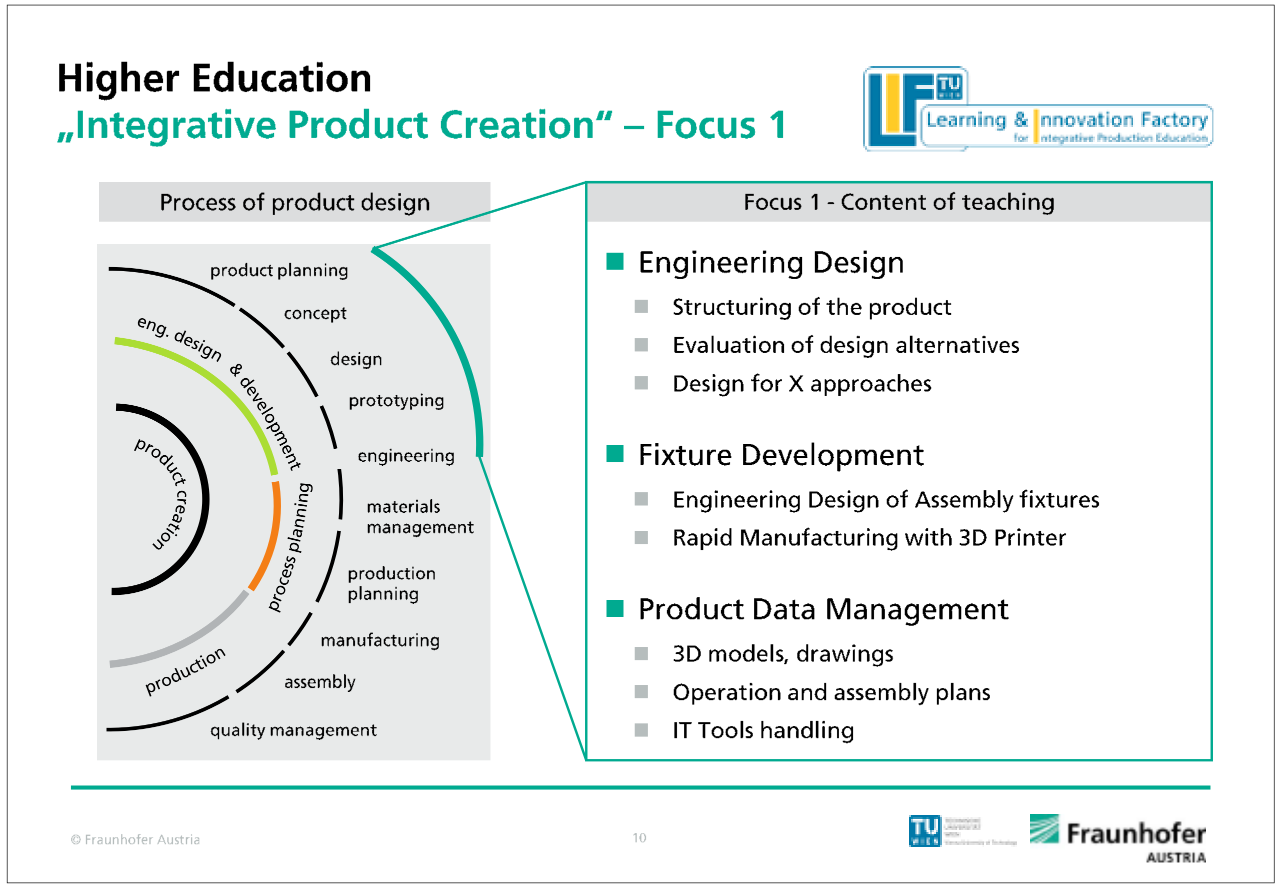
Higher Education
„Integrative Product Creation“ – Focus 1
Learning & Innovation Factory
Process of product design
product planning
concept
design
prototyping
engineering
materials management
production planning
manufacturing
assembly
quality management
eng. design & development
product creation
process planning
production
Focus 1 - Content of teaching
Engineering Design
Structuring of the product
Evaluation of design alternatives
Design for X approaches
Fixture Development
Engineering Design of Assembly fixtures
Rapid Manufacturing with 3D Printer
Product Data Management
3D models, drawings
Operation and assembly plans
IT Tools handling
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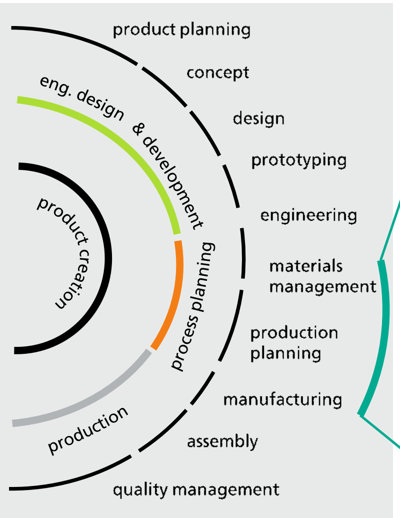
Higher Education
„Integrative Product Creation" – Focus 2

Process of product design

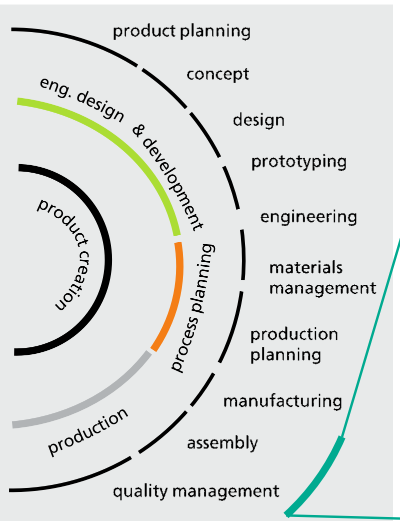


Focus 2 - Content of teaching

- Production Engineering
  - Design for manufacturability
  - Technology and process planning
    - Selection of processes, equipment and tooling
    - Definition of machining parameters, set-up instructions and quality assurance checkpoints
    - sequencing of operations
    - creation of Manufacturing BoMs and Routings
    - NC-programming
- Production Planning
  - Material requirements planning
  - Scheduling
- Machining
- Quality inspection

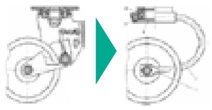
Higher Education
„Integrative Product Creation" – Focus 3

Process of product design



Focus 3 – content of teaching

- Design for Assembly
  - Approaches
  - Product structure
  - Assembly process and operations
  - Implementation with examples

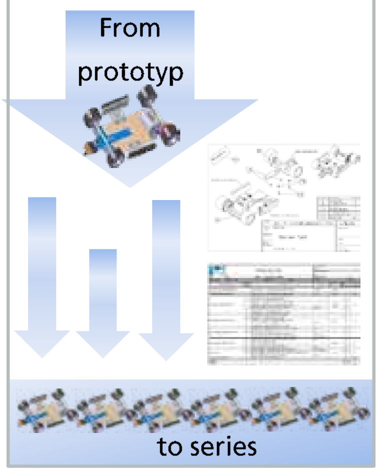


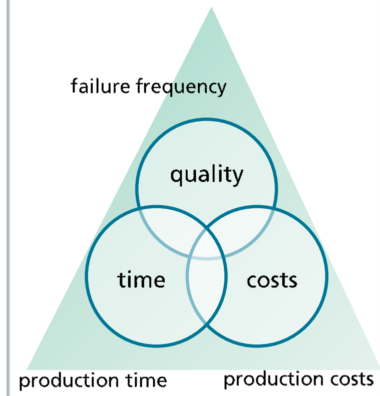
- Time Management
  - Time observation vs. MTM

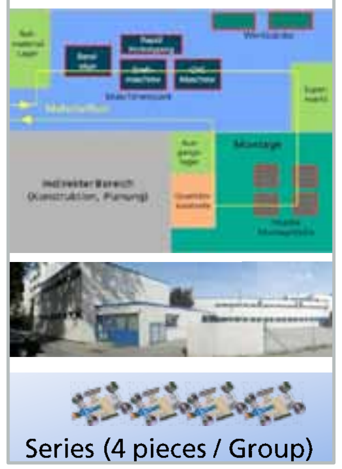
- Manufacturing Costs
  - Calculation methods and practice
  - Potentials for cost reduction

Higher Education
„Integrative Product Creation" - Tasks

Task 1	Task 2	Task 3
Development and Planning	Product and Process optimization	Manufacturing & Assembly

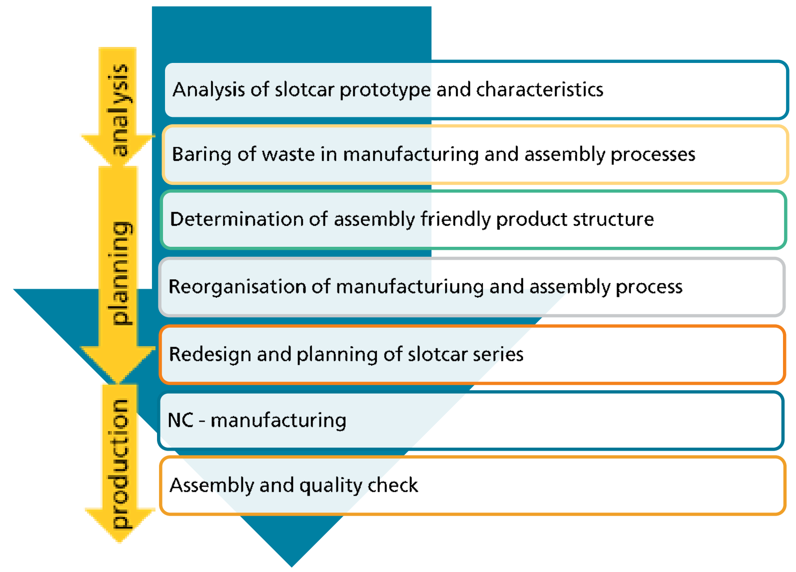






Higher Education
„Integrative Product Creation" - Tasks

Student's tasks



Higher Education
„Integrative Product Creation"

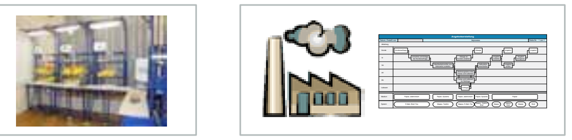
Vision and implementation of the Learning and Innovation Factory of the Vienna University of Technology

LEARNING FACTORY AS ADVANCED EDUCATION TOOL FOR INDUSTRY

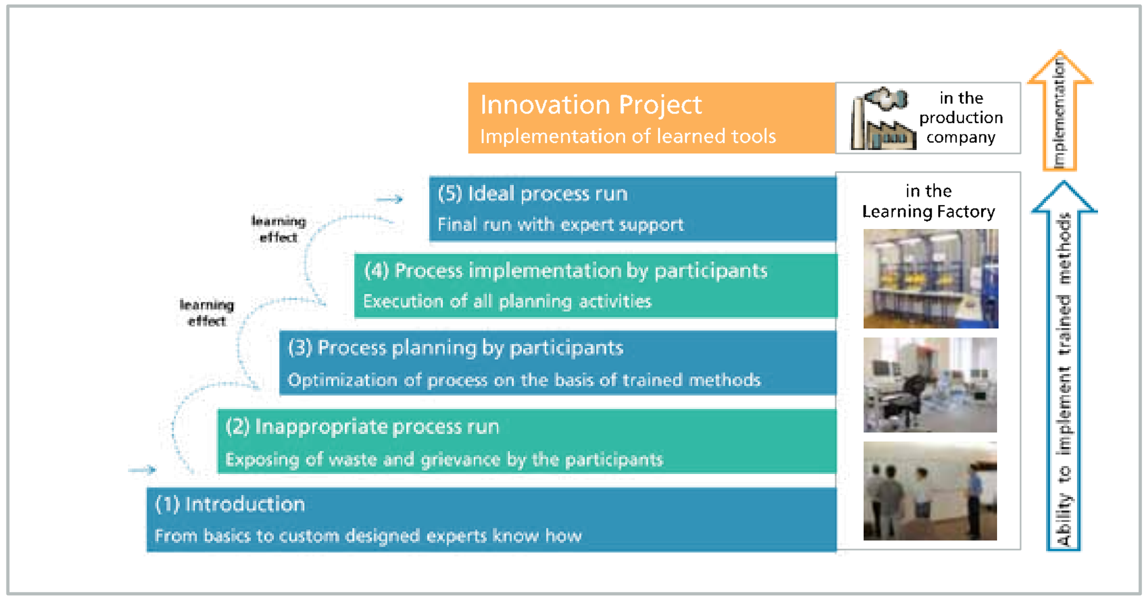
Advanced Education for Industry
Training with following project monitoring

Theory → Implementation

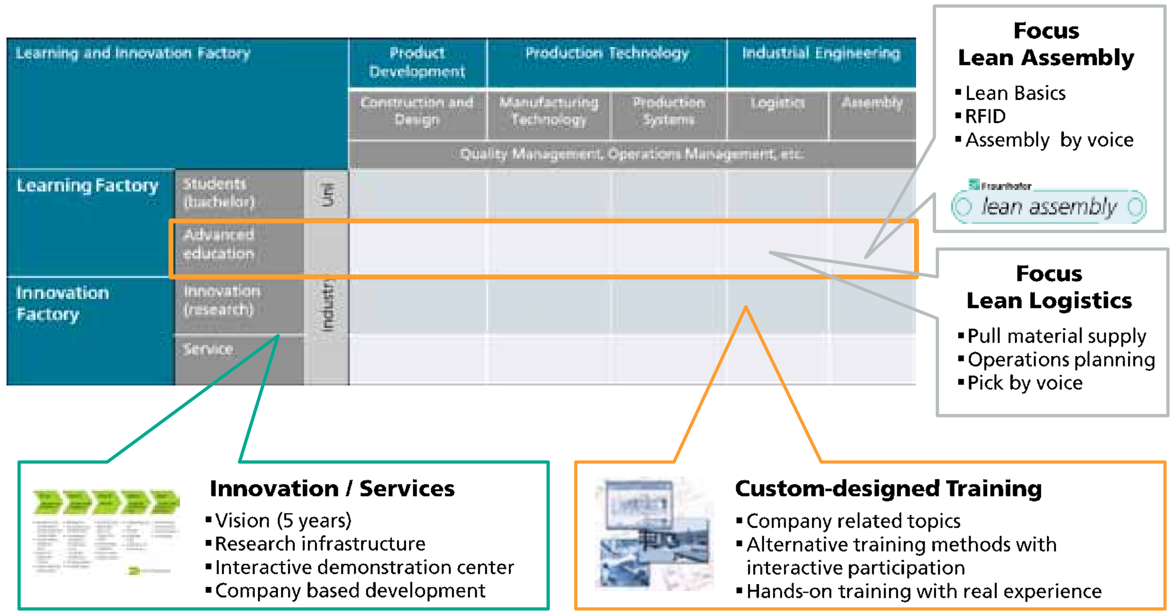
Thematically Introduction	Hands-on Training	Innovation Project
in the production company or the learning factory	in the learning factory of the Vienna University of Technology	in the production company
▪ Seminar / workshops ▪ Theoretically Background ▪ Basics to custom designed experts know-how ▪ Business and managements games	▪ Demonstration of the ideal situation ▪ Holistic approach ▪ Interactive explanation and application of methods	▪ Implementation of learned tools ▪ Optimization of operation values by trained employees ▪ Support by FhA experts



Training Model: Industry
5 + 1 steps



Advanced Education
Focus



Lean Assembly
Advanced hands-on training

- Training of expertise in methods for optimization of assembly and logistics processes in a **„labour for lean methods"**
- Existing content of teaching (modular):
  - Assembly and process planning
  - Time management and capacity planning
  - Time device / frequency
  - One Piece Flow, continuous flow production
  - 5S, SMED, Poka-Joke
  - Lean factory layout planning
- Current development:
  - RFID time tracking
- Preview:
  - Assembly / pick by voice

Common planning of assembly and material flow

Separation of assembly and logistics tasks

Lean Assembly
Advanced hands-on training

Contact Persons

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PTC GLOBAL PRESENCE

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800+
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27,000 Total active customers

1.5 Million active commercial customer seats

Industries Served

- Automotive
- Industrial
- Medical device
- Aerospace & defense
- Electronics & high tech
- Retail & consumer

Market Segments

- Mechanical CAD (MCAD)
- Product Lifecycle Management (PLM)
- Application Lifecycle Management (ALM)
- Supply Chain Management (SCM)
- Services Lifecycle Management (SLM)

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www.beewatec.de

Corporate philosophy

World is changing. Globalization and international cooperation determine our working environment and the way we think as never before. Fixed, rigid solutions designed "forever" are increasingly replaced by **intelligent, flexible approaches** that better satisfy the requirements of speedy production and reaction, as well the need for price squeezing in many areas.

»Processes connected with flexibility« - we are committed to support you on your way to process optimization.

Portrait

Company name:	BeeWaTec GmbH
Affiliated companies:	ANT-System GmbH; Haid GmbH & Co.KG
Subsidiaries:	BeeWaTec s.r.o. (Czech Republic) BeeWaTec Bt (Hungary)
Number of employees:	approx. 119 (throughout Europe, groupe)
Distribution channel:	direct sales, field service, distributors, branch offices

Flexible system for all sectors of industry

As a medium-sized company BeeWaTec relies consequently on a continuous high standard of quality – this applies for the production of our products as well as for the application of these systems at the customers' plants. Technical equipment is no longer a company's most important capital - satisfied and committed **staff members** are a company's driving force.
For this reason, topics such as the simplification and facilitation of daily working processes, ergonomics and health protection play an important role.
Well-known companies figure among the customer base of our corporate companies and its partners. Our product portfolio enables you to create anything you want and in any industry sector you are working in – automotive industry, supplying industry, electrical industry or any general industry.
Therefore, we provide support along your way of process optimization: individual advice, engineering, supply of kits and/or complete developments (e.g. work stations, material supply systems from warehouse to work station by using tugger trains etc.), trainings and workshops, up to a highly-skilled international sales and service network.

Product portfolio

- The **BeeWaTec pipe racking system by G.S ACE** opens up new ways of designing your ideas - from work stations to tugger trains - a versatile, flexible and above all high-quality kit system that allows you to implement your ideas quickly and simply.
- With our own **low cost AGV** system, as well as our **trailer systems**, we offer tried and tested intralogistic solutions.
- You will find a broad range of working aids for **assembly work stations,** for the **workshop** and for **workflow management,** all of which make use of the pipe racking system. Also we draw your attention to our **Business Equipment catalogue,** featuring an extensive programme of tables, work benches, cupboards, trolleys, chairs and so on.

Services

- **Technical support** and expert advice from our experienced staff, nationally and internationally
- **Planning support:** construction of your projects and the drawing up of building plans
- **User training:** workshops in your own plant or in our company – for a successful start with your system
- **Continuous Improvement**: our kits are being continuously improved. We should also be pleased to design products, components or complete solutions especially for you!

References

TRUMPF • SIEMENS • DrägerSafety • Zeiss • Mahle Schmalz • Kärcher • ABB • Festo • Bosch Automotive Lighting • Volkswagen • Daimler Flextronics • etc.

Schoeller Arca Systems GmbH

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2700 Wiener Neustadt - Austria
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P: +43 2622 20656 0
F: +43 2622 20656 21
E: info.neustadt@schoellerarca.com
W: www.schoellerarcasystems.at

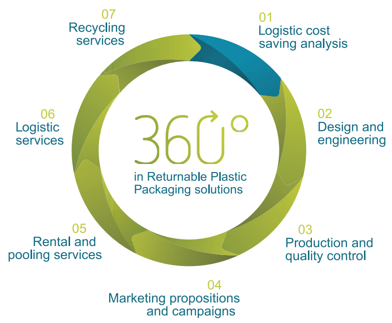
Head office: Zwolle (The Netherlands)
Global group turnover 2010: € 433 mio
Employees (worldwide): approx. 1000

Operating in over 50 countries, Schoeller Arca Systems provides reliable, high quality plastic packaging systems and services. As an innovative and experienced development partner, we are committed to helping our customers reduce their overall logistics costs and enhancing product branding. Our systems are used in a broad variety of industry segments including, beverage, automotive, agriculture, retail distribution, postal services and pool providers. Through our own production facilities and selected licensee partners, we are able to combine a global presence with fruitful local partnerships.

At the core of our business is a relentless dedication to our customers' needs. We help customers earn higher rates of return through the use of more efficient secondary packaging, and generate higher revenues through more effective product branding. We design and manufacture innovative, high-quality plastic solutions for industrial and commercial use, and we provide customers with services that enhance the value of our physical products. By the same token, we consult our suppliers on a regular basis and develop long-term relationships that foster innovation, stable production and deliveries.

Product range

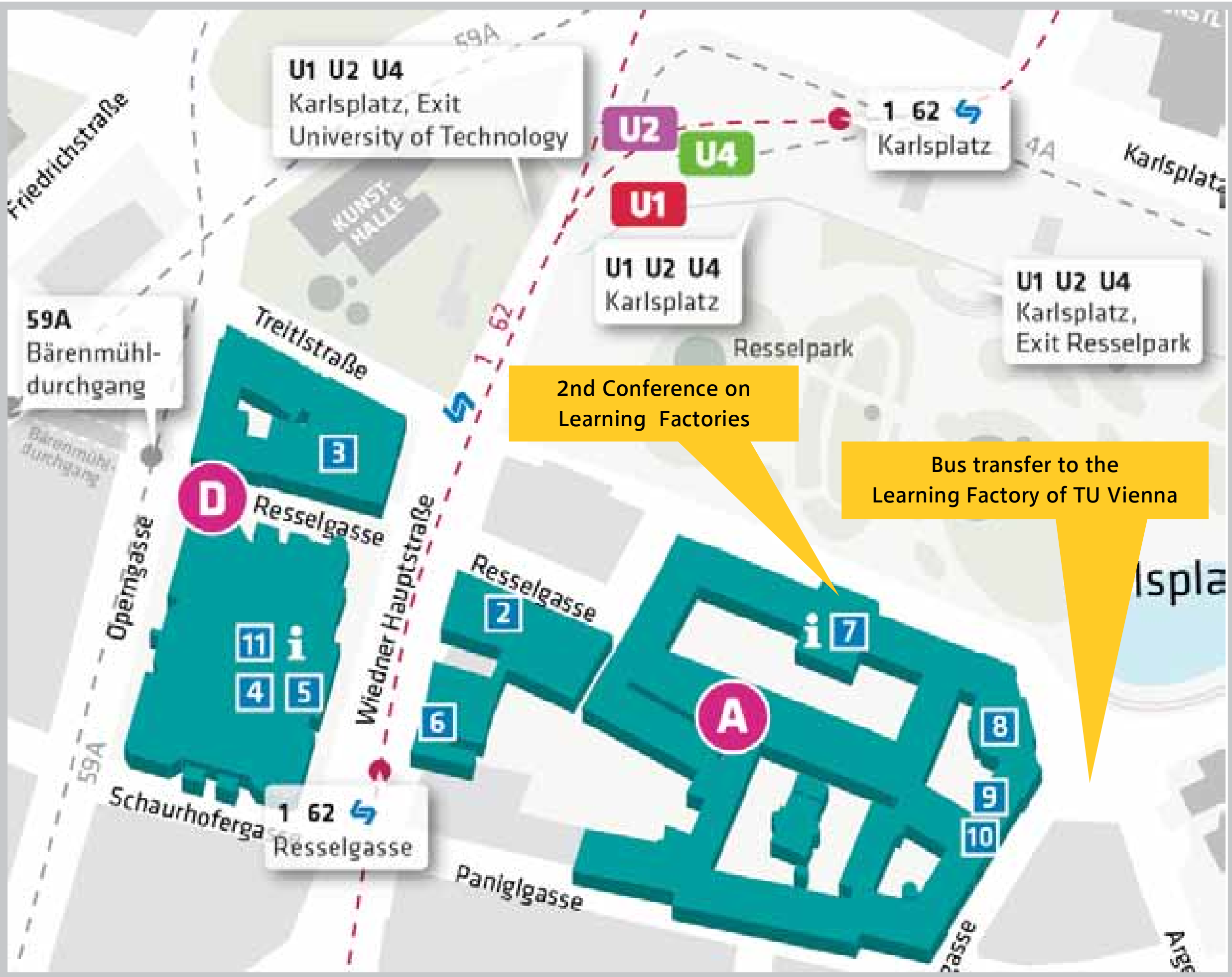
- Rigid pallet containers "**BIG BOX**" (1.200 x 800, 1.200 x 1.000)
- Foldable large containers "**MAGNUM**" (800 x 600, 1.200 x 800, 1.200 x 1.000)
- Intermedia bulk container „**COMBO**" for fluid handling
- Euro containers, stackable containers (**VDA R-/RL-KLT**)
- Stacknest containers „**INTEGRA/ TELLUS**" with/ without (attached) lid
- Nestable containers "**SMALL BOXES**"
- Foldable small containers „**PRELOG**"
- Plastic pallets „**EOS**" and „**BIPP**"
- Storage trays, modular & storage bins „**SYSTEM 9000**"
- Customised solutions (workpiece carrier, inlays, dividers, inserts, blister packaging, ...)
- Services: "**360º IN RETURNABLE PLASTIC PACKAGING SOLUTIONS**"



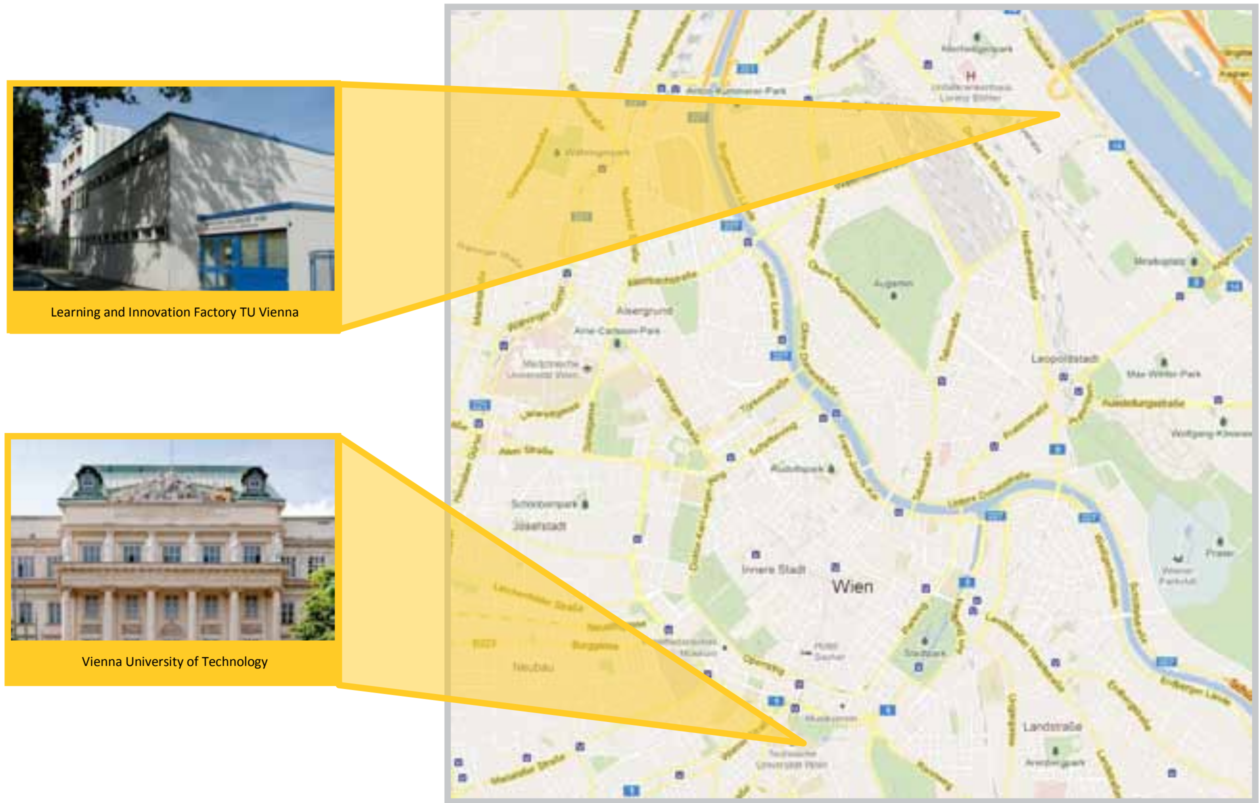
Industries:

1. **Agriculture**
2. **Automotive Industry**
3. **Beverage Industry**
4. **Chemical and Pharmaceutical Industry**
5. **Postal Services**
6. **Fluid Handling**
7. **Food Processing**
8. **Pooling Services**
9. **Retailing**
10. **Recycling & Waste Management**

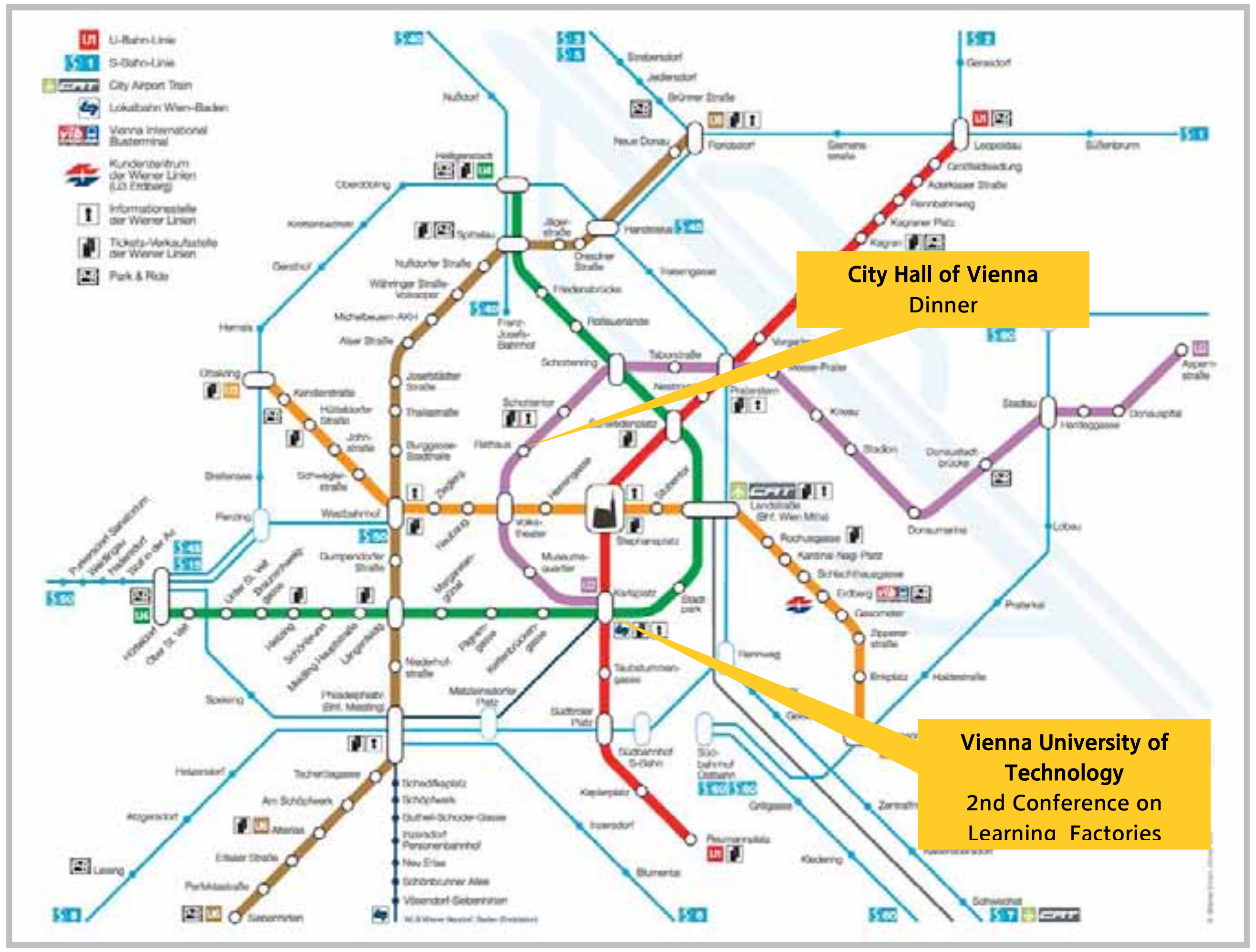
Bus transfer to the Learning and Innovation Factory of the Vienna University of Technology



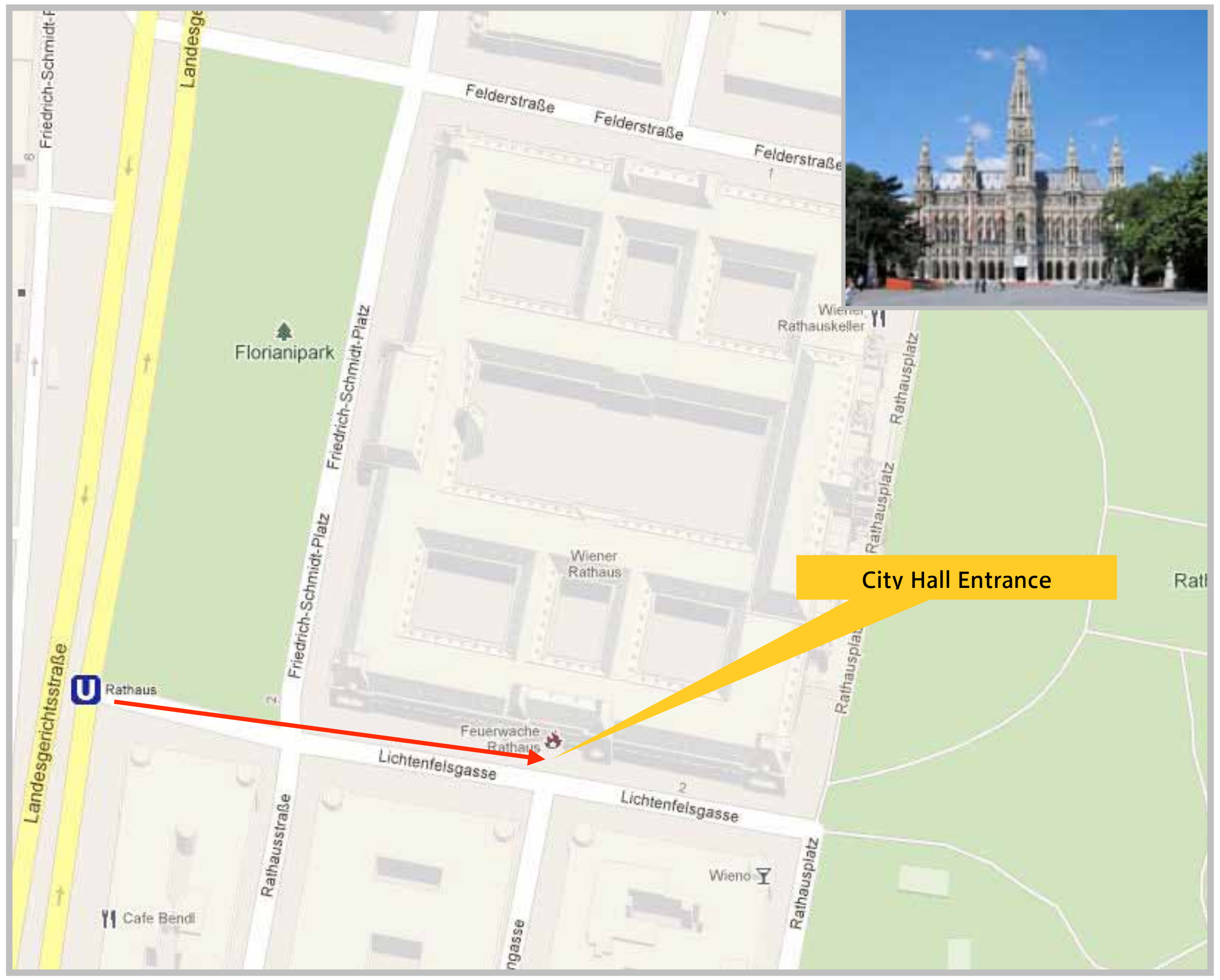
Learning and Innovation Factory of the Vienna University of Technology
Laboratory for Production Engineering and Laser Technology
Engerthstrasse 119
1200 Vienna



Evening event at the City Hall of Vienna
From “Karlsplatz” with the subway U2
(direction Aspernstrasse) to “Rathaus”



Entrance of the Vienna City Hall



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Notes

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