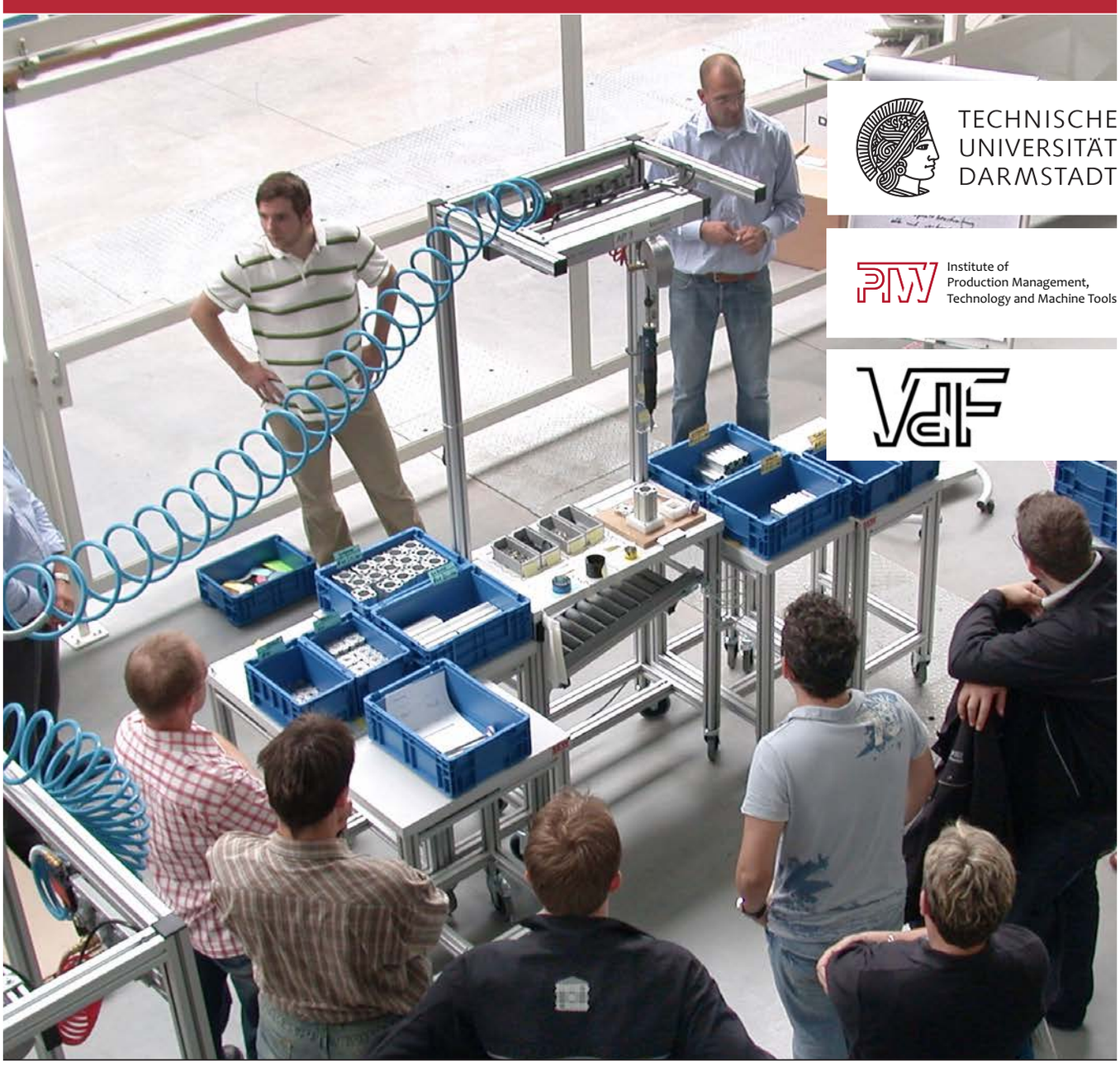
CiP

1st Conference on Learning Factories
May, 19th 2011 | Darmstadt

Institute of Production Management, Technology and Machine Tools (PTW)
Technische Universität Darmstadt | Prof. Dr.-Ing. Eberhard Abele



TECHNISCHE UNIVERSITÄT DARMSTADT

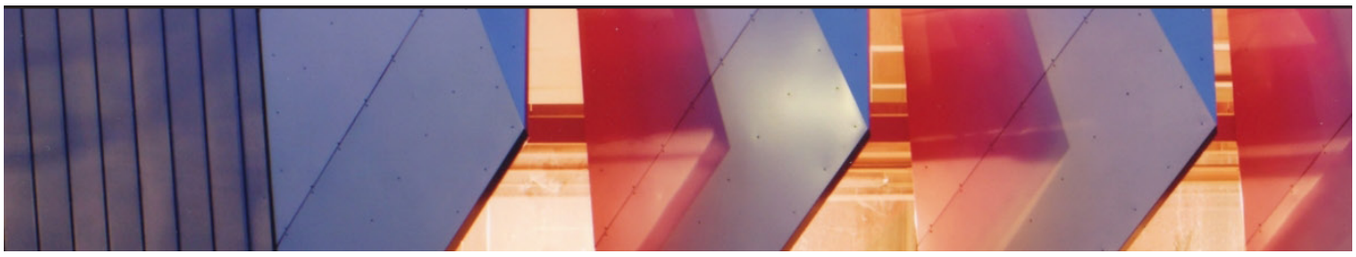
Institute of Production Management, Technology and Machine Tools

VdF

CiP

Learning Factory CiP at the
Technische Universität Darmstadt

1st Conference on Learning Factories May, 19th 2011 | Darmstadt



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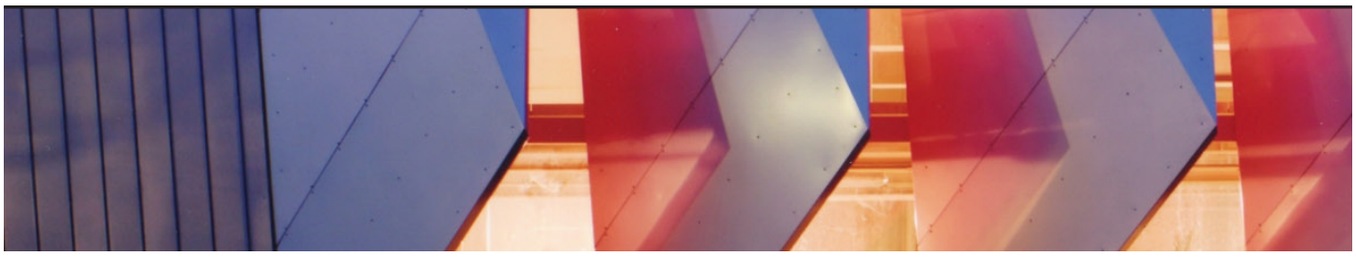


I hear and I forget;
I see and I remember;
I do and I understand.

Confucius
Chinese thinker & social philosopher (551 BC - 479 BC)

Preface

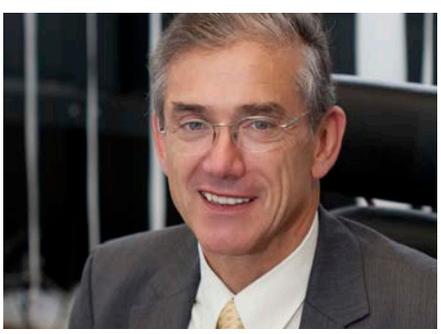
1st Conference on Learning Factories

The production of the future is determined by shorter product life cycles and at the same time by increasing varieties in technologies, standards and methods. The challenge for industrial companies as well as for universities is therefore to establish more effective and sustainable methods for knowledge enhancement and knowledge transfer. Lifelong learning will become a crucial aspect for production engineers.

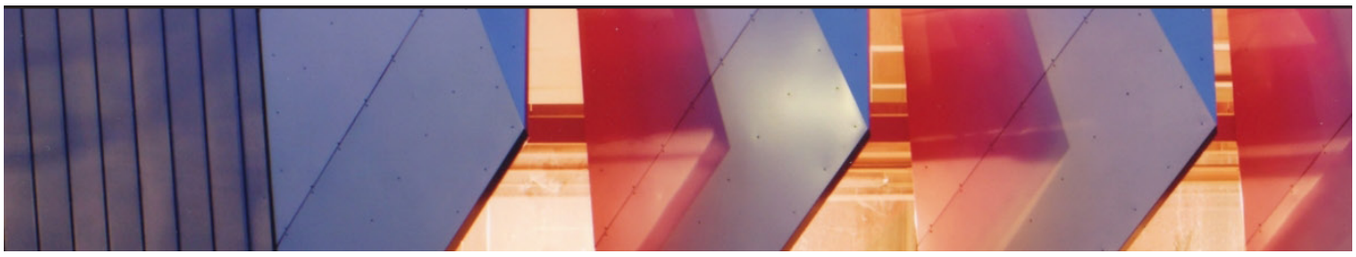
To cope with this challenge more and more companies and universities build up learning factories. Trainings in such a facility are more effective and efficient than any other didactical approach known by now.

To learn more about these factories and to discuss didactical approaches we kindly welcome you to Darmstadt to the first conference on learning factories.

Darmstadt, May 2011

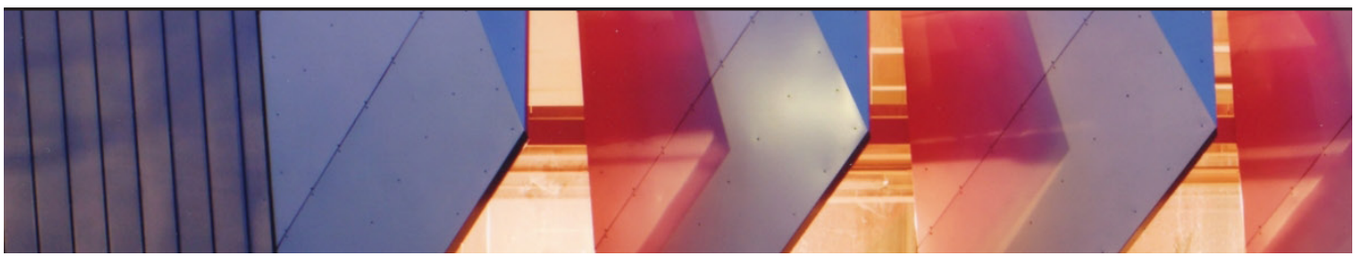


Prof. Dr.-Ing. Eberhard Abele
Head of Institute PTW



Conference Program

08:30		Check-in and hand out of the conference documents
09:00		**Opening** | Vice-President of the TU Darmstadt, Prof. Holger Hanselka
Block I	Learning and competence-building as a competitive factor	
09:15		Prof. Eberhard Abele | PTW, TU Darmstadt The future of production: Qualification and practical training as a key factor for the production location Germany
09:45		Prof. Ralf Tenberg | Technology Didactics, TU Darmstadt Learning factories as a contribution to competence-oriented learning in universities and companies
10:15		Jürgen Geiger | McKinsey & Company Implementation of lean production in the industry by learning factories
10:45		*Coffeebreak*
Block II	Learning factories in operational application	
11:15		Prof. Wilfried Sihn / Prof. Friedrich Bleicher | Vienna University of Technology Integrated, scalable concept of a learning factory at the Vienna University of Technology
11:45		Dr. Reinhard Pittschellis | Festo Didactic GmbH & Co. KG Future concept learning factories – practical training at vocational schools and universities
12:15		Dr. Christoph Siegel, Daimler AG The application of a learning factory for extensive training of employees
12:45		*Lunch*
13.45		Markus Reichert, SEW-EURODRIVE GmbH & Co KG Qualification of employees in the development department with the SEW Life Training Center
14:15		Prof. Gunther Reinhart, IWB, TU Munich Live experience of energy productivity – the training factory at Technische Universität München (TUM)
14:45		Frank Göller, Festool Engineering GmbH Qualification in the Festool production system
15:15		*Coffeebreak*
Block III	Leaders as Teachers	
15:45		Dr. Jens Deuster, Robert Bosch GmbH Integrated concept of skill for the Bosch Production System
16:10		Frank Krause, STAUFEN.AG Challenge leadership – Coaching as leadership concept in lean production
16:45		*Transfer to the process learning factory*
17:30		Introduction of the learning factory CiP and walkthrough in live operation Get-together with a stand-up reception in the learning factory



Prof. Holger Hanselka

In 2001 Prof. Dr. Hanselka accepted the chair position for director of Fraunhofer Institute for Structural Durability and System Reliability LBF in Darmstadt and the chair for System Reliability and Machine Acoustics (SzM) of Technical University Darmstadt.

Since October 2006 he is acting as a member of the board of directors of Fraunhofer Gesellschaft as well as chairman of the Fraunhofer Group for Materials and Components.

Prof. Dr. Holger Hanselka was elected as Vice-President of the TU-Darmstadt. Since 2011 he is responsible for knowledge and technology transfer, cooperation activities with industry and scientific institutions, formation of spin-off companies, patent management, as well as international relations and alumni.

Prof. Hanselka is initiator and coordinator of LOEWE-Zentrum AdRIA, a consolidated cooperation of Fraunhofer LBF, 22 professors of TU Darmstadt and Hochschule Darmstadt. Prof. Hanselka is speaker of SFB 805. Moreover, he is a member of acatech – Deutsche Akademie der Technikwissenschaften, Munich. Additionally, he is the main coordinator of the Fraunhofer Project System Research Electromobility, a networking cooperation of 33 Fraunhofer Institutes.

Furthermore, Prof. Hanselka operates as an active member of numerous committees and associations, partly also as a member of the board of directors. He is working as an expert among others for the EU, the BMBF, the AiF and the DFG.

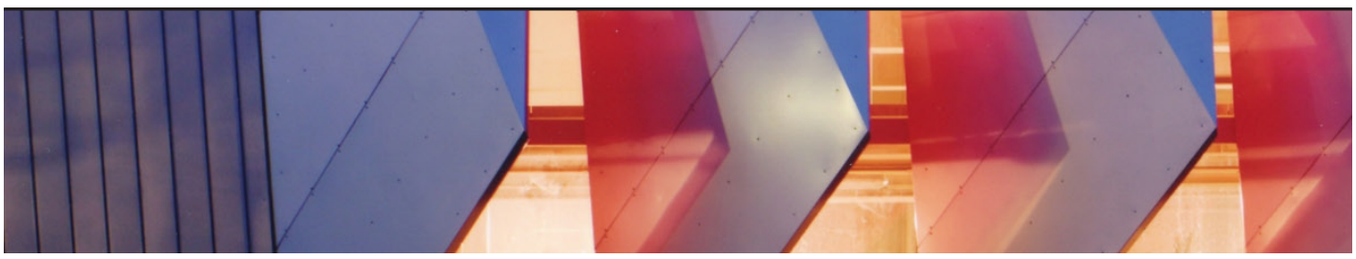
Technische Universität Darmstadt

The Technische Universität (TU) Darmstadt is one of Germany's leading technical universities. Its around 270 professors, 4,000 employees and 23,000 students devote their talents and best efforts to the significant future research fields energy, mobility, communications and information technologies, housing and living conditions. The wide variety of disciplines represented are all focused on technology, as viewed from the vantage point of engineering, the natural sciences, the humanities, and the social sciences, and cover the full range of academic endeavor, from the origination of basic concepts to practical, everyday applications.

TECHNISCHE UNIVERSITÄT DARMSTADT

Opening of the conference

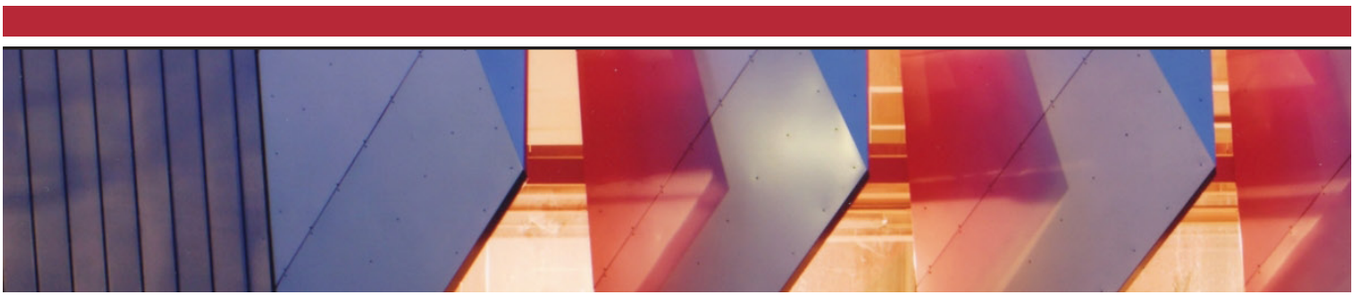
Prof. Holger Hanselka



Block I
Learning and competence-building as a competitive factor

Block II
Learning factories in operational application

Block III
Leaders as Teachers



Prof. 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.

PTW, 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.

PTW
TU DARMSTADT

The future of production: Qualification and practical training as a key factor for the production location Germany

Prof. Eberhard Abele
Sven Bechtloff
Jan Cachay

Darmstadt, Germany | May 19th 2011

TECHNISCHE UNIVERSITÄT DARMSTADT

CiP PROZESSLERNFABRIK

The future of production: Qualification and practical training as a key factor for the production location Germany

Prof. Dr.-Ing. E. Abele
Dipl.-Ing. S. Bechtloff
Dipl.-Wirtsch.-Ing. J. Cachay

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

CiP Centre for industrial Productivity

www.prozesslernfabrik.de

Content

PTW TU DARMSTADT

CiP

- 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 to our new vision

Initial situation for a new approach

Survey among 50 staff managers and directors:

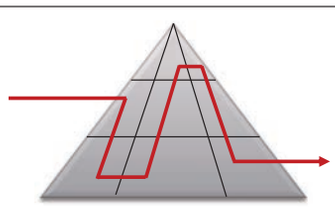
- In what are alumni of Technische Universität Darmstadt good at?
- Where is a need for improvements?

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

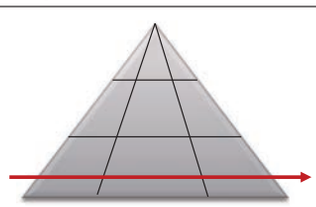
function-oriented



Organisation manages itself autonomously in vertical processes

- Knowledge
- Careers
- Abilities
- Perceptions

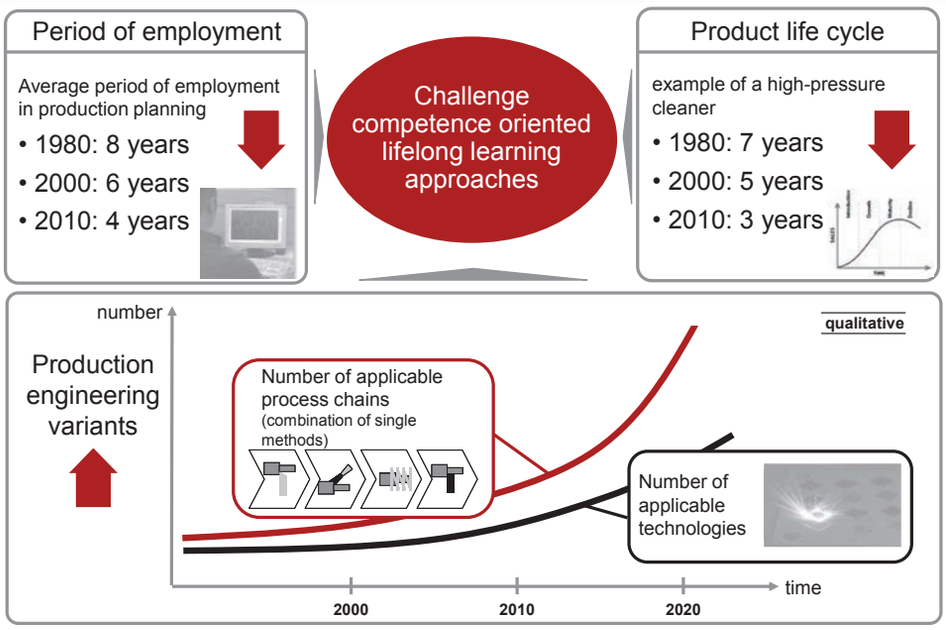
process-oriented



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



Learning by experience on the shopfloor gains lasting knowledge and skills

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

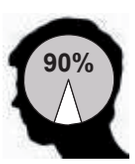
10% of what we read

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

Source: Coverdale

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

Properties and probable application ranges of learning factories

Probable application ranges

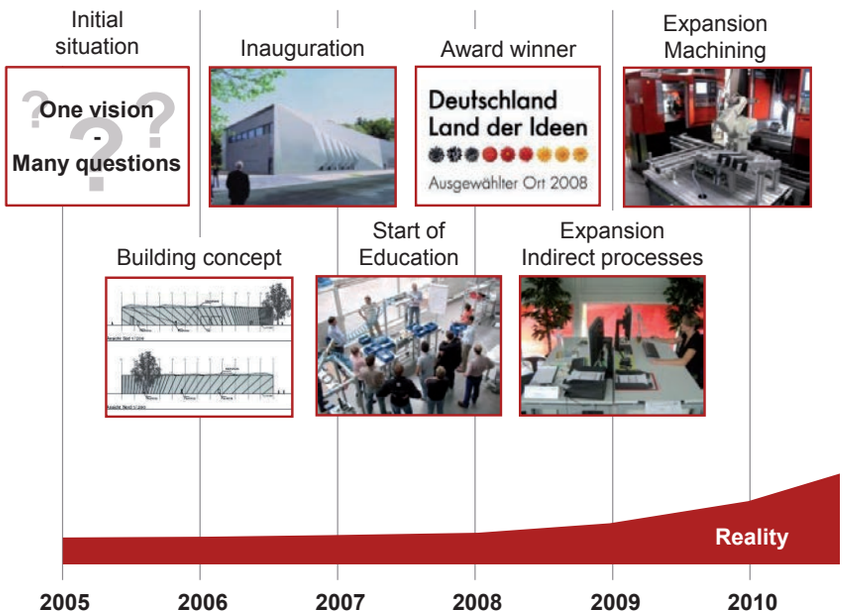
Education	Advanced Training	Knowledge platform	Network
- Universities - Vocational schools - Enterprises	- Groups - Small and medium sized enterprises - Job-seekers	- Innovations - Testing environment - Application	- Learning factories - Industry - High schools

Learning  **factory**

Properties

Didactic	Experimental Area	Visualization	Workforce
- Methodology - Technics - Organisation	- Real products - Machines - Assembly	- Slides - Didactic cells - Demonstrations	- Researcher - Trainer - Factory staff

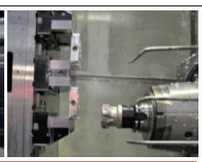
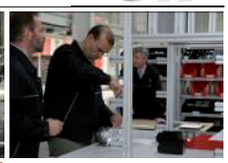
Process learning factory CiP at Technische Universität Darmstadt: Milestones in recent years



First steps: Questions considered from idea to realisation

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



Mass product

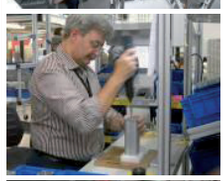
- A complete value stream is provided
- Products are not sold but disassembled

➢Pneumatic - Cylinder

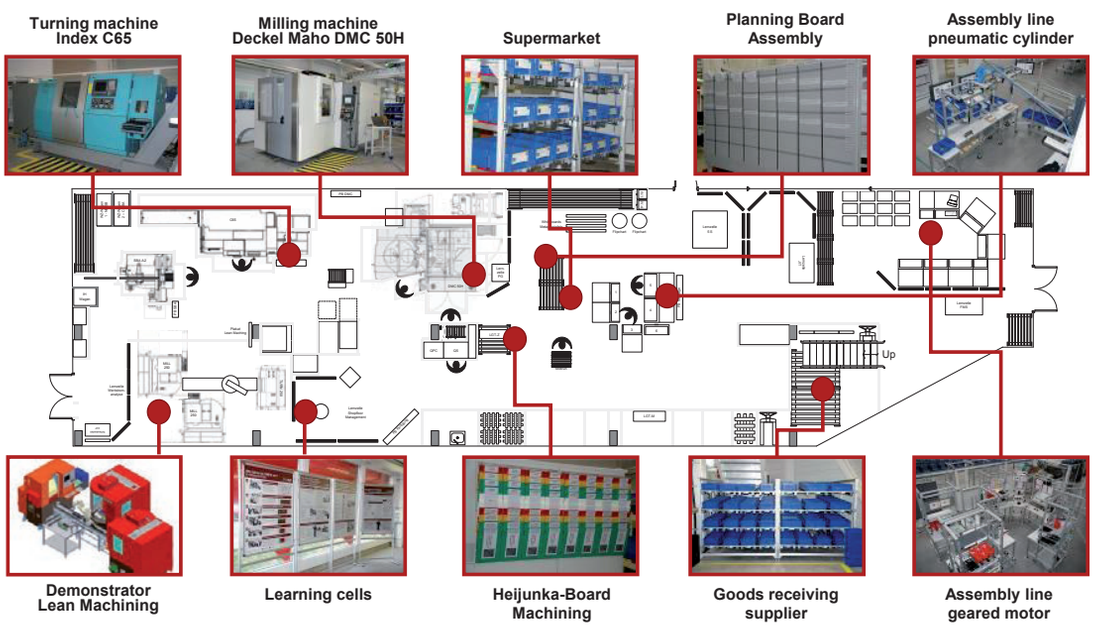
Standard product with high variance

- About 4.000 different variants are possible

➢Electric-engine


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

PTW TU DARMSTADT CiP

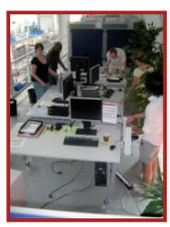
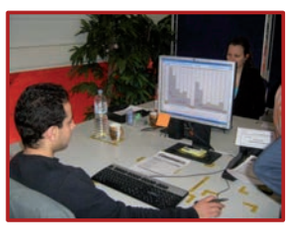
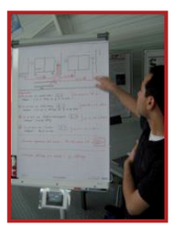
Realised departments with indirect processes:

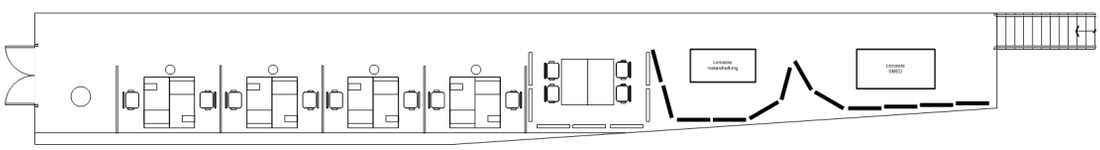
- Sales
- Purchase
- Development
- Production planning and control
- Idea management

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





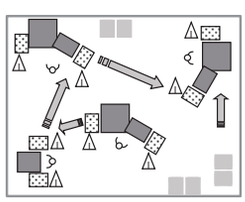
By various configurations of a flexible machining cell an economic valuation of several production setups is possible

PTW TU DARMSTADT CiP

Batch Production*

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

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

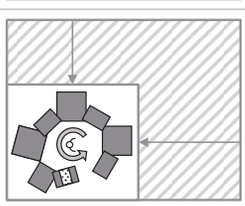


11,30 € / piece
(Lot size 150)

Chaku Chaku cell

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

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

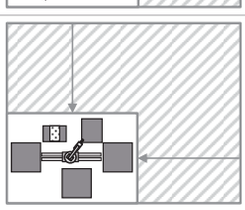


8,50 € / piece
(Lot size 40)

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 €

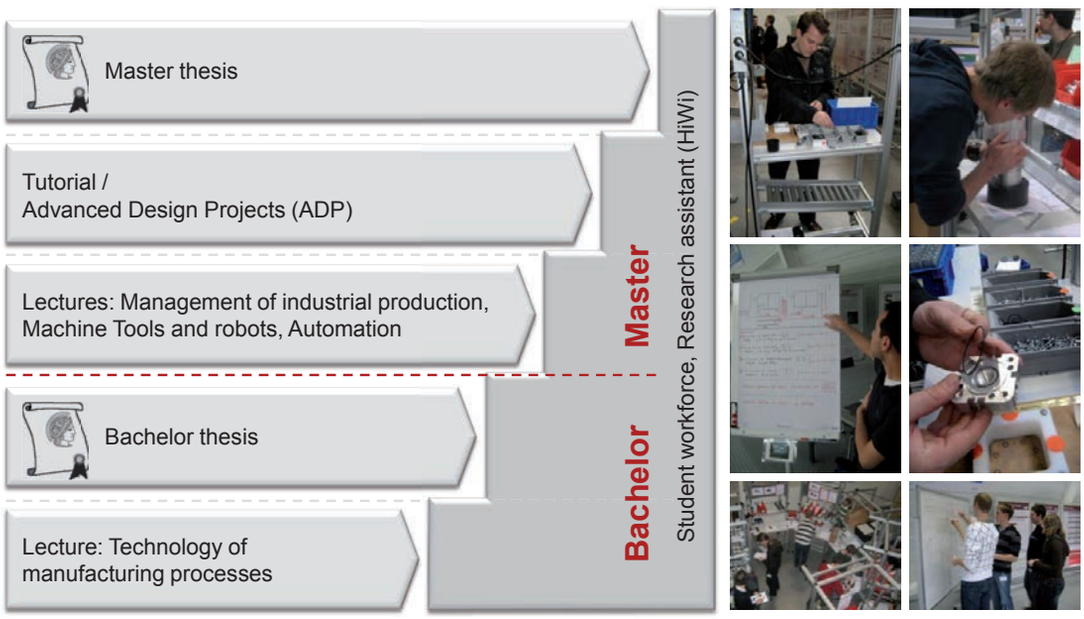


8,20 € / piece
(Lot size 230)

Economic valuation

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

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



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

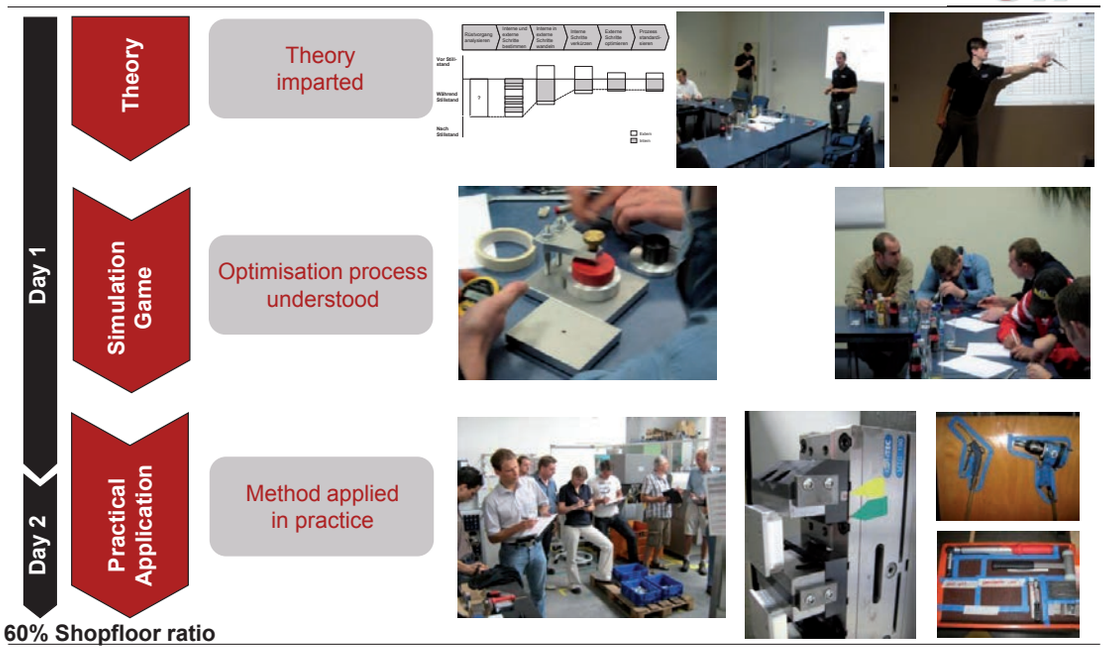
Phase 1: Lean understanding	Phase 2: Lean core elements	Phase 3: Lean culture
Lean Basics **Basics and diagnosis**** • The need for Lean • 7 types of waste • Value stream mapping • OEE **Value stream design**** • Pull principle • Flow production • In-takt production • Value stream design **Quality techniques**** • Lean quality assurance • Poka Yoke • Problem solving • Jidoka	**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 **Technology Optimisation*** • Selection of parameters **Lean Quality** **Measuring system analysis**** • Capability of measuring systems **Machine capability**** • Machine acceptance test **Process capability and SPC**** • SPC, control charts	**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

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

Ability to develop operational excellence in the individual environment

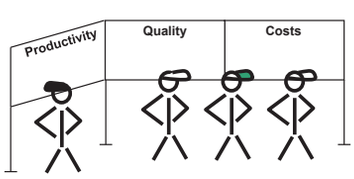
Transformation of CiP to a Lean best practice enterprise

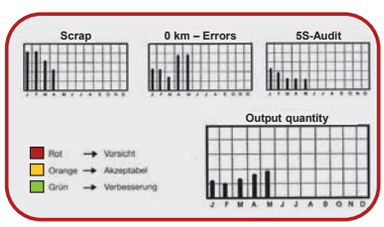
Examples for the structure of learning modules: Workshop Quick change-over (SMED)



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

Daily performance dialogue

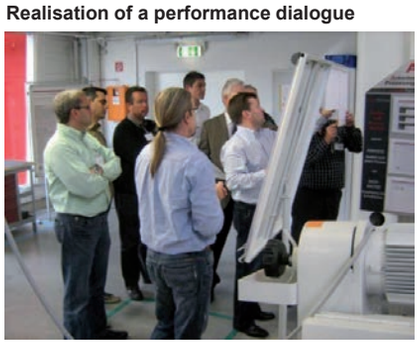




- Which key performance indicators (KPI) are necessary?
- How can these KPI be determined and visualised?
- Which actions can be taken immediately?

Development of a shopfloor management board

Realisation of a performance dialogue



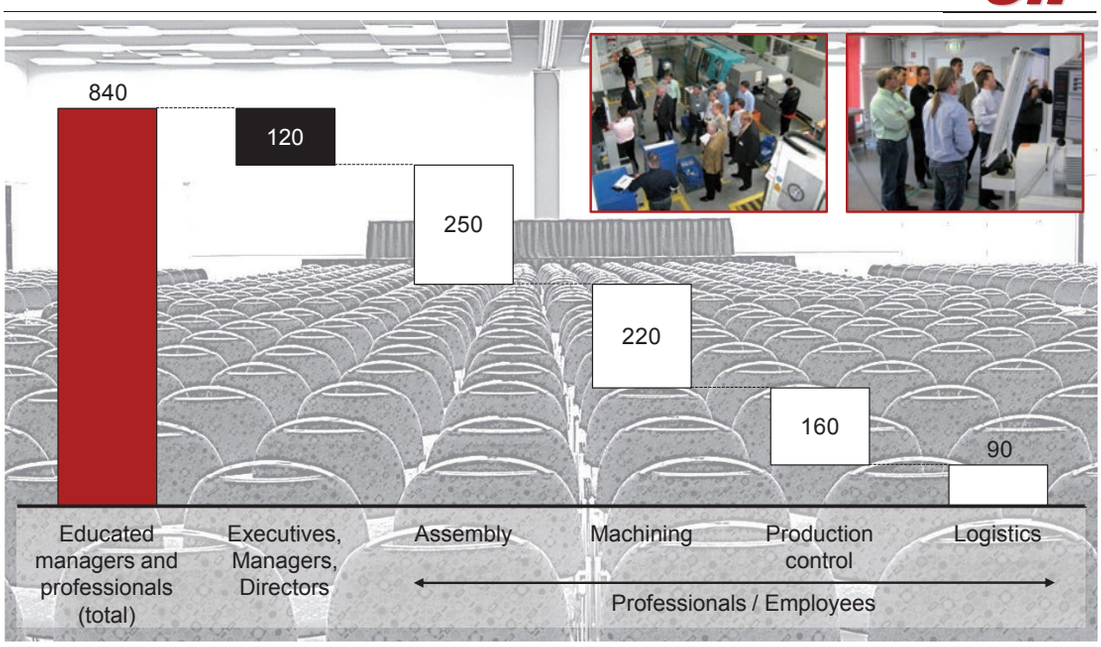
Previous cooperation partners in research and education

Research and vocational education with partner companies

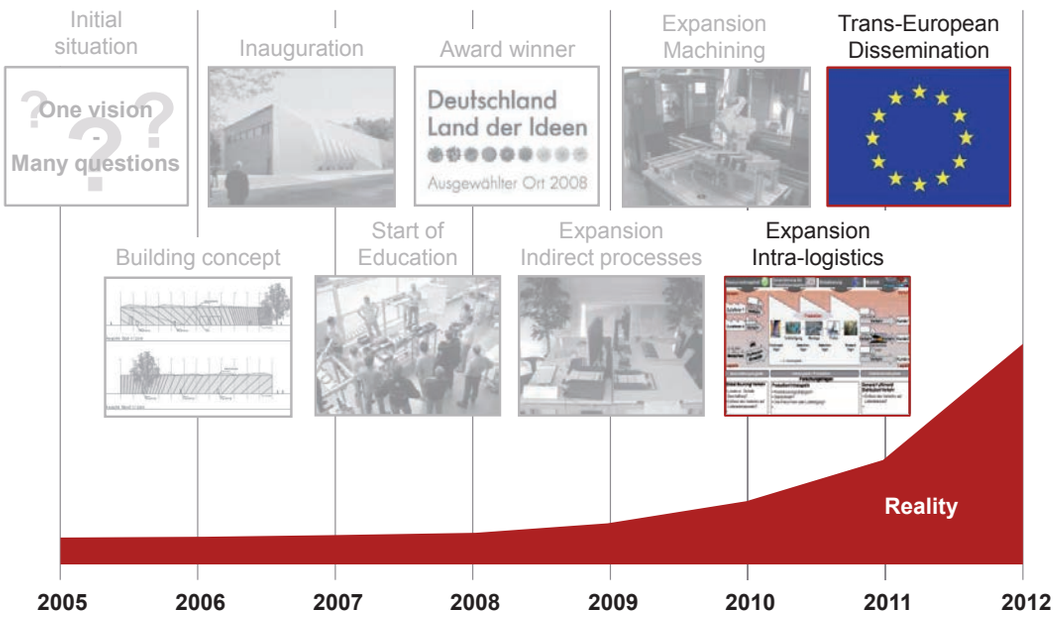
Management Training

Vocational education with regional SME

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



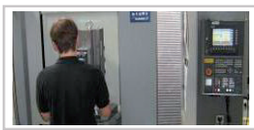
Process learning factory CiP at Technische Universität Darmstadt: Current milestones



Current research topics of the CiP staff

Personnel Management and Compentence Development in Lean Production

- Methods for leadership and didactical concepts for competence development in principles and methods of lean production
- Personnel management and capability for daily improvement routines on the shopfloor

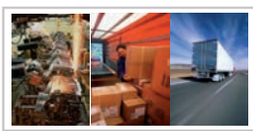


Increase of Overall Equipment Effectiveness (OEE)

- Methods to reduce waste of machine tools, i.e. optimization of setup time (SMED), maintenance organisation, fast ramp-up
- One-Piece-Flow: flexible organisation of machine-intensive departments

Lean-IT: Supporting Lean Production with IT-Solutions

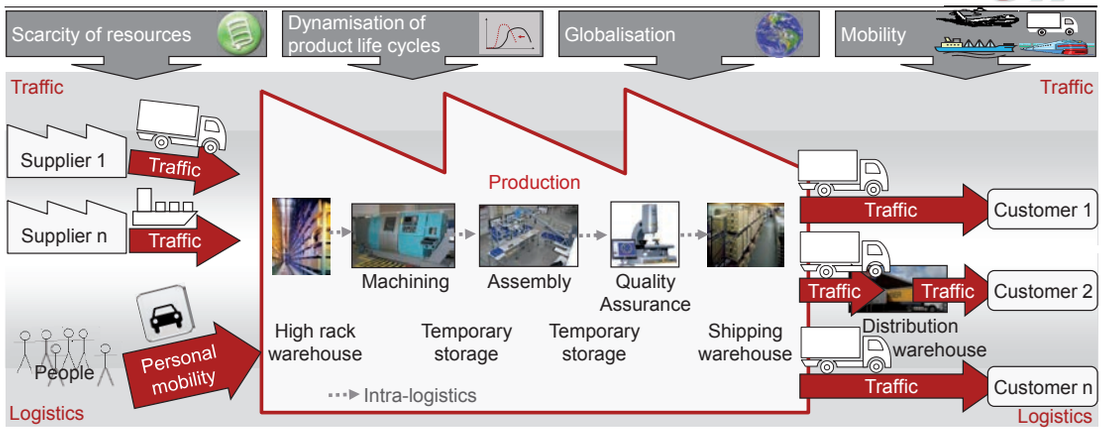
- Simulation-based planning of lean material and information flows
- Dynamic adjustment of Kanban-loops based on leveled Production



Production Logistics for Lean Production

- Flexible and adaptable 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? • …

Potential operational areas for model factories can be found close and far related to production industries

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

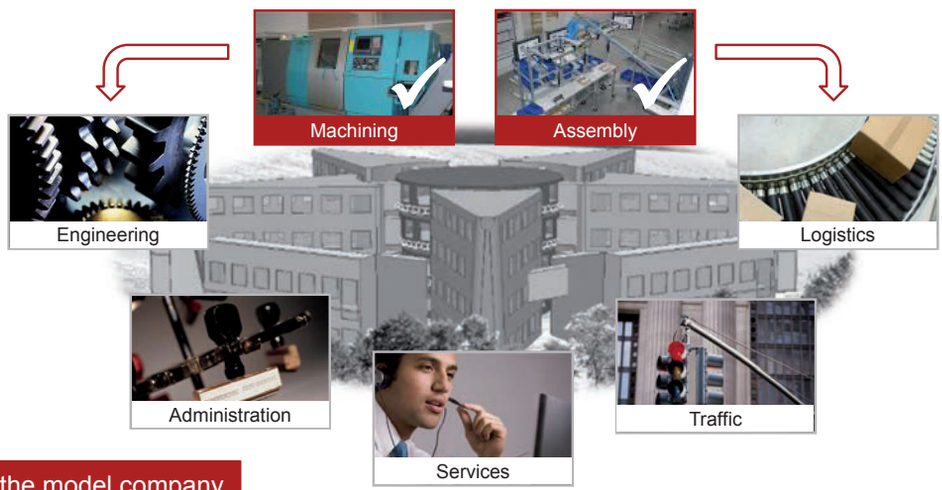
European universities in cooperation with Technische Universität Darmstadt (extract)

- Hungarian Academy of Science
- IPS, Setubal, Portugal
- ITIA-CNR, Milano, Italy
- KTH Stockholm, Sweden
- NTB, Buchs, Switzerland
- Reutlingen University, Germany
- Technical University Kaiserslautern, Germany
- Technical University Munich, Germany
- Technical University Vienna, Austria
- University of Split, Croatia
- University of Patras, Greece
- …

Targets of the initiative on European Learning Factories

- Establishment of an European cooperation between universities / institutes working as 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

Our vision for the year 2020:
Model company at Technische Universität Darmstadt



Intention of the model company

- 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

Your contact persons at Process Learning Factory CiP

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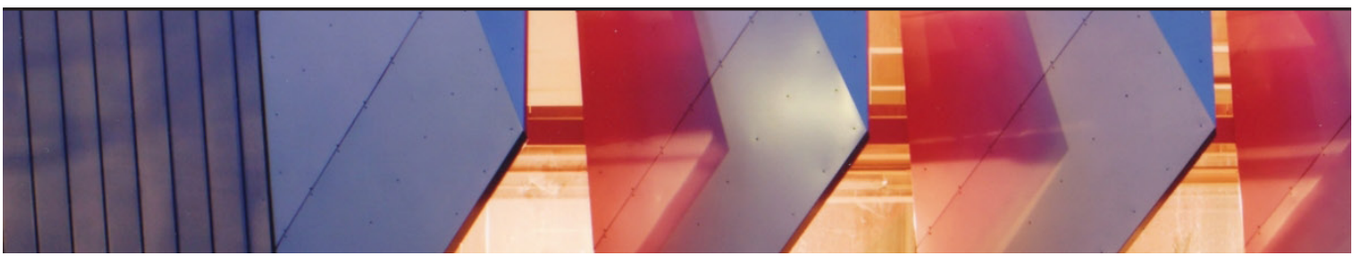

Prof. Ralf Tenberg

Prof. Dr. habil. Ralf Tenberg holds in current a chair for Didactics of Technology at TU Darmstadt. He is a skilled draftsman in engineering, teacher for apprenticeship in machine building and did his doctor's degree in the field of didactics of technology. He represented the chair of Berufspädagogik at the Justus v. Liebeig University Gießen, got a call to the RWTH-Aachen and held for five years a chair for Vocational Education and Training at the Leibniz University Hannover. He is associated in various professional communities, appraiser in programs for research promotion and curricula commissions and filled the executive committees of two notable science associations.

Technology Didactics, Technische Universität Darmstadt

Didactics of Technology is an interdisciplinary area of research and teaching between human sciences and engineering sciences as well as between schools and economy. In current, there is a main focus in the exploration of technical competencies. Therefore at first differentiated studies attend to the expertise of apprentices and skilled workers. At second it is tried to transform this theoretical and empirical findings to large scale analysis designs. To meet the therefore high methodically requirements, the Didactics of Technology cooperates with in-house experts of psychometrics and external experts in competency-exploration (Universities of Stuttgart and Munich). Current theoretical and empirical results are (amongst others) used for the didactical enrichment of the Learning Factory (Prof. Abele, Production Technology).

Learning factories as a contribution to competence-oriented learning in universities and companies

Prof. Ralf Tenberg

TECHNISCHE UNIVERSITÄT DARMSTADT

Technik Didaktik

Learning factories
as a contribution to competence-oriented learning in universities and companies

Prof. Dr. Ralf Tenberg
Technische Universität Darmstadt
Fakultät 3 / Humanwissenschaften

TECHNISCHE UNIVERSITÄT DARMSTADT

Agenda

Technik Didaktik

- Theories of Competency
- Professional Competency and Knowledge
- A competency-based Curriculum
- Research Professional Competencies in Learning Factories

TECHNISCHE UNIVERSITÄT DARMSTADT

Agenda

Technik Didaktik

- **Theories of Competency**
- Professional Competency and Knowledge
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Prof. Dr. Ralf Tenberg, Arbeitsbereich Technikdidaktik

TECHNISCHE UNIVERSITÄT DARMSTADT

Theories of Competency

Technik Didaktik

Competencies
Dispositions for autonomous and multiple acting

(Chomsky, 1965)

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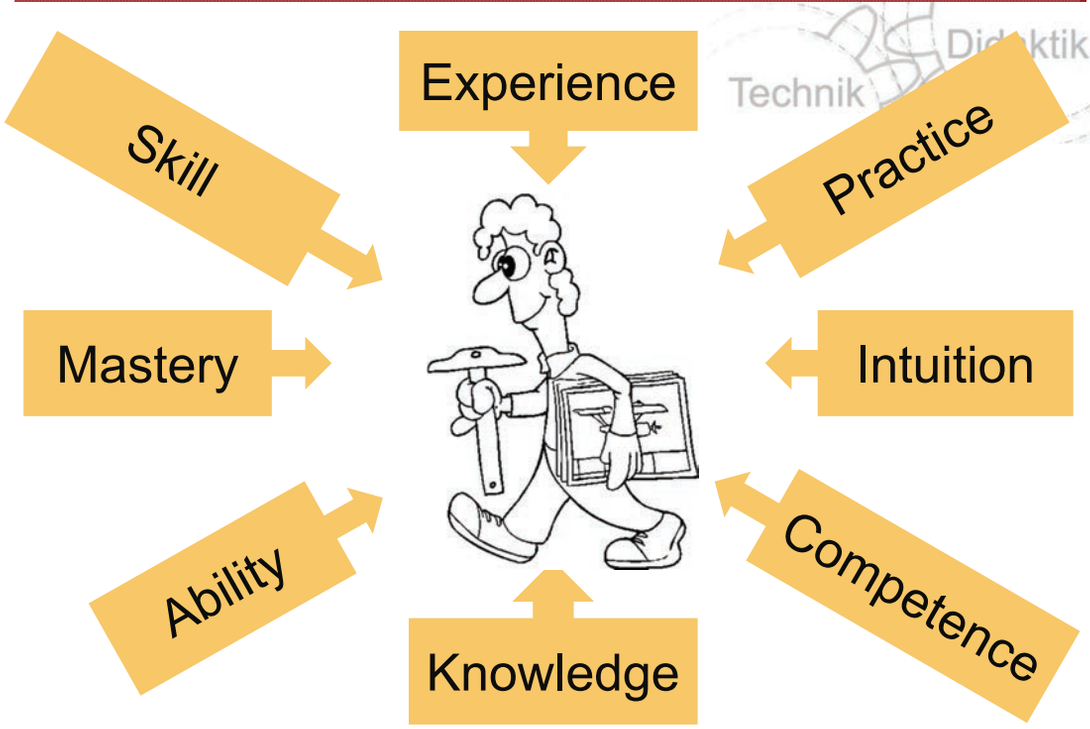
Theories of Competency



Prof. Dr. Ralf Tenberg, Arbeitsbereich Technikdidaktik

TECHNISCHE UNIVERSITÄT DARMSTADT

Theories of Competency

Structure Models

What determines competency?
Relational or causal frameworks of multiple determining factors
Proof: Validating the construct

Level Models

How to express differences in competency?
Theoretical frameworks of multiple measuring variables
Proof: Validating the test

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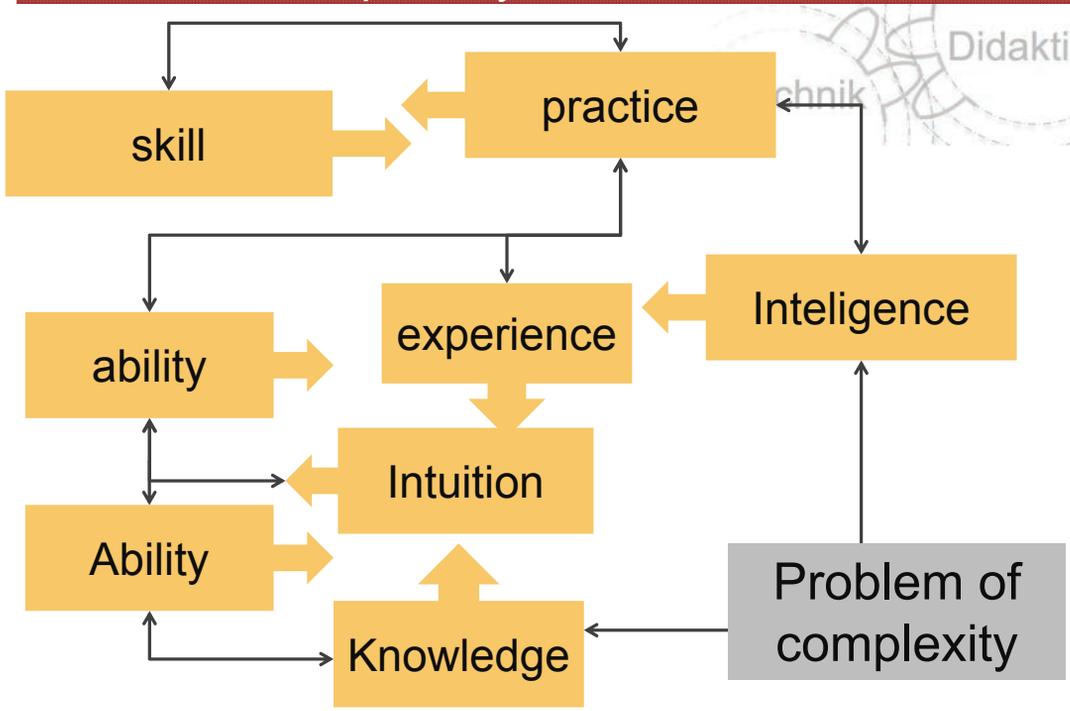
Theories of Competency



Prof. Dr. Ralf Tenberg, Arbeitsbereich Technikdidaktik

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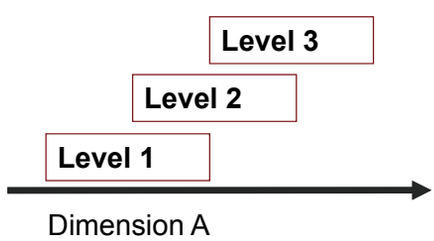
Theories of Competency



Problem of dimensions

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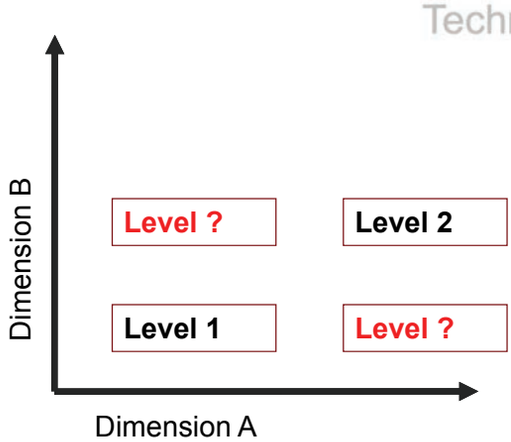
Theories of Competency

Technik Didaktik



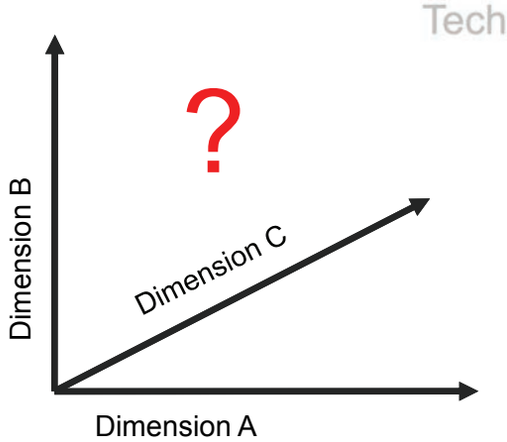
Problem of dimensions

Prof. Dr. Ralf Tenberg, Arbeitsbereich Technikdidaktik

TECHNISCHE UNIVERSITÄT DARMSTADT

Theories of Competency

Technik Didaktik



Problem of dimensions

TECHNISCHE UNIVERSITÄT DARMSTADT

Theories of Competency

Didaktik

Structure Models

What determines competency?
Relational or causal frameworks of multiple determining factors
Proof: Validating the construct

Level Models

How to express differences in competency?
Theoretical framework of multiple measuring variables
Proof: Validating the test

Conclusion
Any current model of competency is a partial construct, including some selected factors and defining a special context

Prof. Dr. Ralf Tenberg, Arbeitsbereich Technikdidaktik

TECHNISCHE UNIVERSITÄT DARMSTADT

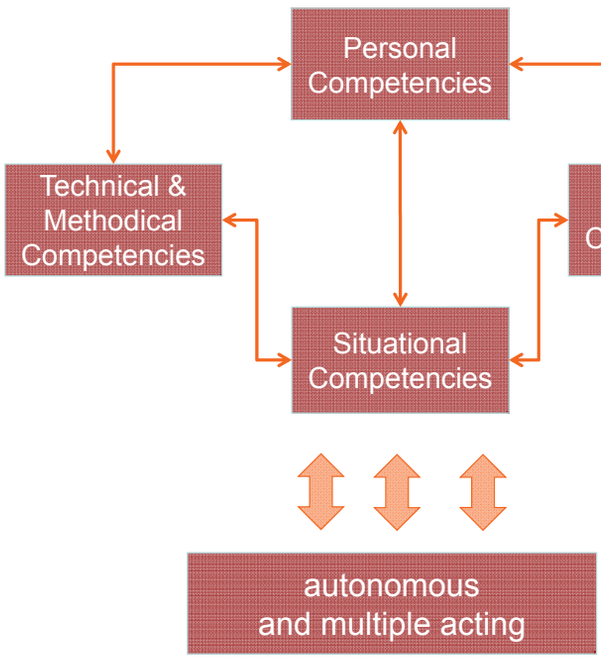
Agenda

Didaktik
Technik

- Theories of Competency
- **Professional Competency and Knowledge**
- A competency-based Curriculum
- Characteristics for a Competency-orientated Learning space
- Research Professional Competencies in Learning Factories

TECHNISCHE UNIVERSITÄT DARMSTADT

Professional Competencies and Knowledge



Erpenbeck & Rosenstiel, 2007

Prof. Dr. Ralf Tenberg, Arbeitsbereich Technikdidaktik

TECHNISCHE UNIVERSITÄT DARMSTADT

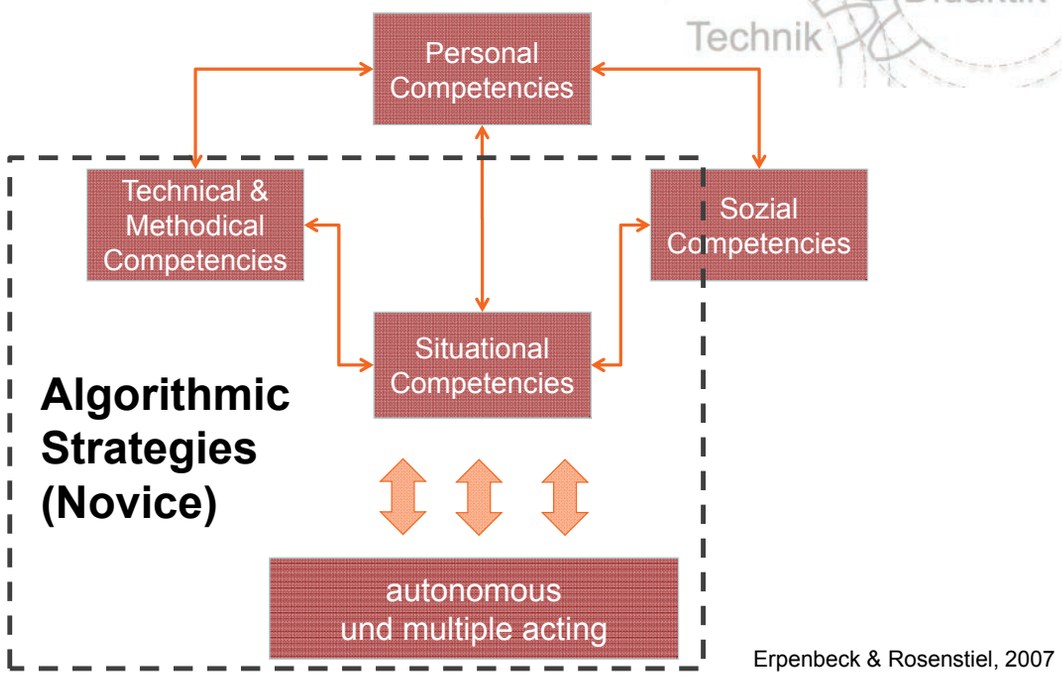
Professional Competencies and Knowledge

Algorithmic Strategies (Novice) → Definite tasks / problems to solve systematically

Heuristic Strategies (Expert) → Indefinite tasks / problems to solve creatively

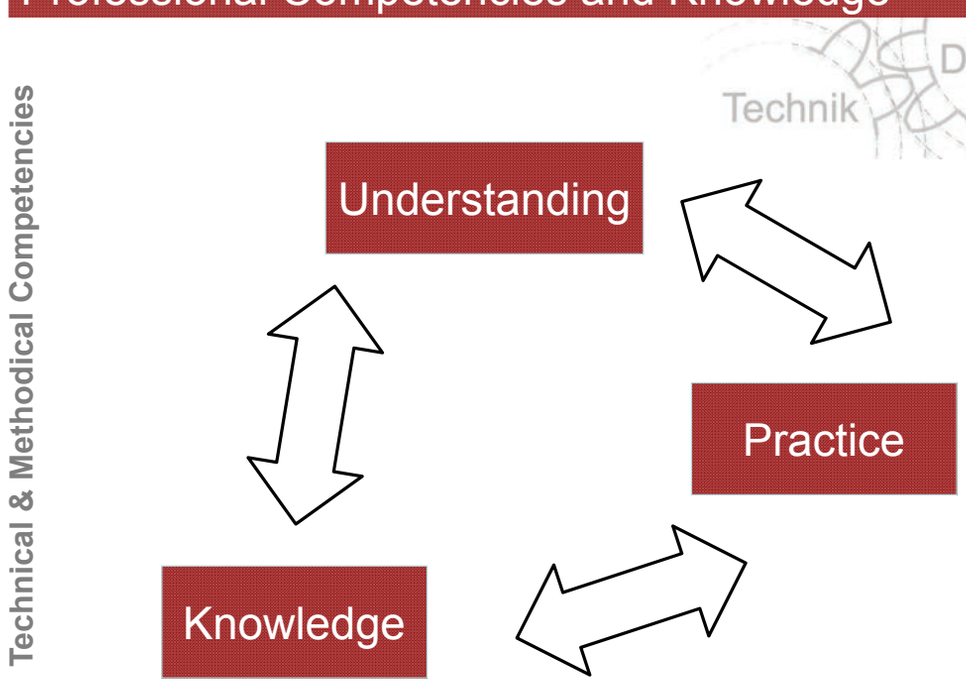
Erpenbeck & Rosenstiel, 2007

Professional Competencies and Knowledge



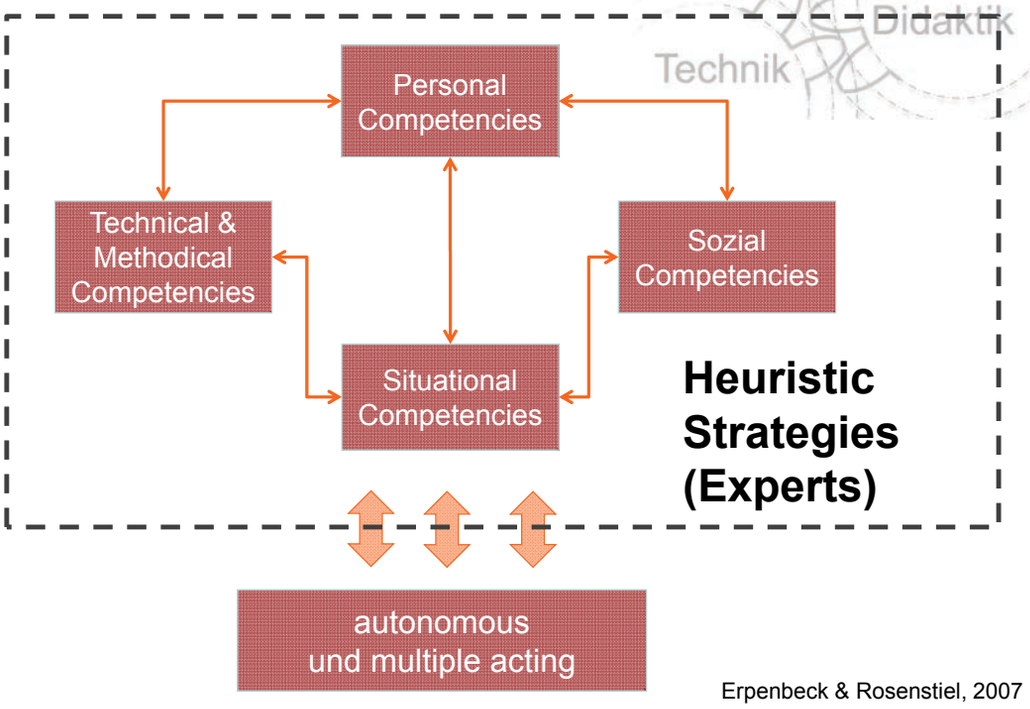
Erpenbeck & Rosenstiel, 2007

Professional Competencies and Knowledge



TECHNISCHE UNIVERSITÄT DARMSTADT

Professional Competencies and Knowledge



Erpenbeck & Rosenstiel, 2007

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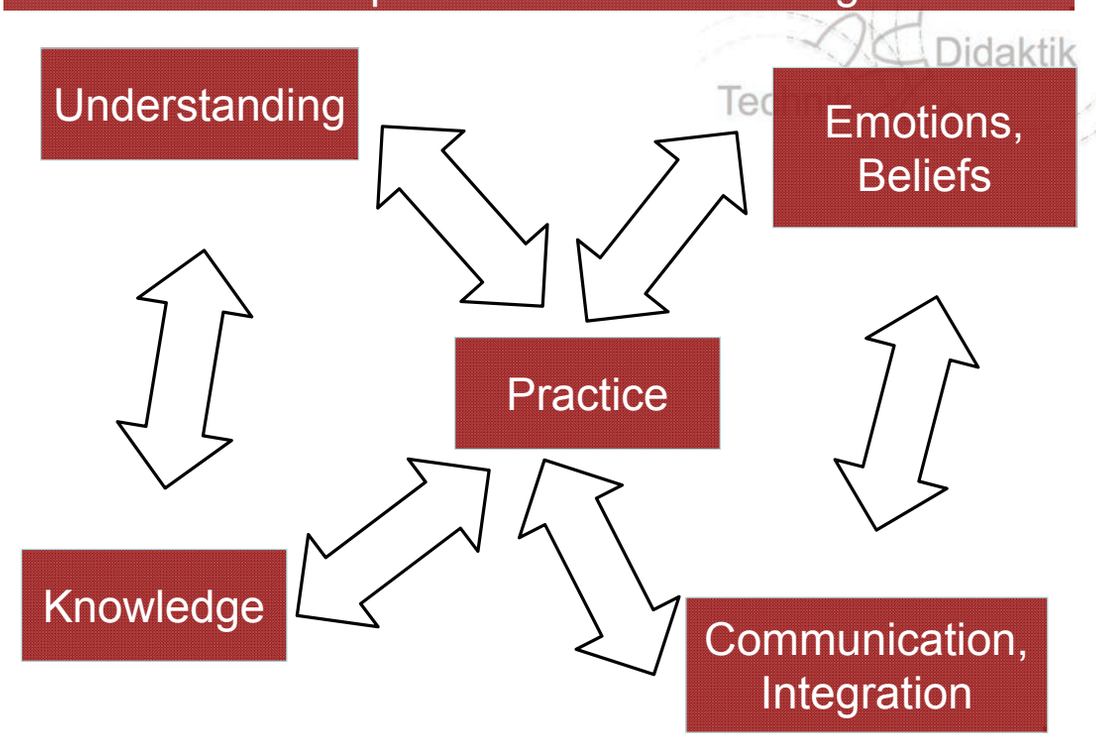
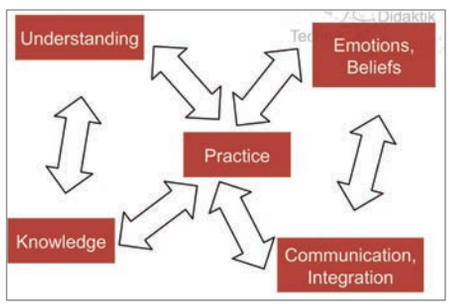
Professional Competencies and Knowledge



TECHNISCHE UNIVERSITÄT DARMSTADT

Professional Competencies and Knowledge

1. Conduction of specific and complex knowledge
2. Providing space for generative communication and interaction
3. Facilitation of diverse professional learning-activities
4. Realization of multiple relevant Feedbacks



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Professional Competencies and Knowledge

1. Conduction of specific and complex knowledge
2. Providing space for authentic and learning-promotive communication and interaction
3. Facilitation of diverse professional learning-activities
4. Realization of multiple relevant Feedbacks

Learning Factory

TECHNISCHE UNIVERSITÄT DARMSTADT

Professional Competencies and Knowledge

Explanation, Illustration

Information, Orientation, Planing

TU Darmstadt Learning Factory
(Prof. Dr. Abele)

Trial, Realization

Approval, Evaluation

Prof. Dr. Ralf Tenberg, Arbeitsbereich Technikdidaktik

TECHNISCHE UNIVERSITÄT DARMSTADT

Agenda

- Theories of Competency
- Professional Competency and Knowledge
- **A competency-based Curriculum**
- Research Professional Competencies in Learning Factories

TECHNISCHE UNIVERSITÄT DARMSTADT

A competency-based curriculum

Technik Didaktik

- Conduction of specific and complex knowledge
- Providing space for authentic and learning-promotive communication and interaction
- Facilitation of diverse professional learning-activities
- Realization of multiple relevant Feedbacks

What kind of knowledge and which explicit facts, relationships, processes and problems to solve?

Prof. Dr. Ralf Tenberg, Arbeitsbereich Technikdidaktik

TECHNISCHE UNIVERSITÄT DARMSTADT

A competency-based curriculum

Technik Didaktik

- Conduction of specific and complex knowledge
- Providing space for authentic and learning-promotive communication and interaction
- Facilitation of diverse professional learning-activities
- Realization of multiple relevant Feedbacks

What kind of knowledge and which explicit facts, relationships, processes and problems to solve?

What kind of feedbacks in which situations and conditions to whom from whom?

TECHNISCHE UNIVERSITÄT DARMSTADT

A competency-based curriculum

Technik Didaktik

What kind of knowledge and which explicit facts, relationships, processes and problems to solve?

Learning Factory Curricula

What kind of Feedbacks in which situations and conditions to whom from whom?

Prof. Dr. Ralf Tenberg, Arbeitsbereich Technikdidaktik

TECHNISCHE UNIVERSITÄT DARMSTADT

A competency-based curriculum

Technik Didaktik

Requirement for …
- planning
- designing
- evaluating

learning processes for an explicit development and proof of specific competencies

What kind of knowledge and which explicit facts, relationships, processes and problems to solve?

Learning Factory Curricula

What kind of Feedbacks in which situations and conditions to whom from whom?

TECHNISCHE UNIVERSITÄT DARMSTADT

A competency-based curriculum

Technik Didaktik

- Relevant competencies (both, TM and others)
- Level of problem solving and transfer
- Typical activities and processes
- Corresponding knowledge

Learning Factory Curricula

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TECHNISCHE UNIVERSITÄT DARMSTADT

A competency-based curriculum

Technik Didaktik

Competency 1		
Learning activity	**Professional knowledge**	**Understanding knowledge**
1.1		
1.2		
1.3		
1.4		

TECHNISCHE UNIVERSITÄT DARMSTADT

A competency-based curriculum

Technik Didaktik

Example:

Competency: Students are able to realize a value stream analysis		
Learning activity	**Professional knowledge**	**Understanding knowledge**
1.1: Students explore and explain the symbols of value stream analysis	content and context of the symbols	
1.2: Students deal in a case study with a fictional company	arrangement of the of the symbols, logical and spatial arrangement	exact knowledge of all particular production processes
1.3: Students realize a project in the learning factory	ditto (in direct action)	ditto
1.4: Students explore and explain production aims	key performance indicators	Structure and determination of indicators

TECHNISCHE UNIVERSITÄT DARMSTADT

Agenda

Technik Didaktik

- Theories of Competency
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TECHNISCHE UNIVERSITÄT DARMSTADT

Research

Technik Didaktik

Design Based Research

- A provisory curricula for a singular format will be applied (low level, circumscribed to technical, methodical and situational competencies)
- Modification and optimation of tasks, information-materials, demonstrators, learning-cells, feedback-materials
- Generating a specific competency-diagnostic
- Conclusions about curricula and learning-scenario
- Modification and optimation the provisory curricula
- Transfer to other formats (higher levels)
- Standardization of the diagnostic

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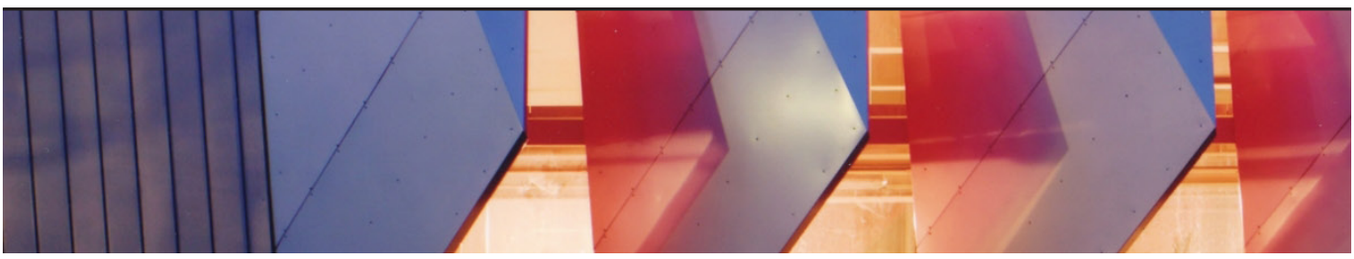
Technik Didaktik

Many thanks for your advertence!



Jürgen Geiger

Jürgen Geiger is Principal in the Düsseldorf Office of McKinsey & Company. He has joined McKinsey in 2000 and is leading the German Operations Practice as well as McKinsey's model factories in Germany. He has been leading many projects in the automotive, industrial, and energy sector as well as for service companies in Germany, France, Italy, Spain, Scandinavia, UK, Eastern Europe, USA, Middle East, China, India, Argentina, and Brazil. His client base includes large corporations as well as midsized companies – family or private equity owned.

Examples of recent projects

- Major transformation program (from diagnostics to implementation) at a truck and bus manufacturer – covering reduction of costs (material, manufacturing, and overhead) and net assets as well as increasing revenues in domestic and export markets
- Reduction of energy consumption in a production process leveraging the McKinsey Lean Energy Plant in Munich
- Conducting a lean transformation at one assembly plant and rolling it out leveraging the Lean Model Plant in Darmstadt
- Major direct material cost reduction program at a leading international car manufacturer through technical redesign (design-to-cost) and low-cost country sourcing
- Optimization of direct material management processes (planning, controlling, cost expectations, product calculations) at an automotive OEM

McKinsey & Company

McKinsey & Company is the world's leading top management consultancy. Founded in 1926 in the United States, McKinsey now has about 90 offices in 50 countries. Our more than 8,000 consultants around the globe serve companies and institutions on key questions of strategy, organization, and operational excellence. McKinsey advises the majority of the world's 100 largest industrial and service companies, fast-growing SMEs, innovative start-ups, and public and private institutions.

McKinsey&Company

Implementation of lean production in the industry by learning factories

Jürgen Geiger

McKinsey&Company

McKinsey Learning Factories

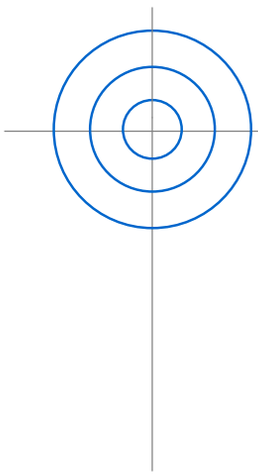
Implementation of lean production in the industry by Lean Learning Factories

CAPABILITY FOR PERFORMANCE

First learning model conference
Darmstadt, 19. May 2011

McKinsey&Company

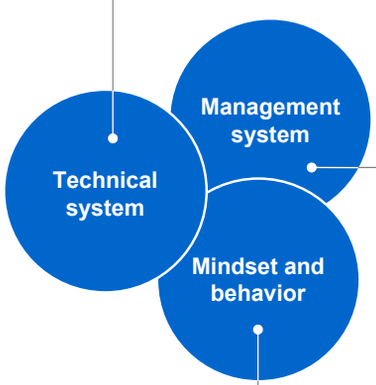
Objectives for presentation



- Provide our perspective on lean production programs
- Presenting our innovative way for building lean capabilities using learning factories
- Outlook: "the road we want to continue"

SOURCE: McKinsey

Lean production excellence is driven by success in 3 key dimensions



"The way assets and resources are configured and optimized to create value and minimize losses"

- Principles
  - Relentless loss elimination
  - End-to-end system design
  - Priority on people: health and safety
- Elements of operating system
  - Material and information flow
  - Quality systems
  - Manpower systems
  - Maintenance systems

"The formal structures, processes, and systems through which resources are managed in support of the operating system"

- Performance management
- Organizational design
- Support function processes
- Continuous improvement infrastructure

"The way people think, feel, and conduct themselves in the workplace – individually and collectively"

- Focus – compelling purpose and clear direction
- Execution – people work well together day-to-day to get things done
- Skills – people work effectively in their roles
- Improvement – relentless drive to do better

SOURCE: McKinsey

"Soft success factors" play a very important role in lean transformation programs

SELECTED EXAMPLES

Addressed by learning factory

Diagnosis of current and required capabilities
Complement the diagnosis with an evaluation of current and required capabilities

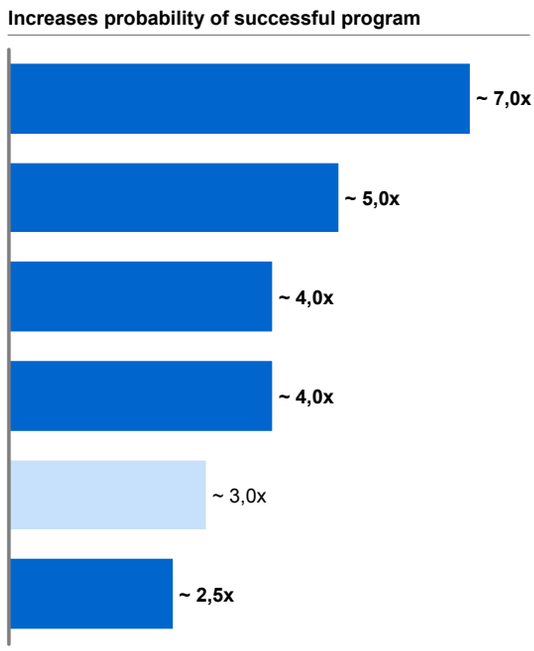
Active involvement ("co-creation")
Ability of employees to take initiatives to achieve the transformation goals – the more intensively employees can be mobilized, the more probable the chance of success

Conscious role modeling by top management
Top management as role models who live the desired changes and motivate employees

Mobilize employees by means of continuous communication
Stimulate and involve them through continual communication (e.g., develop a change story)

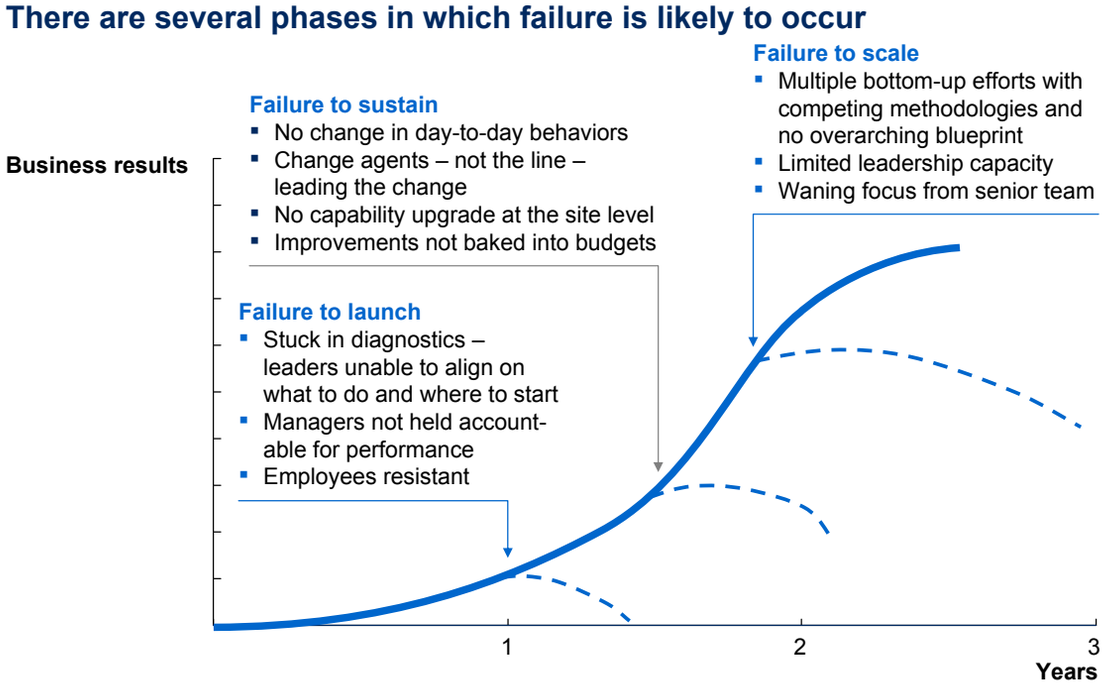
Build on respective strengths
Focus on strengths and weaknesses of the organization (not only weaknesses)

Develop the top management
Build up and support management talent in/through the program



SOURCE: McKinsey Quarterly survey "Transformational Change", January 2010

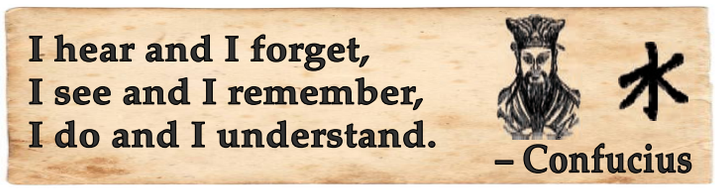
There are several phases in which failure is likely to occur

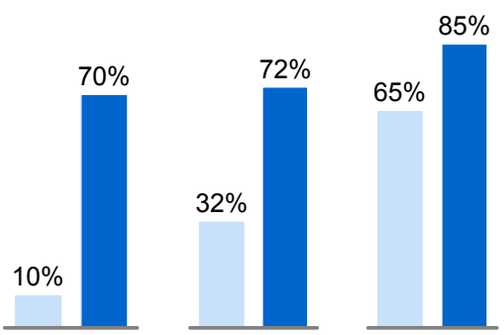


Sites involved	< 2	< 10	Network
People involved	100s	1,000s	10,000s

SOURCE: McKinsey

Capability building (adult learning) works best in an experiential, physical learning environment (learning factory)





Key features

- Realistic learning environment in which **managers** and **employees** are trained to lead lean programs
- Tools and skills are presented and immediately applied in **real-life settings** of a work place
- Learning factories specifically designed for specific functions, e.g., **lean production,** lean service operations, etc.

SOURCE: McKinsey

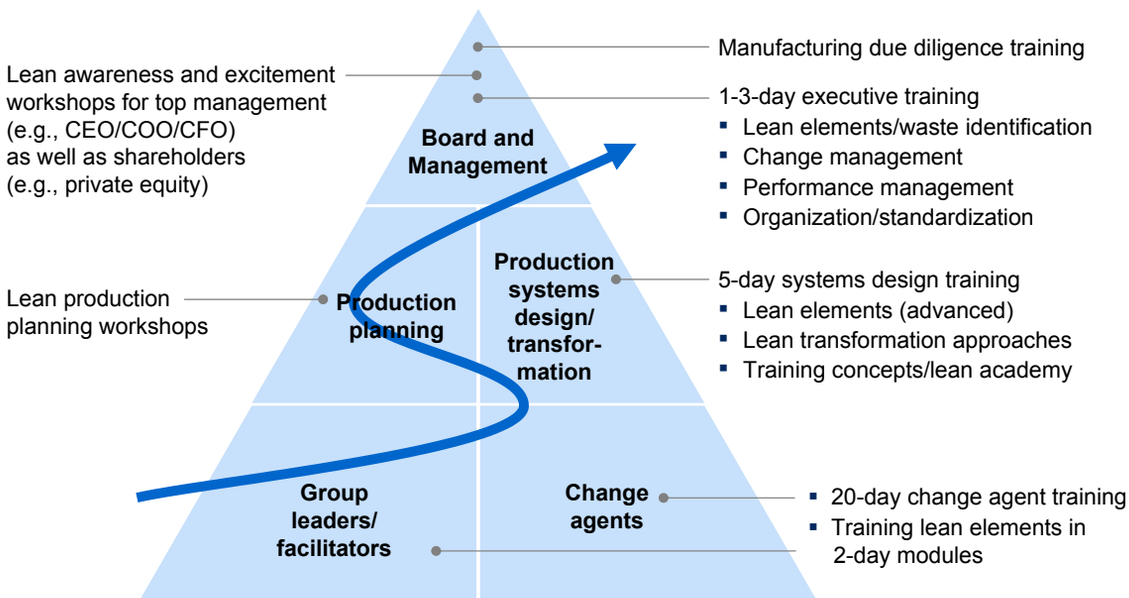
McKinsey Learning Factories offer 5 types of services

Events und trainings at the learning factory	▪ Top management lean training ▪ Lean awareness training ▪ Change agent boot camps
Corporate model factory start-up package	▪ Setup of a client-customized training center/learning factory – Model factory as core element to train lean methods and tools – Additional corporate training elements
Lean capability toolbox	▪ Standardized training modules for the entire training center ▪ 50 theory and 35 practical modules build the platform to compose target-group-specific trainings ▪ Building trainer resources within client organization ("train the trainer")
Corporate lean academy	▪ Overarching approach to build a corporate lean academy ▪ Career paths/organizational anchoring ▪ Target-group-specific trainings curricula ▪ Performance management in capability building
Large-scale lean transformation powered by model factory	▪ Integrated approach of transformation (Mini-T, Flexi-T, workshop transformation) and capability building to boost speed – Anchoring of trainings curricula and transformation planning – On-the-job/off-the-job coaching as integrated elements

SOURCE: McKinsey

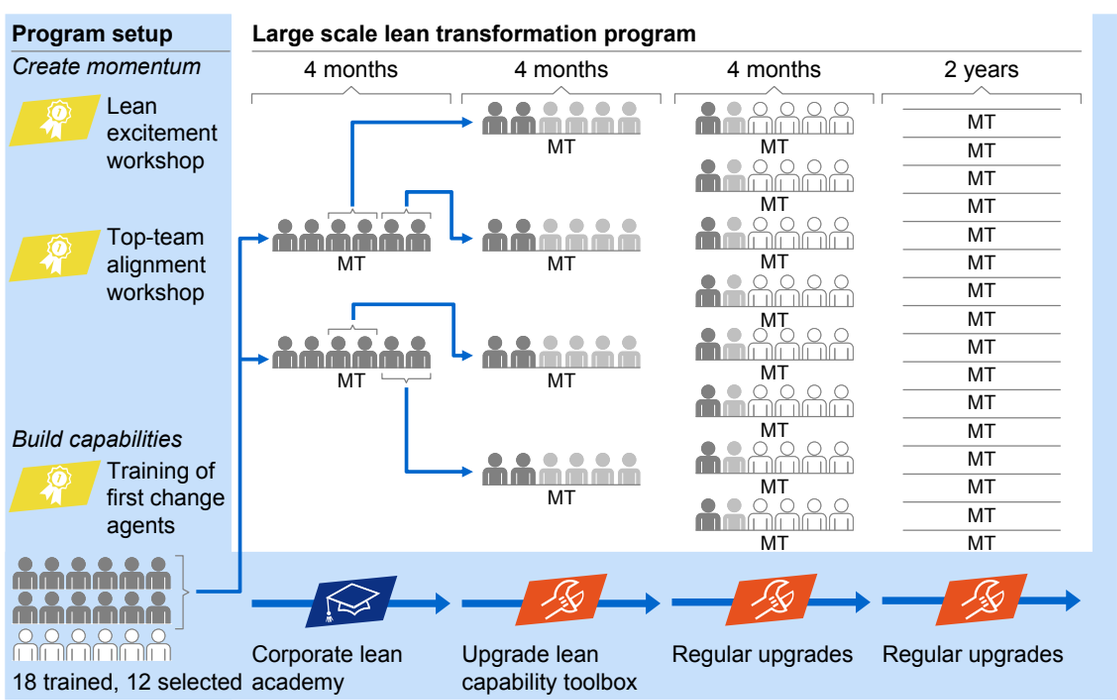
Content needs to be tailored to the audience

NOT EXHAUSTIVE



SOURCE: McKinsey

Client example – supporting large-scale lean transformation program



SOURCE: McKinsey

McKinsey operates a network of various learning factories

Model Factory Darmstadt with focus on "lean" production capability building

Center of Engineering Excellence (CE²) Munich with focus on "lean R&D and concurrent engineering" capability building

CiP
Darmstadt (2007)

INEXO
Lyon (2009)

INEXO Lyon with lean manufacturing and lean service operations

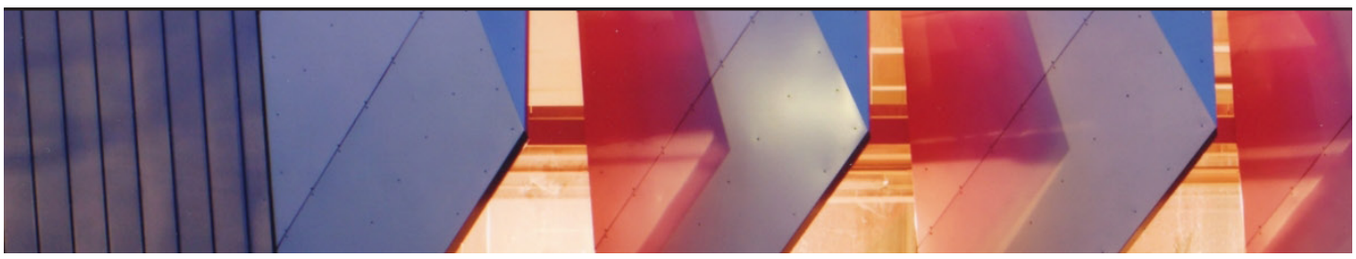
LEP Lernfabrik für Energieproduktivität **Munich (2009)**

Learning Factory Munich with focus on "green" capability building

International expansion:
Italy, Maroco, USA,
South America, South East Asia

SOURCE: McKinsey

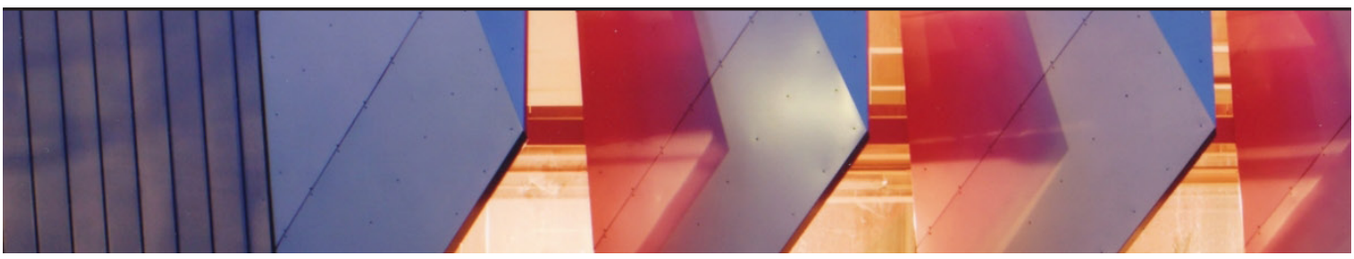
McKinsey&Company



Block I
Learning and competence-building as a competitive factor

Block II
Learning factories in operational application

Block III
Leaders as Teachers



Prof. Wilfried Sihn

is Professor at the Institute of Management Science since 2004 and head of the Institute since March 2009; Professor Sihn was Deputy Director of the Fraunhofer Institute for Manufacturing Engineering and Automation (IPA) in Stuttgart, and is Director of Fraunhofer Austria since December 2008. Professor Sihn 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. Professor Sihn was instrumental in developing such concepts as the Fractal Company.

Prof. 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 Chipping Technology and is head of the Institute of Production Engineering 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, parallel kinematics, EDM-technologies, rapid manufacturing.

Vienna University of Technology

Institute of Management Science/Fraunhofer Austria - Institute of Production Engineering and Laser Technology
Founded in 1815, the Vienna University of Technology (VUT) is renowned for its long tradition. It enjoys high recognition in teaching as well as in research and as partner of innovation oriented enterprises.
The Institute of Management Science/Department for Industrial and Systems Engineering in Cooperation with Fraunhofer Austria focuses on the areas production management, logistics and process management. Successful projects in application-oriented research projects and industry R&D projects are proof of the reliable background of the department and form a broad basis of satisfied partners and customers.
The Institute of Production Engineering and Laser Technology (IFT), a department of the Vienna University of Technology, covers a wide range of production processes, machine tools techniques and represents a wide range of automation solution in production engineering. In development of manufacturing processes for state of the art production, the IFT is one of the most significant research centres for production engineering in Central Europe.

TU WIEN TECHNISCHE UNIVERSITÄT WIEN Vienna University of Technology

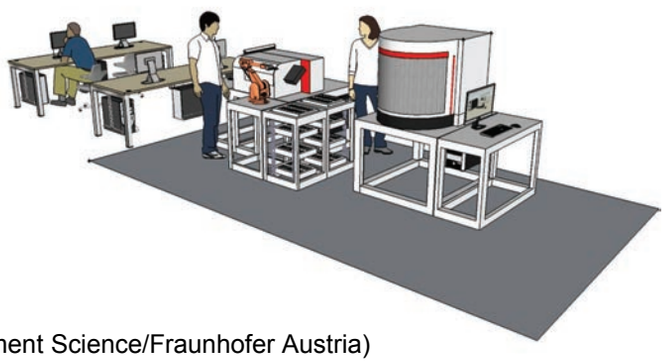
Integrated, scalable concept of a learning factory at the Vienna University of Technology

Prof. Wilfried Sihn
Prof. Friedrich Bleicher

Integrated, scalable Concept of a Learning Factory

at the Faculty of Mechanical and Industrial Engineering,

Vienna University of Technology



Prof. Wilfried Sihn (Institute for Management Science/Fraunhofer Austria)

Prof. Friedrich Bleicher (Institute for Production Engineering and Laser Technology)

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Vienna University of Technology – Faculty of Mechanical and Industrial Engineering

Vienna University of Technology (TU Vienna)

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

Faculty of Mechanical and Industrial Engineering

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

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Faculty-wide learning factory through cooperation of:

Industrial Engineering

Institute of Management Science
Division Industrial and Systems Engineering/ Fraunhofer Austria

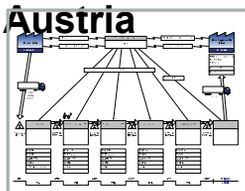
Product Development

Institute for Engineering Design
Division Mechanical Engineering Informatics and Virtual Product Development

Production Engineering

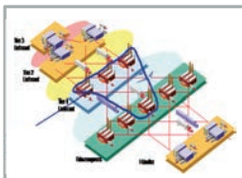
Institute for Production Engineering and Laser Technology

Institute of Management Science Division Industrial and Systems Engineering/Fraunhofer Austria



Production Management

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



Logistics Management

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

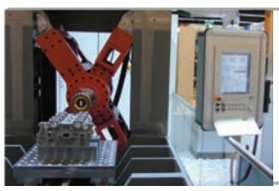
Process Optimization

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

Institute for Production Engineering and High Efficiency Laser Technology

Technology and processes

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



Production systems and control technologies

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

IT-supported production management and quality

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

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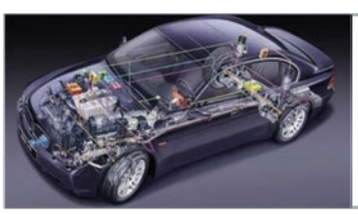
Institute for Engineering Design M. Engineering Informatics and Virtual Product Development

IT- Tools for tasks and processes

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



IT integrated in innovative products

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

Research Focus

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

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Integrated Scalable Learning Factory
Target and Unique selling proposition?

INTEGRATED Concept

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

SCALABLE

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

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Order Fulfillment from Design to Product

3D Model → real Product → Delivery

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

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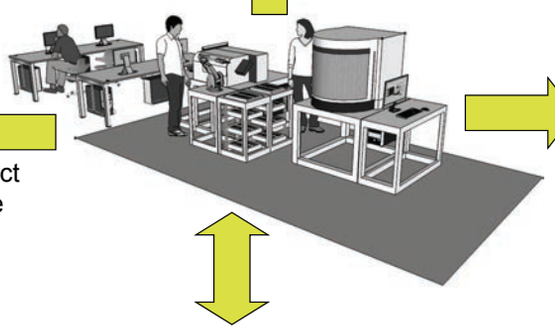
Benefits in Research, Education and Industry Cooperation (1/2)

Services for Industry
(e.g. use of a high-tech development environment,
Machine tool acceptance test)



Education
(e.g. Integrative Product Creation Module in the bachelor curriculum)

Training
(e.g. Assembly Training, Manufacturing Lab, Lean Logistics Workshop, Lean Production Workshop Virtual Product Development)

Research
(e.g. Lean Assembly, Factory planning, development of new production technologies)

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

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

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Existing education modules in Industrial Engineering

Assembly Training Cell

- Lean Basics
- Job Engineering
- Time Management tools

Lean Layout

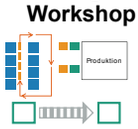
3D Model — real Product — Delivery

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

Lean Administration

Production Planning and -control Workshop

Lean Logistics Workshop



TPM Workshop

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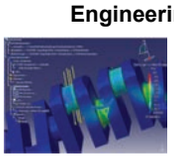
Existing education modules in Product Development

Engineering Design



- CAD
- CAE/FEM
- Parametric Design

3D Model — real Product — Delivery

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

Virtual Product Development

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

Product Lifecycle Management

- Requirements
- Configuration
- Knowledge Management
- Life Cycle Analysis

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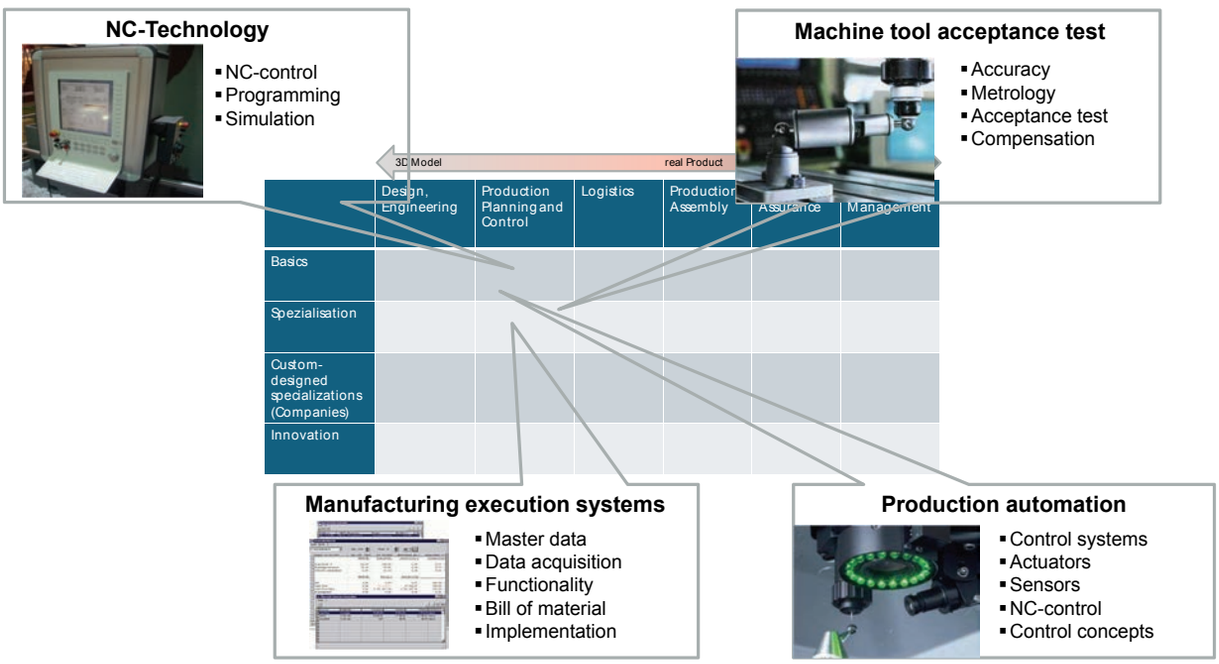
Existing education modules in Production Engineering



Actual situation

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

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

Further Steps of Development

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

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

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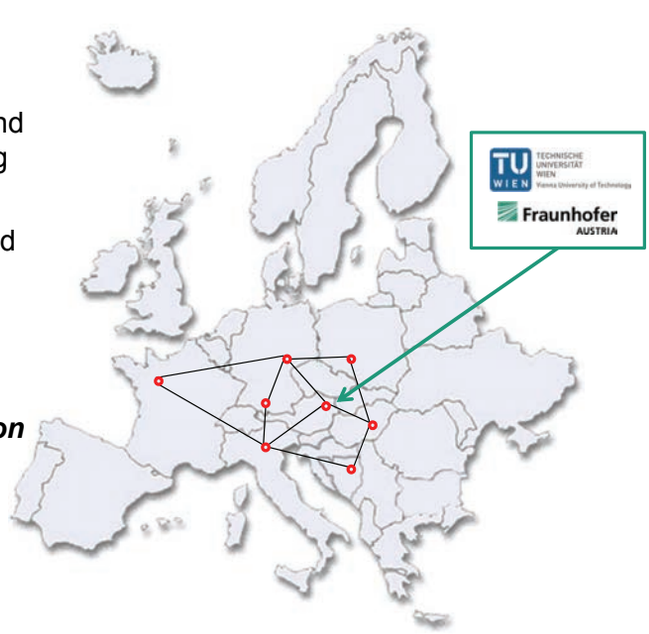
Vision: European Learning Factory Network

- International know-how exchange and collaborative development of training content
- Collaborative marketing activities and coordination of training content with different focus-topics
- Main focus of the Learning Factory Vienna:
  Integrated Product- and Production Engineering



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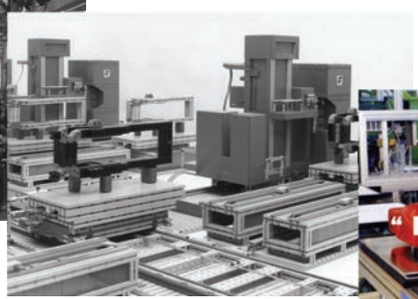
Learning Factories – a long tradition at Vienna University of Technology

Job Shop in the 1920s



Computer controlled factory models in the 1980s

CIM Factory in the 1990s

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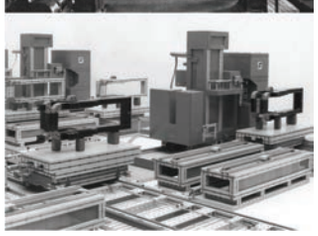
Lessons learned from past initiatives

- Learning factory is an integrated concept rather than a physical plant
- Focus on integration of processes rather than automization
- System modules (machine tools, controls, software) meet requirements of teaching concept but are kept as simple as possible
- System modules allow multiple use (teaching, r&d, postgradual education)
- System modules are loosely coupled, making upgrade and continuous system evolution easy
- System modules, architecture and communication adopt standards
- Rigid overall concept, decentralized development and maintenance of System modules



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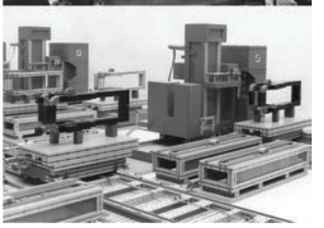
Motivation for a new Learning Factory

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



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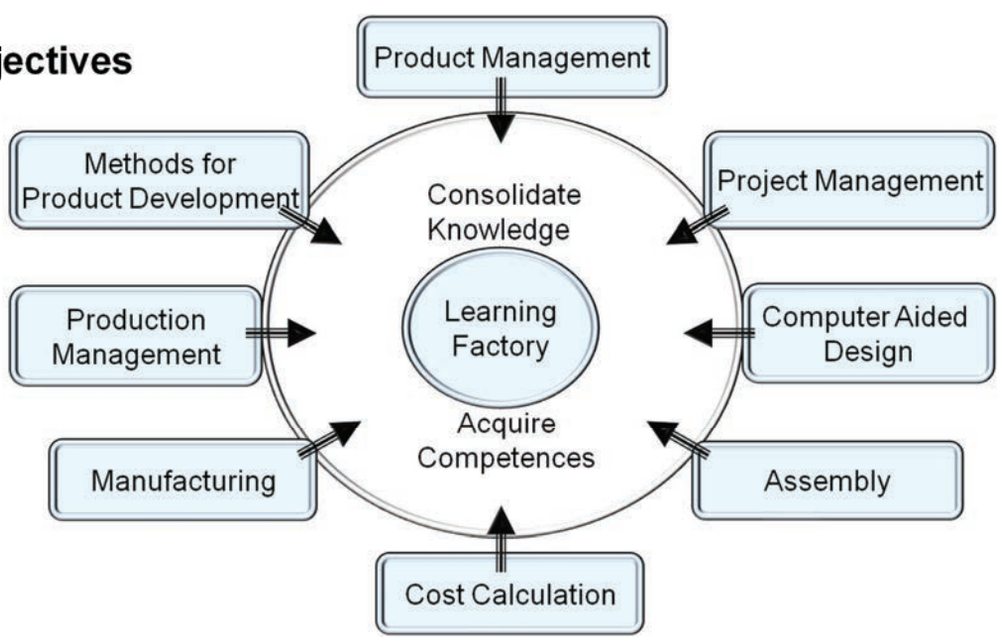
Learning Factory in the new bachelor curriculum

Objectives



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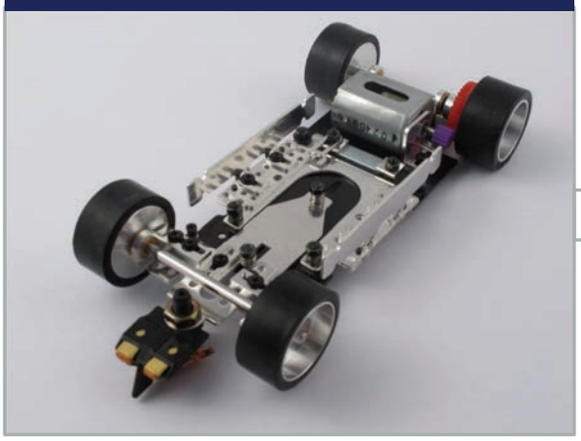
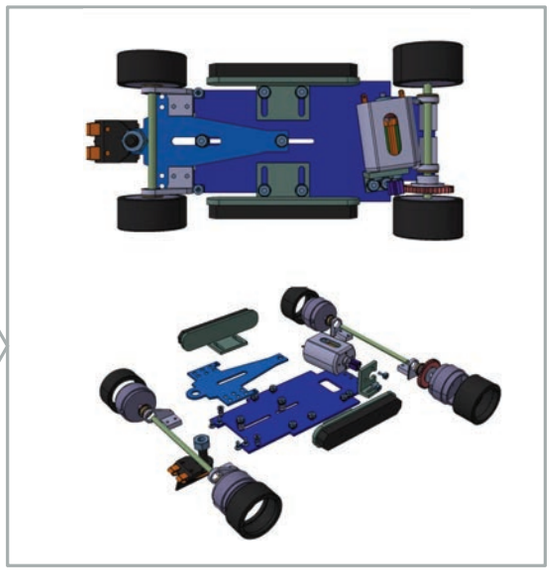
Learning Factory in the new bachelor curriculum

Product

real slotcar as initial point of work



Re-designed slotcar



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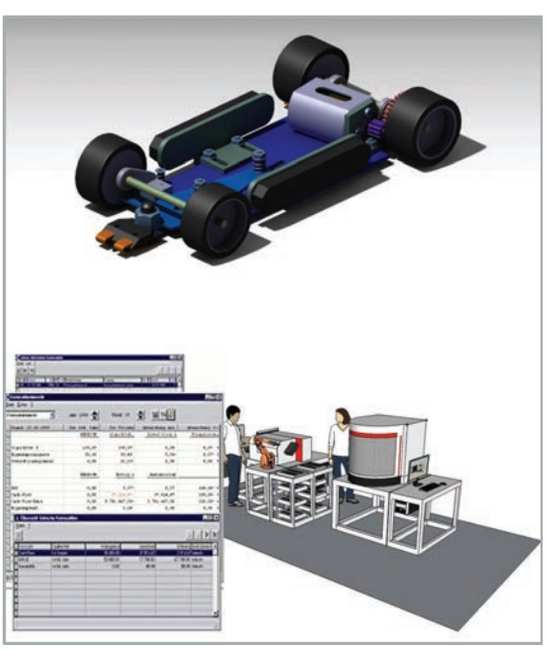
Learning Factory in the new bachelor curriculum

Project work

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



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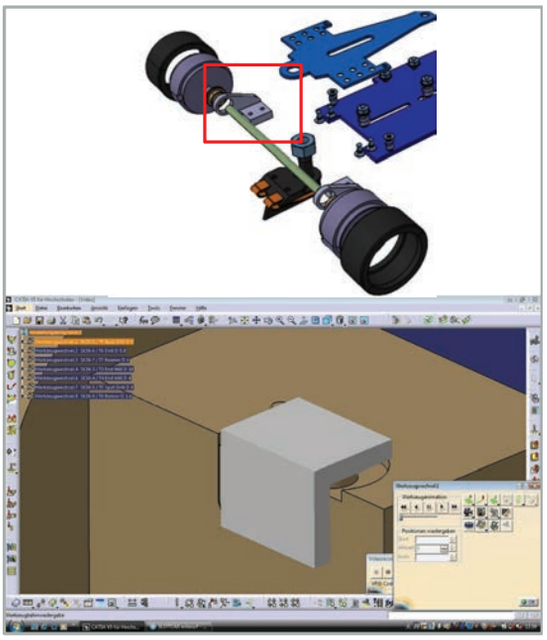
Learning Factory in the new bachelor curriculum

Project work

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

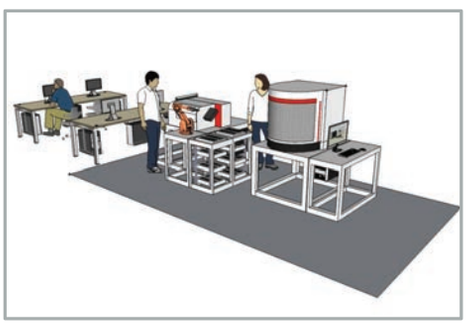


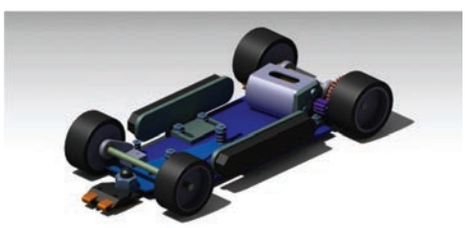
Learning Factory in the new bachelor curriculum

Project work

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

Learning Factory – Production Engineering Equipment





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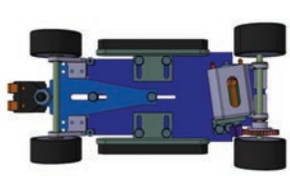
Learning Factory in the new bachelor curriculum

Field test



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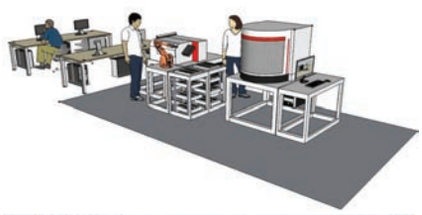
Learning Factory in the New Bachelor Curriculum

Future topics

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



Contact Persons

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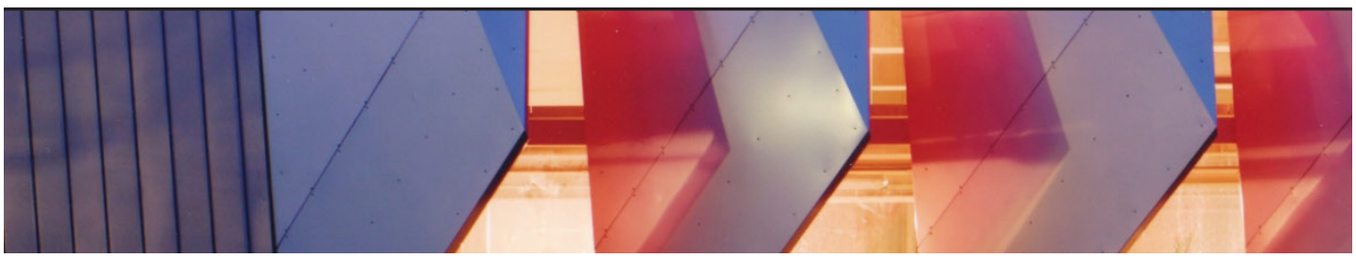

Dr. Reinhard Pittschellis

Dr.-Ing. Reinhard Pittschellis studied mechanical engineering at the Technical University Braunschweig from 1988 to 1993, where he graduated to Dr.-Ing. with research about “grippers for micro assembly” in 1998. From 1994 to 1997 he completed post graduate studies in economy.
From 1998 to 2001 he worked for Siemens in Munich, where he developed placement heads for SMD Placement machines, followed by a year as manager development for the company Maxon Motor in Switzerland. Since 2002 he is head of development and product management of Festo Didactic GmbH&Co. KG.

Festo Didactic GmbH & Co. KG

Worldwide leader in professional, industry-oriented qualification solutions for process and factory automation in the field of industrial training, vocational and higher education.

Learning Systems:
From technology oriented Training Packages to Learning Factories, Software, Teachware and fully equipped turnkey learning centres for schools and universites.

Training and Consulting:
Approx. 42,000 course participants per year attend more than 2,900 courses. Modular and quality-assured training content in over 39 languages. Industrial Consulting projects in the areas of Product development, Lean production, Procurement and Logistics.

FESTO

Future concept learning factories – practical training at vocational schools and universities

Dr. Reinhard Pittschellis

FESTO

Future Concepts for Learning Factories

Training in Vocational Schools and Universities

Dr. Reinhard Pittschellis
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Pitt@de.festo.com

FESTO

Target Group – Vocational Training

Vocational Training

Training that emphasizes skills and knowledge required for a particular job function (such as typing or data entry) or a trade (such as carpentry or welding). (*)

Number of apprentices

Beruf	Trade	#
Industriemechaniker	Industrial mechanics	52.248
Mechatroniker	Mechatronics	26.388
Elektroniker für Automatisierungstechnik	Electronics for automation technology	6.042

(*)http://www.businessdictionary.com/definition/vocational-training.html
(**) Quelle: "Datensystem Auszubildende" des Bundesinstituts für Berufsbildung auf Basis der Daten der Berufsbildungsstatistik der statistischen Ämter des Bundes und der Länder (Erhebung zum 31.12.); Absolutwerte aus Datenschutzgründen jeweils auf ein Vielfaches von 3 gerundet; der Insgesamtwert kann deshalb von der Summe der Einzelwerte abweichen.

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Learning Content - Common Didactical Principles (*)

- Learning Content is based on typical job related actions
- Learning by doing
- Actions by the student
  - Planning
  - execution
  - check
  - evaluation
- Holistic approach - integration of
  - Technology
  - Economy
  - Social
  - Environment
  - safety

(*) Rahmenlehrplan für den Ausbildungsberuf Industriemechaniker/Industriemechanikerin, Beschluss der Kultusministerkonferenz vom 25.3.2004

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Learning Content (Samples)

Industrial Mechanics (*)

- Production of components
- Programming of CNC machines
- Assembly and disassembly of Machines
- Setup of systems including controller
- Maintenance of systems

Electronics for Automation Technology (**)

- Programming
- Connect subsystems to to networks
- Programming of process control
- Check of safety measures
- Failure analysis

Process Compentencies

(*) Rahmenlehrplan für den Ausbildungsberuf Industriemechaniker/Industriemechanikerin, Beschluss der Kultusministerkonferenz vom 25.3.2004
(**) Rahmenlehrplan für den Ausbildungsberuf Elektroniker für Automatisierungstechnik / Elektronikerin für Automatisierungstechnik, Beschluss der Kultusministerkonferenz vom 16.5.2003

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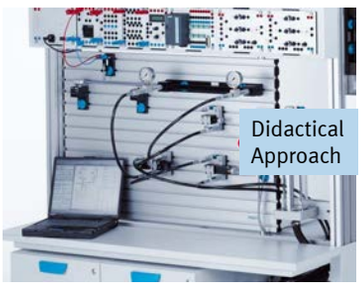
From Technology Training to Process Competence



Didactical Approach

Learning Factory

Realistic Processes

Technology Training in the Laboratory
Components, circuits,

Learning Factory = Didactic Medium

Mastering Processes in the factory
Assembly, Programming, Setup, maintenance, failure analysis, process control, ...

Training in Real Factories ?
- Too complex
- Too expensive
- Not available
- Learning progress too slow

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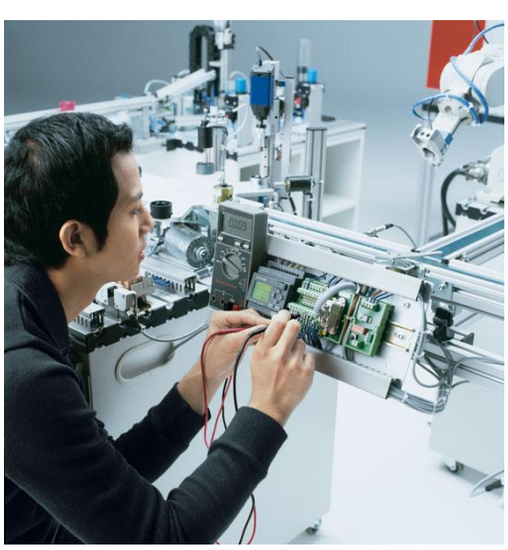
Demands on Learning Factories as a Didactic Medium

Didactic Medium: tool to realize didactic objectives (*)

Functions(*):
- Illustrate the learning content
- Demonstrate the principles
- Show underlying structures
- Motivate the students
- Trigger actions

Demands:
- Close to reality
- Fast learning success
- High (didactical) qualitiy, long life time
- Low Budget
- Support for Teachers



(*) Andreas Hüttner: Technik unterrichten, Europa Lehrmittel, 3. Auflage 2009

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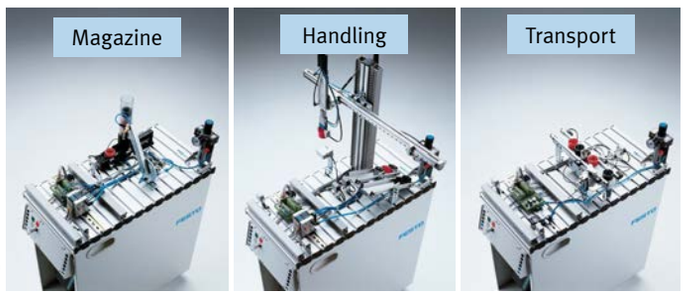
Reduced Complexity



Real Production Machine
- Magazines
- Handlings
- Transport system
- Many types of sensors
- Many types of actuators
- Many different functions

Learning Factory
- Divided into stations
- One process step or function per station
- but: industrial components and processes!
- Limited number of sensors per station
- Limited number of actuators per station
- One PLC per station -> simplified programm

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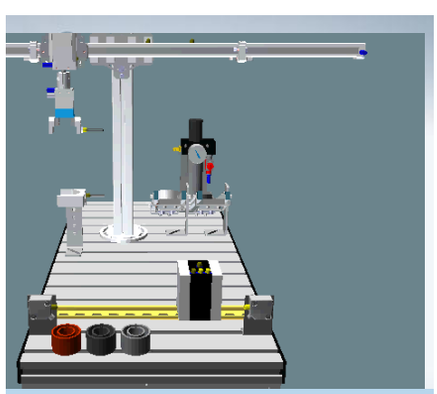
Reduced Complexity



Industrial Handling
- 4 Axis
- AC-Servo drives
- High Speed, High Precisison
- Complex work cycles

➢ Complex, dangerous, expensive

Handling for Learning Factory
- 2 axis
- DC Motor with Encoder
- limited accuracy, Limited speed
- Simplified Process
- Easy to understand, safe, cost effective

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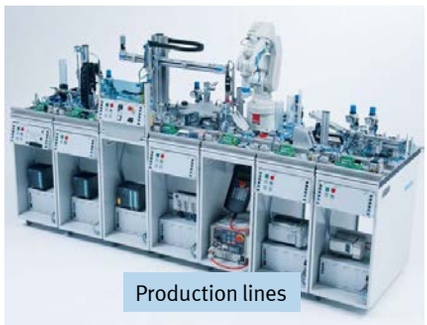
Fast Learning Success

modules

stations



Production lines

1. Focus on principles: use simple example of a process
2. Step by step: from simple to complex
3. Use existing knowledge, use existing components
4. Use of industrial components: direct transfer into practice
5. Motivation: interesting applications, hands on approach, realisze new ideas

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Quality

Different quality demands in industry and education

Industry:

- Focus on economy: speed, precision, ...
- long operation times
- Only few setups
  -› low number of cycle of connector operation
- maintenance by experts
  -› sensitive to handling failures

Education:

- Focus on learning succes
- short operation time
- many setups
  -› high number of cycle of connector operation
- Maintenance by beginners
  -› non-sensitive to handling failures

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Quality - Sample

Industry:
- Control Cabinet with fixed wiring
- Coast effective, few connecting cycles

Education:
- Edutrainer with 4 mm laboratory plugs
- More expensive, many connecting cycles

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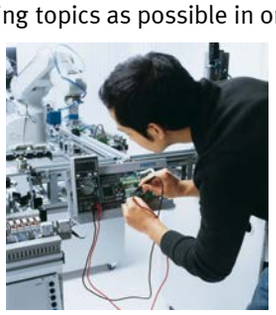
Budget

- Limited Budget in Schools
- Covering as many learning topics as possible in one system


Assembly / Setup


Failure Analysis


Programming


Safety

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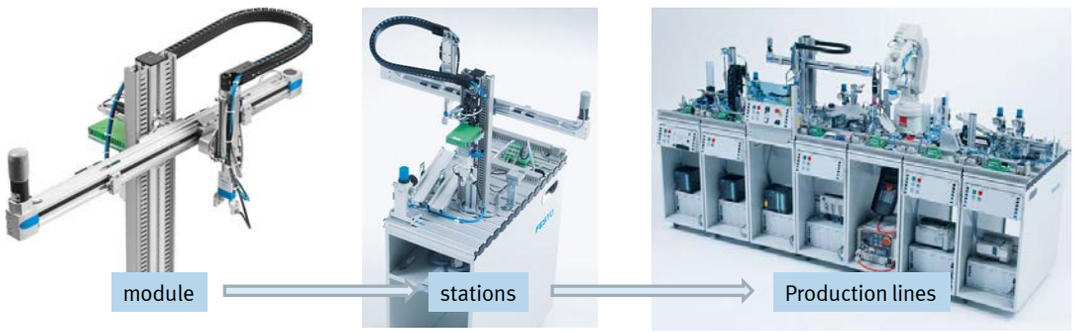
Budget – from module to production line



Use modules to teach technology, e.g.
- Wiring DC-Motor
- Control of DC Motor
- Function of encoder

Use stations to teach programming, e.g.
- Programming sequences
- Programming operating modes
- Safety functions

Use stations to teach process control, e.g.
- processing of orders
- Programming field bus
- maintenance
- Optimize the line

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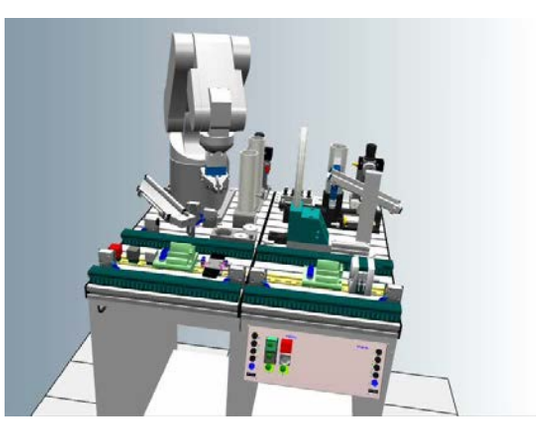
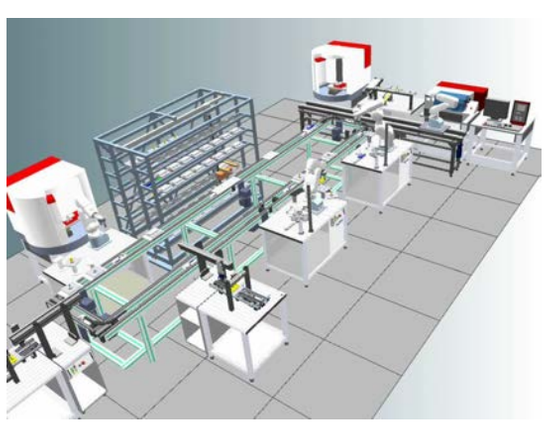
Budget – Using Simulation

- Ideal situation: every student has the same system
- Unpossible with real system – but easy with simulation





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Support for Teachers

Make education more efficient

- Provide courseware
  - Theory books
  - Excercises (with solutions!)
  - Electronic media
  - Simulation
- Easy and fast Setup
  (no waste of time for preparing the class room)
  - Easy storage
  - Larger equipment with wheels

FESTO

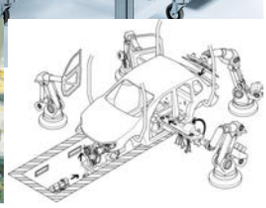
Serving Different Branches and Applications

Mechatronics and Factory Automation
Content:

- Sensors and Actuators
- Programming Sequences
- Material Flow
- Industrial Robots
- Field Bus
- Setup systems
- Maintenance
- Failure analysis

Samples:

- Car industry
- Electronics assembly



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Serving Different Branches and Applications

Process Automation

Content:

- Valves and pumps
- Sensors for process control
- Closed loop control
  - Temperature
  - Pressure
  - Flow

Sample:

- Chemical industry
- Water / waste water industry

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Serving Different Branches and Applications

Agro-Food-Beverage
Content:

- Handling of liquids and loose material
- Filling bottles
- Hygiene
- Process control
- Closed Loop Control

Samples:

- Food industry

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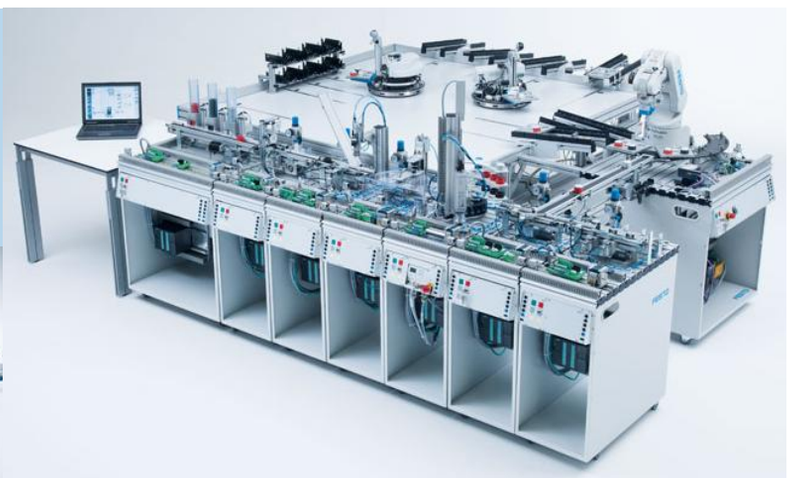
Serving Different Branches and Applications

Logistics with Mobile Robots

- Control of mobile robots
- Path planning
- Logistics planning



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Serving Different Branches and Applications

Hyper-Flexible Production

- Flexible workcells with integrated material flow
- Add-on process modules
- Exchange of modules within minutes
- Fast change of logistic and material flow

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Universities and Vocational Schools

Different demands in universities and vocational schools

Vocational:
- Focus on state of the art technology
- Focus on hands on approach

Education:
- Focus on latest technology
- Focus on theory

MPS	Prolog Factory	MPS Transfer Factory
☑ Vocational	❑ Vocational	❑ Vocational
❑ University	☑ University	☑ University

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Summary

- Target: achieve process competencies
- Learning Factories are didactic media
  - Demonstrate the principles
  - Show underlying structures
  - Motivate the students
  - Fast learning success
  - High (didactical) qualitiy
- Different demands in industry, vocational and universities

FESTO

Thank your for your attention!

Dr. Christoph Siegel

As head of Operational Management Counsel Department (OMCD) since 2007, Dr. Christoph Siegel was responsible for the global implementation of the lean philosophy within Daimler commercial vehicles. The assignment of OMCD is the implementation of the management system „Truck Operating System „ based on the three strategic pillars: first, Competence Center for Lean Management Consulting. Second, Sustainability through standards and assessment and third, qualification and training. Prior to working in the OMCD, he has been assigned to lead global production axis and at that time accomplished the turnaround with lean management.
Effective May 2nd 2011, he took over the responsibility for the Daimler foundry in Mannheim and „Atlantis Foundry“ in South Africa.

Daimler AG

The company's founders, Gottlieb Daimler and Carl Benz, made history with the invention of the automobile in the year 1886. 125 years later, in anniversary year 2011, Daimler AG is one of the world's most successful automotive companies. With its divisions Mercedes-Benz Cars, Daimler Trucks, Mercedes-Benz Vans, Daimler Buses and Daimler Financial Services, the Daimler Group is one of the biggest producers of premium cars and the world's biggest manufacturer of commercial vehicles with a global reach.
Daimler Financial Services provides its customers with a full range of automotive financial services including financing, leasing, insurance and fleet management.
As an automotive pioneer, Daimler continues to shape the future of mobility. The Group applies innovative and green technologies to produce safe and superior vehicles which fascinate and delight its customers. With the development of alternative drive systems, Daimler is the only vehicle producer investing in all three technologies of hybrid drive, electric motors and fuel cells, with the goal of achieving emission-free mobility in the long term. This is just one example of how Daimler willingly accepts the challenge of meeting its responsibility towards society and the environment.

DAIMLER

The application of a learning factory for extensive training of employees

Dr. Christoph Siegel

DAIMLER

The application of a learning factory for extensive training of employees

Mercedes-Benz FREIGHTLINER FUSO WESTERN STAR Thomas Built Buses BHARATBENZ

Darmstadt, 19th May 2011

Dr. Christoph Siegel, Daimler AG – Daimler Trucks

What's your story Mr. Average? A curriculum vitae of lean qualification

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69

Plant Kassel
01 234 / 567891 0

Joe
Average

DAIMLER

Mr. Joe Average enters Daimler Trucks

From Mr. Averages CV

- 2001 – career entry as Operating Engineer at the Kassel plant
- 2004 – project: optimization of machining line for rear axle gears

Lean Management Training

- 03/02 – basic training Lean Management in the TOS* Office Kassel
- 04/10 – Trainings in the PSF**: "total productive maintenance" and "fast changeovers"




* TOS = Truck Operating System

** PSF = Process Simulation Facility

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Lean Qualification and the Process Simulation Facility (PSF) at Daimler Trucks

1 Lean Management at Daimler Trucks – Lean Qualifikation

2 Product Range and Development of the PSF at Daimler Trucks

3 The Qualification Approach

DAIMLER

Operational Excellence is the foundation for profitable growth

What is TOS?

TOS is the Daimler Trucks way to develop and live lean business* and continually improve it. The focus of our lean business and its processes is
the chain of demands coming directly from the customer.

Within TOS we qualify and develop our people in the priciples of Lean Management for their region, their teams and for themselves - using, improving and passing their knowledge: *becoming a Learning Organization.*

What does TOS mainly impact?

TOS -
Truck Operating System

Who is the target group?

TOS is for all Daimler Trucks-Employees

Responsibility for implementation of TOS is on:
Every single Daimler Trucks-Manager

* Lean business: Meet customers demands with as less as possible ressources

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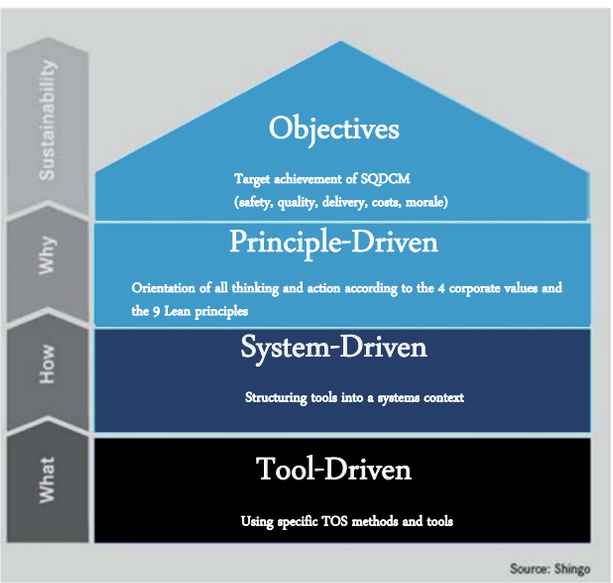
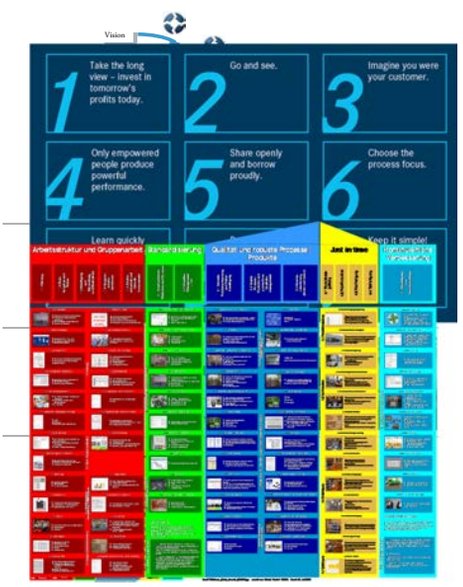
Mr. Joe Average: how to train him as problem-solver, lean thinker, Lean Manager with lean behavior?





DAIMLER

Broad portfolio of TOS Trainings throughout all management levels is the Key to Sustainability

Management Training

- Basic lean philosophy
- Learning to see (Value stream, Diagnostic tools)
- Shopfloormanagement
- Leadership in a lean environment

Expert Training direct and indirect

- Common design of Expert Projects
- Trained skills: Lean, Project management, Leadership, Soft Skills, Shopfloor management
- New training approach (no benchmark worldwide) for
- Part of lighthouse approach

Process Simulation facility

PROZESS LERN FABRIK

- Assembly process
- Logistics process
- Manufacturing process
- Order processing
- Energy Efficiency

Employee Qualification

- Basic Trainings for new employees
- Lean tools and methods (value stream mapping, PDCA, Problem Solving)
- Moderation and Supervision

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Mr. Joe Average becomes a manager

From Mr. Averages CV

PROZESS LERN FABRIK

- 2005 – Employee for industrial planning, promotional candidate, later manager industrial planning
- 2008 – Project: improve energy efficiency in the production facility

- 05/03 und 05/04 – Promotional Candidate Training (2 weeks training including 3 days in the PSF)
- 08/01 – Energy efficiency training in the PSF: Manufacturing of Turbo Charger components

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Lean Qualification and the Process Simulation Facility at Daimler Trucks

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To simulate a full line production environment the portfolio of the PSF has continuously been adopted

Manufacturing

- Hydraulic Press:
  - 1 day Total Productive Maintenance
  - 1 day Fast Changeover
- Manufacturing cell
  - 1-3 days Energy Efficiency

Assembly and Logistics

- 3 days TOS Philosophy and Methods for Managers, Promotion Candidates and suppliers
- 1 day Direct or Indirect Processes for Teams / Work Groups

Order and Delivery

- 3 days TOS Philosophy and Methods for Managers, Promotion Candidates and suppliers
- 1 day Direct or Indirect Processes for Teams / Work Groups

Philosophy

- Modules to Shop Floor Management culture and KPI* development

* KPI = Key Performance Indicators

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Example on continuous improvement within training in process simulation facility

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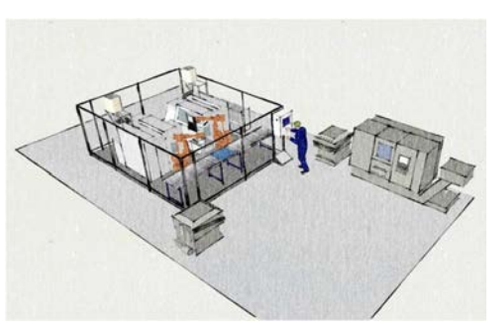
New methods to improve Energy Efficiency are communicated using the PSF concept

Key facts

- 16 new energy related methods build the common basis for projects and qualification
- Simulation is embedded in existing Turbo Charger value stream
- Trainings for different management levels using various manufacturing technologies



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Senior manager Joe Average

From Mr. Averages CV

- 2010 – promotion as senior manager industrial planning; project: optimization of the cycle-time for tool supply
- 2011 – project: setup and lead shopfloor management

- 10/08/10 – Team development day with managers of own department. PSF indirect: Order processing of the turbo charger
- 11/04/27 - Training PSF: Shopfloor meeting – questioning techniques & problem solving process




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Lean Qualification and the Process Simulation Facility at Daimler Trucks

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A new way of spreading the "lean virus" had to be found

Targets:

- **End-to-End change management** for direct and indirect processes in a realistic environment
- Training participants **get active** using the TOS philosophy, tools and methods
- Integration of existing **standards**
- Scalable and flexible training environment to allow adaption to **different customer groups**
- Use group characteristics as chance for development for **diverse solutions** to the same problem

DAIMLER

The Process Simulation Facility has proven to provide maximum knowledge transfer for all hierarchy levels

Real Product: Turbo Charger	▪ Production environment ▪ Real world complexity, logistics and ergonomics
Real Processes: Manufacturing and order management	▪ In-house parts management ▪ Integrated order management process
Content Focus: Trainings include specific methods	▪ Shopfloormanagement ▪ KPIs, Yamazumi-Board ▪ Production Learning System
Customer Focus: Trainings for all mgmt. levels	▪ Supervisor Focus: Continuous Improvement and standardization ▪ Management Focus: Communication and decision making on the shop floor

Simulation of
change management
for direct and indirect processes
in a
realistic environment

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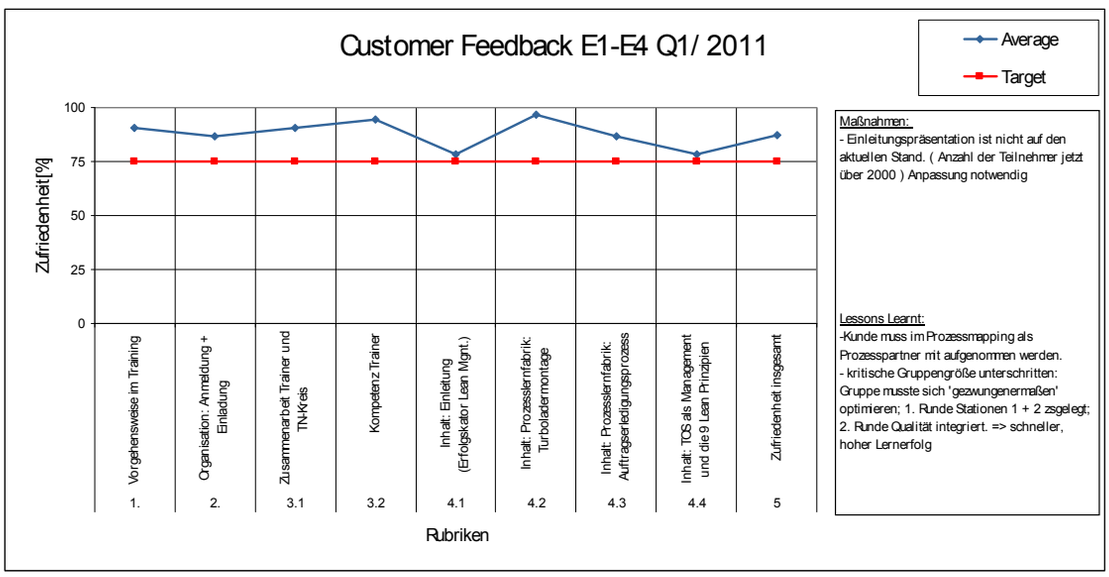
Feedback is good but we always train ourselves to be better tomorrow



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"My story is all about Lean Management qualification – how about you?"

DAIMLER

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Plant Mannheim
01 234 / 567891 0

Christoph
Siegel

Markus Reichert

Markus Reichert has worked as a consultant and trainer for the WIEPROconsulting department at SEW-EURODRIVE GmbH & Co KG since 2004.
During his academic studies, he absolved a process consultant course at Robert Bosch GmbH. Afterwards he had worked for a consulting company for 2 years focusing on organizational development, change management and management development.

At WIEPROconsulting, he is also responsible for optimization projects with lean focus in the Graben production and logistics plant, as well as with comprehensive reorganization projects of entire sections in various business processes of SEW-EURODRIVE on national and international level.

Since spring 2010, Mr. Reichert has been responsible for the WIEPROconsulting business process management.

SEW-EURODRIVE GmbH & Co KG

SEW-EURODRIVE is movement, tradition, innovation, quality, and service all in one - we prove this to our customers every day and have done so for 80 years. We do not just move countless conveyer belts, bottling plants, sports stadium roofs, gravel plants, assembly lines, processes in the chemical industry, your luggage at the airport, or even you on escalators; no, we also are moving ourselves. In our company, there is no such thing as standstill. Every day, nearly 500 researchers and developers are working on creating the future of drive automation and making it a little better. Collectively, about 14,000 employees around the world are moving to solve their tasks and optimize processes. This is how SEW-EURODRIVE has evolved throughout its history to become the market leader in the industry of drive automation with a turnover of more than EUR 2 billion. The movement you need is created with various product solutions and drive systems. Depending on the requirement or the industry, SEW-EURODRIVE offers individual solutions from the comprehensive modular concept with gearmotors and frequency inverters, servo drive systems, decentralized drive systems, and industrial gear units.

SEW EURODRIVE

Qualification of employees in the development department with the SEW Life Training Center

Markus Reichert

WIEPRO consulting

Qualification of employees in development departments

- The SEW value adding system
- Life Training Center
- Transfer of lean thinking in daily work

Markus Reichert,
Head of WIEPRO-GM

Darmstadt, 19.05.2011

WIEPRO consulting

CONSULTANT PROFILE –
MARKUS REICHERT

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SEW-EURODRIVE - Driving the world

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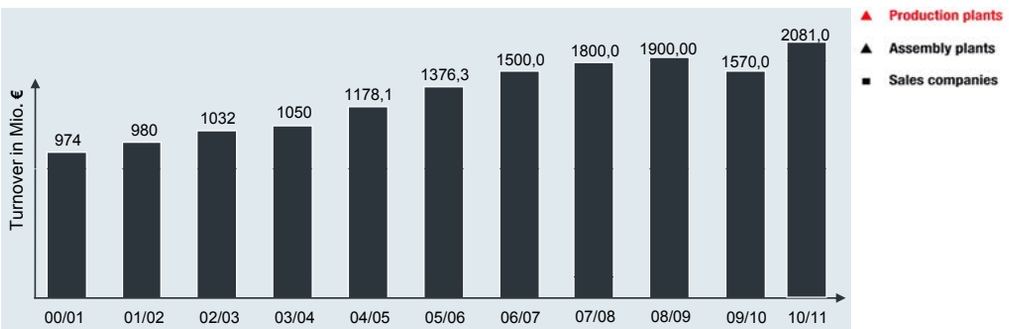
Driving the world

WIEPRO consulting

Think global, act local

- 15 Productionplants
- 75 Assemblyplants
- 44 countries with SEW representants
- 28 Technical offices in Germany
- 6 Service Competence Center
- over 13.000 Employees worldwide



Driving the world

WIEPRO consulting

Solutions for drive requirements

WIEPRO consulting

SEW-EURODRIVE Productportfolio

WIEPRO consulting

WIEPROconsulting

A systematic change process

- Internal consulting department of SEW-EURODRIVE
- Founded in 2000 by Mr. Soder, General Manager Technology
- "WIEPRO" stands for: Wissen entwickeln – Prozesse optimieren (Develop knowledge – optimize processes)
- Main task of WIEPROconsulting:
  Provide the framework to build up and permanently establish a practical innovation and change management

➔ WIEPROconsulting realizes – together with the employees – a systematic, consistent and continuous improvement of all sectors of the company – according to the SEW Value-Adding System

➔ The goal of WIEPROconsulting:
Do not work harder but in a more productive way!

WIEPRO consulting

The SEW-Value Adding System

Revolution through Evolution

Aim / Mission	continous excellence in business process through the value adding system in a business				
Organisation	Businesswide working- and business process design	WIEPRO consulting	Development of innovative concepts for achievments of competition advantages		
Formal Principle	Order and Safety at work place	Optimasation of procedures	Communication in the company	Improvement of performance	Management and Motivation
Methods	5S Teamwork Standard-procedures	One piece flow Flow production KANBAN	Transparency through Visualization	TQM, TPM Prod. in cycle time Standardization	Project work Qualification Target agreement

Goal-oriented System

Concepts and Transformation strategies

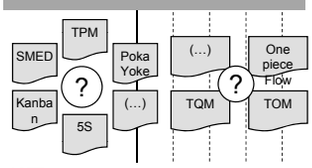
WIEPRO consulting

The way to Business Exzellence

A value stream oriented businessorganisation

Lean degree of maturity

Traditionell	Prozess excellence	Business Excellence
Improvement is random and function-orientated	Improvement is systematic and process-oriented	Improvement orients oneself towards the overall performance of the value stream
Arbitrariness of methods	Perfection Value-adding system-oriented KVP - Organisation Implem. Value Adding System	



Degree of cooperation

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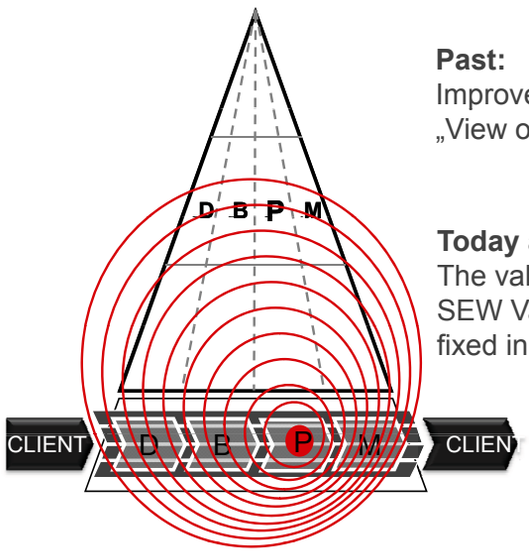
A value stream-oriented business organisation

The performance of the value stream has high priority to all activities



Past:
Improvements resulted after
„View of the product in the construction“

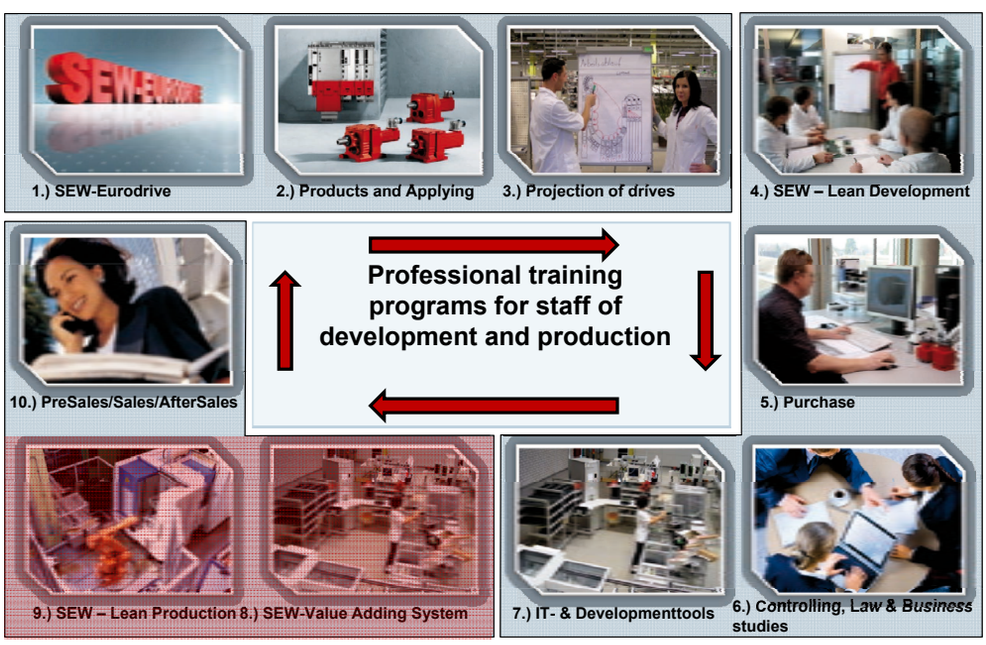
Today and future:
The value-generated principles of the SEW Value Adding System have to be fixed in the business!

D: Development B: Buying P: Production M: Marketing

WIEPRO consulting

1st Step: Theoretical Part of the Training

10 Qualification blocks for training in 4 weeks



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The Qualification block 8+9

The SEW-Value Adding System (Lean Production)

WIEPRO-Consulting
Buildup / Organisation / Contents/ Commitees / Rules / Duties

The SEW – Value Adding System
Buildup / Design principles / Methods / Rules / Applications

The application in product and innovation
Practical Example / Rules / PDCA / Improvement programs / Cogging
Innovation process and Value Adding Process / Next Steps

Basic theory to give an overview of all topics of the SEW value adding system!

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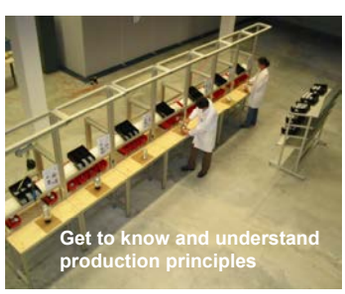
2nd Step: practical qualification

Knowledge about the entire value chain – Life Training Center



✓Active cooperation at WIEPRO-Processdevelopment-team motivates and qualifies staff to perfect performance from the start

✓At the WIEPRO-LiveTraining-Center staff gets trained specifically and therefore prepared for new processes and technologies

✓ Learning by doing is the equation to success for motivated and high qualified staff members

Activity-based learning at the SEW-LiveTraining Center

The Idea and the Aim

- Show the strengths and weaknesses of different production organizations
- Through an approach of theory and praxis specific knowledge should be created for complete processes of modern production organizations.
- At training, real problems should be solved playfully by using new methods and concepts. Also their effectiveness should be tested.
- Comprehension of performance development for
  - Flow of material
  - Compensation of waste
  - Compensation of processing time
- Successful teamwork should be learnt in single planning phases and applying phases

WIE*PRO*-LiveTrainingCenter

Active-based learning

Day 1
- Buildup and Rules of the LiveTrainingCenter
- Job fabrication: Theory and Praxis
- Assessment of results
- Team-organization u. Process-optimization
- Analysis of sequence
- SEW-Value Adding System
- Planning of flexible production and logistics concepts

Day 2
- Planning and buildup of production and logistics concepts
- Testing of the carried out production
- Analyzing results
- Methods for process-optimization
- Concept-adaption
- Transfer into reality > Tour of the company productionfacilities

Day 3
- Optimization until process-excellence reached
- Conclusion of results
- Alternative results and examples of experience




Practical learning with the SEW-LiveTrainingCenter

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Product range

A modular system provides a large variety of products

Modular products provide more than 100 varieties

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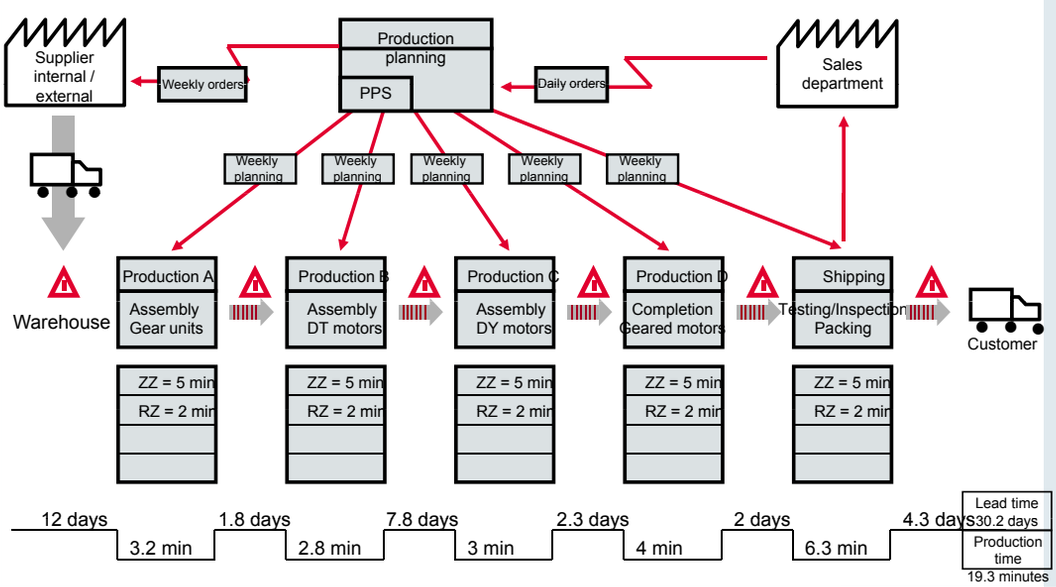
Production method: job shop production

Learn and understand the way



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Job shop production

Principle of the production method

Characteristics:

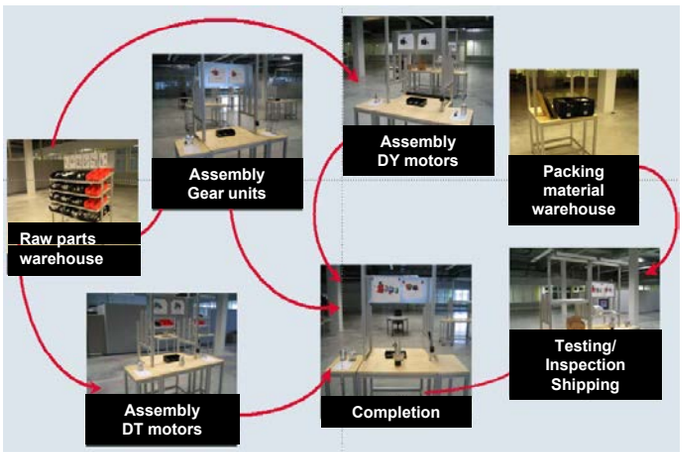
- Similar machining processes in one job shop

Use:

- Many different products with different work sequences
- Made-to-order production and series production

Coordination problems:

- Suboptimum coordination caused by multi-level production of individual orders
- Waiting and idle times, temporary storage



Optimization problems:

- Complex system
- High lead times, many buffers
- Continuous adjustment of production plan

Practical example
Assembly of geared motors

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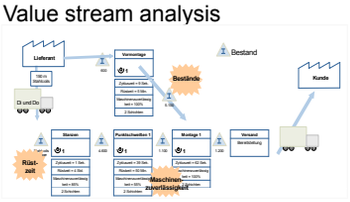
Active-based learning at WIE*PRO*-LiveTrainingCenter

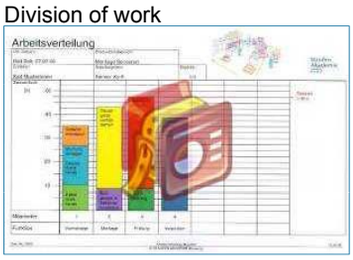
Analysis

Value stream analysis



Clear design of single of a single process,
Cutting points and Problems in Is-progress.

Division of work



Within a working system, design and line balancing has to be investigated and defined for a division of work.

Overview of varieties per workplace

Variantenübersicht		
Prozessart	Baugruppe 1 (z.B. Getriebe)	Zeit
Variante 1	Fußgetriebe	
Untervariante 1	R37 > Getriebesatz i = 24,42 // Abtriebswelle Ø = 22 mm	~70 Sek
Untervariante 2	R47 > Getriebesatz i = 23,28 // Abtriebswelle Ø = 22 mm	
Kundenspezifika	keine	
Variante 2	Flanschgetriebe	

Prozessart	Baugruppe 2 (z.B. Motor DT)	Zeit
Variante 1	Fußgetriebe	
Untervariante 1		
Untervariante 2		

Adequate knowledge of a product and varieties is necessary for working system planning!

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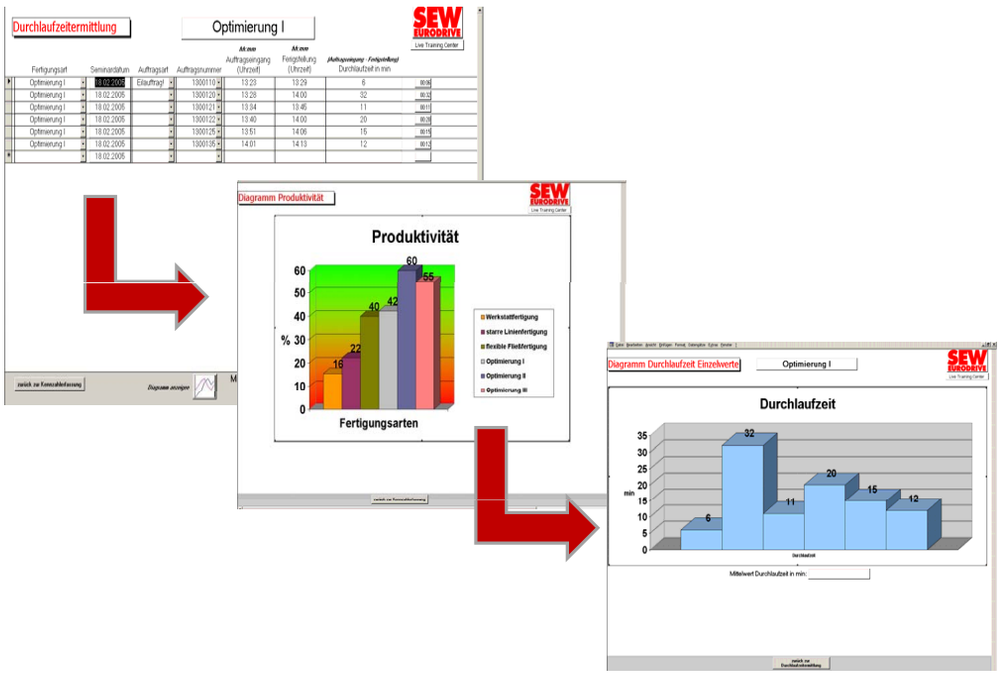
Analysis



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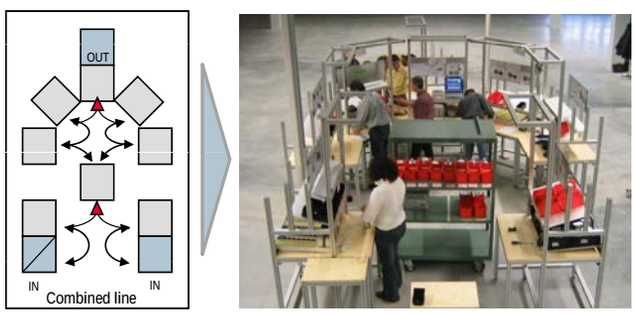
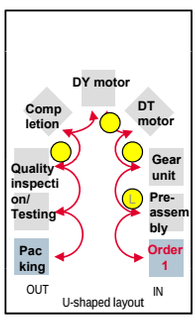
Final solution of flexible flow production at the Life Training Center





Realized gearassembly solution in our assemblyplant in the Netherlands.

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3rd Step: transfer to real life

interdisciplinary synchronous projectwork in productdevelopment and productionarea

Space for your individual notes!

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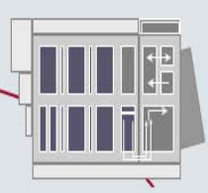
Fields of activity to improve performance

The SEW value-adding system – a concept to achieve competitive advantages



Professional performance in excellent processes
The best method as a standard

Employees in the center of attention
Open up capacities

Comprehensive and innovative process and organization structure
Determine the basic conditions

Integrated quality control systems within the process flow
How can we achieve quality?

Intelligent combination of man and machine
Do not worker harder but in a more intelligent way

Value-adding design of business processes and workplaces
Manufacture the products the customer needs in a waste-free way

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Methodology

Systematic process work

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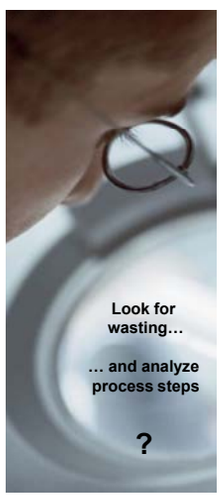
Process observation

Identify wasting before you eliminate it

See – Identify – Assign – Demonstrate – Develop – Test

"Productivity hunters"

- **Process observation**
  - Video analysis
  - Paper Process Excellence
  - Cardboard Engineering
  - Realization
  - Audit management



Results of the observation are analyzed and discussed

Determined potentials are presented in a transparent way

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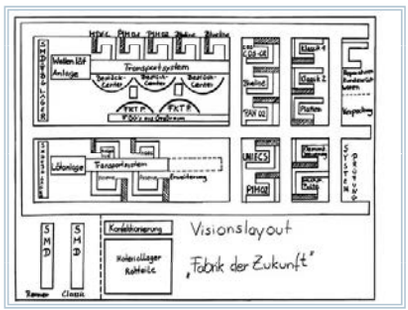
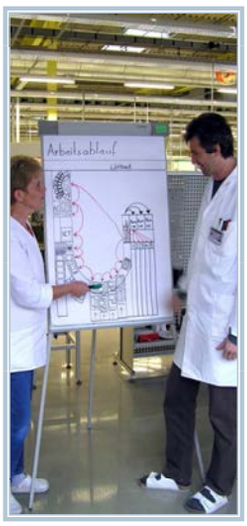
Innovative process development

Use the ceativity and motivation of the team

Develop and choose the perfect future process in the project team





- Process observation
- Video analysis
- ❖ Paper Process Excellence
- Cardboard Engineering
- Realization
- Audit management

Paper Process Excellence
Systematic proceeding

- ❖ Evaluate analysis results
- ❖ Develop 3 layout variants within the team
- ❖ Define advantages and disadvantages of each layout
- ❖ Evaluate layouts using chosen criteria
- ❖ Evaluate the favorite layout using a cost-benefit-analysis
- ❖ Improve the chosen layout and prepare it for Cardboard Engineering

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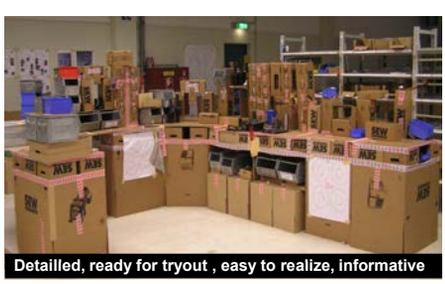
Innovative process development

Creative destruction of existing processes

Look for detailed solution, test them in an inexpensive way, realize quantum leaps


Detailled, ready for tryout , easy to realize, informative

Execution-oriented assembl

- Process observation
- Video analysis
- Paper Process Excellence
- ❖ Cardboard Engineering
- Realization
- Audit management

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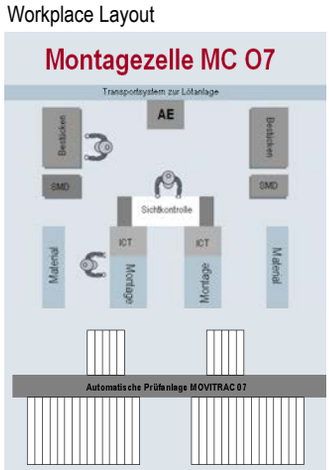
Productionprocess MOVITRAC 07(A) Former situation

Product

Workplace Layout



Workplace details

27

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Productionprocess MOVITRAC 07(B) new situation

Space for your individual notes!

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Thank you very much for your attention!

Do you have questions or remarks?

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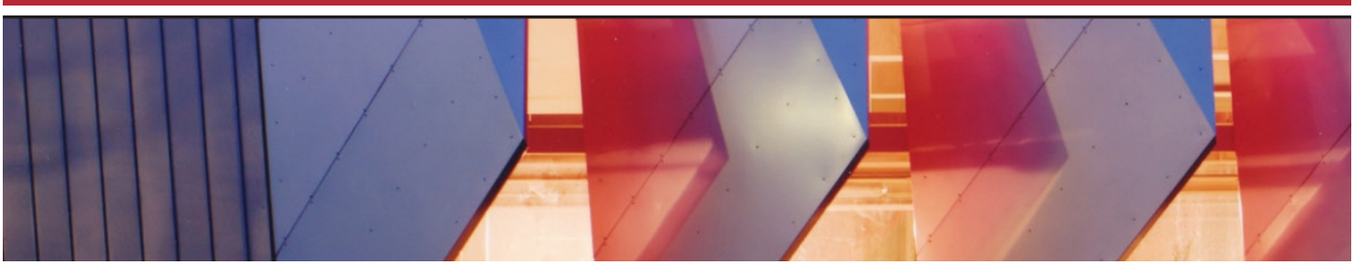


Prof. Gunther Reinhart

is full professor for Industrial Management and Assembly Technology and director of the iwb (Institute for Machine Tools and Industrial Management) at Technische Universität München (TUM) . After studying mechanical engineering with the emphasis on design and development, he was research assistant at iwb from 1982 to 1988 with Prof. Dr. Joachim Milberg. During the last two years he was in charge of the assembly automation department. After receiving the Ph.D. from TUM he started his industrial career with the 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 the iwb.

From March 2002 to February 2007 Professor Reinhart took a sabbatical from university to become a member of the executive board of IWKA Corporation, a large German supplier of engineering, robotics and plant equipment with 13,000 employees worldwide. He was in charge of Technology and Marketing (CTO) focused on the discovery of new global market opportunities, the establishment of an internal auditing system and the development of the IWKA packaging technology group.

2007 Professor Reinhart turned back to university and has served with Professor Michael F. Zäh as co-director of the Institute for Machine Tools and Industrial Management (iwb) with more than 100 employees and two locations: Garching near Munich and Augsburg. He is also the chairman of the Bavarian Cluster for Mechatronics and Automation and since January 1st 2009 head of the Fraunhofer IWU research-department for Resource-Efficient Converting Machines (RMV). He has also supervised the research projects and the doctoral theses of some 100 research associates.

IWB, TU Munich

The Institute for Machine Tools and Industrial Management (iwb) of Technische Universität München is one of the major production technology 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 the 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 the iwb dedicate themselves to those fields in their research, teaching, and industrial exchange.

Live experience of energy productivity – the training factory at Technische Universität München (TUM)

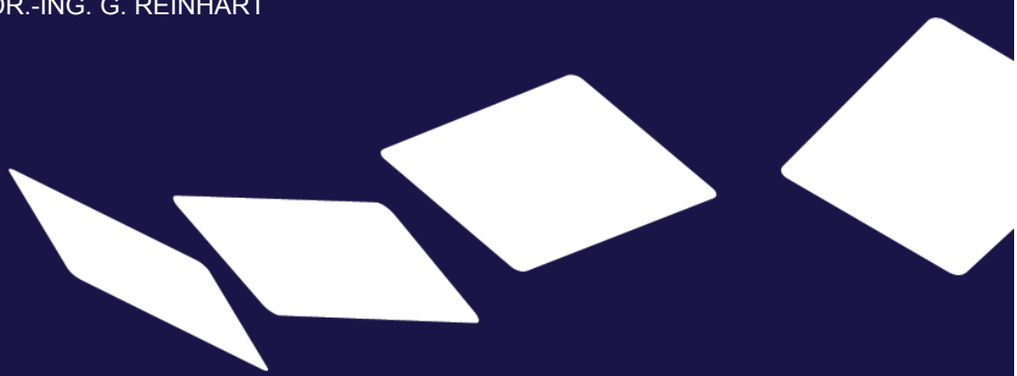
Prof. Gunther Reinhart
Florian Karl

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

LIVE EXPERIENCE OF ENERGY PRODUCTIVITY – THE TRAINING FACTORY AT TECHNISCHE UNIVERSITÄT MÜNCHEN (TUM)

DARMSTADT, MAY 19, 2011
1ST CONFERENCE ON LEARNING FACTORIES

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



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

Agenda

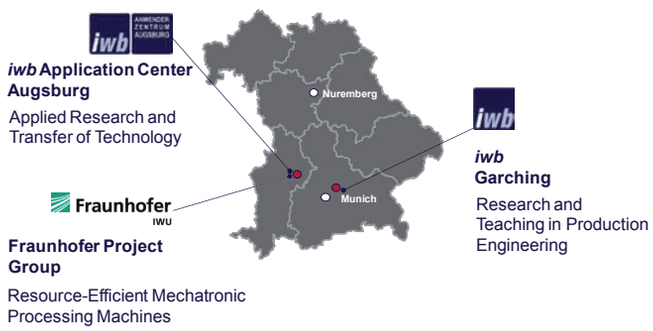
- Brief Presentation of *iwb*
- Initial Situation
- Training Factory for Energy Productivity (LEP)
- Didactic Concept at LEP
- Conclusion and Outlook

Brief Presentation of *iwb*

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

Infrastructure

- Largest institute within the Department of Mechanical Engineering at TUM
- 5.100 m² office space
- 3.650 m² laboratory



***iwb* Application Center Augsburg**
Applied Research and Transfer of Technology

Fraunhofer Project Group
Resource-Efficient Mechatronic Processing Machines

***iwb* Garching**
Research and Teaching in Production Engineering

Brief Presentation of *iwb*

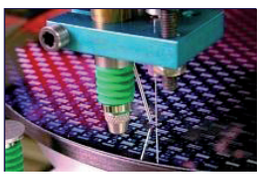
Institute for Machine Tools and Industrial Management
Prof. Dr.-Ing. M. Zäh
Prof. Dr.-Ing. G. Reinhart

Research Areas of *iwb*

Production Organization and Logistics

Mechatronic Manufacturing Systems

Manufacturing and Assembly Technologies



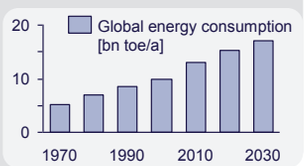
Initial Situation

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

Growing Importance of Energy Consumption

Impacts on Resource Consumption

- Growing energy prices
- Reach of resources
- Political regulations (e.g. CO_2-certificates)
- Increasing environmental awareness of customers
- …



toe: tons oil equivalent

Deficits and Potentials in Production

- Lack of awareness for energy and resource consumption
- Deficits in knowledge about optimization potentials
- Deficits in knowledge about saving potentials
- Existing potentials to reduce up to 30 % of energy consumption in today's production
- …

Realization of the Training Factory for Energy Productivity (LEP) at *iwb*

- Developing of awareness for energy consumption in a practical training environment
- Learning environment for teaching a methodic approach to reduce energy consumption in production

Initial Situation

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

Growing Importance Training Factories

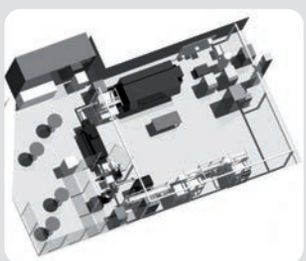
	Books and presentations	Simulations and games	Practical training	Complete implementation
			LEP	
Learning by	Listening, reading	Seeing	Transfer	Transfer
Duration	4 h	6 h	8 h	4 months
Degree of memory after 3 months[1]	10 %	32 %	65 %	65 %

1: Experiences at CiP 2007 - 2009 at PTW – TU Darmstadt (70 companies, ~ 1.000 participants)

LEP – An Innovative Learning Environment

Typical Production Environment

- Characteristic model of a semi-efficient production line (manufacturing of a gearbox)
- Combination of technologies and components of different ages
- Displaying manual and automated production steps
- Demonstrating different forms of energy (steam, heat, compressed air, electricity)



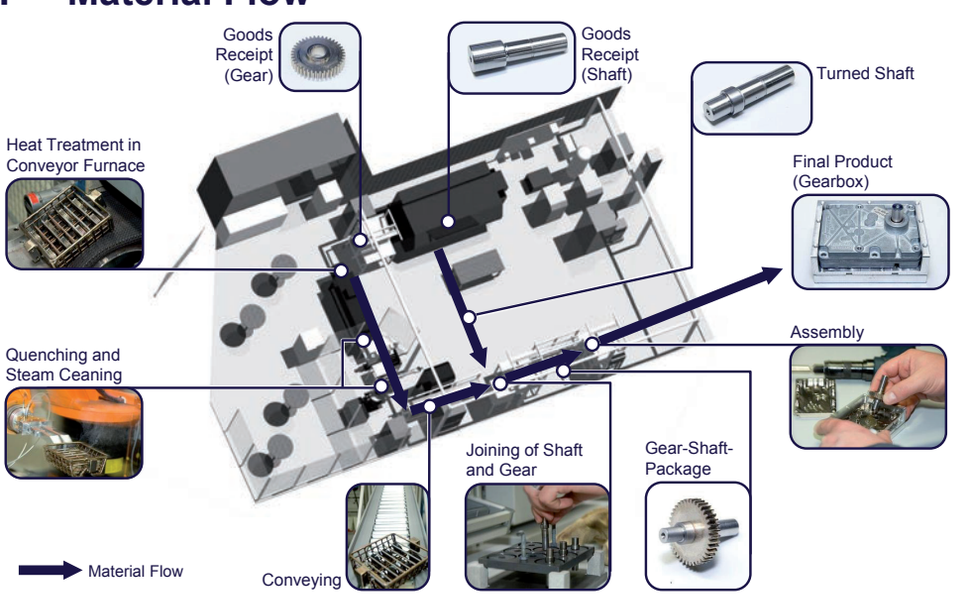
Shop Floor of LEP

- Training of students as well as industrial specialists and managers
- Gradual methodic optimization of LEP through training and visualization of energy savings
- Research environment equipped with the most modern measuring technology
- Buildup in cooperation btw. *iwb* and McKinsey&Company, but separate usage

Training Factory for Energy Productivity (LEP)

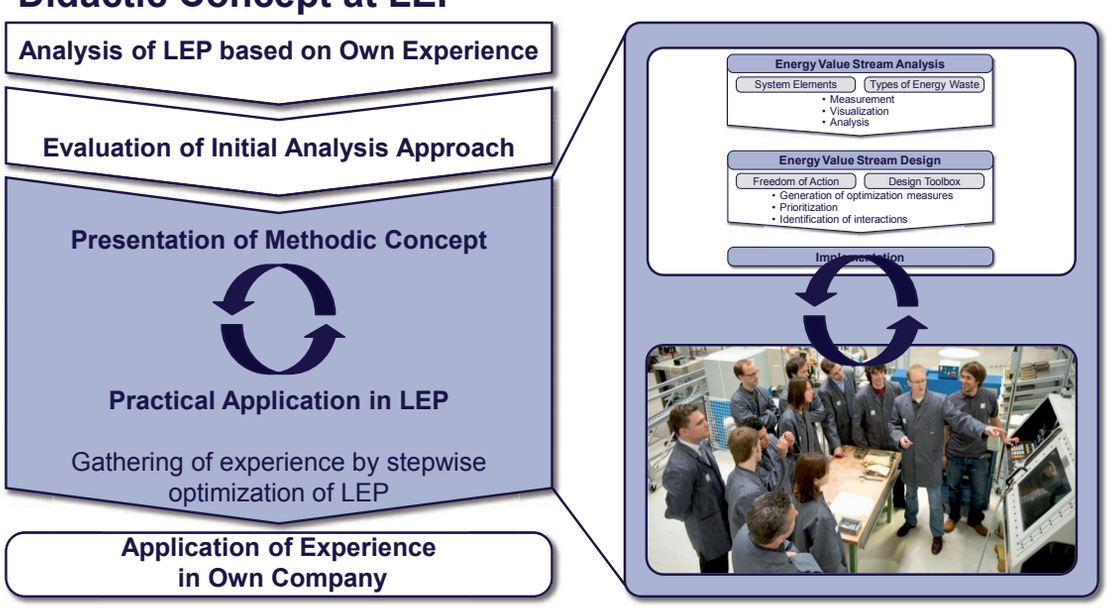
Institute for Machine Tools and Industrial Management
Prof. Dr.-Ing. M. Zäh
Prof. Dr.-Ing. G. Reinhart

LEP – Material Flow



LEP – Movie

Didactic Concept at LEP

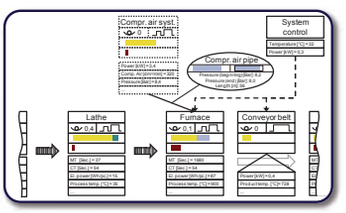


Optimization Approach Applied – Energy Value Stream

Energy Value Stream Analysis

System Elements | Types of Energy Waste

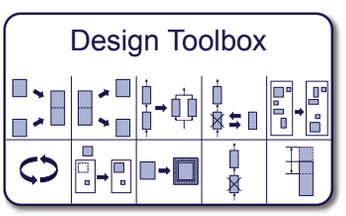
- Measurement
- Visualization
- Analysis



Energy Value Stream Design

Freedom of Action | Design Toolbox

- Generation of optimization measures
- Prioritization
- Identification of interactions



Implementation

Didactic Concept at LEP

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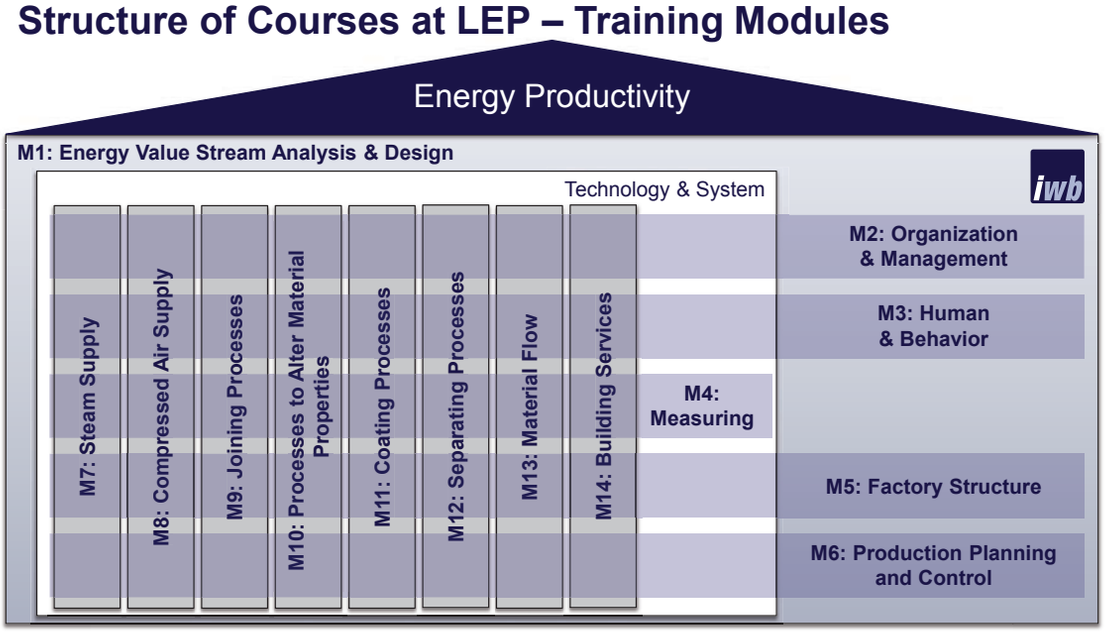
Prof. Dr.-Ing. G. Reinhart

Structure of Courses at LEP – Training Modules



Competences of *iwb* – Training Courses

1-day Training Course

Duration: 1 day
Participants: max. 15 people

- Sensitization for energy productivity
- Identification of energy waste
- Practical application of the methodology “energy value stream” (analysis and design including measurement and evaluation)

Expert Training

Duration: 1 – 5 days (coming soon)
Participants: max. 12 people

- Based on 1-day training course
- Consideration of additional training modules

Practical Course for Students

Duration: 10 days
Participants: 20 students

- Sensitization for energy productivity
- Practical application of the methodology “energy value stream” in various modules
- Measurement techniques
- Group work (energy productive green-field planning)

Didactic Concept at LEP

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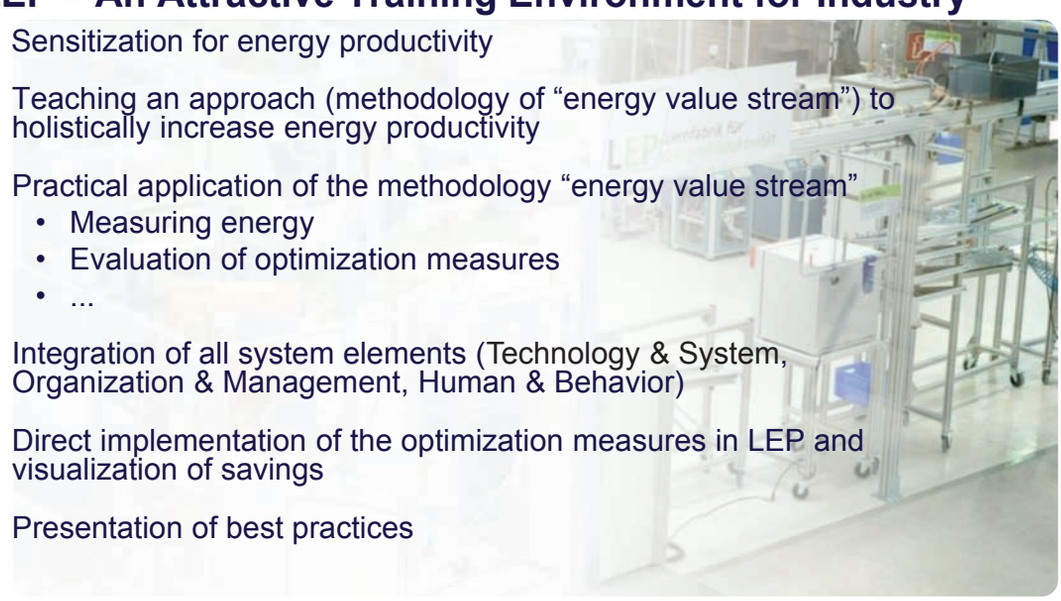
Prof. Dr.-Ing. G. Reinhart

LEP – An Attractive Training Environment for Industry

- Sensitization for energy productivity
- Teaching an approach (methodology of “energy value stream”) to holistically increase energy productivity
- Practical application of the methodology “energy value stream”
  - Measuring energy
  - Evaluation of optimization measures
  - ...
- Integration of all system elements (Technology & System, Organization & Management, Human & Behavior)
- Direct implementation of the optimization measures in LEP and visualization of savings
- Presentation of best practices



Conclusion and Outlook

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

Conclusion

- Growing importance of energy consumption in production *versus* existing untapped potential
- Demand for a practical training environment
- Realization of the Training Factory for Energy Productivity with various training opportunities

Outlook

- Exhibiting interactions between “LEAN” and “GREEN”
- Enhancement of LEP
  - New processes
  - Upgrading of measurement equipment and visualization
  - New training modules
  - Simulation of energy consumption

Institute for Machine Tools and Industrial Management
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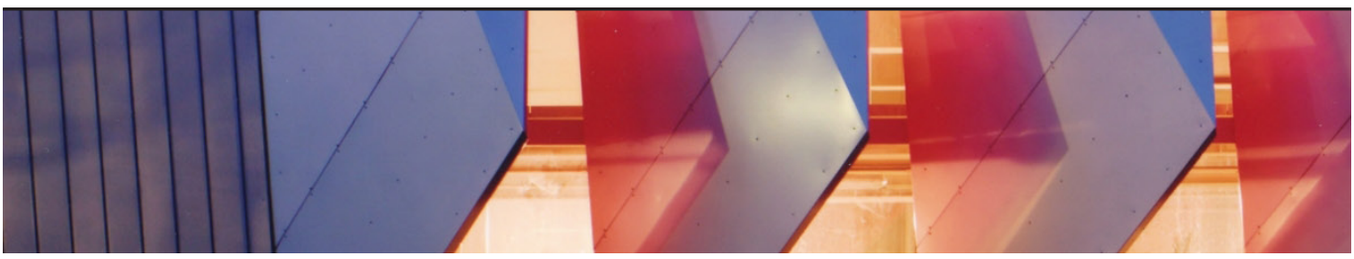


Frank Göller

Frank Göller has a wide spectrum of operative expertise, holding various executive positions at Audi, VW and Bentley over a six-year period. He gathered valuable experience in strategy planning and implementation while active as a consultant at McKinsey & Company. He holds a degree (Dipl. Kfm.) in technical business management. Before becoming a partner at Festool Engineering, he was CEO of a start-up in the renewable energy industry. Mr Göller is responsible for the overall coordination of projects for each respective client. He specialises in designing large scale transformation programmes, developing production strategies and optimising ramp-up management.

Festool Engingeering GmbH

Festool Engineering was established in 2001, building on Festool GmbH's many years of industry experience and excellence. (Festool GmbH was awarded Factory of the Year subcategory awards in 2002 and 2005 and the top prize in 2008.) As a consulting firm, Festool Engineering employs the expertise gained through the restructuring of Festool GmbH and numerous client projects to provide its domestic and international clients with outstanding process solutions in production, logistics, order processing and administration.

Festool Engineering works across industry lines, assisting a wide range of companies in optimising their processes and securing their longterm competitiveness by analysing and improving their direct and indirect business processes and initiating change management tailored to their corporate needs.

FESTOOL

Qualification in the Festool production system

Frank Göller

festool engineering

Passion for Change

WE ARE ALBE
TO MSAETR
ALL KDNIS OF
TSAKS. EEVN
THOSE TSKAS
WE DID NOT
KONW EXTESID.

FESTOOL Products – Tools for the highest professional standards

Structure of the TTS Inc.

Tooltechnic Systems PLC

Data Processing Systems
Logistics
Finance and Accounting
Systems
Purchasing
HR-Management

Sales Companies Worldwide

FESTOOL
PROTOOL
TANOS
narex
schneider
AGT Thermotechnik

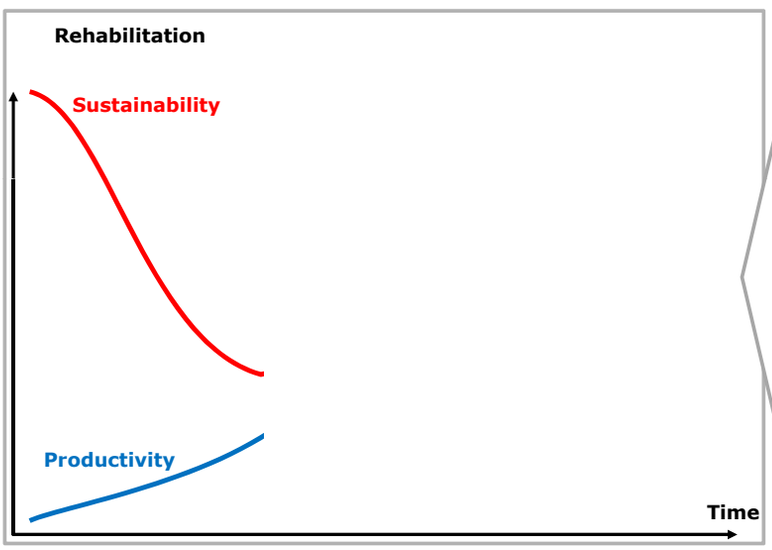
festool engineering
e-pro solutions GmbH
KursWerkstatt Besser selbermachen

Brands | **Services** | **Customer Surface**

Three phases of change process: rehabilitation – system change – sustainable improvement

Phase 1

Long-time vision:
- **Premium vendor**
- **most coveted brand of the target group**



Target:
fix-sell or close

Target state:
Stabilization of the earnings

Procedure:
Rehabilitation after V-model
- Staff reduction
- Cleaning product portfolio
- Streamlining dealer network

Source: Festool Engineering

Two main questions when it comes to implementing lean methodology

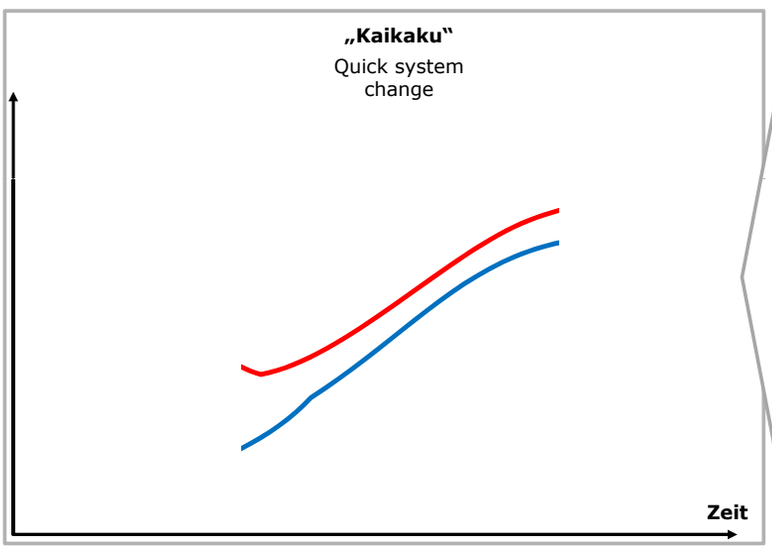
How to overcome the inertia of gravity?

How to keep it in the orbit?

Three phases of change process: rehabilitation – system change – sustainable improvement

Phase 2

Long-term vision:
- **Premium vendor**
- **most coveted brand of the target group**



Target:
Unique position through operational excellence
- 24-h Delivery
- 98% Delivery reliability
- Handling of exploding number of variants

Target state:
- Complete Re-Design of the value chain
- All employees are familiar with Lean tools and principles

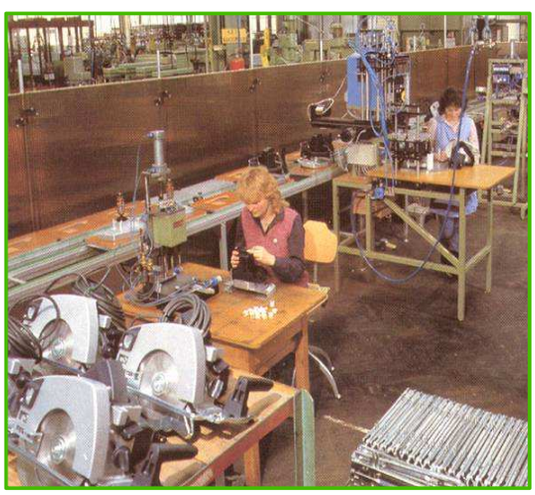
Procedure:
- Japan Study Tour
- Processing measures list

Quelle: Festool Engineering

Change process in the Festool factory Neidlingen

Production today

Production in 1980



2002 **2005** **2008**

Source: Festool Engineering

The content of the Festool production system

Festool
production system

Targets	Tools and target achievement	Supporting elements
Productivity + Flexibility	(U)-Cells, Best Point Principles	CIP - Integration of staff; „ALLEZ"-Employee flexibility Motivation / Incentive system; Objective development process; Process responsibility
	Low Cost Automation (LCA)	
	OEE-Optimization, TPM	
Just-in-time + Stock minimization	Pull-Principles, KANBAN-System	
	Synchronization, Leveling	
	Optimization of set-up (SMED)	
Quality + Standardization	Problem solving competence	
	Visual Management, Poka Yoke	
	Standardization and 5S	

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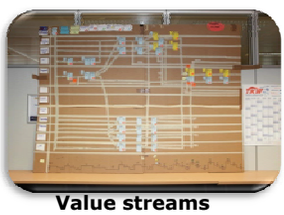
What have we done?

Process observations

Work shops

Visits to Toyota

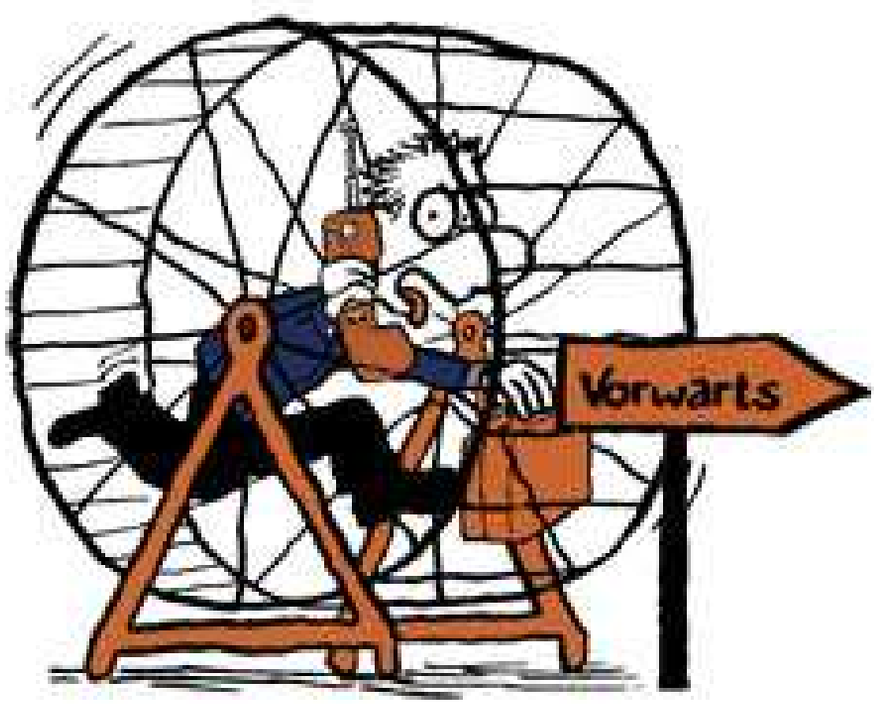


Value streams

Japanese consultants

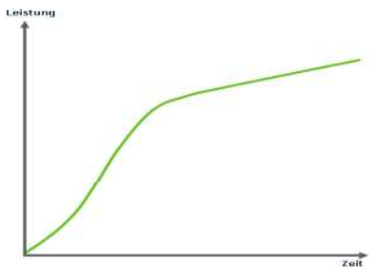
Facts and figures

Measures lists



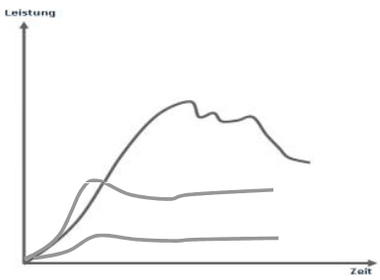
KAIKAKU and KAIZEN – 2 complementary ways to improve

Target:



- Quick start with KAIKAKU
- Continuous improvement with KAIZEN

Reality:



- Quick start with KAIKAKU (structural change)
- Constant decrease of performance

Why is it so hard to improve in a sustainable way?

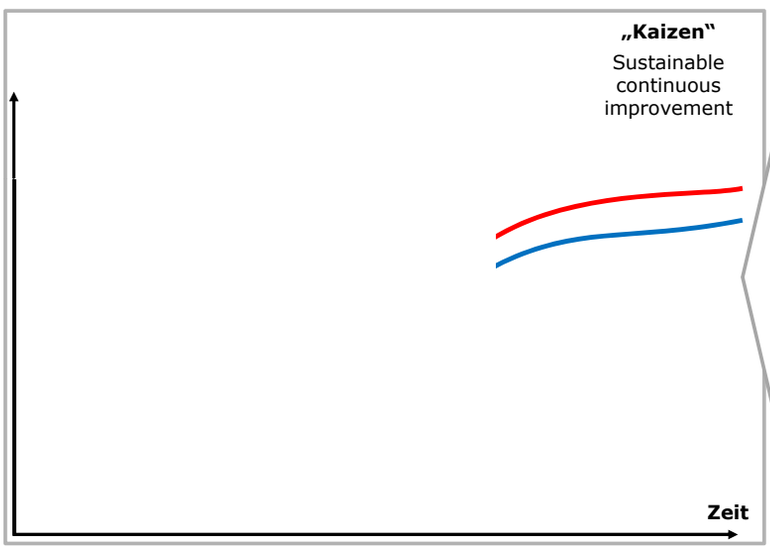
- Kanban
- One-piece-flow
- SMED
- 5S
- Standards
- Visual Mgmt.
- Problem solving capabilities
- Working with standards
- Employee involvment in problem solving
- Leadership culture
- Change culture

Visible elements have been copied successfully - but the essential parts of the systems remained the same!

Three phases of change process: rehabilitation – system change – sustainable improvement

Phase 3

Long-term vision:
- **Premium vendor**
- **most coveted brand of the target group**



Target:
Sustainable continuous productivity improvements

Target state:
- Anchoring of the improvement methodology in line
- Management structure for daily process monitoring and improvement

Procedure:
- Adapting structure of organization
- Introduction of direct employee coaching

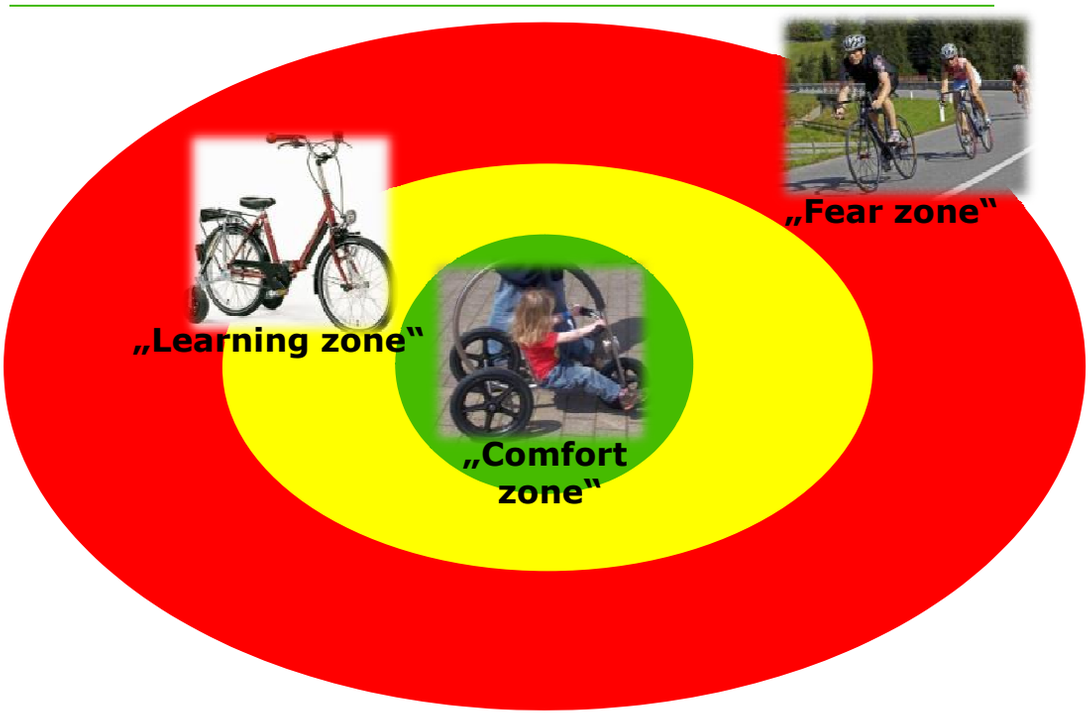
Source: Festool Engineering

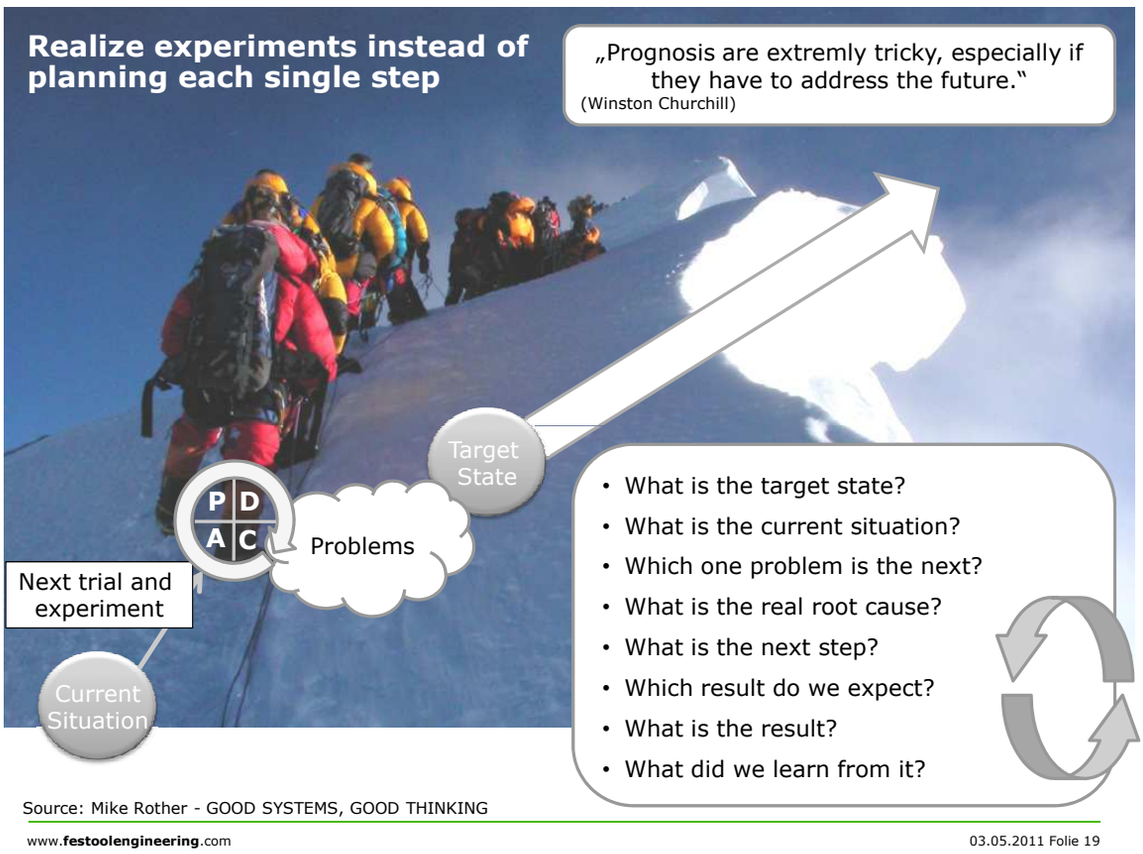
The Festool productions system 2.0

Festool Production system 2.0

Principles	People	Tools
		Leveling
One-Piece flow	Target states and PDCA	Pull/KANBAN
		SMED
100% Value creation	Systematic learning	U-Layout
		Best-Point
	Kaizen training	TPM
		Poka Yoke
Zero defects	Passion for Change	Visual Management
		Standards and 5S

Do you fear experiments?




Realize experiments instead of planning each single step
„Prognosis are extremly tricky, especially if they have to address the future."
(Winston Churchill)
Target State
P D
A C
Problems
Next trial and experiment
Current Situation
• What is the target state?
• What is the current situation?
• Which one problem is the next?
• What is the real root cause?
• What is the next step?
• Which result do we expect?
• What is the result?
• What did we learn from it?
Source: Mike Rother - GOOD SYSTEMS, GOOD THINKING
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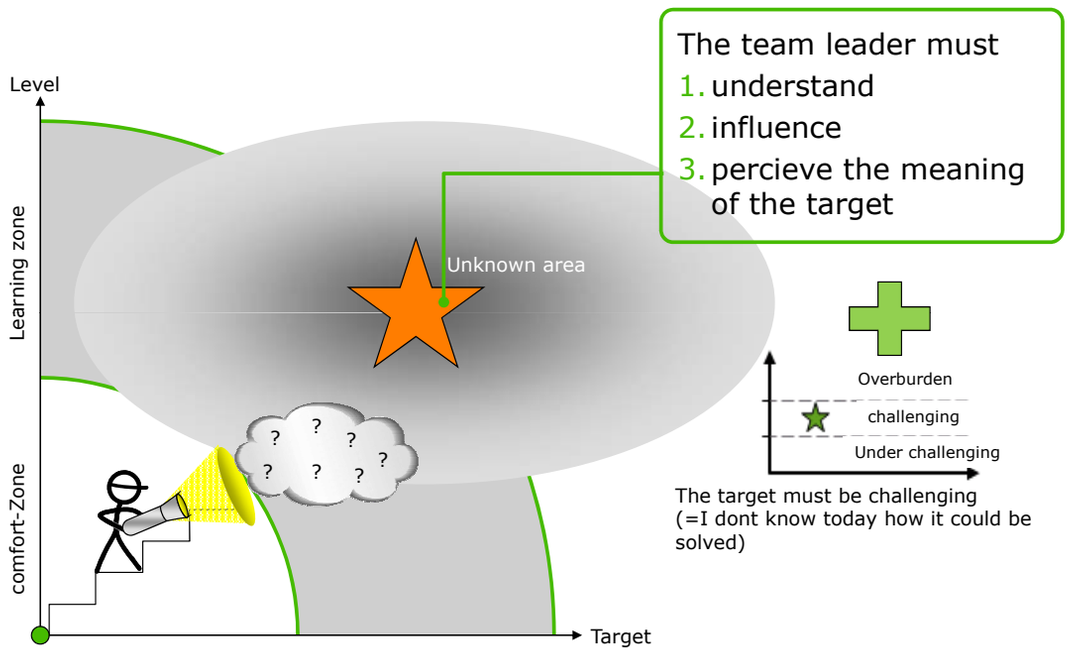
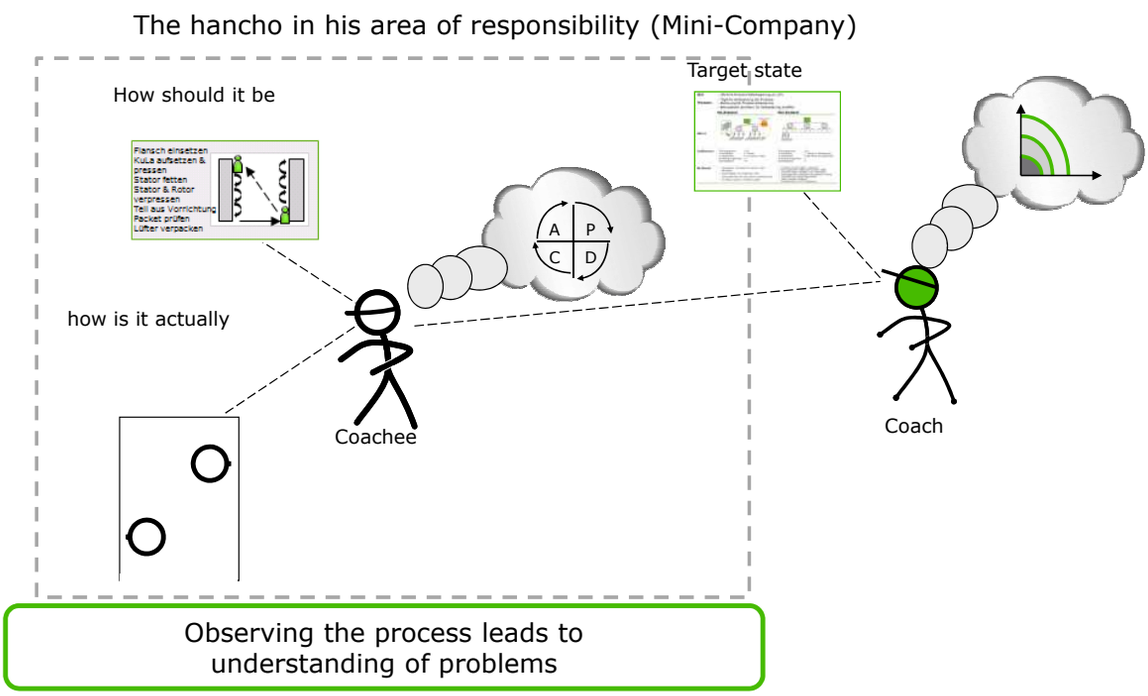
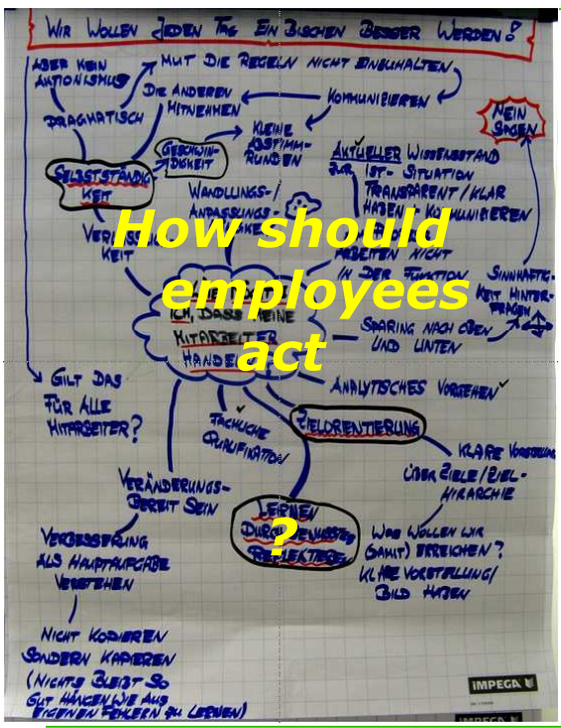
If we would only tackle problems of which the solutions we already know…



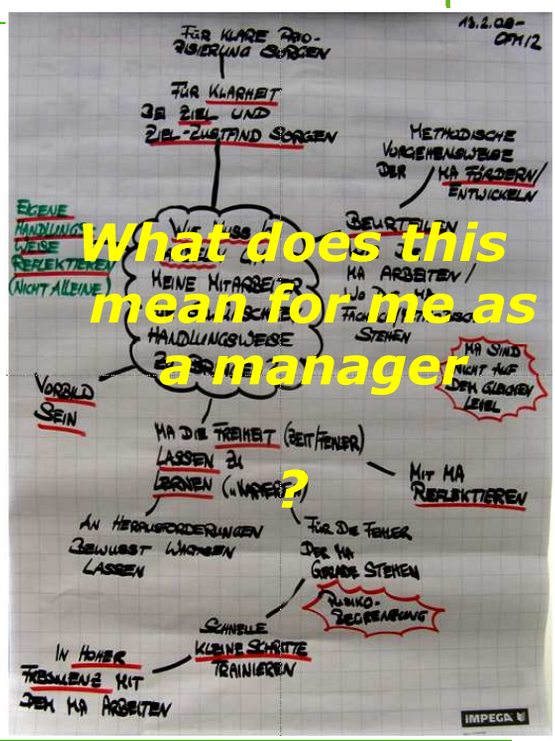
Regular coachings by the manager help the hancho to develop his own area



Key questions



How should employees act ?



What does this mean for me as a manager ?

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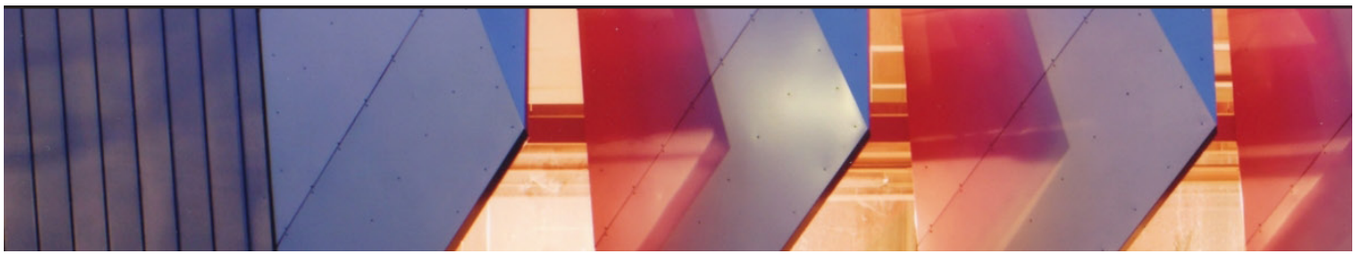
engineering



Block I

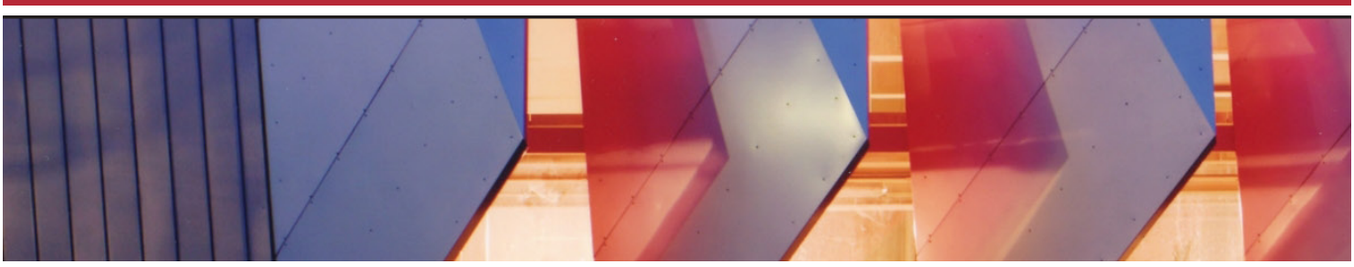
Learning and competence-building as a competitive factor

Block II

Learning factories in operational application

Block III

Leaders as Teachers



Dr. Jens Deuster

Jens Deuster is responsible for the Bosch Production System in the division Diesel Systems of the Bosch group since March 2006. Before this he worked for 4 years as a department manager for technical functions in the Bursa plant, Turkey. In 1997 he started his career at Bosch in the corporate audit department. He studied industrial engineering at the Technical University Darmstadt, Ecole des Mines – Nancy, France and Technical University Berlin. After his studies he did his PhD in economics at the Technical University Berlin. His professional life began as assistant of the executive management and responsible for quality management, internal organization and information technology in 1996 in the Grässle Company, Pfinztal, a small enterprise specialized in machinery for the beverage industry.

Robert Bosch GmbH

The Bosch group (47.3 billion EUR in sales, 283,500 associates in 2010) was founded in 1886 and celebrates its 125th anniversary this year. It has three business sectors: automotive technology, industrial technology and consumer goods & building technology. Diesel Systems is the biggest division of the automotive technology business sector. The sales with third parties of Bosch Diesel Systems were 7,572 billion EUR in 2010. Bosch Diesel Systems is the worldwide Number 1 in Diesel technology. In 1927 Bosch Diesel Systems was the first to start series production of Diesel injection components – the breakthrough for Diesel road vehicles. In 1997 Bosch Diesel Systems introduced the first passenger car Common Rail System worldwide which is today the standard in nearly all modern Diesel vehicles. Bosch Diesel Systems has 35 production, development & application locations in 19 countries around the world. About 54,000 employees are working exclusively in the Diesel sector.

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Technik fürs Leben

Integrated concept of skill for the Bosch Production System

Dr. Jens Deuster


Conference on Learning Factories: May 19th, 2011
Clean. Efficient. Diesel!
We shape the future of diesel.
Dr. Jens Deuster
Head of the Bosch Production System at Diesel Systems
Integrated Concept of Skill for the Bosch Production System (BPS)
125 Bosch 1886–2011
1
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Clean. Efficient. Diesel!
We shape the future of diesel.
1 Bosch Group & Diesel Systems
2 General Conditions for a Skill Concept
3 Integrated BPS Qualification Concept
4 Implementation in a Value Stream
5 Outlook & Summary
125 Bosch 1886–2011
2
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Structure of the Bosch Group

Bosch-Group*
Sales: 47.3 billion EUR
Associates: 283,507

Automotive Technology
Sales: 28.1 billion EUR
Share of Sales: 60%

Industrial Technology
Sales: 6.7 billion EUR
Share of Sales: 14%

Consumer Goods and Building Technology
Sales: 12.5 billion EUR
Share of Sales: 26%

* all figures as of 2010

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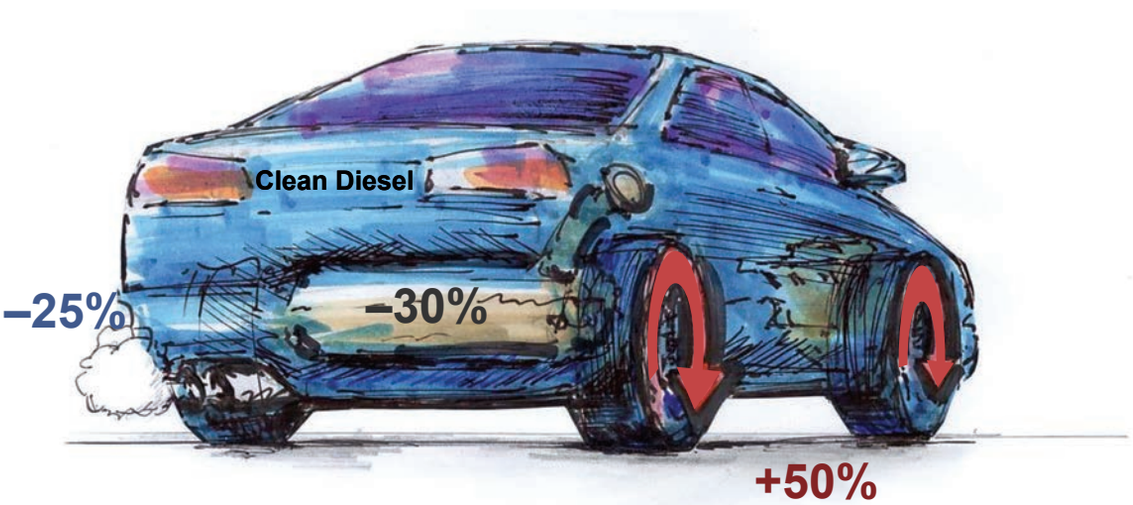
Key Figures: Bosch Group & Diesel Systems

Bosch-Group	2009	2010
Total Sales Revenue	**38,174**	**47,259**
Percentage Share generated outside Germany	76	77
Associates (as per 01/01 of the respective following year)	**270,687**	**283,507**
Percentage Share outside Germany	59	60
Capital Expenditure	**1,892**	**2,379**
Research & Development Cost	**3,603**	**3,810**
Profit after Tax	**-1,214**	**2,489**

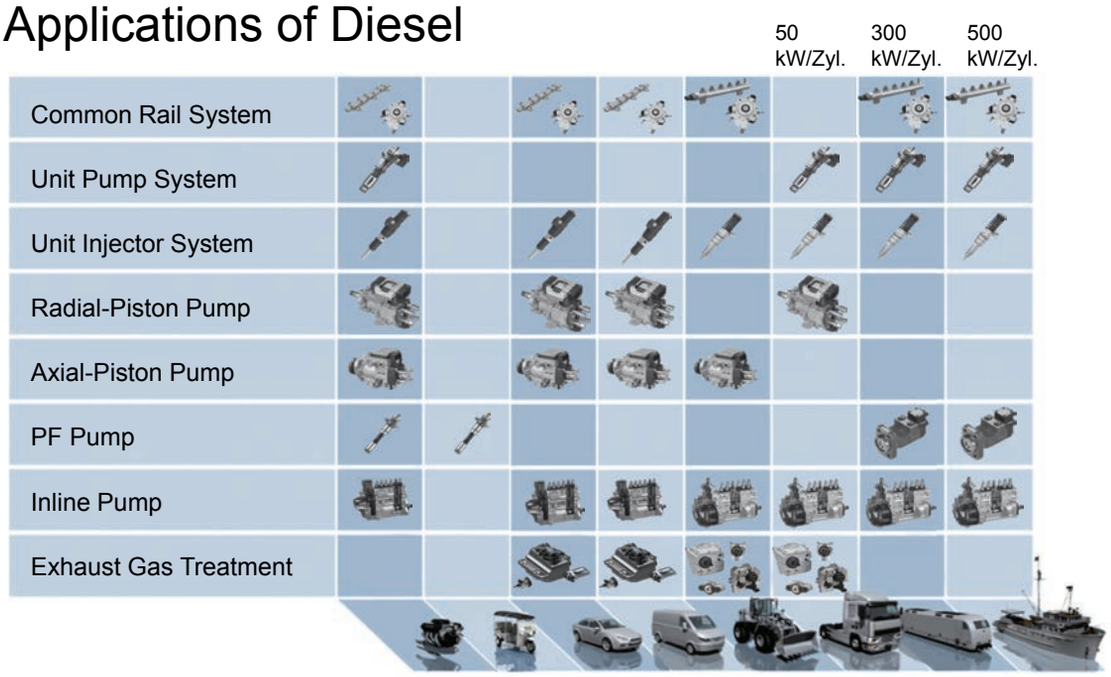
Diesel Systems		
Sales with third Parties	**5,347**	**7,572**
Associates (as year average)	**51,788**	**52,240**

Arguments pro Diesel



- ⇨ 30% less fuel consumption
- ⇨ 25% less CO_2 emission ... than comparable gasoline engines
- ⇨ 50% higher torque

Applications of Diesel



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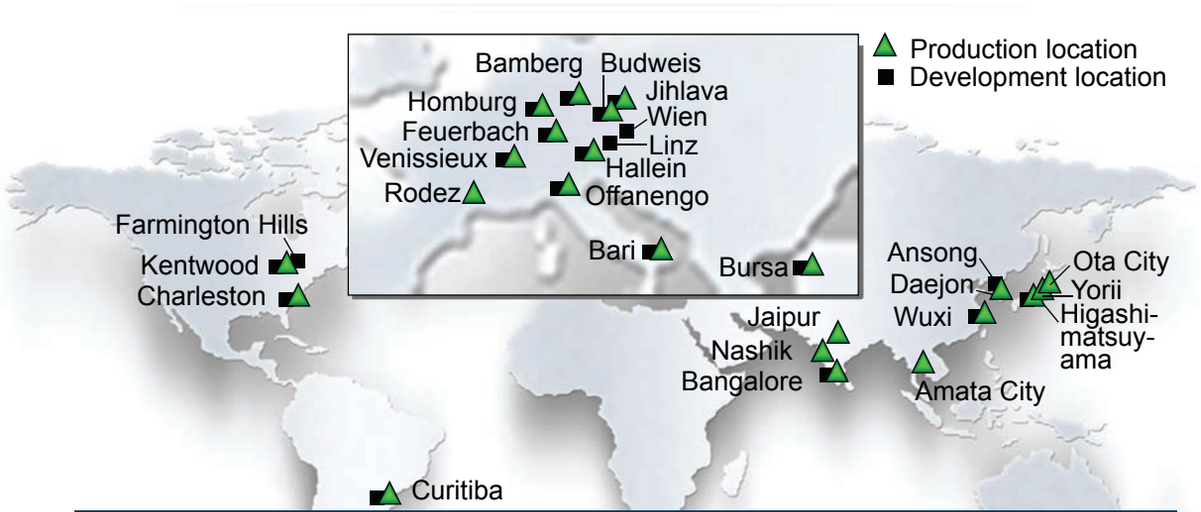
Diesel Systems: International Network



⇨ 35 Production, Development & Application Locations and 69 Value Streams in 19 Countries
⇨ Worldwide around 54,000 Associates

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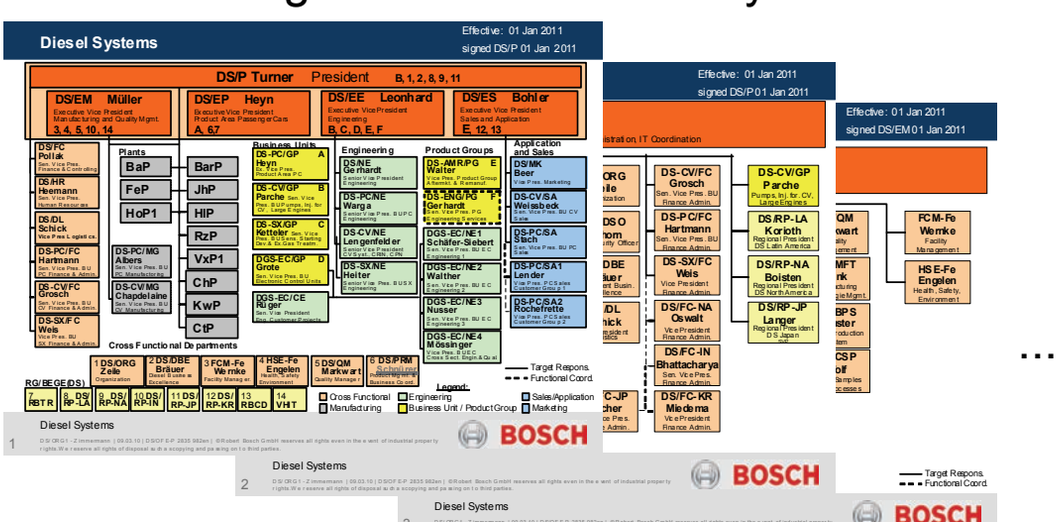
Functional Organization & Hierarchy Levels



⇨ The Bosch Production System is a change initiative:
Thus it has to incorporate all functions and hierachy levels.

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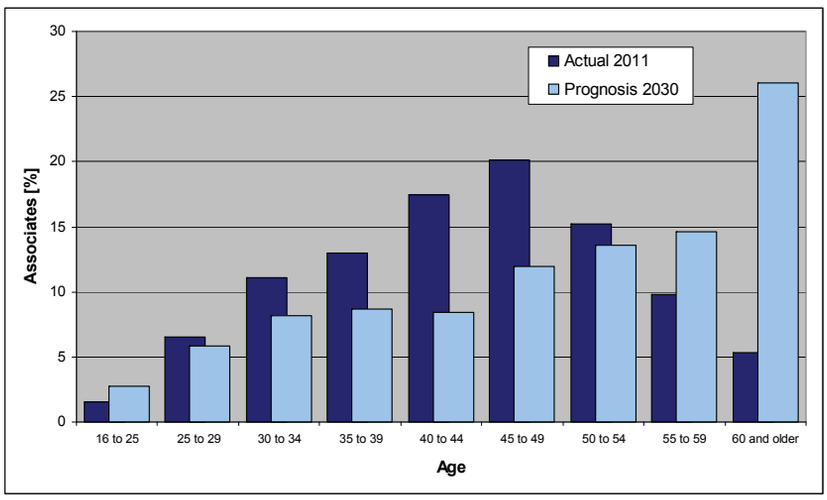
Demographic Change at Bosch



⇨ The average age of an Bosch associate in Germany will increase from today's 43 to 49 years in 2030.

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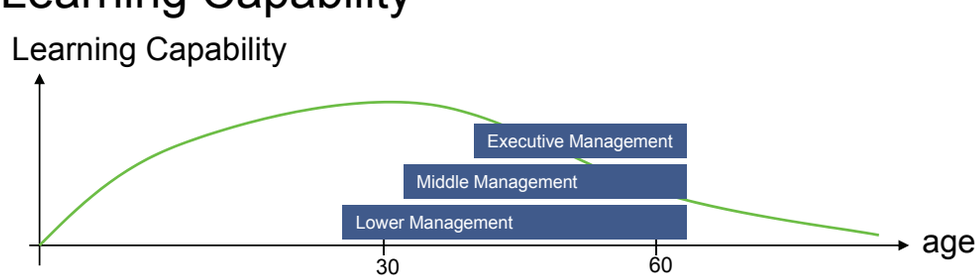
Learning Capability



- The peak of the learning capability is achieved at the age of 30 years, afterwards it decreases continually.
- At the age of 60 years you have the learning capability of a 14-years-old girl, at the age of 65 years of a 10-years old boy.
- But there is hope: Young people must save new information for learning, elder people can use their memory for learning.

⇨ Elder people learn by linking old and new knowledge and by associations. A skill concept has to focus on this due to the age pyramid in a company.

Requirements to a skill concept

A skill concept has to be ...

- standardized internationally despite intercultural diversity in order to ensure a common understanding.
- mandatory in order to focus the management attention.
- common to all functions and hierarchy levels in order to drive the entire organization towards the “true north”.
- value stream and “go to gemba” oriented in order to link the common understanding to the daily work of the associates.
- focused on implementation in order to motivate the associates by successful examples.
- evolutionary as people learn via small steps.
- linked to the experience of the company in order to convince also the elder associates.

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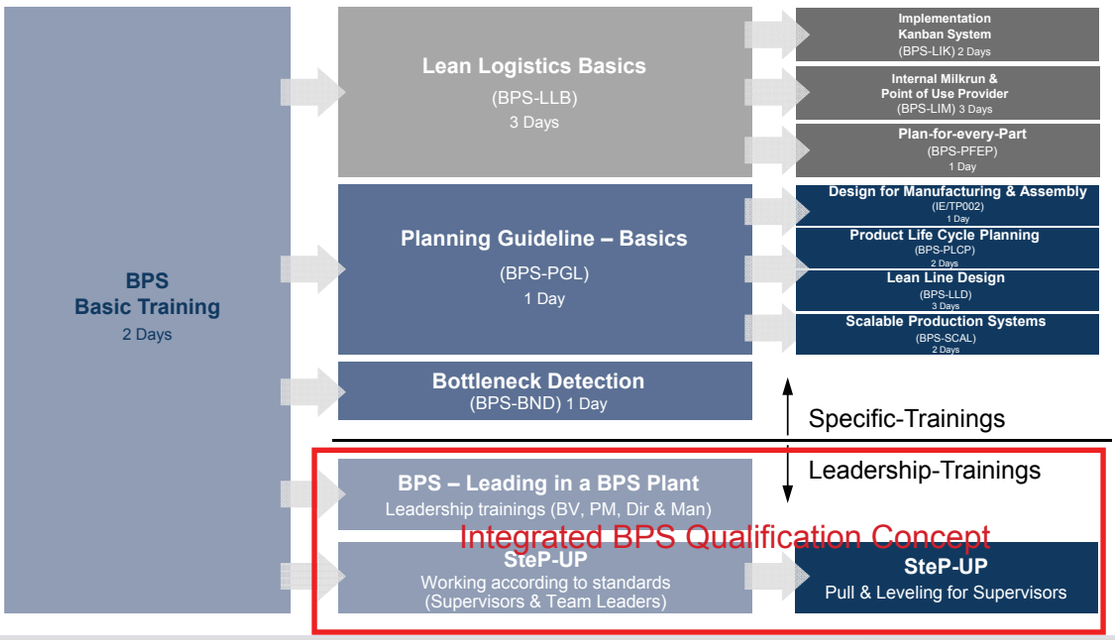
BPS–Qualification via Trainings



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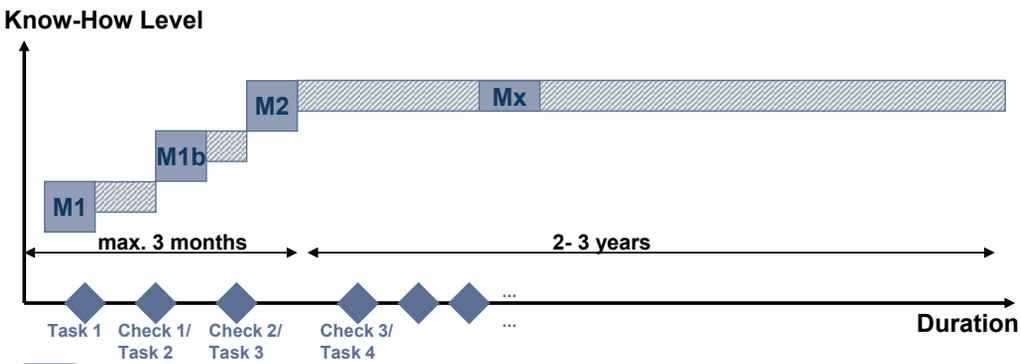
Integrated Concept: Leading in a BPS Plant

Qualification Measure	Content
BV 1 day — Review improvement of Value Stream development	How can I prove and drive the progress of value stream development in the plants?
PM 3 days — Set frame conditions, derives key topics	How do I derive areas of activities out of the business case? How do I develop my value stream managers?
Director, Manager Module 1: 3 days; Module1b: 1 day; Module 2: 3 days; Derives target conditions	How do I develop my value stream target oriented? How are result and process KPI's linked?
Planner Planning Guideline: 1 day; Working acc. to Standards: 2 days; Pull+Leveling: 2 days	How do I plan a non-ambiguous system? How do I define target conditions and its validation?
Supervisor Working acc. to Standards: 3 days; Pull+Leveling: 2 days; Shop Floor Management Cycle: 2 days; Achieves target conditions	What is my part in deriving target conditions? How do I achieve target conditions step by step?
Teamleader Working acc. to Standards: 3 days; Shop Floor Management Cycle: 2 days; Ensures working acc. to standards, drives improvement on shop floor	How can I assure the compliance of standards? How do I recognize deviations? How do I react?
Operator Working acc. to Standards: 4 h; Works according to standard, indicates deviations	Why do I do standardized work? What is my re-action if I can not work per described standard?

SteP-up

Value Stream oriented Approach



M1 Training-Module 1: Improvable System

Mx Additional Training-Module if required

M1b Training-Module 1b: Shop Floor Management Cycle

M2 Training-Module 2: Value Stream Exercise

Transfer- / Coaching phase with concrete transfer tasks

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Tracking of the Qualification Concept

	Total head count	BPS100	Leading in a BPS Plant	Step Up Stand. Work	Step Up Pull & Lev.	Operator	LLB
BV	5	3	5				
BU/DS Support*	22	7	21				
PM	44	41	39				
Dep. Head	674	534	216				97
2nd level of Leadership	1.304	1.072		376	40		
1st level of Leadership	2.404			605			
Operator	30.360					190	

Colour Code: **Red** <60%, **Orange** <90%, **Green** ≥90% Coverage

not mandatory Status as of 06.2010

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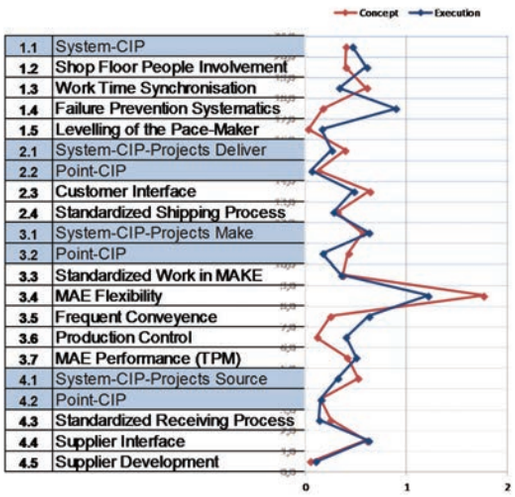
New BPS Assessment: Part of the Concept



The new BPS Assessment ...

- serves as success control of the training modules.
- is a training module.
- is used to clarify open questions and to train the people in “Go & See”.
- is focused on asking the right questions.

⇨ The new BPS Assessment is used as part of the integrated qualification concept. Coached by BPS experts the value stream core team assesses by itself the maturity of its own value stream.

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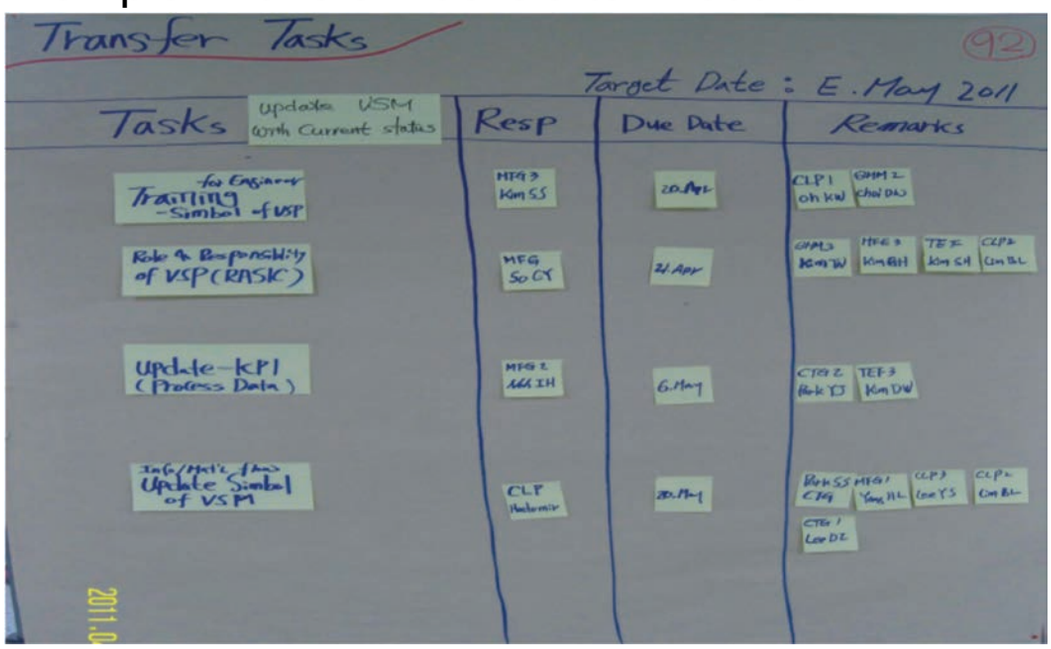
Example: Transfer Tasks after Module 1



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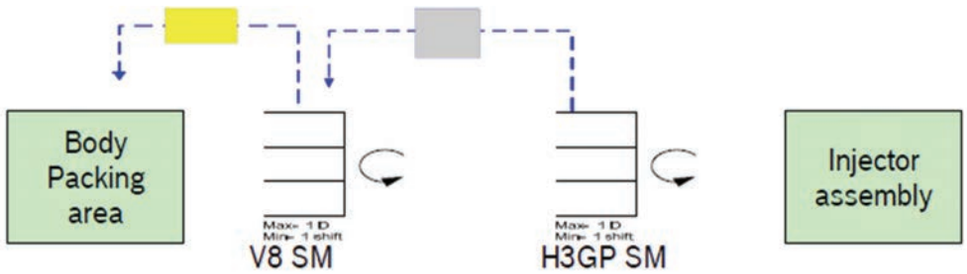
Example: Transfer Tasks after Module 2

Transfer Tasks : (Status 31.08.2010)

- Decoupling of the Body and Assembly value stream .
- OEE improvement on Chirons. (from 65 to 77%)
- OEE improvements on ECM (from 55 to 60 %)
- OEE improvement on A/F milling machine (from 70 to 80% ??)
- OEE Implementation on Local MAE : all machine (from 68% to 75%)

Example: Decoupling of Assembly from CKD



1. SM will be in assembly inwards stores (H3GP)
2. Direct movement of parts from V8 to H3GP
3. Paper movement from V8 to H3GP to assembly
4. Communication between V8 SM to H3GP SM via transport KANBAN
5. Replenishment of V8 SM to by injector body via production KANBAN

Note:- Due to space constraint in assembly cleaning area, SM is considered in H3GP area.

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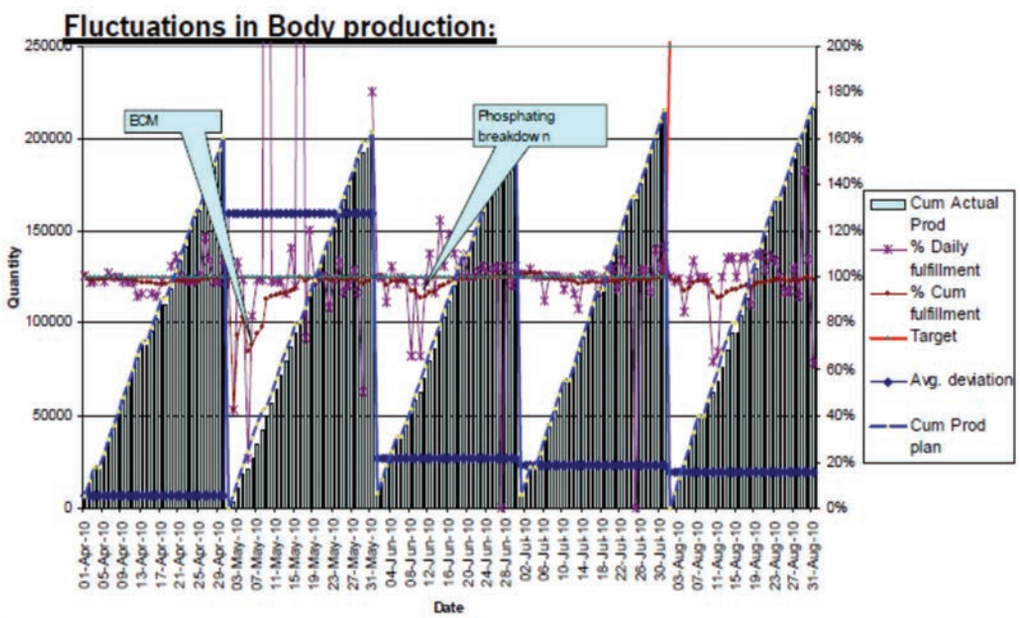
Example: Decoupling of Assembly from CKD



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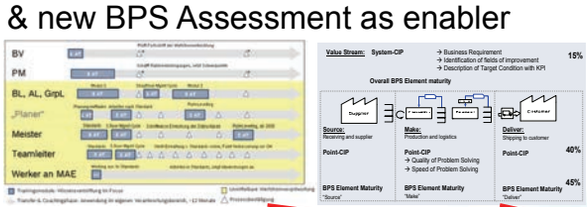
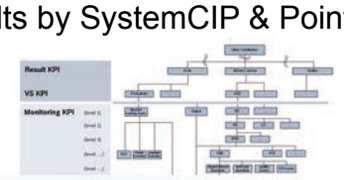
Continuous Learning as Enabler

- BPS as integrative part and driver towards Diesel Business Excellence following the EFQM model

BPS integrated qualification concept & new BPS Assessment as enabler



Continuous improvement of results by SystemCIP & PointCIP



DS specific qualification:
- PM qualification days: leveling, PGL, LLD, etc.
- Operators via Shop floor CIP
- Shop floor management cycle for all leaders

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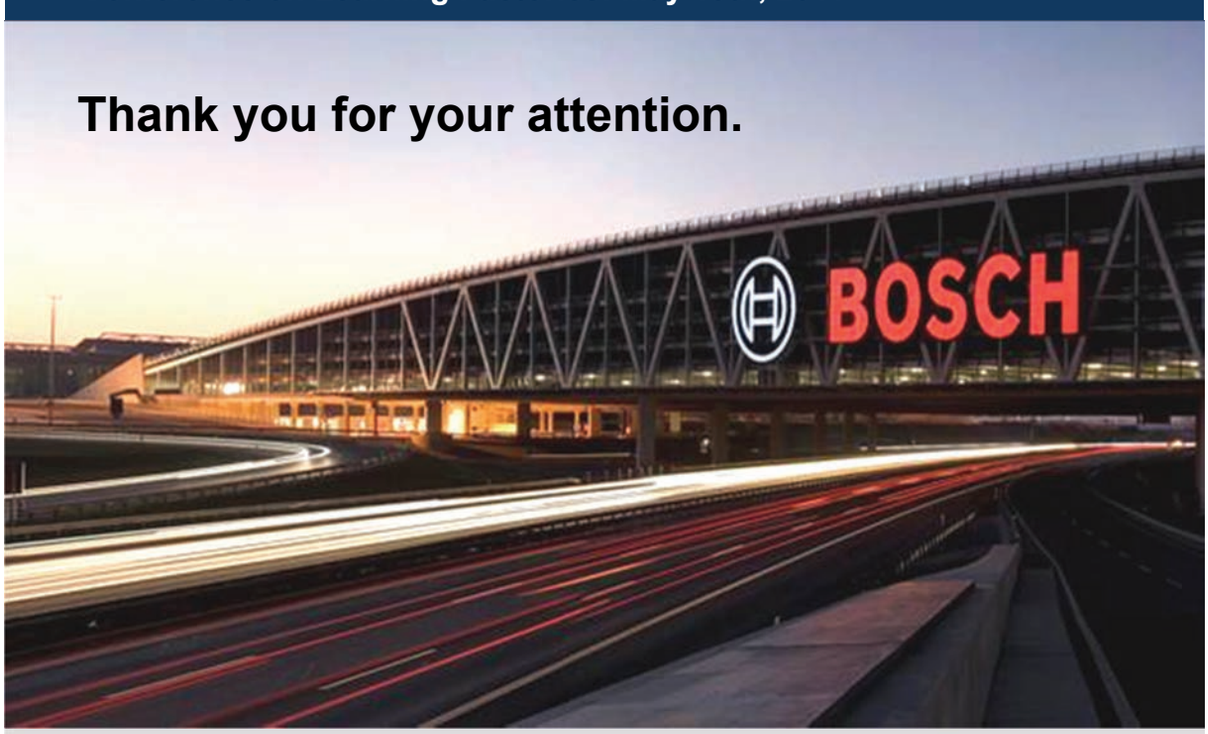
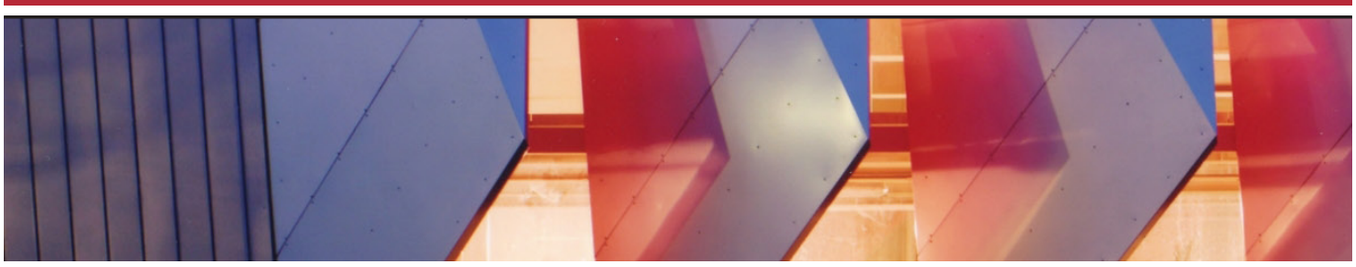
Key Messages

- Trainings may be abused frequently as distraction from daily business life.
- A successful qualification concept must include the implementation of the lessons learned as “success control”.
- Therefore the qualification measure should take place in the environment of the trainees.
- The smaller and the more often the qualification and implementation steps are planned the faster success can be achieved.
- The qualification concept should be standardized, the implementation should be individualized.

Conference on Learning Factories: May 19th, 2011

Thank you for your attention.





Frank Krause

Frank Krause as Director of Competence Development is responsible for the further professional development of Staufen AG. After university, he worked as a production management assistant for ZF Getriebe GmbH; as project manager, he started the KAIZEN initiative. As Senior Associate for Porsche Consulting GmbH, he supported companies on the road to BestPractice. At Robert Bosch, he was responsible for the Lean Enterprise sector and the global implementation of the Bosch production system. At Staufen AG, his main area of competence is coaching executives in lean thinking.

STAUFEN AG

The internationally active Staufen AG has established itself on the German market in the top tier of Lean Management consultancies. As a 'partner on the path to peak performance', our defined target is to implement the speedy and sustainable optimisation of value creation processes. We provide support in the establishment of a lean leadership culture, a lean system and the creation of an individual improvement organisation. In addition, our consultants develop tailor-made concepts to cope with crisis situations: as turnaround or interim managers, they are able to realise increases in profit and efficiency within specific sectors or company-wide restructuring. Working with well-known companies, medium-sized businesses and large corporations such as MAN, Voith or SEW-EURODRIVE, Staufen AG has outstanding references in all key sectors. A total of 100 employees in Germany and in offices in Switzerland, Italy, Poland and China provide on-site support to customers through consultation and assistance with practical implementation as well as training and qualification.

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Challenge leadership – Coaching as leadership concept in lean production

Frank Krause

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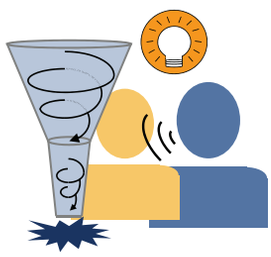
Management and leadership in the training organisation

The renunciation of MBO as illustrated by the example of Toyota



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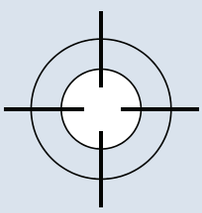
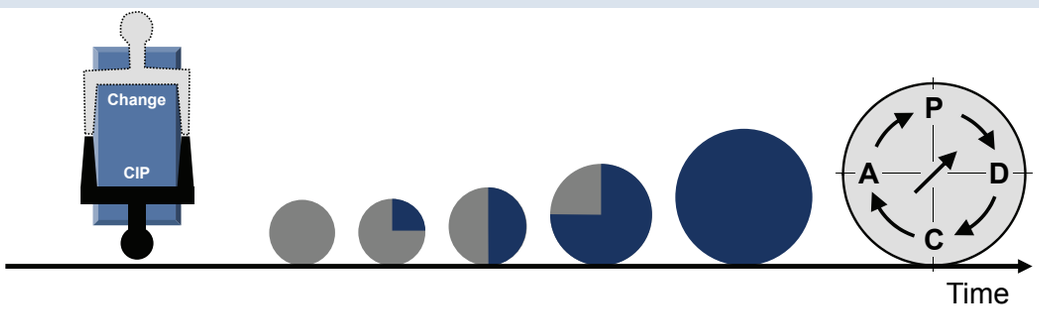
What is the purpose of this presentation?



The aim of this presentation is to explain leadership behaviour which can increase employees' ability to solve problems. The example used is that of Toyota. Target setting, target development and target agreement = MBO is supplemented by instruction on how to achieve these targets. The mentor supports the mentee in finding solutions to problems => Management by Process Improvement (MBI).



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Keynote lecture: Management and leadership in the training organisation

Toyota – “Respect for people”

Management and leadership

- Historical development
- Management and leadership tasks
- Leadership principles and styles

Leadership at Toyota

- „Management by process improvement (MBI)
- Target setting versus target state description
- Enabling learning by mentoring

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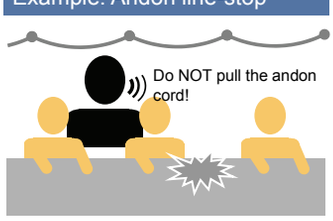
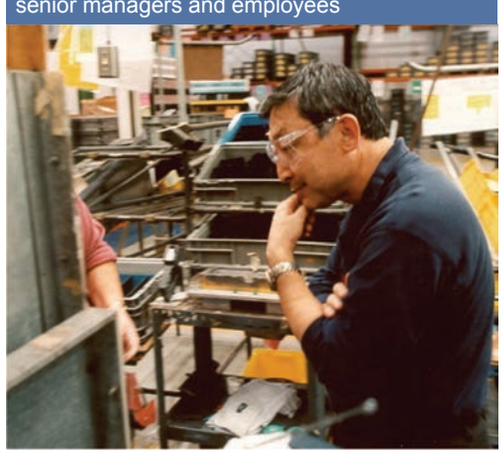
One important element has frequently been overlooked in the adaptation of "Lean World" methods and tools – leadership performance.

Original	Incomplete copy	What has been overlooked:
	Example: Info centre  Example: Andon line-stop 	Manner and nature of co-operation between senior managers and employees 

Details of leadership processes at Toyota have only been described since 2001 - but they have been effective throughout.

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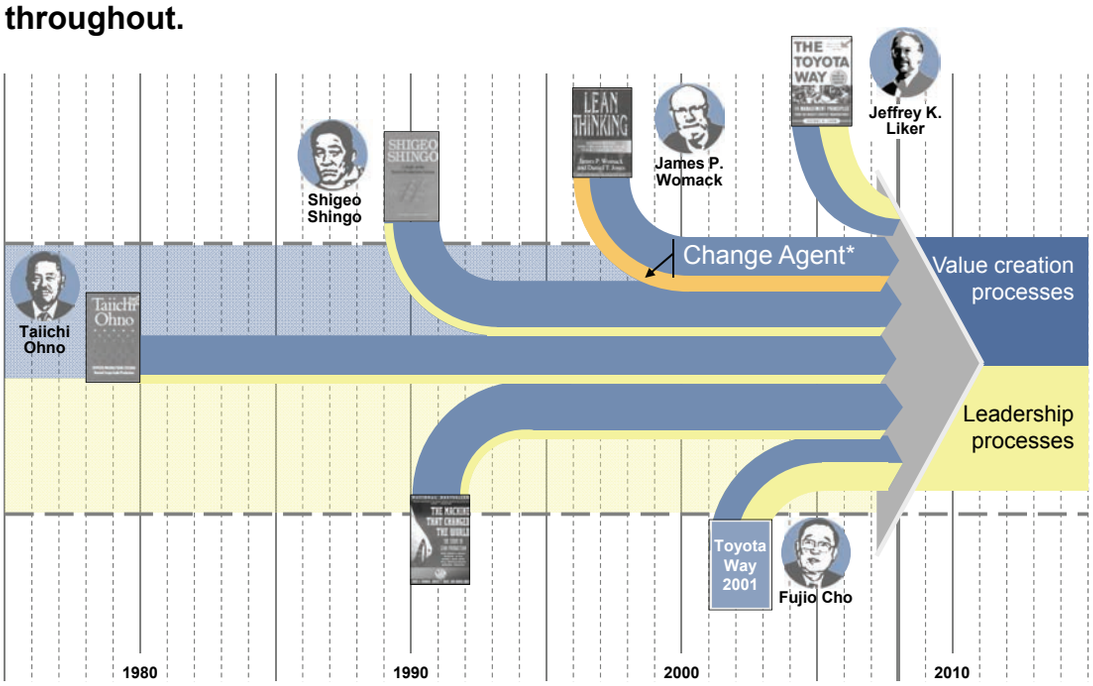

*Change agent: senior manager authorised to implement the lean transformation process

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Management and leadership theories have their - frequently less reflected - roots in a particular concept of human nature.

Concept of human nature	Organisational consequences
Rational-economic man	
▪ Primarily motivated by monetary incentives; passive; manipulated, motivated and controlled by the organisation; acts rationally.	▪ Classic management functions: planning, organising, motivating, controlling; the main focus is on the organisation and its efficiency. The task of the organisation is to neutralise and control irrational behaviour.
Social man	
▪ Primarily motivated by social needs; driven by the meaningless of the work to look for satisfaction in social relationships at the workplace; more controlled by the social norms of his/her workgroup than by checks and incentives of his/her superiors; assumptions of the Human-Relations movement.	▪ Development and support of groups; social recognition of employees by managers and the group; the need for recognition, a feeling of belonging and identity has to be satisfied; group incentive systems take the place of individual incentives.

Reference: Betriebshütte Management & Produktion Edgar Schein

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Management and leadership theories have their - frequently less reflected - roots in a particular concept of human nature.

Concept of human nature	Organisational consequences
Self-actualising man	
▪ Human needs can be ordered in a hierarchy; humans strive for autonomy and prefer self-motivation and self-control; there is no inevitable conflict between self-realisation and the achievement of organisational targets.	▪ Managers support and promote (not motivate and control); delegation of decisions; transition from extrinsic motivation to intrinsic motivation; codetermination at the workplace.
Complex man	
▪ Extremely adaptable; the urgency of individual needs is subject to change; is able to learn and acquire new motives; different motives matter in different situations; assumptions of the situational theory of leadership.	▪ Managers diagnose situations; they have to be able to recognise differences and vary their actions in accordance with specific situations; there is no "one size fits all" correct organisation.

Reference: Betriebshütte Management & Produktion Edgar Schein

Management and leadership in the training organisation k_EN.ppt
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If you want to lead, you need to know exactly what drives your employees.

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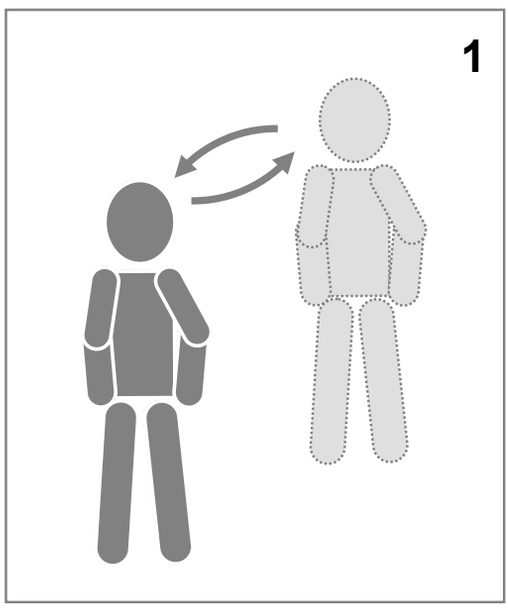
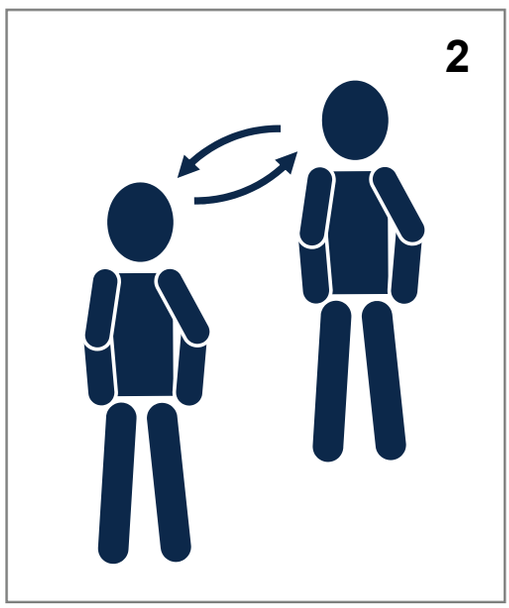
Leadership of staff requires the leader to be organised and controlled himself/herself.





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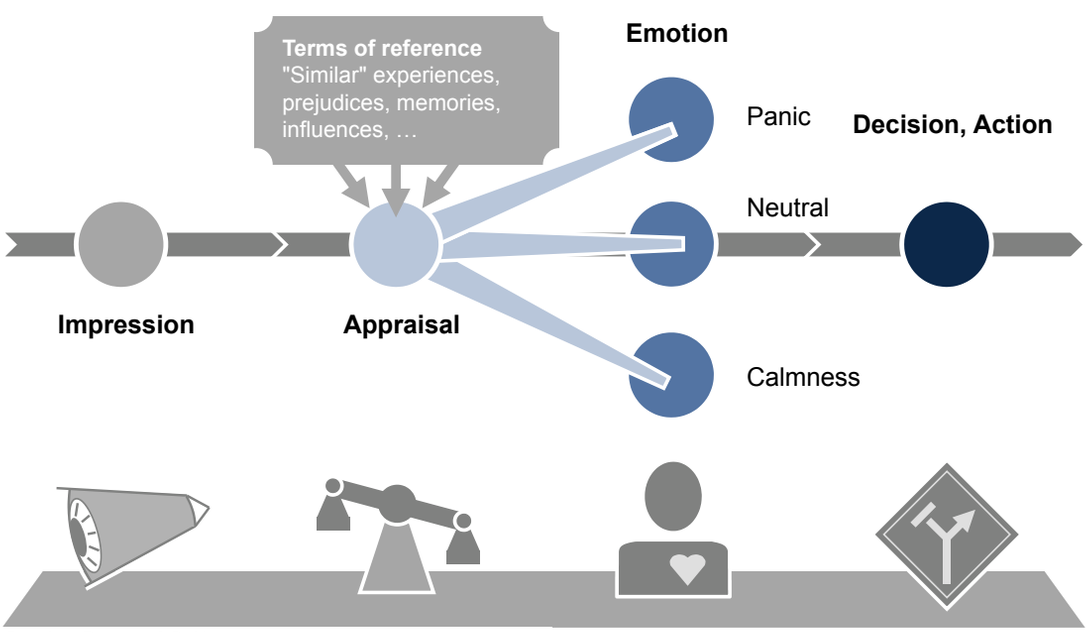
Understanding one's own patterns of behaviour is the vital first step to influencing them.



Based on: Roseman & Smith

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Management tasks and leadership tasks are often confused.

The 6 fundamental management tasks

Selecting staff
Employing, training, assessing, sanctioning, rewarding.

Analysing & Decision making
Analysing facts consistently, searching for root causes, recognising fundamental connections, drawing conclusions.

Planning
Developing fundamental principles, devising vision-mission strategies.

Delegating
Instructing and delegating tasks, in writing or orally.

Organising the company structure
Reporting, authorisations, competences, responsibilities.

Controlling
Monitoring whether company functions are being performed correctly.

Leadership qualities are not the focus of any of these tasks.

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Leadership takes place in the interaction between superiors and staff.

The 6 fundamental leadership tasks

Dealing with problems
Hands-on leadership "Go&See“, efficient consensus building, practice- and target-oriented

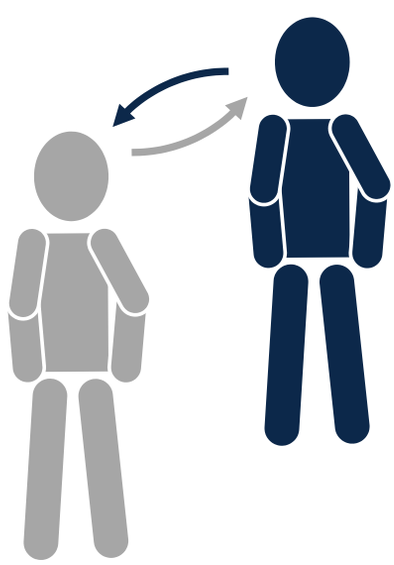
Agreeing targets
Participatory, ambitious, focused

Promoting
Foster competences, mentoring, providing perspectives and development opportunities.

Informing
Open, convinced, honest; agreement between words and actions

Recognising demotivation
Creating trust, encouraging, inspiring

Controlling
Checking whether a member of staff has all the skills to perform a given task.



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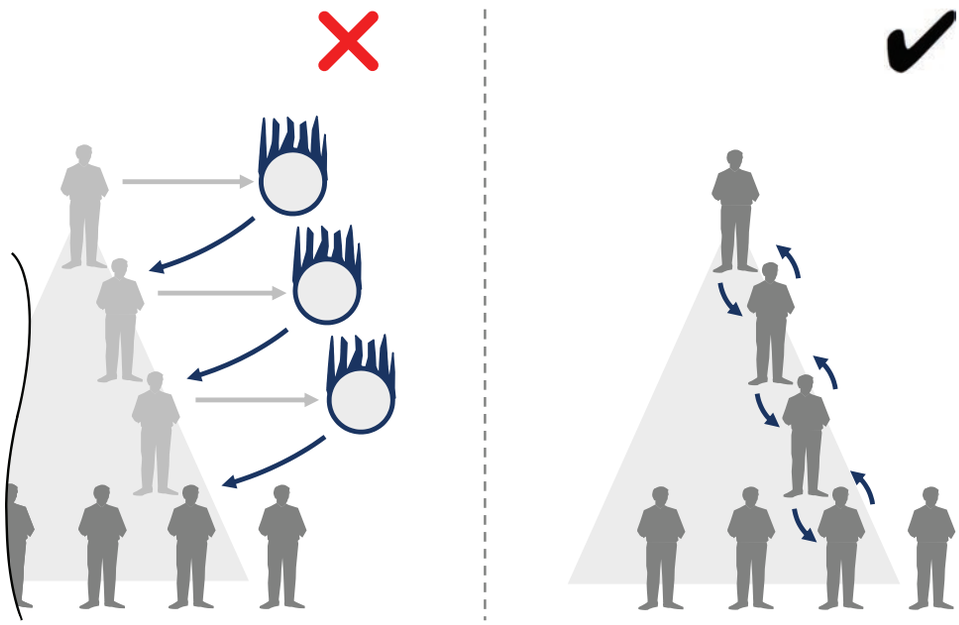
The leadership task of motivation cannot be delegated to an external motivator.



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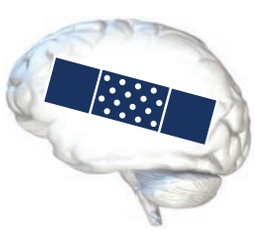
It can be assumed that a psychologically and socially healthy person does not require external motivation.

Healthy person

Naturally self-motivated

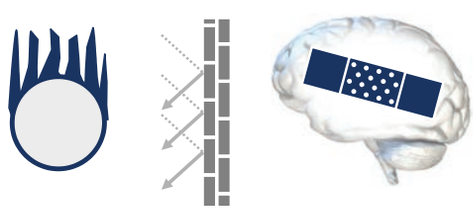
Does not require an external source of motivation

Unhealthy person



Naturally demotivated

Demotivation cannot be made up for by external motivation



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Keynote lecture: Management and leadership in the training organisation

Toyota – "Respect for people"

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- Historical development
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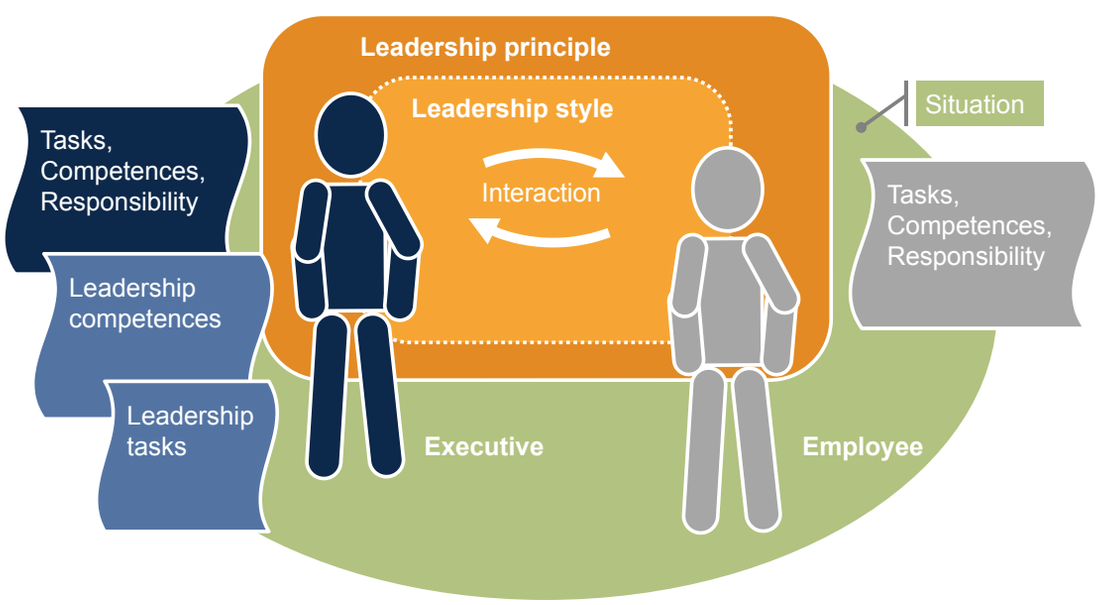
Key terms:



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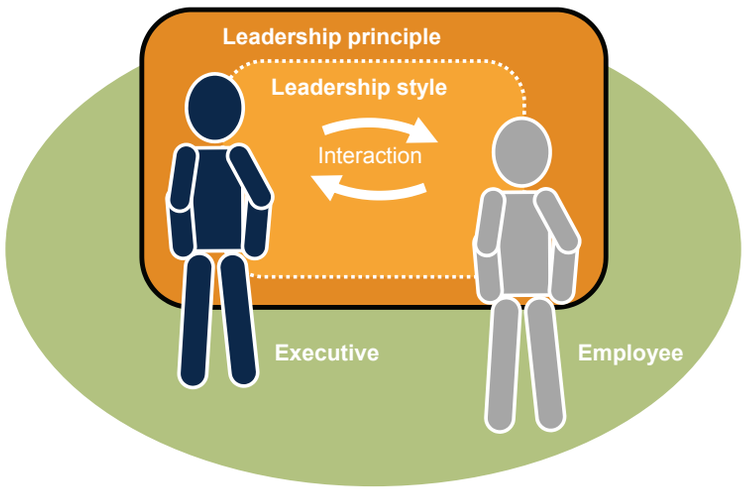
Key terms:

Leadership principle (Management by…):
Which aspect of my member of staff's work do I want to influence?

e.g.:
…his/her targets (management by objectives)

… his/her targets (management by delegation)



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Examples of leadership principles that don't deserve the tag, but unfortunately are much too common.

Helicopter management:

Hovering above everything, touching ground from time to time, creating a lot of dust and then once more disappearing into the air.

Ping-Pong management:

Passing each problem back and fore or on, until it has solved itself.

Mushroom management:

Keeping staff in the dark and covering them with manure; when they show their heads, cutting them off straightaway.

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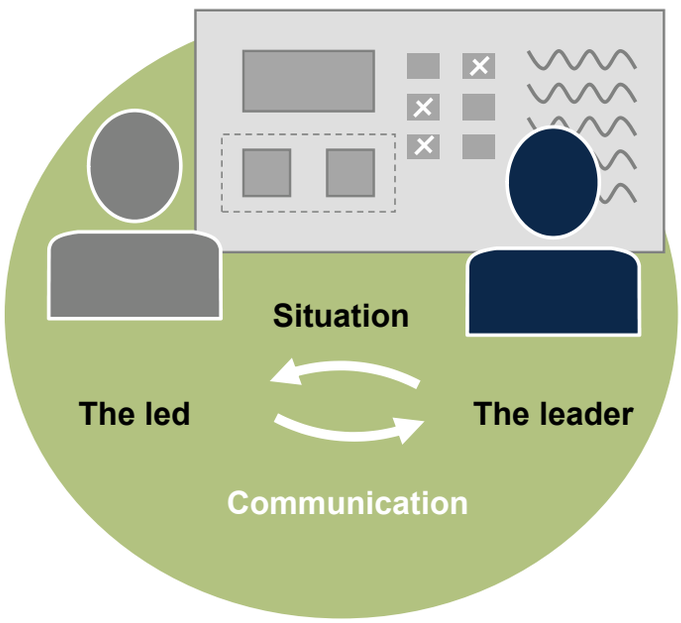
Different settings require different leadership styles.

The most appropriate leadership style depends on the nature of ....

- **… the leader**
  e.g. moral concepts, personality traits
- **… the led**
  e.g. competence, commitment
- **… the situation**
  e.g. the kind of organisation, the nature of the problem
- **… the communication**
  e.g. face-to-face, in writing or by actions



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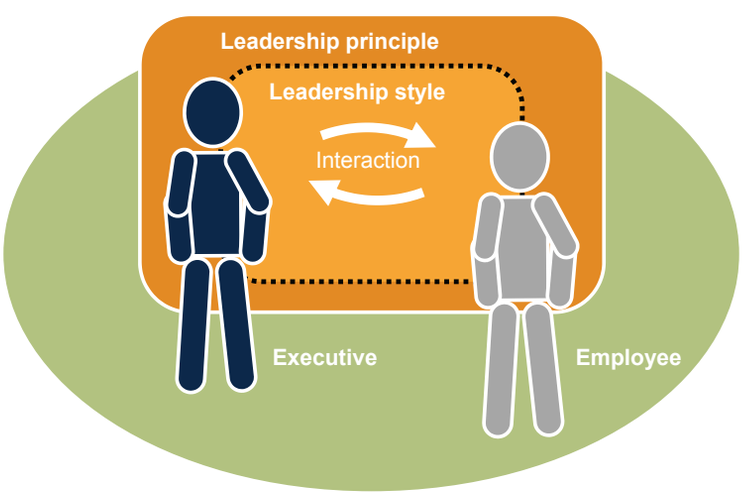
Key terms:

Leadership style:
How do I behave with my member of staff in direct interaction in order to influence his/her work, behaviour etc.?

e.g.:
… like a dictator.

… like a mentor.



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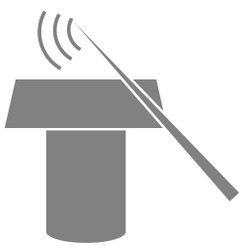
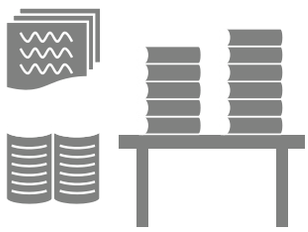
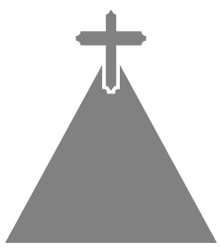
Leadership style is the manner in which a superior treats his employees.

Leadership style		
Authoritarian	**Bureaucratic**	**Patriarchal**
		
"Everyone listens to my command."	"Rules define the framework, others are welcome to do the rest."	"It is fine for me to be authoritarian, because, after all, I look after everyone else. "

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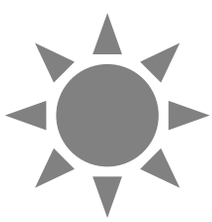
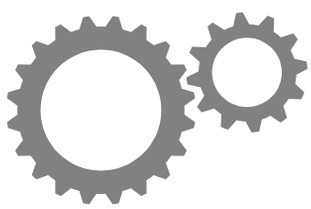
Leadership style is the manner in which a superior treats his employees.

Leadership style		
Caring(laissez-faire)	**Charismatic**	**Co-operative**
		
"The main thing is that people have a sense of well-being in the team."	"I convince others with my charisma and enthusiasm."	"Together we achieve more."

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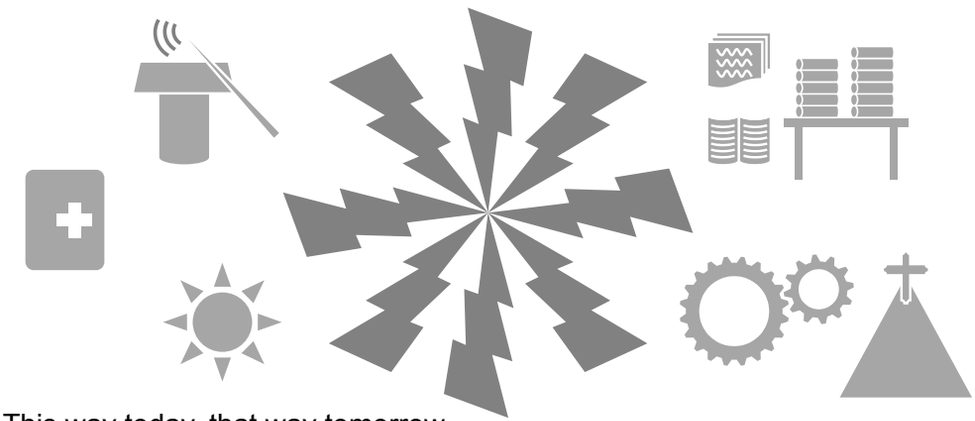
Leadership style is the manner in which a superior treats his employees.

Leadership style

Autocratically (arbitrarily)



This way today, that way tomorrow.
"I don't care what I said yesterday."

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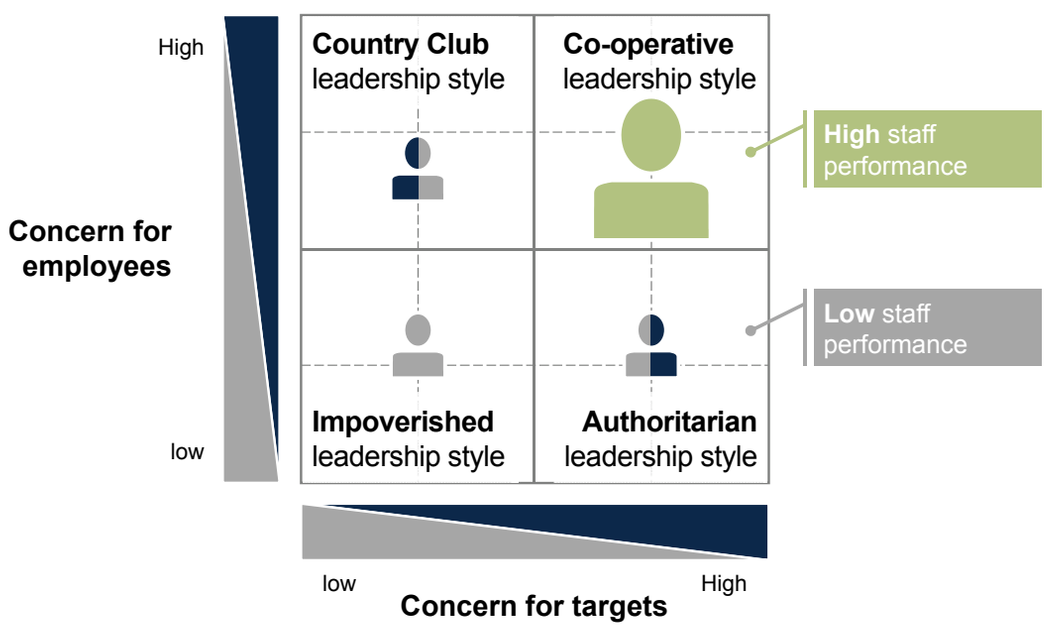
If the concern for people and the concern for production are equally strong, the leadership style is truly co-operative.



Based on: Blake/Mouton

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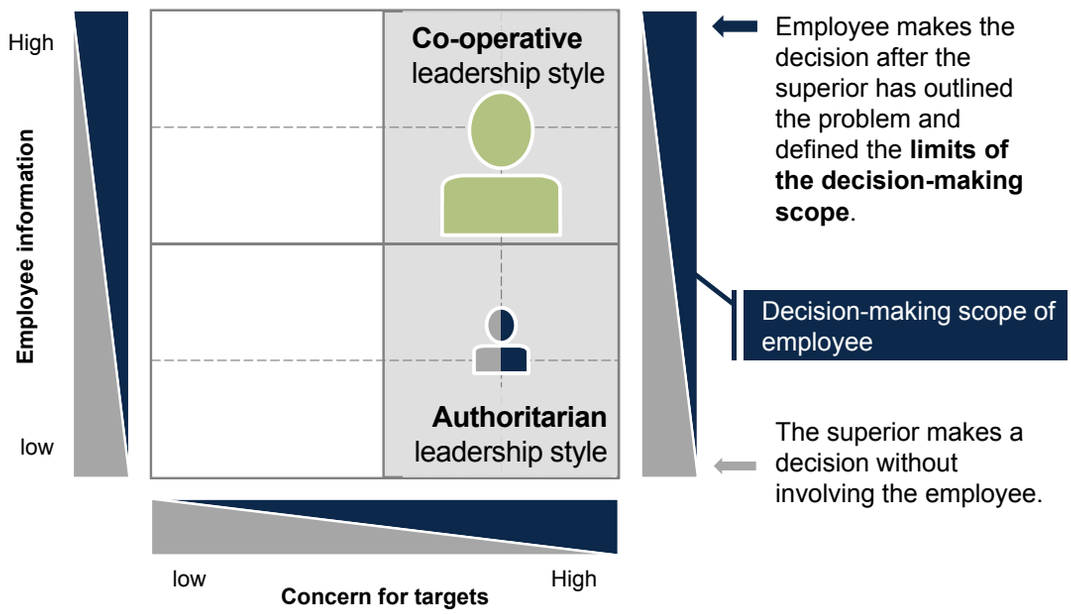
If there is a high focus on targets, the leadership style ranges between authoritarian and co-operative.



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The acceptance of decisions depends on …

…the degree to which those affected have been involved in the decision making process.

…the (expected) impact of the decision on those affected.

…the relationship between decision-makers and those affected.

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Statements by managers which stop staff from collaborating:

"Everyone should see that…“

"We have never given it a try, because most likely it is not going to work."

"It did not work when I tried it last; for that reason, it'll most likely not work now, either. "

"That is no longer the current thinking."

"It will not work as well in practice as the theory looks on paper."

Reference: The New Shopfloor Management, Kiyoshi Suzaki

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The leadership style of the Lean Manager is based on co-operation in accordance with the principle of "Management by process improvement".

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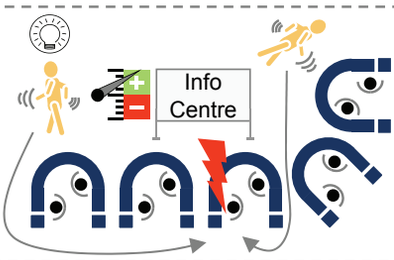
Others
Required for Lean Enterprise

Leadership style		+	Leadership principle	
Patriarchal	Charismatic		**M**anagement **b**y **O**bjectives	**M**anagement **b**y **C**ontrol
Authoritarian	Caring		**M**anagement **b**y **D**elegation	**M**anagement **b**y **E**xception
Bureaucratic	Co-operative (Mentoring)		**„Management by process improvement“**	



The Genchi-Genbutsu principle results in a strong link with reality.

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Approach	Result:	Management style
Personal verification on site (Go-to-genba*)	**Managers are familiar with their processes**	**Management by process improvement (Genchi-Genbutsu)**

Character

Extremely close link with reality

Source: Hans-Jürgen Classen, Andos Innovative Management Systems Ltd.
*Genba: the place where it happens. In conjunction with production systems referring to the place of value creation.

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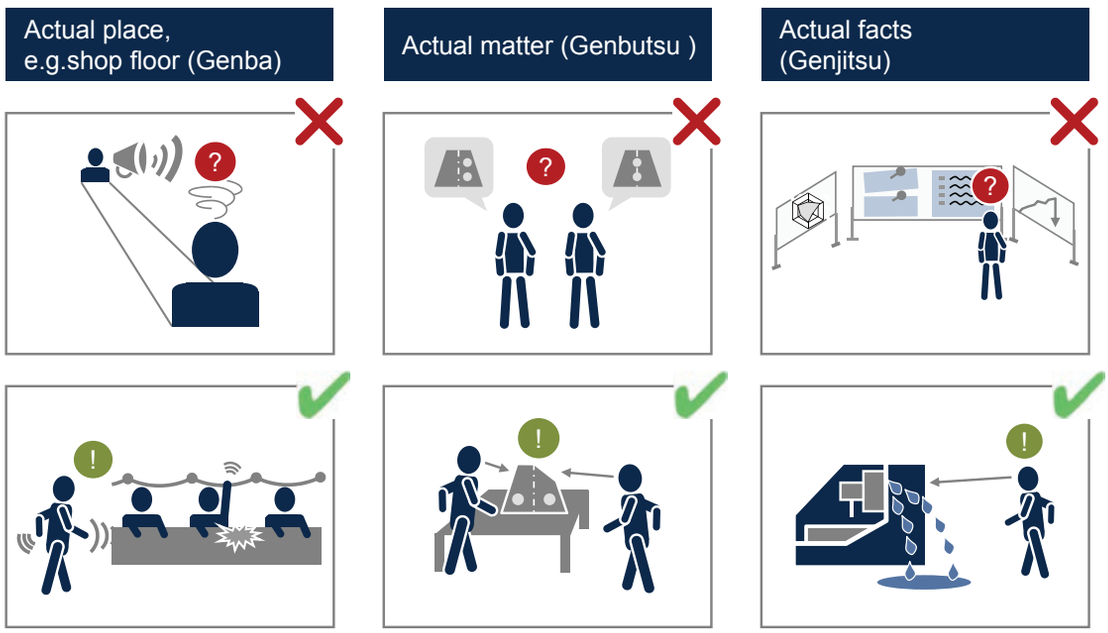
Approach: A Lean Manager relies only on reality.



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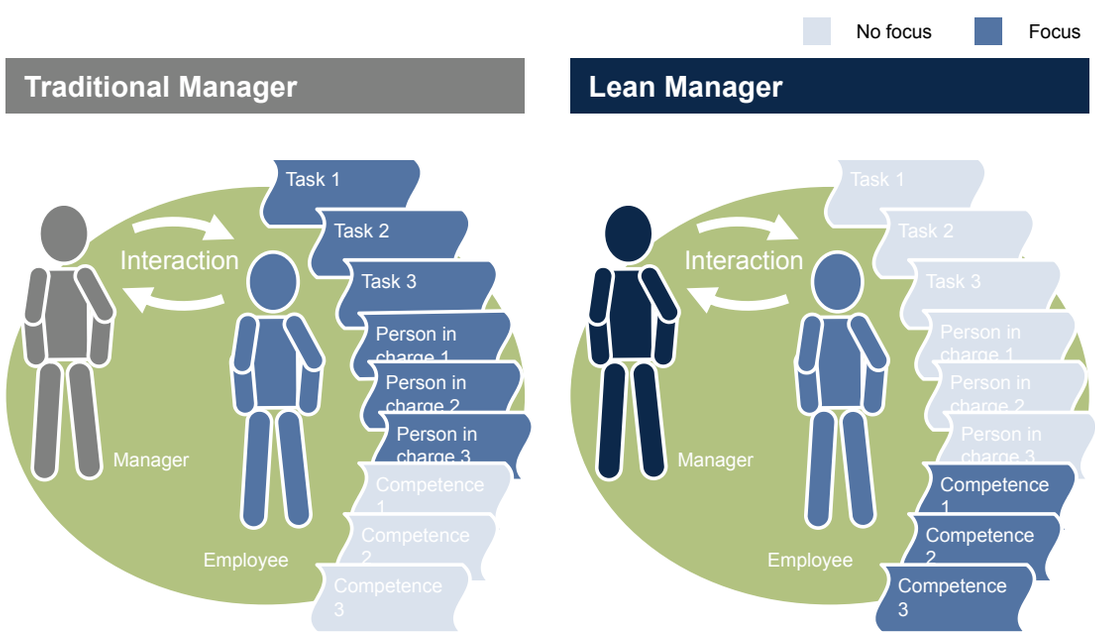
A Lean Manager does not focus on the allocation of tasks, but on the building of competence.



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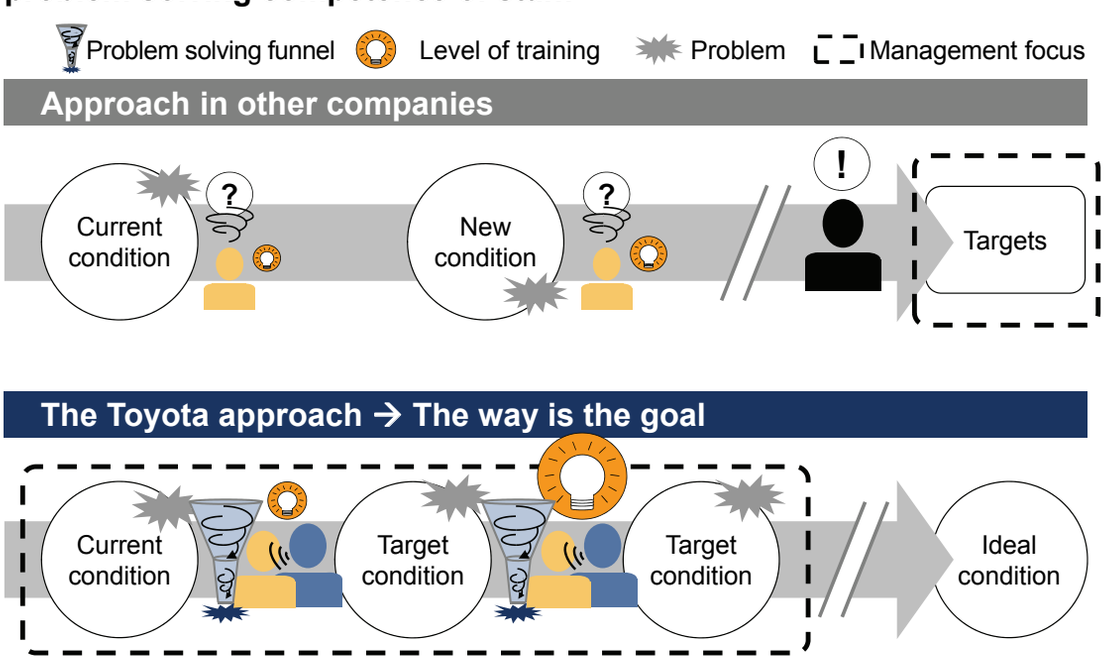
Management at Toyota is focussed on improving the problem solving competence of staff.



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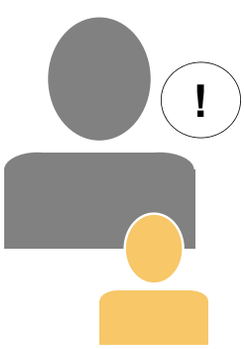
Setting up a lean company requires a very specific style of leadership - the mentor.

"Dictator"	1908s "Empowerment*"	"Mentor"
"You do exactly as I say....."	"Now it's your turn…!“	"Follow me… and let's make sure that we both understand."



*increasing an employee's own responsibility

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"Socratic questions" are used to guide employees towards structured work flows.

Socratic questions	How do you do this job?	How do you know that you are doing the job correctly?	How do you know that the result is free from faults?	What do you do when a problem appears?
PROBLEM				
Prompting the solution	That was bound to happen!	You must surely know that you are doing the job wrongly!	Let me have a go! (I'll show you how it is done)	We need a poka-yoke device!

Based on: Steven Spear, H. Kent Bowen, „Decoding the DNA of the Toyota Production System", Harvard Business Review 1999

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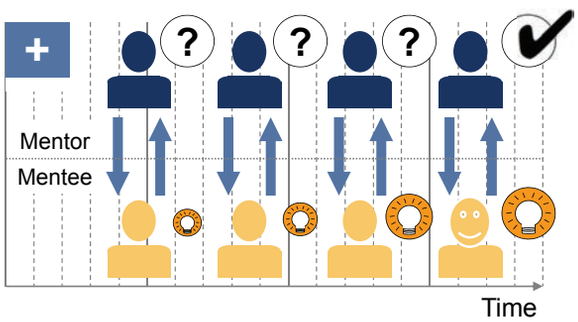
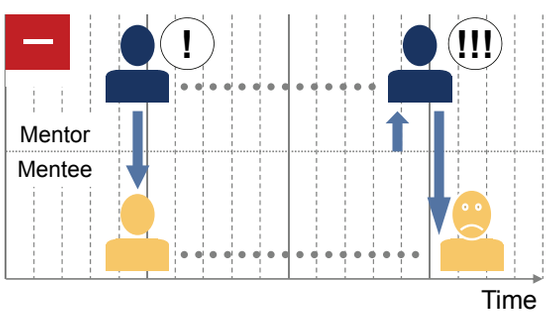
What does the mentor role involve in detail? Frequent feedback loops support the learning process.





Frequent feedback loops

The mentor insists on tight deadlines for the next measure and conducts review meetings (including ad-hoc ones) at the earliest opportunity on location (where the work is done).

Holding weekly review meetings is already too slow.

The Western approach is "Make a plan and implement it"

The Toyota approach is "Make a plan and then keep on adapting your steps to what is actually happening".

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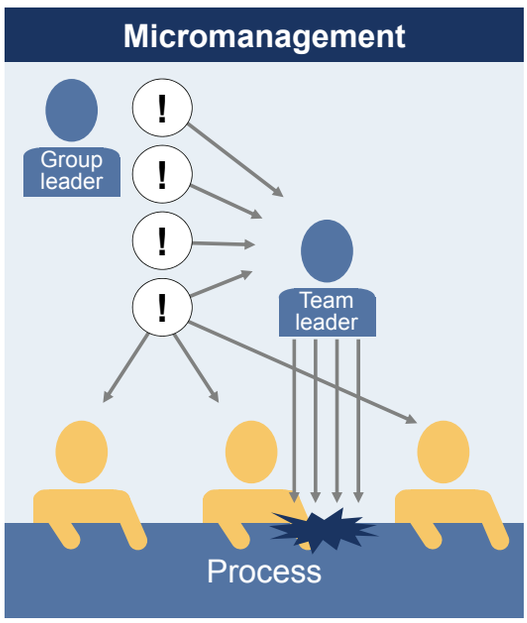
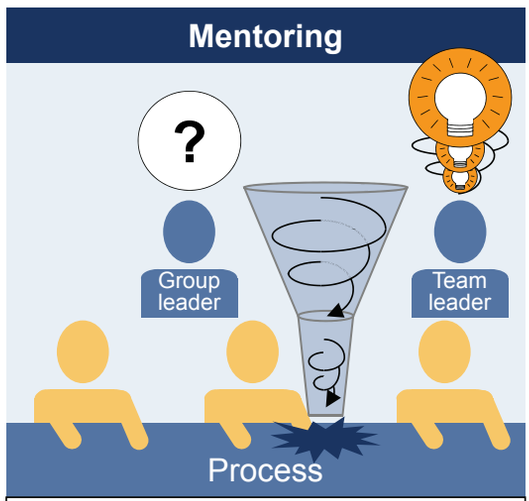
Note: Mentoring is not micromanagement – its purpose is to have the mentee learn the problem solving process "by doing"





"If the solution suggested by the mentee solves the problem adequately, the mentor has to accept it."

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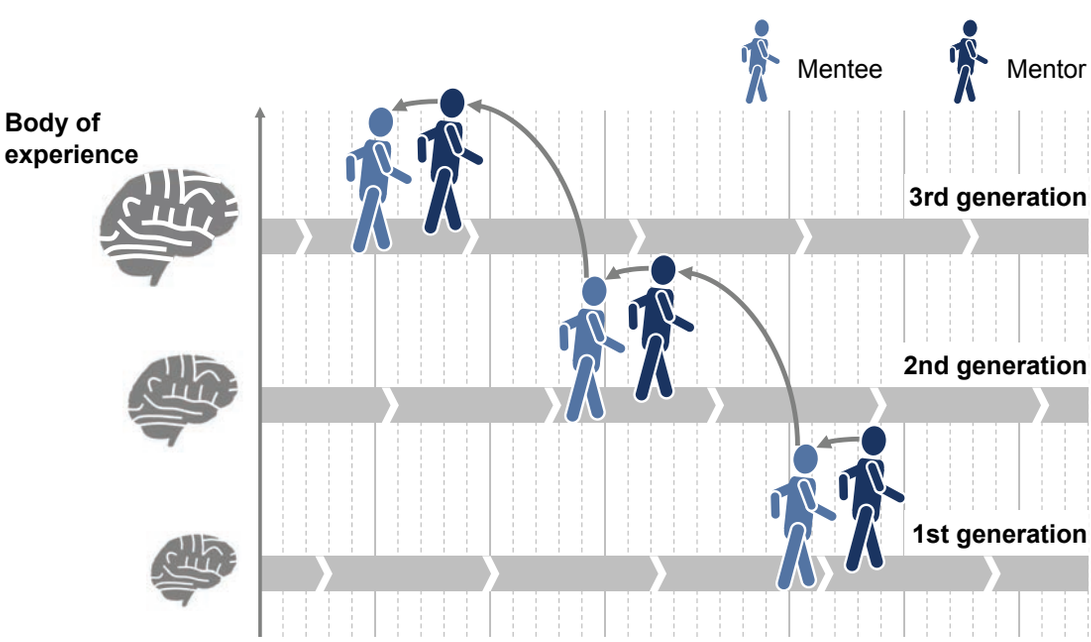
The collective knowledge is passed on through mentoring – the company's "treasure of experience" grows.



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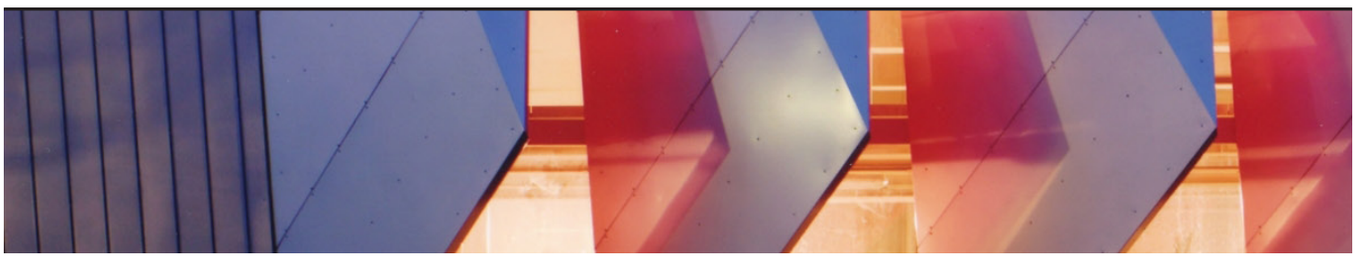
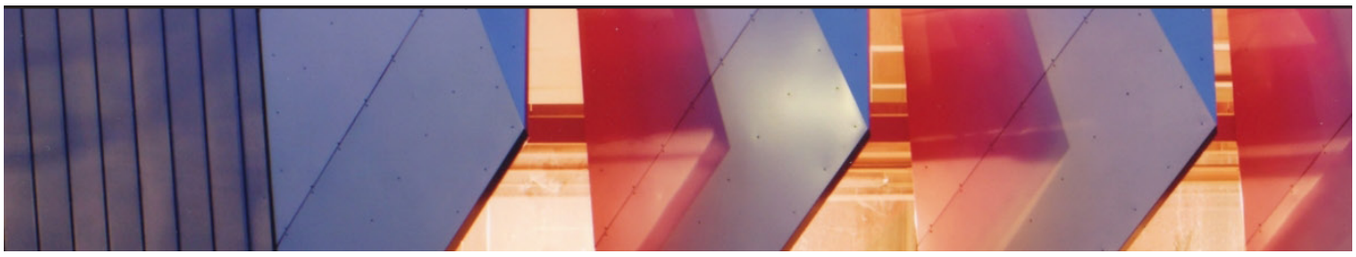
Your partner on the way to BestPractice.

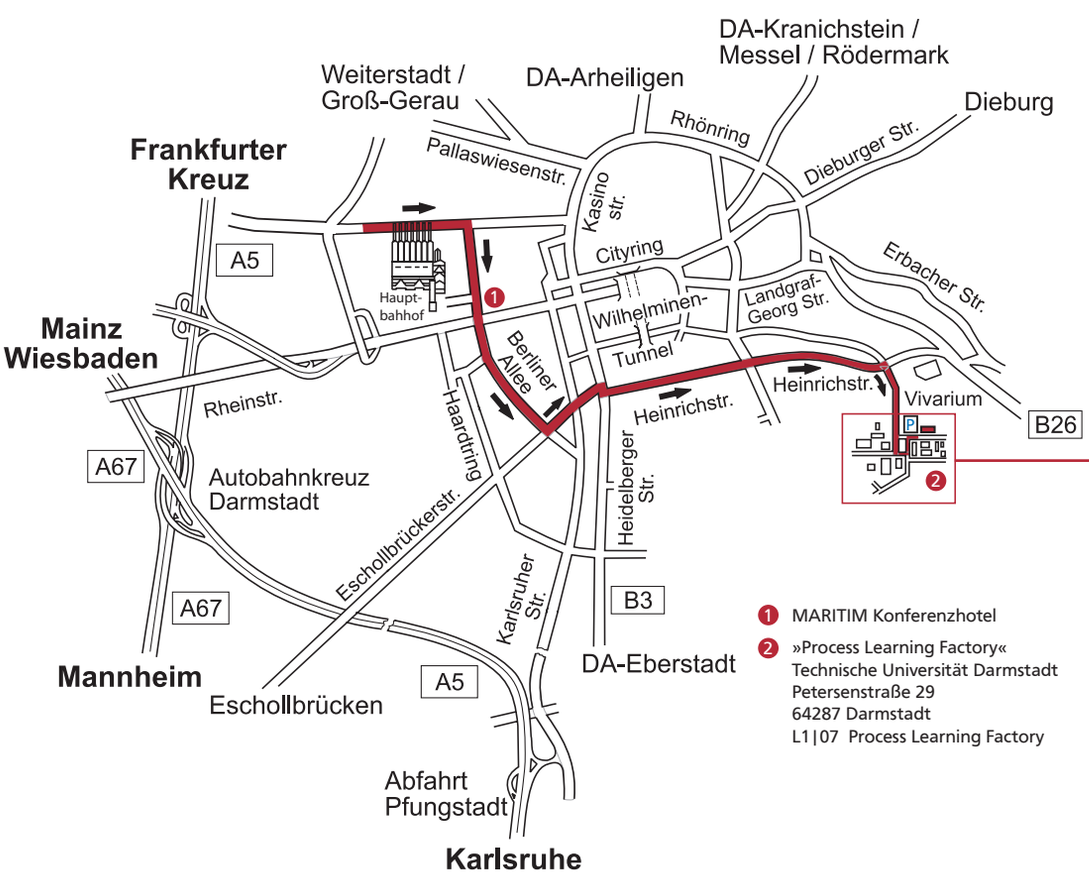


Partners of the Learning Factory CiP



Map

Darmstadt
Your way to the Campus Lichtwiese
Process Learning Factory L1|07



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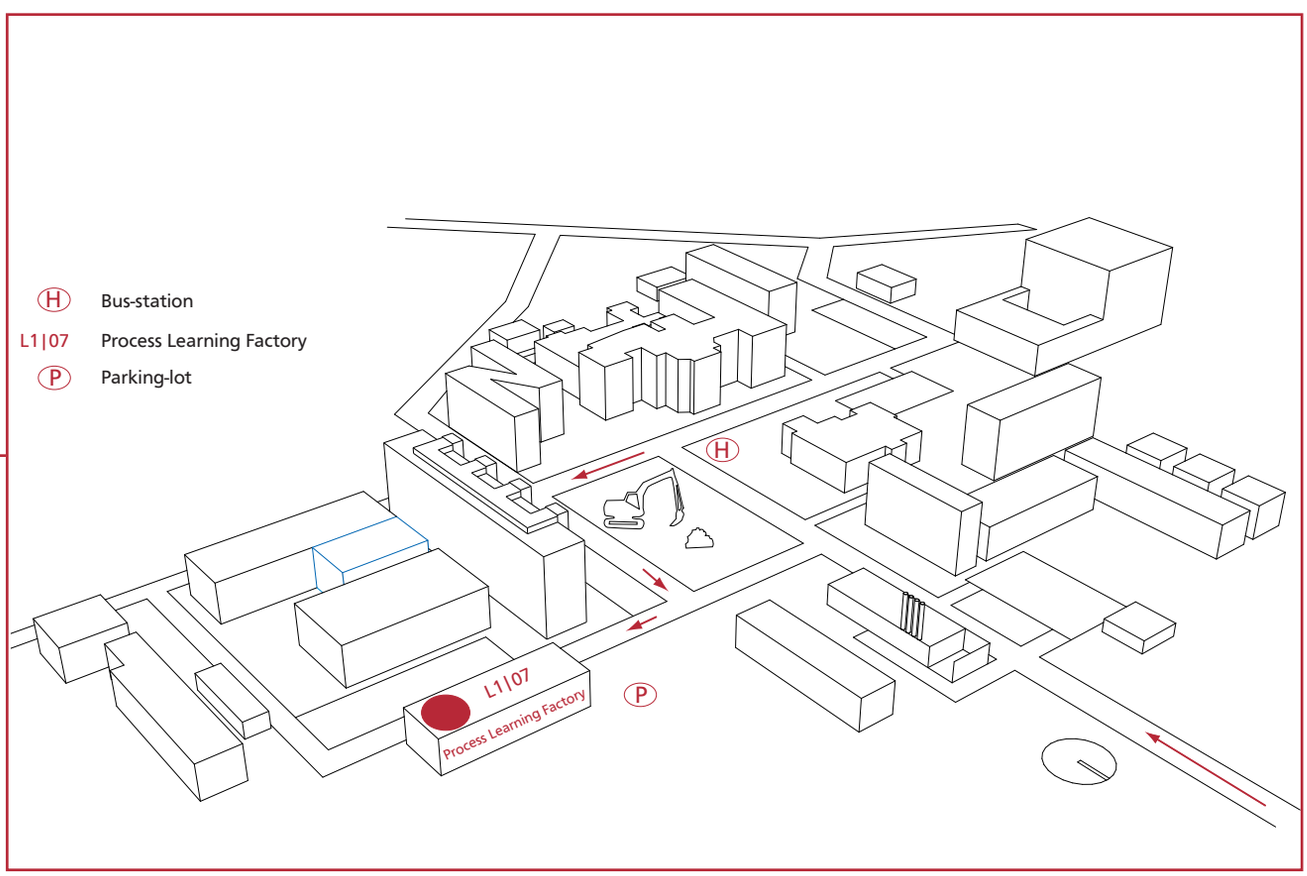
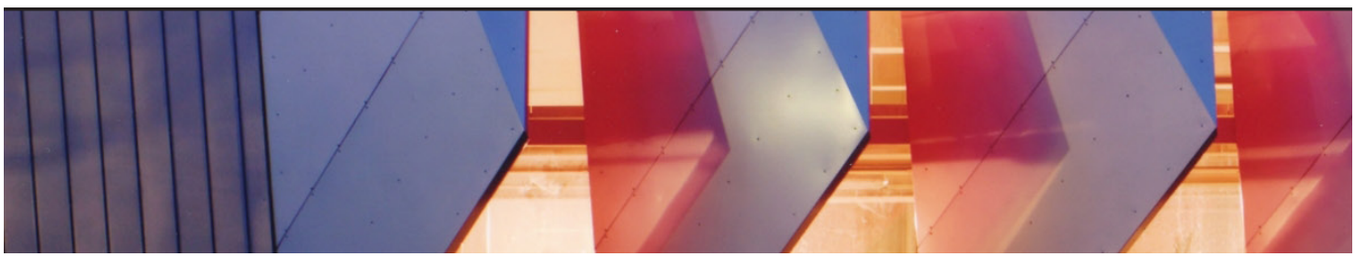


Visit to the learning factory
Introduction of the learning factory CiP
and walkthrough in live operation



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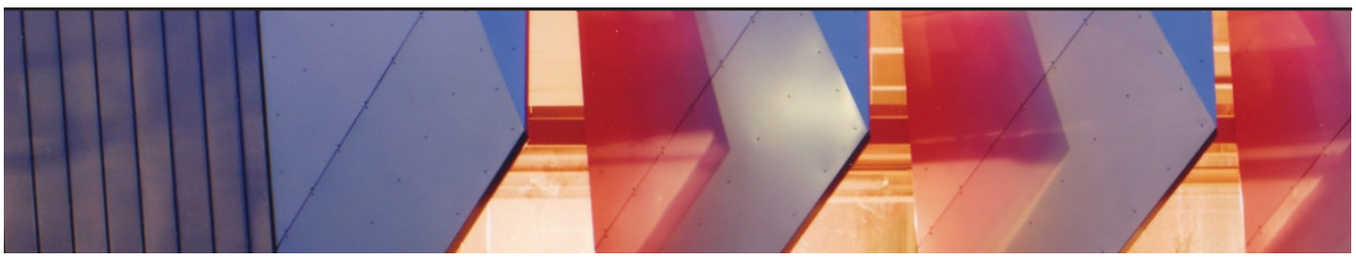

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