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IFS Innovative Factory Systems

# Mobile Learning Day X(tended) 2014, 06. November

## Learning & Assistance in the Future Factory

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Stv. Forschungsbereichsleiter Innovative Fabriksysteme (IFS)

Wissenschaftlicher Koordinator Technologie-Initiative SmartFactory KL e.V.

# Presentation Outline

## A – Perspective on Learning & Knowledge Sharing

1. Which are the **developments** influencing training and knowledge sharing in manufacturing?
   - demands on the human worker
   - demands on the manufacturing enterprises
2. How can **emerging technologies** support new training and knowledge sharing trends in manufacturing?

## B – Demonstration of two visionary systems

**1 –**
**Virtual training system for assembly processes In automobile industry**

**2 –**
**Social Network as a mobile knowledge sharing solution for the shopfloor**

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# Overview of the trends and challenges in manufacturing

**Demographic Change**

**Globalization**

**Changing Customer Demands**

New and Changing Markets

Emerging Competition

Skills Shortages

Wide Variety of Products and Product Variants

**Need for improved qualification**

Ageing /Changing Workforce

Individual Customer Solutions

Knowledge as a Productive Asset

Shorter Product Life Cycles

Penetration of ICT technology

**Knowledge-based Economy**

**Rapid Technological Developments**

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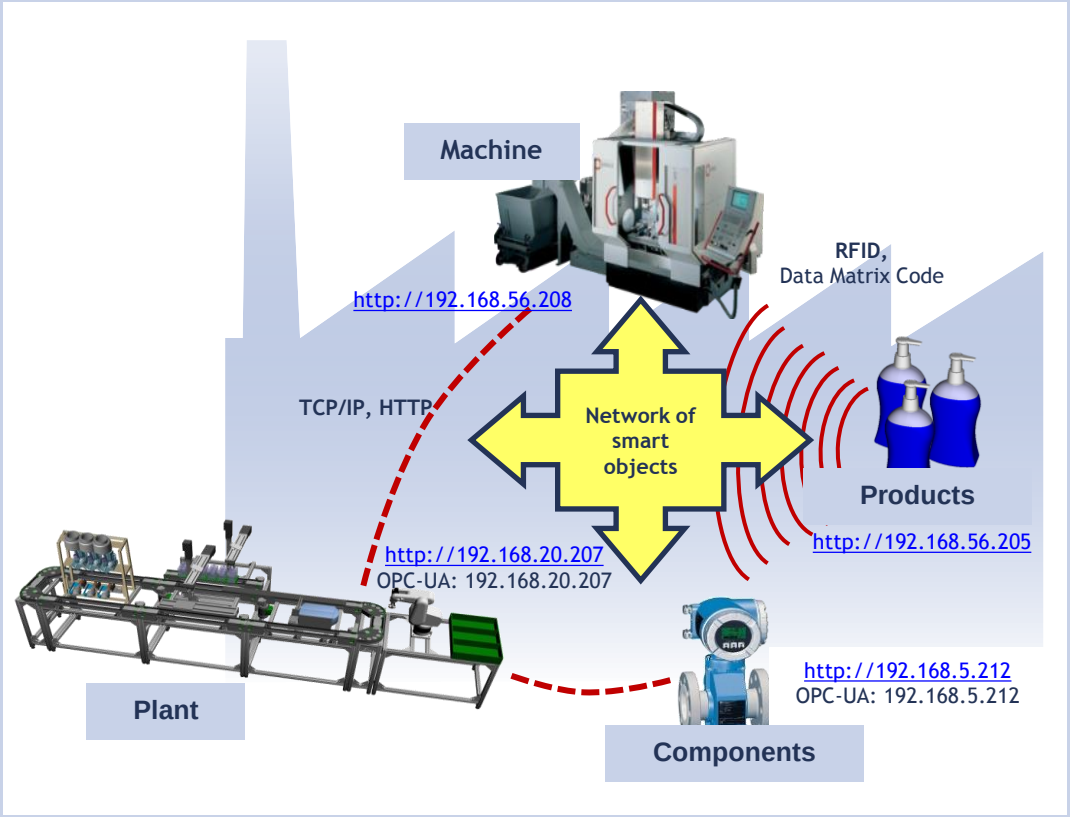
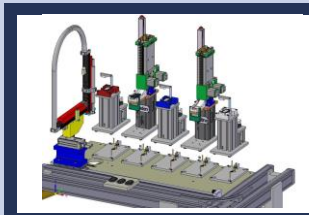
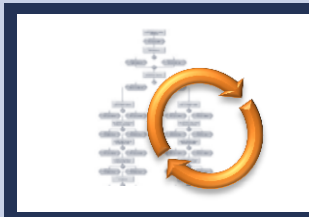
# Paradigms of a Cyber-Physical Production System (CPPS)




Cyber-Physical Systems — Internet of Things



Modularity and Plug&Play



Autonomously organized processes

Synchronisation of the real and virtual world

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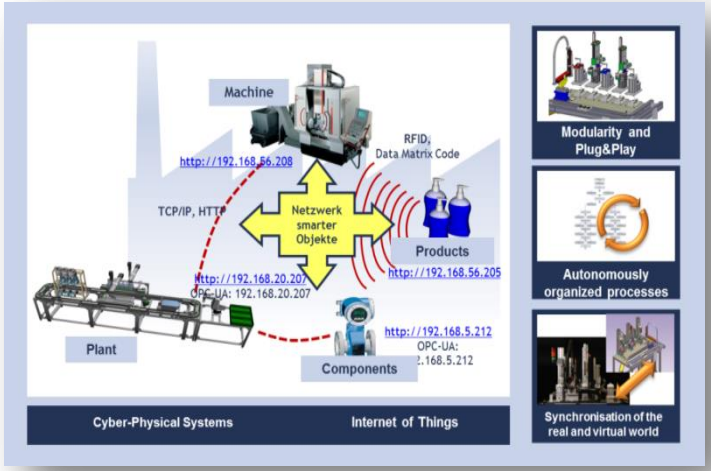
# Computer-Integrated Manufacturing (CIM) ≠ Industry 4.0


70-80ies

**CIM-illusion:**

***man-abandoned factories***




today

**Industry 4.0:**

***the human in the middle?***

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# A – Perspective on Training & Knowledge Sharing




**Computer-based Training & Knowledge Sharing**


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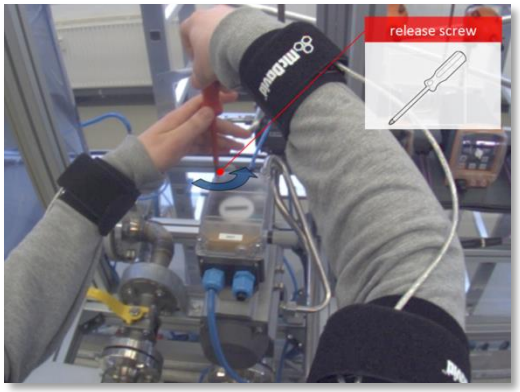
# 1 – Learning Process


**Classic vocational training is based on traditional learning principles (behaviorism, cognitivism).**

Incorporate **situated and networked learning**

- which takes place **continuously and embedded in daily work**
- where learner actively **interacts with the learning environment** instead of being a passive recipient
- where learning/training will be provided **on an ad-hoc basis at the right place of action**
- Which is supported by computer technology, which is will always be **available – complementing and supporting the role of teachers, mentors and experts.**

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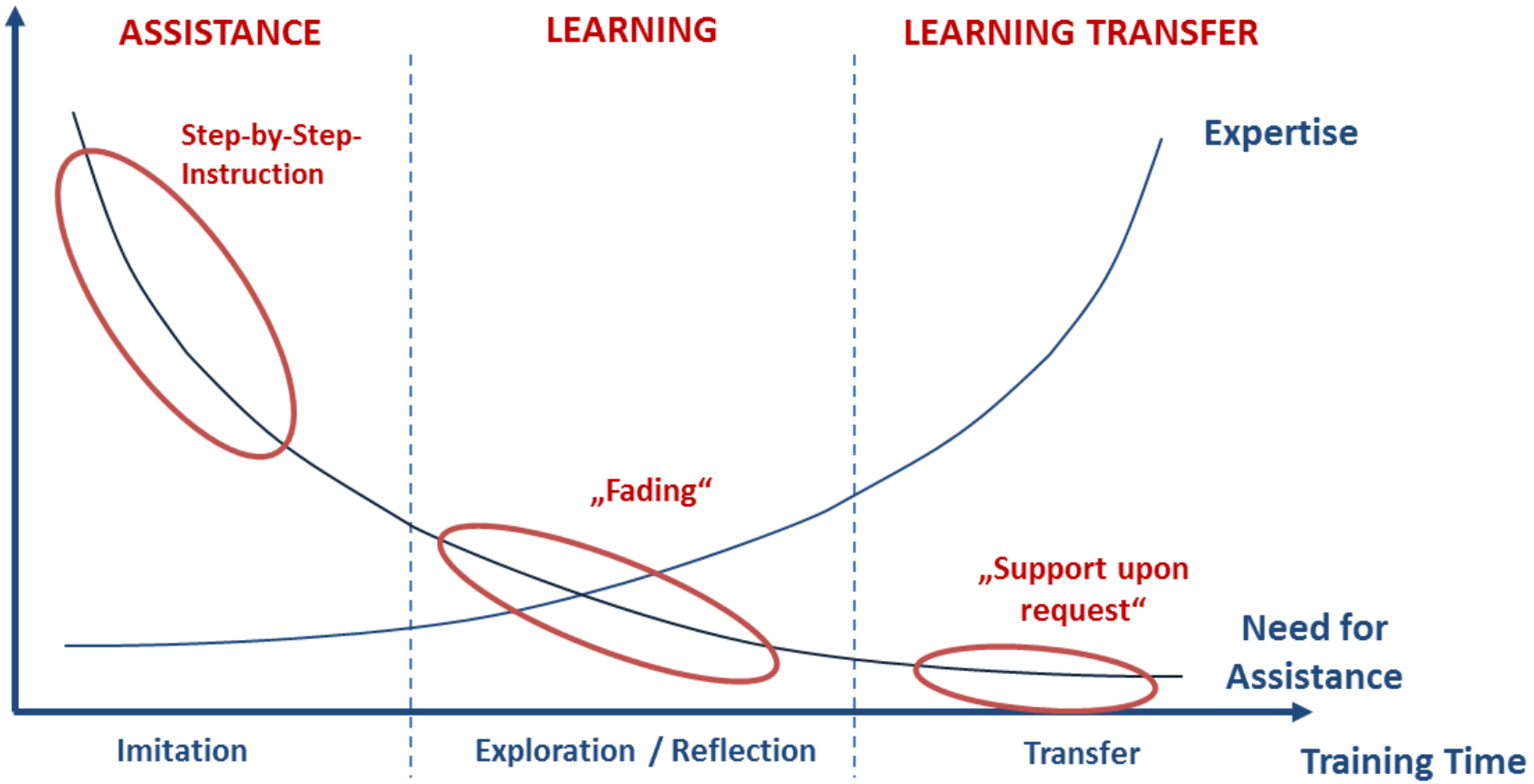
# 1 – Learning Process

## Adaptive Support and „Fading“

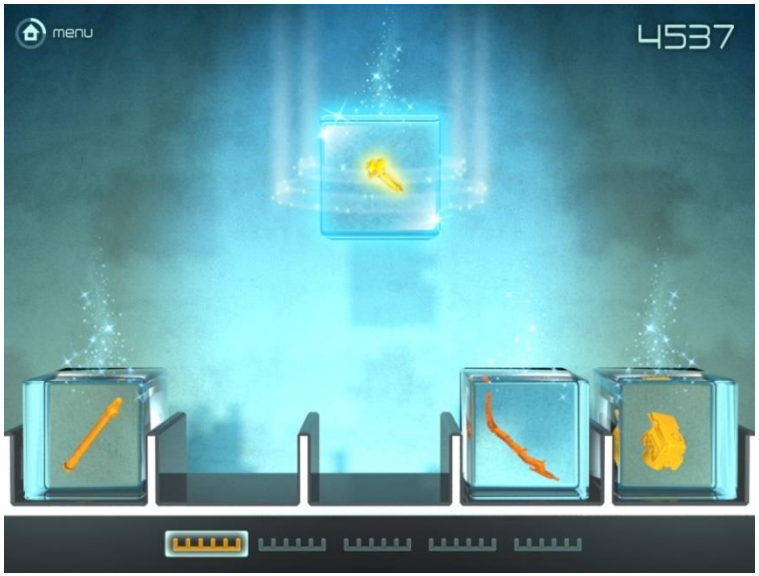



Eiriksdottir and Catrambone (2011)

# 1 – Learning Process

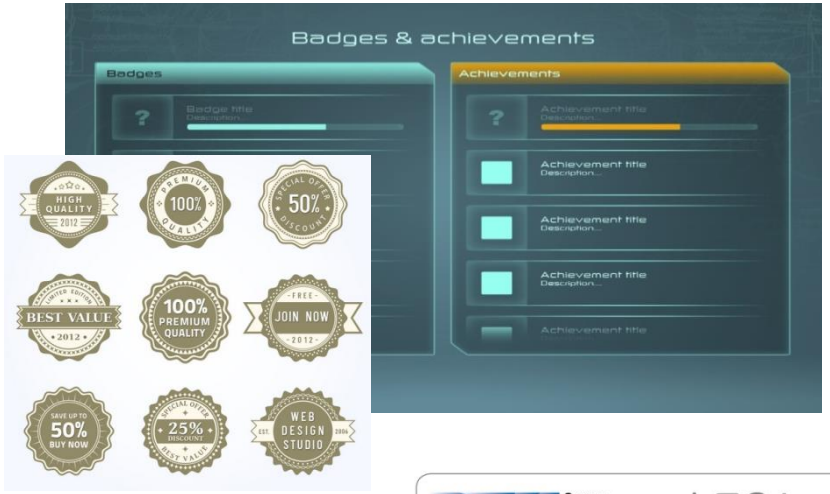
## Game-based learning

- explore and manipulate and even destroy without serious consequences
- engaging and motivating („flow state”)




## Personalisation

- track and reward experience (“badges”, “achievements”)
- provide different difficulty levels
- Etc.

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# A – Perspective on Training & Knowledge Sharing




**Computer-based Training & Knowledge Sharing**


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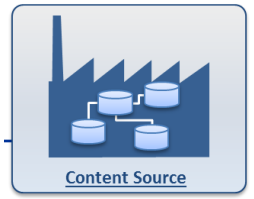
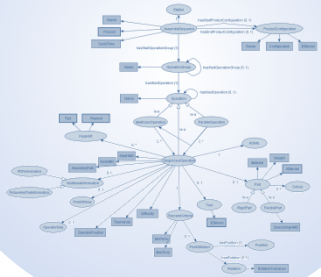
# 2 – Content Sources

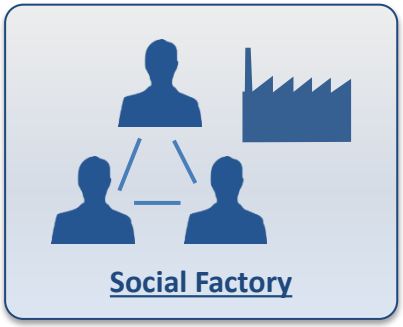


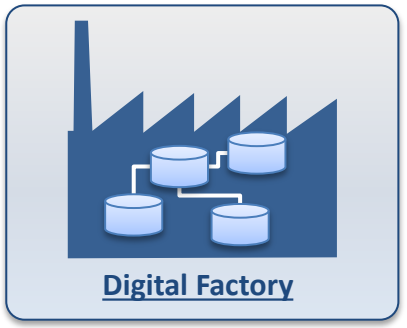

Recommendations, Comments, Annotations, Reports

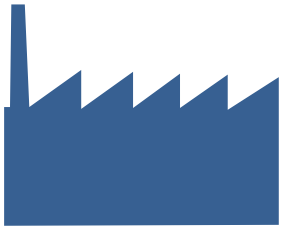
Process Models, CAD Models, Instructions, Standards

Semantic Core Modell





shopfloor

KPI, Live Status, History Data, Error Messages, etc


office

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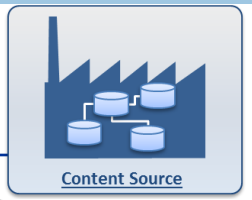
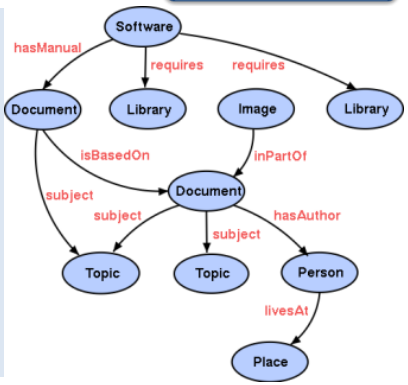
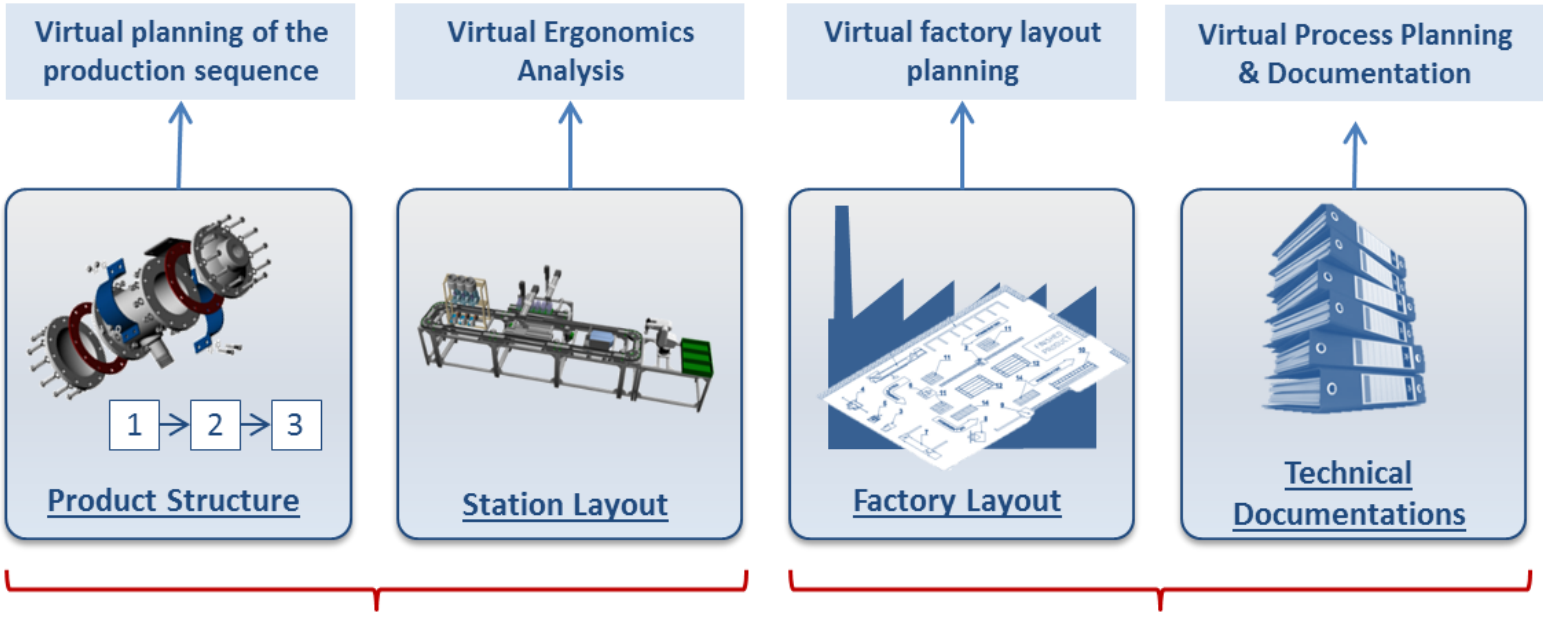
# 2 – Content Sources: Digital Factory




- **Prerequisite:** information structures in the digital factory are modeled in a **modular**, **open** and **semantically expressive** way
- can be dynamically aggregated and used in new training and knowledge-sharing applications.



# A – Perspective on Training & Knowledge Sharing




**Computer-based Training & Knowledge Sharing**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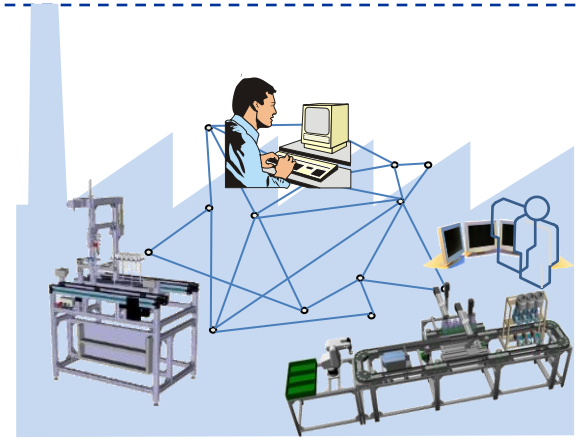
# 3 – Delivery Mechanisms

uni-modal, stationary



multi-modal, mobile

**Industrie 4.0**

**Today** **Tomorrow**

long-cycle

**Trends in Manufacturing**

**Trends in Human-Machine-Interaction**

Short-cycle

. . .

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# 3 – Delivery Mechanisms


High immersion
High costs
Low flexibility

Low immersion
Low costs

**High immersion**
**Low costs**
**High flexibility**

**Developments in ICT**

**Advanced User Interaction**

- Mobile Interaction
- Gesture-based Interaction
- Speech-based Interaction

**Advanced Visualization**

- Augmented Reality
- 3D-visualisation

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# B – Demonstration of two visionary systems

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AMBI WISE

**VISTRA (EU-FP7)**

**Formelles Lernen**

**Praktische Fähig- und Fertigkeiten**

**AmbiWise (BMBF)**

**Informelles Lernen**

**Problemlösungsstrategien, etc.**

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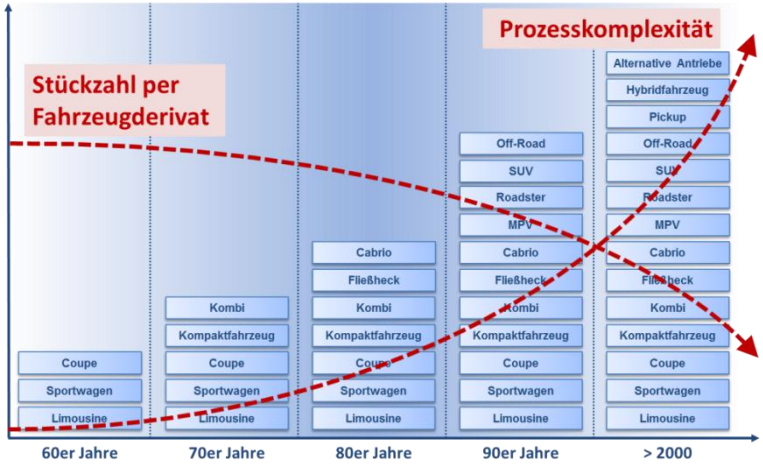
# Boundary Conditions and Motivation for Virtual Training

## Economical Boundary Conditions




**Highly competitive**

**Increasing number of products and variants**

**Short-life product cylcle**

## Technological Boundary Conditions

**Complexity of production processes (>10. 000 parts)**

**High proportion of manual work**


KRAMMER, P.; NEEF, D.; PLAPPER, P.: Adva*nced Manufacturing Technologies for General Assembly.* o.O.: SAE Technical Paper, 2011

EIGNER, M.: *Product Lifecycle Management: Ein Leitfaden für Product Development und Life Cycle Management*. Dordrecht/Heidelberg/London/New York: Springer, 2009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# Boundary Conditions and Motivation for Virtual Training


+


60er Jahre 70er Jahre 80er Jahre 90er Jahre > 2000

Incr

**Before the ramp-up:**

Operators must be acquainted perfectly

with the products and the respective assembly processes

→ **Qualification (hardare training + virtual training)**

KRAMMER, P
EIGNER, M.:
York: Springe

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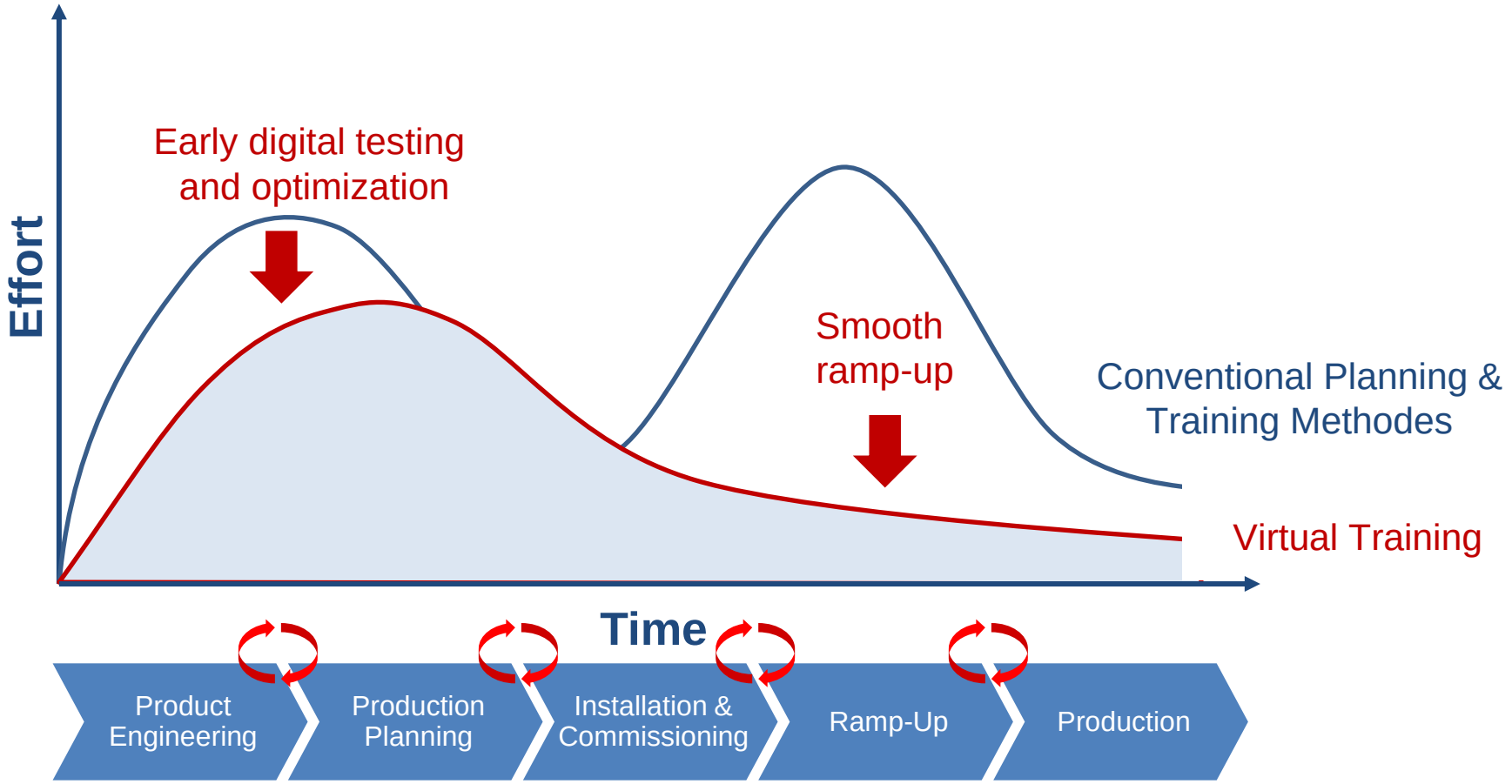
# Boundary Conditions and Motivation for Virtual Training




- **Secure ramp-up and production phase (less errors, shorter time-to-production)**
- **Reduction of physical hardware and protoyping**

# Application 1 – Virtual Training - Requirements


+


Training of **complex manual assembly processes of blue-collar workers**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# Application 1 – Virtual Training

Peter, an employee at an assembly line for automatic gear boxes, was informed that the production of a **new product type** will start at his line started in four weeks. To familiarize at an early stage with the new product and its assembly process, he uses a **virtual, gesture-based training system.**

All **product models and process descriptions** used in the training are provided by the design and **planning tools of the digital factory**. The training system explains **the assembly process step by step using a combination of animations and speech-based instructions.**

# VISTRA Training Simulation – Hardware Setup


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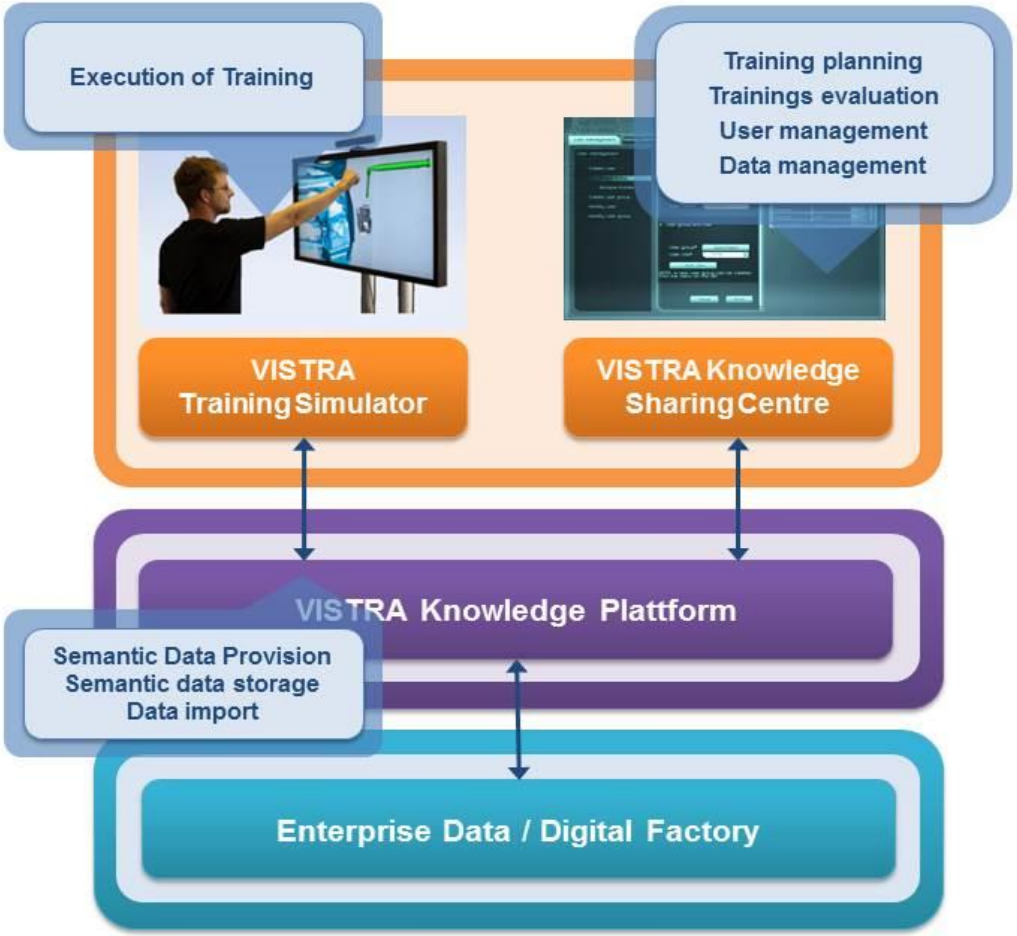
# VISTRA System Architecture

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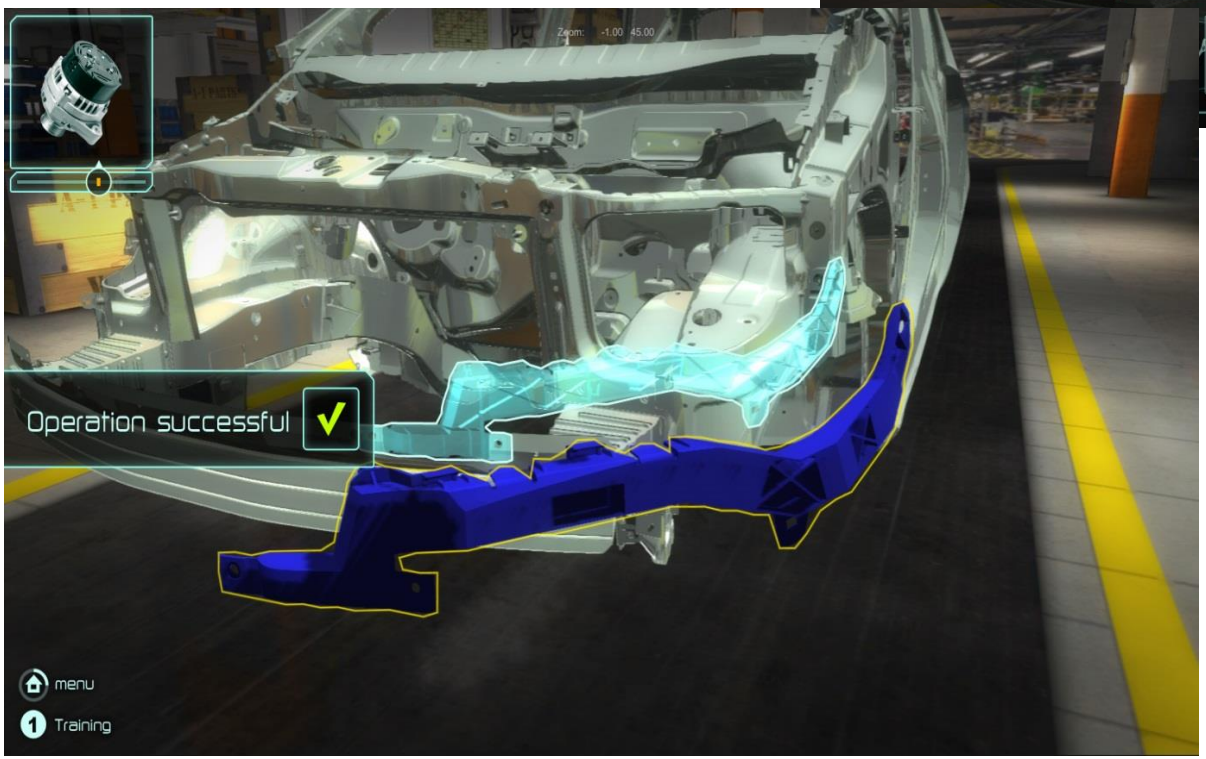
# VISTRA Training Simulation – Second Prototype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# Reference architecture of the VISTRA information interface

Other IT-Tools

Virtual Training

Webbrowser

VKSC - Information Interface

Digital Factory

Re-use of existing data in new applications to support the shopfloor workers

**F3 –**
Loose and flexible data delivery

**F2 –**
Persistent storing and managing of data in semantically expressive representation

**F1 –**
Import and merge of heterogeneous input data

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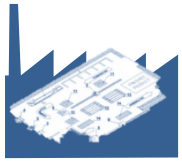
# Information modell for virtual training

**Virtual training requires multi-faceted data from different sources**

**Product Design**



**Manufacturing Design**

Assembly sequence

Station layout & Plant structure

Geometry models

Simulation models

Assembly paths

**Semantic Core Mdell**

Additional information

Team Structure & Responabilies

Feedback & Statistics

**Training**

**Organisation**

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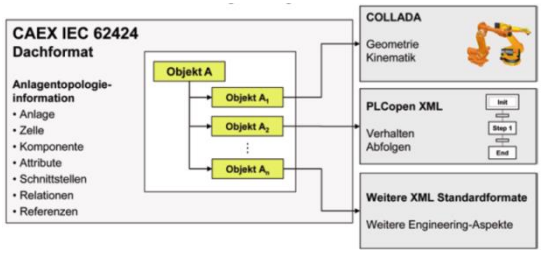
# Information modell for virtual training

## Digital Factory

**AutomationML**




Automation Planning

**Other focus and application domain**

## E-Learning

**SCORM**
**IMS Content Packaging**

SCORM™
Sharable Content Object Reference Model

IMS®
Innovation
Adoption
Learning

**Not suitable for the representation of complex production scenarios**

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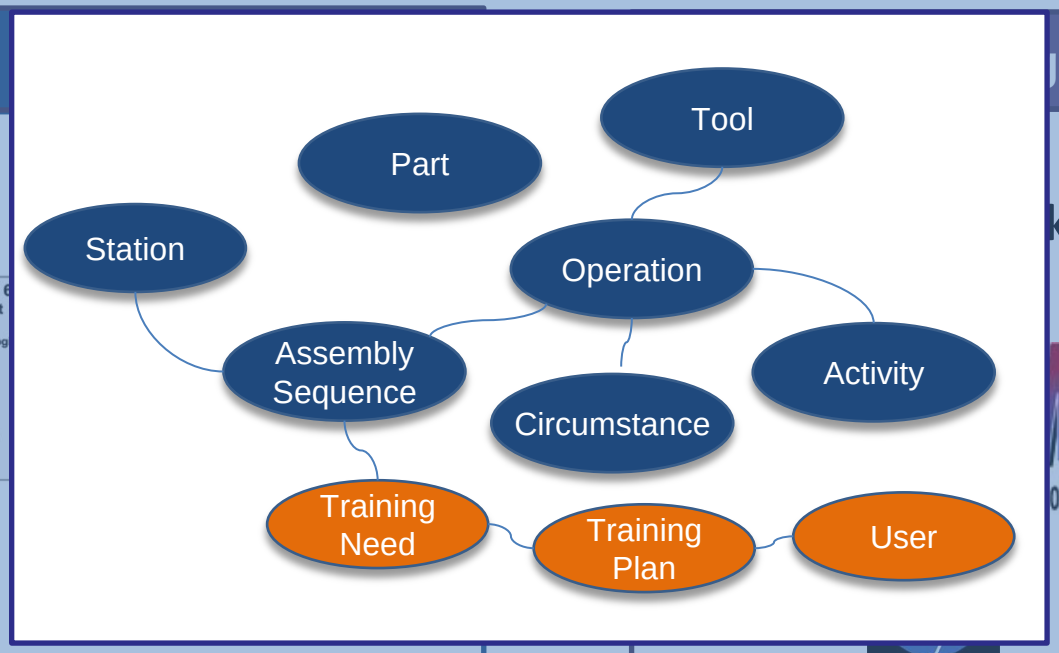
# Information modell for virtual training




**No data format specification:**

**with a cross-phase understanding of assembly processes (digital factory)**

**suitable for the qualification (e-learning)**

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# Manual Work Station


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# B – Demonstration of two visionary systems

vistra

AMBI WISE

| VISTRA (EU-FP7) | AmbiWise (BMBF) |
| --- | --- |
| Formelles Lernen | Informelles Lernen |
| Praktische Fähig- und Fertigkeiten | Problemlösungsstrategien, etc. |

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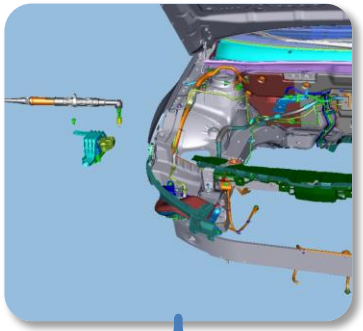
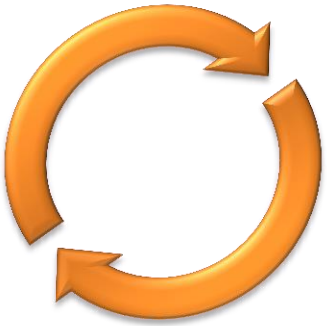
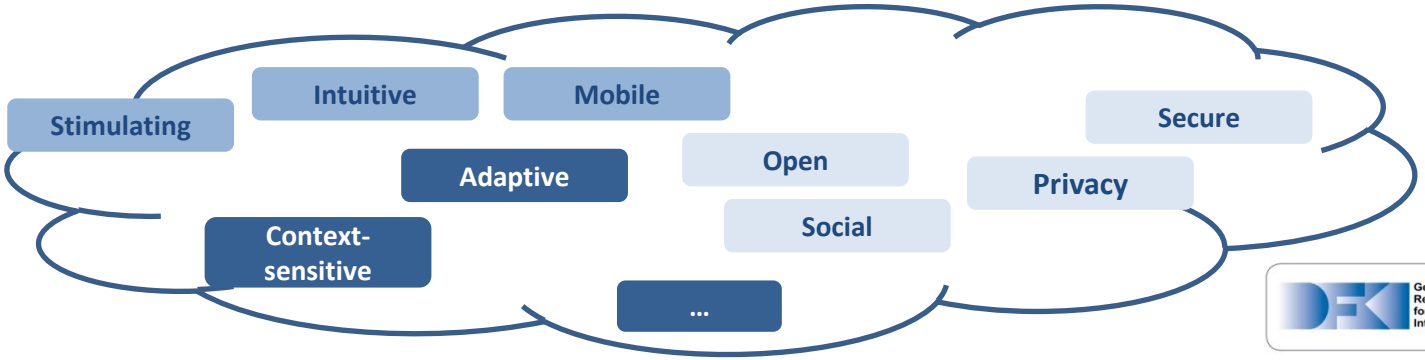
# Application 2 – Knowledge Sharing – Idea





Product Engineering → Production Planning → Installation & Commissioning → Ramp-Up → Production

**Enable knowledge sharing between white-collar and blue-collar workers** based on mobile applications and social media design.

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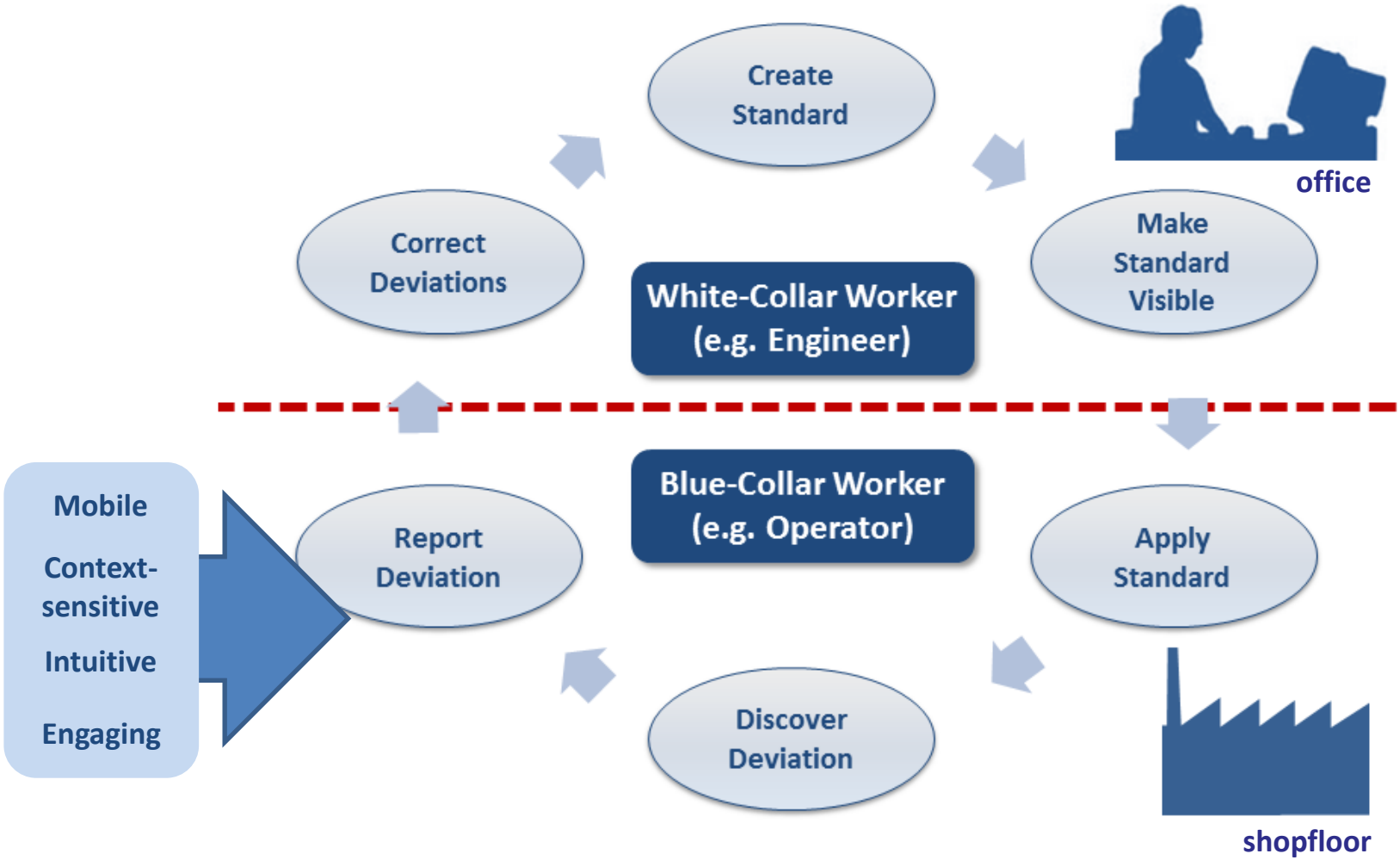
# Application 2 – Knowledge Sharing – Concept

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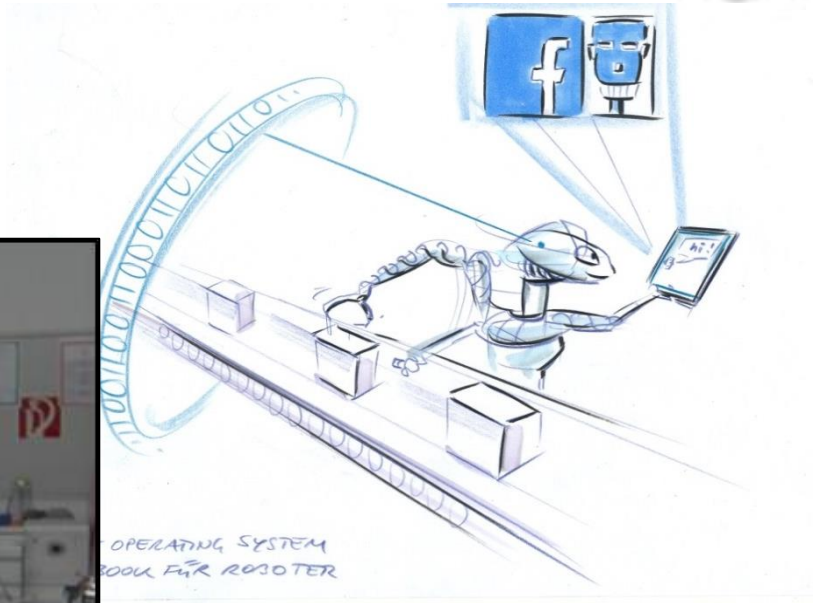
# Application 2– Knowledge Sharing – Scenario

## Mobile App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# Summary „Social Smart Factory“

**Profiles for Human Worker and Cyber-Physical Systems**

- reflects the idea of the internet of things

**Knowledge Sharing between blue and white collar worker is stimulated:**

- By advanced mobile and intuitive user-interaction (e.g. scanning bar code)
- Social media design with rewards system and knowledge worker

**Combined with context-aware technologies:**

- Location-based services
- Augmented Reality

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# Summary

It is assumed that training and knowledge sharing:

- will be provided to a **greater extent on an ad-hoc basis directly at the place of action.**
- will take place in **dynamic networks supported by social media design.**
- will be based on content from newly accessed sources, such as the **digital factory and “social” factory.**
- will be provided by means of **advanced, but low-cost interaction technology.**

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# Thank you for your attention...

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