Karlsruhe Institute of Technology

Keynote
Industry 4.0

ICNS 2016

Steffen G. Scholz

KIT – University of the State of Baden-Wuerttemberg and
National Research Center of the Helmholtz Association

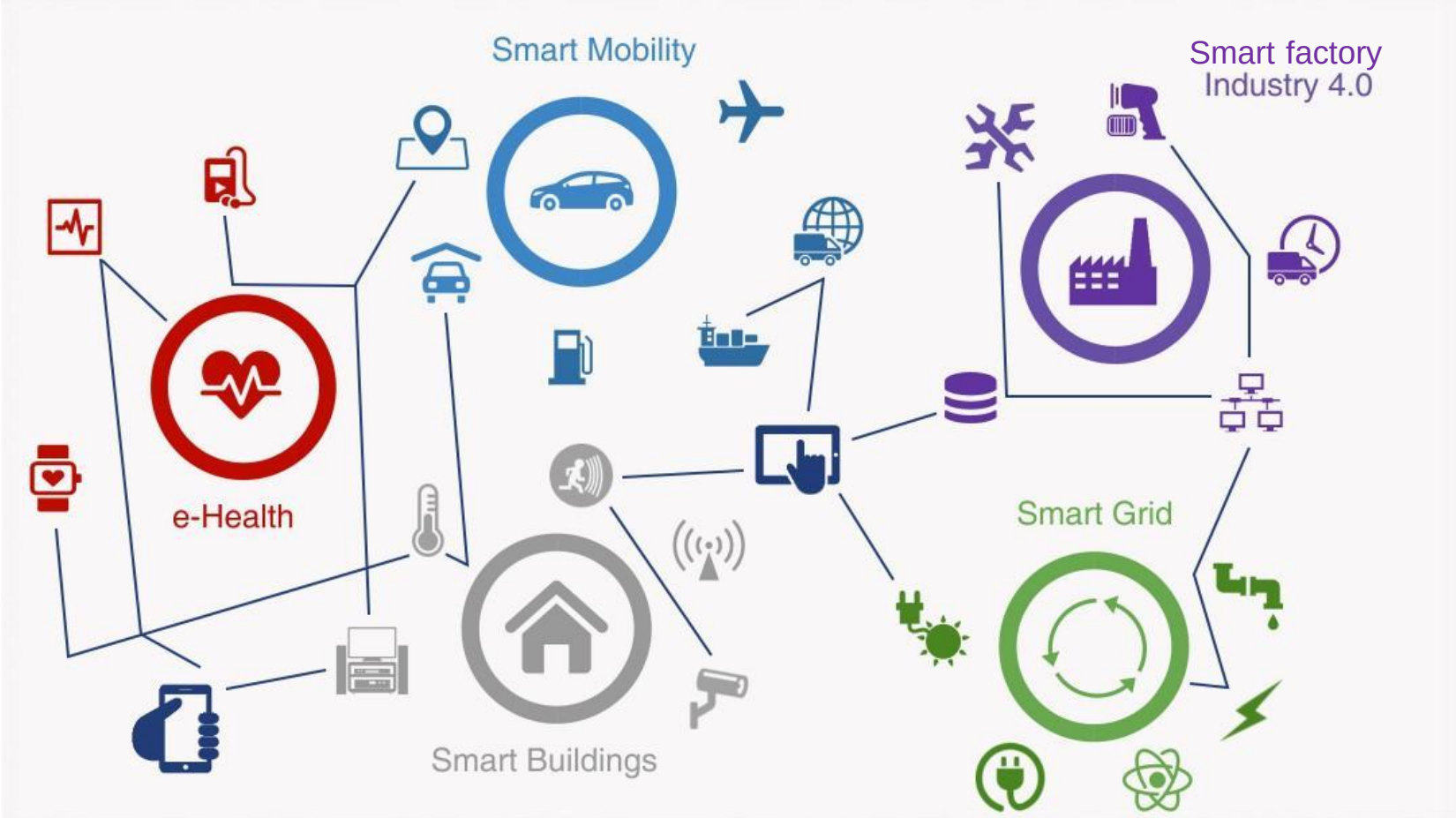
The Mission


IMMER SCHNELLER ZUR VERNETZTEN WELT
1997
6 Millionen Geräte mit Internetzugang
2020
50 Milliarden vernetzte Geräte
2020
7 Milliarden vernetzte Menschen
1995
15 Millionen Menschen haben Zugang zum Internet

Fourth Industrial Revolution

The Internet of Things

The domains of the IoT



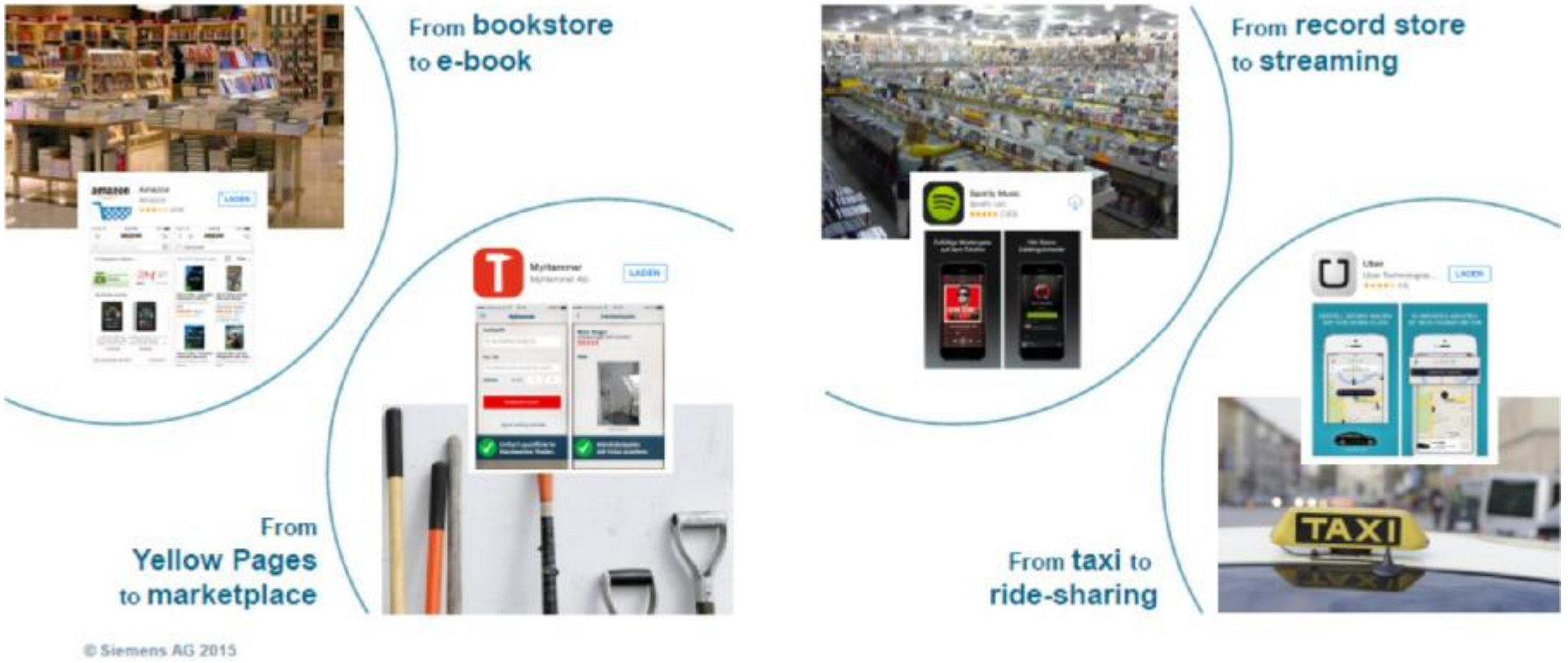
Source: Bosch

The Internet of Thing

”We define the internet of things as sensors and actuators connected by networks to computing systems. These systems can monitor or manage the health and actions of connected objects and machines. Conneted sensors can also monitor the natural worls, people and animals.”

McKinsey Global Institut

The Internet of Thing



Source: Siemens

The Human in the Centre…

Self organised and distributed artificial intelligence

Fast and automatic network integration , highly flexible

Open standards

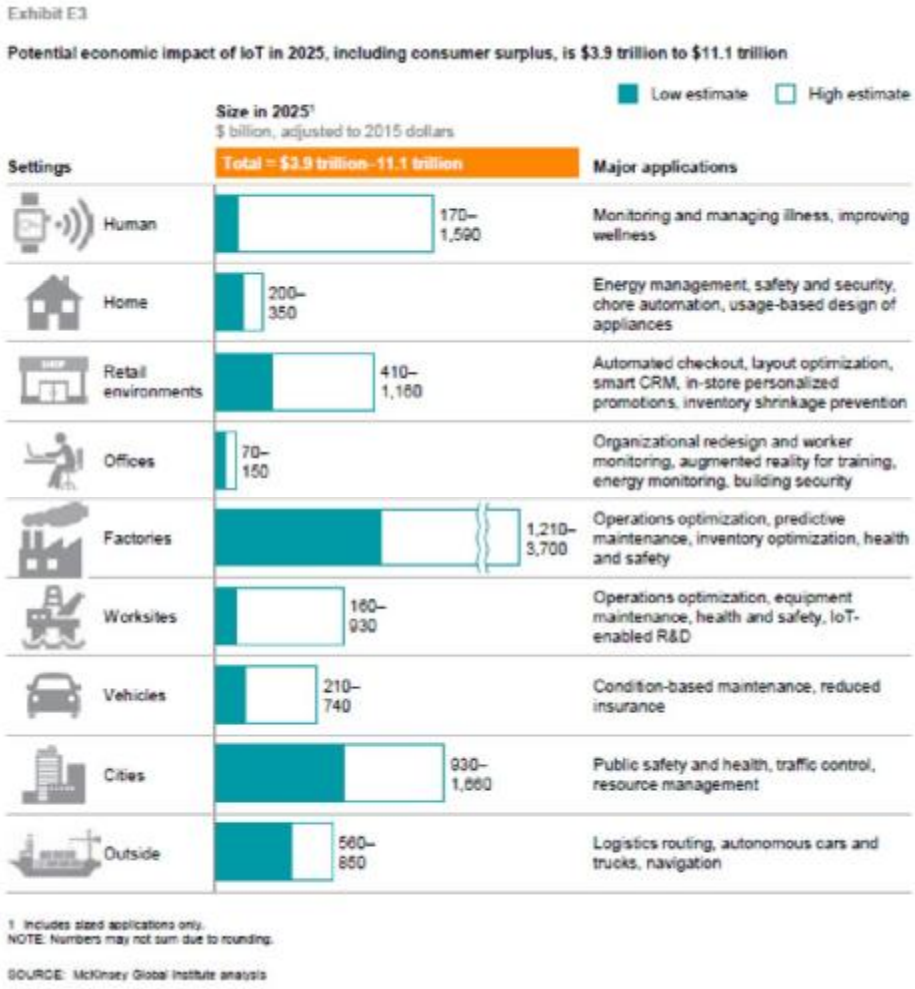
Virtual real-time image

Digital integrated life-cycle-management

Safe and secure added-value networks

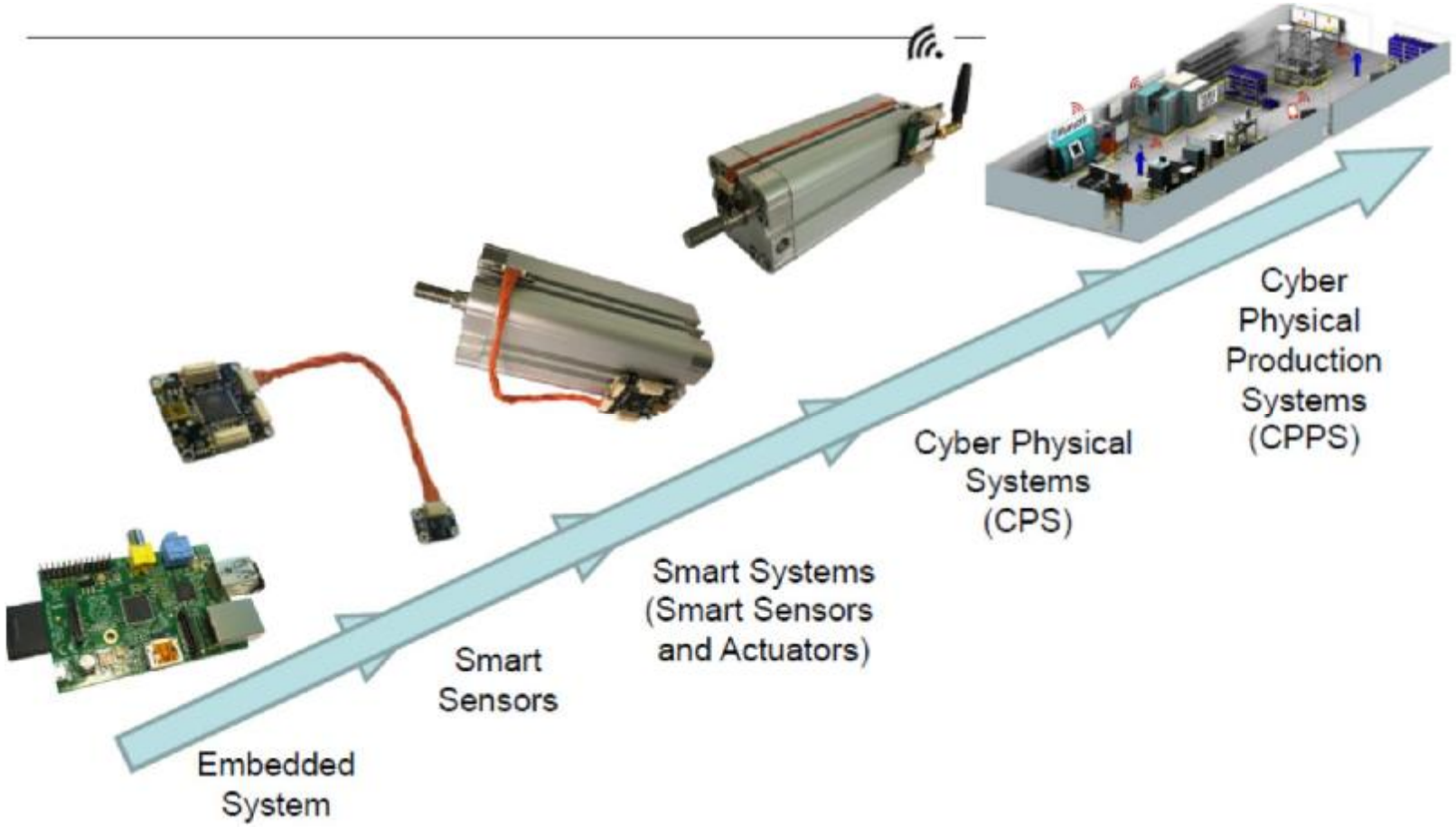
Humans as actors and in the centre

Industry: the biggest market for the IoT



Source: McKinsey

Embedded System enabling CPS and CPPS



Opportunities and Challenges

Industry 4.0 will bring

- New business models
- Energy saving
- Better maintenance
- Worker health and safety
- Inventory optimization (know at anytime the number of part, supply chain management; ex: How many screws are still in the box)

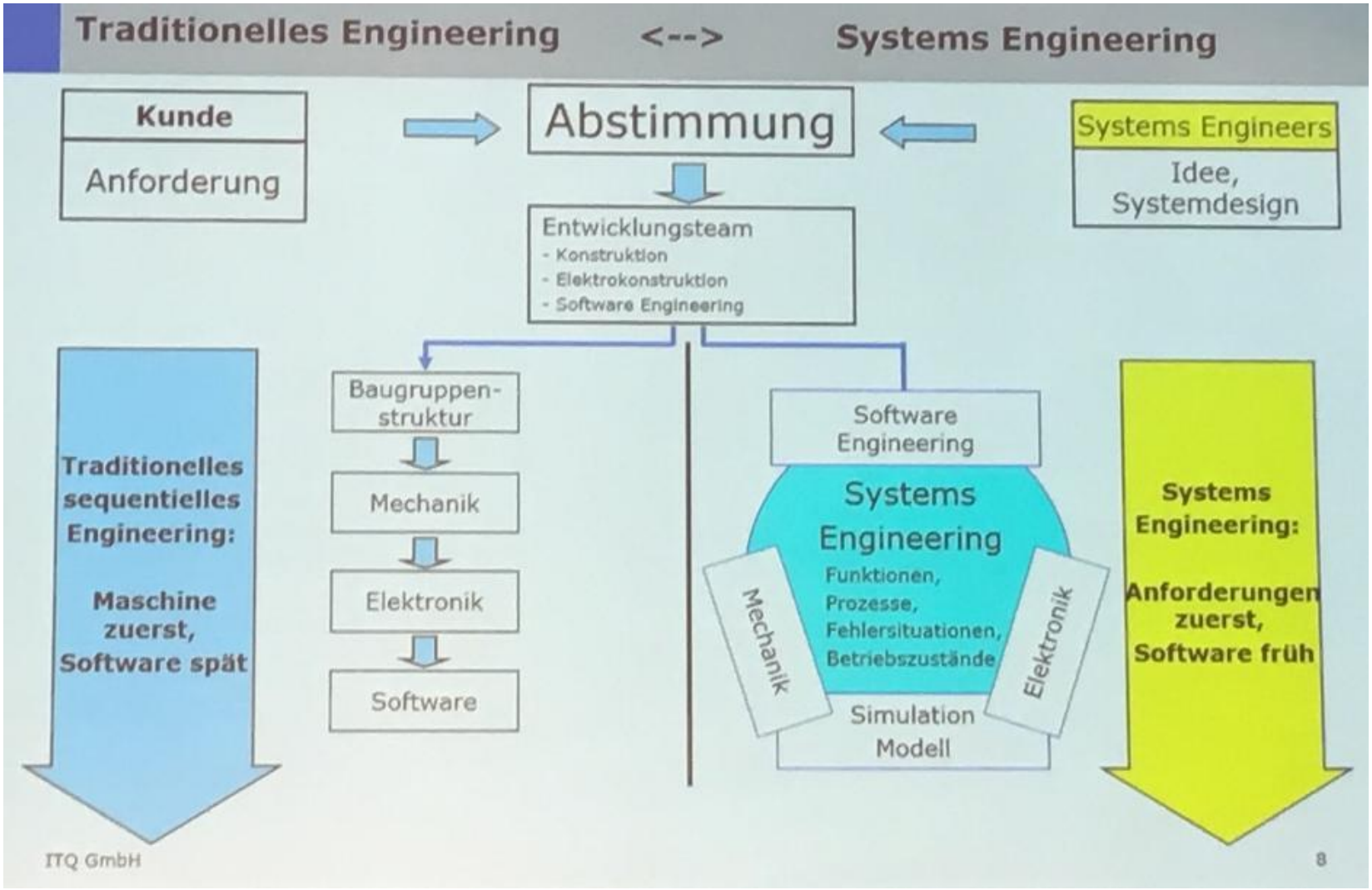
The technologies Used by the Internet of thing

- MEMS
- RFID (Track the product, product memory)
- Always cheaper, smaller and more powerful computation capacity.

30-70%
Drop in the price of MEMS sensors in past five years

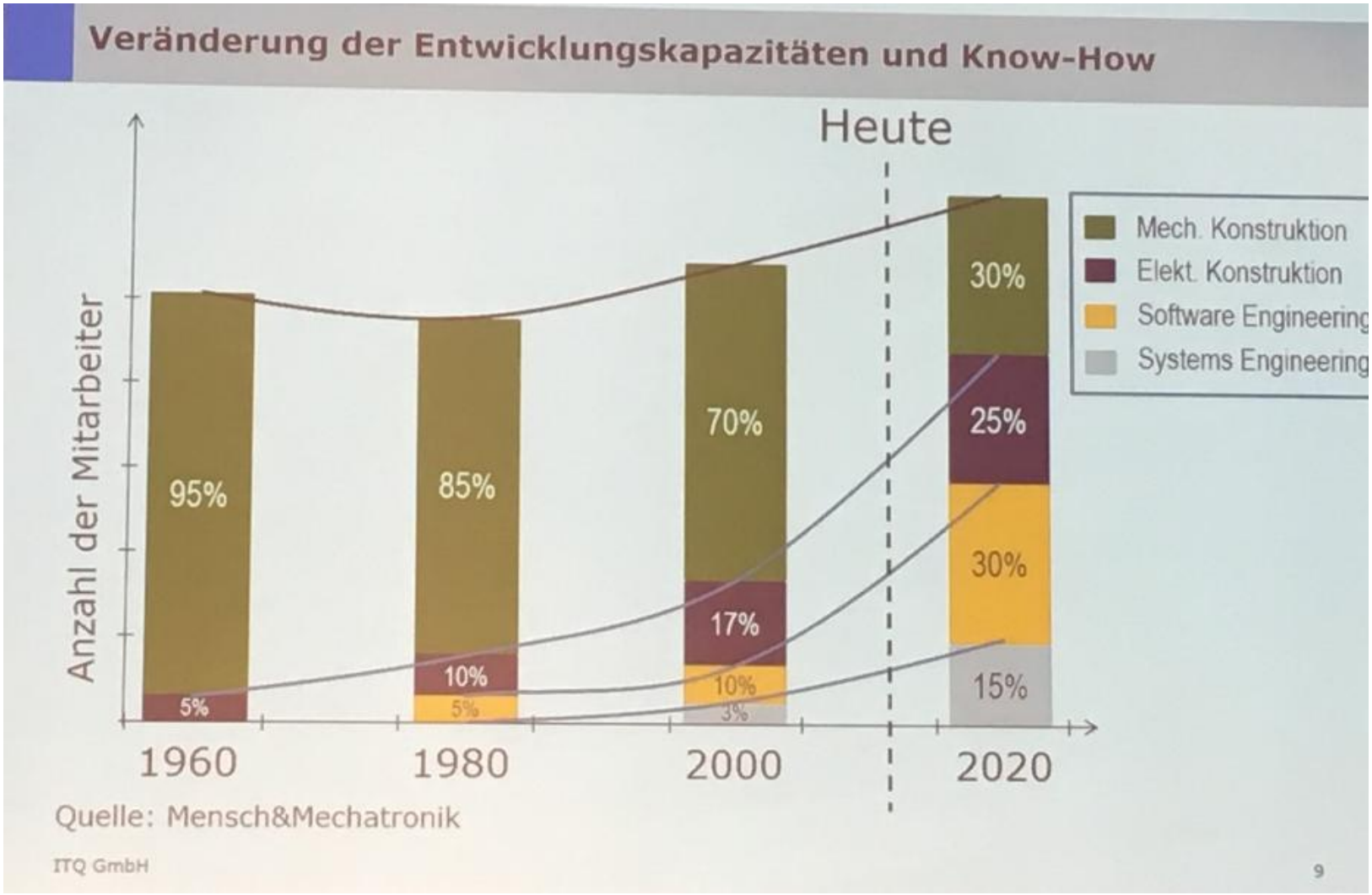
Although the price of the technologies driving I4.0 has dropped, it still needs to be cheaper to make the new industrial revolution fully happening.

Changes in the way of working



Source: ITQ

Changes in the way of working



Observation

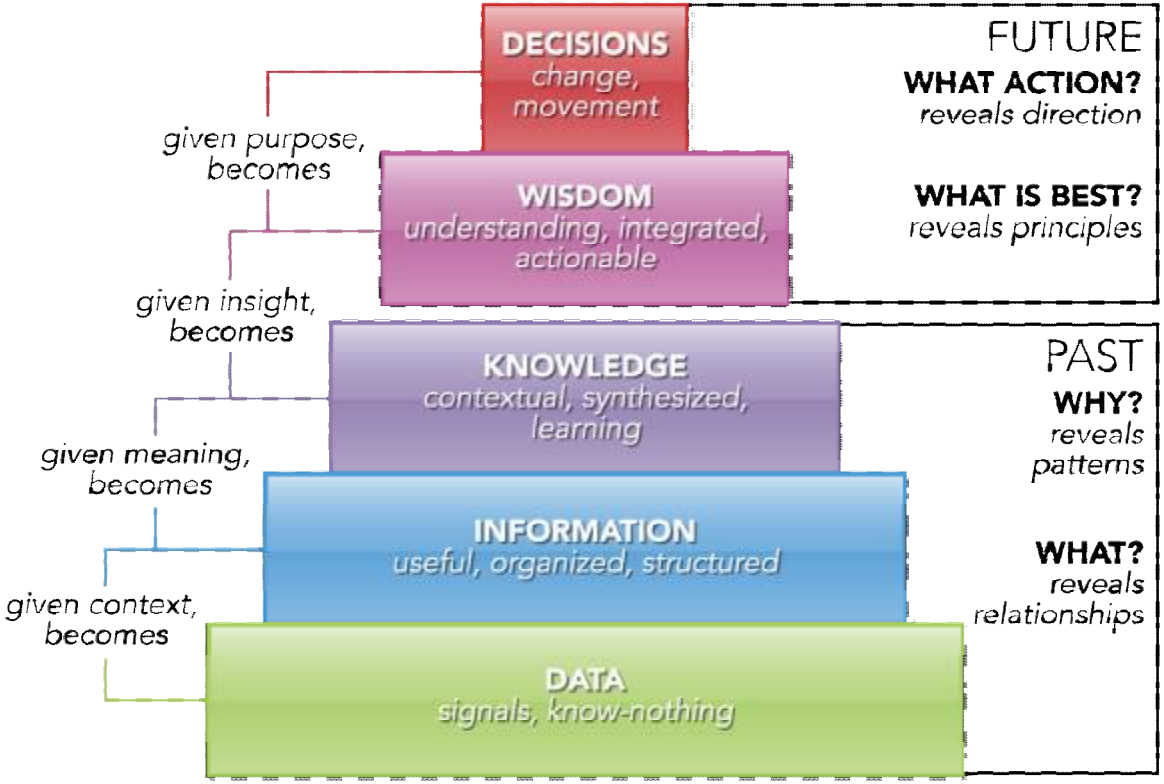
- Productivity stop to progress in the past years. It seems that flexibility, productivity and quality are three mutually exclusive options. If one wants to improve one of them, one has to sacrifice one of the other.

Þ There is a need for a need paradigm

Þ Need for Fast (highly automated lines producing a large number of products), flexible (short lead time, small batch size), efficient (high quality and low defect rate) factory.

New paradigm

How to compute the enormous quantity of data comming from sensors and convert it in value creation?



Examples

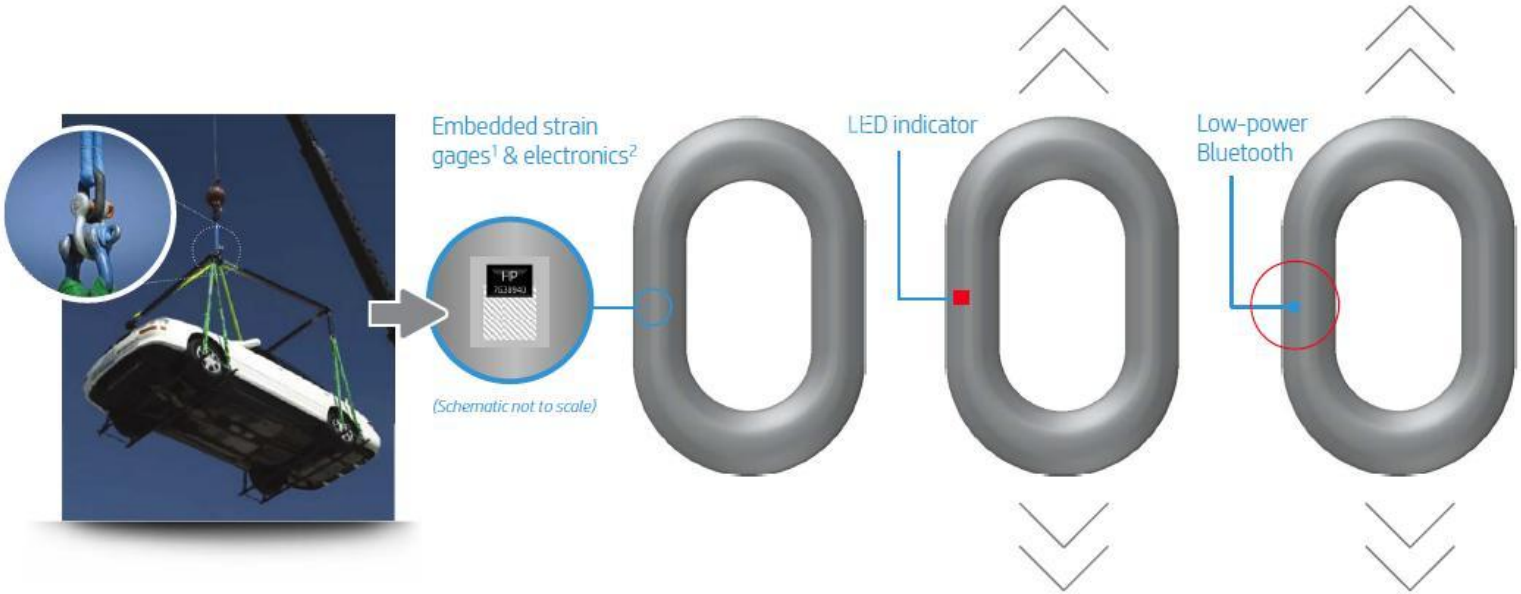
Concept of the bosch tightening tool

- Smart tightening tool couple with real-time 3D Indoor localisation: Allow to know what has happened at any time and any place on the production line. If a problem occurs (series of product are defect), the data from the production tool can be analysed and the problem identified. Instead of recalling thousands of products only few with actual default could be recall.

Source: Bosch

3D printed connected HP chain link

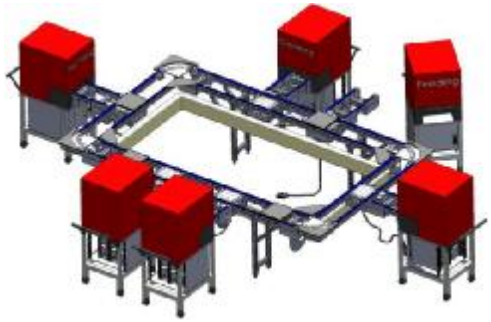
In situ measurement available during operation

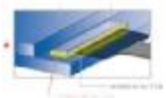


Source: HP

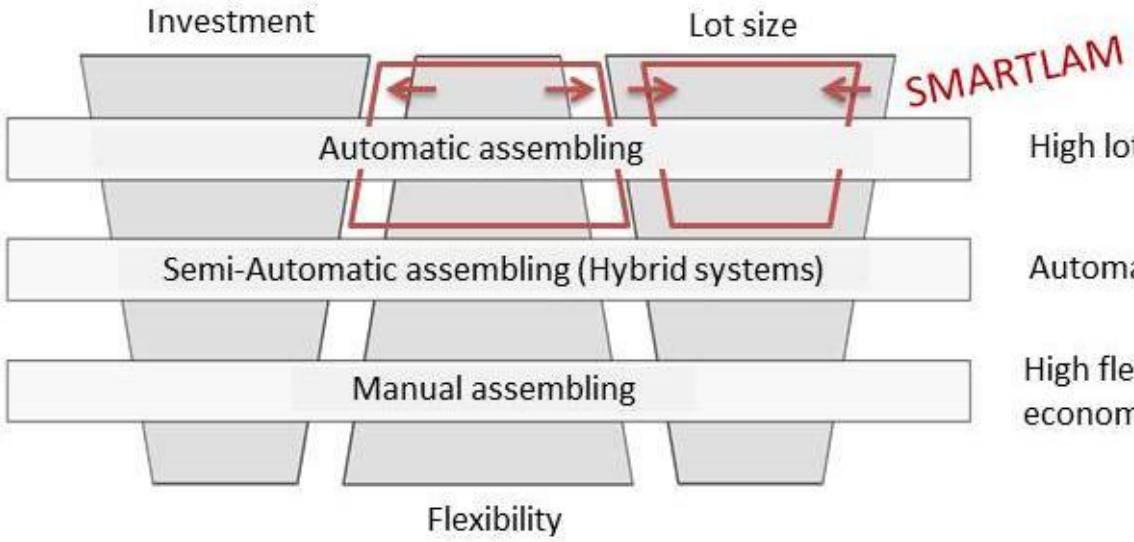
SMARTLAM: Modularity concept

- Smartlam 6 modules
  - Lamination
  - Laser welding
  - Laser structuring
  - Printing module (aerosoljet printing)
  - Assembly
  - Inspection



Targets	RTD		Applications
• Capability to rapidly produce complex 3D meachatronic micro systems • Increased flexibility and scalability of processes • Reduced energy consumption • Reduction of develop-ment and sale up time • Product quality improvement • Waste reduction and reduced impact on the environment	 3D-I Modelling & design approach  3D-I compatible production platform  SMARTLAM adaptive control and vision inspection	**SMARTLAM Platform modules** 3D- Aerosol inkjet printing  Laminating of polymer films   Micro laser cutting, milling, welding, sintering  Polymers with advanced properties	Towards Next Generation micro products that are: • Complex in geometry • Multi-Material • Three dimensional • Micro sized with nano features  **Consumer (sensor, user interfaces)**  **Bio-Medical (e.g.disposables, hearing aids)**  **Energy (e.g. Energy harvester, printed batteries, organic PV)**

Smartlam: Increasing Flexibility for small lot size



High lot sizes, high investment

Automation of quality related processes

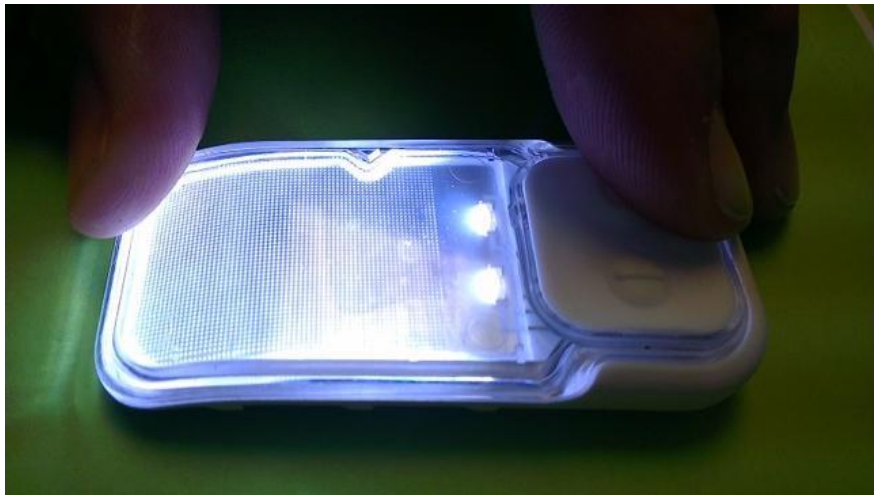
High flexibility, low investment, not economic for high lot sizes

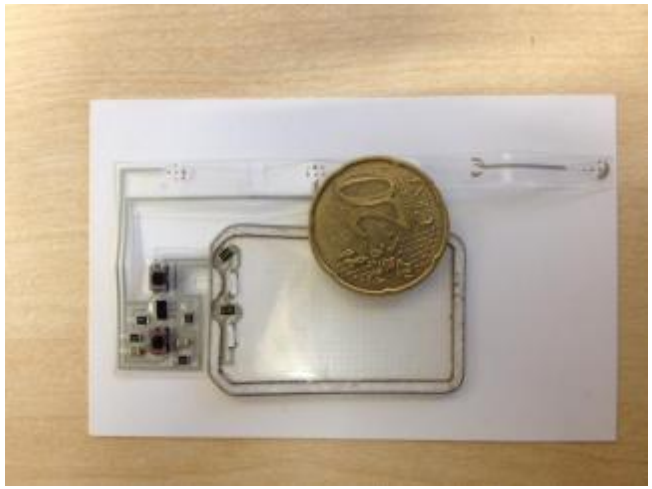
Abb. 1-2 Auswahlkriterien für Montagesysteme

Source: Lotter – Montage in der industriellen Produktion , original in German

DLED Lighting - APPLICATION

- Light source embedded into surgical instrument
- Product includes 1. planar light-guide LED chip source, electronic control, switch and power source
- Sealed and to have high hermiticity for medical accreditation.
- Custom size and light specifications for different surgical procedures
- Specification will evolve over time
- Disposable
- Cost/volume critical – e.g. Veterinary market



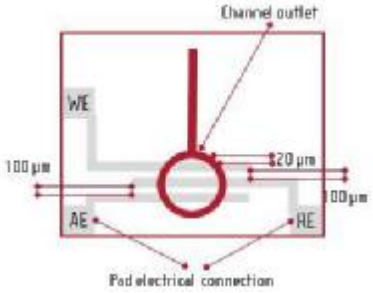


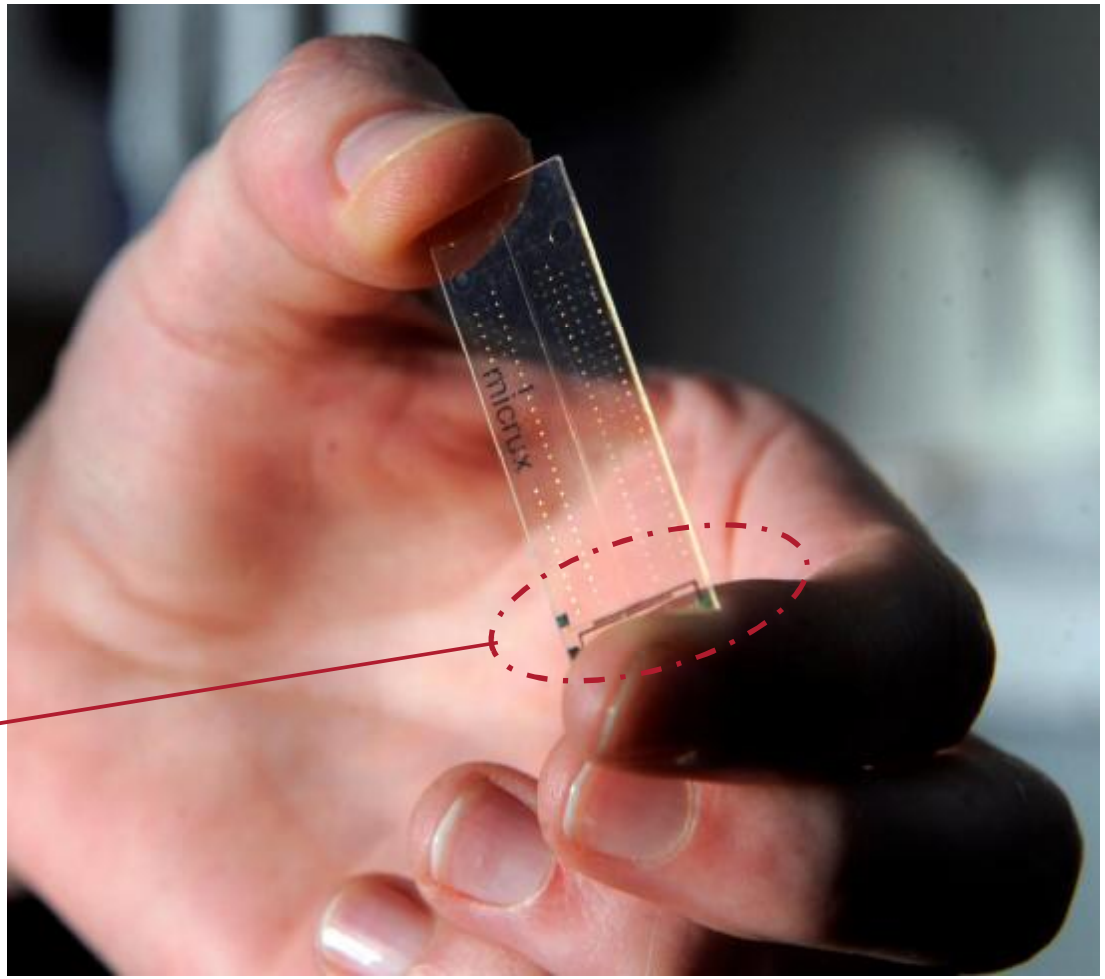
Microchips electrophoresis with electrochemical detection

PATENT:

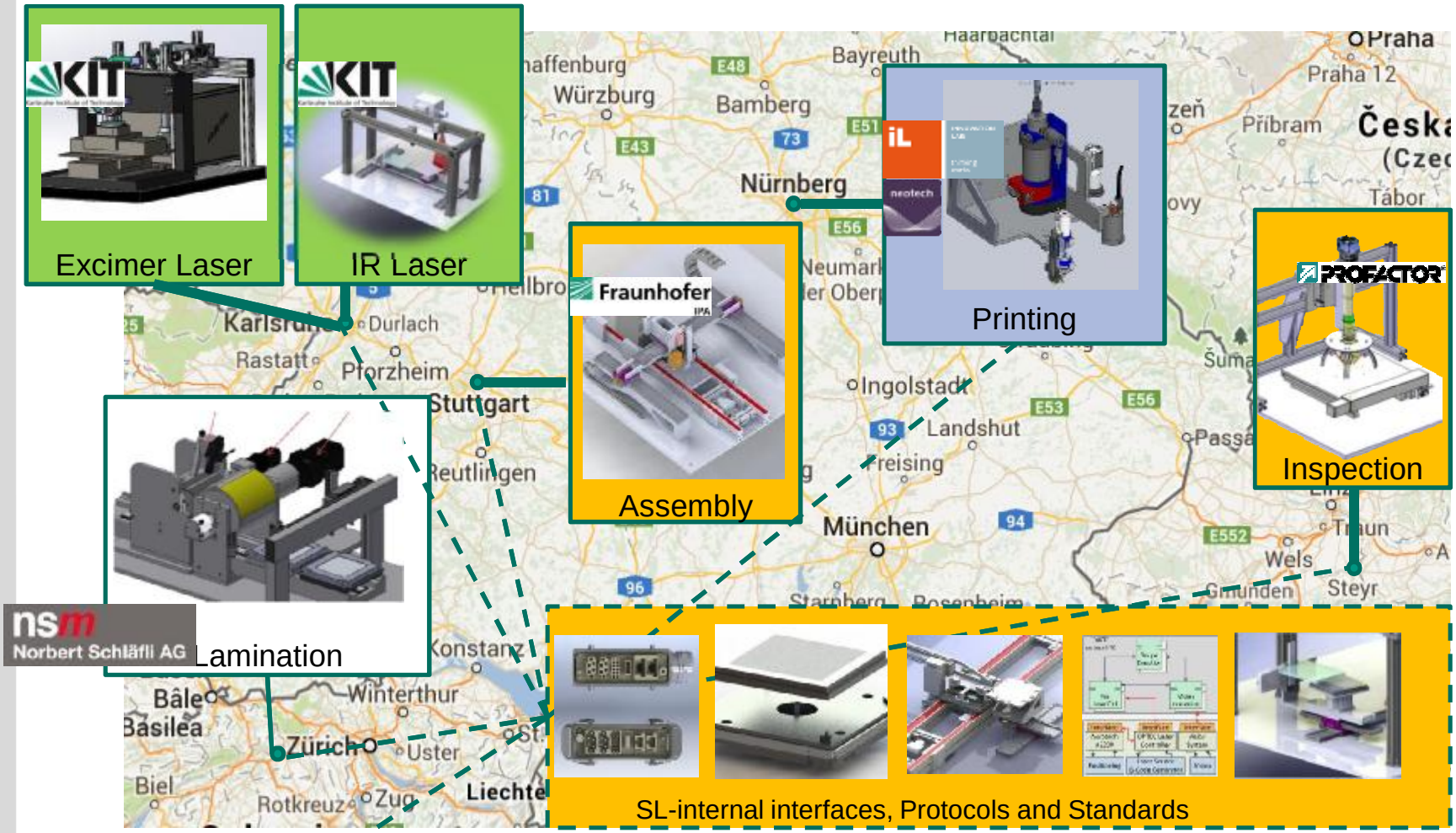
Application number: 200802006, Publication number: ES 2 320 619 (B1), Priority data: 30/06/08

A. Costa-García, M.T. Fernández-Abedul, M. Castaño-Álvarez, A. Fernández-la-Villa, D.F. Pozo-Ayuso. "Microchips capillary electrophoresis of resin EPON SU-8 with integrated electrochemical detection",





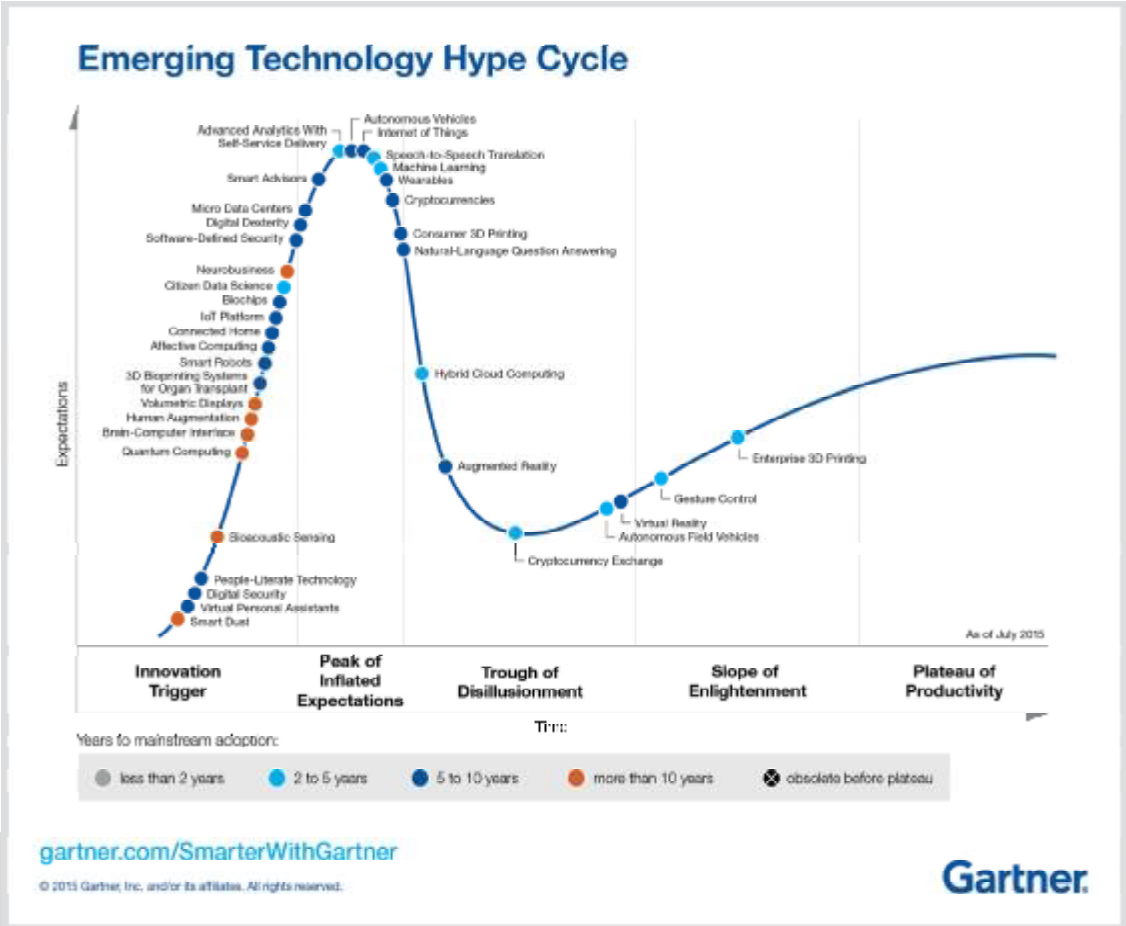
Demonstrator Setup: SMARTLAM Manufacturing Cells



The Future

Gatner Hype-Cycle

- In order to fully implement I4.0 all stakeholders (component suppliers, equipment manufacturers, factory operators, OEMs, users,…) should adopt it.
- Companies have to adapt (change business model) fast or may die.



Thanks a lot…