« Construction Equipment in an Agile World »

Session 1 „ Innovation in manufacturing processes ”
16th October 2014, Crowne Plaza -Antwerp

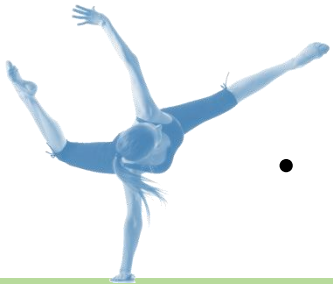
CECE Congress 2014 - 15, 16, 17 October - Antwerp, Belgium

« Innovation in manufacturing processess »

Panelists of the Session

« Innovation in manufacturing processes »

- **Mark Sweeny**, Vice President at Caterpillar Inc
- Industrie 4.0, the Aachen approach by **Axel Demmer,** Fraunhofer IPT, Former Head of the Fraunhofer Group for Production and head of the Fraunhofer Additive Manufacturing Alliance
- Smartfactory by **Dominic Gorecky**, Head of Human-Machine-Interaction Group at the Innovative Factory Systems Department, German Research Center for Artificial Intelligence (DFKI)
- How does additive manufacturing impact the manufacturing process and the design of construction equipment? by **Jan Geeraert,** Business Unit Manager, Technological Domain Advanced Manufacturing at Sirris, collective centre of the Belgian technology industry
- **Moderator : Chris Decubber**, Research Programme Manager, EFFRA



From the keynote presentation: **Win in Europe**

Requires talented people driving value by delivering best quality, highest velocity, lowest costs in region

Challenges & Opportunities

- Manufacturing Future Products
- Economic
- Social
- Environmental

Sustainability

FACTORIES OF THE FUTURE

Multi-annual roadmap for the contractual PPP under Horizon 2020

Prepared by EFFRA

European Factories of the Future Research Association
a MANUFUTURE initiative

Policy Research

Technologies & Enablers

- Advanced Manufacturing Processes
- Mechatronics for Advanced Manufacturing Systems
- Information & Communication Technologies
- Manufacturing Strategies
- Knowledge Workers
- Modelling, Simulation & Forecasting

Challenges & Opportunities

- Manufacturing Future Products
- Economic
- Social
- Environmental

Sustainability

Research & Innovation Priorities

Domain 1: Advanced Manufacturing Processes
Innovative processing for both new & current materials or products

Domain 2: Adaptive and Smart Manufacturing Systems
Innovative manufacturing equipment at component & system level, including mechatronics, control & monitoring systems

Domain 3: Digital Virtual & Resource Efficient Factories
Factory design, data collection & management, operation & planning, from real-time to long term optimisation approaches

Domain 4: Collaborative & Mobile Enterprises
Networked factories & dynamic supply chains

Domain 5: Human-Centred Manufacturing
Enhancing the role of people in factories

Domain 6: Customer-Focused Manufacturing
Involving customers in manufacturing value chain, from product process design to manufacturing associated innovative services

Technologies & Enablers

- Advanced Manufacturing Processes
- Mechatronics for Advanced Manufacturing Systems
- Information & Communication Technologies
- Manufacturing Strategies
- Knowledge Workers
- Modelling, Simulation & Forecasting

?

- **Main challenges**
- **Main opportunities**
- **Next steps - priorities**

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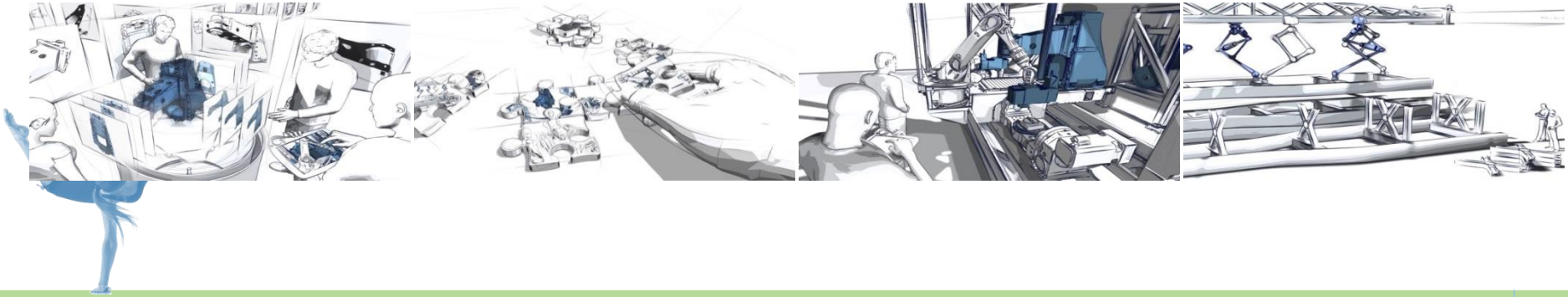
Industrie 4.0

Axel Demmer
Fraunhofer Institute for Production Technology IPT, Aachen (GER)



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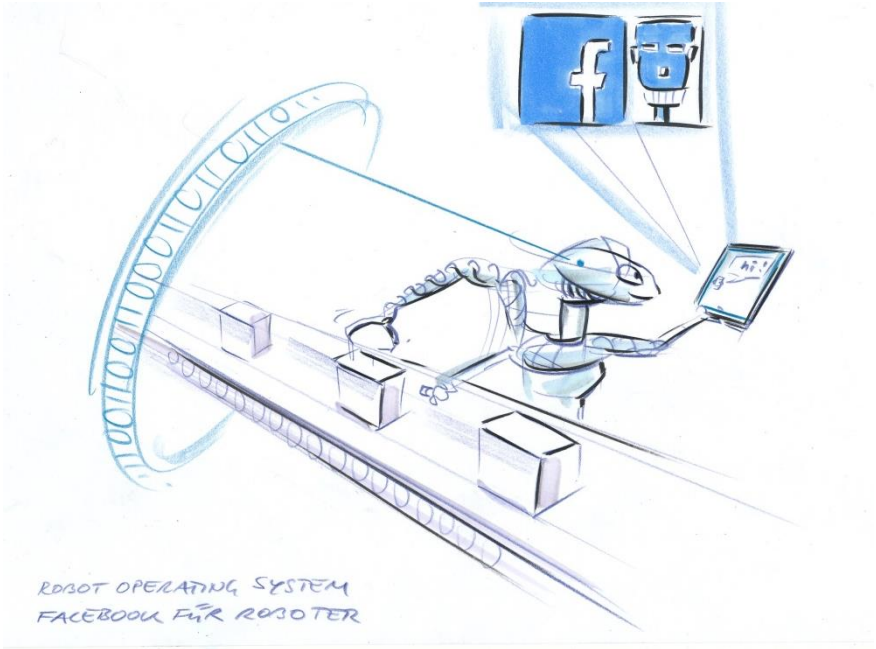

Industry 4.0
- from the Human and HMI perspective

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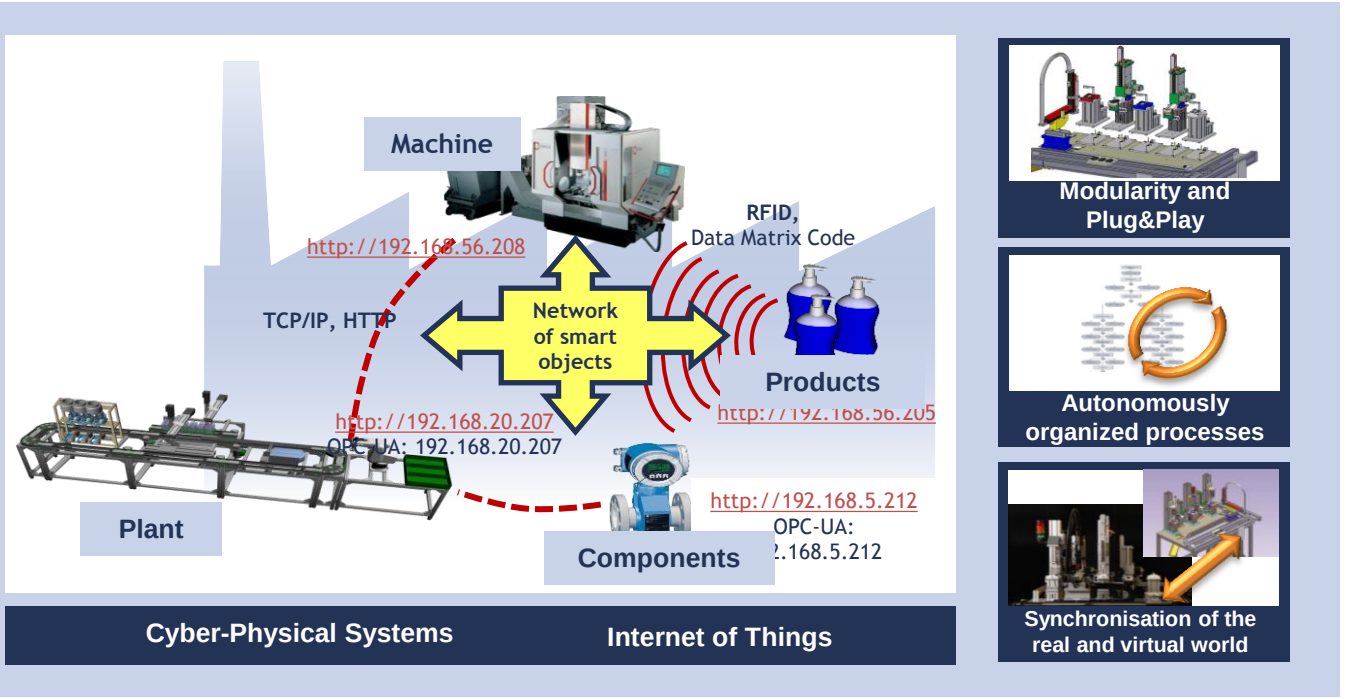
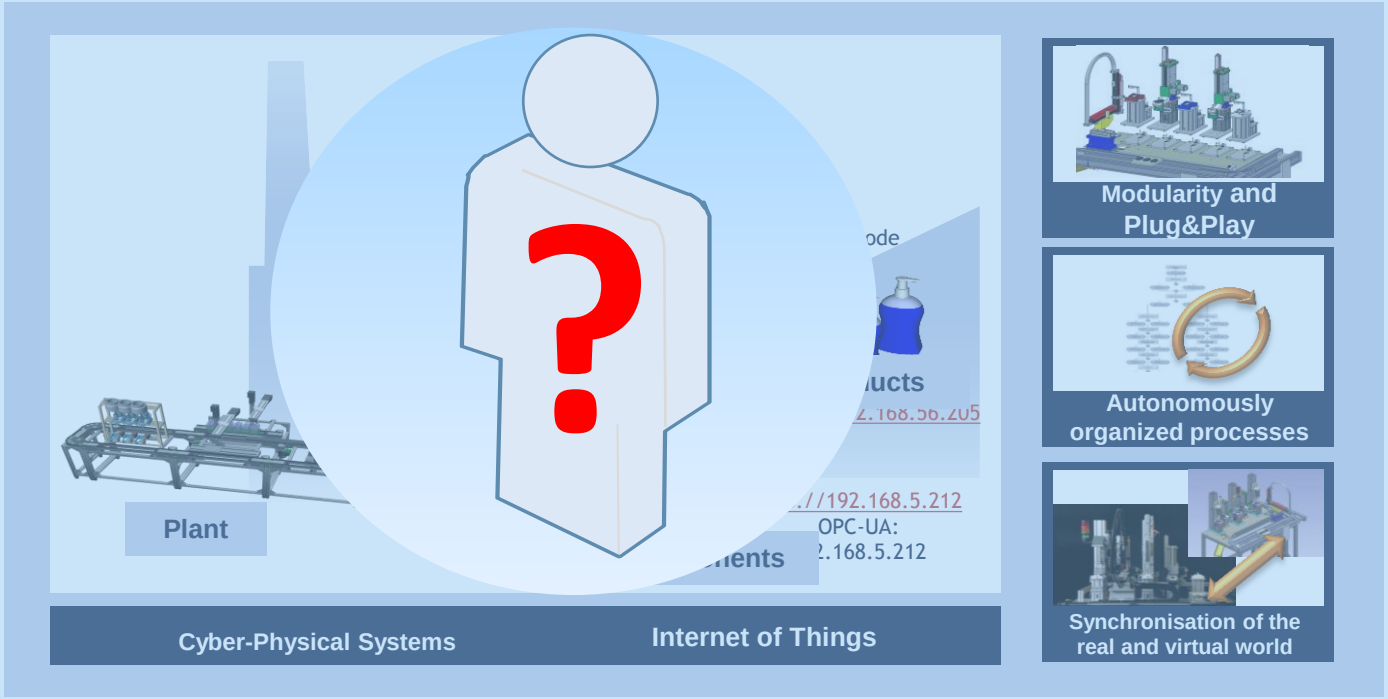
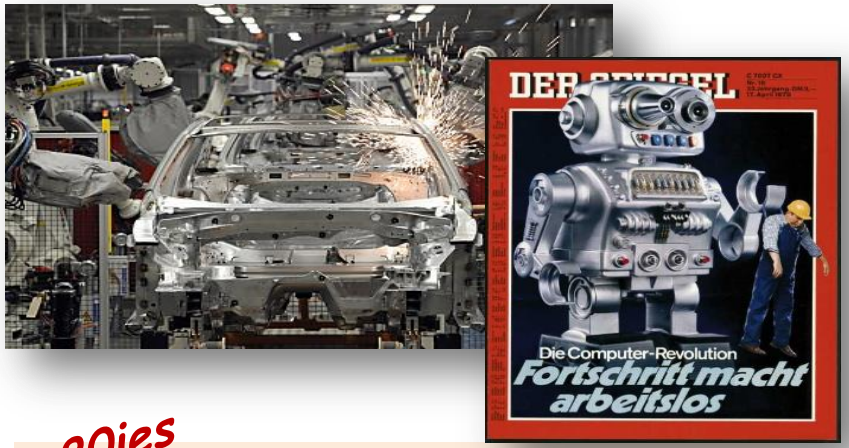
Paradigms of a Cyber-Physical Production System (CPPS)

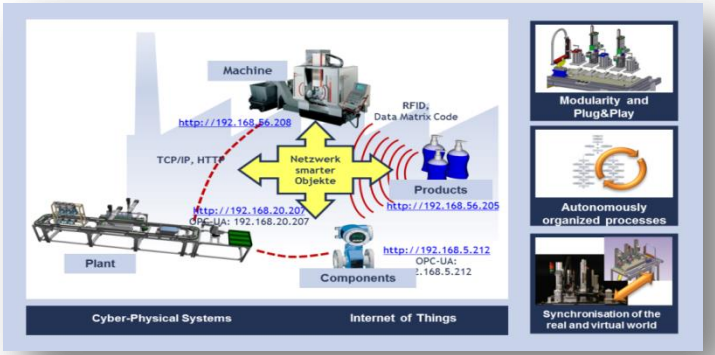


Paradigms of a Cyber-Physical Production System (CPPS)



Computer-Integrated Manufacturing (CIM) ≠ Industry 4.0





70-80ies

CIM-illusion:

man-abandoned factories

today

Industry 4.0:

the human in the middle?

Compared to machines,

humans are good at …

- Recognizing complex stimuli: pictures, voices, patterns, language etc.
- Associative memory
- Explaining phenomenons
- Improvisation and flexibility regarding new situations
- High learning ability
- Estimation
- Inductive conclusions

Compared to machines,

humans are limited at...

- Carrying out complex, multilayer tasks
- Short-term memory
- Big data storage
- Reliable, fatigue-free performance
- Physical strength
- Deductive conclusions

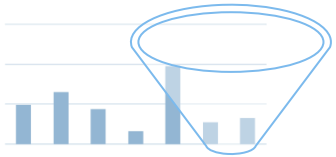
Cyber-Physical-Production-System - Control Loop

- Adapted production strategy
- Problem solution

Autonomously organized processes according a given production strategy

CPPS

Capture of comprehensive, real-time information



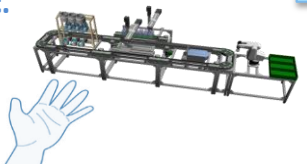
CPS

Aggregation and pre-processing of information

Human

Interpretation

Potential for Optimization
Error, Defect, etc.



Human

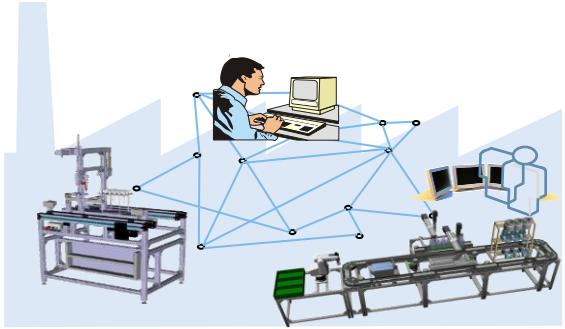
Intervention

take strategic decisions

monitor

intervene

FORMS OF INTERACTION IN A CYBER-PHYSICAL WORLD



long-cycle

Industrie 4.0

Today

Tomorrow

Trends in Manufacturing

Trends in Human-Machine-Interaction

. . .

Short-cycle

Advanced Visualisation & Interaction

Mobile devices such as *smartphones*, *tablets* and *smartglasses* are the main tool in dealing with CPS and the information provided by them.

Ability to operate via

- touchscreen
- language recognition
- gesture recognition

uni-modal multi-modal

Ruggedized Tablets

Siri, etc.

Leap Motion, Kinect, etc.

Smart Assistance Applications – Services

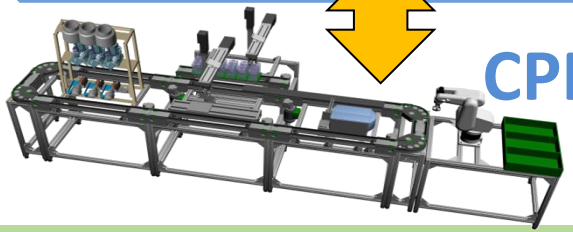
Communication:
E-Mail, Timeline, Microblogs, Instant-Messenger, Video-conferences & 'view-sharing'

Integration of Production-IT and Knowlegde Management

VR/AR as mediator

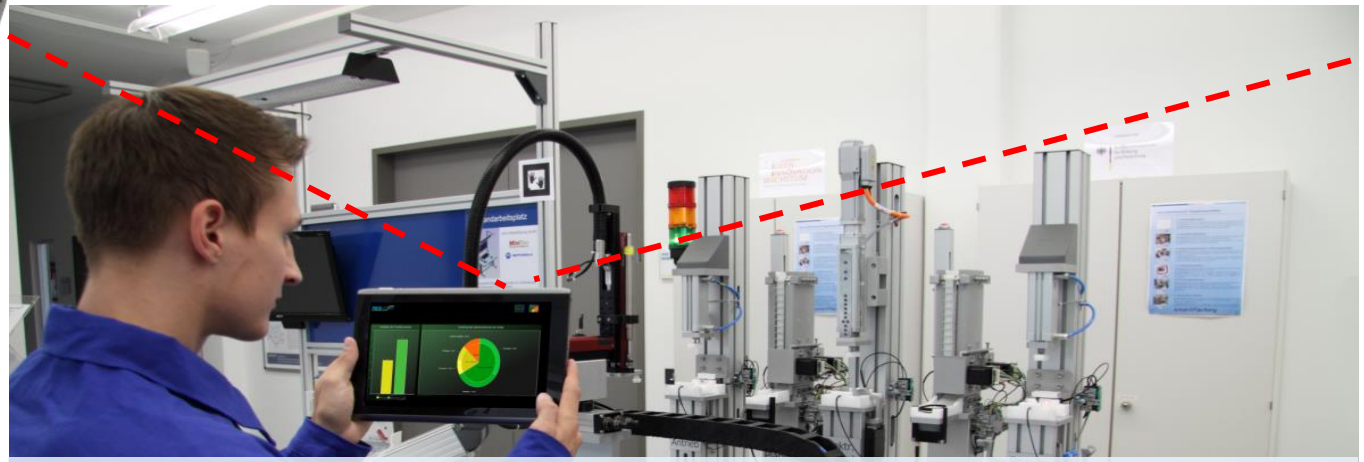
Assistance:
e.g. navigation & location-based content and applications

Interaction and device access:
Live-Data, Parameterization, etc.



CPPS

Smart Assistance Applications – Location /context awareness



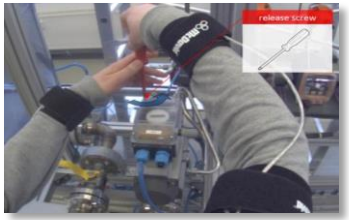
Requirements:

- **Location /context awareness:** Identify and evaluate position / context of components and human
- **Active information filtering:** Only relevant for information and interaction options are accessible.

no proprietary, fix control panels 1: m-access

Learn and Assistance systems

Support the human operator **in difficult, infrequent or previously unknown situations**


Development of adaptive, learning assistance systems:

- **mobile devices** and **advanced sensors** to detect and to characterize context and human action
- **Low-effort generation of workflow model**

Example 1 – Smart AR-Informationsystem

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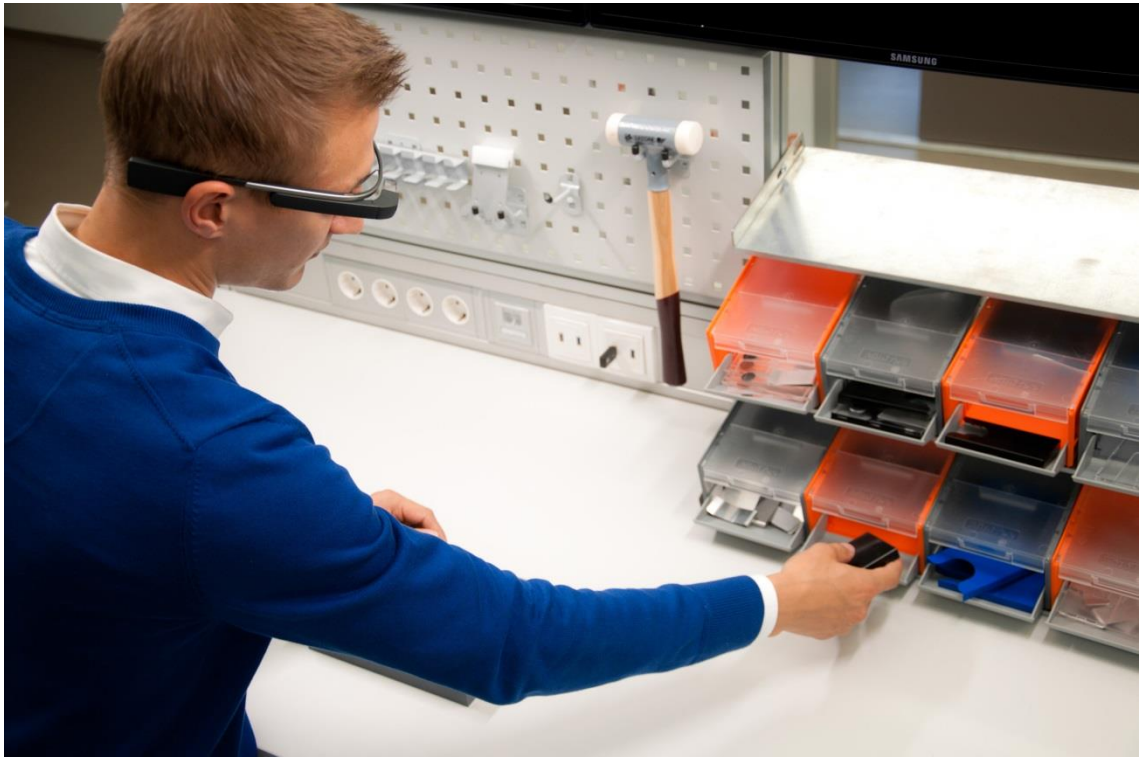
Example 2 – Manuel Workstation at the SmartFactory



Example 2 – Manuel Workstation at the SmartFactory

Example 3: Virtual Training - VISTRA

Example 3: Virtual Training - VISTRA

Thank you for your attention!

smartFactory KL

Dominic Gorecky
Deputy Head of Research
Innovative Factory Systems
DFKI GmbH

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How does additive manufacturing impact the manufacturing process and the design of construction equipment?

Jan Geeraert , SIRRIS Business Unit Manager – Advanced Manufacturing

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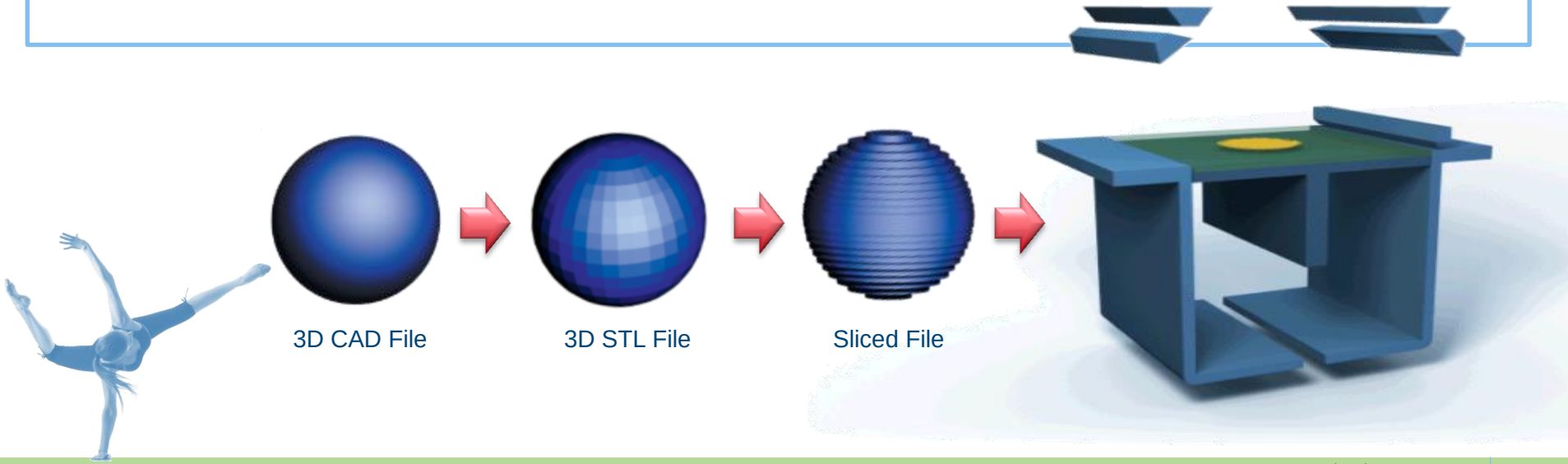
What is Additive Manufacturing?

- Manufacturing by material **additions** ≠ **substractive manufacturing**

- To transform a **3D process to a succession of 2D processes**



What is Additive Manufacturing for you today?

OR ?

Fu… …h
hi…

Low cost solution for personal use…

but low performance!

Design for AM – Engineering²

"This type of injector manufactured with traditional processes would take more than a year to make, but with these new processes it can be produced in less than four months, with a 70 percent reduction in cost."

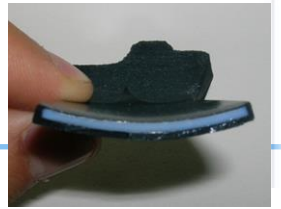
Situation of Additive Manufacturing in the world?

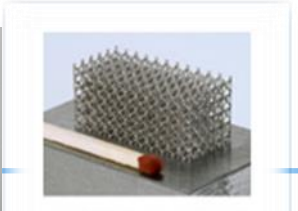
- Technologies : 7 categories of process

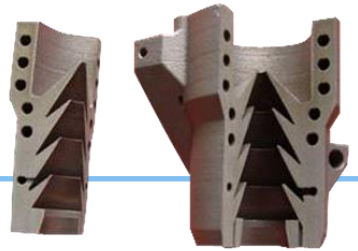
- Materials available:

Polymer | **Metal** | **Ceramics** | **Other…**

- A design revolution of product and process with beneficial effects !
  - Reduction of the time to market and cost optimization
  - Higher complexity of products possible
  - Customization without tooling costs (small series, …)
  - Environmental benefits
  - Localized production
  - …

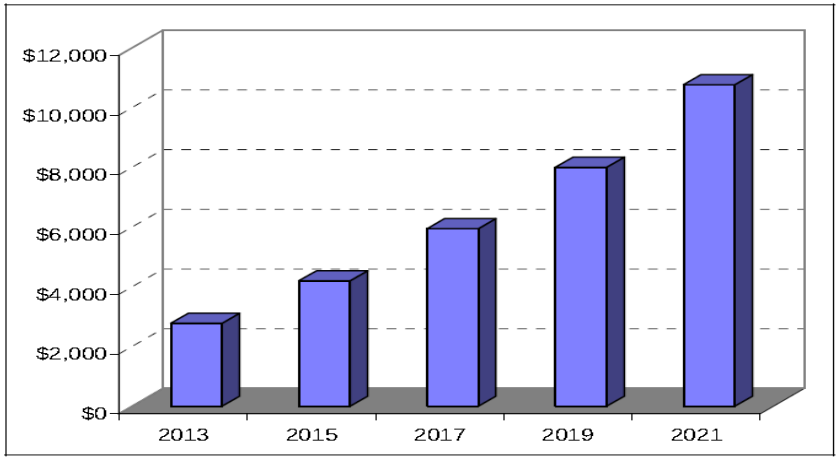




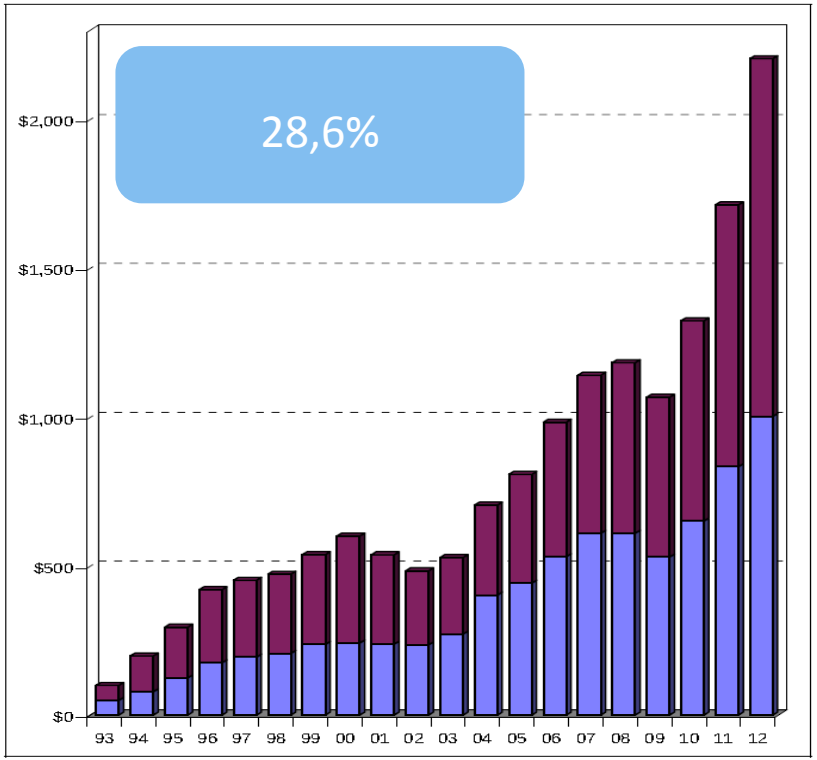


Situation of Additive Manufacturing in the world?

23 years of double digit growth



Source: Wohlers Associates, Inc.



Source: Wohlers Associates, Inc.

AM market expected to continue its double-digit growth:

- $1 billion level took 20 years
- $2 billion level took 5 more years
- $4 billion level is expected by 2015

Flying Cam case study

Unmanned helicopter

Initial Design:

Weight: 530gr

3 materials

Final Design:

Weight: 392 gr

1 material

Technology: LBM (MB Proto)

Topology Optimization

Additive Manufacturing

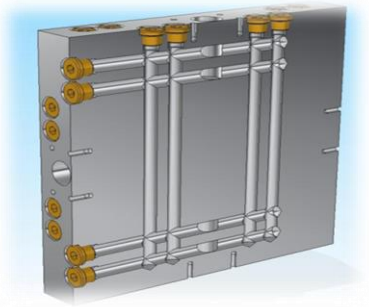
- 20% weight with the same mechanical performance and an easier assembly

Hydrauvision case study

Heat exchanger

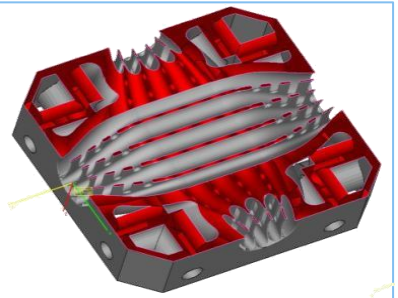
Initial Design:

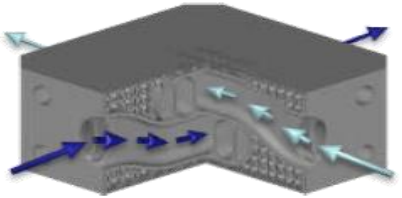
Weight: 19,2 kg
Dimension:
210 x 210 x 70mm
Volume: 2900 cm³



Final Design:

Weight: 0,74 kg
Dimension:
85 x 85 x 38mm
Volume: 244 cm³





AM design

Additive Manufacturing

- 93% weight with the same mechanical performance

- 92,3% pressure drop

Additive Manufacturing in construction equipment?

R&D - Validation, prototypes

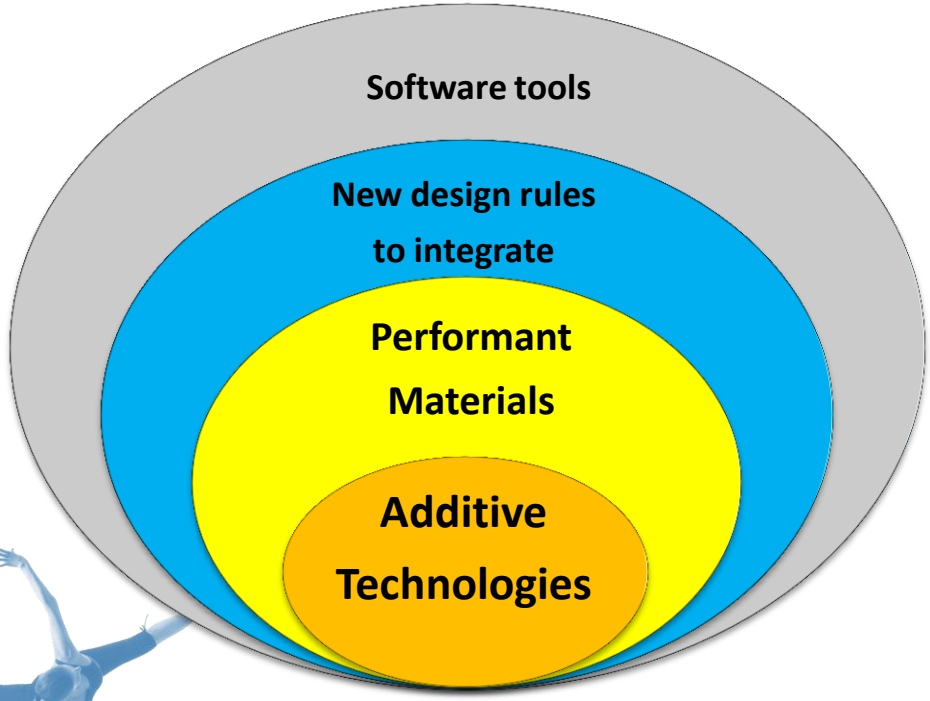
Direct Manufacturing

- Lightweight parts – Lattice structures
- Internal channels (heat exchanger)
- Complex structures (improvement of performance)
- Gradient structures and coating finish
- …

- Wax and lost models by 3D Printing
- Sand tooling (Voxeljet)
- Quick cast models
- …

And … ?

Additive Technologies … a performant tool to increase competitiveness.



Use of software to help R&D

Think AM and you will innovate

A large range of materials (polymer, metal and ceramic)

A large range of available technologies

Thank you for your attention

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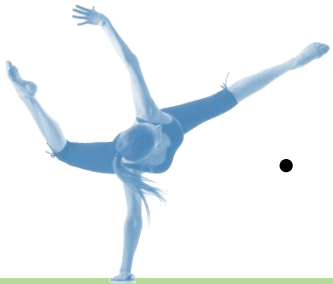

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?

- **Main challenges**
- **Main opportunities**
- **Next steps - priorities**

- **Challenges**
  - Responsiveness to market dynamics
  - Associating the right solutions (technologicial and organisational) and deploying them rapidly

    Also includes the challenges on skills
  - Resources
  - Address challenges with an integrated approach (also from the technological point of view)
    - Example: I4.0 and how Humans add value within a cyber phycisal manufacturing environment
    - Integrate disruptive approaches (such as additive manufacturing) with legacy approaches

Date: 16/10/2014

- **Opportunities**
  - Construction equipment industry is delivering a manufacturing system

    Many challenges and technologies in common

    Hence the ‘feeling’ and knowledge about manufacturing approaches and embedded technologies be used for innovating own manufacturing facilities (to a certain degree)
  - Europe has a strong record in terms of manufacturing equipment → still big potential to be strong in manufacturing in Europe

- **Next steps - priorities**
  - Plan the transformation of the factories (migration path) – but it is a dynamic plan
  - Integrate the innovative approaches and the associated teams
  - Engage in technology demonstration activities – involving other machinery sectors as well

COFFEE BREAK PM - 16 October 2014

SSAB

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