Implementation of Industrie 4.0 in an industrial Company

Example thyssenkrupp

engineering.tomorrow.together.
In the past the focus was on productivity only –
In future connecting value chains is a key success factor
thyssenkrupp's innovation strategy

Resource Efficiency
- Raw Materials
- Energy
- CO₂

Sustainability
- Products and Solutions
- ThyssenKrupp’s Production

System Optimum vs. Local Optima

Leading edge technology
- Products
- Processes

Cycle economy

Sustainability includes economical, social and environmental aspects
thyssenkrupp will use the digital technologies available to create a competitive advantage.

In the past, industry was focused on productivity –
In future, the connection of value chains will be the key of success.
SCENARIO 1: “Flexperience“

PEOPLE & LIVING
People are highly experience driven in every moment of their life and like to move and be active. In this world no daily routines exist. The work environment is flexible and offers self-fulfillment for the people.

MOBILITY INFRASTRUCTURE
Buildings have diverse purposes and are seamlessly connected within one system. In this world a flexible and seamless infrastructure between buildings enables an individual last mile.

MOBILITY BEHAVIOR
Mobility is more than getting from A to B – it’s a platform to do sports, shop, interact etc. Mobility is shared and diverse to offer people the flexibility for their diverse demands.
### External perception: thyssenkrupp is one of the 50 “smartest companies” 2015

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<thead>
<tr>
<th>Rank</th>
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*Quelle: MIT Technology Review 2015*
Digital Transformation
Success of the digital transformation depends on three elements

- Internet Business
- Industrie 4.0 / Industrial Internet of Things
- Big data / Predictive Analytics

Nobody needs the Digital Transformation, if it has no added value!
thyssenkrupp trades materials in the U.S. since many years online!
Internet Business

„materials4me“ is an additional sales channel for thyssenkrupp Material Services

What we offer

Quality metals & plastics despatched same day.

Conventional and new customers 24/7/365 can buy materials online. Delivery by the existing logistic chain.
Steam engine

1. Industrial Revolution

Dampfhammer „Fritz“ (1861)
2. Industrial Revolution

Lawn mower production (1930s)

Source: Historisches Archiv Krupp
Implementation of Industrie 4.0 in an industrial Company

Reinhold Achatz

Automation

3. Industrial Revolution

Automated production line with robots (1989)

Source: Historisches Archiv Krupp
Industrie 4.0: Project „Installation-Monitoring“
Transformation of Industry was driven by value creation

What value is created by the fourth industrial revolution?

1. Industrial Revolution

Pig iron production in England [t]¹

100,000t

1780

2. Industrial Revolution

Chassis production time Ford Model T [min]

Before and after the implementation of conveyer belts²

12:30 h

13:30 h

1870

1913

1914

3. Industrial Revolution

Robots sold per year³

1 unit

160,000 units

1961

2012

Industrie 4.0 - ThyssenKrupp‘s Objectives

Seamless communication and integration of processes allows to …

- React more flexible on customer requests
- Reduce cost
- Increase quality
- Increase throughput
- Reduce environmental foot print
The three core elements of the implementation strategy of Industrie 4.0 at thyssenkrupp – ERP, MES, and PLM – are preconditions.

ERP = Enterprise Resource Planning
MES = Manufacturing Execution System
PLM = Product Lifecycle Management
Implementation at thyssenkrupp
Digitalization starts with Description of Business Model and Process Design

1. Business Model / Process design
2. Process redesign / Detailed process description
3. IT-Transformation
   unTe @ BAs
daproh @ BAs
Example: System Engineering
Seamless Engineering on Site

On Site Monitoring System

Service Order handling:
- Spare part handling
- Retooling
- Relocation
Virtual Commissioning
Integrated Engineering

Controls / PLC

- HMI
- SPS

Realtime Simulation incl. Bus Simulation

Visualization

- WinMOD

3D-Visualization
Simulation of Material Flow / Logistics
Original Robot Programs
Save Human Robot Collaboration to Increase Flexibility and Productivity

Robot Cell

Clear separation of human and robot / robot does not recognize the human worker.

Human-Robot-Collaboration

Collaboration between human and robot / The robot recognizes the human person
Example: Cam shaft production
Smart Factory

Example: Real time controlled assembly and machining of camshafts to avoid errors and reduce cycle time

Status of previous machine and update of process parameters

Assembly

Trueing

Grinding
Example: Steel Europe
Horizontal Integration - Cross Factory Exchange
Medium-wide-strip steel production at Hoesch Hohenlimburg

Main customers

Cold rolling industry

Automotive industry
Horizontal integration - Cross factory / cross company exchange
Costumers control their orders - thyssenkrupp reduces assets and increases throughput

Slab production at HKM (vendor)

thyssenkrupp Hoesch Hohenlimburg

... defines start of production

Customer

Production of medium wide strip steel

Slap casting

... defines product details

IT-System and business processes

... books orders directly into system

thyssenkrupp Hoesch Hohenlimburg

Costumers control their orders - thyssenkrupp reduces assets and increases throughput

26 | 2016-04-22 | Tokyo | Implementation of Industrie 4.0 in an industrial Company | Reinhold Achatz
Big Data: Transparency
Example: Data are available in real time

All employees have access to data from a single source
Big Data and Predictive Analytics

The analysis of structured and unstructured data allows to get more information.

Today we are analyzing what happened in the past, with predictive analytics we can use historical data to predict the future.

Examples for projects in progress:
- Price prediction
- Optimize material on stock
- Predict quality of end product by analyzing production data of the parts
- Predictive maintenance
- Analyzing social media

Today we are only using a fraction of the available information.
Great opportunities by utilization of the already available information/Big Data!
Example: Material Services
Optimization of stock turn
Optimization the use of loading and unloading slots for trucks

Just-in-time-delivery.
Inventory and stock management.
Supply-Chain-Management.
Example: Elevator maintenance
Example Elevator Maintenance: Big Data / Analytics
thyssenkrupp Elevator and Microsoft cooperate in data analysis

Technicians at thyssenkrupp's call center in Seoul, South Korea

Goal: Increasing the efficiency of maintenance and services for thyssenkrupp's elevators
Big Data and Predictive Analytics
Optimization of services at thyssenkrupp Elevator (MAX)

Blue Box has a standardized interface to the cloud

Blue Box

tk E Software

TCP/IP
GSM/POTS
standardized interface

Microsoft Cloud Services

ERP*

* *) ERP: Enterprise Resource Planning
Big Data and Predictive Analytics
Example: Production of electrical steering systems

Objective: Prediction of the quality of an assembled system by analyzing the production data of the parts
Trust and Security are Preconditions

With Industrie 4.0 all data of a company are digitally available. Therefore cyber security is a precondition.

The extended exchange of data and information between factories or even companies requires a high level of trust.
Industrial Data Space
Secure data exchange between companies
The Industrial Data Space aims at a »Network of Trusted Data«

- **Trustworthiness**
  - Certified Members

- **Decentralization**
  - Federated Architecture

- **Openness**
  - Neutral and User-Driven

- **Scalability**
  - Network Effects

- **Sovereignty**
  - Data and Services

- **Security**
  - Data Exchange

- **Governance**
  - Common Rules of the Game

- **Ecosystem**
  - Platform and Services

Source: Fraunhofer
Industrial Data Space
Architecture principal

Source: Fraunhofer
Digital Transformation/Industrie 4.0 creates significant challenges for enterprises and employees
New business models will be feasible by digital transformation

<table>
<thead>
<tr>
<th>Today's business model</th>
<th>Future business model</th>
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<tbody>
<tr>
<td>Cars are sold to the end customer</td>
<td>Customer buys a mobility solution from A to B</td>
</tr>
</tbody>
</table>

Quellen: http://www.pkw.de/ratgeber/auto-verkaufen/auto-verkaufen-tipps/main.jpg (links), deinewege.info (rechts)
Digital technologies and new business models will change all industries. The classical business have a fair chance to be the winner of the digital transformation, if they use the new opportunities proactively.
Thank you for your attention!