THE FOURTH INDUSTRIAL REVOLUTION AND TEN THESES ON DIGITALIZATION

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The fourth industrial revolution

FIRST Industrial Revolution
- Introduction of mechanical production facilities with the help of water and steam power

SECOND Industrial Revolution
- Introduction of division of labor and mass production with the help of electrical energy

THIRD Industrial Revolution
- Use of electronic and IT systems that further automate production

FOURTH Industrial Revolution
- Production technology, advanced materials, automation and digitalization
What is on the agenda today?

What are the potential benefits of digitalization of production and automation of supply chains?

What are the Danish initiatives on advanced manufacturing and how can industry and academia collaborate?
Outline of the talk

- Introduction to Industry 4.0
- The Digital Economy
- Smart Production
- Reindustrializing Denmark
- Digital Transformation
- Summary and conclusions
ICT technologies converging to the Internet of Things

Global GDP ~$70 Trillion

Developing Economies $29 Trillion
- Non-Industrial Economy $18.1 Trillion

Advanced Economies $41 Trillion
- Industrial Economy $10.8 Trillion
- Industrial Economy $9.7 Trillion
- Non-Industrial Economy $31 Trillion

Other $14.3 Trillion

Other $23.1 Trillion

Industrial Internet opportunity ( $32.3 Trillion ) 46% share of global economy today

Source: World Bank, 2011 and General Electric

From: Evans and Annunziata, 2012
The Economics of Digitalization: Value Drivers

Source: CISCO, 2013

IoE Value at Stake: $14.4T
(2013-2022 10-year NPV)*

21 use cases

- Asset utilization: $2.5T
  - SG&A and CoGS reduction from improved business process execution
  - Improved capital efficiency

- Employee productivity: $2.5T
  - Improved labor efficiency
  - Fewer or more productive person-hours

- Supply-chain / logistics efficiency: $2.7T
  - Improved process efficiency
  - Reduced waste in supply chain

- Improved customer experience: $3.1T
  - Improved customer lifetime value
  - Additional market share (more customers)

- Innovation: $3.0T
  - Improved RD&E speed, reduced TTM
  - New business models and new sources of revenue

* Net present value
SMART PRODUCTION
Everything gets smart...

Smart Phones

Smart Homes

Smart Cars

Smart Factories

Source: Zülke, 2013
Computers in industry is not really a invention

- IT and Computers in industry is not really a new thing
  - Remember CIM?

- However, Industry is lagging behind on digitalization
  - Replacement of the steam engine with electrical motors

- Technological Singularity
  - Moore’s Law
  - Metcalf’s Law
  - Convergence

- We cannot predict the future!
Technology, Evolution and Innovations…

- Predictions about IT
  - “I think there is a world market for maybe five computers.” - Thomas Watson (Chairman of IBM), 1943
  - “There is no reason anyone would want a computer in their home.” - Ken Olsen (CEO, Digital Corp.), 1977
  - “The internet is just a passing fad.” – Bill Gates (CEO, Microsoft), 1995
REINDUSTRIALIZATION
Manufacturing Academy of Denmark (MADE)

**Denmark** - the most competitive manufacturing country in the world
National (Re-) Industrializing Programs

- General Electric
  - Industrial Internet Consortium
- Germany
  - Industrie 4.0
- US
  - Smart Manufacturing
- India
  - Make in India
- Netherlands
  - Smart Industries
- Sweden
  - Produktion2030
- Denmark
  - Manufacturing Academy of Denmark (MADE)
Manufacturing in Denmark?

- Industrie 4.0
  - DFKI
  - Hannover, 2011+
  - German Government and Industry (200 mEUR)

- The Vision of Industry 4.0
  - Smart Factory

- Germany
  - As the biggest market
  - With the best vendors

- Danish industry 2000-2010
  - BVT
    - 16,5% -> 12,5%
  - FTE
    - -110.000 (25%)

- Manufuture
  - Produktion 2025

- Manufacturing Academy of Denmark (MADE)
  - 5 Universities
  - 2 Technological Institutes
  - 50+ Companies
# MADE/SPIR Platform for Future Production

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## Digitalization of Supply Chains and Smart Production

### Vision
- We want to enable the rapid design, implementation and evaluation of innovative value creating automated digital business solutions in the supply chain.

### Platform
- Platform for experiment with new technologies and concepts
- Zero investment, low cost and low risk
- Rapid and live prototyping
- Exploring and learning
- Roadmap for scaling
SAP/Festo Cyber Physical Research and Learning Factory
DIGITAL TRANSFORMATION
The Internet of Everything

Networked Connection of People, Process, Data & Things

People
Connecting people in more relevant, valuable ways

Process
Delivering the right information to the right person (or machine) at the right time

Data
Leveraging data into more useful information for decision making

Things
Physical devices and objects connected to the Internet and each other for intelligent decision making

Source: CISCO, 2013
Ten theses on digital transformation

Source: Møller, 2015
Vision: Digital Transformation

• The journey towards the future of digital manufacturing will be an **evolutionary process**
• Current basic technologies and experience will have to be **adapted** to the specific requirements of manufacturing engineering and **innovative solutions** for new locations and new markets will have to be **explored**
• Achieving the benefits from digital manufacturing is a long-term endeavor and will involve a gradual **experimental learning** process involving both **technology, systems** and **management** processes
• For a company it will be key to ensure that the value of existing manufacturing systems is **preserved**
• At the same time, it will be necessary to come up with migration strategies that **deliver benefits and productivity** from an early stage.

Kagermann, Wahlster & Helbig, 2013
SUMMARY AND CONCLUSIONS
Case: Automotive
Reflections from the back of the theater

- The potentials are high, but so are the risks!
- We don’t want to talk about
  - Failed IT projects
  - Security and trust
  - And of course over-engineering
  - …
Thanks for your Attention

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