Topics:
**Discover the Factory! (Industry 4.0)
NOTES FOR THE LECTURER**

14/7/2020

Workshop structure

- Manufacturing today
- Factories today
  - What is made in factories?
  - GAME: Guess what is being made in the video
- Four Industrial Revolutions
- Industry 4.0
  - Main Ideas
  - Smart Factory
  - Predictive Maintenance
  - 3D Printing
  - Smart Sensors
- Discussion and Future Challenges

Background

- The workshop focuses on two things:
  - It firstly emphasizes that a lot of products in everyday life are made in factories – including food, electronics and pens. At the end of this part, participants should be aware that nowadays most of the things surrounding them are products of manufacturing.

  - The main goal of the presentation is to explain how manufacturing has changed and what the current industrial transformation in form of Industry 4.0 brings. The past three industrial revolutions are presented. The Fourth industrial revolution is then explained together with its most important applications.

Understanding the topic

- All slides have PowerPoint notes including recommendations what to say. Sometimes it provides links to good sources of background information for the le...
- Part of presentation is also the video *Skoda_industrialni_milníky.mov* (attached separately). It can be played either before the presentation, after slide 21 or at the end.

- **Industry 4.0**
  - **Germany Trade & Invest: INDUSTRIE 4.0 SMART MANUFACTURING FOR THE FUTURE**
  - It can be downloaded here: https://www.manufacturing-policy.eng.cam.ac.uk/documents-folder/policies/germany-industrie-4-0-smart-manufacturing-for-the-future-gtai/view
  - **BCG's Embracing Industry 4.0 and Rediscovering Growth**
  - https://www.bcg.com/en-ru/capabilities/operations/embracing-industry-4.0-rediscovering-growth.aspx
- **Smart Factory**
  - Explanatory video (with Predictive maintanance, Digital twin and security issues mentioned as well):
  - https://www.youtube.com/watch?v=k3sIL2Z7Gv8
  - * If you have time, it can be screened to participants of the workshop too.
- **Digital twin**
  - A good video: https://www.youtube.com/watch?v=fEI5oz33Ia8

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Discover the Factory!

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Factory
Car factories today

- Automated:
  - Manufacturing of components and subassemblies

- Not fully automated:
  - Assembly

Factories today
What is made in factories?

- Cars
- Airplanes
- Cell phones
- Pens
- Headphones
- USB cords
- Food production – sweets, drinks…

- Any other examples?   >>> DISCUSS

GAME:
Guess what is being made in the video!

- A picture or video showing making of particular product will be played.
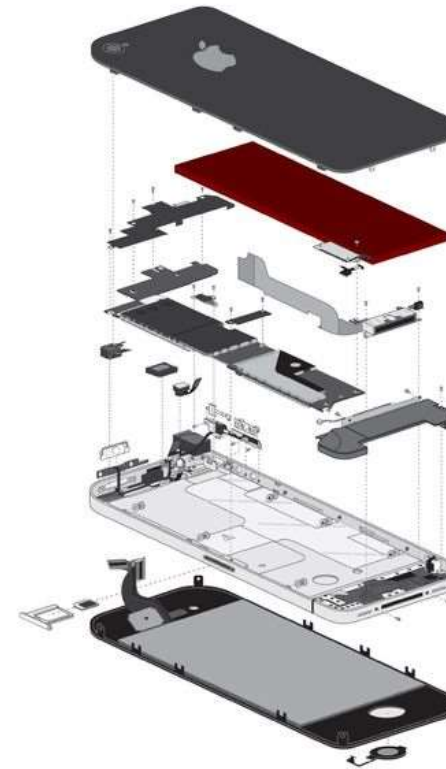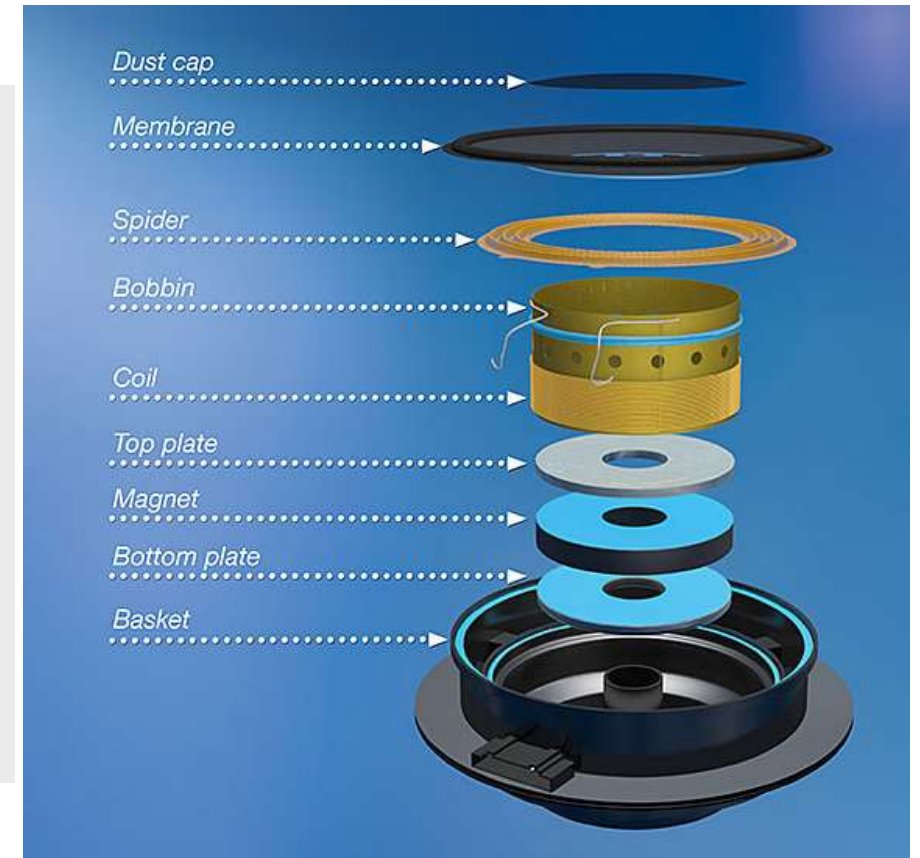- If you know what it is, raise your hand and share your guess.
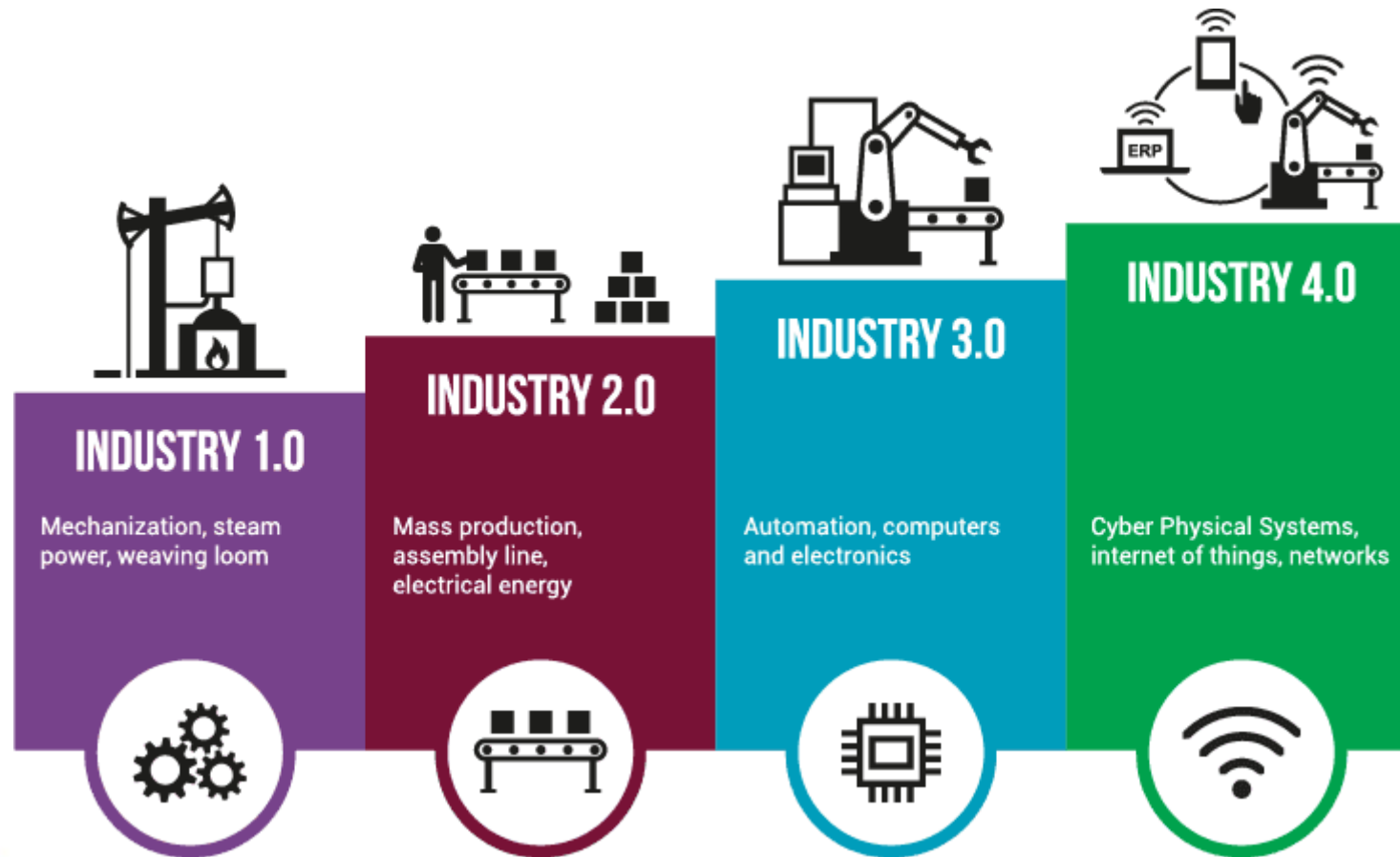
Pasta

Smartphone cover

Loudspeaker

Dust cap
Membrane
Spider
Bobbin
Coil
Top plate
Magnet
Bottom plate
Basket

Source: https://youtu.be/Qd09PRfMlv0

Box of chocolates

Fountain pen

Industrial revolutions

Industrial Revolutions

- Video: Skoda_industrialni_milníky.mov (attached separately)

1ˢᵗ Industrial Revolution
Introduction of steam

- Steam/water-powered machines replace human power and hand work
- Efficiency of steam engines increases
- Iron production easier with introduction of coke
- First machine tools are invented

Machines driven by belts from an overhead lineshaft

A late version of a Watt double-acting steam engine

2nd Industrial Revolution

Introduction of electricity
Specialization of workers

- Beginning of electrification
- Electrically-powered mass production
- Manual workers perform one operation (specialization of the workers)
- Moving assembly line - constant material flow, workers perform one specific operation of the manufacturing process
- Large scale steel production
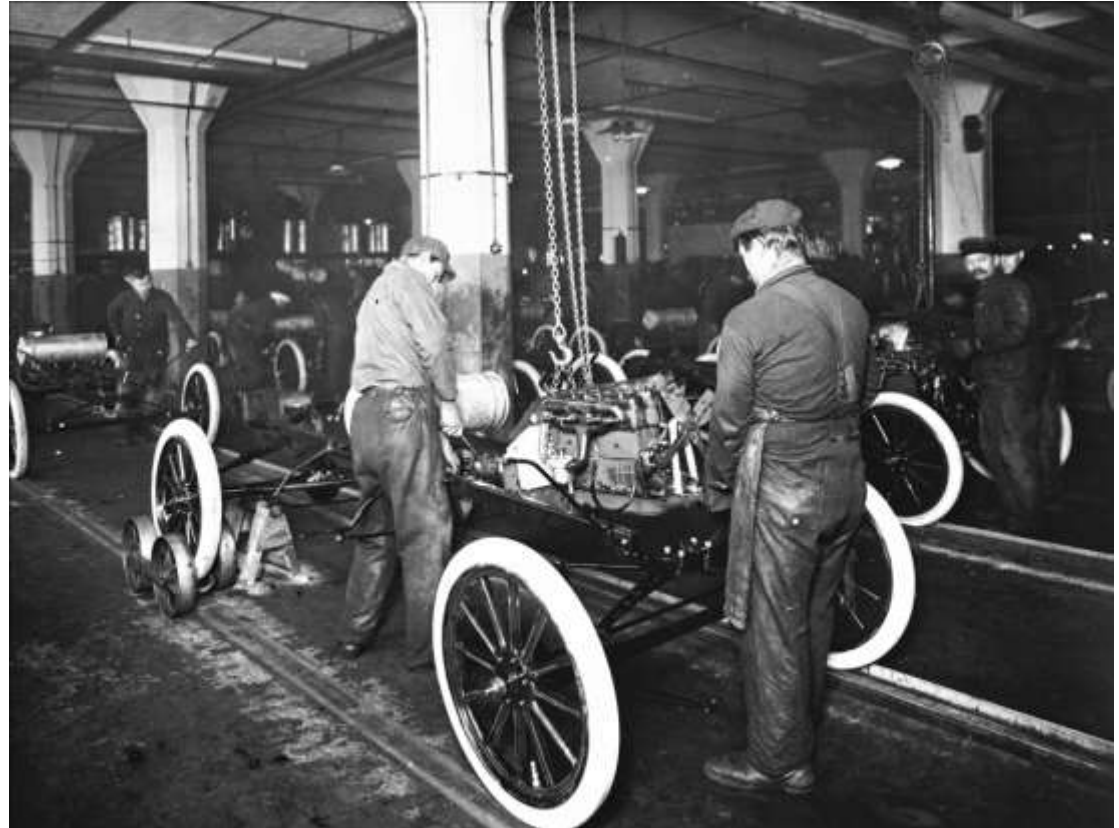
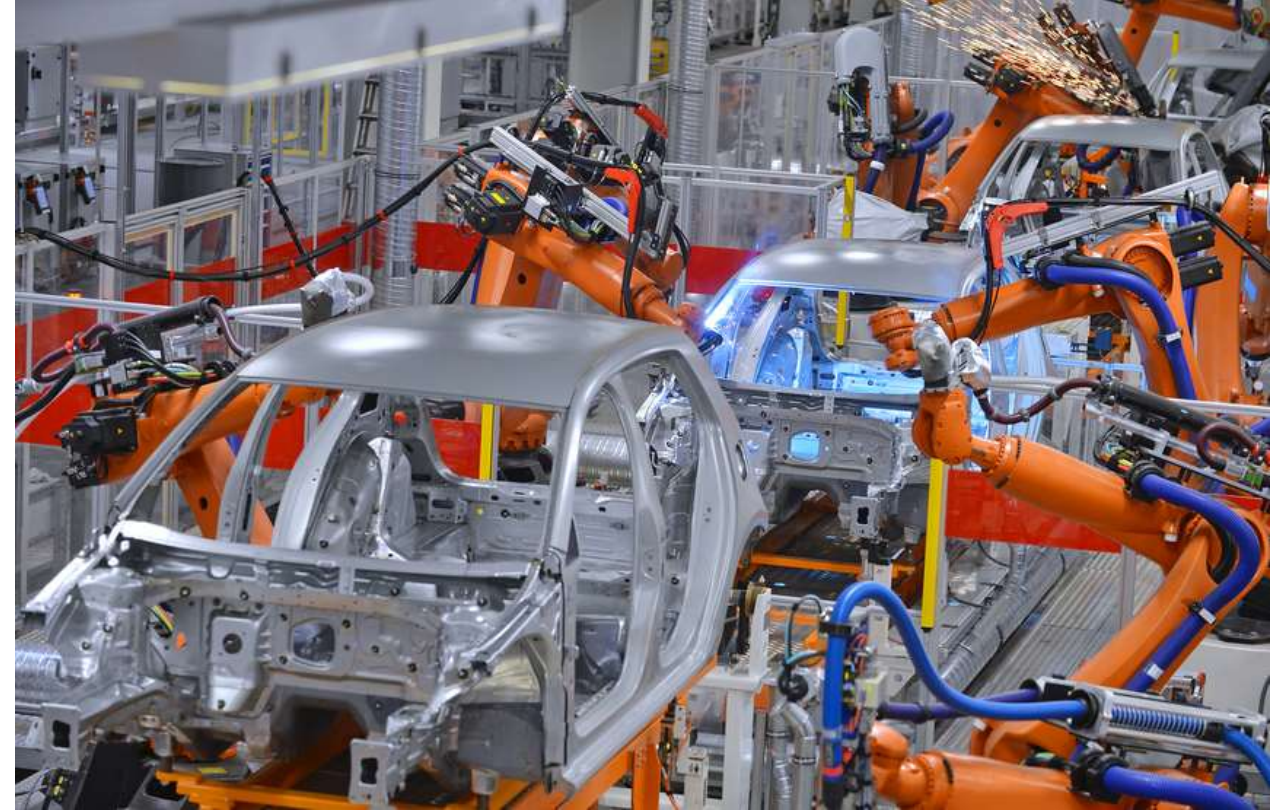Moving assembly line of Ford Model T

3rd Industrial Revolution
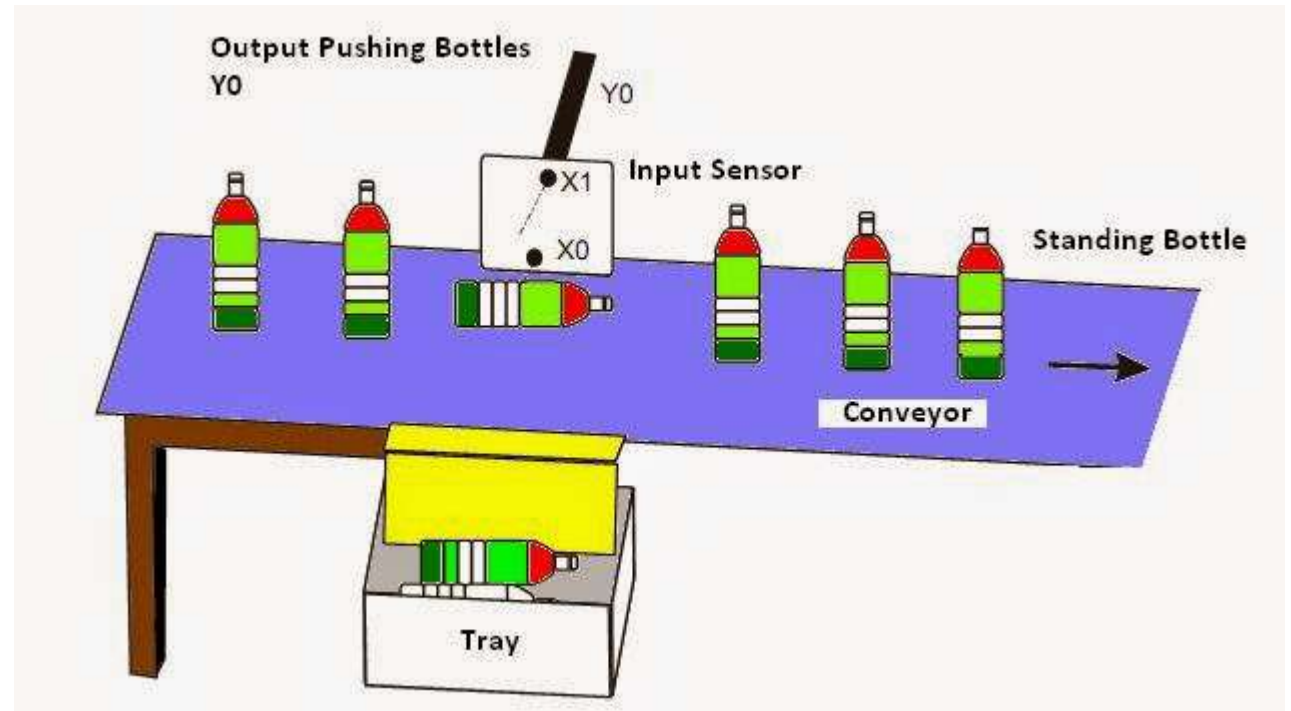## Introduction of computing

- Digital revolution
- Automation of manufacturing with electronics and IT
- Digital electronics replace analogue devices
- PLC – programmable logic controllers
- Beginning of data collection from the manufacturing process

Automated welding process

Programmable logic controllers (PLC)

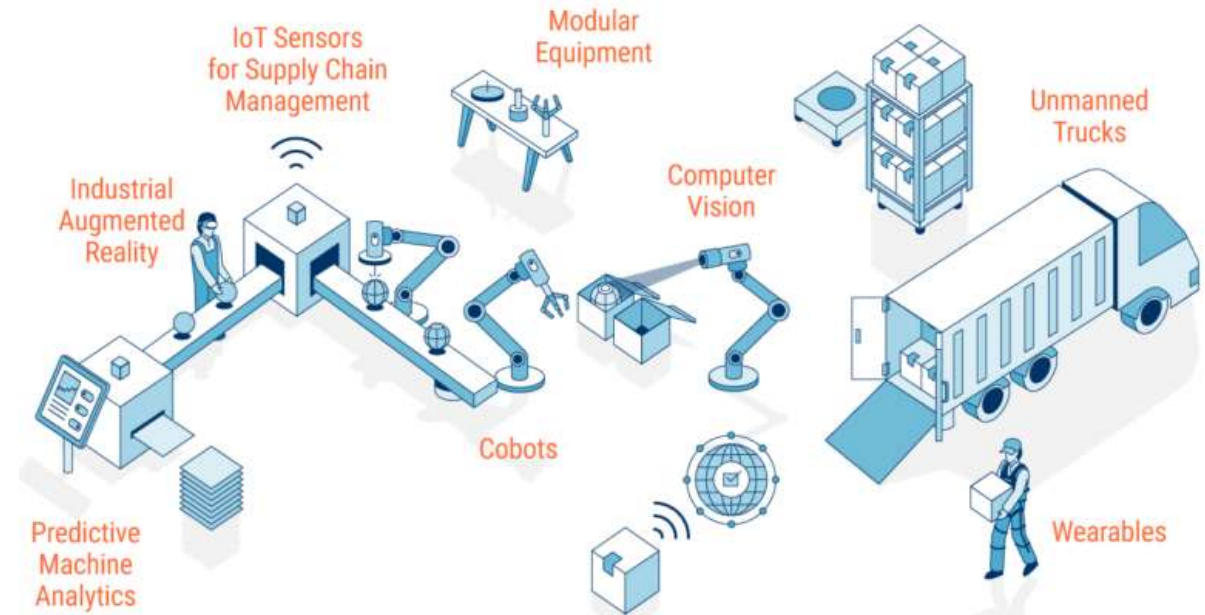# 4ᵗʰ Industrial Revolution

Introduction of cyber-physical systems

- Cyber-physical systems
- Internet of Things (Industrial IoT)
- Cloud and Cognitive Computing
- Artificial Intelligence
- Information shared among all parts of the manufacturing process
- Computers responsible for making more complex decisions (humans involved in less decisions on operative level)
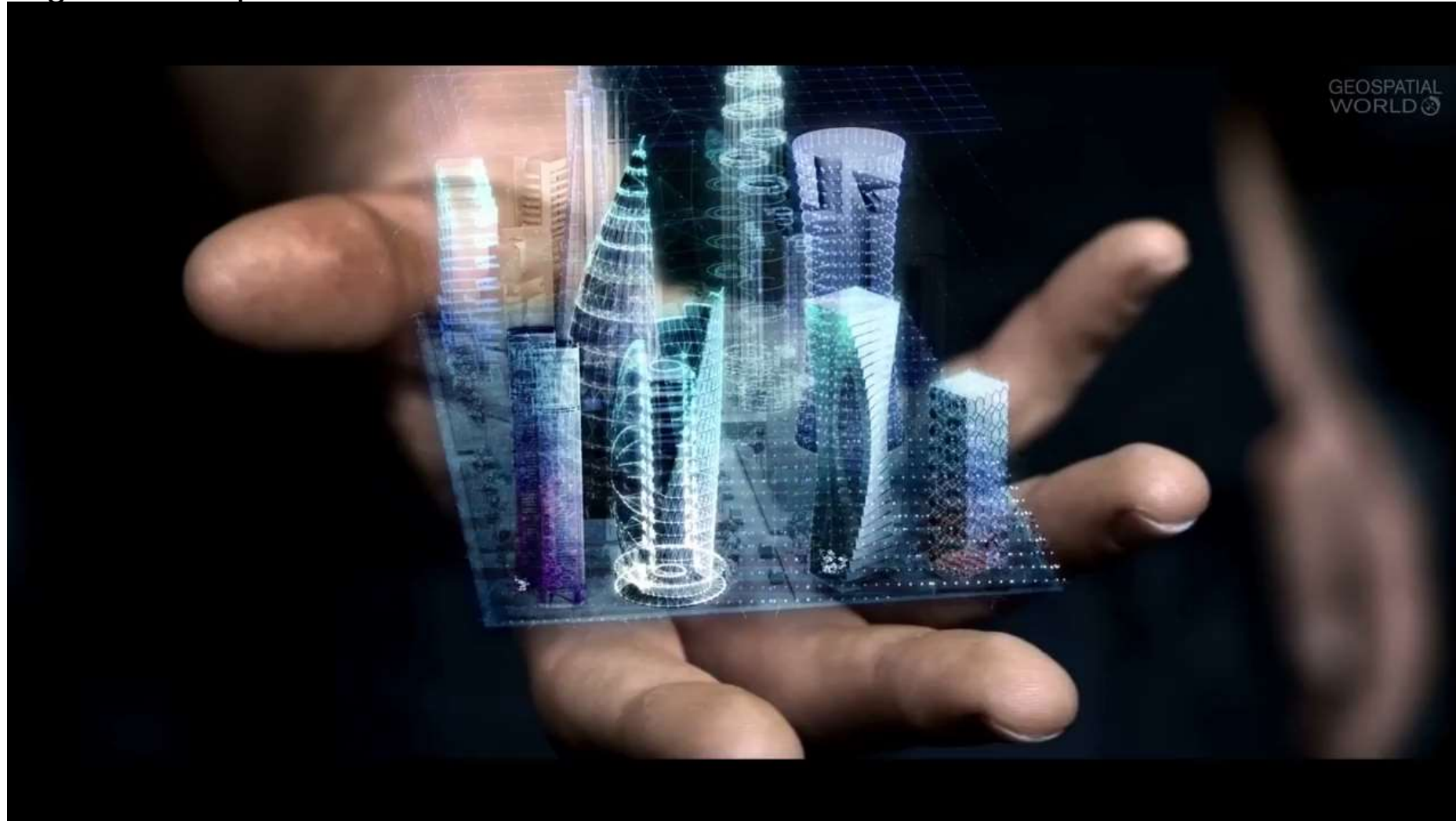
4ᵗʰ Industrial Revolution Smart Factory

- Monitoring and connection of physical processes
- Digital twin - Virtual copy of the physical factory and product
- Internet of Things connects all systems
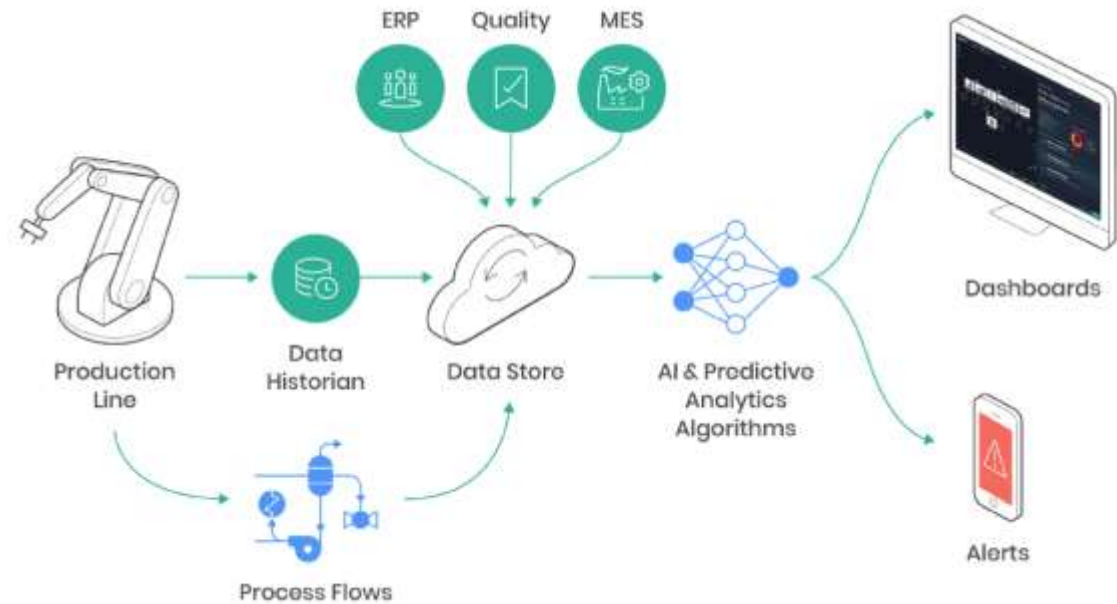- Communication and cooperation of cyber-physical systems and humans

Digital twin explained

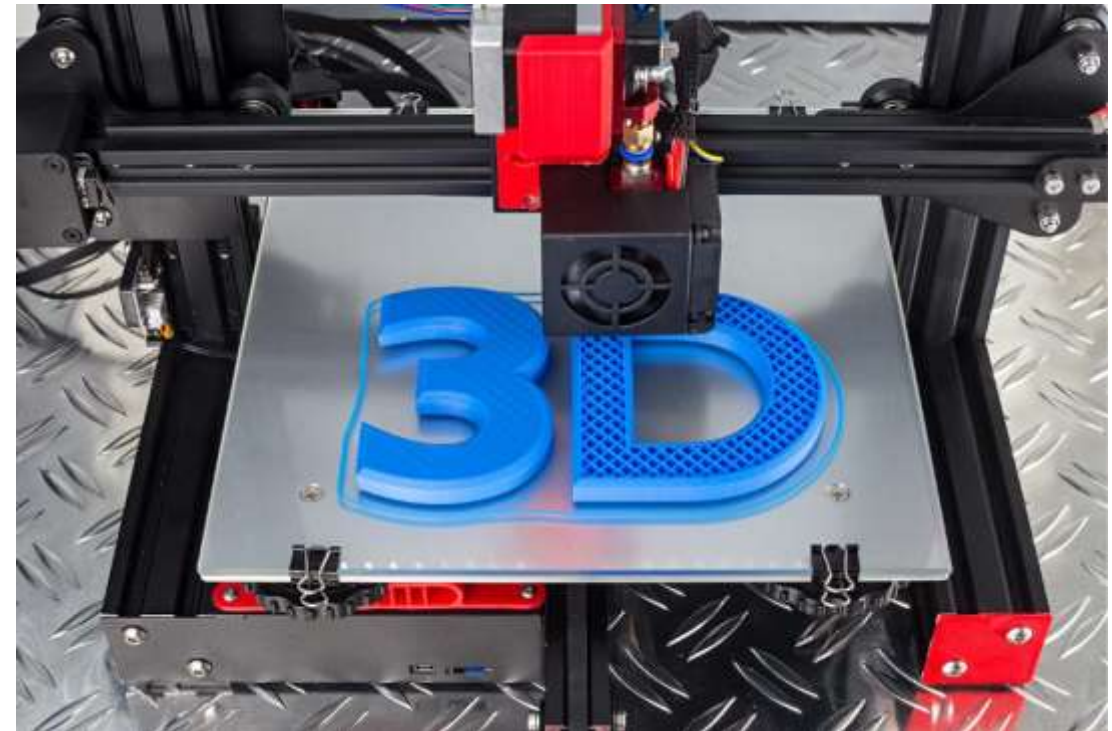# 4th Industrial Revolution Predictive Maintenance

- Goal: Predict when a machine needs a maintenance > plan the maintenance in advance
- Often making use of machine learning
- Training of prediction models requires enough data

4th Industrial Revolution
3D Printing

- Simplification of the product design (optimization of the geometry)
- Increase of flexibility
- Design process can be faster – 3D printing speeds up prototyping
- In low-volume production reduction of lead times and costs
- Possibility to print spare parts individually

4ᵗʰ Industrial Revolution Smart Sensors

- Support for Internet of Things and Predictive maintenance
- Smart Sensors attempt to be:
  - Wireless
  - Low power
  - Robust
  - Self-diagnostic
  - Self-calibrating
  - Data pre-processing
  - Every sensor has its IP address

Discussion and Future Challenges

- IT security of Internet of Things?

- Job market transformation? Highly qualified engineers will be needed for design and operation of smart factories.

- Reliability of image recognition and machine-to-machine communication?

- Machine/computer more reliable than a human?

- Legal issues? Are the regulations ready?

- Is the society ready for Industry 4.0?