



This activity has received funding from the European Institute of Innovation and Technology (EIT), a body of the European Union, under the Horizon 2020, the EU Framework Programme for Research and Innovation



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.

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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 led
- Part of presentation is also the video Skoda_industrialni_milniky.mov (attached separately). It can be played either before the presentation, after slide 21 or at the cruc.



- Industry 4.0
 - Germany Trade & Invest: INDUSTRIE 4.0 SMART MANUFACTURING FOR THE FUTURE
 - It can be downloaded here: <u>https://www.manufacturing-policy.eng.cam.ac.uk/documents-folder/policies/germany-industrie-4-0-smart-manufacturing-for-the-future-gtai/view</u>
 - BCG's Embracing Industry 4.0 and Rediscovering Growth
 - <u>https://www.bcg.com/en-ru/capabilities/operations/embracing-industry-4.0-rediscovering-growth.aspx</u>
- 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: <u>https://www.youtube.com/watch?v=fEI5oz33Ia8</u>



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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







Source: https://unsplash.com/photos/jHZ70nRk7Ns https://www.skoda-storyboard.com/cs/inovace-cs/technologie-cs/doba-kvality/attachment/b_apx0182_mk02-2/

Factories today

What is made in factories?

- Cars
- Airplanes
- Cell phones
- Pens
- Headphones
- USB cords
- Food production sweets, drinks...
- Any other examples? >>> DISCUSS







Source: https://www.seattletimes.com/business/boeing-aerospace/boeing-will-accelerate-787-production-to-14-per-month/

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.











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Source: https://youtu.be/Ff6AyG_9Uok

Pasta







Source: https://www.seriousfood.co.uk/products/spaghetti/

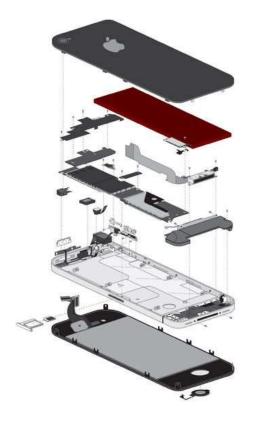






Source: https://youtu.be/psDO1rPFQ1Y

Smartphone cover





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Source: https://www.pinterest.com/pin/344525440219569237/





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Loudspeaker







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Source: https://www.gato-audio.com/fm-8.html https://www.assemblymag.com/ext/resources/lssues/2016/October/speakers/asb1016delo1a.jp





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Box of chocolates







Source: https://4.imimg.com/data4/DQ/HB/MY-11275158/corporate-chocolate-gift-box-







Fountain pen

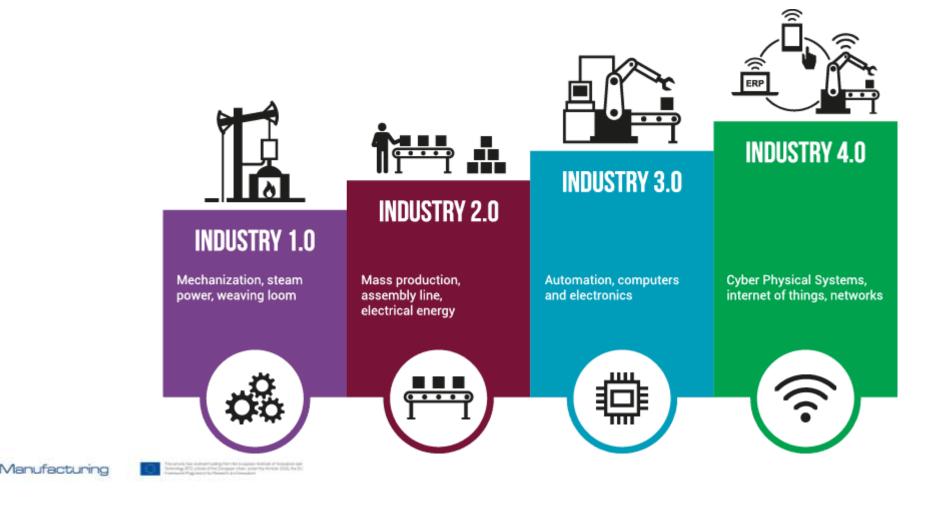






Source: https://upload.wikimedia.org/wikipedia/commons/7/7b/Fountain_pen_writing_%28literacy%29.jpg

Industrial revolutions



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Source: https://www.snicsolutions.com/wp-content/uploads/2019/12/Blog-Manufacturing.png

Industrial Revolutions

• Video: Skoda_industrialni_milníky.mov (attached separately)



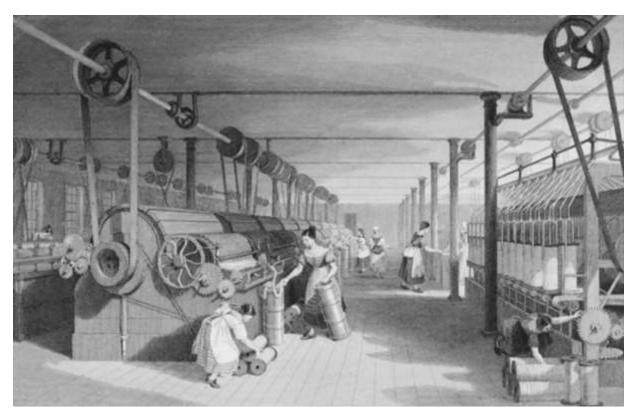
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Courtesy of ŠKODA AUTO,

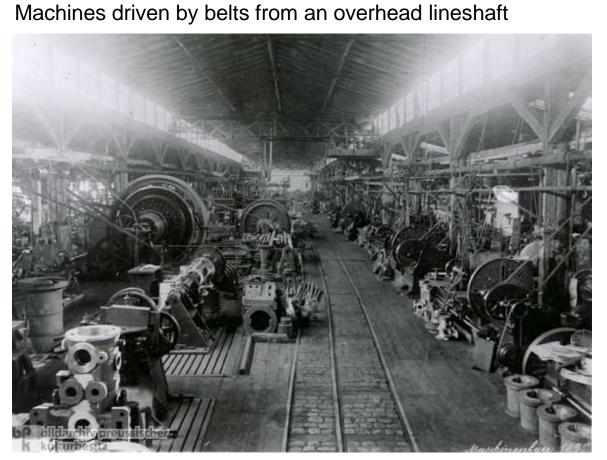
1st Industrial Revolution Introduction of steam

- 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





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A late version of a Watt double-acting steam engine





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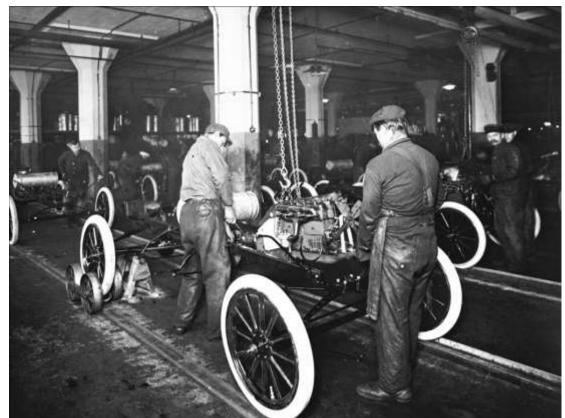
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2nd Industrial Revolution

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

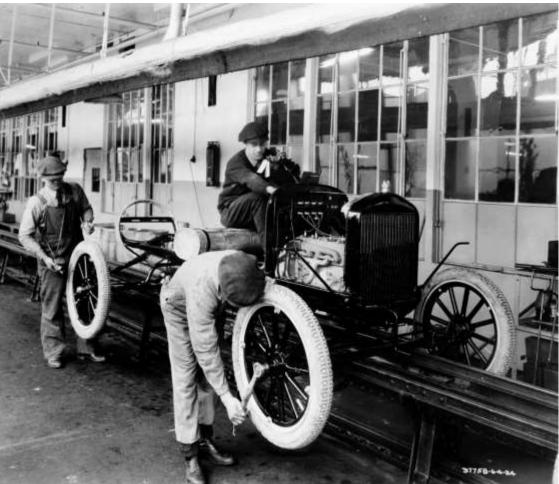




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Source: https://media.ford.com/content/fordmedia/fna/us/en/features/game-changer--100th-anniversary-of-the-moving-assembly-line.html







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Source: https://media.ford.com/content/fordmedia/fna/us/en/features/celebrating-the-moving-assembly-line-in-pictures.html

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





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Automated welding process



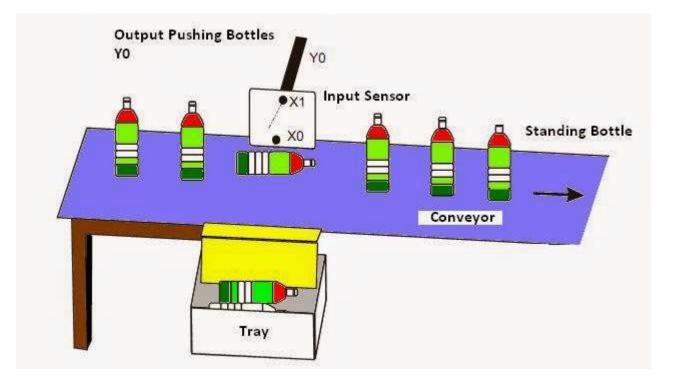




Source: https://ft9k8203gbm133d4o14bwuhw-wpengine.netdna-ssl.com/wp-content/uploads/2018/02/robotic-welding-neck-inspection.jpeg https://www.autotrainingcentre.com/wp-content/uploads/2016/08/One-of-the-first-industrial-applications-of-robotics-was-used-in-welding.jpg

Programmable logic controllers (PLC)









Source: https://www.conrad.com/p/siemens-6ed1052-1cc08-0ba0-6ed1052-1cc08-0ba0-plc-controller-24-v-dc-1628682 http://plc-scada-dcs.blogspot.com/2013/12/basic-plc-ladder-programming-training.html#axzz6RixcMRvc

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)





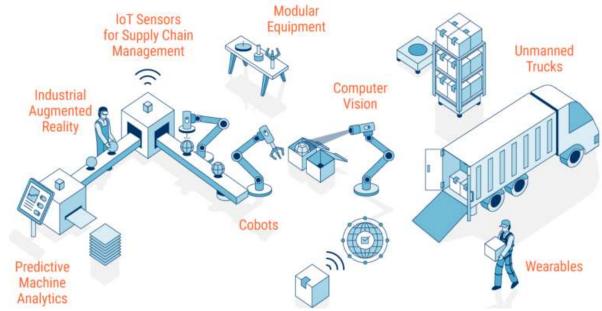




Source: https://thumbor.forbes.com/thumbor/960x0/https%3A%2F%2Fblogs-images.forbes.com%2Fbernardmarr%2Ffiles%2F2018%2F09%2FAdobeStock_203804824-1200x480.jpg https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/

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 cyberphysical systems and humans







Digital twin explained



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Source: https://www.youtube.com/watch?v=iVS-AuSjpOQ

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

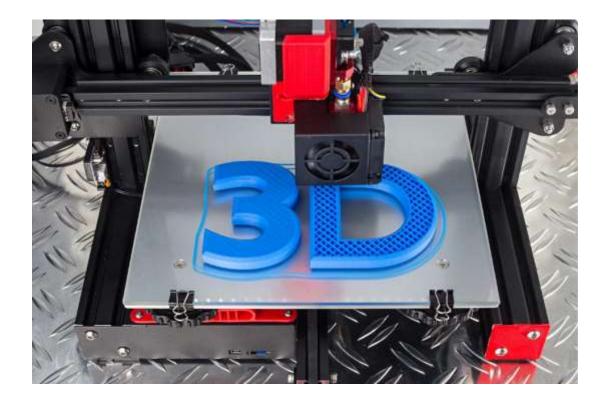






4th Industrial Revolution 3D Printing

- 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







Source: https://specials-images.forbesimg.com/imageserve/1140075616/960x0.jpg?fit=scale

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 machineto-machine communication?
- Machine/computer more reliable than a human?
- Legal issues? Are the regulations ready?
- Is the society ready for Industry 4.0?





Source: https://thumbor.forbes.com/thumbor/960x0/https%3A%2F%2Fblogs-images.forbes.com%2Fbernardmarr%2Ffiles%2F2018%2F09%2FAdobeStock_203804824-1200x480.jpg