Karlsruher Institut für Technologie

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Practical Implementation of Industry 4.0: Human involvement in modern production processes

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Industrial revolution

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- In Modern history, the process of change from agrarian and handicraft based economy to one dominated by industry and machine based manufacturing
- At each level, leads to technological, socio-economic and cultural development.

Source : dyimage.org

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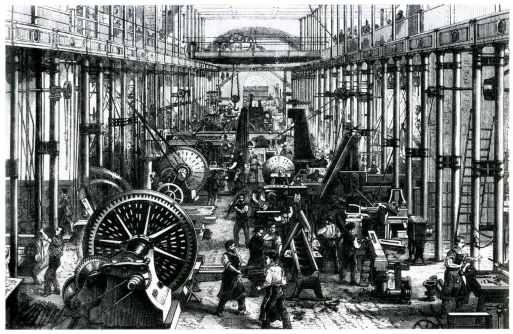
First Industrial revolution

- Started in Britain and lasted from 1760 to 1830.
- Spread to Belgium and then France, followed by the rest of Europe.
- Centred around the use of new basic materials such as Iron and Steel
- As well as new energy sources such as coal, the steam engine and the Internal combustion engine



www.wikipedia.org

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Second Industrial revolution

- Took place between the late 19th and 20th centuries.
- More natural and synthetic materials began usage, such as lighter metals, new alloys and synthetic products such as plastics.
- As well as new sources of energy. Such as ‘electricity’
- Developments in machines, tools and ‘computers’ gave rise to the first fully mechanized factories.
- The ‘assembly line’ first gained significance

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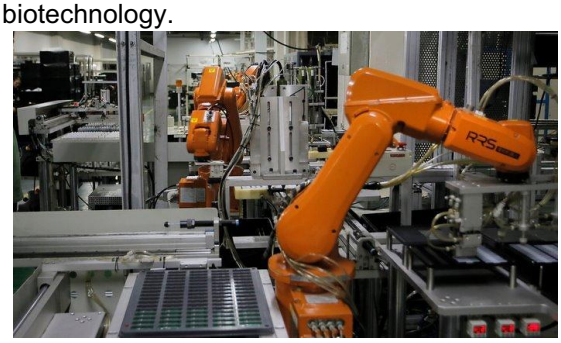
Third Industrial revolution

- Starting from the second half of the 20th century.
- Fuelled by the development of a new source of energy – 'Nuclear'
- Saw the rise of electronics with the transistor and microprocessor.
- But also saw the rise of telecommunication and computers.
- Facilitated miniaturisation, automation and new industries related to space and biotechnology.



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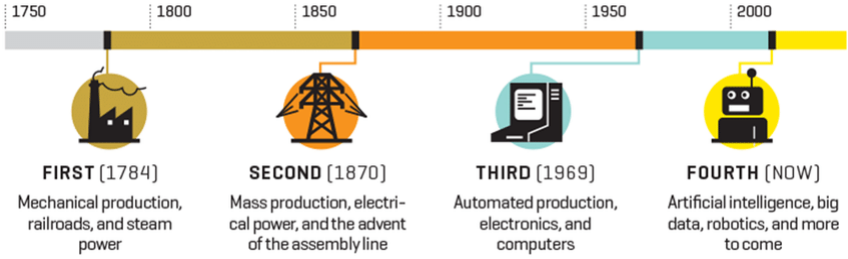
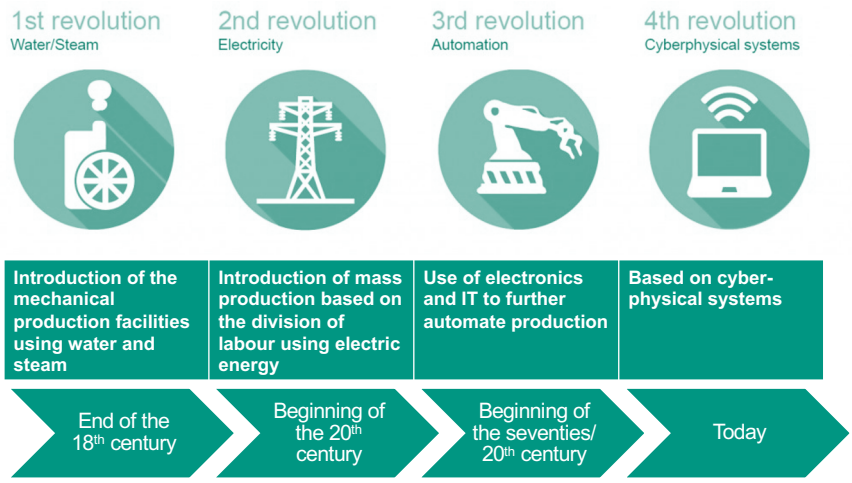
Quick Summary

- First industrial revolution – used water and steam to mechanize production
- Second industrial revolution – used electric energy for mass production
- Third Industrial revolution – used electronics and IT to facilitate automated production.



- What's next? What more could we possibly want?

Fourth Industrial Revolution



Source: DKFI 2011

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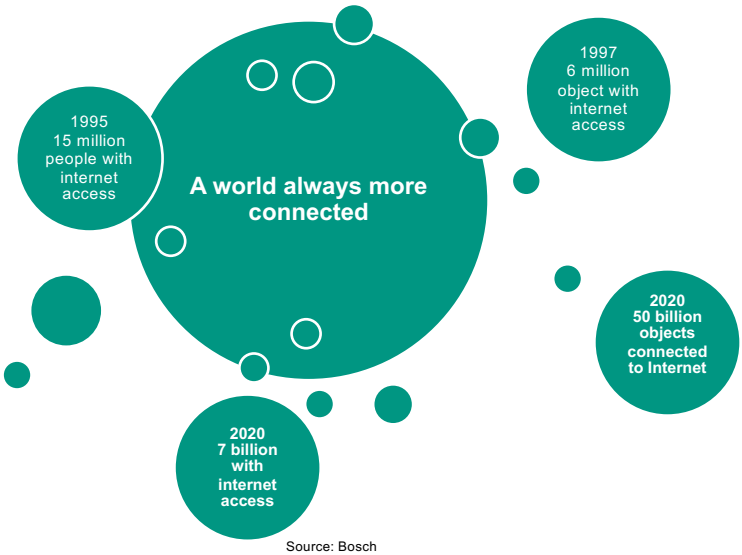
Industry 4.0: The Mission



Source: Bosch

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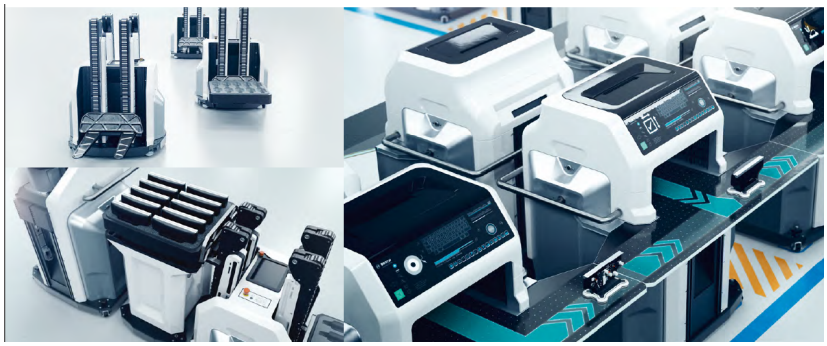
1. Self organised and distributed artificial intelligence



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2. Fast, automatic and highly flexible network integration

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3. Open standards

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4. Virtual real-time image

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5. Digital integrated life-cycle-management

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6. Safe and secure added-value networks

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7. Humans as actors and in the centre

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Humans as actors and in the centre

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Centrality of the human Factor

"The world will always need human brilliance, human ingenuity and human skills."

(Brad Keywell, Co-founder and CEO, Uptake)

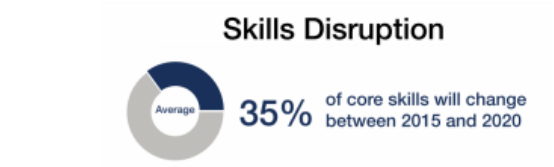
Source: https://www.weforum.org/agenda/2017/06/the-fourth-industrial-revolution-is-about-people-not-just-machines/ and https://talentorganizationblog.accenture.com/financialservices/wp-content/uploads/2018/04/Human_AI_Interaction.jpg

Centrality of the human Factor

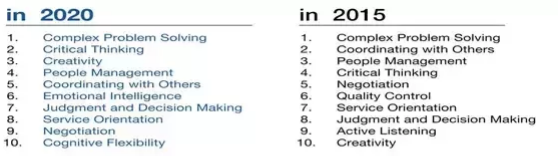
- It is the empowerment of people, and not the rise of machines, what the Fourth Industrial Revolution is about
  - Mindset shift: People and their mindsets have to respond to the change brought by the Fourth Industrial Revolution. The possible rewards are numerous: enhanced security and safety, higher standards of living and increased human capacity. People will do better at their jobs with the technology of today and the future.
  - Human and machine: The best player is actually a team of both machine and human. Machines can store huge amounts of data and facilitate unbiased decision-making. Humans provide skills for strategic and creative decision making to win.
  - Power of data, power of people: The power of data to make faster and better analyses and decisions and the power of people to supply judgement and ingenuity should be integrated to achieve faster and better results with fewer errors.
  - Virtuous loop: Mechanics actions (fixing something, using the experience, judgment and skill) provide data that feed back into the software while improving predictions and analytics. Mechanic used human skills were not replaced by technology, technology empowered them to do their job.

Centrality of the human Factor

- Skills 4.0: Change in demand of core skills
- Achievement and development of increased cognitive and taxonomic levels of competency
- Need for hardworking, self-educated workers



Source: http://www.talenttalks.net/wp-content/uploads/2018/12/Skills-desruption-300x280.png



Source: Future of Jobs Report, World Economic Forum

Source: https://qph.fs.quoracdn.net/main-qimg-957f4dccb744843e02b5558b222ca050.webp

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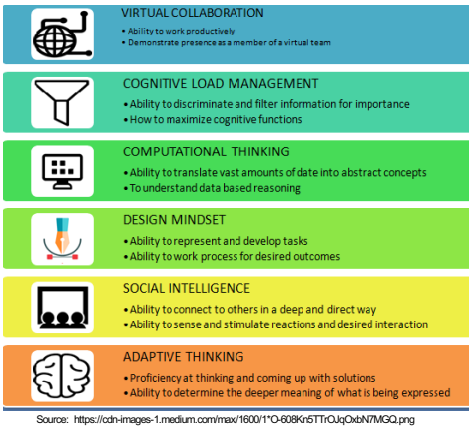
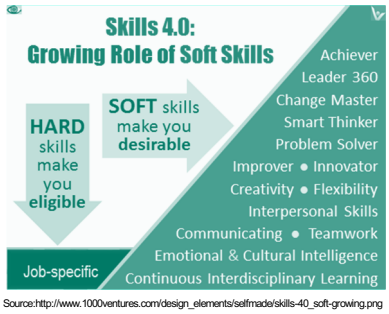
Centrality of the human Factor

- Skills 4.0: Skill Sets required for Industry 4.0



Source: https://cdn-images-1.medium.com/max/1600/1*O-608Kn5TTrOJqOxbN7MGQ.png

Source: https://www.opndoor.com/yahoo_site_admin/assets/images/Top-5-soft-skills-in-demand1.16492815_std.jpg



Source:http://www.1000ventures.com/design_elements/selfmade/skills-40_soft-growing.png

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Centrality of the human Factor

- Leadership 4.0: An evolution of leadership styles was visible over the past three industrial revolutions.
- Autocratic and democratic leadership styles served leaders during prior industrial revolutions
- A different approach is needed in Industry 4.0 as technology reduces the possibility to control people
- Leadership 4.0 requires agility, innovation, collaboration and resilience

Source:https://l4mastery.com/

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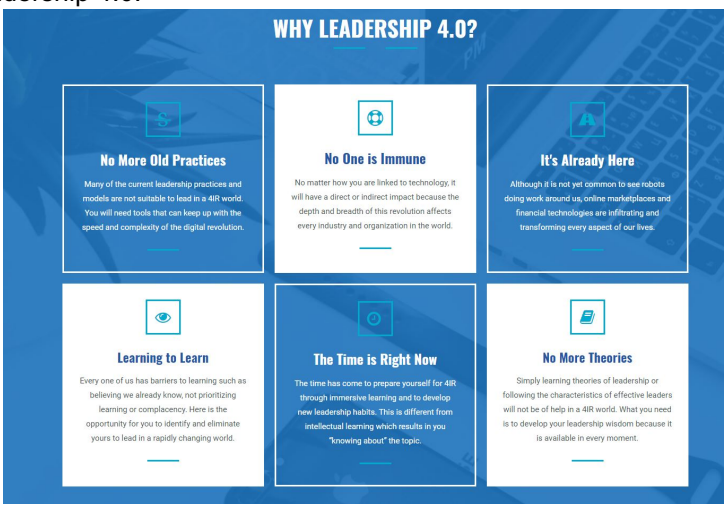
Centrality of the human Factor

- Leadership 4.0:



Source:https://l4mastery.com/

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Centrality of the human Factor

- Festo Training and Consulting – An Example of Leadership 4.0 and Change

Source:https://www.youtube.com/watch?v=h_W1D0khC-M

Centrality of the human Factor

- Leadership 4.0: “We need leaders who are **emotionally intelligent**, and **able to model** and **champion co-operative working**. **They’ll coach**, rather than command; they’ll be **driven by empathy**, not ego. The digital revolution needs **a different**, **more human kind** of leadership.”

(Prof. Klaus Schwab, Founder,and Executive Chairman, World Economic Forum)

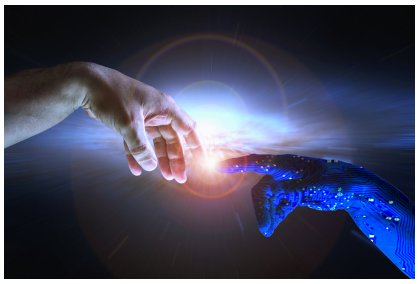
Source:https://i4mastery.com/

Centrality of the human Factor

- The Importance of Humans will persist in the Industry 4.0 Framework

- Humans and Artificial Intelligence (AI)

AI as a job enabler to accelerate learning processes break down complexity of tasks. Artificial Intelligence and humans can accomplish a lot more than any of them alone.



Source: https://thenextweb.com/contributors/2017/07/31/humans-will-stay-competitive-age-artificial-intelligence/

- Humans and the Internet of Things (IoT)

IoT enables to generate huge amounts of data analysing people and their performance at work on a daily basis, which helps decision makers in strategic decisions. To absorb the impact of IoT, the right workforce composition is needed.

Source: https://www.digitalistmag.com/iot/2016/04/14/internet-of-things-will-fundamentally-change-hr-04145502

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Centrality of the human Factor

- The Importance of Humans will persist in the Industry 4.0 Framework

- Humans and Augmented Reality (AR)

AI robotics, systems and tools become more and more sophisticated while creating the „augmented workforce“. Augemented Workforce describes the process of humans and technology working together on tasks (machine learning etc.)

Source: https://www.wartsila.com/twentyfour7/innovation/augmented-humans-fiction-or-reality

Tesla's Case: Necessity of Human Workers in Industry 4.0

Source: https://swipeguide.com/human-workers-in-industry-4-0/

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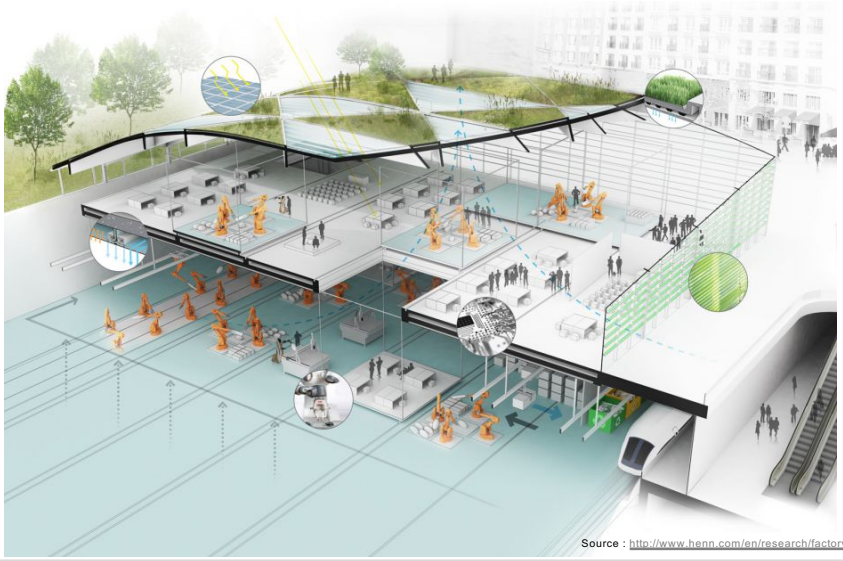
Industry 4.0 – Enabling the Factory of the Future



Source : http://www.henn.com/en/research/factory-future

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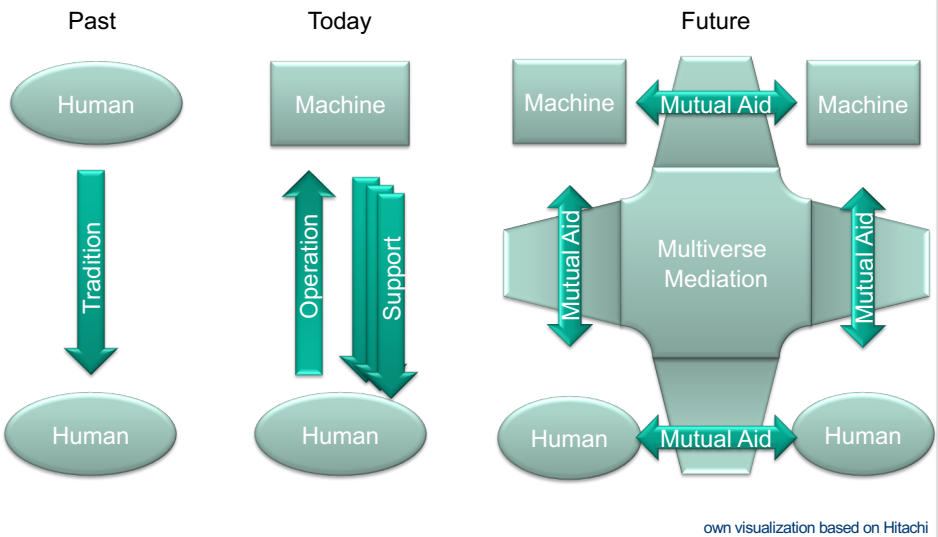
Integration of Human-Machine Interaction



own visualization based on Hitachi

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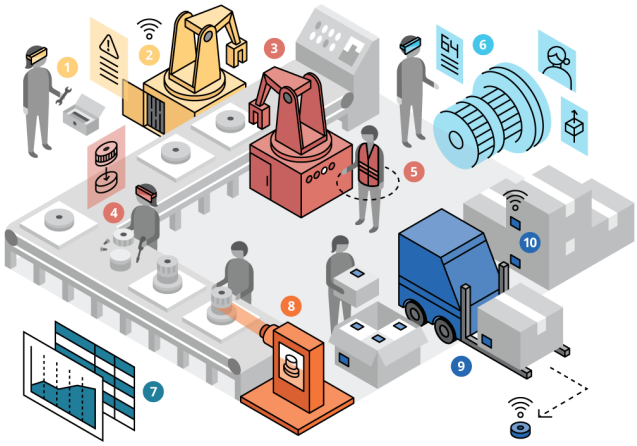
Factory of the Future - a Vision



Maintenance & operations

1 Smart goggles provide metrics, instruction, and remote support to maintenance workers. 2 Sensors on machines generate diagnostic data and machine learning helps predict failures and improve productivity.

Production

3 Smart robots automate production. 4 Smart goggles with cameras and motion sensors help train workers and overlay assembly instructions. 5 Smart equipment like safety vests and hard hats monitor surroundings.

Design & development

6 Virtual prototypes allow rapid iteration, assembly simulation, advanced testing, and remote collaboration. Full-body motion tracking informs ergonomic design of workspaces and assembly lines.

Reporting & analytics

7 All devices are connected to a data management system, which digitally documents each step of the process. Advanced analytics predict demand patterns to optimize production.

Quality control

8 Machines use sensors, computer vision, and photogrammetry to evaluate products against standards. 3D models give inspectors access to all product specs during production.

Distribution

9 Beacons and smart goggles guide operators through the warehouse. Autonomous vehicles manage inventory. 10 Product sensors provide visibility into the entire supply chain.

Source : Deloitte

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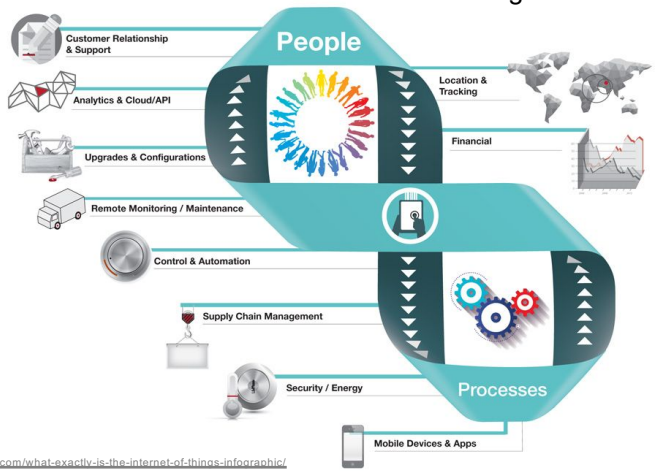
People and Processes

- The data is then used to integrate data with people, processes and systems to enable better real-time decision making



https://www.postscapes.com/what-exactly-is-the-internet-of-things-infographic/

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Thank you!
31 22.10.20 Steffen G. Scholz Institute for Automation and Applied Informatics - IAI