How industry 4.0 can help to achieve SDGs?

Ceramic Industry Case Study

Smart-Edu4.0

Erasmus+ project

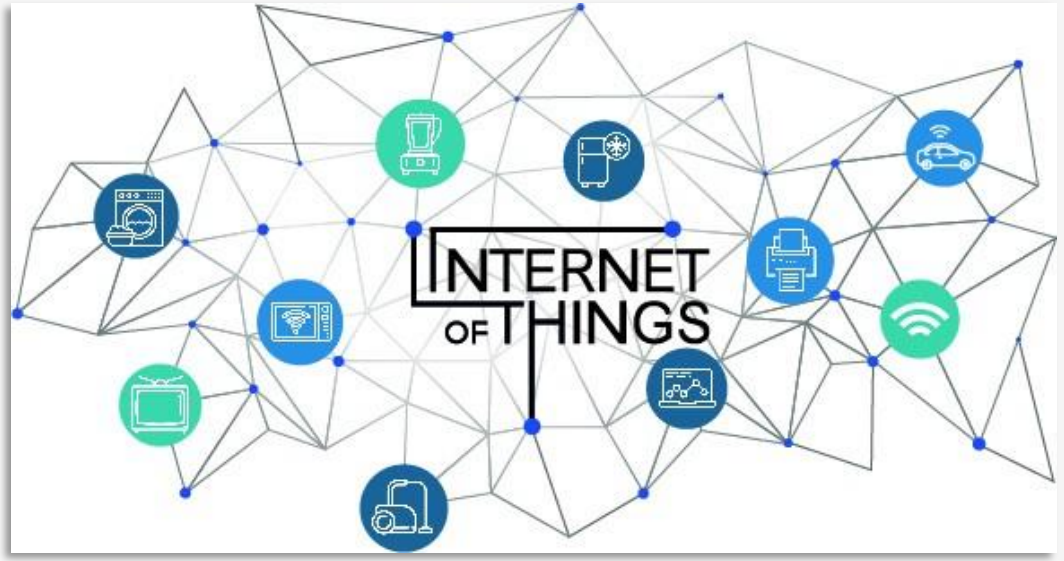
Co-funded by the
Erasmus+ Programme
of the European Union

Technologies used in I4.0:

- Internet of Things (IoT):

The connection of machines equipped with sensors to the Internet. Internet-connected machines can generate, process and communicate data in real time to humans or other machines.

Example: A sustainable smart building with connected IoT sensors will turn-off lights and air-condition when people exit a room.



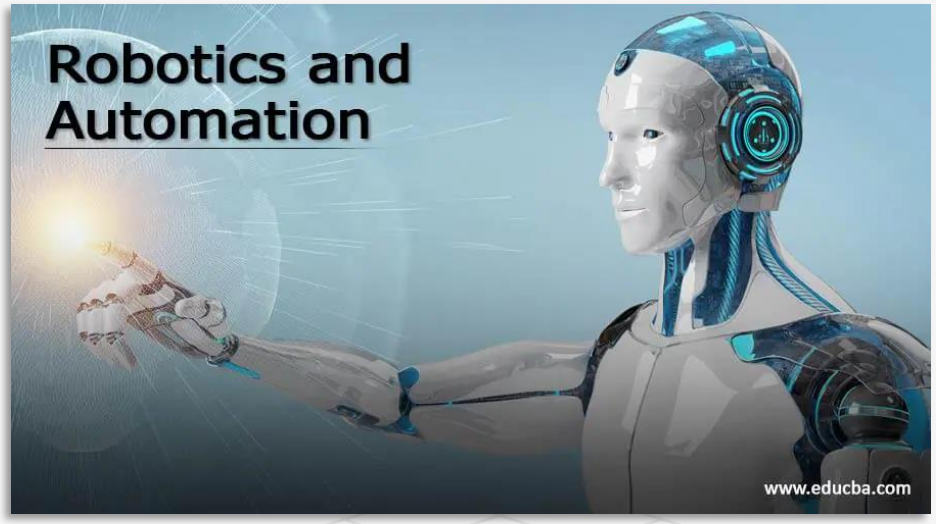
Braccini, A. M., & Margherita, E. G. (2019). Exploring organizational sustainability of industry 4.0 under the triple bottom line: The case of a manufacturing company. *Sustainability*, *11*(1), 36.
https://simonbrard017.medium.com/the-internet-of-things-iot-describes-the-network-of-physical-objects-so-known-as-things-cb8c9c994603

Technologies used in I4.0:

- Robotics:

Devices that can autonomously perform gestures or movements. They are designed and programmed to perform any desired manipulation tasks. Robots can be autonomous in their operation, or collaborative with humans.

Example: In the assembly line, different kinds of robots take on the hard work into the process and workers act as supervisors.



- Additive manufacturing

Known as 3D printing. A wide range of different materials (e.g., plastics, metals, composite materials) can be used

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https://www.educba.com/robotics-and-automation/.

Technologies used in I4.0:

- Cloud computing

Enable to IT infrastructure companies to offer services through the internet

- Big Data and Analytics:

The overwhelming and unstructured amount of data generated by I40 technologies within the organization. They are stored on servers through cloud computing and are analyzed with business intelligence, machine learning and analytics software.

Example:

Data from smart vehicles are transferred to a cloud server, analysed and suggest routes and modes of transportation with the minimum environmental impact.

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Industry 4.0 and SDGs

Industry 4.0 can help to achieve the Sustainable Development Goals (SDGs) by:

- enabling more efficient and sustainable production and consumption practices,
- reducing waste and emissions,
- promoting sustainable supply chains, and
- facilitating collaboration and innovation towards sustainability goals.

https://climate.mit.edu/posts/industry-40-industrial-revolution-heart-sdg-agenda-2030

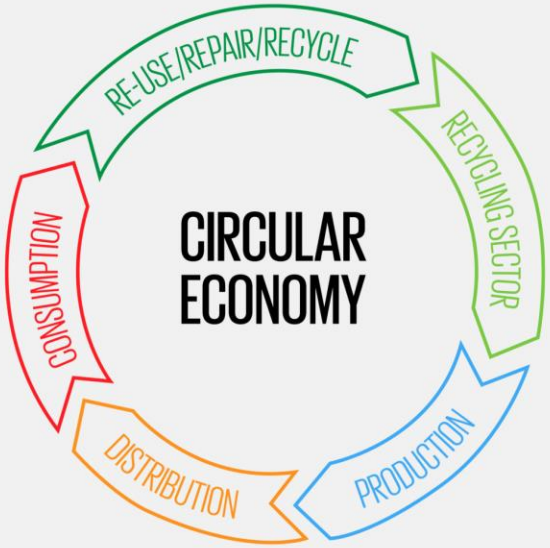
Industry 4.0 and SDGs: Resource efficiency

Industry 4.0 technologies can help improve resource efficiency by optimizing processes and reducing waste. This can help achieve SDG 12 (responsible consumption and production) by promoting more sustainable production and consumption practices.

https://jointsdgfund.org/sustainable-development-goals/goal-12-responsible-consumption-production

Industry 4.0 and SDGs: Circular economy

Industry 4.0 can help promote a transition towards a circular economy by enabling the reuse and recycling of materials. This can help achieve SDG 12 by reducing waste and pollution and promoting sustainable production and consumption practices.



https://wdo.org/designing-towards-circular-economy/

Industry 4.0 and SDGs: Sustainable supply chains

Industry 4.0 can help promote more sustainable supply chains by providing greater transparency and traceability. This can help achieve SDG 8 (decent work and economic growth) by promoting fair labor practices and SDG 12 by reducing waste and emissions.

https://www.greenbiz.com/article/your-sustainable-supply-chain-program-really-good-you-think

Industry 4.0 and SDGs: Renewable energy

Industry 4.0 can help promote the use of renewable energy sources and improve energy efficiency. This can help achieve SDG 7 (affordable and clean energy) by promoting the use of renewable energy and SDG 13 (climate action) by reducing greenhouse gas emissions.

Source: https://upload.wikimedia.org/wikipedia/commons/thumb/a/aa/Sustainable_Development_Goal_07CleanEnergy.svg/1200px-Sustainable_Development_Goal_07CleanEnergy.svg.png2030
https://greece.iom.int/sites/g/files/tmzbdl1086/files/sdgs-icon/e_web_13.png

Industry 4.0 – Advantages and Disadvantages

Advantages

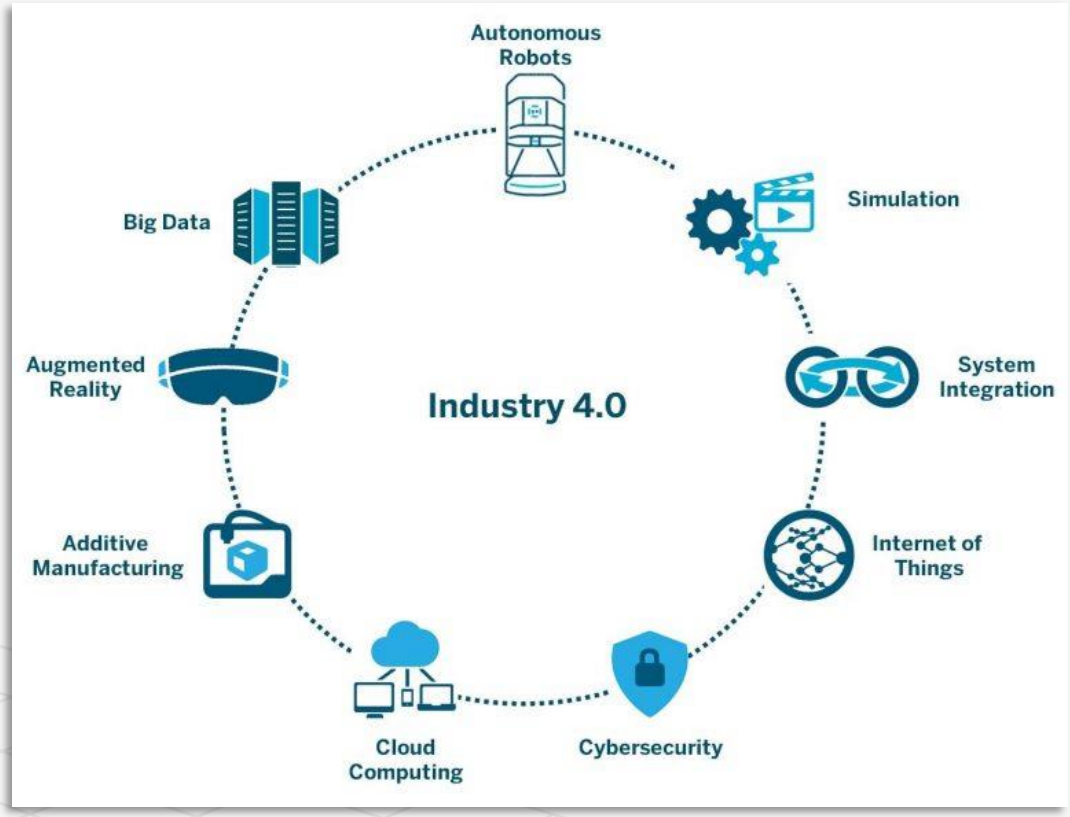
- more effective ways of producing goods
- improve warehouse management (through sensors)
- reduce warehouse inaccuracy
- shorten time to market
- improve product manufacturing life cycles
- efficient use of resource
- balance energy consumption based on the needs
- ameliorate working environment (passing hard-muscular work to machines)
- safer workplace
- increase employees morale

Source: Braccini, A. M., & Margherita, E. G. (2019). Exploring organizational sustainability of industry 4.0 under the triple bottom line: The case of a manufacturing company. *Sustainability*, *11*(1), 36.

Industry 4.0 – Advantages and Disadvantages

Disadvantages

- pollution increase because of the exploitation of electricity and natural resources
- high cost of implementation
- workforce reduction because many activities pass from humans to machines



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https://www.invoiceinterchange.com/industry-4-0-what-is-it-and-how-does-it-benefit-the-smes/.

Case Study - Manufacturing company in the ceramic industry

https://www.arabnews.com/node/1537131/business-economy

https://www.lippert.de/industrial-solutions/

https://www.designboom.com/design/laufen-factory-visit-ceramic-casting/

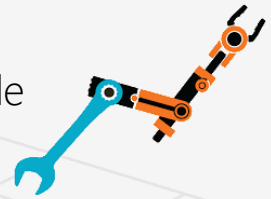
Initial Production Characteristics

production characteristics:

- handmade
- low technology adoption
- increased waste
- has a product defect rate higher than other industries
- consumes a great amount of energy

In 5 years the company switched from a traditional assembly line to a smart factory, making use of

- ➢ IoT technologies 

- ➢ automatic forklifts 
- ➢ robotic arms 
- ➢ mechanical arms activated by people 

Source: Braccini, A. M., & Margherita, E. G. (2019). Exploring organizational sustainability of industry 4.0 under the triple bottom line: The case of a manufacturing company. *Sustainability*, *11*(1), 36.

Initial needs for the conversion to a smart factory

- Redesign of the physical factory layout

  I40 assembly line requires more space due to the use of several large-sized machines

- Factory equipped with autonomous machines

  Produce products and move them from one place to another

- Machines interconnection in a cyber-physical system

  Manages the production process (assembly line) efficiently

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3 production phases

Phase A

- activities prototype
- goods production

(ends with the baking of the products)

Phase B

product reprocessing in case of mistakes

Phase C

- packaging
- shipment
- waste disposal

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Current adoption of Industry 4.0

- **fully integrated assembly line**
  - ✓ Human interaction is minimal in the production phase
  - ✓ Production process is digitally traced

  (concerning lead time, machines that produce products and workers operating the machines)

- **design phase digitalization**
  - ✓ use CAD to develop new products
  - ✓ Internal research centre for new materials and production steps
  - ✓ 3D printing for making prototypes during the design phase (testing improvement)
-

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Current adoption of Industry 4.0

- robots do the hard work and workers act as robots supervisors
  - ✓ the finished products are moved to shelves by fork trucks
  - ✓ defective products marked by workers and transferred to a secondary phase by fork trucks
  - ✓ workers use their past knowledge on ceramics production and suggest new settings for the machine

    -> improve process and product quality

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Current adoption of Industry 4.0

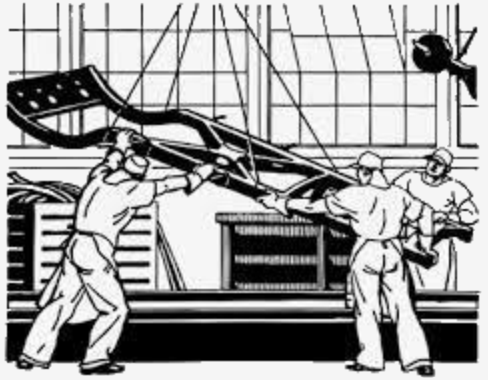
The **traditional assembly line** remains:

- For products with small demand

  Otherwise their cost would increase considerably

- To train workers in the ceramic production process and increase their expertise in the technical aspects of the process

  After the training, the workers will move to the integrated assembly line



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Economic Impact – Achieved Results

- production increased by 30%
- lead time decreased
- range of products increased
- quality of products increased: more practical and enduring products with a refined design
- defective and damaged products decreased (defect rate: from 30% to 9%)
- monitor production process (machines status, products tracking)
- order inaccuracy reduced

Competitive Advantage

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Environmental Impact – Achieved Results

Raw and water consumption are reduced

- materials and resources are re-used (re-use of defective products)
- reduce waste of chalk molds and metals. They are only used by the traditional assembly line

Energy consumption reduced

- heat generated for baking, re-used for the cooling of the final product
- solar panels installation
- fewer damaged products

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Environmental Impact – Achieved Results

Reduced waste due to

- reduced accidental damage (autonomous trucks are now used for the products transferring across the assembly line)
- reduced defect rate (robots are more precise during the production process)
- re-use defective products

Regarding costumer:

New redesigned products do not contain pollutants and require fewer resources during their daily life usage!

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Social Impact – Achieved Results

Safer environment

- All dangerous health phases become entirely automated and being executed by machines
- Heavy manual jobs transferred to machines
- Number of incidents reduced
- Happier employees

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Social Impact – Achieved Results

Work become more mental and less manual

- Workers have to activate, deactivate machines
- Worker's duties enriched (operate machines and make production process more efficient with less defects)
- Work transformed from labour-intensive to knowledge-intensive tasks

The number of employees remained stable

The transition to I4.0 does not imply the reduction of employment level as the workers from operators of mechanical machines became supervisors

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Any questions?

Thank you ☺

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