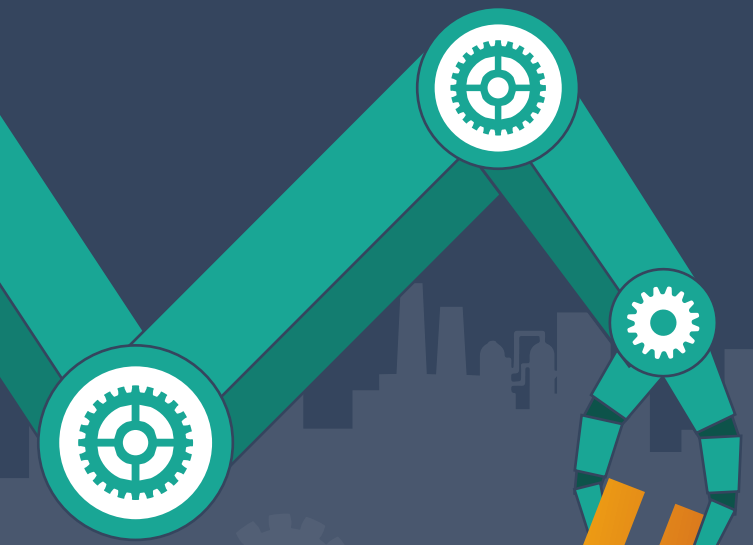

INDUSTRY 4.0

Industry 4.0 technologies for Sustainable Development

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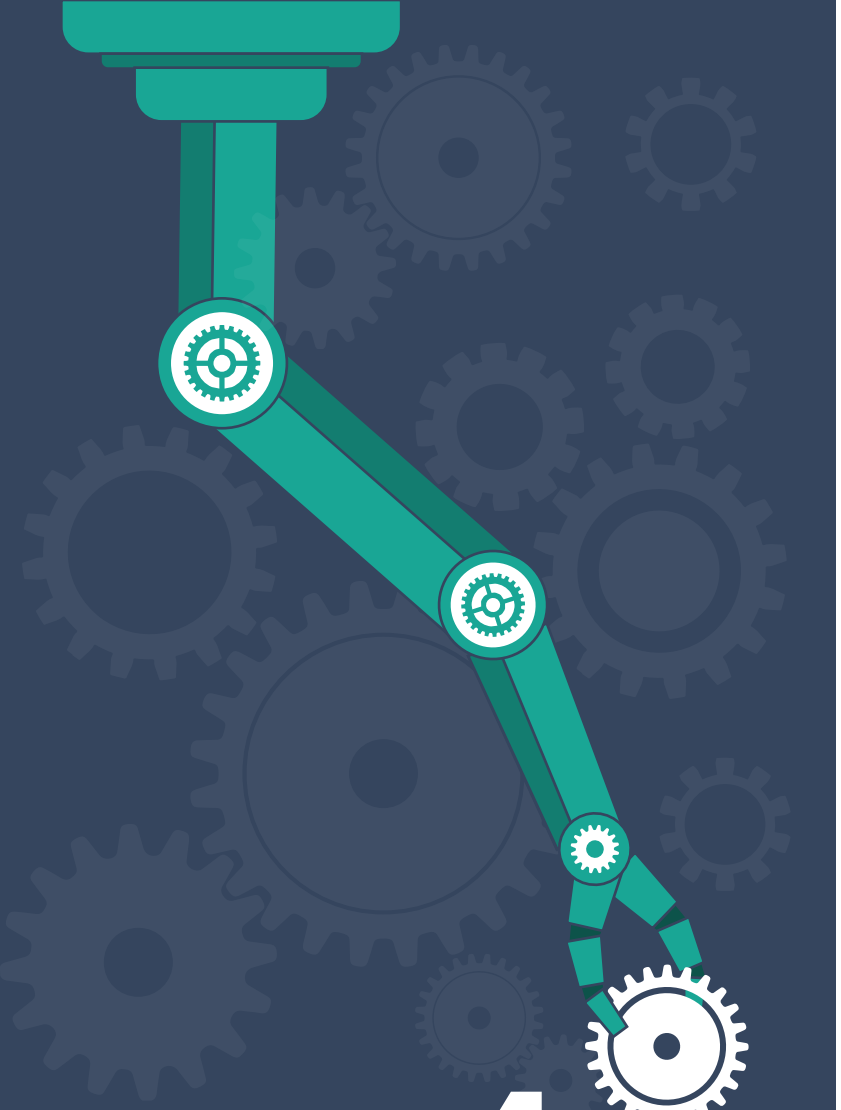
Some steps

- **2002** Degree in Business Management
- **2003** Visiting researcher at Center for Business Ethics in Boston
- **2006** PhD in Marketing and Communication
- **2010** Consultant for Terre Solidali (NGO) operating in Kenya
- **2015** Researcher at University of Salerno
- **2019** Professor of Management at DISA-MIS, University of Salerno
- …**2022** Guest Lecturer in Kabete Campus



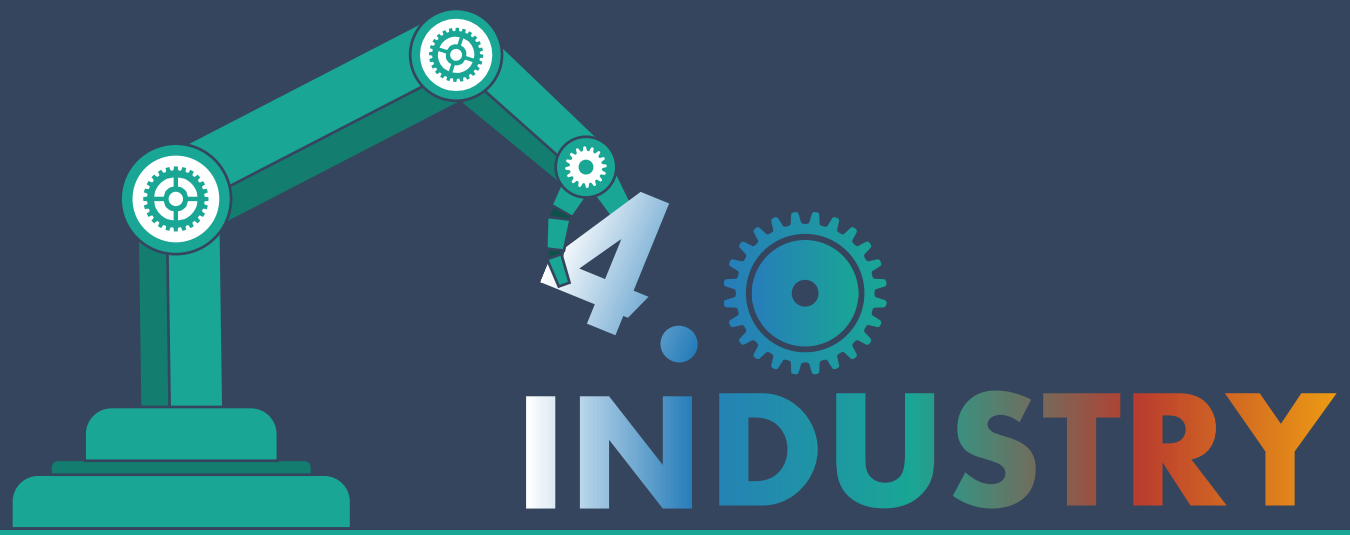
Our topics

01 What is Industry 4.0?

02 What are key technologies in Industry 4.0?

03 How these can be used?

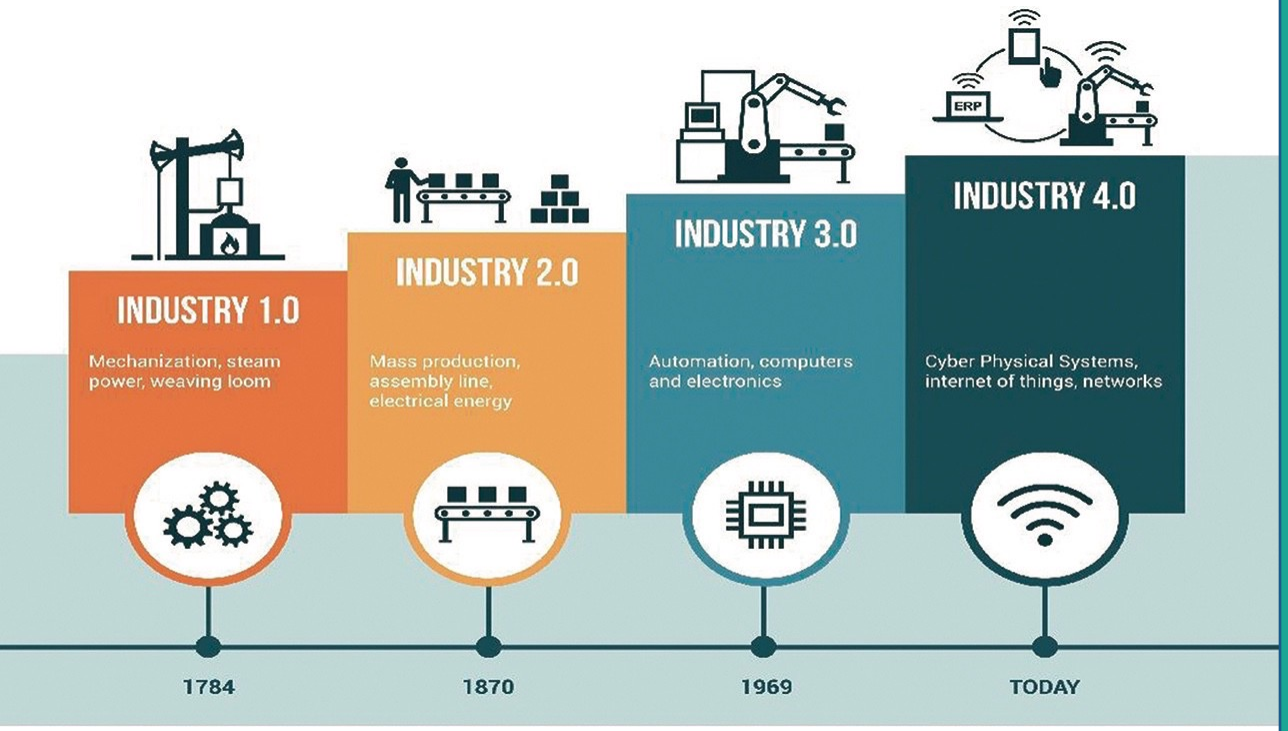
04 What opportunities for Sustainable Development?



What is Industry 4.0?

Industry 4.0 is a process that arises from the fourth industrial revolution and is leading to fully automated and interconnected industrial production.

Industrial Revolutions



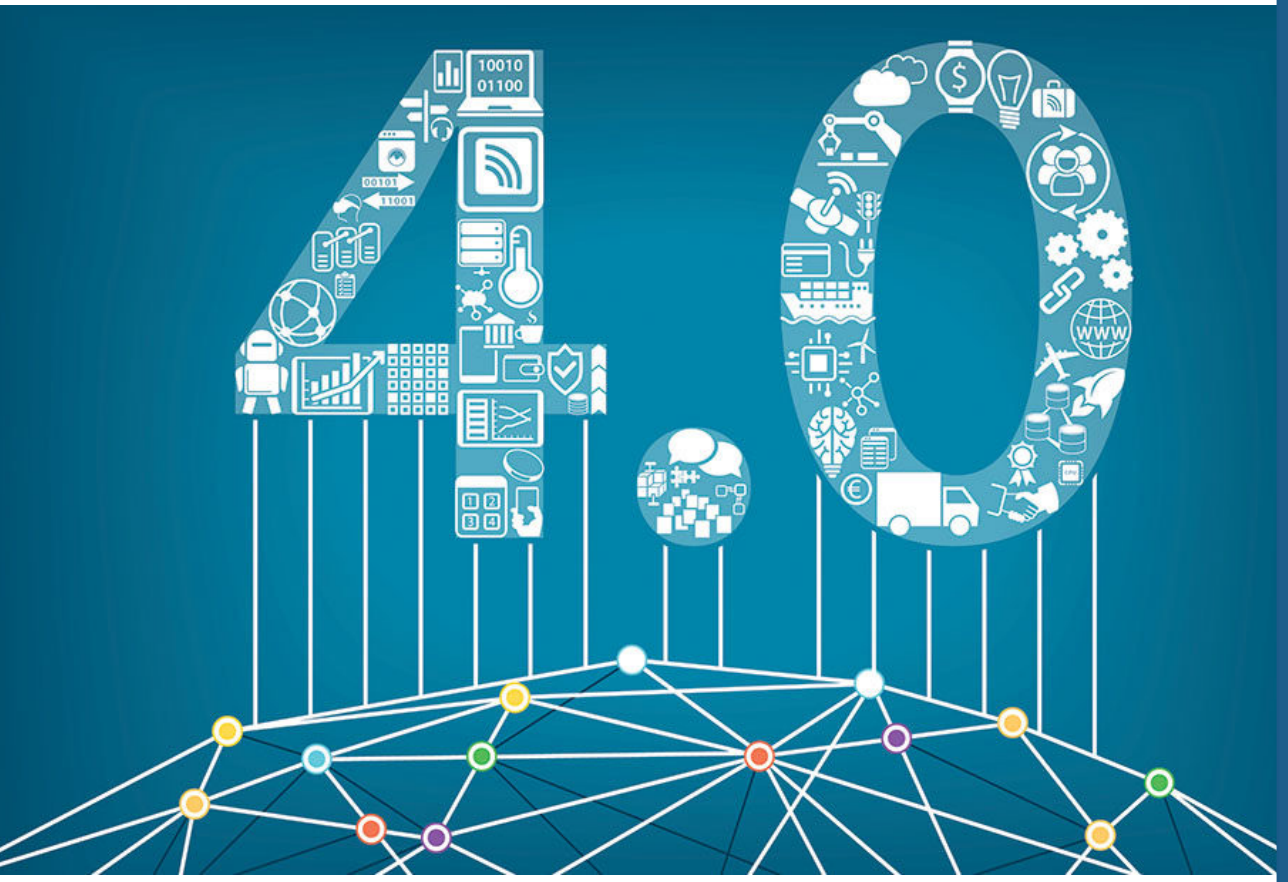
1780 - The first industrial revolution represented a great change in the way of producing: for the first time a new source of energy was used, **coal**, and a new medium, **the steam engine**.

1870 – In **the second industrial revolution** the use of **electricity**, **chemicals** and **oil** spread gave new power the metallurgical, chemical and electrical sectors. Mass transport systems are born, communications are easier. Medicine makes important discoveries and people's lives are lengthening considerably .

1950 - Electronics and information technology are the two innovations that kick off the **third phase of the industrial revolution**. Computers enter people's homes and production systems are characterized by ever-increasing automation. Distances are reduced, man goes to the moon, the phenomenon of globalization is born.

Today - According to many economists, historians and experts, we are immersed in a phase which, due to the extent and depth of the change, has the characteristics of a real **fourth industrial revolution**. The heart of this revolution is **digital technology** that is leading us towards an automated and interconnected industrial production system.

Industry 4.0



The term industry 4.0 refers to a further developmental stage in the organisation and management of the entire value chain process involved in manufacturing industry. Another term for this process is the ’fourth industrial revolution’.

The fourth industrial revolution, sometimes also called **Smart Manufacturing**, is linked to the concepts of services, mass customization of products and remote control of processes.

The widespread adoption by manufacturing industry and traditional production operations of information and communications technology (ICT) is increasingly blurring the boundaries between the real world and the virtual world in what are known as cyber-physical production systems (CPPSs).

Four pillars of development

Data usage

The first concerns the use of data, computing power and connectivity, and includes big data, open data, Internet of Things, machine-to-machine and cloud computing to address the centralization of information and storage.

Analytics

Once the data is collected, it is necessary to derive value from it. Today only 1% of the data collected is used by companies, which could instead obtain advantages starting from "machine learning“ that is machines that improve their performance by "learning" from the data gradually collected and analyzed.

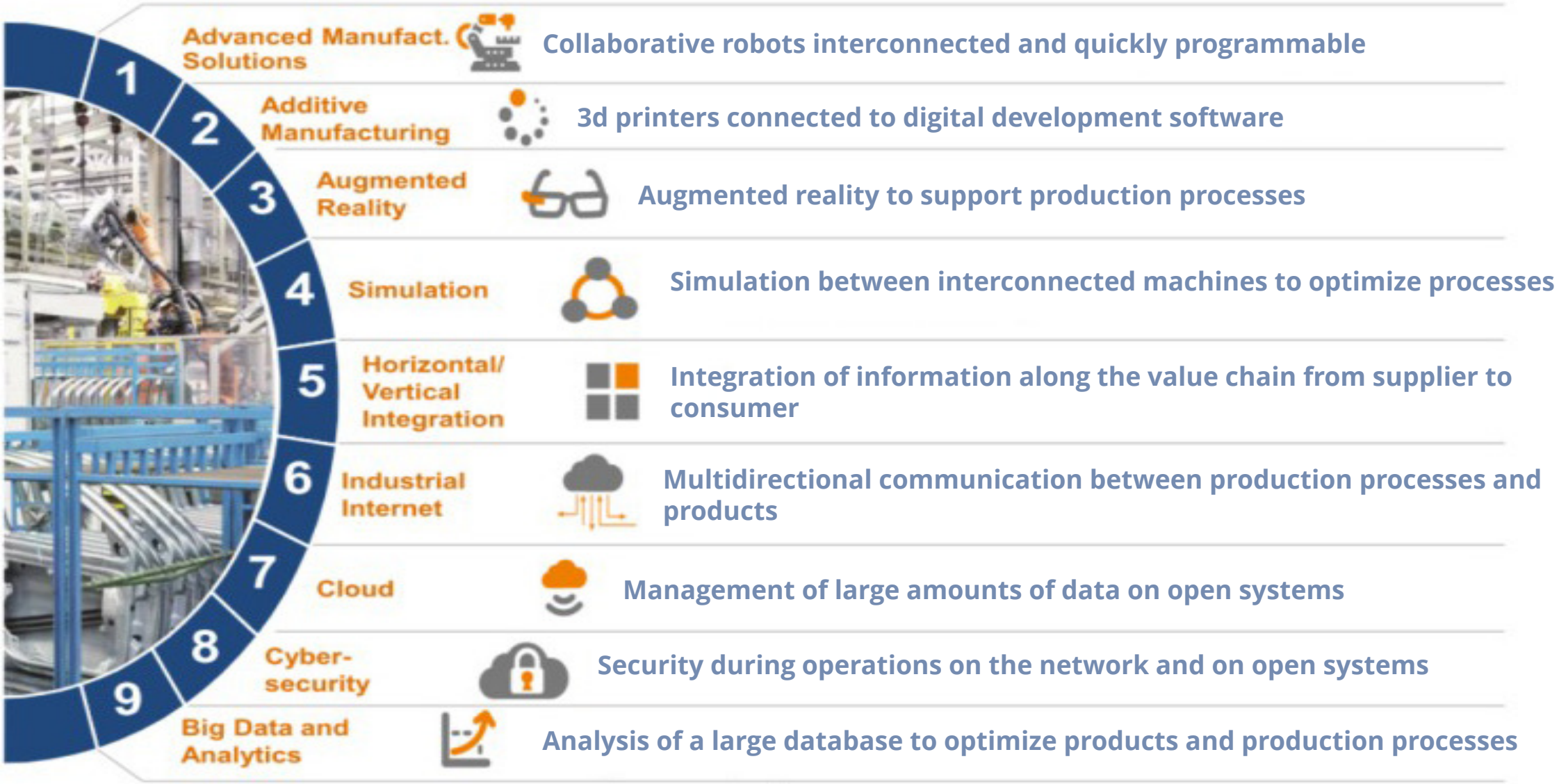
Interaction between man and machine

The third direction of development is the interaction between man and machine, which involves "touch" interfaces, which are increasingly widespread, and augmented reality.

Transition from digital to real

It includes additive manufacturing, 3D printing, robotics, communications, machine-to-machine interactions and new technologies to store and use energy in a targeted way, rationalizing costs and optimizing performance.

Enabling technologies of industry 4.0



1. Advanced manufacturing solution

It includes the group of additive technologies composed of different models of **machines or systems that can be connected to each other and allow remote control**.

The main component is "**Collaborative Robotics**" or the sharing of a workspace between man and robot in an efficient and safe way thanks to the artificial intelligence of the machines that are able to perceive the surrounding space.

The use of robots in the production process is not new, however, even the latter are subject to improvements and evolution. The new robots will be more **self-sufficient, autonomous, interactive** and built as an integrated work unit that works alongside the human workforce.

They will replace simple and repetitive jobs (easily standardized and adaptable to the capabilities of the machines) and in part complement the employment of the workforce as new activities based on soft skills will be born, that is, those skills that guarantee problem solving skills.

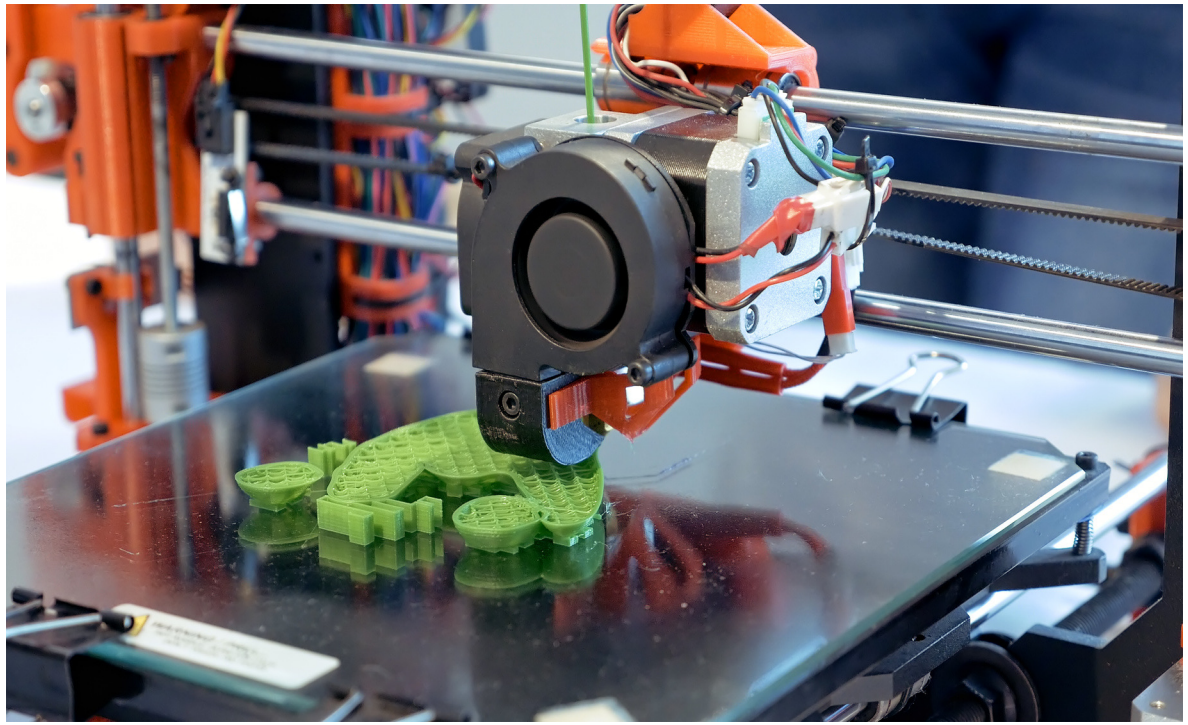
2. Additive manufacturing

The terms **3D printers** and **additive manufacturing** are often used interchangeably as they both **refer to the creation of three-dimensional physical objects from a digital model that represents their design.**

In traditional manufacturing, the creation of a product took place through the removal of material from a raw component. With additive manufacturing, on the other hand, a component is made through the layered deposit of material.

The result is the possibility of **creating customized products with complex geometric characteristics**, not achievable with traditional techniques, using a smaller quantity of raw material, but even more a reduction in prototyping times and costs relating to variants.

The innovation of 3D printing is not recent, but today the field of use of this technology is wider since larger objects can be made in a wide range of materials (metal, ceramic, wax, polymers, etc.) and the cost of machines suffered a reduction.



3. Augmented reality

The **evolution of virtual reality**, based on a totally fictitious information environment, is represented by augmented reality which, on the contrary, integrates reality with information of any form (textual, graphic, sound, etc.) in real time.

Augmented reality is therefore to be considered an integration of the physical environment with the aim of simplifying the user's activity and enhancing interactions with the real world.

The possibility of replacing paper documentation (e.g. work instructions, technical drawings, etc.) with voice commands directly in the operator's field of vision, displaying the operations to be carried out in a particular work phase in real time are some examples of activities that they can be carried out by increasing the quality of the product and making the work more flexible.

4. Simulation

Simulations are used in manufacturing processes **to analyze real data in real time in a controlled virtual model**, considering plants, products and operational personnel. The goal is to test and optimize processes even before their physical implementation, **reducing installation times and increasing product quality**.

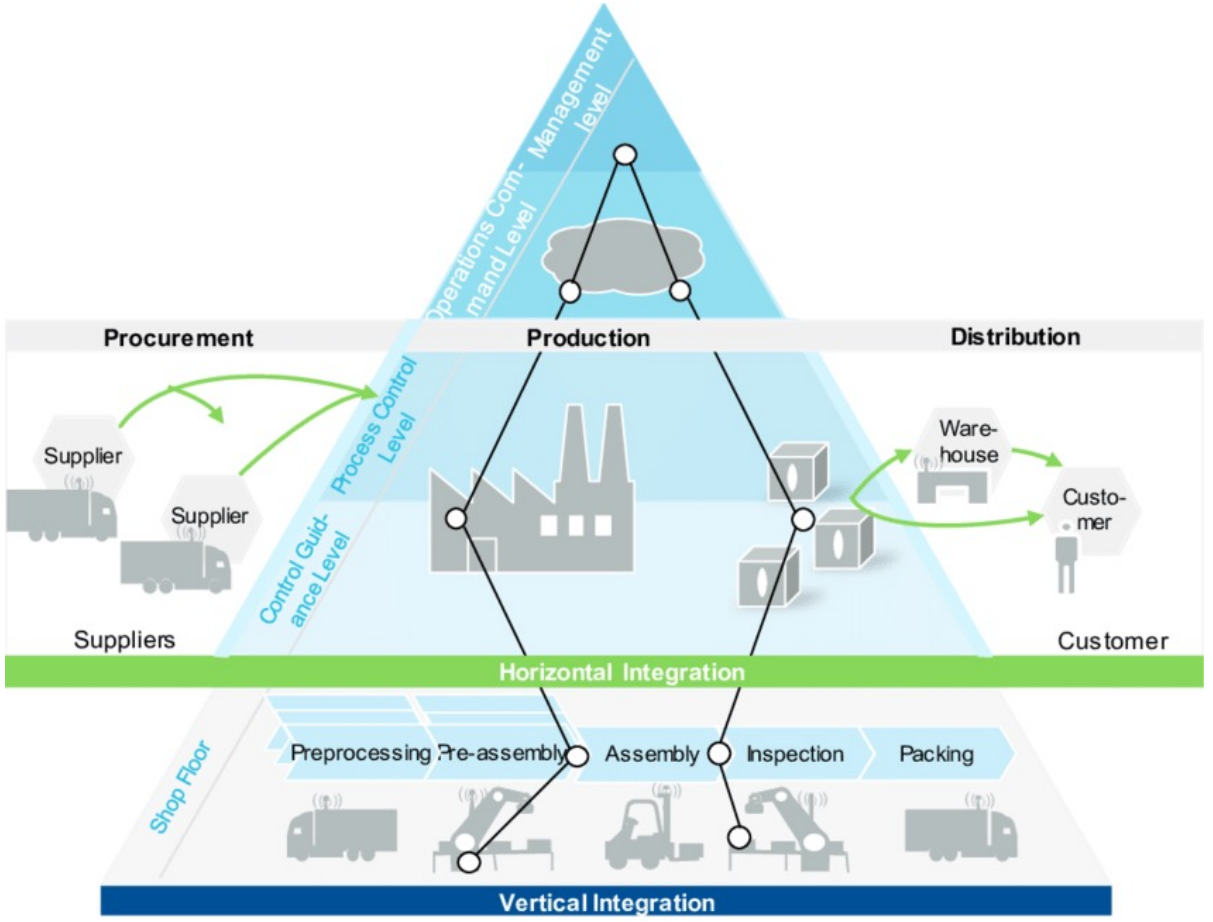
In this way it will be possible to **implement corrections** in the production process of a given product **without facing the huge costs deriving from learning-by-doing**, reduce the setup time of the machines and increase the quality of industrial processes as well as of the products produced.

5. Horizontal/Vertical integration

The adoption of interconnected technologies, both vertically and horizontally, allows us to analyze big data and **create open systems for their sharing in real time**. This will allow digitization and integration along the entire value chain, in order to create an efficient and effective automated flow. In general, time and cost savings are achieved throughout the production process and an increase in the value of the product for the customer.

The goal of industry 4.0 is the convergence and coexistence between the Operation Technology (OT) and Information Technology (IT) system.

In particular, **vertical integration** allows the company to relate to all members of the value chain, from suppliers to end customers, determining shared working standards and objectives. **Horizontal integration**, on the other hand, supports the management of information between business areas that contribute to the definition of the life cycle of a product.



6. Industrial internet

The concept of the Internet of Things (IoT) expresses the application of technological components and devices inserted inside physical objects (which can be machines) making them "intelligent" and able to communicate and interact with each other and with the surrounding world , through the internet and thanks to a standardized language.

We are not just talking about a machine-machine interface, but rather a man-machine system. With the IoT you can focus on **a set of technologies that allow you to connect any type of device to the internet.**

Flexibility, product customization, real-time dialogue between customer, design, supplier and production are the effects of the development of the IoT.

7. Cloud

The Cloud consists of a **common, flexible and open design IT infrastructure to share data, information and applications across the internet beyond company boundaries**, in order to follow the transformation of business models with the necessary capacity.

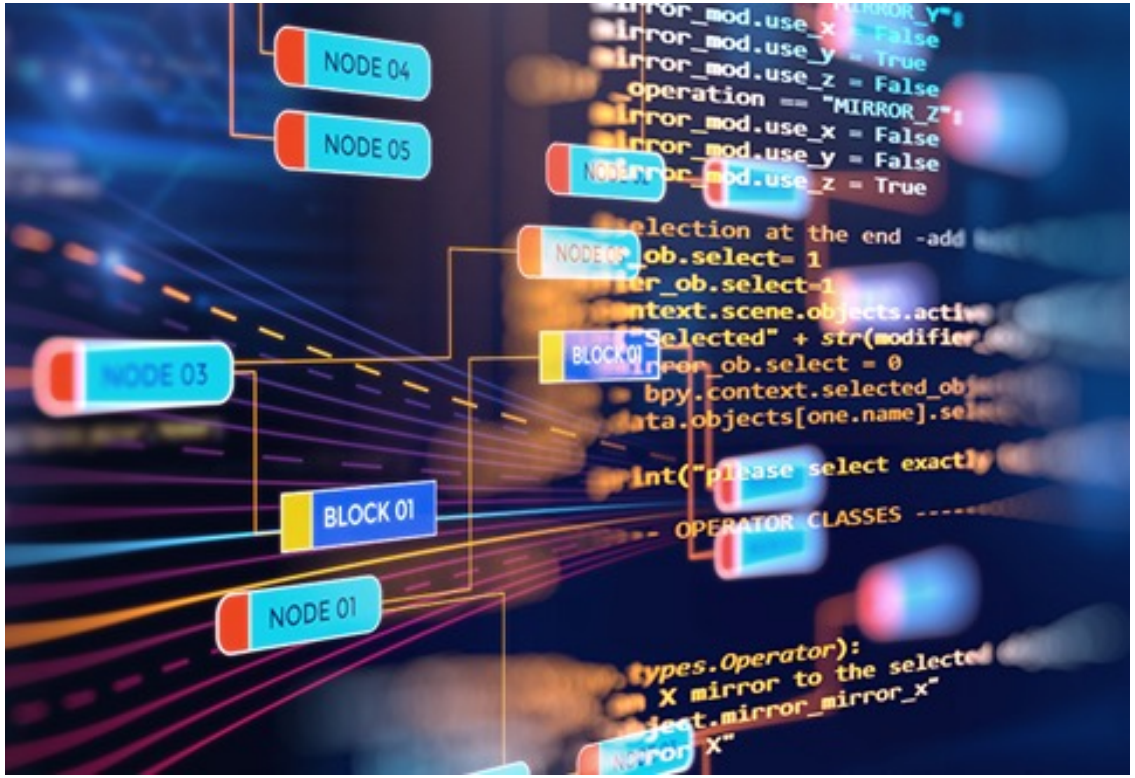
In a context of considerable flexibility of production and organizational processes and given the growing demand for product customization by the consumer in industry 4.0 ", the cloud represents the most suitable means for achieving collaboration between companies and, once the set goal, to allow the dismantling of these temporary virtual organizations, in function of new business opportunities.

8. Cybersecurity

In a world totally connected on the network and the use of increasingly standardized protocols, also required by industry 4.0 itself, the issue of Cybersecurity systems increases to guarantee the company the security of information relevant to the business. The reason is simple: any device connected to the internet is hackable.

The need to protect industrial systems from cyber threats, secure and reliable communications, identity management and machine and user access are essential.

The term cybersecurity indicates the set of technologies (processes, products and standards) **aimed at protecting IT systems** from attacks that can lead to the loss or compromise of data and information.



9. Big Data and Analytics

The term **Big Data and Analytics means the collection and analysis of data from different sources that pass through the internet** and that describe, for example, market trends, consumer habits, brand reputation, demand for goods and more.

From the 90s to today, data analysis has evolved from decision support to support the execution of decisions at the top management level.

Through appropriate tools for the management of big data, companies can effectively extract economic value from the acquisition and processing of large volumes and varieties of data, being able to identify possible future scenarios and what actions to take to optimize results.

The growth prospects are enormous. Companies need to generate the appropriate skills to customize the path, adapting it to their own reality without losing precious opportunities.

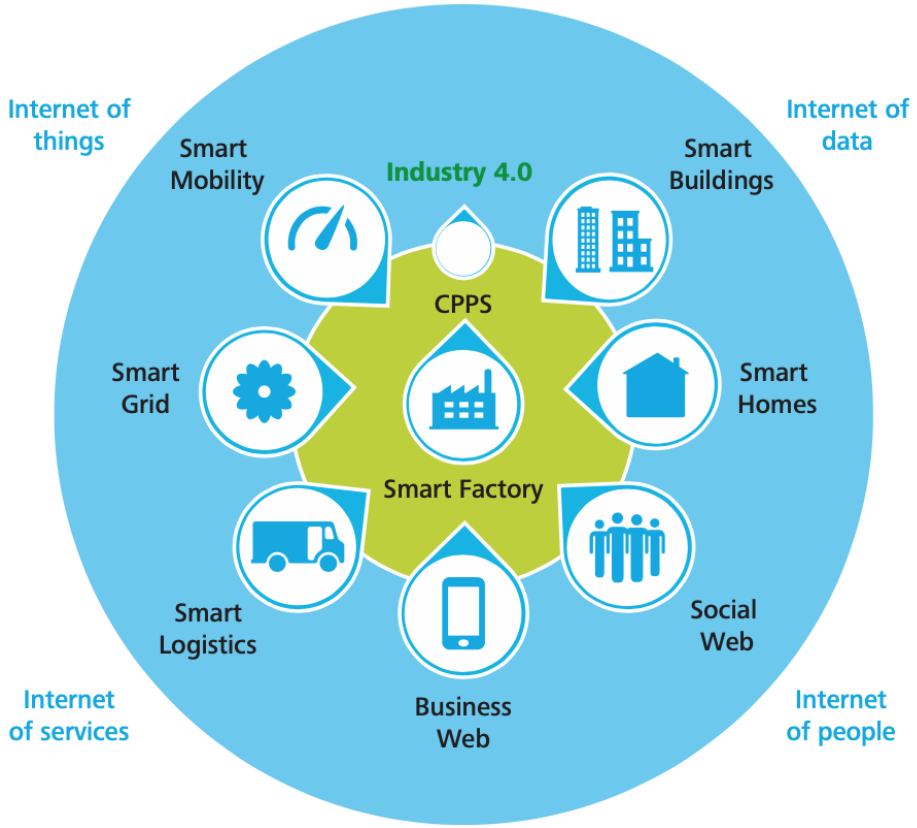
Key concept, in the face of so much new technology available, do not fall in love with the novelty and pursue it at all costs to become technological, because the goal remains to become more competitive.

Big data and Artificial Intelligence

Data collection so extensive in terms of volume, speed and variety that specific analytical techniques and methods are required for the extraction of value or knowledge. The term used in reference to the ability to analyze and relate a huge amount of heterogeneous structured and unstructured data in order to discover links between different phenomena and predict future ones.

Artificial intelligence (AI) is the ability of a machine to display human abilities such as reasoning, learning, planning and creativity.

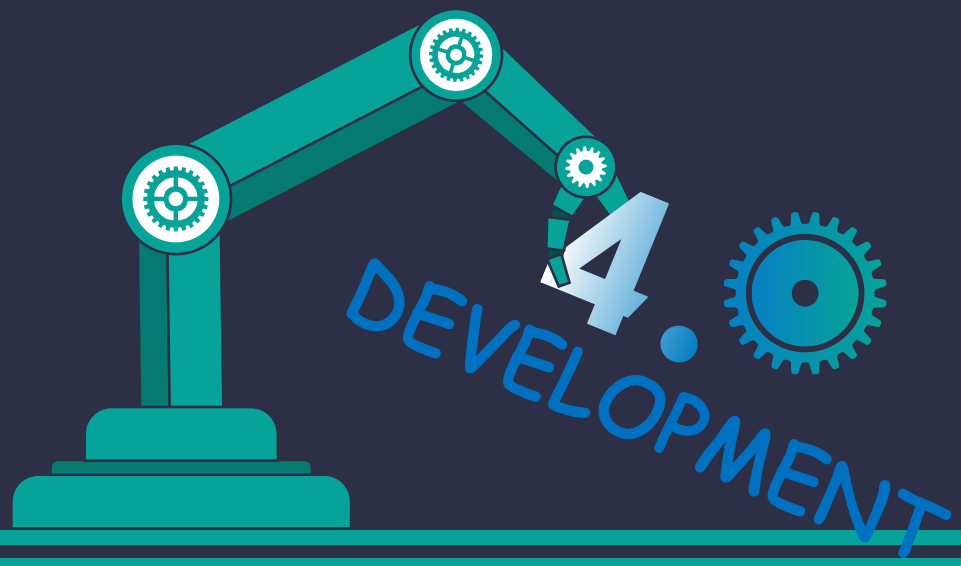
The Industry 4.0 environment



Outside the industries we are witnessing this revolution as well.

Smart city use information and communication technology (ICT) to improve operational efficiency, share information with the public and provide a better quality of government service and citizen welfare.

Digital healthcare, Public transportation, Energy saving are just a few examples of the endless applications of the internet of things and technologies 4.0 are improving our lives.



How can these technologies be used in agriculture and pastoralism?

This project was born from the collaboration of AA International Ltd, Research Institution based in Aberystwyth, Ceredigion, UK DISA-MIS of the University of Salerno and AgriTechTalk International, a not-for-profit Community Interest Company.

The aim of the project is to create a fully automated model capable of identifying the health level of the zebu.

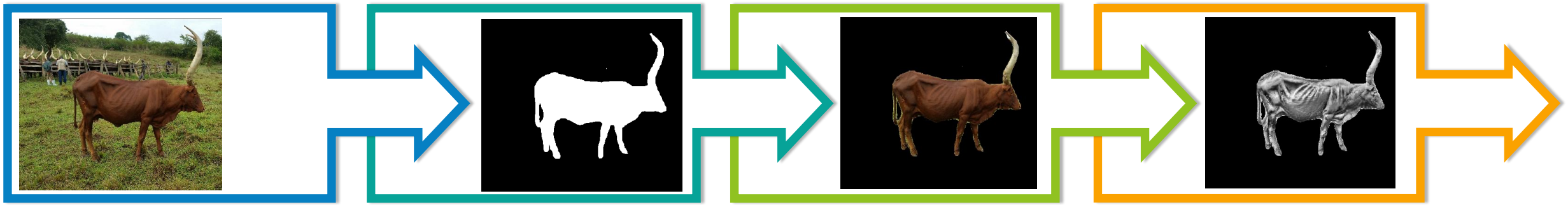
Below we will see the main points of the work carried out and how these are perfectly integrated with the development guidelines of industry 4.0.

Real Example of 4.0 Industry Implementation

PICTORIAL EVALUATION TOOL (PET) GRADING SYSTEM -LIVESTOCK BODY CONDITION SCORES

Pipeline of our work

Two models have been developed for this work.
The first model is responsible of identifying the animal in the photo and modifying this photo in order to produce a result that emphasizes the characteristics of the animal necessary in the evaluation phase.
The second model will deal with evaluating these characteristics.



Taking the photo

For the project in exams we will only use photographs as data, thus not making use of external data such as the tonnage of the animal.

Identify the animal

The first step to do is to identify the animal

Remove the context

Once the animal has been identified, we will remove the contest to avoid disturbing elements that could affect the assessment of the animal's health conditions.

Emphasize the details

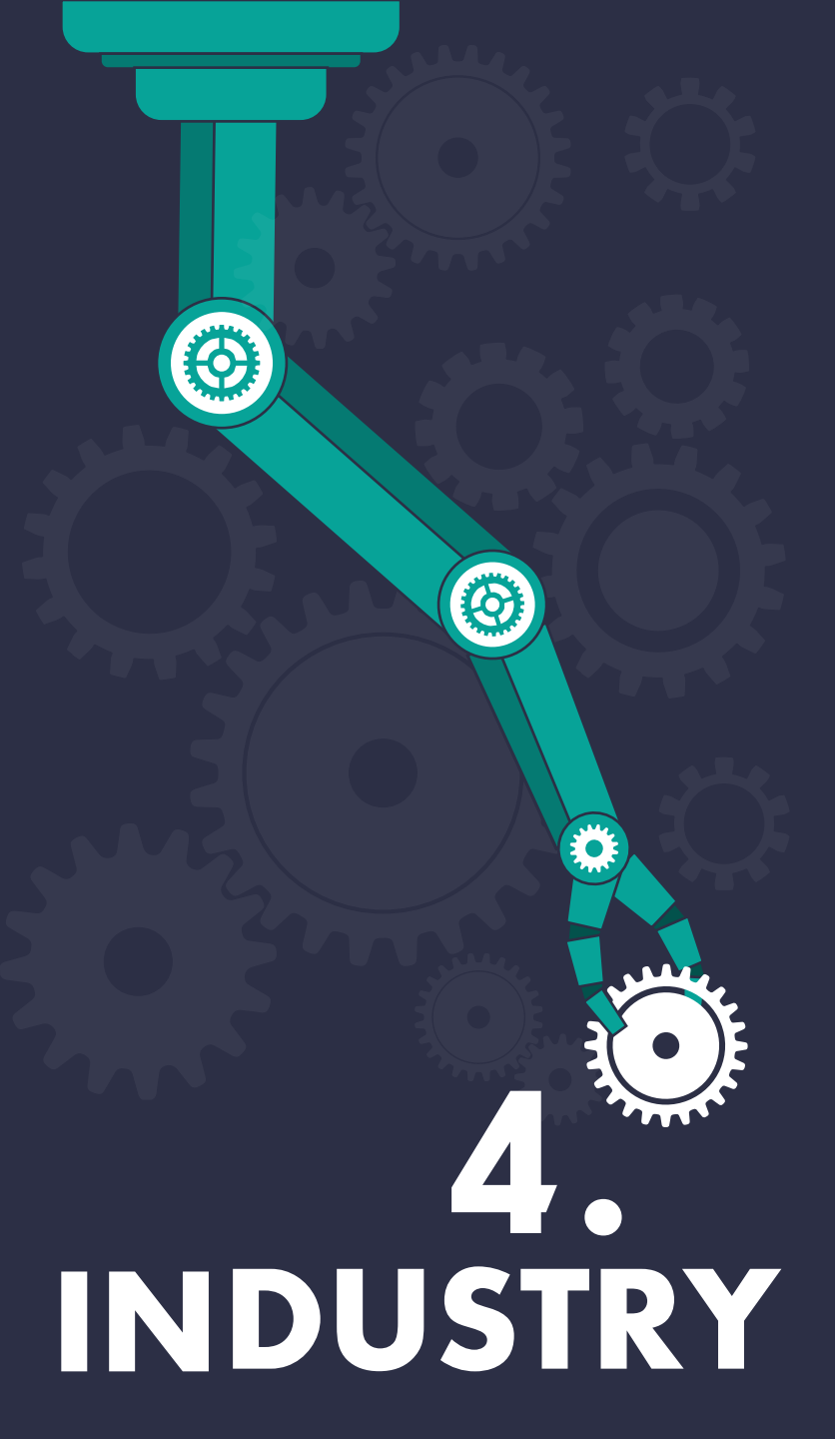
Not being able to use external data, it is good to make the most of those in our possession. Emphasizing data such as bone exposure can be a great help in the evaluation phase.

Current Problem: lack of data

Importance of data

An artificial intelligence model has a very simple basic functioning: by processing the data, it “trains” to generalize the conditions that generated that data. In the case of our cows, therefore, by feeding our model the data of malnourished and healthy cows, the model will learn to understand what differences a cow will be from a malnourished one and will be able to identify all future cows without the human intervention. The data therefore serve to generalize the problem and consequently, the more data we have, the more we can generalize, thus creating increasingly precise models.

Currently our project has encountered a problem: identifying a cow in a photo is easier than understanding why a cow is healthy or not. With the data at our disposal it was easy to create the first model but more data is needed to better generalize the second model



Future developments

01 **Real-time diagnostics of entire herds**

It will be possible to identify the conditions of each cow present in one or more herds and create reports, all through simple cameras and without the need for human personnel who can be dedicated to more important tasks.

02 **Prevent a case of severe malnutrition**

With the diagnostics in real time and active 24 / 24h it will be possible to constantly monitor the animals in order to avoid worsening of the conditions.

03 **Let the model work on other breeds**

It is obviously possible to further generalize the problem and extend the diagnostics to other animal breeds.

04 **Automatically customized diets**

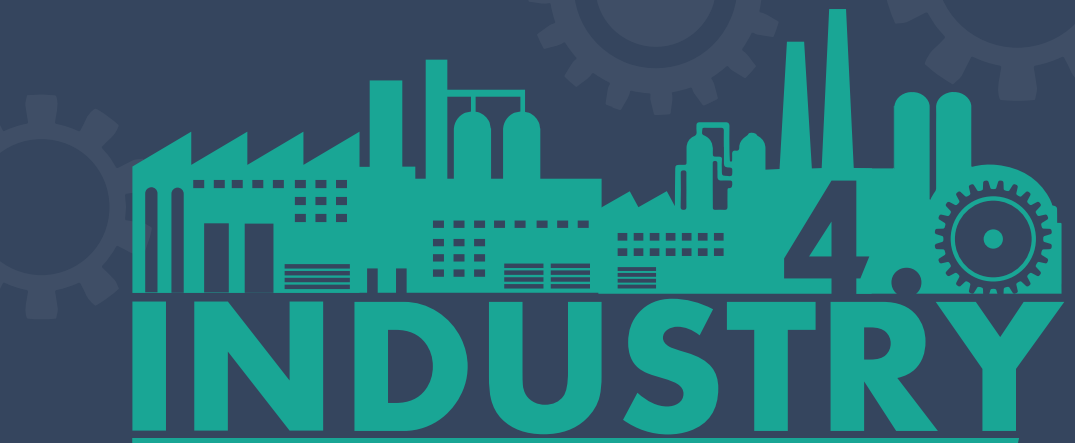
At the basis of industry 4.0 there is the interconnection of devices. It will be possible to connect the video camera that identifies the health conditions of the animals with a food dispenser in order to give the animal the best diet for its needs.

Society 5.0

A human-centered **society** that balances economic advancement with the resolution of social problems by a system that highly integrates cyberspace and physical space

…towards a Digital Humanism

A possible and sustainable future characterized by cyber-physical-social dynamics that seeks to implement a continuous improvement process for an increased quality of life



Thank You