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DIGI-VET

Fostering Digitization and Industry 4.0 In Vocational Education and Training

MODULE 2

Terms & History of Industry 4.0

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Coordinator:

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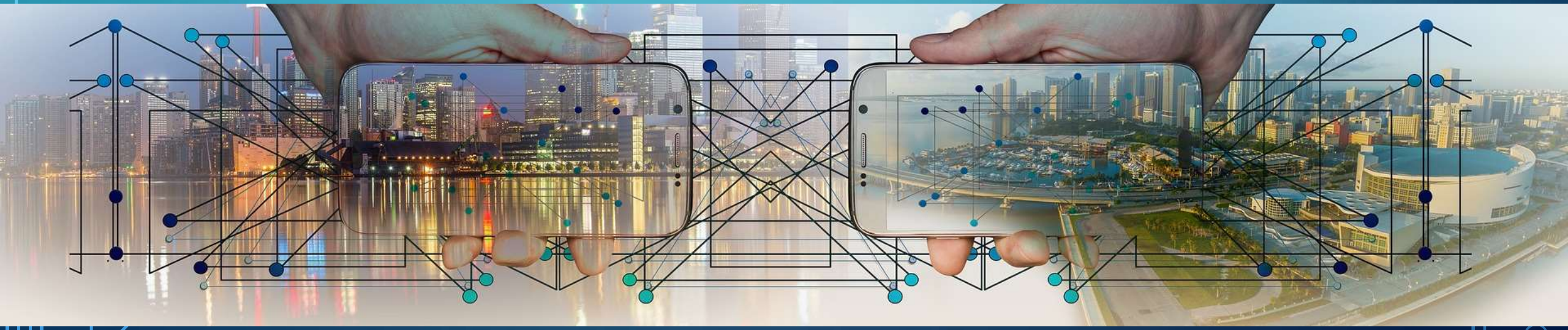
WHAT IS INDUSTRY 4.0?

- Industry 4.0 is essentially the Digital Networking of people, machines and products.
- It is also known as the 4th industrial revolution that concerns industry.
- Although the terms "industry 4.0" and "fourth industrial revolution" are often used interchangeably, “Industry 4.0" factories have machines which are intensified with wireless connectivity and sensors, connected to a system that can envision the entire production line and make decisions on its own.
- Essentially, industry 4.0 is the trend towards automation and data exchange in manufacturing technologies and processes which include cyber-physical systems (CPS), the internet of things (IoT), industrial internet of things (IIOT), cloud computing, cognitive computing and artificial intelligence (AI).



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WHAT ARE ALL THESE TERMS?

Cyber-physical systems (CPS)

Cloud computing

The internet of things (IoT)

Artificial intelligence (AI)

Cognitive computing

Industrial internet of things (IIOT)

CYBER-PHYSICAL SYSTEMS (CPS)

CPS are objects which have embedded software and electronics connected to each other in a system, for example, robots, drones and other movable machines. This way physical and mechanical objects and processes are connected with software-controlled objects and processes – with the real and virtual worlds converging. CPS can be used for traffic control or for managing intelligent electricity networks.

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Image from Pixabay
https://pixabay.com/illustrations/cloud-computing-network-internet-2001090/

CLOUD COMPUTING

Cloud computing covers all activities taking place on an online service (For example: sending e-mails, processing documents via an online platform and saving them there, playing videos or analysing data). It makes an IT infrastructure which makes it possible for data to be saved on decentralised computer systems via the internet and to be available at any time at any place as long as there is an internet connection. Thus, a cloud provider offers a complete working place in a virtual form (such as computer, memory, platforms and software applications) creating great flexibility for the user.

THE INTERNET OF THINGS (IOT)

The IoT is a network of connected devices that can communicate with each other and provide data to users through the Internet. IoT devices can connect to the Internet and often have sensors that enable them to collect data. An IoT device can be useful on its own, but when you use numerous devices together, they become even more valuable.

IoT technology enables the user to collect data automatically from many different functions. IoT technology can also be used to automate equipment and parts of industrial operations.

Image from Pixabay
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Image from Freepoint Technology Inc.
https://getfreepoint.com/iiot-role-play-manufacturing/

Industrial internet of things (IIOT)

IIoT is a subcategory of IoT. The term refers to IoT technology used in Industrial settings, namely in manufacturing facilities. IIoT is a key technology in Industry 4.0, the next phase of the industrial revolution. Industry 4.0 emphasises smart technology, data, automation, interconnectivity, artificial intelligence and other technologies and capabilities.

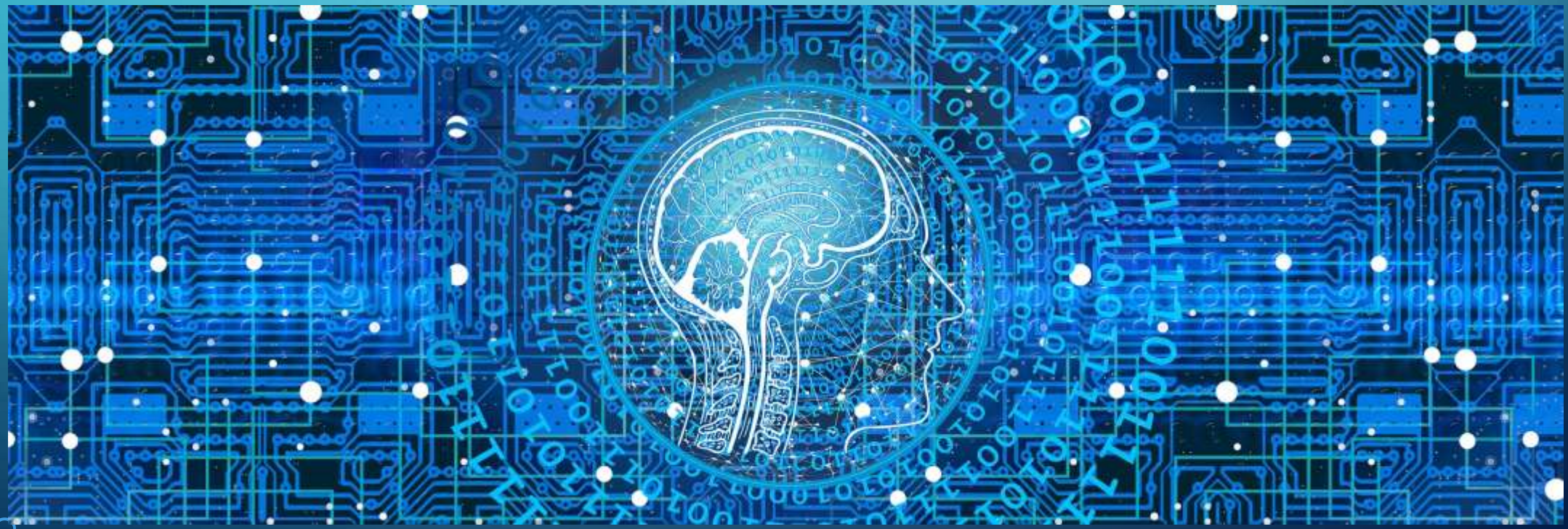
These technologies are revolutionising the way factories and industrial organizations are run.

COGNITIVE COMPUTING

The use of computerised models to simulate the human thought process in complex situations where the answers may be ambiguous and uncertain. The phrase is closely associated with IBM's (International Business Machine) cognitive computer system, Watson. Cognitive computing overlaps with AI and involves many of the same underlying technologies to power cognitive applications, including expert systems, neural networks, robotics and virtual reality (VR).

ARTIFICIAL INTELLIGENCE (AI)

The ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings.



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SMART MANUFACTURING

Related terms: smart factory, smart production, smart data

Smart manufacturing is used to describe an environment in which computers are in charge of decision-making.

In a smart manufacturing environment, physical and digital are connected and communicate with one another to improve production.

The broad definition of smart manufacturing covers many different technologies. Some of the key technologies in the smart manufacturing movement include big data processing capabilities, industrial connectivity devices and services, and advanced robotics.

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HISTORY OF INDUSTRY 4.0

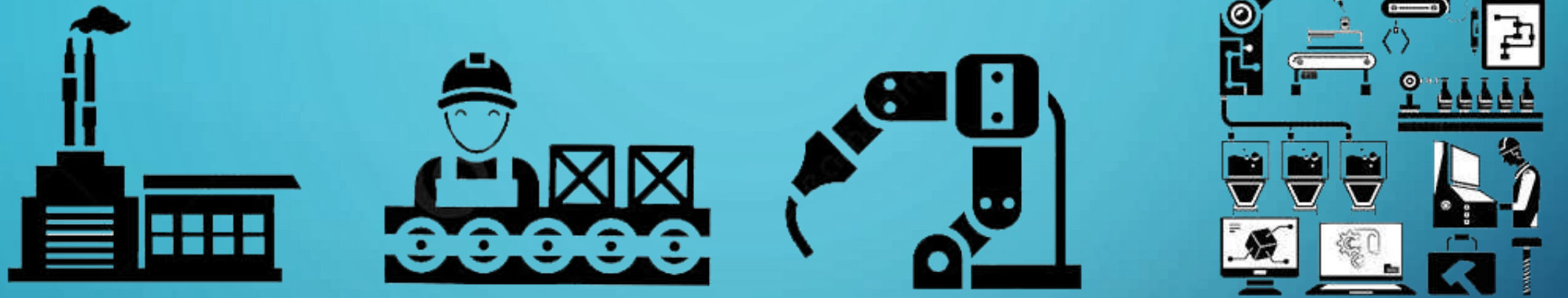

Image from Techutzpah
https://techutzpah.com/evolution-of-industrial-revolution-4-0/

HISTORY OF INDUSTRY 4.0

The **First industrial revolution** began with the mechanization and mechanical power generation in 1800s. It brought the transition from manual work to the first manufacturing processes (mainly in the textile industry). An improved quality of life was a main driver of the change.

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The **Second industrial revolution** was triggered by electrification that enabled industrialization and mass production. It was a period when advances in steel production, electricity and petroleum caused a series of innovations that changed society. With the production of cost effective steel, railroads were expanded and more industrial machines were built.

The **Third industrial revolution** is characterized by the digitalisation with introduction of microelectronics and automation. In manufacturing this facilitates flexible production, where a variety of products is manufactured on flexible production lines with programmable machines. Such production systems however still do not have flexibility concerning production quantity.

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Image from Pixabay
https://pixabay.com/photos/industrial-4-0-information-2470457/

Today we are in the **Fourth industrial revolution** that was triggered by the development of Information and Communications Technologies (ICT). Its technological basis is smart automation of cyber-physical systems with decentralized control and advanced connectivity (IoT functionalities). The consequence of this new technology for industrial production systems is reorganization of the automation systems to a self-organising cyber physical production system, that allows flexible mass custom production and flexibility in production quantity.

INDUSTRY 4.0 - THE FOURTH INDUSTRIAL REVOLUTION

Check out this video, produced by the Siemens company regarding Industry 4.0 and the vision of tomorrow's manufacturing…

https://www.youtube.com/watch?v=HPRURtORnis

AGRICULTURE 4.0 AND INDUSTRY 4.0

The Industry 4.0 trend is transforming the production capabilities of all industries, including the agricultural sector. Connectivity is the basis of this transformation and IoT is the key for enabling this technology which is a huge part of the agricultural equipment.

According to the European Parliament definition, Agriculture 4.0 is "*a farming management model based upon observing, measuring and responding to inter and intra-field variability in crops*". The goals are mainly increasing the productivity of the crops while ensuring a higher environmental sustainability.

Basically, to produce quantity and quality with less. And for that there are several tools, techniques and technologies.

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DRONES

The use of drones is starting to be developed in the Agriculture 4.0 sector in several ways.

1. Soil and field analysis: Drones can be helpful at the start of the crop cycle. They are able to produce precise 3-D maps for the early soil analysis, which is useful in planning seed planting patterns. After planting, drone-driven soil analysis provides data for irrigation and nitrogen-level management.

2. Planting: Startups have created drone-planting systems that achieve an uptake rate of 75% and decrease planting costs by 85%. These systems shoot pods with seeds and plant nutrients into the soil, providing the plant all the nutrients necessary to sustain life.

3. Crop spraying: Distance-measuring equipment, meaning ultrasonic echoing and lasers, enables a drone to adjust altitude as the topography and geography vary, and thus avoid collisions. Consequently, drones can scan the ground and spray the correct amount of liquid, modulating distance from the ground and spraying in real time for even coverage. The result: increased efficiency with a reduction of in the amount of chemicals penetrating into groundwater.

**Experts estimate that aerial spraying can be completed up to five times faster with drones than with traditional machinery.*

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DRONES

Image from Pixabay
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4. Crop monitoring: Vast fields and low efficiency in crop monitoring together create the largest obstacle in farming. Unpredictable weather conditions make the process even more challenging which increase risk and field maintenance costs. Previously, satellite imagery offered the most advanced form of monitoring. But there were drawbacks. Images had to be ordered in advance, could be taken only once a day, and were imprecise. Furthermore, these services were extremely costly and the images' quality was low especially on days where the weather was poor. Today, time-series animations can show the precise development of a crop and reveal production inefficiencies, enabling better crop management.

5. Irrigation: Drones with hyperspectral, multispectral, or thermal sensors can identify which parts of a field are dry or need improvements. Additionally, once the crop starts growing, drones allow the calculation of the vegetation table, which describes the relative density and health of the crop.

6. Health assessment: It's essential to assess crop health and spot bacterial or fungal infections on trees. Drone-carried devices can identify which plants reflect different amounts of green light and NIR light, by scanning a crop using both visible and near-infrared light. This information can produce multispectral images that track changes in plants and indicate their health. A speedy response can save an entire crop. In addition, as soon as a sickness is discovered, farmers can apply and monitor remedies more precisely. These two possibilities increase a plant's ability to overcome disease. And in the case of crop failure, the farmer will be able to document losses more efficiently for insurance claims.

INTERNET OF THINGS (IOT) IN AGRICULTURE 4.0

Agriculture 4.0 is considered as one of the areas with bigger growth potential within the Internet of Things (IoT) industry.

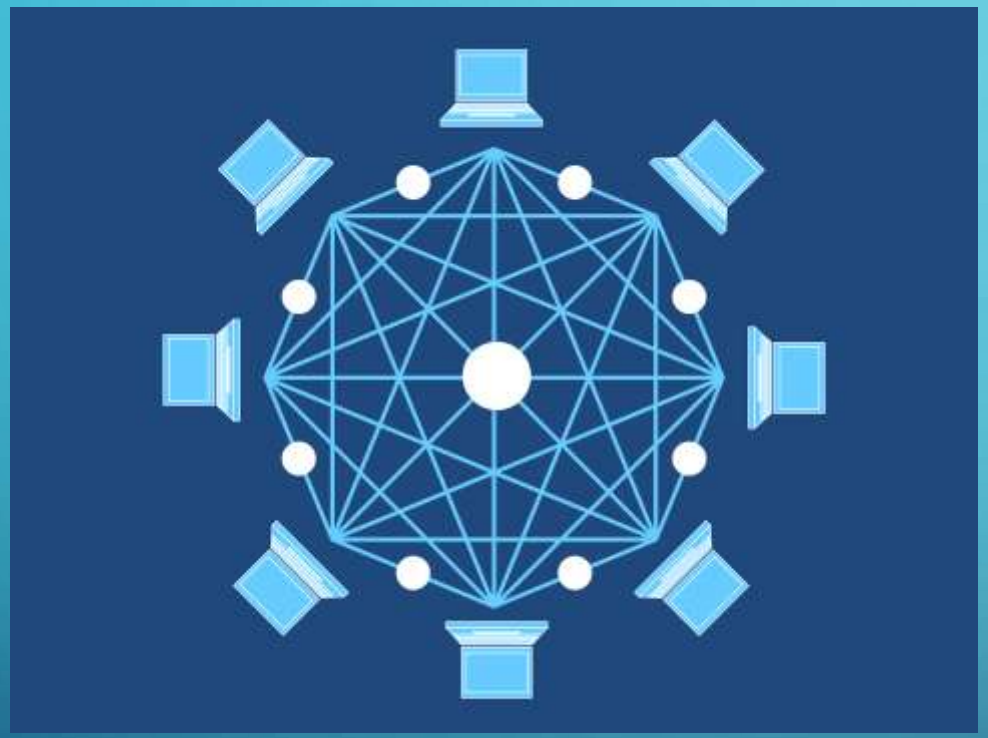
Deploying IoT devices in farmlands capable of remotely sending data related with the crops opens a whole new world of possibilities.

These devices could possibly include a number of sensors that measure several parameters affecting the evolution of the crops, such as the soil moisture, the temperature or the electrical conductivity of the ground. All this data allows a real time monitoring of the status of the crops as well as, through statistical models, predicting when watering or fertilizing on certain areas will be needed.

A good example of a company who has invested in this sector is Cobo Group.
Here is a video on how their products can be implemented in Agriculture 4.0 and consequently in Smart farming.

Image from Youtube Video or Cobo Group
https://www.youtube.com/watch?v=s_DHDpl5o5k

BLOCKCHAIN



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https://pixabay.com/el/illustrations/blockchain-block-%CE%B1%CE%BB%CF%85%CF%83%CE%AF%CE%B4%CE%B1%CF%82-3019121/

The technology everyone is talking about is **Blockchain.**

Blockchain technology could transform the entire food industry, by increasing efficiency, transparency and collaboration throughout the food system.

What's special about blockchain technology is that through cryptography we can create an ledger of assets and transactions that cannot be tampered with or "hacked". It helps to keep tabs on supplies and could reduce cases of illegal harvesting and shipping frauds.

HOW CAN BLOCKCHAIN TECHNOLOGY HELP FARMERS?

- Food Safety: Bringing transparency to the supply chain will allow consumers to identify and remove bad actors and poor processes. This ensures ideal conditions from farm to market, and we can find the source quickly in the event of a food safety emergency. This could save time and money.
- Traceability: The benefit here will that consumers will be able to trace exactly the origins of their goods. They will be able to know exactly where the food comes from and who grew it. This could also prevent food fraud and false labeling.
- Transaction Cost: A few companies are making progress in creating more transparent and efficient supply chains through the use of blockchain technology. They are applying the technology directly to the grain trade and also plan to expand into other agricultural commodities, such as cotton.
- Opening New Markets: The premise here is that if trust and accountability can be created among the people within this Industry, there is reduced need to evaluate each person individually on their trustworthiness and ability to execute. This means that the people who are not involved in this Industry could potentially be jobless or have a very little work through this technology.
- Logistics: Dealing with products that often have a very short shelf life, in uncertain conditions in high quantities means a lot of waste (of food and money) if not consumed on time.

Image from Pexels
https://www.pexels.com/photo/green-leafed-plants-2218364/

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Thank you for your attention!