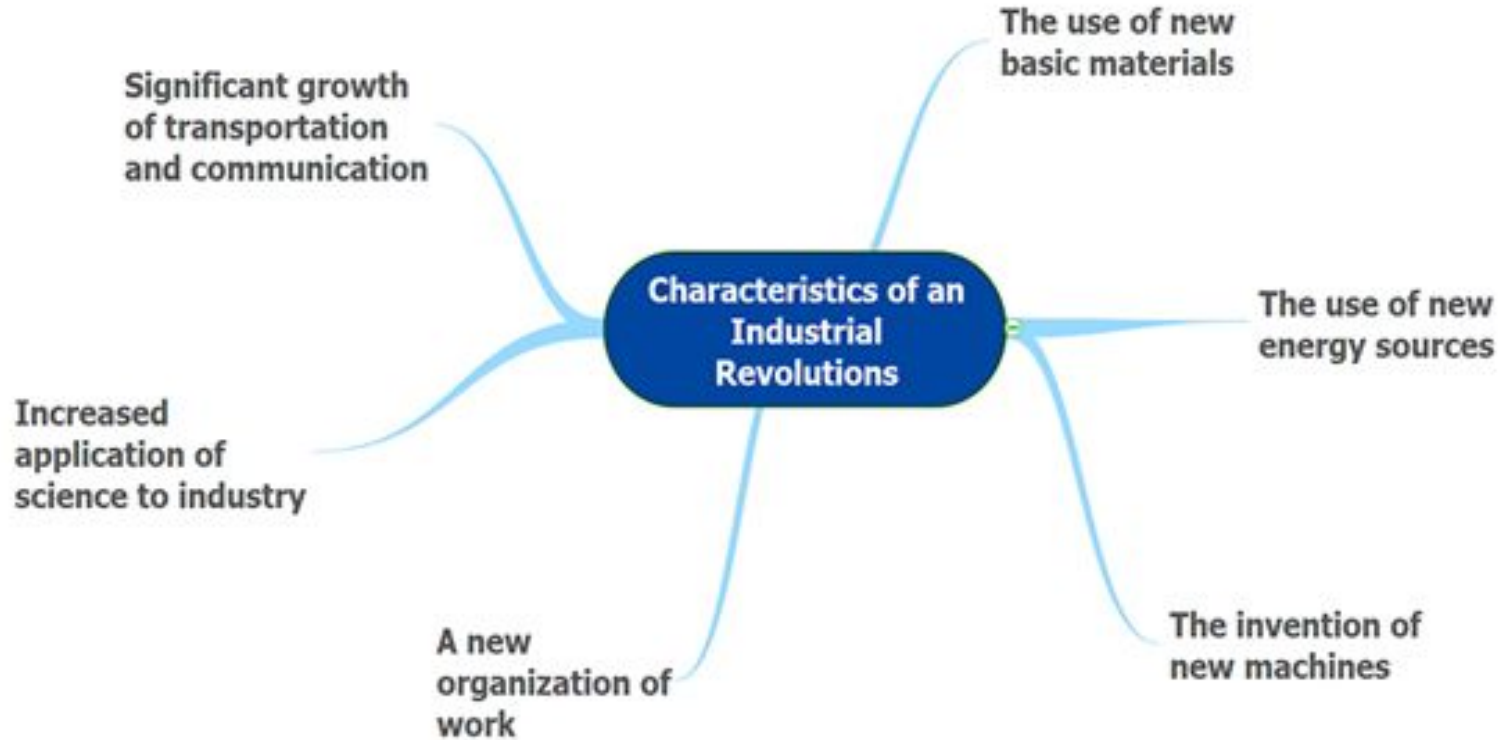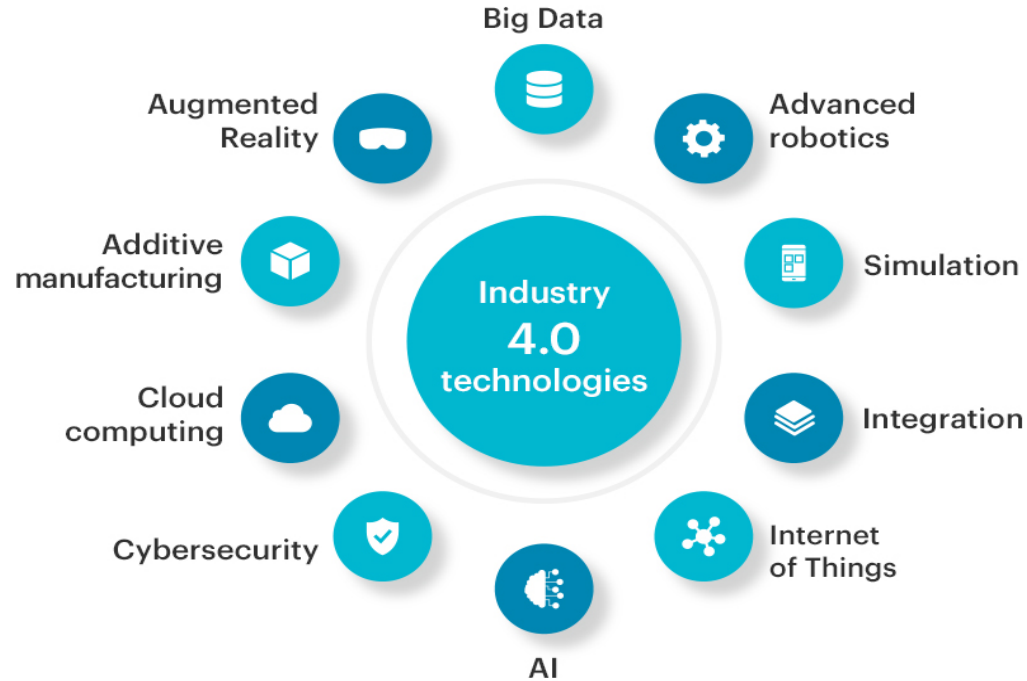# Industry 4.0

**Topic: Key technologies**

# KEY TECHNOLOGY OF INDUSTRY 4.0

# 1. Cyber-Physical system:

**A cyber-physical system (CPS) or intelligent system is a computer system in which a mechanism is controlled or monitored by computer-based algorithms**

Ex- A current cyber-physical system is at MIT's Distributed Robot Garden. In this unique venture, robots take care of a tomato garden. Each tomato plant is fitted with a sensor, and the robots keep track of a plant's status to see how it's doing or if it needs specific attention.

Ex- Smart-Grid, Plugging vehicle charging system



Ex- Wire-able sensor and Implantable devices which helps in disease diagnosis and prevention.

# 2. Big Data Analytics:

**It involves the collection, storage, and analysis of large volumes of data which utilizes advanced algorithms and machine learning techniques to process the information generated by machines, sensors and other digital systems.**

Ex- Customer Data Base, Emails, Customer Medical Record, Social network(NetFlix), Amazon Inc

Ex- Education sector, Healthcare sector, Transportation, Banking sector, Government sector

## 3. Advanced Robotics:

**These robots are equipped with AI, computer vision and sensor technologies to interact with the physical environment and collaborate with human in various industrial process.**

Automation leads to increased productivity, reduced errors and ability to perform specific task

## 4.Simulation:

**Simulation tools or technologies optimizes the business process in all kinds of industries by enabling the recreation of virtual processes or technical systems in the real world with in a controlled environment.**

Ex- AnyLogic, MathWorks, Siemens, Arena, Dassault Systèmes, Autodesk, Flexin, Simul8, Aspen Technology, AVEVA, Simio

# 5.Integration:

**Integration is the act of bringing together smaller components or information stored in different subsystems into a single functioning unit.**

**Horizontal Integration**: **Horizontal integration is the acquisition of a business operating at the same level of the value chain in the same industry**

**Example-** Facebook Inc.'s (now Meta Inc.'s) 2012 acquisition of Insta gram (social media)

**Vertical Integration**: **Vertical integration is a strategy that allows a company to streamline its operations by taking direct ownership of various stages of its production process rather than relying on external contractors or suppliers**

**Example-** Netflix (NFLX) is a prime example of vertical integration. The company started as a DVD rental business before moving into online streaming of films and movies licensed from major studios. Executives then realized they could improve their margins by producing some of their own original content like the hit shows "Grace & Frankie" and "Stranger Things." It also produced some bombs, like 2016's The "Get Down," which reportedly cost the company $120 million

# 6.Internet of Things(IOT):

The IoT refers to providing new services by connecting objects in the world through wired and wireless networks in various ways**.**
**IOT** is a

Ex- **Amazon Go**, the first offline store launched by Amazon, a global e-commerce market, is a prime example. Amazon Go aims to become a completely unmanned store with a system in which there are no employees in the store and all products are automatically paid for when customers visit, select products, and leave the store.

Consumers download the app on their smartphone, enter the store and select a product, and then leave. It will be paid for via the connected credit card.
Ex: Smart home, Smart farming, smart city,

# 7. Artificial Intelligence(AI) and Machine learning:

AI encompasses technologies that enable machines to perform tasks that typically require human intelligence. Machine learning, a subset of AI, involves algorithms that allow systems to learn from data and improve performance over time

Ex- Google Maps, Facial detection, ChatGPT,  Amazon Alexa, Apple's siri, Google assistant
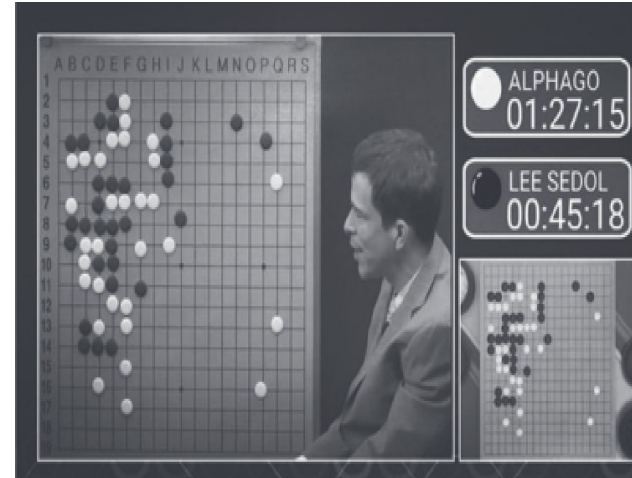
# 8. Cyber security:

Cyber security refers to a set of techniques used to protect the integrity of an organization's security architecture and safeguard its data against attack, damage or unauthorized access

Ex- Network security examples include firewalls that prevent illegal access to a network and antivirus. Antispyware software and VPNs (Virtual Private Networks) are other examples used for secure remote access

# 9. Cloud Computing:

Cloud computing provides on-demand access to shared computing resources over the internet.
It enables the storage, processing, and retrieval of vast amounts of data and facilitates the deployment and management of complex software systems.

Cloud computing allows organizations for remote servers, software, and services for efficient data management and computation.

| Model type | Examples | User |
|---|---|---|
| SaaS: Software as a Service | Google Docs, SalesForce | End customers |
| PaaS: Platform as a Service | App Engine, Azure | Developers |
| IaaS: Infrastructure as a Service | Amazon Web Service | System admins |

# 10. Additive Manufacturing:

Additive manufacturing (AM) or additive layer manufacturing (ALM) is the industrial production name for 3D printing, a computer controlled process that creates three dimensional objects by depositing materials, usually in layers.

The benefits of this technology applied to industry 4.0 include precision in product design, reduction of human errors in manufacturing, customization, reduced logistics and manufacturing costs, and great flexibility, agility, and adaptability for manufacturing lines.

Layer by Layer structure
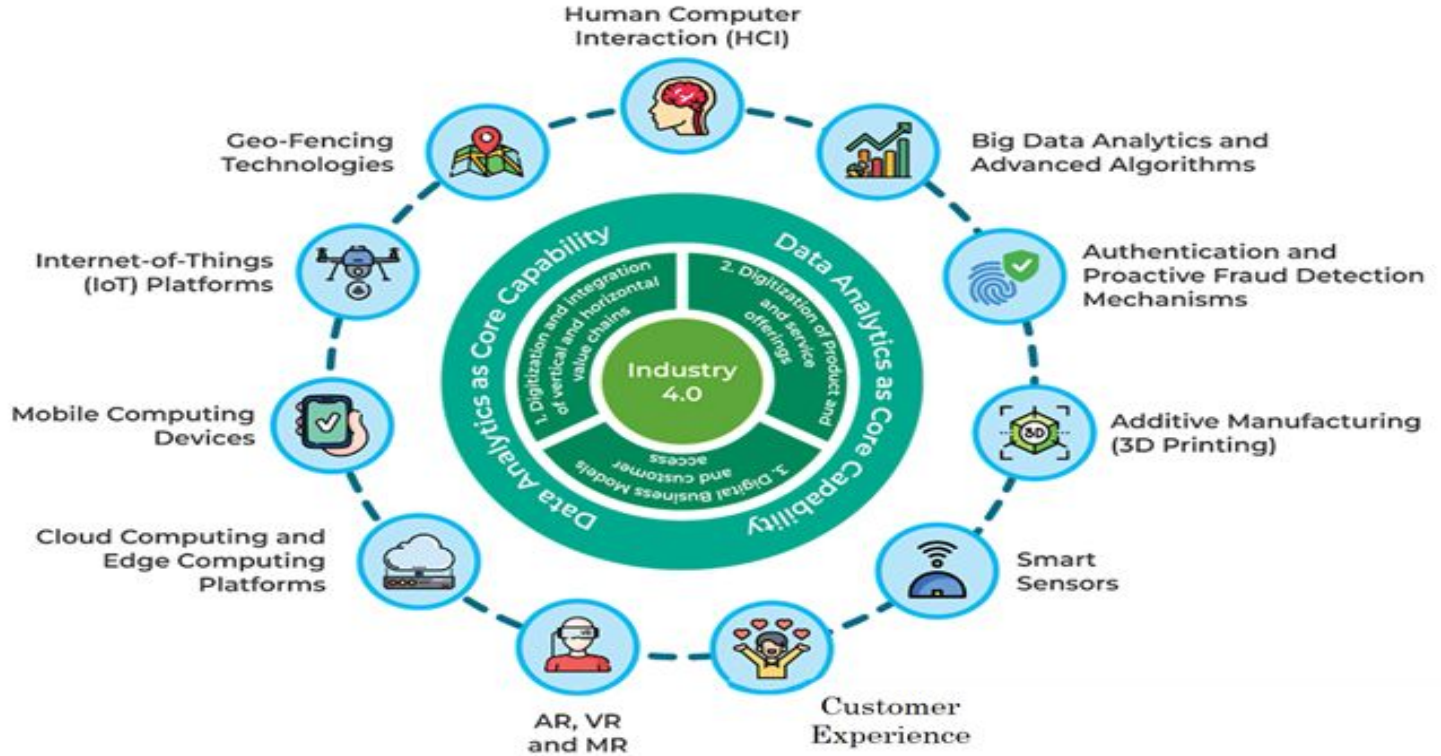Less wastage
Gretter Customization

# 11. Augmented Reality:

Augmented reality (AR) is the real-time use of information in the form of text, graphics, audio and other virtual enhancements integrated with real-world objects.

3 – Layered Framework

Human Computer Interaction (HCI)

Geo-Fencing Technologies

Big Data Analytics and Advanced Algorithms

Internet-of-Things (IoT) Platforms

Authentication and Proactive Fraud Detection Mechanisms

Mobile Computing Devices

Additive Manufacturing (3D Printing)

Cloud Computing and Edge Computing Platforms

Smart Sensors

AR, VR and MR

Customer Experience

Data Analytics as Core Capability

1. Digitization and integration of vertical and horizontal value chains

2. Digitization of product and service offerings

3. Digital Business Models and customer access

Industry 4.0

## Perception Layer(digitization):

The perception layer, also known as the "sensing" or "physical" layer, is the foundational level of Industry 4.0.

It deals with data acquisition from physical objects and processes. This layer consists of sensors, actuators, and other devices that collect data from machines, equipment, products, and the environment.

The data collected include various parameters such as temperature, pressure, humidity, vibration, location, and more. These sensors are crucial in enabling the digitization and monitoring of physical processes.

## Network Layer( Data Analytics) :

The network layer also called the "communication" layer, facilitates the transfer of data between the perception layer and the higher layers of the Industry 4.0 framework.

It comprises various communication technologies and protocols that allow seamless connectivity and data exchange.

Internet of Things (IoT) plays a significant role in this layer, enabling the integration and interaction of devices and systems. The data collected by the sensors in the perception layer are transmitted through the network layer to be processed and analyzed at higher levels.

It involves data processing, analytics, and decision-making using advanced technologies such as artificial intelligence (AI), machine learning, big data analytics, and cloud computing.

## Information Layer :

The information layer, also known as the **"cyber" or "digital" layer**, is the topmost layer of the Industry 4.0 framework.

This layer aggregates, processes, and analyzes the data received from the network layer to derive valuable insights, patterns, and trends.
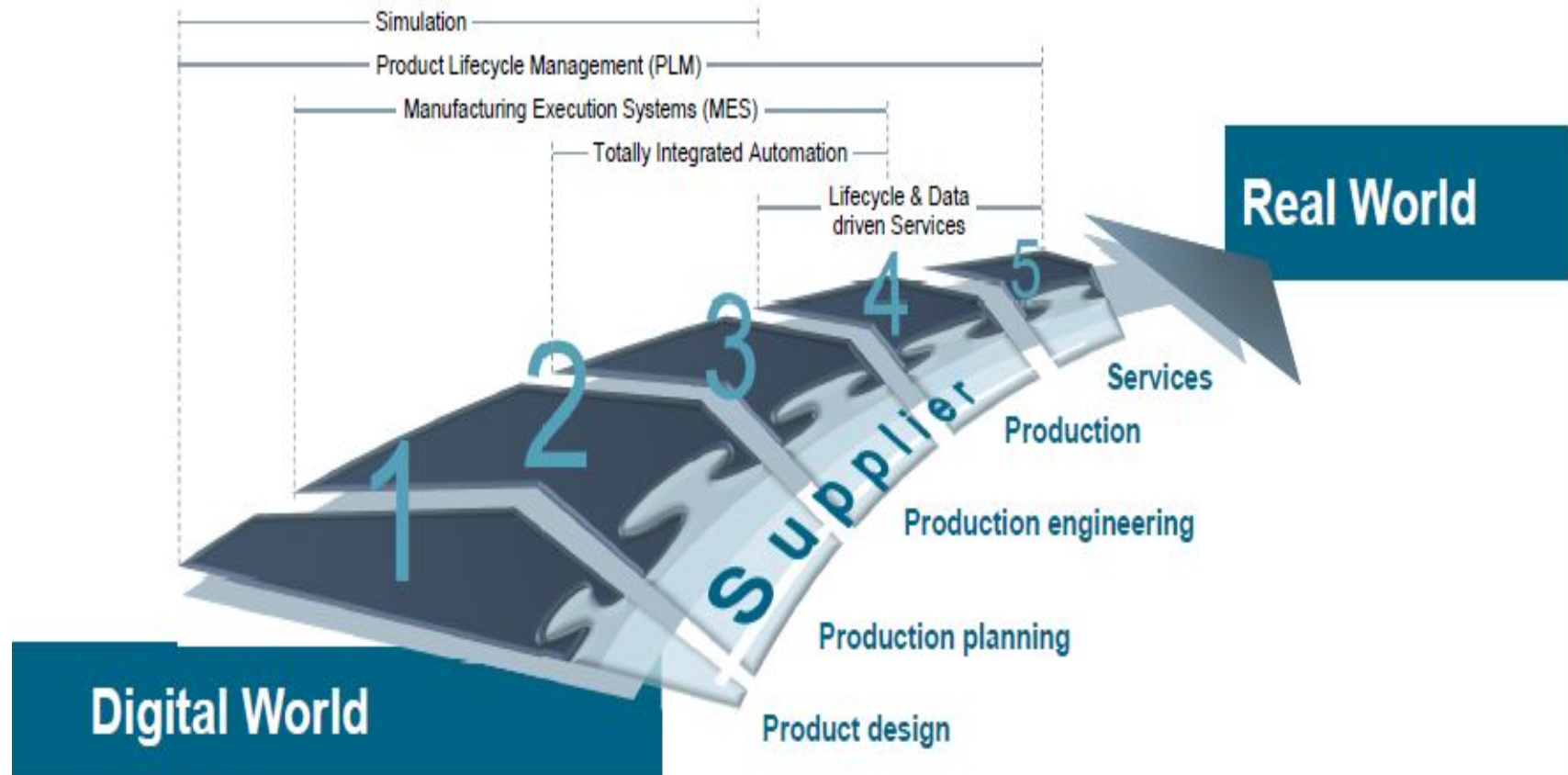
The information layer enables real-time monitoring, predictive maintenance, optimization, and intelligent decision-making to improve operational efficiency and performance.
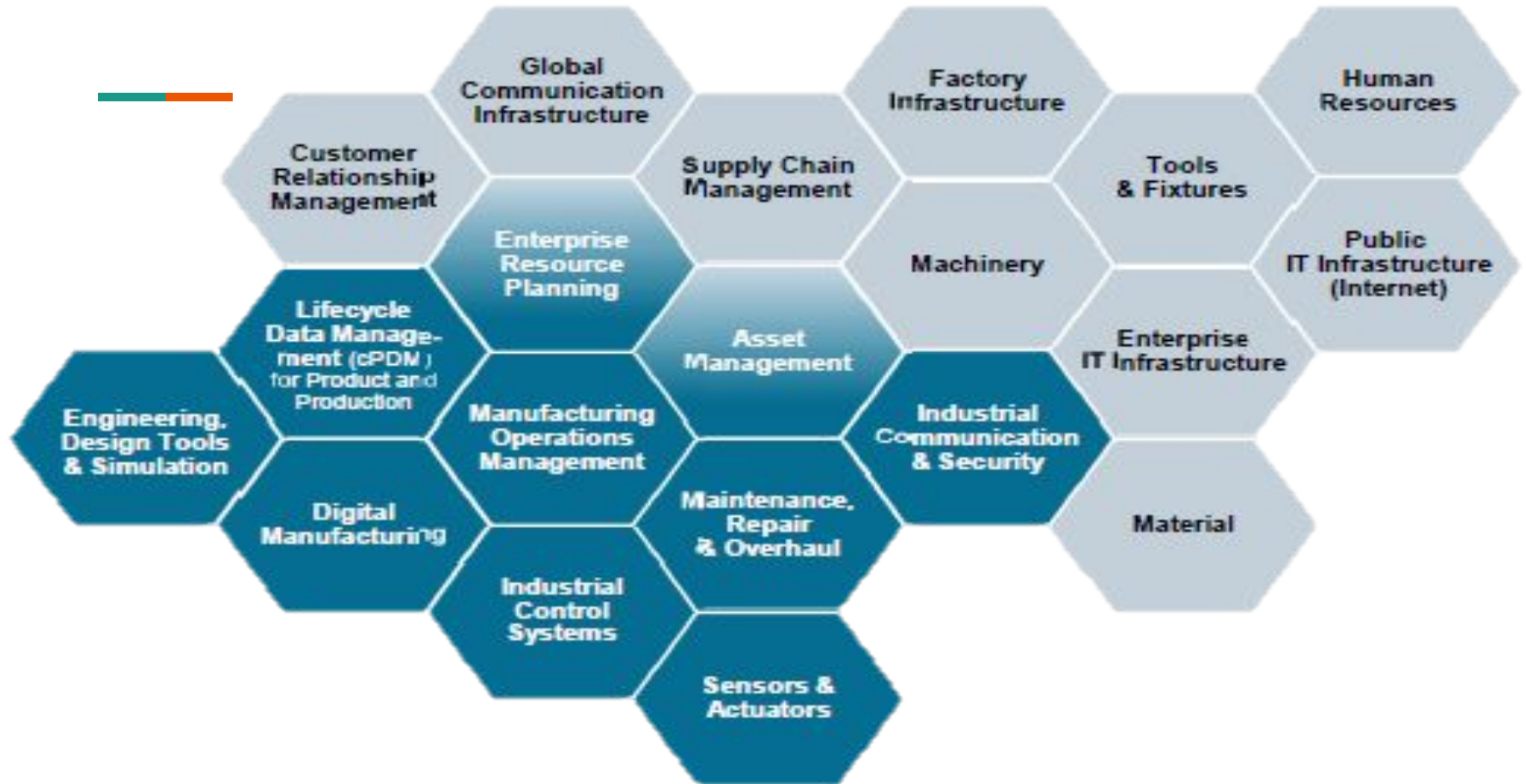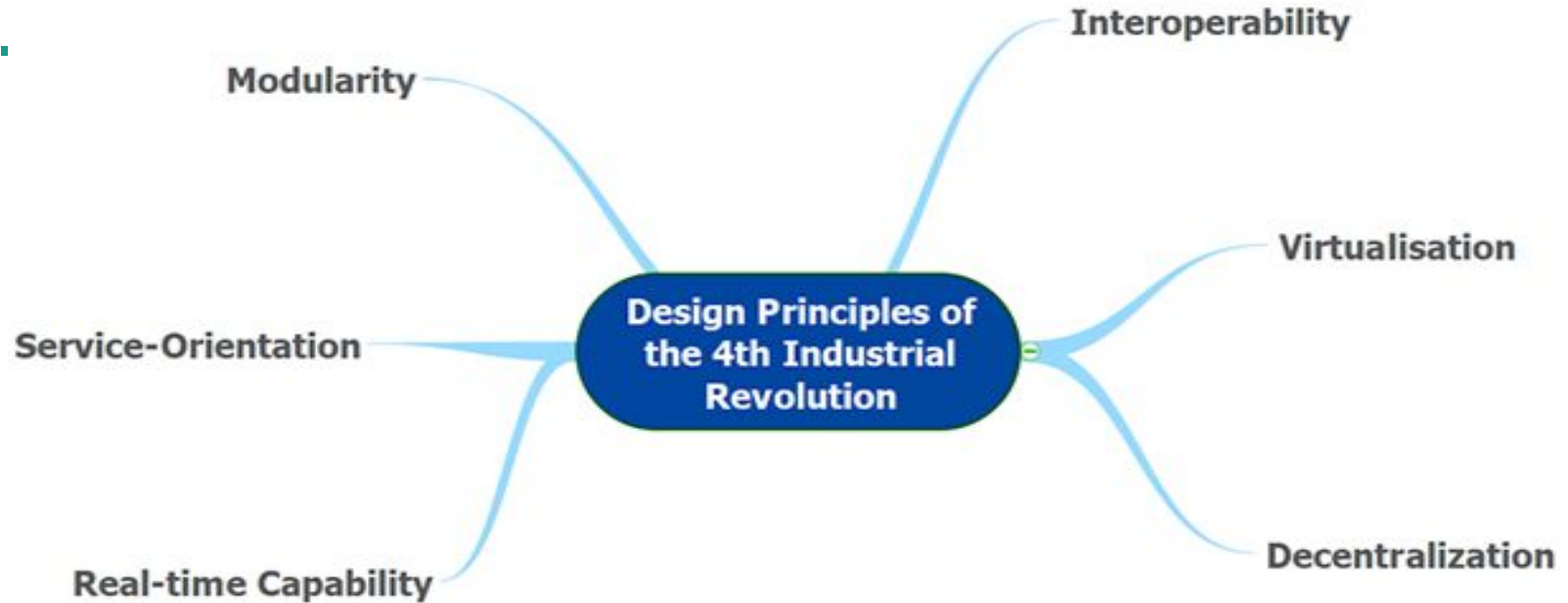
- Thank You