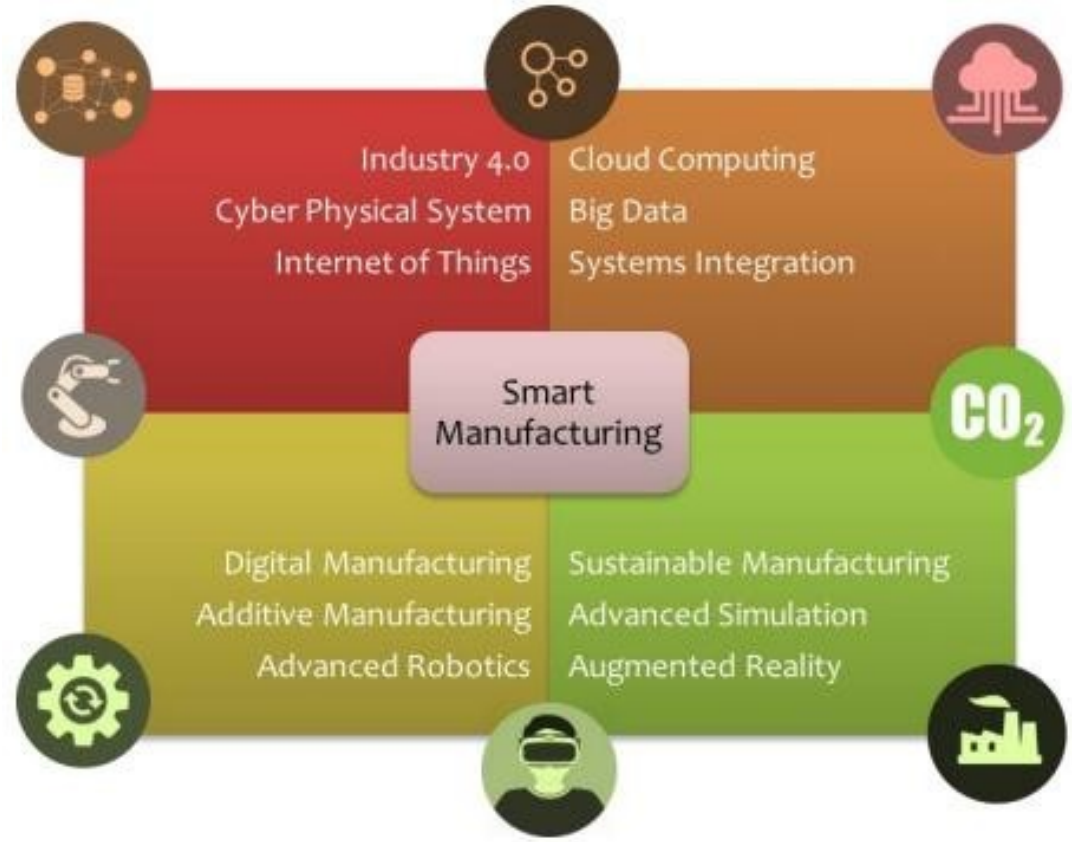
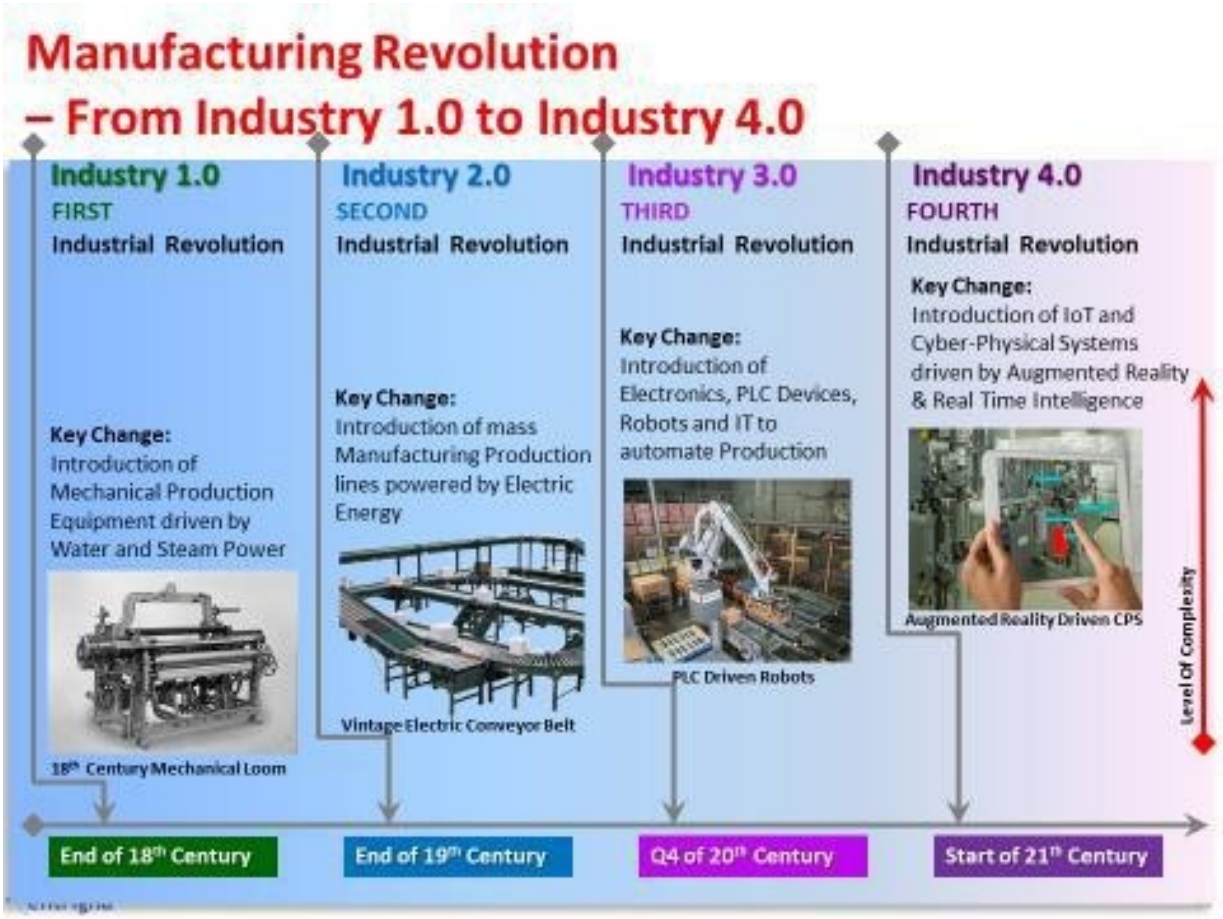
Smart Manufacturing



Industry 4.0:

Industry 4.0 is a name for the current trend of automation and data exchange in manufacturing technologies. It includes cyber physical systems, the Internet of Things (IoT), Cloud computing and Cognitive computing. Industry 4.0 is commonly referred to as the 4th Industrial revolution. Industry 4.0 creates what has been called a "smart factory".

The term "Industry 4.0" originates from a project in the high-tech strategy of the German government. The term "Industry 4.0" was revived in 2011 at the Hannover Fair. In October 2012 the Working Group on Industry 4.0 presented a set of Industry 4.0 implementation recommendations to the German federal government. On 8th April 2013 at the Hannover Fair, the final report of the Industry 4.0 was presented.



Functions of Industry 4.0:
There are four **design principles** or **functions** or **Features** of Industry 4.0:
Interoperability: where machines, devices, sensors and people are connected and communicated with each another.

Information transparency: The transparency afforded by Industry 4.0 technology provides operators with vast amounts of useful information needed to make appropriate decisions. Inter-connectivity allows operators to collect immense amounts of data and information from all points in the manufacturing process, thus aiding functionality and identifying key areas that can benefit from innovation and improvement.

Technical assistance: First, the ability of assistance systems to support humans by aggregating and visualizing information comprehensively for making informed decisions and solving urgent problems on short notice. Second, the ability of cyber physical systems to physically support humans by conducting a range of tasks that are unpleasant, too exhausting, or unsafe for their human co-workers.

Decentralized decision: the ability of cyber-physical systems to make simple decisions on their own and perform their tasks as autonomously as possible.
Benefits of Industry 4.0 (Advantages of Industry 4.0):
Improved Productivity

Improved Efficiency

Increased Knowledge Sharing and Collaborative Working

Flexibility and Agility

Makes Compliance Easier

Better Customer Experience

Reduces Costs

Creates Innovation Opportunities

Higher Revenues

Increased Profitability

Getting A Return On Investment

Applications of Industry 4.0:

Internet of Objects (IoT)

Embedded Software

Big Data and Data Analytics

Machine to Machine Communication (M2M)

Cloud Solutions

Intelligent Robot Automation Systems

Augmented Reality

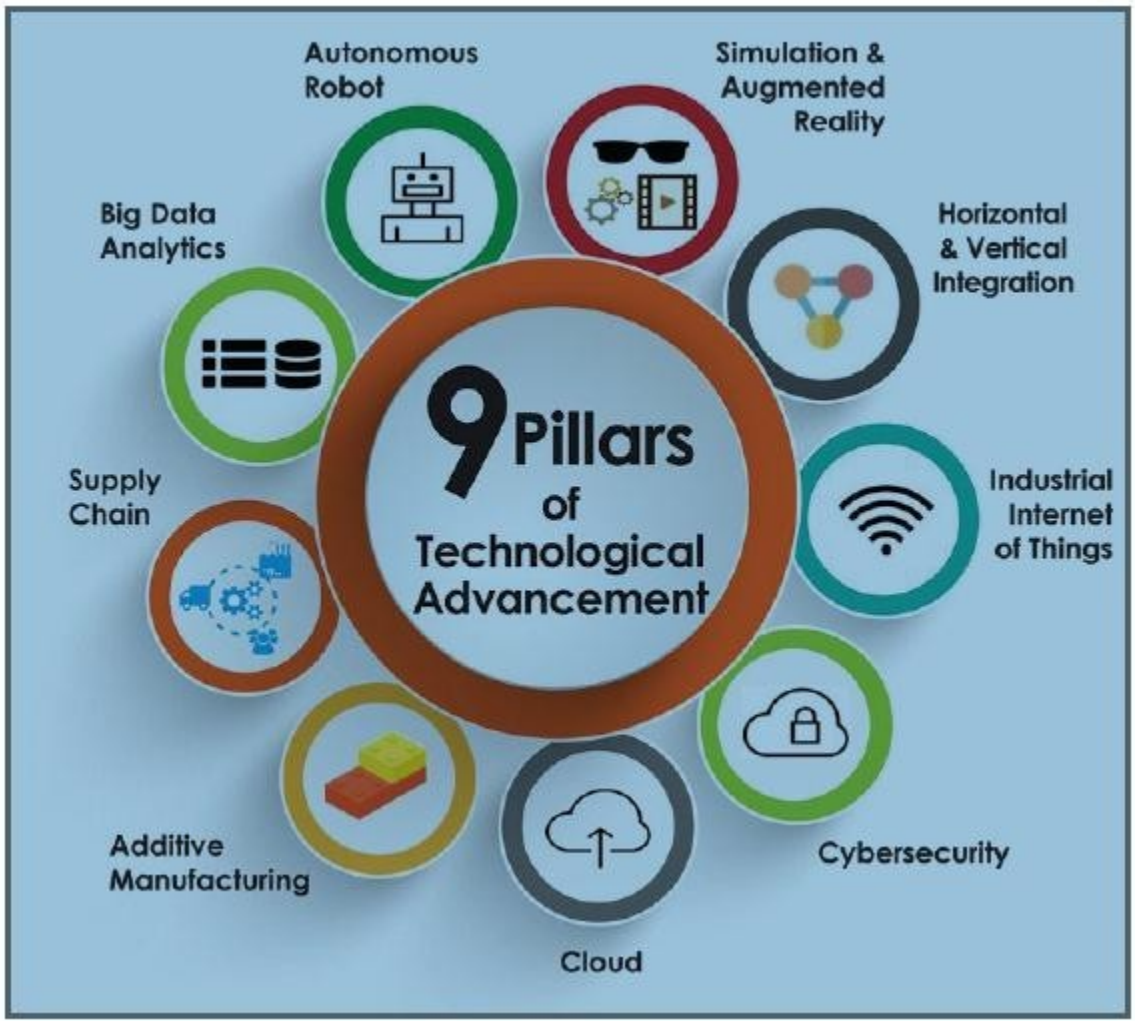
Simulation

Additive Manufacturing (3D PRINTING)

Cyber Security

Central Monitoring and Control (SCADA)

Components of Industry 4.0 (Pillars of Industry 4.0):



Industrial Internet of Things (IIoT): The Internet of Things refers to the networking and connectivity of smart devices. When you think of IoT, devices such as smartphones, tablets, and laptops are usually top of mind. In the world of manufacturing, this technology is often referred to as the Industrial Internet of Things (IIoT). Manufacturers are attaching sensors to machines and other physical assets on the plant floor to collect data which influences decisions real time and leads to increased efficiency and productivity.

Cybersecurity: Cybersecurity is responsible for providing protection to the stored information, either on a device, or on the network. The system is capable to protect the information from threats like computer strikes, or even from physical kind of threats.

Cloud Computing: With the advent of IoT and Industry 4.0, the reality is that data is being generated at a staggering speed and at high volumes, making it impossible to handle manually. This creates a need for an infrastructure that can store and manage this data more efficiently. This is where cloud computing comes in. Cloud computing offers a platform for users to store andprocess vast amounts of data on remote servers. It enables organisations to use computer resources without having to develop a computing infrastructure on premise. The term cloud computing refers to information being stored in the "cloud", accessed remotely via the Internet.

Big Data Analytics: The concept of big data applies to large, diverse and complex datasets that affect the organizational decision making of a company concerning their strategy. Therefore, the increase in level of data and improvements on technological capabilities accelerates firms'

competitive advantage by increasing productivity, innovation and competition.

Autonomous Robots: Robots are used in manufacturing industries in order to solve complex tasks which cannot be solved easily by a human. By the traditional automation strategy, companies could not fully implement JIT strategies and continuous improvements if they do not opt for autonomous robots. The usage of more industrial robots in factories accelerates with Industry 4.0. Robots could be used in several areas such as production, logistics, distribution activities and could be controlled remotely by humans thanks to the human robot cooperation.

Additive Manufacturing: Additive manufacturing, or 3D printing, is a key technology driving Industry 4.0. Additive manufacturing is a process of converting digital 3D models to create parts with a 3D printer layer by layer. Within the context of Industry 4.0, 3D printing is emerging as a valuable digital manufacturing technology. AM offers a huge scope of possibilities for manufacturing from tooling to mass customisation across virtually all industries.

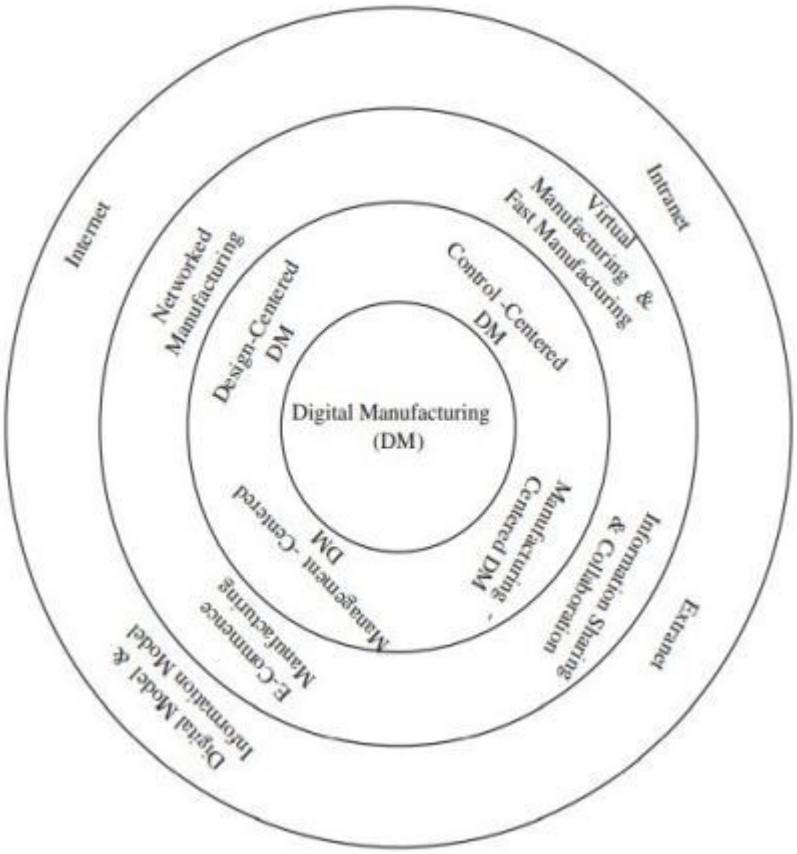
Augmented Reality: Augmented reality bridges the gap between the digital and physical worlds by superimposing virtual images or data onto a physical object. For this, the technology uses AR-capable devices, such as smartphones, tablets and smart glasses. In the context of manufacturing, AR could enable workers to speed up the assembly process and improve decision-making. For example, AR glasses could be used to project data, such as layouts, assembly guidelines, sites of possible malfunction, or a serial number of components, on the real part, facilitating faster and easier work procedures.

IOT Applications in Manufacturing:

- Digital/Connected Factory
- Facility Management
- Production Flow Monitoring
- Inventory Management
- Plant Safety and Security
- Quality Control
- Packaging Optimization
- Logistics and Supply Chain Optimization

Digital manufacturing

It is a manufacturing technique that uses computer technologies to improve the efficiency and flexibility of manufacturing operations. It's also known as Industry 4.0



Here are some of the benefits of digital manufacturing:

- Precision: Digital manufacturing can create precise products.
- Flexibility: Digital manufacturing can make manufacturing processes more flexible and responsive to changing market demands.
- Efficiency: Digital manufacturing can improve efficiency and reduce machine downtime.
- Integration: Digital manufacturing can integrate different stages of production, allowing for seamless communication and coordination.
- Customization: Digital manufacturing can enable customization and mass production.

Digital manufacturing uses a variety of technologies, including: 3D printing, Computer-aided design (CAD), Computer-aided manufacturing (CAM), Computer numerical control (CNC), and Robotics.

Some of the applications of digital manufacturing include: product life cycle management, smart factory initiatives, and value chain management

WHAT IS VIRTUAL MANUFACTURING?

The general idea one can find behind most definitions is that "Virtual Manufacturing is nothing but manufacturing in the computer". This short definition comprises two important notions: the process (manufacturing) and the environment (computer).

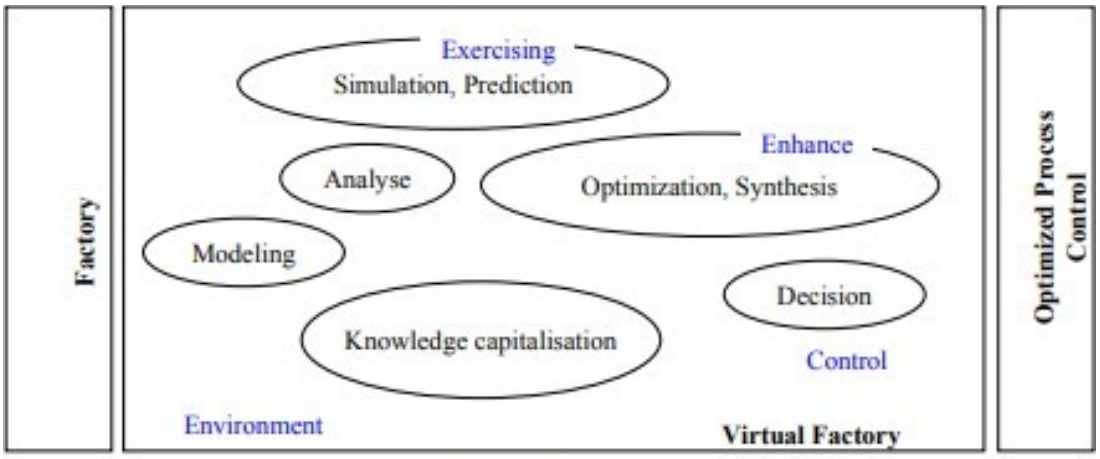


Figure 1: Virtual manufacturing

Environment: supports the construction, provides tools, models, equipment, methodologies and organizational principles,

Exercising: constructing and executing specific manufacturing simulations using the environment which can be composed of real and simulated objects, activities and processes,

Enhance: increase the value, accuracy, validity,

Levels: from product concept to disposal, from factory equipment to the enterprise and beyond, from material transformation to knowledge transformation,

Decision: understand the impact of change (visualize, organize, identify alternatives).