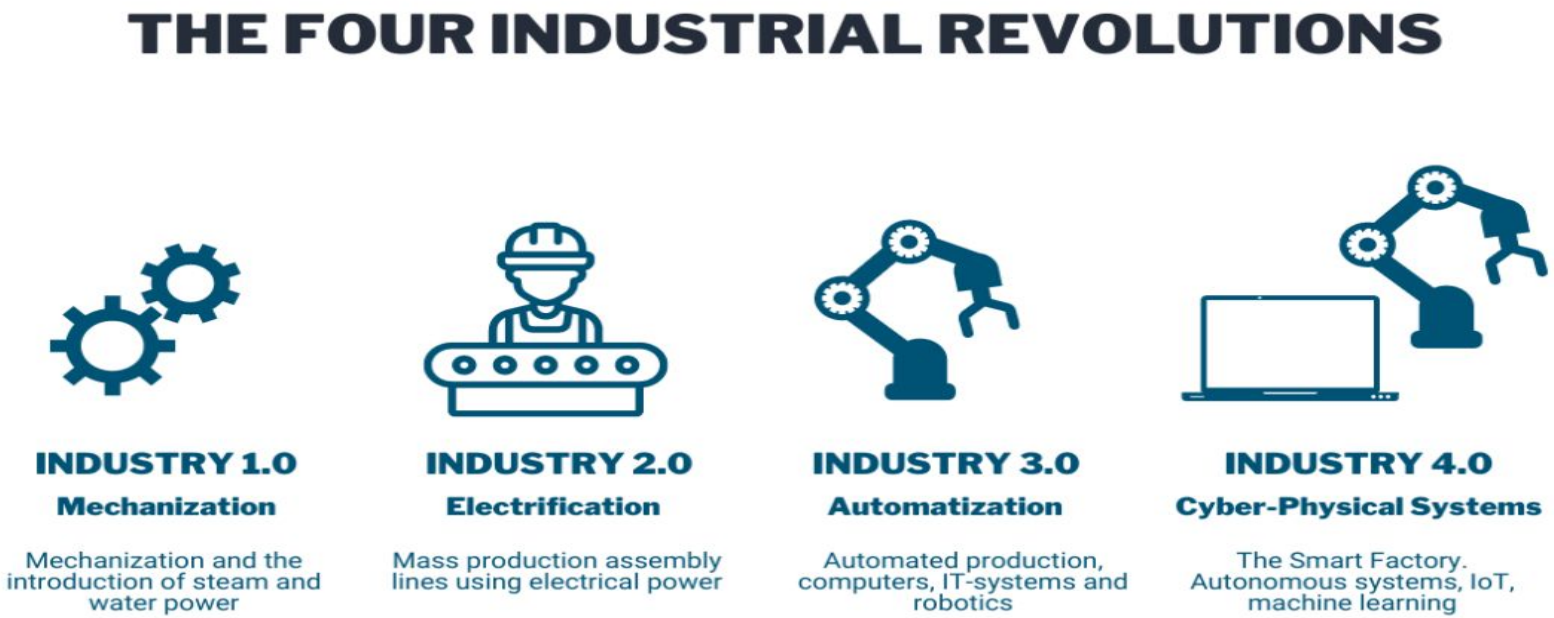
Industry 4.0

Topic: Introduction, Historical context, key technologies

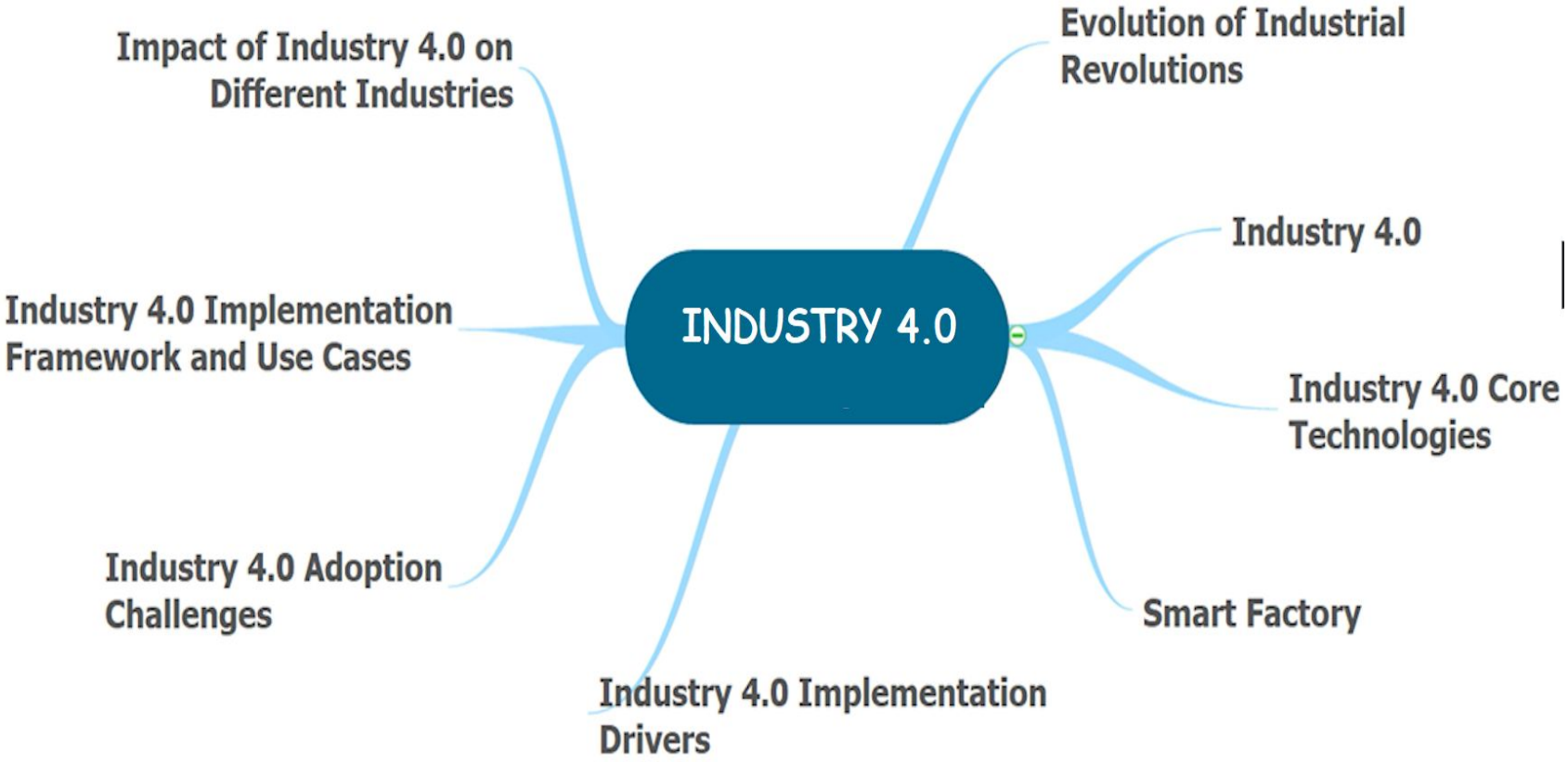
Prepared by: Prof. Suprava Patnaik

Different industrial revolutions:

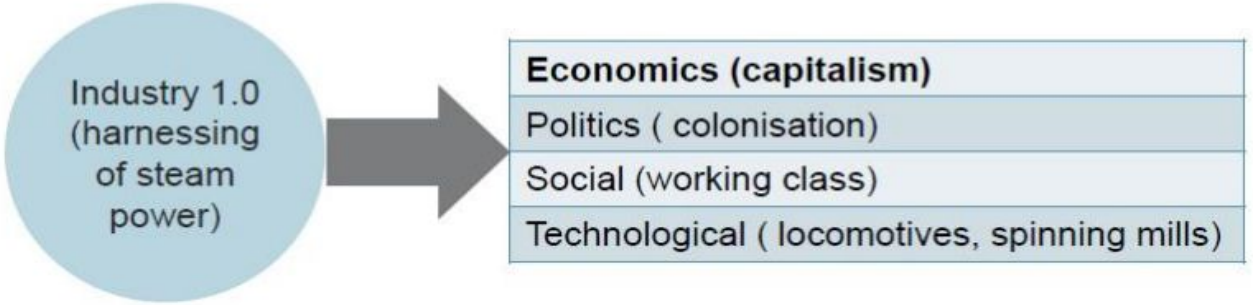


https://humix.com/video/d49204da5b00214f93d02bc829210e7122191cb3

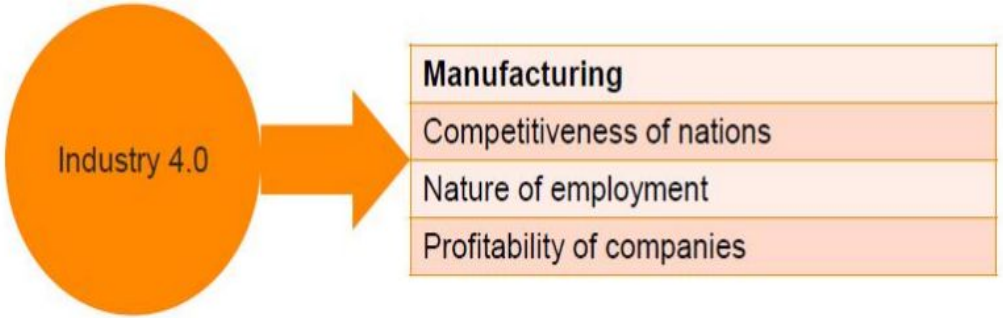
COURSE OUTLINE



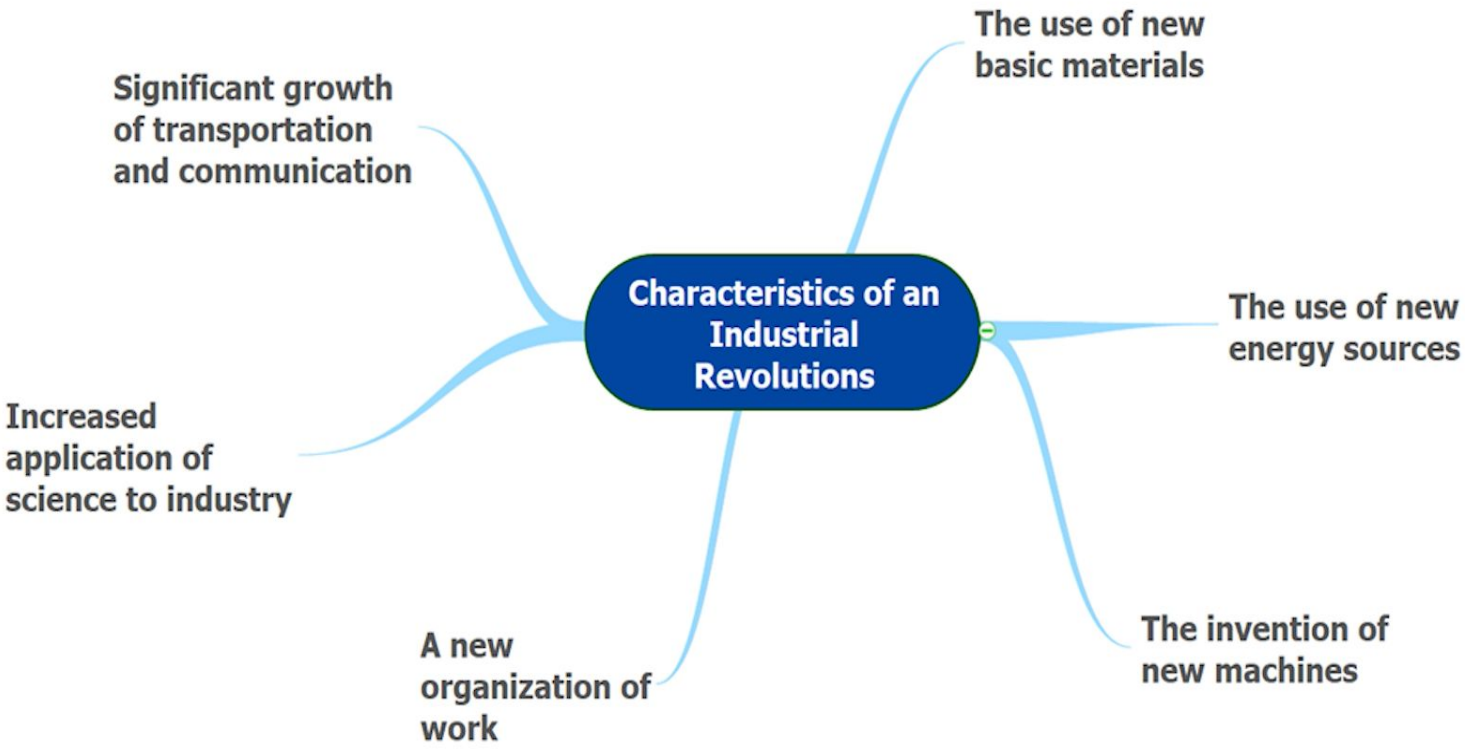
IS INDUSTRY 4.0 A REVOLUTION



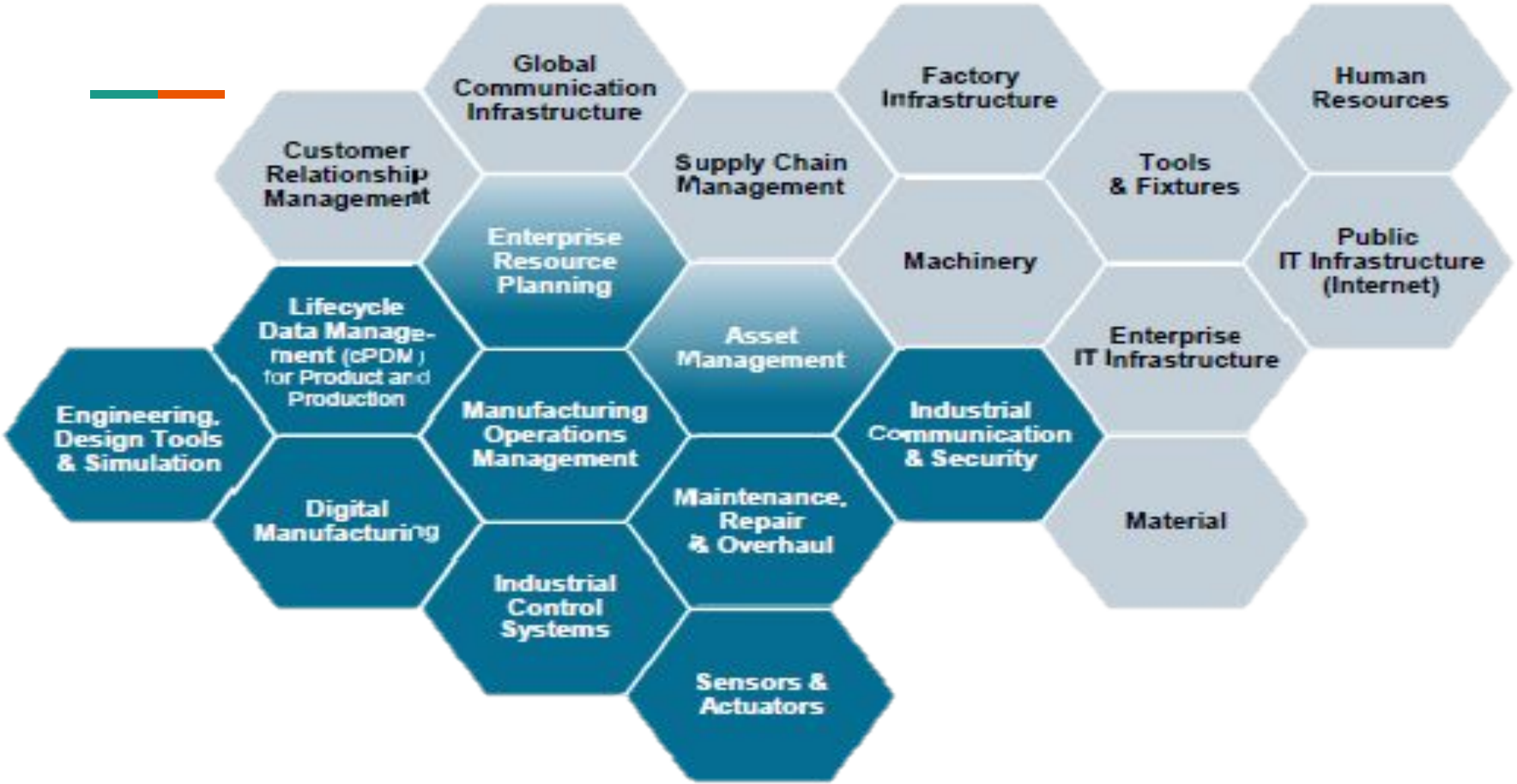
- A movement is called revolution when it impacts multiple dimensions of the society



CHARACTERISTICS OF INDUSTRIAL REVOLUTION



IMPACTING ALL ASPECT OF VALUE CHAIN



INTRODUCTION

- Definition and Concept: It represents the current wave of technological advancements and their integration into industries. Focus involves the use of
  - digital technologies (AR and VR, digital twins, , etc.)
  - connectivity (Cloud Computing, IoT, M2M communication, etc)
  - data-driven decision-making (AI based prediction, data analytics, etc.)

- Objective: **collect and leverage Industrial Big Data** uses
  - to drive manufacturing and supply chain automation,
  - provide real-time insights,
  - establish communication feedback loops for faster decision-making in the manufacturing process.

HISTORY OF INDUSTRIAL REVOLUTION-I

- Industrial Revolution – a change from making things by hand to making them in factories.

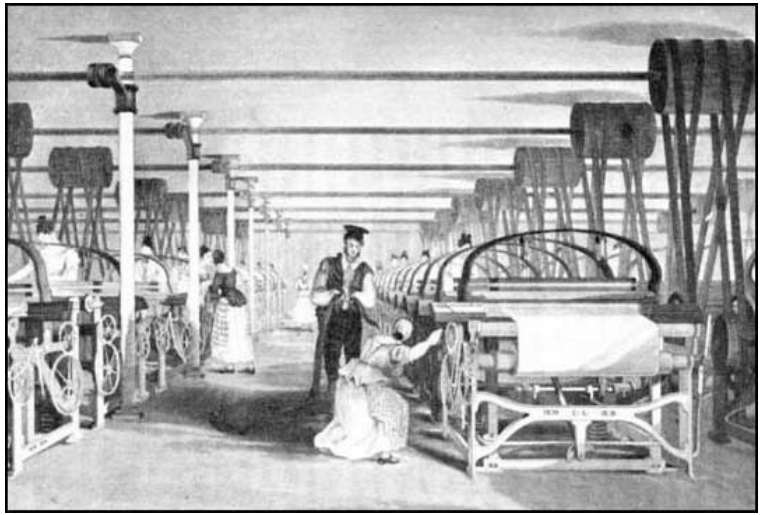
AN ORIGINAL STEAM ENGINE

INDUSTRY 1.0: 1st Industry Revolution (1760-1830)
MECHANIZATION

- Started in GreatBritain
- Machine and tools replaced animals and human labor
- Driven by steam and internal combustion engine
- Widespread use of iron and steel for machinery
- Mechanisation of sinning wheels resulted 8 times increase in output
- Adaptation of coal powered factory system
- Developement of canals and roads for transportation.

HISTORY OF INDUSTRIAL REVOLUTION-II

- With the invention of the spinning jenny and the power loom, the textile industry took off. Clothes could now be made far faster than ever before.



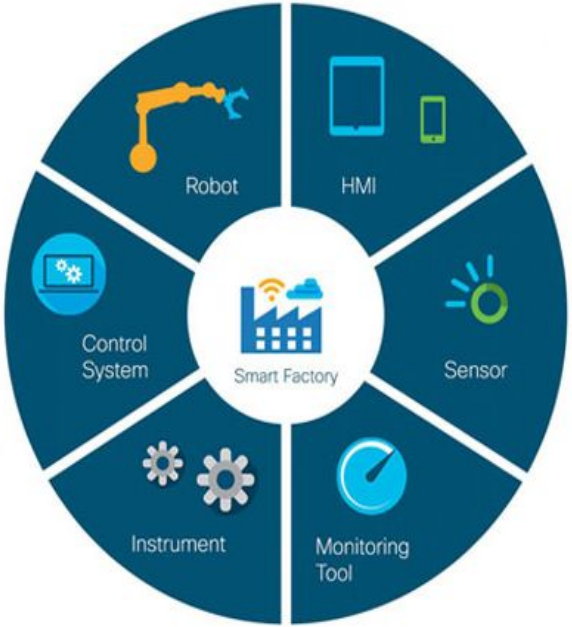
Water power used in power looms to weave cloths

INDUSTRY 2.0: 2nd Industry Revolution (1830-1947)
MASS PRODUCTION

- Introduction of assembly line and mass production in factories.
- Introduction to electricity and petrolium as sources of energy
- Invention of automobile, telegraph, telephone, radio
- Shipping made easy by railways and telegraph lines
- New materials like stainless steel, rare earth metals and plastics are used
- Improved standard of living with focus on public health

HISTORY OF INDUSTRIAL REVOLUTION-III

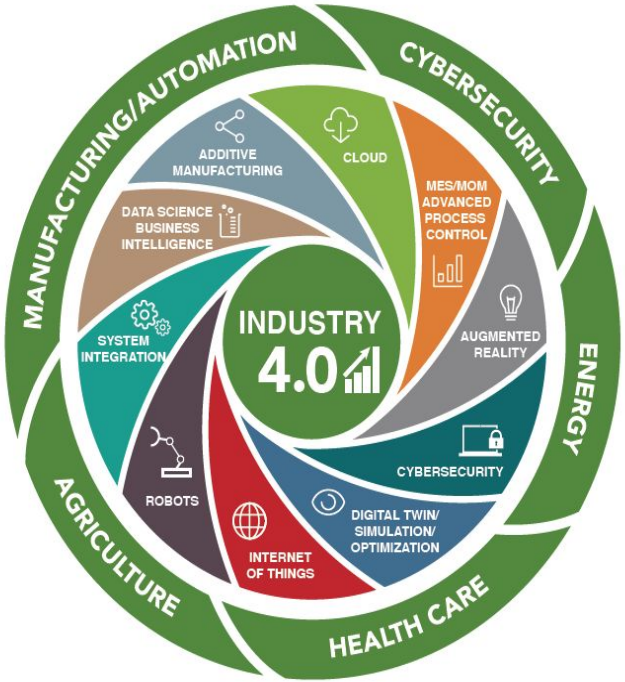
- SCADA, PLC, CAD etc. are started as automation and design tools



INDUSTRY 3.0: 3rd Industry Revolution (1947-2015)
DIGITIZATION and AUTOMATION

- Also known as digital revolution
- Shift from mechanical and analogue technology to digital technology
- Electronica and Robotics integrated into manufacturing procedure
- Rise in telecommunication and computers
- New energy sourcessuch as nuclear and renewable are explored
- Invention of Internetand World-Wide-Web
- Widespread factory automation using robots and PLCs
- Computers; semi conductors, main frame computing, personal devices, internet

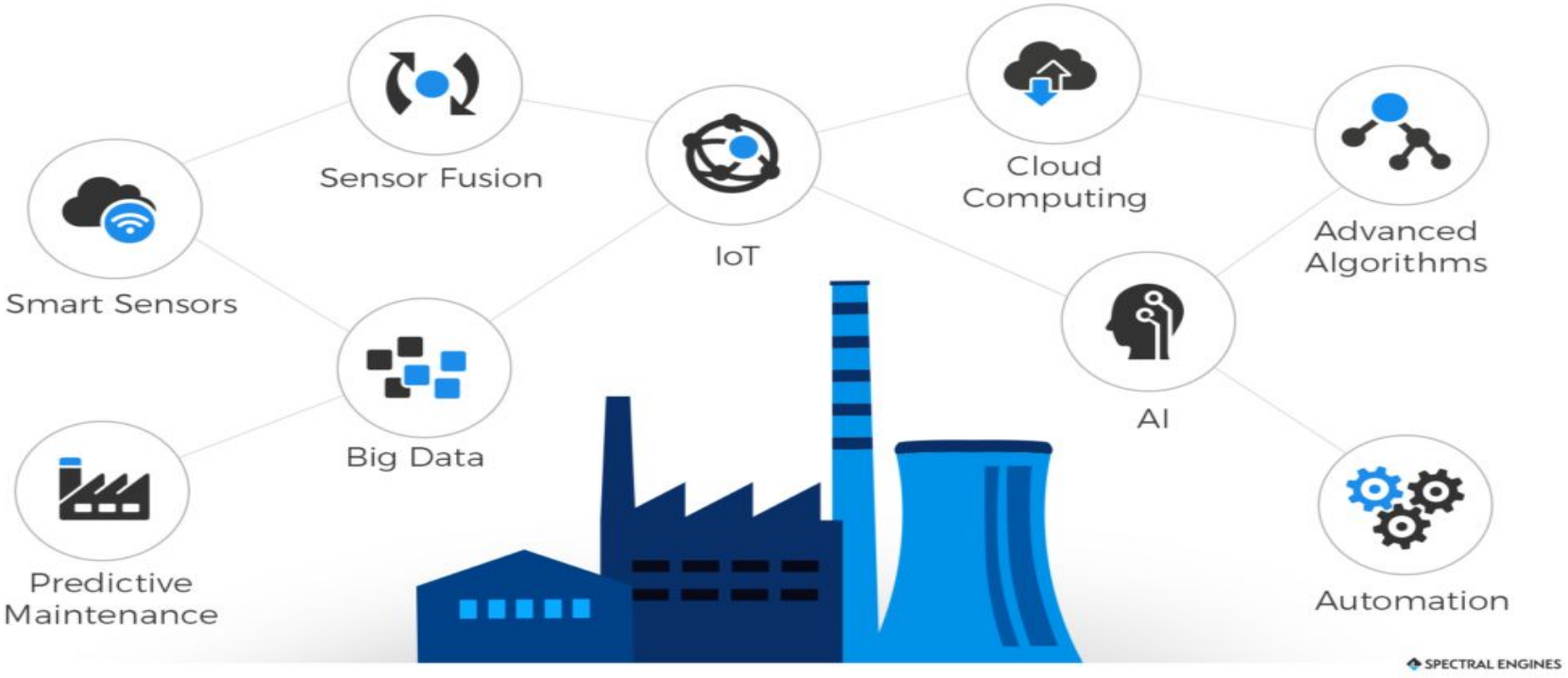
HISTORY OF INDUSTRIAL REVOLUTION-IV



INDUSTRY 4.0: 4th Industry Revolution (2015 -)
Convergence of Digital-Biological-&-Physical innovations

- The rise of interconnectivity and advanced automation
- Invention of advanced technologies such as AI, Gene editing (CRISPR), advanced robotics, self-driving vehicles, aditive manufacturing (3D printing, Digital twines, etc.
- Use of smart M2M (Machine to machine) communication enables self-diagnosis, real time analysis and

INDUSTRY 4.0 FRAMEWORK

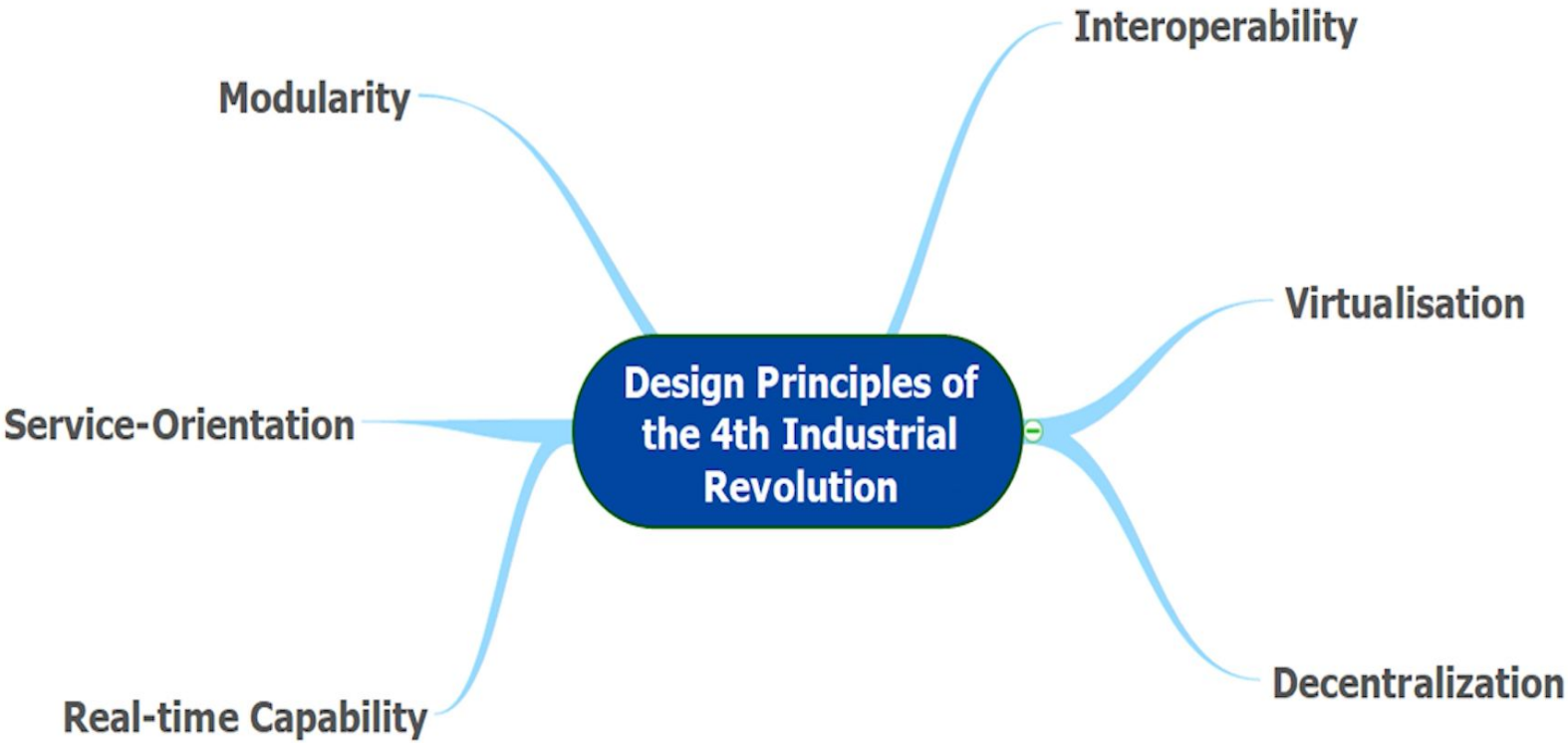


INDUSTRY 4.0 ENVIRONMENT

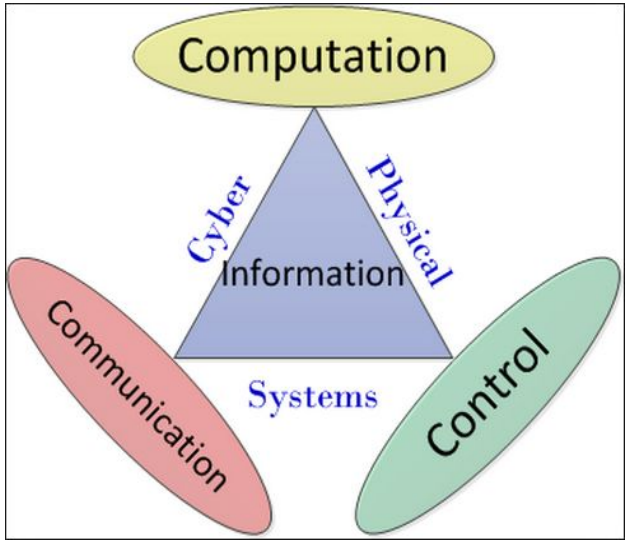
- Internet of Things
- Internet of Industrial Things
- Internet of Medical Things
- Internet of Services(service oriented architecture)
- Internet of Everything (people-data-thing-processes)
- Internet of payments

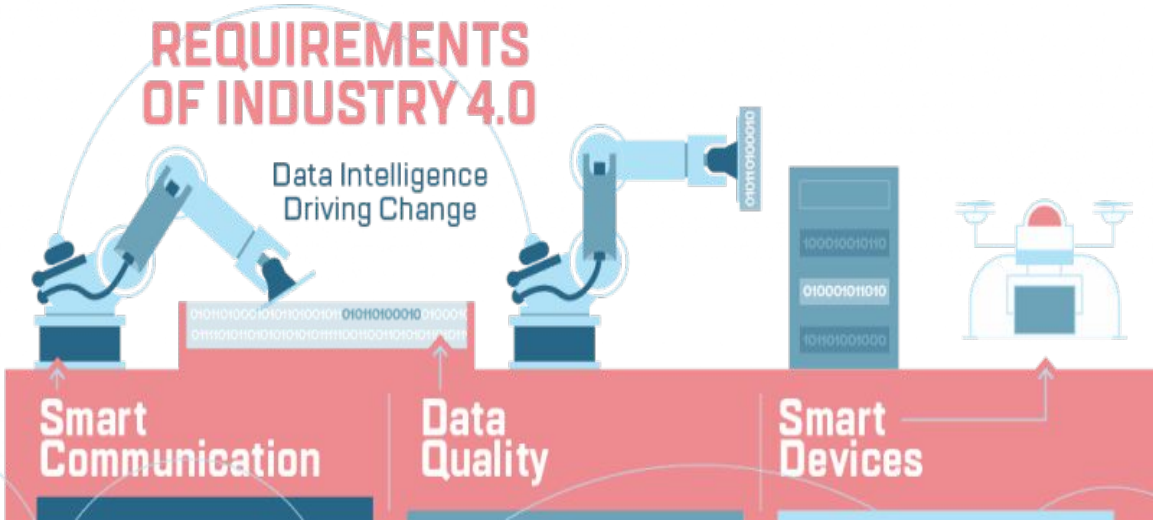
- Internet of Skills
- Internet of Data
- Internet of Behaviour
- Internet of DNA
- Internet of Energy
- Internet of Military Things
- Internet of Body (Body signals to Network)
- Internet of Nature

DESIGN PRINCIPLES



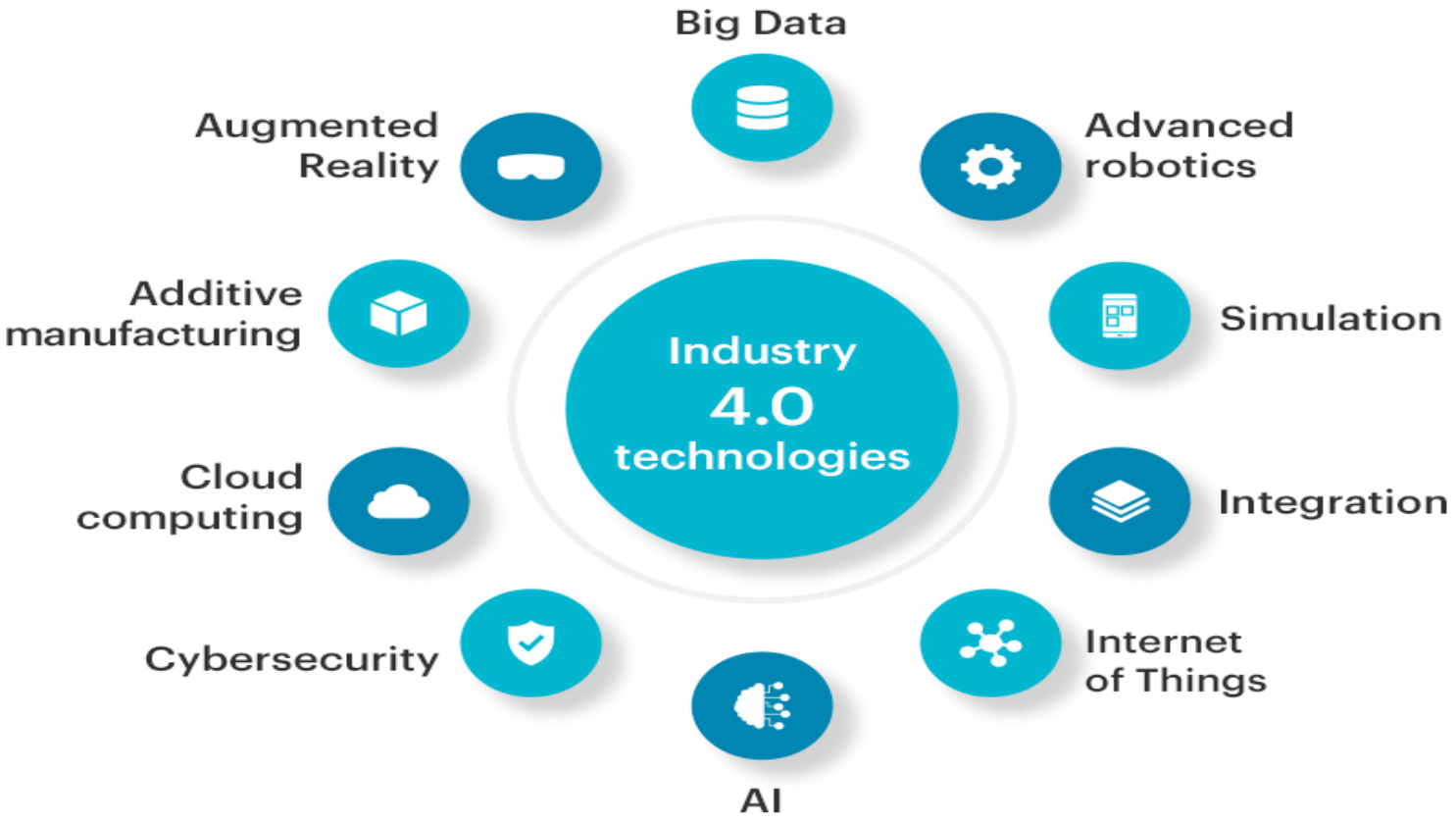
CYBER PHYSICAL SYSTEMS AND I4.0



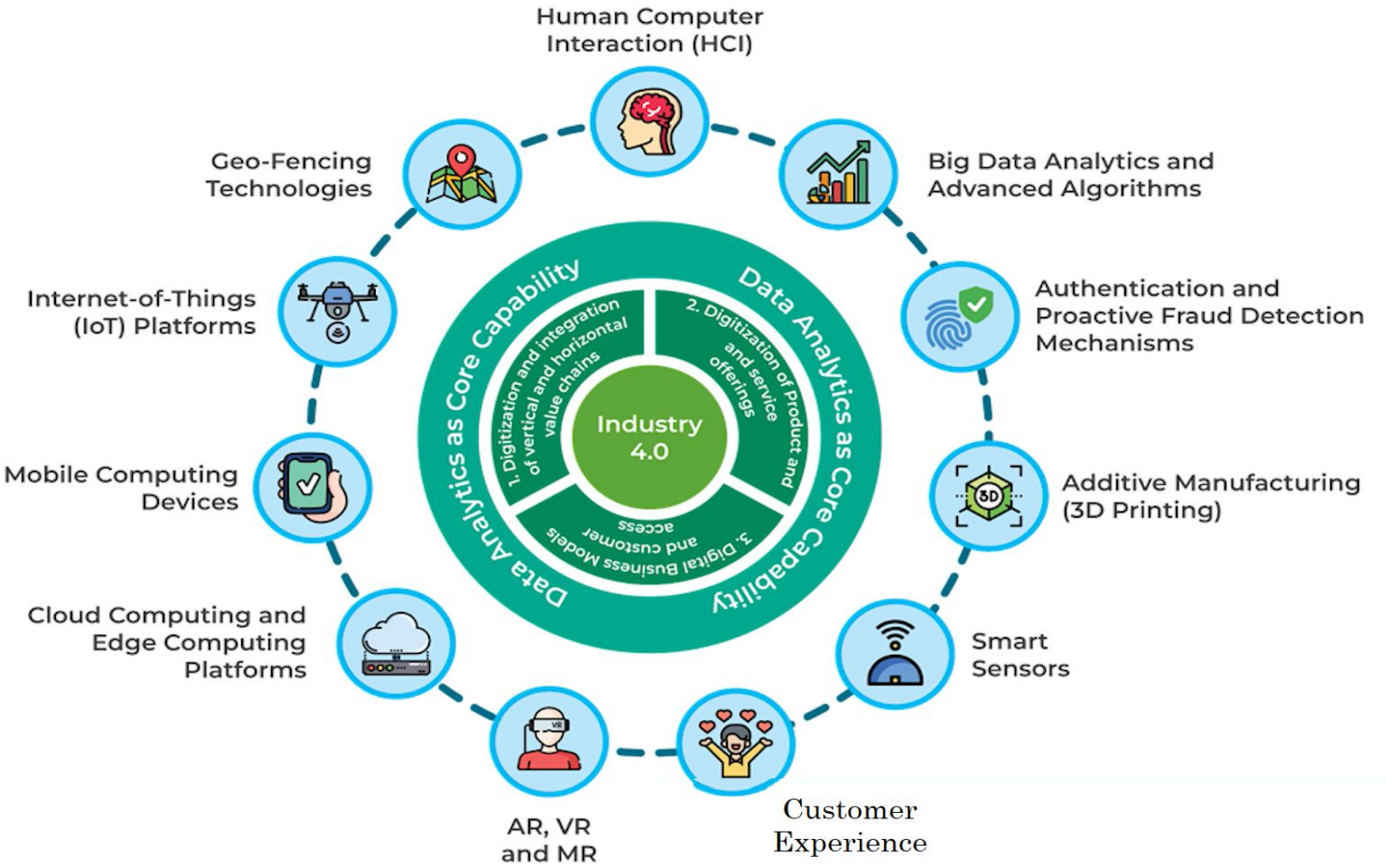


- A **cyber-physical system** (**CPS**) is a system of collaborating computational elements controlling physical entities. CPS are physical and engineered systems whose operations are monitored, coordinated, controlled and integrated by a computing and communication core. They allow us to add capabilities to physical systems by merging computing and communication with physical processes.
- The cyber-physical systems are the basis and enable new capabilities in areas such as product design, prototyping and development, remote control, services and diagnosis, condition monitoring, proactive and predictive maintenance, track and trace, structural health and systems health monitoring, planning, innovation capability, agility, real-time applications and more.

BUILDING BLOCKS OF INDUSTRY 4.0

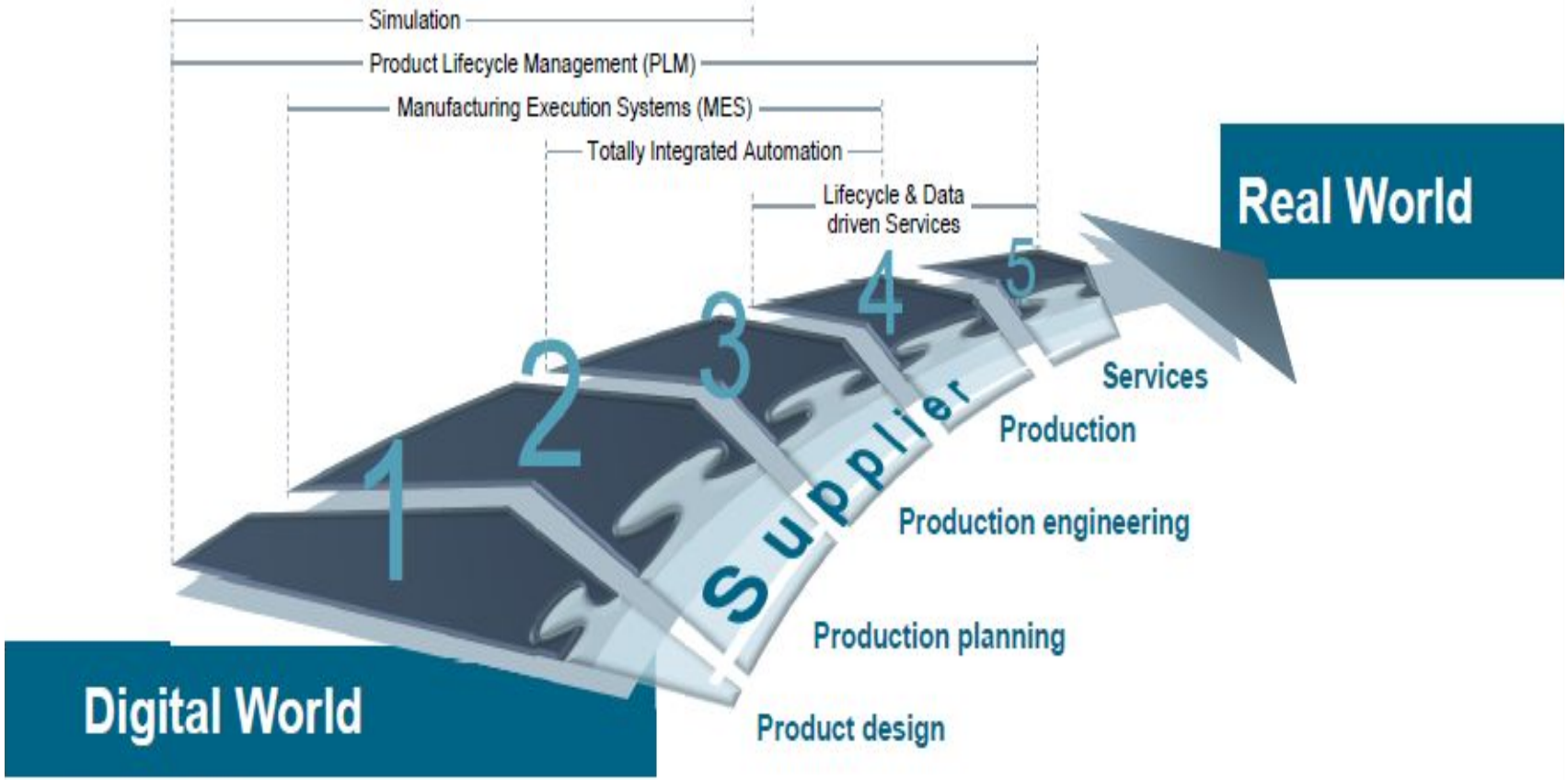


3 - Layered Framework



DIGITAL ENTERPRISE

ENTIRE VALUE CHAIN IS DIGITIZED AND INTEGRATED



. Thank You