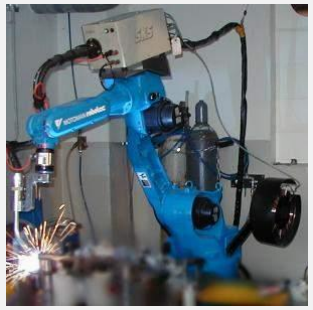
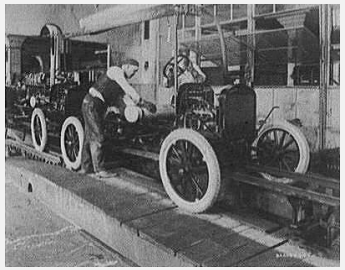
# IR4.0

# Industrial Revolution





**4. Industrial revolution**
Based on cyber-physical-systems

**3. Industrial revolution**
Through the use of electronics and IT further progression in autonomous production

**2. Industrial revolution**
Introducing mass production lines powered by electric energy

**1. Industrial revolution**
Introducing mechanical production machines powered by water and steam

Level of complexity

| Industry 1.0 | Industry 2.0 | Industry 3.0 | Industry 4.0 |
|---|---|---|---|
| End of the 18th century. | Beginning of the 20th century | Beginning of the 70th | Today |

Source: DFKI/Bauer IAO

Industrial Evolution

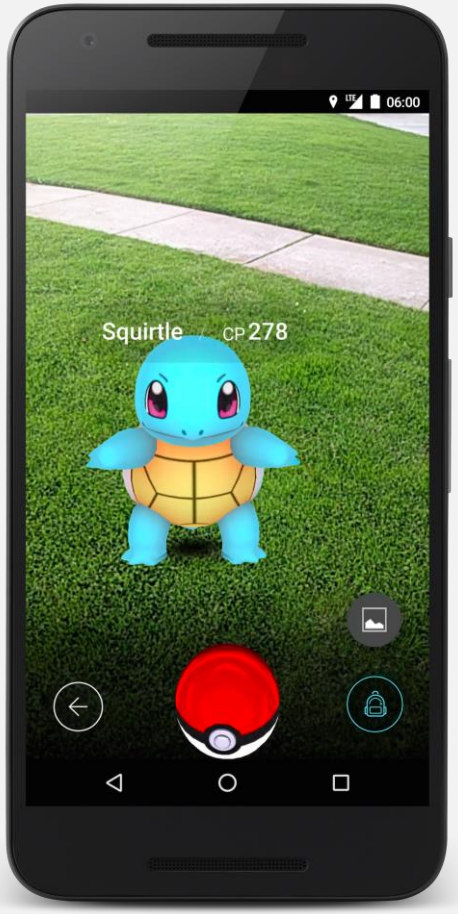
- 1760 to 1840 - Ushered in Mechanical production; railways and steam engine
- 1870 to 1940 - Mass production; electricity and assembly line
- 1960 to 2010 - Computers; semi conductors, main frame computing, personal devices, internet


Phases of Industrial Revolution

# Time to reach 100 Million Customers

| | |
|---|---|
| Telephone | 75 Years |
| Web | 7 Years |
| Facebook (Meta) | 4 Years |
| Instagram | 2 years |
| Pokémon Go | 1 month |


Industrial Revolution




# Why?

# IR 4.0

A collective term for technologies and concepts of value chain organization. Based on the technological concepts of **cyber-physical systems**, the Internet of Things and the Internet of Services, it facilitates the vision of the NextGen Transformation.

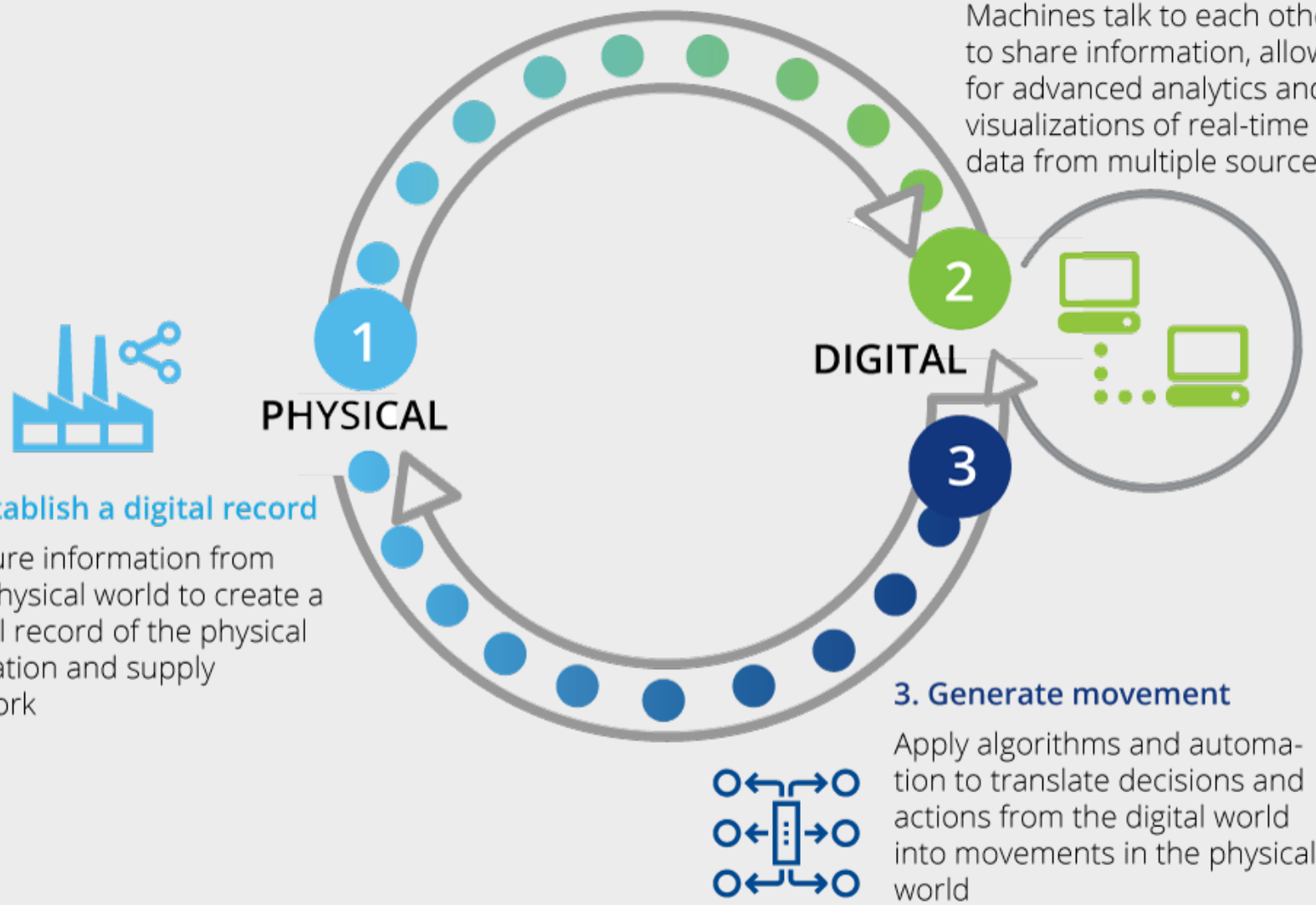
# IR 4.0

Americans prefer to call this concept- smart factory and Europeans call it- Industry 4.0 (Germans came up with the term). So don't be baffled when you hear terms like smart factory and Industrial IOT. They all refer to Industry 4.0 as there is no consensus about how we call it.

# CPS

A cyber-physical system (CPS) is a system of collaborating computational elements controlling physical entities.

Cyber-Physical System

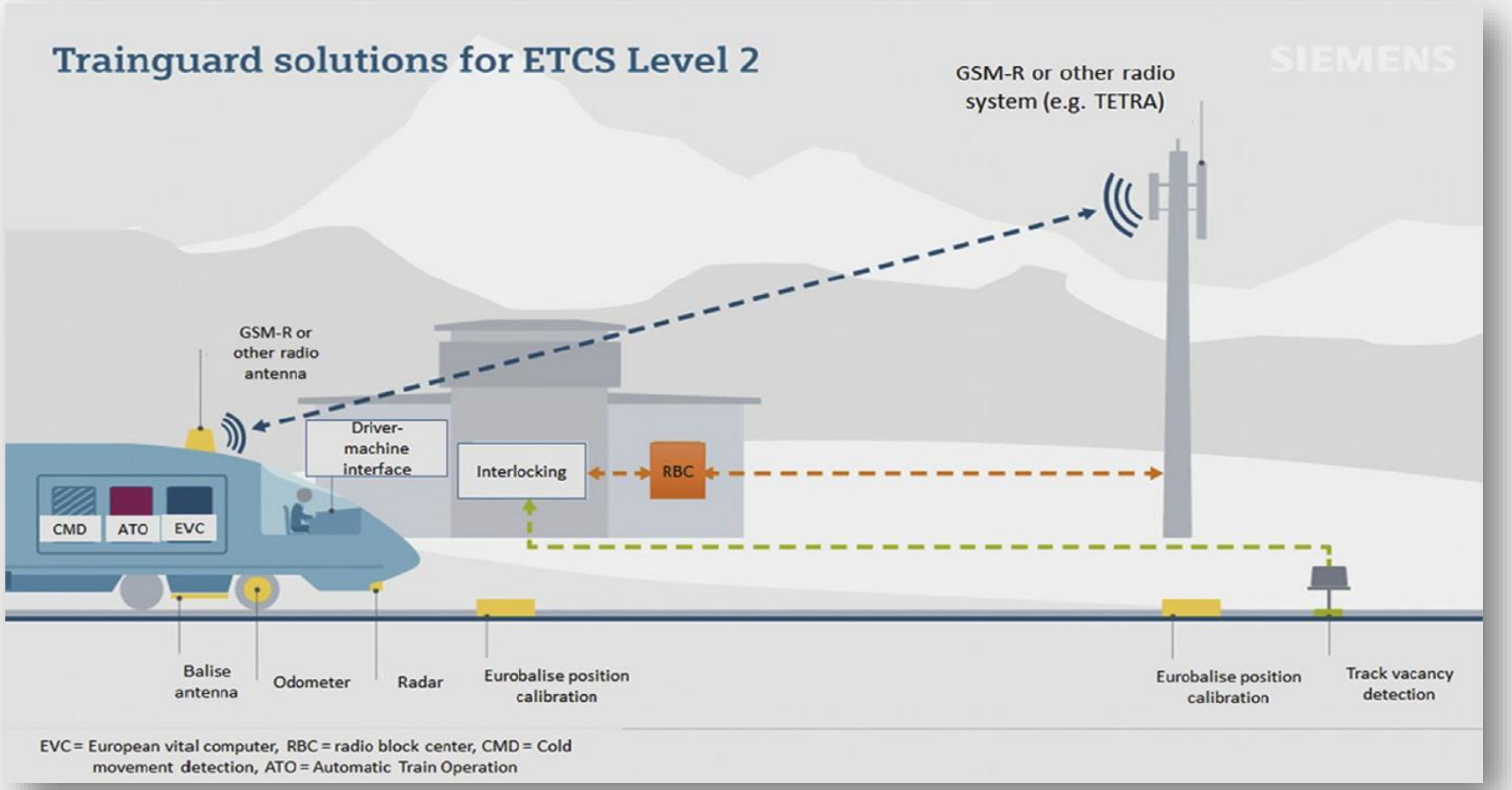



Source: Center for Integrated Research.



Cyber-Physical System

European Train Control System (ETCS) using CPS system called **Trainguard**, which transmits the variable track vacancy detection information to the onboard antenna. The driver gets the permitted speed, the line profile ahead, speed restrictions and ETCS specific data through a display. The drivers get a warning once the train exceeds the maximum permitted speed. The actuators become active to decelerate the train to the permitted speed if he fails to respond.



# The Nine Pillars of Industry 4.0


9 Pillars of Industry 4.0

# Big Data and Data Analytics

Data analytics, once an IT application is now penetrating into manufacturing and supply chain industry. Power of data analytics and pattern recognition can be harnessed in the manufacturing industry to reduce downtime and wastages.

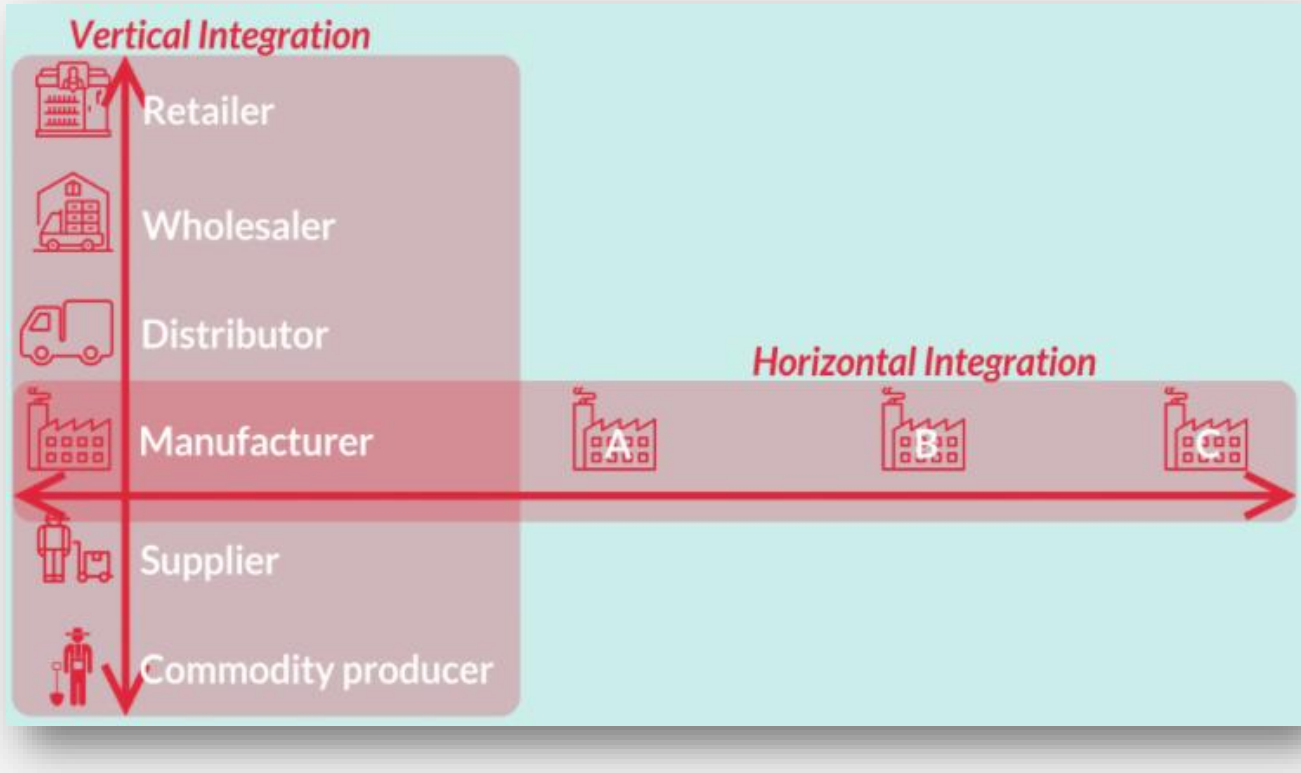
# Simulation

A simulation, in present day is used to design components that are manufactured. In Industry 4.0, it can be used to simulate a virtual environment of the factory itself with the real time data and analyze the productivity before a change in the factory can be made. This helps engineers to visualize the design in a much better manner consequently helping them identify problems and obstacles in the early stage

# Horizontal and Vertical Integration

Horizontal integration takes networking among the cyber-physical systems and enterprise systems to an unprecedented level.

Vertical integration makes it even better. Every system and humans at all hierarchy has all the data with required abstraction. Notable challenge faced in vertical integration is the communication protocol.



# Internet of Things (IoT)

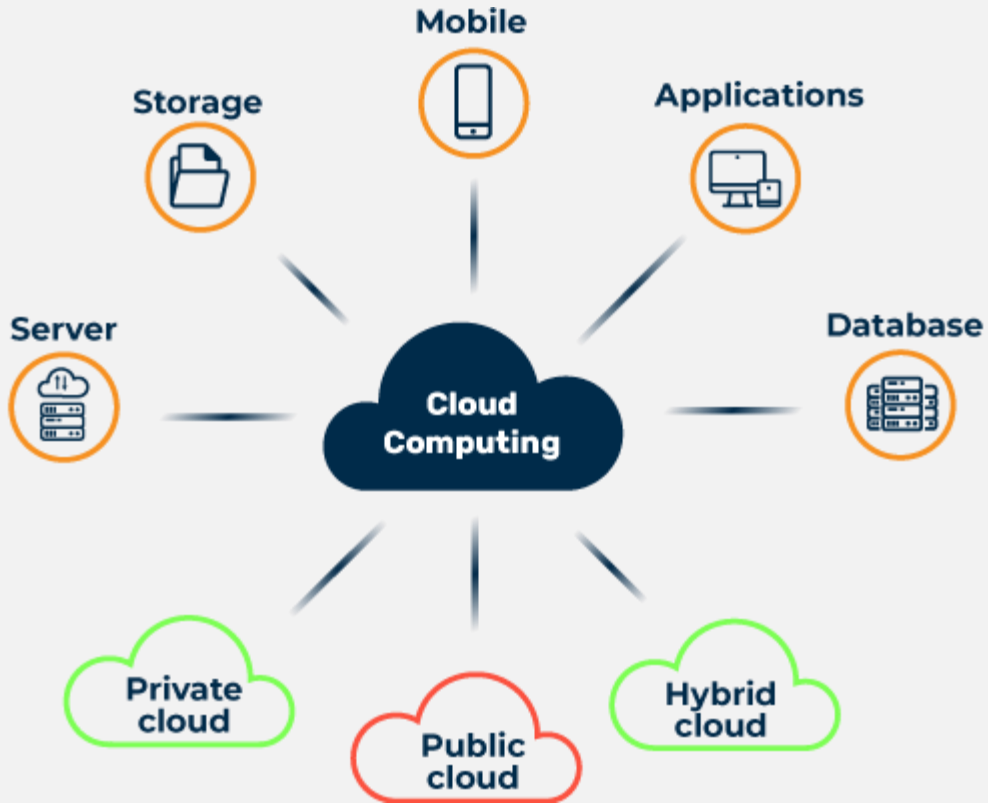
An ecosystem in which all the sensors and actuators with the ability to function separately and communicate with every other element is called IOT. Industrial IOT is the same but with increased ruggedness to survive the harsh environments of the industry.

# Autonomous Robots

While the manufacturing industry has made great strides when it comes to automation over the last few years, there is still a lot of untapped opportunity. Collaborative robots are designed to fill the gaps between traditional robots and human workers and open up new areas for automation. These robots are designed to work in ways similar to humans, with the added ability to monitor and transmit data.

# The Cloud

Cloud is a remote system that can be accessed provided from anywhere using the internet. There are a lot of cloud services available today of which notable are IaaS, PaaS, SaaS. Communication among machines themselves and between machines and humans are hugely backed by cloud services.



# Cyber Security

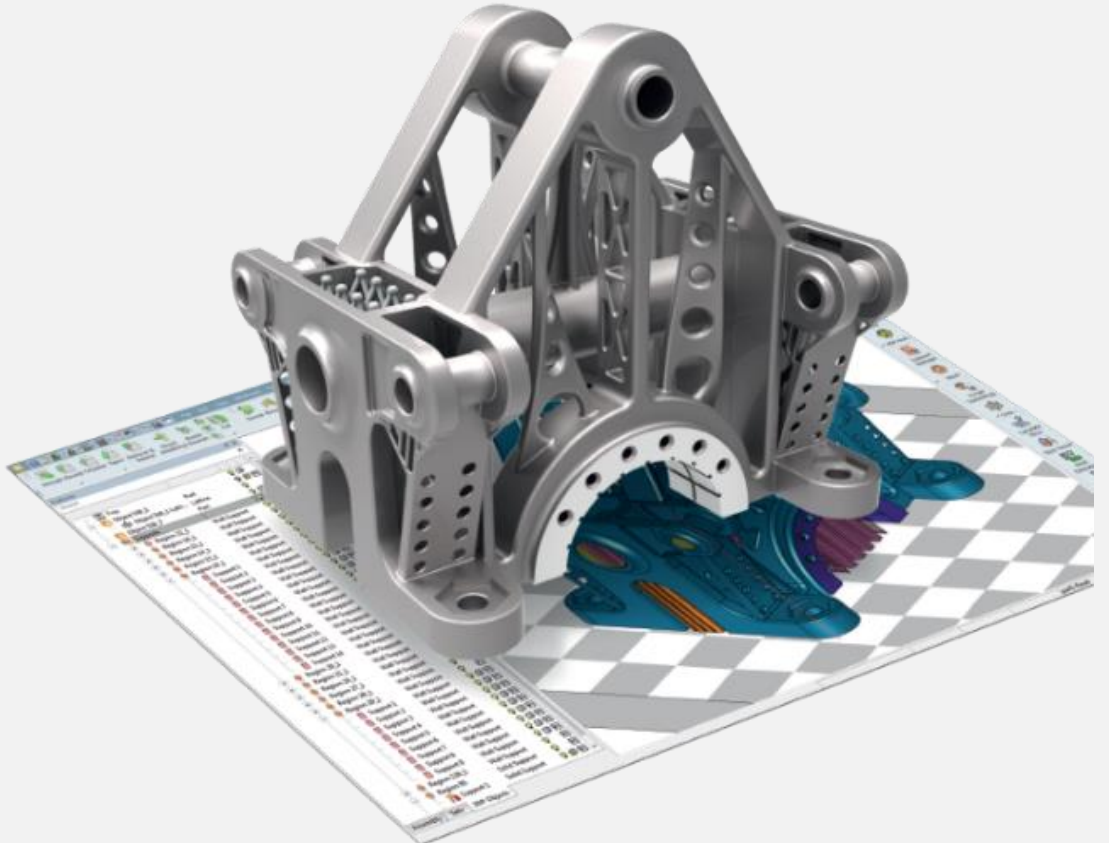
Cyber security becomes the talk of the town since the dawn of Information technology. The greatest nightmare of any information technology firm is having their server and data hacked. Preventing such a catastrophe and safeguarding the data and performance of the server is the sole purpose of cybersecurity.

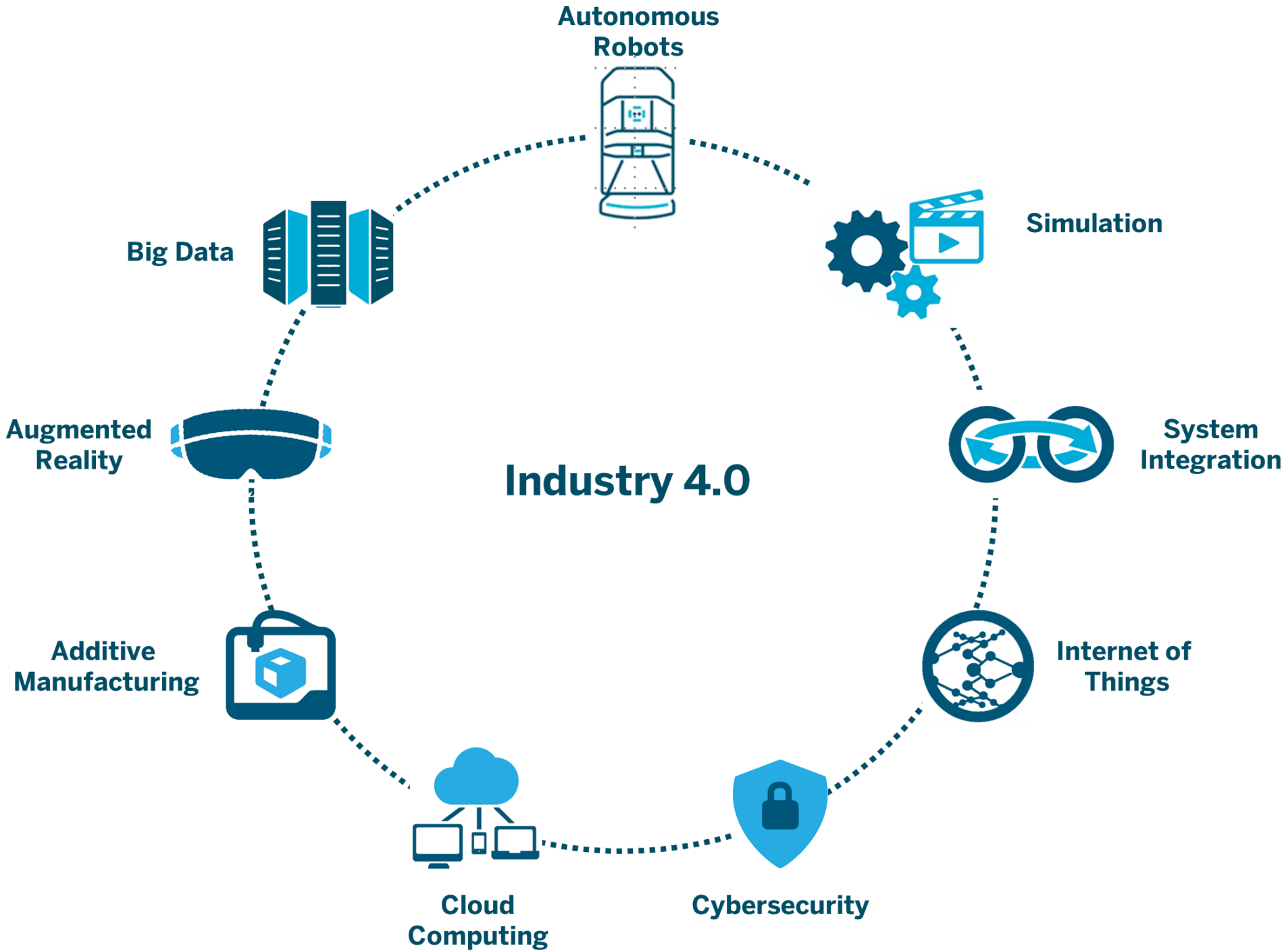
# Augmented Reality

Augmented Reality based systems are storming the technology industry. Few years ago they found their applications only in flight simulators. Today remote repair instructions can be sent to literally any part of the earth with internet accessibility. It helps technicians to enhance their skills by practicing high end repairs and maintenance over and over again using augmented reality.

# Additive Manufacturing and 3D Printing

Companies are already using additive manufacturing techniques like 3D-printing to make prototypes and Proof of concepts. The flexibility of Industry 4.0 allows us to design complex designs which are nearly impossible with conventional manufacturing processes.




Autonomous Robots
Simulation
System Integration
Internet of Things
Cybersecurity
Cloud Computing
Additive Manufacturing
Augmented Reality
Big Data
Industry 4.0

# Are we ready?