Sustainability and

- IoT

- Mechatronics

- Edge Cloud Computing

- Agriculture and Food Technology
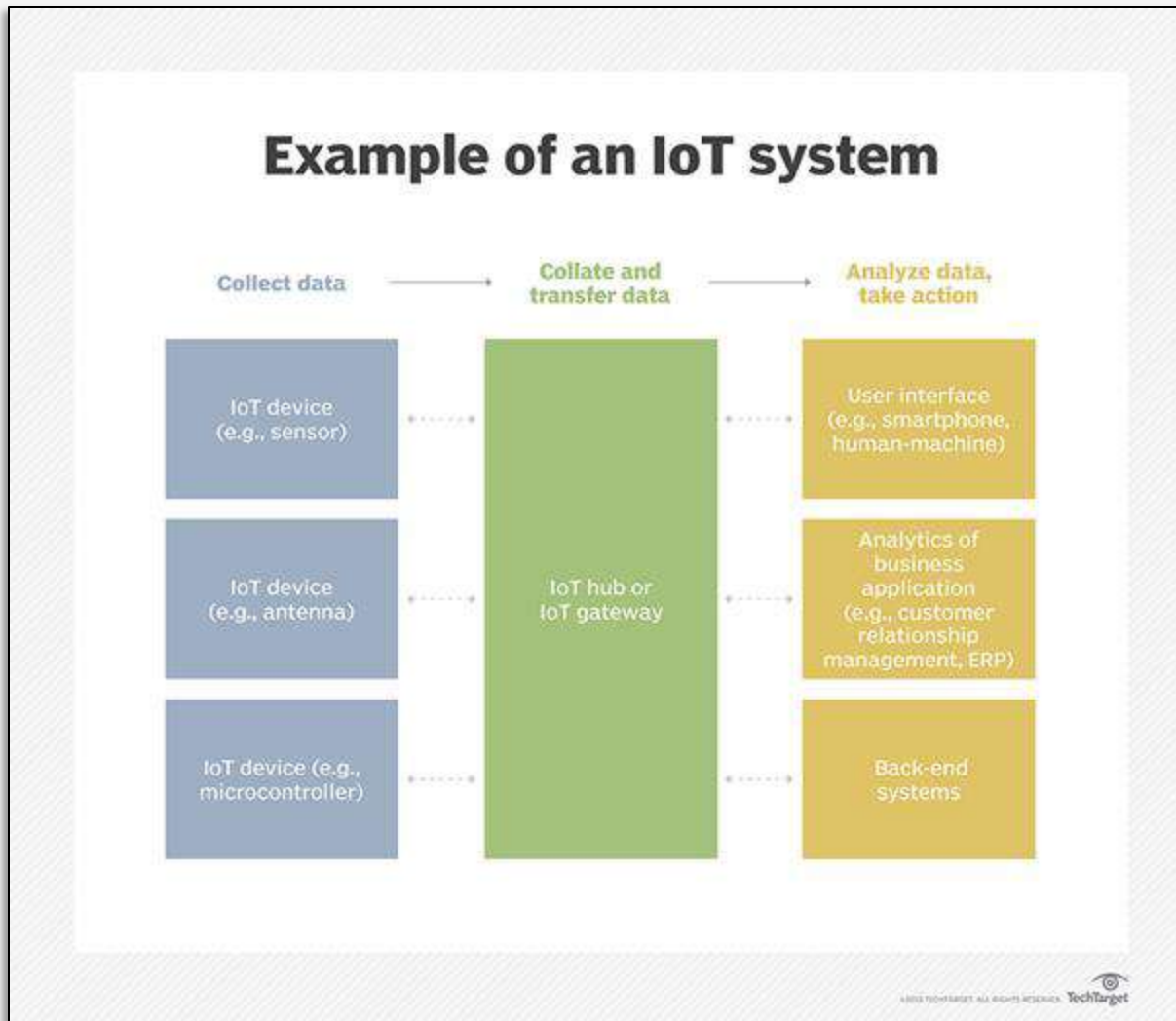
Smart-Edu4.0

Erasmus project

What is IoT (Internet of Things)

A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable ICTs.

https://www.linkedin.com/pulse/internet-things-iot-concept-reality-digitalforce-online/

Characteristics:
- Interconnectivity
- Things–related services
- Heterogeneity
- Dynamic changes
- Enormous scale

Source:: Recommendation ITU-T Y.2060

IoT Example

Example of an IoT system

The IoT, is a system of

- interrelated computing devices,
- mechanical and digital machines,
- objects,
- animals
- people

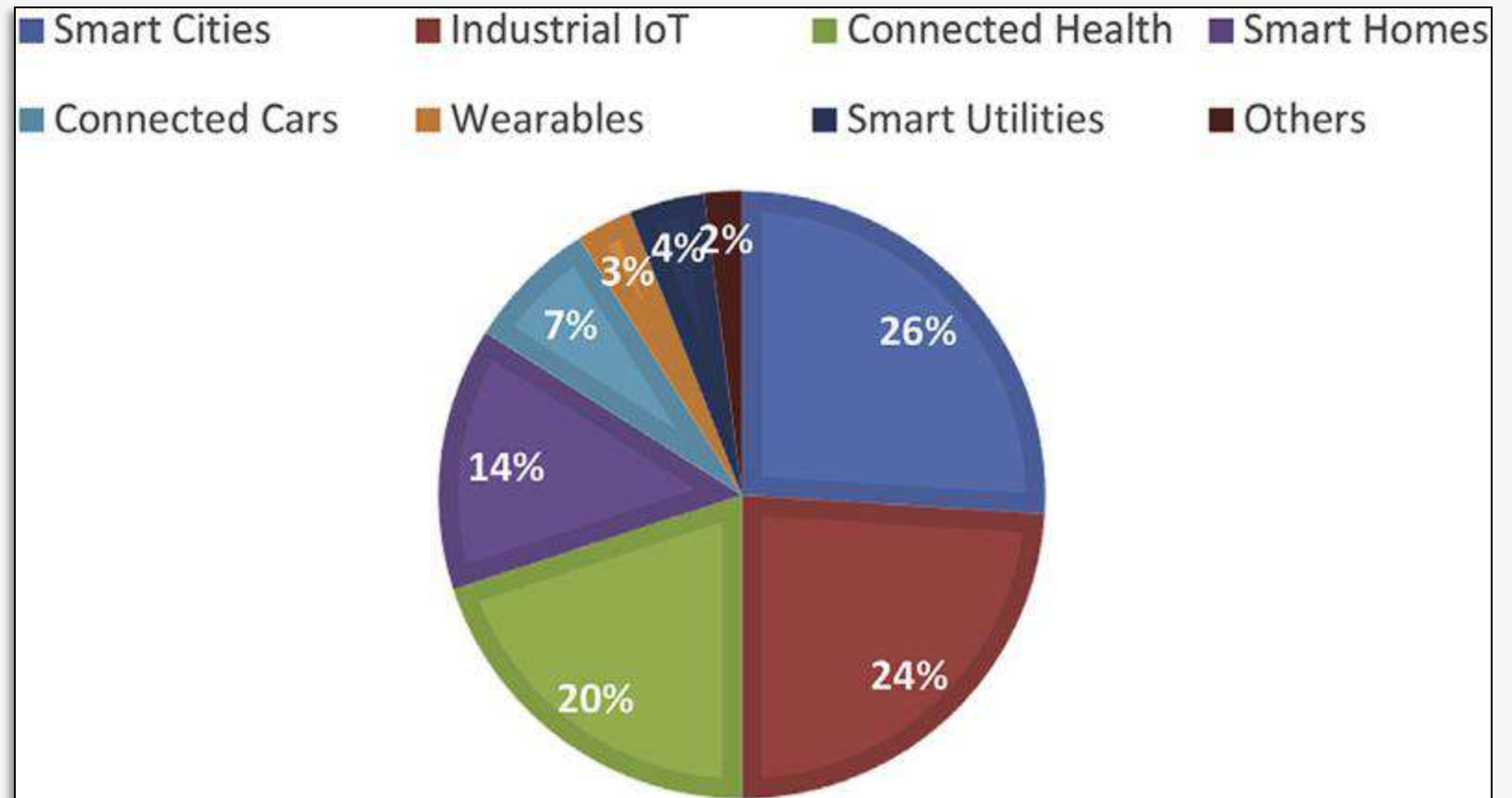that are provided with unique identifiers (UIDs) and the ability to transfer data over a network **without** requiring human-to-human or human-to-computer interaction.

Are the IoT Solutions available today?

The main goal of IoT technologies is to simplify processes in different fields, to ensure a better efficiency of systems (technologies or specific processes) and finally to improve life quality.

General market structure of IoT technologies

- ■ Smart Cities
- ■ Industrial IoT
- ■ Connected Health
- ■ Smart Homes
- ■ Connected Cars
- ■ Wearables
- ■ Smart Utilities
- ■ Others

Pie chart values: Smart Cities 26%, Industrial IoT 24%, Connected Health 20%, Smart Homes 14%, Connected Cars 7%, Wearables 3%, Smart Utilities 4%, Others 2%

https://www.researchgate.net/figure/General-market-structure-of-the-Internet-of-Things-technologies-3_fig1_355019169

Source: Nizetic, S., Djilali, N., Papadopoulos, A., Rodrigues, J.J.P.C., 2019. Smart technologies for promotion of energy efficiency, utilization of sustainable resources and waste management. J. Clean. Prod. 231, 565e591. Osterrieder, P., Budde, L., Friedli, T., 2020. The smart factory

Key factors for developing IoT applications

The development of specific IoT application areas strongly depends from several key factors such as:

- general available advancements in electronic components

- available software solutions and user friendly surrounding

- solutions related to sensor technologies and data acquisition

- quality of network, i.e. network connectivity and infrastructure

- sufficient energy supply for production and operation of IoT devices
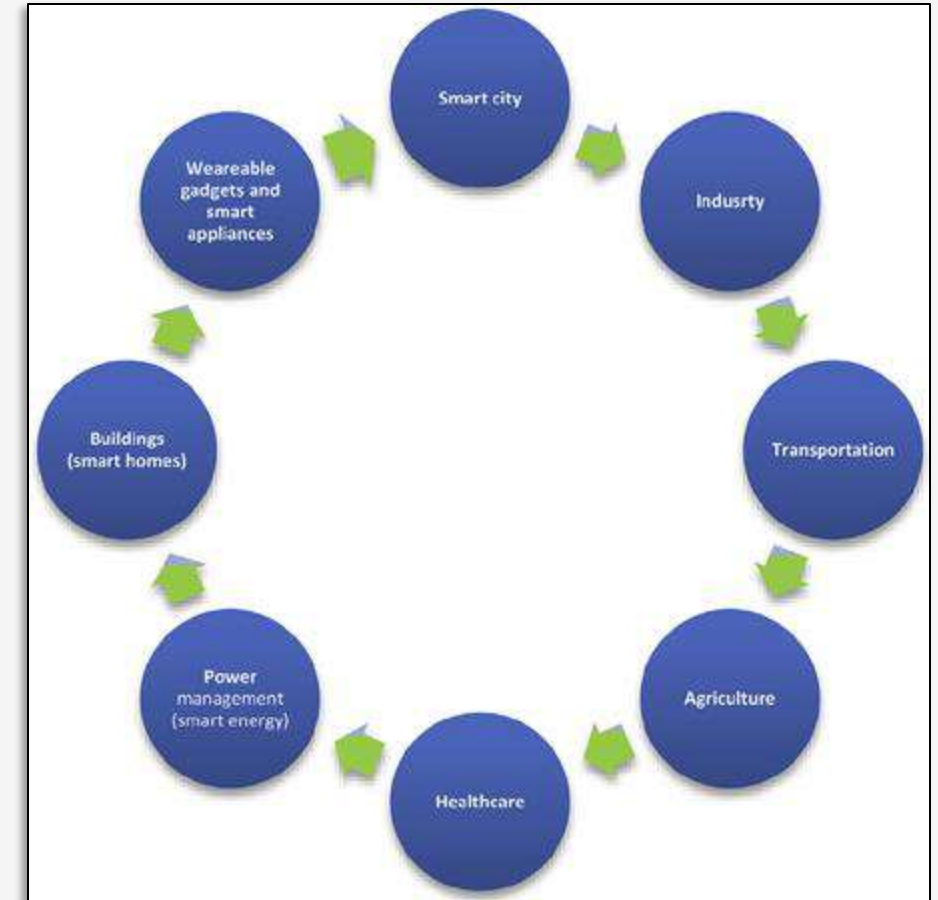
IoT in industry
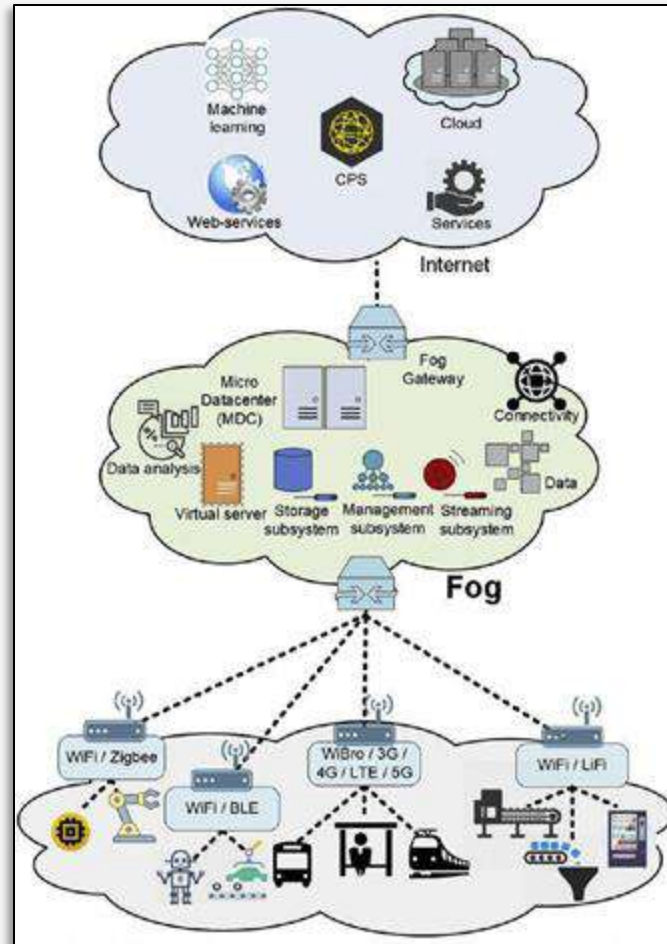
➢ The application of IoT technologies in industrial applications would allow for an increase in efficiency regarding the production process and would ensure more efficient communication and networking between operators and machines.

➢ It would allow for more competitive companies on the market with more efficient quality control with a minimization in losses.

➢ A critical feature would be the development, design and integration of various useful sensors in the industrial applications

Source: Aazam, M., Zeadally, S., Harras, K.A., 2018. Deploying fog computing in industrial internet of things and industry 4.0. IEEE Transactions on Industrial Informatics.PP (99):1–1. Abdou, M., Mohammed
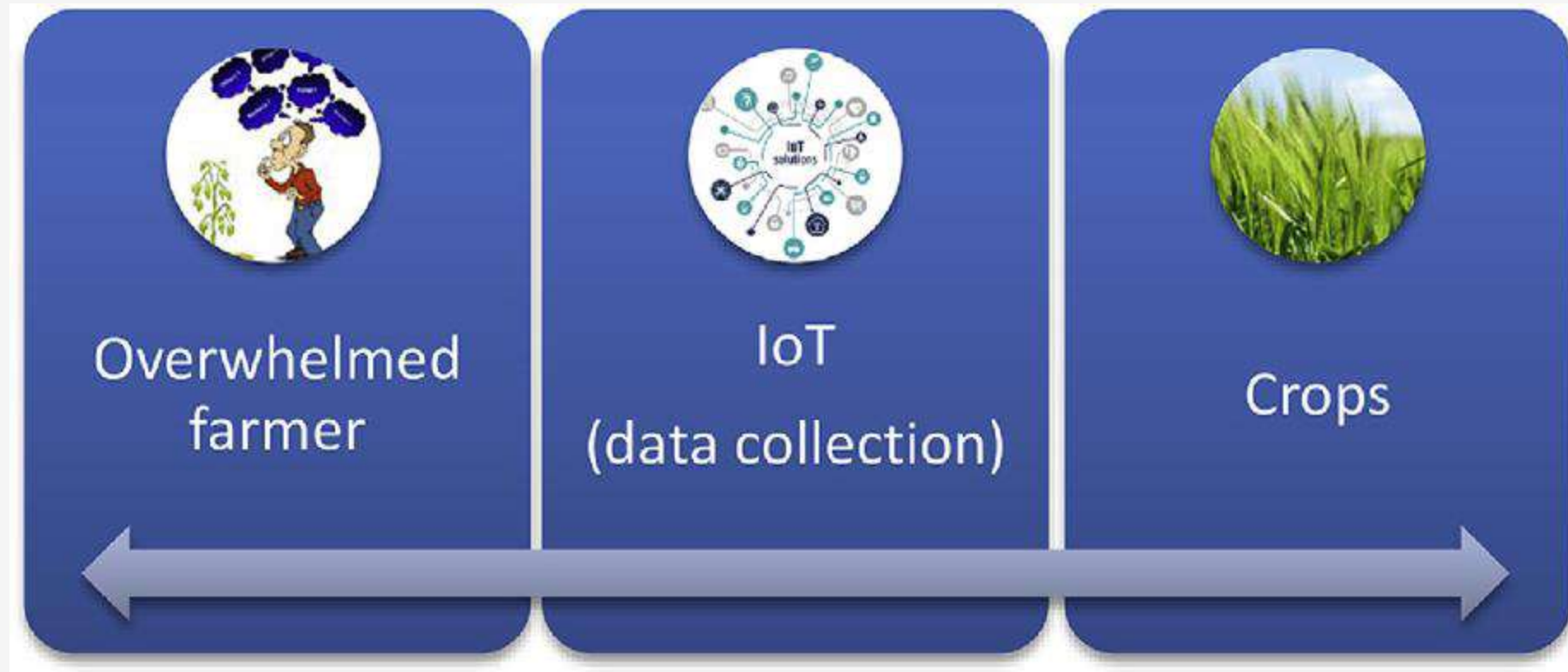
IoT in smart city concept

Different challenges in Smart City concept
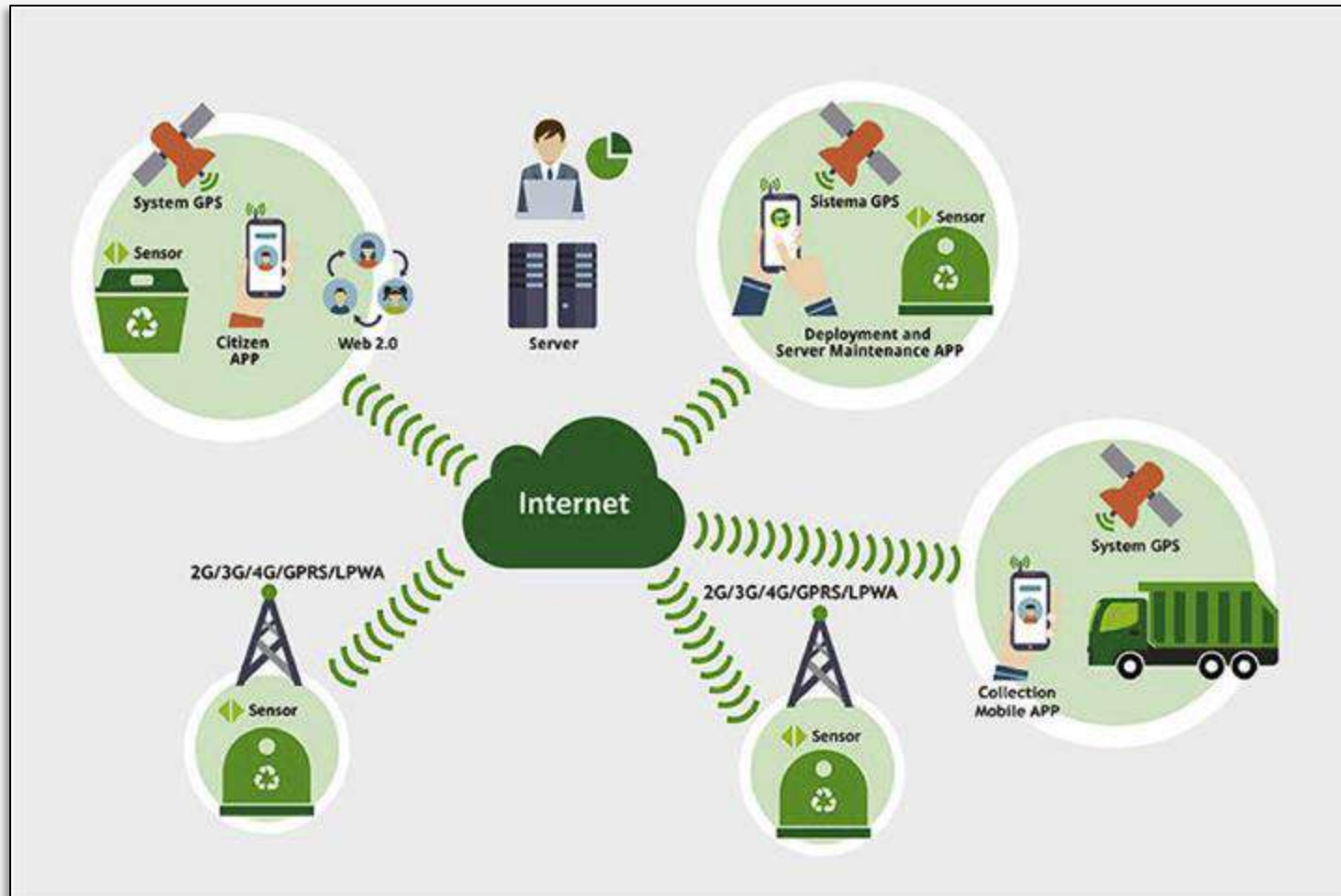
IoT in agriculture

IoT in agricultural production from farmer's perspective

more precise seeding,   fertility crop management,   sensing and monitoring technologies, better education of farmers
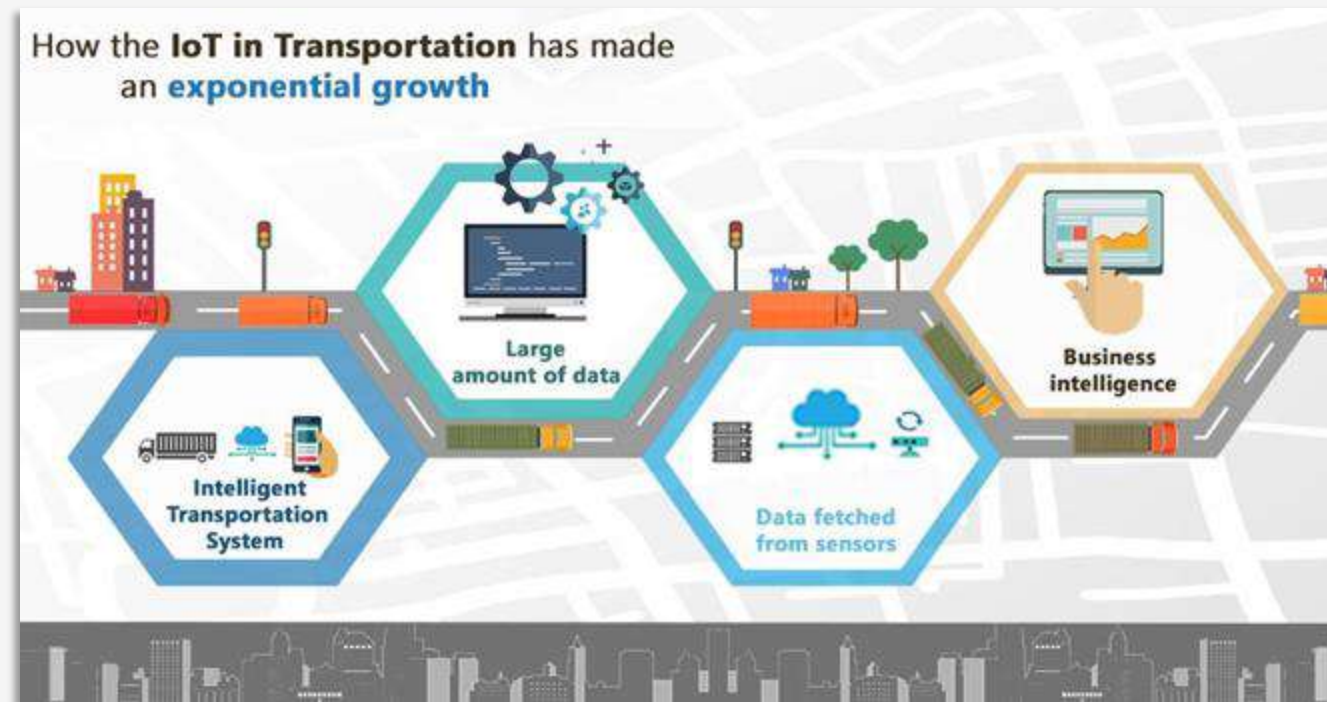
IoT in waste management

Innovative IoT based technological solutions are expected to be developed in upcoming years, especially from a smart city concept perspective and that could support smart waste management systems and a circular economy concept.

IoT in healthcare

An increase in the service quality of healthcare systems could be utilized through IoT support (mainly collection of patient health data) and finally with the improvement of patient safety and care since it could also lead to an increase in patient life expectancy.

https://sbr-technologies.com/advantages-of-iot-in-healthcare/

There is an enormous potential in smart medical devices for different purposes that can be utilized for the monitoring of various vital and valuable human functions such as heart rate, skin temperature, movement monitoring, etc.

Support of IoT in:

remote health monitoring, monitoring a patient's general health condition and nutrition status, rehabilitation after a serious disease, ensure proper cyber safety due to potential attacks, smart hospital information system.

IoT in transportation

Transportation modes will be significantly changed in upcoming decades.

In general, there is a demand for more environmentally suitable transportation options that are already being gradually developed with an expected penetration on the market. A necessary development of transportation infrastructure is needed for specific vehicle technologies to ensure desirable vehicle autonomy.


How the **IoT in Transportation** has made an **exponential growth**

Intelligent Transportation System

Large amount of data

Data fetched from sensors

Business intelligence

The most significant IoT application area is in the case of **the smart car (vehicles) concept**. The smart car concept considers the utilization and optimization of different internal functions in the car that are supported by IoT technologies. The application of IoT would upgrade driver experience and increase in comfort and safety.

IoT in smart grids and power management

IoT products and technologies in smart power management is expected to enable

- accurate forecasting and
- different load strategies

in the case of renewable generation.
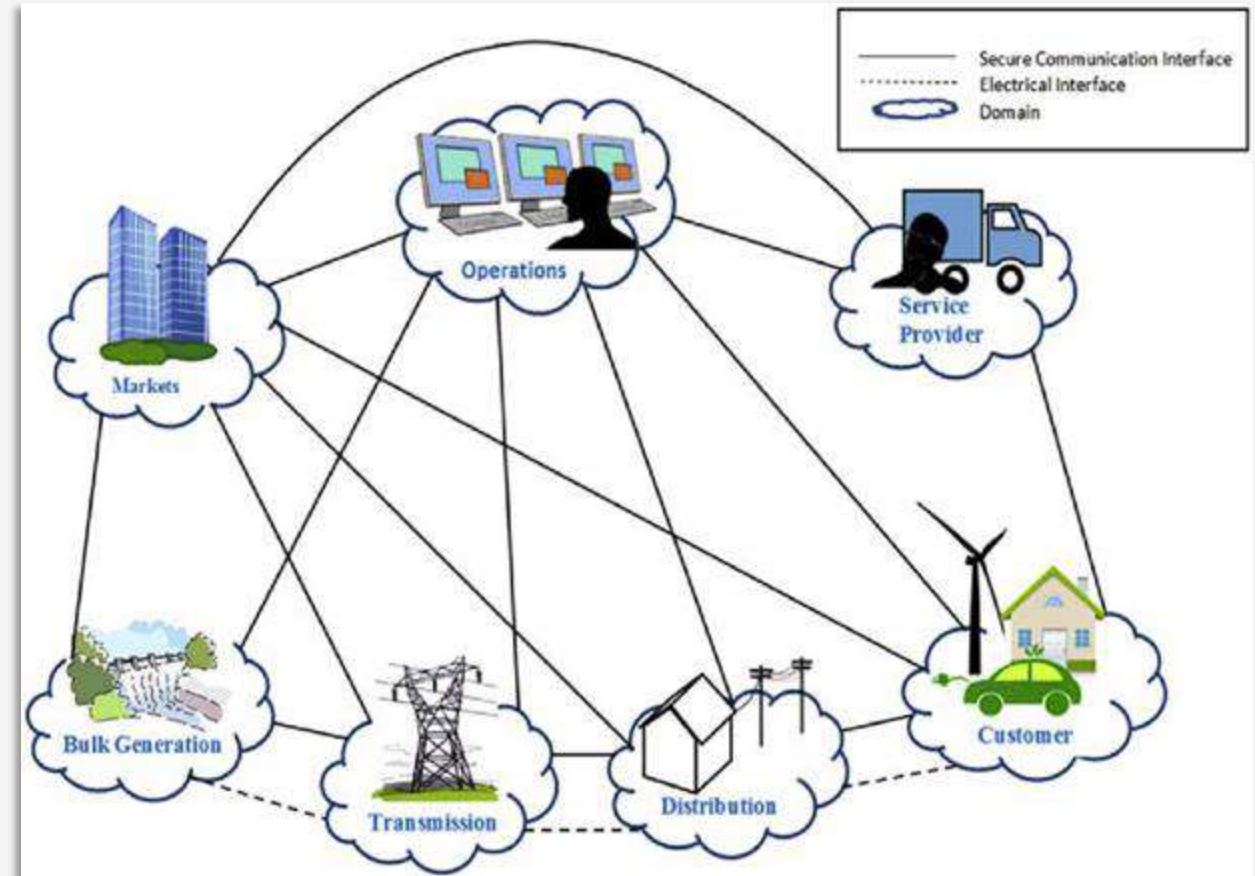
https://europepmc.org/article/pmc/pmc7368922

Megatrends are provoking a rise in Energy Demand
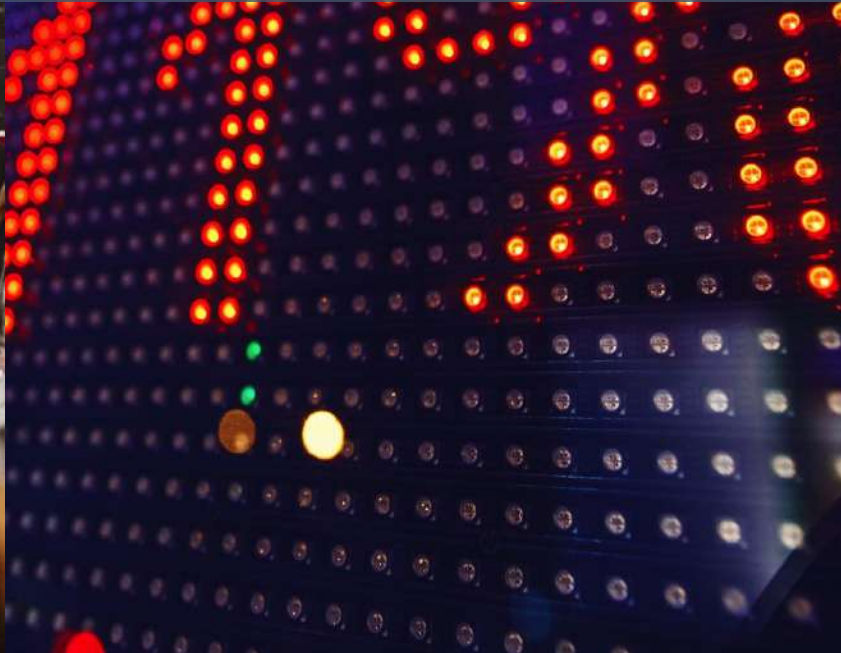
URBANIZATION

+2.5B people in cities
by 2050

Source: United Nations, DESA

DIGITIZATION

50B connected things
by 2020

Source: Cisco

INDUSTRIALIZATION

+50% Energy consumption
by 2050
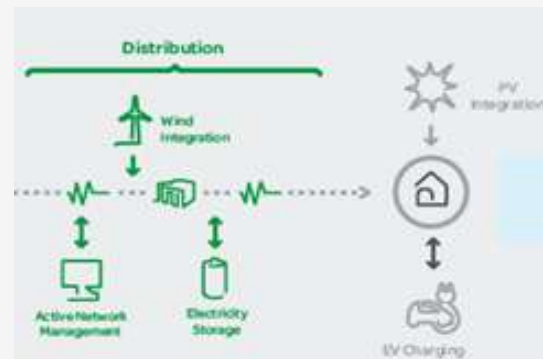
Source: IEA

Source: Schneider Electric

Our World will be...

MORE ELECTRIC

Demand for electricity driven by sustainability, intelligent devices, and evolution of key energy consumers

MORE CONNECTED

Internet of Things will connect at least 50bn devices by 2020

MORE DISTRIBUTED

- Provide local energy to facilities, around positive energy and micro grids, to empower users
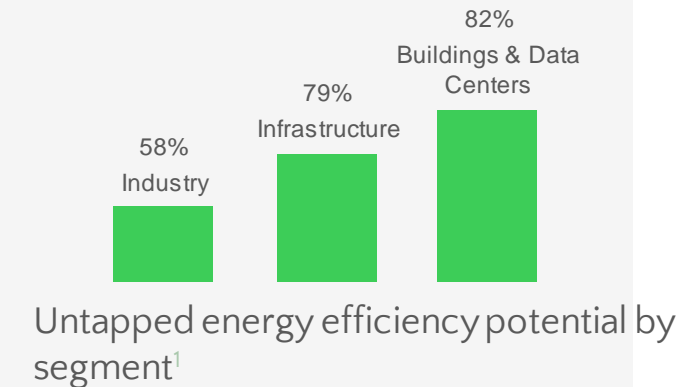- Falling prices of renewable energy

MORE EFFICIENT

- 2/3 of energy efficiency potential remains untapped[1]
- Buildings, industry & infrastructure end–users and datacenters all look to improve performance, efficiency and environmental footprint

82% Buildings & Data Centers
79% Infrastructure
58% Industry

Untapped energy efficiency potential by segment[1]

1: World Energy Outlook 2012, OECD / IEA, Internal analysis

Source: Schneider Electric

Smart Grid & Smart City IoT Solutions

Smart Grid Operator

"IT/OT integration from field to control center to enterprise"

Smart Generator

"Producing power efficiently"

Energy Services Provider

"Bridging supply & demand"

Renewable Operator

"Making renewables dispatchable"

Smart Buildings & Homes

Smart Energy

Smart Water

Smart Mobility

Smart Public Services

Smart Data Center

Smart Integration

Source: Schneider Electric

Industry IoT Solutions

From **design** to **maintenance** – **Sustainability & Efficiency** of the operations

Energy and Sustainability

Improve the sustainability of the operations and reduce the energy bill.

Process Management

Strive for zero waste while increasing the flexibility.

Source: Schneider Electric

Building & Homes IoT Solutions

From grid to floor space: **safety, comfort, reliability, efficiency and sustainability**

Buildings:

Smart Electrical Distribution Panels

Building Management System

Energy & Power Management

Power Meters

Homes:

Connected Home System

Home Automation

Lighting & Temperature Control

Source: Schneider Electric

Sustainability and IoT create connected technologies that ……

RESHAPE INDUSTRIES

TRANSFORM CITIES

ENRICH LIVES

IoT and Sustainable Development Goals (SDGs)

https://www.collidu.com/presentation-iot-for-sustainable-development

IoT Contribution to Achieving SDGs

IoT FOR SUSTAINABLE DEVELOPMENT

How the IoT Contributed to Achieving this Goal?

Costs
Improving agri-food productivity by reducing producing costs and increasing product quality.

Impact
Reducing the impact of agricultural activity on the consumption of natural resources.

Production
Multiplying the production and income of small producers.

Diversity
Maintaining and Improving genetic diversity in food products.

Sustainability
Achieving sustainable and resilient agricultural production.

Food Market
Achieving a stable, sustainable, and accessible food market for everyone.

Allocation
Preventing market distortions (too much food for too few people and vice versa)

Sample Headline
This is a sample text that you can edit. You can change font (size, color, name).

https://www.collidu.com/presentation-iot-for-sustainable-development

Source: libelium

IoT technology applications for
Ambient Assisted Living (AAL) domain

Ambient Assisted Living (AAL or simply assisted living) encompasses technological **systems** to support people in their daily routine to allow an independent and safe lifestyle as long as possible.

An AAL approach is the way to guarantee better life conditions for the aged and people with limited mobility, chronic diseases and in recovery status with the development of innovative technologies and services.

Modern assistive technologies constitute a wide range of technological solutions aimed at improving the well-being of the elderly.
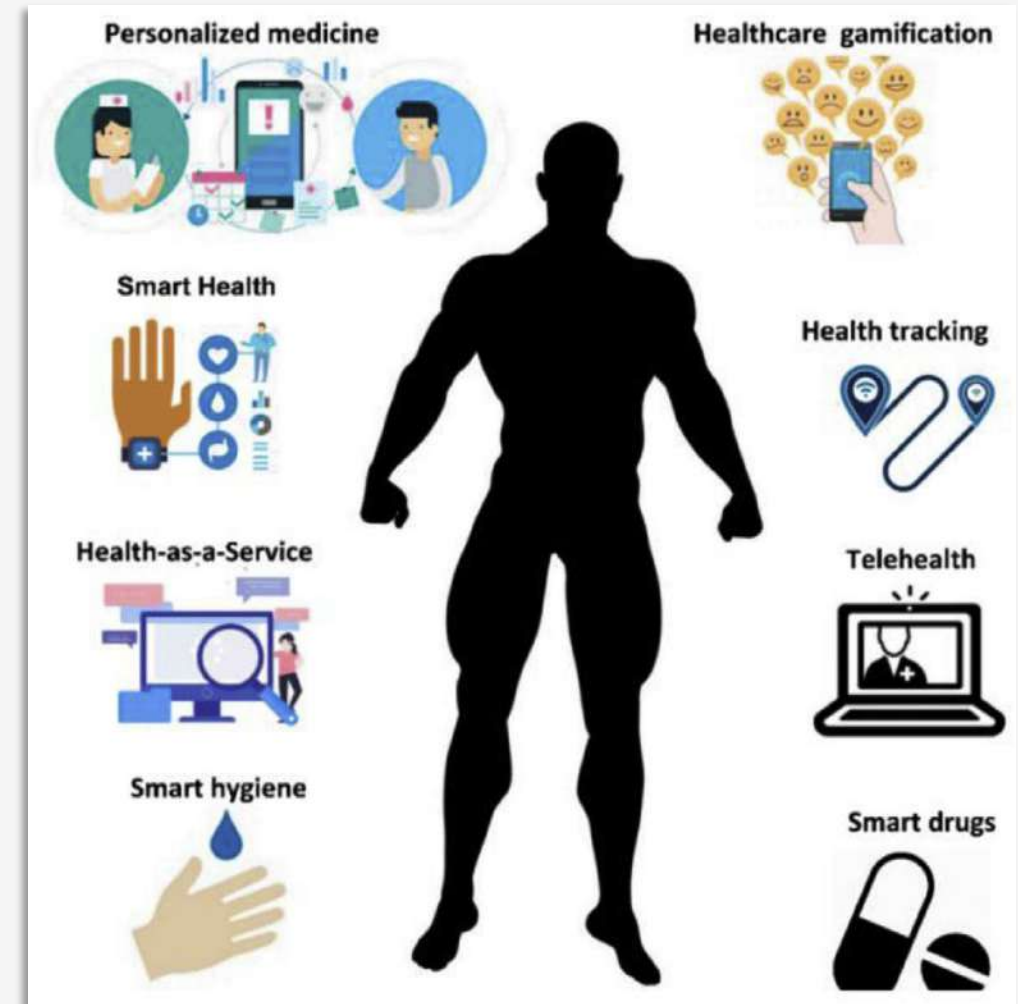
Source: Maskeliunas, R., Damasevicius, R., Segal, S., 2019. A review of internet of things technologies for ambient assisted. Living environments. Future Internet 11, 259. https://doi.org/10.3390/fi11120259.

Examples of IoT in developing countries

https://www.slideshare.net/OnyiegoB/urban-fire-riskspptx

Slum fires

https://www.allerin.com/blog/developing-countries-and-their-tryst-with-iot

Fires can move quickly in informal settlements and slum areas, given that homes are close in proximity.

Low-cost, solar powered sensors networked together can quickly detect and relay to authorities when fires emerge. Its connected sensors identify via GPS where the fire has started. The network sounds alarms, sends texts to threatened residents, and notifies authorities of the location where fire mitigation efforts should be targeted) .

Currently being tested in Nairobi and Cape Town, with participation by two thousand households.

Infectious outbreaks

Epidemiological models of the spatial spread of Ebola can (and have been) developed to model the spread of the virus.
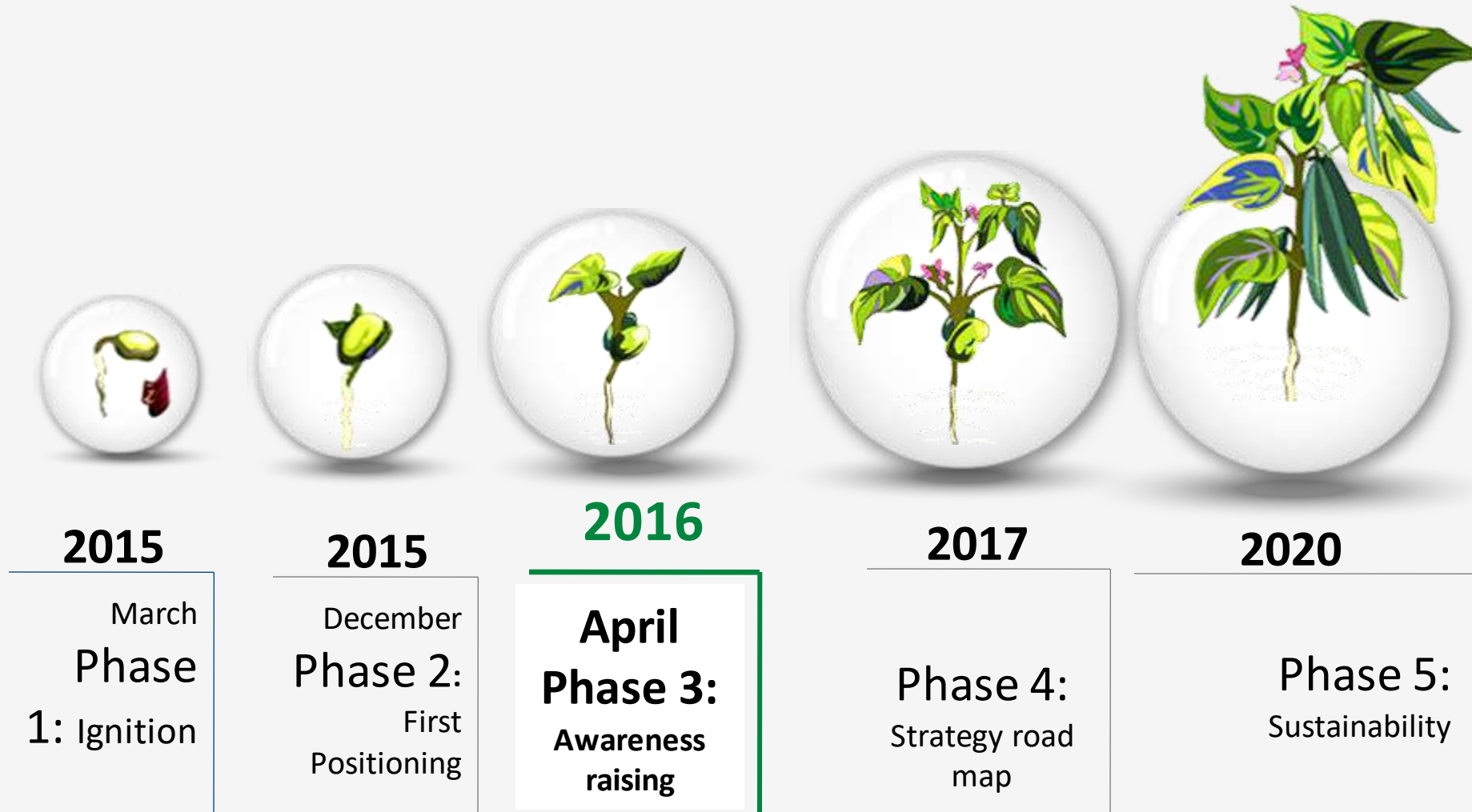
These models can help assess the likely routes of infected individuals between populations, predict possible new outbreaks and help focus the delivery of eventual vaccines.

https://robertcowley.wordpress.com/tag/africas-urban-revolution/

Source: https://www.slideshare.net/GayaBranderhorst/iot-and-sustainable-development-united-nations

AIOTI in the long term and stepping stones

2015
March
Phase 1: Ignition

2015
December
Phase 2: First Positioning

2016
April
Phase 3:
Awareness raising

2017
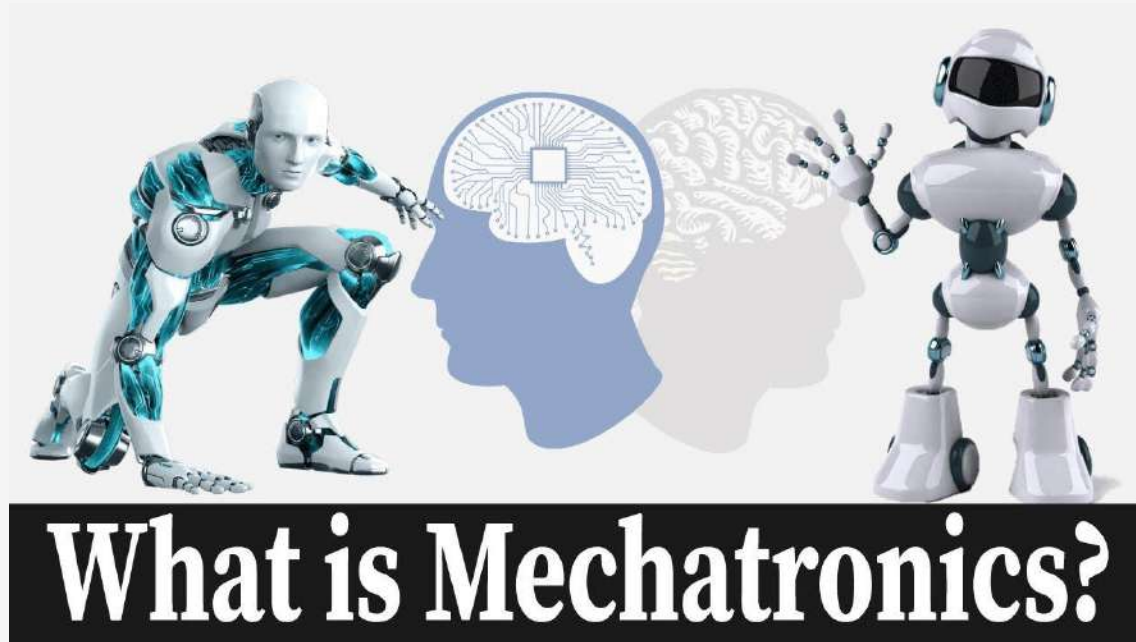Phase 4: Strategy road map

2020
Phase 5: Sustainability

Future directions in the field - further issues

- The rapid development of IoT technologies causes fast consumption of raw materials to produce different electronic devices.

- Electronic devices are becoming more economically acceptable where a potentially large population would be affected.

- The sustainability aspect and long-term effects of IoT technologies are not clear and insufficiently investigated.

- Electronic waste will become one of the major issues caused with the planned rise of IoT products.

- IoT technologies can cause social impacts in specific industrial branches or businesses.

- Significant advancements in both specific electronic components as well as user-friendly software solutions are required.

- Further development in sensing technologies and advanced data acquisition systems is also required.

- The minimization of energy consumption in IoT devices is a crucial target, i.e., reduction of energy supply.

Mechatronics

TheEngineeringWorld https://leverageedu.com/blog/mechatronics-engineering/

https://www.mechatronic.me/2021/02/what-is-mechatronics.html
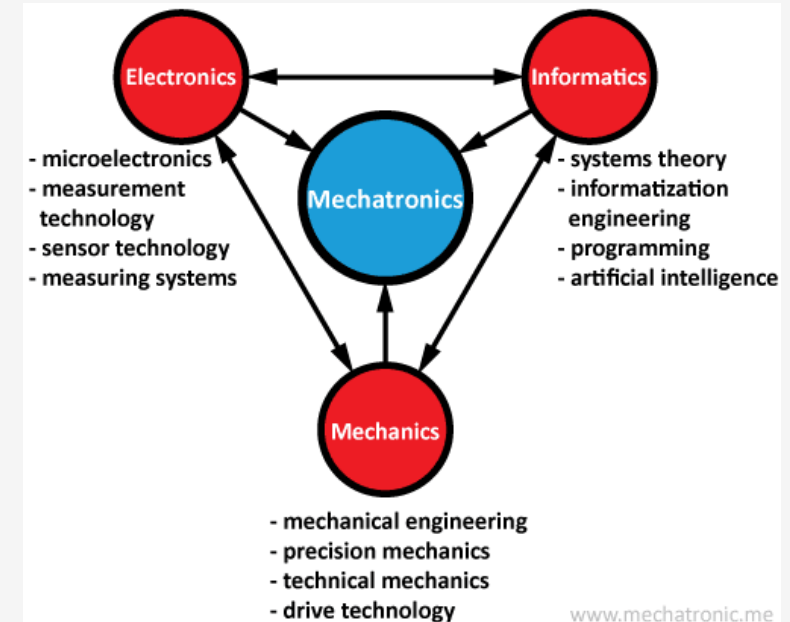
Mechatronics is a relatively new field of engineering which combines elements of electrical engineering, mechanical engineering, electronics engineering, and information technology.

There is an enviable roles of manufacturing processes in a sustainable fourth industrial revolution having a deep overview in mechatronics applications.

Applications of Mechatronics

Running Shoes

a

Advantages
•**Automatically changes cushioning** in shoe for different running styles and conditions for improved comfort

b BigDog

System Can
•Carry 340 lb
•Run 4 mph
•Climb, run, and walk
•Move over rough terrain

Advantages
•Robot with **rough-terrain mobility** that could carry equipment to remote location.

Smoke Detector System **c**

Smoke
Smoke Test
Smoke IC
LED Driver
Ion Chamber (or Photo Chamber)
Smoke Signal
Horn Driver
To other units, Escape lights, Aux. Alarms, etc.
I/O
Horn

Prosthetics **d**
•Arms, Legs, and other body parts can be replaced with electromechanical ones.

e Automobiles

Typical Applications
•Brake-By-Wire system
•Steer-By-Wire
•Integrated vehicle dynamics
•Camless engines
•Integrated starter alternator

OEM Driven
•Reliability
•Reduced weight
•Fuel economy
•Manufacturing flexibility
•Design freedom
•Advanced safety features
•Cost

High Speed Trains **f**
•Train Position and Velocity constantly monitored from main command center.
•Error margin in scheduling no more than 30 seconds
•Fastest trains use magnetic levitation

JR-Maglev
Top Speed: 574 km/h (357 mph)
Country: Japan

Magnetic Levitation

Transrapid
Top Speed: 550 km/h (340 mph)
Country: German

https://www.researchgate.net/figure/Applications-of-Mechatronics-a-Sport-b-robotics-c-home-d-medical-e-automobiles_fig1_349501729

(a) Sport

(b) Pobotics

(c) Home

(d) Medical

(e) Automobiles

(f) Transportation

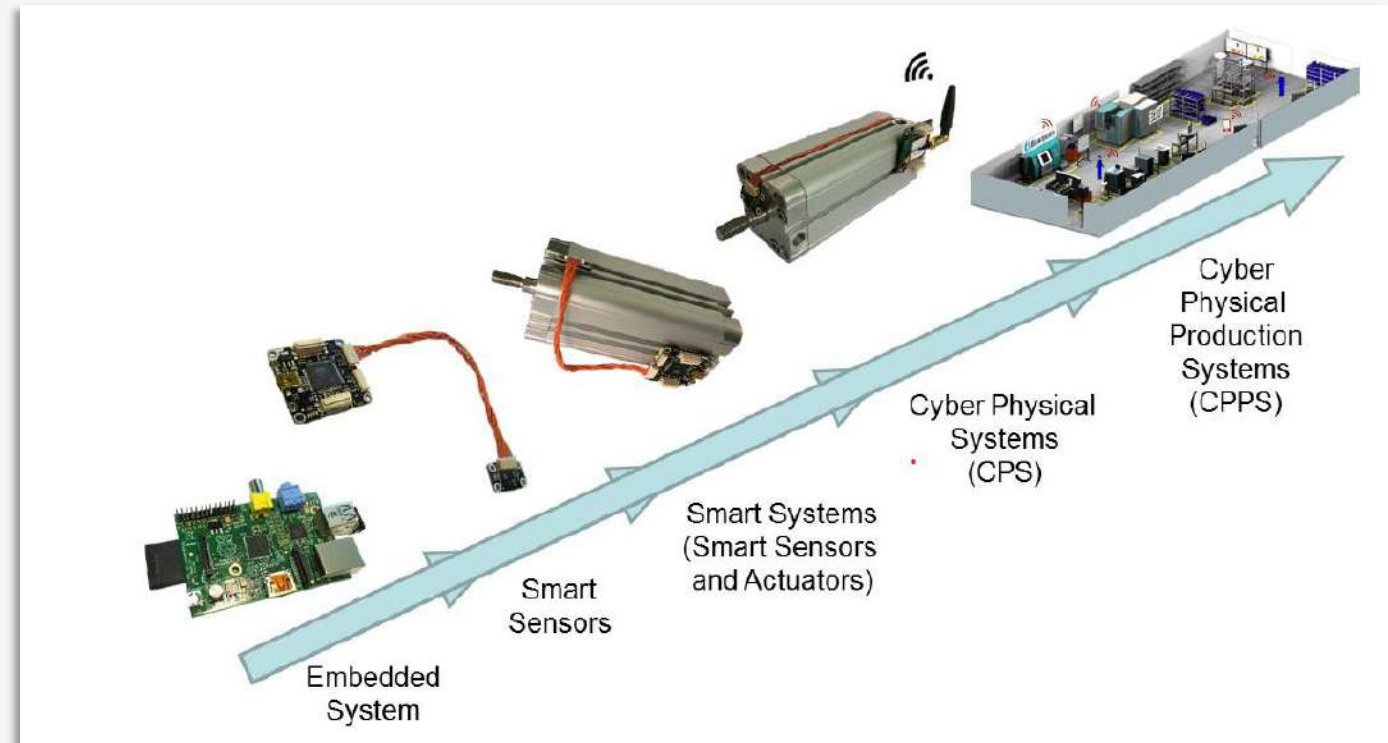These applications play a major role in the fourth industrial revolution as bridges upon which it is built.

Cyber-Physical Systems

For Industry 4.0 the key approach is to equip future products and production systems with embedded systems as a basis for smart sensor and smart actuators for enabling communication and intelligent operation control.

These so-called Cyber-Physical Systems challenge design and development processes and require appropriate engineering approaches.

Source: R. Anderl, Industrie 4.0-advanced engineering of smart products and smart production, in: Proceedings of International Seminar on High Technology, 2014, p. 19.

Autonomous Robots

Currently many manufacturers have turned to the use of robots in dealing with the various complex manufacturing processes that are undergone in various industries.

An increase in autonomy, flexibility, and collaboration is a main driving force in their continual use, an example is Kuka which is offering autonomous robots that interact with one another.

https://www.digikey.gr/en/supplier-centers/kuka-robotics

https://www.controldesign.com/connections/data-acquisition-monitoring/news/33006018/man-or-machine-what-is-ai
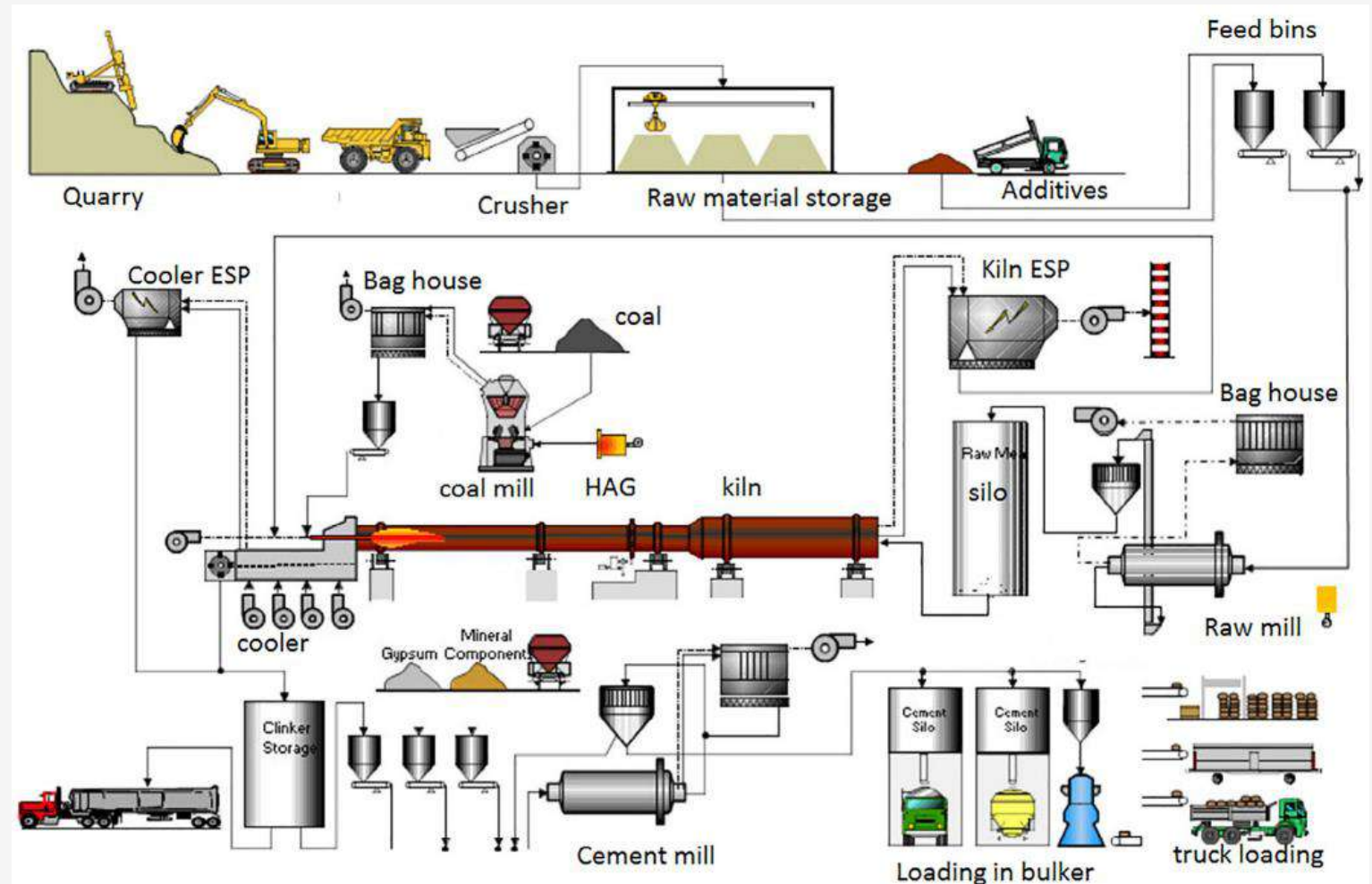
Implementation of the model in a cement factory

Cement manufacturing process

The lime stone is processed in many steps to obtain the final output of cement with some additives.

• Lime stone mining

• Lime stone crushing

• Grinding of lime stone with iron ore and alumina

• Pulverized coal preparation for burning in pyro-processing

• Pyro-processing

• Clinker grinding with gypsum

• Cement packing and transportation