# INTERNET OF THINGS

Today, objects and devices are part of an information chain enabled by digital communication in networks and high-performance data analysis. They are used as parts of multi-layered intelligent systems: this is referred to "**Internet of Things**" (**IoT**) and "**Industry 4.0**".

We can define the "Internet of Things" (IoT) as **the access of information on an object through a digital communication channel.**

Industry 4.0 uses IoT technology for production, greatly enhancing efficiency, productivity and flexibility.

Any IoT system comprises the following elements:

- SENSORS
- DATA LOGGERS
- GATEWAYS
- DATA ANALYSIS

TRANSDUCER / SENSOR   LOGGER   GATEWAY   BRAIN
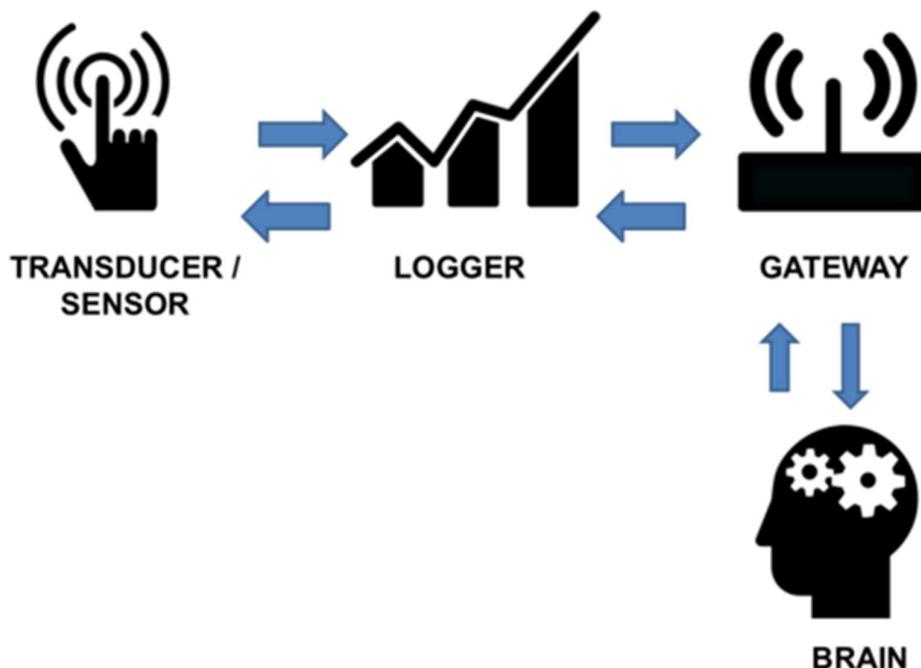
TRANSDUCER/SENSOR

A sensor senses a parameter of interest related to an object carrying out a useful function. The parameter is related to the environment near the object, to the function of the object, or to its usage conditions. Usage conditions are related to how severely or effectively the component is being used.

LOGGER

The Logger powers the transducers and sensors, acquires data, transforms it into a digital signal. The logger can store data locally if the system is isolated for some time.

GATEWAY

A gateway will acquire logger data and transmit through a digital telecommunication channel to a database, which is accessed by a "brain". It can be wired to the brain, or transmit data through a LAN, VPN, or the world-wide web, depending on how sensitive the information is and whether the system works isolated or with other systems.

BRAIN

The brain analyses the data and feeds back key information, relying on a model of the device.
The brain can be a human intelligence analyzing data at regular intervals, an artificial intelligence carrying the same function automatically, or a combination of both. The analysis process leads to an informed decision about actions to perform.

The Internet of Things is related to the following information transformation model.
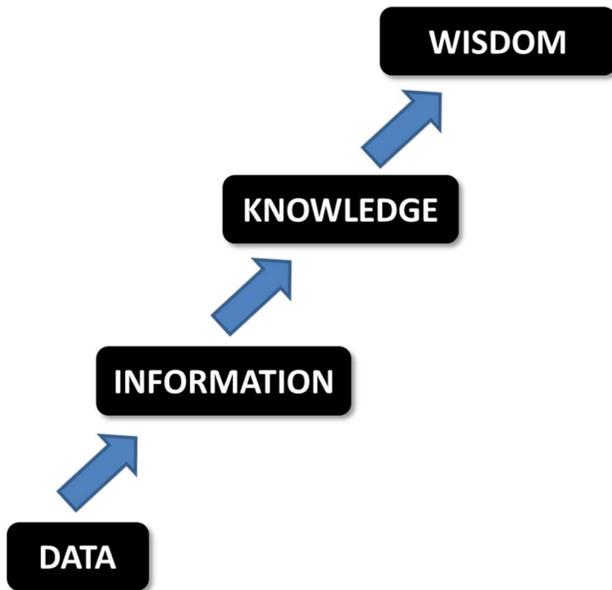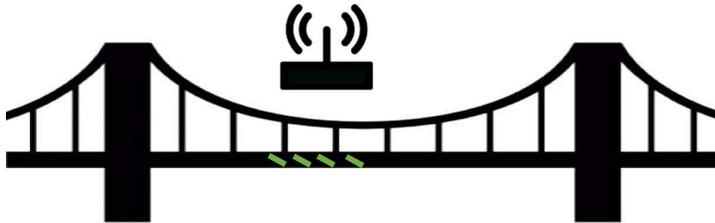

THE IoT INFORMATION CHAIN ELEMENTS:

CLOSING THE LOOP

The information chain is closed in a loop when human or machine adapt their behaviour to maximize device life, reduce usage and maintenance costs, or maximize functional performance and safety.

Most of the benefit and performance is secured by closing the information loop.

Example:

IoT BRIDGE

A gateway loads strain data from a loaded point of a bridge, and a brain transforms the strain history into information on usage: was the bridge loaded excessively by a vehicle carrying more mass than allowed? Is the bridge structure damaged? Does it require urgent inspection, or replacement of structural components?

ADAPTIVE MAINTENANCE AND SAFETY

A sensor may be measuring the temperature of the air surrounding a device, or sensing a parameter related to the function of a device, like a deformation signal related to how much load is applied to the device.

This information allows monitoring the health of the device, determining its residual life and when maintenance should be scheduled: rough usage will typically lead to shorter life; mild usage will increase life and reduce maintenance effort. If high temperature is detrimental to a device life or creates and safety-critical condition, usage is adapted to reduce temperature, thereby increasing life and delaying maintenance or replacement.

INDUSTRY 4.0

Monitoring of the function of multiple objects (e.g. robots) allows coordinating their performance in an automatic, optimum mode. Monitoring process execution allows collecting useful data on production and performance with high reliability.