

IoT Adoption Cases

Bologna February 19, 2020

Paolo Lasagni





VOLUMES



SERVICES



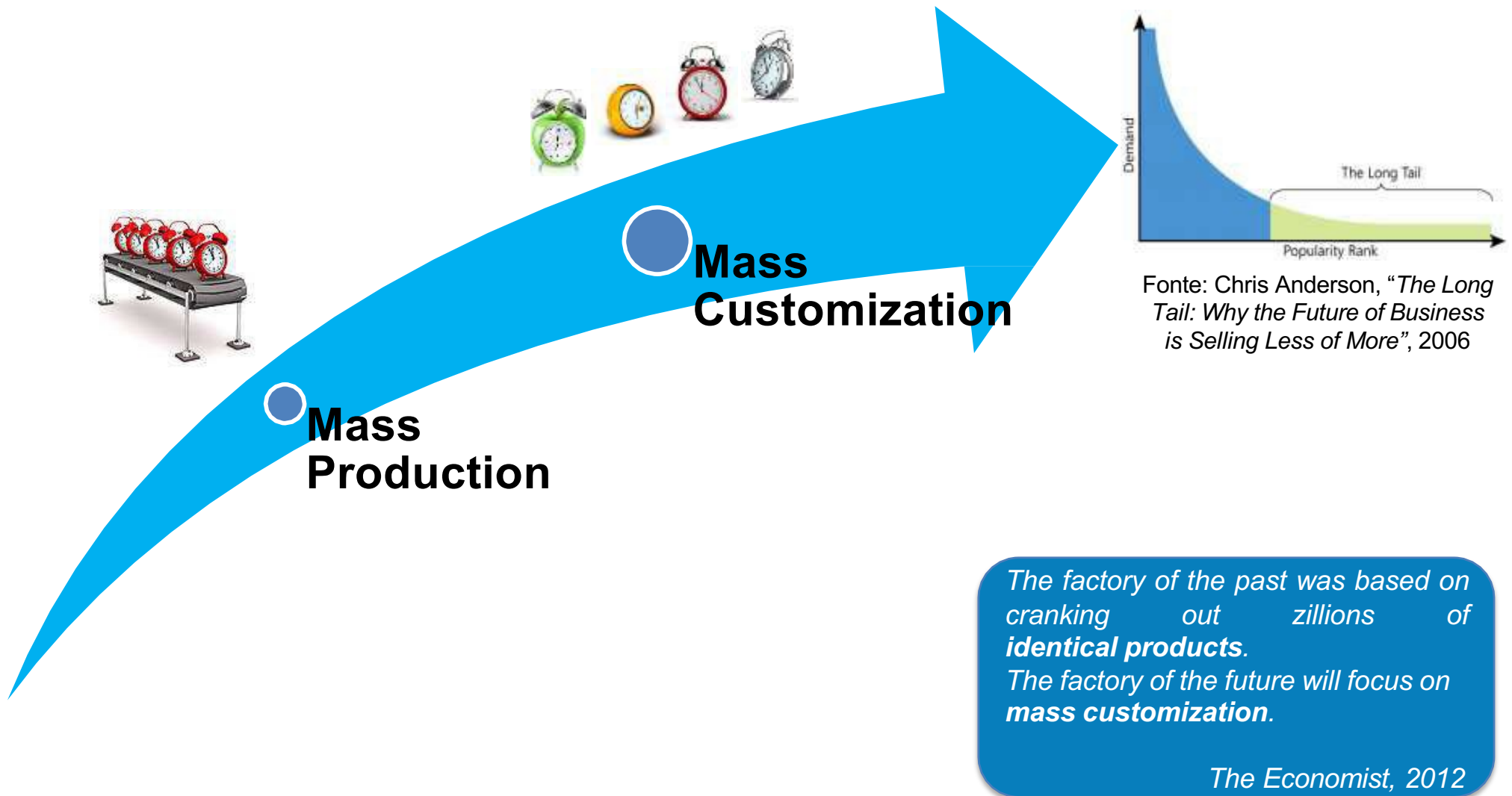
PERSONALIZATION

FRAMMENTAZIONE

SERVITIZATION

CUSTOMIZATION







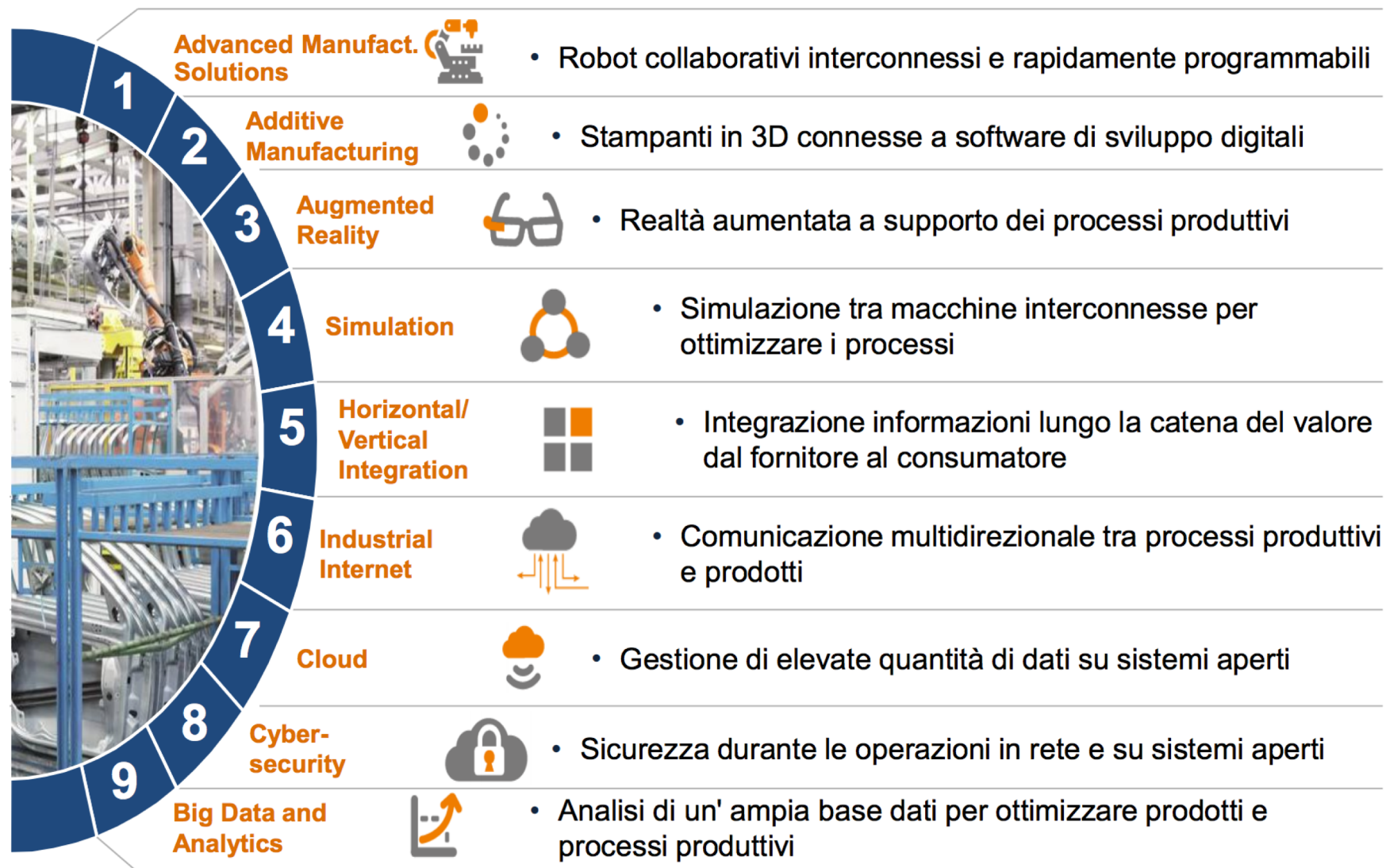
“Be ready to revise any system, scrap any method, abandon any theory, if the success of the job requires it.”

Henry Ford

- The focus is on the real-time connection between humans, machines and objects for the digitization and computerization of the supply chain which then leads to the final product
- The aim is to dominate the variability and uncertainty of the parties involved along the entire value chain:
 - suppliers
 - clients
 - Production line
- Uncertainty due, for example, to timetables, breakdowns, delays, financial aspects, changes in technology ...

- The aim is to create a flexible production system capable of keeping up with the variability of the market and the environment
 - Personalization of products according to the individual customer (mass customization)
 - Collaborative robots that will work in contact with man
 - Workflows reproduced in a virtual way before physically preparing it in the workshop, to check its abstract behavior and enhance its performance (digital twin)
 - ...

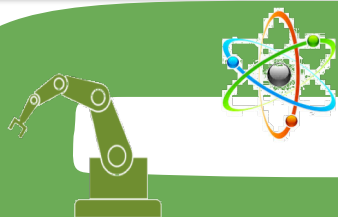
- Unlike the previous industrial revolutions in which technology joined man to improve and make human activities more productive, Industry 4.0 proposes itself as a paradigm that, although partially, is not limited to being supported but for some activities it replaces the man





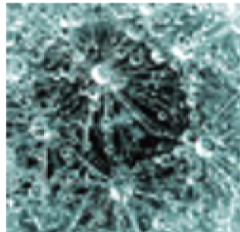
- They are technologies already present not only in laboratories but also in the most innovative companies
 - The first additive manufacturing patent dates back to 1986, the stereolithography of C. W. Hull
 - Robotics entered the company with the third revolution (1960 UNIMATE was born The first industrial robot), but they were (are they?) Locked in cages. Today we have collaborative robots
 - Augmented reality. The first experiment dates back to 1968, Ivan Sutherland of Harvard invented the "sword of Damocles".
 - Cloud Computing ... now almost a catchphrase!





3.0 Terza rivoluzione industriale

1101

Internet of boffins	Internet of geeks	Internet of masses	Mobile Internet	Internet of things
				
1969 - 1995	1995 - 2000	2000 - 2007	2007 - 2011	2012 & beyond



- The concept of "**naked technology**" returns from the third revolution.
- In 2002, Forrester, analyzing 3,500 global businesses for 20 years, found that introducing technology into a business without simultaneously changing processes and organization creates **waste and chaos**: bare "technology" cancels productivity improvements and reduces the return on investments.



George Colony CEO di
Forrester

- Industry 4.0 will perhaps be remembered as the revolution that will **connect the world of data (bits) to the physical world of atoms**, the world of machine tools with the world of computers, the world of customers with that of manufacturers



TECHNOLOGIES THAT ENABLE IOT



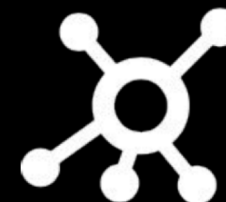
Big data
(unstructured
data)



IPv6



Cheap sensors
(50% cheaper)



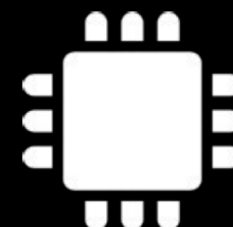
Cheap bandwidth
(40x cheaper)



Ubiquitous wireless
coverage
(free wifi)



Smartphones
(personal gateway)



Cheap
processing &
smarter
(60x cheaper)

For the Past 10 Years

What can be connected ?

With a little imagination it is possible to network practically everything, even:

- animals (for example through signals that allow their location),
- plants (through sensors that control the lighting or water requirement)
- people (using pacemakers or other devices for remote control of biological parameters).

Persone



Today we use devices with a web interface to connect to social channels. With IoT it will be possible to connect in new and more useful ways.

"Wearable" devices are already changing the way we connect.

Processi



Thanks to IoT, the right information will be provided to the right person, at the right time and in the most appropriate way.

Dati



The data generated by the objects, combined with the analyzes, provide useful information for people and machines. The better the decisions are made, the better the results will be.

Oggetti



Concrete entities connected to the Internet and to each other. They detect and acquire more and more data, becoming aware of the context, and provide more practical information to support both people and machines.

Well connected Chris Dancy's gadgets

Google Glass

Voice-controlled eyepiece computer with an optical head mounted display and similar functionality to a smartphone

Narrative camera

Pinned to chest. Takes photo every couple of seconds

Blue HR

Heart rate monitor

Pebble watch

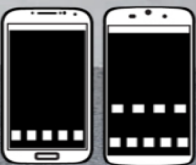
Gathers and displays data from sensors

Lumoback

Strapped around waist. Measures posture and gives a signal when you slouch

Moto X, Galaxy S5

Apps primarily monitor and control environment remotely



BodyMedia Fit

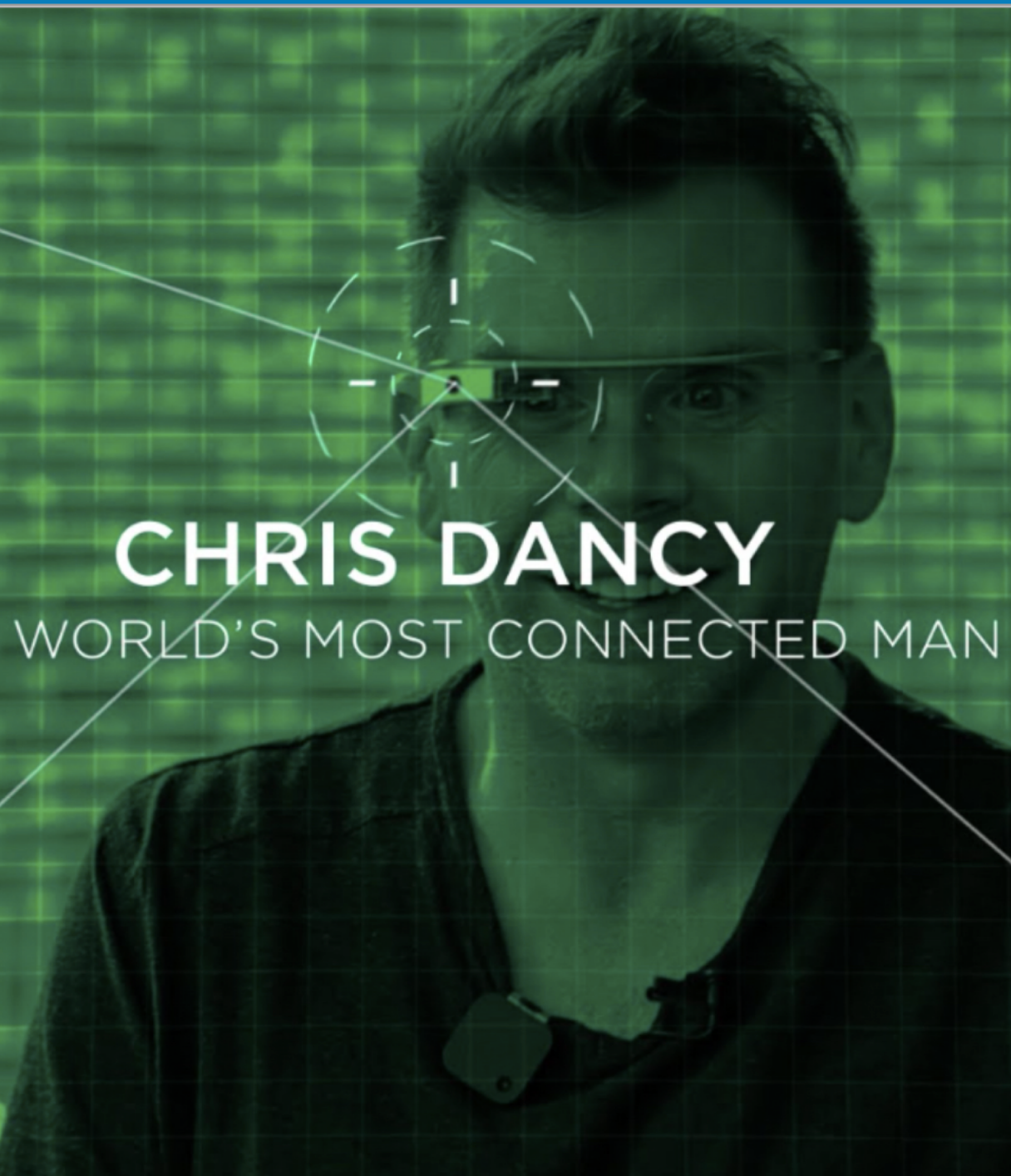
Armband with multiple sensors to measure the body's performance, awake or asleep

Fitbit

Wrist mounted sensors measure physical performance

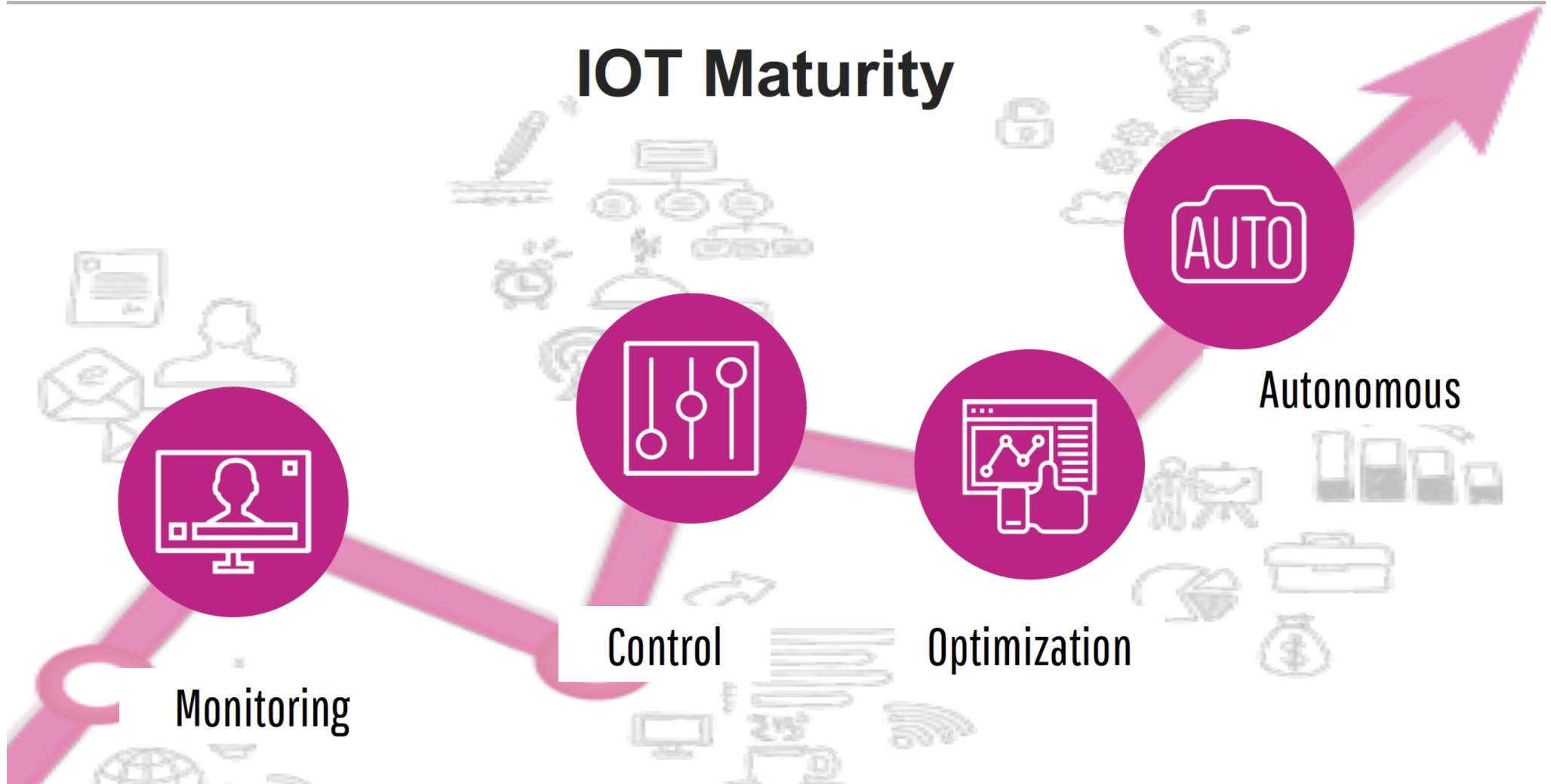
iPhone S5

Used mainly to gather and display personal information





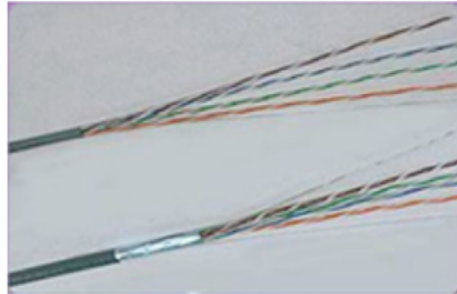
IOT Maturity



IoT Applications Maturity



Copper



Fiber

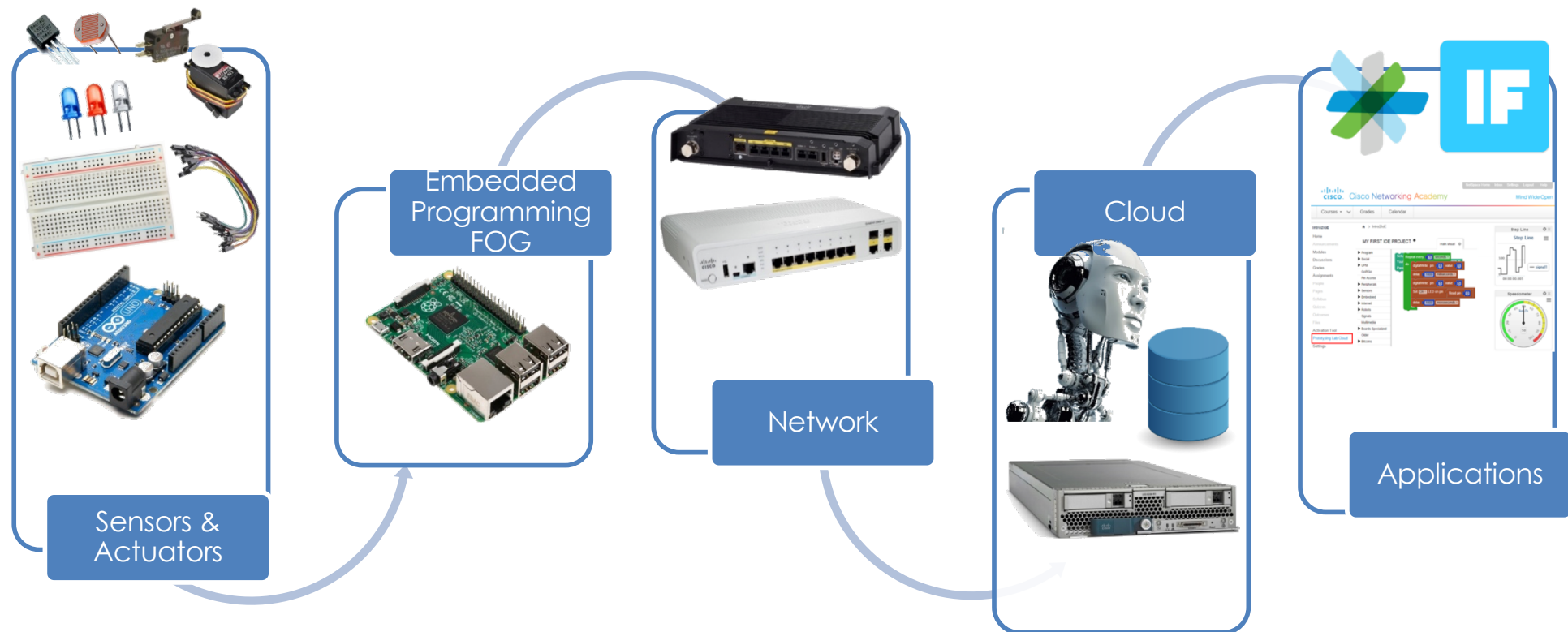


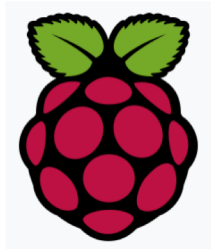
Wireless



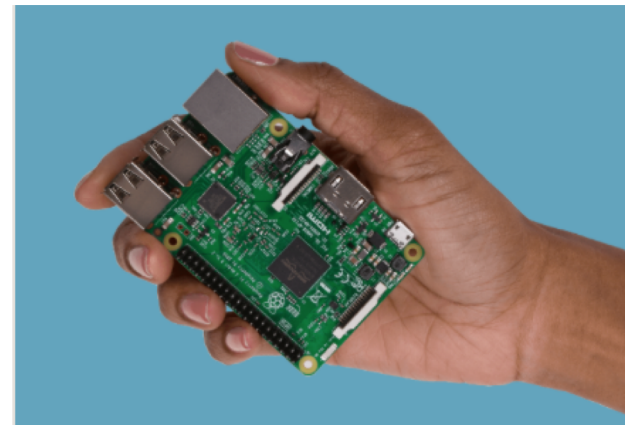
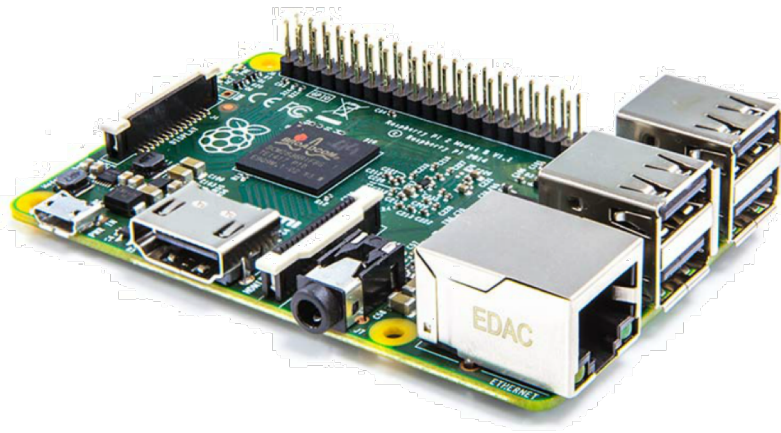
WiFi, Bluetooth, ZigBee, Z-Wave, 2G/3G/4G cellular, 6LowPAN, Thread, NFC, Sigfox, Neul, LoRaWAN

Key components of IoT Solution





- Pi is a small and cheap computer.
- It has USB ports which can be used to connect various devices including keyboards, mice, external drives and cameras.
- The Pi2 has a 10 / 100Mbps Ethernet port and 40 pins GPIO at 3.3V.
- Other Pi Ports: an audio output, an SD card slot and a micro USB connector (used for power).
- The Pi can run a number of operating systems, including Linux and Windows



- microcontroller with pins connected to the I / O ports
- a voltage regulator
- a USB interface that allows communication with the computer used to program
- a cross-platform integrated development environment (IDE) (available for Linux, Apple Macintosh and Windows)





Industrial automation



Smart Health

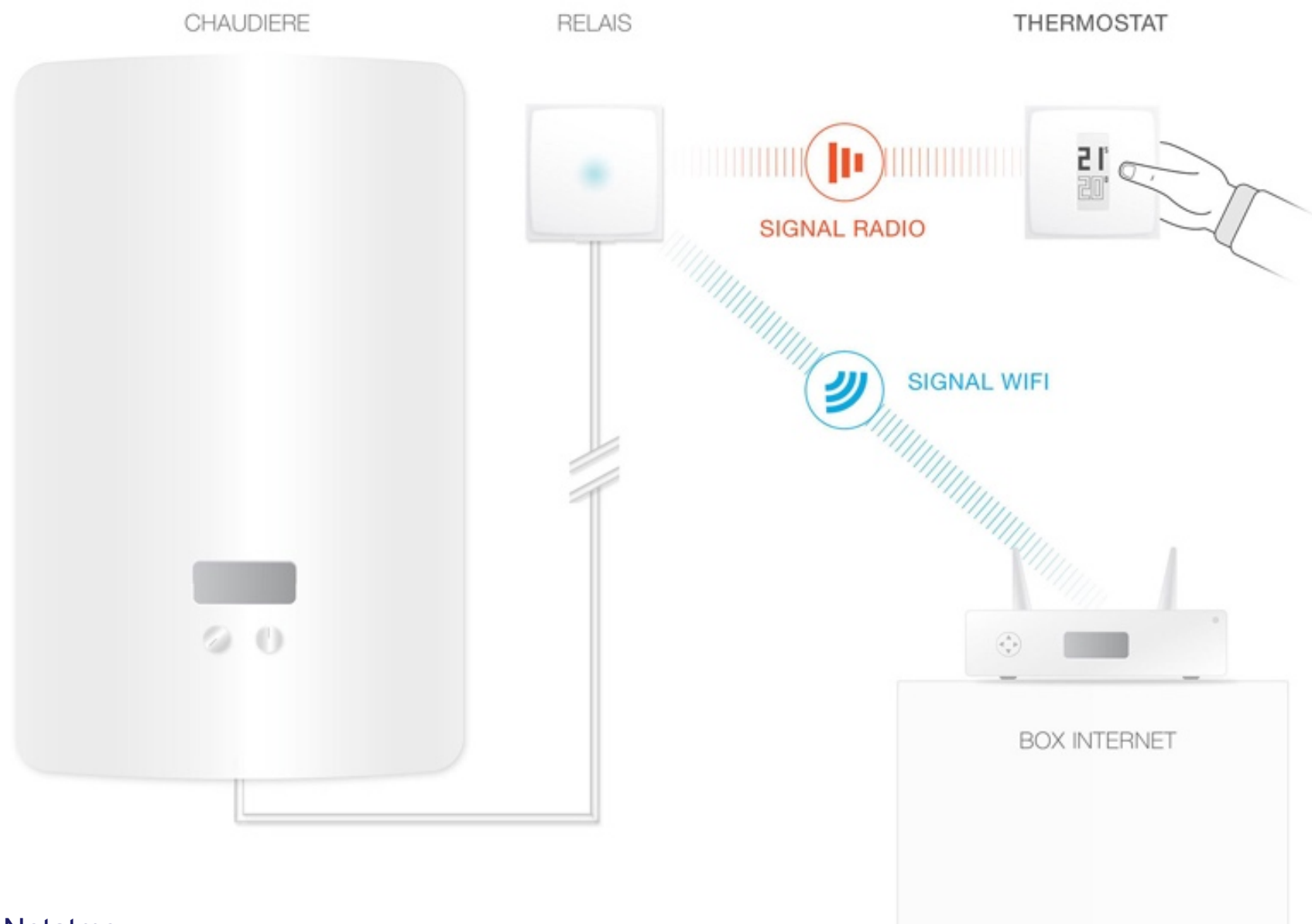


Smart Home (domotica)

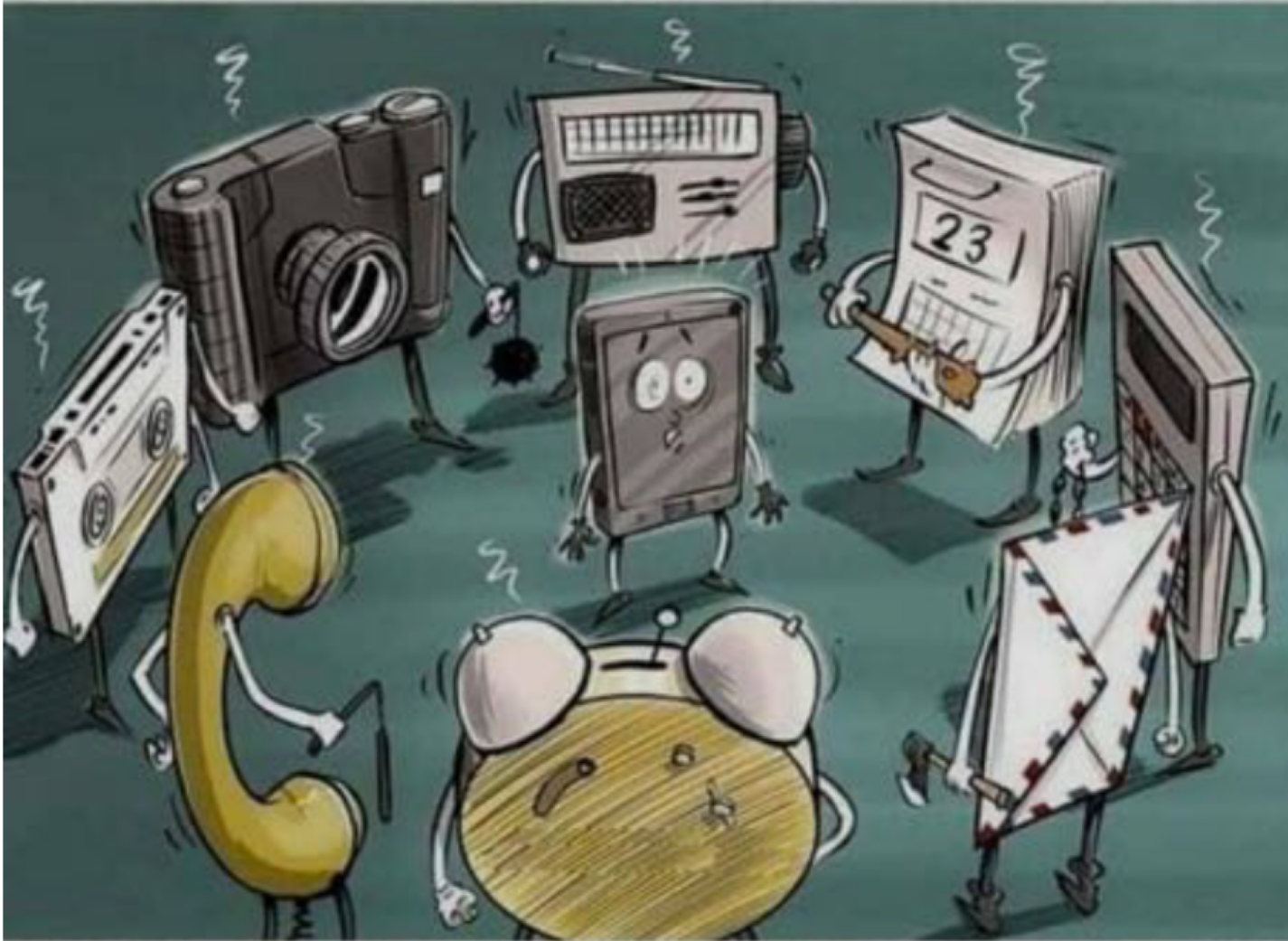


Smart City

Smart Home



"Ohh. ! So you're the
one who,



took all our jobs."

New competitors



Alexa



Siri



Google Now



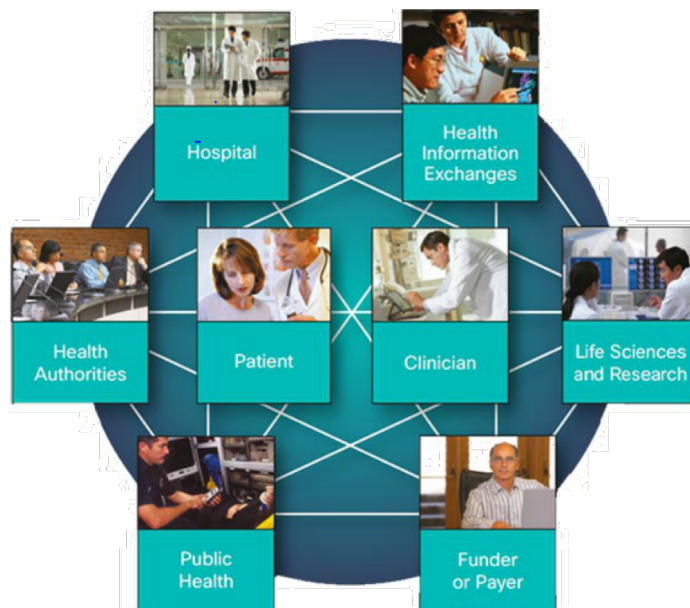
Cortana

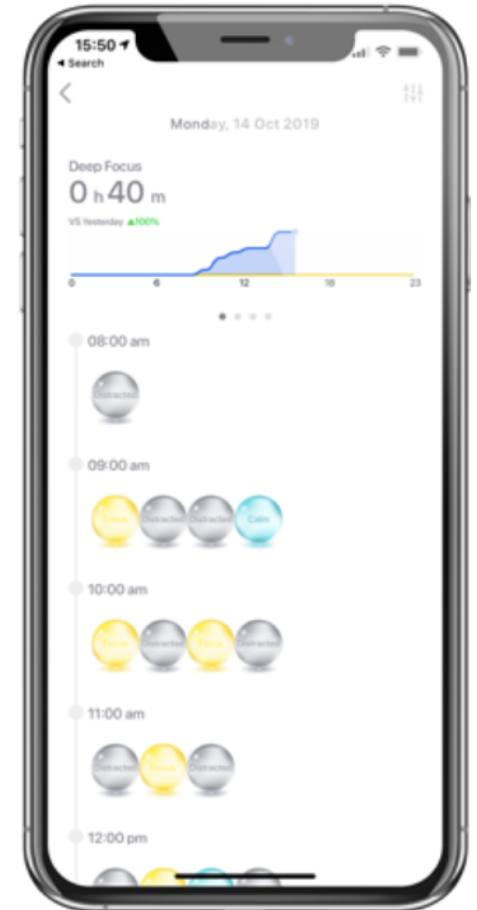


Smart Health

Healthcare challenges:

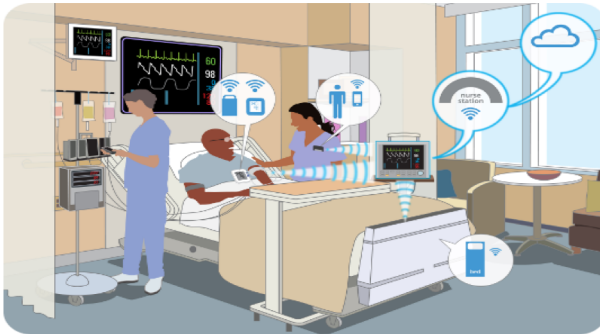
- Population aging
- Growing demand for services
- Shortcomings in key medical specialties
- Increase in health care costs for the community







Wearable
Tech



Intelligent tags for medicines
Tracking the use of medicines

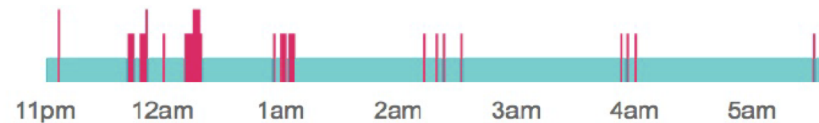
Smart Appliances



Sleep



Your sleep pattern ■ asleep ■ awake



You went to bed at
11:00PM

Time to fall asleep
0min

Times awakened
20

You were in bed for
6hrs 40min

Actual sleep time
6hrs 6min

8 h 50 mins asleep

1d 1w 1m 3m 1y

■ Awake for 212 mins (81x)
■ Restless for 278 mins (91x)



Thursday, February 27

Sleep Stats

Time asleep over the past 30 days in hours



Times awoken over the past 30 days

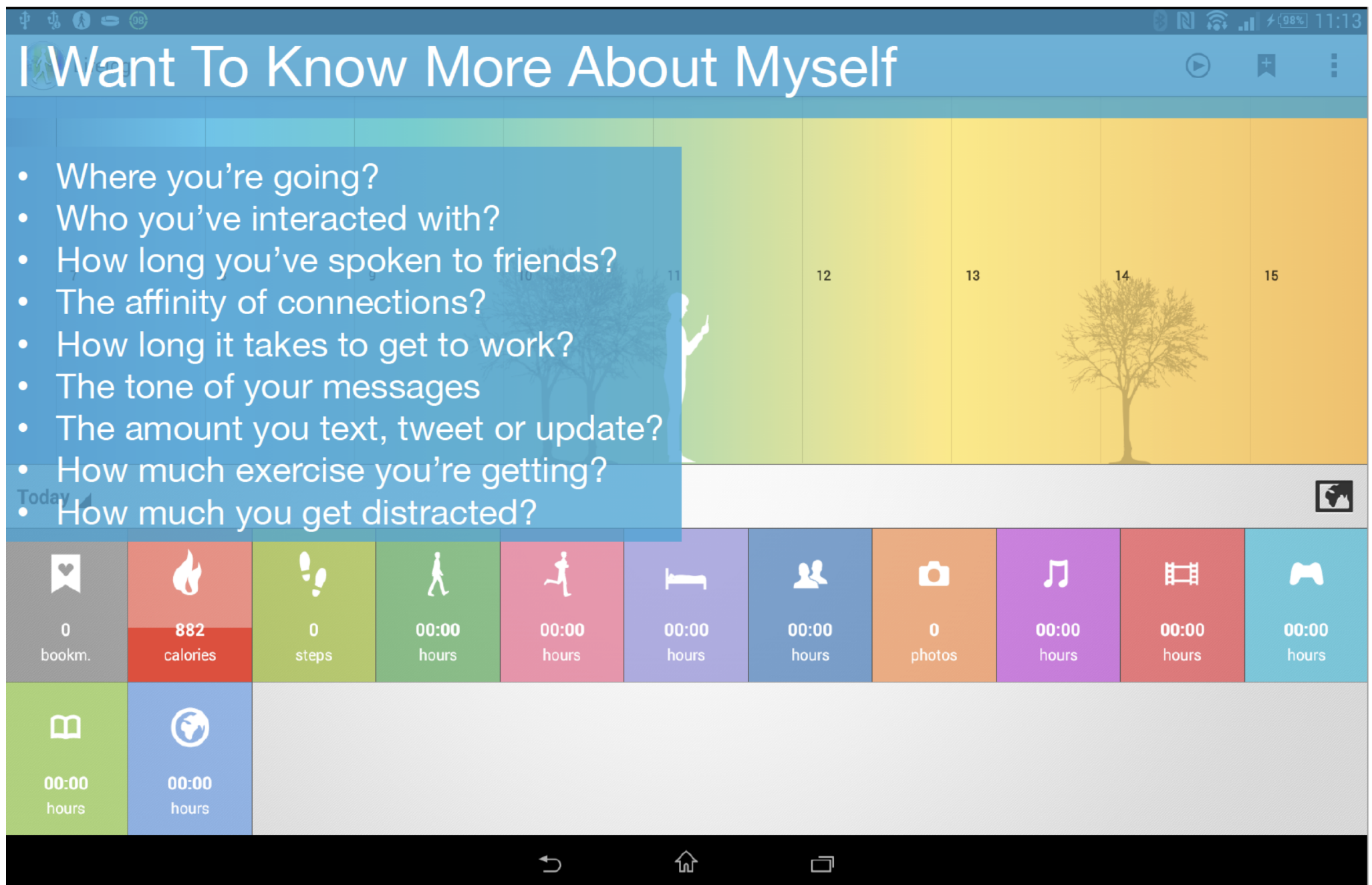


fitbit flex
Wireless Activity + Sleep Wristband





Am I Healthy?

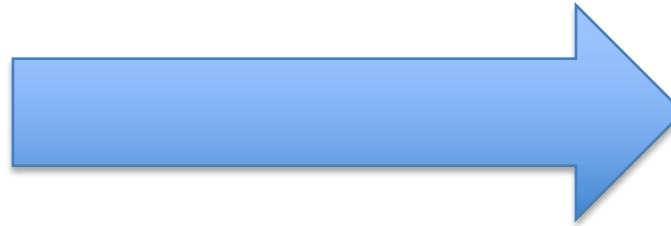
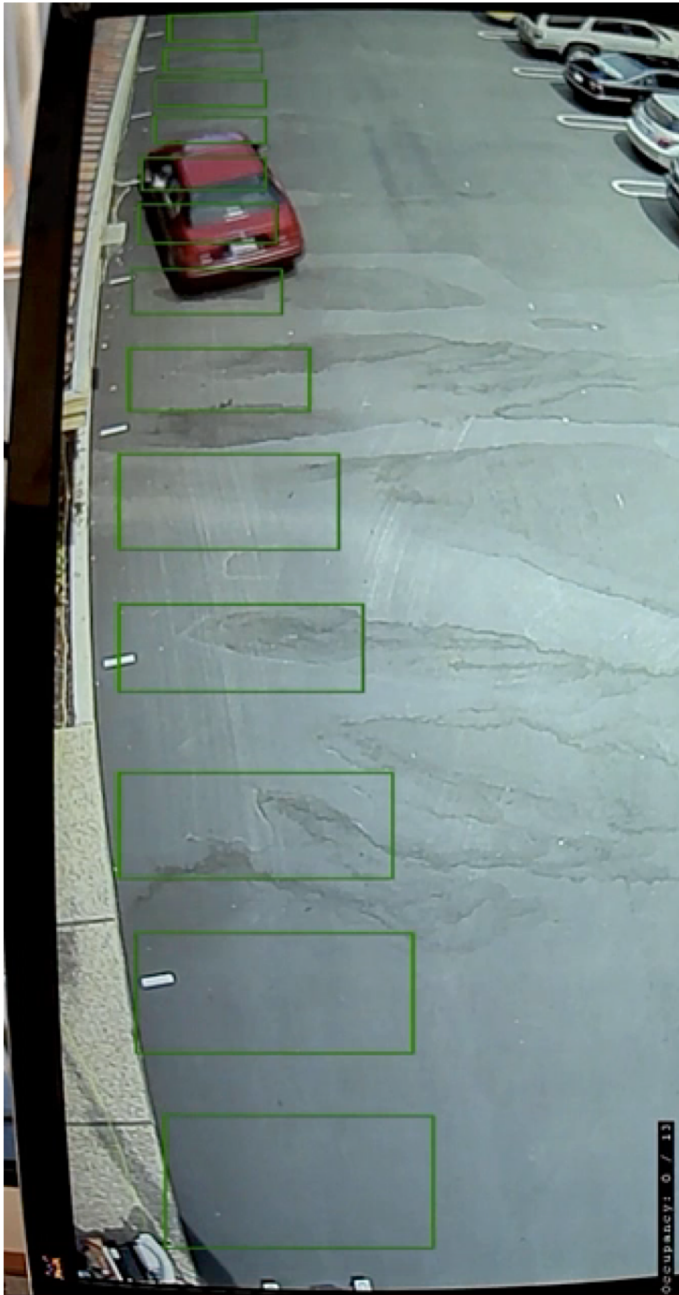


Smart City

- Challenges faced by modern cities
 - crowding
 - Increased pollution
 - Increased traffic congestion
 - Inadequate parking spaces
 - Inefficient use of street lighting, water and waste management
 - Pressure to provide safer and safer cities
 - Budget constraints
- IoT solutions
 - Lighting management, Control centers, parking management, Safety and Security, Traffic management systems,...



IoT Connected Smart Parking



Sensors that detect the presence or absence of a car can send the information to a data center, which makes it appear on the smartphone app.

For example, the Streetline project, already being tested in Los Angeles and Indianapolis. If it works in the future, parking will be easier.

Smart Parking

Create **USD 41 Billion** by providing visibility into the availability of parking spaces across the city.



Residents can identify and reserve the closest available space, traffic wardens can identify non-compliant usage, and municipalities can introduce demand-based pricing.

[Source: <http://www.telecomreseller.com/2014/01/11/cisco-study-says-ioe-can-create-savings/>]

- Challenges in electricity
 - Rapid increase in consumption is severely testing energy suppliers
 - Growing pressure to use low carbon energy sources instead of fossil fuels.
 - New ways of thinking about the management and generation of electricity are needed



- IoT solutions for the electricity network
 - The intelligent grid allows more complex interconnections between producers, storage facilities and electricity consumers.
 - The smart grid supports consumers who generate energy for themselves and the grid





Gas Monitoring

Generate **USD 69Billion** by reducing meter-reading costs and increasing the accuracy of readings for citizens and municipal utility agencies.

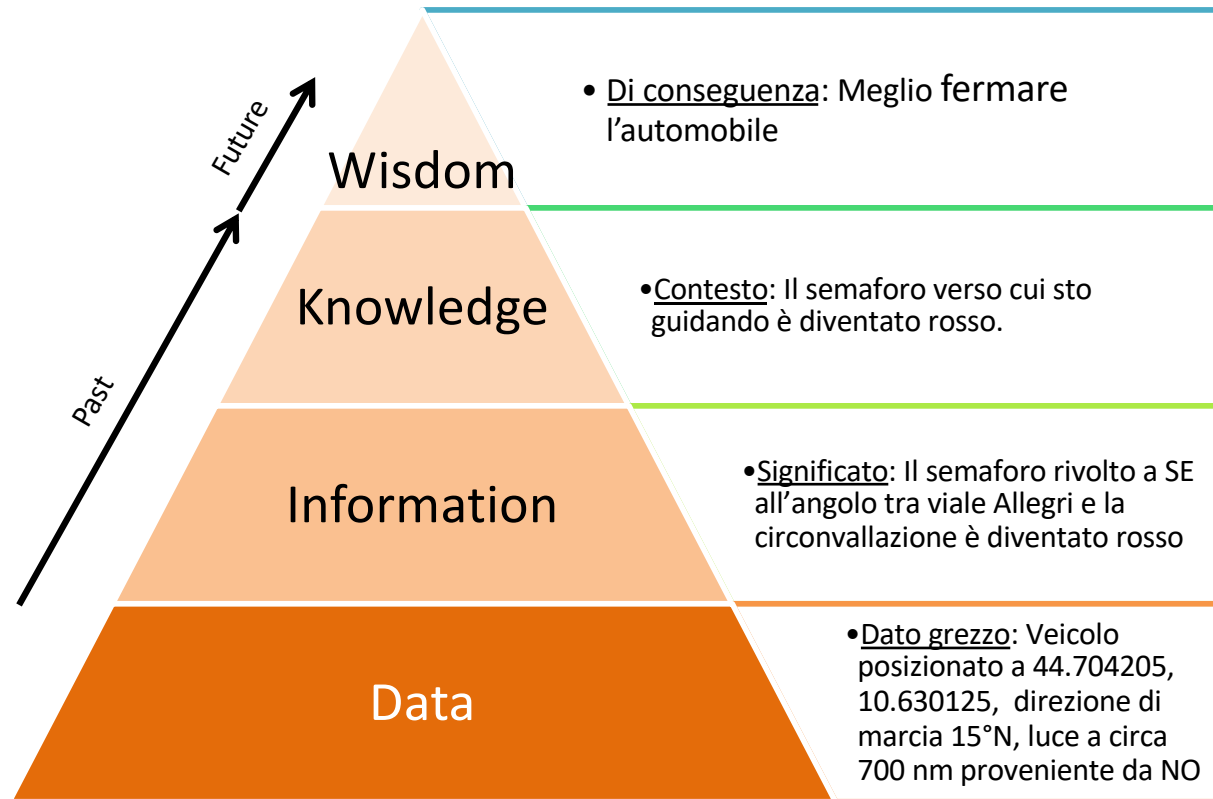
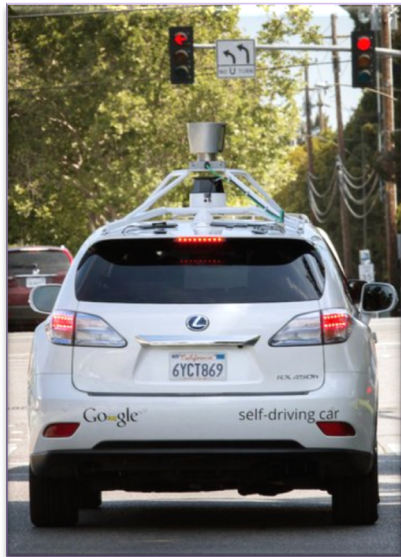
[Source: <http://www.telecomreseller.com/2014/01/11/cisco-study-says-ioe-can-create-savings/>]

Water Management



Could generate **USD 39Billion** by connecting the household water meter over an IP network to provide remote information on use and status

[Source: <http://www.telecomreseller.com/2014/01/11/cisco-study-says-ise-can-create-savings/>]

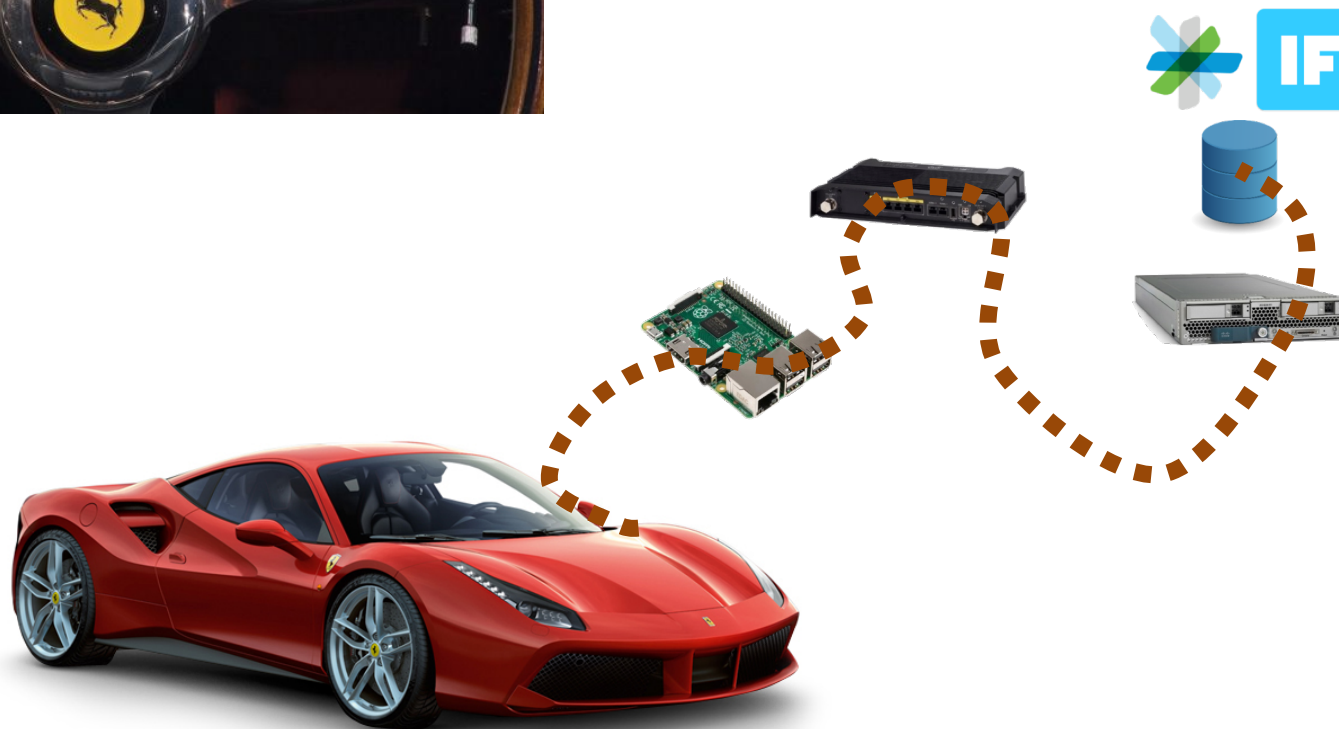


Sensors: position, speed, direction, acceleration, cameras, ...

Actuators: robotized steering, brake system, propulsion control,...



Service
Repair
Needed



Industrial Automation

- Compared to IoT objects, IIoT devices are more resistant, because they must operate in extreme conditions, e.g.
 - high temperatures
 - corrosion
 - immersion in water
- They are often applied to cranes, probes and other machinery that are generally difficult to reach and therefore created with a long-lasting battery.
- They must meet much more robust cybersecurity requirements than IoT devices

- Challenges in production
 - Production must continuously integrate new innovative technologies into the existing infrastructure.
 - Non-collaborative, "silo" technologies are a serious problem.
 - Heterogeneity in technologies increases costs and complexity.
 - This lack of integration leads to a wide range of problems, including:
 - Inefficient operations
 - Slow response times both in the factory and on the market
 - Poor quality control
 - Overload
 - Compromised security

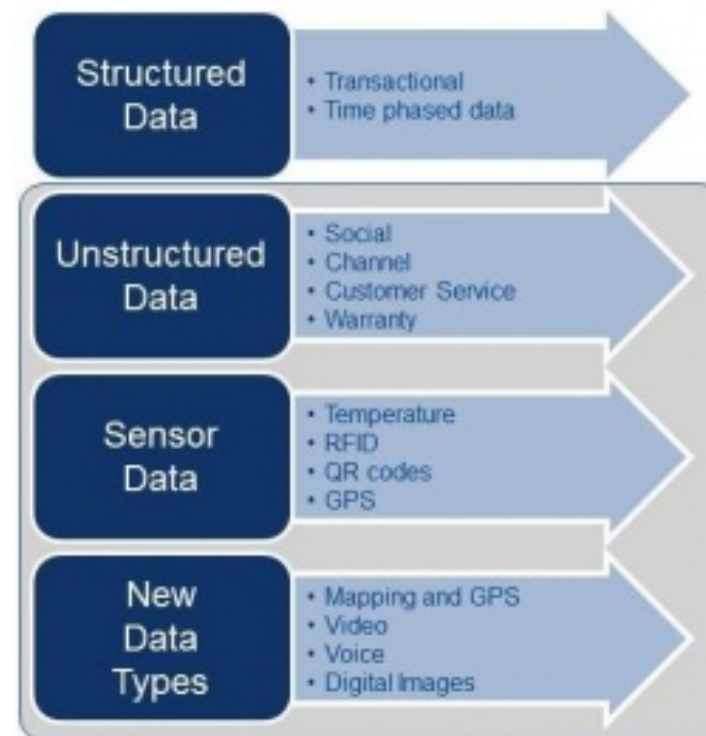


- IoT solutions for production
 - IoT solutions connect the right people to the right information.
 - Connected sensors offer a unique level of visibility in factory operations and in the supply chain flow.
 - The data collected help identify trends and relationships, revealing opportunities for improvement.
 - For example, automakers now use sensor data to decide if conditions are favorable for painting a car.

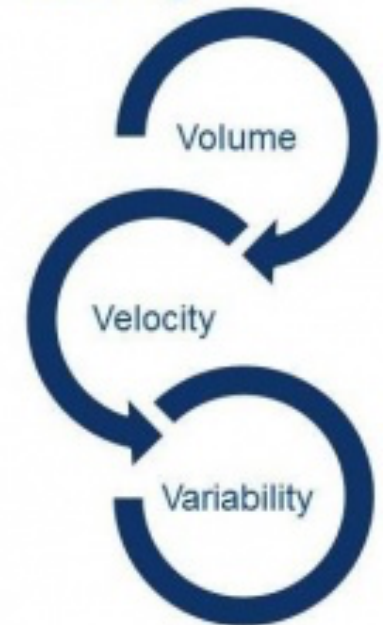


- Huge volumes: an A350 aircraft has 6,000 sensors and generates 2.5 TB / day
- Advanced Machine Learning on a heterogeneous, structured and unstructured knowledge

Big Data Supply Chains



Challenges:



Environmental impact

The connected objects will allow to optimize production processes and economic activities in real time by significantly reducing pollution and the consumption of resources.

For example, public lighting, if managed with new technologies, could contain electricity consumption by 40%. Or the crops, which could be irrigated in a much more efficient way than the traditional one if monitored by a network of sensors capable of communicating the actual needs of the plants to the water supply system, determined on the basis of the temperature, the season, the soil moisture and weather forecast.



Privacy

Living in a world of sensors, meters and everyday objects capable of collecting and exchanging information on how they are used, on our habits and on our state of health exposes us to the risk of losing control of what we communicate on the Net.



- Default, weak and hard-coded credentials
- Difficult to update firmware and operating system
- Lack of vendor support for repairing vulnerabilities
- Vulnerable web interfaces
- Unencrypted "clear" protocols and open "ports"
- DoS / DDoS
- Physical theft and tampering



IoT and agri-food

- The long-term international food scenario leaves no doubt about a guideline: by 2050 the demand for food will increase considerably (values between 59% and 98%, according to estimates)
- The reasons:
 - increase in the world population, which will go from 7 billion people in 2017 to 9.7 billion expected by 2050
 - the increase in the need for calories by the current population (+ 50% kcal / person / day), which in large part is not yet sufficiently fed, is the most relevant part

- According to FAOOCSE analyzes, to meet this demand by 2050 world agricultural production should increase by at least 70% compared to current ones:
 - cereal production is expected to increase by 50%
 - meat of 60%



- It is not possible to think that we can sustain this growth through the simple increase in cultivated land or the use of other agricultural resources (such as farms) for obvious reasons related to the environmental, social and economic unsustainability of these practices.
- On the contrary, growth must be pursued through various innovations on different fronts: processes, products, needs and meanings, society, biology, etc. Much of these innovations will be generated and supported by the ongoing digital transformation, characterized
- Digital innovation can contribute in a way substantial with its pervasiveness at all levels



- field sensors on machinery
- Drones
- Satellite imagery
- Decision support systems
- Quality control sensors
- Big Data Analysis
- Systems for dematerialization
- Integrated traceability
- Systems for the optimization of logistics
- eCommerce and food delivery platforms
- Blockchain
- Smart labels
- Sensors for the reduction of waste
- Meal kits
- Big Data analysis

- The agricultural company becomes the first link in the collection of useful data, in a different way, up to the final consumer:
 - field data
 - meteorological data
 - machinery data
 - equipment data
 - operational data
 - harvest data
 - warehouse data

- Technological evolution in agriculture has been talked about since the 90s thanks to:
 - satellite technologies, GPS and machinery software,
- The sector has seen the spread of the concept of "Precision Agriculture", to carry out targeted and efficient agronomic interventions, taking into account the actual crop needs and the biochemical and physical characteristics of the soil.

- Precision Agriculture is the set of technologies that allows you to manage variability in the field, giving each plant:
 - what he needs
 - when he needs it.
- Objectives:
 - maximize productions
 - increase production quality
 - eliminate waste with consequent benefits for the farmer and the environment
- Core technologies:
 - semi-automatic driving
 - variable dosage.

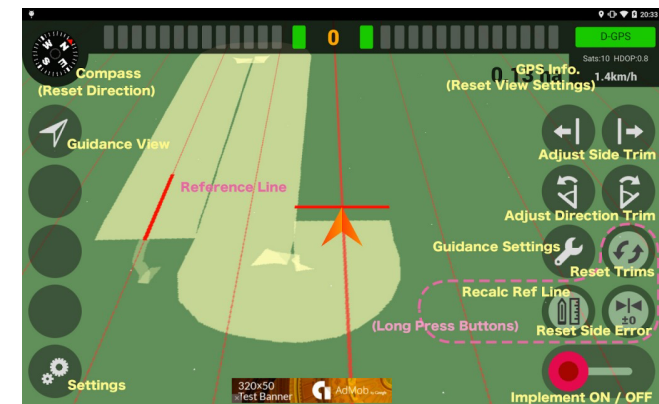
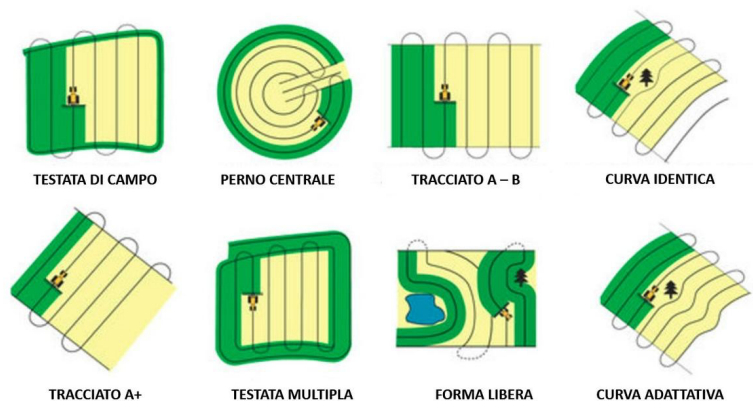
Today, thanks to the full maturation of technologies and the push of digital innovation, this strategy lives a "second youth":

- through the Internet of Things and Big Data Analytics, for example, Precision Agriculture is able to provide and manage more information, in a more accurate and timely manner, allowing to automate productive activities otherwise unrelated and integrated.
- the latest technological innovations have made it possible to extend the use of these systems to the entire company dimension (for example, from the field to the company center) and to the entire supply chain, reducing costs and coordination bureaucracy and improving product quality and traceability

Internet of Farming + Precision Agriculture = Agriculture 4.0

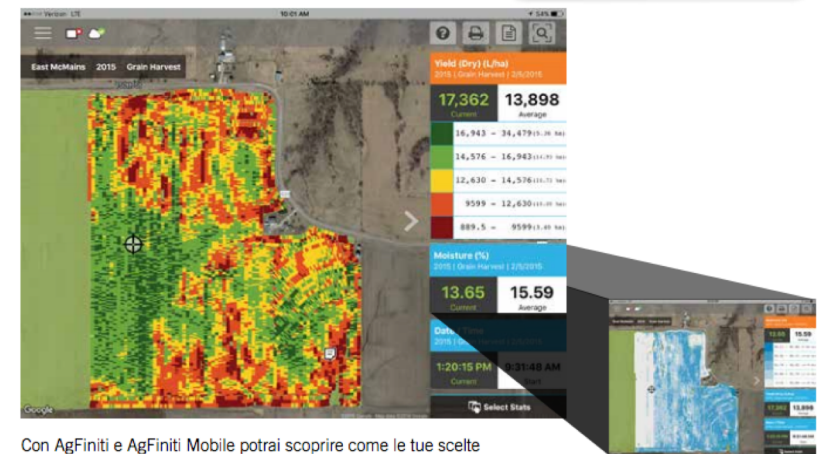
- Smart Farming is the application of ICT technologies in agriculture. An example is IoT based smart farming.
- A system built for field monitoring with the help of sensors (light, humidity, temperature, soil moisture, etc.) and automation of the irrigation system.
- Farmers can monitor field conditions from anywhere.
- IoT based Smart Farming are technologies also suitable for small plots of organic farming, family farming, conservation of particular or high quality varieties, etc.)
- In terms of environmental issues, IoT-based smart agriculture can deliver great benefits, including using more efficient water, or optimizing treatments.

- The installation of semi-automatic driving systems (via GPS) on tractors allows them to move in the field with greater precision than that guaranteed by an operator
- This eliminates overlaps ranging from 10% up to 25%
- There is therefore a similar saving of seeds, fertilizers, plant protection products and so on.



The variable rate dosing (which is considered the next step to assisted driving) allows you to provide the plants with the inputs they need (water, fertilizers, plant protection products) with precision:

- In a field there can be strong differences in fertility: different composition of the soil, leveling works that have removed the most superficial layers in some points, repeated fertilization defect over the years
- If fertilized evenly, this soil will have different productions: abundant in fertile areas, scarce in others.
- The variable dosage fertilization has the purpose of leveling these differences: not uniformly but taking into account the real needs, different within the same plot.



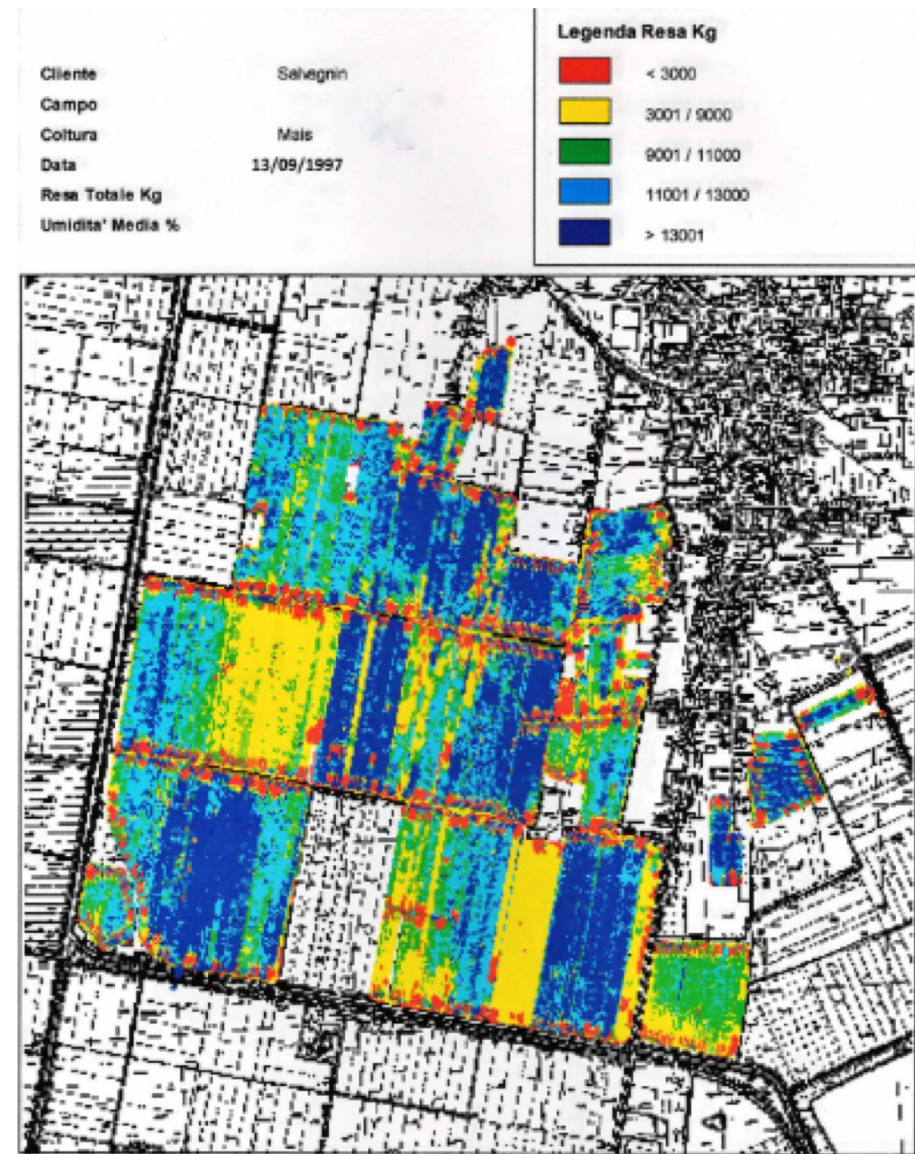
For this purpose, maps created ad hoc with the help of tools such as satellites, drones, proximity sensors, etc. are used.

- Electronics technologies (basic or even very advanced) for:
data acquisition (monitoring):
 - sensors for the detection of crop vegetation indices, "on the go" sensors for soil characterization, sensors applied to machines and equipment for internal and external management, sensors mounted on drones and use ad hoc satellite and aerial images;
 - use of information within the production context (operational control).
 - For example, analysis of chlorophyll in real time. It is performed through special sensors mounted on the nose of the tractor and which are able to read the vigor of the plants, transmitting the information to the software that manages the fertilizer spreader. The latter will thus be able to increase or decrease the dosage based on the vigor shown at that time by the crops.
- Positioning technologies: the information for the production cycle is integrated with indispensable data when a spatial (or site-specific) dimension of the production process comes into play

Porto Felloni

- The company from Lagosanto (FE) has over 30 years of experience including 20 in precision agriculture
- The company cultivates both conventionally and organically.
- The main crops are: cereals, corn, tomatoes, green beans and other fruit and vegetables
- Despite the cultivated area is below sea level, they manage to make three production cycles in one year, thanks to tubular drainage systems for sub-irrigation and pivot irrigation systems for organic crops, guaranteed in all months of the year by the local consortium.

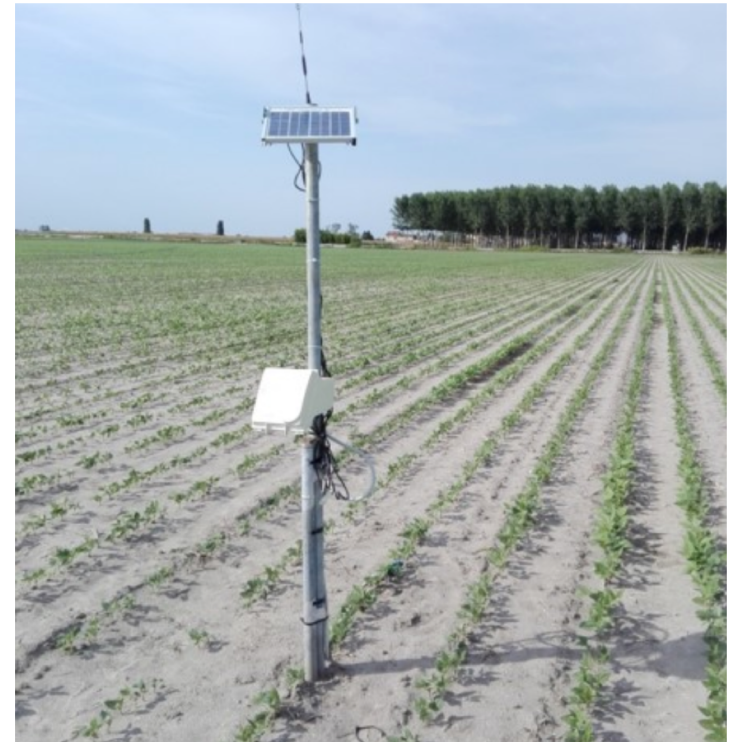
- The company stands on reclaimed land (before there was the sea) and the soils of the 550 hectares show great differences
- Due to the lack of homogeneity of the soils, sample analyzes of the soil have been carried out since 2000 and, thanks to the use of a combine equipped with yield sensors, these georeferenced satellite data have been crossed with the yield maps



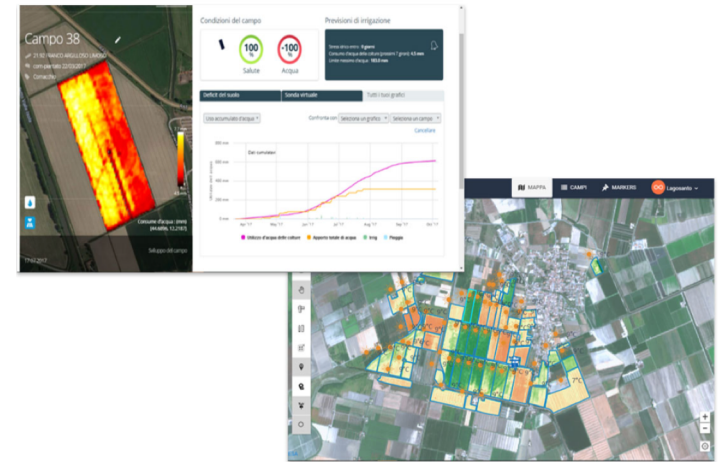
The company has a network of sensors that measure the exact soil moisture every 10 cm for the study of soil variability.

The analysis of the geo-referenced chemical-physical properties allows for variable rate fertilization in particular on wheat and maize with reference to the most important element which is nitrogen, because they have loose soil where nitrogen tends to leach (slip) because of the rains. In addition to nitrogen, the control and monitoring of organic matter is vital.

The company has adopted semi-automatic driving systems on machines that are equipped with gps which, in addition to following the preset routes, allow you to distribute the technical means such as seeds, fertilizers and pesticides at variable rates.



Macchine a guida semi automatica



The company has adopted semi-automatic driving systems on machines that are equipped with gps which, in addition to following the preset routes, allow you to distribute the technical means such as seeds, fertilizers and pesticides at variable rates.

Thanks to the presence of an RTK antenna for the correction of the satellite signal, an accuracy in the passage of the equipment in the field of 1-2 cm is guaranteed during all operations.

In order to be able to monitor its crops promptly, particularly on cloudy days or without satellite coverage), the company has equipped itself with two drones since 2018:

- one with multispectral sensor
- one with 4K optical camera.

The two drones are used for high-resolution monitoring of horticultural crops (on all tomatoes), to monitor these short-cycle crops from a nutritional point of view and to be able to fertilize them through the elaboration of vegetative indices and subsequent prescription maps. foliar so as to uniform and areas of the field at the time of ripening and harvesting.

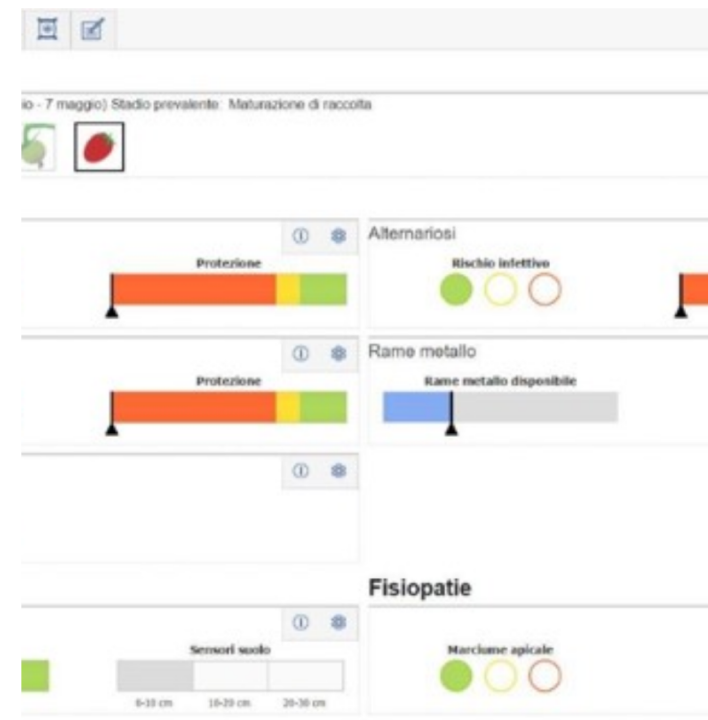
Furthermore, the high resolution images (from 2 to 5 cm) allow to identify fungal diseases or pest attacks in order to promptly treat the identified and geolocalized area, as well as prevent water stress by identifying the areas most at risk, where the first symptoms occur visible at leaf level thanks to multispectral sensor technology.



Porto Felloni uses forecasting platforms (DSS- Decision Support System) that offer decision support systems for the optimization of the most delicate cultivation phases.

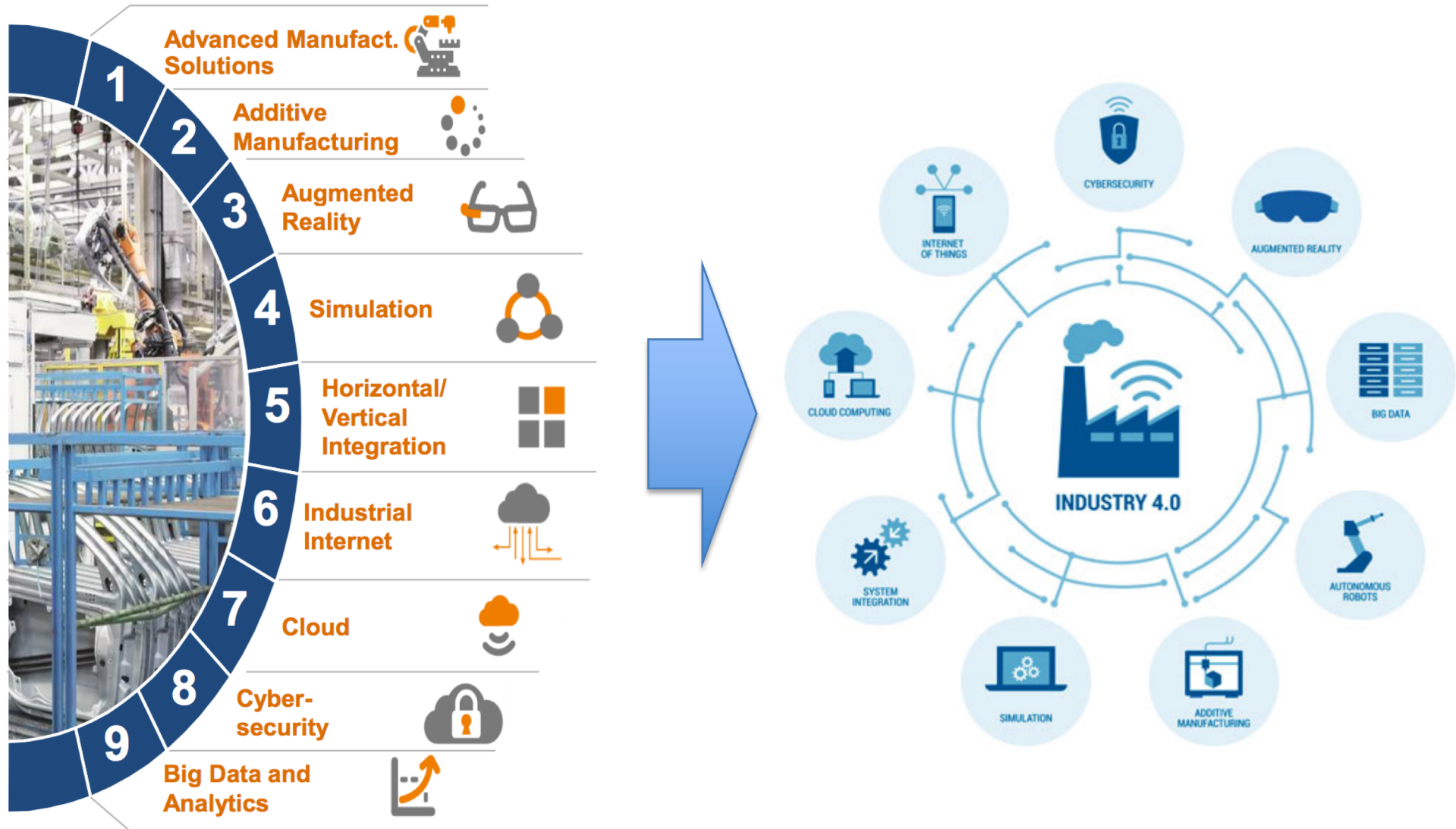
These platforms act as meteorological and epidemiological forecasting models for the crops in progress, useful for the prevention of certain diseases in relation to the weather conditions present: the weather data are reliable and precise as they come both from the control units placed on the company land and from a dense network of control units that from weather probes in the area.

The models are able to convert complex climatic and crop phenomena into easy and clear operational choices in the field, are capable of managing the information held by the company such as soil analysis, historical data, and help in making decisions by offering agronomic advice for optimizing production inputs at best throughout the crop cycle.



The need for platforms

Why a platform?



- Develop a set of standards between companies, education systems and nations.
 - The same type of wiring,
 - The same applications or programming
 - The same protocol or set of rules applicable to everyone
- Development of energy sources to feed billions of sensors:
 - wind
 - Solar
 - Hydroelectric
 - ...

Figure 1. Magic Quadrant for Industrial IoT Platforms

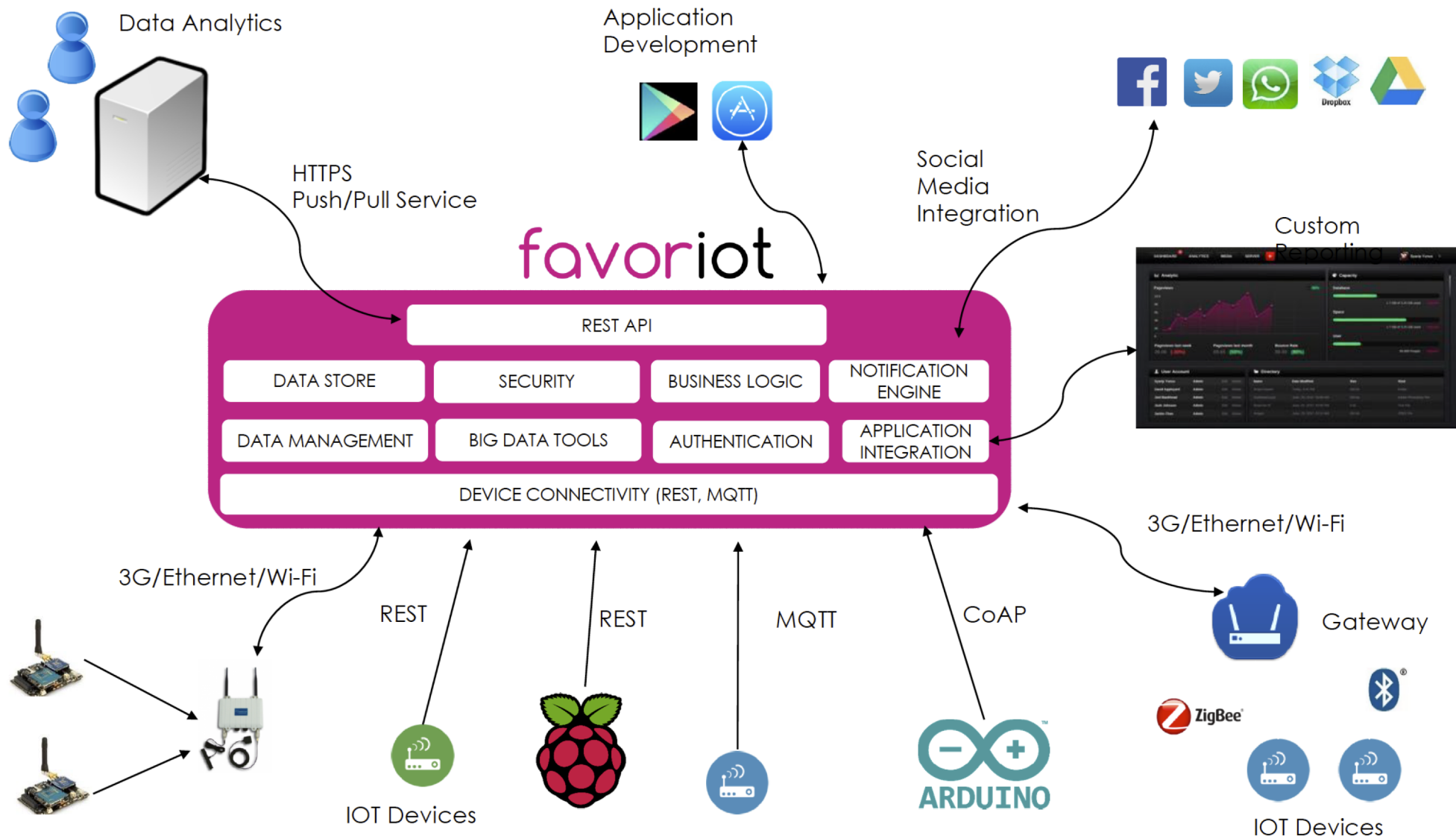


Source: Gartner (June 2019)

As of June 2019

© Gartner, Inc

Example of IoT platform



Example of IoT platform



“I have not failed
1,000 times. I have
successfully
discovered 1,000
ways to NOT make
a light bulb.”

Thomas Edison

