UX for connected devices

UX for connected devices

When we think of design for connected products, we tend to focus on the most visible and tangible elements:

- the industrial design
- the user interfaces (UIs) found in mobile and web apps and on the devices themselves.

They are important concerns, which have a major impact on the end user's experience of the product. But they're only part of the picture.

You could create a beautiful UI, and a stunning piece of hardware, **and users could still have a poor experience of the product as a whole.**

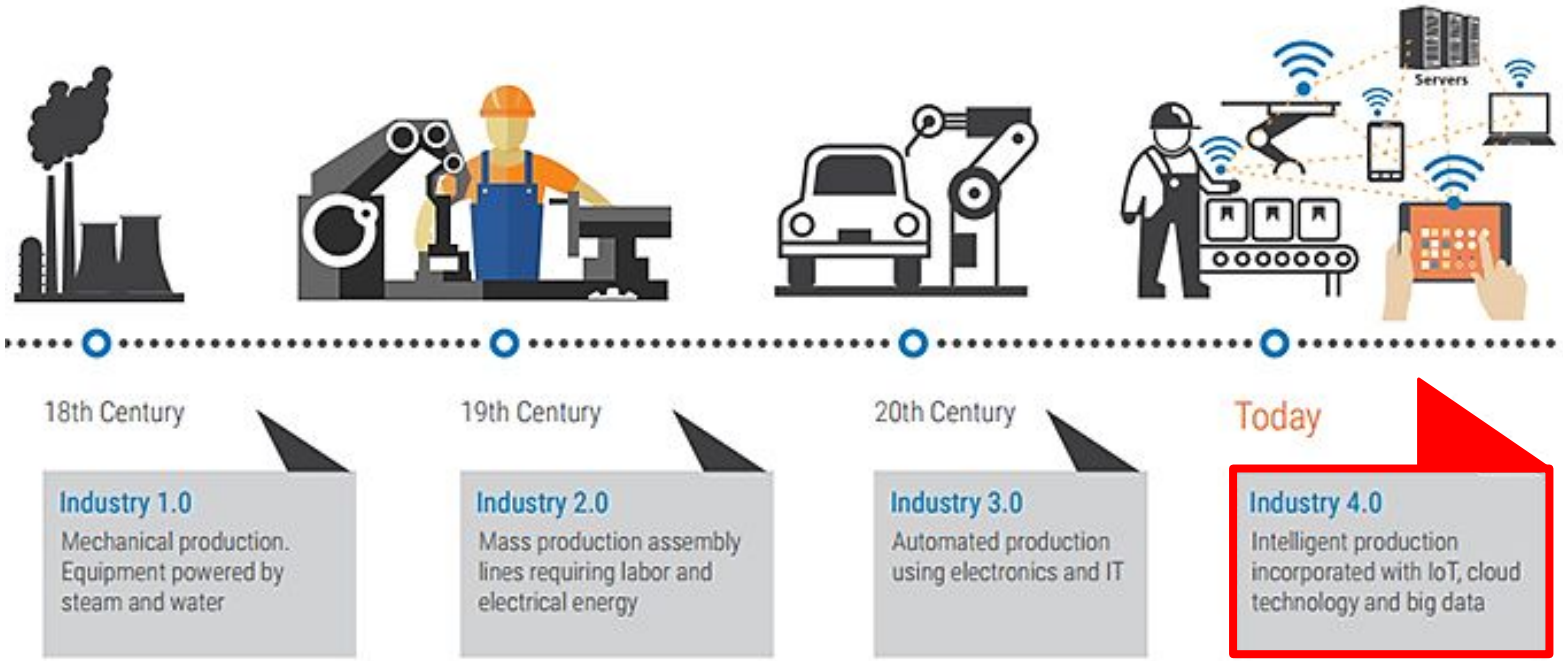
INTERNET

Internet[1] è una rete ad accesso pubblico che connette vari dispositivi o terminali in tutto il mondo. Dalla sua nascita rappresenta il principale mezzo di comunicazione di massa,[2][3][4] che offre all'utente una vasta serie di contenuti potenzialmente informativi e di servizi.

The Internet of Things

The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or 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

THE INDUSTRY 4.0

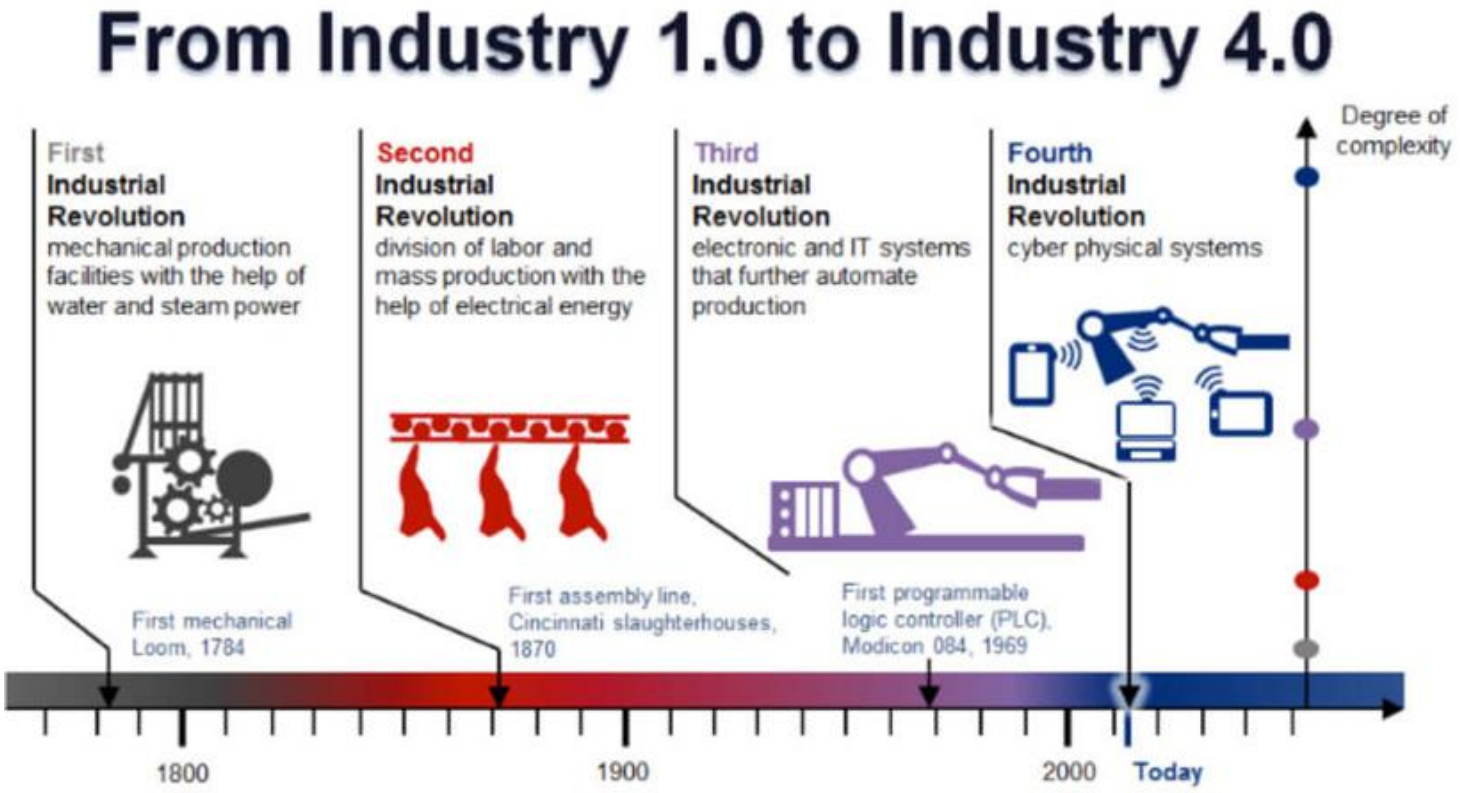


THE INDUSTRY 4.0

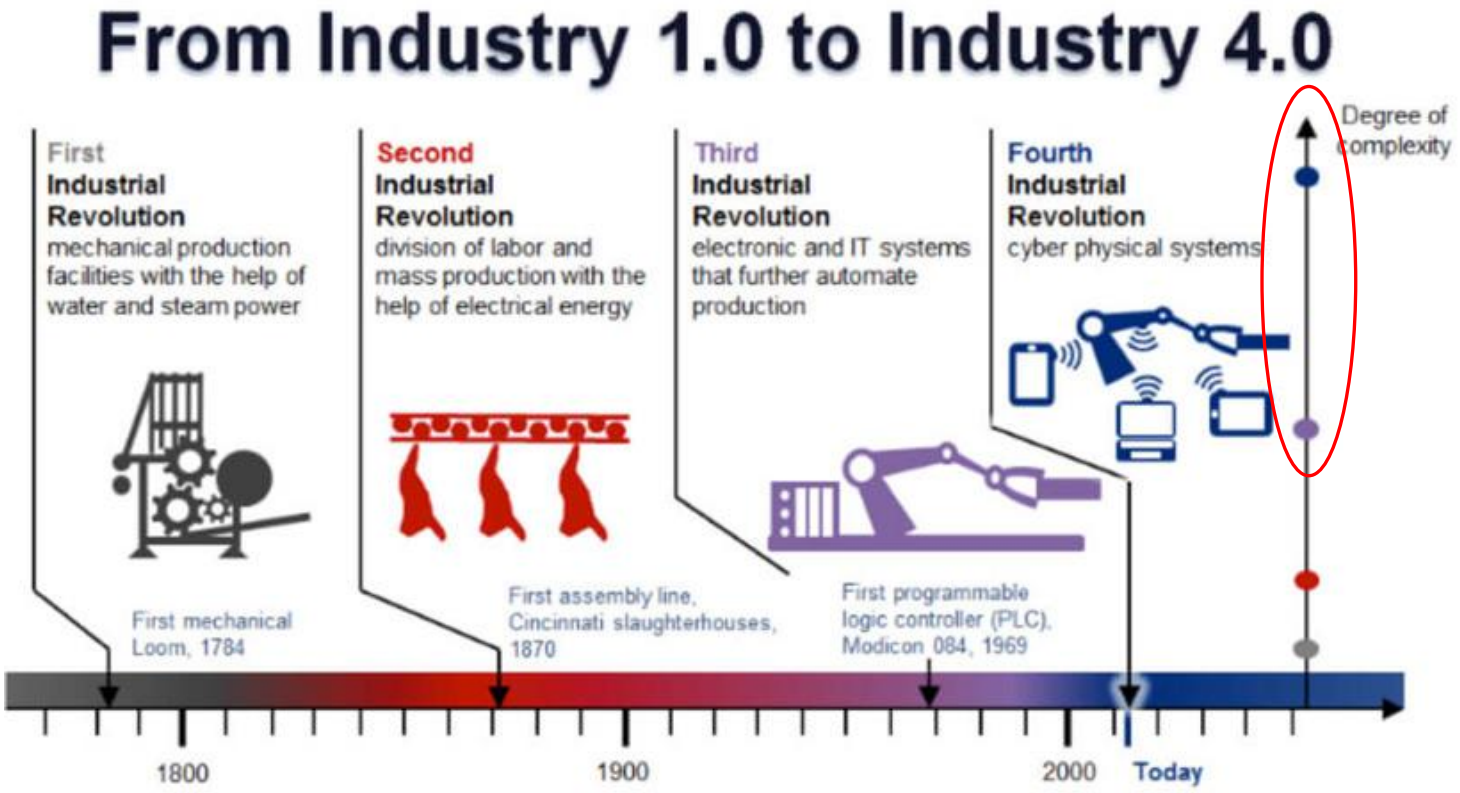
- Industry 4.0 describes the ***organisation of production processes*** *based on* ***technology and devices autonomously communicating with each other along the value chain****:* a model of the 'smart' factory of the future where computer-driven **systems monitor physical processes, create a virtual copy of the physical world** and make decentralised decisions based on self-organisation mechanisms. The concept takes account of the increased digitalisation of manufacturing industries where **physical objects are seamlessly integrated into the information network**, allowing for decentralised production and real-time adaptation in the future.
- Industry 4.0 was initially developed by the German government to create a coherent policy framework to maintain Germany's industrial competitiveness.

From: Industry 4.0 Study for the ITRE Committee - *www.europarl.europa.eu/RegData/etudes/STUD/.../IPOL_STU(2016)570007_EN.pdf*

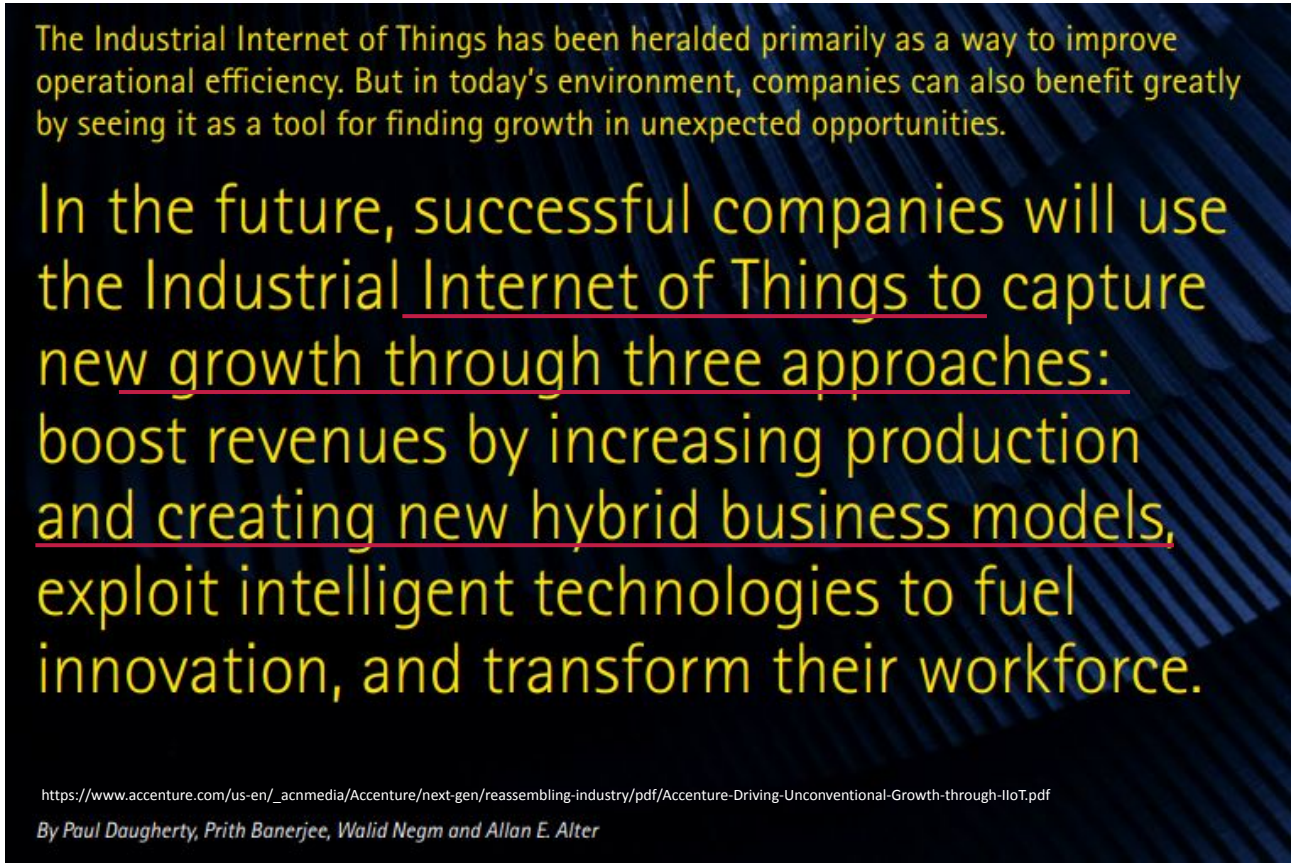
THE INDUSTRY 4.0



THE INDUSTRY 4.0



INDUSTRY 4.0

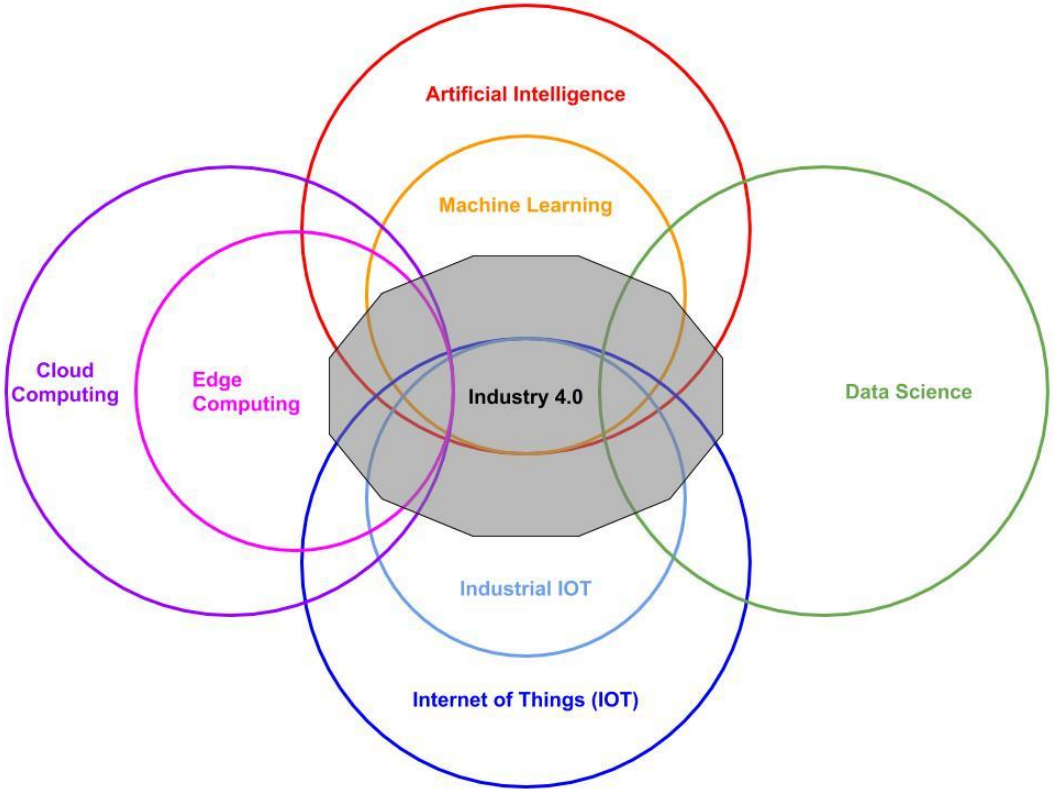


DIGITAL TWIN

A digital twin is a digital replica of a physical entity.

By bridging the physical and the virtual world, data is transmitted seamlessly allowing the virtual entity to exist simultaneously with the physical entity.

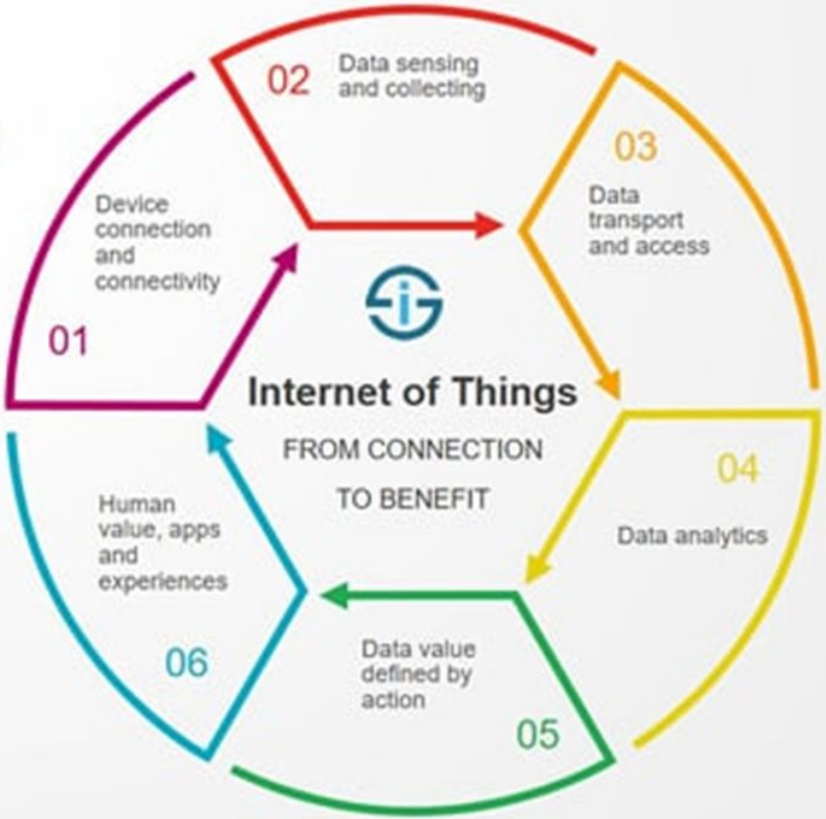
Digital twin refers to a digital replica of physical assets, processes, people, places, systems and devices that can be used for various purposes.



4.0 HOLISTIC VISION

The Internet of Things

From connecting devices to human value



01 Device connection

IoT devices
IoT connectivity
Embedded intelligence

02 Data sensing

Capture data
Sensors and tags
Storage

01 Communication

Focus on access
Networks, cloud, edge
Data transport

Data analytics 04

Big data analysis
AI and cognitive
Analyis at the edge

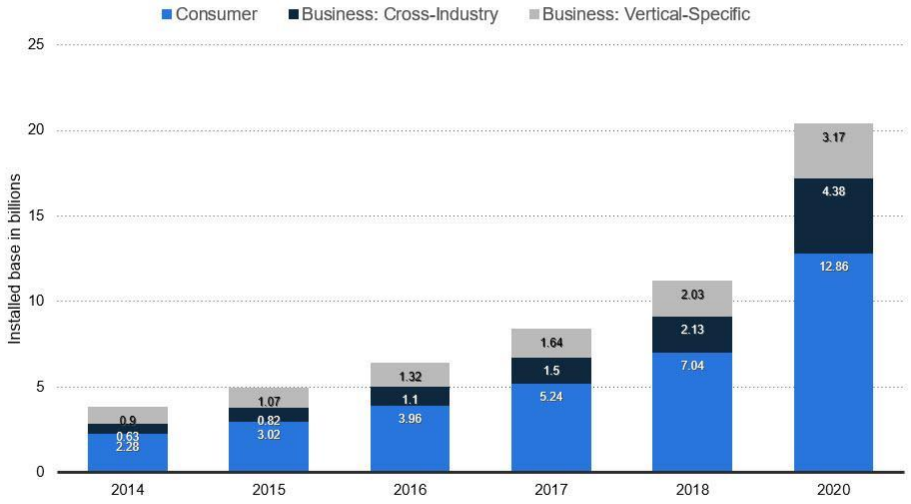
Data value 05

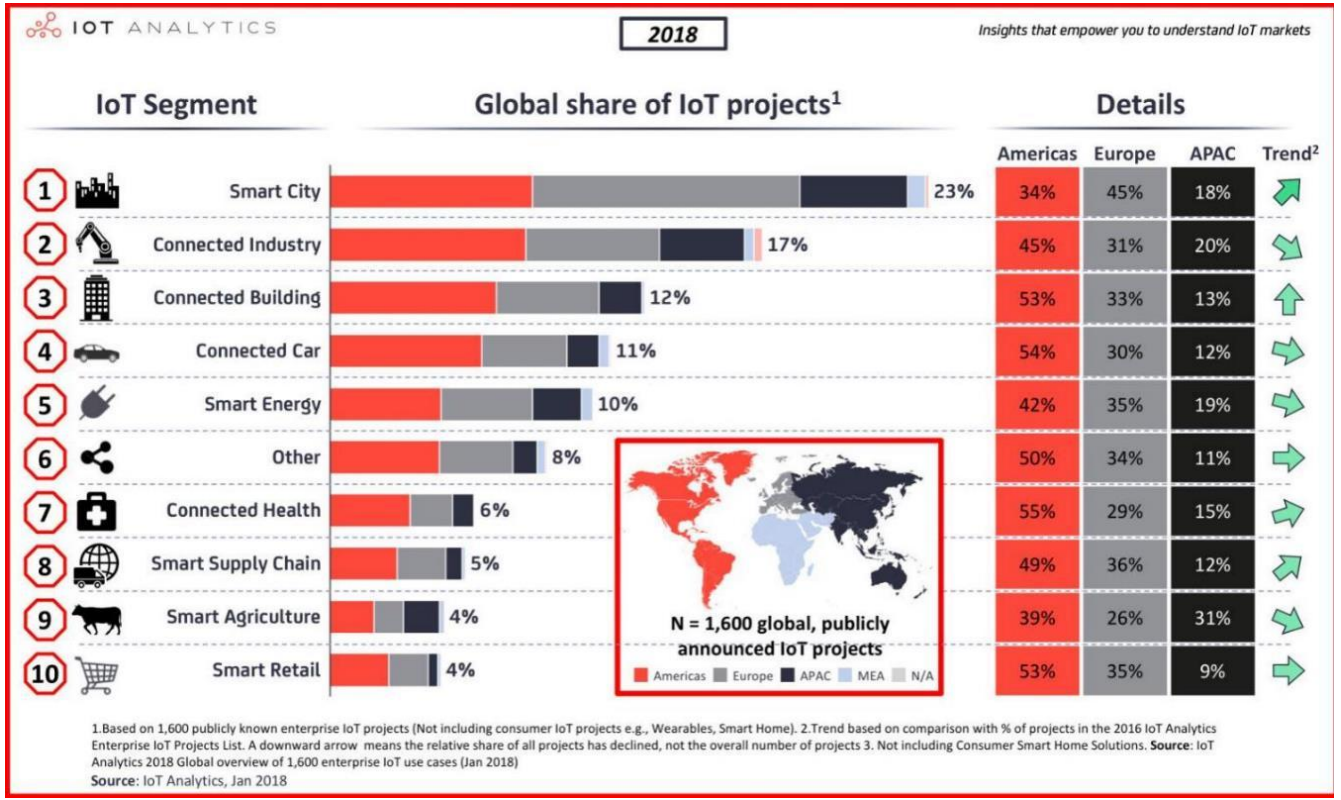
Analysis to action
APIs and processes
Actionable intelligence

Human value 06

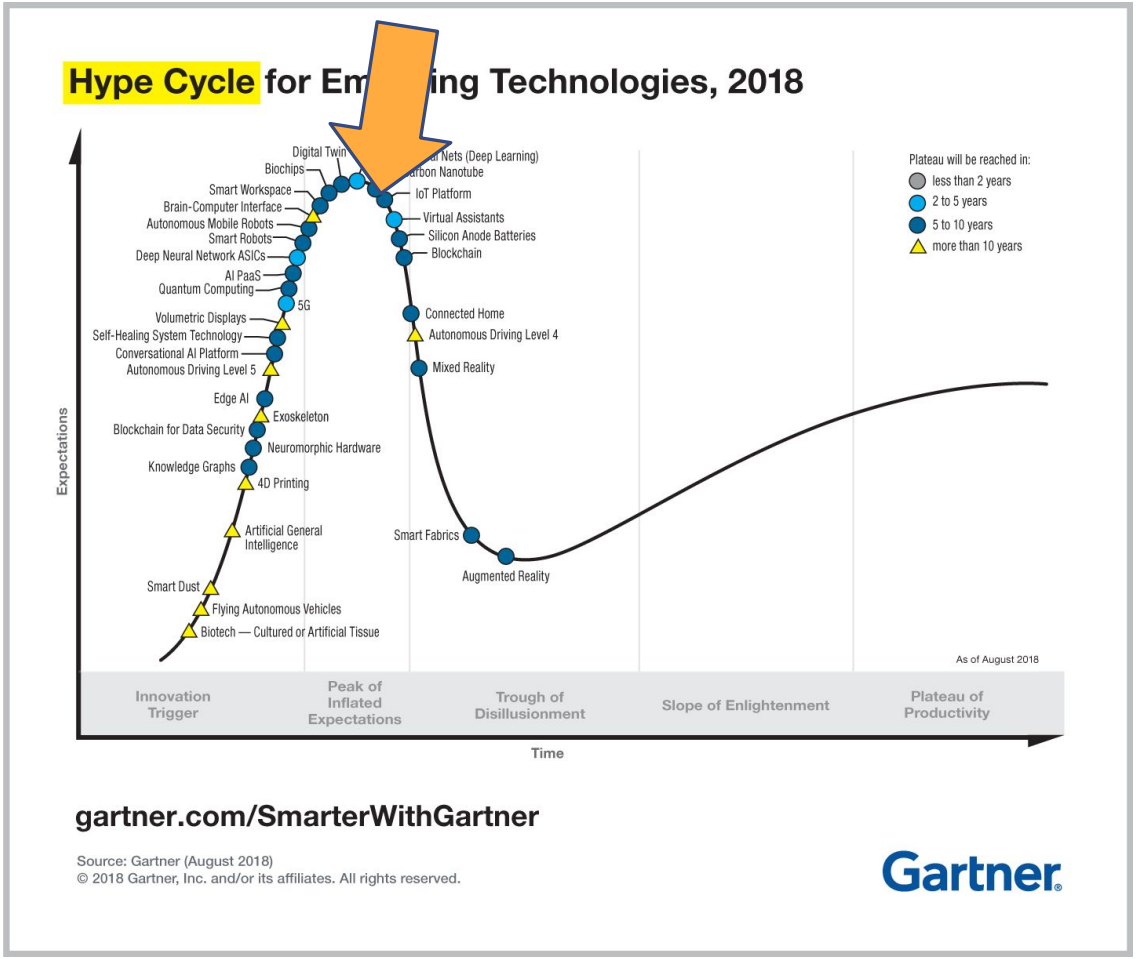
Smart applications
Stakeholder benefits
Tangible benefits

The Internet of Things (IoT) Units Installed Base By Category 2014 to 2020 (in billions of units)





https://www.forbes.com/sites/louiscolumbus/2018/06/06/10-charts-that-will-challenge-your-perspective-of-iots-growth/#ce3f6623ecce



THE INTERNET OF THINGS

The **Internet of things** (**IoT**) is the network of devices such as vehicles, and home appliances that contain electronics, software, sensors, actuators, and connectivity which allows these things to connect, interact and exchange data.[1][2][3][4]

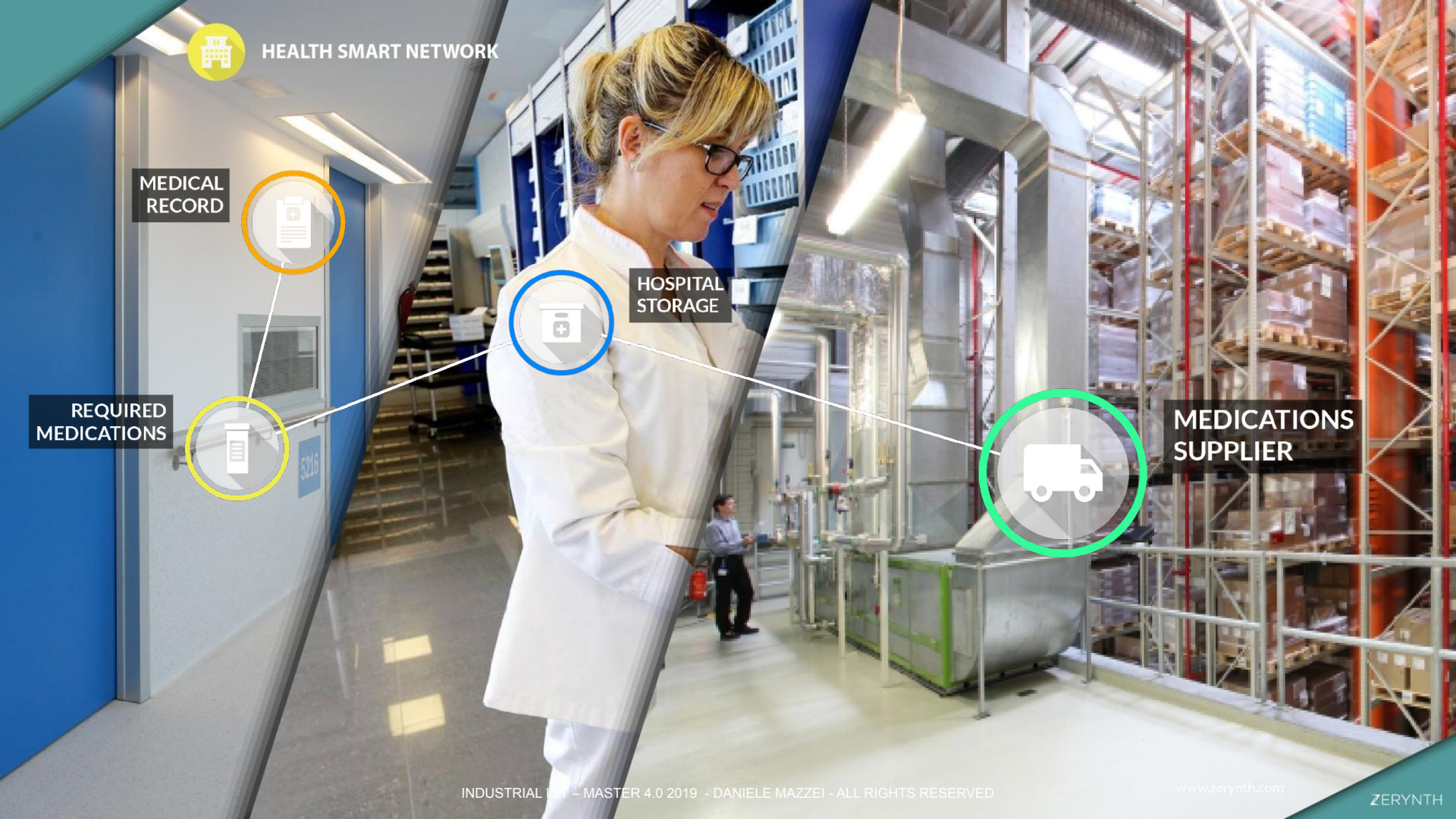
IOT IS JUST AN ENABLING TECHNOLOGY!

PRODUCTS AND SERVICES IN THE 4.0 ERA

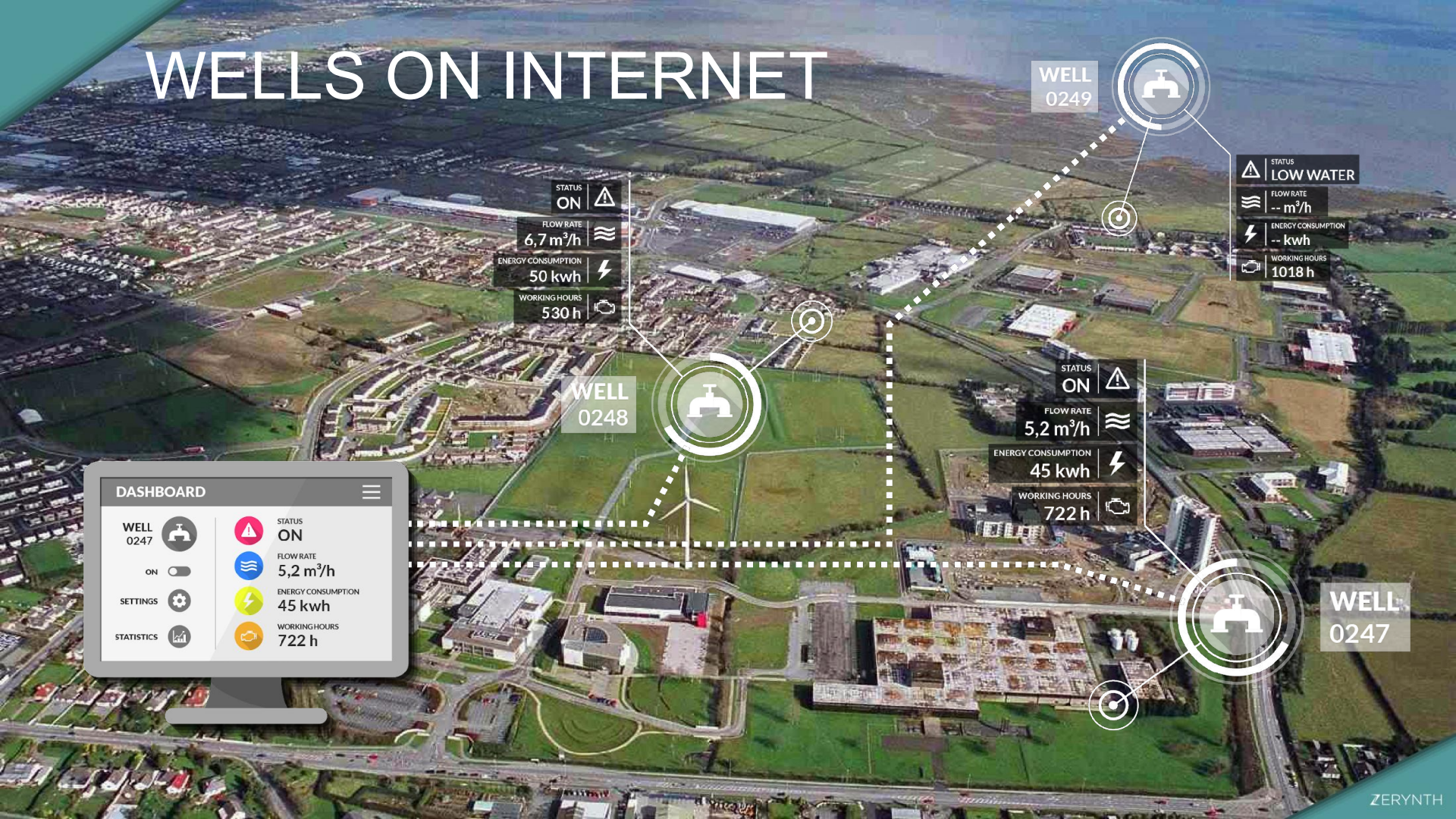
UBIQUITOUS TECHNOLOGY AND BIG DATA

4.0 SMART PRODUCTS AND SERVICES

A smart product is a physical device with a digital service at its heart


HEALTH SMART NETWORK
MEDICAL RECORD
HOSPITAL STORAGE
REQUIRED MEDICATIONS
MEDICATIONS SUPPLIER


FACTORY ON INTERNET
LINE 0374
STATUS ON
HOURS TO NEXT MAINTENANCE 327 h
LINE 0374
STATUS OFF
HOURS TO NEXT MAINTENANCE 96 h
LINE 0376
STATUS UNDER MAINTENANCE
HOURS TO NEXT MAINTENANCE NOW
ENERGY CONSUMPTION 45 kwh
VIBRATION LEVEL MEDIUM
OIL LEVEL OK
WORKING HOURS 10 h
LINE 0377
STATUS ON
HOURS TO NEXT MAINTENANCE 238 h
ENERGY CONSUMPTION 41 kwh
VIBRATION LEVEL LOW
OIL LEVEL OK
WORKING HOURS 6 h
LINE 0378
STATUS ON
HOURS TO NEXT MAINTENANCE 112 h
DASHBOARD
LINE 0377
ON
SETTINGS
STATISTICS
STATUS ON
HOURS TO NEXT MAINTENANCE 238 h
VIBRATION LEVEL MEDIUM
OIL LEVEL OK
ENERGY CONSUMPTION 45 kwh
WORKING HOURS 10 h
www.zerynth.com
ZERYNTH


WELLS ON INTERNET
WELL 0249
STATUS LOW WATER
FLOW RATE -- m³/h
ENERGY CONSUMPTION -- kwh
WORKING HOURS 1018 h
STATUS ON
FLOW RATE 6,7 m³/h
ENERGY CONSUMPTION 50 kwh
WORKING HOURS 530 h
WELL 0248
STATUS ON
FLOW RATE 5,2 m³/h
ENERGY CONSUMPTION 45 kwh
WORKING HOURS 722 h
WELL 0247
DASHBOARD
WELL 0247
ON
SETTINGS
STATISTICS
STATUS ON
FLOW RATE 5,2 m³/h
ENERGY CONSUMPTION 45 kwh
WORKING HOURS 722 h
ZERYNTH

NEW DESIGN PRINCIPLES

UX for IOT

Designing for the IoT **is inherently more complex than web service design.**

Some of this is to do with the current state of the technology.

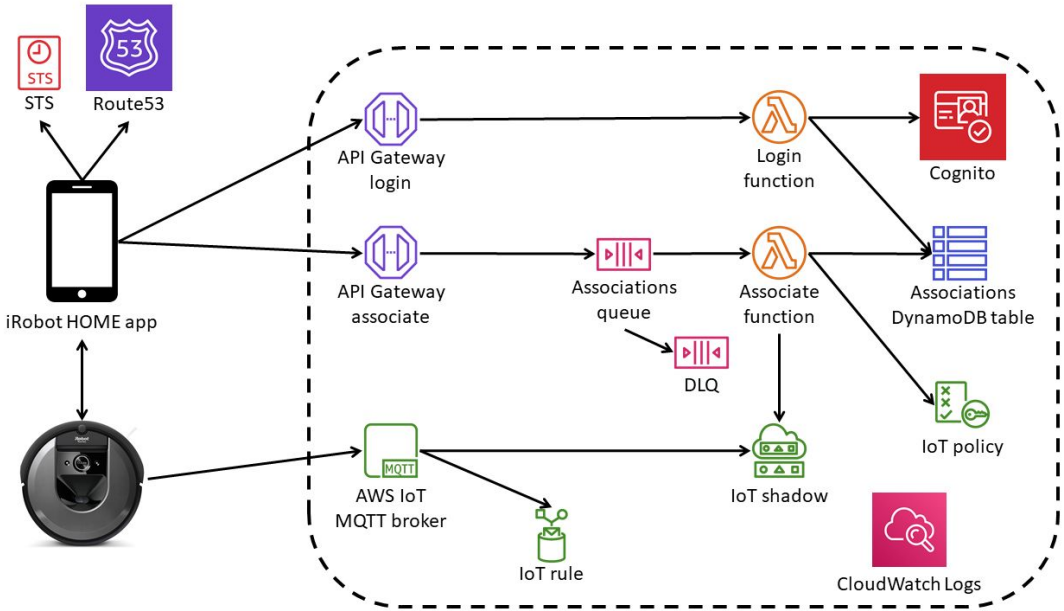
Some of this reflects our as-yet immature understanding of compelling consumer IoT value propositions.

Some of this stems from the fact that there are more aspects of design to consider. **Tackling them independently creates an incoherent user experience (UX).**

UX for IOT

Designing a great connected product requires a holistic approach to user experience.

It spans many layers of design, not all of them immediately visible.



https://aws.amazon.com/solutions/case-studies/irobot-iot/

Why UX for IOT is different?

Connected products pose design challenges that will be new to designers accustomed to pure software services.

Many of these challenges stem from:

- The specialized nature of IoT devices
- Their ability to bridge the digital and physical worlds
- The fact that many IoT products are distributed systems of multiple devices
- The quirks of networking

Specialized Devices, with Different Capabilities

Many of the “things” in the Internet of Things are **specialized, embedded computing devices.** Unlike general-purpose computers (smartphones and PCs), their **hardware and software is optimized to fulfill specific functions.**

Their **physical forms must be designed** and engineered.

Their **UI capabilities may extend from screens and buttons into physical controls**, audio, haptics, gestures, tangible interactions, and more.

But **user interactions must be designed without the benefit of the style guides and standards** that web and mobile designers can rely upon.

Some may have no user input or output capabilities at all. The only way to find out what they are doing or what state they are in may be via a remote UI.

Real-World Context

Connected products exist in the physical world.

Sensors enable us to capture data we did not have before for digital transmission, allowing us to take more informed actions in the real world.

Actuators provide the capability for digital commands to produce real-world effects.

They can be remotely controlled, or automated. But unlike digital commands, real-world actions often cannot be undone.

https://www.oreilly.

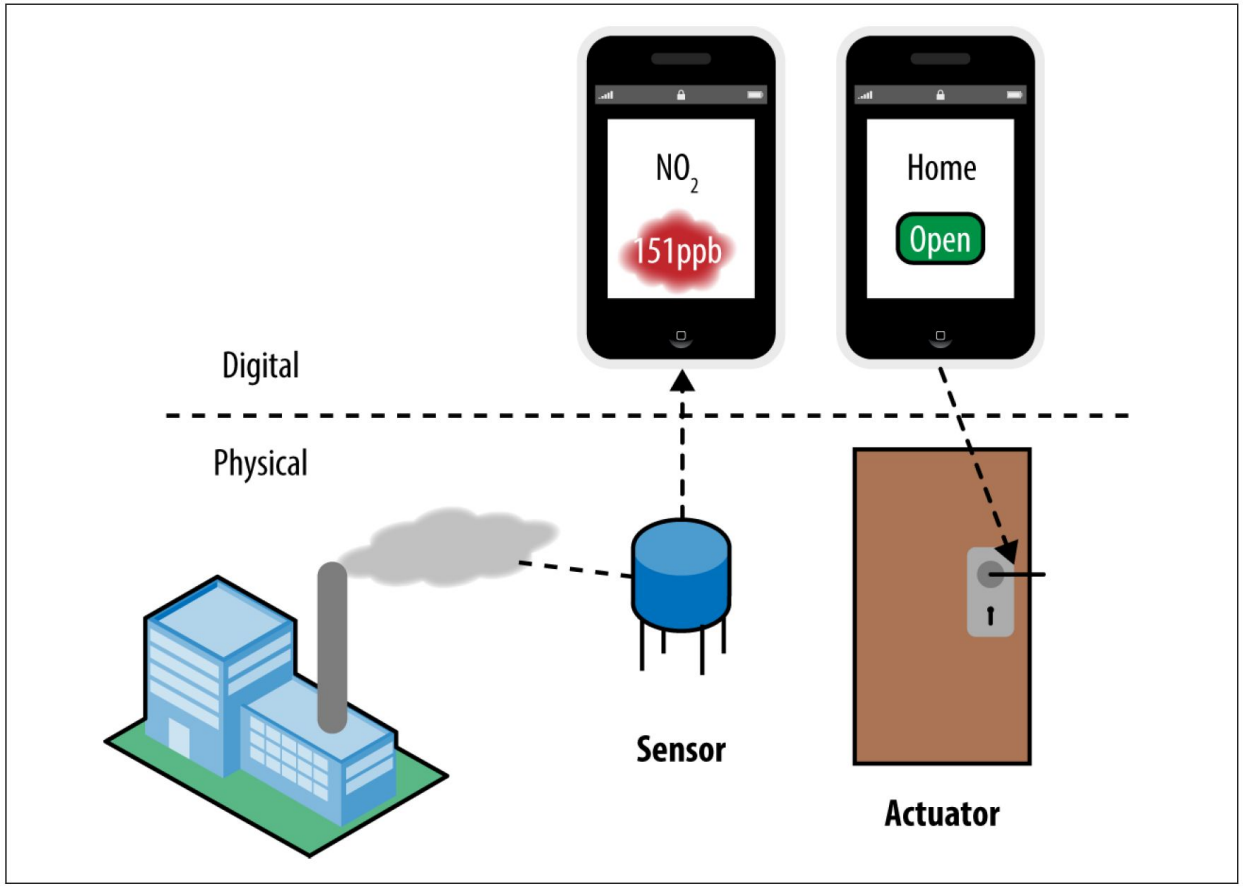


Figure 1-2. Sensors convert readings from the physical environment into digital information; actuators convert digital instructions into mechanical actions.

Real-World Context

The physical context of use creates further challenges.

Devices may need to be ruggedized for outdoor use.

An in-car system needs to be designed to minimize distraction while driving.

A remotely controlled oven needs to minimize the risk of fire.

Devices must adhere to regulatory requirements such as radio interference or waste recycling standards.

And the social context of use may be particularly complex, especially in the home.

Techno-centric solutions which are insensitive to the needs of the occupants will fail. For example, an assisted living product needs to balance the need of vulnerable people

Designing for Systems of Devices and Services

Many connected products are systems of diverse devices and services.

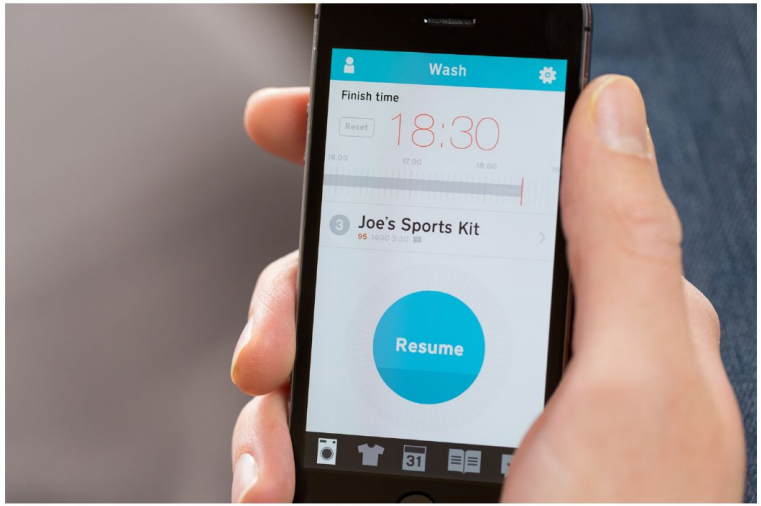
Functionality may be distributed across multiple devices with different capabilities.

Designers need to **consider how best to distribute functionality** across devices.

They need to **design UIs and interactions across the system as a whole** — not treating devices as standalone UIs — to ensure that the overall UX is coherent.

This is **interusability.** Much of the information processing for an IoT product will often happen in the Internet service. So the whole system experience is often equally or more important than any single device UX.


Wash
Delay
Start / Stop
Notify
Conditioner
Detergent


Wash
Finish time
Reset
18:30
Joe's Sports Kit
Resume

DAN erved)

Designing for Systems of Devices and Services

Furthermore, they need some understanding of how the system works.

Even quite simple connected products are conceptually more complex than non-connected ones.

Code can run in more places. Parts of the system will inevitably go offline from time to time.

When this happens, basic knowledge of which component does what will help users understand the consequences, and figure out what action may be required.

Designing for Systems of Devices and Services

In this context, the designers and engineers of connected products should do their best to create **a unified environment for the IoT system**.

In other words, the challenge of a seamless experience is to **integrate diverse independent components into a one-stop solution** while saving its functionality and reliability.

Direct vs remote configuration

Over the last 30 years, the prevailing trend in UI design has been direct manipulation.

Users control visual representations of objects and immediately see the outcome of their actions (which can be reversed)

But many IoT interactions are displaced in location (remote control) or time (automation). This breaks the link between user actions and visible, reversible consequences!

Design for Networks

Another major factor is the impact of the network on UX.

Designers from web and mobile software backgrounds have the luxury of assuming that devices will be nearly always connected.

In IOT this is not true anymore!

Design for network

Our experience of the physical world is that things respond to us immediately and reliably.

Light switches do not “lose” our instructions or take 30 seconds to produce an effect.

Delays and glitches are inherent properties of physical networks and transmission protocols.

But they may feel strange experienced through “real-world” things. It’s impossible to engineer these issues entirely out of any Internet-connected system.

Design for power saving

In addition, the nature of connected devices is that they often connect only intermittently, in order to conserve power.

Computers promise to provide us with precise, accurate, and timely data about the world around us.

But distributed IoT systems may not always be in sync, and different devices may therefore report different information about the state of the system.

IEEE Internet of Things

IEEE

Social impacts of IoT
- Impacts and Acceptance of Users
- Change in the societal organization
- Democratization and control of the infrastructure
- ...

Business Models and ecosystems
- New Business Models
- New Value Chains
- Creation of new Ecosystems
- Application domains
- ...

Services and Applications
- Trials
- Specific Services (e.g., Smart Cities, Social IoT)
- Applications
- ...

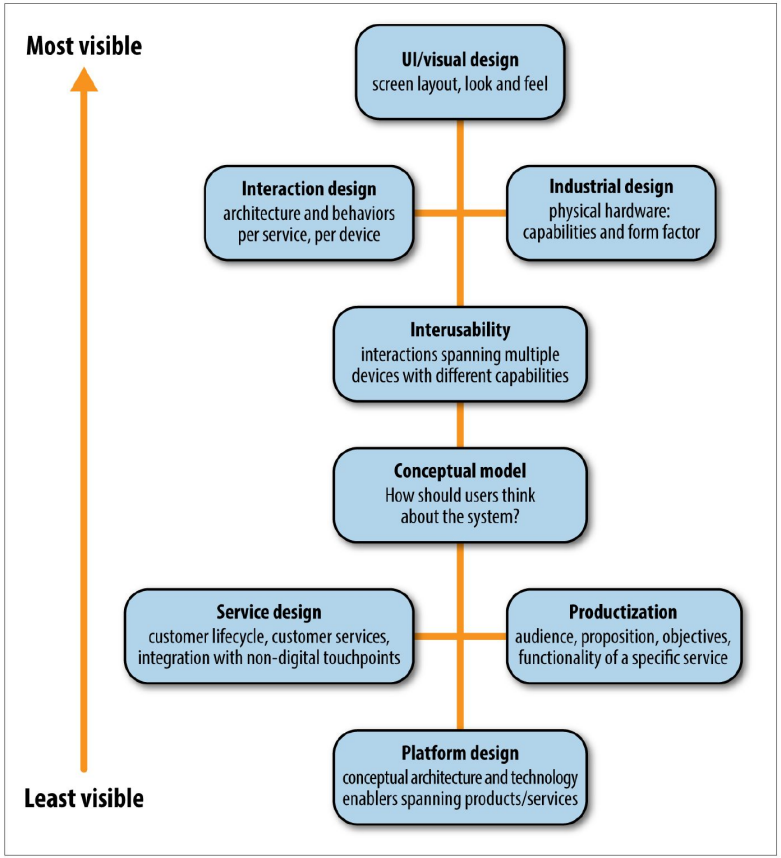
Software Architecture
- Operating Systems
- Middleware
- Cloud Solutions
- APIs and Interfaces
- Data Management and Big Data
- ...

Enabling Technologies and System Architecture
- Sensors
- Gateways and MicroSystems
- Protocols
- Energy Management
- Organization of Sensors networks
- ...

Management
- 0-Touch management==
- Autonomics and self-organization of large IoT systems
- New processes and organizations
- ...

Security and Privacy
- Management of personal data
- Privacy and Security Framework for IoT
- ...

Figure 1. Technological and social aspects related to IoT



UX for IOT flow and architecture

A good overall product requires integrated thinking across all these layers.

A stunning UI means nothing if your product concept makes no sense.

A beautiful industrial design may sell products in the short term, but can’t mask terrible service.

