

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.

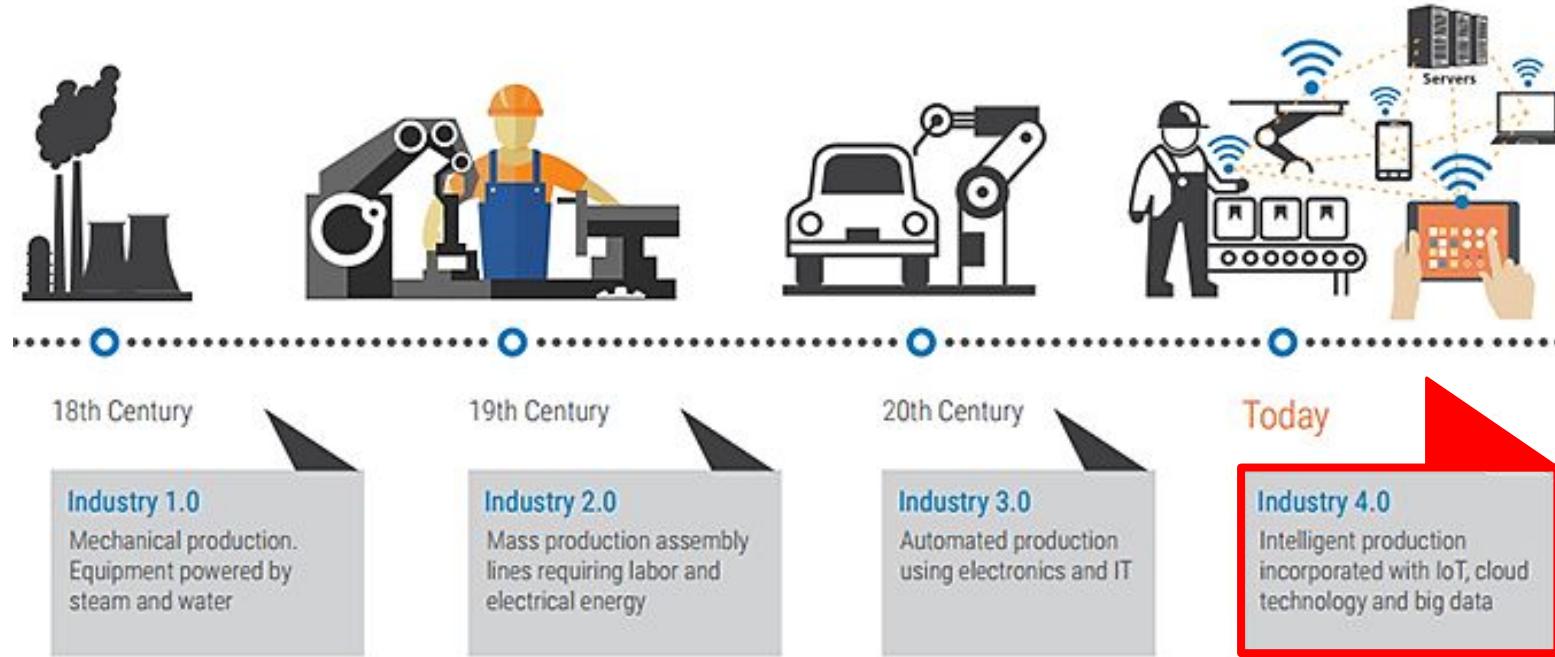


The Internet of Things

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

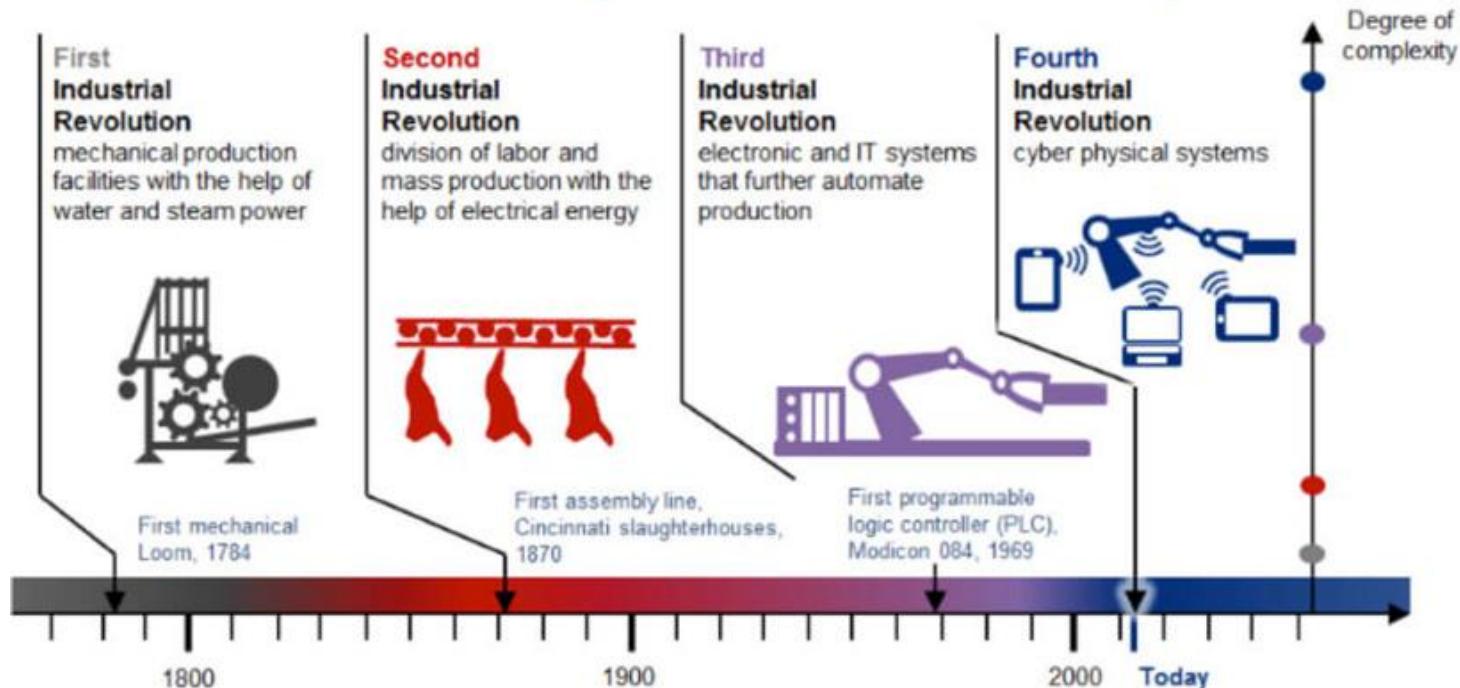


- Industry 4.0 describes the *organisation of production processes based on technology and devices autonomously communicating with each other along the value chain*: a model of the 'smart' factory of the future where computer-driven **systems monitor physical processes, create a virtual copy of the physical 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](http://www.europarl.europa.eu/RegData/etudes/STUD/.../IPOL_STU(2016)570007_EN.pdf)

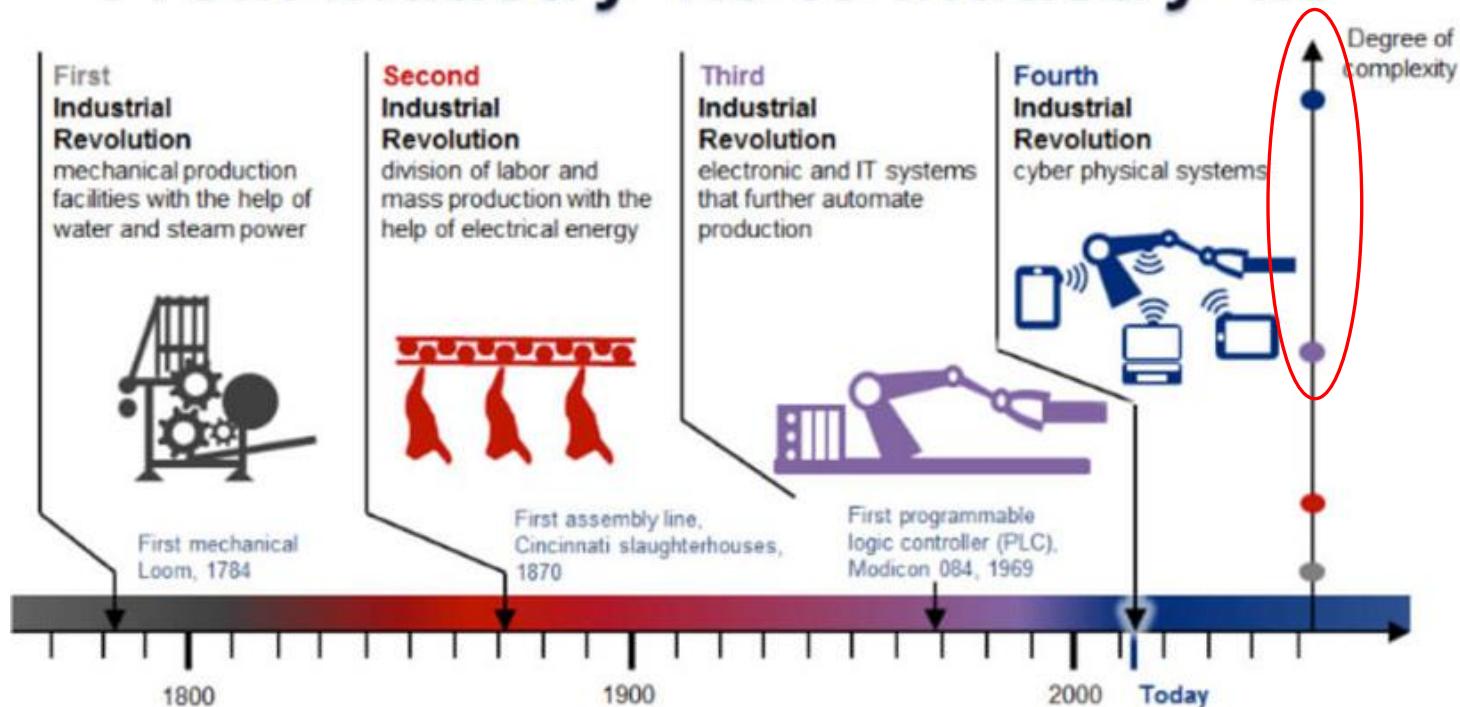
THE INDUSTRY 4.0

From Industry 1.0 to Industry 4.0



THE INDUSTRY 4.0

From Industry 1.0 to Industry 4.0



INDUSTRY 4.0

The Industrial Internet of Things has been heralded primarily as a way to improve operational efficiency. But in today's environment, companies can also benefit greatly by seeing it as a tool for finding growth in unexpected opportunities.

In the future, successful companies will use the Industrial Internet of Things to capture new growth through three approaches: boost revenues by increasing production and creating new hybrid business models, exploit intelligent technologies to fuel innovation, and transform their workforce.

https://www.accenture.com/us-en/_acnmedia/Accenture/next-gen/reassembling-industry/pdf/Accenture-Driving-Unconventional-Growth-through-IIoT.pdf

By Paul Daugherty, Prith Banerjee, Walid Negm and Allan E. Alter

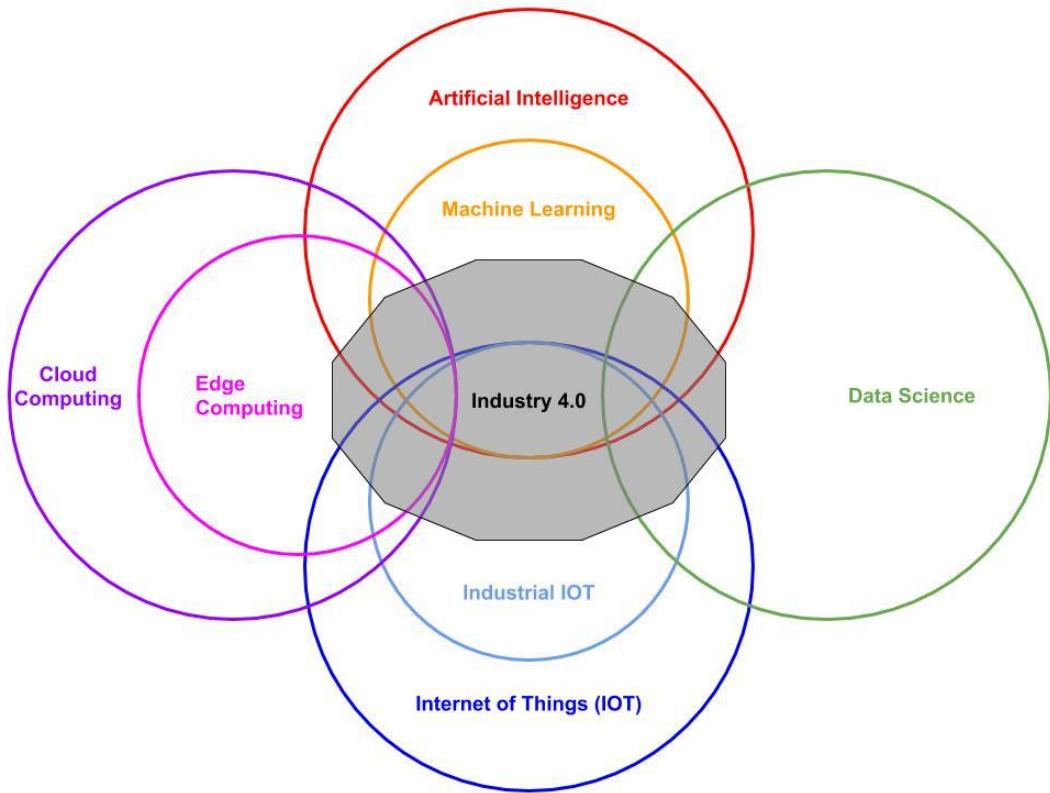


DIGITAL TWIN

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

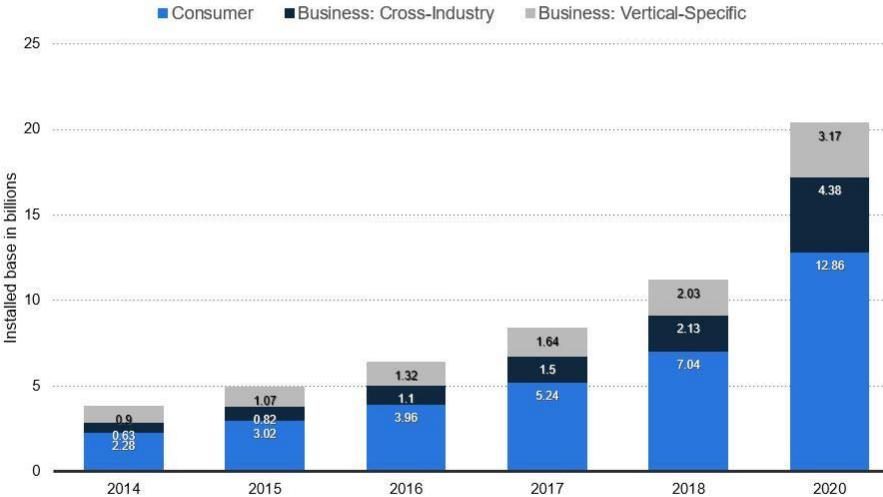
By bridging the physical and the virtual world, data is transmitted seamlessly allowing the virtual entity to exist simultaneously with the physical entity.

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

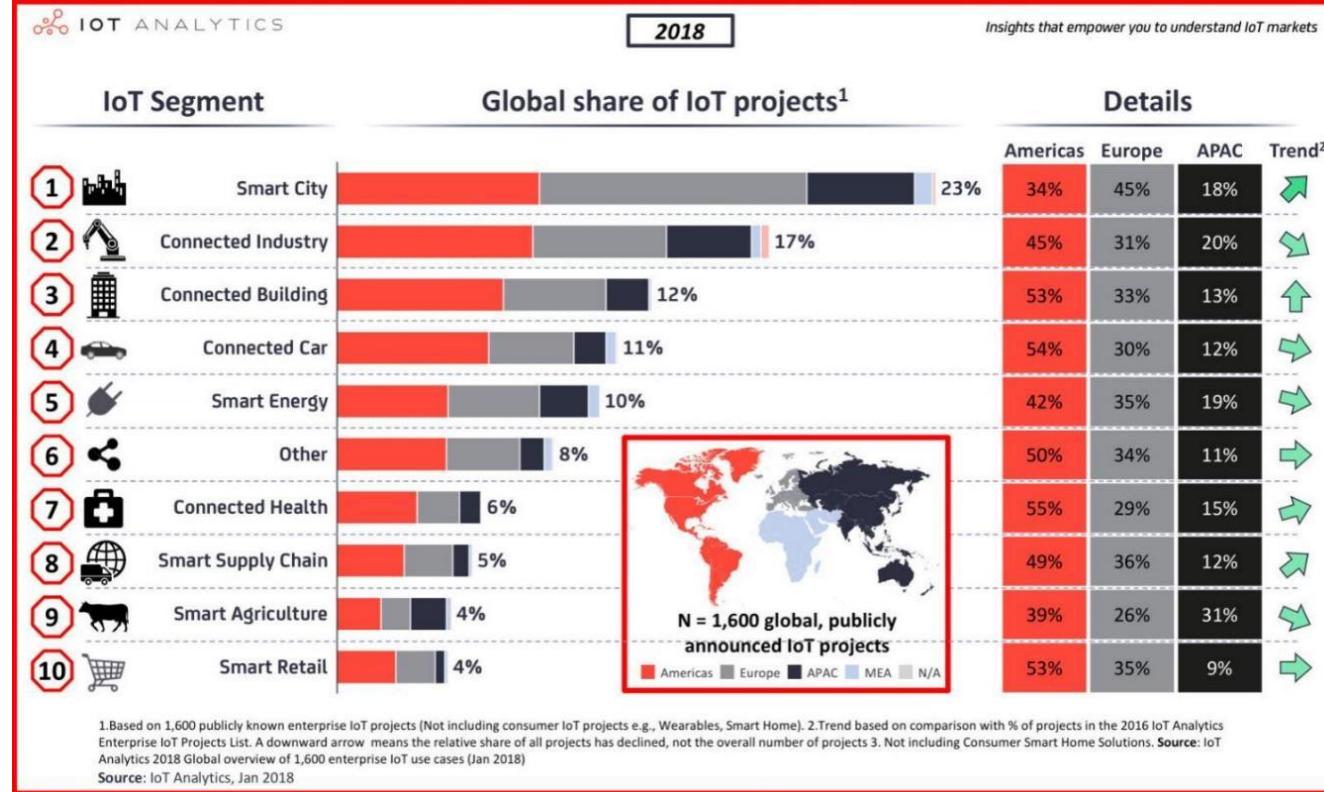


4.0 HOLISTIC VISION

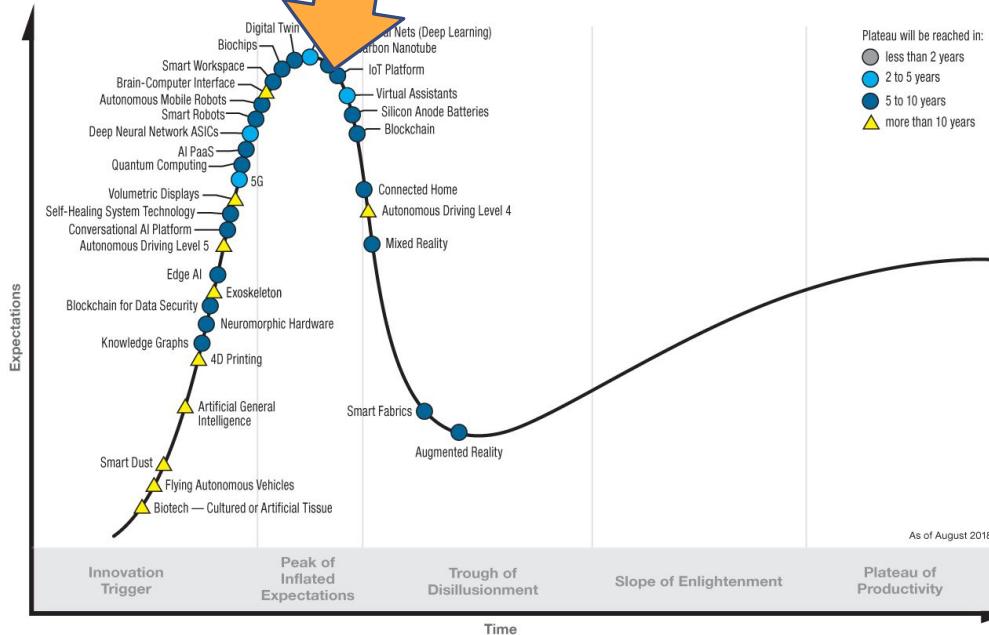
The Internet of Things (IoT) Units Installed Base By Category 2014 to 2020 (in billions of units)



statista



Hype Cycle for Emerging Technologies, 2018



gartner.com/SmarterWithGartner

Source: Gartner (August 2018)
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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



REQUIRED
MEDICATIONS



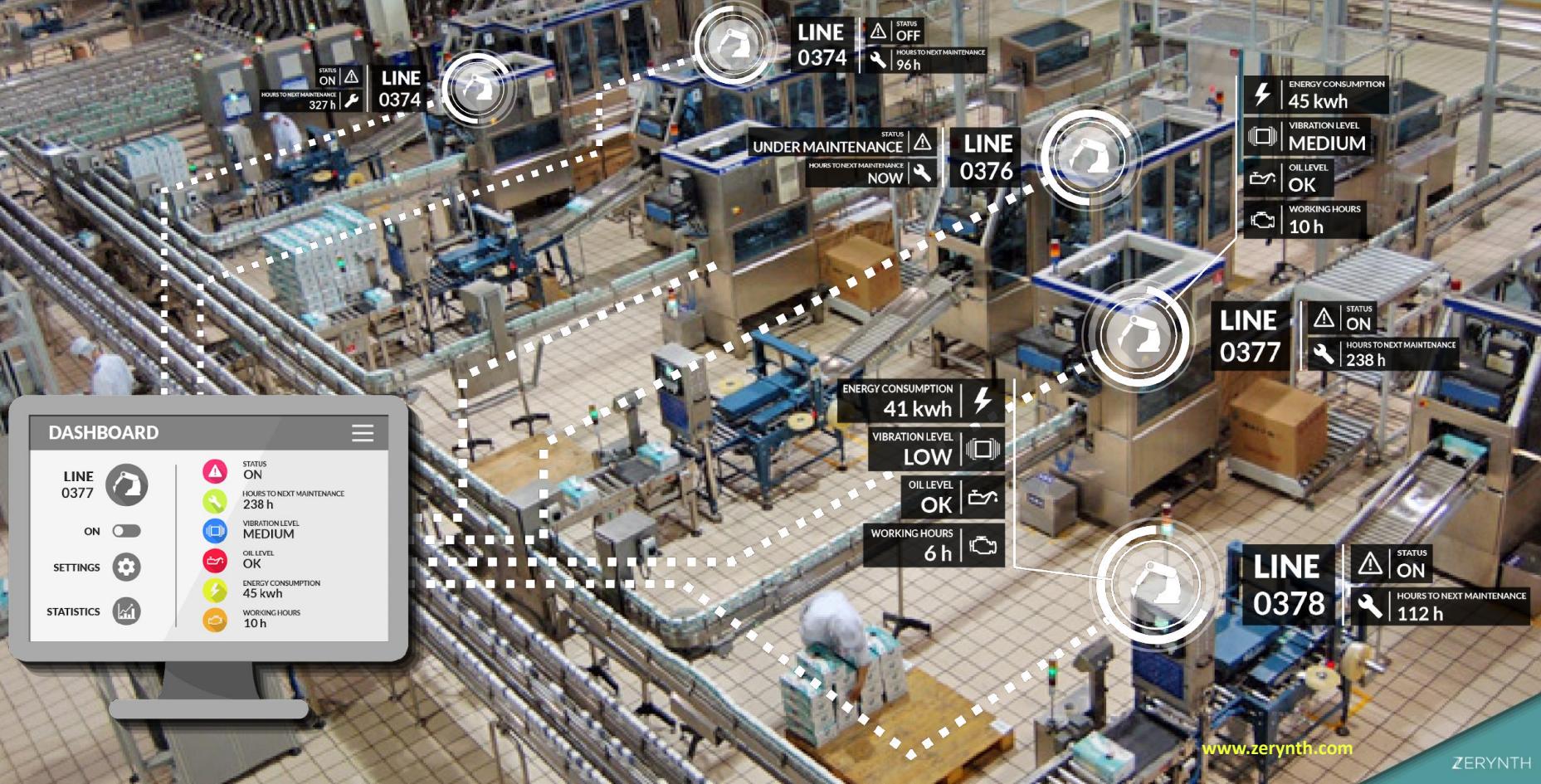
HOSPITAL
STORAGE



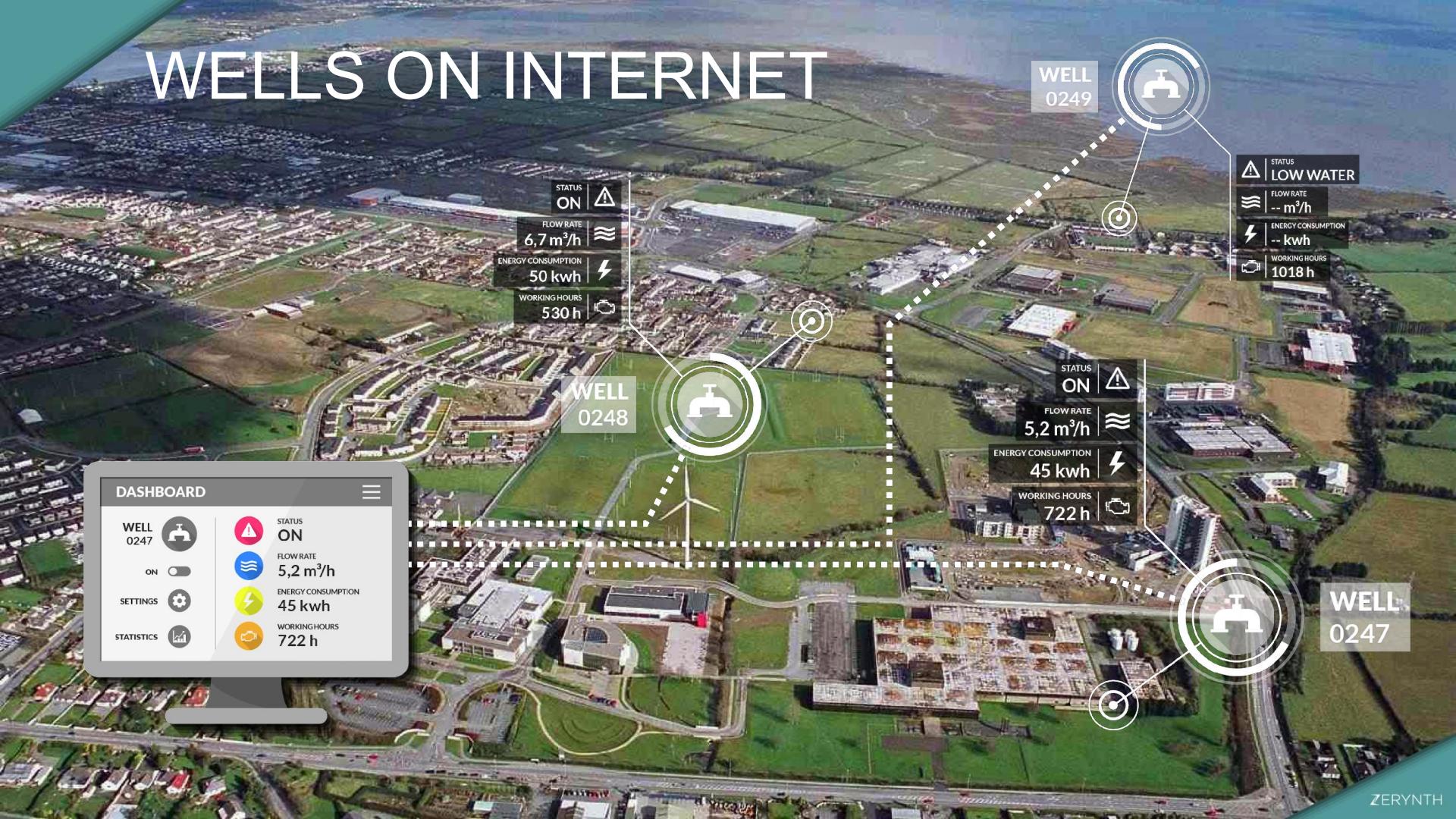
MEDICATIONS
SUPPLIER



FACTORY ON INTERNET



WELLS ON INTERNET



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.

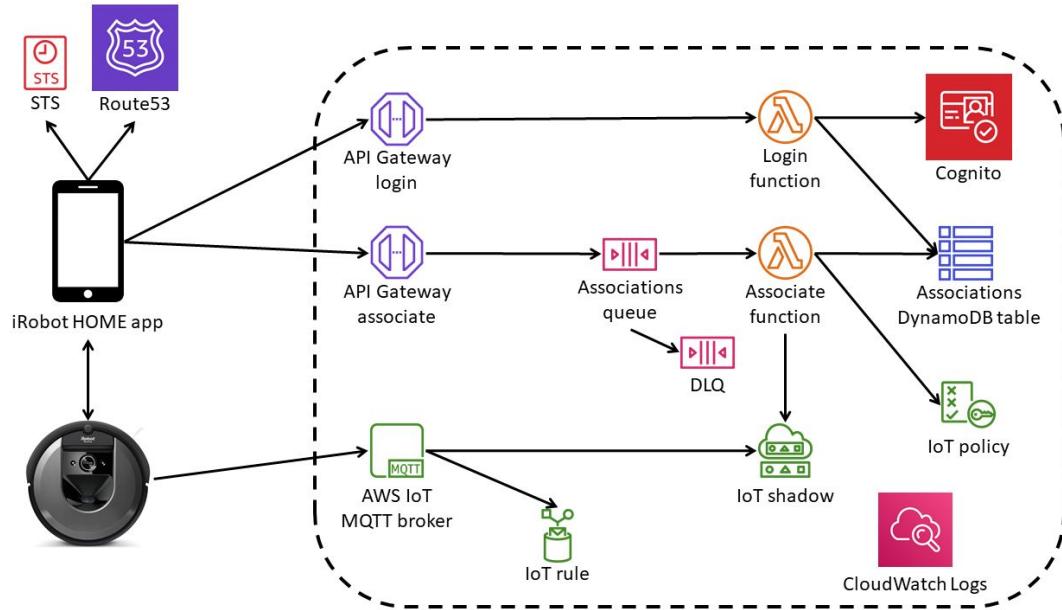
Some of this stems from the fact that there are more aspects of design to consider. **Tackling them independently creates an incoherent user experience (UX).**

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.com>

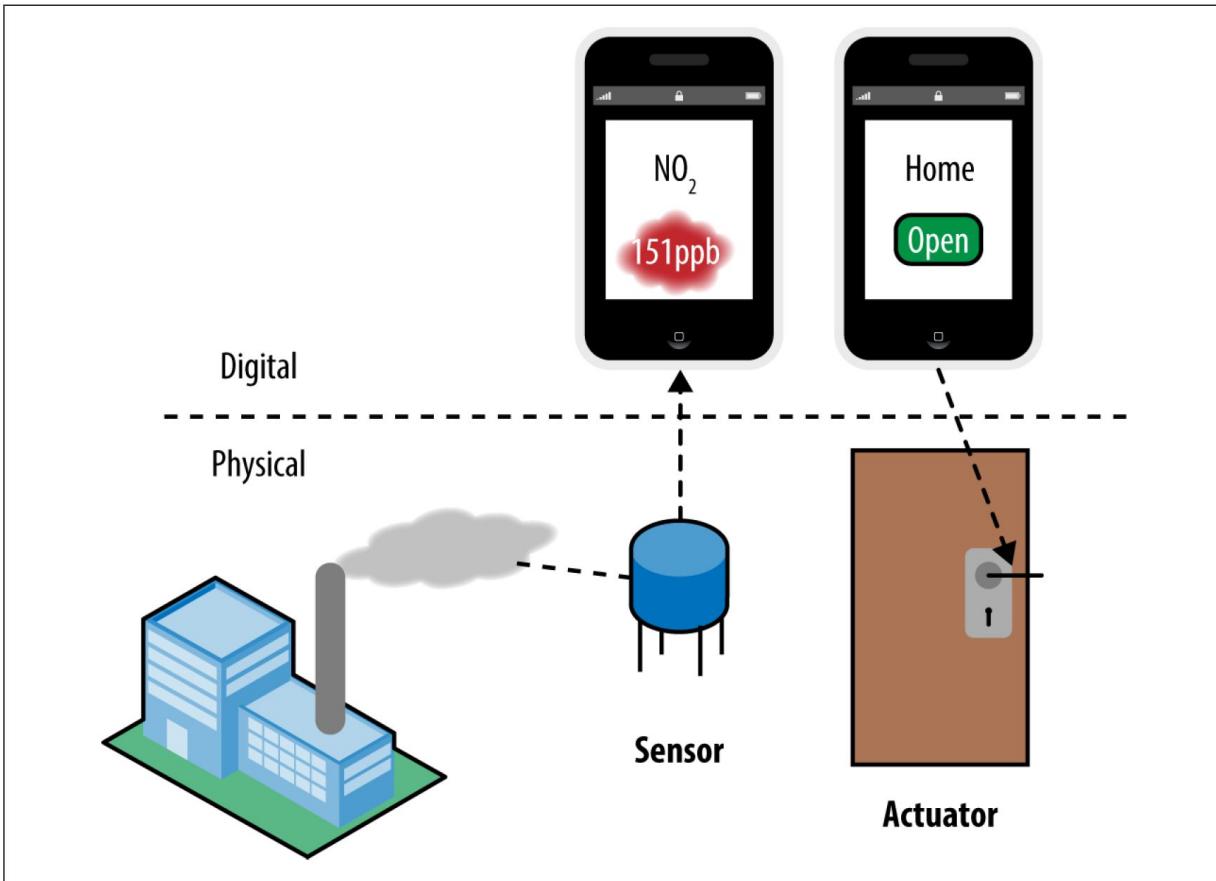


Figure 1-2. Sensors convert readings from the physical environment into digital information; actuators convert digital instructions into mechanical actions.

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

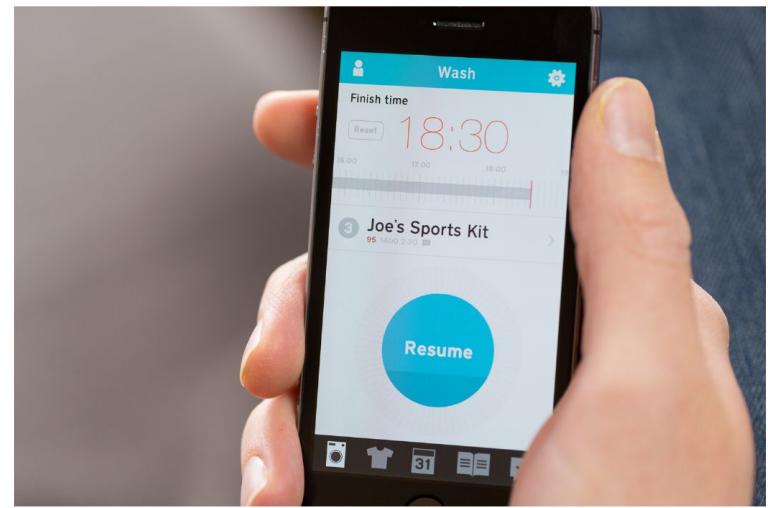
Many connected products are systems of diverse devices and services.

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.



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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.

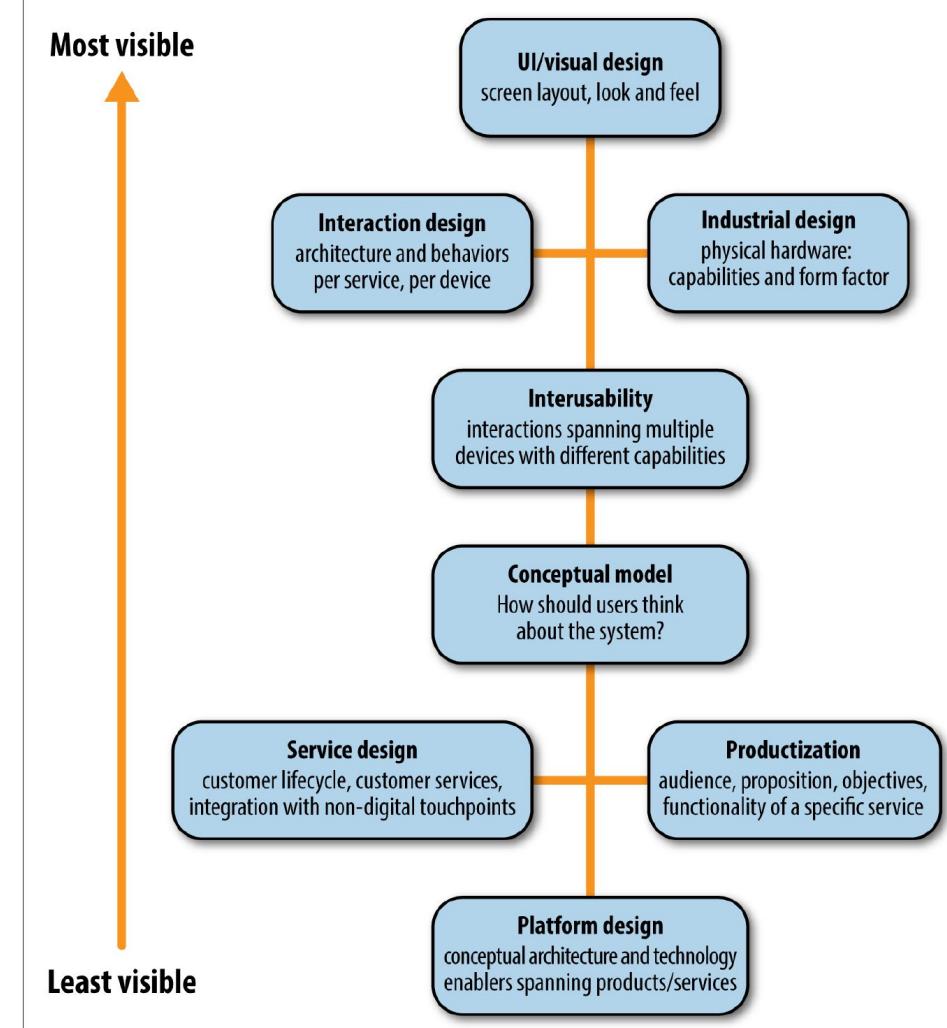
Design for power saving

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.

UX for IOT flow and architecture



UX for IOT flow and architeture

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.