Enabling technologies II

Have you ever walked around the island of Cabrera? Since July 2026 you can do it from your phone: the Consell de Mallorca and the University of the Balearic Islands (UIB) published *Mallorca Digitalitzada*, a website and an app with 360-degree videos, 3D reconstructions and augmented reality for 50 heritage sites, from Bellver Castle to La Dragonera. The project cost 600,000 euros of EU funds. Is that virtual reality? Augmented reality? A digital twin? By the end of this page you will be able to tell.

The five technologies of the previous lesson were mostly about data. Today's six are more varied: some touch the physical world (robots, 3D printers), one connects (5G), and some change how we see or how we trust (augmented reality, digital twins, blockchain). They are the upgrades at the far end of the tech tree, and most of them need the first five as prerequisites.

What you will learn

- Describe **blockchain**, **robotics**, **additive manufacturing**, **augmented and virtual reality**, **5G** and **digital twins**, with their key characteristics and limits
- Give a real example of each one, at the plant or in the business
- Read a manufacturer's **spec sheet** and compare two real products
- Avoid three classic traps: blockchain is not cryptocurrency, 5G is not just "faster internet", and a 3D model is not a digital twin
- Decide which of the eleven technologies fit your company, which might, and which do not

Blockchain

A **blockchain** is a shared record (a **ledger**) copied on many computers, where entries are grouped in blocks linked by cryptography, so that nobody can change a past entry on their own without the others noticing.

Characteristic	In plain words
Distributed	Many synchronised copies, not one central database
Tamper-evident	Changing an old block breaks the links and everybody sees it
Consensus	Participants agree on new entries, usually without a central authority
Smart contracts	Small programs stored on the chain that run automatically when a condition is met

A real case: in a pilot with IBM on Hyperledger Fabric, the US supermarket chain Walmart cut the time needed to trace a packet of sliced mangoes back to its farm from about **7 days to 2.2 seconds**. Farmers, packers, transporters and the shop all wrote to the same ledger.

Careful: blockchain is not cryptocurrency

> Cryptocurrencies are one application of blockchain, not the technology itself. And blockchain is usually slower and more expensive than an ordinary database. It only makes sense when **several parties that do not fully trust each other** must share one record. A single company with its own database does not need it.

Robotics

> **Robotics** is the design and use of programmable machines that do physical tasks, more and more often next to people.

Type	What it is like	Typical task
Industrial robot	Fast, precise, heavy loads; works behind a fence or safety barrier	Welding, painting, palletising
Cobot (collaborative robot)	Designed to work next to people without a fence; slower, lighter loads	Packing, screwing, feeding a machine
Autonomous mobile robot	Moves around a building on its own	Carrying goods in a warehouse or a hospital
Drone	Flies, usually with a camera	Inspecting roofs, solar fields, crops

Robots are described by a **spec sheet** (the manufacturer's technical data). The Universal Robots UR5e cobot, for example, lifts a **payload** of 5 kg with a **reach** of 850 mm. Closer to home, the Son Espases hospital in Palma uses a Da Vinci Xi surgical robot, and in August 2025 it performed the first robotic thoracic surgeries in the Balearic public health system.

> **Careful: software robots are not robots**
> **RPA** (robotic process automation) is software that repeats rule-based tasks on a screen, as a person would: copying invoices into the ERP, filling forms. It is very useful, and many DAM graduates will build it, but it is software, not robotics.

Additive manufacturing

> **Additive manufacturing** (3D printing) builds an object by adding material layer by layer from a digital 3D model, instead of cutting it out of a block or pouring it into a mould.

Characteristic	Consequence
Layer by layer from a file	You can send the part by email and print it far away
Complex shapes, no moulds	One printed piece can replace an assembly
Short runs and custom parts	Prototypes, spare parts, prostheses
Slow and expensive at scale	For a million identical parts, a mould still wins

The famous case: GE Aviation's fuel nozzle for the LEAP jet engine. Printed in metal as **one piece instead of 20**, it is 25% lighter and five times more durable than the previous model.

Augmented and virtual reality

> **Augmented reality (AR)** adds digital information on top of what you see (through a phone or glasses). **Virtual reality (VR)** replaces what you see with a simulated environment (through a headset). In between, **mixed reality** places digital objects that interact with the real room.

	AR	VR
What you see	The real world + digital layers	Only the simulated world
Device	Phone, tablet, smart glasses	Headset
Plant example	A technician sees repair instructions on the machine	Training operators on a dangerous procedure
Business example	A shop app that shows the sofa in your living room	A virtual visit to a hotel room before booking

Mallorca Digitalitzada mixes several things: its 360-degree videos and 3D reconstructions are virtual experiences you watch on a screen, and the project also includes augmented-reality content in an experimental app. Limits: devices cost money, 3D content is expensive to produce, and long sessions tire people.

5G

> **5G** is the fifth generation of mobile networks, defined by the International Telecommunication Union (ITU) as IMT-2020.

The ITU describes 5G with **three usage scenarios**, and they are its real characteristics:

Scenario	What improves	Use
eMBB (enhanced mobile broadband)	Much more speed	Video, mobile work
URLLC (ultra-reliable low-latency communications)	Very low **latency** (delay) with very high reliability	Remote control of machines, vehicles
mMTC (massive machine-type communications)	Huge numbers of devices at once	Massive IoT: meters, sensors

5G also allows **private networks** inside a factory or a port, and **network slicing**: several virtual networks on the same antennas, each with its own guarantees. In Spain the first commercial 5G service was launched by Vodafone on 15 June 2019 in 15 cities.

> **Careful: 5G is not just "faster internet on the phone"**
> For a company, the interesting parts are latency and the number of devices, not the download speed. A port that wants to control cranes remotely cares about URLLC; a water company with 100,000 meters cares about mMTC.

Digital twins

> A **digital twin** is a virtual replica of a real asset, process, building or city that is **kept up to date with real data** (usually from sensors), so that you can monitor it, simulate changes and predict what will happen.

Characteristic	In plain words
Connected to the real thing	Live data flow from the asset to the model
Simulate before acting	Try a change on the copy, not on the factory
Predict	Anticipate failures, peaks, risks
Needs the other technologies	IoT feeds it, the cloud hosts it, AI predicts with it

In the city-builder, the digital twin is the whole game: a live copy of the city on your screen, fed by the sensors. In November 2025 the Govern de les Illes Balears announced a *Gemelo Digital de Baleares* (about 4.6 million euros) to monitor the archipelago in real time and simulate scenarios for emergencies, water resources and tourist flows. It was an announcement: when you cite it, say so.

> **Careful: a 3D model is not a digital twin**
> A beautiful 3D reconstruction of Bellver Castle that never changes is a model. It becomes a twin only when real data keep it in sync with the real thing. That is the test to apply to *Mallorca Digitalitzada*: is anything there fed by live data?

The six, side by side

Technology	One characteristic	One limit
Blockchain	Tamper-evident shared ledger	Slower and costlier than a database
Robotics	Repeats physical tasks precisely	Investment, integration, safety of people
Additive manufacturing	Complex parts without moulds	Slow and expensive for large series
AR / VR	Digital layers on reality / a simulated world	Device cost, content creation, fatigue
5G	Low latency and massive numbers of devices	Uneven coverage, compatible devices
Digital twins	A live, data-fed replica	Useless without good sensors and data

In class: spec-sheet detective

Each member works on today's technologies of their own section of Deliverable 2, in the browser, and hands in one **technology card** per technology on Classroom (class activity, individual). **No AI tools.**

Technology	Your task	Hand in
5G	Open a public coverage map such as nPerf (`nperf.com`) and look up your company's address	Which operators offer 5G there, the date of the map data, and which of the three scenarios the company would need
Digital twins	Find a real digital twin (a city, port, building or factory)	Name, who, when, and the test: what live data feed it?
AR / VR	Open `mallorcadigitalizada.com` and try two resources	For each one: AR, VR, 360° video or 3D model, and why
Robotics	Open the spec sheets of two real robots of the same type (two cobots, two warehouse robots…) from the manufacturers' websites	A comparison table: payload, reach or speed, weight, typical

Technology	Your task	Hand in
		task; which one could work at your company
Additive manufacturing	Find a real part made by 3D printing in industry, and one part of your company that could be printed	The case with its source; the part and why
Blockchain	Read a real traceability case (the Walmart case study at `lfdecentralizedtrust.org` is one)	Who the parties are, why they need a shared ledger, and whether your company has several parties that do not trust each other

Each card has three fields: **what it is and three characteristics**, **a real deployment with its source cited**, and **verdict for our company** (fits / maybe / does not fit, with half a line of reason). With the minutes left, the group fills a table of the eleven technologies with the verdict of each one.

For your project

The cards of today and of the previous lesson are fields 1, 2 and 7 of your technology sheets in Deliverable 2. The group table of eleven verdicts is the first draft of the **summary matrix** of the group part. “Does not fit” is a good answer if it is reasoned: a software company hardly needs additive manufacturing, and saying so shows judgement.

Key takeaways

- **Blockchain** is a distributed, tamper-evident ledger; it only pays off when several parties that do not trust each other share one record.
- **Robotics** ranges from fenced **industrial robots** to **cobots** that work next to people; **RPA** is software, not robotics.
- **Additive manufacturing** builds layer by layer from a file: complex, custom and short-run parts, but slow for big series.
- **AR** adds layers to the real world; **VR** replaces it.
- **5G** is defined by three scenarios: more speed, very low **latency** with high reliability, and massive numbers of devices.
- A **digital twin** is a replica kept in sync with real data; a 3D model without live data is not one.

Quick check

1 A winery, its grape growers, the bottling plant and the distributor want one shared record of where every bottle comes from, and none of them wants another to control it. Which technology fits best?

A A spreadsheet in the winery’s cloud
B A blockchain shared by all the parties
C A digital twin of the winery
D A cobot in the bottling line

2 What is the main difference between an industrial robot and a cobot?

- **A** The cobot is always faster and carries more weight
- **B** The cobot is designed to work next to people without a fence, usually slower and with lighter loads
- **C** The cobot is software that automates screen tasks
- **D** There is no difference: it is a marketing name

3 A boatyard needs a spare plastic part for an old engine that is no longer manufactured. Which technology helps most?

- **A** 5G
- **B** Blockchain
- **C** Additive manufacturing
- **D** Virtual reality

4 A technician wears glasses that show the next repair step on top of the real machine. What is it?

- **A** Augmented reality
- **B** Virtual reality
- **C** A digital twin
- **D** Robotics

5 For a port that wants to control cranes remotely, which 5G characteristic matters most?

- **A** The download speed for videos
- **B** Very low latency with very high reliability (URLLC)
- **C** Massive numbers of cheap devices (mMTC)
- **D** The new phone models

6 A city publishes a detailed 3D model of its old town, built in 2024 and never updated. Is it a digital twin?

- **A** Yes, any 3D model of a real place is a digital twin
- **B** No: a digital twin must be kept up to date with real data from the real place
- **C** Yes, as long as it can be viewed in virtual reality
- **D** No, because digital twins only exist in factories

7 Which statements about blockchain are true? Pick two.

- **A** Cryptocurrencies are one application of blockchain, not the technology itself
- **B** A blockchain is always faster than an ordinary database
- **C** Changing an old entry is detected because the blocks are linked by cryptography
- **D** A blockchain needs one central authority to validate every entry

You now know the eleven upgrades of the tech tree. The next question is what comes out of them: new products, new services and markets that did not exist. Next: Products, services and markets.

Solutions

1. B · Several parties that do not fully trust each other, one record that nobody should be able to change alone: that is exactly the case where a **blockchain** is worth its cost.

2. B · **Industrial robots** are fast and strong but work behind barriers; **cobots** trade speed and payload for the ability to share the space with people. Software that automates screens is **RPA**.

3. C · One custom part, no mould, no factory making it any more: a typical job for **additive manufacturing**. Somebody models the part in 3D (or scans it) and prints it.

4. A · The technician still sees the real machine, with digital information added: **augmented reality**. In virtual reality the real world would disappear.

5. B · Remote control needs the order to arrive almost instantly and always: **URLLC**. Speed (eMBB) and massive devices (mMTC) are the other two scenarios, useful for other jobs.

6. B · The test is the **live data**. Without sensors keeping it in sync, it is a model, however beautiful. Digital twins exist for machines, buildings, ports and whole cities.

7. A, C · Blockchain is **tamper-evident** and usually works by **consensus** without a central authority. It is slower and more expensive than a database, which is why it only pays off in specific cases.