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5.9 Management and information systems (HL)

The internet of things, artificial intelligence and big data

Another area of disruptive innovation involves the increasing connectivity between objects in the physical environment. This connectivity, combined with the data generated and artificial neural networks that you learned about in Section 5.9.1 (/study/app/y12-business-management-a-hl-may-2024/sid-351-cid-174702/book/critical-infrastructures-id-39509), opens new markets and industries.

The internet of things (IoT)

The internet of things (IoT) describes connections (networks) of physical objects using software that enables them to communicate and exchange data. These are sometimes called ‘smart’ devices or systems.

You may have a smartphone, a smart TV, a smart speaker, a smart home device, a smart security camera or a smart watch. Some homes have a robot vacuum, a smart temperature meter and smart light bulbs. As smart systems become more sophisticated and integrated, smart appliances, smart clothing and many other smart technologies – including autonomous vehicles and systems – will connect together. Smart cities are already using technologies to increase connectivity in order to share data to improve city systems including transportation, energy, waste management and others.

Video 1. What is the internet of things?

Another example of the internet of things is in the world of sport. Sports technology companies are installing chips, sensors and other devices into footwear, clothing, watches and equipment. The aim of this is to help coaches monitor athlete performance and health (by using data analytics to improve training), enhance diets and personalise coaching to improve individual output. This is opening up new markets for sportswear and sports science. All of this data can be accessed from smartphones or tablets at any time to help coaches make effective real-time decisions on the performance of athletes. By enabling every tiny detail of an athlete's performance to be tracked and monitored, this technology is being used to improve in-game techniques.

Artificial intelligence

Artificial intelligence is the ability of a computer-controlled robot, or autonomous robot, to carry out tasks previously carried out by humans. In manufacturing, sensors and robots work in synchronicity with machines to produce goods in an automated factory, known as a smart factory. With the right programming, machines can even improve their own functioning over time. Machine learning is a type of artificial intelligence that uses data and algorithms to improve processes and outputs over time.

Artificial intelligence is changing the way in which business is conducted, in every sector. **Table 1** outlines a few examples of artificial intelligence in the primary, secondary and tertiary sectors.

Table 1. Examples of the benefits of artificial intelligence in different sectors.

Sector		Examples of benefits of AI

Primary sector	 Credit: Bunlue Nantaprom / EyeEm, Getty Images	• Increases efficiency of food production through precise monitoring and application of nutrients, reducing pesticide and water use and improving sustainability. • Drones can closely monitor crops and soil and can also track livestock.
Secondary sector	 Credit: gong hangxu, Getty Images	• Minimises waste and identifies defects, improving lean production. • Factory data is stored in the cloud and machine learning corrects problems and improves efficiency. • Factories operate with little human intervention, reducing costs of labour.

Tertiary sector	 Credit: Ekkasit Keatsirikul / EyeEm, Getty Images	• Robots and sensors monitor consumer behaviour and engagement, improving sales forecasting, pricing decisions, product placement and customer segmentation. • Sensors and cameras monitor stocks (inventory) so that reorders are made automatically. • Sensors and cameras monitor stores and automatically calculate purchases in a consumer's cart, charging the customer's card as they leave the store. • Chatbots provide 24-hour customer service, reducing the need for human labour.

Whilst the capabilities of artificial intelligence vary by sector and business, generally AI can:

- improve decision-making with use of production, stock, sales and customer data
- automate processes to ensure speed, consistency and efficiency
- develop new markets through innovations and capabilities
- provide virtual assistance for customer service and other areas

Theory of Knowledge

Artificial intelligence analyses large data sets to identify patterns and trends and then takes action based on that knowledge. Until recently, this is something that has only been done by human beings. Knowledge is usually associated with human beings, so a question arises as to what extent the processes of artificial intelligence mean knowledge is now stored outside of human beings.

- Does artificial intelligence allow knowledge to reside outside of human knowers?

Big data

Big data refers to large amounts of data collected by advanced technologies. The volume and variety of data gathered is impossible for human beings to process; the analysis and processing of this data is only possible with machines.

The more data these systems process, the more they can improve decision-making for businesses. Through the internet of things, connected devices communicate more and more, enabling systems to adapt and tailor their capabilities. This results in improved decision-making and more streamlined production processes. This in turn leads to higher returns on capital investment, more targeted promotions, increased customer engagement and development of new products and services.

Making connections

You could use a variety of business tools when considering a business decision to implement machines with artificial intelligence.

A decision tree, force field analysis, investment appraisal or the Ansoff matrix may help you to assess the benefits and drawbacks of adopting such technology.

Deep learning is a more sophisticated version of machine learning and also uses big data to improve outcomes. It relies on the use of artificial neural networks (ANN) introduce in Section 5.9.1 (/study/app/y12-business-management-a-hl-may-2024/sid-351-cid-174702/book/critical-infrastructures-id-39509). This is the technology that enables self-driving vehicles to make steering, speed, and braking decisions based on information from a context that changes second-by-second. The same algorithms are being used to develop sophisticated robotic assistants that can manage emails, calendars or small tasks, or which can help provide assistance around the home or in retail settings.

Deep learning technologies are also helping to provide advancements in cyber security, health care, catering, deep-sea exploration and automotive and logistics industries, to name a few. It is causing disruptive change across many industries.

Risks associated with the internet of things, artificial intelligence and big data

It is important to consider that all of these elements– the internet of things, artificial intelligence and big data – work collectively and have risks and limitations associated with them, some of which are outlined in **Table 2**.

Table 2. Risks associated with the IoT, AI and big data.

Technology	Risks and limitations
Internet of things (IoT)	**Cybersecurity.** DDoS attacks, malware, ransomware and hackers threaten the security of connected devices and systems. **Poor internet infrastructure.** This reduces connectivity and limits sensor effectiveness, especially in countries that lack 4G and 5G networks.
Artificial intelligence (AI)	**Capital costs.** AI technologies, especially if needed on a large scale, can be very expensive, at least initially. **Ethics concerns.** Poor algorithm programming can lead to discrimination and bad decisions, privacy violations and job losses. **Legal concerns.** Laws still lack clarity on liability when AI malfunctions; legal privacy protections are lagging behind advancements in technology.

Big data	**Security.** Storing vast amounts of data increases risk of loss or of theft from cybercriminals. **Costs.** Data centres, cloud computing and cybersecurity add costs to a business's operations. **Ethics concerns.** Collecting, storing and processing data can lead to privacy violations; data can be used to manipulate consumer behaviour or to discriminate against certain groups.

Concept

Change

Disruptive innovations such as virtual reality, the internet of things, artificial intelligence and big data are changing industries. As a result, many new businesses are emerging that deliver goods and services with these technologies. Some existing businesses are adapting their models to use these new technologies; other businesses are finding that they cannot adapt and go out of business. Thus, technological change is a key element of the external environment (Section 1.1.5 (/study/app/y12-business-management-a-hl-may-2024/sid-351-cid-174702/book/tool-swotsteeple-analysis-id-36504) STEEPLE) that affects business operations.

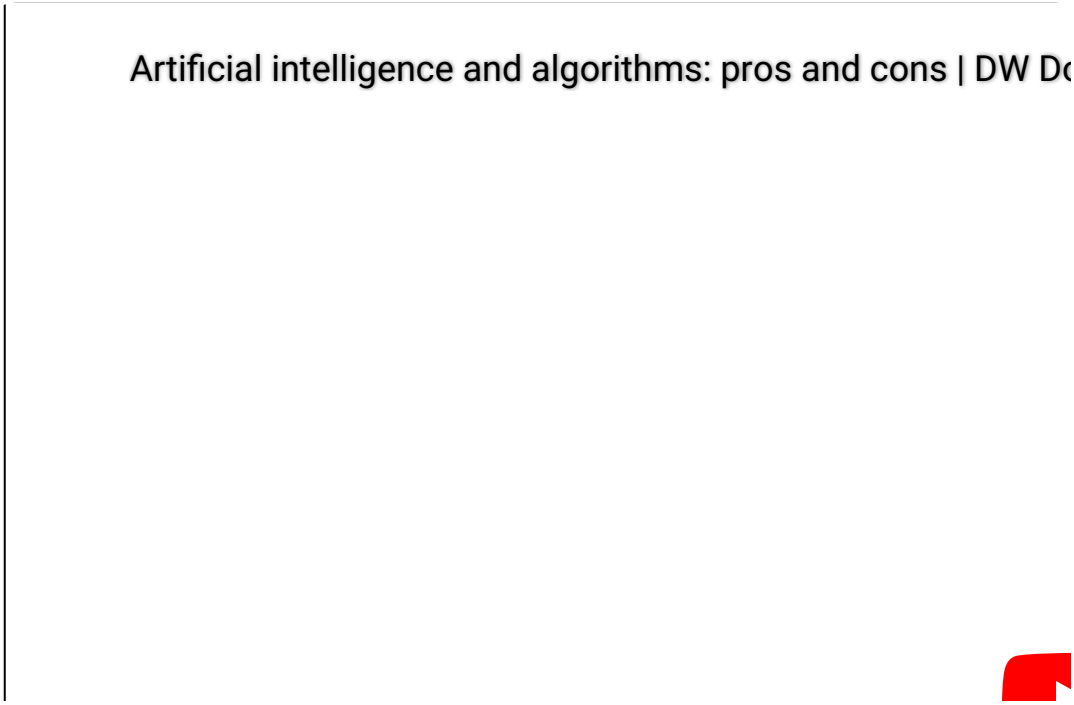
Activity

Learner profile: Principled
Approaches to learning: Thinking skills (critical thinking)

Video 2 addresses some pros and cons of artificial intelligence in various contexts. The full video is about 42 minutes long, but is divided into four sections as follows:

1. AI in medicine (0:00-15:05)
2. AI in China (15:05-23:00)
3. AI and the power of big technology companies (23:00-30:40)
4. AI and self-driving cars (30:40-42:25)

Each section mentions some benefits of AI, but also highlights some ethical issues.



Video 2. How is AI used and what are the ethical risks?

- In a small group or alone, watch one of the four sections of **Video 2**.
- With your group members or alone, develop an inquiry question related to the ethical issue(s) outlined in that section of the video.
- Identify the key stakeholders involved in the AI application and list their main interests.
- Share your work with other students who developed ethics inquiry questions for the other video sections. Do any of the questions overlap? Are there any ethics themes that arise from these questions?