

While product liability rules are there to promote high quality and safety in products, when it comes to more complex robots, legislation could ultimately deter developments in robotics, so a fine balance is needed.

Inquiry

3.7D Robots and autonomous technology dilemmas and 3.7A Types of robots and autonomous technologies (content)

Reflect

Reflect on new ideas and understandings, and discuss future developments

- Does your conclusion include a reflection based on new ideas and understandings that are a result of the analysis and evaluation?
- Does your conclusion include a discussion of possible new trends and future developments?
- Does your conclusion answer the inquiry question?

- Select a country of your choice and research how the development of regulations and laws is impacting one type of robot or autonomous technology, for example the regulation of autonomous vehicles in Singapore, or the regulation of service robots in South Korea.
- Reflect on the implications that these technologies are having on your chosen scenario.
- Provide a supported opinion about the future of legislation and the use of this technology.



Activity: HL Extended Inquiry



3.7D Robots and autonomous technology dilemmas, 3.7A Types of robots and autonomous technologies (content) and 5.1B Changing populations

Once you have studied Section 5.1B, complete this inquiry activity.

Challenge: Research and describe the global challenge.

Many developing countries have aging populations, which are predicted to create issues in the future.

- Use effective research skills to describe the challenge of an aging population in detail.

Intervention: Research and evaluate the use of social robots as one intervention for this challenge.

- Research and evaluate this intervention using the HL extended inquiry framework.
- Make a recommendation for steps for future action.

Present your work in the form of a written report.

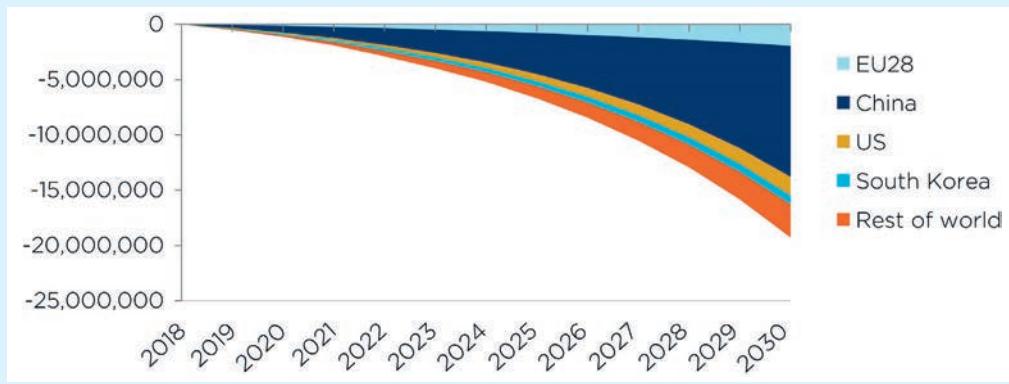
■ Displacement of humans in multiple contexts and roles

Earlier in this chapter we discussed the use of robots in manufacturing as well as the development of service and social robots. So, there is no doubt that these robots will impact the workplace – whether it is replacing jobs on a production line, or working alongside humans in the service industry.

REAL-WORLD EXAMPLE

Automation and job losses

In June 2019, Oxford Economics predicted that up to 20 million manufacturing jobs around the world could be replaced by robots by 2030. Automation is replacing lower-skilled jobs, with workers moving out of manufacturing into jobs in the transport, construction and administration industries, which are also likely to undergo a certain level of automation. This is a challenge for governments, which promote innovation on one hand but also need to address the issues of unemployment.



■ Projected cumulative jobs losses by automation, up to 2030

www.bbc.com/news/business-48760799

So, which industries will be susceptible to automation next?

Workers in the food industry spend a lot of their time performing physical tasks that are repetitive and in a predictable environment, therefore their jobs are more susceptible to being automated. Meanwhile, industries such as education and health care, which involve interpersonal work, are more likely to be an area for the cobots. Cobots can be medical assistants and monitor health conditions to alert human nurses when needed. They can also be used by law enforcement agencies or security companies for patrolling. In this instance, any suspicious activities would be referred to a human officer. However, despite cobots operating with humans, robots performing these routine tasks will still effectively replace some, if not all, of the lower-skilled jobs.

So, we may be looking at a future where we do not need taxi drivers, or car sales people (as we may no longer be car owners), but new jobs will also be created: jobs that assist robots in their learning, robot engineers, robotic technicians, robotic sales people, software developers and robotic operators to name just a few.

Links

This content links to
4.2B Employment and labour.

Inquiry

3.7D Robots and autonomous technology dilemmas (content) and 4.3D Agriculture (contexts)

Analyse

Analyse impacts and implications for relevant people and communities

- Is your inquiry question supported by additional questions to consider for analysis and evaluation?
- Does your analysis focus on the impacts and implications for people and communities?
- Is your analysis effective, sustained and well-supported by evidence?

Conduct research and then analyse your findings to address the following questions:

- How are robots being used in agriculture? In which areas are they replacing workers or working alongside humans?
- How is this affecting the industry?

EXAM PRACTICE QUESTIONS



Paper 1 (core)

- 1 Define the term 'uncanny valley'. [2 marks]
- 2 Outline two reasons why robot developers would want humans to develop an emotional relationship with robots. [4 marks]
- 3 Explain two reasons why there are underdeveloped laws about the use of robots in some countries. [6 marks]
- 4 For one industry of your choice, evaluate the use of robots in the industry, using real-life examples to support your answer. [8 marks]

TOK

Knowledge and technology

The impact robots have had on knowledge has given rise to new ethical debates. When looking at the new knowledge being created by these machines, one may ask the following questions:

- Who is the owner of this knowledge?
- When an autonomous robot is required to make ethical decisions, who is responsible?
- What criteria should we use as a foundation for the ethical programming of these machines?
- Is it possible to have a global agreement?
- Is the absence of an emotional human an improvement on ethical decision-making by a robot?
- How can a robot be programmed when two ethical principles contradict each other?
- When looking at the scope of robots, what does it mean when a robot is said to 'know' something?
- Is it possible for robots to acquire knowledge?



Creativity, activity, service (CAS)

Robotics club

Research different clubs on offer at your school. Is there a robotics club? If so, see the club coordinator and offer to support the students and help by creating activities each week.

If there is no existing robotics club, see how many friends would like to join and set one up. This would make an ideal CAS project. You will need to find out what robot kits the school has, and seek approval, plan and design each session. Run the club for 8 to 10 weeks, and do not forget to reflect!



Extended essay (EE)

The evolution of robotics, its uses and the intended and unintended consequences may give rise to some interesting topics for an extended essay.

Look at one of these topics as a focus for the essay, for example, how a specific use of robots is impacting a particular context, such as health and the provision of health care.



Reflection

Now that you have read this chapter, reflect on these questions:

- What type of robots have you personally encountered?
- In which contexts are robots having a significant impact?
- To what extent are robots replacing humans in the workplace?
- To what extent is the community that you live in ready for autonomous vehicles?
- Should limits be imposed on robot developments?
- To what extent are current robot legislations a barrier for development and adoption?
- How are robots being used as an intervention for changing populations?
- To what extent is it possible to agree on the ethical decision-making by robots?



Learner profile

Principled

When discussing the many ethical debates surrounding the use of robots, consider your viewpoint on these moral dilemmas.



Section 4

Contexts

4.0

Overview of real-world contexts

UNDERSTANDINGS

By the end of the section, you should be able to:

- ▶ demonstrate knowledge of a range of real-world examples in different contexts
- ▶ understand the content and digital systems that are used in each real-world example
- ▶ relate each real-world example to relevant concepts
- ▶ understand how real-world examples will be used as a basis for Paper 1 and Paper 2
- ▶ extend some of the real-world examples to include challenges and interventions for higher-level topics.



When studying digital society, it is important to have an understanding of a range of real-world contexts and how they relate to the content and contribute to our overall understanding of the major concepts.

This section consists of seven chapters highlighting real world contexts with examples:

- cultural
- economic
- environmental
- health
- human knowledge
- political
- social.

The importance of the contexts section

The first chapter in this section starts with an exploration of **culture**. Culture encompasses all the ‘ways we live’ in a digital society, including traditions, customs, arts and creativity. Just as physical locations have their own unique cultural norms and expectations, digital spaces have their own sets of norms and cultures. Culture is also impacted by how we integrate digital technologies into our daily life and activities.

This is followed by an exploration of the **economic** context: the areas where digital tools impact business, employment, market and international activities. This chapter explores a diverse range of areas in which the nature of work has shifted due to our digital society, as well as the changes in markets, trade and commerce.

The **environmental** context encompasses how the creation and disposal of digital goods are impacting the environment, how technologies are being used to monitor the natural world, and how innovations are used to make our existing activities more efficient and sustainable.

The **health** chapter discusses the ways the medical profession is integrating digital tools for patient care as well as developing and refining their best practices and treatments. Additionally, this chapter explores how digital technology can impact the human body – both the risks and benefits of augmentation of the body with digital systems. Finally, the chapter concludes with an examination of the mental health concerns of life in a digital society, now that we are constantly connected and interacting in ways that were not possible just a few decades ago.

The impact of digital technologies on learning and education in both academic and professional settings are discussed in the **human knowledge** chapter. This includes formal and informal access to knowledge, as well as how the internet has made information and knowledge more accessible.

This chapter also explores how discovery and innovation have evolved with the integration of digital technologies.

The **political** chapter looks at a wide range of topics including government use of technologies, such as the integration of digital technology in political campaigning. It also discusses the issues and challenges that arise in regulating digital technologies, including the emergence of cybercrime and digital warfare.

Finally, the **social** chapter explores how our demographics, class, family, location and other identity markers are impacted by technology. This section shines a light on digital divides, encouraging you to reflect on your own experiences and identities, and how your reality may differ from those with a different social background from you.

How to use this section

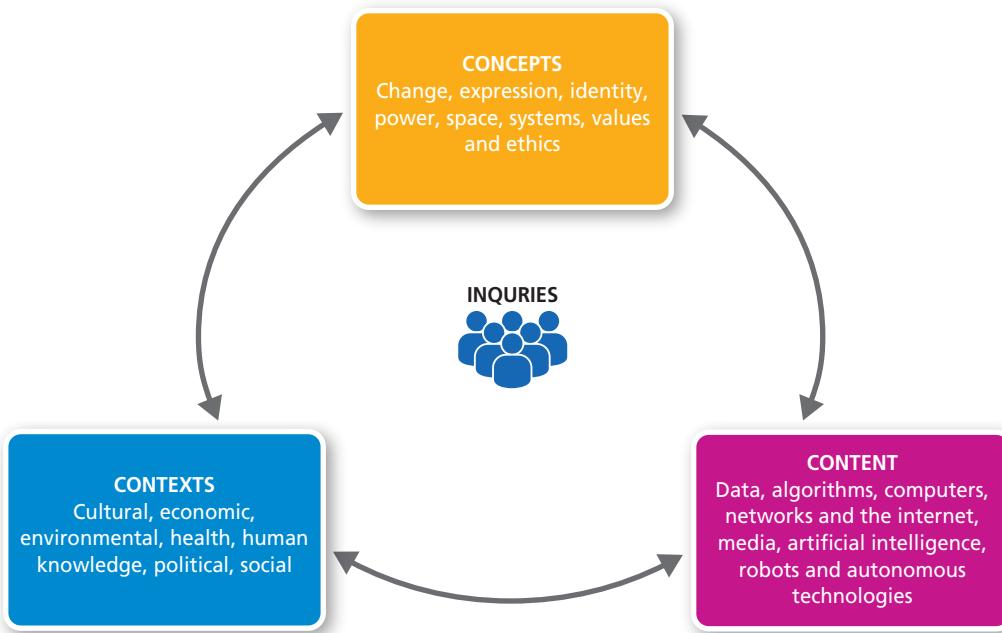
Each chapter contains an overview of the context as well as a sample of real-world examples and activities. You are encouraged to use these examples or to conduct your own inquiry activities. It is recommended to follow the inquiry process and consider:

- 1 Other examples where digital technologies or phenomena are relevant to the context or information from this section.
- 2 Multiple sources about the topic or digital technology you are investigating, especially those with differing perspectives and backgrounds.
- 3 Individuals and communities (stakeholders):
 - a at the local, regional and global level
 - b with various involvement such as end-users and creators of digital technology.

- 4 Brainstorm the positive and negative impacts of the technology on the stakeholders.
- 5 **Connection to concepts:** What concepts are most significant in the real-world example that enable you to look at it in different ways?
- 6 **Connection to content:** Ensure you can articulate the step-by-step process of how the digital technologies work and what relevant content will help you to understand that process.
- 7 Respond to the activities provided.

Context and the 3Cs

By completing inquiries in the context chapters, you will be able to apply all parts of the 3Cs diagram to each real-world example.



Digital society: Contexts

For the core syllabus for higher-level and standard-level students:

- Context: The specific real-world example as it relates to individuals or people and communities at a local or global level.
- Content: Digital systems and technologies used in the specific real-world example.
- Concepts: Relevant to the specific real-world example.
- Stakeholders: Consideration of the impacts and implications of the use of digital technologies.

Higher-level students may also extend the real-world examples from Section 4 to the HL extension challenges and interventions in Sections 5 and 6.

4.1

Cultural

UNDERSTANDINGS

By the end of this chapter, you should understand:

- ▶ innovations in digital technologies have changed the definition, creation process and sharing of cultural artifacts and traditions
- ▶ digital technology tools are integrated into our daily lives and activities, causing the evolution of both what people do and how they do it
- ▶ digital technology is both an asset and a threat to existing traditions and ways of being
- ▶ technologies have connected groups and subcultures, as well as created new spaces for youth engagement and connection.

This chapter examines our way of life in a digital society. It includes creative expression, as well as the tools, methods and approaches that are used to both generate and share media and other cultural artifacts.

Culture is also defined by how we live, work and engage in leisure activities. Families and communities often have their own traditions, practices and customs that they share from generation to generation. Within cultures, smaller subcultures also have their own practices and customs.

4.1A Arts, entertainment and popular culture



Art and entertainment have been part of cultures and cultural expression for thousands of years.

Popular culture encompasses the music, dances, movies, performances, art and other forms of expressive media enjoyed by a society. Even food is part of pop culture.

The interaction between digital technologies and culture is intricately balanced, with each informing and influencing the other's development. For over 200 years, artists, authors and (more recently) filmmakers have described future settings with flying cars, interactive advertisements and humanoid robotic assistants.

◆ **Popular culture:** The music, dances, movies, performances, art and other forms of expressive media enjoyed by a society.

As digital technology integrates into all aspects of society, it also shapes and provides bridges between modern cultures. The internet gives people access to new, virtual experiences all over the world, often overcoming distance, wealth and resources divides.

Access to the arts has also evolved significantly due to advances in digital technologies – this includes access to performances, art galleries and museums, as well as new approaches to artistic creation.

Overall, arts organizations believe that the internet and social media have increased engagement and made art more accessible to a diverse audience base. This access reduces the digital divide and provides more opportunities for expression. Others argue that digital technology dilutes the aesthetics of traditional arts by opening new pathways for artistic expression and creation. In addition, developments such as cell phones can disrupt live performances, and contribute to the expectation that all digital content should be free.

■ Genres, techniques and forms

Digital technology has transformed art, music, performing arts and other **genres**, or categories, of artistic expression. While different **forms** and manifestations of culture continue to develop, common forms of cultural expression include painting, graphic design, sculpture, literature, film, music, theatre and fashion; even architecture can be considered a form of cultural expression.

The **techniques** used to create, edit and publish art have evolved and adapted to advances in digital technology. New tools, in combination with advancing software, have shifted the landscape for photography, including the scanning, storage and restoration of classic photos. Digital photography and cameras are now so commonplace and affordable that the world now captures more photos every two minutes than were taken during the entire 1800s.

Although the use of smartphones has made it easy to capture moments in our lives and memories to look back on, there is growing concern that we have become too busy trying to capture a photo that we no longer fully enjoy the moment.

◆ **Genre:** A category of art.

◆ **Form:** The physical natures of a work of art, for example painting, graphic design, sculpture, literature, film, music, theatre, fashion and architecture.

◆ **Technique:** The way an artist uses their technical skills to create their art.

Inquiry

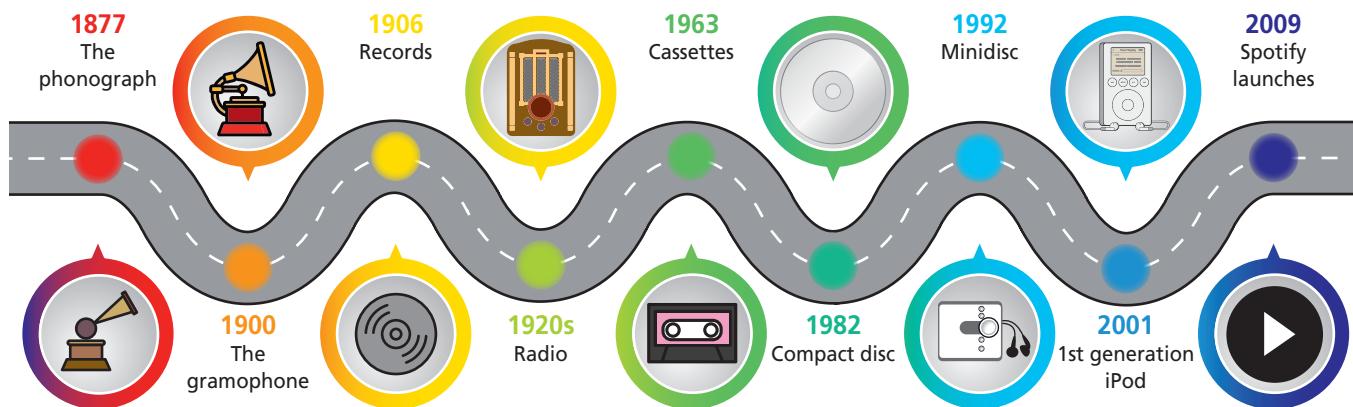
Linda Henkel, a professor of psychology at Fairfield University, USA, conducted a study in 2013 on how taking photos impacts our experience and memory.

Use this research to evaluate the impact that taking photos has on our memory and experience of an event.

- Conduct research into Linda Henkel's study, and on how taking photos impacts the experience and memory. Use at least three different sources.
- Describe the details of the study.
- Discuss the impact this has on both an individual's experience and their memory of the event.
- Evaluate the claim that the camera on a smartphone undermines the appreciation of art.
- Reflect on at least one occasion where you or a friend has used the camera on your smartphone in this way. Do you agree with the outcomes of this study?

Ways to experience art and entertainment

Prior to the 1900s, music could only be heard in live performances. Over the past 100 or so years, the way music is produced, experienced and stored has evolved to the point where people can access and listen to high-quality recordings instantly anywhere in the world.



Evolution of technology in music

It is not only the music industry that is shifting dramatically with emerging digital technologies. Modern cinema has captured the acting and drama that was once reserved for playhouse stages, and now video **streaming** platforms bring this content directly into homes. Art galleries are digitizing their collections and many are hosting online galleries and **online exhibitions** – some interactive and immersive – where one can take a virtual tour to see timeless pieces without leaving the comfort of home. Advances in technology have made cultural experiences more readily accessible, affordable and instantaneous.

◆ **Streaming:** Multimedia (especially video and audio) that is delivered digitally with little or no intermediate storage.

◆ **Online exhibition:** An exhibition in a virtual venue (cyberspace).

ATL ACTIVITY

Research

Research online museum tours or exhibitions and try one out.

- Conduct research to find a list of free online museum or exhibition tours, such as Google Arts & Culture, Musée du Louvre or the Met 360° Project.
- Create a shortlist of those that interest you.
- Select two on your shortlist to try out and spend at least 15 minutes on each site.
- Compare and contrast the experience of the online tour with a recent visit to a physical museum/exhibition.

Links

This content links to Chapter 2.1 Change.

EXAM PRACTICE QUESTIONS



Paper 1 (core)

- 1 Discuss the decision for an owner of an art gallery to develop a virtual tour that is accessible online. [8 marks]

Memes, online forums, internet celebrities and influencers

The internet has built and developed its own culture. **Memes** can take a range of forms but often use images combined with text. Modern memes are often silly, diverse and cater to a wide range of audiences. Internet memes have even been mobilized to advance the causes of social issues. For example, in 2014 the ALS (amyotrophic lateral sclerosis) ice bucket challenge raised over US\$220 million in funds for ALS when it went **viral**. Participants were challenged to post a video of themselves pouring a bucket of ice water on their head while promoting awareness of ALS and encouraging donations.

ATL ACTIVITY

Research

Research the origin of the 'Pepe the Frog' internet meme.

- Conduct research to find an image of Pepe the Frog.
- Can you find its original source?
- How has it been used and repurposed?

ATL ACTIVITY

Communication

Create your own meme.

- Research and find a free online meme generator or online image editing software.
- Try out the different tools in the software.
- Create your own meme to raise awareness of an issue or to communicate a message.
- Share your meme with your peers.



■ The ice bucket challenge

Online forums are any platform where people can post and discuss messages. They can be anonymous, use display/user names or actually (attempt to) identify the true authors. Reddit is one popular forum that hosts anything from Photoshop battles (such as 'People with Bird Heads') and fan-fiction threads (where amateur authors create their own stories, sequels and spinoffs to their favourite books, movies and stories) to personal finance threads, where users can ask practical questions about money matters.

As social media has become more prevalent, internet celebrities, also called social media **influencers**, have gathered large numbers of followers to their profiles. Thanks to the ease with which content can be created and shared, influencers have been able to build their own brands and pave their own paths to success, regardless of their age, gender identity, religion or social class. Many have been rewarded with record labels, advertising deals, promotional sponsorship and more.

Links

Memes are also discussed in Chapter 3.5 Media.

ATL ACTIVITY

Research and thinking

Research real-life examples where social media influencers have been criticised. Suggest ethical criteria that social media influencers should adhere to. You may address promoting sponsored products, respecting local cultures, and standards for fact checking/accuracy.

Links

This content links to Chapter 2.7 Values and ethics.

REAL-WORLD EXAMPLE

The Monkey Selfie

In 2011, photographer David Slater set up camera equipment in an Indonesian jungle. While the camera was unattended, a monkey (named Naruto) took a selfie using the photographer's equipment. As the photo became famous on the internet and began to generate global interest, David Slater started to earn revenue from the photo.

People for the Ethical Treatment of Animals (PETA) engaged Slater in a lawsuit claiming that since the photographer was the monkey, revenues from the photo should go toward preserving habitats for monkeys like Naruto. The two parties eventually settled and Slater agreed to donate 25% of the revenue from the photos to groups that protect monkeys in Indonesia.

The American courts involved in the case argued that there is 'no indication' that American copyright laws extend to animals. This raises an ethically debatable question over what protection animals and non-humans should have, not just in matters of copyright but in many legal processes.

Inquiry

Explore

Explore and collect information from relevant sources

- Do these other sources provide claims and perspectives that will be useful in the inquiry?
- Have you gathered a range of content from secondary and primary research and investigations?
- Can you provide clear justification for three main sources for their usefulness in the inquiry?

Research how the internet is being used to raise awareness and funds for an issue or cause. Make sure that you have enough sources to be able to:

- describe how the internet was being used
- have at least two examples of awareness campaigns to support your inquiry
- have different perspectives from two stakeholders.

Analyse

Analyse impacts and implications for relevant people and communities

- Is your inquiry question supported by additional questions to consider for analysis and evaluation?
- Does your analysis focus on the impacts and implications for people and communities?
- Is your analysis effective, sustained and well-supported by evidence?

- Analyse the impacts that this technology is having on the campaigners and the public.

Links

This content links to Chapter 3.5 Media.

Concept connections

- **Identity:** Selfies and social media have become part of our identity and are often the first place people and organizations investigate to find out about people.
- **Systems:** A monkey taking a selfie in the jungle of Indonesia invoked a lawsuit from an animal rights organization that centred around extending copyright laws to non-humans – this has implications for both the judicial and economic sectors.
- **Power:** The original US Copyright Law only protected artwork for 14 years. In 1976, however (possibly due to lobbyists from Disney, as Mickey Mouse's copyright was about to expire), the law was changed to cover the author's life plus 50 years (or 75 years for business copyrights). How does longer copyright protect and/or hinder artists, creativity and progress?
- **Space:** Selfies and social media have extended the reach of our identities and expression to many people; we now live in extended social spaces.
- **Change:** Selfies and social media can be permanent records of ourselves. While we may change much about ourselves over time, including our interests and our relationships, social media does not change with us and can act against us.
- **Expression:** Selfies and social media have changed the way we document our lives and experiences. Do you think the monkey was emulating human behaviour, or just curious and pressing buttons that happened to result in a selfie photo?
- **Values and ethics:** What values and ethics considerations apply in the real-world example, The Monkey Selfie?

4.1B Home, leisure and tourism

Digital technologies are embedded into our daily lives. Modern conveniences have transformed the ways we live, travel and relax. In 1905, the first electrical appliance revolutionized the way bread was toasted. In just over a century, the convenience this first toaster offered has expanded into automated vacuums, phone-controlled thermostats and fridges that can automatically order more milk when you start running low.



■ Kitchen appliances have come a long way!

Leisure has also evolved, whether you are indoors glued to a screen watching an endless stream of content or playing video games, or outdoors with your smartwatch keeping track of your steps as you hike through the wilderness (and your GPS keeps you from getting lost). While we are not yet entering *The Matrix* or *Ready Player One* levels of virtual reality, digital technology has become an integral part of the way that humanity enjoys itself.

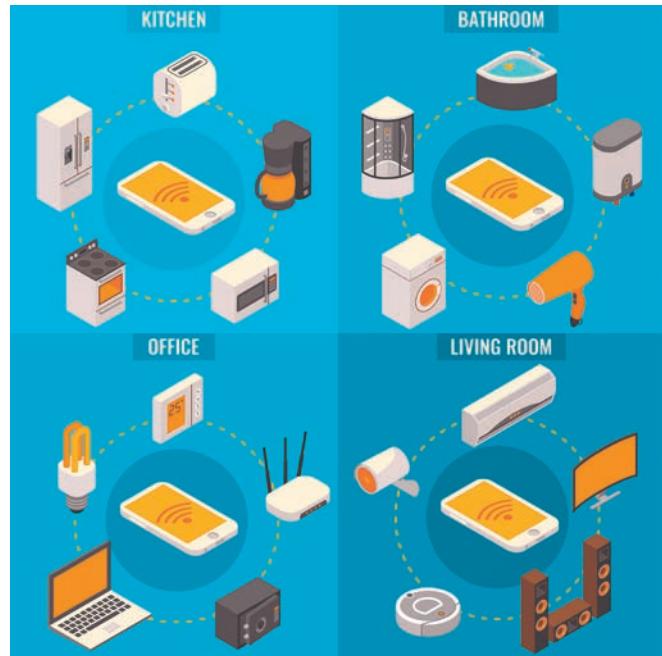
Travel has never been easier, with translation apps, peer-reviewed forums, online booking systems and an endless stream of bloggers sharing tips and recommendations to ensure you have the most unique experience, just like they did.

Links

This content links to Chapters 3.4 Networks and the internet, and 3.7 Robots and autonomous technologies.

Home appliances, services and technologies

The **internet of things (IoT)**, introduced in Chapter 3.4, encompasses the billions of network-connected devices found in homes, ranging from vacuums and toasters, to thermostats and lightbulbs. By connecting objects to the internet, they can be controlled remotely from anywhere in the world. **Smart homes** are equipped with internet-connected lighting, heating and other electronic devices. Waking up in a smart home could mean that your window blinds open automatically, as your thermostat heats up your room, while your coffee pot starts, as your virtual home assistant turns on your favourite news channel, while your vacuum starts cleaning, and your dog food dish dispenses another ration of food, while your ... you get the idea!



ATL ACTIVITY

Social

With a group of friends, research and present on the different digital technologies used in a smart home.

- In your group, assign one person to each of the areas:
 - security and door access
 - smart entertainment systems
 - lighting and heating controls
 - kitchen and laundry appliances
 - bathroom applications.
- Research the digital technologies available for your given area.
- Describe each technology, including its purpose and how it functions, with suitable images.

◆ **Smart homes:** Homes equipped with internet-connected lighting, heating and other electronic devices.

REAL-WORLD EXAMPLE

Hacked home security cameras

In 2018, an elderly couple in Leeds, England, installed remote-access cameras in their home after someone broke into their tool shed. Due to limited security features in the camera software, during the three years that the cameras were installed, their security footage was accessed over 5000 times in 70 different countries. This meant that they unintentionally allowed access to their private lives.

www.bbc.com/news/av/uk-44117337



Concept connections

- **Identity:** Early adopters are quick to incorporate new technologies into their homes and lives. Having the newest gadget or feature can become part of a person's identity, just as much as technological resistance can become an identity marker to those who prefer to limit the integration of digital tools into their lives.
- **Systems:** Security is only as effective as its weakest point. By introducing a wider range of devices into the network ecosystem, potential vulnerability points are made available to hackers and malicious users.
- **Change:** How does increased connectivity of the IoT change the way we approach our household appliances, chores and everyday activities?

IoT security tips

While security cameras can be password protected, there are other steps that many smart device users can take to improve the security and limit access to their devices:

- Using more complex passwords and checking the administration settings can allow users to limit unwanted access to their devices.
- Check the data permissions when installing a device or app and only share data that is essential to device functionality.
- Routine software updates will help address any known bugs or security risks that the company has identified and addressed.
- Finally, setting up a separate network for your IoT devices will ensure that any security breaches do not give hackers access to your computers, phones and other sensitive data.

EXAM PRACTICE QUESTIONS



Paper 1 (core)

- 1 To what extent are IoT smart home devices improving the quality of living for their users? [8 marks]

It is not only homes that are going digital. Digital society provides access to an endless array of online services. Food can be ordered and delivered from our phones; you can even interview and hire dog sitters, cleaners, florists, gardeners and other services using applications. Greater connectedness has evolved into the **gig economy**, where individuals and organizations exchange short-term/task-based services using digital platforms.

◆ **Gig economy:**

Labour market in which individuals and organizations exchange short-term/task-based services using digital platforms.

ATL ACTIVITY

Research

Research local examples of the gig economy.

- Interview family members to find out how they currently use the gig economy.
- Find out the details of the goods or services being used, for example transportation or food delivery, the frequency with which they are used, and the reasons why they prefer to use them.
- Reflect on the different responses from your family members.
- What conclusions can you draw?

Sports, gaming and hobbies

Digital systems have been integrated into sports in a range of ways. Professional sports use cameras and sensors to help refine the accuracy of events, for example to confirm goals, penalties and more.

ATL ACTIVITY

Thinking

Prepare for a debate: Should referees rely on digital sensors to ensure more unbiased calls in sports, or is the human perspective an essential part of the sports tradition/game?

- Conduct wider research into the use of sensors in sports events.
- Divide the group into two – one group will support the idea that sensors are an important technology, while the other group will research why they are not.
- Conduct the debate and, at the end of the session, take a vote.

Athletes are often equipped with wearable technology devices that have sensors to monitor their health and vitals to maximize their performance and minimize the risk of injuries. It is also common for phones, watches and other devices to track steps and activity, so that all users can have data and statistics about their health progress and work toward goals such as 10,000 steps, or elevating their heart rate for at least 30 minutes a day. In Chapter 3.1 you may have completed the ATL activity to investigate the data collected by a smartwatch. Now we will evaluate the impact that sports watches may have on the wearer.

EXAM PRACTICE QUESTIONS

Paper 1 (core)

- 1 Evaluate the decision of professional sports teams to require athletes to use wearable technology during competitions. [8 marks]

Links

Revisit Section 3.3A
Types of computers, to see how wearables are making their way into the leisure industry.

In 2020, the average consumption of online content doubled from about three hours a day in previous years to six hours a day. Whether it was scrolling through social media, streaming video content, chatting with friends or playing games, 2020 saw a dramatic growth in the time spent consuming digital content as well as major shifts in how the content is delivered, most likely due to the COVID-19 pandemic.

Streaming services were able to bypass movie theatres and ‘premier’ blockbuster movies in people’s homes (for a fee, of course) and many social interactions moved into **virtual conferencing platforms**, such as Zoom or Google Meet, that allow multiple users to video chat at the same time. While these were used significantly in schools and workplaces during the pandemic, families and friends also used these tools to celebrate holidays ‘together’, host game nights or just catch up.

Video games have continued to evolve since the release of *Pong* by Atari in 1972. **Augmented reality** bridges the real world with fantasy in games such as PokéMon GO, which uses GPS location and cameras to get people out and walking in real life as they progress through the game. **Virtual reality** platforms and headsets also allow for immersive experiences where you move and interact in a fully simulated environment.

ATL ACTIVITY

Research

Meta (previously Facebook) has been investing heavily in virtual reality and augmented reality research and development, and the creation of metaverses.

Research which industries are investing in virtual/augmented reality. Summarize two real life examples.



Gaming consoles continue to evolve. Instead of a large upgrade every seven years or so, we now see yearly updates to platforms and a marked shift toward streaming and downloading content. Game designers are increasingly prioritizing the ‘feeling’ they want players to have while gaming, then building story and gameplay around that. Additionally, there is a shift in gaming towards more inclusiveness and diversity, both in terms of the players and the content of the games.

REAL-WORLD EXAMPLE

Snapchat’s augmented reality selfie games

In 2018, Snapchat launched a series of augmented reality games called Snappables. These were among the options of special effects ‘lenses’ on the social media’s camera features. Using augmented reality technology, these games allow users on ‘selfie mode’ to interact with a digital environment to play games. They can send these to friends, who can join in and play along.

<https://techcrunch.com/2018/04/25/snappables-snapchat-games>

Concept connections

- **Expression:** Augmented reality tools are creating new ways for people to communicate and interact, even asynchronously or over large distances.

Links

In Section 4.4A Medicine and health, you will continue to explore how medical professionals and patients use wearable technologies in the health context.

◆ Virtual conferencing platform:

Digital platform that allows multiple users to video chat at the same time, for example Zoom or Google Meet.

Links

This content links to Chapter 3.5 Media.

ATL ACTIVITY

Communication

- What new ways of communicating and keeping in touch with your friends are popular?
- How have these evolved throughout your own experiences?
- What augmented-reality experiences have you encountered?
- Share examples and findings with your classmates.
- Try out a new method for interacting digitally with your peers. For example, you could play new types of online games with your friends or experiment with new features in communication/social media tools that you are already using.

EXAM PRACTICE QUESTIONS

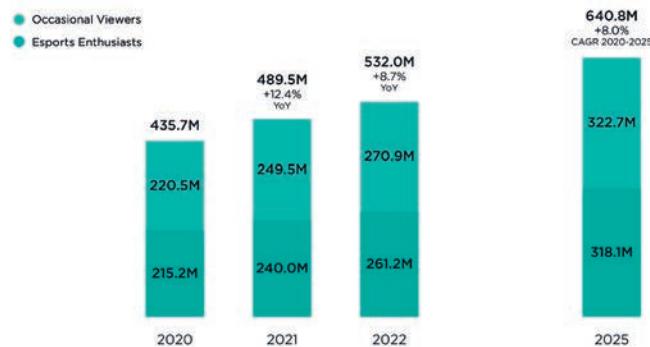


Paper 2



Esports Audience Growth

Global | For 2020, 2021, 2022, and 2025



Due to rounding, esports enthusiasts and occasional viewers do not add up to the total audience in 2022.

©Newzoo | April 2022 Global Esports and Live Streaming Market Report
newzoo.com/esports-report

- Source A: E-sports audience growth in 2019



2022 Esports Revenue Streams

Global | With Year-on-Year Growth



Newzoo's esports revenue figures always exclude revenues from betting, fantasy leagues, and similar cash-payout concepts, as well as core game revenues.

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newzoo.com/esports-report

- Source B: E-sports revenue in 2019

- Identify two trends from Source A. [2 marks]
- With reference to Source B, explain two possible reasons for the changes in the revenue streams compared to the previous year. [6 marks]

Travel, sharing platforms and tourism

Travel has evolved to become more affordable and accessible in digital society. Forums and blogs allow travellers to share tips and tricks, and leave insights about their experiences so that others can learn and follow in their tracks. They also offer **ranking systems** for companies and organizations that cater to tourists, collecting data from **customer reviews** to guide and identify the best experiences for future travellers.

ATL ACTIVITY

Thinking

Evaluate the use of travel platforms to rate travel activities in your local area.

- Visit a travel forum, such as Yelp or TripAdvisor, for your home town or a nearby destination and browse through the entries.
- Evaluate how suitable the comments and rankings provided are.
- To what extent do you agree with the ratings and comments?
- Draft a review of one of your favourite businesses.

Another useful development for travel are **translation apps**, which use artificial intelligence to bridge language barriers by converting one language into another. They can translate in real time, allowing two people to communicate through an app that translates the language back and forth, or by translating text in a photo to allow travellers to quickly understand signs and menus.

EXAM PRACTICE QUESTIONS



Paper 1 (core)

- 1 **Outline** the step-by-step process that is started in the digital technology hardware and software when you give a voice command to ask your virtual assistant (Alexa, Siri or Google, for example) to play your favourite song using a specific app (for example iTunes, Spotify or YouTube). [4 marks]

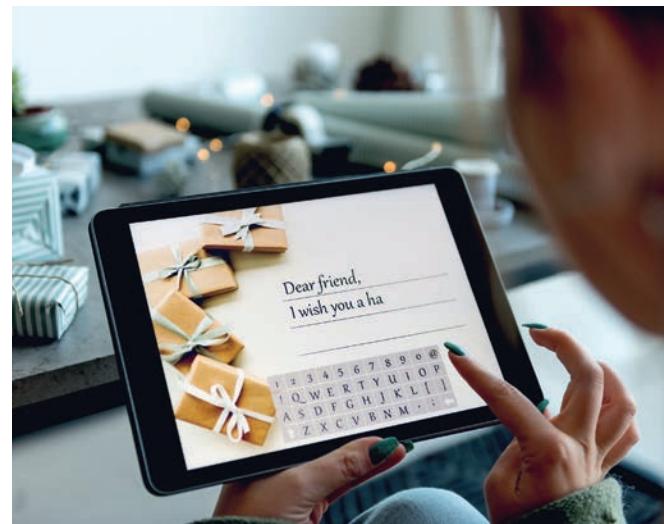
Links

This content links to Section 3.1G Data security.

4.1C Heritage, customs and celebrations

Ideas and traditions are passed down from one generation to the next in all cultures. Some of these rituals are preserved in their original forms, others have been adapted and assimilated into the digital society environment, while others grow obsolete and fade out of existence.

Heritage refers to the objects and qualities that are passed down from generation to generation; these could include traditions, rituals, natural resources, significant buildings or other valuable items and concepts. Among these are **customs** – traditional ways of behaving or doing things, linked to a specific place, time or culture. Finally, **celebrations** refer to the important events and milestones that are honoured and observed within a culture. This could include holidays, birthdays, historical events, harvest rituals and more. Heritage, customs and celebrations continue to exist and evolve in digital society.



Holiday e-cards

Many countries celebrate special days, some of which are religious, while others mark a point in history. Many of these holidays include a tradition of exchanging gifts, sending cards or sharing a meal together. Gifts that were originally home and handmade evolved to be store bought, and now many purchases are executed online from home. Mailing individual holiday cards, possibly containing family photos and personalized notes, has evolved into mass email lists, where hundreds can be sent the same card with one click. Video calling brings families together even when members are scattered around the globe, and with just a few clicks, social media allows us to publish, share and comment on the highlights of our holiday and compare our posts (and number of likes) with our friends.

EXAM PRACTICE QUESTIONS



Paper 1 (core)

On 23 December 2011, an e-card with the subject 'Merry Christmas!' was supposedly sent by the US President's office (from 'jeff.jones@whitehouse.org') to a massive number of recipients. Recipients who clicked to download and open the card (a .zip file) saw an animated Christmas tree while a trojan virus accessed their saved documents and passwords, and uploaded them to a server in Belarus.

- 1 a Identify two common file types for animated images. [2 marks]
- b Outline two precautions to prevent falling victim to an email-based scam. [2 marks]
- c Outline two characteristics of a '.zip file'. [2 marks]
- 2 Outline four steps in the process of how victims opening the e-card resulted in their files being uploaded to servers in Belarus. [4 marks]
- 3 In response to the news about the e-card trojan virus, some employees decided to search for, download and install FREE email protection software for their work computers instead of waiting for instructions from their employer. Evaluate this decision. [8 marks]

Rites of passage

A **rite of passage** is a ceremony or tradition to mark when an individual leaves one group and enters another. Traditionally these could include ceremonies to acknowledge events such as births, marriage, death. Many cultures have a rite of passage that marks the transition from childhood into adulthood; for example, in Mexican, Caribbean and other Latino cultures, when a girl turns 15 she celebrates her *quinceañera*, which marks the passage from girlhood to womanhood.

Digital societies have evolved new rites of passage to mark milestones in the virtual and physical world. This could be a child's first smartphone, their first social media account, the removal of parental controls/monitoring tools from their devices, being allowed a TV/computer in their bedroom, reaching 1000 followers, and more. While these may not have traditional and cultural ceremonies attached, these milestones can often be as significant to the individual as traditional milestones and rites of passage.

◆ **Rite of passage:** A ceremony or tradition that marks when an individual leaves one group and enters another, for example a birth, marriage or death.

ATL ACTIVITY

Research and communication

Prepare for a debate: Should children below the age of 11 own a smartphone?

- Conduct wider research into the use of smartphones by children.
- Divide the group into two – one group will support the idea that young children should be able to own a smartphone, while the other group will research why they shouldn't.
- Conduct the debate and, at the end of the session, take a vote.

Expression and preservation of cultural heritage, customs and tourism

As digital technology continues to evolve and more time passes, there is a risk that historical traditions and customs will be eroded or disappear altogether. Heritage sites and museums make significant efforts to protect and preserve significant artifacts. UNESCO, a sub-organization of the UN, is involved in the preservation of over 1000 World Heritage Sites across the globe. For each one, their website provides visitors with descriptions, photos and conservation strategies. This both documents these valuable sites and creates a space for people to learn more about these institutions.

Digitization of cultural heritage creates a digital equivalent of cultural artifacts that can be accessed by a larger public, while also allowing the safe storage and preservation of the original artifact. Digital alternatives offer greater accessibility to students, teachers and researchers, who can now use tools to study these items online. This also reduces the risk of damage to the original item.



REAL-WORLD EXAMPLE

An Amish approach to technology



The Amish are a subset of Christianity in the USA and are usually portrayed as living simple lives in plain clothes and as rejecting of new technologies. While they do choose to use horse-pulled buggies instead of cars, and do not use zippers on their clothing, they do not reject all technology outright. Instead of quickly adopting new technologies like most of American culture, they are more cautious and discerning, taking time to examine whether the tool will be helpful or detrimental to their community before deciding whether to embrace a new technology and, ultimately, a new way of living.

There are more than 40 different subcultures within the Amish umbrella, and their decisions on integrating technology varies from community to community. For example, in one community a farmer may choose to have a phone with voicemail in his professional life, but it will be kept outside the house to prevent disruptions to family life. They may use battery-powered lights for turning signals on their horse-drawn buggies, and may also have solar panels to generate energy without having to join the nation's electricity grid.

As the world evolves, so does the Amish community. While many still live off the land as farmers as in previous generations, the youngest generation of Amish workers are often in entrepreneurial positions. When faced with adopting new technology, they ask themselves 'Will this technology hurt the Amish way of life?' While this may be a lengthy and slow process, this reflection, investigation and inquiry helps the Amish to navigate the balance between progress and tradition. As a result, they are able to protect their traditions and culture while also enjoying the benefits of technology.

www.npr.org/sections/alltechconsidered/2013/09/02/217287028/amish-community-not-anti-technology-just-more-thoughtful

ATL ACTIVITY

Thinking

Look for personal relevance by evaluating a digital technology in your home and how it is impacting your family life.

- Select one digital technology used by your family that is relatively new in your home, for example a new gaming console or smart TV.
- Complete the table to compare how this digital technology is impacting your family members.

Positive impacts	Negative impacts

- Evaluate how disruptive the new digital technology has been on your family life and whether it was a good decision to bring it into your home.
- Reflect on what family life was like before digital technology was introduced and whether it was better then.

Concept connections

- **Identity:** How does the adoption of (or decision not to adopt) new digital technologies influence our sense of identity?
- **Systems:** Bringing a smartphone into a place that has never had one before has cultural implications. Suddenly, people must learn how to respond when they receive messages and develop norms for communicating and responding on the phone. What other impacts might the integration of digital technology into new locations have on the existing culture? Does rejecting digital technology ensure the protection of existing heritage?
- **Space:** As digital technology brings the world closer together, does it also drive communities farther apart? Many Amish people reject cars and smartphones because they believe they erode the strength of the family. Many families across the globe set limitations on smartphone use, for example at the dining table because it detracts from the family meal. Some schools implement smartphone-free zones where students disconnect from screens to play games such as chess, read books, make art or just talk to their friends face to face. Do we need to protect spaces from the negative impacts of digital technology?
- **Values and ethics:** Think about your own values and beliefs, then look at how you use digital technology. Which apps are in alignment with your beliefs and values? Which challenge them?

ATL ACTIVITY

Self-management

Can you go for a day without any digital technology? Select a day (probably a day on a weekend) and make a list of the digital technologies you use or come in to contact with. Keep a pen and paper close to make notes and reflect on the experience.

4.1D Subcultures

Subcultures are cultural groups that exist within a larger culture. They often have beliefs or interests that vary from the dominant culture. Digital systems create opportunities for these subcultures to meet and connect in virtual and physical spaces. In its early stages, being an internet user was its own subculture, as early adopters could chat online and connect with others who shared their passion and interest for technology.

◆ **Subculture:** Smaller cultural groups that exist within a larger culture.

Youth cultures

The internet creates a space for more unique and multi-layered identities. Young people can gather and connect with a community of people who share their interests and passions, have common challenges or family structures, and more. The apps that young people use are often different from those of adults, and these apps tend to move/change rapidly. Viral content in youth communities may seem different or nonsensical to adult users, for example, the user who gained 10,000 followers on TikTok for posting a video of herself clapping along to a song.

Within a digital society, research has shown that users aged 13–24 often prefer social media applications. They check these apps frequently but only stay on them for a short period of time. On an average day, they may check their smartphones 150–300 times, while older users average closer to 100 times a day (the numbers vary depending on the source). Young users are less likely to be on email or productivity sites by choice when compared with older users.

The ease with which youth subcultures can form and proliferate through the use of digital technology can have serious implications. The disconnect between adults and teens/young adults can be made worse, as **youth culture** in digital society is very different from the youth culture of earlier generations. The digital worlds young people live in are outside the experience of older generations and are difficult for them to understand. Also, people with bad intentions can infiltrate and use these subcultures for their own purposes. Groups around the world often have a youth branch that works through social media to attract them to their causes.

Youth subcultures can also divert young people away from their own cultures, locally and nationally. This is known as **soft power** – where the cultural values of one society are spread through the use of digital technology to the detriment of the native culture. This was originally seen with the spread of Western ideas, initially through the world wide viewing of Western movies. Some countries have tried to counter this by promoting their own movie industries, such as India with Bollywood and Nigeria with Nollywood. Some countries have also developed their own national social media platforms that use their national language(s), such as WeChat in China.

◆ **Youth culture:** The culture and social norms of teenagers and young adults.

Links

This content links to Chapters 2.2 Expression, 2.3 Identity, 2.4 Power and 2.7 Values and ethics.

ATL ACTIVITY

Research and Thinking

Compare and contrast applications used by adults and teenagers in your community. Use specific examples and findings from your research to support your claims. You may focus on what apps they use, or if they use them differently than adult users. Applications you could look at include Twitter, Facebook and Snapchat.

ATL ACTIVITY

Research

Research the impact of digital technology by two different types of youth subcultures. Research real-world examples from at least two distinct communities. Possible examples include those based around music, fashion, sports or hobbies; they can be local or national.

◆ **Online community:** A group of people united by a shared interest or purpose who use digital tools to communicate with each other.

◆ **Guidelines:** Norms and rules for membership and participation.

◆ **Forum:** Online discussion sites that allow users to post and reply to messages.

◆ **Moderation:** A system designed to ensure messages posted online comply with the rules set by the online community.

Online communities and forums

Online communities (or internet communities) are groups of people united by a shared interest or purpose who use online tools to communicate with each other. Like all communities, they often have a set of norms or **guidelines** for membership and participation. Communication and interactions are often conducted on **forums** – or message boards – which are online discussion sites that allow users to post and reply to messages. Some forums are **moderated**, meaning that content must be approved before it goes public.

The proliferation of online communities and forums creates subcultures that have both benefits and issues, from a personal level up to societal level. Users can become members of a wide range of different groups, and there is more **fluidity** in digital groups, allowing people to join and leave groups with greater ease than in-person groups.

Radicalization through the internet is now a major issue for governments around the world. Using social media, people can form online communities to share ideas and resources that are radically different from those in society. The internet has been shown to be very effective for the spread of radical ideas as it is so vast, diverse and easy to use. Keeping track of those who are radicalized, and stopping radicalization, is very difficult. These radical ideas are often violent and include groups that are extremist or have political, social, economic or religious interests.

Inquiry

The dark web is a part of the internet where groups can meet in secret to conduct business, communicate and share ideas. Much of the activity on the dark web is illegal.

- Research the technology used by the dark web and the range of activities that it is used for.
- Research how law enforcement and state authorities deal with the issues raised by the dark web.

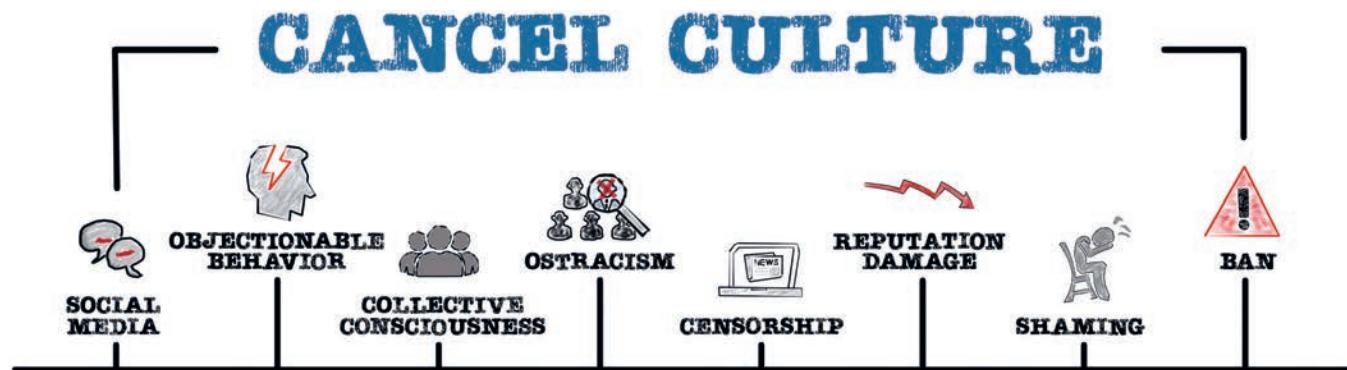
ATL ACTIVITY

Thinking

Look for personal relevance in this topic and the groups you belong to.

- List all of the groups you belong to in two columns – the ones in the physical world and then the virtual one,
- Select which of these groups brings you the most happiness and reflect why.
- Select which of these groups brings negativity into your life. Reflect why you are a member of these groups.
- Reflect on how many of the groups selected in the previous two points are physical or virtual.

Cancel culture



Cancel culture has been enabled by the use of social media. It describes the public backlash that results online when a person or organization says or does something that is considered objectionable or offensive. Cancel culture often takes steps towards ending the career of the person who initiated the offensive action. While social media can be used to highlight questionable comments and spark debate in a society, it can be taken too far and becomes destructive rather than constructive criticism. Proponents argue that cancel culture promotes accountability and can be used to further social justice efforts through collective actions. Critics, on the other hand, argue that it has evolved into social media mob rule that actually mutes the voices of citizens and violates their access to the free exchange of ideas, thoughts and speech. It can be regarded as a form of vigilante justice, targeting any celebrities or influencers that push the moral boundaries of society.

◆ **Fluidity**: The ease with which people can join/leave digital subcultures.

◆ **Radicalization**: The use of the internet to share ideas and resources that are radically different from those in mainstream society.

◆ **Cancel culture**: Public backlash on social media when a person or organization says or does something that is considered objectionable or offensive.

REAL-WORLD EXAMPLE

Cancel culture

A high-profile case of cancel culture happened when author JK Rowling voiced concerns that the push for transgender rights could endanger women's rights. Critics and social media campaigns called for a boycott of her books. It remains difficult to truly end someone's career through cancel culture. However, despite the negative attention, JK Rowling's book sales continued to increase in the UK.

www.washingtontimes.com/news/2021/feb/16/top-10-recent-examples-cancel-culture

www.vox.com/culture/2019/12/30/20879720/what-is-cancel-culture-explained-history-debate

Extended essay (EE)

- Investigate the impacts of digital tools on a specific genre or medium of art. For example, the development of holographic concerts on the live music industry or how immersive art experiences impact how people experience art.
- Investigate the impacts (advantages and disadvantages) of the use of social media of a group you are associated with or that operates in your local area or country.

Concept connections

- **Identity:** How can cancel culture be used to advocate for traditionally marginalized groups and be a voice for oppressed or targeted communities?
- **Power:** Many argue that cancel culture offsets the power dynamic and expensive influence of public figures and celebrities.
- **Expression:** How does cancel culture limit the expression of dissenting thoughts?
- **Values and ethics:** Does cancel culture violate celebrities' rights to free speech? Does their larger audience and platform justify a higher sense of accountability? Who determines the moral code that must be adhered to?

Creativity, activity, service (CAS)

E-sports tournament

Set up an e-sports tournament at school. To start this initiative off, write a proposal and obtain approval from your school. Include details such as when it will be, who it is for, where it will be held, which e-sports it will include and how the tournament will run. Do not forget to include details of the educational value of this tournament – it will help you get approval.

TOK

- How do cultural values and identities shape our approaches to learning, knowledge and value?
- What cultural conflicts can arise as digital tools create global communities?
- How valuable is the contribution of various cultures to society, considering the different perspectives of each culture?

Reflection



Now that you have read this chapter, reflect on these questions:

- What are your personal, family and local cultures, values and traditions?
- How do digital tools shape the way you live and experience day-to-day life?
- How do IoT and smart home devices impact your daily life experience?
- What rites of passage are valued in your community/school/family? Explore both physical/traditional passages and virtual milestones.
- How do you connect with others over digital platforms? Are you a part of any virtual communities?
- To what extent do you engage virtually with people who come from different backgrounds or identities as yourself?

4.2

Economic

UNDERSTANDINGS

By the end of this chapter, you should understand:

- ▶ business and commercial organizations have evolved to integrate, build and rely on digital systems in a digital society
- ▶ digital innovations offer new and alternative approaches to work and employment; they create new jobs while making others obsolete
- ▶ digital tools have created new and virtual markets to supplement or replace traditional methods of exchanging goods, services and financial instruments
- ▶ digital communication tools have connected global markets for the production and selling of goods, and many commercial organizations operate across borders.

As the world becomes more interconnected, economics, business and financial institutions have adjusted and evolved to meet the demands of an ever-changing marketplace. New tools and digital technologies made old jobs obsolete, created new jobs and even changed the workday experience. Offices, businesses and managers have shifted in how they engage their employees productively, and capitalist values have shifted from maximizing profits to better meeting the needs of customers. Online marketplaces, digital payment methods and new production processes have shifted the selling and buying experience, and globalization has created a world market for production, labour and sales of goods and services.

4.2A Business

■ Operation and organization of businesses

As technology and society have evolved in the twenty-first century, business practices and values have also adapted and changed. The goal of maximizing profits and revenues has also shifted towards maximizing value for customers, knowing that profits will follow if customers are satisfied. Additionally, short-term profits may be sacrificed to invest in improving the customer experience and retaining long-term, loyal customers.

Businesses used to rely on a vertical hierarchy, where a boss or manager develops roles and hires employees to complete specific tasks. Every employee reports to a supervisor above them, with decisions made at the top trickling down through managers to staff. Now teams are more dynamic and work in shorter cycles, which is facilitated by the use of a variety of digital technologies including email, video communications, shared calendars and collaborative access to files and resources. While employees still have specific roles or duties, many companies have created spaces and opportunities for employees to branch out from their defined responsibilities and incorporate their passions and talents. Executives at the top will often solicit ideas and feedback from the bottom, and foster leadership and collaboration across the entire organization.

Digital tools facilitate common practices in the day-to-day business operations today. These may include **transaction processing systems**, which incorporate all of the resources, software and hardware needed to manage sales, purchases and other transactions. **Office automation systems** help to centralize and organize data, improve communication between workers and departments, manage calendars and facilitate collaboration. Other systems exist to develop and manage corporate

◆ **Transaction processing system:**

A system designed to incorporate all of the resources, software and hardware needed to manage sales, purchases and other transactions.

◆ **Office automation system:**

A system designed to centralize and organize data, improve communication between workers and departments, manage calendars and facilitate collaboration in businesses.

databases, as well as to facilitate data analysis to optimize decision-making and monitor performance. The IoT has also been adopted by many businesses to facilitate efficiency.

ATL ACTIVITY

Research

Research the impacts of customer sales tracking tools. Possible examples include loyalty programmes.

ATL ACTIVITY

Research

Visit a local supermarket or other store and ask them to explain how their transaction processing systems work and how they benefit the store.

EXAM PRACTICE QUESTIONS



Paper 2

- Research how the adoption of IoT in various market segments varies greatly over time and location in billions of units or in the amount of expenditure. Record findings for some of the market segments over a range of years (i.e. 2018 and onwards) and for particular country and/or worldwide. Cite sources.

Market segment	2018	2020	2022
Utilities			
Government			
Banking and financial services			
Physical security			
Manufacturing			
Agriculture			
Health care			
Retail			
Information and IT			
Transportation			
Other			
Total			

- 1 Analyse the statistics collected and identify two trends in IoT. [2 marks]
- 2 For one of the market segments, explain two ways IoT is being used. [4 marks]

Diversity in business and corporations

Diversification, when a company enters into a new market or industry, is also a growth strategy used by businesses. There are four main types of diversification:

- **Horizontal diversification** is when a business adds on products or services that are complementary to their core business. An example would be a social media platform building a direct messaging platform or a marketplace for buying and selling.
- **Conglomerate diversification** is when a company adds new products that are completely separate from their existing operations. This could be a search engine investing in self-driving car technology.
- **Vertical diversification** involves taking over a new part of the product's supply or production chain. Examples include online stores purchasing their own delivery fleet to ship purchases to the consumer, or when a computer company begins producing its own microprocessors instead of purchasing them.
- **Concentric diversification** involves adjusting the existing product lines to meet a wider customer audience. For example, a social media platform could adapt its content for younger users, or for business/corporate accounts.

◆ Diversification:

When a business enters into a new market or industry.

◆ Horizontal diversification:

When a business adds on products/services that are complementary to their core business.

◆ Conglomerate diversification:

When a business adds new products that are completely separate from their existing operations.

◆ Vertical diversification:

When a business takes over a new part of their supply or production chain.

◆ Concentric diversification:

When a business adjusts their existing product lines to meet a wider customer audience.

Inquiry

Analyse the diversification strategies used by a large digital technology company.

- Identify a large technology company.
- What is their primary market/industry? What was the original product or service they provided?
- How have they diversified their business?
 - Horizontal diversification: What complementary products/services do they offer in addition to their main product line?
 - Conglomerate diversification: What unrelated products/services have they branched out into or begun working on?
 - Vertical diversification: How have they taken over parts of their supply/production/delivery chain?
 - Conglomerate diversification: How have they adapted their existing products to reach a broader audience?
- To what extent have these strategies been effective in reaching more customers and growing their business?
- Suggest other potential diversification strategies and explain how those will reach more customers and grow the company.

Diversity in business also refers to the hiring and incorporation of people from a range of demographic indicators. This can include the integration of employees from various ethnicities, social spheres, genders and sexual orientation. In many countries it is illegal to **discriminate** or make biased decisions based on social identity, women and non-white employees remain underrepresented in executive roles.



REAL-WORLD EXAMPLE

Bias in an AI algorithm

In 2014, Amazon developed software that used artificial intelligence algorithms to review job applicant resumes and rank them. By 2015, Amazon realized that the ranking was not fair and showed bias against women. The reason for this bias in the data sets used to train the algorithm, which were based on historical data that was 60% male.

◆ **Diversity:** In business, this refers to the inclusion of people with a range of demographic indicators.

◆ **Inclusive:** In business, this refers to an environment in which people of all backgrounds feel valued, safe and respected.

◆ **Discriminate:** The unjust treatment of people based on gender, social identity, race or disability.

Links

For more on demographic indicators see Chapter 4.7 Social.

Inquiry

With reference to two real-world examples, research the approaches taken by Silicon Valley tech companies to increase diversity in the workplace. Possible examples are Twitter and Google.

REAL-WORLD EXAMPLE

Psychometric surveys

When applying for jobs, many companies require **psychometric surveys**, a computer-based test to measure an individual's mental capabilities and behavioural style. These tests are used to screen out applicants who may not be a good fit with the company culture or may not have the communication skills necessary to work well with their colleagues. While some tests are research based and use known measures, other tests ask questions that might have an adverse impact on the hireability of people with disabilities.

In the US, the American with Disabilities Act bans employers from asking questions about one's health status, but some of the psychometric survey assessment items are based on mental health evaluations. One assessment company, Unicru, was involved in a legal case because their automated personality testing system was suspected to discriminate against people living with bipolar disorder. The questions were similar to medical assessment questionnaires, which had prevented jobseekers from getting interviews for minimum-wage jobs in the past – digitizing discrimination based on mental health that would otherwise be illegal.

Another company, HireVue, has integrated web-camera analysis and artificial intelligence in order to analyse candidates' facial movement, speaking voice and other traits as they respond to a 30-minute interview to automatically generate an employability (likelihood of success) score based on over 500,000 data points. HireVue claims that it streamlines the most time-consuming parts of the interview process and identifies skills, such as problem-solving and teamwork, that might not be readily apparent from a resume or transcript.

Critics argue that these undisclosed **black box algorithms** (introduced in Chapter 3.2) are unfair, deceptive, biased, unproven and cannot be trusted. They say it is not possible to use voice tone or mannerisms to automatically determine someone's employability, and that it creates a new method of discrimination that is a major threat to workers' privacy and lives. Proponents maintain that it creates a more balanced and quantitative approach to a subjective process.

Critics fear that it will undermine diversity, while proponents view these tests as a useful tool for improving diversity and overcoming the existing bias in hiring practices.

www.washingtonpost.com/technology/2019/10/22/ai-hiring-face-scanning-algorithm-increasingly-decides-whether-you-deserve-job

www.recruiter.com/i/what-hbos-persona-gets-right-and-mostly-wrong-about-personality-tests

<https://medium.com/@ianhierl/cathy-oneil-weapons-of-math-destruction-chapter-6-7131535f1bc7>

◆ **Psychometric survey:** A survey designed to measure an individual's mental capabilities and behavioural style.

ATL ACTIVITY

Thinking

Look for a personal relevance in the following task.

- Take an online psychometric test, for example the Myers–Briggs personality profile:
www.16personalities.com/free-personality-test
- Evaluate how accurate, complete and reliable the results are for you.

Concept connections

- **Change:** As the internet makes job applications more accessible, resulting in more candidates applying for the same jobs, is the use of artificial intelligence necessary and/or justified to screen applicants quickly and focus human resources only on the best candidates determined by the algorithms?
- **Expression:** The use of web-camera analysis interview tools quantifies the way people respond and interact with virtual interviews. What characteristics do they value? Is it possible to cheat the system?
- **Power:** The processes of black box algorithms are not transparent. They often provide scores with minimal indication of how those scores were generated. How do these processes empower/disempower employees and employers?
- **Systems:** How does artificial intelligence replicate and improve on existing bias in the hiring process?
- **Values and ethics:** Considering the limitations, should companies use artificial intelligence to analyse personality traits in order to be able to build and hire the team that they feel will be most successful?

4.2B Employment and labour

The workforce in a digital society overlays traditional employment opportunities with new and evolving opportunities for entrepreneurship and work. Nearly every job has some connection or involvement with digital technologies. Postal workers scan package details into databases, office managers coordinate online calendars and schedules, and nearly every professional must spend at least part of their day responding to e-mail or other messages.

The internet also facilitates networking for the exchange of goods and services on a task-by-task basis. This has resulted in short-term employment opportunities, or ‘gigs’, where people can request or offer services online with platforms helping to match supply with demand.

Working practices

Start-ups are companies in their initial stages of business. Many digital technology companies are in this category, and it can create a stressful environment as they rely on new product releases, grants and investments to satisfy investors and build their market reputation. To offset these challenges, many start-ups have been redesigning the workplace and work experience, encouraging working from home and incorporating game rooms or meditation spaces into their offices.

Office design incorporates all of the functional and decorative components of the working environment. Many modern offices include open floor plans, flexible furniture and glass walls that allow employees to transform spaces to meet their needs in any given situation. Even established tech companies want to offer spaces for their developers to recharge in and get off screen. For example, Twitter’s office in San Francisco includes a rooftop garden, an arcade room and a musical ‘jamming’ space to give employees a space to unwind in if they need breaks during their work day. Because many jobs are serving online and digital tasks, some employees are able to work from home almost permanently. During the COVID-19 pandemic, many industries found that employees could work from home effectively using video-conferencing platforms and other digital tools. **Remote working** allows employees to conduct business and complete tasks from anywhere that they are able to connect to the essential networks.

Links

Chapters 3.6 and 3.7 discuss how automation through artificial intelligence and robotics is displacing many workers.

◆ **Office design:** The functional and decorative components of the working environment.

◆ **Remote working:** Conducting business and completing tasks from anywhere that employees are able to connect to the essential networks, for example, working from home.

ATL ACTIVITY

Thinking

Imagine you are working for the IT department of a company that requires their staff to work remotely. At the next team meeting you are required to research and present:

- technologies that employees would need to be able to access company servers, and to be able to attend company meetings and to handle customers remotely
- recommendations for the measures you would put in place to ensure the security of all company and customer data.

Digital nomads work remotely and do not tie themselves down permanently to any particular location. For example, a website developer could travel the world while logging in daily to complete tasks anywhere that they can get online. This can help create a good work-life balance, and also boost tourism revenues for the countries where digital nomads work. In some regions, special hostels and hotels market themselves to digital nomads by promising great internet connectivity, comfortable workspaces, affordable accommodation and also the ability to network with other digital nomads around the globe.

There are often legal challenges to working outside of your home country, and many companies and digital nomads may violate immigration policies if appropriate permissions and visas are not obtained. Additionally, there is an added security risk to the data and information that the employees are working with if they are tempted to use public Wi-Fi facilities.

ATL ACTIVITY

Research

Research the type of jobs that are available for digital nomads.

- Reflect on how this may impact where you choose to live.
- Does this lifestyle appeal to you?
- If yes, what makes it attractive?
- If no, why not?



Crowd work, microwork and gig economies

Crowdsourcing allows companies to save time and money by collecting information, ideas or work from a group of people, usually over the internet. Instead of hiring a single person to complete a task, the task may be open to the public or a group. This can improve the speed, flexibility, diversity and scalability of projects, however someone usually still has to review and curate the crowdsourced work and, depending on the 'crowd', the work could be biased or potentially fall short of the intended goal.

Links

Use your knowledge from Chapter 3.4 Networks and the internet, and 3.1G Data security in this activity.

◆ Digital nomad:

A person who works remotely and is not tied down to any particular location.

REAL-WORLD EXAMPLE

Crowdsourcing

Artist Aaron Koblin paid 10,000 people US\$0.02 to draw sheep. He curated a gallery of sheep where visitors could watch the sheep being drawn, or zoom out to see the entire herd.

◆ Crowdsourcing:

Collecting information/ideas/work from a large group of people, usually over the internet.

While crowdsourcing seeks information or work, **crowdfunding** solicits people for money to support start-ups, charities and other causes. Many creative projects, charities and entrepreneurial initiatives use crowdfunding as an alternative approach for securing the capital or resources they need to realise their projects.

◆ **Crowdfunding:**
Collecting money over the internet to support start-ups, charities and other causes.

ATL ACTIVITY

Thinking

Look for a personal relevance in the following task.

- Sign up for Amazon Mechanical Turk – www.mturk.com – and think about how you could participate in crowdsourcing projects (terms and conditions may apply).

Small tasks like the ones in the activity above are a form of **microwork**, where short-term projects can be completed quickly for payment. The growing demand for microwork has led to the **gig economy**, where online platforms facilitate matching between short-term service providers and customers on a payment-by-task basis. The gig economy offers a range of services including customized crafts, pet-sitting, ride-sharing, and more. The **sharing economy** overlaps with the gig economy and includes assets or services that can be shared between individuals, often using an online booking system. For example, many cities have installed electric scooters or bikes that can be rented for short-term use.

◆ **Microwork:** Short-term projects completed quickly for payment.

◆ **Sharing economy:** Assets or services that are shared between individuals, often using an online booking system.

■ Examples of gig and sharing economies

Sector	Description	Examples
Transportation	Digital platforms that enable freelance drivers to provide transport services, for example taxis, ride sharing and restaurant food delivery	Uber, Lyft, Careem, Bla Bla Car, DoorDash, Grubhub
Asset sharing	Digital platforms that enable person-to-person sharing of property, such as holiday homes, parking spaces and equipment	Airbnb, VRBO, Turo, Zipcar
Professional services	Digital platforms that connect freelancers with businesses for microwork, administrative assistance, writing/translation	Upwork, Fiverr, PeoplePerHour, Catalant, Guru
Handmade goods and individual services	Digital platforms that enable people to sell homemade goods and services such as dog walking and tutoring	Etsy, Airtasker, Rover, GoPeer

Employee organizations may include labour unions or any agency where employees gather for the purpose of improving relationships between employees and employers. Employee organizations advocate for workers' rights through tools such as collective bargaining, where improved benefits and working conditions are negotiated on behalf of a group of employees. Collective bargaining has resulted in higher wages, better benefits and safer workplaces. However, non-traditional employment opportunities have developed based on digital technologies that bypass some of the rights and progress that has been made. For example, companies like Uber may have different legally required benefits for their full-time employees than for their contracted workers (drivers), even if they work the same number of hours.

ATL ACTIVITY

Research

Many companies in the gig economy consider their 'short-term task providers' to be contract workers rather than full-time employees. In some countries, this allows them to limit the benefits they provide, such as health insurance, parental leave and so on.

Research the impacts on companies and gig workers if these workers are classified as contract workers instead of full-time employees. Use real-world examples from at least two different companies to support your claims. Possible examples include Uber and Lyft in various countries around the world.

Automation and employment

With software and machines automating more work, companies no longer need to hire as many employees, and some people may find themselves out of a job if a computer program is able to do their work. As of 2021, one in three workers are at risk of at least part of their job being automated in the next 10 years. However very few jobs will be fully automated. In these jobs, it is expected that tasks will evolve, and workers will have to adapt to the new environment. Jobs in unpredictable environments, such as caregivers, gardeners and plumbers, have some protection as they are very difficult to automate and less financially lucrative to developers.

Inquiry

For an industry of your choice, research how automation, through artificial intelligence and robotics, have had an impact on both the companies and employees.

REAL-WORLD EXAMPLE

Amazon's smart warehouses

Amazon's dominance of the online retail industry evolved in large part due to its rapid delivery times. One tool that enabled them to offer one-day deliveries is the use of a range of robots and artificial intelligence. Amazon uses deep learning and artificial intelligence to make inferences about what people will buy to ensure that local warehouses are ready to distribute items, even before shoppers have made purchases. After the purchase is made, a team of humans working alongside machines prepare the products for delivery. Since 2012, when a purchase is made, an army of Roomba-like robots brings entire shelves to human workers, allowing the warehouses to hold 50% more stock and retrieve it three-times faster, saving the cost of shipping goods by 40%. Each robot can lift shelves weighing over 500 kg.

Amazon diversified by buying out the company that supplies the robots, and then stopped selling them to competitors such as Gap and Walmart.

With up to 800 robots moving around the factory at once, a centralized optimization algorithm helps to direct their traffic to maximize efficiency without causing crashes between the robots. To accommodate the robot army, Amazon's warehouses have installed charging stations, ceiling lighting has been blocked out to improve the efficacy of sensors, and QR codes are embedded in the floor. Additional robots help with moving heavier items and labelling packages.

Links

This content links to Chapters 3.6 Artificial intelligence and 3.7 Robots and autonomous technologies.

Links

This content links to Section 5.1B Changing populations.



■ Robots working in a warehouse

While complete automation remains at least a decade away, Amazon still employs human warehouse workers. However, it is estimated that their labour force is 50% lower due to the integration of robots in their warehouses. Humans working alongside the robots complete jobs such as shelving new goods and picking items off the shelves when the robots arrive at their workstation. Productivity levels of the humans are monitored to ensure that they keep up efficient rates, and they risk discipline or even termination if their pace slows. Depending on how long they have been at the company, they have anywhere between 15 and 30 seconds to load or unload a specific item from the shelf, and an error rate of more than 0.01% will result in disciplinary action.

Amazon uses **gamification** to incentivise speed and accuracy in human workers – their efficiency enables them to ‘compete’ against other workers, for example in a race-car simulation, where each moved package helps speed their car along a track. Winners can earn ‘swag bucks’ that can be used to purchase Amazon-brand merchandise.

Amazon’s warehouses are frequently under scrutiny, however, for their harsh and intense working conditions. Their warehouse injury rate is nearly double that of their competitors, particularly during high frequency times such as ‘Prime Day’.

www.youtube.com/watch?v=IMPbKVb8y8s

www.theverge.com/2019/5/22/18635272/amazon-warehouse-working-conditions-gamification-video-games

Concept connections

- **Identity:** The personal identity of workers is often linked to the type of work they do. How has automation impacted workers’ identity?
- **Power:** Power is embedded and exercised through digital systems. How has automation impacted the power relationship between companies and their employees?
- **Space:** How does the warehouse environment change when humans and robots work side by side? Is it more or less human orientated?
- **Systems:** Automation involves complex technologies, both digital and other types. Are human elements considered in the design of these systems?
- **Values and ethics:** Is it acceptable for companies to prioritize decreases in product costs and delivery times if they correlate with an increase in safety risks for employees?

◆ **Gamification:**
Applying elements of game playing to other activities to encourage participation or efficiency.

4.2C Goods, services and currencies

E-commerce, e-trading and online marketplaces



E-commerce is the buying and selling of goods and services online. In today's world, nearly anything can be ordered or purchased online. **Brick and mortar stores**, or those with a physical building, usually offer online purchasing options also through their apps or websites. E-commerce can be classified into three main categories:

- business-to-business
- business-to-consumer
- consumer-to-consumer.

For example, an online bookstore is business-to-consumer because the company is selling the product directly to the end-user. A variety of **online marketplaces**, such as Etsy, Amazon and eBay, allow individual sellers and buyers to post advertisements, photos and products for new and used goods that they hope to sell. **E-trading**, or online trading, is a subsection of e-commerce centred on buying and selling financial products, such as stocks, bonds or other assets, on online trading platforms.

◆ **E-commerce**: The buying and selling of goods and services online.

◆ **Brick and mortar store**: A retail outlet with a physical building.

◆ **Online marketplace**: A digital platform that allows individual sellers and buyers to trade.

◆ **E-trading**: The trading of financial products, such as stocks, bonds or other assets, online.

ATL ACTIVITY

Research

Compare your online shopping experience of two e-commerce platforms.

- You are required to go through the steps of shopping online (without completing the payment step, unless you really wish to purchase a product).
- Choose a product that you wish to buy, for example a book, item of clothing or some IT hardware, and identify two online stores that you could use to buy it, for example, Amazon and Waterstones for books.
- Complete the following table to compare the sites.

Feature	Store 1	Store 2	Note down any differences, which store you prefer and why
Describe the shopping aspect of the store, e.g. how you could browse the products			
Outline the payment methods available			
Were there any additional features of the shopping experience?			
What personal details do you have to provide?			
Find and read the privacy and security policy. Was it present – yes/no?			

◆ **Microtargeting**: The strategy of using consumer data and information to create personalized content and advertisements.

Personalized and targeted marketing

Many free services online are funded through advertising. Advertising becomes more valuable if it can be personalized to the viewer. **Microtargeting** is the strategy of using consumer data and information to create personalized content and advertisements. When people browse the internet, cookies, location and device information provide advertising services with key information that enables them to show advertisements that will increase the likelihood of people becoming aware of products and services and provide access to the related website.

Links

Flip forward to Section 4.6A Political processes to see how microtargeting strategies are being used in political campaigns.

Cryptocurrency, non-fungible tokens (NFTs), cashless society, micro-transactions

Traditional currencies are centralized and controlled, usually by the government, which sets the rates and makes printing decisions about the money. **Cryptocurrencies** are digital currencies that use blockchain technology to create a decentralized encrypted ledger that facilitates online transactions, sometimes allowing for anonymous exchanges. Currency values are more volatile as they are unregulated, and a speculative market can drive their worth up and down with few safeguards in place.

◆ Cryptocurrency:

A digital currency that uses blockchain technology to create a decentralized encrypted ledger.

ATL ACTIVITY

Research

With reference to two real-life examples, research how cryptocurrencies are being used, for example, used to pay for things (the first transaction with Bitcoin was to purchase a pizza) and the impact that they are having in countries that have adopted them.

A **non-fungible token (NFT)** is a unique, one-of-a-kind digital artifact – usually drawings, music or art – that is combined with blockchain technology to allow a unique identification of the artifact. NFTs allow artists/creators to retain some ownership of their work, while collectors can verify that they own an authentic digital creation. The blockchain technology enables the authentication of the digital object. It is currently unclear if NFTs will bring digital art sales up to the same level as classical art, or if this will be more comparable to trading cards, where hundreds of similar cards exist but a few valuable ones in circulation may make them worth money to interested collectors.

◆ Non-fungible token (NFT):

A unique digital artifact (usually drawings, music or art) combined with blockchain technology to allow a unique identification and authentication of the artifact.

REAL-WORLD EXAMPLE

Nyan Cat

An animated gif of Nyan Cat, a 2011 meme of a flying cat, was linked to an NFT and sold for more than US\$500,000 in February 2021.

www.bbc.com/news/technology-56371912

ATL ACTIVITY

Research

How are NFTs being used in e-commerce? Reference at least two real-world examples in your response.

A **cashless society** is one in which all transactions are carried out electronically. This could be facilitated through online transactions, bank transfers, credit cards, cryptocurrencies or other technologies. By 2017, in Sweden, only 20% of all transactions were made in cash. As society moves toward digitization, and phones are equipped with wallets, a cashless society seems like it could become a reality. China is already broadening and implementing mobile payments using apps such as AliPay and WeChat. However, 25% of the world does not have a bank account, which means that a cashless society would limit their ability to purchase and exchange goods and services.

◆ Cashless society:

A society in which all transactions are carried out electronically.

◆ Micro-transactions (mtx):

The purchase of virtual goods for small sums of money in games/apps.

Micro-transactions (mtx) refer to purchases of virtual goods for small sums of money. These are common in free-to-play games and apps where you can purchase player skins/outfits, extra lives/playtime or bypass challenging rules to make the game more enjoyable and easier. Somewhere between 5 and 20% of gamers make micro-transactions, but these in-game purchases can add up over time, especially when there is a large player base.

One controversial example of micro-transactions are in-game **loot boxes**, where players pay real money to purchase a mystery item. Critics claim that these in-game purchases by gamers, particularly younger ones, are a form of gambling, and video games are far less regulated than casinos.

◆ **Loot box:** A virtual consumable that contains a random/mystery item. These can be purchased or won in games/apps.

Inquiry

Some countries have banned loot boxes in video games and apps. With reference to real-world examples, evaluate the impacts and implications of this decision on the affected stakeholders, such as the video game manufacturers and the game players.

Additive manufacturing

Additive manufacturing, also known as 3D printing, adds raw materials layer by layer to build an object or product. This process is less wasteful than **subtractive manufacturing**, which creates an object by cutting or carving a larger material into the desired shape. Additive manufacturing can also save costs for specialized projects. 3D printing usually begins with the creation of a CAD file containing a 3D rendering or model of the desired object. Usually, a plastic spool is heated up and 3D printers build the product from bottom to top using the model. Other applications of 3D printing include printing food, body organs and even houses!

ATL ACTIVITY

Communication

Design (and print) a 3D model using CAD software such as Blendr, Tinkercad or SketchUp.

◆ **Additive manufacturing:** Adds raw materials layer by layer to build an object or product, as in 3D printing.

◆ **Subtractive manufacturing:** Creating an object by cutting or carving a larger material into the desired shape.

EXAM PRACTICE QUESTIONS



Paper 1 (core)

- 1 Describe the components and steps involved in the process of developing a 3D printed artifact from a 3D model. [4 marks]
- 2 Distinguish between additive and subtractive manufacturing in product development refer to a real-world example in your response. [6 marks]
- 3 In 2014, NASA sent 3D printing hardware to the International Space Station. Discuss the impact and implications of providing astronauts with access to 3D printing technology. [8 marks]

REAL-WORLD EXAMPLE

Reddit manipulates the stock market

GameStop is a video game store that has been in steady decline as malls have lost popularity and e-commerce has become more common, exacerbated by the COVID-19 pandemic. Professional hedge fund traders decided to short the stock – a risky investment strategy that pays off if the stock price goes down, which many indicators and data points made it seem likely.

In January 2021, a group of individual traders on Reddit noticed this heavy shorting of the stock and decided to work together to build demand for the stock. They gathered enough demand to move the price from US\$20 to US\$350, earning them money while also exploiting the risks taken by the professional hedge fund managers. To minimize their losses, funds that had 'shorted the stock' were trapped – they either had to continue losing money or purchase GameStop stock, which would alleviate their risk but further increase the stock price. Basically, once the GameStop stock price started going up, due to the large

number of 'shorts' it created a snowball effect that drove the price up even higher and created a feedback loop.

While this was in part a profitable prank executed by a group of individual day traders, it demonstrated the power of social media to manipulate the stock market, which could potentially be replicated by monitoring what stocks are being shorted by large investment firms.

Online e-trading platforms have implemented limitations on trades of volatile stocks, but individual investors, some with large social media followings, are arguing that they are being unfairly banned from the markets and opportunities that are available to large investment firms and corporations.

While the GameStop stock price surge may have been a reckless collaboration of a small social media group, it showed that a small collection of individuals could challenge the large banks and firms, and shift the rules of the investment world.

www.vox.com/the-goods/22249458/gamestop-stock-wallstreetbets-reddit-citron

Concept connections

- **Change:** The trading of shares has changed significantly with the use of digital technologies. How has this change been both evolutionary and transformative?
- **Power:** Should individual investors have access to the same trading tools, platforms and equipment as professional traders and hedge fund managers?
- **Space:** Digital technologies have made it easy to participate in share trading from around the world, with both positive and negative impacts.

- **Systems:** How have digital technologies impacted the trading of shares?
- **Values and ethics:** While it was not illegal to surge the GameStop stock price, it was a risky move that exposed volatility in a financial market. Some say it was like David attacking Goliath, while others accused the group of being a reckless mob, treating financial trading like a game.

4.2D Globalization

Borderless selling and global sourcing

Borderless selling (or borderless marketing) is the process of selling goods across national borders. Through the global reach of the internet, large and small businesses are able to reach clients across the world and widen their exposure and sales potential. Some countries have tax laws that benefit borderless selling, making it possible for international businesses to offer products and services at prices competitive with local providers. Borderless selling has been effective in the gig economy, music distribution, telemarketing and phone support, e-commerce and other fields where the goods and services can be purchased outside of the country they are created in.

◆ **Borderless selling:**
The process of selling goods across national borders.

Global sourcing is the supply side equivalent of global selling. Companies buy the materials, goods and services they need to produce or maintain their business from countries all over the world. This can help corporations to access cheaper labour, more specialized workers or specialized materials.

While global sourcing allows for more competitive pricing and creates jobs across the globe, critics argue that corporations often bypass labour and environmental regulations when seeking out the most cost-effective sources and labour for their operations.

◆ **Global sourcing:**

Buying materials, goods and services from all over the world; the supply-side equivalent of borderless selling.

ATL ACTIVITY

Research

Research your own, and your family and friends, participation in the globalization of business and commerce (buying and selling across borders). To what extent has it been a positive or negative experience?

Offshoring, outsourcing, reshoring, inshoring and insourcing

As more tasks and work can be completed remotely, and the convenience and speeds of international shipping are improving, companies are looking to the global labour market when deciding how to operate most efficiently.

Offshoring, or **outsourcing** to another company, is the practice of moving corporate operations overseas, usually to areas with lower costs of labour or more favourable tax and environmental regulations. Low-skilled jobs are often outsourced to areas with a lower cost of living where companies can pay employees a fraction of what it would cost for the same work to be completed in their country.

Reshoring (or inshoring) is the practice of bringing previously outsourced jobs back from overseas. As the costs of offshoring increase, due to rising labour and shipping costs and shifting regulations, as well as political and consumer pressure, the trend towards outsourcing is starting to shift.

Nearsourcing is the practice of establishing operations as close to where the end-products are sold as possible. This reduces transportation costs and lowers the environmental impact. As companies are reshoring some services, many are deciding if nearsourcing is a good method for determining the most efficient places to establish operations.

Insourcing is the labour practice of finding existing in-house employees to complete a task that would normally be given to workers outside of the organization.

◆ **Offshoring:** The practice of moving corporate operations overseas.

◆ **Outsourcing:** The practice of moving corporate operations to another company, usually overseas.

◆ **Reshoring:** The practice of bringing previously outsourced jobs back from overseas, also called 'inshoring'.

◆ **Nearsourcing:** The practice of establishing operations as close to where the end-products are sold as possible.

◆ **Insourcing:** The practice of finding existing employees to complete a task rather than outsourcing it.

Inquiry

Research businesses in your local area to see how and why they use, or have considered using, each of the following labour practices: insourcing, outsourcing, nearsourcing and offshoring.

Research how digital technologies are used in each type of sourcing for the businesses and how they facilitate insourcing, outsourcing, nearsourcing and offshoring.



Reflection



Now that you have read this chapter, reflect on these questions:

- How can businesses leverage digital technologies to improve their products, marketing and operations?
- How is the use of digital technologies addressing inequalities in the workplace and furthering issues of inequality?
- How does remote working and video conferencing shift the nature of work in a digital society?
- What apps and products are you using that rely on the gig economy? Do you know anyone earning money from these companies as contracted workers?
- How do digital technologies change the labour market?
- What percentage of your shopping do you do physically versus online? What about your parents?
- Where do you encounter targeted advertising? Do you find it useful or invasive?
- How do cryptocurrencies work and can they be a viable alternative to centralized currencies?
- How do technologies such as 3D printing change manufacturing processes and impact workers?
- What global corporations do you interact with? What websites/tools would allow you to engage in commercial activity outside of the country you reside in?
- What issues and concerns arise when companies engage in offshoring and outsourcing practices?



Creativity, activity, service (CAS)

Get involved with a small business in your community. See how they are using technology (including social media) and look for ways to optimize or improve their digital platforms.



Extended essay (EE)

The use of digital technologies in large and small businesses, especially the impacts on local people and society, can be a focus for an extended essay.

4.3

Environmental

UNDERSTANDINGS

By the end of this chapter, you should understand:

- ▶ the creation and use of digital tools impacts natural resources and ecosystems; these same tools are also used to make processes more efficient, with the potential for both a reduction in natural resource use or an accelerated consumption of them
- ▶ digital tools and other consumable products contribute to various types of pollution and there are actions in the development and disposal of products that individuals and corporations can take to minimize their negative environmental impact
- ▶ technology and data are being used to optimize spaces, infrastructure and communities; technologies also help individuals and organizations plan and navigate these spaces more effectively
- ▶ the agricultural industry has evolved to incorporate digital technology to improve efficiency and lower costs in the production, distribution and management of agricultural goods.

A digital society has both positive and negative impacts on the environment. Digital tools are used to make processes more efficient, reducing pollution and waste from existing systems. However, these tools also use scarce natural resources such as cobalt. Running digital systems requires energy, which can come from ‘renewable’ or ‘clean’ sources, such as solar or wind, from non-renewable sources such as coal, oil and natural gas.

As devices become obsolete, or are replaced by newer and better products, the physical waste that accumulates – known as **e-waste** – takes up lots of space and can leak chemicals and other hazardous materials into the environment. While there are ways to **recycle** e-waste, many of those processes are expensive, or result in the burning of non-reusable materials.

Many cities are using digital technologies to create a healthier, safer and more efficient environment for their citizens. As populations increase, digital tools help to optimize the systems and structures to meet the needs of their citizens effectively and efficiently. **Smart cities** integrate sensors, voice recognition and other new technologies to better manage transportation, energy distribution and other services.

◆ **E-waste:** Discarded electronic and electrical devices.

◆ **Recycle:** The process of converting waste into reusable materials.

◆ **Smart city:** A city that integrates sensors, voice recognition and other new technologies to better manage transportation, energy distribution and other services.

4.3A Natural resources and ecosystems

The natural environment provides many tools and energy sources to support life and activity on the planet. Natural resources range from water, solar and wind to the animals and trees that populate the planet. Natural resources can be **renewable** or clean if they are constantly being replenished. In contrast, there is a limited supply of other resources, such as crude oil, which will eventually be depleted – this makes them **non-renewable**. Digital technology developments consume resources in their production but can also make existing systems more energy efficient or help us to move towards more renewable energy solutions.

Biodiversity is the variety in animal and plant life in a particular community or **ecosystem**. Rapid population growth and economic expansion are threatening biodiversity and changing existing ecosystems. While digital technologies offset some of these impacts by increasing the efficiency of agriculture (farming) and forestry methods, it cannot compete with the increases in demand for the

◆ **Biodiversity:** The variety in animal and plant life in a particular community or ecosystem.

◆ **Ecosystem:** A community of living organisms and the physical environment that they live in.

use of land and consumption of natural resources. As a result, more animals are endangered as environments such as rainforests are being cut down and repurposed for more lucrative endeavours, such as farming cattle or harvesting palm oil.

■ Use and distribution of natural resources, including in digital systems and devices

REAL-WORLD EXAMPLE

Cobalt mining in the DRC

Cobalt is a chemical element that is essential in the rechargeable batteries found in smartphones and laptops. Over half of the world's supply is found in the Democratic Republic of the Congo (DRC). Many major corporations, including Apple, Sony and Samsung, purchase cobalt from artisanal mines – small-scale mining sites with limited tools.

Cobalt mining for an extended period of time is dangerous. Workers can inhale metal dust, which can lead to serious lung disease, while direct skin contact with cobalt can cause itchy rashes. In many artisanal mines (as of 2016), workers rarely have face masks, gloves or protective clothing, and 90% of miners complained of coughing and breathing problems. Limited labour laws and regulations mean that mining accidents and collapses are common. Additionally, some artisanal mines employ children as young as four years old. Miners continue to work

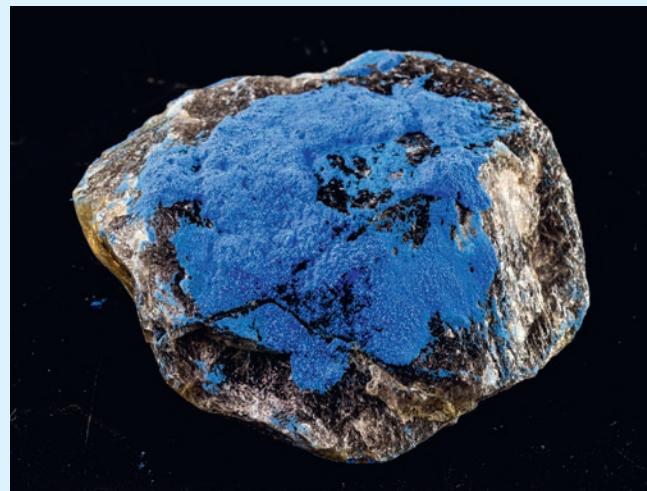
despite the risks, however, as there are limited economic opportunities in the region. It provides access to income and can help some workers afford to attend school.

Many tech companies claim to be exploring regulations and policies to ensure that they are not supporting suppliers that take advantage of their workers. The companies say that boycotting these mines would not help to improve conditions for those working and living in the region. However, critics argue that they are not doing enough as they are profiting from human rights abuse and child labour.

www.vox.com/world/2017/3/7/14828272/apple-congo-cobalt

www.cbsnews.com/news/the-toll-of-the-cobalt-mining-industry-congo

[www.washingtonpost.com/news/the-switch/ wp/2017/03/03/apple-cracks-down-further-on-cobalt-supplier-in-congo-as-child-labor-persists](http://www.washingtonpost.com/news/the-switch/wp/2017/03/03/apple-cracks-down-further-on-cobalt-supplier-in-congo-as-child-labor-persists)



Concept connections

- **Systems:** When we buy digital technologies, are we saving money at the expense of the miners and manufacturers who supply the materials to make them?
- **Values and ethics:** What obligations do consumers, companies and businesses have to ensure safe and sustainable conditions for workers in the supply chain when using and manufacturing digital technologies?

Inquiry

To what extent should corporations be accountable for improving labour conditions in their supply chains for the production of digital technology devices?

- Conduct research into the collection of natural resources to build consumer electronic goods. This could be an investigation of cobalt mining in the DRC, niobium in Brazil, tungsten in China, or many other possibilities.
- Explore at least three different sources – be mindful of bias.

- Discuss the labour conditions of the natural resource mines and collection sites that supply materials to digital technology companies. What safety conditions are in place? Are children working? What are the hours and wages?
- Evaluate steps taken to protect workers and ensure ethical business practices in digital technology supply chains.
- Look into policies from digital technology brands that you use. Do you agree with the values and ethics of their business practices?

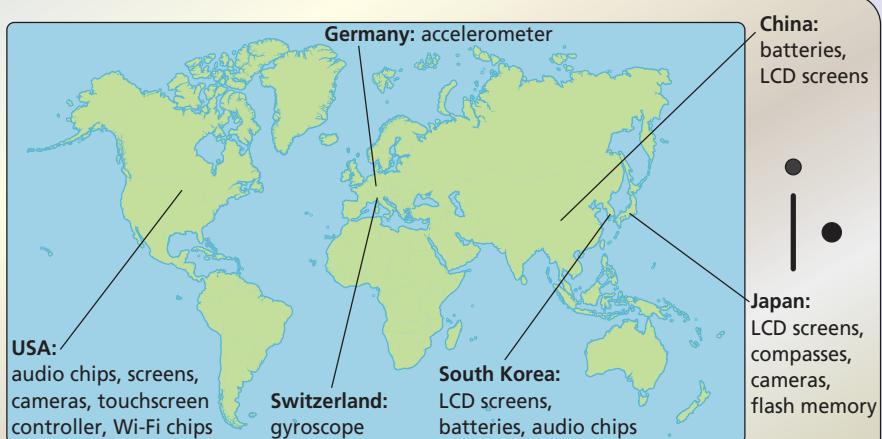
Digital tools and systems are produced and operated using resources. For example, cobalt is a non-renewable magnetic metal that is mined and processed to develop batteries. The scratch-resistant glass used to make many smartphone touch screens contains a range of materials such as silicon dioxide, aluminium, magnesium and sodium. These resources must be processed and manufactured from their natural state into the parts, components and end products you are able to purchase in stores.

ATL ACTIVITY

Research

Where are the components of your smartphone made?

- Conduct research to find out where all the components of one brand of mobile phone come from.
- What impact do you think this has on the environment?



Operating electronic devices also requires a significant amount of energy. Google operates its own fleet of electricity generators, which helps to ensure that its computers, storage servers and other products remain ready at all times, even if there is an interruption to the local electricity grid. This is how its search engine is ready and able to respond to the 75,000 queries it handles per second. In 2019, the amount of electricity used by Google (about 12.4 terawatt hours) exceeded the use of the entire country of Sri Lanka.

A global **digital divide** exists, as wealthier nations often have greater access to digital tools, services and resources. They are also responsible for a larger portion of the waste and environmental damage. Wealthier countries and corporations often harvest resources and dispose of waste in places where it is less expensive to conduct businesses. As a result, digital artifacts (such as a cell phone, computer or video game system) might be designed in the USA but manufactured in China using resources collected in the DRC, before being shipped globally to retailers in over 70 countries.

■ Protection and threats to ecosystems and biodiversity

Radio, GPS and satellite technology enable those who work with endangered species to track and monitor their locations on the planet. They can even send notifications if the animals' usual movements are interrupted, which can help emergency response teams save the lives of endangered animals.

REAL-WORLD EXAMPLE

Rainforest Connection

Rainforest Connection is a non-profit that uses digital technology to mitigate and prevent biodiversity loss. They retrofit old smartphones with solar power and place them in forests, using their sensors and microphones to detect and report the sounds and vibrations of illegal deforestation and poaching. In addition to helping protect wildlife, their smartphones collect real-time audio data from forests that can be used by scientists and policymakers to further protect and understand forest ecosystems.

https://rfcx.org/our_work

EXAM PRACTICE QUESTIONS



Paper 1 (core)

- Outline four digital technologies used by Rainforest Connection to collect, store and analyse data collected in the forests to detect illegal activity. [4 marks]

Scientists use climate models to collect and analyse data, to better understand how the Earth's climate has changed in the past and to predict future climate trends. Climate models are an extension of weather forecasting, which uses historical patterns to predict the weather, but it examines changes in decades instead of hours. The models rely on **supercomputers** to process thousands of calculations per second, analysing data from the Earth's atmosphere, oceans, land and ice-covered regions. The models allow scientists to run simulations and see how various components in Earth's climate system relate to one another. They are also used to investigate the degree to which any changes are the result of natural causes, human activities or a combination of both.

◆ Supercomputers:

Refers to high-performance computers capable of high-speed calculations that are required in scientific and engineering fields.

Inquiry

With reference to real-world examples, research how climate models are produced and then evaluate the decision to rely on these climate models when making global policies and decisions. Possible models include the energy balance model, global temperature model and greenhouse effect model.

EXAM PRACTICE QUESTIONS



Paper 1 (core)

- Identify two inputs that might be tracked and used by climate models. [2 marks]

Natural events and disasters

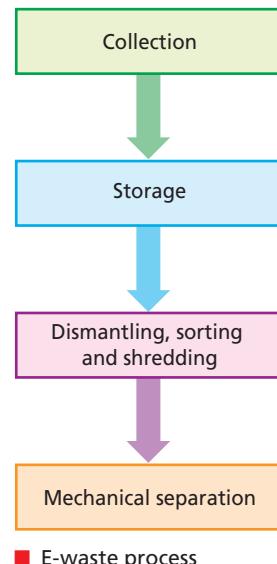
While natural disasters such as earthquakes, floods, fires and disease outbreaks remain difficult to prevent, digital technologies and data analysis are helping to make them more predictable so that communities can prepare and plan accordingly. Robots and drones are used to deliver aid as well as investigate damage sites and transmit information to rescue workers. Social media is used to raise awareness about events and allow those living near a disaster to inform their loved ones that they are safe. There are even technologies that allow phones to communicate directly with one another even when the network is compromised or inaccessible.

In 2018, natural disasters cost the world over US\$130 billion in damages, affected over 68 million people and caused nearly 12,000 deaths. Digital tools increase the human capacity to predict, prevent and respond to natural disasters. Artificial intelligence and machine learning are being used to analyse vast amounts of data to identify patterns in tectonic motion that can help to track earthquakes (while prediction remains very difficult in this field). New forecasting models are being developed that will be able to predict the onset, duration and severity of heat waves. Natural flooding, such as that caused by increased rainfall or storms, can be better predicted and used to identify areas that are susceptible to flash flooding. Data analysis is even being used to forecast and mitigate the spread of diseases, for example, using satellite imagery to monitor the migration of insects that transmit certain diseases.

4.3B Pollution and waste

As digital technology continues to develop faster and faster, buyers upgrade and replace their technology with the newest and latest trends. The obsolete technology is often thrown away or recycled. Over 40 million tons of electronic materials are disposed of globally each year, including approximately 150 million cell phones. While electronic waste makes up only 2% of the waste in landfills, it accounts for 70% of toxic waste.

■ Recycling and waste management



When garbage is thrown away, it is often taken to landfills, where piles of trash accumulate over time. Because electronic parts are manufactured with potentially harmful chemicals, such as lead or mercury, they harm the environment if they end up in landfills. When exposed to heat, these chemicals contribute to air pollution and, when it rains, they can pollute nearby water sources.

E-waste services claim to ‘properly dispose’ of your electronics. Often this begins with collecting obsolete electronic devices and storing them until they can be transported to a facility where parts are sorted, dismantled and shredded. Magnets are then used to separate metallic components that can be processed for further use or resale. E-waste services are often outsourced to developing countries to save financially or to keep up with the demand as more electronics are disposed of. In some cases, e-waste ends up being dismantled ‘in backyards’ in developing countries, where non-salvageable parts are burnt as trash, adding to air pollution and health risks to anyone in the vicinity. While e-waste recycling allows some of the product to be salvaged or repurposed, it still contributes to pollution and global inequality.

◆ **E-waste service:**
A business that collects obsolete electronic devices and sorts them into recyclable and non-recyclable elements.

ATL ACTIVITY

Research

With reference to real-world examples, research the drawbacks and concerns of e-waste recycling. Possible research topics include e-waste chemicals (for example mercury, lead and beryllium), e-waste working conditions in Ghana and e-waste combustion.

ATL ACTIVITY

Communication

Create your own e-waste flyer.

- Research local solutions for properly disposing of e-waste.
- Create a post, poster or map to inform your peers of how to access these sites and properly dispose of electronic waste.
- Share it with your peers.

Types of pollution

Digital technologies often contribute to various forms of **pollution**.

The accumulation of waste materials contributes to **solid pollution**. The packaging and plastics used in consumer electronics contribute to solid waste, which can lead to overcrowded landfills or end up in waterways.

When e-waste is exposed to heat, either in landfill or when burned, chemicals, gases and particles are released into the air, causing **air pollution**. This can contribute to global warming, acid rain, respiratory illness, heart disease, cancer risks and wildlife degradation. When those same chemicals are connected with water (resulting in **water pollution**), either through rain or contact with a stream, river or ocean, it can increase the risk of waterborne illness as well as damage the ecosystems that rely on that water (marine life or agriculture).

Noise and **light pollution** refer to excessive noise or light in the environment. Cars, loudspeakers, floodlights, screens and dense populations contribute to these. Light pollution makes it hard to see the stars and disrupts nocturnal wildlife, migratory patterns and human sleep cycles. Noise pollution also disrupts sleep cycles and can also be linked to higher blood pressure and communication problems.

◆ **Pollution:** The introduction of substances or energy into the natural environment that cause a negative impact.

◆ **Solid pollution:** Solid waste material.

◆ **Air pollution:** Pollution released into the air either through exposure to heat or burning.

◆ **Water pollution:** Pollution released into water.

◆ **Noise pollution:** Excessive noise in the environment.

◆ **Light pollution:** Excessive light in the environment.



ATL ACTIVITY

Thinking

- Download a stargazing app and look out at your night sky.
- How many of the stars on the app can you actually see? Does light pollution interfere with your ability to see the stars?

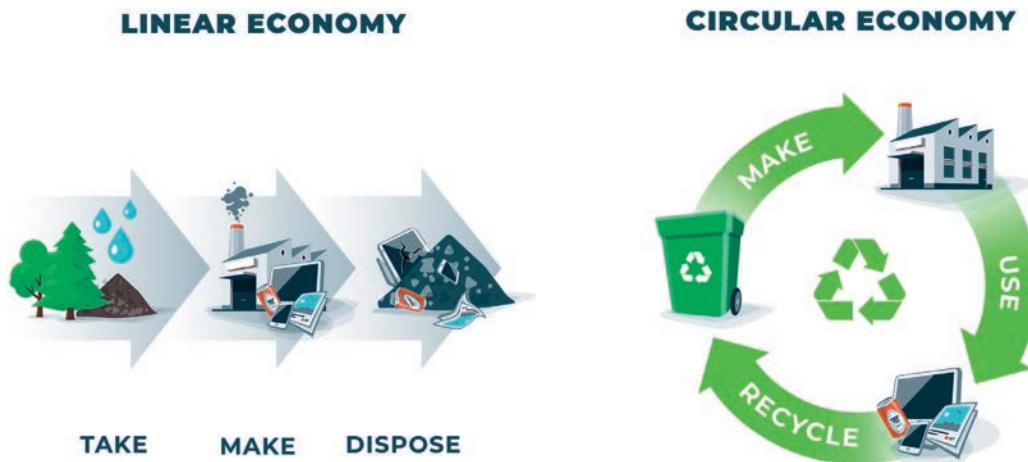
Inquiry

Research the world's most polluted cities and the actions (or inaction) taken to mitigate the environmental impacts of digital technologies.

■ Green computing, e-waste, planned obsolescence

Planned obsolescence is the development of products with intentionally short lifespans so that companies can get repeat sales as devices are replaced or upgraded. While some perceive this as a strategy of corporate greed, enabling businesses to sacrifice the environment as they capitalize on consumer markets, proponents argue that the rapid turnover of digital technology products fuels innovations and creates more jobs. While it is largely responsible for significant waste accumulation, it does enable digital technology to continue to develop and improve.

Corporate take-back policies (or buy-back policies) are when a company will repurchase old digital devices when they become obsolete. This encourages companies to build in a more sustainable manner so that old parts can be integrated into future products. It also creates an incentive for more durable or long-lasting parts. This is one way for companies to shift from a linear production model, where materials are mined and used for a single item that is eventually disposed, toward a **circular economy** where existing resources are reused and repurposed to minimize waste and reduce the demand for new materials.



REAL-WORLD EXAMPLE

ecoATM

ecoATM has over 4500 kiosks across the USA that purchase used cell phones. Users provide information about their phones, such as the model and condition, and the automated kiosk will buy the phone on the spot. Most of the phones they purchase are resold to keep them out of landfills, while the others are recycled. Users are directed to erase all personal data from their devices prior to submitting them into the kiosk. The company claims that it has helped to keep over 28 million phones out of landfills since 2009.

www.ecoatm.com/pages/how-it-works

Inquiry

To what extent are electronic buy-back programs, such as ecoATM, effective in reducing the environmental impact of outdated devices?

ATL ACTIVITY

Research

Research how e-waste recycling programs and corporate take-back programs work in your region for the digital technologies that you use regularly.

◆ Planned obsolescence:

The development of products with intentionally short lifespans so that companies can get repeat sales as devices are replaced or upgraded.

Green computing is the study and adaptation of computer design, engineering, manufacturing, use and disposal to reduce their negative environmental impact. Green computing prioritizes energy-efficiency and proper e-waste disposal to reduce the **carbon footprint** or the total amount of greenhouse gases generated.

ATL ACTIVITY

Thinking

You are concerned about the environmental harm that computers and computer manufacturers are causing. Investigate this at an individual, organizational and governmental level.

- 1 **Individual:** Research and describe some of the environmental factors that you could consider when purchasing or using a computer (for example, energy/paper saving).
- 2 **Organization:** select two computer manufacturers and research their initiatives to be environmentally responsible with regard to:
 - a the use of non-renewable natural resources in manufacturing
 - b the global transportation of manufactured components.Evaluate which company is acting more ethically.
- 3 **Government:** Identify ways in which governments can encourage local citizens and organizations to be more environmentally responsible computer users. What role should governments play in this?

◆ **Green computing:**

The study and adaptation of computer design, engineering, manufacturing, use and disposal to reduce their negative environmental impact.

◆ **Carbon footprint:**

The total greenhouse gas emissions caused by a person, place or product.

EXAM PRACTICE QUESTIONS



Paper 1 (core)

- 1 Outline three ways that individuals can be environmentally friendly when using their digital devices. [3 marks]
- 2 Explain three ways that the disposal of digital technologies can harm the environment. [6 marks]
- 3 Discuss the decision by companies to donate obsolete digital technologies to schools in developing countries instead of disposing of them. [8 marks]

REAL-WORLD EXAMPLE

Planned obsolescence in printer cartridges



Modern printer cartridges are a prime example of planned obsolescence. Microchips on the cartridge or printer use sensors to disable a cartridge before it is fully used up. Owners often must replace the entire cartridge as very few printer ink cartridges are refillable. In North

America, 350 million printer ink cartridges end up in landfills each year. The impact of producing these items is also harmful for the environment.

In 2017, a French lawsuit accused printer companies Epson, HP, Canon and Brother of showing components 'at the end of their life' prematurely. This would be a violation of France's Hamon Law, which requires transparency about the product lifespan and prohibits 'deliberately reducing a product's lifetime in order to increase replacement rates'. The complaint by consumer group Halte à l'Obsolescence Programmée (End Planned Obsolescence) resulted in an investigation into Epson's business practices. Apple received a similar complaint for slowing down older iPhone devices to enhance the battery performance.

While some see planned obsolescence as corporate greed, others describe it as a natural phenomenon in a consumer-driven market that is always seeking the newest and best things. Where products in the past were developed to last decades (sometimes even centuries), most modern technological developments naturally become outdated within a few years.

www.forbes.com/sites/davidschrieberg/2017/09/26/landmark-french-lawsuit-attacks-epson-hp-canon-and-brother-for-planned-obsolescence/?sh=4c0c0bc91b36

Concept connections

- **Change:** How do the continual changes and progress in digital technology make products obsolete earlier?
- **Power:** How much power do concerned individuals have to force digital technology companies implement an effective end-of-life programme for their products?
- **Systems:** Digital technologies have a complex life cycle involving many different systems that are often unseen and unknown that have an impact on our environment.
- **Values and ethics:** When does it become unethical for companies to make consumers replace outdated products?

ATL ACTIVITY

Communication

This would make a good CAS activity.

How can you take action to dispose of e-waste ethically in your school?

- Visit a local dump or e-waste service centre and learn more about their systems.
- Make a guide for your school telling students where they can take their batteries, old devices and other e-waste for proper recycling.

4.3C Cities, infrastructures and built environments

As populations grow, cities and communities are looking for new and innovative ways to create healthy, safe and sustainable living environments for their residents. Many towns are working to incorporate more green spaces and gardens to ensure access to fresh air and to offset the carbon emissions from traffic in congested areas. New technologies are making these spaces more efficient, sustainable and healthy for the communities that can afford to invest in these upgrades.

REAL-WORLD EXAMPLE

Tengah – Singapore's next smart city

In 2021, Singapore began construction on their 'forest town', Tengah, a new eco-friendly town of 42,000 homes enhanced with abundant greenery and public gardens. The city will integrate a 328-foot wide eco-corridor (or park) running through the centre, to protect wildlife and water systems, and as space for a nature reserve.

City planners aim to keep cars, traffic and parking underground so that the ground level is safer for pedestrians and to promote cycling and walking. Tengah will also host electric vehicle charging stations, and the roads are being built to be compatible with a future of autonomous cars and self-driving vehicles. Shifts such as these will not only make the city a more pleasant place to live, but it will also reduce the pollution and carbon emissions of the city.

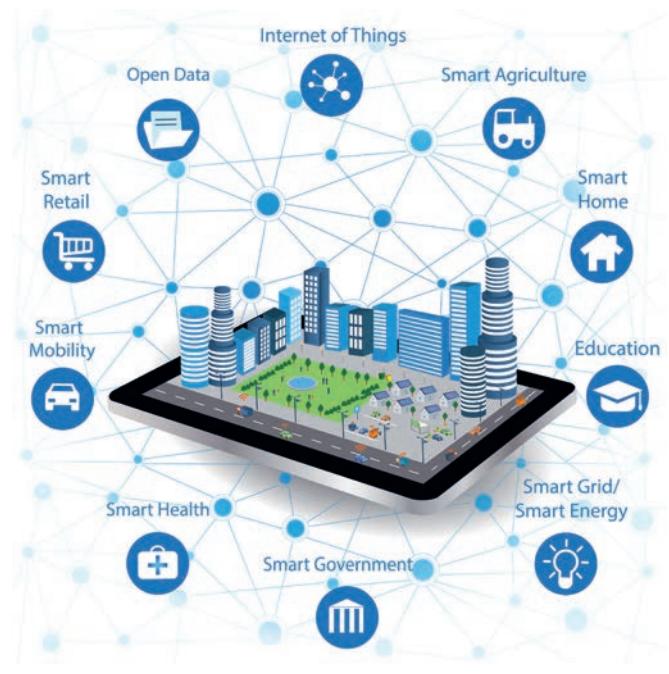
Tengah, Singapore, is just one example of a growing movement to incorporate sustainability and greenery into city living. Envisioning and planning a new town gives city officials a blank slate to devise a more sustainable way of living that can both accommodate large populations and integrate technology to improve environmental access and sustainability.

Other digital technologies being implemented in cities include those for waste management, gunshot detection, smart traffic control systems, smart air quality and smart street lighting.

◆ **Infrastructure:** The structures and facilities, such as roads, buildings or power supply, that allow a place to operate effectively.

Local and regional infrastructures

Cities are using IoT technologies to improve the quality of life for their residents. **Infrastructure** includes any of the structures and facilities, such as roads, buildings or power supply, that allow a place to operate effectively. **Smart cities** are combining their infrastructure with information technologies to create more sustainable and efficient living environments.



■ Elements of a smart city

REAL-WORLD EXAMPLE

Smart cities

Pittsburgh, a city in the USA, upgraded their traffic lights with sensors to analyse and respond to traffic patterns in real time, reducing traffic by 41% and emissions (pollution) by 21% on the road.

Seoul, South Korea, reduced garbage collection costs by 83% with smart trash cans and recycling bins that auto-schedule pick-ups when they are full, rather than relying on pre-planned schedules.

The Japanese government is experimenting with different robots that can navigate crosswalks and avoid plants and pedestrians to make contactless deliveries throughout the country.

www.thalesgroup.com/en/markets/digital-identity-and-security/iot/inspired/smart-cities

www.iotcommunications.com/blog/smart-city-solutions-examples

Links

This content links to Chapters 3.7 Robots and autonomous vehicles and 2.5 Space and Sections 5.3A Climate change and action, and 5.3C Managing pollution and waste.

Inquiry

Research real-world examples to analyse the impacts of smart city technologies on the communities they serve. Possible examples include Virtual Singapore, the DubaiNow app and Oslo's investment in electronic vehicle-charging technology.

■ Transportation and wayfinding, maps, global positioning systems (GPS) and geographic information systems (GIS)

Wayfinding refers to the technologies and systems that give directions to people as they navigate a physical space, such as trying to find the closest ice cream store on the way home from school.

Wayfinding is possible due to the **global positioning system (GPS)**, which uses satellite **trilateration** to locate GPS-enabled devices.

ATL ACTIVITY

Communication

Create an interactive community resource map.

- Investigate software that can create an interactive map for a smartphone.
- Create an interactive map of your local community on a topic of your choice. For example, you could create a map identifying the best restaurants in your city, or the most fun places to shop.

◆ **Wayfinding:** The technologies and systems that give directions to people as they navigate a physical space.

◆ **Global positioning system (GPS):** A satellite-based navigation system.

◆ **Trilateration:** Technology that uses three satellites to pinpoint our device's location.



When combined with a mapping platform, users can interact with data displayed on a geographic map using data collected from **geographic information systems (GIS)**.

These three technologies also make it possible for cell phones to provide step-by-step directions from one location to another, monitor a taxi route, or display the exact number of minutes until a bus arrives at a specific stop.

◆ **Geographic information system (GIS)**: A system that connects data to a map.

ATL ACTIVITY

Research

Investigate how GPS satellites and the map on your smartphone work together to provide you with your location on a map.

REAL-WORLD EXAMPLE

Waze

Waze is a community-driven mapping app that aggregates data from users in real time to provide the fastest navigation routes, as well as notify drivers about hazards, police, accidents, traffic and other things that could impact their journey. Like most navigation apps, mapping platforms are combined with GPS location services to both locate users and guide them towards their destination. The app collects data automatically to monitor traffic and determine optimal routes based on drivers currently on the road. Users can also manually enter data and information about their trip (such as police car locations and road hazards).

The app uses **gamification** – users can go up levels the more they use and engage with the app. It also incorporates social interactions by allowing groups of

friends to share their routes, and shows their icons on the screen if a friend happens to drive nearby.

The large number of icons and data points can crowd the screen, however, and make it difficult for users to access their routes. In addition, ads, pop-ups and reroutes can be distracting to drivers, encouraging them to look at application notifications instead of the road. While the app argues that displaying police data encourages safer driving, particularly where police are present, police officers argue that alerting drivers to police presence can make them a target or undermine their traffic control efforts. Finally, with all of the data and updates being transferred while the app is in use, the app causes a significant drain on batteries.

www.investopedia.com/articles/investing/060415/pros-cons-waze.asp

Concept connections

- **Power:** How does Waze empower users? At whose expense?
- **Space:** GPS allows users to navigate new spaces more strategically and with greater information.
- **Systems:** Live traffic updates and recommendations allow people to avoid congested areas. This has the potential to create a feedback cycle that helps to improve the congestion as fewer drivers will navigate through crowded areas.
- **Values and ethics:** The data collected by apps that use GPS to determine and use your location can be sensitive as it allows for your movements to be tracked. What policies should be implemented by governments to minimize the negative impacts and implications?

EXAM PRACTICE QUESTIONS



Paper 1 (core)

- 1 Describe two sensors that could be used in a smart city. [4 marks]
- 2 Explain how GPS would be used to help an autonomous vehicle navigate from point A to point B. [6 marks]
- 3 Discuss how citizens could be impacted through the use of smart city digital technologies. [8 marks]

4.3D Agriculture

Agriculture, like other industries, can benefit from the use of digital technologies. Whether it is the use of the internet and mobile technologies to connect farmers to new markets, the use of robots and artificial intelligence to help automate processes, or the use of digital satellite imagery to reduce the cost of monitoring, digital technology is being introduced at a local and countrywide level.

■ Agricultural production and distribution



Agricultural production refers to the farming of crops and animals to create food, fuel, fibres and raw materials. While agriculture is often thought of as part of the food industry, it is also significant in production of materials used to make clothing, cleaning products, energy and more. In a digital society, agricultural operations incorporate sensors, robots, GPS and other technologies to yield more crops using less labour and resources. Digital tools allow farmers to monitor individual plants and exactly how much water, fertilizer and other materials each plant receives, reducing the costs and environmental impact of their operations, while also making farms safer places to work.

Distribution of agriculture is how the products get from the farmers and growers to the customers. For example, a banana picked in Costa Rica to be sold in the US will be transported by truck to a refrigerated shipping container, where it will travel by boat for 48 hours (often in air-conditioned containers) before it arrives in Miami, Florida, for distribution in the US. The bananas in the stores in Florida have already travelled over 1100 miles (1700 km).

Transporting large amounts of food requires substantial resources to both fuel the trucks and boats used for transports and maintain appropriate temperature controls in the shipping containers and storage areas so that the produce does not rot. Digital technologies are often used in this chain of activities, mostly having large efficiency benefits.

As people become more aware of the costs of transporting food over long distances (financially and environmentally), many are turning to local alternatives such as farmers markets or subscribing to local farm delivery services. While some farmers host their own websites and online stores to distribute directly to customers, many start-ups are building platforms and services to partner with farms and connect them with local customers.

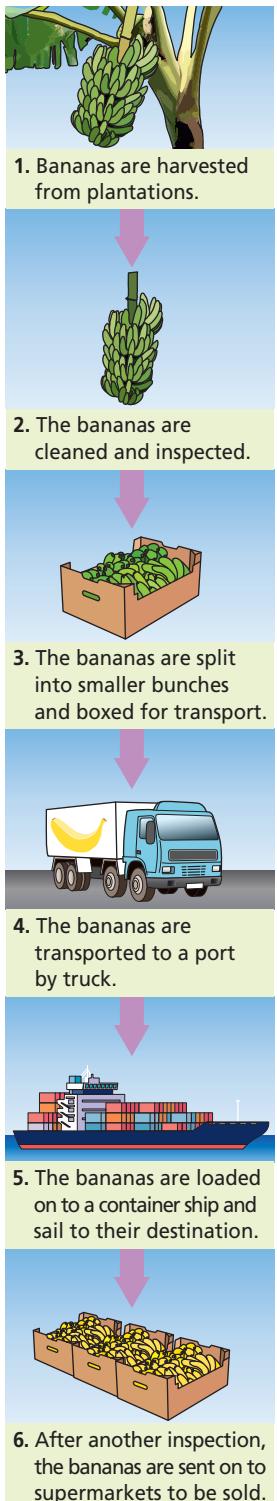
ATL ACTIVITY

Research

Research how food arrives at your table.

- Choose an imported food product that is available in local stores in your community.
- Research the details of the production process. Where is it farmed, and how it is transported, stored and processed?
- How is digital technology currently being used along the journey?

◆ **Distribution:** The movement of products from farmers and growers to customers.



REAL-WORLD EXAMPLE

FarmBot

FarmBot is a farming robot, based on open source technologies, that can help to plant, water and monitor seeds automatically. It uses microcomputers, computer vision, an onboard camera, motors and interchangeable drill bits to automate the process. There is an application that includes a graphical interface for growers to plan their garden without coding. FarmBot moves in a similar way to a 3D printer, with motors that move its position along the x- and y-axis, as well as a third motor that allows it to move vertically as it plants seeds or water plants.



■ FarmBot

While the FarmBot machinery costs over US\$2500, the software and design specs are freely available for manufacturers or hobbyists to create their own if they have access to the right materials. Additionally, because it is an open-source platform, programmers can customize it for their own gardens. FarmBot makes it possible for amateur farmers to start their own gardens indoors or in their backyards, making it accessible for anyone who wishes to automate their gardening and grow their own produce.

<https://farm.bot>

Links

Revisit Chapter
3.7 Robots and
autonomous
technologies.

Concept connections

- **Change:** The change from manual and old technologies in agriculture to now include digital technologies is an example of evolutionary change as the fundamentals have not changed.
- **Space:** FarmBot allows for more precise planning and use of limited space to maximize yields in small zones.
- **Values and ethics:** The decision to make their software open source means that others can recreate and build FarmBot without purchasing anything from the company. What company values might this decision indicate?



Inquiry

Discuss the impacts and implications for the environment of using robots in agricultural production. Make reference to real-world examples in your response. Possible examples include Harvest CROO, Harvest Automation and Abundant Robotics.



Extended essay (EE)

You could investigate the questionable manufacturing decisions of large digital technology companies. Choose a specific component or resource and evaluate the environmental impacts of its collection, use and disposal.



Creativity activity service (CAS)

- **Save the planet:** Start a social media campaign for an environmental cause, educating your peers on how to properly dispose of their e-waste.
- **E-waste project:** With the evolution of computing comes the increase of e-waste. Initiate a project in school for the collection of e-waste. You may need to start this project by researching which organizations are available locally to receive this waste and what they are willing to receive. Following on from this, initiate a collection campaign that will raise awareness about e-waste and provide a collection service for the school community.



Reflection



Now that you have read this chapter, reflect on these questions:

- What natural resources are used in the production of digital technologies? What social and ethical concerns arise from the harvesting and use of these resources?
- How can digital technology help to diminish the negative impacts of human activity on the environment?
- What are the different options for disposing of obsolete digital systems? What are the impacts and implications of each option? What are the viable recommendations for getting rid of hardware components ethically?
- What is the potential for smart city technologies to improve the quality of life for citizens? What are the risks and concerns of these technologies?
- How do GPS and transportation apps help us navigate the world around us more efficiently?
- How do digital technologies impact the agricultural processes of production and distribution?

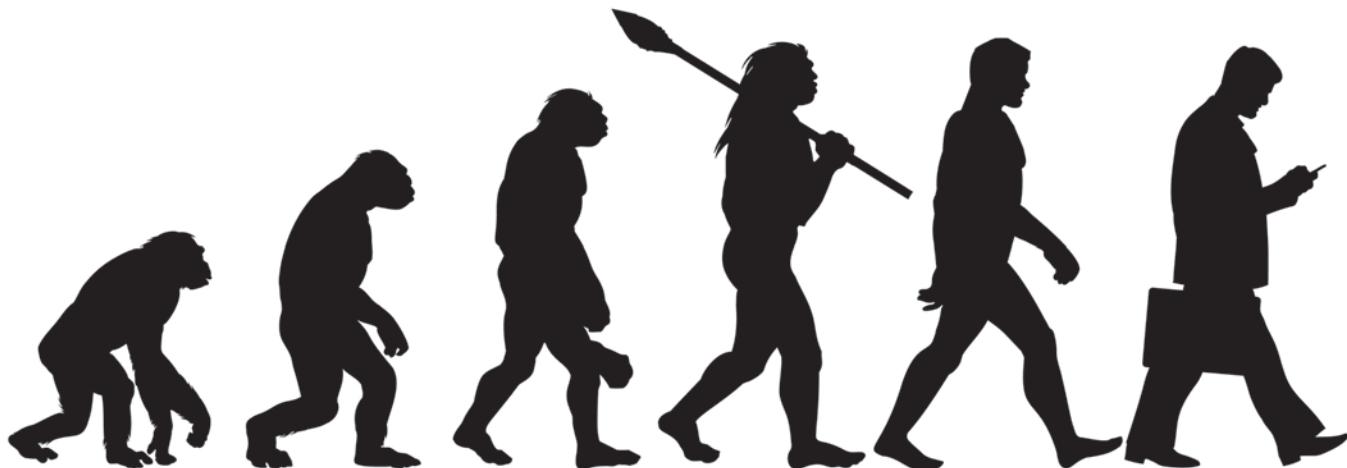
4.4

Health

UNDERSTANDINGS

By the end of this chapter, you should understand:

- ▶ innovations in digital technology have evolved in the health and medical systems including the treatment of patients and the systems used to manage hospitals and other health care facilities
- ▶ digital technology tools can be used to overcome the limitations of the human body, which range from augmenting our existing capabilities to developing accessibility tools to create a level playing field for those living with disabilities
- ▶ the use of digital technologies has physical and mental health impacts.



Digital technology tools are changing the way our bodies function. The time spent on devices has impacts on our physical body, and the emotional impacts of social media use can be devastating. However, other innovations have given doctors and health care providers more tools and resources for monitoring health indicators and interacting with patients in remote areas. When examining the impacts and implications of health developments on individuals and communities, it is important to explore the trade-offs for various stakeholders.

4.4A Medicine and health

The medical field is adapting rapidly as technology evolves. New robotic and diagnostic technologies equip health care providers with new tools and data. Paper charts are moving on to cloud-based databases, and video conferencing makes doctor visits possible when hospital and home visits are not. Wearable technology can be used to monitor patients as well as athletes, and a range of software applications and tools exist to help individuals track their meals, activities and other health-related habits.

Approaches to the design and delivery of medical diagnostics and care

Medical diagnostics includes the equipment, tools and processes that allow professional medical personnel to observe a patient's health in order to determine what treatment to provide. This can range from listening to heart and lung activity using stethoscopes to monitoring blood pressure and other physical indicators of vital health signs.

Artificial intelligence is being used to analyse and monitor images, scans and data, while machine learning tools are being trained to recognize cancerous cells in tissue samples better than humans can, as well as suggest diagnoses in other areas. **False positives** are a common issue in many of these tools. Their recommendations and diagnoses often need to be re-evaluated by human medical professionals once an irregularity is identified.

◆ **Medical diagnostics:**

The equipment, tools and processes that professional medical personnel use to make a diagnosis.

◆ **False positive:** A test result that incorrectly suggests a condition is present.

REAL-WORLD EXAMPLE

AI in predictive medicine

The US Department of Justice spent millions of dollars to maintain prescription drug databases to track the prescriptions of certain controlled substances in real time. This was contracted out to a company called Appriss, which used machine learning algorithms to generate data insights. NarxCare, one of Appriss' databases, identified patients at risk of misusing opioids by analysing the patients' drug shopping behaviour, along with medical claims data, electronic health records and criminal justice data, and used this to assign the patients an overdose risk score.

Appriss stated that NarxCare's score was not designed to replace a doctor's diagnosis, but many busy physicians –accountable to the police and federal law on how they handle patients with high scores – were pressured to act on the score.

In one case, the algorithm was responsible for a patient being denied medical treatment prescribed by their doctor and the cancelling of the opioids that were being used to alleviate pain while the hospital was monitoring their condition.

www.wired.com/story/opioid-drug-addiction-algorithm-chronic-pain

Links

This content links to
3.6E AI dilemmas.

EXAM PRACTICE QUESTIONS



Paper 1 (core)

- 1 To what extent should artificial intelligence systems be relied upon when making decisions about patient health? [8 marks]

Patient care is also evolving as technology develops. IoT devices, including **wearable medical devices**, offer continuous, real-time data to improve treatment, diagnosis and monitoring of patients by medical professionals. These tools, combined with video-conferencing technology, enable **telemedicine** – the remote treatment of patients – reducing the costs and making the process more efficient for both providers and patients. Additionally, **robotic surgeries**, and robot-assisted surgeries increase precision, flexibility and control for doctors compared with conventional approaches. Often these procedures can be performed through smaller incisions, reducing the risk and healing time for the patient.

◆ **Wearable medical device:**

A device that can be worn to provide continuous, real-time data to improve the treatment, diagnosis and monitoring of patients.

◆ **Telemedicine:** The remote treatment of patients.

◆ **Robotic surgery:** Surgery carried out using robotic systems, for example mechanical arms controlled by a surgeon.

Inquiry

With reference to two real-world examples, research and evaluate the impacts and implications of robotic surgery on the work of medical professionals. One example to consider is the da Vinci Surgical System.

Medical research and development

Research and development (R&D) in health technology helps to solve global health problems, improve on existing treatment processes and innovate new diagnostic tools, medications, vaccinations and treatment approaches. Key stakeholders involved in medical R&D include universities, governments, non-profit organizations, private corporations and philanthropic donors. Many of the countries and communities most impacted by disease and other health risk factors have fewer resources to spend on R&D than healthier communities, which makes it less profitable. As a result, much R&D in these areas relies on philanthropic donations or government allocation of resources. Of course, digital technologies are a key part of the R&D process and are often expensive items.

ATL ACTIVITY

Research

Research how scientists are fighting global diseases using a range of digital technologies for collaboration, data collection and data processing, resulting in modelling and predictions used to develop new products.

Health and wellness records, monitoring and tracking

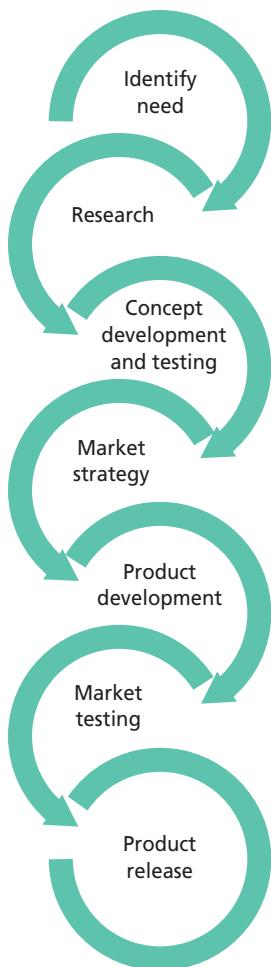
Paper charts used in hospitals to record data about patients are moving online, where **digital health care records** store vital information, patient history, allergy information and more in a centralized database. This offers immediate and timely access to information, and helps to improve accuracy as the patients' records are stored, searched and analysed and can be shared directly with other stakeholders. Medical professionals are having to spend more and more time documenting and typing these records, while on the other hand IoT devices are increasingly being used to measure and record medical data.

Ransomware attacks on hospitals, are increasing. A 2021 survey of 600 American hospitals found that over 40% had experienced some form of ransomware attack, many delaying patient care, and some increasing death rates.

Another issue is that insurance and medical companies are eager to obtain access to these records for their own purposes, often without due consideration for patient privacy and security. The use of digital health records requires strong laws and regulations to protect patients' privacy.

◆ Research and development (R&D):

Work on innovating, improving and introducing new services or products.



■ The seven

◆ Digital health care records:

Digital health care records: Online databases that store patient information.

ATL ACTIVITY

Communication

Create a visual representation that explains in a step-by-step manner how a doctor working in a rural clinic can access electronic medical records stored centrally at the city hospital.

Your visual representation should include:

- a network diagram to show the technologies used to connect the rural clinic to the city hospital
- details of the security measures taken to secure the connection, the central database and the desktop in the clinic
- how the doctor accesses the central database
- what data is stored in the electronic medical records
- how the doctor would search for the patient's records.

Patient monitoring outside of the hospital setting has also evolved. Wearable technology and health monitoring software can help patients collect data, monitor their activity and share information with their health care providers.

One study showed that around 50% of prescription drug users are taking their medication incorrectly.

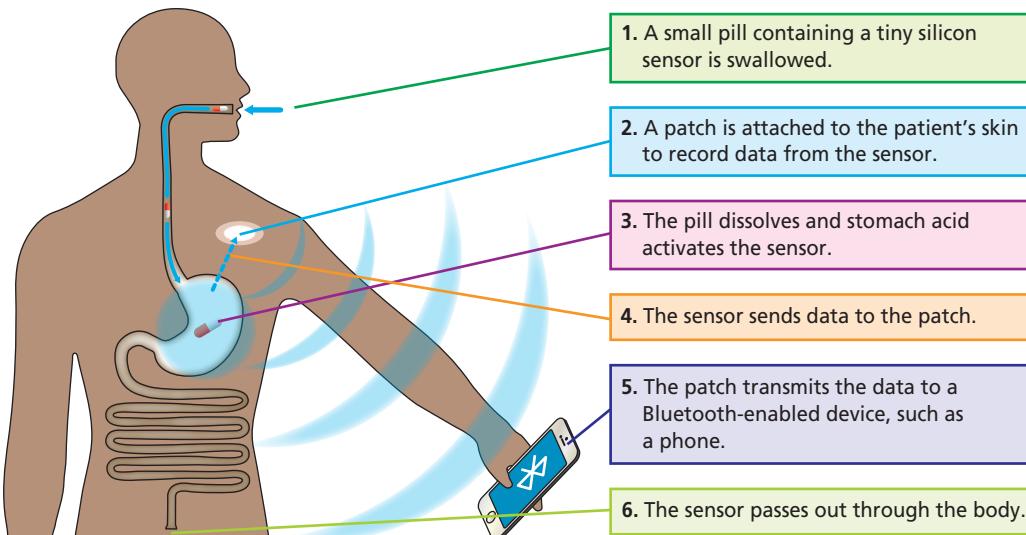
Digital medication, or smart pills, include ingestible sensors that can monitor vital body functions, as well as when the pill was taken, which can then be transferred by Bluetooth to a patient's cell phone or computer and uploaded to their doctor's records or application, giving doctors access to more data and the ability to ensure that their patients are following their treatment plans accordingly.

One key application of this was in the treatment of patients with schizophrenia, which allowed doctors to have reliable data on whether or not their patients were actually taking their medication.

Links

This content link to Chapter 3.4 Networks and the internet.

◆ **Digital medication:** Prescription medicine that contain an ingestible sensor; also known as 'smart pills'.



How ingestible sensors work

Wearable devices such as smartwatches are increasingly becoming common as individuals monitor and track their own health and activity levels, but often they are not used effectively, and issues can arise with self-medication and diagnosis based on the data. Doctors and medical researchers are using these devices to collect real-time data from patients, but the quality and use of the data needs to be reviewed.

ATL ACTIVITY

Thinking

To what extent should patients have access to and ownership of the data in their electronic medical records? Reference at least two real-world examples in your response. Possible examples to research are Athenahealth's medical software and the 'CHS Heartbleed' cyberattack.

REAL-WORLD EXAMPLE

Telehealth



During the COVID-19 pandemic, the number of physicians using telehealth services jumped to 90%, up from 32% in the USA before the pandemic. Nearly half of the patients used their smartphones for these services. Because 85% of Americans have a smartphone, telehealth is more accessible if it can be implemented on mobile devices.

However, a University of Michigan study found that older patients, non-white patients and non-English speaking patients were least likely to use the video features in telemedicine, in part due to **internet connectivity** and **digital literacy** issues. In addition to providing medical advice, clinicians needed to provide technical support to teach their patients how to log in and connect to video conferences.

While smartphones and video-conferencing technology make telehealth more accessible globally, there remains a divide in communities that lack digital literacy and network connectivity resources.

Telehealth is growing in some countries and has become one of the main ways of extending health care to remote communities in rural areas, and where there is a lack of medical professionals and accessible facilities.

<https://searchunifiedcommunications.techtarget.com/news/252505307/Tech-issues-keep-mobile-telehealth-from-reaching-underserved>

ATL ACTIVITY

Social

In groups of three or four, consider an alternative perspective through this role play activity.

The roles are:

- patient – you are seriously ill and have visited your local rural clinic
- doctor (rural clinic) – you are diagnosing the patient; you are not a specialist and you have not seen a case like this before, so you call on the help of the specialist in the city hospital
- specialist doctor (city hospital) – you are a specialist supporting the doctor in the rural clinic; you have to try to diagnose the patient
- family member of patient (optional) – you are with the patient and are there to support and ask the doctor questions.

To make this activity more realistic, each doctor should be in a different room using video-conferencing software.

Act out the role play and, afterwards, reflect on your roles:

- How did the patient (and family member) feel? Did they have any concerns? If so, what were they?
- How did the clinic doctor feel about diagnosing the patient? How helpful was the specialist doctor?
- How did the specialist doctor feel about helping the doctor in the rural clinic? Were they able to do a good job? Was it easy to support the doctor in the rural clinic? What were the barriers?

◆ **Internet connectivity:** The ability to connect to the internet.

◆ **Digital literacy:** The ability to use various digital platforms.

Concept connections

- **Change:** Change usually has positive and negative impacts and implications. Some have been listed in the example. Identify some more.
- **Expression:** The issue of problems in communications due to the nature of telemedicine has been raised by both doctors and patients. Identify some of them.
- **Identity:** As a consequence of the lack of physical contact between patient and doctor, the patient might feel that their symptoms and problems are not fully appreciated by the doctor. Identify some examples.
- **Power:** Telehealth has the power to increase the isolation of people and the feeling of lack of control over their lives, but it can also have the opposite impact. Make some inquiries to doctors and patients who use telehealth about this issue.
- **Space:** Telehealth has enabled medicine to enter the virtual world. Are there any uses for virtual reality and augmented reality in telehealth?
- **Systems:** Telehealth requires the interaction between a range of digital technologies. Identify some and explain how they interact.
- **Values and ethics:** Telehealth can be expensive to develop and run. Where should the doctors, hospitals and medical administration put their efforts and money? Which people, communities and regions should have priority?

EXAM PRACTICE QUESTIONS



Paper 1 (core)

- 1 To what extent can telehealth replace face-to-face contact between patients and medical professionals? [8 marks]
- 2 To what extent is telehealth a solution to the barriers of access to specialist health care provision? [8 marks]

Links

The content on access to health care and medicine links to Section 5.1A Local and global inequalities.

4.4B The human body

Transhumanism is a movement that aims to use technology to evolve and augment the human experience. This can include a range of methods in which machines and digital technologies are integrated into daily life. Technically, a wearable health watch that counts steps and provides reminders on when to stand up or exercise falls into this category. However, more advanced technology examples may include implanting microchips to help control bodily functions, or using bionic limbs. The main idea is that digital technology can help overcome the physical and mental limitations of the human body.

◆ **Transhumanism:** A movement that aims to use technology to evolve and augment the human experience.

REAL-WORLD EXAMPLE

Technological augmentation, bio-hacking, implanted technology, exoskeletons and organ printing

Google Glass was released in 2012. It incorporated camera and display screens into a network-connected pair of glasses. In theory, it should offer an **augmented reality** experience, overlaying digital information onto the reality in front of you. The product also allows users to check messages, view photos, get directions, and have spy-level access to

information. However, costs, limited battery life and data limitations kept the full vision from becoming a reality in the first roll out. The market did not catch on to this wearable computer, and Google shifted its emphasis from the general public to supporting manufacturing industries and integrating their technology into safety goggles.

ATL ACTIVITY

Research

Research the latest versions of Google Glass-type glasses. List the technology involved, how it works, and the impacts and implications.

The integration of digital technology with the human body did not end in 2012, however.

Bio-hacking is a broad term that encompasses any activity that helps you gain control over your own biology. This can range from nutritional supplements, meditation practices and intermittent fasting to stem-cell injections and more. Others may use implant technology, such as **RFID** computer chips, so that they can open doors or monitor their body nutrient levels using near-field communication technologies.

The underlying philosophy of bio-hacking is that the body's shortcomings can be overcome. However, many bio-hacking techniques ignore the health and safety tests and trials that are part of traditional medicine, making these practices risky, as well as expensive.

◆ **Bio-hacking:** Any activity that helps you gain control over your own biology.

◆ **RFID:** Radio-frequency identification.

◆ **Microchip implant:** Implanting an RFID transponder under the skin.

REAL-WORLD EXAMPLE

Microchip implants



A human **microchip implant** is usually an RFID transponder that contains a unique ID number and connects to an external database that could include information such as medical histories, allergies, contact information, criminal records and more.

In Sweden, thousands of microchips have been implanted in people's hands that make it quick and easy to unlock their homes, enter a gym or sign in at work. The chips are about the size of a grain of rice and usually are inserted near the thumb.

While these chips offer conveniences, they raise privacy concerns about tracking and monitoring the chip's use and patterns, as well as security concerns with the risk for identity theft or increased surveillance. They also raise safety concerns as they could have health complications, including infections. However, advocates argue that the convenience and advantages of implanted microchips will offer a competitive edge in the labour market in coming years.

www.bbvaopenmind.com/en/technology/innovation/technology-under-your-skin

Concept connections

- **Change:** The use of RFIDs has facilitated changes in our lives already. Investigate other possible uses of RFIDs.
- **Power:** The use of RFIDs to access and use places and systems also enables the tracking of our activities. What should be done to limit the use of this information?
- **Systems:** Explain how the use of RFIDs requires the interaction of other systems. Explain how the data will be transferred and used in one of these systems to enable the benefits of RFIDs.
- **Values and ethics:** For current and possible new uses of RFIDs, explore the different perspectives about why they should or should not be used.

ATL ACTIVITY

Research

Research two examples of RFID chip integration used in implant technologies. Research the benefits and possible negatives.



Exoskeletons (also known as power suits or augmented mobility) are a wearable robotic tool that was originally used in the military to help lift heavy items. Exoskeletons can range from powered gloves to full body power suits. They enhance the strength and stability of the human body and allow humans to control and operate heavy machinery, lift more, jump higher and otherwise augment the human body. They incorporate sensors, motors, microcomputers and more. Exoskeletons can also be used to help rehabilitate people who have lost the ability to walk, or overcome other physical injuries and disabilities.

Inquiry

Research two real-world examples of uses of exoskeletons by disabled military veterans, and accident and disaster victims. Discuss the actual and potential capabilities.

Organ printing and **bioprinting** use the same additive manufacturing process as 3D printing, by extruding successive layers of material until a 3D object is produced. However, instead of plastic, it prints with a combination of cells, proteins or biocompatible plastic that simulates the skeleton.

Bioprinting files are often created using CT or MRI scans, then 'bioink' is prepared by mixing cells appropriate to the tissue desired. Bioprinting uses an additive manufacturing process, layering the cells in the appropriate layout using one or multiple printheads. Finally, the printed structures are crosslinked, stabilizing the structure by exposing it to the appropriate lights or elements to build covalent cell bond structures. The process results in a natural tissue that can be used to study disease and which may eventually be used more extensively to repair damaged organs and tissues.

◆ **Exoskeleton:** A wearable robotic tool that supports/strengthens the human body.

Links

This content links to Section 3.7C Evolution of robots and autonomous technologies.

◆ **Organ printing:** The 3D printing of organs using a combination of cells, proteins or biocompatible plastic that simulates the skeleton.

◆ **Bioprinting:** The 3D printing of tissues using a combination of cells, proteins or biocompatible plastic that simulates the skeleton.



■ Bioprinting

ATL ACTIVITY

Thinking

Prepare for a debate: Is bioprinting of human tissues and organs ethical? Are there any legal issues involved?

- Conduct wider research into bioprinting.
- Divide the group into two – one group will support the idea that bioprinting has medical benefits, while the other group will research the ethical and legal objections to bioprinting.
- Conduct the debate and, at the end of the session, take a vote.

Links

The content in this section links to Section 5.2C Diversity and discrimination.

◆ Assistive technology:

Any item, equipment, programme or product that enhances the life for people living with disabilities.

Accessibility approaches for differently abled people and communities

Accessibility innovations go far beyond the settings in smartphones, in many cases providing the necessary accommodations to overcome physical barriers and challenges. **Assistive technology** is any item, equipment, programme or product that enhances the life for people living with disabilities. Many tools combine artificial intelligence with camera technologies to help support those with sight limitations by transforming visual and tactile information into auditory information. For example, the ‘show and tell mode’ on Amazon’s Alexa allows it to tell users ‘what they are holding’ as long as it is visible to the camera. For those who are unable to hold video game controllers, Microsoft has developed a set of ‘Eyes First’ games that are playable using only eye movements.

ATL ACTIVITY

Research

Research assistive digital technologies. Report your findings by making a table with disabilities in the first column, and digital technology accessibility solutions in the second column.

ATL ACTIVITY

Thinking

Find a personal relevance through exploring the accessibility options available in the operating system, and software such as word processors, on your computer and/or smartphone.

- Try out the different accessibility options on your computer.
- Complete the following table with your findings.

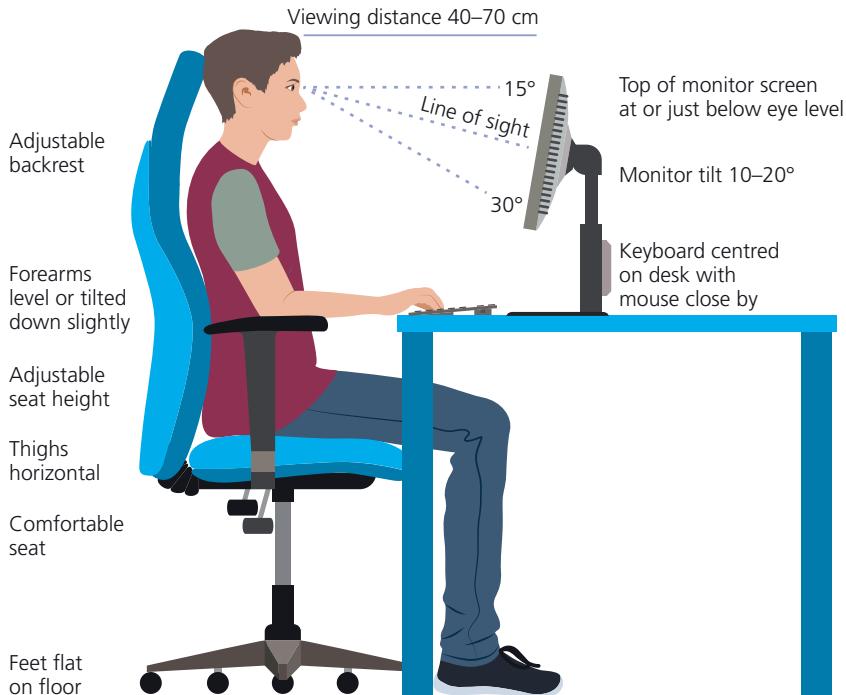
Accessibility feature	Who would benefit?	What are the benefits?
e.g. Magnifier	People with visual impairments	Allows the user to magnify the screen up to 16 times the size, making it easier to read what is on the screen

ATL ACTIVITY

Research

Research the use of digital technologies, including artificial intelligence, to help people with no vision. Compare these digital technologies with those used in cochlear implants for hearing.

Ergonomic design



◆ **Ergonomic design:**
Designing workplaces, products and systems so that they meet the physical and emotional needs of the user.



Ergonomic design involves adjusting the tools and environment to meet the physical and emotional needs of the user. Awkward body positions while using a tool, whether working on a laptop or operating large machinery, can result in injury or harm, particularly when a movement is repeated over long periods of time. Ergonomic keyboards, for example, conform to the natural positioning of human fingers, allowing for a better body position and relaxed shoulders. Over time, incorporating ergonomic design principles into the workplace can improve posture as well as prevent back injuries, arthritis and other musculoskeletal injuries.

ATL ACTIVITY

Research

Research the range of health-related problems that are associated with the use of digital devices, their causes and possible solutions.

Complete the following table with notes of your findings:

Health-related problem due to the use of digital devices	Causes	Solutions
Headaches and migraines		
Eye problems, e.g. macular degeneration		
Mental well-being, e.g. depression, anxiety, problems with sleep, obesity		
Repetitive strain injury (RSI), e.g. carpal tunnel syndrome		
Neck and back pain		
Hearing loss due to headphones		

EXAM PRACTICE QUESTION



Paper 1 (core)

- 1 To what extent are employers responsible and accountable for employees' health issues caused by the use of computers in the workplace, and when working from home? [8 marks]

4.4C Mental health

■ Approaches to understanding and ensuring mental health

Mental health conditions, such as depression and anxiety disorders are increasingly prevalent in developed nations. More than half of their populations are likely to suffer from one of these conditions during their lifetime, and even those who are not diagnosed may still struggle from stress or other mental health challenges.

Digital solutions for mental health range from smartphone apps where users can log their moods and monitor their vital signs, to remote therapy options where users can video chat with licensed therapists. Other offerings include self-assessment quizzes and tools, online resources, forums and support communities. Digital solutions allow for more personalization and discretion, which helps to overcome the stigma that can accompany many mental health challenges in today's society.

EXAM PRACTICE QUESTIONS



Paper 1 (core)

- 1 To what extent should users rely on the results of online mental health screening tools, such as online depression screening tests, and the result of web searches on health symptoms? [8 marks]

■ Intersections of digital systems and mental health, for example, attention, addiction and anxiety

Social media apps utilize the same neuroscience and addictive elements that go into planning a casino. They are designed to strategically trigger the release of dopamine – a natural chemical that impacts the feeling of pleasure – in a way that maximizes usage and engagement on the application. The brain reacts to social media in a similar manner as it reacts to addictive drugs. Notifications, infinite scroll and personalized content are all tools used by social media applications to increase your usage and, in many cases, convert your screen time into advertising revenue.

Social media addiction is characterized as being overly concerned with social media, where the urge to use social media is so strong that it starts to impair other important parts of life.

Two powerful ways to mitigate the impacts of social media addiction include turning off notifications and setting time limits. Engaging meaningfully in the non-digital world, either with in-person friends or finding a hobby can also help to replace the time spent scrolling through news feeds with something more fun and positive. Taking vacations from social media, such as a screen-free day or a weekend offline, can help as well.

◆ **Social media addiction:** Psychological or behavioural dependence on social media to the detriment of other important parts of life.

Social media can have a mixed impact when it comes to depression. People who have positive relationships, interactions and support on these platforms have lower levels of depression and anxiety. However, the pressure to compare oneself with others, cyberbullying and negative interactions online can increase depression and anxiety. The types of interactions and relationships a person has online are a significant determining factor in how social media use may impact their mental health.

The impact of digital technologies on mental health extends beyond social media. In 2018, the World Health Organization identified **video game addiction** or '(internet) gaming disorder' as prioritizing gaming over other interests and escalating gaming engagement to the point of interfering or having negative impacts on one's life.

◆ **Video game addiction:** Psychological or behavioural dependence on playing video games to the detriment of other important parts of life.

ATL ACTIVITY

Research

- Explore the 'screen time' features on your phone if applicable. How often do you use your phone? What applications do you use the most?
- Research topics such as 'video game addiction' and 'smartphone OCD', and compare the results with your own personal experience.
- Which of these recommendations might help you to use and engage with your phone more responsibly?
 - Reorganizing your home screen to remove distracting apps.
 - Find a place to charge your phone at night that is away from your bed.
 - Turning off all non-essential notifications.
 - Setting time limits on certain apps.
 - Switching your phone to grayscale so it is less desirable to look at.
- Recommend best practices for your peers to adjust their digital device usage and settings.

◆ **Virtual reality exposure therapy (VRET):** Therapy designed to reduce a person's fear and anxiety by confronting the experiences in a computer-generated virtual environment.

REAL-WORLD EXAMPLE

Using virtual reality for PTSD treatment

Post-traumatic stress disorder (PTSD) is a psychiatric disorder that can occur when people experience or witness a traumatic event. This can include natural disasters, war, violence or serious accidents. People with PTSD may feel intense and disturbing thoughts, and experience flashbacks back to the traumatic event long after the actual event happened.

Exposure therapy is a treatment that aims to help reduce a person's fear and anxiety by actively confronting the experiences that the person fears the most. For many with PTSD and other anxiety-related disorders, however, it would be unsafe to revisit the traumas that they have experienced. Instead, **virtual reality exposure therapy (VRET)** is being tested as a potential treatment.

VRET allows an individual to safely immerse themselves in a computer-generated virtual environment where they can confront situations or locations that might not be safe in real life. For example, Vietnam combat veterans may be immersed into the same imagery that soldiers experienced

while on the front lines. Early studies showed that VRET helps to reduce the symptoms of PTSD and may help people to overcome other fears and anxieties.

VRET remains expensive, however, and its availability is limited compared to traditional exposure therapy. VRET is still being tested for use with younger patients, and for use for other mental illnesses. The potential for self-medication with VRET is still being researched.

www.psychiatry.org/patients-families/ptsd/what-is-ptsd

www.verywellmind.com/virtual-reality-exposure-therapy-vret-2797340



EXAM PRACTICE QUESTIONS



Paper 1 (core)

- 1 To what extent should VRET be used as a preventative treatment for those who work in potentially PTSD-inducing situations? [8 marks]

Concept connections

- **Change:** VRET is an extension of current practices where people with PTSD gradually confront their experiences and learn to cope. Investigate the differences between the new and the old practices.
- **Expression:** The use of VRET enables a person to express themselves in a different way than previously by letting them relive the situation.
- **Identity:** The use of VRET is closely associated with a person's identity as it focuses on the experiences of the individual.
- **Power:** There is a significant power relationship between a doctor and patient in any treatment regime. Investigate the use of VRET for self-medication.
- **Space:** Virtual space is at the heart of VRET treatment. Investigate other uses of virtual reality to allow people to experience other environments virtually.
- **Systems:** VRET systems are based on entertainment virtual reality systems. Investigate the differences between VRET and other virtual reality systems.
- **Values and ethics:** There is real potential for both harm and good with the use of VRET as its effectiveness is still being investigated.

Creativity, activity, service (CAS)

Volunteer at a local hospital, senior centre or sports team and see how they are integrating new digital technologies into their practices.

Extended essay (EE)

Explore the impacts of bioprinting on patients in need of organ transplants.

TOK

At what point do humans augment themselves to the point that they are no longer considered a human? What are the ethical considerations that must be considered when 3D printing living cells/tissues?

Reflection



Now that you have read this chapter, reflect on these questions:

- How are people in your community using technology to improve their health? This could be through the use of smartwatches that monitor movement and heart rate activity, diet tracking apps, or perhaps you know/are someone with diabetes using applications that monitor insulin levels.
- How do you feel about technological augmentation? Would you want RFID chip implants or a robotic exoskeleton to expand the capabilities of your own body?
- Look at your workspaces, classrooms and study spaces. How could you implement ergonomic design to make them more comfortable and prevent long-term injuries?
- Reflect on your relationship with your digital devices. Log the time spent on your devices and your moods and feelings when using or not using them. How would it feel to spend a weekend off-screen? What steps would you need to take in order to fully disengage from technology for a period of time?
- What supports are available to you, your family and peers if you or someone you know is experiencing mental/emotional health challenges?

UNDERSTANDINGS

By the end of this chapter, you should understand:

- ▶ digital technologies are redefining the purpose, methods and outcomes of formal and informal education
- ▶ digital societies use digital tools and processes to develop new science and technology.

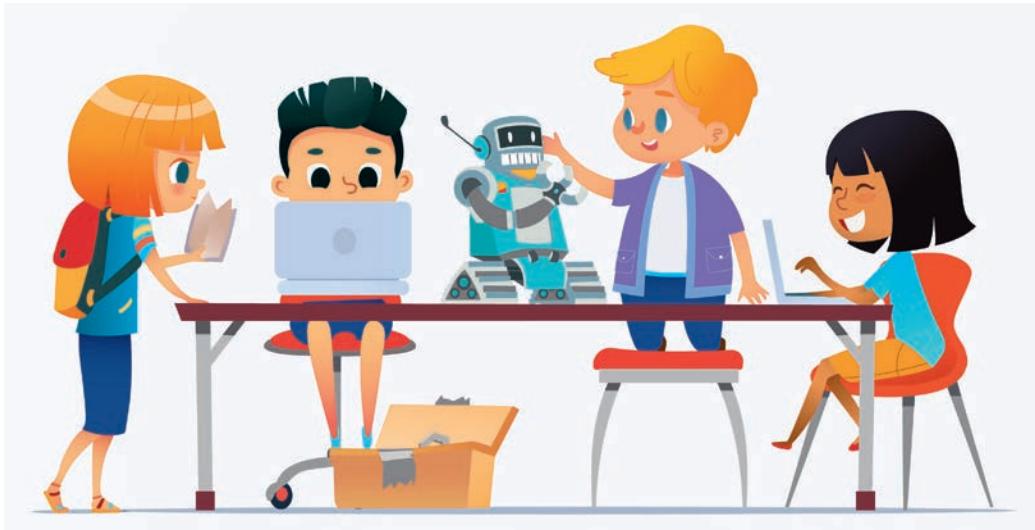
Modern education structures were designed during the Industrial Revolution, with schools aimed to equip students with the skills and values required to work in a factory environment. Schools provided good training in punctuality, following procedures and being agreeable. In today's digital society, however, we are entering a post-industrial era, and the skills and values of the past are no longer sufficient to prepare students as future workers, leaders and citizens.

In the past, education was essential for passing down knowledge from one generation to the next but, with the advent of the internet and search engines, limitless content knowledge is (almost) only a click away.

Advances in digital technology have also shifted innovation and development. Computing power (and eventually quantum computing power) has shifted the distribution and development of knowledge. Computers can run simulations and modify experimental variables much faster than humans can, and quantum computing will further expand the capacity to run tests and make simulated predictions.

4.5A Learning and education

■ Design and delivery of formal education



Educational systems are changing with the introduction of new digital technologies based **pedagogies**, or teaching approaches, that are evolving to better equip learners with the knowledge, tools and skills they need for jobs that do not yet exist. Students are being taught to use and explore digital technologies, both to develop their mastery of content and their skills and comfort with various tools. A greater emphasis is being placed on **social-emotional learning** and **critical-thinking skills**, and classrooms have evolved from a teacher lecturing to interactive group work, projects and activities based on neuroscience and research in best practices and facilitated by the use of digital technologies. Teaching and learning regularly utilizes web-based tools to help deliver information, check students' understanding and encourage collaboration. **Creative computing** gives students the digital tools they need to generate their own content and demonstrate their learning in areas such as graphic design, video production, programming and more.

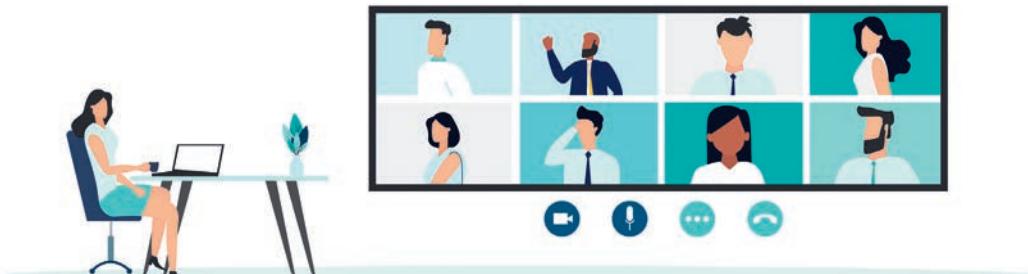
ATL ACTIVITY

Communication

A range of digital technologies are used in education today to enhance teaching and learning. Imagine that you are marketing one of these technologies and have been asked to set up an education exhibition to promote it. Your job is to persuade the teachers to buy/use it.

- Research digital technologies of the future classroom.
- Select one digital technology from your research.
- Prepare a display to demonstrate the digital technology being used – this will either be with the actual technology or, if this is not available, you can use a video to demonstrate it.
 - Demonstrate the digital technology being used – in real life or via a video clip.
 - Describe the product including its features and price.
 - Describe the impacts this technology will have on the students' learning.
 - Describe the impact that this technology will have on teachers.
 - Describe the disadvantages for teachers and students of the technology.
 - Suggest ways of using the positives of the technology while minimising the negatives.
 - Cite your sources and include a bibliography.

Remote learning makes education available over a network connection. This can be conducted using video-conferencing software (such as Zoom or Google Meet), hosting and sharing pre-recorded video lessons, broadcasting television and radio content, or a variety of other forms that allow students to access materials without being in the same room as their teacher and peers. **Synchronous** learning occurs in real time and allows for dialogue and live interactions while **asynchronous** learning is available at any time and responses may be delayed or scheduled. Remote learning gives learners access to more courses and content without the need to travel or physically relocate.



◆ **Pedagogy:** An approach to teaching.

◆ **Social-emotional learning:** Skills that help students to understand their emotions and build empathy and understanding towards themselves and others.

◆ **Critical-thinking skills:** The process of conceptualizing, applying, analysing, synthesizing, and/or evaluating information.

◆ **Creative computing:** The interdisciplinary area at the cross-over of the arts and computing.

◆ **Remote learning:** Education that occurs over a network connection, for example, using video-conferencing software.

◆ **Synchronous:** Remote learning that happens in real time with a live teacher.

◆ **Asynchronous:** Remote learning that can happen at any time, for example, using pre-recorded content.

Remote, or distance, learning was developed decades ago as a solution for students living in very remote areas with only radio contact, for students who could not attend formal schooling due to illness or disability, and for students who had other duties, such as work, and could not find time to participate in education during the day. Universities also offer formal courses through remote learning for the same reasons. Originally these courses were called ‘correspondence courses’ as all communication was done by physical mail, with the student receiving the work and resources by mail and sending the assignments back by mail. Wherever possible, contact between the students and teachers was made by phone or radio.

ATL ACTIVITY

Research

Research the advantages and disadvantages of remote learning for students and teachers. Base your research on the experiences of friends and family, and secondary research from academic sources or news articles.

ATL ACTIVITY

Research

Research companies, schools and universities that offer online courses for secondary students and university students. If possible, consult teachers and students who use online learning for a range of reasons. Research why and how the online course operates, and find reviews of the course. Try to find why some students succeed with online courses, and why a significant proportion of students do not complete the courses.

■ Approaches to non-formal and post-formal education, for example, skill training, competency development and self-directed learning

The internet is home to a wide range of human knowledge and learning opportunities that enable learners to access the information they are passionate about, making **self-guided learning** more accessible and available. Many universities publish and share course recordings, and their online platforms offer **massive open online courses (MOOCs)** where a single course if available for a nearly unlimited number of students to participate in.

ATL ACTIVITY

Thinking

Find a MOOC that interests you and try out online learning for yourself.

- Visit an online learning platform, such as Coursera, edX or Udemy.
- Enrol in a class that interests you.
- Take note of the features that they use, such as quizzes, forums, interactive applications, video lectures and more.
- Try to complete a unit or chapter of the course (or the whole thing if you are feeling motivated).
- Respond to the prompt: To what extent are online courses making high-quality learning more accessible? Reference real-world examples in your response.

◆ **Self-guided learning:**

A strategy that allows students to direct their own learning.

◆ **Massive open online course (MOOC):**

An online course that is available for a nearly unlimited number of students to participate in.

Skills training is available online for those who want to train in a new field, and for those whose profession requires it. Food safety courses are available online for those who are planning to work in a kitchen setting, for example, and CPR/first-aid training can be completed online before going to a testing centre for a live skills assessment.

There are many different ways for people to be educated and trained. It usually consists of classroom lectures with textbooks, images, videos, podcasts, computers, hand-held devices and other electronic appliances, role play and secondary research, of course, using libraries and the internet. The use of virtual and augmented reality in education and training is becoming more common, however. It can turn a normal lesson into an educational experience, similar to real-world excursions and practical

classes, but with greater capabilities. There are limitations with these new technologies, of course, including the cost and time-consuming design and development. Also, the range and usefulness of the reality depicted can be limited.

Inquiry

Research the use of virtual and augmented reality in education and training to determine how it is used and its effectiveness.

Online learning can help to develop a range of competencies. **Competency development** can be achieved through exercises and activities to improve or extend professional skill sets. **Behavioural competencies** include interpersonal skills, responding to feedback and other key traits in how work gets done, while **functional competencies** focus on the technical skills and abilities needed to perform in their job. For example, a paediatric nurse could have very high functional competencies as they take health information for a small child but, if they do not have the behavioural competencies needed to work with children and families, they may receive complaints from unhappy clients.

Inquiry

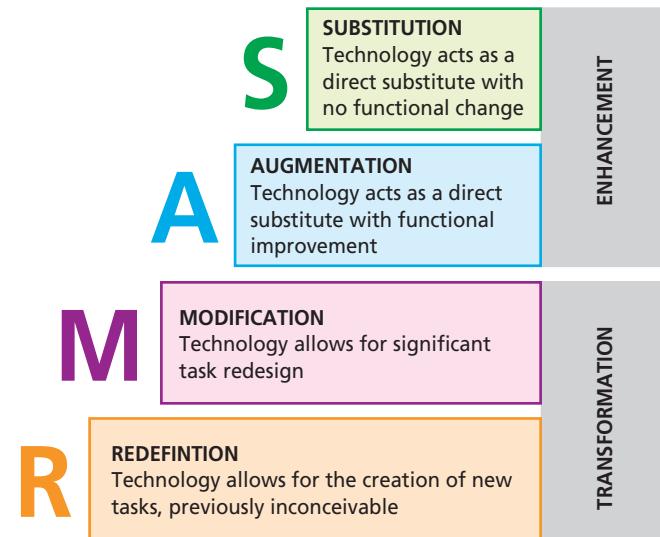
Discuss the benefits and drawbacks of allowing employees to complete training virtually. Make references to real-world examples in your response. Possible examples include workplace safety, sexual harassment awareness courses, food safety and CPR/first aid.

Which of the competencies are more suitable for online learning?

Digital pedagogies

Digital pedagogies are the approaches to teaching that integrate digital tools into the learning environment, and the decision-making involved when deciding whether to use a digital tool in a lesson or to stick with a traditional ‘low-tech’ approach.

One example of a framework for analysing educational technology is the **SAMR model** through which teachers and learners can analyse how technology is impacting the lesson:



■ SAMR model

Links

This content links to Section 3.5C Immersive digital media.

- ◆ **Competency development:** The practice of developing competencies in particular skills.
- ◆ **Behavioural competencies:** The interpersonal skills required to do a job well.
- ◆ **Functional competencies:** The knowledge required to do a job well.

- ◆ **Digital pedagogies:** Approaches to teaching that integrate digital tools into the learning environment.
- ◆ **SAMR model:** A framework for analysing educational technology.

- Is it **substituting** for a low-tech alternative (such as replacing a poster project with a presentation slide)?
- Is it **augmenting** the experience with a similar but increased functionality (such as incorporating multimedia in the presentation that would not be possible in a poster alternative)?
- Does it offer a significant redesign or **modification**, for example, using a cloud-based platform to allow students to share their work and synthesize their work with their peers?
- Does it **redefine** the learning experience in a way that would not be possible without the technology? For example, students could share their work with learners from a different country and ask questions to see how their findings would be different if they lived in a different location.

All levels of the SAMR model provide educational benefits depending on the course, the students and the outcomes required. It is important to be aware that not all low-level educational apps will be innovative and more effective, however.

ATL ACTIVITY

Thinking

Evaluate an educational app according to the SAMR model.

- Download one educational app on to your phone.
- Interact with the app and then answer the questions in the following table.
- Share your findings with other students to ensure that you have covered all levels of SAMR.

Name of app	
Describe the educational value of the app	
Identify which level of the SAMR model the app is	
Substitution: What would the app substitute in the analogue world with little functional change?	
Augment: Are there any improvements to the current education that could not be achieved before?	
Modification: Are there any modified tasks that you can do with this app better than before?	
Redefinition: Are there any new tasks that would previously have been impossible and would increase the value of the education?	

EXAM PRACTICE QUESTIONS



Paper 1 (core)

- 1 'Many educational digital technologies are useful but do not improve education.'
Discuss this statement. [8 marks]

REAL-WORLD EXAMPLE

Berkeley deletes online content

At the start of 2017, the University of California, Berkeley (Cal) hosted over 20,000 video and audio lectures that were free and open to anyone who wanted to learn. However, after receiving complaints from Gallaudet University (which instructs using American Sign Language), the US Department of Justice signed an order that required all online education content to be accessible to people with disabilities, such as blind and deaf learners. Cal would have needed to add captions, screen reader compatibility and other accommodations in order for their 20,000 audio and video lectures to comply.

Due to the costly nature of implementing these requirements, Cal decided to remove the publicly available content and began work on developing alternative course offerings that would require a login but would also meet higher accessibility standards. Requiring logins and authentication might also provide intellectual property rights for the professors who develop the courses, and prevent unauthorized redistribution of the content.

www.insidehighered.com/news/2017/03/06/u-california-berkeley-delete-publicly-available-educational-content

Concept connections

- **Change:** Relate the levels in SAMR to the various types of change in Section 2 Concepts.
- **Expression:** How do students in a virtual learning environment express themselves differently than in a physical learning environment?
- **Identity:** As with many online activities, you do not have to display your full identity. To what extent is this useful for online courses?
- **Power:** Access to quality education, such as through MOOCs, is empowering for people in the lower economic and social classes.
- **Space:** Digital technologies allow for both a physical and virtual learning environment, or a blend of both.
- **Systems:** MOOCs are very expensive to develop and maintain as they are complex systems.
- **Values and ethics:** Do governments have a duty to support the development and use of MOOCs as a benefit for society?

Links

The characteristics of computer networks that have been proven valuable in education are discussed in Chapter 3.4 Networks and the internet.

The characteristics of augmented and virtual reality that make them useful for supporting training are discussed in Section 3.5C Immersive digital media.

4.5B Science and technology innovation

Innovation science and technology are essential for progress in human knowledge and the future of our digital society. The growth of data processing and computing power have empowered researchers to conduct experiments on immense data sets in faster time than previous generations. New developments in academic and corporate settings are yielding new products, processes, research and other innovations.

Both corporations and countries understand that investing in research and development (R&D) processes will help them to stay relevant for the future, and they are exploring ways to turn futuristic ideas into present-day realities.

Approaches to scientific and technology research and development

R&D encompasses all work directed toward innovation, creation and improvement of products and processes. It also involves incorporating new data tools such as visualizations, data mining, big data analytics and more.

EXAM PRACTICE QUESTIONS



Paper 1 (core)

- 1 Quantum computers encode in qubits instead of binary data. Where 8 bits in a computer can represent any number between 0 and 255, 8 qubits can represent those same numbers simultaneously. In research situations, quantum computers are able to examine a multitude of possible combinations and run a variety of simulations simultaneously.

To what extent will quantum computing impact research and development in academic environments? [8 marks]

Social media and the interactivity of the internet have opened up many new forms of research. **Open innovation** is a growing trend in which organizations incorporate external sources such as customer feedback, external agencies and patents, into their research and development strategy, rather than relying only on their own internal knowledge and resources. Sometimes R&D teams will intentionally provide journalists and social media with new information to solicit feedback and ideas from the general public.

Citizen scientists are ordinary people who want to become involved in scientific research with the aim of increasing scientific knowledge. They are people in the community with the skills and passion to find answers to questions about the world and how it works.

Sharing knowledge can help all types of research and ultimately can provide social, economic and environmental benefits. Many citizen scientists have an interest or hobby in a particular area, such as ecology, animal behaviour or astronomy, and some are interested in the power of knowledge for causes such as conservation and medical advances. Much of the work of citizen scientists is the collection of data that would be too expensive or difficult for a small research team to do. Other types of work include the simple processing of data, such as examining images of the stars to find interesting or targeted changes. There are many apps that have been set up by research institutions, such as the Smithsonian Institution, that make it easy to participate in research.

◆ Open innovation:

When organizations incorporate external sources into their research and development strategy.

◆ Citizen scientists:

Ordinary people who want to become involved in scientific research with the aim of increasing scientific knowledge.

ATL ACTIVITY

Research

Research opportunities for becoming involved in scientific research in your local area and also internationally. Make a list of the different types of activities involved.

Report back to your class as they might want to use these opportunities for CAS and their personal interests.

Participating in research as a source of data has also been facilitated by the internet. You can now volunteer (and even be paid) to complete surveys and provide other information as part of market research, take part in online focus groups, and in medical and psychological scientific research.

ATL ACTIVITY

Research

Research opportunities for volunteering in research programs at your local universities and research institutes.

Report back to your class as they might want to use these opportunities for CAS and their personal interests.

REAL-WORLD EXAMPLE

Sci-Hub

Scholarly journals and research often require a subscription to access them. This creates a digital divide, as many scientific research papers are only available to those who can afford them. Much of this research was created in non-profit or tax-funded universities, but the findings are hidden behind a **paywall** by for-profit publishers and databases such as JSTOR or ERIC.

Sci-Hub is a free online database website that hosts 85% of all academic papers, many of which normally requires a subscription to access. Many of the articles were obtained using tactics to get access to paywalled material, then uploading the content to the Sci-Hub database. Sci-hub has over 600,000 daily users, with the most per-capita users coming from Iran, Tunisia, Greece and Portugal. Sci-hub bypasses the copyrights and payments of academic publishing companies, but makes these resources available and free for researchers and academics across the globe.

<https://thediplomat.com/2020/09/kazakhstans-robin-hood-the-geopolitics-of-sci-hub/>

◆ **Paywall:** A method of restricting access to digital content unless a subscription is paid.

ATL ACTIVITY

Thinking

Discuss the decision by research databases to charge access to published research. Reference real-world examples in your response, such as JSTOR and Sci-Hub.

Concept connections

- **Power:** The academic publishing industry has been criticized for shifting power away from the public scholars and universities that often generate the content and knowledge into the hands of corporate research journals and databases who own the copyright and charge viewers for access to resources created using public funds.
- **Values and ethics:** Is it ethical for researchers to bypass paywalls if they cannot afford to pay for the journals or articles that they need in order to complete their studies (which in theory benefits all of humanity/human knowledge)?

Creativity, activity, service (CAS)

Learn a new software

Teach yourself new IT skills by completing an online course. Before starting, conduct some initial research into which online platforms provide IT courses. Perhaps your school has already registered with a platform that can be used, or see what free courses are available.

Select the platform and the course to register. Work through the required activities, and don't forget to document the journey for CAS.

TOK

Who should own the knowledge that created using taxpayers' money and community resources?

Reflection



Now that you have read this chapter, reflect on these questions:

- What digital tools are used at your schools? What do you interact with in the classroom? What systems or Learning Management Systems (LMS) tools help with school logistics? Do your teachers use any platforms or tools to share content/information that you don't interact with directly?
- Have you or someone you know learned something independently and/or online?
- What would you do if you wanted to learn a new skill? What options do you have at your disposal?
- Where have digital tools been used effectively in your learning experience? What opportunities for improvement have you noticed? Have you witnessed any changes over the past few years?
- What are current events and focuses for research and development? What is trending in university publications, news stories and other innovative sources?
- What opportunities to be a part of scientific research in your local area interest you?

4.6

Political

UNDERSTANDINGS

By the end of this chapter, you should understand:

- ▶ political processes use digital tools to promote candidates and agendas, as well as to facilitate civic engagement, political activity and processes such as voting
- ▶ governing bodies that define the various organizations, jurisdictions and communities that may have political influence or representation to specific communities are increasingly using digital technologies
- ▶ digital warfare and terrorism exist both in the physical and virtual domains; weapons technologies help to develop more effective tools for warfare (and/or terrorism) while digital tools help to facilitate the communication and management of members, groups and other stakeholders
- ▶ managing digital technologies is challenging as prior laws and local jurisdictions are not always suitable to meet the new needs and issues that arise in a universal digital society; lawmakers may not be able to adjust and organize quickly enough to keep up with the pace of change, while businesses and criminals may begin to implement their own agendas and policies.

Innovations and challenges move hand in hand in the political context of digital society. Digital voting and campaigning tools can give more voters access to the polls and information that they need to engage in democratic processes, but it has also resulted in a host of security, privacy and misinformation issues that have endangered the institutions, careers and lives of voters and politicians.

Various governments, agencies and non-government actors employ a range of tools and resources to facilitate their agendas. This can include nationwide digital ID cards used to develop a citizen database, online appointment scheduling for government facilities, or local school boards collecting feedback on an upcoming policy decision. In the political context, digital tools may be used to improve the efficiency of an organization, or offer more transparency and interaction to the relevant stakeholders.

Advances in technology, data and artificial intelligence in warfare have created more efficient military operations and have saved the lives of soldiers. Additionally, they have led to major innovations in health, space travel and medicine. On the other hand, reliance on digital systems has created a new platform for warfare, where (nation-backed and politically motivated) hackers can hold companies, regions or infrastructures hostage digitally.

Finally, a digital society has a greater capacity to monitor its citizens. Whether it is speed cameras on the highway or amber alerts to help stop a kidnapping, a more connected society has the capacity for more surveillance. Is greater security worth the privacy trade-offs? Are policies and regulations effective in maintaining security while potentially impacting human rights?

4.6A Political processes

Voting and campaigning

Political processes in a digital society focus on the systems and tools that facilitate the transition of power and information in a nation (or city or region). In a democracy, this includes the processes used to vote and elect leaders, as well as the tools those leaders use to campaign as they run for office. Political processes also include activities by citizens, organizations and corporations to participate and influence the government. This can range from lobbying to organizing like-minded individuals around a political movement or cause. There is also a large amount of advertising and propaganda that is used to promote candidates and/or ideas to influence the population.

Digital tools are used to organize, facilitate and communicate a wide range of political processes. This includes using digital or internet voting platforms to collect and count votes, analyse social media data to help a candidate strategize, and using social media advertising to spread a desired message about a candidate or cause.



Inquiry

Select two recent campaigns or elections that used social media or digital campaigns. They can be from different times and locations. Some examples include Trump using Twitter in the USA, Bolsonaro using WhatsApp in Brazil and the Obama 2008 campaign in the USA.

- Research how they used social media or digital marketing tools to reach potential voters.
- Compare and contrast the approaches used. What did they have in common? What made each one unique?
- Evaluate the success of each campaign.

Voting

The challenge of counting millions of anonymous votes in a short period of time can be greatly reduced through the use of digital and electronic platforms. **Electronic voting systems** may count votes the moment they are cast at specified locations, while **online voting** lets voters cast their ballot without ever leaving their homes. Both of these systems rely heavily on databases to keep track of who is eligible to vote and who receives the votes. However, many critics believe that there could be a risk to the privacy of the voter and the accuracy of the results.

- ◆ **Electronic voting system:** A digital system designed to count votes the moment they are cast.
- ◆ **Online voting:** A system that allows voters to cast their ballot online.

ATL ACTIVITY

Communication

Challenge: Electronic voting machines are meant to make voting more efficient, but there are issues. A variety of voting digital technology is available and can be investigated.

- Using effective online research skills, investigate electronic voting machines that have been used successfully in recent political elections.
- Summarize details of the technology used, including the benefits to the voting process and any challenges that may be faced.
- Draft a proposal for a new electronic voting system for a local use of your choice, for example voting for the school council or local politicians.
- Present your findings to your class.



■ Electronic voting

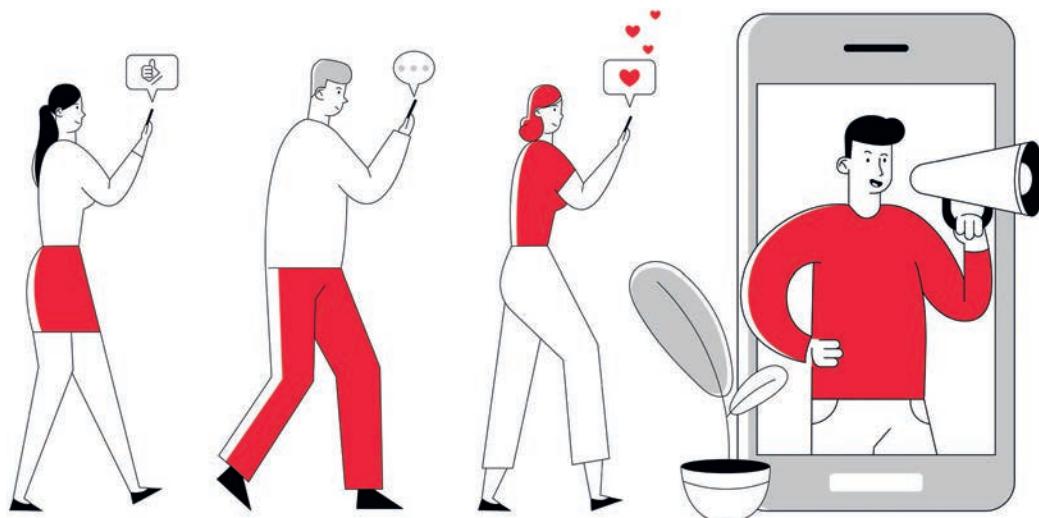
■ Political advertising and propaganda

When running for political office, candidates face the challenge of trying to appeal to a wide base of voters who are passionate and opinionated about a variety of issues. In today's society, big data (large data sets that may be analysed using digital technology to reveal patterns, trends and associations) and social media equip campaigns with the tools to market their candidates to individual voters, showing them the messages and media that are most likely to motivate them into a desired action, whether it is changing their voting habits or suggesting a donation. They don't need to waste resources on individuals that the data shows are already set in their beliefs and habits.

Providing individualized content to advertise or promote a politician (or a product) is known as microtargeting. These messages become **propaganda** when they contain biased or one-sided information. Because these messages can be targeted at specific groups and users, it is harder to hold creators accountable for misinformation when compared with radio or television advertisements, which are exposed more scrutiny by larger audiences, the media and regulatory bodies.

◆ **Propaganda:** Biased or one-sided information.

■ Formal and informal forms of political participation, such as lobbying, political movements and activism



Links

The content on political speech and activism links to Section 5.2B Participation and governance.

The internet has created a power shift as more and more people have the access and ability to publish and share their thoughts with audiences, viewers and allies around the globe. Even those who are still too young to vote are using social media to learn more about current events, advocate for the environment, protest racial injustice and amplify their impact on issues facing their community. Digital technologies have also changed the way lobbying is conducted: concerned citizens and organizations can communicate with their representatives by email, using online feedback tools and even engaging with their offices on social media platforms.

REAL-WORLD EXAMPLE

Campaigning: A brief history of presidential election advertisements in the USA

Political campaigns build voter profiles by collecting massive amounts of personal data (increasingly available online and for purchase). They use these profiles to target individuals and subgroups with personalized advertisements, news, (mis)information, advertisements and other content with the intent of swaying their views and actions.

While microtargeting tactics, such as the use of direct mail and regional television advertisements (at least in the US elections since 1992), were already being used, they did not become nationwide until the 2004 elections. Four years later, the rise of social media made microtargeting even more powerful.

As early as 2008, for instance, the Obama campaign had reportedly gathered as many as one thousand variables about each voter drawn from voter registration records, consumer data warehouses, and past campaign contacts to better target its messaging.

Source: <https://privacyinternational.org/blog/845/voter-profiling-2017-kenyan-election>

Obama's 2008 campaign combined microtargeting tactics with big data and the strategic use of social media to target statistically influenceable voters and mobilize them towards voting, organizing and fundraising.

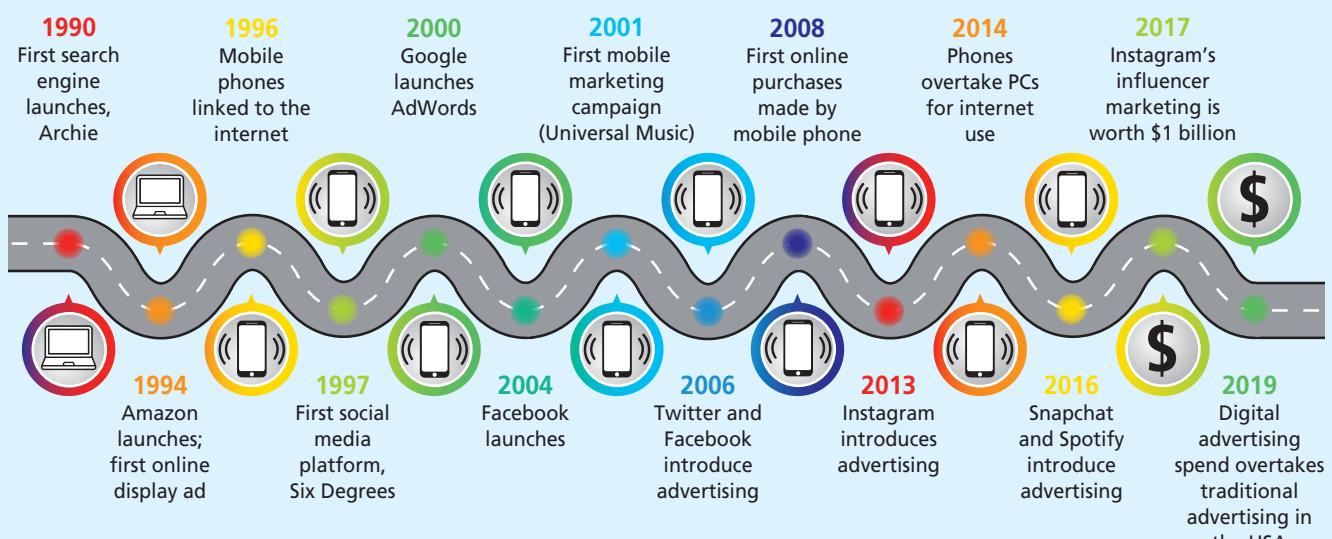
Soon, individuals were receiving different campaign advertisements than their peers based on their own unique voter profiles.

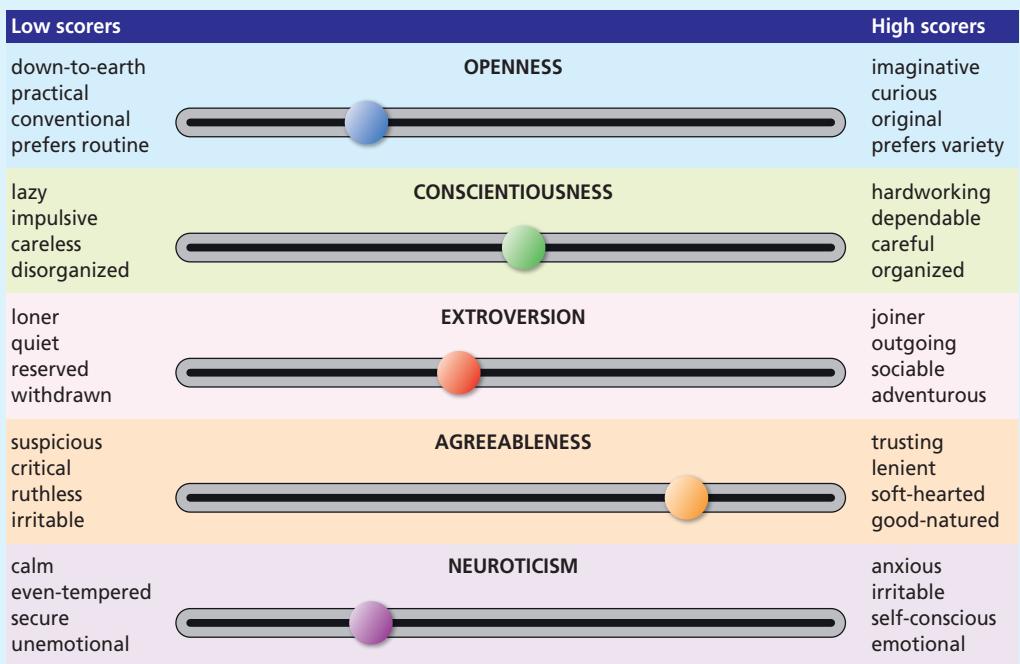
◆ **Psychographic analysis:** An analysis of people based on their activities, interests and opinions.

Because the larger population may not ever see the ad, it is hard to hold it accountable to any regulations or fact checking.

As we entered into the 2010s, the interconnection between social media and elections became more standard. Multiple firms that specialized in collecting, analysing and microtargeting potential voters emerged, each vying to shift voters toward their employing candidate. One company involved in this was (the self-described 'global election management agency') Cambridge Analytica.

Cambridge Analytica built a free survey application called 'mydigitallife' but, hidden within their terms and conditions, was that anyone who used the app not only shared access to their own Facebook profiles but also the profiles of all their friends. Soon, with only 270,000 users, Cambridge Analytica could access the names, locations, history of likes, and even some private messages of over 87,000,000 Facebook users. This privacy violation eventually cost Facebook nearly US\$5 billion in fines. Using this data, Cambridge Analytica created a **psychographic analysis** of each voter, ranking them on key personality traits such as openness, conscientiousness, extroversion, agreeableness and neuroticism.





■ OCEAN model of personality traits

Hired by the Republican party Cambridge Analytica used this data to microtarget users with curated content, most likely to move them towards voting for a particular candidate. This content ranged from standard political advertisements to fake news articles camouflaged as sponsored posts. The growth in personalized advertisements often showed potential voters what they wanted to hear, taking advantage of the human capacity toward **confirmation bias** – our willingness to accept news and facts that confirm our existing beliefs. Suddenly, social issues and popular opinions were becoming more polarized. People who only obtain their information from a few sources that they already agree with can be said to be in an echo chamber, as the sources align with and reinforce their existing beliefs.



It wasn't only US politicians and advocacy groups that took advantage of these new campaigning tools.

In 2018, 13 Russian citizens were charged with the crime of interfering in the 2016 US presidential election by using fraudulent social media accounts to impersonate real and fictitious Americans, to:

- purchase advertisements and posts in order to create 'political intensity through supporting radical groups' – many of their posts focused on race, immigration and religion, and some even encouraged minority groups *not* to vote
- organize and promote unofficial rallies targeting specific groups, such as 'Support Hillary – Save American Muslims' and 'Miners for Trump'
- publish political advertisements online expressly promoting Donald Trump or opposing Hillary Clinton in the eight months leading up to the election; a violation of US policy/laws for campaign advertisements.

<https://digitalcommons.butler.edu/cgi/viewcontent.cgi?article=1007&context=bjur>

www.americanbar.org/groups/crsj/publications/human_rights_magazine_home/voting-in-2020/political-advertising-on-social-media-platforms

www.washingtonpost.com/opinions/2019/11/01/dont-abolish-political-ads-social-media-stop-microtargeting

www.classaction.org/media/comforte-et-al-v-cambridge-analytica-et-al.pdf

www.newscientist.com/article/2166435-how-facebook-let-a-friend-pass-my-data-to-cambridge-analytica/

Concept connections

- **Change:** Given the events of the past, how do you predict elections and campaign advertising will evolve in the future?
- **Expression:** The way that social media works means that anyone can express their own opinion and ideas, often without them being supported by evidence.
- **Identity:** Microtargeting reinforces our political identity by showing advertisements and content that aligns with our existing values and beliefs.
- **Power:** Politicians and others are trying to use digital technology to gain political power as they implement precise microtargeting and other advertising tactics to influence people's behaviour.
- **Space:** Social media creates unique digital spaces that customize content for the specific viewer. It is harder to hold information to accountability standards when the content displayed may not be visible to a broad audience.
- **Systems:** The interconnection of different systems is apparent as data is collected, processed and sold in order to provide advertisers the microtargeting tools to customise content, and ads for individual users.
- **Values and ethics:** Some actors are violating legal and ethical standards in order to promote their own political and/or social agendas.

ATL ACTIVITY

Research

Research current elections around the globe. How are politicians and citizens using digital tools (social media in particular) to organize, advertise and gain support for their causes?

Do not limit your search to national elections. Local/regional elections and campaigns may also offer valuable insights and innovative use of digital tools.

EXAM PRACTICE QUESTIONS



Paper 1 (core)

In the months leading up to the 2017 presidential election in Kenya, advertisements for two websites began to flood Google searches, Twitter, Facebook and YouTube accounts across Kenya. These websites used data collected from social media platforms to target their advertisements and send potential voters to websites that presented a biased outlook, with one highlighting President Uhuru Kenyatta's accomplishments and the other attacking the challenger Raila Odinga.

Kenyatta won the election, but Odinga challenged the results, in part due to the lack of security in the electoral servers. He claimed that the servers were hacked and that an algorithm was inserted to artificially inflate the number of votes for the incumbent president. The Supreme Court accepted this challenge, nullified the election and called for a second election. In the 60 days between the elections, 25 Kenyans were killed and over 100 badly injured in protests.

- 1 **a** Outline one method of network security that could be used to protect the electoral servers and the database. [2 marks]
- b** Identify two items of data stored in an online voter database. [2 marks]
- c** Define the term 'algorithm'. [2 marks]
- 2 **a** Distinguish between electronic voting and online voting. [3 marks]
- b** Explain three steps required for a citizen's vote to be updated in the election database. [3 marks]
- 3 To what extent should social media companies be held responsible for hosting content that led to death, violence and protests during the Kenyan elections? [8 marks]

4.6B Governing bodies

■ Organization and role of local, regional, national and global governing institutions

This subtopic explores the manner in which varying government and non-government bodies, agencies and organizations engage with digital technology to both streamline their internal processes and provide information and services to their end-users (the citizens or organization members).

Many of the same tools that economic institutions use to manage projects, conduct outreach, develop a database of customers and manage their products can be applied here. However, governments and non-government organizations must often adhere to additional laws or policies depending on their location.

We have also seen a rise in non-state actors using digital tools for political organizations or international activities that were once only available to nation states. The following table provides definitions and examples of the different levels of government.

Level of government	Definition	Examples
Global	Operates internationally, trans-nationally or regionally across national borders	UN, EU, Organisation for Economic Co-operation and Development (OECD), etc.
National (central)	A country's political authority	US government, Australian government, etc.
Regional	Governs a particular region and enforces the laws that central government passes	California State Assembly (within the USA), Bali Provincial Government (within Indonesia), local council, etc.
Local	Focuses on a specific community or group	School district, parks and recreation department, etc.

ATL ACTIVITY

Research

Explore government information websites.

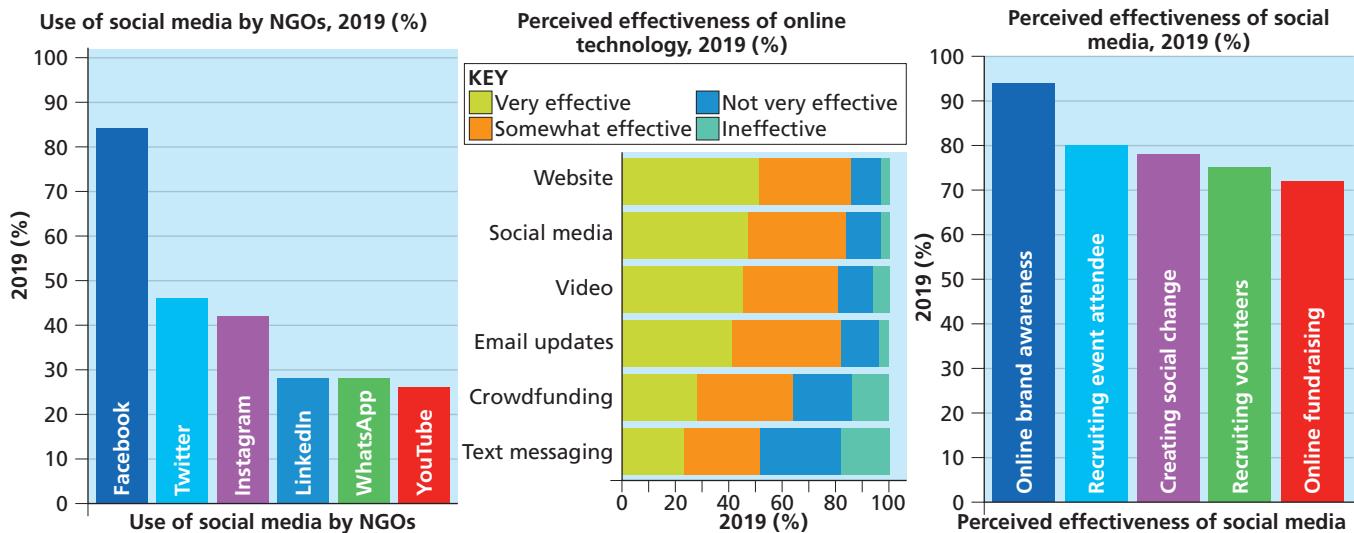
- Search for the government website where you live (usually these have '.gov' in the URL). Explore the website and make notes on:
 - What features are available?
 - What information does it share?
 - What services does it offer?
 - How user-friendly does it feel?
- Now repeat this process for local governing bodies in different countries.
 - What is common between the different sites?
 - Do any of them offer mobile apps (consider installing them)?
- Government tools are often criticised for being outdated, difficult to navigate and inefficient. How does that compare with your findings?

■ Non-governmental organizations (NGOs) and non-profit organizations (NPOs)

Non-governmental organizations (NGOs) are transnational organizations that operate independently of any government agency. They vary in size from a small collection of volunteers to large, multi-billion dollar corporations with many paid members of staff. By definition, they are also non-profit organizations (NPOs), meaning that any money earned cannot be used for the personal gain of its employees or supporters.

◆ **Non-governmental organization (NGO):** Transnational organization that operates independently of government agencies.

These groups often focus on humanitarian or environmental causes. They employ digital tools to collect funds, manage volunteers and events, build stakeholder and member databases, send emails and automate common processes.



- How technology helps NGOs to increase efficiency and to reach volunteers and donors

Data: https://assets-global.website-files.com/5d6eb414117b673d211598f2/5de82e1550d3804ce13ddc75_2019-Tech-Report-English.pdf

Non-state political actors

In addition to organizational actors such as NGOs and NPOs, non-state actors also includes societal, technological, war-fighting and/or individual actors. Violent non-state actors can include terrorist organizations, guerrilla fighters, organized crime and drug cartels, as well as religious/political extremist groups.

Digital communication tools and modern weaponry technology have shifted the power landscape, giving non-state actors access to a wider audience, strategies and information, as well as more destructive weaponry that was previously reserved for a nation's formal military. The internet has made it more affordable to broadcast, disseminate and exchange information quickly and globally, as well as reducing the cost.

The internet also enables political actors to alter **transparency** (the availability and accountability of information) by changing the accuracy, clarity and freedom of information available. Digital communication tools can be used to increase transparency by reporting or publicizing otherwise hidden events, such as corruption and human rights abuses. However, these same tools can be used to decrease transparency by spreading disinformation, misinformation, fake news and propaganda (biased or one-sided information).

Inquiry

- Identify an NGO, for example Doctors without Borders or Oxfam International.
- Explain its mission and goals.
- Describe the features available (if any) on its website (or mobile app, email, WhatsApp group, social media).
- Evaluate the impact of these features toward the NGO's ability to fulfil its mission.
- Explain challenges or opportunities for further growth that you notice from your inquiry.

EXAM PRACTICE QUESTIONS



Paper 1 (core)

- 1 Some non-state political actors can deal in fake news, disinformation, misinformation and propaganda. Discuss the responsibility of social media platforms to limit violent and false rhetoric on their platforms.

Possible examples you could use in your discussion are Facebook banning COVID-19 vaccine misinformation (and/or Holocaust denial posts), Twitter suspending Donald Trump's account and YouTube blocking Sky News. [8 marks]

REAL-WORLD EXAMPLE

Biometric passports

In 2019, India began to roll out e-chip enabled **biometric passports** (previously only available to diplomats). These passports contained an electronic microprocessor chip in addition to the usual pages for photos, identification information and visas/stamps. This chip contains unique **biometric information**: physiological details about the holder that cannot change, such as their fingerprints. This improves the capacity for authentication, as a visual check of the passport photo can be combined with a fingerprint scan to check that the fingerprints match the data on the chip. The chip can used to store other data also, such as previous travel information.

Storing the data on the passport itself overcomes key issues in security and privacy. The microprocessor is difficult to **counterfeit** and can include software to prevent tampering with the information by unauthorized users or notify officials in case of irregularities. In addition, the holder's fingerprints can be checked by immigration officials without having the privacy risk of their information being stored on a government database. The machine can compare the live fingerprints with the data stored on the passport.

While it requires a large financial investment to distribute the passports and readers, it will pave the way for more automation in Indian airports. Additionally, while airports are transitioning over to the new system, they can still implement their existing protocols as the biometric passport includes all of the same details as their existing passports.

India is on track to join a growing list of countries using biometric passports.

◆ **Biometric passport:**

A passport that contains an electronic microprocessor chip biometric information about the passport holder.

◆ **Biometric information:**

Physiological details about a person that cannot change, such as their fingerprints.

◆ **Counterfeit:** To imitate fraudulently.

ATL ACTIVITY

Research

Investigate the use, or planned use, of biometric identity cards or passports in your country or another country.

- What data is being captured and stored?
- What is the data required for?
- How does the biometric system verify the person using this digital technology?
- Describe the benefits to both citizens and governments of using this type of system.
- Investigate resistance to the use of biometric identity cards or passports in your and other countries.

Concept connections

- **Identity:** Biometric data is unique to the individual. What risks exist by including biometrics in identification databases? To what extent does the use of biometrics both increase the risk of identity fraud and prevent it?
- **Systems:** What events may unfold at the individual and global level as a result of implementing a new ID system? For example, in the big picture, airports will have to invest in new technology, and a global standard for biometric passport data scanning may eventually need to be developed. At a more micro level, individuals will need to register their fingerprints (or other biometric data), increasing the costs and privacy risks of obtaining the document.
- **Power:** Biometric passports give power to authorities to control who can receive them. This provides the government with more power over their citizens.
- **Space:** Biometric passports enable easy access and movement between spaces controlled by different governing bodies, but the trade-off is that more power is given to the governing bodies.
- **Change:** Biometric passports have increased this control, especially now that they can be linked to national and international databases.
- **Expression:** Biometric data is an expression of our identity. It may threaten our identity if the data can be copied and used without our permission.
- **Values and ethics:** The designers and developers of biometric passports have an ethical duty to ensure that the data is protected and only used for certain purposes. Also, do we have an ethical right to use other forms of identification instead, as there are concerns about the security of the data and its use?

4.6C Conflicts and war

■ Warfare

Military technologies include weapons, vehicles, equipment and infrastructure that is used for the purpose of warfare. Offensive technologies are used to harm the enemy, while defensive technology protects soldiers and infrastructure from their enemies.

Military technology also includes transportation, communication and sensors that are used to move soldiers/weapons, coordinate information between units and collect information from the surroundings.

Military funding is often used to develop new and innovative technology that may later have uses in other contexts. For example, GPS **trilateration** technology, which uses a trio of satellites to pinpoint our phone's location, was originally developed by the US Department of Defense in 1994. The military also invented the first virtual reality simulator in 1979, to help train pilots to fly fighter jets.

● Inquiry

The military in many countries have been investing in artificial intelligence, robotics and other digital technologies for use in warfare. With reference to at least two digital technologies, discuss the issues arising from their use and their effectiveness.

Digital warfare

Digital warfare, or cyberwarfare, is the use of digital attacks to disrupt vital computer and warfare systems. Both its name and definition are a point of debate, but it can be broadly defined as covering the use of any digital technology to disrupt or impact the storage, sharing and communication of information or systems. It is also known as ‘information warfare’ or a ‘cyber attack’.

Digital warfare can take a variety of forms, such as international surveillance, or spying on individuals and countries, and even hacking the phones of politicians. **Sabotage** is the disruption of the computers and systems that operate military, economic infrastructure or other vulnerable networks. Distributed denial of service attack (DDOS) involve overwhelming a site or service, such as a bank or database, so that it is not available to its intended users. Additional cyberwarfare tools include ransomware or propaganda when used for political purposes.

Terrorism

While there is no globally accepted definition of **terrorism**, it often manifests as the unauthorized use of violence/force to create fear and coerce a government or its people toward a political or social cause. Terrorist groups often lack the military resources to engage in direct warfare successfully, so they prioritize high-profile attacks such as hijackings, kidnappings, suicide bombings and other methods with high shock value.

Digital tools and developments have enhanced computing and telecommunications capacities across the globe. However, these same developments have increased terrorist organizations’ communicative capacity, anonymity and ability to coordinate operations remotely. Widespread internet access has offered more outlets for radicalization of individuals and accelerated the mobilization of potential actors.

◆ **Digital warfare:** the use of digital technology to disrupt or impact vital computer and warfare systems.

◆ **Sabotage:** The disruption of computers and systems that operate military, economic infrastructure or other vulnerable networks.

ATL ACTIVITY

Research

Ransomware is a major threat to businesses and other organizations. Research how ransomware works, the impacts it can have, and the range of responses to deal with it.

◆ **Terrorism:** The unauthorized use of violence/force to create fear and coerce a government or its people toward a political or social cause.



End-to-end **encryption** scrambles messages and data, making it harder for law enforcement to track and disrupt communications. Additionally, **virtual private networks (VPNs)** anonymize the user's internet activity by hiding their location and routing it through a 'secure tunnel', further preventing law enforcement agencies from tracking their activity. The same tools that protect privacy and increase communication capacity can, when combined with terrorist intent and a radicalized user, set the grounds for more efficient and organized terrorist recruitment and activity.

ATL ACTIVITY

Research

Governments and digital technology companies may take action to censor publication or prevent access to information that does not align with the laws and values of the hosting site/nation. However, these tools can often be bypassed through the use of VPNs or other tools.

Investigate censorship in a region of your choosing and see how stakeholders are impacted by it, and to what extent actors are able to bypass these internet constraints.

Find and install a VPN (or a free trial). Try the same search from a few different 'countries'. What do you notice? Visit your favourite media site, such as YouTube or Netflix. Do the recommendations for your viewing change?

Links

This content links to Section 5.2A Conflict, peace and security.

EXAM PRACTICE QUESTIONS



Paper 2 (core)

Source A

Unmanned combat air vehicle used for air strikes.



Source B

Excerpt from a UN report into Libya's uses of autonomous drones to take out rebel forces, March 2021.

On 27 March 2020, the Prime Minister of Libya, Faiez Serraj, announced the commencement of Operation PEACE STORM, which moved GNA-AF to the offensive along the coastal littoral. The combination of the Gabya-class frigates and Korkut short-range air defence systems provided a capability to place a mobile air defence bubble around GNA-AF ground units, which took Hafter Affiliated Forces (HAF) air assets out of the military equation. Libya classifies HAF as a terrorist rebel organization.

The enhanced operational intelligence capability included Turkish-operated signal intelligence and the intelligence, surveillance and reconnaissance provided by Bayraktar TB-2 and probably TAI Anka S unmanned combat aerial vehicles. This allowed for the development of an asymmetrical war of attrition designed to degrade HAF ground unit capability. The GNA-AF breakout of Tripoli was supported with Firtina T155 155 mm self-propelled guns and T-122 Sakarya multi-launch rocket systems firing extended range precision munitions against the mid-twentieth century main battle tanks and heavy artillery used by HAF.

Logistics convoys and retreating HAF were subsequently hunted down and remotely engaged by the unmanned combat aerial vehicles or the lethal autonomous weapons systems such as the STM Kargu-2 (see annex 30) and other loitering munitions. The lethal autonomous weapons systems were programmed to attack targets without requiring data connectivity between the operator and the munition: in effect, a true 'fire, forget and find' capability. The unmanned combat aerial vehicles and the small drone intelligence, surveillance and reconnaissance capability of HAF were neutralized by electronic jamming from the Koral electronic warfare system.

Source: <https://undocs.org/S/2021/229>

Source C

Extract from 'The Story of America's Very first Drone Strike', *The Atlantic*, 30 May 2015

In the autumn of 2001, however, the United States was unwilling to launch a full-scale land invasion in a region 7000 miles from home. Instead, a plan evolved to send into Afghanistan a small number of CIA agents and Special Forces in support of anti-Taliban militias, with the aid of the US Air Force. That first October night was a powerful display of coordination involving laser-guided munitions dropped from the air and Tomahawk cruise missiles launched from the sea. General Tommy Franks, who then led the US Central Command (CENTCOM), the military command overseeing operations in Afghanistan, wrote in his memoir *American Soldier* that the assault involved in total some 40,000 personnel, 393 aircraft, and 32 ships.

But one aircraft did not feature at all in the Air Force's complex planning: a tiny, CIA-controlled, propeller-driven spy drone, Predator tailfin number 3034 which had crept into Afghanistan some hours earlier. It now hangs suspended in the Smithsonian Air and Space Museum in Washington, D.C., its place in history assured. Yet its actions that first night of the war – in which numerous agencies in the vast US military-intelligence machine each played sharply contradictory roles – remain steeped in controversy.

Source: www.theatlantic.com/international/archive/2015/05/america-first-drone-strike-afghanistan/394463

Source C

Human Rights Watch released a report stating that representatives from around 50 countries will meet in the summer of 2021 at the UN to discuss worldwide policy alignment on 'killer robots' or 'lethal autonomous weapons systems'. In their report, Human Rights Watch expressed objections to delegating lethal force to machines without the presence of meaningful human control.

Bonnie Docherty, senior arms research at Human Rights Watch said: 'The fundamental moral, legal and security concerns raised by autonomous weapons systems warrant a strong and urgent response in the form of a new international treaty ... International law needs to be expanded to create new rules that ensure human control and accountability in the use of force.'

Human Rights Watch proposes a treaty that covers the use of all weapons that operate autonomously that includes limitations and restrictions such as banning the use of killer robots, with many claims reinforcing that meaningful human control must be involved in the selection and engagement of targets. It goes on to define the scope and prevalence of 'meaningful human control' to ensure that humans have access to the data, risks and potential impacts prior to authorizing an attack.

Adapted from: www.hrw.org/news/2021/08/02/killer-robots-urgent-need-fast-track-talks

- 1 With reference to Source A, identify two different or unexpected impacts of 'killer robots'. [2 marks]
- 2 With reference to Source D, explain why it may be difficult to reach global agreement on 'killer robot' policy. [4 marks]
- 3 Compare and contrast how Sources B and C present their messages of events involving unmanned combat aerial vehicles events. [6 marks]
- 4 With reference to the sources and your own knowledge, evaluate the decision to ban automated military technology. [12 marks]

4.6D Laws, regulations and policies

■ Public and private policy, including professional codes, rules and regulations

Digital technologies change so quickly that the legal system cannot keep up with them. National, regional and local policy makers have often adapted old laws to manage and regulate the digital world. Now that is changing, as many countries are passing legislation to guide, regulate or limit new technologies, as well as the companies responsible for creating and operating them.

Internet regulation in the USA has evolved from a 'light-touch regulation' towards reprimanding and punishing technology corporations that fail to protect the security and privacy of their users. In 2016 the EU passed **GDPR** laws, which established standards for privacy, transparency and security for any organization collecting and storing data on EU citizens and/or residents. India is developing its own data-protection infrastructure, while China filters and censors the information that is passed along its network.

■ Surveillance and monitoring

Given that nearly all data is stored online, corporations, service providers and governing bodies have varied access to the data and information being sent on the web. While this data is often anonymized, in many countries there are arrangements with local law enforcement and governing agencies that give significant access to data and activity that many internet users would presume to be private.

A digital society creates the potential for surveillance and monitoring of online activity, as well as the use of cameras and other sensors, to collect information about activities happening in everyday life (such as traffic movements). Facial-recognition technology is also being deployed in many places to make the surveillance and monitoring of citizens more effective, and more efficient.



Inquiry

With reference to two different sources, discuss the decision to ban police use of facial-recognition cameras in California to prevent crime.

■ Crime and lawbreaking

Faster than governments and law enforcement can regulate technologies, criminals find new and innovative ways to reappropriate digital tools or break into secure systems, accessing sensitive data and disrupting essential operations. Programmers and developers on both sides of the law compete as governments and corporations work to protect their systems from vulnerabilities and criminals seek out new ways to skirt the law, remain anonymous and conduct illicit activities through the use of otherwise legal (and sometimes illegal) digital tools.

Digital surveillance is the collection of data about a person's online communications, connections, finances and other available information. As you surf the web, information is sent from your device, through your network, to your ISP and ultimately through the internet until it reaches the destination site. Along the route, information is scanned, recorded and stored. While this may seem like a privacy violation, this same information is used by technology companies to offer you the customized and individualized user experience that you expect on today's websites. This data is also used by advertisers and other sites. **Data brokers** are companies that collect and store information about users and sell it on to companies or advertisers.

With the vast quantities and value of data circulating on the internet, cybercrime is growing at a rate of 15% a year, costing companies US\$3 trillion worldwide in 2015 (and predicted to move above US\$10 trillion by 2025).

Cyber attacks can result in identity theft of individuals or access to personal accounts (including banks and social media), while for businesses it can disrupt operations or even steal data and trade secrets. Some of the most common cybercrime attacks include phishing, device theft and login theft (the theft of a person's login credentials). Ransomware was in the headlines in 2021 as a major oil pipeline in the US was locked by hackers –the company paid a fee of US\$4.4 million (in Bitcoin) to regain access to their oil pipelines.

◆ **Digital surveillance:**

The collection of data about a person's online communications, connections, finances and other available information.

◆ **Data broker:** A

company that collects and stores information about users and sells it on to companies or advertisers.



ATL ACTIVITY

Research

List the types of cybercrime. Make a table that includes definitions and real-world examples.

REAL-WORLD EXAMPLE

WeChat

WeChat, an app that is mainly used in China, facilitates:

- phone calls and text messages
- social media (similar to Facebook, Instagram and WhatsApp)
- a productivity suite (like Microsoft Office or Google Drive)
- banking/payment options (like Google Pay, Venmo, and PayPal)
- its own app store and third-party service providers (equivalent to Uber, Amazon, Travelocity or Deliveroo, for example)
- access to doctors, hospitals, traffic, utility bills, travel visas and driving records.

It is used by 92% of the Chinese market, keeping users in contact with their friends and family, and easing everyday activities ranging from paying for coffee, checking the weather and renting a city bike to making doctor's appointments.

In 2020, WeChat had 1.24 billion users and sent over 45 billion messages a day (including 305 million video messages), with users spending an average of 66 minutes a day on the app (25 minutes longer than the average Facebook user). Most users open the app at least 10 times a day, while 20% of users opened it over 50 times a day. Over a third of all the data on China's networks is WeChat-related.

However, in addition to making civilian life efficient and connected, it also enables the government to monitor and manage its citizens and what content they receive. The internet is highly restricted in China in comparison to other countries; Chinese users cannot access Google, Facebook, YouTube or the *New York Times* (although it is possible to bypass the system with a VPN). This restriction and censorship of the internet is casually known as 'The Great Firewall of China'.

Additionally, WeChat censors content using server-side censorship, scanning messages once they are uploaded to 'the cloud' and blocking those that contain certain keywords. Neither user is notified that the messages were blocked, and the messages may be stored for up to six months.

<https://jingdaily.com/3-wechat-savvy-users>

www.fabernovel.com/en/article/economy/wechat-the-shape-of-the-connected-china

www.nytimes.com/interactive/2019/11/13/magazine/internet-china-wechat.html

www.bloomberg.com/news/articles/2016-06-09/life-in-the-people-s-republic-of-wechat

<https://techjury.net/blog/wechat-statistics/#gref>

<https://citizenlab.ca/2020/05/wechat-surveillance-explained>

ATL ACTIVITY

Thinking

Reflect on your mobile phone use.

- Make a list of all of the activities that you have done on your phone in the last 24 hours.
- List the app/website and duration.
- If someone was to gain access to your activity, what would it say about you?
- Does it represent you accurately? Could it be misinterpreted? Does it reveal too much information about you?
- Reflect on the results and make recommendations on how you could change your mobile phone use.

Concept connections

- **Change:** Cash is becoming less common as more and more businesses rely on mobile payments, as in WeChat.
- **Expression:** To what extent does server-side censorship impact people's ability to express ideas. To what extent does it protect society?
- **Systems:** WeChat is a tool that is integrated into daily life in China. It is used for payments, communication and more, which requires extensive connections between digital systems.
- **Values and ethics:** Some nations value the freedom of speech, while others value respect for authority. Where does your community fall on this spectrum?

Creativity, activity, service (CAS)

Since you have studied impacts and implications of digital technology, what opportunities exist for you to get involved with an issue, organization, movement or political candidate?

TOK

How can we determine the difference between propaganda, information, misinformation and fake news?

Extended essay (EE)

Some ideas to consider developing include:

- Evaluate the impacts of social media on a specific election of your choosing.
- Investigate the security and reliability of voting tools and systems used in elections.
- To what extent are specific laws effective in regulating digital platforms?



Reflection

Now that you have read this chapter, reflect on these questions:

- How do digital tools facilitate election processes in your home town, region and/or country?
- Where do you encounter political advertising, activity and organizations that use digital technology?
- What new innovations in weapons, warfare or communication are being used by armies and/or terror organizations?
- What do you do to protect yourself against cybercrime? Have you come across any suspicious activity on digital platforms?
- What information are you sharing online? What would your ISP observe if they monitored your activities on their networks?
- Examine your school's acceptable use policy for digital technology. How does it align with the reality of digital technology use on your campus? How is it enforced? Do you have any recommendations to improve it?

4.7

Social

UNDERSTANDINGS

By the end of this chapter, you should understand:

- ▶ various components of an individual's social identity impacts how one operates in a digital society and the amount of privilege and alliance they have access to in both physical and virtual spaces; some of these components are age, gender, ethnicity, ability, beliefs and nationality
- ▶ social class defines an individual or group's access to resources and prestige within their community, and digital society overall
- ▶ digital tools are shifting the family dynamic including how people meet, connect and spend time with loved ones.

An individual's experience in digital society is very dependent on their own social identity, the people and communities they engage with, as well as the **dominant cultures** of their social networks.

Social identity markers can be broken down to include factors such as race, education, gender and more. Many of these characteristics are not consciously chosen but are a function of family status, genetics and other factors. Often, having these markers aligned with the dominant culture allows one to experience a set of privileges or advantages.

Intersectionality explores the overlap and interconnection that a specific and unique set of identity markers may create, particularly focusing on the discrimination and disadvantages faced by those who do not align with the dominant group. This often manifests in digital spaces as cyberbullying or online hate speech, where people may be targeted or harassed for who they are. When all or some of your identity markers match the dominant culture, you may experience the world from a place of **privilege**.

While formal **caste systems** (separating groups by social class) have become less common in recent years, **social class** still plays a significant role with regard to the level of resources, access and knowledge available to communities because of their economic, social or cultural wealth. The differences in social status often correlate to access to new and effective digital technologies. This **digital divide** usually corresponds with the level of access to resources in the physical world.

Digital technology is also reshaping how we communicate and stay in contact with friends and family. Social media tools help to keep families and friends connected, even to the extent of using GPS location features to keep track of where your loved ones are at any given time. Online social circles have developed that allow people to build friendships and connections over shared interests, whether as fans of a particular franchise or as collaborators (and competitors) in online games.

Communications technology is also redefining romantic landscapes. People download dating apps that target specific identity markers (such as religion or ethnicity), while others are using virtual reality technology to simulate romantic experiences missing in their everyday life.

◆ **Dominant culture:**

A culture that has established its own norms and values as the standard for the entire group.

◆ **Intersectionality:**

The overlap and interconnection that a specific and unique set of identity markers may create.

4.7A Social components of identity

■ Aspects related to international-mindedness and/or common humanity

International-mindedness is a mindset in which one sees their connection to the global community and has a sense of responsibility to its members. Internationally-minded people make a conscious effort to embrace and respect diversity, and to learn more about people who have different cultures, appearances and lifestyles than their own. The internet and the ubiquitous use of smartphones have enabled all of us to learn more about other countries and cultures. It is very difficult not to see the connections between the communities around the globe when we look at items in our news feeds; and not just items about issues and events but cultures, appearances and lifestyles.

◆ **International-mindedness:** A mindset in which one sees their connection to the global community and has a sense of responsibility to its members.

ATL ACTIVITY

Research

Research online articles around the world about a significant issue, event or situation from different countries and cultures. You may need to use a translator app to read them. How different and/or similar are the ideas and perspectives from the different sources? How does this show that international-mindedness is being developed around the world?

■ Age and demographic components

Demographic components are statistical data points that are used to characterize or label groups of people. Common examples of demographics include age, gender, occupation, cultural background and family status. Data analysis can be used to identify and explain trends and patterns that influence subgroups of people.

◆ **Demographic components:** Statistical data points that are used to characterize or label groups of people.

Inquiry

Research how demographic segmentation has had an impact on the design, analysis and use of survey data, especially for census surveys designed by national governments.