Technology and Innovation in United Nations Peace Operations

Course Author

Dr. A. Walter Dorn

Series Editor

Ramona Taheri

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Technology and Innovation in United Nations Peace Operations

Peacekeeper uses an uncrewed aerial vehicle (UAV) smart controller with a built-in screen to view the terrain from an aerial perspective. Several hundred UAVs, mostly micro-UAV quadcopters, are now deployed in the field as UN-owned equipment. Contingents have also brought larger UAVs and used them to great effect. Ogossagou, Mali. 2 September 2022. UN Photo by Harandane Dicko.

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First edition: 2023 by Dr. A. Walter Dorn

Technology and Innovation in United Nations Peace Operations

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Course Author's Video Introduction »

View a video introduction of this course at <https://www.youtube.com/watch?v=O3ax9VMKENI>.

Method of Study

This self-paced course aims to give students flexibility in their approach to learning. The following steps are meant to provide motivation and guidance about some possible strategies and minimum expectations for completing this course successfully:

- Before you begin studying, first browse through the entire course. Notice the lesson and section titles to get an overall idea of what will be involved as you proceed.
- The material is meant to be relevant and practical. Instead of memorizing individual details, strive to understand concepts and overall perspectives in regard to the United Nations system.
- Set personal guidelines and benchmarks regarding how you want to schedule your time.
- Study the lesson content and the learning objectives. At the beginning of each lesson, orient yourself to the main points. If possible, read the material twice to ensure maximum understanding and retention, and let time elapse between readings.
- At the end of each lesson, take the End-of-Lesson Quiz. Clarify any missed questions by rereading the appropriate sections, and focus on retaining the correct information.
- After you complete all of the lessons, prepare for the End-of-Course Examination by taking time to review the main points of each lesson. Then, when ready, log into your online student classroom and take the End-of-Course Examination in one sitting.

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- A note about language: This course uses English spelling according to the standards of the *Oxford English Dictionary* (United Kingdom) and the *United Nations Editorial Manual*.

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LESSON
1

Background

In this Information Age, technology affects every facet of human life, including how wars are fought and peace is kept.

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In This Lesson »

Section 1.1 The Technology Revolution

Section 1.2 Peacekeeping Technology

Section 1.3 A Scientific Foundation

Section 1.4 Key Concepts

Lesson Objectives »

- Learn about the current technology revolution.
- Give examples of technological applications in peacekeeping.
- Understand some scientific principles behind technology.
- Grasp key concepts about technological evolution.

The United Nations Entity for Gender Equality and the Empowerment of Women (UN-Women) offers computer training to internally displaced persons (IDPs) living at a protection of civilians site (PoC 3) run by the UN Mission in South Sudan (UNMISS) in Juba. Trainees are taught to type, as well as to organize and file computer records, to access and browse the internet, and to send email. 20 April 2016. UN Photo by JC McIlwaine.

Introduction

Human beings need to understand how technological transformation affects the long-term welfare of the planet, both for good and bad, to help harness technologies for good and minimize the harmful effects.

Technology has given humans the ability to constantly transcend physical limitations. This means that the world appears to be shrinking while human movement becomes faster. For example, the first circumnavigation of the globe took three years to complete (led by Ferdinand Magellan in 1519–1522), while a modern airplane completed circumnavigation in 31 hours, and satellites routinely orbit the earth every 90 minutes.

Watch the UN video "#UNGSC Presentation - Short Version | United Nations Global Service Centre" at <https://www.youtube.com/watch?v=RwwhAn29_pU>.

Section 1.1 The Technology Revolution

Technological advancement in computing power has been particularly awe-inspiring and impactful. The first programmable electronic general-purpose computer[1] was considered a marvel because it could carry out up to 385 multiplication operations per second. By 2022, a supercomputer could perform one quintillion (one billion billion) operations per second.[2] In 1955, an IBM 650 computer had 375 bytes of core memory and cost $200,000 — not to mention that it weighed over 2,000 kilograms.[3] Today, a laptop with one terabyte (1,000 billion bytes) of hard disk space can be purchased for a few hundred dollars. This is a 500-billionfold improvement in the price-to-performance ratio, putting fantastic computing power into around 50 per cent of households worldwide by 2019.[4]

Because of technology, communication around the globe has also become much easier. When rotary phones first became commonplace in the modern world, an intercontinental voice call cost several dollars a minute. Now, a video call can be made to most places in the world for free using applications (apps) on data-enabled mobile phones. Some populations have managed to leapfrog a whole generation of technology, i.e., skipping fixed phones on landlines and moving directly to mobile phones, capable of an ever-expanding set of uses and apps. The Internet and mobile email have made the world more interconnected than ever before.[5] The tremendous (though uneven) expansion of the Internet in all regions of the world is shown in Figure 1-1. As of 2023, 65 per cent of the world's population was using the Internet, which is increasing yearly.[6]

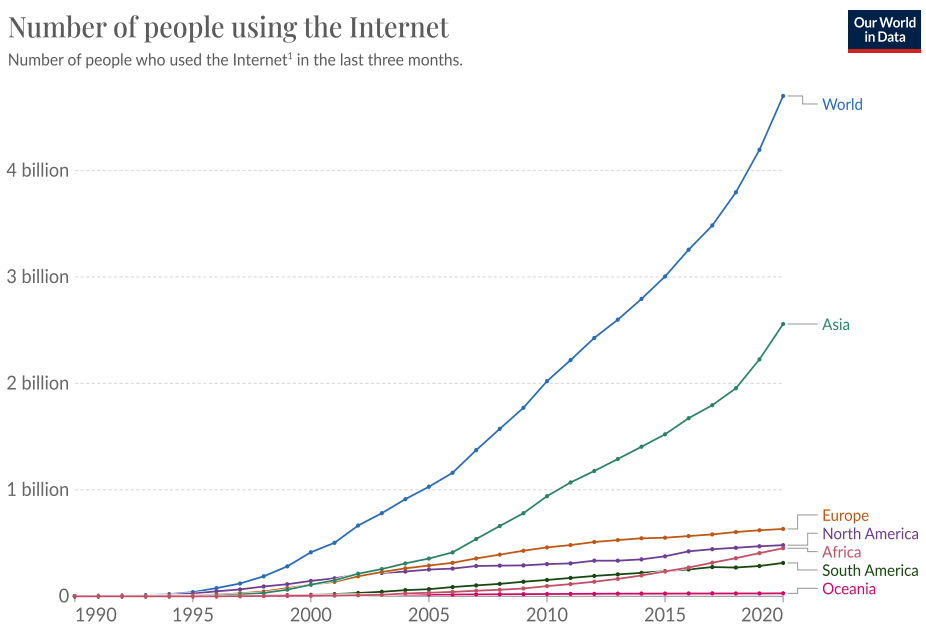

Figure 1-1: Internet Use by Share of the Population in Different World Regions

Source: Hannah Ritchie, Edouard Mathieu, Max Roser, and Esteban Ortiz-Ospina, "Internet", Our World in Data. Available from: <https://ourworldindata.org/internet>.

1) Electronic Numerical Integrator and Computer (EINAC) in 1945.
2) Jon Brodkin, "1.1 quintillion operations per second: US has world's fastest supercomputer", 31 May 2022. Available from: <arstechnica.com/information-technology/2022/05/1-1-quintillion-operations-per-second-us-has-worlds-fastest-supercomputer>.
3) Portia Isaacson and Egil Juliussen, "Window on the 80's", *Computer*, Vol. 13, No. 1, January 1980, 5. Available from: <https://ieeexplore.ieee.org/abstract/document/1653334>
4) Statista, "Share of households with a computer at home worldwide from 2005 to 2019", 27 July 2022. Available from: <https://www.statista.com/statistics/748551/worldwide-households-with-computer/#:~:text=In%202019%2C%20almost%20half%20of,was%20closer%20to%2080%20percent>.
5) International Telecommunication Union, *Measuring Digital Development: Facts and Figures 2022* (Geneva: ITU; 2022). Available from: <https://www.itu.int/hub/publication/d-ind-ict_mdd-2022/>.
6) Statista, "Number of internet and social media users worldwide as of April 2023", 22 May 2023. Available from: <https://www.statista.com/statistics/617136/digital-population-worldwide/>.

These and many other advancements constitute a technological revolution. Furthermore, the term **industrial revolution** can be applied when new inventions cause wide-scale (global) changes to commercial processes, fundamentally changing human life. Table 1-1 shows an overview of such revolutions, each making a major impact on how people lived, moved, and worked from those time periods onwards.

Table 1-1: Industrial Revolutions and their Driving Technologies[7]

Industrial Revolution	Beginning (approx.)	Technologies
First	1760	• Steam engine • Mechanized agriculture
Second	1870	• Internal combustion engine • Electricity and electric lighting • Telephone ("vocal telegraph")
Third	1960	• Nuclear energy • Computers • Telephone ("vocal telegraph") • Earth-orbiting satellites
Fourth	1990	• Internet (World Wide Web) • Electronic commerce • Artificial intelligence • Autonomous/uncrewed vehicles

While these revolutions have greatly improved people's lives, they have also increased the ability of humans to hurt each other, including when waging war. Some technologies offer great destructive power. One startling example is the thermonuclear test known as the Tsar Bomba carried out by the Soviet Union above its Arctic island, Novaya Zemlya, in 1961. A single bomb exploded with a yield of 50 megatonnes of TNT.[8] This is more than 10 times the explosive power of all the weapons of World War II combined, including the atomic bombs dropped on Hiroshima and Nagasaki (15–20 kilotonnes of TNT each) and all the conventional bombs dropped on cities such as Dresden, London, and Tokyo.

The technological revolution of the last century came with significant responsibilities for humanity: to maintain peace and security rather than starting wars, which in their extreme form could destroy human civilization as a whole, and to better the human condition.

This course explores how that technology has improved the capacity and effectiveness of peacekeeping by the UN, an organization which arose from the catastrophe of World War II and is the result of global (civilizational) evolution over the past century. This review shows how technological progress within the UN is possible while also tempering enthusiasm for technological solutions by showing the factors that constrain their adoption.

7) Helen Sydney Adams, "Industrial Revolution timeline: 1760 to manufacturing today", 17 June 2022. Available from: <manufacturingdigital.com/smart-manufacturing/industrial-revolution-timeline-1760-to-manufacturing-today>.

8) TNT stands for trinitrotoluene, a commonly used explosive material, first prepared in the 1860s and used in military munitions from the start of the twentieth century. The explosive yield of TNT is used as a standard to compare the size of explosions.

Section 1.2 Peacekeeping Technology

Although the UN has been relatively slow to experiment and adopt new technologies, the worldwide technological revolution has not left the international organization behind. UN workers widely use smartphones to communicate with each other, locals, and family back home. These same phones are used to record images for UN investigations (including of mass atrocities) and to transmit them to centralized UN databases.

Night-vision devices have allowed peacekeepers[9] to pierce the darkness, traditionally the domain of smugglers, kidnappers, and attackers. For instance, night-vision goggles allow operations to be run around the clock, including robust night operations where peacekeepers can gain the upper hand over warring factions, gangs, and human rights violators. Night awareness is further enhanced using ground surveillance radars, acoustic/seismic sensors, and uncrewed aerial vehicles (UAVs), sometimes called unmanned or uninhabited aerial vehicles.

Image or video captures on night-vision equipment and other devices can be stored centrally on a **geographic information system** (GIS) such as the UN's Unite Aware suite. GIS can show transmitted information on computerized maps made available to faraway mission staff, sometimes in real time (i.e., immediately after they are taken). GIS often makes information much easier to share, digest, categorize, and use.

Using the **global positioning system** (GPS) for precision peacekeeping, the nearest patrol unit can be identified on a constantly updating GIS map, and this unit can be tasked to mount a rapid response to a nearby conflict. Tracking tools can follow the movement of UN vehicles on screens in real time to view their location, helping the organization know when vehicles are stopped or in danger or where they are going. And when peacekeepers arrive, they might consider using **non-lethal weapons** instead of lethal weapons to quell any violence. To communicate in areas without mobile phone networks, peacekeepers can use their radios: TETRA (ultra-high frequency [UHF]) radios for communications within line of sight or high frequency (HF) radios for longer communication, even transcending the curvature of the earth. Furthermore, satellite phones allow peacekeepers to communicate from any location on the planet's surface, even in remote and austere conflict zones.

If peacekeepers are injured during their work, a host of medical technologies are available to medics and doctors in the field — from tourniquets to stop immediate bleeding to special instruments at the operating table for major surgeries. Telemedicine allows doctors elsewhere, sometimes on another continent, to determine an illness and prescribe remedies (often medicines).

Cloud computing allows UN data to be shared with its stations and missions around the world. The UN Global Service Centre (GSC, see Figure 1-2) stores data from disparate missions centrally, more efficiently, and with important redundancy. To secure data continuity against disruption, the computer systems in Brindisi, Italy, and Valencia, Spain, act as backups for each other. If one location experiences a failure, the other instantaneously picks up the management of the global data system for UN peacekeeping.

Furthermore, commercial cloud computing from large providers allows the UN to use video-teleconferencing (e.g., through Microsoft Teams) between UN staff on mission and in offices around the world. This proved especially useful during the COVID-19 pandemic, as staff at UN Headquarters and other offices worked mainly from home. The software programs used and the data produced are stored on remote servers, which can be accessed all over the planet.

9) This course uses the term "peacekeeper" to refer to those deployed on peace operations under mandates from the UN. Over the years, the range and type of mandated tasks assigned to peace operations have expanded significantly in response to evolving patterns of conflict and best to address the greatest threats to international peace and security. Accordingly, several peace operations now have more "robust" mandates authorizing the proactive use of force with the "use of all necessary means" to ensure protection of civilians, law and order, and disruptions to the political process, among others. Robust peacekeeping entails the use of force beyond self-defence and defence of the mandate.

Figure 1-2: The Two High-Tech Facilities that Make Up the GSC

Source: Global Services Centre. UN Photos by Luca Nestola.

As the UN handles sensitive information electronically, it needs to take great efforts to protect its data, resources, and reputation, especially to prevent breaches. After some setbacks, the UN has enhanced its cybersecurity posture by introducing safety measures such as two-factor authentication,[10] intrusion detection systems, network analysis, employee cybersecurity courses, and a variety of novel technical and procedural controls.[11] This is in addition to the long-standing practice of using anti-virus software, firewalls, data encryption, and mandatory software/hardware updates.

Section 1.3 A Scientific Foundation

The technological revolutions were made possible by the amazing advancement of modern science as humans discovered and unlocked the secrets of the physical universe. Scientists continually sought to quantify and measure natural phenomena using experimentation and testing. They uncovered new natural laws, principles, equations, and links between observables. This new knowledge could then be harnessed for technological development.

Particularly important was the growing understanding and use of the **electromagnetic spectrum**, an energy that exists in all parts of the universe. Experiments allowed scientists to discover that visible light, radio waves, and X-rays are all forms of waves of the electromagnetic field, which is produced by moving electric charges. These forms differ only in the frequencies of the electromagnetic waves. With frequency measured in cycles per second (Hertz), these waves conformed to the equation:

$$c = f \times L$$

where:

- c is the speed of light (3×10^8 m/s in air or a vacuum);
- f is frequency (in Hertz, sometimes represented by the Greek symbol ν, pronounced "nu"); and
- L is the wavelength (in metres, sometimes represented by the Greek symbol λ, pronounced "lambda").

10) In two factor-authentication, staff logging in online must confirm their identity by pressing a key on their mobile phones or copying a one-time code from their mobile phones to the computer interface or use specific authentication software on the computer or phone. The UN uses two-factor authentication for almost all staff accounts.

11) UN, "Cybersecurity". Available from: <unite.un.org/information-security>; *UN, Cybersecurity in the United Nations system organizations: Report of the Joint Investigations Unit*, JIU/REP/2021/3, March 2021. Available from: <unjiu.org/sites/www.unjiu.org/files/jiu_rep_2021_3_english.pdf>.

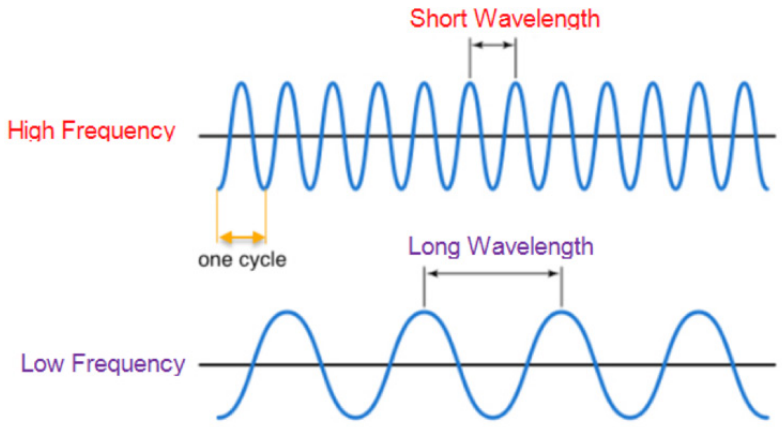

Figure 1-3: The Relationship Between Frequency and Wavelength of a Sinusoidal Wave

Source: Ada McVean, "Light, Wavelengths, and Inactivating COVID-19", McGill University, 12 June 2020. Available from: <https://www.mcgill.ca/oss/article/covid-19-general-science/light-wavelengths-and-inactivating-covid-19>.

The wavelength is the distance between wave peaks of the electromagnetic wave. When the frequency increases, the wavelength decreases proportionally (i.e., by the same factor). This is illustrated in Figure 1-3. The enormous span of the electromagnetic spectrum, with wavelength and frequency, is shown in Figure 1-4.

The human eye sees only a small slice of the electromagnetic spectrum: visible light has a wavelength of about 0.4 to 0.7 µm (micrometres, i.e., millionth of a metre or 10^{-6} m). Instruments can measure over 15 orders of magnitude (i.e., 15 factors of 10 or a million billion times) more than humans can see. This includes X-rays (less than 3 nanometres in wavelength) to radio waves (from centimetres to thousands of kilometres). Furthermore, the unaided human eye has limited optical resolution and no capacity for zooming. By contrast, electro-optical devices can extend human capacity manifold, enhancing observation and also making interpretation and assessment easier. Sensor systems can also record images or videos for analysis, dissemination, and future reference.

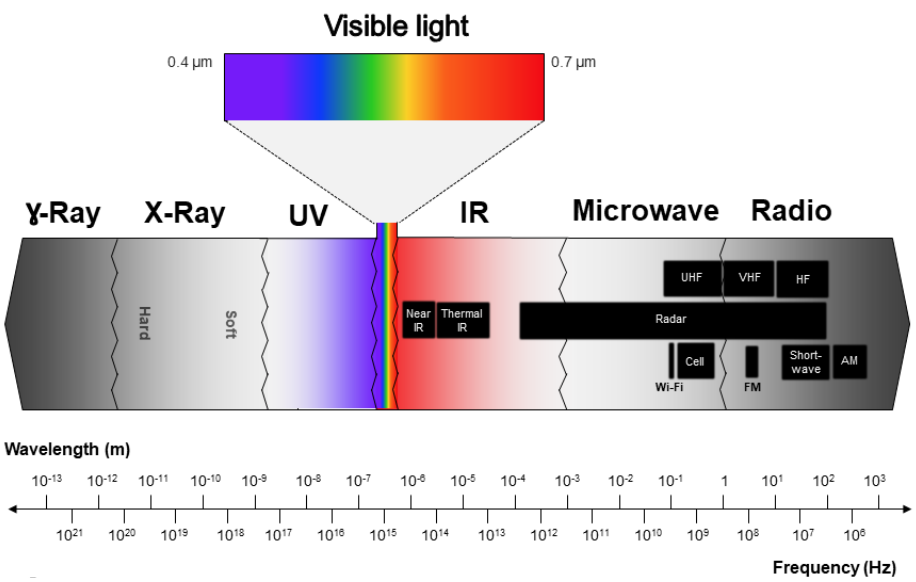

Figure 1-4: The Electromagnetic Spectrum

Wavelength and frequency are shown on a logarithmic (powers of ten) scale.
Designed and drawn by Walter Dorn.

Besides electromagnetic waves, technology can measure other forms of energy (e.g., acoustic/seismic signals and quasistatic electric and magnetic fields) and various types of materials (e.g., chemical and biological agents and nuclear particles). All of these observables are useful in human affairs, with some uses in peacekeeping, as Lessons 3 and 4 will show.

The many truths about the physical universe were discovered using the **scientific method**: humans find ways to quantify and measure natural phenomena, then experiment with them by controlling one aspect (variables such as frequency or intensity) and observing the effects. The nature and links between many phenomena were increasingly understood in millions of controlled experiments and illustrated using graphs and diagrams. The scientific urge is to "make everything as simple as possible, but not simpler" (a quote that is sometimes attributed to Albert Einstein). However, because the physical universe is so complex, science must often be complex and sophisticated.

With a greater understanding of the physical universe, human beings have been able to harness natural phenomena to make new tools, called technologies, that could, in turn, be used to explore deeper into the universe. This is the complementary nature of science and technology (S&T). ***Greater knowledge leads to better tools, and better tools lead to greater knowledge.*** With this process, amazing discoveries and powers have been developed and used both for good and for ill. Through research and development (R&D), scientists, engineers, and technologists have found ways to apply science to practical problems, while also developing new concepts.

Section 1.4 Key Concepts

A few concepts can help to make sense of the technological revolution. First, a definition of technology is the reproducible application of knowledge, especially scientific knowledge, for a practical end. In short, technologies are science-based tools. Technologies can be physical (e.g., machines, devices, or hardware) or non-physical (e.g., designs or software). Hardware and software are often combined into a system using integrated circuitry based on digital logic.

Computers are based on a binary code whose basic unit is a type of digit (discrete numerical value) called a bit, which is either 1 or 0. Eight of these bits in order make a byte. Modern mobile phones and computers typically have a storage capacity of well over a gigabyte (GB or a billion bytes) in memory. The storage capacity of computers has increased exponentially for many decades, following Moore's law, which states that the number of transistors on a microchip doubles every two years, as was observed by Gordon Moore as early as 1965. This means that humans have the ability to produce smaller devices with greater capacity and computing speed. Because of the exponentially increasing capacity of integrated circuits, ever more sophisticated actions can be carried out with great consistency on an ever-widening array of devices.

In common parlance, digital technology encompasses the devices and methods to collect, store, process, use, and disseminate electronic data. It is synonymous with information technology (IT), often described more broadly as information and communications technology (ICT) to emphasize that it is also used as a means of communication. One of the striking advancements of digital technology is artificial intelligence (AI), whose application to peacekeeping will be discussed in this course.

The world has witnessed technological convergence in recent decades because of the miniaturization and increased capabilities of circuits and other electronic devices. Functions formerly carried out on separate devices are now carried out on a single device. For instance, a telephone was originally only used for conversations from a fixed location (e.g., a phone booth, an office desk, or a home table), but telephones acquired the functionality of radios when mobile phones became widespread in the early 2000s. Talking while moving became possible wherever there

was a connection to a mobile network, with cells being created by the range of a transceiver (transmitter/receiver cell site/tower). Mobile phones started to incorporate cameras to allow the functions of both still and video cameras. When data was added to voice transmission, smartphones allowed videoconferencing, including while travelling. Furthermore, GPS receivers and accelerometers allow tracking of phone movement. With data speeds increasing dramatically from bits per second (bps) to megabits per second (Mbps) and faster connections to the Internet becoming available, it became possible to design and download software for an ever-widening set of apps.

Technological devices cannot be considered in isolation as innovators and managers seek to solve real-world, practical problems. This course considers that three factors have a major effect on the success or failure of innovation: **technology, process, and people**. No matter how advanced, devices are of no value unless they are properly employed by humans and optimized through an effective process. Too often, in technological progress, the technology of a device is over-emphasized (especially because of the "cool" factor), while the other two factors are forgotten. Effective processes link the physical devices with the people who develop, maintain, and use the technology, all of whom need to gain technological familiarization and skill.

However, before exploring the specific tools and associated people and processes in peacekeeping it is also wise to look at technology's advantages and disadvantages (pros and cons) since many of these general lessons can be applied to peacekeeping.

End-of-Lesson Quiz »

1. **Which industrial revolution saw the introduction of e-commerce, artificial intelligence (AI), and self-driving (autonomous) cars?**
   A. The First Industrial Revolution
   B. The Second Industrial Revolution
   C. The Third Industrial Revolution
   D. The Fourth Industrial Revolution

2. **While industrial revolutions have improved people's lives, they have also:**
   A. Decreased people's willingness to go to war
   B. Reduced the explosive power of weapons
   C. Increased the ability to do damage to others
   D. Limited the effectiveness of peacekeeping

3. **Are peacekeepers permitted to use mobile phones?**
   A. No, they are a security risk.
   B. Yes, but only for keeping in touch with their families during leisure time.
   C. No, only satellite phones may be used.
   D. Yes, for private and work communication and for recording images for UN investigations.

4. **Peacekeepers use radios to communicate _____ mobile phones.**
   A. rather than
   B. because they do not have
   C. beyond the range of
   D. if they lose their

5. **What is telemedicine?**
   A. Remotely consulting doctors to assist with diagnosis and prognosis
   B. Implanting connected devices in a patient
   C. Using television for medical education
   D. When the only medical help available is over the phone

6. **The UN has enhanced its cybersecurity posture by introducing:**
   A. Safety measures
   B. Intrusion detection systems
   C. Network analysis
   D. All of these

7. **Microwave ovens use _____ to heat.**
   A. energy on the electromagnetic spectrum
   B. X-rays
   C. visible light
   D. thermal rays

8. **In essence, technologies are _____-based tools.**
   A. computer
   B. science
   C. intelligence
   D. software

9. **What is Moore's law?**
   A. The number of transistors on a microchip doubles every two years
   B. The number of microchips worldwide doubles every two years
   C. The size of transistors halves every two years
   D. Anything that can go wrong with technology will go wrong

10. **Smartphones are an example of technological convergence because:**
    A. They improve over time.
    B. They become cheaper over time.
    C. They include a certain level of computing power in a single device.
    D. They include functions other than making calls previously only available using separate devices.

Answer Key provided on the next page.

End-of-Lesson Quiz »

Answer Key »

1. D
2. C
3. D
4. C
5. A
6. D
7. A
8. B
9. A
10. D