Thomas Carroll, PhD

FUTURE SKILLS 2030

Prepare for the 4th industrial revolution

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By Thomas Carroll, PhD

Lifeisalaboratory.com

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Dedication

To my wife Jane, and my children Mick, Kieran and James

For your endless love, support, and inspiration. You are the reason this journey was possible.

"The future belongs to those who learn more skills and combine them in creative ways."

Robert Greene

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"The only way to make sense out of change is to plunge into it, move with it, and join the dance."

- Alan Watts

Executive Summary

The future of work is rapidly transforming due to the advent of Artificial Intelligence (AI) and other cutting-edge technologies such as advanced computers, robotics and biotechnology. The convergence of new technologies with global forces such as climate change, globalization, geopolitics and shifting demographics presents both opportunities and challenges. The transition to net-zero is also creating new opportunities for green jobs.

AI, particularly generative AI (genAI), is significantly impacting the workplace by primarily enhancing human roles instead of replacing them. The future will likely see more role augmentation rather than job replacement, with significant opportunities for increased efficiency, consistency, and acceleration in knowledge roles.

These developments are reshaping industries and altering the skills required to succeed in the modern job market. Comprehensive educational programs are needed to equip young people with essential skills and provide ongoing support for adults seeking to reskill or upskill. Updating educational programs is crucial for preparing future workers. Support for adults and transitioning workers is also necessary to keep their skills current. Most importantly we all need to take charge of our own learning - agency is key. Personal agency in learning means being proactive, self-motivated, and responsible for one's own educational journey.

This eBook is a learning resource included with the online course 'Future Skills 2030 - Prepare for the 4th Industrial Revolution'. The course introduces the concept of the 4th Industrial Revolution and futures thinking. The course looks at 17 key technologies along with the other forces driving change in our world in 2024. The course also explores the key skills needed to survive and thrive in today's world and how to acquire these new skills. An important assignment in section 4 of the online course is to develop a personal skill development plan. Throughout the course, participants are provided with links to additional books and resources to help deepen their knowledge.

The pace of change is accelerating. Standing still and disengaging can quickly lead to obsolescence. Continuous learning, growth, and skill enhancement are vital to keeping up with this rapid evolution. By understanding emerging trends and preparing proactively, individuals and organizations can position themselves better for success in an unpredictable world.

Welcome to Future Skills 2030!

"Skills have become the global currency of the 21st century. Without proper investment in skills, people languish on the margins of society, technological progress does not translate into economic growth, and countries can no longer compete in an increasingly knowledge-based global society"

- OECD Secretary-General Angel Gurría

Author's Note

Welcome to the online course, '*Future Skills 2030-Prepare for the 4th Industrial Revolution*' and to this companion ebook! As you begin the course I want to give you an overview of the course material. I also want to give you an update on where we are in 2024 in terms of technology and other major forces shaping the constantly evolving future of work. The current wave of technological advancements is a pivotal moment in human history.

The 4th industrial revolution is unlike any we have witnessed before. Characterized by a fusion of technologies blurring the lines between the physical, digital, and biological spheres, it challenges our ideas about what it means to work, to learn, and to succeed. The rapid pace of change, driven by groundbreaking advancements in artificial intelligence, robotics, the Internet of Things, autonomous vehicles, 3D printing, nanotechnology, biotechnology, quantum computing, and the increasing interconnectivity of global economies, has profound implications for our labor markets, education systems, and social fabric.

The Future Skills 2030 course is tailored for students, professionals, educators, policymakers, parents and anyone else interested in understanding the skills essential for thriving in this new era. It not only provides insights into the technologies and other drivers of change shaping our future but also focuses on the skills that will be invaluable in navigating this transformation.

Each lecture of the course delves into different facets of the 4th Industrial Revolution, from understanding the technological breakthroughs to exploring the soft skills that will become increasingly important, such as curiosity, emotional intelligence, adaptability, and collaborative ability. We will look at how traditional educational paths are evolving and the importance of lifelong learning in a world where change is the only constant. Furthermore, this course is not just about understanding the change; it's about empowering you to be a part of it. Whether you are looking to reshape your career, enhance your skill set, or simply gain a deeper understanding of the rapidly changing world around you, "Future Skills 2030" offers both the insights and the practical advice you need. We all need to be proactive and develop a positive attitude towards self-improvement.

As you go through the course, I invite you to reflect on your own journey, challenge your perceptions, and embrace the endless possibilities that the future holds. The 4th Industrial Revolution is not just about technology—it's about how we adapt, evolve, and use these advancements to create a better, more inclusive, and sustainable world for the generations to come. The future is not a distant reality anymore. It is here. It is now. And it is for us to shape and define. The world is changing and if we don't embrace change and change with it, then the world may decide it doesn’t need us anymore.

Welcome to a journey of discovery and empowerment!

Thomas Carroll PhD,

Laois, Ireland,

June, 2024.

1. Overview of the Online Course

This online course 'Future Skills 2030' is designed to offer a comprehensive understanding of the technological advancements defining the 4th Industrial Revolution and their effects on industries, economies, and the global workforce. Additionally, the course explores other drivers of change that shape our world. All these forces of change interact in various ways, creating an unpredictable environment. The following is an overview of what you can expect throughout the course:

Section One - Introduction

We begin with an exploration of what constitutes the 4th Industrial Revolution, its key drivers, and how it differs from previous industrial revolutions. This module sets the foundation for understanding the broader context of the course.

Futures thinking

In this section, we also explore the concept of Futures Thinking, alternatively known as Futures Studies, Futurology, or Strategic Foresight. Unlike predicting the future, Futures Thinking involves examining possible future scenarios based on evidence from past and present trends. This approach to strategic design helps us consider what might change and what might remain constant in the future, enhancing our strategic planning.

A student starting high school in the USA in 2024 will graduate in 2028 and, if they pursue a college education, will earn a Bachelor's degree by 2032. In Ireland, where I live, secondary school typically lasts five or six years, depending on whether the student takes an additional year called the Transition Year. Thus, a student beginning secondary school in 2024 will graduate in 2029 or 2030, and if they continue to a four-year Bachelor's program, they will graduate in 2033 or 2034. As we look toward the early 2030s, we must ask: Where are we headed? What technologies and forces are driving changes in our world? What skills will be required for the world of work in the early 2030s? The future is not predetermined. By altering our actions today, we can shape the future we want. Preparing for the future of work by acquiring the right skills now is crucial. This message is powerful and empowering—we all have the **agency** to influence and create the future through our actions today.

In futures thinking, we use the future to change the present."

- Sohail Inayatullah

Image: *A future worker as 'imagined' by ChatGPT*

Section 2 - Technologies

Section two of the course delves into the specifics of technologies that are shaping the future, including our changing energy landscape, artificial intelligence, the Internet of Things, blockchain, and more. You will learn how these technologies are combining in unexpected ways, transforming industries and creating new opportunities. There are rapid and ongoing developments in these technologies and I do my best to keep the course material updated. In fact, because of the rapid pace of change I have to keep updating and adding new material to the course on an ongoing basis. This is an important point as online courses offer a level of agility and responsiveness that traditional educational courses often struggle to match. This flexibility allows online education to stay current with rapid changes in technology, industry practices, and job market demands, providing learners with the most relevant and up-to-date knowledge and skills.

Section 3 - Skills

Section three looks at how jobs and career paths are changing in response to technological advancements and other change drivers. This section focuses on the skills that will be in high demand, such as curiosity, creativity, digital literacy, complex problem-solving, and adaptability. Section three also covers the strategies needed to adapt to the changing work environment. This includes embracing lifelong learning, reskilling, and upskilling to stay relevant in the workforce.

Section 4 - Conclusion and next steps

In section four of the course we conclude with steps for preparing for the challenges and opportunities of the future and preparing a personal skill development plan. Section four also includes resources for further learning.
Throughout the course, interactive elements such as quizzes and assignments enhance participant understanding and engagement. Linked to each lecture are external resources which will deepen your knowledge. Take the time needed to go through these resources. By the end of this journey, you will have a good understanding of the 4th Industrial Revolution, the skills needed for the future of work and how to go about reskilling and upskilling.

Headline quotes & statistics

There is nothing like a few choice quotes or statistics to get us to pause and reflect on the magnitude of change in our world today. This happened to the author a few years ago when he attended his son’s graduation from secondary or high school. The school principal in her speech to the school community referenced the commonly stated assertion that many children in primary school today will work at jobs that haven't even been invented yet. This is coming to pass. Reflect on the new jobs that

didn't exist even 10 years ago. Some examples are Chief Heat Officer (CHO), Blockchain Analyst, TikTok Marketer, Contact Tracer, Chief Listening Officer, Chief Automation Officer (CAO), Drone Operator, Cloud Architect, Podcast Producer, Metaverse Research Scientist, Social Media Influencer, Telemedicine Practitioner, AI Ethicist and many more. In fact most of today's jobs hadn't even been invented in 1940.

The reality is that many of us, along with members of our families, may have jobs that no longer exist in the 2030s! According to the Massachusetts Institute of Technology (MIT), technological change is simultaneously replacing existing work and creating new work. It is not eliminating work altogether. Technology will alter the set of jobs available and the skills that they demand. Change will affect all of us to a greater or lesser extent and in this course we look at which professions are most vulnerable to automation.

The people and documents quoted below give a sense of the rapid pace of change in 2024:

- At the beginning of the century, Ray Kurzweil, Futurist and Chief Engineer at Google, predicted that 20,000 years of progress would be crammed into the next 100 years.

- Almost no occupation will be unaffected by the adoption of currently available technologies. Six in ten US jobs will face medium to high exposure to automation. Brookings Institute (2019).

- The OECD estimates that 1.1 billion jobs are liable to be radically transformed by technology in the next decade (WEF, 2022).

- According to the World Economic Forum (WEF), in the **next five years, 83 million jobs are projected to be lost** and **69 million are projected to be created**, constituting a structural labour-market churn of 152 million jobs, or 23% of the 673 million employees in the data set being studied. This constitutes a reduction in employment of 14 million jobs, or 2% (WEF, 2023).

- **Half of all employees around the world need to upskill or reskill by 2025** to embrace new responsibilities driven by automation and new technologies. That figure doesn't include all the people currently unemployed (WEF, 2021).

- LinkedIn data shows that skill sets for jobs have changed 25% since 2015 and are projected to shift by 65% by 2030 globally.

- By 2035, there will be significant changes in the skills required to succeed in the labour market - National Foundation for Educational Research (UK).

- 55% of hiring managers across Europe believe their companies are missing out on skilled candidates because they lack traditional qualifications (Linked-In).

- 65% of employers rated relevant work experience as significant or critical when hiring, compared to less than half (46%) for academic qualifications (Department of Education, UK).

- The total amount of data created, captured, copied, and consumed globally is forecast to increase rapidly. It was 2 zettabytes in 2010 rising to 64.2 zettabytes in 2020. It is predicted to reach 181 zettabytes by 2025! One zettabyte is equal to a trillion gigabytes. (Source: Statista.com).

- "80% of the workforce, 93% of managers and 77% of senior leaders feel poorly prepared for the future". Garther (2020).

- 45% of global CEOs are not confident that their companies would survive more than a decade on their current path (PwC, 2024).

- "All signs point to the hybrid model as the future of work, dialing up pressure on organizations to foster new forms of collaboration while reinventing employee experiences and evolving how they define the workplace". Foundry (2022).

- Sixty nine per cent of the world's most admired companies value **learning agility and curiosity** over career history and experience when it comes to hiring. Korn Ferry (2022).

- The shelf life of most worker's skills is only 5 years - we need to keep learning or become out of date. The World Economic Forum says workers need to assess their skill level **every two to three years** to keep up with change.

- The days of working for 40 years at one job and retiring with a good pension are gone. In January 2022 the median number of years that wage and salary workers had been with their current employer was only **4.1 years**. US. Bureau of Labor Statistics (2022).

- A World Economic Forum study estimated that wide-ranging investment in upskilling has the potential to boost global GDP by $6.5 trillion by 2030 (WEF, 2021)

- It is projected that in 2027, 86.5 million people will be **freelancing** in the United States and will make up 50.9 percent of the total U.S. workforce (Statista.com).

- **Training workers to utilize AI and big data** ranks third among company skills-training priorities in the next five years and will be prioritized by 42% of surveyed companies. (WEF, 2023)

- **Generative AI** has all the hallmarks of a technology that could significantly change how companies operate (about 60% of CEOs expect Generative AI to

create efficiency benefits). It's also approaching a critical juncture, seemingly poised to transform business models, redefine work processes and overhaul entire industries. (PwC, 2024)

- The **Generative AI** market size is projected to reach US$44.89bn in 2023. The Generative AI market size is expected to show an annual growth rate (CAGR 2023-2030) of 24.40%, resulting in a market volume of **US$207.00bn by 2030**. (Statista.com).

- On May 1, 2023, IBM Arvind Krishna said the company expected to pause hiring for roles it thinks could be replaced with artificial intelligence in the coming years. This amounts to replacing 7,800 jobs with AI.

- One of the biggest risks to national education systems today is that traditional ways of educating are losing currency and relevance and are not adapting quickly enough to the needs of a dynamic economy (OECD, 2019).

The Significance of the 4th Industrial Revolution

The 4th Industrial Revolution represents a fundamental change in the way we live, work, and relate to one another. It is characterized by a fusion of technologies that blur the lines between the physical, digital, and biological spheres, marked by breakthroughs in various areas such as artificial intelligence, robotics, the Internet of Things (IoT), genetic engineering, quantum computing, and other technologies.
The significance of the 4th Industrial Revolution lies in several key areas:

Technological Advancements: This era brings unprecedented advancements in technology. AI and machine learning are revolutionizing industries by enabling better decision-making and automation. The ongoing expansion of 5G networks, despite economic and geopolitical challenges, underscores the resilient demand for high-performance connectivity, with projections indicating a broad reach of this technology by 2029. IoT is transforming everyday objects into smart devices, creating a more interconnected world. These advancements are reshaping industries, from manufacturing to healthcare. AI, in particular, is emerging as a powerful technology to augment rather than replace human capabilities, offering opportunities to reduce drudgery and enhance productivity.

Economic Impact: The revolution has the potential to boost global income levels and improve the quality of life for populations around the world. However, it also presents challenges such as income inequality and job displacement, as automation may replace some jobs and change many others, requiring a shift in workforce skills. Factors including the green transition and geo-economic conditions will contribute to job churn, with almost a quarter of jobs being disrupted by 2027 (WEF, 2023).

Workforce Transformation: The demand for new skill sets is creating both opportunities and challenges. There's a growing need for skills like complex

problem-solving, critical thinking, creativity, people management, and emotional intelligence. Traditional education systems are being challenged to provide the necessary training for these future skills.

Societal Changes: The 4th Industrial Revolution is changing the way we interact with each other and with technology, influencing everything from governance to privacy to social relationships. The rise of digital platforms has transformed social interaction, while also raising concerns about data privacy and security. The shift from tangible assets ("atoms") to intangibles ("bits") is redefining economic value and societal norms.

Environmental Considerations: Advanced technologies offer powerful tools for addressing environmental challenges and enabling more sustainable use of resources. However, they also raise ethical questions about the stewardship of the planet and its resources.

Healthcare Revolution: Breakthroughs in biotechnology and genetic engineering are paving the way for personalized medicine, extending life expectancy, and improving the quality of life. These advances, however, come with ethical and moral implications that society must address. The rapid development of COVID-19 treatments, such as the oral pill Paxlovid, exemplifies the potential of AI-driven drug design, which significantly accelerated the process from years to months, saving millions of lives.

In summary, the 4th Industrial Revolution is not just about technological changes; it's about how societies adapt to these changes. It represents a comprehensive transformation that offers immense opportunities while also posing significant challenges, requiring a collaborative effort from governments, industry leaders, and individuals to navigate successfully.

Emerging Technology and Geopolitics

Emerging technologies are reshaping the global geopolitical landscape in profound ways. As nations and corporations develop and deploy advancements such as artificial intelligence, cybersecurity systems, and quantum computing, they create new arenas for power dynamics and international competition. The race for technological superiority is not just about innovation; it's deeply entwined with national security, economic strength, and influence. For instance, 5G technology is at the center of a major global dispute, with countries vying to set international standards and control the network infrastructure that will support future digital communications. Similarly, AI's role in military technologies and cybersecurity positions it as a strategic asset that can tilt the balance of power. This intertwining of technology and geopolitics necessitates careful considerations of ethics, governance, and international cooperation to manage the benefits and risks these technologies pose on a global scale.

In the USA, the National Science and Technology Council curates a list of Critical and Emerging Technologies (CETs) significant to national security. According to the Australian Strategic Policy Institute's (ASPI) Critical Technology Tracker (2023), western democracies are losing the global technological competition, including the race for scientific and research breakthroughs and the ability to retain global talent. China's global lead extends to 37 out of 44 technologies that ASPI is tracking, positioning itself as the world's leading science and technology superpower. This dominance in high-impact research across critical and emerging technology domains will have significant implications for global power and influence.

The COVID-19 pandemic, geopolitical tensions, and changes in global supply chains have disrupted the previous assurance that international supply chains would balance required goods. Countries have shown a willingness to withhold supplies of critical materials as a weapon of economic coercion, and an energy crisis is gripping much of the world due to the Russian invasion of Ukraine.

Automation technologies are transforming work, society, and the economy. According to the ASPI, China and the US are far ahead in the race for technological supremacy. A small, second-tier group of countries, including India and the UK, as well as South Korea, Germany, Australia, Italy, and occasionally Japan, also play significant roles in various technological fields.

The countries that are often considered the most technologically advanced have strong economies, significant investments in research and development (R&D), robust educational systems, and active contributions to scientific and technological innovation. Some of the most technologically advanced countries include:

- China: Rapidly growing in technology, with significant developments in telecommunications, artificial intelligence, and technology manufacturing.
- United States: A leader in technology, particularly in software, biotechnology, aerospace, and artificial intelligence. Home to Silicon Valley, the hub of global tech innovation.
- Japan: Known for its advancements in robotics, electronics, automotive, and manufacturing technology.
- Germany: Recognized for its engineering, especially in automotive and mechanical sectors, and also excels in efficiency technology.
- South Korea: Renowned for its advancements in digital technologies, semiconductors, electronics, and telecommunications.
- Switzerland: Leading in pharmaceuticals, health technology, and precision manufacturing.
- Sweden: Notable for its innovation in telecommunications, information technology, and environmental technology.
- Israel: Known for cutting-edge advancements in cybersecurity, agricultural technology, and medical innovations.
- United Kingdom: Strong in biotechnology, pharmaceuticals, and aerospace.
- Singapore: Focuses on technology-driven sectors including biotechnology, information technology, and clean energy.

These countries are often at the forefront of technological trends due to their infrastructure, investment in tech industries, and policies that promote innovation. As automation and other emerging technologies continue to evolve, these nations will likely maintain their leadership positions, influencing global power dynamics and shaping the future of work, society, and the economy. The race for technological superiority remains not just a matter of innovation but is deeply entwined with national security, economic strength, and international influence. The intertwining of technology and geopolitics underscores the necessity for strategic governance, ethical considerations, and international cooperation to navigate the complex landscape of technological advancement and its global implications.

Disruption in business

The concept of disruptive innovation, as originally developed by Clay Christensen, builds on Joseph Schumpeter's idea of "creative destruction." The key point is that incumbent firms don't miss new trends by ignoring their customers; instead, they listen too carefully to their most sophisticated customers. This focus often leads them to overlook basic but rapidly improving technologies that can disrupt their market from below. Companies that get it wrong, like Kodak or Blockbuster, face significant decline or extinction. Executives can make seemingly sensible decisions, yet disruptive innovations often do not end up being as transformative as expected. Disruption can manifest as full-on or partial, with most companies finding ways to navigate and cope with the threat of disruption, ensuring their survival and adaptation in a changing business landscape.

The new digital mindset

Building on the concept of disruption in business, organizations have been told for over a decade that they need to adopt a digital mindset. With the advent of generative AI (genAI), the stakes are higher than ever. Combining human and machine capabilities will likely demand a whole new level of digital transformation. Through their work with hundreds of organisations worldwide, KPMG professionals have identified four key attributes that can drive this mindset shift:

1. **Connecting End-to-End:** A connected enterprise reflects the impact of change and disruption on its value chain, business outcomes, and customer experience.
2. **Everyone is an Innovator:** All employees are encouraged to innovate in how tasks, roles, and delivery are carried out by a combination of humans and machines.
3. **A Growth Mindset:** An innovative and flexible culture encourages agility, collaboration, and transformation.
4. **The Courage to Act and Challenge:** Everyone is seen as a leader with the autonomy and freedom to act, while being accountable for meeting business objectives.

These attributes are essential for organizations to navigate the complexities of the digital age, ensuring they remain resilient and competitive in the face of ongoing technological advancements and market disruptions.

Other drivers of change in 2024

Beyond technological advancements, section 2 of the course examines other significant drivers of change in today's world. One major factor is climate change, which ranks as the second megatrend following technological disruption. It seems that every time we look at the news, there is a new climate emergency. We witness floods, heatwaves, droughts, wildfires, and massive storms. For instance, Hurricane Ian caused extensive damage in Cuba, Florida, and the Carolinas in September/October 2022. Shortly after, in November 2022, Hurricane Nicole struck Florida. Remarkably, since record-keeping began in 1853, Florida has experienced only two other November hurricanes, in 1935 and 1985. Events that were once considered 100-year occurrences are now happening with increasing frequency. According to the World Meteorological Organization (WMO), 2023 was the warmest year on record. Record breaking temperatures continue in May 2024 with India recording temperatures around 50.6°C (123.08°F) in parts of the country.

In addition to climate change, we face globalization, shifting geopolitics, economic transformations, rising human populations and migration, aging demographics, and the global COVID-19 pandemic, which has further accelerated change since 2020.

The period of 2022/23 also marked the onset of the largest war in Europe since 1945, triggered by the Russian invasion of Ukraine. This conflict has brought the threat of nuclear escalation and has caused a food and energy crisis. In East Africa, tens of millions of people continue to suffer from extreme hunger, exacerbated by conflict, drought, and inflation. Additionally, another war erupted in the Middle East in late 2023. Both wars continue in 2024.

Each driver of change is significant on its own, but it is the convergence of multiple factors and technological changes that creates true disruptions. This is a crucial point—the interplay of these changes leads to a complex and unpredictable world.

Image: *DALL-E's depiction of a green energy future city scene featuring flying taxis, humanoid robots and driverless cars.*

"Technology is a gift of God. After the gift of life it is perhaps the greatest of God's gifts. It is the mother of civilizations, of arts and of sciences."

—Freeman Dyson

2. Understanding Core Technologies

Understanding the core technologies driving the Fourth Industrial Revolution is crucial for several reasons. These technologies, including artificial intelligence, the Internet of Things (IoT), blockchain, and advanced robotics, are fundamentally transforming industries and reshaping the global economy. Grasping their principles and applications enables businesses and individuals to stay competitive and innovate effectively. It also allows for the anticipation of market shifts and the development of strategies to harness these technologies for growth and efficiency. Furthermore, a deep understanding of these technologies is essential for addressing ethical and societal impacts, ensuring that their integration into various sectors promotes sustainability, equity, and security. In essence, knowledge of these core technologies empowers us to navigate and thrive in the rapidly evolving landscape of the Fourth Industrial Revolution.

Core technologies covered by the course

Here we examine the different technologies covered in section 2 of the online course. Each of these technologies is a subject area in its own right. The course sets out to give a high level overview of each topic and how all these technologies come together and interact to create disruptive change. For example, driverless cars are a collection of different technologies coming together as you will learn in Lecture 18. As mentioned previously, into this technological mix we also have other drivers of change such as climate change, geo-political change, social change, changing demographics etc. Given the complexity, this is why predicting the future is impossible and we talk of possible futures that may emerge. This also highlights the danger of working in silos. We need to be able to look across all the drivers of change to understand the complexity of the skills landscape. Listed below are the topics covered in section two of the course which will give you a good understanding of the key technologies driving change in the 4th industrial revolution.

Topics covered in section 2:

1. Energy supplies and technologies
2. Computers - both conventional and quantum computers
3. Mobile computing
4. The internet and the world wide web
5. Internet of things & digital twin
6. Cloud computing
7. Big data
8. Artificial intelligence
9. Robotics
10. Self driving vehicles
11. Drones, flying cars and jet packs
12. Brain computer interfaces

13. Virtual and augmented reality & the metaverse
14. Additive manufacturing (3D printing)
15. Blockchain technology
16. Biotechnology and genetic engineering
17. Nanotechnology

Over a relatively short space of time (say for example a 5 year period) there are new innovations and developments in all these technologies. I first launched the future skills course in 2019. Think of how much change we have seen in the world since then. This is why many people can be caught off guard by the rapid pace of change. The spread of new technology is becoming increasingly rapid. For example, it took radio (launched in the 1920s) 50 years to reach 50 million users. In comparison the generative AI chatbot, ChatGPT, launched in November 2022, took only 2 months to reach 100 million users. ChatGPT's record was surpassed by Meta's Threads, which amassed 100 million users in less than a week after its launch in July 2023!

Observations underpinning technology change

Observations underpinning technology change refer to the key trends, principles, and phenomena that drive and shape the evolution of technology. These observations are critical in understanding how technology evolves and impacts various aspects of society, economy, and daily life. In the course we focus on Moore's law and Metcalfe's law but I have included additional laws/observations below.

Moore's Law
In 1965 Intel co-founder Gordon Moore conjectured that computer processing power would double every 18 months. This observation has proved remarkably accurate and with this dramatic increase in computing power has come innovations such as smartphones and autonomous vehicles. The problem with Moore's Law in 2022 is that the size of a transistor is now so small that there just isn't much more we can do to make them smaller. Some experts are predicting that Moore's law will come to an end in the next five years. While traditional Moore's Law scaling may be slowing down or reaching its practical limits, the spirit of innovation in the semiconductor industry continues. New technologies and approaches are being developed to push the boundaries of what is possible in computing. Thus, while Moore's Law in its original form may be nearing an end, the quest for increased computing power and efficiency is far from over.

Gilder's Law
American technologist George Gilder predicts that bandwidth will grow at three times the pace of computing power. Bandwidth is the volume of information that can be sent over a connection in a measured amount of time. Gilder's law implies that if computing power doubles every 18 months then bandwidth doubles every 6 months. This rapid expansion of bandwidth has profound implications for the capabilities and applications of digital networks. The dramatic increase in bandwidth supports the proliferation of data-intensive applications, such as streaming video,

online gaming, cloud computing, and the Internet of Things (IoT). Advances in fiber optic technology, wireless communication (e.g., 5G), and network infrastructure are key drivers of the bandwidth growth described by Gilder's Law.

Metcalfe's Law

Metcalfe's Law, named after Robert Metcalfe, the co-inventor of Ethernet, is a principle that describes the value of a telecommunications network. Metcalfe's law says that every time you add a new user to a network, the number of connections increases proportionally to the square of the number of users. The law says the value of a network is proportional to the square of the number of nodes in the network. In mathematical terms, if a network has n users, its value can be expressed as n^2. In plain language, the value of a product or service increases as more people use it. This law explains the value of companies such as Facebook (Meta).

Kryder's Law

The density of information storage (hard drive capacity) doubles approximately every 13 months. The implication of this law is that rapid improvements in data storage capacity and reductions in cost have made it feasible to store and process vast amounts of data, essential for big data analytics, AI, and other data-intensive applications of the 4th Industrial Revolution.

Bell's Law

Bell's law of computer classes formulated by Gordon Bell in 1972 and states that a new class of computing devices emerges roughly every decade, creating new industries and computing environments. Bell's Law underscores the rapid evolution and diversification of computing devices, from mainframes to PCs to smartphones and wearables, each wave bringing new opportunities and challenges.

Gartner Hype Cycle

New technologies follow a hype cycle, starting with inflated expectations, followed by a trough of disillusionment, and eventually reaching a plateau of productivity. Impact: Understanding the hype cycle helps businesses and investors navigate the adoption and investment in emerging technologies, avoiding pitfalls and recognizing sustainable opportunities.

Wright's Law

Wright's law is the observation that the cost of a given technology decreases as a function of cumulative production, reflecting learning curves and economies of scale. Impact: Wright's Law predicts cost reductions in manufacturing technologies, renewable energy, and other areas, facilitating wider adoption and integration of advanced technologies in Industry 4.0.

The Law of Accelerating Returns

Proposed by Ray Kurzweil, it suggests that technological change is exponential rather than linear. As each generation of technology improves and accelerates, it leads to faster development and greater technological advances. This principle suggests that advances in technology build on each other, leading to faster and more profound

innovations over time. Kurzweil's theory extends beyond Moore's Law, which specifically addresses the exponential growth of computing power, to encompass all forms of technological advancement.

Digital Convergence

This is the tendency for different technological systems to evolve towards performing similar tasks. The smartphone is a prime example of digital convergence, combining communication, computing, entertainment, and productivity tools into a single device. Platforms like Microsoft Teams, Zoom, and Slack combine messaging, video conferencing, file sharing, and collaboration tools into single solutions for workplace communication. As convergence continues to evolve, it will have profound and wide-reaching impacts on society, economy, and culture. Understanding and leveraging digital convergence is crucial for businesses, policymakers, and consumers to navigate the digital landscape effectively.

Disruptive Innovation

Disruptive innovation is a term coined by Harvard Business School professor Clayton Christensen to describe a process by which a product or service initially takes root in simple applications at the bottom of a market and then relentlessly moves upmarket, eventually displacing established competitors. This type of innovation disrupts existing markets by creating new ones or significantly altering the landscape of existing industries. For example digital cameras started with lower image quality compared to film cameras but offered convenience and lower costs. As digital technology improved, it disrupted the traditional photography industry. Online education platforms, such as Udemy, Coursera and Khan Academy, started by offering free or low-cost courses. Over time, they have improved their offerings and are increasingly recognized as legitimate alternatives to traditional higher education institutions.

Varian's Law

Varian's Law, named after Hal Varian, Chief Economist at Google and a prominent figure in the field of information economics, refers to the principle that "we tend to overestimate the short-term impacts of new technologies while underestimating their long-term effects." Varian's Law emphasizes the significant, often transformative, long-term impact of technological advancements, even if their immediate effects appear limited or disappointing. The Varian Rule holds that "A simple way to forecast the future is to look at what rich people have today; middle-income people will have something equivalent in 10 years, and poor people will have it in an additional decade."

Amara's law

This law states that "We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run". The implications are that in the early stages of development of a technology there can be a lot of hype but change is actually slow. However as a particular technology develops, it can take us by surprise as we underestimate the impact and overall importance - especially in the long term. Things change slowly at first and then rapidly later as exponential growth of the

technology takes off. This law was coined by Roy Amara, past president of The Institute for the Future. An example of Amara's Law in action was the internet. Short-Term: In the early days, the internet was hyped as a revolutionary technology that would immediately transform communication and business. Long-Term: While initial changes were significant, the profound impact of the internet on nearly every aspect of modern life, including commerce, education, social interaction, and entertainment, was underestimated.

Carlson Curve (Moore's Law for biology!)

The Carlson Curve, named after biotechnologist Rob Carlson, is a principle that describes the rapid advancement and decreasing costs in DNA sequencing technology. It is analogous to Moore's Law in the semiconductor industry, which predicts the exponential growth of computing power. The Carlson Curve specifically highlights the dramatic improvements in the speed and cost-efficiency of genomic sequencing and synthesis. Owing to advancements in technology, the expense of sequencing the human genome decreased from USD$1 billion in 2003 to less than USD$1,000 by 2022. This signifies a reduction of a million times in less than two decades, outpacing Moore's Law by a factor of a thousand! These trends have far-reaching implications across various fields, including biomedical research, personalized medicine, agriculture, and biotechnology. As genomic technologies continue to evolve, they promise to unlock new possibilities and challenges, shaping the future of science and medicine in profound ways. Understanding and leveraging the Carlson Curve can help stakeholders navigate the opportunities and ethical considerations associated with the genomic revolution.

Moravec's Paradox

Moravec's paradox is a phenomenon observed by robotics researcher Hans Moravec, in which tasks that are easy for humans to perform (eg, motor or social skills) are difficult for machines to replicate, whereas tasks that are difficult for humans (eg, performing mathematical calculations or large-scale data analysis) are relatively easy for machines to accomplish. The paradox underscores the complexity and subtleties involved in basic human functions that are often taken for granted. Understanding Moravec's Paradox helps in designing systems where humans and machines complement each other's strengths. Machines can handle data processing and computational tasks, while humans manage tasks requiring perception, dexterity, and social interaction.

Datafication

Datafication refers to the process of transforming various aspects of life, business, and society into data that can be quantified, measured, and analyzed. This concept has become increasingly significant with the rise of digital technologies, big data, and the Internet of Things (IoT). Through datafication, various activities, behaviors, and processes are converted into data points, which can then be used to gain insights, make decisions, and create value. Datafication is a transformative trend that reshapes how organizations and societies operate by converting various aspects of life into data. While it offers significant opportunities for enhanced decision-making,

personalization, and efficiency, it also presents challenges related to privacy, security, and ethical use. Navigating these challenges requires careful consideration of data management practices, regulatory compliance, and ethical standards to ensure that datafication benefits society while safeguarding individual rights.

The Principle of Ubiquitous Computing

The principle of ubiquitous computing, also known as pervasive computing, envisions a future where computing technology is seamlessly integrated into the everyday environment, making computers and sensors pervasive yet unobtrusive. This concept, introduced by Mark Weiser in the late 1980s, aims to embed technology into the background of daily life so that people interact with it naturally and effortlessly. One example of ubiquitous computing is 'Smart Homes'. Smart homes are equipped with interconnected devices like smart thermostats, lighting systems, security cameras, and appliances that can be controlled remotely and can learn and adapt to the residents' habits and preferences. Another example is 'Wearable Technology' - devices like smartwatches and fitness trackers that monitor health metrics, provide notifications, and interact with other devices to offer a comprehensive user experience.

Democratization of Technology

The process by which access to technology rapidly continues to become more accessible to more people. This democratization is driven by lower costs, user-friendly interfaces, and widespread Internet access. This process aims to make advanced technology accessible, affordable, and usable for the general public, enabling widespread innovation and empowerment. The democratization of technology holds the promise of empowering individuals and fostering inclusive innovation by making advanced tools and resources accessible to a broader audience. While significant progress has been made, ongoing efforts are needed to address challenges such as the digital divide, security, and ethical considerations. By continuing to promote accessibility, affordability, and education, society can harness the full potential of technology to drive positive change and improve the quality of life for people worldwide.

Sustainability in Tech Development

Sustainability in technology development refers to the creation and deployment of technologies that meet current needs without compromising the ability of future generations to meet their own needs. This involves considering environmental, social, and economic impacts throughout the lifecycle of technology, from design and production to use and disposal. There is an increasing focus on how technology can be developed and used in ways that are environmentally sustainable and energy-efficient. An example would be adopting circular economy principles where products are designed to be reused, refurbished, remanufactured, or recycled, thereby reducing waste and conserving resources.

Ethical and Social Implications

Recognizing that technology is not value-neutral and its development and deployment have ethical and social implications that need to be carefully considered. By addressing privacy, bias, transparency, and societal impacts, we can ensure that technology serves the common good and contributes positively to society. Engaging stakeholders, adhering to ethical standards, and promoting digital literacy are key steps in this process.

Moore's Law of Mad Science
Every eighteen months, the minimum IQ necessary to destroy the world drops by one point. — Eliezer Yudkowsky. Eliezer Yudkowsky is a prominent figure in the fields of artificial intelligence (AI) and rationality. Moore's law of mad science is a stark reminder of the rapid pace of technological advancement and the corresponding increase in potential risks. It emphasizes the need for vigilance, ethical considerations, and proactive measures to ensure that powerful technologies are developed and used safely and responsibly. By addressing these challenges, society can harness the benefits of technological progress while minimizing the risks of catastrophic misuse.

In summary, the 4th Industrial Revolution is driven by a confluence of technological advancements and principles that collectively accelerate innovation and transformation across industries. The observations listed above are essential for anyone involved in technology development, policy-making, or strategic planning in technology-centric organizations. Understanding these underlying trends and principles helps in navigating the complex landscape of technological change and its implications for the future.

Other technologies?

The course encompasses 17 areas of technology. However, are the 17 technology areas detailed in section 2 exhaustive? No, they are not. These represent the primary technology areas, but there are additional ones as well. Moreover, some topics covered can be further subdivided. For instance, the Australian government, in its list of Critical Technologies in the National Interest, includes Artificial Intelligence but divides it into three subcomponents:

- Machine learning, including neural networks and deep learning
- AI algorithms and hardware accelerators
- Natural language processing, including speech and text recognition, analysis and generation

The Australian Strategic Policy Institute (APSI's) Critical Technology tracker currently hosts 64 technologies. In the USA the National Science and Technology Council (NSTC) was established to identify critical and emerging technologies to inform national security-related activities. They have a list of 19 critical and emerging technology areas that are of particular importance to the national security of the United States (below).

Critical and Emerging Technologies List, NSTC, Feb 2022

The following critical and emerging technology areas are of particular importance to the national security of the United States:

- Advanced Computing
- Advanced Engineering Materials
- Advanced Gas Turbine Engine Technologies
- Advanced Manufacturing
- Advanced and Networked Sensing and Signature Management
- Advanced Nuclear Energy Technologies
- Artificial Intelligence
- Autonomous Systems and Robotics
- Biotechnologies
- Communication and Networking Technologies
- Directed Energy
- Financial Technologies
- Human-Machine Interfaces
- Hypersonics
- Networked Sensors and Sensing
- Quantum Information Technologies
- Renewable Energy Generation and Storage
- Semiconductors and Microelectronics
- Space Technologies and Systems

Many of the technologies covered in Future Skills 2030 overlap with those in the NSTC. However, the NSTC also includes additional technologies with clear military applications, such as Directed Energy (lasers) and Hypersonics (missiles). It's important to note that technologies often have dual uses, serving both civilian and military purposes, as seen with nuclear energy and nuclear missiles.

Artificial Intelligence and Machine Learning

Artificial Intelligence (AI) and Machine Learning (ML) represent some of the most groundbreaking advancements in modern technology, fundamentally altering how we interact with the world and solve complex problems. Artificial intelligence can be described as digital brains inside large computers. AI refers to the broader concept of machines being able to carry out tasks in a way that we would consider “smart”. It encompasses everything from robotic process automation to actual robotics. Machine Learning, a subset of AI, is based on the idea that we can build machines to process data and learn on their own, without constant supervision. In essence, ML is the practice of using algorithms to parse data, learn from it, and then make a determination or prediction about something in the world. Thus, unlike hand-coded software routines of the past, ML systems can analyze vast amounts of data and improve their functionality over time. These technologies have a wide range of applications, from personalized customer experiences on e-commerce sites, to

AI-driven diagnostics in healthcare, to optimizing logistics and efficiency in manufacturing.
One example is using AI to discover new materials that can supercharge technological breakthroughs. Discovering these materials typically involves months or even years of trial-and-error research. In late 2023, Google DeepMind introduced graphical networks for material exploration (GNoME), predicting structures for 2.2 million new materials, with over 700 created in labs and currently undergoing testing (Merchant et al, 2023). Alongside GNoME, Lawrence Berkeley National Laboratory unveiled a new autonomous lab that uses data from the materials database, including GNoME's discoveries, to engineer new materials with machine learning and robotic arms, eliminating the need for human intervention.
One of the most promising areas of AI is automated drug discovery. In 2020 an Al system sifted through 100 million molecules to create the first machine-learning-derived antibiotic-called halicin (yes, after HAL from 2001: A Space Odyssey) -which can potentially help fight tuberculosis (Stokes et al, 2020). There are ongoing developments in the use of AI in healthcare.
In 2024, an AI tool named Mia, tested by the NHS in the UK, successfully identified early signs of breast cancer in 11 women that had been missed by human doctors. This AI tool was piloted alongside NHS clinicians and analyzed the mammograms of over 10,000 women. The AI system, developed by Kheiron Medical Technologies, was trained on a large dataset of mammograms and demonstrated a high accuracy rate in detecting cancerous signs that were extremely small and difficult to spot with the human eye. This trial is part of ongoing efforts to enhance cancer detection and improve patient outcomes through advanced technology.
As these technologies continue to evolve, they hold the potential not only to automate tasks but also to develop new ways of approaching problems and creating innovations in various fields.
However as pointed out by Vidal-Alaball et al. (2023), while AI can handle vast data and offer precise forecasts, it cannot substitute the skills and expertise of professionals in clinical decision-making. AI still depends on the interpretative and clinical judgment of a trained healthcare professional and lacks the ability to offer the empathy and emotional support frequently needed in healthcare settings.

Generative AI

Traditional AI and generative AI (genAI) differ significantly in their functions and capabilities. Traditional AI relies on algorithms to analyze data, identify patterns, and make predictions. It applies these patterns to perform specific tasks, making it ideal for repetitive tasks and numerical processing. For example, recruitment teams can use AI algorithms to screen resumes, identify gaps in candidates' skills and experiences, and match candidates with specific job requirements. Additionally, they can scan social media to gather more information about candidates, particularly their behavior outside of work. This approach significantly reduces selection time, allowing HR professionals to focus on the most qualified individuals.

On the other hand, genAI is a form of AI that creates original content, such as images, text, video, and music, by drawing from a vast foundation of data. This capability surpasses the limitations of task-specific AI systems and can drive innovation across various roles and industries. GenAI is not limited to routine operations; it has the potential to inspire creative and novel solutions. However, to fully unlock the value of genAI, organizations need to understand the roles and tasks it can enhance and recognize the potential productivity gains at stake.

In 2023 we saw an explosive growth of generative AI tools. For example ChatGPT was launched by its parent company, OpenAI, on November 30th, 2022. Less than a year after many of these tools debuted, one-third of respondents surveyed by McKinsey in April 2023 said their organizations were using generative AI regularly in at least one business function. According to PwC's 27th Annual Global CEO Survey, 2024, within the next three years, nearly seven in ten respondents anticipate that generative AI will increase competition, drive changes to their business models and require new skills from their workforce. The generative AI market market is expected to be worth $207 billion by 2030.

It's important to recognize that AI differs significantly from human intelligence and the human brain. While humans create machines to perform tasks observed in the world by animals and people, we generally don't design these machines in the same way nature designed us. This distinction is eloquently captured by AI pioneer Frederick Jelinek (below). AI represents a different form of intelligence compared to human intelligence, yet it can achieve similar outcomes.

"Airplanes don't flap their wings."

- Frederick Jelinek
(1932-2010)

Image 3: *The workplace in 2050 as imagined by DALL-E, a generative AI model developed by OpenAI*

"Any sufficiently advanced technology is indistinguishable from magic."

—Arthur C. Clarke

Internet of Things (IoT) and Smart Technologies

The Internet of Things (IoT) and Smart Technologies are revolutionizing how we interact with the world around us, signifying a major shift in the realm of digital connectivity. IoT refers to the network of physical objects — 'things' — that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet. This integration enables everyday objects, from household appliances to industrial machines, to send and receive data, turning them into 'smart' devices. Smart technologies, as a part of this ecosystem, leverage this interconnectedness to enhance efficiency, convenience, and decision-making processes. For instance, a smart thermostat in a home can learn the owner's preferences and adjust the temperature automatically, while on a larger scale, smart technologies in cities can optimize energy use and traffic flow, contributing to sustainable urban living. The potential of IoT and Smart Technologies extends across various sectors, including healthcare, agriculture, manufacturing, and transportation, promising enhancements in monitoring, automation, and optimization. However, this rapidly growing network also presents challenges in terms of data security, privacy, and the need for robust infrastructures to support extensive connectivity. As IoT continues to expand, it is set to play a pivotal role in shaping the future landscape of technology and society.

Digital twin

Digital twins are detailed, data-driven digital representations of products in the field. As more products come equipped with sensors, manufacturers gain the ability to collect data in the digital twin, enabling real-time analysis of product performance and conditions. By aggregating data from the digital twins of all their products in the field, manufacturers can gain performance insights at a scale not unlike that of iPhones and other consumer electronics.
Tesla creates a digital twin of every vehicle it sells. Sensors from thousands of cars continuously stream data into each car’s simulation in the factory, where Artificial Intelligence (AI) interprets the data and determines whether a car is working as intended or if it needs maintenance. For many maintenance issues, Tesla’s software integrations are so thorough that problems can be fixed with software updates—for instance, adjusting the hydraulics to compensate for a rattling door. By merging AI and IoT, Tesla is able to constantly learn from the real world and optimize each of its cars individually, in real time.

Robotics and Automation

Robotics and Automation represent a transformative force in modern industry and daily life, marking a significant shift in how tasks are performed and managed. Robotics involves the design, construction, and operation of robots — machines capable of carrying out a series of actions automatically. These robots, ranging from

industrial arms in manufacturing plants to autonomous vehicles and drones, are increasingly being integrated into various sectors for tasks that require precision, endurance, and efficiency.
Automation, closely linked with robotics, refers to the use of technology to perform tasks without human intervention. It encompasses not just physical robots but also software programs and AI systems that automate digital tasks, like data entry or customer service interactions. The synergy of robotics and automation is driving innovations in fields such as manufacturing, where they increase productivity and safety; healthcare, with robotic surgeries and automated diagnostics; and even in everyday life, through robotic vacuum cleaners and smart home systems. This technological revolution brings significant benefits, including increased efficiency, lower costs, and the ability to perform tasks in environments hazardous for humans. However, it also poses challenges, such as workforce displacement and the need for new skills training. As robotics and automation continue to evolve, they will undeniably shape the future of work, production, and lifestyle, bringing both opportunities and challenges that need to be thoughtfully addressed.

Blockchain and Cybersecurity

Blockchain and cybersecurity are increasingly intertwined in the digital age, offering robust solutions to enhance data security and trust in online transactions. Blockchain technology, originally devised for the digital currency Bitcoin, is a decentralized ledger of all transactions across a network. It offers a high level of security by design, using distributed ledgers and cryptographic hashing to ensure that each transaction is securely recorded and immutable. This feature makes it particularly appealing for applications that require transparent and tamper-proof record-keeping, such as in finance, supply chain management, and identity verification. On the other hand, cybersecurity, which involves protecting systems, networks, and programs from digital attacks, is crucial in safeguarding sensitive data and maintaining privacy in an increasingly connected world. The integration of blockchain in cybersecurity solutions offers a new paradigm, where the decentralized and transparent nature of blockchain can help prevent fraud, unauthorized data access, and reduce single points of failure. However, while blockchain brings potential advantages in terms of security and trust, it is not a panacea. The technology must be implemented wisely, considering the specific requirements and vulnerabilities of each system. As cyber threats continue to evolve in complexity, the role of technologies like blockchain in cybersecurity strategies becomes more significant, offering innovative approaches to securing digital assets and building trust in the digital era.

Biotechnology and genetic engineering

Biotechnology and genetic engineering are at the forefront of scientific advancement, offering groundbreaking possibilities in healthcare, agriculture, and environmental conservation. Biotechnology encompasses the use of living organisms or their products to modify human health and the human environment. It is a diverse

field with applications ranging from medical therapies to the manufacture of biofuels. Genetic engineering, a subset of biotechnology, involves directly manipulating an organism's genes using biotechnology. It has enabled significant achievements, including the development of genetically modified crops that resist pests and diseases, enhanced production of therapeutic proteins, and gene therapy techniques for treating diseases. In medicine, genetic engineering has been pivotal in the advent of personalized medicine, where treatments are tailored to an individual's genetic makeup, enhancing the efficacy and reducing the side effects of treatments. Moreover, biotechnology and genetic engineering are crucial in addressing some of the most pressing environmental challenges, such as bio-remediation and the development of sustainable biofuels. However, these fields also raise ethical, social, and environmental concerns, particularly around the safety and morality of altering natural life forms. As these technologies continue to evolve, it is essential to balance their immense potential for innovation with careful consideration of the ethical and ecological implications they carry.

Dual Use of New Technology: For Good and Bad

New technologies often come with dual-use capabilities, meaning they can be harnessed for both beneficial and harmful purposes. On the positive side, advancements in fields such as artificial intelligence, biotechnology, and cybersecurity can lead to significant improvements in healthcare, education, and public safety. For instance, AI can enhance diagnostic accuracy in medicine, automate mundane tasks to increase productivity, and even predict and mitigate natural disasters. However, these same technologies can also be exploited for malicious activities. Cybercriminals can use sophisticated algorithms to launch more effective cyberattacks, manipulate social media to spread misinformation, or infringe on personal privacy through surveillance. The dual-use nature of technology underscores the importance of ethical considerations, robust regulatory frameworks, and vigilant oversight to maximize benefits while minimizing potential harms. Balancing innovation with responsibility is crucial to ensure that new technologies contribute positively to society while mitigating risks and preventing misuse.

3. Skills for Industry 4.0 and how to acquire them

"I think, at a child's birth, if a mother could ask a fairy godmother to endow it with the most useful gift, that gift would be curiosity."

— Eleanor Roosevelt

Section three of the course focuses on the essential skills for Industry 4.0 and the future of work, covering both hard and soft skills. Josten et al. (2019) predict that 47% of jobs will be automatable within the next decade, with 35% of all jobs being fully automatable. Their research also indicates that 'thinking' and 'people' skills will become increasingly vital for the fourth industrial revolution. Additionally, section three incorporates insights from other key publications and research on future skills, including the World Economic Forum's Future of Jobs Report 2023.

A digital mindset

Developing strong digital skills is essential for navigating daily life, including tasks like shopping, banking, and accessing government services. Without these skills, individuals risk falling behind in an increasingly digital world. Embracing a learning mindset is critical for acquiring and enhancing digital skills.

In the United Kingdom, over eighty percent of job advertisements now require digital skills, according to the UK Government. Research by Lloyds Bank Group and IPSOS MORI highlights an acute shortage of these skills, with around 11.7 million people aged 15 and older lacking essential digital skills for everyday online activities. This underscores again the need for lifelong learning and confidence-building to ensure everyone can participate in the digital economy.

Costa et al. (2024) highlight that as older digital skills become obsolete, new ones, particularly in Information Technology (IT), emerge. For example, while basic computer literacy was commonly required in 2016, by 2022, there was a higher demand for advanced IT skills such as cybersecurity, AI, and cloud solutions.

Skills in the age of AI

The transformative effects of the latest AI technologies are profound. Advanced language models now facilitate meaningful, fluid conversations on any subject, providing professionals with virtual expert insights into marketing strategies, product design, legal issues, communication techniques, logistics, medical diagnostics, and more. This technology offers deep exploration and precise answers, drawing from the forefront of current knowledge, customized for unique requirements and situations. The emergence of such technology is a monumental leap in cognitive capabilities, akin to the advent of the internet. According to McKinsey, in the US, genAI combined with robotic process automation (RPA) could replace almost 30 percent of hours worked by employees by 2030. An International Monetary Fund (IMF) discussion paper highlights that nearly 40 percent of global employment is exposed to AI, with advanced economies more at risk but better positioned to benefit from AI compared to emerging markets and developing economies. Forrester supports this view, noting that genAI's influence on jobs increases with education levels, impacting only 2.7 percent of jobs requiring a high-school diploma but up to 21 percent of those needing a degree. Costa et al., (2024) found that Future workers are expected to use

AI to handle technical tasks, allowing them to engage more in collaborative work, thereby increasing the value of interpersonal skills.

Importance of a disruptive mindset

A disruptive mindset is a way of thinking that challenges conventional wisdom and embraces innovation, creativity, and change. It involves a willingness to question existing norms, explore new possibilities, and take risks to achieve breakthrough results. Here are key characteristics of a disruptive mindset:

Questioning the Status Quo: Individuals with a disruptive mindset constantly question current practices, systems, and assumptions, looking for ways to improve or completely transform them.

Embracing Change: They are open to change and view it as an opportunity rather than a threat. This openness allows them to adapt quickly to new circumstances and stay ahead of the curve.

Innovation and Creativity: A disruptive mindset thrives on creativity and seeks out innovative solutions to problems. It encourages thinking outside the box and finding unique ways to address challenges.

Risk-Taking: People with a disruptive mindset are not afraid to take calculated risks. They understand that failure is often a part of the innovation process and use it as a learning opportunity.

Visionary Thinking: They have a forward-thinking approach, envisioning future possibilities and working towards making them a reality. This includes anticipating trends and staying ahead of industry changes.

Resilience and Perseverance: A disruptive mindset involves resilience in the face of setbacks and perseverance in pursuing goals, even when the path is difficult or uncertain.

Customer-Centric: They focus on creating value for customers by addressing unmet needs and delivering superior experiences, often leading to market disruption and new business models.

Collaborative and Inclusive: A disruptive mindset values diverse perspectives and encourages collaboration, believing that the best ideas often come from a variety of sources.

In essence, a disruptive mindset is about thinking differently, challenging the norm, and being proactive in driving change and innovation. It's a mindset that seeks to transform industries, create new markets, and improve the world through bold and unconventional ideas.

Hard Skills

Hard skills are specific, teachable abilities that can be defined and measured, such as proficiency in a foreign language, computer programming, machine operation, or accounting. These skills are often acquired through formal education, training programs, or specific work experience, and are typically essential for performing particular tasks or duties in a job role. The hard skills needed to perform job-specific tasks change in response to changing technology. In the era of Industry 4.0, hard skills are increasingly vital. Industry 4.0, characterized by advanced automation, data exchange, and digital technologies, demands a workforce proficient in specific technical competencies.

Soft Skills

Soft skills are non-technical abilities such as communication, teamwork, problem-solving, and emotional intelligence that are essential for effective interpersonal interactions and professional success. While hard skills are crucial in Industry 4.0 for handling advanced technologies and data-driven processes, soft skills are equally important for ensuring a productive and innovative work environment. The integration of automation, artificial intelligence (AI), and the Internet of Things (IoT) transforms how people work, emphasizing the need for strong interpersonal and cognitive abilities.

According to LinkedIn's Global Talent Trends 2019 (Bulletin 5), 92% of employers stated that so-called 'soft skills' are equally or more important than hard skills, with creativity being of particular value. In a world where hybrid remote working will be more common, self-awareness and self-management are also becoming increasingly important. Here are some of the key soft skills needed for industry 4.0:

1. Adaptability and Flexibility: Industry 4.0 is characterized by rapid technological changes and evolving work processes. Employees need to be adaptable and flexible, able to quickly learn new tools and adjust to new methods. This adaptability ensures that they can effectively integrate new technologies into their workflow and contribute to continuous improvement.

2. Collaboration and Teamwork: The interconnected nature of Industry 4.0 requires collaboration across various departments and disciplines. Soft skills like teamwork, effective communication, and the ability to work well in diverse teams are essential. Collaborative efforts foster innovation and ensure that projects are completed efficiently and effectively.

3. Problem-Solving and Critical Thinking: With the complexity of modern industrial systems, employees must possess strong problem-solving and critical thinking skills. These abilities help them analyze complex situations, identify underlying issues, and

develop effective solutions, thereby maintaining smooth operations and improving processes.

4. Communication Skills: Clear and effective communication is vital in an environment where humans and machines interact closely. Employees must be able to convey technical information to non-technical stakeholders, document processes accurately, and facilitate knowledge sharing within the organization.

5. Leadership and Emotional Intelligence: As teams become more dynamic and diverse, leadership skills and emotional intelligence gain importance. Leaders need to inspire and motivate their teams, manage conflicts, and create an inclusive work environment. Emotional intelligence helps in understanding and managing one's emotions and those of others, leading to better team dynamics and productivity.

6. Self-awareness and self-management: These skills are part of emotional intelligence, which is a critical component of effective interpersonal interactions and professional success. Self-awareness involves recognizing and understanding your own emotions, strengths, weaknesses, and values. Self-management involves regulating your emotions, behaviors, and impulses to achieve personal and professional goals.

7. Creativity and Innovation: The push for innovation in Industry 4.0 requires creative thinking. Employers particularly value creativity as it drives technological advancements and provides a competitive edge. Employees who can think outside the box and come up with novel solutions to complex problems are indispensable.

8. Lifelong Learning: The continuous evolution of technology means that employees must engage in lifelong learning. A mindset geared towards continuous improvement and the willingness to acquire new skills are fundamental for staying relevant and competitive in the workforce.

In conclusion, while hard skills are necessary for operating the technologies of Industry 4.0, soft skills ensure that these technologies are used effectively and harmoniously within organizations. A balanced combination of both skill sets is essential for thriving in the era of Industry 4.0.

Transferable Skills

Transferable skills also known as portable skills, are abilities applicable across various job roles and industries, including both soft skills like communication and problem-solving, and hard skills such as technical proficiency. Transferable skills are essential in the dynamic landscape of Industry 4.0. These skills, which are not tied to a specific job or industry, allow individuals to adapt to various roles and responsibilities, making them highly valuable in an era characterized by rapid technological advancements and shifting job requirements. Dawson et al.,(2023) researching in the UK, found that transferable skills are important for young people's

employability. 57% of employers said they value transferable skills over technical skills, compared to just 10% who say they value technical skills more. As mentioned already, transferable skills can encompass both hard and soft skills, depending on the specific skill in question. Here's a breakdown:

Soft Transferable Skills:
Most soft skills are inherently transferable because they involve personal attributes and interpersonal interactions that are broadly applicable.

- Communication: The ability to convey information clearly and effectively.
- Teamwork: Collaborating well with others to achieve common goals.
- Problem-Solving: Analyzing situations and finding solutions.
- Adaptability: Adjusting to new conditions and challenges smoothly.
- Leadership: Guiding and motivating a team.
- Emotional Intelligence: Understanding and managing one's own emotions and those of others.
- Self-Awareness and Self-Management: Effectively managing one's time and emotions to complete tasks efficiently.
- Critical Thinking: Evaluating information and arguments to make reasoned judgments.

Hard Transferable Skills:

- Digital Literacy: Proficiency with digital tools and technologies.
- Project Management: Planning, executing, and overseeing projects.
- Data Analysis: Interpreting and utilizing data to inform decisions.
- Foreign Languages: The ability to communicate in multiple languages.
- Technical Writing: Creating clear and precise documentation.
- Statistical Analysis: Applying statistical techniques to interpret data.
- Coding/Programming: Writing and understanding code for various applications.
- Design Software: Using tools like Photoshop or CAD software proficiently.

Note that there are also hard skills that are not easily transferable due to their highly specialized nature. These skills are typically specific to certain industries, tools, technologies, or methodologies and may not be applicable or useful outside their particular context. For example skills related to the maintenance and repair of specific aircraft models are highly specialized and not easily transferable to other fields.

Strategies for Learning New Technologies

In "Future Skills 2030: Prepare for the 4th Industrial Revolution," a key focus is on strategies for effectively learning and adapting to new technologies. As technology evolves at an unprecedented pace, the ability to learn and adapt becomes crucial for success in both personal and professional spheres. It's a challenge to keep up with

the pace of change. We need to develop new skills for emerging opportunities in areas such as AI, cyber-security, cloud management, quantum computing etc. The Open University's 2022 Business Barometer estimated that 78% of UK organisations suffered a decline in output, profitability or growth due to a lack of available skills.

Fortunately, it has never been easier to learn new skills than it is today. There is so much information available online at a relatively low cost and at a time you need it. You can learn at your own pace. Research in neuroscience shows that brain aging may be reversible: the brain is plastic in all stages of life, and its maps can restructure themselves through learning experiences. So the good news is that we can learn at any age and lifelong learning is supported by neuroscience.

Many companies are prioritising the training of their staff. According to LinkedIn Learning (2024), 90% of organizations are concerned about employee retention and providing learning opportunities is their number one retention strategy. According to KPMG (2024), learning in the flow of work is an enabler of operational effectiveness. Learning in the flow of work drives agile, adaptable and knowledge driven operating models.
It is essential to take responsibility for your own learning rather than relying on others, such as your employer, to organize it for you. To reskill and upskill, especially considering various circumstances, we may need to shift our focus from formal courses. Most of us cannot afford to stop everything and return to college, making continuous and ubiquitous learning crucial. Technology facilitates self-learning with a practical employment focus, enabling rapid reskilling for everyone.

The COVID-19 pandemic demonstrated how online education could sustain learning during lockdowns. Platforms like Udemy and Coursera, along with YouTube tutorials, provide valuable resources for teaching ourselves new skills through trial and error. Additionally, generative AI tools like ChatGPT can significantly enhance your ability to learn new skills efficiently and effectively. We will look at AI powered learning in more depth in Chapter 4.

Learning new technologies can be challenging yet rewarding. Here are some effective strategies to help you master new tools, platforms, or systems:

1. Set Clear Goals:

- Define what you want to achieve with the new technology.
- Break down the learning process into manageable milestones.

2. Utilize Online Resources:

- Take advantage of online tutorials, webinars, and courses (e.g., Coursera, Udemy, Khan Academy).
- Follow industry blogs, YouTube channels, and forums related to the technology.

3. Hands-On Practice:

- Engage in practical, hands-on projects to apply what you've learned.
- Experiment with different features and functionalities to gain a deeper understanding.

4. Join Communities and Networks:

- Participate in online communities, forums, and social media groups related to the technology.
- Attend meetups, conferences, and workshops to network with other learners and professionals.

5. Learn from Experts:

- Seek mentorship from experienced professionals in the field.
- Follow thought leaders and experts on social media and learn from their insights.

6. Structured Learning Paths:

- Follow structured learning paths or curricula offered by educational platforms.
- Enroll in certification programs to gain formal recognition of your skills.

7. Stay Updated:

- Keep abreast of the latest trends and updates in the technology.
- Subscribe to newsletters, podcasts, and industry publications.

8. Build a Portfolio:

- Create projects or contribute to open-source initiatives to showcase your skills.
- Document your learning journey and the projects you've worked on.

9. Collaborate with Peers:

- Work on group projects or collaborative learning sessions with peers.
- Share knowledge and feedback to enhance your learning experience.

10. Allocate Regular Time:

- Dedicate consistent time slots for learning and practicing the new technology.
- Balance your learning schedule with other commitments to ensure steady progress.

11. Apply Learning to Real-World Problems:

- Identify real-world problems that can be solved using the new technology.
- Implement solutions and analyze the outcomes to reinforce your learning.

12. Reflect and Iterate:

- Regularly reflect on what you've learned and identify areas for improvement.
- Iterate on your learning approach based on feedback and self-assessment.

By following these strategies, you can effectively learn and master new technologies, staying competitive and adaptable in the ever-evolving tech landscape.

"Reskilling, upskilling and continuous learning will be crucial to firms' ability to compete and grow. The need toreskill — at scale — is massive"

- Mark Williamson (KPMG)

Skillset and Mindset

Both skill set and mindset are important! A skillset refers to the collection of abilities, knowledge, and competencies that an individual possesses, which enables them to perform specific tasks and roles effectively.
What do we mean by mindset? Mindset is defined as the established set of attitudes held by someone. The relationship between skillset and mindset is integral and mutually reinforcing. While a skillset comprises the specific abilities and knowledge an individual possesses, a mindset represents the attitudes and beliefs that influence how those skills are acquired and applied.

We need a growth mindset or a mindset of intellectual curiosity to build our skillset. As technology and other forces continue to disrupt the workplace, we must build a habit of lifelong learning if we want to succeed in our chosen careers. We also need a playful mindset in order to experiment with life and try things out. This is the idea that I was trying to capture when I named my website *'Life is a Laboratory'*! It's not just about needing to adopt curiosity and lifelong learning but about wanting to be curious and drive lifelong learning and have that positive mindset of growth and learning. When we are fearful of the future this will limit our thinking processes and our ability to think outside the box.

Strategies for Building a Growth Mindset

Cultivating a growth mindset involves shifting your perspective and adopting new habits that encourage continuous learning and improvement. Here are some effective strategies to help build a growth mindset:

1. Embrace Challenges:

- **Step Out of Your Comfort Zone:** Take on tasks and projects that push your limits.
- **View Challenges as Opportunities:** See difficulties as opportunities to learn and grow rather than obstacles.

2. Learn from Criticism:

- **Seek Constructive Feedback:** Actively ask for feedback from peers, mentors, and supervisors.
- **Use Feedback Positively:** Instead of feeling defensive, use feedback to identify areas for improvement and development.

3. Celebrate Effort Over Results:

- **Value the Process:** Focus on the effort and strategies used rather than just the outcome.
- **Recognize Persistence:** Celebrate persistence and hard work, even if the desired results are not immediately achieved.

4. Cultivate Curiosity and Lifelong Learning:

- **Be Inquisitive:** Ask questions and seek to understand how things work.
- **Pursue New Knowledge:** Regularly engage in activities that expand your knowledge and skills, such as reading, taking courses, or attending workshops.

5. Reframe Failures as Learning Experiences:

- **Learn from Mistakes:** Analyze what went wrong and how you can improve in the future.
- **Develop Resilience:** Understand that failure is a natural part of the learning process and use it to build resilience.

6. Set Learning Goals:

- **Specific and Measurable Goals:** Set clear, achievable learning goals that focus on skill development and knowledge acquisition.
- **Track Progress:** Monitor your progress towards these goals and adjust your strategies as needed.

7. Surround Yourself with Growth-Minded People:

- **Seek Supportive Environments:** Engage with communities, teams, and organizations that value growth and continuous improvement.
- **Learn from Others:** Observe and learn from the attitudes and behaviors of people who exemplify a growth mindset.

8. Practice Self-Reflection:

- **Regular Reflection:** Take time to reflect on your experiences, what you've learned, and how you can apply this knowledge going forward.
- **Journaling:** Keep a journal to document your progress, challenges, and insights.

9. Adopt a Positive Language:

- **Use Growth-Oriented Language:** Replace negative self-talk with positive affirmations. For example, instead of saying "I can't do this," say "I can't do this yet."
- **Encourage Yourself:** Use encouraging and supportive language when talking about your abilities and potential.

10. Focus on Effort and Strategy:

- **Effort-Based Praise:** Praise yourself and others for the effort and strategies used, not just for inherent talent or intelligence.
- **Continuous Improvement:** Always look for ways to improve your approach and methods.

11. Practice Patience and Perseverance:

- **Understand Growth Takes Time:** Acknowledge that developing a growth mindset and acquiring new skills takes time and consistent effort.
- **Stay Persistent:** Maintain perseverance through setbacks and keep a long-term perspective on your goals.

By consistently applying these strategies, you can develop a growth mindset that fosters continuous learning, resilience, and a positive approach to challenges and opportunities.

"Every child is an artist. The problem is how to remain an artist once we grow up."

- Pablo Picasso

4. Career Navigation in a Changing World

"Most economic fallacies derive from the tendency to assume that there is a fixed pie, that one party can gain only at the expense of another."

—Milton Friedman

In the rapidly evolving landscape of the 4th Industrial Revolution, identifying future-proof careers is more crucial than ever. The art and science of pinpointing professions that are likely to withstand the test of time and technological upheaval is crucial. It underscores the significance of careers centered around uniquely human skills—such as creativity, problem-solving, and emotional intelligence—and those in burgeoning fields like artificial intelligence, renewable energy, and biotechnology. The chapter goes beyond just listing potential job titles; it offers a nuanced understanding of how macroeconomic trends, technological advancements, and global challenges are shaping the job market. It encourages readers to look for roles that not only align with future market demands but also resonate with their personal skills and passions. This guidance is not about chasing the next big thing; it's about understanding the underlying currents of change and positioning oneself to ride the wave of technological and societal transformation.

New Skills Emerging in 2024

According to Costa et al. (2024), the rate of change in skill requirements varies significantly across occupations. Roles such as IT directors and cybersecurity professionals experience rapid changes, while positions like teachers and carpenters see much less evolution. The most significant changes involve shifts in core skills, including data analysis, leadership, social media, UI design, strategy execution, and technical support.

As job roles evolve, many workers need to train and retrain to keep their careers progressing. In 2022, a large share of job vacancies across various occupations required competencies in IT and advanced data analytics. Despite the emphasis on technology skills, the most sought-after skills remain clear communication, high-quality client services, efficient office management, and effective customer relations, reflecting the structure of British business and the enduring importance of personal interaction skills.

Costa et al. (2024) also observed a rapid emergence of new skills while many others are disappearing. Notable new skills include design thinking, virtual learning environments, sustainable development promotion, and the use of artificial intelligence. The technology sector is witnessing the most significant changes, with skills categorized into Analysis and Information Technology. Rapid changes are seen in roles like computer system installers, electrical trades professionals, aerospace engineers, and cybersecurity experts. In contrast, teaching professionals, textile workers, basic construction workers, and machine operators have experienced slower changes.

KPMG's report 'Future of Work: Shaping the Workforce of the Future with AI' (2024) underscores the rising importance of skills such as digital literacy, effective use of AI tools, quality assurance for AI outputs, and a continuous learning mindset. Costa et al.'s study, focusing on the UK job market from 2016 to 2022, revealed a significant shift in skill demands, with 20% of job listings in 2022 requiring at least one new skill, up from 5.6% in 2016. Meanwhile, the prevalence of 'old skills' dropped from over 22% in 2016 to less than 10% in 2022. These shifts are particularly notable in the Information Technology and Health Care sectors.

According to Costa et al., British employers highly value effective communication skills with colleagues, clients, and the broader social and market context. This underscores the enduring importance of traditional skills like proficient English and effective writing and speaking abilities.

Green skills

Industry 4.0, characterized by the integration of digital technologies, automation, and data exchange, is transforming manufacturing and production processes. In this context, green skills have become increasingly important to ensure sustainable development and to address environmental challenges. Climate change is one of the biggest challenges of our time, and reaching net zero requires a green workforce. However, there is a significant lack of awareness about green jobs despite widespread concern for climate change. A survey by the Learning and Work Institute in the UK found that 63% of respondents had never heard of green skills. Here is a list of the key green skills required for industry 4.0:

1. Energy Management
2. Sustainable Design and Manufacturing
3. Waste Management and Circular Economy
4. Environmental Compliance and Standards
5. Pollution Control and Mitigation
6. Digital and Data-Driven Sustainability
7. Sustainable Supply Chain Management
8. Renewable Energy Technology
9. Environmental Impact Assessment
10. Sustainable Agriculture and Biotechnology
11. Green Building and Infrastructure

12. Education and Training in Sustainability

Green skills are indispensable in 2024, driving both environmental sustainability and economic growth. As industries evolve and new regulations emerge, the demand for these skills will continue to rise, highlighting the need for comprehensive education and training programs focused on sustainability.

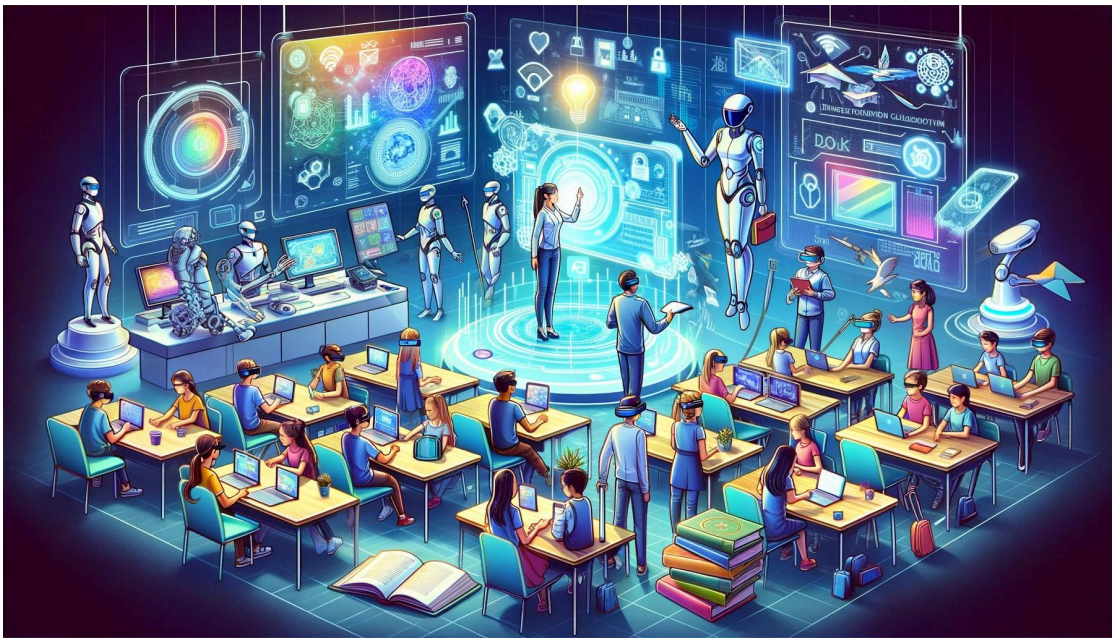
Covid-19 and the future of work

I have already mentioned COVID-19 as a driver of change, but we specifically examine its impact on the future of work in section three of the online course. The COVID-19 pandemic has brought massive global disruption, affecting not just how people and organizations work, but also how they learn and develop necessary skills. COVID-19 has accelerated the digitization of tasks previously performed in-person and forced many to adapt to remote work quickly, often with no other option. The long-term effects of COVID-19 on technology and work mean we will never fully return to pre-pandemic business practices, shifting to a '*work is what I do, not where I am*' paradigm. A 2021 Accenture study found that most workers favor a hybrid work model, though some, like those in healthcare and retail, must remain onsite. With appropriate resources, workers can maintain health and productivity regardless of their location. These profound shifts have proven productive for many but painful for others, potentially exacerbating existing inequalities. The pandemic has also sped up structural changes in the economy, emphasizing the urgent need for reskilling.

The great resignation

The term "Great Resignation," coined in May 2021, described the record number of people leaving their jobs since the beginning of the COVID-19 pandemic in 2020. After an extended period of working from home without a commute, many individuals prioritized their work-life balance, leading them to become freelancers, join the gig economy, or start their own businesses. This shift has forced companies to work harder to retain good staff by giving employees a greater sense of agency and allowing for flexible remote working arrangements. Concurrently, the "Great Reconsideration" has encouraged many employees to re-evaluate their priorities, goals, and ways of living and working. People are reconsidering their relationship with work, family, community, and the environment, questioning traditional notions of success, and seeking more meaning, purpose, and fulfillment in their lives and jobs. As of early 2024, indications suggest that the Great Resignation is tapering off, but the effects of this period of reflection and change continue to influence the workforce.

Education 4.0



Education 4.0 as imagined by Artificial Intelligence. A depiction of a futuristic classroom with diverse students using advanced technology (ChatGPT).

Education 4.0 refers to the transformation of education systems to align with the needs and opportunities of the Fourth Industrial Revolution. This era is characterized by the integration of digital technologies, artificial intelligence, robotics, the Internet of Things (IoT), and other advanced technologies into various aspects of life and work. Education 4.0 leverages these digital tools to create blended learning environments and align educational goals with the current and future demands for digital skills and competencies. This approach facilitates learning in smaller, more frequent segments, allowing individuals to learn at their own pace and convenience, a significant advantage of online learning. However, adult learners face unique challenges compared to younger students, as their lives are often filled with other responsibilities. Thus, adult learning requires courage and substantial intellectual and emotional effort. Education 4.0 aims to prepare students of all ages for the modern digital economy by incorporating innovative teaching methods, personalized learning experiences, and the development of relevant skills.

Key Characteristics of Education 4.0

1. Personalized Learning:
    - Tailoring education to meet the individual needs, strengths, and interests of each student.
    - Using data analytics and adaptive learning technologies to provide customized learning paths.
2. Interdisciplinary Curriculum:
    - Integrating subjects and promoting a holistic understanding of complex problems.

- Encouraging project-based and problem-based learning that mirrors real-world challenges.

3. Technology Integration:
    - Utilizing digital tools, online platforms, and immersive technologies like virtual reality (VR) and augmented reality (AR) to enhance learning experiences.
    - Emphasizing digital literacy and the ability to navigate and leverage digital resources.
4. Lifelong Learning:
    - Promoting continuous learning and upskilling throughout one's career to keep pace with technological advancements.
    - Offering flexible learning opportunities, such as online courses and micro-credentials.
5. Skill Development:
    - Focusing on developing 21st-century skills, such as critical thinking, creativity, collaboration, communication, and emotional intelligence.
    - Encouraging entrepreneurial thinking and the ability to innovate.
6. Teacher Role Evolution:
    - Shifting the role of teachers from knowledge transmitters to facilitators, mentors, and coaches.
    - Providing teachers with professional development opportunities to effectively use new technologies and teaching methods.
7. Collaboration with Industry:
    - Partnering with businesses and industries to ensure that educational programs are aligned with current and future workforce needs.
    - Providing students with hands-on experience through internships, apprenticeships, and real-world projects.
8. Global and Inclusive Perspective:
    - Encouraging global awareness and cross-cultural competencies.
    - Ensuring that education is inclusive and accessible to all, leveraging technology to reach underserved communities.

Role of employers in the education system

Employers are preparing to play a bigger role in the education system and especially in Education 4.0. By actively participating in Education 4.0, employers not only help in developing a skilled workforce that meets the demands of the modern economy but also ensure their own competitiveness and ability to innovate in a rapidly evolving technological landscape. For example, according to research in the UK by the Edge foundation (2022) businesses were most likely to have links with universities (84%), followed by colleges (77%) and schools (74%). Of respondents who are engaged with the education system, eight in ten (79%) provide work experience placements and seven in ten (72%) provide careers advice and motivational talks.

AI-powered learning

We have already entered the era of generative AI tools like ChatGPT, Google Gemini, and others. The recent advancements in generative AI, coupled with its widespread accessibility, have made it feasible for organizations to incorporate learning directly into their workflow in ways that are both efficient and economically sustainable. Traditional training will co-exist with AI-powered digital assistants that deliver learning at the point of need. Generative AI can also be a powerful tool for enhancing your learning experience as an individual. Here's how you can utilize it effectively:

1. **Personalized Learning:** Generative AI can analyze your learning patterns, strengths, and weaknesses to create a personalized learning curriculum. This ensures that the content is tailored to your specific needs and learning pace, making it easier to grasp difficult concepts.
2. **Interactive Content Creation:** AI tools can generate interactive and engaging learning materials such as quizzes, flashcards, and simulations. These can help reinforce learning through active participation and practice.
3. **Language Learning:** Generative AI can help you learn new languages by providing conversational practice and real-time corrections, mimicking natural language interactions that are crucial for language acquisition.
4. **Writing and Research Assistance:** AI can assist in writing essays, reports, and research papers by suggesting ideas, correcting grammar, and ensuring stylistic consistency. It can also help conduct preliminary research by summarizing articles and extracting key information.
5. **24/7 Tutoring:** AI-driven platforms can act as tutors available round the clock, offering explanations, solving problems, and answering questions instantly, thus providing support outside regular class or work hours.
6. **Visualization Tools:** AI can create visual aids like graphs, charts, and mind maps to help you understand complex data and abstract concepts visually.
7. **Enhancing Creativity:** Generative AI can inspire creative projects by generating art, music, or creative writing drafts that you can further refine and develop.
8. **Adaptive Assessments:** AI can design tests that adapt to your knowledge level, providing a more accurate measurement of your learning progress and identifying areas that need improvement.

Psychology of change

By understanding and addressing the psychological aspects of change, organizations and individuals can more effectively implement Industry 4.0 technologies and ensure a smoother transition for their workforce. At the individual level, when we make changes in our work or in our personal lives the transition is unsettling. Change will shift your identity - what you do now, how others see you, and how you perceive yourself all change.

When we transition towards a new self and identity there is a period of exploring and investigation and also a later phase of making commitments and these phases can be unsettling. We have to move away from our past areas of competence and confidence and redefine ourselves. We have to move from being an expert on one topic to being a novice on another topic. All of this is unsettling. We have to leave behind our old identity and be judged on a whole new set of criteria.

Change is an inevitable part of life. To navigate change effectively, it's essential to prepare both mentally and practically. Mentally, developing a growth mindset helps you embrace change as an opportunity for growth rather than a threat, allowing you to adapt more readily to new circumstances (Dweck, 2006). Building resilience through mindfulness, self-care, and social support further strengthens your ability to cope with adversity (APA, 2020). Practically, staying informed about industry trends and being flexible in your plans can help you anticipate changes and adjust accordingly (Harvard Business Review, 2017). Setting clear, achievable goals and continuously enhancing your skills ensure you remain prepared for future opportunities, while maintaining a strong support network provides the emotional and practical backing needed during transitions (WEF, 2020; Cohen & Wills, 1985). By combining mental readiness with practical strategies, you can navigate change more effectively and confidently.

Multi-stage careers

The concept of multi-stage careers is becoming increasingly relevant in the era of Industry 4.0, where rapid technological advancements are transforming the nature of work and the skills required. Unlike traditional career paths that followed a linear trajectory—full-time education, full-time work, and then full-time retirement—multi-stage careers involve multiple phases, each characterized by different roles, industries, or skill sets.

Traditionally, careers followed a predictable three-stage life: starting with full-time education, transitioning to full-time work, and concluding with retirement at the age of 65 or so depending on which country you live in. Peer pressure often reinforced these transitions, as everyone moved through these stages simultaneously.

However, today's world is witnessing the emergence of a multi-stage life. Factors such as increased longevity and rapid technological changes are leading to more frequent transitions throughout our lives. People are increasingly switching between employment and self-employment, changing careers, and continuously learning to keep up with evolving demands. Mid-career reskilling and upskilling have become common as individuals return to education to stay relevant. Moreover, many are choosing to work later in life, beyond traditional retirement ages.

As a result, managing transitions effectively has become crucial. Individuals must be adept at reinventing themselves as needed, driven by personal and professional circumstances. This may involve reskilling or upskilling, transitioning to new jobs, or

moving into self-employment. Embracing these changes is essential for thriving in a dynamic and ever-changing work environment shaped by Industry 4.0.

Agency

In the era of Industry 4.0, characterized by rapid technological advancements and digital transformation, the concept of agency—individuals' ability to make choices and take control of their own lives—becomes increasingly important. Agency is the sense that I am the one who is causing or generating an "action". A person with a sense of personal agency perceives himself/herself as the subject influencing his/her own actions and life circumstances.
According to Shaffer and Zalewski (2011), maintaining employability requires developing the capability to acquire new skills independently and being self-directed learners. Effective documentation and communication of new skills through marketing are also crucial. Research by Forrester (2023) indicates that more jobs will be influenced by generative AI than lost to it, suggesting that workers should focus on leveraging technology rather than competing with it.
With a multi-stage career individuals have to take more responsibility, more personal agency. This is less of a joint enterprise between you and your employer. You have to plan your future, take financial preparations for your future and investigate the options you have to upgrade your own skills. Personal agency is a vital component in navigating the transformations brought about by Industry 4.0. By fostering a culture of continuous learning, adaptability, and proactive engagement, individuals can harness the opportunities presented by new technologies while mitigating the risks associated with rapid change. Organizations and policymakers must support this process by providing the necessary resources and creating an environment that encourages personal agency.

Equity and Inclusion in Relation to Industry 4.0

"The test of our progress is not whether we add more to the abundance of those who have much; it is whether we provide enough for those who have little."

—Franklin D. Roosevelt

Industry 4.0, marked by rapid technological advancements and the integration of digital tools, poses significant challenges and opportunities for equity and inclusion. As automation, artificial intelligence, and other technologies reshape industries, there is a critical need to ensure that these advancements do not exacerbate existing inequalities. Often, those who need retraining the most are the least likely to receive it, as companies prioritize upskilling their already skilled workforce (McKinsey, 2021). This highlights the importance of individuals taking ownership of their learning and the necessity for inclusive policies that provide equal access to education and reskilling opportunities. Digital capability disparities, such as those in the United Kingdom where 13 million people lack essential digital skills, further underline the need for inclusive digital literacy programs. Moreover, addressing gender disparities in STEM fields and ensuring that technological advancements benefit diverse populations, including underrepresented groups and people with disabilities, are essential for fostering an inclusive Industry 4.0. Employers must shift towards hiring based on skills and competencies rather than traditional credentials, creating environments where all individuals can thrive and contribute to the digital economy. Ensuring equity and inclusion in Industry 4.0 is not only a social imperative but also a driver for innovation and economic growth.

Skills trap

The skills trap refers to the phenomenon where workers find themselves unable to advance or adapt in their careers due to a lack of necessary skills, particularly in rapidly evolving industries driven by technological change. As companies increasingly adopt advanced technologies and automation, there is a growing demand for specialized skills that many current workers do not possess. This creates a divide where those who are already highly skilled continue to receive training and development opportunities, while others, particularly those in lower-skilled positions, are left behind. This lack of access to reskilling and upskilling opportunities exacerbates economic and social inequalities, as individuals trapped in this skills gap face limited job prospects and career advancement. Overcoming the skills trap requires comprehensive strategies that include accessible education, continuous learning opportunities, and targeted support for underrepresented groups, ensuring that all workers can adapt to the demands of Industry 4.0 and beyond.

Universal Basic Income

Universal Basic Income (UBI) is a financial model where all citizens receive a regular, unconditional sum of money from the government, regardless of their income, employment status, or wealth. This concept aims to provide a safety net that ensures everyone has the financial means to meet their basic needs, thereby reducing poverty and income inequality. UBI is particularly relevant in the context of Industry 4.0, where automation and technological advancements are expected to disrupt traditional job markets and potentially lead to significant job displacement. By providing a stable income floor, UBI could empower individuals to pursue education, reskilling, entrepreneurship, or part-time work without the immediate pressure of

financial instability. It also has the potential to boost economic stability and consumer spending, as individuals have more financial security. While UBI presents a promising solution to the economic challenges posed by rapid technological change, it also raises questions about funding, implementation, and its long-term effects on the labor market and social structures.

'Curiosity is more important than knowledge.'

- Albert Einstein

5. Conclusion and Next Steps

Automation creates opportunities for a better future of work by reducing the need for humans to perform dirty, dangerous, or monotonous jobs, augmenting human efforts, and creating new roles. While technology is expected to create more jobs than it eliminates, automation will undoubtedly be disruptive. As seen in previous industrial revolutions, Industry 4.0 will make some roles obsolete, transform others, and require leaders to anticipate and manage change effectively.

Technological advancements often face significant time lags from invention to widespread adoption due to challenges in practical implementation, regulation, and consumer acceptance. For example, the integration of autonomous vehicles is slower than anticipated due to the complexities of real-world driving conditions.

Change and disruption are recurring themes, as shifts in work structure generate both opportunities and challenges. People's decisions today are influenced by their vision of the future, making it crucial to understand future trends to take proactive actions now.

Everyone must prepare for future changes and disruptions, as no one is immune. The course encourages ongoing learning as the cornerstone of personal and professional growth. Embracing continuous learning through various means—whether upskilling, reskilling, or pursuing personal enrichment—enhances one's skillset and adaptability. Learning thrives in curiosity, practical experiences, and interactions. Keep the flame of curiosity alive and commit to lifelong learning to build a more informed, capable, and resilient self.

Building a Personal Skill Development Plan

In *"Future Skills 2030: Preparing for the 4th Industrial Revolution,"* planning for long-term success is addressed in section 4 with the understanding that goal-setting is a cornerstone of personal and career development. Assignment number 5 *'Building a Personal Skills Development Plan: Preparing for Your Future'* will give you an opportunity to plan for your future career. In an era marked by rapid technological and social change, clear and adaptable goals are more important than ever. It advises starting with a self-assessment to understand one's strengths, weaknesses, interests, and values. This self-awareness forms the foundation for setting SMART goals - Specific, Measurable, Achievable, Relevant, and Time-bound. The course encourages students to envision where they want to be in the context of the 4th Industrial Revolution, considering the emerging job landscape and the skills that will be in demand. Setting both short-term and long-term goals is recommended, with short-term goals acting as stepping stones towards the larger, long-term aspirations. Additionally, the course underscores the importance of flexibility in goal setting, advocating for regular review and adjustment of goals in response to changing personal circumstances and external factors such as market trends and technological advancements. The ultimate message is that effective goal setting is a dynamic process that not only guides professional and personal growth but also fosters resilience and adaptability in an ever-evolving world.
A well-crafted plan includes specific actions and timelines, along with resources such as courses, workshops, or mentorship opportunities to facilitate learning and skill development. Regularly reviewing and updating the plan helps track progress and adapt to changing circumstances or new opportunities. By committing to continuous learning and skill enhancement, individuals can stay competitive in their fields and achieve their full potential.

Staying Updated with Future Trends

In "Future Skills 2030: Preparing for the 4th Industrial Revolution," a key focus is placed on the importance of staying updated with future trends. As technological advancements and global dynamics rapidly reshape industries, the ability to anticipate and adapt to future trends becomes critical for professional success and organizational relevance. The course highlights several strategies for staying informed. It encourages regular engagement with a variety of information sources such as industry journals, trend reports, online courses, and professional networks. Attending webinars, conferences, and workshops is also emphasized as a means to gain insights from experts and thought leaders. It is also recommended to leverage social media and digital platforms, not just as passive observers, but as active participants in discussions about future developments. Additionally cultivating a diverse professional network that includes individuals from different industries and backgrounds to gain a broader perspective on emerging trends is valuable. Importantly, the course underscores the need for a mindset that is open to change and willing to continuously learn and unlearn. By integrating these practices into their professional lives, individuals and organizations can position themselves to not

only respond to the changes brought by the 4th Industrial Revolution but to actively shape and benefit from them.

How to Stay Connected

Please stay connected using social media. There is a dedicated Facebook group for this course where I share course updates and which provides an opportunity for interaction amongst students. You can also follow me on social media such as on Instagram and through my website. Remember to check for updates to this ebook and the course, as the field of the 4th Industrial Revolution is rapidly evolving. I am working to improve and update the course on an ongoing basis. Updated content is regularly added to reflect the latest developments and research. My goal is to make this course a 5 star course and the best online course available on the internet on the topic of Future Skills and the Fourth Industrial revolution.

Resource Library

"Self-education is, I firmly believe, the only kind of education there is."

– Isaac Asimov

As we have seen over and over in this e-book, things are changing fast. It is very easy to overestimate how things will change in the short run and also very easy to underestimate the impact of change in the long run. There is no doubt that as individuals we need to invest in our futures. Curiosity and life-long learning is essential. We cannot leave investment in our own reskilling and upskilling to our employers or the government etc. A university degree is no longer enough to guarantee continued employment. We are responsible for our own reskilling and upskilling. We also need to be prepared to move from employer to employer as greater automation closes down some roles and opens up others. We need to develop the mindset of Learnability - the ability and willingness to learn driven by curiosity.
Throughout the online course there are resources for further learning under each lecture topic. At the end of the course there are also suggested next steps to continue learning and enhancing your skills into the future. Curiosity and lifelong learning is key to a successful future and learning how to learn is key to that. A sample of resources from the online course is presented below.

Recommended Books, Articles, Videos and online tools

In "Future Skills 2030: Prepare for the 4th Industrial Revolution," a variety of resources are recommended to further explore the concepts and skills discussed in the course. These resources include courses, books, articles, and videos that provide deeper insights into the technological advancements and the evolving job market of the future. Below is a sample of the recommended materials. A more comprehensive list is provided on the course.

Books

- "The Fourth Industrial Revolution" by Klaus Schwab. An insightful book by the founder of the World Economic Forum, offering a detailed look at the characteristics and implications of the 4th Industrial Revolution.
- "Life 3.0: Being Human in the Age of Artificial Intelligence" by Max Tegmark - This book explores the future of artificial intelligence and its impact on the future of life on Earth and beyond.
- “The Future of the Professions - How Technology Will Transform the Work of Human Experts” By Richard Susskind and Daniel Susskind. The book presents groundbreaking research on how technology will transform the work, and relevancy, of professionals.
- "Thank You for Being Late: An Optimist's Guide to Thriving in the Age of Accelerations" by Thomas L. Friedman - Friedman discusses how to live in an age of rapid technological change and globalization.
- "The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies" by Erik Brynjolfsson and Andrew McAfee - A book that delves into how digital technology is changing our jobs, lives, and economy.
- "Drive: The Surprising Truth About What Motivates Us" by Daniel H. Pink - Pink examines the elements of true motivation and how they play out in the context of the 4th Industrial Revolution.

Articles

- "The Future of Employment: How Susceptible Are Jobs to Computerisation?" by Carl Benedikt Frey and Michael A. Osborne - An influential paper discussing the potential impacts of automation on employment.
- "Skills for the 21st Century: What Should Students Learn?" by the Center for Curriculum Redesign - This article explores the skills that will be crucial for students in the 21st century.
- Various articles from the Harvard Business Review and McKinsey Quarterly focusing on leadership, technology, and the future of work.

Videos

- TED Talks on the Future of Work - These talks feature various experts discussing how work is changing in the modern world and what skills will be essential.

- "The Future of Learning" by Gerd Leonhard - A thought-provoking presentation on the future of education and learning in a technology-driven world.
- Lectures from the World Economic Forum - Videos discussing the impact of the 4th Industrial Revolution on different sectors and economies.

List of Online Resources and Tools

- **Udemy:** Where you are now! A platform with a wide array of courses on different subjects, including web development, photography, and personal development.
- **Coursera:** Offers courses in collaboration with top universities and organizations covering a wide range of topics, including data science, AI, and business management.
- **edX:** Provides access to courses from universities like MIT and Harvard. It's a great resource for courses in engineering, computer science, and more.
- **Khan Academy:** Known for its comprehensive free educational resources, particularly in the areas of math, science, and computing.
- **LinkedIn Learning:** Offers a vast library of courses focused on professional development, including soft skills like leadership and communication, as well as technical skills like programming and data analysis.
- **Codecademy:** Ideal for those wanting to learn coding and computer programming from scratch.
- **FutureLearn:** Offers a range of courses in partnership with international universities and institutions on topics like digital marketing, cybersecurity, and business strategy.
- **MIT OpenCourseWare:** Provides free course content from the Massachusetts Institute of Technology, covering subjects such as engineering, physics, and economics.
- **TED Talks:** Offers inspirational and informative talks on a variety of topics including technology, innovation, and design thinking.
- **Google Digital Garage:** Offers free online courses from Google on digital marketing, career development, and data and tech.
- **Pluralsight:** A technology skills platform offering courses in software development, IT operations, and creative techniques.
- **Skillshare:** Focuses on creative education, including courses in graphic design, photography, and creative writing.
- **DataCamp:** Specializes in courses for data science and analytics, offering interactive learning experiences.
- **Harvard Online Learning:** Provides access to learning content from Harvard University, covering a wide range of academic and professional development topics.

These books, articles, videos and other online resources and tools offer flexible learning opportunities to develop a wide array of skills relevant to the demands of the 4th Industrial Revolution. They allow learners to keep pace with evolving technologies and industry trends, ensuring continuous personal and professional growth.

"The illiterate of the 21st century will not be those who cannot read and write, but those who cannot ***learn, unlearn, and relearn****."*

- Alvin Toffler

Feedback and Course Evaluation

I am working to update and improve this course on an ongoing basis. Please send your feedback and suggestions on this ebook or on the online course via the Udemy messaging system or by email to: tcarroll@apiconsult.com
I do take your suggestions on board and have improved the course based on student feedback. For example the downloadable external resource lists for each section of the course were added as a result of student feedback.
Please forgive my mispronunciation of the word 'algorithm' in the course - my dyslexic brain reads this word as alogrithm!! I think I have now eliminated all instances of this mispronunciation 🙂. Please share this e-book with those who you think will be interested in this topic and will benefit from this book/course. Your friends, family and professional network. I have done the work upfront so the more people that benefit from my efforts the better!
Finally, please also do me a big favor and rate the course including this book (hopefully 5 stars!) and leave a comment. This will help others to find the course. Thank you so much!

Tom Carroll,
Co. Laois Ireland,
June 2024.

About the author

Thomas Carroll, PhD, is passionate about Futures Thinking and the Future of Work. With a background in education and international development, he has dedicated over six years to investigating the intersection of technology and the evolving workplace. Tom has created several widely popular online courses on these subjects and related areas. Beyond his professional endeavors, he is an avid beekeeper who draws inspiration from nature and hiking. For more insights into Tom's work, visit www.lifeisalaboratory.com.

"The Gross National Product does not include the beauty of our poetry or the intelligence of our public debate. It measures neither our wit nor our courage, neither our wisdom nor our learning, neither our compassion nor our devotion. It measures everything, in short, except that which makes life worthwhile."

—Robert F. Kennedy

Glossary

Artificial Intelligence (AI): A branch of computer science focused on creating systems capable of performing tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and language translation.

Augmented Reality (AR): An interactive experience where real-world environments are enhanced by computer-generated perceptual information, across multiple sensory modalities.

Automation: rapid technological change associated with robotics and artificial intelligence, jointly known as automation technologies.

3D Printing: A process of making three dimensional solid objects from a digital file, creating the object by laying down successive layers of material.

Big Data: Extremely large data sets that may be analyzed computationally to reveal patterns, trends, and associations, especially relating to human behavior and interactions.

Blockchain: A decentralized, distributed ledger technology that records the provenance of a digital asset, known for its key role in cryptocurrency systems such as Bitcoin.

Cloud Computing: The delivery of computing services over the internet, including storage, processing power, and software applications.

Critical Thinking: The ability to analyze information objectively and make a reasoned judgment.

Cybersecurity: The practice of protecting internet-connected systems, including hardware, software, and data, from digital attacks or unauthorized access.

Data Analytics: The process of examining large data sets to uncover hidden patterns, correlations, and insights, often using statistical and computational techniques.

Digital Literacy: The ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills.

Education 4.0: Represents a shift towards a more dynamic, flexible, and technology-enhanced approach to education, aiming to equip learners with the skills and knowledge needed to thrive in the rapidly changing landscape of the 21st century.

Emotional Intelligence (EI): The capability of individuals to recognize their own emotions and those of others, discern between different feelings, and use this information to guide thinking and behavior.

Entrepreneurship: The process of designing, launching, and running a new business or startup.

Fourth Industrial Revolution: The ongoing transformation in technology and industry driven by advancements in AI, robotics, the Internet of Things (IoT), genetic engineering, and other emerging technologies.

Gig Economy: A labor market characterized by short-term contracts or freelance work as opposed to permanent jobs. Workers in the gig economy typically engage in various temporary or flexible jobs.

Hard skills: Skills specifically required for more precisely defined tasks and associated with specific occupations. They are often referred to as technical or hard skills. Typically, hard skills are gained through education, training programs, certifications, and on-the-job training.

Hyperautomation: The application of advanced technologies like AI and machine learning to increasingly automate processes and augment human capabilities.

Innovation: The process of translating an idea or invention into a good or service that creates value or for which customers will pay.

Internet of Things (IoT): The network of physical objects—"things"—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet.

Lifelong Learning: The ongoing, voluntary, and self-motivated pursuit of knowledge for personal or professional development throughout an individual's life.

Machine Learning: A subset of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed.

Nanotechnology: The manipulation of matter on an atomic or molecular scale, especially to build microscopic devices.

Net Zero: net zero refers to the balance between the amount of greenhouse gas (GHG) that's produced and the amount that's removed from the atmosphere. It can be achieved through a combination of emission reduction and emission removal.

Personalization: The tailoring of products, services, and experiences to individual customers' preferences and needs.

Problem-Solving Skills: The ability to find solutions to difficult or complex issues.

Quantum Computing: A type of computing that uses quantum mechanics phenomena, such as superposition and entanglement, to perform data operations.

Remote Work: A working style that allows professionals to work outside of a traditional office environment, often implying a digital or 'virtual' working space.

Reskilling: The process of learning new skills or training for a different job or role, often in response to changing job requirements and technological advancements.

Skills gap: is a term used to describe the mismatch between the skills that employers require and the skills that job seekers possess.

Skillset: A skillset refers to the collection of abilities, knowledge, and competencies that an individual possesses, which enables them to perform specific tasks and roles effectively.

Skills trap: This typically refers to a situation where individuals or organizations become overly reliant on their current skills and fail to adapt or learn new skills that are necessary to stay relevant in the evolving market or technological landscape. This can lead to decreased competitiveness and potential obsolescence.

Soft skills: Are personal attributes, personality traits, inherent social cues, and communication abilities needed for success on the job. They characterize how a person interacts in his or her relationships with others. Unlike hard skills, which are about a person's skill set and ability to perform specific tasks, soft skills are interpersonal and broadly applicable across job titles and industries. Examples of soft skills are: communication skills; team-work; problem-solving; adaptability; leadership; emotional intelligence etc.

STEM Skills: These refer to abilities and knowledge in Science, Technology, Engineering, and Mathematics. These skills include analytical thinking, problem-solving, and proficiency in various technical and quantitative areas, essential for careers in these fields and beyond.

Sustainable Development: Economic development that is conducted without the depletion of natural resources. It aims to balance economic growth with environmental preservation and social equity.

Technological Disruption: The introduction of new technologies that necessitate a change in the way work is organised and the readiness to take on these new technologies.

Technical Skills: The abilities and knowledge needed to perform specific tasks, often relating to IT, engineering, and scientific fields.

Transferable skills: Are abilities applicable across various job roles and industries, including both soft skills like communication and problem-solving, and hard skills such as technical proficiency. These skills enhance employability by making an individual adaptable to different work environments.

Upskilling: The process of learning new skills or improving existing ones to enhance performance in one's current job or career.

Virtual Reality (VR): A simulated experience that can be similar to or completely different from the real world, often used for entertainment, education, and training purposes.

Workplace Diversity: The inclusion of different types of people (different races, cultures, genders, ages, etc.) in a business or organization.

Workflow Automation: The design, execution, and automation of processes where tasks, information, or documents are passed from one participant to another for action, according to a set of procedural rules.

"As we look to the future, the picture is summarised by the acronym VUCA – volatility, uncertainty, complexity, and ambiguity."

- World Economic Forum

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Future Skills 2030

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