



# GenZ White Paper:

Strengthening Human Competences  
in the Emerging Digital Era



**GenZ**

**UNIVERSITY  
OF OULU**

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## Executive summary

We are witnessing an emerging digital revolution. For the past 25–30 years, at an increasing pace, digital technologies—especially the internet, mobile phones and smartphones—have transformed the everyday lives of human beings. The pace of change will increase, and new digital technologies will become even more tightly entangled in human everyday lives. Artificial intelligence (AI), the Internet of Things (IoT), 6G wireless solutions, virtual reality (VR), augmented reality (AR), mixed reality (XR), robots and various platforms for remote and hybrid communication will become embedded in our lives at home, work and school.

Digitalisation has been identified as a megatrend, for example, by the OECD (2016; 2019). While digitalisation processes permeate all aspects of life, special attention has been paid to its impact on the ageing population, everyday communication practices, education and learning and working life. For example, it has been argued that digital solutions and technologies have the potential to improve quality of life, speed up processes and increase efficiency. At the same time, digitalisation is likely to bring with it unexpected trends and challenges. For example, AI and robots will doubtlessly speed up or take over many routine-based work tasks from humans, leading to the disappearance of certain occupations and the need for re-education. This, in turn, will lead to an increased demand for skills that are unique to humans and that technologies are not able to master. Thus, developing human competences in the emerging digital era will require not only the mastering of new technical skills, but also the advancement of interpersonal, emotional, literacy and problem-solving skills.

**More focus is needed to strengthen the human competences required for a sustainable digital future: interpersonal, emotional, literacy and problemsolving skills.**

It is important to identify and describe the digitalisation phenomena—pertaining to individuals and societies—and seek human-centric answers and solutions that advance the benefits of and mitigate the possible adverse effects of digitalisation (e.g. inequality, divisions, vulnerability and unemployment). This requires directing the focus on strengthening the human skills and competences that will be needed for a sustainable digital future. *Digital technologies should be seen as possibilities, not as necessities.*

There is a need to call attention to the **co-evolutionary processes** between humans and emerging digital technologies—that is, the ways in which humans grow up with and live their lives alongside digital technologies. It is imperative to gain in-depth knowledge about the natural ways in which digital technologies are embedded in human everyday lives—for example, how people learn, interact

and communicate in remote and hybrid settings or with artificial intelligence; how new digital technologies could be used to support continuous learning and understand learning processes better and how health and well-being can be promoted with the help of new digital solutions.

Another significant consideration revolves around the **co-creation** of our digital futures. Important questions to be asked are as follows: Who are the ones to co-create digital solutions for the future? How can humans and human sciences better contribute to digitalisation and define how emerging technologies shape society and the future? Although academic and business actors have recently fostered inclusion and diversity in their co-creation processes, more must be done. The empowerment of ordinary people to start acting as active makers and shapers of our digital futures is required, as is giving voice to those who have traditionally been silenced or marginalised in the development of digital technology. In the emerging co-creation processes, emphasis should be placed on social sustainability and contextual sensitivity. Such processes are always value-laden and political and intimately intertwined with ethical issues.

Constant and accelerating change characterises contemporary human systems, our everyday lives and the environment. **Resilience** thinking has become one of the major conceptual tools for understanding and dealing with change. It is a multi-scalar idea referring to the capacity of individuals and human systems to absorb disturbances and reorganise their functionality while undergoing a change. Based on the evolving new digital technologies, there is a pressing need to understand how these technologies could be utilised for human well-being, sustainable lifestyles and a better environment. This calls for analysing different scales and types of resilience in order to develop better technology-based solutions for human-centred development in the new digital era.

This white paper is a collaborative effort by researchers from six faculties and groups working on questions related to digitalisation at the University of Oulu, Finland. We have identified questions and challenges related to the emerging digital era and suggest directions that will make possible a human-centric digital future and strengthen the competences of humans and humanity in this era.

# 1 Introduction

The term ‘digitalisation’ refers to the ways in which digital technologies are embedded in the lives of individuals, groups and communities. Its impact on human life has been acknowledged as a megatrend and emphasised by several organisations including OECD (OECD, 2016), United Nations in their Sustainable Development Goals (UN SDG) (UN, 2020), The Finnish Innovation Fund (Sitra, 2020), McKinsey & Company (2017) and Monitor Deloitte (2017). Thus, we are witnessing a digital revolution that affects everybody and requires the renewal of human capabilities and competences in all aspects of life—for example, in educational and working environments. The world’s citizens will, in large parts, witness and experience how artificial intelligence (AI), the Internet of Things (IoT), virtual/augmented/mixed reality (VR/AR/XR), robotics, 5G/6G and systems and solutions related to them will become more intelligent, ubiquitous, and invisible. People will spend an increasing amount of time taking part in tasks, activities and processes that—whether they know it or not—involve one or more of these technologies. Such new technologies will simplify and speed up some (highly complex and routine) processes while complicating and slowing down others; they will provide support and help in some situations, while obstructing others; they will provide some people with new possibilities for interaction and learning while isolating others and they will generate new work opportunities for some while killing other branches of trade and industry. In view of this, one tangible possibility is that contemporary thinking around digital transformation is still too simplistic and narrow and takes human beings for granted. More emphasis is needed to understand how human potential can be enhanced as part of the digital revolution.

**Contemporary thinking around digital transformation is too narrow and takes human beings for granted.**

For example, digitally enabled automation and AI are set to become the primary drivers of the next technological evolution, predicting a major transition in the labour market from routine-based skills to new social and creative skills. The growing use of AI applications has been predicted to bring about the most significant changes at work. Furthermore, the COVID-19 pandemic has only sped up digitalisation processes. It has allowed or forced (depending on the vantage point) people to work and study remotely or in multiple locations. It has had a dramatic impact on trade and the service sector (e.g. restaurants, cultural services and sports), transformed how and where people spend their free time and practice their hobbies and separated and kept apart people from

their close family members, relatives and friends. Nevertheless, while COVID-19 has made many aspects of digitalisation more ubiquitous and explicit, the numerous ways in which emerging digital technologies are intertwined in our everyday lives and societies at home, school and the workplace require focused attention in their own right. More knowledge is needed about human-centric digitalisation.

**How can those competences that are unique to humans be strengthened? Answers are needed to make possible a human-centric and sustainable digital future.**

The core digitalisation challenge is the following: How can we strengthen those skills that are natural and unique to humans (and which machines cannot replicate) and, in this way, pave the way to a human-centric and sustainable digital future? This perspective casts critical light on the widely held view that developing digital technologies and increasing the pace of digitalisation alone improve quality of life and solve societal problems. The world cannot be led by intelligent technologies because they lack capacities that are profoundly human, such as the capability to sense and display emotions, establish shared meanings in interactions with others and solve complex societal problems in ethical, creative and flexible ways. *Digital technologies should be seen as possibilities rather than as necessities. Society and humans should drive technologies, not the other way around.*

Making possible human-centric and sustainable digital futures requires answers to the following core questions: What human skills and capabilities are needed to cope and function in an increasingly digital world? How can those skills be strengthened so that humans are empowered alongside the digitalisation process? How can humans tame or domesticate new digital technologies so that using them becomes an everyday skill? What new forms of work are created in the digital world? What forms of marginalisation and exclusion do new digital technologies bring with them?

Chapter 2 presents a summary of global megatrends and how they are interconnected with the digitalisation megatrend. Chapter 3 presents the GenZ vision and framework for gaining the in-depth knowledge that is needed for tackling these megatrends. Chapter 4 provides some conclusive remarks.



## 2 Global megatrends in light of digitalisation

This chapter provides a summary of global megatrends related to digitalisation and the adoption and use of new technologies. The summary is based on reports published by the UN SDG (2020), (Sitra, 2020), the Organisation for Economic Co-operation and Development (OECD) (2016), McKinsey (2017) and Deloitte (2020) and other international bodies.

### 2.1 Digitalisation shapes communications

During the last 50 years, digital devices, tools and practices have increasingly shaped communication and communication habits (OECD, 2016, p. 14). The members of Generation Z—the generation born after 1995—are the first to have always been surrounded by digital communication tools and are viewed by many as digital natives. The digitalisation megatrend will continue to shape everyday communication (OECD, 2016, p. 15). Humans will be increasingly surrounded by, communicating through or interacting with digital technologies. Human communication and digital technologies will be even more closely intertwined in the future. This trend will be stimulated, for example, by faster wireless technologies made possible by 5G and 6G (the latter in the 2030s). At the same time, the reliability, stability and safety of digital communication will be a pressing issue in the future (OECD, 2016, p. 14).

**In the future, humans will be increasingly surrounded by, communicating through and interacting with digital technologies.**

Ubiquitous connectivity will continue to help ease ‘the strains of mobility’ (OECD, 2016, p. 9). There will be countless options to interact with family members, friends and colleagues, regardless of distance, place and time, affecting when and how we are available and accessible to interaction. The use of a digital device or platform will more often be the only means of contacting service providers, public administrations or officials. The range of languages used for digital communication may narrow down. This is because the English language will continue to play a key role in global communication (OECD 2016, p. 9), but at the same time, it may

present a serious hindrance to people’s access to information and possibilities to communicate.

Digital communication will be even more multimodal and intermedial—involving talk, writing, and visual information—than today. More realistic digital spaces and places for interaction will become commonplace. Social interactions will be possible in and through ‘mixed reality’ environments, where realistic 3D images of places, objects and people can be projected and replicated to remote places in real time and in full motion (Matinmikko-Blue et al., 2020). Interactions with artificial and intelligent assistants—dramatic improvements to chatbots or the current versions of Alexa and Siri—will be capable of more realistic interactions with humans over time.

Along with the accelerating pace of digitalisation and the practices and habits of communication, interaction and co-presence will continue to change (OECD, 2016; McKinsey & Company, 2017; Monitor Deloitte, 2017). For example, with the number of routine-based jobs decreasing, it will be commonplace for work tasks and activities to involve more communication, requiring workers with good interactional, managerial and problem-solving skills (McKinsey & Company, 2017, p. 20, 32, 39). There is a need to better understand how digital technologies afford communication and shape communicative practices across different aspects of life (Monitor Deloitte, 2017, p. 6) (see Section 3.1). This is particularly important in post-pandemic societies, where digital and hybrid interactions will be commonplace.

### 2.2 Education needs redirection in the digital era

The United Nations (UN) has identified continuous learning (also lifelong learning) as an important sustainable development goal (SDG). Education is the tool to ensure that future citizens acquire relevant skills—including technical and vocational skills—for employment, decent jobs and entrepreneurship. Ensuring equal education for all requires that children stay at school and complete their education.

## **Social and creative skills will drive future digital working life. This requires new thinking in education.**

solving (adaptive thinking and design mind-set) and process skills (resource management and transdisciplinary skills). In general terms, strengthening these human skills requires an increased emphasis on social and creative skills and less focus on routine-based skills.

Responding to these needs may require new thinking in the field of education with more focus on such human capabilities as creativity, socioemotional and collaboration skills, which technologies cannot replace. Furthermore, it is important to ensure that future teachers have the resources and tools to support their pupils' and students' growth and skills development in view of the above requirements.

At the same time, the rapid progression of digital technologies offers new possibilities for developing teaching and education. It is thus important to explore how they could be harnessed in teaching and learning to support and benefit quality education and lifelong and continuous learning.

The McKinsey Global Institute (2017) has identified four skills that are driven by major digital trends and will be needed in future working life. These are technical, cognitive, creative and interpersonal skills, and they will account for half of work activities by 2030. Thus, future occupations will require social (negotiation and collaboration skills), technical (programming, technology design and maintenance skills), problem-

## **2.3 Digitalised working life requires flexibility**

In some respects, digital transformation has resulted in better jobs, increased productivity and higher wages. However, at the same time, together with other rapid changes (e.g. shorter and temporary work contracts, part-time jobs and frequent job changes), it has created pressure for people to develop their skills continuously and effectively (OECD, 2019). New technologies (e.g. robotics and artificial intelligence) and digitalisation processes are expected to change work markets. More jobs will involve focusing on non-routine tasks, problem-solving and creative and complex communication activities. These processes are related to the increased polarisation of labour markets. For example, following the processes of robotisation in manufacturing and automation in services, jobs matched to lower-medium levels of education are disappearing, especially in OECD countries. At the same time, jobs for the more highly educated as well as low-paid jobs are increasing (i.e. the middle class is diminishing; see the U-shape structure, OECD 2019, Figure 3.4).

### **Digitalisation will change work and work markets dramatically. How can human competences be developed and strengthened to meet changing working-life requirements?**

As a result, the demand for high-cognitive skills (written and oral expression), social and emotional skills and reasoning and problem-solving skills is also likely to increase. These abilities will be key to promoting and increasing resilience and the adaptability of individuals and nations (OECD, 2019, Figure 3.3). This raises the following questions: How can higher-level and inherently human capabilities and competences be updated, developed and strengthened to match the needs for changing working life skills? How can new skills be taught to meet future working-life requirements?

One fundamental working life competence in the emerging digital era concerns literacies. In the near future, the importance of digital, technological and information literacies will only increase. Possessing adequate and appropriate literacy skills extends beyond the ability to use digital software and applications or to configure a computer. For example, it is necessary to be able to critically reflect on information and knowledge that is abundantly available everywhere; it is crucial to recognise the sources of information and assess their reliability. Further, it will be important for people to understand how machines work and how they can be operated, for example, in digital fabrication. It is also crucial to understand the nature of data: How can data be transformed, stored, transferred and analysed? Finally, it is crucial to actively explore and find solutions to how technology can empower humans, enhance their skills and efficiently support them as part of their work.

Work environments and the nature of work tend to change over time in response to changing markets, technological developments and external shocks. Responding to sudden and sometimes unpredictable changes in working life requires flexibility and readiness to adapt. Such changes may

be only temporary, while others may have long-term and lasting consequences. The global COVID-19 pandemic is a case in point. The outbreak of the virus launched various unexpected changes, with a groundbreaking impact on working life. One concrete and dramatic change it introduced is the increased amount of remote or multilocal work and the associated digital leap that has taken place in a broad range of occupations. It is difficult to estimate the short- and long-term consequences of the pandemic on working life or which of the changes we are now witnessing will be permanent. Nevertheless, changes and shocks (e.g. those introduced by new digital technologies or the COVID-19 pandemic) will continue to pose new requirements for working life and well-being. New knowledge about these unknown changes in future working life is needed for the purposes of reducing inequality and unemployment and increasing employability and individual, organisational and regional resilience.

## 2.4 Digitalisation transforms everyday life

Our everyday lives are transforming not only because of the quick development of digital technologies but also because they are being adopted very quickly (OECD, 2016, p. 15; Sitra, 2020). As novel technologies are becoming embedded in everyday life ‘without us even noticing it’ (Sitra, 2020), they alter the ways people communicate (OECD, 2016, p. 15), think and operate (Sitra, 2020). Because of the development in artificial intelligence, in particular, the next wave of digitalisation is already underway; technologies are not only helping people to do things faster and in more convenient ways, but they are also profoundly changing the ways things are done (Sitra, 2016). Consequently, there is a growing need to discuss the impact of technology—involving participants and stakeholders broadly—and to develop new competences to understand technology (Sitra, 2020).

**New digital technologies are invisibly embedded in our everyday lives. They influence the ways in which people think, operate and communicate.**

It is expected that as AI-powered applications become more common, they will bring about significant changes in everyday life, comparable to the changes the internet once brought to society (Sitra, 2020). It is suspected that the growing use of data, development of algorithms and increased computing capacity and interconnectedness will lead to increased use of voice-controlled machines, speech and facial recognition, traffic automation, conversational robots and personalised recommendation systems (Sitra, 2020). It is expected that in the long run, blockchain-driven services and quantum computing will be employed more widely and computer programs will gain more decision-making power (Sitra, 2020).

It should be noted that novel technologies can both increase and decrease equality (Sitra, 2020) and social inclusion. They can offer better access to education and other knowledge-based services (OECD, 2016, p. 17) and support and facilitate the transition to a more sustainable society (Sitra, 2020). At the same time, new innovations may increase inequality between people (OECD, 2016, p. 15) and create divisions (Sitra, 2016) as the benefits of innovations tend to accrue to innovators and their customers (OECD, 2016, p. 15). There may be an increased divergence in the technological realities in society emerging both from differences in how people use technologies and related competencies (Sitra, 2020). New divisions may emerge depending on whether people are able to use new technologies, have access to them or have the power to influence their development and adoption (Sitra, 2020). Moreover, technology adoption can contribute to the vulnerability of societies as they become more dependent on increasingly complex systems.

The mitigation of adverse impacts requires the strengthening and development of new technological competences both on the levels of individuals and nations (OECD, 2016; Sitra, 2020; UN Sustainable Development Goals 4, 5 and 10). These include competences associated with data use and rights, understanding the impact of algorithms and AI systems, and mitigating cybercrime (Sitra, 2020). As to everyday life, key questions include the understandability and ease of use of technology and related opportunities to make choices and exercise influence (Sitra, 2016). Moreover, increased resilience to adapt to shocks created by technology is called for (Sitra, 2016). This concerns, importantly, not only structures (e.g. power grids and information networks) but also ‘culture and people’s competences (Sitra, 2020). Moreover, for all actors in society to benefit, innovations must diffuse (OECD, 2016, p. 17) and new concepts, such as social, frugal and inclusive innovation and social entrepreneurship, are expected to contribute to a more inclusive approach to innovation (OECD, 2016, p. 17). An important question is: Who gets to decide on technology—corporations, governments, people or all of them together (Sitra, 2020)?

Overall, relational power is suggested to strengthen, and the significance of networks and interaction will be emphasised in the future (Sitra, 2020). Moreover, it is expected that we will see a significant growth in exercising influence through information (Sitra, 2020). Collective decision-making is not only important for the creation of an inclusive approach to innovation but also for democracy (Sitra, 2020). New forms of technology-enabled participation and engagement have already emerged (e.g. citizens' initiatives and participatory budgeting or social media giving rise to various movements), but they have not significantly changed the political systems. It remains an open question whether the 'participatory turn' will be realised and whether the mechanisms for making and implementing decisions will be revised (Sitra, 2020).

## 2.5 Digitalisation interconnects with the ageing of the population

The ageing of the population presents various challenges to digitalisation. In just three decades from now, the 60+ population in the world will grow to 21% and the older population (80+) will be predominantly female (60% of population). There will be fewer births, and people will live longer; life expectancy will be around 78 years (OECD, 2016). The ageing of the population is not only a trend in rich developed countries, but many less developed countries will also need to adapt quickly to the consequences that ageing presents (WHO, 2021). The number of health-related problems, such as dementia and falls, will increase, which will have significant societal implications (Sitra, 2020). There will also be changes in the lifestyles, consumption patterns and types of products and services the ageing population demands and needs (OECD, 2016). Additionally, climate change, in the form of increasingly common heatwaves, will introduce challenges to the elderly (Sitra, 2020). There is a need to find sustainable and human-centric solutions that help the elderly population to stay healthy longer, remain mobile and live on their own. At the same time, such solutions may lower the costs that the ageing of the population presents for societies. Digitalisation can play a key role in this, and there are expectations towards new technologies—for example, mobile and wireless devices, robotics and artificial intelligence—to provide solutions for these problems (OECD, 2016). For example, portable devices that monitor health are already common, and the data obtained through such devices enable personal and preventive care (Sitra, 2020).

**There is a need to find human-centric solutions that help elderly to stay healthy longer. Digitalisation can play a role in this.**



In a globalised world with increased mobility and families being spread around the world, more and more communication between elderly parents and their children and grandchildren takes place digitally and through video connections (see also Section 2.2). Furthermore, there is a need to invest in lifelong and continuous learning (see also Section 2.3) in order to support the skills of the ageing population in the increasingly digitalised world. At the same time, it is of utmost importance to take into account the needs and requirements of the ageing population in the development and design of new digital technologies (OECD, 2016). This calls for co-creative processes involving and engaging elderly people.

### 3 The GenZ vision for better digital futures: Key challenges and solutions

More knowledge is needed to understand the **co-evolutionary processes** between humans and digital technologies and what it means for a person to grow up with and live alongside new digital technologies. Multidisciplinary expertise about these processes needs to be integrated into **co-creation work** that brings together experts and stakeholders from different backgrounds to tackle challenges and questions concerning digitalisation and to develop better digital futures. Identifying and describing co-evolutionary processes and tackling the challenges involved in co-creative processes paves the way to more **resilient** individuals, organisations and societies (see Figure 1).

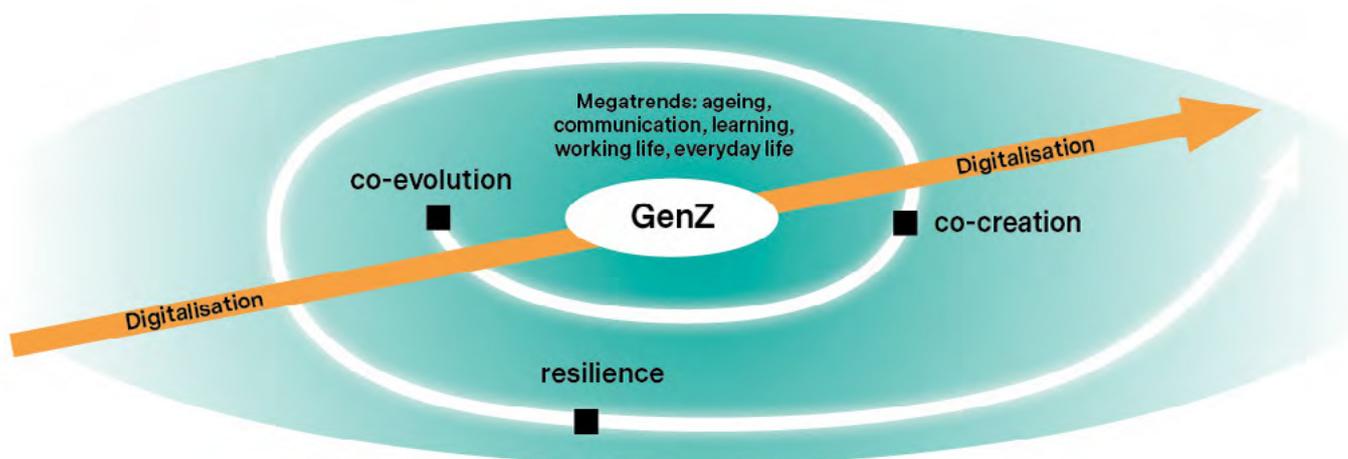


Figure 1: The GenZ vision for better digital futures

#### 3.1 The co-evolution of humans, human competences and digital technologies

What are the everyday human competences and capabilities that are needed to live, learn to live and learn to learn in a society in which intelligent technologies play a significant role? How can these capabilities be strengthened? To respond to these questions, it is crucially important to understand and describe the co-evolution of people and technologies. Digital technologies mediate the actions and interactions of individuals and different communities. At the same time, they are shaped by people and are adapted to different purposes (see also Section 3.2). Digital technologies are increasingly enmeshed with diverse aspects of life, for example, in everyday communication, working life and education. They also play an important role in promoting health and well-being. This means that people need to possess a diverse set of new competencies to make use of the opportunities provided by such technologies and to meet the challenges they impose.

**A better understanding of the co-evolution of humans and digital technologies is needed. Humans must be the centre of attention.**

The general challenge in understanding the co-evolution of humans and digital technologies is that emerging digital technologies introduce changes that are difficult to anticipate and examine. They influence people in different ways and can both decrease and increase equality. To address this challenge, human-centric approaches that explore the co-evolution of humans and digital technologies are needed. Among other things, they can consider the following themes: 1. co-evolution in digitally-mediated interactions, 2. co-evolution in lifelong learning and 3. co-evolution in the promotion of well-being.

Addressing these themes involves answering the overarching questions illustrated in Figure 2.



Figure 2: The co-evolution of humans, human competences and digital technologies

### Co-evolution in digitally mediated interactions

Large parts of our everyday interactions are moving over to and being mediated by digital platforms. For example, different remote and hybrid solutions have rapidly increased, and while offering new possibilities for interaction for some, they may present challenges and difficulties for others (Stokoe et al., 2021). Furthermore, AI systems are becoming ubiquitous (Sitra, 2020). On one hand, humans interact with AI-powered 'intelligent' agents (e.g. Alexa and Siri). On the other hand, AI systems collect and react 'intelligently' to data (Elliott, 2019) about human behaviour and use it to filter and control the information humans can access. Consequently, they shape the ways in which information is created and mediated and have the potential to influence the ways in which people think, communicate and make decisions (Sitra, 2020). Thus, from the perspective of co-evolution, it is crucial to understand the ways in which digital mediation transforms interactions, both between humans and between humans and technologies. Moreover, we need to better understand the human competencies that become important in these settings (Stokoe et al., 2021).

## Expertise in the social sciences and humanities is called for to understand digital technologies and their use from a human perspective.

impairments caused by ageing or other reasons, or they can be affected in unequal ways by automated decision-making (see e.g. Birhane, 2021). Overall, it is difficult to anticipate how different people are affected by the technologies to which they are introduced. This applies to each of the described megatrends: ageing, communication, education, everyday life and work (Chapter 2).

While the rapid development of digital communication technologies is evident, their impact on the evolution of human communication continues to be underexplored. For example, there is a need to strengthen human–human and human–computer communication skills (Monitor Deloitte, 2017, p. 6), enabling the positive co-evolution of humans and emerging digital technologies. Existing knowledge of natural language use, natural interactions and natural social practices (Housley et al., 2019) can be used to identify and describe the practices and processes by which digital technologies are and will become intertwined in human–human and human–machine interactions. Overall, expertise in the social sciences and humanities is called for to understand technologies and their use from a human perspective, considering the varying needs and practices of people of different ages and from varying sociocultural backgrounds. This understanding is important for developing useful and sustainable technologies (see Section 4.2), policies and practices to enhance ethical and socially sustainable communications and interactions. It is also vital to consider what knowledge, resources and competencies are crucial for people from the perspective of lifelong learning and work (see ‘Co-evolution in lifelong learning’) and for people’s well-being (see ‘Co-evolution to promote well-being’).

While the use of digital and intelligent technologies offers new opportunities for societies, it is also necessary to consider the new challenges they present. A digitally enabled world is working for some but not equally for everybody (UN, 2021). People have diverse knowledge, competencies and resources to make use of and exert control over the use of technologies, and they appropriate technologies in different ways to their existing practices. For example, people can differ in their abilities to use technologies due to, for example, cognitive and mobility

### Co-evolution of digitally mediated (inter)action

The challenge: Large parts of our everyday interactions move over to digital platforms and are being mediated by artificial intelligence (AI) systems, which are becoming ubiquitous and ‘embedded in everything’.

#### Required actions:

- It is crucial to build a better understanding of how digital communication technologies are used, how people behave in and around technologies and how people experience their use.
- There is a need to promote and develop a human-driven and AI-safe society that is composed of AI-literate individual groups and communities.

#### Pressing questions to address:

1. What competencies are required from people to benefit from digital technologies?
2. What are the possible large-scale and societal effects of increased digital remote interaction?
3. How can digital communication systems, including AI-powered ones, best support human communication and everyday life?
4. What are the best practices that support ‘hybrid’ and ‘blended’ models of interaction in multilocal working life and education?
5. How can people be educated/supported to operate with and around intelligent communication systems and recognise and describe their logic and operations?
6. How can existing knowledge about human–human and human–computer interaction be used to inform the development of human-centric and ethical intelligent communication systems?

#### Needs and resources:

Expertise in social sciences and humanities on human–human communication and human–computer interaction

Positive attitude towards the development of human-centric AI communication systems

## Co-evolution in Continuous Learning

Understanding the processes involved in the co-evolution of humans and digital technologies provides an important background for supporting education. It is needed for developing learning contents (e.g. curriculum development in view of digitalisation) and understanding the circumstances and contexts of learning in digitalised environments and the individual and group processes involved in learning. It is also important to acknowledge that learning does not only take place in schools. Thus, it is necessary to embrace the notion of lifelong or continuous learning and take into account how learning happens in workplaces and informal contexts (UN, 2021). Educating future citizens who have relevant skills, including technical and vocational skills, is important for fair and decent employment and entrepreneurship. Developing the competence and resilience of people is also crucial to functioning democratic systems and social equality. The key challenge is as follows: It is difficult to anticipate what the key competencies in the future are (see the outline of the global megatrends in Chapter 2), let alone to design educational practices that meet those unknown future challenges.

**Educating future citizens who have relevant skills, including technical and vocational skills, is important for fair and decent employment and entrepreneurship.**

There is much interest in advancing digital technologies that support teaching, learning and education for the needs of ongoing learning. Yet, many ideas (e.g. implementing data and artificial intelligence in education) still lack systematic views and an understanding of human learning processes. Additionally, in our rapidly changing world, people will need to be able to adapt to new situations and tasks, collaborate productively and proficiently, develop socio-emotional skills for tackling challenging problems and take the initiative to set goals and monitor themselves and others.

In digitalised societies, it is natural to support the learning of digital skills. However, what is equally important—and may receive less attention—is how such inherently human capabilities as learning, creativity and

collaboration (see Section 2.3) can be strengthened in the emerging digital era. Furthermore, attention should be paid to exploring how new technologies can be harnessed to support and extend those capabilities. For example, more knowledge is needed on the ‘invisible’ processes that take place in the human mind—such as the regulation of learning, knowledge construction and motivational beliefs (e.g. self-efficacy). To understand these complex individual- and group-level processes, there is a need to make them visible. Fortunately, research advances in the field of learning sciences and learning analytics can make, to some extent, individual- and group-level processes visible to both learners and researchers (Saint et al., 2020). These processes can also be supported by and traced using new technologies, such as motion detection, eye tracking or psychophysiological measures (Järvelä et al., 2020). Today, there is a premise that the integration and development of new technologies, along with a theoretical understanding, can help in designing powerful learning environments that can support the competencies needed in continuous learning.

### Uncovering the invisible learning processes with technological support

The challenge: To understand the invisible and complex learning processes of human cognition, motivation and emotions that support lifelong learning

#### Required actions:

- There is a need to make complex learning processes visible in order to understand and support them.
- We need to integrate a theoretical understanding of the human learning processes to support the adaptive development of technologies and AI.
- There is a need to harness technological innovations, such as sensor technology, facial expression recognition and AI solutions, to strengthen human awareness of these complex learning processes.

#### Pressing questions to address:

1. How can learning processes and skills serve humans to co-evolve with new technologies in the emerging digital era?
2. How can technology help make the learning processes visible?
3. How can humans enhance their learning skills by harnessing technology?
4. How does the human body respond to different media formats?
5. Which aspects of analogue processing need to be retained in digital formats (e.g. what is the cognitive role of the fine-grained motor skills needed to write with a pencil during writing tasks)?

#### Needs and resources:

There is a need to apply theoretical and methodological expertise in learning sciences for the utilisation of a multidisciplinary approach in designing technological innovations and AI to support complex learning processes.

Multidisciplinary research should combine cognitive and neurological psychology and education and subject disciplines.

Policymakers face the challenge of creating educational mechanisms that ensure the adaptation to the skill sets that are needed in the future (McKinsey & Company, 2017).

We need the culture of lifelong learning among all citizens, regardless of their age, educational experience or socio-economic background.

### Co-evolution to promote well-being

From a co-evolutionary perspective, digital technologies have both favourable and adverse effects on the health and well-being of people. Novel AI-powered technologies have assisted in health research, in drug development and in conducting public health interventions and are transforming health-care practices, as they are expected to be increasingly used to support medical decision-making, enable personalised medicine and help reach underserved populations (WHO, 2021). In everyday settings, technological development has offered and will continue to offer people new ways to connect and interact with each other (OECD, 2016, p. 15), learn, gain and create information and spend time across boundaries of time, place and social context—all of which can lead to positive consequences for well-being.

Despite the many benefits to individuals and society, the use of digital technologies also has adverse impacts on people's health and well-being. In health care, an increase in their use can involve new risks, such as fortified biases in health-care services and decreased human autonomy in medical decision-making (WHO, 2021). In everyday life, increased reliance on technology has been associated with depression and anxiety, sleep disturbances, reduced physical activity, addictive behaviour (Männikkö et al., 2017; Piteo & Ward, 2020) and information overload and anxiety (Soroya et al., 2021). Moreover, increased technology use can increase the risk of social isolation, which might result in the progressive weakening of social and community ties and in worsening well-being. The mitigation of these impacts tends to focus on monitoring and limiting access to digital technologies. However, this approach can also limit the positive impacts of these technologies on people (Boulianne & Theocharis, 2018).

## Digitalisation has the potential to act as an equalising force, but modern development also carries the risk for greater inequalities.

Digitalisation has the potential to act as an equalising force, but modern development also carries the risk for greater inequalities. Overall, the divergence of people's technological realities is expected to deepen based on the differences in the use of digital technology on the one hand and related *competencies* on the other (Sitra, 2020). Various kinds of digital divides and exclusions vis-à-vis digital technology are still strong in society, especially among the young generation—generation Z—concerning the access, use, design and development of digital technology (e.g. Iivari et al., 2018; Vainionpää et al., 2020). Moreover,

technology-based divisions can contribute to a variety of other concerns, including health inequalities and marginalisation. Then again, there is also a strong belief in the power of design and technology to mitigate problems around inequality, marginalisation and oppression (e.g. Iivari et al., 2021). Hence, there is a growing need to understand how the ways people use digital technologies influence their health and well-being and the kinds of competencies that are critical to mitigating the potential adverse effects and gaining the benefits of these technologies.

### Changing digital media practices may have both favourable and adverse influences on health and well-being

**The challenge:** Digitalisation has radically changed the structures of society and the daily life of people over a relatively short period of time. This has both favourable and adverse impacts on people's health and well-being.

#### Required actions:

- Besides the need to examine the impact of digitalisation on health care, a more nuanced understanding of the ways the use of digital technologies influence people's health and well-being and of the competencies that are critical to mitigating the potential adverse effects and gaining the benefits of digital technologies is necessary.
- These developments can create divisions and inequality between people and thus need to be addressed.

#### Pressing questions to address:

1. What are the potential undesirable consequences of using digital technologies for health and well-being from the perspective of individuals and groups with diverse life situations, competencies and needs?
2. What are the key competencies people need for understanding and making use of the changing digitalised environments for better health and well-being?
3. Does digitalisation strengthen social networks or lead to social isolation?
4. How is the rapid deployment of intelligent technologies altering the need for integration into social groups and institutions?
5. How can the potentially harmful effects of digital media be mitigated at the individual, community and society level through support, competence development, design and regulation?

#### Needs and resources:

Novel discipline-crossing collaboration and expertise between health sciences, social sciences, humanities and computer science are needed to tackle these challenges. A mixed-method approach and new methods are needed to examine the impact of individual digital systems, of practices that are changing with digital technologies and of the overall digitalisation processes on health and well-being.

### 3.2 Co-creating a better world

Eventually, when new technologies are adopted in society, they become socio-technologies. The development of socio-technologies is hardly ever linear but a complex systemic phenomenon that is nonlinear and sometimes counter-intuitive. Furthermore, socio-technologies evolve through multiple parallel adoption paths. Some people are eager to or highly skilled in adopting and appropriating new technology-mediated practices, while others are not. Including people from various backgrounds is, therefore, already critical at the design stage. To this end, co-creation needs to identify and involve the necessary knowledge for human- and technology-driven innovations. While both academic and business organisations have recently been aiming to innovate by fostering inclusion and diversity, more must be done. We argue that the next logical step is to empower people as active agents in their digital lives rather than just passive consumers and that co-creation is one of the keys for it (see Figure 3). Co-creation opens up possibilities for better public services that account for all citizens; it creates new business opportunities through a better understanding of user needs and offers meaningful possibilities for everybody to shape their own digital future instead of letting others create it for them.

**Some possess the skills to adopt new technology-mediated practices, while others do not. Including people from various backgrounds is critical at the design stage.**

The GenZ project looks at co-creation from three different perspectives, as follows. First, we would like to understand 1) how to **collaboratively create value** for all stakeholders in the service-dominant logic (see e.g. Vargo et al., 2008); the aim is that when all stakeholders experience value, they are willing to commit to the solutions. For us, this entails seeing technology users in the design process as active participants and co-designers (Sanders and Stappers, 2008), who do not only inform but also give voice to those that have traditionally been left out from technology design processes in the past, such as children, the elderly or minorities. We see that this enables 2) the creation of more **sustainable solutions**, not

only in the traditional ecological sense of sustainability but also solutions aiming at fairness at large: solutions that are inclusive, support equality and diversity and are 'built and used in sustainable and beneficial ways for humankind' (Loebbecke & Picot, 2015). For the solutions to be durable, they need to be 3) understood and developed in and for their **sociocultural context**, in which the web of individual actors with their histories, interactions and discourses should not be ignored (Scollon & Scollon, 2004).

GenZ employs co-creation as an approach that envisions digitalisation going in a hyper-inclusive and broadly beneficial direction and asks how human sciences can contribute to boundary breaking to enable ambitious and interactive human-technology development in intelligent socio-technical futures. We seek answers to this question through new forms of collaboration and co-creation across three specific themes, as follows.



Figure 3: Co-creation is one path towards empowering people to take control of their digital futures.



## Collaborative value creation

New innovations often lead to initially painful changes in how our lives are organised. Approval of digital innovations, hence, is not a given, and the more radical and faster implemented innovations are, the more doubts and suspicions can be expected. Accommodating the adoption of digital innovations will help avoid a digitally stratified society and various related conflicts. For this reason, especially at the organisational level, digital innovation hubs are becoming critical actors. Such hubs typically revolve around a certain theme (e.g. digital health) and pull together governmental, academic and local industry operations to support digital transformation through multi-partner cooperation and expertise sharing. Collaboration between various stakeholders helps create more acceptable and beneficial innovations for everyone.

It is not enough, however, to see co-creation as something happening between organisations; we need everybody to be able to build a better world for all of us. Users of technology are also needed as participants in the collaborative process when the resulting innovations affect their lives. The problem is that while co-creation is discussed as a way to engage users and the community in the design of digital products and services, meaningful engagement is often lacking, as power over the process of development is unequally held by particular players, such as investors, large digital multinationals and governments. One example of such a situation is how teachers are often asked to support edtech product design by having their students ‘test’ new products. The corporate message of value for the teachers and students is that they ‘get to see state-of-the-art’ technologies; however, how much this participation actually supports effective student learning and teacher professional development is often very unclear. Another issue is that involving users in the design process is not straightforward: Many issues relating, for example, to motivation and interest require skills and competencies. However, power and politics prevail. All parties benefit if the users have at least some understanding of the design process itself, while the current educational system is very limited in providing citizens with such an understanding broadly. It is also relatively demanding for technology developers to be inclusive: such an endeavour demands new kinds of skills, competencies and mindsets, particularly in the case of working with challenging groups of participants, such as children, the disabled, the elderly or minorities—working with them requires sensitivity. However, it is unsustainable that our digital futures are built only by a relatively homogenous group of people; thus, diversity is a necessary step. It is important to ensure that the participation is not only decorative or tokenistic (see e.g. Hart, 1992) but instead genuine, taking into consideration that it needs to be meaningful and impactful despite its political, contextual and educational features (Kinnula & Iivari, 2021).

## Creating sustainable digital futures requires collaboration and participants from diverse backgrounds

Advancements in digital technology provide novel ways for ordinary people to take a more active role in shaping our digital futures. Creative and collaborative innovation is enabled, for example, by new emerging technologies on digital fabrication and physical computing. Such technologies are now available to ordinary people in makerspaces of various kinds. They are typically community-operated workspaces where people collaborate to innovate and create prototypes and, in the best case, market-ready solutions. While it is common for any space to have its own specific equipment and workflows, several processes and characteristics can be defined as best practices for fostering

cooperation between spaces. Having the same core processes available in all spaces and sharing information efficiently in specific makerspace networks is creating a platform for disruptive distributed manufacturing. In fact, in the USA, Congressman Bill Foster introduced legislation to support a national *Fab Lab* (fabrication laboratory) network in order to ‘provide aspiring inventors and entrepreneurs with access to Fab Labs, lowering the entry barrier for small businesses and manufacturing’. Being shared by nature and connected to the market economy, Fab Labs could lead to new economic models. Developing such things could lead to a higher employment rate and a stronger economy while increasing the quality of life for users. The inability to follow this development could lead to local recession, unemployment and poor quality of life in the community. To this end, we must understand how new businesses and value creation can develop in new digital fabrication environments. We need to network at all levels, from citywide to global, study all emerging value creation models and stay actively tuned to agile networks. To make this possible, we argue that ordinary citizens who grow into innovators are one of the keys: When they learn about the possibilities Fab Labs offer, they can utilise them to better their personal lives but also the lives of other people through business opportunities. For this to happen, one should participate in collaborative projects in education and business within their network and finally develop one’s own business model to join in this development.

## ‘Navigating change’

### The challenge:

In an ever-digitalising society, it is essential to empower people to start making and shaping our digital futures—this leads to better products and services, less resistance and fear regarding new ways of living and to generally more inclusive digital futures. Such empowerment requires new skills and competencies, as well as interest and motivation, from all the stakeholders involved. The current structures, including the educational system and industry practices, provide limited support for this.

### Pressing questions to address:

1. How can societal approval of disruptive digital innovation be nurtured?
2. How can value be created in new emerging or futuristic infrastructures, such as makerspaces, Fab Labs or software laboratories?
3. How do digital innovations impact the actors, structures and practices of existing systems?
4. What are the factors that work to attract citizens as creators and contributors to the new collaborative value-creation processes?
5. How can we move towards a more meaningful engagement of ‘end-users’ in the co-creation of digital environments through acknowledging the political and power structures underlying co-creation?

## Sustainability

In the GenZ context, sustainability refers not only to the traditional sense of environmental impact but also to social sustainability (Vallance et al., 2011) and the long-term feasibility and impact potential of services. We link this to recent discussions on digitalisation, in which humans and their (work) practices are set to focus on designing digital solutions to augment and exploit human capabilities (Baptista et al., 2020), thus creating more efficient systems instead of concentrating on the technology (Schneiderman, 2020) or designing solutions to replace humans (Richter et al., 2018). We suggest that combining these human-centric views with an aim for value co-creation as it is understood in service-dominant logic in marketing (Vargo & Lusch, 2016) (i.e. aiming for creating value for all stakeholders) is key to creating a more sustainable world for us—better services and products for everybody, more durable solutions and increased agency and empowerment of humans.

For this, issues such as ethics and the long-term viability of business models need attention. Given the rapidly ageing population and the potential of digital solutions in health care, a good example can be found in health data management and use. Health data are now extremely broadly leveraged by private actors as a building block in various services and in making various inferences about the users. This also happens far too often outside informed consent: Data are collected for a purpose and then reused in an ethically questionable way for something else. There is no lack of public-privacy-related scandals in which one’s health data have been used for purposes not communicated initially. Mobile apps often collect more data than they require, and the intrinsic business and utility value of the data is now clear. While the negative effects often claim the spotlight in the media, this development also offers great opportunities for people to become engaged and empowered data producers.

**A complete rethinking of data management may be in the best interests of the people generating the data: all members of society.**

Digital services and hardware that collect and manage immense amounts of personal data with varying degrees of sensitivity are proliferating rapidly in our everyday lives (OECD, 2016, p. 15; Sitra, 2020). While the data enable AI-based solutions with great positive potential, people have difficulties in understanding what data is being collected and siloed, and the myriad recent scandals about data misuse or leaks highlight the issues around data management. To make matters worse, the (re)use of personal data is heavily regulated and protected by multiple layers of legislation that differs between countries. While created to protect users, the same legislation often also restricts the use of data for social good and societally beneficial innovations or research purposes. Finally, the value of data is

not fully understood by the public, and there is an identified opportunity to better compensate people for their data when used for purposes that derive value from it for the broader society or businesses. Indeed, people’s personal data is extremely valuable, but seldom do the data producers—ordinary

citizens—see how data is stored, reused and leveraged for profits by commercial actors. This is not ethically sustainable and is something we must collaboratively address. A complete rethinking of data management may be in the best interests of the people generating the data: all members of society.

### ‘Thinking in generations, not quarters’

#### The challenge:

Traditional ways of understanding sustainability solely via environmental footprints are no longer sufficient. We need to stop thinking about the development of digital solutions as single entities and instead start seeing them as a part of a whole—as socio-technologies, with potential unforeseeable links to other realms of human life than originally intended. Personal data reuse ethics necessitate considering new business models and how to best serve people in the long term without sacrificing their data governance rights.

#### Pressing questions to address:

1. How can we create digital solutions that augment and empower humans, exploiting their capabilities instead of replacing them?
2. What are the value flows and types of human-centric personal data management? Value comes in many forms: Data has value that can be measured in money, reductions in time, improvement of processes or even as a resource for research (e.g. in the form of training data for future AI-based solutions). Should we be able to adopt a human-centric data management model, understanding these value flows is imperative to drive the adoption of such a model.
3. What new business models that maximise the benefits to the people creating the bulk of the data can human-centric personal data management offer?
4. In which other ways (besides monetary) can organisations and individuals benefit from the newly discovered value flows of personal data when the data are controlled by the individuals?
5. What are the new sustainable long-term business models afforded by new ways of managing and sharing personal data across different actors? How can value be created in emerging digital fabrication networks?
6. How can we increase the representative diversity of people participating in the co-creation of a responsible knowledge society with new technologies with the aim of enabling and sustaining democratic participation in digitalisation?
7. Why do current higher education institutional structures, processes, resources and policies not facilitate sustainable development globally or do it so poorly?

### Context dependency

A fundamental premise in developing user-friendly technologies, especially for the general public, is to consider their context of use. In which situation, where, for what purpose and by whom are the solutions used? In co-creation, context should be understood as everything that impacts the use or adoption of a digital solution. This encompasses a plethora of considerations, such as the user-facing attributes (e.g. usability and explainability) of a given digital service, the constraints and trade-offs that service providers must make and larger societal issues, such as legislation, overall resistance to technologies or even cultural factors. Such a nuanced understanding of context will facilitate the *broad societal approval of digital transformations*.

### In which situation, where, for what purpose and by whom are digital solutions used?

As a domain that touches upon most people in the future, we wish to highlight *e-health services*. Understanding the context of future e-health solutions is critical due to the ageing population and the need to better grasp how different generations engage with digital health services (Hirvonen et al., 2020), which are imperative in avoiding an emerging resource crisis in health care.

Digital transformations—that is, ‘the combined effects of several digital innovations bringing about novel actors (and actor constellations), structures, practices, values and beliefs that change, threaten, replace or complement existing rules of the game within organizations and fields’ (Hinings et al., 2018, p. 52)—depend on societal approval to succeed. Creating digital solutions in a context-sensitive fashion, together with all stakeholders and from the onset, leads to better (more usable, useful, culturally, politically, socially and organisationally appropriate) solutions which minimise the inevitable resistance. As a particularly interesting, pivotal example of

## ‘Accounting for everyone’

### The challenge:

As technologies become adopted across a broad range of societal contexts, it is becoming increasingly difficult to design technologies that work for everyone, not just the majority. Suboptimal solutions lead to resistance to technologies, and resistance slows down progress. The challenge here is to identify and involve all relevant stakeholders early in the design and iterative implementation processes of digital services.

### Pressing questions to address:

1. How can we best increase the representative diversity of people taking part in co-creative processes?
2. How can we cater to those contexts that are currently invisible, neglected and marginalised while addressing and supporting digitalisation within a variety of (cultural, social, organisational, political, economic and geographical) contexts and needs?
3. Which parts, processes and contexts of society have been missed earlier and can we model them at the service design stage already to ensure the least resistance for new digital innovations?

### Needs and resources for all of the above:

A multidisciplinary research approach following mixed-methods data acquisition approaches, including quantitative long-term analysis from a variety of case studies, as well as qualitative work, such as ethnographic research, to understand the views of different stakeholder groups.

## 3.3 The importance of building resilience

Resilience is one of the major conceptual tools to deal with change and transition towards human well-being and more sustainable societies. In general, it refers to ‘the long-term capacity of a system to deal with change and continue to develop’ (Stockholm Resilience Centre, 2015, p. 3). Originally, the concept was used for analysing the stability of ecological systems and how they reacted to disturbance, stress and other external shocks (Holling, 1973), but soon, resilience thinking began to influence research and change management beyond ecology (Davoudi, 2012), including the use of terms such as business, tourism and community resilience (see Saarinen & Gill, 2019). In addition, resilience is commonly understood as a multi-scalar idea that involves different (operational) levels, which are often divided into individual, organisational and regional resilience (see Hall et al., 2018; Martin & Sunley, 2015) (see Figure 4).



Figure 4: From individual, organisational and regional resilience to the resilience of communities.

## Individual resilience

Individual resilience can be defined as a person's ability to cope with stress and adversity while continuing to function effectively following misfortune, change or failures (Garcia-Dia et al., 2013). We live in an increasingly volatile and uncertain, shock-prone world, which warrants individuals and social groups building efficient resilience not only to survive the shocks and stresses but also to adapt to them, transform and be better prepared for future changes. The capacity for adaptation is shaped by individual capabilities and resources, life events and the living environment, including socio-economic factors (Fletcher & Sarkar, 2013; Jacobsen et al., 2016).

Academic research has analysed the role of protective factors, such as assets, resources and strengths, in the process of adaptation (Windle, 2010). How should we improve these assets? Could we somehow combine them with the ideas of co-evolution and co-creation? While some may be more resilient by nature or have certain (cognitive and non-cognitive) skills that make them more resilient, we also need to understand and research how to improve protective factors, such as assets, for people. Furthermore, individuals also learn from past crises, and thus, resilience can be promoted and developed. Individual resilience can help build community resilience. However, we need to be critical that we do not (intentionally or unintentionally) use resilience building as a justification for focusing on only the symptoms but not the root causes of harmful changes in our lives and living environments. For example, in addition to adapting to the impacts of climate change, we need to mitigate the change and limit the amount of carbon dioxide emissions.

### **Building individual resilience does not solely rely on digital skills but also calls for learning other types of skills.**

Digital technology has been viewed as a tool which has the potential to facilitate increased resilience across a range of contexts (Deloitte, 2020). Recent developments in frontier technologies, including AI, robotics and big data, have further increased the many ways that digital technology innovations can improve resilience (UN, 2021). This underscores the paramount role of the ongoing co-evolution of humans and digital technologies. However, a balance needs to be found—we should not rely too much on technology in adapting to the effects of shocks and other changes that make us vulnerable.

Emerging technologies introduce changes which may not only improve our resilience but also require resilience. The COVID-19 crisis has heightened awareness of the benefits of digitalisation, digital inclusion and digital skills development, which can help individuals to cope with the crisis and future shocks (e.g. turning to digital technologies to maintain certain levels of activity during the COVID-19 pandemic via remote working). Nevertheless, building individual resilience does not solely rely on digital skills but also calls for learning other types of skills. This requires education at various levels. How do we do that and who will do it? (See Section 2.3.) We need a culture of lifelong learning among all citizens, regardless of their age, educational experience or socio-economic background. Adult learning can be undertaken in the form of a) formal education or training, b) non-formal education or training or c) informal learning (OECD, 2019, box 4.2).

The unique added value of human capital is increasingly linked to the performance of complex tasks that require knowledge-intensive skills and know-how. The future workforce transition in skill needs has been expressed as a shift to a new mix of skills: technical, social and creative (e.g., remote-working and multilocal work (Deloitte, 2020). Digitalisation allows employees to focus on non-routine tasks, problem-solving and more creative and complex communication activities. This has meant that demand for high-cognitive skills, such as written and oral expression, reasoning and complex problem-solving has increased (OECD, 2019).

**The challenge:**

How can we enhance people's resilience? There is a danger that humans rely too much on technology when they face shocks. Strengthening skills other than digital is often overlooked in contemporary discourses on humans' development. How do we make sure that all people have the chance to acquire the required digital and other skills needed in the future? While technological progress can move quite quickly, people's ability to adapt to it is far slower.

**Required actions:**

- Lifelong learning and strengthening skills other than digital can help individuals adapt and become resilient to external shocks, lowering their vulnerability.

**Pressing questions to address:**

1. Which skills are more necessary in times of shock or crisis?
2. Which indicators can be used to define people's resilience?
3. How can one learn to be resilient?
4. How do we motivate people for lifelong learning?
5. Are older adults prepared to gain the skills needed to develop resilience?

**Needs and resources:**

Cross-disciplinary research and multidisciplinary expertise, collaboration (e.g. between firms and educational institutes)

**Organisational resilience**

Duchek (2020a) defined organisational resilience as 'an organisation's ability to anticipate potential threats, to cope effectively with adverse events, and to adapt to changing conditions' (p. 220). In the same vein, Denyer (2017) interpreted organisational resilience as 'the ability of an organization to anticipate, prepare for, respond and adapt to incremental change and sudden disruptions in order to survive and prosper'. The latter definition is highly similar to that of regional resilience (Martin, 2012), which we discuss in the next section.

Today, firms and employees must learn to cope with constant temporariness and to live with flexibility and unpredictability. Yet, how can we build up organisational resilience and leadership in harmony with individual resilience? In the digital age, leaders need to understand human beings as vulnerable and unique individuals who are concentrating on finding their underlying passion and motivation. This highlights that the resilience of firms and other organisations largely relies on the resilience (and well-being) of their employees. At the organisational level, this requires both managerial and technical skills. Individuals are key to fostering organisational resilience. New organisational and leadership models and support systems need to be developed and implemented to enhance well-being in remote work, crises and exceptional situations, such as the COVID-19 pandemic.

**The resilience of firms and other organisations largely relies on the resilience and well-being of their employees.**

Digitalisation and new technologies are increasingly changing our society, including labour markets and job requirements. The nature of our work and the work environment tends to change over time in response to market changes, technological developments and external shocks. Firms and other organisations must be flexible and ready to adapt to sudden and sometimes unpredictable changes in conditions. This highlights the need for new knowledge about the possible changes in future work.

Following the ideas of Schumpeterian creative destruction, entrepreneurial dynamics override incumbents and new work possibilities are created. Creative destruction means that new job possibilities necessitate new types of knowledge, skills and work abilities (Simonen et al., 2020). This is a challenge for workers and firms, as well as educational institutes. How can we forecast future trends in the rapidly growing and transforming digital world?

**The challenge:**

The management philosophy of firms has recently changed from 'just-in-time' thinking (efficiency and profit maximisation) to 'just-in-case' thinking (bigger inventories, etc.). This has created increasing tension between efficiency vs resilience thinking. Risk management is too often construed as a means of maintaining the leanest possible operations in the name of efficiency. Without extra stocks, there is much greater vulnerability and firms have little or no ability to absorb shocks (e.g. in the supply chain), which in turn can quickly turn into failures.

**Required actions:**

- Much more emphasis is placed on recovery-driven thinking rather than loss-avoiding or profit-seeking thinking.

**Pressing questions to address:**

1. How can organisational resilience and leadership be built in harmony with individual resilience?
2. How do we support possibilities for lifelong learning in firms, especially in Small and mid-size enterprises (SMEs)?
3. How can we meet the growing challenges of teleworking/remote working?
4. How can digitalisation help develop market accessibility?

**Needs and resources:**

Theoretical and methodological expertise through a multidisciplinary approach to designing technological innovations



## Regional resilience

Regional development is a cumulative process of change in which social and technological innovations and industrial waves follow one another (Martin & Sunley, 2015). The process of regional development has also become more prone to shocks, as regions have become increasingly interconnected as a result of globalisation. In addition, global environmental change characterised by changes in climate and biological diversity has an increasing impact on local and regional development prospects. Thus, global crises may have potentially significant and rapid consequences for regional development in the future. The technological and economic shocks can be local, national or global in origin. Shocks can be sudden or characterised by slow onset changes, they can be temporary or long-lasting, or regions can face one shock or series of shocks (e.g. Martin & Gardiner, 2019). These shocks may push a region out of its predictable growth path.

The concept of regional resilience has been utilised to describe how regions respond to changes in their economic and technological environments (e.g. Bristow & Healy, 2014; Martin, 2012; Martin & Sunley, 2015; Martin et al., 2016; Reggiani et al., 2002). Attention has shifted from local competitiveness (competitiveness indexes) to local resilience (resilience indexes). How well can a region respond to and recover from shocks and disturbances through effective regional policy? Equally important is the ability of regions to anticipate and prepare for disturbances and recover from them through regional policy. Regions can learn from previous crises in a similar way as individuals. However, a one-size-fits-all approach to understanding and managing resilience is ineffective. Given the heterogeneity of crises, each has its own unique characteristics, severity, duration and influence on the regional economy and resilience.

Regional innovation strategies, emphasising the engagement of actors and the links between the actors on various levels and a collective forward-looking attitude, help a region's ability to adapt to changes in the local business environment and support resilience in its various forms. The framework of creative resilience (Simonen et al., 2020) identifies three elements as the core of creative resilience: knowledge creation, entrepreneurship and community spirit.

The COVID-19 crisis prompted renewed attention to the concept of regional resilience but also revealed opportunities linked to digitalisation. One of the aims of the EU's digital strategy (digital transition) was to enhance the resilience of people, firms and regions (European Commission 2021a, 2021b). Over time, increasing digitalisation can enable regions to adapt their industrial and technological structures to changes in the economy, allowing for long-term regional path renewal and restructuring processes. Investments in digitalisation in the public and private sectors, the utilisation of digital solutions and the generation of new business models can potentially improve regional resilience to shocks and are critical for long-term economic growth and regional development. Replacing obsolete and unproductive business activities with new fields of technology and knowledge can be compared to Schumpeter's description of 'creative destruction.' Supporting SMEs in particular in the use of digital solutions (e.g. online platforms) and improving the digital skills of employees are some of the objectives of the EU's digital strategy.

**The challenge:**

How do we identify the sources of future economic growth in regions? How can we support the transition to digital technologies at the regional level? How can we use digital technologies to engage quadruple helix actors in a way that enhances regional resilience and sustainable development?

**Required actions:**

- Resilient strategy requires the active engagement and participation of all actors (public sector, private sector and civic society in general) and the local population in particular, and digitalisation can be a facilitator.

**Pressing questions to address:**

1. How can various players' values, expectations, preferences and interests influence the trajectory of a region's resilience?
2. What role does actor-led collaboration play in the development of resilient regions?
3. How can the sustainable and inclusive development of regions and places be proactively ensured in times of crisis?
4. How do voices from communities at different spatial and temporal scales contribute to building a more resilient and sustainable society?
5. How can technology be used to improve communication, collaboration and, for example, data gathering?
6. How artificial intelligence can help us identify opportunities to develop resilience in its various forms and levels?



## 4 Conclusive remarks

This white paper presents the GenZ vision for gaining new knowledge about digitalisation processes that shape different aspects of life and will continue to do so in the future. It has outlined challenges and questions that research and societies need to tackle in order to make possible human-centric and socially sustainable digital futures.

The white paper targets a broad readership. It has been written for researchers across disciplinary boundaries involved and interested in digitalisation, technology designers and developers, and policy-makers. It is a collaborative effort by researchers from six faculties and groups working on questions related to digitalisation at the University of Oulu, Finland. It highlights the importance of supporting and strengthening human competences that are profoundly human and which machines cannot replicate. Such competences include the capability to sense and display emotions, establish shared meanings in interactions with others and solve complex societal problems in ethical, creative and flexible ways. Additionally, it argues that contemporary views, dialogue and thinking around digitalisation take humans for granted; more research in social sciences and humanities (SSH) is needed to identify and describe digitalisation processes and phenomena, and this research must place human-beings (not technology) at the centre of attention. This will be critical in ensuring that everyone has a better and more sustainable digital future. Three concepts are central and helpful, offering a starting point for developing better vocabulary to talk about human-centric digitalisation: co-evolution, co-creation and resilience.

More knowledge is needed to understand the **co-evolutionary processes** between humans and digital technologies and what it means for a person to grow up with and live alongside new digital technologies. This is important because large parts of our everyday lives, interactions and communication will move over to digital platforms. This will offer new possibilities but also present challenges for (continuous) learning and education; it will also impact people's health and well-being.

Multidisciplinary expertise about the co-evolutionary processes needs to be integrated into **co-creation work** that brings together experts and stakeholders from different backgrounds to tackle questions concerning digitalisation and to develop better digital futures. Digitalisation impacts everybody. Hence, it is essential to involve people broadly in the planning and designing of their digital futures. Such co-creative work builds foundations for the development of digital solutions that are inclusive and work for everybody; this will pave way for sustainable socio-technologies.

Identifying and describing co-evolutionary processes and tackling the challenges involved in co-creative processes will provide important knowledge for enhancing the **resilience** of individuals, organisations and societies. Special attention needs to be put on how individuals, organisations and societies adapt to digitalisation and are able to "bounce back" when disruptions and challenges emerge.

The chapters in the white paper sought to identify a number of contemporary challenges with respect to the different dimensions of digitalisation that require careful consideration and deserve closer critical attention.

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