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DIGITAL INNOVATION AND THE FUTURE OF WORK

Hans Schaffers, Matti Vartiainen and Jacques Bus (Editors)



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Digital Innovation and the Future of Work

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Digital Innovation and the Future of Work

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Preface

Work is a fundamental human activity and forms an important part of our lives. For many people, work is a goal-oriented activity, allowing us to create something useful or, as in the arts, beautiful. Work also enables us to learn and improve skills and capabilities, shape our creativity and fulfil our human potential. However, working as an activity can take many different forms, including hard labor under difficult circumstances aimed only at earning a living. This can be observed in low-quality jobs in developing countries but also in the ‘gig’ jobs of the modern platform economy. Technology, and in particular those set of technologies that drive the ongoing process of digitalization, plays a key role in shaping the modern world of work. It does so in various ways, for example by enabling new forms of team cooperation and working on a distance, by influencing how work activities are organized and coordinated in different ways such as in customer driven supply chains, networks or platforms, by assisting the worker and teams in conducting complex tasks, by automating work tasks, and by monitoring and managing working behavior and performance. Digital technological innovations and the drive towards new business models exploiting such technologies are bringing important work-related issues on the forefront, such as quality of work, working conditions, worker participation, self-organization of work, and workplace innovation. Digital innovations also raise broader societal and ethical debates regarding data surveillance, data sovereignty, privacy intrusion and market dominance. Technologies that constitute the current wave of digitalization, such as artificial intelligence, Internet of Things, robotics, big data, wireless networks, enterprise platforms and other will further influence on transforming the nature of work, the work environment and its societal context. Therefore, it is important to understand the implications of digitalization for the future of work and the future work environment from a human and societal perspective. To this end, this book brings together a collection of studies from different perspectives and authored by a diverse group of experts to address the technological, economic and political forces shaping the new world of work and the prospects for

human-centric and responsible innovations. Five major topics are covered: 1. The evolution of digital technology impacting ways of working; 2. The role of artificial intelligence in new ways of working; 3. Transformation of work, jobs and employment; 4. Digitalization and need for skills and competencies; and 5. New forms of decentralized working and cooperation. We hope the book will be useful not only for scientists, engineers and students but also for practitioners and policy makers.

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List of Abbreviations

AI	Artificial Intelligence
AM	Additive Manufacturing
ARPA	Advanced Research Projects Agency
AR/VR	Augmented Reality / Virtual Reality
ART	Anticipated Radical Technology
AS	Autonomous Systems
CAD/CAM	Computer Aided Design/Computer Aided Manufacturing
CBPP	Commons-Based Peer Production
CERN	Conseil Européen pour la Recherche Nucléaire (European Organization for Nuclear Research)
COVID-19	Pandemic caused by coronavirus (SARS-COV-2)
DAI	Distributed Artificial Intelligence
DevOps	Practices combining (Software) Development and (IT) Operations
DLT	Distributed Ledger Technologies
EHR	Electronic Hospital Records
EPR	Electronic Patient Records
ERP	Enterprise Resource Planning
EV	Electric Vehicles
EU	European Union
EU-KLEMS	Database for EU-level analysis of Capital, Labour, Energy, Manufacturing, Services
EUWIN	European Workplace Innovation Network
FLOSS	Free/Libre and Open Source Software
GCT	Game-Changing Technologies
GDPR	General Data Protection regulation
GNP	Gross National Product
GOF AI	Good Old-Fashioned Artificial Intelligence
GVN	Global Value Producing Network
HIV	Human Immunodeficiency Virus
HLEG	High Level Expert Group

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IC	Intensive Care
ICO	Initial Coin Offering
ICT	Information and Communication Technologies
ID	Identity Document
IP	Internet Protocol
ILO	International Labour Organization
IoT	Internet of Things
KBC	Knowledge Based Capital
ML	Machine Learning
MLM	Mobile Labor Markets
MR	Mobile Robotics
MS	Microsoft
OECD	Organisation for Economic Cooperation and Development
OODD	Out-Of-Distribution Data
PIAAC	Programme for the International Assessment of Adult Competencies
PoC	Proof of Concept
P2P	Peer-to-Peer
RBTC	Routine Biased Technical Change
R&D	Research and Development
RTI	Radical Technology Inquirer method
SME	Small and Medium-sized Enterprises
SMS	Short message Service
STEM	Science, Technology, Engineering, and Mathematics (competencies)
STSD	Socio-Technical Systems Design
TQM	Total Quality Management
VI	Vertical Integration
VT	Virtual Team

1

Introduction

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1.1 Digitalization in a Changing Society

The concept of digitalization captures the widespread adoption and impact of digital technologies in our lives, in our workplaces, organizations and business models, and in the transformation of our economy and society. Digital technologies for data processing and communication underly far-reaching and high-impact innovations such as the Internet of Things, artificial intelligence (AI), big data and data analytics, robotics, wireless multimedia, enterprise platforms, social networks, and blockchain. These digital innovations embody important new opportunities for prosperity and well-being. There is no shortage of publications explaining how digital technologies and their applications enable innovative products, services and business models, and how they facilitate new networked forms and patterns of collaboration, production, and working. Visionary scenarios such as Industry 4.0 and smart cities testify to a technology-optimistic view. While the process of innovation, experimentation, and practical adoption is ongoing and alternating successes with failures, such innovations are transforming a range of sectors including manufacturing, health care, transport and logistics, food and retail, energy, and public and commercial services. Additionally, digital technologies and applications bring considerable changes in job quality, working conditions and work practices, organization and management, and in the very nature of labor and work as a human activity. This way they deeply affect people's activities, behaviors, and daily lives. In terms of the changes induced by digital innovations and accelerated by the network effects they

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are often subject to, they can be considered as game-changing, pervasive, and disruptive, in multiple ways.

As digital innovations often require integration in a broader technical, organizational, and social environment, they cannot only be considered through the lens of purely technical innovations as represented by electronic systems, networking technologies, software infrastructures, and networked applications. Digital innovations relevant for the future working environment must contribute to and form part of a more comprehensive sociotechnical systemic innovation acceptable to workers. Examples include platform-based work systems, value creating networks, and urban public service systems. The creation and acceptance of such systemic workplace-related innovations require the alignment of a diversity of technologies, processes, organizations and people, as well as stakeholder engagement, and capabilities for adaptation, integration, and learning.

An important aspect of digital technologies and their applications in an increasingly connected world is how they are offering new opportunities for collecting and analyzing all kinds of data, including personal data, and for control and coordination based on such data, while respecting privacy and other ethical considerations. A data-driven approach allows a more efficient and effective organizational coordination, cooperation, and networking, for example in often complex and globalized supply networks, as well as the coordination of work activities in such networks. But we should not forget the potential negative aspects of such globalized supply chains, in terms of commodification of work, lacking worker rights and protections, and unregulated exploitation of natural resources, which creates wide ranging negative external effects. Given these effects and possibly accelerated by the current Corona pandemic, we may enter a period of more seriously considering pathways toward alternative, more decentralized and localized production and work systems, which give more attention to workers' satisfaction.

The way digital technological innovations are created and applied is often the focus of intense societal debates. Key issues include privacy and security; surveillance, control, and power; quality of work and work-life balance; competition and market dominance; and digital divides and social cohesion. In relation to these debates, our society is facing a range of often complex dilemmas and different interests in the continuing process of creating, deploying, and applying digital technological opportunities. At the societal level, the strive for economic benefits of digitalization sometimes hinders social innovation and cohesion. As extensively studied by

Soshana Zuboff in “The Age of Surveillance Capitalism” [1], surveillance-based business models based on commodifying personal data, such as created by Google and Facebook, are conflicting with the idea of data sovereignty and self-determination. At the level of business, ethical dilemmas emerge regarding the exploitation of employee data, which can create conflicts with respect to responsible employee policies. The identification and understanding of the dilemmas and challenges surrounding digital innovation and the stimulation of the public discourse is already one of the challenges in how society addresses and is giving shape to digital innovation. Technological impact analysis, development of digital ethics principles, implementing corporate social responsibility policies, creating responsible and user-centric forms of innovation, and stimulating the public debate are among the wide variety of necessary but also inherently imperfect ways of handling these challenges. A prerequisite for resolution of these dilemmas is the public debate on sometimes difficult trade-offs between different interests and diverging worldviews involved.

Against this background, this book focuses on understanding the implications of “digital innovation” in relation to “the future of work.” Thomas Malone’s book “The Future of Work” [2] took its point of departure in the role of information and communication technologies in enabling new forms of decentralized organization such as networks, internal markets, and communities. Yochai Benkler’s “The Wealth of Networks” [3] elaborated on the model of peer production and sharing, and on the economics of social production (the contribution by Michel Bauwens and Sarah Manski in this book is in addressing the related topic of commons-based peer-to-peer economies). Another key development has been the combined development of AI, platform ecosystems, and crowd-based forms of organizing [4]. Clearly all this has important implications with respect to the “world of work,” which includes besides the changing nature of work also the new forms of digitally enabled organizing and cooperation. This book aims at exploring these implications in more detail including the ways for handling the actual and potential dilemmas and challenges involved. In this sense, the book takes a human- and society-centric perspective regarding the emerging practices of digital working, cooperating, and organizing. Our intention is to shed light on the forces shaping the new “world of work” and on the prospects for “human-centric” and “responsible” digital innovation in that context. To this end, the book critically examines and identifies the actual and potential impacts, implications, and challenges of digital innovation as related to work. Let us

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now first discuss how the nature of work is transforming due to the forces of digitalization.

1.2 The Future of Work Revisited

1.2.1 Mechanisms that Transform Ways of Working

Converting information to a digital format, digitalization of tools, products and services, value-adding processes, working environments, and the adoption of digital business models gradually change the nature of work and ways of working in micro-, small-, medium-sized, and large companies, in local regions such as cities, and globally on virtual online platforms. This development is shown as changes in the work settings or work environment, and where and when work is done. Digitalization penetrates the components of sociotechnical work systems and their contexts to varying degrees, generating the need to update human practices and competencies.

The technology affects a work process by transforming the microstructure of its phases, which is then mirrored in other components of the work system. As the value-producing process is usually still steered and managed by human activities, the changes are also needed in human tasks and jobs. Through this process of transformation, digitalization also replaces, hybridizes, and renews tasks and job contents. This, on its behalf, leads to a need to reorganize and structure organizations. As a consequence, many other organizational and human-related issues are under pressure. For example, restructuring and organizing of work units are needed, resulting in new ways of working, leadership practices, and competencies. The outcomes of this transformation are digitally influenced products and services. The impacts of digitalization do not stop here, as they reflect on how to organize and manage work relations. The remaining hybrid and newly created tasks and jobs need restructuring and reorganizing.

The COVID-19 pandemic forced us to experiment with transformed ways of working in practice. A survey by Eurofound [5] shows that over a third (37%) of those working in the European Union began to telework as a result of the pandemic—over 30% in most member states. The largest proportions of workers who switched to working from home were found in the Nordic and Benelux countries (close to 60% in Finland and above 50% in Luxembourg, the Netherlands, Belgium, and Denmark, and 40% or more in Ireland, Sweden, Austria, and Italy). For comparison, a present US survey study [6] collecting a total of 25,000 responses from April 1 to

April 5, 2020, showed that over one-third of the workers responded to the pandemic by shifting to remote work, while another 11% were laid off or furloughed [7]. Younger people were more likely than older people to switch from commuting to remote work. A representative survey among the German working population [7] tells that every second one was working fully or partly from home in mid-March 2020. Meanwhile, 41% responded that their job is not suitable for working from home. The studies on telework during the pandemic show that most teleworkers collaborated virtually with their colleagues, managers, and customers during their working days. Therefore, digital competences are especially needed in remote virtual work mode. These and similar studies around the globe tell that this “natural experiment” has until now brought forth unanswered questions on how to anticipate these kinds of partly unexpected situations, organize remote work and working conditions, and needed social and virtual support.

1.2.2 Future New Ways of Working Based on “Old” New Ways of Working

What is common to new ways of working is “flexibility.” The *flexible structures* of working life involve organizing assignments into temporary projects for which a group of workers is assembled as necessary to realize the project at hand. Virtual dispersed teams are used as a standard way of cooperating. The main trend is to build flexible, adaptable forms of organizations. More often, work is organized within and between workplaces into *temporary projects*. Also, individual assignments are often temporary, especially when working on platforms.

At the individual level, different forms of remote work lay a basis for other ways of working. In more detail, when work assignments are done outside the “main place of work,” it is referred to as remote work or telework. Thus, remote work is defined as “working outside the conventional office using telecommunication-related technologies to interact with supervisors, coworkers, and clients.” When employees are changing their working locations daily or weekly, they are doing mobile and multilocal work. The development of digital working environments, such as global online platforms employing microproviders, has expanded working locations worldwide. Fully digital work has appeared detached from any stabilized social and organizational settings as *detached temporary global telework*. Detached global teleworkers often work from their homes on different continents.

Remote workers often collaborate from their present locations in temporary or permanent virtual teams and communities. The second main type of the now traditional “new ways of working” is virtual collaboration in distributed teams and projects. Distributed or dispersed work also has deep historical roots. Team members working in different locations and their geographical distances from each other constitute a distributed team. These teams become virtual when extensively utilizing various forms of computer-mediated communication that enable geographically dispersed members to coordinate their individual efforts and inputs.

Digital online platforms serve more and more as crowdsourced dispersed workplaces. A “platform” is a “palette” consisting of usable components to be used for different purposes by one or several actors. Platforms as the working context can be global and/or local. Such work platforms (e.g., Amazon Mechanical Turk) act as employment agencies. An employer somewhere in the world digitally posts tasks for the site’s users to complete. A worker enters the platform using his/her own or a borrowed device, selects a task, completes it, gets credited with the proceeds, and selects the next task. Each completed task earns the worker remuneration.

A key issue for the future organizations is to become more resilient. Resilience does not only refer to adaptation, but rather to the capability for renewal of ways of working. In the future, it is necessary to be ready to absorb external shocks and to rapidly learn from them, while simultaneously anticipating new ones. Resilient people; work processes; work environments; and organizations get knocked down and get up again, ready to learn from events, and to be ready for future challenges. In this sentence I am not sure if semicolons should be used or rather commas.

1.3 Artificial Intelligence and Working Life

AI is an example of key technologies studied in several chapters of this book creating considerable dilemmas for society in general and future of work in particular. The scope of potential applications of AI in the production and work environment is wide ranging. Think of self-learning robots, quality control and predictive maintenance in manufacturing, the use of big data in supply chain management, and the use of AI in decision support in marketing, sales, and human resource management. There is also an increasing attention toward potentially negative aspects of AI, such as its impact on job quality, surveillance, and decision-making. In the beginning of June 2020, Amazon, IBM, and Microsoft decided to put the brake on the development of face

recognition, which is based on machine learning AI. It appeared that in the current state of affairs, it only worked properly on white men, and, for example, very badly on black women. In a letter to the Congress published on the IBM's website, IBM's CEO Arvind Krishna said: "because there is the danger that this technology will be abused for massive surveillance and racial profiling, in particular law enforcement should limit its use" [8]. Of course, this decision was made against the background of the "Black Lives Matter" movement that started in the United States. A good thing is that with this decision a myth about big data was dumped. It is indeed not true that more data used for machine learning automatically leads to more precise AI predictions, as the data need to be representative for the group for which the results are used. This is addressed in Chapter 5 of this book.

A second myth, also discussed in Chapter 5, concerns the basic methods for machine learning predictive analysis. Predictions, even if a large and good representative data set is used for machine learning of the algorithm, will be based on statistical averages and a limited set of behavioral parameters. In particular, predicting human behavior based on the average behavior of a representative group of humans does not take into account that humans are not behaving averagely and worse, they can behave very irrationally. But during machine learning, outliers will be discarded or hardly given considerations. The consequence is that although a certain behavior can be likely, it cannot be taken for true, certainly not if the person under consideration is himself/herself an outlier (e.g., a person with a handicap).

A third myth is that machines will become more powerful than people and will therefore take over the world and make human beings slaves. This is discussed in detail in Chapter 4 of this book. The conclusion of Emilio Mordini, who has written this chapter, is "that AI is great as far as it is used as a tool to amplify and enhance human analytic, dichotomic skills. It is not good for understanding emotions and enjoying art expressions. The current debate about the hypothetical risk that AI might one day surpass human intelligence is largely misplaced."

Nevertheless, serious dangers exist in using AI, as appeared from the above-mentioned decision of three companies on face recognition. Human beings crave to belong and be accepted by their group, society, or nation. This characteristic can be used by people in power to force them through strong surveillance in a harness being designed for them based on AI predictions, e.g., through a "good citizen rating system" rewarding good behavior. Such systems are already under development and in use, for example, in China. Those companies in democratic states recognize this is laudable. But whether

it is enough to avoid this is questionable. The question whether the machines surpass human intelligence is likely not very opportune, but whether people will be made to act like machines by an intelligent and powerful few, is probably a realistic danger. Of course, this does not hold in the political context only. It also is applicable to the working environment, and maybe even more so, given the dependencies between an employer and an employee. In this sense, this book offers some fundamental insights into the future of work.

1.4 Digital Work and the Human Condition

The increasingly important role of digital technologies such as AI in combination with current societal challenges due to the Corona pandemic and climate change raises new questions regarding the “future of work” in a society characterized by connectivity and systemic interdependencies. In discussing “work” in his recent book, “21 Lessons for the 21st Century,” Yuval Harari [9] expects a decrease in jobs due to merging of information technology, robotics, and biotech. Learning algorithms and biometric sensors enable computers to be continuously updated and easily integrated in networks, which may considerably improve health care, for example, in developing countries. In these and other sectors, jobs may disappear due to the applicability of AI, causing the possibility of mass unemployment, social disruption, and even shifting dictatorial power to algorithms. In a recent article [10], Harari reflects on the “world after coronavirus” and suspects that the current emergency measures may become a “fixture for life,” as some countries have implemented far-reaching forms of data surveillance to monitor the spread of coronavirus.

This current situation also invites to reflect about what philosopher Hannah Arendt called the “human condition.” In her still important book of more than 60 years ago under this title, Arendt designates three fundamental human activities in the *vita activa*: “labor,” “work,” and “action” [11]. Throughout human history these activities have changed, shaped by the same conditions they helped creating them. What we currently call “working life” may combine these elements. In her vision, *labor* aims at fulfilling the direct demands and bare necessities of life. Arendt understands the human condition of labor as life itself, which necessitates labor, which is cyclic and repetitive and aimed at consumption. One may think of not only low-quality jobs in developing countries but also the flexible low-quality jobs in the platform economy. Distinct from labor, *work* aims at creating a world

of useful and durable things, and is associated with efficiency, utility, and applying technology to exploit nature and become its master. At the same time, this attitude, in the extreme form which we are witnessing in the current era called the Anthropocene, creates irreversible destruction of our living environment with potentially grave consequences for current and future generations. Maybe it also brings the insight that after all human beings are not disconnected from nature and that we are part of a world characterized by all kinds of interdependencies. Arendt's third activity of *action*, which also includes *speech*, relates us to other humans in a "web of relationships" and is the domain of plurality and politics. In this sense, Arendt invites us, in the current age of digitalization and global societal challenges, to rethink the "world of work."

1.5 Overview of Book Contributions

Whereas all contributions address the future of work, cooperation, and organization in a context of digitalization, there is a broad diversity of perspectives. The initial chapters address the long-term evolution of (digital) technology in relation to future working challenges. The next set of chapters select their starting point in studying the implications of AI on humans, work, and organizations. Thereafter, a third collection of chapters addresses various aspects of the future of work and employment as transformed by the forces of digitalization. The fourth theme is how digital technologies affect human capabilities, skills, and competences. Finally, several chapters focus on how digital technologies are enabling new forms of cooperation and innovation in open and decentralized networks.

1.5.1 Technology Evolution and Future Ways of Working

In Chapter 2, Sofi Kurki and Markku Wilenius take their point of departure in the expected impact of the Coronavirus and similar on the future of work and employment. The authors explore the future of work through two different long wave theories, implying that human sociotechnical systems can be understood in terms of long range cyclical renewal processes. While the well known Kondratieff wave theory addresses the long-term transformation of socioeconomic systems, the more recent but lesser known approach of Malaska focuses on socioevolutionary theory of social change. Both streams of work raise questions regarding the transformation of work and evolution of skills in human-centric organizations. The authors conclude—also motivated

by the implications of the current Corona pandemic for the nature of work and employment—that there is an even greater need to focus on human skills and capabilities that make us better as human beings.

A detailed assessment of the impact of emerging technologies on society and, in particular, working life is presented by Risto Linturi and Osmo Kuusi in Chapter 3. The authors describe a framework for technology foresight and technology driven societal transformation presenting recent findings of a foresight research program, which is still ongoing. In using transition theory concepts for integrating technology push and demand pull, the foresight study addresses the linkages between 100 radical technologies and 20 types of societal and human goals associated with the so-called “global value-producing networks,” such as passenger transport, manufacturing, built environment, and automation of work. The authors demonstrate that all of such value-producing networks face a paradigm-level transformation due to anticipated progress of enabling radical technologies and goal-seeking behavior of actors in each network, which will challenge existing professions, the way we organize work, use our tools and capabilities, and even the need to work for money.

1.5.2 Artificial Intelligence, Humans, and Work

Chapter 4, authored by Emilio Mordini, offers fundamental insights into the relation between human and artificial intelligence. The author observes that our epoch is fascinated by human-like minds and by the fantasy of intelligent machines, which might surpass and substitute human intelligence. Intelligent machines may imitate human skills, such as intuition, emotions, sentiments, capacity for perceiving atmosphere and context, and human’s capacity for sense of humor. The author argues that computational machines may replicate human intuitive skills but they cannot exactly duplicate them. The chapter neither aims to grade natural vs. artificial intelligence nor to raise any ethical consideration on AI; rather aims to show the inherent limits of AI and its applications. A conclusion is that the current debate about the hypothetical risk that AI might one day surpass human intelligence is largely misplaced.

A more design-oriented perspective is offered by Abhishek Gupta and Jutta Treviranus in Chapter 5. They argue that AI can either automate and amplify existing biases or provide new opportunities for previously marginalized individuals and groups. Small minorities and outliers are frequently excluded or misrepresented in population data sets. Even if their data is included, data-driven decisions favor the statistical average,

thereby disadvantaging small minorities. Small minorities and people at the margins are also most vulnerable to data abuse and misuse. The authors state that current privacy protections are ineffective if you are an outlier or in some way anomalous. Their chapter discusses the challenges, dangers, and opportunities of machine learning and AI for individuals and groups that are not represented by the majority.

Valerie Frissen in Chapter 6 argues that AI has a huge potential to facilitate, enhance, and transform human activities. However, concerns have arisen about the risks involved, and a strong call for new ethical and regulatory frameworks has emerged helping to build human-centered, responsible approaches to the use of AI. The chapter discusses two cases of using ethical guidelines related to AI in working practices. The first case addresses approaches to develop responsible AI in health care, more specifically for intensive care, whereas the second case focuses on using AI for data-driven approaches in the domain of public safety and organized crime. The author observes that in both cases particularly the issue of data quality raises concerns. A conclusion is that rigorous and standardized protocols will be required for collecting and using data for AI applications. Furthermore, the two cases demonstrate interesting differences and practical complexities in the way moral and ethical considerations are being taken into account.

1.5.3 Transformation of Work and Employment

The way digital technologies affect the quality of work is addressed by Christian Korunka in Chapter 7. First, a short overview of the general development of digital technologies in the “world of work” is presented, focusing on impacts of “conventional” digital technologies such as computers, office equipment, and software tools. The author then discusses theoretical approaches aimed at explaining these effects, based on the social acceleration concept of Hartmut Rosa and the concept of paradoxes in digital technologies. Based on these concepts, new demands related to digital technologies in the current world of work are discussed and examples of empirical studies investigating these new demands are presented. The author proposes several evidence-based recommendations with the aim of increasing quality of working life when working with digital tools.

A closer look into the work-related implications of eight game-changing technologies is offered by Eleonora Peruffo and Enrique Fernández-Macías. In Chapter 8, these authors argue that since the industrial revolution,

economic development has been punctuated by leaps driven by the successive introduction of radical technological breakthroughs. Until recently, these breakthroughs mostly concerned the manufacturing sector, with services acting as a kind of residual category that collected all the labor displaced by technological progress. The digital revolution has led to the emergence of several major technological breakthroughs with a very significant disruptive potential for both manufacturing and services in Europe. The authors bring together qualitative research findings spanning from 2015 to 2018 which describe the potential impacts of eight different game-changing technologies on work and employment in Europe. The technologies studied increase flexibility and allow mass customization of goods and services, make manufacturing and services increasingly undistinguishable, and increase the efficiency and control of economic processes. In addition, these technologies often have labor-saving effects that may transform the structure of employment and tasks in Europe. The authors conclude that negative implications in terms of autonomy, privacy and control of workers, and conflicts related to the opacity of managerial algorithms or the ownership of the data generated in the workplace will become increasingly salient.

The role of platform work is the focus of Irene Mandl and Christiano Codagnone in Chapter 9. Platform work has emerged as an employment form and business model in Europe about a decade ago, and while still small in scale, it is dynamically developing. This also refers to an increasing heterogeneity within platform work, which results in different effects on employment and working conditions of platform workers. The authors propose a classification of platform work using a combination of five criteria: (1) scale of tasks, (2) skills level required to fulfill them, (3) format of service provision, (4) selector of task assignment, and (5) form of matching. The classification identifies 10 distinctive types of platform work, and the chapter discusses the employment and working conditions of platform workers affiliated to 5 of these 10 types. The authors stress that there is no type of platform work, which exclusively poses advantages or disadvantages to the workers, and that their opportunities and risks vary quite substantially. The authors conclude that platform work, which is related to small-scale, low-skilled tasks (algorithmically) assigned to the worker by the platform which—beyond matching—also determines work organization tends to raise more challenges for workers and the labor market. The chapter finally proposes

a differentiated policy approach which better considers the heterogeneity in platform work.

1.5.4 Digitalization and the Need for Skills and Competencies

Peter Totterdill, in Chapter 10, discusses the need for aligning human capabilities and digital opportunities of Industry 4.0. He argues that Industry 4.0 is at risk of being no more than the latest in the long line of technological predictions based on exaggerated claims. The risk is of drawing corporate decision-makers into patterns of investment that ultimately fail because they ignore the required synergy between the design and implementation of technologies, on the one hand, and human and organizational factors on the other. The technological advances represented by Industry 4.0 potentially offer real economic and also social benefits. At the same time, realizing this potential and avoiding the mistakes of the past means recognizing the importance of a new and more inclusive paradigm of innovation. The challenge is that of reconciling the ordered, rational organization of work offered by emergent technologies with the creative, dialogical, serendipitous, and even chaotic human interactions that can stimulate innovation.

A closer look at human competencies and skills in digitalized working environments is offered by Matti Vartiainen in Chapter 11. He argues that decisions to integrate digital technologies into work processes have a wide influence in work organizations and their currently used and in the future required competencies. The chapter concentrates on exploring how digitalization is related to present and future competencies by transforming work processes, task and job contents, and the organization of labor, and finally products and services. Changes in work processes produce changes in job and task structures as jobs and tasks are replaced and destroyed when human labor is removed, hybridized when new features and demands are added, and recreated when new, previously unseen work requirements emerge. This, in turn, creates the need for reorganization. This way, digitalization increases pressures to rearrange work system elements anew. In addition to new ways of working and leadership, new competencies are needed. Future-oriented competencies are needed at the individual, organizational, and societal levels. They include competencies to adapt and create new ways of working, anticipation, and digital competencies.

Steven Dhondt, Frans van der Zee, Paul Preenen, Karolus Kraan, and Peter Oeij in Chapter 12 describe a new approach to investigate, unravel,

and explain the implications of digital technologies for skills. To do so, the chapter develops an approach to assess technology in companies in a more precise way, building on three main arguments. Firstly, current approaches to the subject treat all (new and emerging) technologies as equal. A more specific approach to technology is needed. Secondly, instead of starting from the potential of digital technologies, the focus should be on how technology investment decisions of companies are actually taken. Companies do not automatically reason from the available technology potential, but rather build on their current technology and capital stock and competitive position (the potential of technology). Thirdly, the organizational context should be considered. The actual use of skills in companies is strongly related to the organizational context. This is identified as the dominant organizational context. Based on these three main arguments, the authors propose a new research framework for technological impact on work and skills which is applied to two professions in Dutch industry.

1.5.5 New Forms of Decentralized Working and Cooperation

The focus of Chapter 13, authored by Hans Schaffers, is on the changing innovation process in an increasingly digitalized and networked working environment. Products, services, business processes, workplaces, and supply chains become connected, enabled by digital technologies and platforms, and result in new ways of value creation based on new types of business models and new forms of cooperation and governance of innovation. Digital innovations also affect the public sector and the nature of public services, for example, in health care, energy, education, transport, and urban life in the “smart city.” Digitalization reshapes the process of innovation as the combined result of three changes: (a) the changing nature of innovations as digital artefacts, (b) the changing networked and platform-based environment of innovation, and (c) the changing rules and roles in innovation governance. The chapter discusses characteristics of the new forms of innovation in industry, the public sector, and in decentralized ecosystems.

Finally, Michel Bauwens and Sarah Manski in Chapter 14 discuss a new model of value creation called “commons-based peer production” (CBPP). The authors discuss whether it offers new solutions for integrating externalities in our economic systems. CBPP are open, collaborative ecosystems that allow for a fluid flow of contributions toward the joint construction of common goods, i.e., the commons. The authors define the commons as shared resources that are maintained or produced by

a community or a group of stakeholders, governed according to the rules and norms of that community. The chapter elaborates on the forms of cooperation enabled by commons-centric economies, and presents a strategy for commons-based value creation and capture. It also discusses in detail the relation between commons-based economies and blockchain networks.

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