Chapter 1
Introduction: Knowledge and Digital Technology

Robert Panitz and Johannes Glückler

Development happens as a society undergoes structural transformation. Structural change in a society's culture, institutions, and technologies is driven by new ways of thinking, new knowledge, and innovations. Although the latest wave of technological change, often referred to as the fifth Kondratieff cycle (Schumpeter, 1961), has been transforming world society since the 1990s. Innovative uses of digital technology have continued to yield radical and disruptive changes. Digitization has been central to shaping new ways of *observing* (e.g., by collecting big data and augmenting reality), *knowing* (e.g., supported by machine learning), and *transforming* (e.g., by automation and robotics) our environment. As humanity uses its knowledge to advance technologies, which in turn have an effect on human knowledge and our ways of learning, we have dedicated this book to the reflexive relationship between knowledge and technology. In addition, geography is an important, yet frequently neglected, context for the ways in which people and organizations generate new knowledge, how they adopt and use new technologies, and how the use of these technologies affects their knowledge. Coincidently, technological advances have an immediate impact on human knowledge of geography and space. Whereas people once used maps and compasses to find their way around, today GPS-based navigation services take over all the work, with the effect of gradually diminishing both human cognition of space (Yan et al., 2022) and spatial knowledge acquisition (Brügger, Richter, & Fabrikant, 2019). This 19th volume in the Springer Series of *Knowledge and Space* has brought together leading interdisciplinary expertise, new

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empirical evidence, and conceptual propositions on the conditions, impact, and future potential of digital technologies for varying geographies of human society.

Knowledge, Digital Technology, and Space

While we were preparing this book for publication, another new technology knocked at the door of the academy—one promising to change practices not only in universities and education, but in social life more generally. The introduction of new generation technologies of artificial intelligence (AI) and especially *large language models* such as ChatGPT has been challenging incumbent practices of collecting and condensing information in written works, as well as the evaluation of students' outputs aimed at the good reproduction of published knowledge. By the end of November 2022, OpenAI had started to offer public access to ChatGPT. It uses machine learning methods to generate text-based answers to user queries. Whereas computer-generated content was previously marked by an artificial style and tone, the current version of ChatGPT produces text that is hard to distinguish from human-authored content. It has become increasingly difficult to distinguish artificial from natural intelligence in written texts.

When the first cases of ChatGPT-generated student theses appeared, a discussion began over the legal and academic nature of these texts and whether they qualify as plagiarism. Whereas some view AI as a tool to help produce scientific output, others reject it as impermissible. Because ChatGPT uses probability functions to generate texts, some researchers have expressed doubts about the technology's analytical power and reliability (Dwivedi et al., 2023; Else, 2023; Stokel-Walker, 2022, 2023; Stokel-Walker & Van Noorden, 2023; van Dis et al., 2023). Unsurprisingly, various academic journals have adopted diverging policies on how to handle AI-generated texts. While the journal *Science* banishes all articles that are based on AI-assisted tools (Brainard, 2023); *Elsevier* (Elsevier, 2023) and *Springer* (Brainard, 2023) allow such usage on condition that the authors disclose it. Because academic publishers consider AI unable to assume full authorial responsibility, they cannot treat AI as an author. Simultaneously, however, artificial intelligence and Large Language Models (LLM) have created potential for new markets, business models, applications, and services. For example, market research departments have started to use this technology for sentiment analysis. Chatbots or virtual assistants are used for customer communication as well as translator apps and websites. Specialized services such as fraud detection or AI programming assistants are further real-world examples.

These latest developments have evoked a controversy around AI because of the lack of knowledge and uncertainty about the relationships between (i) knowledge and new digital technologies, (ii) digital technology and space, and (iii) digital technology, law, and ethics.

First, the relationship between such technologies and knowledge is reflexive: Technology is the fruit of human creativity and knowledge, but at the same time

changes how we learn and what we need and believe to know. Given the ubiquity of digital geodata and navigation services, for example, what proportion of people could still find their way through unfamiliar territory with only a printed map and a compass? And yet—is such a skill still relevant? Similarly, whereas motivational factors positively affect the adoption of technology, as the authors of technology acceptance studies have shown (Al-Emran & Granić, 2021; Escobar-Rodriguez & Monge-Lozano, 2012; Venkatesh & Bala, 2008), frequent use of cell phones and social media has been reported to negatively affect average student grades (Junco, 2012; Lepp, Barkley, & Karpinski, 2014). This leads to various questions on the *relationship between knowledge and technology*: How will advances in digital technology, such as machine learning, affect how we learn, what we know, and what we believe to be knowledge? How do participatory media change human learning (Martin & Ertzberger, 2013)? How do new sources and magnitudes of data and algorithms affect knowledge creation, and the corresponding processes of validation and interpretation? What kinds of knowledge become obsolete, and what types of new knowledge move to the foreground of human curiosity and exploration? What kinds of skills are needed in the digital age (van Laar, van Deursen, van Dijk, & de Haan, 2017)? These questions encapsulate the grounding interests of this book.

Second, in this book we seek to explore the *relationship between technology and space*. Digital technologies have been transforming the social and spatial relations of industries, markets, and societies. An example is the usage of knowledge management systems and software in most organizations. According to the mirroring hypotheses by Colfer and Baldwin (2016), organizational and communication relations coevolve with technical dependencies. The development of new digital tasks and new forms of digital divisions of labor re-shapes the economic system, its organizational networks, and the structure of societies as a whole (Acemoglu & Restrepo, 2019). The United Nations Conference on Trade and Development has acknowledged this by defining the digital economy as economies connected not only with digital core technologies such as computers, telecommunication, internet, or digital and information technology (IT) sectors, but also with "a wider set of digitalizing sectors" such as media, finance, tourisms, etc. (UNCTAD, 2019, p. 5). At the same time, a nagging question has returned: What is the unique nature of human work that cannot be replaced by technological solutions, and how will technology endanger workplaces in the future (David, 2017; Frey & Osborne, 2017; Tuisku et al., 2019)? This question inspires a further one: How can human work and technology complement each other (Autor, 2015; Kong, Luo, Huang, & Yang, 2019)? Of course, qualified human capital is a prerequisite for technological development (Bresnahan, Brynjolfsson, & Hitt, 2002), which also stimulates research on favorable organizational environments and ecosystems that, in turn, help to spark technological innovation. Researchers working in geographical traditions have deployed concepts of clusters, entrepreneurial ecosystems, and regional systems of innovation to study and support technological advance (Alvedalen & Boschma, 2017; Asheim, Cooke, & Martin, 2006; Bathelt, Malmberg, & Maskell, 2004; Braczyk, Cooke, & Heidenreich, 2004; Malecki, 2018; Porter, 2000; Stam, 2018; Uyarra & Flanagan, 2016). In this respect, this book pursues questions including: How do the digital and

physical worlds affect each other? What opportunities and constraints for the spatial relations of society arise from digital and remote interactions? How do digital technologies and business models affect the organization of the space economy? How does digital life disengage people with the environment? What is the environmental impact of massive digitization?

Third, academic research, theorizing, and technological development are subject to normative beliefs and ethical concerns. Differences in worldviews and paradigms, priorities and interests, methodologies and empirical focus, also shape our views on digital technology. With this volume, we aim to support dialogue among scholars from the social, natural, and engineering sciences by addressing select ethical problems of new technological applications from various perspectives, including data privacy, surveillance, inequalities, resource extraction, and technological determination. The use of a technology already implies ethical questions (Sharkey & Sharkey, 2012) because every new technology enables new forms of action and practices, which potentially divert from extant social institutions or formal regulations (Glückler, Suddaby, & Lenz, 2018) at the moment of insertion in a social context. Because AI acts in part autonomously and may operate according to encoded ethical standards (Hagendorff, 2020), a new wave of ethical debate has surged. Therefore, we here also discuss questions around the *relationship between the ethics, norms, and governance of technology,* including: To what extent can society routinize and trust in automated screening, filtering, and assessments based on algorithms and artificial intelligence? What are the ethical challenges that arise with cognitive and human enhancement? What is the future of intellectual property rights in an age of digital ubiquity?

Structure of the Book

This volume comprises 13 original contributions by researchers of different disciplines, ranging from management and economics, computer science, sociology, and geography to psychology, architecture, and planning, as well as media and communication science. These contributions are organized into three parts, each in response to one of the three guiding questions about the relations of digital technology with knowledge, geography, and ethics outlined in the previous section.

Part I of this book focuses on the reflexive relationship between *Technology, Learning, and Decision-Making*. Its authors demonstrate how digital technologies support decision-making and learning, while depending on human knowledge as a critical prerequisite for the development and productive use of these technologies.

In Chapter 2, Helinä Melkas, Satu Pekkarinen, and Lea Hennala address the reflexivity of knowledge and technology in the context of health technologies and their adoption in elderly care. Care robots offer great potential for healthcare and welfare sectors, thanks to advancements such as improved safety features and cognitive capabilities. Yet a limiting factor is the lack of knowledge on how to effectively apply and interact with these robots. Melkas et al. (2024) inquire about

knowledge as a key factor for the introduction, utilization, and assessment of care robots. To understand the process of orienting oneself to the use of care robots, the authors propose examining the co-creative processes involved in the introduction of technology, the process of familiarization, and the acquisition of new knowledge and skills. The processes and interactions between those providing orientation and those receiving it prove particularly critical for understanding the underlying learning processes. In this regard, actors at the societal level play an important role as providers of orientation knowledge.

Moving from human-machine interaction to the question of algorithmic (in-)dependence of human behavior in decision-making, Joachim Meyer (2024) argues in Chapter 3 that effective data-driven decision-making requires an understanding and modeling of human behavior. Such understanding provides valuable insights into different decision domains and eases evaluation of the available data, thus preventing decisions from being influenced by systemic biases. This insight is particularly vital as the rise of artificial intelligence and data science in decision support systems raises questions about humans' role in decision-making. By examining the analytical processes involved in data-based decision-making, Meyer reveals that human decisions are in fact involved at each step, starting from data preparation and the selection of algorithms to iterative analyses and the visualization and interpretation of results.

Whereas Joachim Meyer illustrates how technological solutions arrive at better decisions through human assistance, Felix Rebitschek (2024) explores how people can be supported to make informed decisions. In Chapter 4, he introduces fast-and-frugal decision trees as interpretable models that assist consumers in decision-making processes under uncertainty. These decision trees help consumers navigate complex information landscapes and evaluate accessible information to make informed decisions. Such tools are valuable in situations where finding quality-assured, objectively required, and subjectively needed information is essential for consumers navigating through uncertain and complex decision environments, such as retail or news platforms. Rebitschek gives an overview of expert-driven decision-tree developments from a consumer research project and examines their impact on decision-making.

In Chapter 5, Nancy Ettlinger (2024) discusses how digital educational technology presents a significant promise and business opportunity that educational institutions and the edtech industry are increasingly choosing to adopt. However, the underlying pedagogy of datafying knowledge prioritizes skills while bypassing contextual and conceptual knowledge. As a result, it encourages a technocratic mindset that lacks emphasis on interpersonal connections, while also obscuring the impacts of these technological implementations, which depend on the acquired expertise of workers. As a result, she argues, the datafication of knowledge contributes to growing social and data injustices, social tensions, and inequalities. Contrary to the assumption that disruptive digital technology has ushered in an entirely new pedagogy, Ettlinger demonstrates that this pedagogy has a history that foreshadows various wide-ranging problems related to non-relational thinking and a lack of criticality within the digital sciences and among their users.

In Part II, we explore the relationship between the *Spaces of Digital Entrepreneurship, Labor, and Civic Engagement*. Its contributions examine the benefits of geographical agglomeration for business scaleups, study the nature and impact of legal regimes on the development of digital markets, discuss the use of digital devices in mobilizing resources for social activism, investigate citizen responses to smart city interventions as well as their implications for political polarization, and highlight the relational spaces of digital labor and its global positioning.

Zoltán Cséfalvay (2024) recognizes the association of digital technology and innovation with the challenge of scaling up business models and entrepreneurial start-ups. As he argues in Chapter 6, digital solutions require a critical mass of customers and infrastructure to unlock their full market potential and value proposition. Entrepreneurial ecosystems and start-up environments are often described as geographical phenomena that foster the growth and scaling up of start-ups. Cséfalvay provides a critical review of this concept and sets out to analyse a comprehensive database of 12,500 scaleups—that is, start-ups that raised more than €1 million—across the European regions and at a city level. He finds a West-East and a North-South divide as well as a concentration of scaleup and funding activities in just a few European cities. In addition, he notes that university towns with locally available human capital contribute to some convergence. Nevertheless, he observes self-reinforcing scaleup ecosystems in only a few cities, whereas large cities in Southern, Central, and Eastern Europe tend to lag behind. Overall, he uses his detailed empirical analysis to offer plentiful evidence of both the benefits of geographical agglomeration in promoting technological entrepreneurship and scaleups and of the enormous spatial variation between cities in their ability to actually promote such technological innovativeness.

In Chapter 7, Luis F. Alvarez León (2024) shows how commercial actors have managed to privatize what public organizations had actually generated as free data by way of making only limited modifications that are sufficient to claim copyright. Concretely, he examines the establishment of geographic information markets in the U.S. and focuses on the development of legal and technical interoperability in the collection and dissemination of geographic information, as well as the establishment of new intellectual property regimes. Alvarez León analyses the institutional configuration between the government, private firms, and the public in the United States. Within this context, the institutional configuration limits the government's ability to act as a producer of geographic information in the market. Data generated by the government is treated as public data with free usage rights, whereas products developed by private firms and individuals based on such public data become subject to property rights. This situation creates a conducive environment for the continuous production, consumption, circulation, and transformation of geographic information within a growing market. Recognizing the institutional, legal, and technical dimensions of the geographic information market, Alvarez León offers a better understanding and illustrative national example of the value production processes associated with geographic information and informational resources.

In Chapter 8, Nancy Odendaal (2024) illustrates the leverage effect of digital technologies on human action in physical space and vice versa. She offers insights

into how digital devices and solutions contribute to resource mobilization for social activism. When "thinking about cyborg activism," she refers to the concept of hybridity and how it characterizes digitally informed social action. She draws on the empirical case of South African cities during the COVID-19 pandemic, highlighting the inefficiencies of cities in addressing inequalities and social problems. In response, civil society organizations employed online and offline strategies to raise awareness, mobilize resources, and exert pressure on the government to effectively address urgent issues. She utilizes two empirical examples to illustrate the characteristics of these mobilization approaches, highlighting the synergy of technology, tactics, and storytelling that shape group efforts. Through the use of both digital and physical methods that establish a dynamic and responsive interaction between materials and individuals, activists participate in a dynamic interplay of resources and awareness across both private and public domains, encompassing emotions and level-headed political strategies, as well as rationality and fervor.

In Chapter 9, Alison Powell (2024) examines citizen action in response to "smart city" interventions in London during COVID-19 lockdowns aimed at improving air quality. Specifically, she explores the experimental implementation of low-traffic neighbourhoods. She reveals that such responses to smart governance resulted in political polarization due to a lack of opportunities to express frictions or dissenting opinions. Through an analysis of posts from a Facebook group that generally opposes the introduction of data-driven low traffic zones, she makes clear that different emotions impact the perceived legitimacy of political actions. Faced with no avenues to express opposing views and feelings within a data-driven smart governance setting, individuals start to question and delegitimize government-collected data. Furthermore, they begin to generate their own vernacular evidence and form common identities. Thus, data frictions become intertwined with affective politics. In other words, if strong feelings are disregarded and not incorporated into the social validation process, a fertile ground for antagonism and animosity is born, potentially resulting in political polarization.

Conceptualizations of space impact our understanding of digital technologies. In Chapter 10, Ryan Burns (2024) argues for a relational understanding of digital work instead of an absolute conceptualization of space. Although researchers of digital labor have shed light on the relations, inequalities, and implications of productive capacities embedded in everyday activities, they have insufficiently addressed the spaces where this labor takes place. From a relational perspective, networks and connections constitute the positions and practices of actors and shape the space of digital labor. According to Burns, digital labor transcends national boundaries and specific locations due to digital connectivity and interactions. With this relational perspective, he shifts the view of digital labor from a discrete, remunerated act to immaterial, cognitive, attentional, and symbolic labor.

Part III comprises a set of chapters that discuss some of the controversial issues regarding the *Ethics, Norms, and Governance of Technology.* Together, they show how those creating new forms of design and governance of digital technologies can potentially respect norms and ethics around data privacy, individual autonomy, and social inclusion. They provide insights into a variety of governance

modes that are associated with digital data, technology, and trade. These modes reach from centralized to decentralized structures, from market to state driven, and from rule enforcement in centralized AI access to big data to improve privacy protection to the withdrawal of personal data from centralized access via personal data repositories.

In Chapter 11, Andranik Tumasjan (2024) focuses on the rise of decentralized business models, marketplaces, and organizations based on blockchain technology. Given the confusion surrounding the meaning of "decentralized" in the context of blockchain technology and business models, as well as the technology's unclear implications for mass customers, Tumasjan discusses the notion of decentralization in blockchain-based decentralized business models. He offers a two-dimensional framework to explain decentralization in such contexts. Building on this typology, he assesses the implications, prerequisites, and desirability of decentralization for the adoption of blockchain-based decentralized business models.

The collection and concentration of personal data by the state is also a contested issue, as it enables the potential of the state for massive surveillance and the erosion of privacy. In Chapter 12, Ido Erev et al. (2024) argue that although digital control and observation of human behavior are common issues in modern societies, the enforcement of rules and laws based on such observations often proves ineffective in preventing involuntary and illegal acts. Moreover, the notion of a highly effective digital system based on big data and artificial intelligence that supports state authority often goes hand in hand with fears of excessive surveillance. In response, the authors propose that the utilization of big data, artificial intelligence, and even simple reactive technology can reduce the need for severe and costly punishments. Instead, just as an irritating sound reminds car drivers to fasten their security seat belt, immediate technological intervention offers the potential, when cleverly designed, to sanction undesired behavior and enforce existing rules in a gentle manner, while preserving privacy.

This discussion is carried further by Chapter 13, whose author takes a critical look at the risks associated with digital technologies for massive accumulation, storage, and extraction of digital personal data. Kôiti Hasida (2024) argues that current systems primarily handle personal data through centralized artificial intelligence and centralized data management. However, such centralized system architectures, along with related regulations, impose usage restrictions on personal data within these systems. But only the individuals who are data subjects have full legal rights to their private data. As a solution, Hasida proposes a decentralized management of personal data, introducing the concept of a personal life repository as a software library that enables decentralized data management. This decentralized approach would offer interfaces for various use cases and incorporate personal artificial intelligence, thereby maximizing the value of personal data. Hasida demonstrates how a personal data repository would support the decentralized management of private data for billions of individuals at a remarkably low cost. Simultaneously, it would ensure high security and privacy, facilitating the development of private AI and graph documents. In essence, this contribution provides insights into a system that enables decentralized governance of private data.

In the final Chapter 14, Jeremy Crampton (2024) switches perspectives on new unregulated markets and business models that are growth driven and focused on value extraction. He discusses how current digital business models and processes create digital geographies that generate value through the emergence of new markets. He focuses on the digital geographies of geofences and cryptocurrencies, highlighting their criticized aspects in relation to their toxic characteristics that promote unsustainable growth and value extraction. Drawing on inspirations from the slow food movement and the ethics of slowness, Crampton introduces the concept of a "slow data economy," along with six underlying principles. He aims these principles at fostering alternative, responsible innovation and business models that prioritize the creation of social value instead of the privatization and extraction of value. The fundamental idea behind the slow data economy is to shift investment focus "from growth and extraction to care and repair".

Conclusion

This 19th volume of the *Knowledge and Space* series has collected international and interdisciplinary expertise around the nexus of knowledge, space, and digital technologies. Since the launch of the commercial internet in the early 1990s, digital technologies have led to the creation of new work practices, occupations, industries, and markets. Digitization has also deeply impacted place and space, including new spatial divisions of labor, the globalization of media, business, and trade, and the interrelations between the physical and the digital in synchronous as well as asynchronous communication and interaction. With generalized artificial intelligence, robotic automation, blockchain technology, etc. a new wave of disruptive transformations is looming. Without claiming to offer a comprehensive or complete analysis of these issues, we present original views, concepts, and empirical evidence that shed light on the interdependence of these new technologies with human knowledge, social norms and ethics, and geographical space.

Through their analyses, this book's authors will demonstrate that, at least for now, technology and human knowledge are inherently interdependent. Although AI algorithms guide our decision-making, they are still founded on human assumptions and decisions. And although robots can technically take over part of human work, the legitimacy and, accordingly, helpfulness of their contributions depends on the social institution. This dependence on social and institutional contexts also points to the role of geography and space in the evolution of digital technologies. The contributors illustrate how strongly technological entrepreneurship and advances benefit from spatial agglomeration in key cities and regions, and how spatial variation in institutional contexts—including spatially bound regulations, social institutions, and organizational fields—shape diverse geographies of technology.

Readers will also find critical assessments of the ethical risks and social injustice emanating from digital technologies when, for example, reducing education to datafication. Conversely, they will learn that digital technology can actually endorse

ethical norms, for example by preserving privacy and autonomy over personal data. However, different forms of regulation and governance modes influence the usage and the design of new digital technologies. Decentralized technological solutions, such as blockchains, often run up against centralized state structures, and product developers can use public data to create private goods that are commercially traded on digital markets. Although digital technologies have the potential to produce common goods, e.g. free data for the sake of all, whether and how these virtues are actually unleashed remains dependent on legal regimes and regulations.

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