INTRODUCTION

This new edited book, The Elgar Companion to Digital Transformation, Artificial Intelligence and Innovation in the Economy, Society and Democracy, examines when, where, how and why artificial intelligence and digital transformation in general can boost innovation and transform the economy, society and democracy.

The book is developed based on the Cyber-D4 nexus, which is a conceptual framework of Cyber-Defense, Cyber-Development, Cyber-Democracy and Cyber-Diplomacy. The framework considers knowledge and innovation to be crucial for the evolution of economy, society and democracy. “Cyber” emphasizes that technologies, including artificial intelligence, are crucial for promoting knowledge economy, knowledge society and knowledge democracy.

In the new context, the joint phrase of “Cyber” should express and emphasize that the processes that drive development, democracy, defense and diplomacy are in fact interrelated; they cross-link, overlap and network with each other. The Cyber-Defense, -Development, -Democracy and -Diplomacy nexus ties new national and industrial cyber strategies, including business strategies for smart cities and the Internet of Things, with local, national, regional and global security and economic objectives. Countering current and new, conventional and asymmetrical, threats in cyberspace requires collaboration between industries, governments, universities and civil society to adopt and adapt to new methods and actions, and to learn, acquire and innovate on knowledge sharing and efficiency through transdisciplinary research. This is, however, challenging in an environment where the government, academia or civil society rarely has access to—or visibility on—privately owned data and/or networks.

Technological development is not just an industrial need, but a societal one. Key dimensions of democracy are traditionally freedom and equality, and these should also apply to the context of cyber-democracy. The understanding of democracy (and
cyber-democracy) may be carried by a combination of theory-based thinking and application-based empirical measurement. Empirical measurement adds clarity to theoretical framing. Empirical measurement, however, may also generate its own dynamics, with results not necessarily falling into clear conceptual boxes, implying that we should be prepared to speak of a co-evolution of theoretical conceptualization and empirical measurement of democracy. Cyber-democracy also relates to knowledge democracy in a global context.

The fragmentation and regionalization of the Internet in an increasingly interdependent world have reshaped diplomatic agendas to meet conventional and asymmetric challenges in innovative ways. The balanced nexus between industries, governments, universities and civil society have also redefined the digital need for intercultural communication as a requirement of human security. Cyber-Defense, -Development and -Democracy in the twenty-first century can no longer be achieved in isolation, without access to or the sharing of outside knowledge. New collaborative private, public and people relationships are needed to promote new opportunities to address cyber challenges.

This Companion consists of six parts and 18 chapters covering different aspects of cyber-security, cyber-democracy, Society 5.0, Economy 5.0 and digital transformation in education.

Part I focuses on cyber-security given that defense considerations are critical for management in industry, government, academia and civil society to address in a world where artificial intelligence, genetics and robotics converge with new cyber challenges and opportunities. Chapter 1, “Categorizing cyber effects” by Charles Harry and Nancy W. Gallagher examines the problem of categorization and measurement of different types of adverse cyber events that company executives, government officials and leaders of non-profit organizations consider. The authors present a taxonomy of disruptive and exploitative cyber events and a framework for assessing their primary, secondary and second-order effects that has been developed by the Center for International and Security Studies at the University of Maryland (CISSM). Chapter 2, “The challenge of advanced cyberwar and the place of cyber-peace” by Elias G. Carayannis and John Draper provides an analytical review, from the cyber-defense perspective, of the existential threat posed by a human intelligence equivalent artificial general intelligence, and more particularly by an above human intelligence artificial superintelligence. Focusing on constraining the risk of an artificial superintelligence waging cyberwar, the authors propose the dual analytical lens for a global peace treaty of conforming instrumentalism and nonkilling and through a Universal Global Peace Treaty they discuss how to constrain the military risks posed by an artificial superintelligence. Chapter 3, “International sea, air and space politics” by Alexandra Fabrykowska discusses the different scientific research areas regarding the maritime space, air space and outer space, and presents potential future innovations and new developments. The chapter highlights the importance of innovation and knowledge democracy in international politics within a Cyber D4 framework (Cyber-Development, Cyber-Democracy, Cyber-Defense and Cyber-Diplomacy).
Part II is devoted to innovation and cyber-democracy and examines the linkages between technological development and the quality of democracy, contextualizing the political system by society, economy and ecology (environment). In this context, Chapter 4, “Innovation as a driver of political preference formation in post-industrial society: origins and consequences” by David M. Wineroither discusses how post-industrial innovation affects the process of formation of political preferences. Highlighting the concepts of cyber-democracy and knowledge economy, the author reviews new modes of political preference formation based on the role of civil society, the dissolution of national boundaries, and the recent developments in technology, education and labor, under a Quadruple Innovation Helix framework. Chapter 5, “Securing democracy in cyberspace” by Andrew N. Liaropoulos analyzes how digital technology threatens democracy and explores the ways in which democracy can be safeguarded against such threats. The chapter discusses both technological solutions and policy regulations, as well the need to reinvent democracy in the digital era and utilize digital technologies to truly benefit democracy. Chapter 6, “Microtargeting and Big Data: opportunities and threats for (cyber-)democracy” by Matthias Keppel examines the opportunities and threats of microtargeting and Big Data in political communication. The chapter provides a theoretical discussion of the terms “microtargeting” and “Big Data” and reviews positive and negative examples in political campaigns, focusing on the benefits of collecting personal data in political competition, as well as the potential threats to democratic systems.

Part III of the Companion focuses on Society 5.0 and examines how new technologies and the integration of physical and cyberspace can guide social development. In the Society 5.0 context, digital transformation aims to the improvement of the environmental sustainability and the quality of life of all peoples. Chapter 7, “Digital and green twins of Industry & Society 5.0: the role of universities” by Elias G. Carayannis and Joanna Morawska focuses on the socially and digitally engaged university model, which can address Industry 5.0 and Society 5.0 challenges and stimulate and strengthen the social dimension of universities missions. Taking into account the Quadruple/Quintuple Innovation Helix approach, the authors emphasize the role of universities as the anchors of innovation ecosystems and the necessity of new value creation in society and economy. In Chapter 8, “Increasing the research relevance for societal actors: the contribution of participatory research techniques to knowledge democracy”, Magdalena Fellner examines how societal actors can be involved in the research process and how this involvement can be used in evidence-based policymaking. The chapter exemplifies potentials to increase the level of participation in research design, discusses the added value when informing policymakers about research outcomes, and presents recommendations for knowledge co-creation between scientists and societal actors. Chapter 9, “Crossing the black and white pattern of a chessboard with the colors of art: digital turn and live reform movement 4.0” by Ruth Mateus-Berr highlights the challenges of digital transformation with regard to climate change, religion, social inclusion, democracy and education. The author notes that giving “right” and “wrong” answers to these problems is comparable to a chessboard with black and white squares. In order to
overcome this rationale, the aim of the chapter is not to find ready-made answers, but rather to present a discussion that may help to understand the consequences of digital transformation.

Part IV of this Companion is devoted to the Economy 5.0 and the Quintuple Innovation Helix frameworks. Chapter 10, “Aligning the Quintuple Helix model of innovation with Vietnam’s context: evidence from artificial intelligence innovation dialogues” by Anh-Nguyet Luong examines how the Quadruple Innovation Helix model is currently operationalized in the AI sector in Vietnam. The chapter analyzes 20 innovation dialogues over the period 2017–19 and provides empirical evidence of dynamic, co-evolving interactions between academia, industry, government and civil society. Chapter 11, “The bright future of ecosystem economies: explainable and reliable artificial intelligence via software–hardware interoperability” by Georg Christoph Hanschitz examines the most significant challenges and limitations of software–hardware interoperability based on the Quintuple Innovation Helix framework. The chapter discusses how the exchange, interaction and transformation of information can produce explainable and reliable artificial intelligence. Chapter 12, “The academic firm within a Cyber-D4 environment” by David F.J. Campbell and Elias G. Carayannis presents the characteristics of the “academic firm”, which is a new type of knowledge-focused and innovation-driven firm. The chapter discusses how the academic firm can operate within a Cyber-D4 environment and support the promotion of knowledge society, knowledge economy and knowledge democracy in the context of Quadruple and Quintuple Innovation Helix frameworks. The authors argue that a fruitful helical interaction between economy, society and democracy appears to emerge.

Part V focuses on different aspects of entrepreneurship and innovation in higher education, giving emphasis on the emerging challenges as a result of the Covid-19 pandemic crisis and the adoption of new technologies. In Chapter 13, “Technology transfer and innovation in higher education governance: comparing conceptual understandings displayed by University Performance Agreements over time”, Magdalena Fellner, Attila Pausits and Florian Reisky compare conceptual understandings and developments of innovation and technology transfer by contrasting performance agreements of Austrian public universities since the early 2010s. The results show that the concepts of “sustainability”, “innovation”, “technology transfer” and “entrepreneurship” display different understandings, while no university stands out positively or negatively in the dimension “technology transfer and innovation”. Chapter 14, “Innovation and student equity in higher education” by Corinna Geppert and Franziska Lessky analyzes selected innovative initiatives in higher education. Based on previous research results, the authors examine whether and how these initiatives address student equity and how these programs might contribute to equitable opportunities for all. In this context, the main findings focus on which student groups benefit from these initiatives, and what dimensions of student equity are tackled. Chapter 15, “Emergency and innovation: the impact of state-of-emergency on innovative educational practices during the Covid-19 pandemic” by Attila Pausits, Stefan Oppl, Sandra Schöhn, Magdalena Fellner, David F.J. Campbell and Martin
Dobiasch examines the impact of state-of-emergency on innovative educational practices during the Covid-19 pandemic. The authors discuss the design and impact of technical equipment in teaching used by Austrian higher education institutions, as well as the technical equipment of teachers/students and their experiences during the Covid-19 pandemic. Also, the chapter presents the effects of the instructional design of learning processes, the necessary competencies of teachers and students and discusses how distance learning affected student life.

Part VI of the Companion is devoted to institutional research and university governance, examining potential implications for higher education institutions of digital transformation and the recent Covid-19 pandemic. Chapter 16, “Accelerating institutional research in China’s higher education institutions” by Qin Zhuoli reviews institutional research efforts in China and discusses how institutional research may be accelerated. The author argues that currently institutional research in China is not mature due to defective higher education systems and an unsound decision-making style of leadership in higher educational institutions (HEIs). The development of institutional research may be based on joint efforts of the government, leaders in HEIs and institutional researchers. Chapter 17, “Institutional research: past, present and future” by Ana Parrón Cabañero is based on an extensive literature review, and provides a comprehensive outline of the evolution of institutional research and its functions in postsecondary education institutions. It describes the multiple functions that institutional research professionals are expected to perform. The author emphasizes the importance of data-driven decision-making and strategic positioning of HEIs and discusses future new visions and roles of institutional research. Chapter 18, “University governance in Austria, Finland and Scotland: possible implications from digitalization and Covid-19” by Kajetan Stransky-Can is the final one in the Companion. It discusses potential implications of digitalization and the Covid-19 pandemic in university governance in different European countries. The author notes that the ongoing approaches towards digitalization in education are linked with cyber-democracy and cyber-development and reflects on recent debates on digitalization and the future of education and work. The presented analysis examines also cross-connections to the Quadruple Helix and Quintuple Innovation Helix systems.

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