Introduction to the *Handbook of Research on Artificial Intelligence, Innovation and Entrepreneurship*

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The Edward Elgar *Handbook of Research on Artificial Intelligence, Innovation and Entrepreneurship (AI4EI)* focuses on *theories, policies, practices, and politics* of technology innovation and entrepreneurship based on Artificial Intelligence (AI). In this context, the Handbook examines *when, where, how, and why does AI trigger, catalyze, and accelerate the development, exploration, exploitation, and invention feeding into entrepreneurial actions that results into innovation success.*

Individual chapters also examine the *theories, policies, practices, and politics* that shape and drive such phenomena, including *modalities, such as the Internet of Things (IoT), challenges, such as privacy and safety concerns, and opportunities, such as augmenting the efficacy frontier of technological solutions enabled by AI.*

The Handbook provides an integrated approach on AI-enabled technology innovation and entrepreneurship, examining different aspects of digital transformation and the role of AI in innovation and entrepreneurship ecosystems. It adopts a *Quadruple/Quintuple Innovation Helix (Q2IH) approach,* where, in addition to the basic model of university–industry–government relations, *the fourth helix of ‘media-based and culture-based public’, ‘civil society’ and ‘arts, artistic research and arts-based innovation’ and the fifth helix of ‘natural environments of society’ are considered.* Thus, the complexity of knowledge production and knowledge application can be better studied.

The nature and dynamics of AI technologies and the power of technological learning and knowledge management are woven together to provide the conceptual infrastructure for competing in the new economy. Competitive, economic and political factors which influence the innovations underlying and driving information-technology-based products, processes and services in organizations, domestically and internationally are studied and discussed. The Handbook emphasizes these dynamics, examining the formation and growth of new technology ventures in a sustaining role of current businesses or a disruptive role enabling technological emergence. It also provides insights into how one could re-formulate and re-align business and technology strategy for mature or new technology ventures in the era of AI as a core business competence. Moreover, this Handbook examines how new technology ventures operate in co-opetitive dynamic environments leveraging, shaping, as well as becoming shaped by applied AI modalities, tools and applications.

The Handbook addresses current and critical issues regarding the nexus of AI modalities and the ways they impact and transform the Societies and Economies around the world. The future of manufacturing, education, labor, health, finance, transportation, defense, and trade is inter-twined with the trends, patterns and dynamics of AI technologies and the way they shape and are shaped by people and culture dynamics as the macro, meso, and micro levels.
In this context, the Handbook focuses on specific aspects of these transformations and aims to provide a strategic integration perspective to inform and enable theories, policies and practices that pivot around the AI-enabled societies and economies of today and tomorrow in a unique and unprecedented manner.

The Handbook consists of eight parts and 26 chapters covering different aspects of AI-driven digital transformation of knowledge economies and societies.

The first part provides an introduction to AI for business, presenting nature, dynamics, content and implications of advanced and emerging AI technologies, methodologies, and tools, as well as how they impact the business competitive landscape and shape new tools and strategies for business success. The chapter entitled “Scientific mapping of artificial intelligence as an emerging field of knowledge” written by Iván Manuel De la Vega Hernández, Angel Serrano Urdaneta, and Oscar Schiappa-Pietra presents a bibliometric analysis of the AI concept examining the most used keywords related to AI and intellectual structure of the AI knowledge base. The presented bibliometric mapping can show the theoretical evolution and the topography of the knowledge base on AI, identifying emerging specialties such as Machine Learning, Deep Learning, Robotics, Natural Language Processing, Support Vector Machine and Neural Network, among others, that open new research avenues. The next chapter entitled “An Odyssey of ideas about AI, innovation and entrepreneur(ship)” by Phillip Harvard presents a semantic Odyssey (quest) through time about the two twinned words composing AI. The chapter aims to define AI as a term that inspires, not threatens, emphasizing the people-friendly future potential of AI. The third chapter by Christos Lemonakis and Constantin Zopounidis discuss how AI, Learning, and Deep Learning may affect the future of business. They explore some of the increasingly wide range of current AI applications and highlight how AI can improve the quality of life today. In the last chapter of this part, Phillip Harvard presents a series of interviews with French innovative entrepreneurs about AI. The author examines how entrepreneurs define intelligence, innovation and entrepreneurship based on their day-to-day realities. The main findings show that the concept of AI, as perceived by entrepreneurs, is related to novelty, improvement, solution of problems, trust, and risk.

The second part of the Handbook is devoted to digital transformation, exploring theories of technological change and the impact of rapidly expanding networks upon the role of Information Systems (IS) or Information Technology (IT) in organizations. It emphasizes that IT/IS are not just back-office process enablers, but they can be of strategic importance to any business. In this context, Chapter 5, entitled “Digital transformation and digital maturity models: A blueprint strategic decision-making framework” by Dimitrios Mitroulis and Fotis Kitsios discuss the critical elements that organizations need to take into consideration for their digital transformation journey. Based on the existing literature of digital transformation maturity models, the authors propose a conceptual framework, along with a case study. The proposed synthesized framework can serve as a blueprint of strategic decision-making in digital transformation. The next chapter entitled “AI and innovation design for new product and service development in digital ecosystems” by Rossana Piccolo, Veronica Scuotto, Armando Papa, Marco Pironiti, and Manlio Del Giudice discusses the advantages and benefits of applying AI to new product development. It focuses on sustainable urban mobility and presents a case study of electric minibuses in the metropolitan area of Turin. The authors demonstrate how this particular case study represents an innovative product/service from the technological point of view, and how design can be the engine of innovation. The seventh chapter by Loizos Michael discusses the four pillars of modern AI systems: the data on which they rely, the task
of organizing these data, the automation of this task, and the type of explanations needed to support this automation. The author underlines that explainability acts as a tool towards the certification of AI systems, not only in terms of their functional performance against some objective metric of accuracy as typically done to date, but more critically in terms of the cognitive compatibility of their reasoning against the subjective needs and abilities of the particular group of humans for which an AI system has been designed and developed. The next chapter by Vangelis Marinakis, Haris Doukas, and John Psarras discusses next generation energy management systems (‘Energy Management 4.0’), presenting the AI-4-Energy framework, which is an open modular framework for supporting AI-on-Demand in the energy sector. It enables cross-sector analytic tools for integrated and intelligent energy management, based on seamless data-information and knowledge exchange under respective sovereignty and regulatory principles. Some next generation energy management applications are also presented in the chapter.

The third part of the Handbook focuses on digital entrepreneurship. The aim is to examine the linkages between AI and value creation (e.g., how to assure or accelerate value creation through AI, how AI transforms and may be incorporated in the value creation process), discussing industry-specific trends and opportunities. The chapter by Fotis Kitsios and Maria Kamariotou analyzes the collaborative roles of various stakeholders in open data ecosystems, highlighting their relationship, networking opportunities, and challenges. The authors propose a theoretical framework and present a case study in the city of Thessaloniki, Greece, regarding the development of civic apps in open data hackathons. The findings show that the development of open data-driven projects is an important tool to increase social networking among the public and private sector actors, non-governmental organizations, citizens, and developers. The chapter entitled “Cognitive agility for improved understanding and self-governance: A human-centric AI enabler” by Benjamin James Knox, Stefan Sütterlin, and Ricardo Lugo focuses on cognitive agility as a necessary requirement for the successful exploitation of AI capabilities in entrepreneurial contexts. The authors emphasize that developing cognitive expertise can mitigate ethical issues, power imbalances, bias, and adversarial factors that present significant challenges to AI-based solutions. The next chapter by Alina Cherepovitsyna focuses on AI-driven innovation and entrepreneurship in the energy sector. The author discusses how AI can help the transformation of the energy sector in order to satisfy the growing demand and meet at the same time current and future environmental targets. The chapter focuses on transformative entrepreneurship, the authors draw attention to the cultural landscape in which businesses are born and developed, embracing technology and culture and overcoming the boundaries of defensive incrementalism to reach the lands of innovations disrupting the current state of the art. The fourth part of the Handbook is devoted to digital business models and Industry 4.0. The main aim is to examine how AI-enabled technologies may affect the development of new business models and also discuss the implications of AI in Industry 4.0, focusing not only on technical issues (blockchain technology, robotics, lean production, intelligent manufacturing), but also on the socio-economic aspects of Industry 4.0. The chapter entitled “The value creation of artificial intelligence: Business models based on the Internet of Things (IoT)” by
Sakshi Aggarwal and Stavros Sindakis discusses the business models based on the IoT and examines how these business models influence value creation of AI. The findings show that AI systems are accepted as a technology, offering an alternative way to tackle complex problems. At the same time, the business model concept offers strategists a new way to consider options in complex, uncertain, and unpredictable environments. The next chapter by Georgios Spathoulas and Sokratis Katsikas examines the implications of blockchain technologies in Industry 4.0. The authors present how blockchain technology is currently being used in the pillars of Industry 4.0, discuss current limitations or challenges, and highlight opportunities that allow to address specific technological or social challenges or to propose new approaches through the use of blockchain technology. The chapter entitled “Artificial intelligence and emerging technologies: Exploring opportunities through smart specialisation” written by Ruslan Rakhmatullin and Fatime Barbara Hegyi examines the linkages between AI and Smart Specialization Strategies (S3). The authors highlight that several S3 priorities in European regions are associated with new and emerging technologies, such as AI, and explore how interregional bottom-up collaborative actions, such as thematic S3 partnerships, can help regions take advantage of the opportunities offered by new technological developments. The authors argue that European regions with complementing research and innovation priorities associated with new and emerging technologies can benefit from an array of synergies by working together and aligning their investment policies and activities.

The fifth part of the Handbook focuses on cyber-security. In their chapter, Efstratios Livanis, Michalis Doumpos, and Constantin Zopounidis highlight and analyze the financial aspects of cyber risk and emphasize the key role of Chief Executive Officers and Chief Financial Officers for the efficient handling of these risks. The authors emphasize that cyber-security is not only an information technology issue, but rather a cross-organizational risk management issue. Therefore, business organizations should evaluate cyber risks and develop strategic plans for their effective management, developing a framework that incorporates the financial risk analysis. The chapter entitled “The future of cyber risk management: AI and DLT for automated cyber risk modelling, decision making, and risk transfer” written by Pankaj Pandey and Sokratis Katsikas proposes an AI-driven, DLT (Distributed Ledgers Technology)-based smart contract system for secured sharing of threat intelligence, risk modelling, structuring of risk transfer instruments, and automated settlement process. The proposed architecture for automation of decision-making processes for cyber risk mitigation and transfer of residual risks is also evaluated. The presented SWOT analysis shows that the strengths and opportunities offered by the proposed system are higher and stronger than the weaknesses and threats identified.

The sixth part of the Handbook is devoted to smart cities, aiming to examine how AI can power the development of smart cities and exploring, at the same time, how smart cities’ infrastructure and digital solutions may affect the development of knowledge-based innovation ecosystems. The chapter entitled “Transformation of smart city public services through AI and big data analytics: Towards universal cross-sector solutions” by Anastasia Panori, Christina Kakderi, and Nikos Komninos examines AI, smart cities and innovation in public services. The authors argue that the impact of smart city public services is still largely untapped by the monolithic architecture of existing smart city services and the fragmentation of smart city solutions and services across different domains, and propose a new framework for smart city services design based on combining different microservices and enhancing them with AI and Big-Data Analytics features. The chapter emphasizes the importance of combining different
forms of intelligence on smart city public services, including human intelligence through data analytics, collective intelligence through crowdsourcing, as well as machine intelligence. In their chapter, Pantelis Sotirelis, Theodora Valvi, Evangelos Grigoroudis, and Elias G. Carayannis explore several smart city architecture models and propose a customized multidimensional SGAM (Smart Grid Architecture Model). The proposed architecture is based on six major pillars in order to achieve cost-efficient and holistic management for smart cities. The main aim is to promote a common ground for the different smart initiatives by adding the notions of formalization and consistency to the reference model. In the last chapter of this part, Luís Farinha, João M. Lopes, and João J. Ferreira explore in-depth some examples of smart city innovations through a case study. The presented study analyzes six collaborative projects in the fields of road prevention, management of underground utilities, analysis of the user experience of mobile operators, prediction of energy consumption in smart buildings, and an integrated technology platform for smart cities. The analysis may help to identify a set of solutions that can be replicated in other territorial realities, allowing the smart city innovation ecosystems to become smarter.

The seventh part of the Handbook examines the impacts of AI-enabled technology innovation and entrepreneurship on civil society, labor, and education. In their chapter, Ariadni Michalitsi-Psarrou, Eleni Kanellou, Christos Ntanos, and Dimitris Askounis examine how simulation of human mobility can contribute to the search of missing children. The authors stress that citizen-sensing applications that use mobile technology depend on the engagement of at least a minimum number of citizens. The presented approach focuses on this problem and illustrates how data analytics, algorithmic processes, modelling, and simulation can provide an innovative solution to a social problem. The next chapter entitled “Career options and necessary technical skills in AI” written by Evangelia Krassadaki and Nikolaos Matsatsinis examines issues related to the labor market in AI technologies. In addition to the direct impacts of AI on employment, the authors note that a new range of specialties and professions will appear in the future. These specialties, in addition to technical skills, are associated with certain human attitudes, competences, and values, justifying the importance of informally acquired social-emotional skills. The next chapter entitled “The impact of AI on expert labor and professions: A neo-traitist analysis of project management” by Ian Stewart and Kun Wang proposes a ‘neo-traitist’ framework to evaluate potential impacts of AI on the professional status of Project Management. As emphasized by the authors, AI presents both threat and opportunity for the status of project management and project managers in society and for the experience of project management by individual practitioners. The proposed framework may be applied in a wide range of other types of professions in contemporary organizations.

The eighth and last part of the Handbook is devoted to AI and democracy, emphasizing that for the full unfolding of knowledge and innovation, the context of a democracy or the context of a knowledge democracy is necessary. Therefore, democracy (or the quality of democracy) as innovation enabler emphasizes the connectedness of knowledge development and of democracy development. In this context, the Handbook examines AI-based digital transformation as a complex nonlinear process with new forms of entrepreneurship and of creative innovation in Industry 4.0, exploring and discussing potential consequences in labor, education, and civil society in general. One of the key concepts suggested is that, at least in the long run, the evolution of a knowledge economy apparently is linked to an evolution of knowledge democracy, that is, Industry 4.0 requires a Democracy 5.0. In their chapter, David F. J. Campbell and Elias G. Carayannis discuss this transition and note that, with a good set of governance and
governance tools, a democracy may stimulate and support the development of an industry (of the economy) from an Industry 4.0 to 5.0 status. They describe the critical role of higher education institutions and systems, given their ability to promote knowledge and innovation through their internal and external governance. The next chapter entitled “Democratizing AI: From theory to practice” by Paul D. Clough and Jahna Otterbacher emphasizes that the current state of the ‘AI Democracy’ maps onto only one of three elements of a democracy, focusing on providing people with the tools and technical infrastructure needed to participate in AI, but not in protecting their freedoms and access to social benefits. In the last chapter of the Handbook, David F. J. Campbell and Elias G. Carayannis discuss the digital transformation of democracy and politics. The presented discussion focuses on the importance of governance and governing, and policy and policy output as criteria for the quality of democracy, by examining the issue of sustainable development. The authors emphasize sustainable development as a crucial dimension for the conceptualization and measurement of democracy and quality of democracy. In this context, a potential benchmark for the successful digitalization or the successful digital transformation of democracy and politics is whether this reinforces a further advancement of sustainable development.

The Handbook should be of interest and value to academics, policy makers, practitioners and researchers or students on the following topics:

- Science, Technology, Innovation and Entrepreneurship
- Artificial Intelligence, Innovation and Entrepreneurship and the Digital Transformation
- Artificial Intelligence and the Future of Industry and Labor, Democracy and Education

The Handbook may also be included with graduate courses. Typical examples of relevant graduate courses are the following:

- Emerging Technologies
- IS/IT Strategies
- New Technologies, Innovation and Entrepreneurship
- New Ventures Financing
- Entrepreneurship and Innovation

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