FROM NETWORKS TO DIGITAL BUSINESS ECOSYSTEMS

The practice of looking to nature for inspiration to solve design problems is not new. Neither is the imitation of features, attributes, or behaviors of actors in natural habitats. Researchers and practitioners have long copied from nature and developed new or enhanced technology through biomimicry. Thus, it was only a matter of time before businesses and their environments would also be described and analyzed through the lens of biology, or more precisely, as ecosystems.

My first scientific contact involving business organizations and natural ecosystems came in the 1990s, when I was researching sustainable process networks (Baumann, 1999). One discussion taking place at that time was about how natural ecosystems, despite being in constant flow, had a point of equilibrium. It was called ecological balance; the influx and loss of resources, actors, habitat, and so on, was sufficiently balanced that the ecosystem survived in the long run. In a state of ecological balance, ecosystems were even believed to withstand certain levels of pollution caused by human activities, provided the balance was not upset too much. Regarding business organizations, my project revolved around networks and their operations. It modeled flows of material and energy as networks rather than linear streams. I soon discovered ecological balance to be a myth, but the network approach proved to be an insightful path to follow, albeit complicated and highly interdisciplinary.

The idea of comparing business systems to biological systems, and regarding industrial organizations as living organisms that respond to changes in their environment dates back to the 1950s (e.g., Beer, 1959) and has since become a mainstream concept (Rothschild, 1990). Moore (1993) is credited with defining the business ecosystem as a loose network of actors such as suppliers, distributors and outsourcing firms that work both cooperatively and competitively to develop new products and exploit their innovations. In later works, Moore also addresses the co-evolution of actors (species) in the business ecosystem through mutual innovations (Moore, 1996).

Following this research tradition, a digital business ecosystem (DBE) can be defined as a network of organizations such as manufacturers, suppliers, distributors, customers, competitors, and government agencies, that together create and deliver a specific product or service in a partly or fully digital environment. The term “business ecosystem” conveys that, analogous to biological ecosystems, DBE actors establish a non-homogeneous community of self-interested entities that nevertheless depend on each other for their survival. The system constantly evolves as actors join or depart, as the DBE is affected by necessary changes in internal
Handbook on digital business ecosystems

structures in response to external forces. Actors also influence each other as they cooperate to achieve common objectives while competing for scarce resources (Corallo et al., 2007; Iansiti and Levien, 2004; Kapoor, 2018). DBE actors communicate through digital information and communication technologies (ICTs) to coordinate tasks and activities. Consequently, information becomes a valuable and often scarce resource (Wunck and Baumann, 2017).

DBEs transcend traditional industrial structures, as firms can be in different sectors or locations but belong to the same DBE while providing unique and customized solutions to individual customers. This idea became very prominent in the concept of Industry 4.0 in 2011 (Baumann, 2018). Again, this view is not new. The exploitation of geographical differences in costs, access to resources, and so on, has led companies to decentralize activities and cooperate with external partners in distributed, modular, and increasingly virtual structures (Baumann, 2013). The emerging business networks have been studied under a variety of terms, such as value creation networks, value creation architectures (e.g., Keen and Williams, 2013), or value-creating webs (e.g., Gretzinger and Royer, 2014). One prominent and intensive discussion is about the role of platforms in DBEs (e.g., Gawer, 2011), brought about by the growth of digital platform players such as Facebook, Amazon, Apple, and Google. Although many DBEs are platform-based, a platform is not a prerequisite for a DBE to be successful.

Due to their digital nature, DBEs are also of interest in scientific areas other than management and economics, such as information systems and engineering. This has come about through the diffusion of digital technologies such as the Internet of Things (IoT), artificial intelligence (AI), digital twins, and blockchains, that allowed for more flexibility as well as sectorally and geographically transcending value creation structures. While information systems and engineering place a stronger focus on the technological feasibility of DBEs, management and economics have been investigating strategies and business models, especially to exploit value from the growing streams of data. The mapping study by Baumann and Leerhoff in Chapter 2 of this Handbook traces these developments and identifies differences and similarities in the topics being discussed in diverse scientific disciplines. It became evident that many DBE research strands are unconnected, even within the same discipline. While theory papers are abundant, in-depth studies into industry applications and recommendations on how to design and manage DBEs are much less common.

OBJECTIVES AND APPROACH OF THE HANDBOOK

It is from a diverse and interdisciplinary viewpoint on DBEs that this Handbook approaches the theory, practice, and organizational phenomena that constitute and exist in DBEs. An interdisciplinary approach is vital, in order to capture the scope of social, economic, political, and technological factors that interact in the emergence and evolution of DBEs and to understand the underlying processes. By concentrating on diverse disciplinary perspectives on DBEs, the Handbook moves beyond discipline-specific silos to potentially facilitate more transdisciplinary conceptual and empirical work on DBEs, including cross-sectoral industry applications. The call for chapters specifically invited scholars in a variety of fields—business, economics, engineering, computer science, and humanities—to share their ideas, concepts, and perspectives on DBEs. The subject matter includes: understanding technologies and their potential for DBEs (for example, the IoT, AI, machine learning, blockchain); markets and business models (for example, value creation through customer integration, data-driven
business models, platforms, and multi-sided marketplaces); governance and management (for example, strategic positioning in business ecosystems, inter-ecosystem competition, human resources and capability management, ecosystem maturity); societal challenges (for example, ethics, sustainability, corporate digital responsibility); and broader industry implications. My hope is that the Handbook on Digital Business Ecosystems will assist in connecting the eclectic and active communities of scholars from various disciplines interested in studying diverse and multifaceted aspects of DBEs.

This Handbook is intended as guidance not only for researchers and students unfamiliar with the topic, but also for managers who have to develop and navigate increasingly complex DBEs for their companies, in order to remain competitive. The interdisciplinary approach, ideas, and concepts discussed herein should also be of much interest to thoughtful practitioners, as the contributions may help to reveal potential linkages between fields along with their practical implications, and so broaden and deepen the understanding of DBE perspectives.

ORGANIZATION OF THE HANDBOOK

The objective for the Handbook is to bring together perspectives and approaches that represent the diversity of disciplines and the many facets of DBE development in practice. The call for chapters for the Handbook on DBEs that had been shared in diverse interdisciplinary communities met with overwhelming success, another indicator for the growing importance of the field. Selecting the best submissions was no easy task and many excellent contributions could not be included in the Handbook. Special thanks go to Alan Sturmer from Edward Elgar Publishing who supported the extension of the Handbook to incorporate more chapters. The final Handbook now comprises 44 chapters from over 80 international scholars and practitioners who share their research and experiences on and in DBEs.

The Handbook is organized into seven parts, each of which is focused on a common theme. Given the transdisciplinarity of DBEs many chapters relate to more than one theme, but were added to the theme which most broadly represents their contribution. Although there is some overlap amongst some of the chapters, each one provides a unique perspective. All chapters are also meant to stand alone as topical readings. The following outline provides an overview of the Handbook themes and a summary of chapters.

Part I (which follows this introductory chapter) presents “Strategies and Perspectives” of DBEs. Contributions concentrate on the origins of DBEs in different disciplines, the variety of perspectives on DBEs and strategies of actors in DBEs, as well as inter-DBE competition. In their mapping study on DBEs Sabine Baumann and Marcel Leerhoff (Chapter 2) trace the emergence of DBEs in various disciplines and connect the topics that are being discussed in theory and practice. They demonstrate that several topics such as platforms, technologies or data-driven business models are broadly researched. However, many important DBE research strands are still unconnected and underexplored. David R. King (Chapter 3) uses organizational learning to discuss strategies that companies can apply to successfully adapt their traditional ecosystem to incorporate digital elements. Interestingly, he identifies several mismatches between theoretical expectations and observed firm behavior. In Chapter 4, Antonio Crupi, Nicola Del Sarto, Alberto Di Minin, and Martin F. Kenney provide insights on new dimensions and strategies relevant for firms to handle more effectively the digital transformation in the light of recent advances in technology, with a particular emphasis on
the role of ecosystems, digital platforms, and absorptive capacity. Päivi Maijanen (Chapter 5) analyzes the role and features of dynamic capabilities in digital platform-based ecosystems where companies need to sense new business opportunities, to seize them proactively with new business model designs and investments, and to continuously transform their tangible and especially intangible resources to achieve strategic targets. Chapter 6 by Sabine Reisinger and Johannes M. Lehner explores the strategic trade-off between exploiting existing resources and investing in new business opportunities. The authors describe four ideal types for resolving such strategic tensions and discuss strategic options of the respective actors in the DBE regarding their position on a two-dimensional framework. Concluding Part I, Gillian Doyle (Chapter 7) argues that the growing scale and complexity of some digital organizations is such that they can be seen as ecosystems in their own right. She examines how changing technologies have encouraged takeovers and consolidation in the television production industry which resulted in organizations that can be regarded as functioning ecosystems.

Part II focuses on “Entrepreneurship” in different facets. As Spigel (2020) points out, entrepreneurship can be explored as an activity of entrepreneurs in DBEs (entrepreneurship in DBEs), or as a type of DBE, that is, entrepreneurial DBE. Stephanie Birkner and Martina Weifenbach in Chapter 8 explore how entrepreneurial purpose acts as a compass that helps entrepreneurs to navigate through ambiguous waters of business model design and to seize business opportunities. Nina Schumacher (Chapter 9) studies the factors influencing digital start-up success from a venture capital investor’s perspective, and shows that only the contextual factors of human capital and finances are deemed to be relevant for success. In Chapter 10, Christian Horneber examines the motivations and opportunities for value creation and value appropriation arising from various forms of integration of digital start-ups in established companies. Part II concludes with Ngozichukwuka M. Enjo Ojo, Oluwasoye P. Mafimisebi, and Felix Arndt discussing the role of DBEs for female entrepreneurship in developing economies (Chapter 11). They show that DBEs can provide female entrepreneurs with access to finance, education, and business networks so that they can thrive amidst uncertainties and severe gender-induced challenges.

Part III of the Handbook is oriented towards “Value Creation and Business Models” in DBEs. Contributions focus on DBE value creation logics, often through different types of platforms, and highlight the specificity of DBE business models in various industrial domains. In Chapter 12, Simon Michalke, Lisa Lohrenz, Dominik Siemon, Christoph Lattemann, and Susanne Robra-Bissantz demonstrate that the successful development and management of digital engagement platforms relies on the design of governance structures and mechanisms that attract and bind a critical mass of actors, balance their heterogeneous interests, and ensure future success through continuous innovation. Employing the design science research approach they derive principles, mechanisms, and enactors to design key features of engagement platforms. Philipp Mosch and Robert Obermaier in Chapter 13 explore the specifics of value creation logics and types of digital platforms in industrial settings. They propose a comprehensive classification framework for platforms in the Industrial Internet of Things and derive practical recommendations for related investment decisions in industry. In Chapter 14, Karolina Bähr expands the understanding of co-creation in DBEs by developing a typology of different customer roles according to their interaction level and their integration of resources. Through real-world cases she illustrates that co-creating customers blur the distinction between consumption and production in DBEs. Reinhard Schütte and Tobias Wulfert (Chapter 15) investigate the digital transformation of traditional retailers as they establish online sales
channels and increasingly integrate with DBEs that include both traditional (offline) actors and new digital actors. Their proposed framework is organized around information systems architecture layers that include generic retail services, matching services, and a development environment. Volker Nissen (Chapter 16) concludes Part III by demonstrating that digital platforms and the associated ecosystems offer excellent opportunities to increase the traditionally bad scaling of consulting services, with potential improvements also in the reach, speed, cost, flexibility, and even quality of service provision. Chapter 16 analyzes existing business models in the consulting sector and proposes the digital consulting ecosystem that takes competition from the company to the network level.

Part IV explores issues concerning the “Governance and Management” of DBEs. Contributions cover organizational and maturity frameworks supporting DBE design, implementation, and operation. Christian Zabel and Verena Telkmann in Chapter 17 study agglomeration factors in the German cross reality (XR) industry to capture the role of location for non-focal firms in emerging DBEs. Their analysis shows that agglomeration effects are not only based on the agglomeration properties of a geographical location and industry type, but may also vary between strategic groups of firms and their respective positioning in a DBe. In Chapter 18, Ricardo Guerrero, Christoph Lattemann, Simon Michalke, and Dominik Siemon propose a DBE maturity model for personal service firms, for example education, retail, hospitality, and craftsmanship. The maturity model (MM) includes a series of dimensions, capabilities, and maturity stages indicating an evolutionary path towards digital maturity, and offers specific guidance for personal service firms to achieve the transition from analog to digital. Christopher Buschow and Maike Suhr (Chapter 19) study objectives and motivations, actors and their positions (particularly the role of keystone organizations) in cross-border collaborative investigations in digital journalism. They build on the results to contrast DBEs as a novel organizational form with conventional business ecosystems. Vinzenz Jeglinsky and Herwig Winkler (Chapter 20) identify obstacles of digitization projects in manufacturing and propose a decision model in order to improve decisions in DBEs. They verify their model through an empirical study and derive practical recommendations to ensure more successful and faster digital project implementations. In the closing chapter of Part IV, Sebastian Floerecke and Franz Lehner in Chapter 21 present a holistic meta-study of success-related factors of Software as a Service (SaaS) providers. Based on the roles of the Passau Cloud Computing Ecosystem (PaCE) model they compare studies on success-related factors of SaaS providers to support executives of SaaS providers in their decision-making processes.

Part V focuses on “Data and Technologies” in DBEs. Contributors address central digital technologies that have been driving the emergence and prominence of DBEs. Oliver Budzinski, Sophia Gaenssle, and Nadine Lindstädt-Dreusicke in Chapter 22 analyze the economics behind algorithmic search and recommender services (SRSs) that play a paramount role in DBEs. Based on a systematic analysis of SRSs as a commercial good and changes because of digitization, they discuss benefits and risks for welfare that arise from the widespread employment of algorithmic search and recommendation systems. In Chapter 23, Wafaa A.H. Ahmed and Bart L. MacCarthy investigate the role of blockchain technology in the supply chain, learning from emerging ecosystems and industry consortia. Their study highlights considerations central to a blockchain consortium’s formation and sustainability, including its governance, technical and industry focus, and participation issues. In Chapter 24, Yu Cui and Prakash J. Singh adapt the supply chain system architecture to DBEs by integrating blockchain mechanisms in order to strengthen supply chain resilience. They use examples from Japanese
industry to demonstrate benefits and risks of their DBE-based architectural model of a supply chain. Ivana Kostovska (Chapter 25) explores the value creation processes in blockchain ecosystems in the creative industries. She shows how blockchain entrepreneurs attempt to attract a large pool of micro-investments to address market imperfections and bottlenecks. In Part V’s final chapter, W.G. Will Zhao and Yimin Yang (Chapter 26) re-examine three onto-epistemologically distinctive socio-material perspectives and illustrate their implications for studying artificial intelligence (AI)-driven interactions of humans and robots in service DBEs. They use the example of deicing robots to derive research directions for studying AI services when applying an onto-epistemological pluralistic approach.

Part VI addresses “Societal Challenges and Sustainability” of DBEs. Contributions explore how DBEs can support more sustainable business models, but also capture societal challenges when stakeholder groups become sidelined in DBE structures. Traci M. Bricka and Amber N. Schroeder (Chapter 27) review challenges of platform work, especially for platform workers, that have arisen within the platform economy. They discuss potential implications for government entities, platform providers, and individuals such as legal employment classifications or the economic precariousness inherent in platform work, and make practical recommendations for stakeholders involved in platform-facilitated DBEs. In Chapter 28, Patrick Peter and Will Ritzrau elaborate how circularity can be implemented in DBEs through a systemic, transparent, and mutually beneficial information exchange on symbiotic reporting platforms. Studying the phases of the life cycle of e-vehicle batteries they identify key success factors for business to transform from linear to circular value creation in order to improve sustainability and make responsibilities for the environmental impact of DBEs transparent. Verena Luisa Aufderheide, Laura Montag, and Marion Steven (Chapter 29) explore value creation opportunities of product-service systems for the photovoltaic (PV) power industry from an ecosystem perspective. They introduce an innovative business model of smart-circular product-service ecosystems for PV panels, and analyze how a DBE should be characterized in terms of actors, roles, and value contribution to successfully implement smart-circular product-services. In Chapter 30, Timo Klünder and Marion Steven develop an instrument to evaluate the anticipated sustainability performance of actors within a DBE. Based on a comprehensive bibliometric analysis they distinguish challenges, properties, and objectives of DBEs in order to derive performance measures that are then incorporated into a benchmarking instrument. Raissa Pershina (Chapter 31) concludes Part VI by studying the role of big data analytics in increasing sustainable capabilities in the online food delivery industry. She introduces the concept of circular participation and illuminates how data analytics support human and non-human decision-makers in their effort to increase sustainable capabilities of the DBE.

Part VII introduces a variety of DBE “Industry Applications and Case Studies.” Contributors delve into industrial examples to illustrate organizing principles of DBEs and analyze benefits and limitations of DBEs in practice. Franziska Götz, Christoph Buck, Michael Rosemann, and Reinhard Meckl in Chapter 32 set the scene by comparing DBEs in the German automotive, finance, insurance, and sporting goods industries. Their study reveals different levels of digital maturity and implementation progress for these industries, specific challenges and opportunities, as well as growth potentials for their DBE. In Chapter 33, Cindy Price Schultz uses the ecosystems perspective to compare three business models of digital news in the same geographic ecosystem: a non-profit, an entrepreneurial model, and a corporate-owned outlet. She compares platforms, innovations, complementarities, interdependencies, and revenue streams to explore the firms’ adaptations to sustain their success with readers, advertisers, and
sponsors. Anna Jupowicz-Ginalska and Krzysztof Sokół (Chapter 34) present a multiple-case study of virtual reality (VR) applications in the media, in order to define three models of building relations between the media implementing VR and the external entities: the cooperative, the internal platform, and the partnership-platform model. In Chapter 35, Katharina Hölzle, Oliver Kullik, Robert Rose, and Matthias Teichert describe the eSports industry and its principal characteristics from a structural ecosystem perspective. They conceptualize eSports as a digital innovation ecosystem and propose a blueprint of the eSports ecosystem comprising its main actors and activities. Reinhard E. Kunz and Alexander Roth (Chapter 36) develop a conceptual framework of an eSports service ecosystem as a domain-specific DBE of increasing relevance to (better) understand the different roles, relationships, and interactions of actors involved in value co-creation. Using a case study approach they demonstrate the dynamic interactions among multiple actors in eSports and how the scope of value co-creation has been extended beyond the firm-and-customer dyad to a service ecosystem. In Chapter 37, Geoffrey M. Graybeal and Benjamin Lawrence explore how the United States restaurant industry used the DBE approach in response to the coronavirus pandemic. They find that in the restaurant industry platform-based delivery models have emerged, as well as a new wave of pop-up “digital-only” brands, host and ghost kitchen models. Samina Husain and Ana Trigo in Chapter 38 deliver perspectives about the future of mobility and how autonomous technology can affect the traditional automotive business ecosystem. They present trends related to automotive industry stakeholders—namely, the incumbents, the start-ups, the big technological companies, the governmental institutions, and the society—and validate the described perspectives by insights obtained from automotive experts. In Chapter 39, Masaharu Tsujimoto and Soichiro Tanaka introduce the case of the Personal Data Trust Bank (PDTB) in Japan that introduced a new platform-based digital ecosystem to create and promote assorted services utilizing personal data (for example, health management information, power and gas utilization information, medication history, household information, and settlement information). Their study analyzes the drivers behind customer intentions to use future services that may be realized through personal data sharing. Franziska Götz, Caroline Reelitz, Christoph Buck, Torsten Eymann, and Reinhard Meckl (Chapter 40) analyze potentials of DBEs in the German health care market. Their findings show that digital health care ecosystems are a promising means to sustain the quality of health care by addressing current challenges of an aging society, multi-morbidity, a low degree of digitization, and few innovations in the health care sector. In Chapter 41, Adrian Toschka explores the use of digital twins in real estate to drive value throughout the building life cycle, as the industry moves towards DBE structures in which new stakeholders complement the traditional incumbents in the production and management of buildings, such as architects, construction companies, and building managers. Victoria Konovalenko Slettli (Chapter 42) addresses big data analytics capability building in the context of DBEs for the case of the Norwegian swine breeding industry. She examines the steps of acquiring and accumulating big data resources and the related complex multi-stage human technological process involving all entities within a given DBE. In Chapter 43, Julia Feldt and Henning Kontny explore case studies of autonomous logistics systems as examples of internal DBEs for order fulfillment. They show how robotic systems can lead to a substantial increase in order picking speed while staying very flexible and demanding significantly less warehouse space. Giovanna Culot (Chapter 44) concludes Part VII and the Handbook with her study on DBEs in manufacturing. Drawing on results of an international expert study to identify evolutionary trajectories and ongoing debates, she analyzes emerging models for
Industry 4.0 which are then tested by a series of illustrative case studies on mass customization and manufacturing servitization.

CONCLUSION

This Handbook provides a comprehensive and detailed exploration of the evolution and current state of DBEs. The Handbook brings together scholars and practitioners from various disciplines (economics, management, sociology, communication, computer science, and engineering) and investigates a multitude of perspectives (entrepreneurship, markets, management, business models, technologies, and societal challenges) on and industrial applications of DBEs.

The field of DBEs is no longer nascent, but is currently growing at a fast pace as it makes its way towards being a mainstream concept. This Handbook provides useful foundations for further theory building and applications in industrial sectors. It also offers various avenues for future research, in particular those that combine multiple disciplines and perspectives. Overall, I hope the interdisciplinary work contained in this Handbook serves as an important step of this evolution and inspires significant pursuit of additional research and industry applications in the future.

This Handbook could not have been completed without the support of numerous people. My deep thanks go to all the contributors for their continuous effort and timely submissions of draft chapters, reviews of each other’s chapters, and their excellent final contributions. I could sense their commitment and deep engagement in all steps of the process. Jade University of Applied Sciences supported the book project by funding a research associate, Marcel Leerhoff, whose assistance in the many administrative and communication processes was invaluable. I would also like to thank the editorial staff at Edward Elgar Publishing for their guidance in completing this important and much-needed Handbook on Digital Business Ecosystems.

REFERENCES


