

Introduction

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BACKGROUND

Radical changes in the geography of costs, production, and human and social capital have affected the organization of business activities, modifying both geographic and sectoral dimensions. Business organizations have reacted by decentralizing production and innovation, shifting activities to external partners and adopting distributed, modular organizational structures. This trend has led to the emergence of the business network.

The business network is ubiquitous throughout the economy. The production and commercialization of products and services rely on a network of interrelated firms which contribute directly or indirectly to its design, creation and delivery (Powell 1990, Castells 1996). Although research has made important contributions towards the understanding of business networks, further theoretical and empirical research is required to develop a better understanding of the processes underlying their structure and evolution.

As early as 1959, Stafford Beer compared business systems to biological systems and argued that an industrial organization is an organism which responds to its environment. The ecological perspective does not see the economy as a machine; on the contrary it argues that the market economy is best understood as a living, evolving ecosystem (Rothschild 1990). Departing from these contributions, this book aims to provide a better understanding of how business networks were born, under what conditions they can survive and what the main variables to be considered are in order to support the design, implementation and evolution of an effective business network structure. Moore (1993) defined the business ecosystem as a loose network of suppliers, distributors and outsourcing firms that work cooperatively and competitively to support new products, satisfy customer needs and incorporate innovations. In Moore's (1996) approach, innovation becomes the locus where business ecosystem species co-evolve. Innovation is a catalyser element for the creation and evolution of the ecosystem.

This ecosystem concept is widely used by Intel, IBM, HP and Microsoft in defining alliances and networks and promoting their products and services. According to Mayer and Kenney (2004), Cisco has successfully grown through the conscious and deliberate acquisition of high-technology firms to become the dominant global networking equipment provider with an active involvement by both the firm and its employees in its ecosystem. As suggested by Iansiti and Levien (2004a), the biological ecosystem can provide a powerful metaphor for understanding these business networks: like a biological system, a business ecosystem is a non-homogeneous community of entities, made up of a large number of interconnected participants with different interests, who depend on each other for their mutual effectiveness and survival, and so are bound together in a collective whole. The structure of a business ecosystem, its relationships among members, the types of connections existing among them and the differing roles played by the members, follow a similar path to that of biological ecosystems (Iansiti and Levien 2004b). At a meso level, business ecosystems show an evolutionary dynamic. As described by Saviotti (2001), the structure of these networks emerges when the individual components of the systems, which are initially combined in a random way, assemble in particular organizations, whose interactions are influenced by institutions. At first the new structure is loosely organized, but gradually becomes more interconnected and rigid. This structure becomes unstable due to changing environmental conditions both internally and outside existing institutions and organizations, in the sense of requiring new firms and new institutions to define the rules. Such rules will be available *ex ante*, but can also be created simultaneously with the diffusion of innovation.

The diffusion of information and communication technology (ICT) has allowed organizations within business ecosystems to use Internet-based technologies in conjunction with face-to-face interaction in order to undertake and coordinate joint tasks. Value generated in Internet-enabled business transcends traditional industrial sector firms belonging to different sectors but to the same business ecosystem (Gossain and Kandiah 1998) or business web (Tapscott *et al.* 2000) and can provide unique and customized solutions to individual customers. Each organization adds one or more distinct aspect of product/service value to the value generated by the ecosystem, by exchanging digital knowledge with other members: the business ecosystem evolves into the digital business ecosystem (DBE).

A digital ecosystem can be defined as the ICT-enabling infrastructure that supports the cooperation, the knowledge sharing and the building of a digital business ecosystem. The digital ecosystem is the pervasive soft support infrastructure populated by digital species able to evolve, adapt and mediate services and knowledge. In this metaphor the digital ecosystem is

'populated by digital species', exhibiting the structure and behaviour of natural species as much as a business ecosystem is populated by business species.

OBJECTIVE AND APPROACH

To date no published academic work has provided a theoretical, analytical or empirical grounding of digital business ecosystems. This book draws on and presents different perspectives of digital business ecosystems to fill this gap, taking an interdisciplinary approach to broaden and deepen the understanding of DBEs. The book is divided into four main parts. Part I presents the theoretical and analytical dimensions of digital business ecosystems. Contributions concentrate on the emergence of business ecosystems and their theoretical underpinnings. Part II explores the organizational dimension of digital business ecosystems. Contributors delve into the main organizing principles using different industrial examples. Part III takes industry- and firm-level approaches as well as some policy implications. Contributions focus on different sectors and highlight the specificity of digital business ecosystems in various industrial domains. Part IV is mainly oriented towards the definition of tools and frameworks supporting DBE design and implementation.

Part I Digital Business Ecosystems: Theoretical Underpinnings

Part I presents two chapters describing the emergence of business ecosystem concepts and evolution toward the digital business ecosystem.

Chapter 1 analyses the business ecosystem metaphor through the lens of biological ecosystem theory. The biological metaphor of the ecosystem is becoming attractive for scholars and managers. The first question addressed in the chapter is related to the effectiveness of the ecosystem metaphor. Although this seems strongly alluring for highlighting emerging organizational structures and behaviour, it is not clear whether it will be possible to extend the well-known properties of natural ecosystems to a business environment. This leads to the second question – the definition of an evolutionary model that supports a business ecosystem. In the business ecosystem perspective, the key question is far from being related to firm selection and is closely related to path-dependent histories of co-evolving organizational forms. Padgett (2001) defines this as the emergence of an organizational genotype (logic of identity) and the process of creating an organizational phenotype (through interaction with surrounding social networks).

Starting from the problem of sustainable regional development for European regions, Dini and Nachira in Chapter 2 trace the rationale for the creation of a new area of research in digital ecosystems in the presence of challenges of socioeconomic development specific to Europe and characterized by an overwhelming predominance of small and medium-sized enterprises (SMEs). Dini and Nachira define the digital ecosystem concept as the enabling technology for a business ecosystem as it represents the digital software environment that supports the development of distributed and adaptive technologies and evolutionary business models for organizations. Throughout the chapter they show how language and the formalization of knowledge play a key role in the dynamics of sustainable socioeconomic development, how digital ecosystems naturally take advantage of this fact, and how this has led to the emergence of a new and very effective paradigm for interdisciplinary research.

Part II The Organizational Dimension of Digital Business Ecosystems

Part II presents the emergence of new organizational models that are mainly independent of geographical and industrial sectors and are fundamental for understanding the organizational dimension of a digital business ecosystem.

Chapter 3 focuses on the histories of the main organizational forms and on the analysis of network organizations with specific reference to open source organization. Grant begins by examining the principal features of conventional corporations and the changing environmental conditions which are creating the need for different types of organizational structures. On the basis of a diagnosis of why these organizational innovations have failed to take root, he considers the fundamental tasks of organization – coordination and cooperation – and the mechanisms needed to achieve these. Grant recognizes that the networked organization is an organizational form that has long been an alternative to the integrated corporation. In this chapter, the more recent and entirely novel form of network organization that is open-source software (OSS) communities is analysed.

Chapter 4 argues that, despite this globalization, few companies have developed their strategies and structures to harness the potential value of global knowledge diversity. Indeed, most companies still see diverse, context-specific knowledge as an impediment to their globalization strategies, rather than as a fount of new competitive advantage. Williamson explores the changes in mindsets, organizational forms and processes that will be required for companies to break free of globalization strategies based on projecting home-grown advantages around the world and to harness more fully the latent value of global knowledge diversity within

DBEs. Using China as a core example, he proposes that as the planet globalizes, companies will need to rethink fundamentally the way different locations within their international networks can contribute to success.

Part III Empirical Studies on Digital Business Ecosystems

Part III is devoted to the analysis of empirical evidence of emerging business ecosystems in different industries and geographical areas, highlighting the specificity of each business ecosystem.

Chapter 5 identifies unique structural features of the Indian software service organizations that have led to the creation of DBEs with a network of relationships, which have facilitated rapid scaling and sustained growth of this industry. These inter-organizational relationships accommodate both complementarities and competitiveness among their members. Free of any grand design, they have emerged as a consequence of the survival and growth strategies of individual members and have led to the creation of interdependencies which are flexible yet resilient. In this chapter Ramachandran and Mukherji debate whether the network of relationships can be conceptualized as an emergent ecosystem.

Using the language of the Cynefin diagram, Chapter 6 argues that the DBE is placed at least in the complex space of the diagram and may possibly be moving towards the chaos space. Some suggestions are offered on how key people like managers of companies and leaders and economic planners of countries can respond to this development, particularly in the field of innovation and economic policy. In this chapter Chuan-Leong Lam draws parallels and examples from the experience of Singapore in dealing with this issue in the past and also some of the future developmental projects.

In Chapter 7 Boisot and Child examine the impact that ICTs might have on China's development trajectory and ask whether network capitalism is but a station on the way to fully-fledged market capitalism or an institutional order in its own right. They use a conceptual framework, the Information-Space or I-Space to explore the institutional options that confront the country under conditions of rapid social, economic and technical change. They argue that China's institutional responses to the transformations that it is experiencing throw new light on what the term 'globalization' can reasonably be expected to cover. This has implications for the country's own emerging business systems as well as for those who invest in China.

Part IV Tools and Frameworks for Digital Business Ecosystems

Part IV deals with frameworks and tools supporting the design and implementation of the digital business ecosystem.

Chapter 8 explores organizations involved in the joint development, production, operation and maintenance of large complex systems. These organizations are increasingly using electronic networks to plan, schedule, monitor, cost, design, procure and support them. Yet the same information technologies (IT) that facilitate such exchanges of information threaten ownership control over the results of R&D and design efforts. Tang and Molas-Gallart discuss how intellectual property (IP) issues affect the deployment of IT networks to share technical data in the context of research and manufacturing collaborations. From an in-depth study of IP management practices in UK defence firms and customer organizations involved in joint projects, they derive a set of recommended practices and policies for improving IP management in such contexts.

Chapter 9 creates a connection between the digital business ecosystem perspective and e-business models through ICT adoption. The diverse character of emerging business ecosystems, the complex nature of ICT and the innovative character of e-business have made it very difficult to comprehend and construct a viable business model without assessing the features of the digital business ecosystem in question and the unique resources and capabilities of the e-business initiating organization. In this chapter Majumdar defines the MAP-STEPS model which provides a roadmap for developing effective and sustainable business models for organizations considering the resources, capabilities, competencies and strategic competitive advantages of the organization; and he suggests guidelines for the implementation of e-business projects.

A digital business ecosystem can be defined as the e-business infrastructure enabling a business ecosystem with each of the ecosystem players as participants. The digital business ecosystem is the space in which digital organizations interact, compete, collaborate and co-evolve around innovation, using e-business technology. In Chapter 10, Brynjolfsson, Quimby, Urban, Van Alstyne and Verrill describe tools and frameworks related to the relationships a firm can develop with its customers and market and the measurement of productivity of a digital organization in its business ecosystem.

Chapter 11 discusses the impact of radio frequency identification (RFID) and smart devices using the results of a study of two US firms. Laubacher also draws implications for other organizations based on an MIT study that is examining the impact of RFID at a leading US consumer goods manufacturer and of smart devices in the sales group of a leading US technology firm. This study looks at how these technologies are reshaping internal processes and reconfiguring interactions between trading partners. In addition, it shows how activity-based performance measurement (ABPM) can be used to measure the costs and benefits of digital ecosystem technology and other management interventions.

Companies which use a business ecosystem approach to understand their environment and develop their strategies have had tremendous success. Each business ecosystem needs an infrastructure supporting interaction and knowledge exchange mechanisms.

FUTURE RESEARCH AGENDA

Although many essential questions have been answered in this book, many other questions remain and require further research. Significant effort is needed to develop social theories and technology models which underpin the design, structuring and evolution of digital business ecosystems.

From a theoretical perspective it is fundamental to explore further the genotype of an organizational structure, its space of possible evolutionary patterns and the relationships between phenotype trajectories and environmental conditions. This analysis, suggested by Fontana (2003) and Padgett and Powell (2003), calls for exploration of the evolution of organizational roots.

Another key question is related to the conceptualization of the interaction between a business ecosystem of firms and a digital ecosystem of software entities as a 'structural coupling' (Maturana and Varela 1998) across different types of interfaces. Structural coupling assigns an equal role to two interacting entities, such that neither is seen to determine the other completely.

From an empirical viewpoint, future research needs to focus on analysis of the micro-elements that underlie DBE structure and, more importantly, the social, economic, and technological processes that lead to DBE formation and evolution over time. To do so, in-depth case studies may help identify the relevant dimensions of digital business ecosystems.

REFERENCES

- Beer, S. (1959), *Cybernetics and Management*, London: English Universities Press.
- Castells, M. (1996), *The Rise of the Network Society*, Oxford: Blackwell.
- Fontana, W. (2003), *The Topology of the Possible*, Draft, May, <http://www.santafe.edu/~walter/Papers/top.pdf>, 15 September 2006.
- Gossain, S. and G. Kandiah (1998), 'Reinventing value: the new business ecosystem', *Strategy and Leadership*, **26** (5), 28–33.
- Iansiti, M. and R. Levien (2004a), *The Keystone Advantage: What the New Dynamics of Business Ecosystems Mean for Strategy, Innovation and Sustainability*, Boston, MA: Harvard Business School Press.
- Iansiti, M. and R. Levien (2004b), 'Strategy as ecology', *Harvard Business Review*, March, 68–78.

- Maturana, H. and F. Varela (1998), *The Tree of Knowledge: The Biological Roots of Human Understanding*, revised edition, Boston, MA: Shambhala.
- Mayer, D. and M. Kenney (2004), 'Economic action does not take place in a vacuum: understanding Cisco's acquisition and development strategy', *Industry and Innovation*, **11** (4), 299–325.
- Moore, J.F. (1993), 'Predators and prey: a new ecology of competition', *Harvard Business Review*, May–June, 75–86.
- Moore, J.F. (1996), *The Death of Competition: Leadership and Strategy in the Age of Business Ecosystems*, New York: HarperBusiness.
- Padgett, J.F. (2001), Organizational genesis, identity and control: the transformation of banking in Renaissance Florence, in A. Casella and J. Rach (eds), *Networks and Markets*, New York: Russell Sage, pp. 211–257.
- Padgett, J.F. and W.W. Powell (2003), *Market Emergence*, Draft, May.
- Powell, W.W. (1990), 'Neither markets nor hierarchy: network forms of organization', *Research in Organizational Behavior*, **12**, 295–336.
- Rothschild, M. (1990), *The Inevitability of Capitalism*, New York: Henry Holt.
- Saviotti, P.P. (2001), 'Special issue: variety, growth and demand', *Journal of Evolutionary Economics*, **11** (1), 119–142.
- Tapscott, D., D. Ticoll and A. Lowy (2000), *Digital Capital*, Boston, MA: Harvard Business School Press.