

Introduction

Purpose of the Book

The study of strategic interorganizational networks has gained increasing attention in the management field over the last two decades (Ahuja *et al.* 2012, Brass *et al.* 2004, Dagnino *et al.* 2015, Kilduff and Tsai 2006, Powell *et al.* 1996). Overall, these studies have contributed to represent the networks' role as a set of channels and prisms that foster the flow of information, knowledge, ideas, and resources (Owen-Smith and Powell 2004, Poldony 2001), as well as to underscore the motivations underlying the formation of interorganizational networks (Powell 1987, Eisenhardt and Schoonhoven 1996, Nooteboom 2004), the relational and structural configuration of interorganizational networks (Burt 1992, Coleman 1988, Granovetter 1973, Uzzi 1997, Schilling and Phelps 2007), the capability of single network actors to manage and take advantage of network participation (Ahuja 2000a, Dyer and Nobeoka 2000, Gulati 2007, Lorenzoni and Lipparini 1999, Soda and Zaheer 2009, Zaheer and Bell 2005), as well as a preliminary detection of network dynamics (Ahuja *et al.* 2012, Dagnino *et al.* 2016, Gulati *et al.* 2012, Rosenkopf and Padula 2008). Nonetheless, a number of under-researched questions remain in the literature (Clegg *et al.* 2016, Phelps *et al.* 2012) concerning the agential properties of networks, the management of network dynamics, the interactions emerging among different network analytical levels, the constraints and negative effects connected with network participation, and so on.

The purpose of this book is to provide scholars with an interpretative analytical framework able to support them in tackling some of the aforementioned under-researched questions. Drawing on strategic network theory, knowledge-based theory, and complexity theory, the framework views strategic interorganizational networks as complex dynamic networks of knowledge, resources, and capabilities. This view consents to shed light on three key issues:

- i) the multilevel architecture that characterizes strategic interorganizational networks;

- ii) the processes of knowledge, resource, and capability transfer, sharing and creation occurring within and between network levels;
- iii) the (endogenous and exogenous) forces that drive the network architecture dynamics, thereby affecting the economic and innovative performance of both the strategic network as a whole and the firms participating in the network.

Value Added of the Book

In order to elaborate the analytical framework proposed and apply it to scrutinize the multilevel architectural dynamics of the strategic networks, this book brings together a set of interconnected ideas elaborated in our previously published studies and in novel and *ad hoc* conducted inquiries under one fold. The previous published articles have been re-edited.

Although each chapter of the book focuses on a relatively well-defined issue of strategic interorganizational networks (see Table I.1), these topics are interconnected. In pursuing a synthesis of the main issues related to the rationale underlying the emergence, development, and change of both strategic networks and their multilevel architecture, the book has the effect of generating a set of overlaying research domains that build upon, as well as inform, preceding chapters. We believe that there is value in bringing together the set of studies we have selected, as this effort allows us to offer scholars insights that may not be forthcoming without such an “anthology”. As each study concentrates on specific issues and research questions, it is not otherwise easy to recognize how it fits in with the comprehensive representation of strategic networks, their economic and innovative potential, as well as their dynamics. Accordingly, it may be useful to interconnect the specific issues by developing a coherent and unifying interpretative framework.

Table I.1 – The Map of the Book

<p>Chapter 1</p> <p><i>Strategic Networks: Mapping the Intellectual Structure of Extant Literature</i></p> <p><i>Focus:</i> Scrutinize the origin of strategic interorganizational networks.</p> <p>Main contributions:</p> <ul style="list-style-type: none"> – to provide a systematic overview of the studies on innovation in strategic interorganizational networks; – to depict the intellectual structure of the literature on innovation in strategic interorganizational networks, and map the extant literature; – to identify the major gaps in the extant literature and propose a future research agenda on the issue.

(continued)



Chapter 2

The Strategic Network as a Complex Dynamic Network of Knowledge, Resources and Capabilities

Focus: Interpret the strategic interorganizational network as a complex dynamic network of knowledge, resources and capabilities.

Main contributions:

- to integrate and extend the hints provided by the resource-based and knowledge-based theories of the firm, and the strategic network approach through the complex systems' view;
- to underscore the coexisting and coevolving analytical levels of a strategic network;
- to pinpoint the properties that typify a complex dynamic network of knowledge, resources and capabilities;
- to enlighten the value creation potential of a strategic network.



Chapter 3

Competitive Bases and Consequences of Strategic Networks' Multilevel Architecture

Focus: Analyze the competitive bases and consequences of the multilevel architecture of strategic interorganizational networks.

Main contributions:

- to scrutinize how the complex systems' view contributes to increase our understanding of strategic network emergence, knowledge potential, and evolution thanks to its holistic and multilevel logic;
- to examine the characteristics of the network analytical levels and the related benefits and limitations;
- to investigate the interactions among the analytical levels of strategic networks.



Chapter 4

Multilevel Architecture of Strategic Networks: The Cases of STMicroelectronics and Toyota

Focus: Scrutinize the emergence and evolutionary dynamics of two business cases applying the conceptual framework developed in Chapter 3.

Main contributions:

- to identify the major commonalities and differences that exist between the evolutionary paths and structural architectures of the networks analyzed;
- to gather a set of propositions regards the fundamental dimensions that define network architectures and the dynamics underlying the emergence and evolution of strategic networks' architectures.

(continued)



Chapter 5

Strategic Network Dynamics Inquiry: A Comprehensive Appraisal

Focus: Review of the extant management literature on strategic network dynamics.

Main contributions:

- to offer a systematic and comprehensive overview of the main research themes and empirical evidence that scholars have dealt with;
- to identify the structure of the most recurrent words in studies on strategic network dynamics according to two key dimensions: the type of network dynamics (i.e., emergence, evolution, and change) and the origin (i.e., endogenous, exogenous and/or multilevel) of the sources of network dynamics;
- to map and classify studies on strategic network dynamics on the basis of the previously identified structure, and highlight the presence of same gaps in the examined literature.



Chapter 6

Architectural Dynamics and Intentional Governance of Strategic Networks

Focus: Examine the drivers underlying the role and scope of intentional governance of the architectural dynamics of strategic interorganizational networks.

Main contributions:

- to identify the specific model of structural dynamics that typify the formation and growth of each level of the network architecture;
- to illustrate the role and scope of intentional governance on behalf of one (or more) network firm(s) in the multilevel network architecture in both the early and later stages of network evolution.

More in detail, the *fil rouge* that allows us to bring together the ideas included in all the chapters is the multilevel and holistic logic provided by the complex systems view. This logic contributes to increase our understanding of the strategic networks' formation, evolution and change in the following ways:

- i) by curtailing the antagonism between holism and reductionism, it assigns a specific role to both the single parts that compose the strategic network and the strategic network as a whole, and to the dynamic interactions between them. Accordingly, we focus on the simultaneous consideration of the specific processes of knowledge, resource and capability deployment and creation that take place *within* and *among* the strategic network levels;
- ii) it leads to reconcile the dichotomy between spontaneous emergence and in-

tentionality in the governance of the dynamics underlying the strategic networks' formation and development. As a result, we are able to investigate how the role and scope of intentional governance in each level of the network architecture change over time according to the structural and relational characteristics that typify the specific level;

- iii) by focusing on the co-evolution of multiple analytical levels, it claims that the continuous interactions taking place within a strategic network rest on both internal and external stimuli. Accordingly, we simultaneously look at the exogenous, endogenous, and multilevel sources of network dynamics and their interactions.

In addition, the book takes advantage from using different but complementary methodological approaches. In detail, in chapter 1 we use a systematic quantitative approach, based on a bibliometric coupling technique, to analyze and visualize the intellectual structure and evolution of studies on innovation in strategic interorganizational networks. In chapter 2, 3, and 6 we use a theoretical approach to respectively scrutinize: (i) the strategic network as a complex dynamic network of resources, knowledge and capabilities; (ii) the multilevel network architecture and the processes of knowledge, resource and capability exploration and exploitation that take place within and among the different network levels; (iii) the key dimensions that influence the role and scope of intentional governance of the multilevel network architecture dynamics. In chapter 4 we apply a qualitative approach to examine the emergence and development of two strategic networks (i.e., STMicroelectronic's global network and Toyota's supplier network in the US) with an embedded design. In chapter 5, we use content analysis to identify the structure of the most recurrent words contained in the literature on strategic network dynamics and to map this literature.

Finally, we believe that the interpretative framework developed in the book bears suggestions for future work. Indeed, the discussion that concludes each chapter, the sets of propositions included in chapters 4 and 6, as well as the final remarks contained in the concluding section spur ideas for further inquiry.

Structure of the Book

The book is organized in six chapters (see Table I.1). A short description of each chapter follows.

Chapter 1 provides a systematic overview of studies focusing on how strategic networks create the conditions that lead to the generation and development of innovations, in an attempt to isolate the origin of these networks. After a brief discussion of the emergence of the field of study on the relationship bet-

ween interorganizational networks and innovation, we propose a detailed analysis of the literature based on the bibliometric coupling approach. This approach allows us to organize studies on innovation in interorganizational networks (published from January 1996 to October 2012) depending on the cited references they share and to identify the intellectual structure of the literature under scrutiny. More in detail, a cluster analysis of the bibliometric coupling frequency normalized matrix suggests the existence of six main research themes: (I) interorganizational networks as a framework that sustains firm innovativeness in specific contexts; (II) interorganizational network dimensions and mechanisms and innovation/knowledge processes; (III) interorganizational networks as a means to access and share resources/knowledge for innovation; (IV) the interplay between firm and interorganizational network characteristics and its effects on innovative processes; (V) empirical research on interorganizational networks in highly dynamic industries; (VI) the influence of the industry knowledge domains' peculiarities on interorganizational network dimensions and characteristics.

Then, we visualize on a specific map the articles on how industry context and dynamics, network' mechanisms and dimensions, as well as organizational conditions and characteristics drive knowledge transfer and creation in strategic networks to spur innovation processes. As a result, we are able to visualize the spatial distances between intellectual themes and we eventually identify the major gaps in the literature and propose a structured path for a future research agenda on the issue. In particular, we structure the research agenda in seven areas: (a) perspectives and levels of analysis; (b) nature of the interorganizational relations and innovation; (c) actors types; (d) generalizability of empirical results; (e) influence of network and other interorganizational forms on innovative performance; (f) how firms manage and take advantage of network participation; (g) interorganizational network, innovation and institutional contexts.

Chapter 2 interprets the strategic network as a complex dynamic network of knowledge, resources and capabilities. More in detail, we use the logic provided by the complex system theory to integrate and extend the hints provided by two relevant management approaches: (i) the resource-based and knowledge based theories of the firm, that focus on the firm level sources of competitive advantage; and (ii) the strategic network theory, that focuses on the network level sources of competitive advantage. The integration of the two conceptual approaches above bring us to sketch an interpretative analytical framework on strategic interorganizational networks which:

- a) considers these networks as a distinct conceptual macro-category that, by embracing and interconnecting a variety of idiosyncratic firms and organiza-

tions, originates a complex dynamic system of knowledge, resources and capabilities;

- b) underscores that, within a strategic network, we can identify three relatively distinct but complementary and coexisting levels of analysis: (1) the micro-systemic level, related to the single firm in the network; (2) the meso-systemic level, related to the various groups of densely connected firms within the network. These firms maintain particularly intense – dyadic or multiple – relationships vis-à-vis those held with the other firms that belong to the network; (3) the macro-systemic level, which concerns the network system as a whole, and the relationships between the latter and the environment in which it operates;
- c) pinpoints the properties that typify the strategic network as a complex dynamic system of knowledge, resource and capabilities: i.e., economic properties, social properties, complex system properties and additional properties.

In order to explain how the strategic network takes shape in pursuing competitive rents, we introduce and model six strategic capabilities (i.e., search, selection, learning, knowledge, institutionalization, and quasi-isomorphism) which, combined together by means of intrasystemic interactions, drive both the evolution of the strategic network and its superior ability to create value. Finally, we depict the implications of the proposed interpretative framework for managerial research and practice.

Chapter 3 delves into the competitive bases and consequences of the multi-level architecture of strategic networks. By means of the holistic and multilevel logic provided by the complex system view, we are able to identify the specific social structures (i.e., shared contexts and shared space) where the interactions among network participating organizations take place at the three different but coexisting and co-evolving levels within the strategic network. We maintain that the interaction contexts referring to the micro-, the meso-, and the macro-systemic level display different relational and structural characteristics. These characteristics support the accomplishment of specific processes of knowledge exploitation and exploration at each analytical level. As a result, semi-independent processes of knowledge evolution occur at each network level and thus each level exhibits a specific role in the strategic network. In addition, we pinpoint that the knowledge, resources and capabilities created at each level are rendered available also to the other levels. This situation gives rise to top-down and bottom-up flows of knowledge and information among the three analytical network levels that spark off further knowledge developments and contribute to generate a superadditive expansion of the synchronic and diachronic knowledge and innovative potential within the strategic network.

Chapter 4 applies the conceptual framework developed in Chapter 3 to scru-

tinize the emergence and evolutionary dynamics of two business cases: i.e., Toyota Motor Company and STMicroelectronics. We find that, during roughly the same time period, Toyota Motor Company and STMicroelectronics were both engaged in setting up a complex network of interorganizational relationships in order to enable these focal firms to acquire and sustain a dominant competitive position in their industries. The scrutiny of the processes underlying the genesis and dynamics of the two networks shows that in both cases there are three significant phases through which they emerge and evolve and, furthermore, that within each phase the contents of the evolutionary process are the same. Despite the fact that the two networks analyzed show numerous strategic similarities and similar processes underlying their emergence and evolution, the resulting multilevel network architectures appear different. In particular, Toyota Motor Company's network is characterized by strong relations between densely connected organizations, a strong network identity and unity of vision. In this case, the evolutionary pathway of the network is largely defined by all the organizations belonging to the network itself. STMicroelectronics's network, on the other hand, includes a wide variety of actors, most of whom maintain relationships with the focal firm but are scarcely connected to one another. This case shows the emergence of a loosely coupled network in which STMicroelectronics plays the principal role in determining the directions towards which the network will further develop.

By juxtaposing the cases, we identify the major commonalities and differences that exist between the evolutionary paths and structural architectures of the two networks analyzed. Through the use of replication logic, we draw four propositions from the tips obtained by means of the cases' juxtaposition. These propositions allow us to gather some analytical generalizations regards the fundamental dimensions which define network architectures and the dynamic relationships which underlie network architecture emergence, evolution and performance. More in detail, the propositions concern: a) the fundamental dimensions of network architectures in a dynamic view; b) the main variable which influences network architecture configuration; c) the causal antecedents of network architecture emergence; and d) the dynamics underlying network stability and instability. On the whole, they represent a starting point for future research regarding the dynamic processes underlying network emergence and evolution. We eventually illustrate a number of interesting aspects and implications of the analysis performed for strategy theory and practice.

Chapter 5 reviews the extant management literature on strategic network dynamics in order to offer a systematic and comprehensive overview of the main research themes and empirical evidence that scholars have dealt with. We select all the scientific articles published in the management field that address dynam-

ics in strategic interorganizational networks within the Scopus database. On the ground of the articles selected, we compute the distribution of the articles over time and we identify the most prolific journals and authors that have driven the development of the topic. In addition, we recognize the most influential articles by counting the number of citations they received.

Then, based on the analysis of the content of the abstracts of the selected articles, we sketch the structure of the most recurrent words in studies on network dynamics published in the management field. We classify these words on the basis of two key dimensions: (i) the reference to processes of network emergence, evolution or change; (ii) the endogenous, exogenous or multilevel nature of the sources of network dynamics. The structure that emerges from this classification leads us to recognize six cells that encompass the main research themes and empirical evidence that scholars have tackled within the literature on network dynamics in time. These themes mirror the priorities that have driven scholars, editors and reviewers over time resulting in the development of the scrutinized literature. In addition, we map and classify studies on strategic network dynamics according to the depicted structure and briefly report the main contribution of each article. Finally, we use the analysis of the past and current development of the examined literature to highlight the presence of some gaps in it and to provide some insights about the direction in which the debate is currently going.

Chapter 6 sheds light on the drivers underlying the role and scope of intentional governance of the architectural dynamics of strategic interorganizational networks. We show that the majority of studies regarding network governance tend to adopt a dichotomic perspective that distinguishes networks that are emergent from networks that are orchestrated. The juxtaposition of studies on emergent and orchestrated networks allow us to identify the differences and points of contact that characterize these two types of networks. These differences are, for example, related to the levels of analysis, the time period, the research methods, the types of ties, and the type of whole network governance mainly considered. The previous analysis displays that the drivers underlying the presence of one (or more) organizations that intentionally influence the changes of the network architecture and the specific activities they engage in remain to be clearly pinpointed. In order to move towards the comprehension of which dimensions influence the role and scope of intentional governance of the network architectural dynamics, we draw on contributions made at the interface between network research and complexity science. These studies identify a limited number of models according to which network structural dynamics may evolve (i.e., scale-free network model, truncated scale-free network model, single-scale network model, and accelerating network model).

We illustrate the distinguishing characteristics of formal and informal inter-

organizational ties, and the knowledge exploration and exploitation processes they support. Given the characteristics identified, we link each type of tie to a specific model of dynamic evolution. In particular, we maintain that the network of formal interorganizational ties displays an accelerating network model, and the network of informal interorganizational ties exhibits a scale-free (or a truncated scale-free) network model. The identification of the model of structural dynamics that typify the formation and growth of formal and informal ties respectively allows us to clarify the role and scope of intentional governance within each structural setting in both the early stages and the later stages of network evolution. Furthermore, given the way each type of tie supports specific knowledge processes within and between network actors, we illustrate the role and scope of intentional governance in multilevel network architectures composed of both formal and informal ties.

The concluding section highlights the main contributions of the book and underscore the relevance of the findings for management research and practice. In addition, we recognize the limitations of the investigation performed that might be provisions for future research.

CHAPTER 1

Strategic Networks: Mapping the Intellectual Structure of Extant Literature¹

This chapter aims to provide a systematic overview of studies on how inter-organizational networks create the conditions that lead the development of innovations. By performing a bibliometric analysis of the aforementioned literature, which provides a means for the organized and quantitative consideration of published articles, we are able to recognize the latent structure underlying this field of research and identify the main research themes scholars deal with.

Accordingly, drawing on the findings of the bibliometric analysis, we clarify the conceptual boundaries of the literature on innovation in interorganizational networks, identify the major gaps in our knowledge and formulate an agenda for future research.

Fifteen years ago, Powell *et al.* (1996) inaugurated a new field of research that looks the networks as a locus of innovation. That is to say the innovation process is rooted in the interactions and knowledge exchanges among a variety of heterogeneous actors, mainly identified in suppliers, customers, science partners, universities, research organizations, government and financial institutions, and so on. Interestingly, the field of studies on interfirm collaboration networks, interorganizational networks of learning, innovation and collaborative activities portfolio has developed pretty quickly and hastily (Ahuja 2000a, Dhanaraj and Parkhe 2006, Schilling and Phelps 2007, Von Hippel 2007, Westerlund and Rajala 2010). Actually, a straightforward search in Google Scholar shows more than 1.8 million results that associate the words innovation and interorganiza-

¹ This chapter has been adapted from “Interorganizational network and innovation: a bibliometric study and proposed research agenda” by G.B. Dagnino, G. Levanti, A. Minà, and P.M. Picone published in *Journal of Business & Industrial Marketing*, 2015, 30(3/4): 354-377, by permission of Emerald Group Publishing Limited. We are also grateful to dr. Minà (Kore University of Enna) and dr. Picone (University of Bergamo) for permission to re-publish the article.

tional and interfirm network (search performed on November 2, 2012). Two main reasons justify the growing interest for the relationship between interorganizational network and innovation. First, it represents a relevant economic phenomena in a number of industries, such as the biotechnology industry (Powell *et al.* 1996, Powell 1998, Baum *et al.* 2000, Owen-Smith and Powell 2004, Gilsing and Nootboom 2006), the semiconductor industry (Podolny *et al.* 1996, Stuart 2000, Dagnino *et al.* 2008), the automotive industry (Dyer 1996, Dyer and Nobeoka 2000), the multimedia industry (Gilsing and Nootboom 2005), the software industry (Chesbrough *et al.* 2008, Tiwana 2008), the furnishings industry (Capaldo 2007), the financial industry (Poldony 2001, Uzzi and Lancaster 2003), and others. Consequently, managers and practitioners are increasingly solicited to grasp strategic options to create and capture value in network relations. Second, differing positions on the relationship between interorganizational networks and the types of innovation (Burt 1992 and 2005, Uzzi 1997, Nootboom 2000, Hagedoorn and Duysters 2002a and 2002b, Uzzi and Spiro 2005), and on how firms inside the boundaries of a network are able to capture value (Gulati 1999 and 2007, Gulati and Wang 2003, Zaheer and Bell 2005) exist in the literature.

While researchers' understanding of the phenomenon has certainly developed, the variety of drivers (such as, innovation/knowledge domain complexity, networked actor heterogeneity and roles, network governance mechanisms, network structures and networked actors' positions, and so on) and level of analysis (actor level, dyadic level and network level) that have been studied presents us with the need for the role of interorganizational networks in innovation generation to be effectively assessed.

We acknowledge that a handful of previous studies (Pittaway *et al.* 2004, Phelps *et al.* 2012) have offered reviews of the literature on networks. The organized broad picture presented by Phelps *et al.* (2012) may be viewed as portraying the historical development of network research spanning three different level of analysis (i.e., interpersonal, interorganizational and interorganizational), as well as using the lenses of the knowledge-based perspective and related constructs. As a result, it highlights a set of relevant insights on the evolution of network literature. Differently, on Pittaway *et al.* (2004) footsteps, we focus on how knowledge transfer inside the boundaries of an interorganizational network offers opportunities for mutual learning and innovation. However, while Pittaway *et al.* (2004) presents a sheer qualitative interpretation of the literature, this paper is rooted in a specific quantitative approach to the formation and advancement of the literature on innovation in interorganizational networks. Our bibliometric analysis of the literature is therefore helpful to gather and synthesize earlier interpretations on how a firm operating within the boundaries of an

interorganizational network may access and leverage valuable knowledge from other networked organizations to enhance its innovation performance.

We use bibliographic coupling technique to organize the studies on innovation in interorganizational networks published from January 1996 to October 2012 anchored in the reference works they share. Bibliometric coupling analysis allows us to draw an overview of how this field of research has developed, eventually recognizing six main clustered research themes:

- a) interorganizational networks as a framework that sustains firm innovativeness in specific contexts;
- b) interorganizational network dimensions and knowledge processes;
- c) interorganizational networks as a means to access and share resources/knowledge;
- d) the interplay between firm and interorganizational network characteristics and its effects on innovative processes;
- e) empirical research on interorganizational networks in highly dynamic industries;
- f) the influence of industry knowledge domain's peculiarities on interorganizational network dimensions and characteristics.

Finally, we identify and visualize in a specific map the articles on how industry context and dynamics, network mechanisms and dimensions, as well as organizational capabilities drive knowledge transfer and recombination in interorganizational networks to spur innovation processes.

The chapter is organized as follows. In section 1.1, we discuss the emergence of the field of study on the relationship between interorganizational networks and innovation. Section 1.2 presents and discusses the methodological features of the research, justifies the sampling and introduces the bibliometric analysis. Section 1.3 proposes a detailed analysis of literature based on bibliometric coupling approach. Section 1.4 develops and discusses a visual map of the innovation network research field. In section 1.5, we examine future opportunities to help advance the research on innovation interorganizational networks. Finally, section 1.6 acknowledges the limitations of the study and gathers a few conclusions.

1.1. The Strategic Network Field of Study

1.1.1. Development of the Interorganizational Network Field of Study

In the past two decades, a turbulent and hypercompetitive environment (D'Aveni 1994) has made more taxing and demanding for firms to effectively com-

pete singlehanded, as it has entailed a steep increase in depth and breadth of knowledge, capabilities and resources required to accomplish innovation processes. This condition has made the case that a single firm, regardless for its size and the financial resources accessible, cannot easily and economically manage the novel necessities². To overcome the difficulties related to the current innovation challenge, on the one hand, firms tend to specialize in one or a few stages of the innovation process and in related knowledge domains. On the other hand, they usually activate an array of interorganizational relationships with heterogeneous partners that allow them to access timely and leverage more effectively complementary (and sometimes alike) sets of resources, capabilities and knowledge. As a result, interorganizational networks emerge over time and innovation arises as a network phenomenon.

Interorganizational networks are complex webs of ties spanning and interconnecting an array of firms and other kinds of organizations within and across industries (Powell *et al.* 1996). Each network actors is endowed with distinctive and specialized sets of resources, knowledge and capabilities. Networks serve as channels through which information, knowledge, ideas and resources owned and controlled by network actors flow; and as prisms that spread evidence of actors' attributes as reliable and valuable partners (Poldony 2001, Owen-Smith and Powell 2004). Accordingly, interorganizational networks allow the interplay among pockets of local expertise and resources scattered throughout networked firms, thereby increasing the likelihood of innovative outcomes to emerge.

In more detail, interorganizational networks potentially provide participating actors advantages from: (a) *static* (or allocative) sources of efficiency tied to economies of knowledge replication, economies of scale, scope and time and economies of innovative labor's division (Arora and Gambardella 1994, Tsai 2001, Hansen 2002, Grant and Baden-Fuller 2004, Inkpen and Tsang 2005); (b) *dy-*

² Specifically, managerial difficulties in dealing with innovation processes are mainly connected with significant levels of variety and variability in the different knowledge bases on which innovation is grounded. In addition, the critical knowledge, capabilities and resources required for innovation may not be acquired in corresponding factor markets, rather they are developed and accumulated internally by choosing appropriate and consistent time paths of investment flows (Dierickx and Cool 1989). Furthermore, whereas some knowledge, resources and capabilities needed are tradable, they require to be absorbed, combined, coordinated and integrated with the existing ones to be deployed in the firms' innovation processes (Cohen and Levinthal 1990, Kogut and Zander 1992, Grant 1996a, Lane and Lubatkin 1998). Finally, the trade-off between the exploitation of current knowledge, capabilities and resources and the exploration of novel knowledge, capabilities and resources (March 1991) represents an additionally managerial challenge. Overall, the fulfillment of innovation processes requires high and risky specific investments.

namic (or adaptive) sources of efficiency connected to learning and knowledge creation economies (Powell *et al.* 1996, Inkpen 1996, Khanna *et al.* 1998, Hagedoorn and Duyster 2002a, Gilsing and Nootboom 2006).

In addition, network participation normally generates benefits from risk sharing (Grandori 1997a). On the whole, these circumstances contribute to originate more efficient, effective and timely innovation processes.

1.1.2. An Overview of Interorganizational Networks as a Field of Study

Studies on interorganizational networks have been mainly conducted at two distinctive, but complementary, levels of analysis:

- i) the *micro* (or actor) level that focuses on a focal firm (named ego) and its ego-centric network (Wasserman and Faust 1994), also termed firm alliances portfolio, consisting of the set of the firm's direct ties (Das and Teng 2002, Ozcan and Eisenhardt 2009); and
- ii) the *macro* (or network) level that instead focuses on the properties and characteristics of the network as a whole (Kilduff and Tsai 2006), i.e. the overarching set of organizational actors and the (direct and indirect) links defined by them³.

Interorganizational network literature includes contents that may be roughly attributed to the following macro-issues: network formation, network relational and structural configuration, network governance and network management.

First, a number of studies aim to explore the motivations underlying *interorganizational network formation* and identified network benefits connected with: obtaining access to new market and technologies (Powell 1987, Hagedoorn 1993, Varadarajan and Cunningham 1995), speeding products to market (Almeida and Kogut 1999), pooling complementary skills (Eisenhardt and Schoonhoven 1996, Hagedoorn and Dusters 2002b), safeguarding property rights (Liebeskind *et al.* 1996), risk sharing (Grandori 1997b), grasping opportunities connected to knowledge exploration and exploitation (Nootboom 2000). The reasons explaining why an interorganizational network emerges drive the process of partner selection

³ A notable field in strategic management literature, which is cognate to interorganizational studies, is alliance research. This research stream focuses especially on the dyadic level and scrutinizes a single interorganizational collaborative relationship (namely, the alliance). Unlike network studies, which stress collective actions and outcomes, alliance research tends to underemphasize collective behaviors and to underestimate the social advantages (and constrains) provided by belonging to an interorganizational network (Dagnino *et al.* 2008).

as they affect the characteristics and attributes of network partners that are critical in the development of interorganizational collaborative relationships (Baum *et al.* 2000, Gulati 2007). Network actors' heterogeneity primarily refers to their goals, knowledge bases, capabilities and competences, perceptions, power and network positions and cultures (Cantù *et al.* 2012, Corsaro *et al.* 2012).

Second, several network studies regard *relational and structural configuration* of interorganizational networks. Scholars investigate the different typologies of network links, and in particular they confront weak (Granovetter 1983, Hansen 1999) and strong (Larson 1992, Uzzi 1996 and 1997) connections. They analyze the configurations that network structure may assume, and above all they compare dense (Coleman 1988) versus dispersed (Burt 1992) network structures. Then, they scrutinize the different capabilities of network ties and the network structures that support or hinder knowledge exploitation and exploration (Nooteboom 2004, Gilsing and Nooteboom 2005) and, therefore, the relationship existing between relational and structural network characteristics and the innovative and competitive performance of both network actors and the network as a whole (Capaldo 2007, Schilling and Phelps 2007, Dagnino *et al.* 2008).

Third, an interesting area of inquiry concerns the *mechanisms* through which an interorganizational network is *coordinated and governed*. These mechanisms include: ex ante and ex post control mechanisms of actors' behaviors, as well as integrative, incentive and social mechanisms. While most researchers consider the aforementioned mechanisms as a substitute (Larson 1992, Uzzi 1997, Dyer and Singh 1998), a growing number of studies tend to recognize them as complementary (Das and Teng 1998, Poppo and Zenger 2002, White and Lui 2005), underscoring the relevance of arranging a suitable and balanced mix of coordinated mechanisms in accordance with innovative and economic network actors' goals (Das and Teng 1998, Blomqvist *et al.* 2005, Mellewigt *et al.* 2007).

Fourth, a number of studies have investigated the capability of single network actors to *manage* and to *take advantage of network participation* (Lorenzoni and Lipparini 1999, Dyer and Nobeoka 2000, Gulati *et al.* 2000) and connected this capability to a range of items, such as the level of prior related knowledge (Lane and Lubatkin 1998, Zahra and George 2002), the previous patterns of interfirm relationships (Ahuja 2000a), the past network structure and actors' positions (Gulati 2007, Zaheer and Bell 2005, Zaheer and Soda 2009), the presence of alignment or misalignment in the perception of problems and solutions among network actors (Corsaro and Shenota 2011) and the creation of a dedicated alliance function and structure inside the actors' organization (Kale *et al.* 2001, Kale and Singh 2007).

1.2. Research Methods

As reported above, this chapter aims to offer a shared understanding of the current configuration of the literature on innovation in interorganizational networks. More specifically, we target to explore how this specific interorganizational arrangement may contribute to firm innovation. By detecting and mapping the clusters of studies and pinpointing the crucial links of its intellectual evolution, we are eventually able to offer a comprehensive scrutiny of the theoretical and empirical abovementioned literature.

We estimate the relative proximities of articles using references and/or citations by exploring quantitative relations of the production, dissemination and the use of recorded information (Tague-Sutcliffe 1992). We use a bibliometric approach that enables a systematic quantitative analysis of citations. Bibliometric tools also make it possible to explore research studies in terms of analytical influential contributions and their connections that have supported the conceptual development of a field (Di Stefano *et al.* 2010). As we refer to “the collection, the handling, and the analysis of quantitative bibliographic data, derived from scientific publications” (Verbeek *et al.* 2002, p. 181) using a quantitative approach, the main advantages of the bibliometric method are its fairness and objectivity (Nerur *et al.* 2008). The opportunity to implement literature reviews applying bibliometric methods has been exploited in management studies as concerns a variety of issues such as: (i) the evolution of strategic management research (Ramos-Rodriguez and Ruiz Navarro 2004); (ii) the dynamic capabilities approach (Di Stefano *et al.* 2010); (iii) knowledge combination (Tsai and Wu 2010); (iv) regional innovation systems (D’Allura *et al.* 2012); (v) technology push and demand pull perspectives (Di Stefano *et al.* 2012); (vi) strategic alliances (Di Guardo and Harrigan 2012); and (vii) marketing anti-consumption behavior (Galvagno 2011).

To recognize the conceptual perspectives that address innovation in interorganizational networks and draw the boundaries between approaches, this paper uses bibliometric coupling analysis (Kessler 1962 1963a and 1963b, Weinberg 1974). Coupling analysis is based on the cited references that articles share. As shared references confirm thematic proximity, bibliographic coupling presupposes reference commonality as a proxy of resemblance of conceptual roots.

1.2.1. Data Sources

Starting from 1990s and through the dawn of the new millennium, a line of research in management research has started to give emphasis to the necessity of broadening the boundaries of investigation to the interorganizational network intended as the “locus of innovation”. Coherently, the time span of our bibliome-

tric analysis comprises the development in interorganizational networks' innovation field starting in mid-1990s, which was essentially benchmarked by the inaugural contribution by Powell *et al.* (1996). We consider articles published in the entire 16 years between January 1996 and October 2012.

The data source is the database of the Social Sciences Citation Index, owned by ISI Thompson. Nonetheless, while the processes we have followed to evaluate the quality and impact of journals is subject of debate, the academic community usually recognizes ISI journals as “certified journals”, and the ones bearing a prominent role in scientific knowledge diffusion.

Interestingly enough, the literature on networks is quite extensive. In particular, the network perspective has been applied in studies than span several disciplines (including sociology, organizational studies, strategic management, marketing and communications, psychology, computer science, physics, and so on) and various network kinds and levels, such as interpersonal networks, intraorganizational networks, interorganizational networks, biological networks, technological networks, and so on. In this chapter, we focus more specifically on the management literature dedicated to interorganizational and interfirm networks. This literature boundary choice is primarily grounded in the condition that we followed previous reviews with a similar objective (Pittaway *et al.* 2004), as well as in the fact that management journals may be oversampled since they publish much of the research on the topic (Phelps *et al.* 2012). On the basis of this research focus, we have selected the articles using the Web of Knowledge platform according to the following criteria. First, we searched for articles that contain the word “network*” and “innovation*” and “interfirm*” (or inter-firm*) in the title, abstract and keywords. Second, we searched for articles that contain the word “network*” and “innovation*” and “interorganizational*” (or inter-organizational*) in the title, abstract and keywords. Merging the results of previous researches, we found 717 articles. We then refined the results for the following criteria: (a) research domain: social sciences; (b) research areas: business economics or operations research management science; (c) document types: article (we exclude proceedings papers, reviews and editorial materials).

We then found 428 articles. Furthermore, we refined a second time the results for the journals on the basis of the five-year impact factor. Impact factor is a quantitative measure citation based on the importance and significance of a scientific journal (Garfield 1979). Because it is considered a gross approximation of the reputation and overall scientific standing of academic journals in which articles have been published, we included the journals that in 2011 presented more than 3.5 in their five-year impact factor⁴. The choice of the impact

⁴ We have then included in this set 13 relevant journals spanning various management fields

factor record certifies that the journals we took into account were the most influential in the management area. The selected articles are then 124.

Finally, we asked a panel of five advanced PhD students/candidates in management and organization to rate, in a dichotomic fashion, all the 124 abstracts of the articles selected, as concerns to whether the abstracts were coherent with our theoretical premises, or closely related to the innovation in interorganizational networks concept in our core argument. This process eventually yielded a total of 67 articles. This practice is considered acceptable in refining bibliometric research since advanced PhD students and candidates, for the time they devote to learning and research, are usually the ones that are deemed more familiar to the larger amount of literature output in their specific fields of investigation.

1.2.2. Compilation Steps

As noted above, bibliometric coupling analysis uses a matrix of bibliometric coupling frequency as the basis for a variety of investigations. We used the 67 studies in our sample to build a square matrix in which the rows and columns represented the articles. The cells indicated the number of shared references.

Given that authors may have different propensities to cite references, following previous bibliometric coupling studies (i.e. Glanzel and Czerwon 1996, Mubeen 1995), we normalized the matrix using the cosine measure (Salton and McGill 1983). The coupling strength between article t and paper q (CS_{tq}) is defined as follows: $CS_{tq} = f_{tq} / \sqrt{f_t \cdot f_q}$ where f_{tq} is the number of common references between article t and article q , while f_t and f_q is the number of references in the papers i and j , respectively. For construction, CS_{tq} values on the interval between 0 and 1.

1.2.3. Analysis

Our set of analyses is composed of two different specific techniques: cluster analysis and multidimensional scaling. We developed cluster analysis on the basis of “farthest neighbor technique” (also known as “complete linkage”) to the matrix of normalized bibliometric coupling strengths. This statistic technique provides a fairly good approximation of the classification with respect to the num-

such as: Academy of Management Journal, Academy of Management Review, Administrative Science Quarterly, Information Systems Research, Journal of Management Studies, Journal of Management, Journal of Operations Management, Journal of Product Innovation Management, MIS Quarterly, Organization Science, Research Policy, Strategic Management Journal and Tourism Management. This choice of data sources may be viewed as the strength of our study because it allows accounting for different management fields and communities of scholars.

ber of groups identified, especially in the case of the stems approach (Ahlgren and Jarneving 2008) and for the need to provide interpretable results (Han and Kamber 2000). We divided the literature into distinct similar groups, where the distance between two clusters is computed as the distance between the two farthest elements in the clusters. Each of the clusters represents a particular subfield of the literature. Using the key words of the abstracts of the articles in each cluster, we conducted a preliminary exploratory analysis using the VosViewer software to filter the main terms on the basis of number of occurrences and term relevance.

In addition, our literature analysis involves the production of a spatial representation of the literature on innovation in interorganizational networks through multidimensional scaling analysis to the matrix of normalized bibliometric coupling strengths. Our goal is to place the articles as regards the map's axes, as well as to recognize the key dimensions that characterize the qualified literature.

To interpret the findings and reduce subjective bias, we used a brainstorming technique to bring the common wisdom among the articles inside a cluster and, eventually, the connections among clusters. Each author was brainstormed individually, and subsequently, all of the ideas were merged into a large table of ideas.

1.3. The Intellectual Structure of the Literature

While more than 700 articles published between January 1996 and October 2012 recall the concepts of innovation and interorganizational network, to identify the intellectual core of field of research under investigation, we have followed a procedure (illustrated in details in the data source section) that has restricted the analysis to 67 articles. More than 50 articles of this set have been published in the past 10 years and, more specifically, 20 articles in the very last 3 years. The recent rapid paced development of the literature on innovation in interorganizational networks confirms that it has achieved the status of a relevant subject matter in managerial studies.

The first-hand inspection of the journals in which the articles were published reveals that *Research Policy* is the most influential in the field followed by *Organization Science* and *Strategic Management Journal*. While *Research Policy* tends to analyze “the economic, policy, management, organizational, environmental and other challenges posed by innovation, technology, R&D and science”, the other two key journals seem more focused on the managerial implications of theoretical and empirical studies.

To identify the intellectual structure of the research on innovation in interorganizational networks, we performed cluster analysis on the bibliometric cou-

pling frequency normalized matrix. Our visual inspection of the dendrogram results and the coefficient analysis suggested the existence of six separate clusters. In the sections that follow, we review the papers located in each cluster and discuss the homogeneous elements of each cluster to extract the explicit backgrounds on which they are grounded.

Cluster 1: Interorganizational networks as a framework that sustains firm innovativeness in specific contexts

As Table 1.1 shows, Cluster 1 is composed of eight papers. The overarching research question is how organizations, interorganizational networks and industry contexts and dynamics interact. Ansari and Krop (2012) find the aforementioned interaction relevant to tackle radical innovation, while Love and Roper (2001) and Nooteboom (1999) illustrate the influences of industrial and regional systems on innovative network outputs. Knudsen (2007) expands actor spectrum, considering how customers contribute to new product development. Other empirical evidences are a mix of industrial specificities, such as tourism (Novelli *et al.* 2006), technological modularity (Staudenmayer *et al.* 2005) and vertical semi-integration versus horizontal cooperation (Tomlinson 2010).

Cluster 2: Interorganizational network dimensions and mechanisms and innovation/knowledge processes

As Table 1.2 illustrates, Cluster 2 contains 18 articles that aim to scrutinize the connections linking network dimensions and network coordination mechanisms with interorganizational innovation and knowledge processes. More in detail, some studies focus on technological transfer and diffusion explaining how distinct network mechanisms (Autio *et al.* 2006, Roijackers and Hagedoorn 2006, Ceci and Iubatti 2012) and network characteristics (Owen-Smith and Powell 2004, Zhao *et al.* 2005, Greve 2009) are able to affect the accomplishment of these processes within an interorganizational network. A more dynamic perspective is offered by Tiwana (2008) that introduces the theme of ambidexterity to assess how structural and relational network dimensions affect knowledge flows and innovation within an interorganizational network.

Another set of studies in Cluster 2 analyze how knowledge transfer is achieved through job mobility (Cantner and Graf 2006, Corredoira and Rosenkopf 2010), and the need to define industry-wide standards and compatibility (Chellappa and Saraf 2010) that lead to interfirm network emergence.

Table 1.1.1. – Alphabetical list of the articles composing Cluster 1

Article	Focus of the study	Method	Sample	Time Span	Main insights
Ansari and Krop (2012)	To analyze what are the factors that influence incumbent performance in the face of a radical innovation.	Theoretical construction and example discussion.	Dutch TV industry.	1995-2010	Incumbent performances in the context of disruptive innovations are linked to the interplay of constructs pertaining to organizational, inter-organizational and industry levels.
Ceccagnoli Forman, and Huang, and Wu (2012)	To examine co-creation of value in a platform ecosystem	Econometric investigation.	1,210 small independent software vendors.	1996-2004	Joining a major platform owner's platform ecosystem improves the business performance of small independent software vendors (ISVs). The impact is greater when ISVs have greater intellectual property rights or stronger downstream capabilities.
Knudsen (2007)	To explore the nature and relative importance of different types of interfirm relationships for new product development success.	Econometric investigation.	632 firms operating in European manufacturing and service industries.	–	Customers are involved more frequently in joint development efforts of new product. Second, firms tend to partner with firms from their own industry.
Love and Roper (2001)	To investigate location and network effects on innovation success.	Econometric investigation.	1133 firms from the UK, 404 firms from Ireland firms and 1186 firms from Germany.	–	There are systematic industrial and regional influences in the efficiency with which such networking inputs are translated into innovation outputs.

(continued)

Article	Focus of the study	Method	Sample	Time Span	Main insights
Nootboom (1999)	To discuss innovative performance's implications of different forms of inter-firm linkage, ways to govern them, different 'generic systems' of innovation, and government policy.	Theoretical discussion.	-	-	The study identifies two "generic" kinds of innovation systems, in terms of the mix of instruments for relational governance, and discusses their merits and flaws with respect to quality of products, diffusion, incremental and radical innovation.
Novelli, Schmitz and Spencer (2006)	To use network and clusters as a framework providing SMEs with innovative opportunities to operate in a competitive tourism environment.	Qualitative investigation.	South East region of the UK.	-	The development of clusters should not be seen as a simple and spontaneous process due to the nature of businesses involved, but as a very complex process linked to strong partner collaboration.
Staudenmayer, Tripsas and Tucci (2005)	To scrutinize the implications of interfirm modularity for product development.	Qualitative investigation.	Sample covers 739 alliances carried out by 557 firms and institutions.	1987-2004	Firms experiencing an environment of interfirm modularity tackle with unique challenges. The concrete firms' solutions to these challenges were creative and in many cases counter to established wisdom.
Tomlinson (2010)	To explore the impact of cooperative ties upon levels of innovation.	Econometric investigation.	436 firms operating in 5 UK manufacturing industries.	2005-2008	The paper finds evidence to support the hypothesis that vertical cooperative ties and their strength are significant factors in explaining firms' levels of innovative performance. In some sectors, horizontal co-operative ties are also important.

Table 1.2. – Alphabetical list of the articles composing Cluster 2

Article	Focus of the study	Method	Sample	Time Span	Main insights
Autio, Hameri and Vuola (2006)	To describe the distinctive mechanisms through which big-science centers generate industrial knowledge spillovers in the economy.	Qualitative investigation.	3 firms in the nano-technology, metallurgy and power electronics industries.	1996-2001	The study demonstrates the distinctive potential that big-science centers offer as a source of knowledge spillovers in national innovation systems.
Breznitz and Zehavi (2010)	To describe how government-anchored networks could be address issues of interfirm trust and coordination.	Theoretical discussion.	–	–	Government sponsored networks are well-suited for responding to several problems that arise in pure private production models.
Cantner and Graf (2006)	To address the evolution of a specific innovator network.	Quantitative investigation.	157 innovating entrants, 107 innovators that exit, and 32 permanent innovators.	1995-1997; 1999-2001.	The job mobility of scientists and the technological overlap between the actors, rather than past cooperation, can predict the resulting network structure.
Ceci and Iubatti (2012)	To investigates the role played by personal relationships within SME networks.	Quali-quantitative investigation.	25 Interviews: 12 with general managers or CEOs and 13 with those responsible for other functions.	2007	The coexistence of personal and professional relationships shapes a unique context that alters the usual dynamics of innovation creation and diffusion.

(continued)

Article	Focus of the study	Method	Sample	Time Span	Main insights
Chellappa and Saraf (2010)	To develop a contingent link between firm IT standards and industry competition.	Econometric investigation and social network method.	95 firms operating in the software industry.	1999-2003	Firms can achieve customer-driven innovation through a careful selection of network partners – not based on rivalry considerations but rather based on their prominence within the network.
Corredoira and Rosenkopf (2010)	To explore mobility's effect on knowledge transfer to firms that lose these employees.	Econometric investigation.	154 US firms.	1975-1995	Mobility-driven knowledge flows are bidirectional. The outbound mobility effect is pronounced when mobility occurs between geographical-distant firms, but attenuates for geographically proximate firms since other redundant knowledge channels exist within regions.
Greve (2009)	To show that valuable innovations remain rare because they are not adopted by distant firms in geographical and network spaces.	Econometric investigation and network analysis.	707 firms	1990-2004	The strong influence of geographical-dispersed interfirm networks on technology diffusion justifies a greater role of interorganizational networks in obtaining competitive advantage.
Lorenzoni and Lipparini (1999)	To focus on the ability to coordinate competencies and combine knowledge across corporate boundaries.	Qualitative investigation.	Three Italian manufacturers of automatic packaging machinery.	1988-1995	This study provides evidence that interfirm networks can be shaped and deliberately designed: over time managers develop a specialized supplier network and build a narrower and more competitive set of core competencies.

(continued)

Article	Focus of the study	Method	Sample	Time Span	Main insights
Owen-Smith and Powell (2004)	To analyze the effects of spillovers in interorganizational networks.	Quali-quantitative investigation.	482 dedicated biotechnology firms.	1988-1999	Geographic propinquity and organizational form fundamentally alter the flow of information through an interorganizational network.
Powell, Koput and Smith-Doerr (1996)	To scrutinize the relationship among interorganizational collaboration and innovation.	Econometric investigation.	225 dedicated biotechnology firms.	1990-1994	When the knowledge base of an industry is both complex and expanding and the sources of expertise are widely dispersed, the locus of innovation will be found in networks of learning, rather than in individual firms.
Roijakkers and Hagedoorn (2006)	To investigate the primarily causes of the grow of inter-firm R&D partnerships and contractual versus equity mechanisms' preferences.	Econometric investigation.	Pharmaceutical biotechnology industry.	1975-1999	The research indicates an overall growth in the number of annually, newly established R&D partnerships where research partners consistently prefer contractual partnerships to equity-based alliances.
Rothaermel (2001)	To examine cooperation between incumbents and new entrants as a mechanism for incumbents to adapt to radical technological.	Econometric investigation.	32 large pharmaceutical firms that have entered into 889 strategic alliances.	1975-1997	Incumbents that focus their network strategy on exploiting complementary assets outperform incumbents that focus on exploring the new technology. However, there are limits to this strategy due to diminishing marginal returns to alliance intensity.

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