IJMR INTERNATIONAL JOURNAL OF MANAGEMENT REVIEWS
British Academy of Management
International Journal of Management Reviews, Vol. 14, 428–443 (2012)
DOI: 10.1111/j.1468-2370.2011.00324.x

Leadership in Interorganizational Networks: A Literature Review and Suggestions for Future Research

Gordon Müller-Seitz
Freie Universität Berlin, Institute for Management, School of Business and Economics, Boltzmannstr. 20, 14195 Berlin, Germany
Corresponding author email: gordon.mueller-seitz@fu-berlin.de

The present review is an investigation of the ways in which interorganizational networks coordinate their activities for the benefit of all parties. In this context 'interorganizational networks' consist of three or more separate, collaborating entities, and the question of their leadership has been well researched in a number of disciplines. Its interest to economic actors is growing. However, the findings of studies that have focused on leadership in such networks are somewhat incoherent. As demonstrated in the present review, this incoherence largely results from the consideration of different forms of network (e.g. hierarchical vs heterarchical), levels of analysis (e.g. organizational vs network), and terms used to describe the phenomena (e.g. governance or orchestration, quite apart from leadership). Against this background, the present review contributes to the body of knowledge on this topic in two main areas. First, the literature is reviewed in order to provide an overview of the key characteristics of forms of network and levels of analysis. Moreover, the view that leadership in such networks influences all members in order to 'make things happen' is suggested. Secondly, future avenues of research are identified in order to stimulate progress in this important area of study.

Introduction

The present review focuses on interorganizational networks, in terms of the collaborations that take place between three or more independent organizations (Grabher and Powell 2004; Jarillo 1988; Provan *et al*. 2007). We selected this particular context because interorganizational networks are commonplace in a number of settings, and have already been well researched; for instance, in the fields of information and communication technology or biotechnology, where R&D plays an important role (e.g. Oliver 2009; Pittaway *et al*. 2004; Powell *et al*. 1996). The collaborative activities of firms that operate in these fields are motivated by factors such as the sharing of the costs and risks associated with R&D, of accessing new markets and skills or of accelerating the cycles of innovation of products.

Acknowledgements
Earlier versions of this paper were presented at the 2009 EGOS Colloquium in Barcelona, Spain, at the 2009 Academy of Management Meeting in Chicago, USA, and at the 2010 EGOS Colloquium in Lisbon, Portugal. Furthermore, the author gratefully acknowledges the support of the Volkswagen Foundation for the project 'Path-Creating Networks: Innovating Next Generation Lithography in Germany and the U.S.' (AZ II/80 308) and the German Research Foundation for the project 'Strategic Leadership in Heterarchical Networks' (MU 3070/1-1). Moreover, I am grateful for Oswald Jones' constructive editorial guidance and to three anonymous reviewers for their thoughtful comments. Finally, I am particularly indebted to Jörg Sydow and Arnold Windeler for their continual, constructive advice and highly appreciated 'heterarchic dialogue', René Bakker for his part in our discussions on the crafting of this review as well as to Amalya Oliver for her inspiration.

In light of the foregoing, it is therefore surprising that authors who have explicitly addressed leadership in such networks have together presented a rather incoherent picture. In the present review, we define leadership to be the exertion of influence in order to 'make things happen' (Huxham and Vangen 2000), despite a lack of formal authority. This incoherence in the literature is startling, given the importance of these networks to their member organizations (Gulati *et al*. 2000), not least to those firms that carry out the leadership function (Beyer and Browning 1999; Lorenzoni and Baden-Fuller 1995). One potential explanation for this incoherence might be that different forms of networks (e.g. hierarchical vs heterarchical), different levels of analysis (e.g. organizational vs network) and different terminologies have been used in previous studies. For example, the common terms used in interorganizational network research relate to governance (i.e. the overall coordination of the network; Jones *et al*. 1997; Powell 1990; Provan *et al*. 2007) or orchestration (i.e. when a 'hub' firm directs the core activities of the network in which it operates; Dhanaraj and Parkhe 2006). Against this background, the aim of the present review is to answer the following two research questions:

> Research question 1: What central characteristics of leadership in interorganizational networks have been found in previous research?
> Research question 2: What avenues of future research can be identified in light of the findings made in previous studies?

In addressing these questions, the present review contributes to the body of knowledge on this topic in two ways. First, we review the work of other authors by focusing on organizational and network levels of analysis as well as their tendency to target hierarchical forms of network. Secondly, we suggest future and complementary avenues of research that might offer a more holistic account of leadership in interorganizational networks.

The remainder of the paper is structured as follows. Section 2 introduces the current understanding of leadership in interorganizational networks. Section 3 describes the approach of the systematic literature review and an overview of the key characteristics of the field. Section 4 identifies four gaps in the research and offers suggestions for future research based on these shortcomings. The conclusions are set out in Section 5.

Leadership in interorganizational networks

Leadership in interorganizational networks has been addressed in a variety of disciplines, such as interpersonal networks (e.g. Granovetter 1973), intraorganizational networks (e.g. Hedlund 1986) and alliances (e.g. Reuer *et al*. 2002). Unsurprisingly, these different disciplinary approaches have targeted different facets of this topic and have used heterogeneous concepts to analyse leadership-related aspects and forms of network.

Using the work of previous authors on this topic as a platform, we define an interorganizational network as a social system in which the joint activities of at least three independent legal entities are reflexively coordinated on a repeated basis, in order that joint benefits may accrue to all the parties concerned (Grabher and Powell 2004; Powell 1990; Sydow and Windeler 1998). Although this definition is rather narrow, it is nevertheless in line with recent research on whole networks (Provan *et al*. 2007) and explicit constellations (Lazzarini 2007). The conception of Provan *et al*. (2007) is useful for the purposes of the present study because it focuses on three or more members that pursue a specific goal while being linked by multiple ties (e.g. contractually or through interpersonal relationships). Following Lazzarini's (2007) notion of explicit constellations, we focus on small forms of interorganizational network in which membership involves formal multilateral agreements such as those found in the airline industry (e.g. Star Alliance, as shown by Lazzarini 2007) or the semiconductor industry (e.g. SEMATECH, as documented by Browning *et al*. 1995). In keeping with Lazzarini (2007), these agreements can assume manifold forms, such as the establishment of technical committees, joint access to airport facilities controlled by individual members, full marketing cooperation or the common use of IT platforms to manage the network.

In any case, network actors must be aware of each other in order to monitor each other's individual as well as joint network-related activities (Grabher and Powell 2004; Jarillo 1988; Provan *et al*. 2007). We have therefore excluded from this review loosely structured large-scale analyses that neglect the interplay between lead firms and other network members: for instance, those relating to clusters (e.g. Sydow *et al*. 2011) or portfolio approaches (e.g. Hoffmann 2005).

Given the variety of conceptions and terms used by different authors, we herein define leadership in interorganizational networks to be the direction of the activities of a network of independent organizations by one or more organization(s), either temporarily or permanently, in which this role is commonly perceived and accepted by the other participants (Huxham and Vangen 2000; Jones *et al*. 1997; Sydow and Windeler 1998). Therefore, the units of analysis for this review concern the individual, organizational, network and field levels of analysis. These units are used in order to allow a comprehensive overview.

It is also important to highlight that leadership in interorganizational networks differs significantly from leadership in individual organizations in that networks cannot direct the planned endeavours of other network organizations via fiat (Podolny and Page 1998; Williamson 1975). This implies that leadership in such networks necessitates the orientation and guidance of the activities of independent, powerful organizations (Beyer and Browning 1999), which can only be carried out by shaping the overall conditions under which the network operates by attempting to influence the rules on activities and relationships (Dhanaraj and Parkhe 2006; Lorenzoni and Baden-Fuller 1995).

Furthermore, we have intentionally chosen the term 'leadership' as opposed to 'governance'. This is because recent work on governance has tended to focus on how the network is structured (e.g. representing a 'select, persistent, and structured set of autonomous firms'; Jones *et al*. 1997, p. 914) and/or to conceive it as a form of coordination (e.g. as being pursued by a network administrative organization (Provan and Kenis 2008; Saz-Carranza and Ospina 2010)). By contrast, a focus on leadership allows us to acknowledge how governance has changed and to be more sensitive to the dynamics of how lead organizations actually influence other network members.

In this context, we find the idea of leadership as 'making things happen' (Huxham and Vangen 2000) to be rather attractive for the following reasons. First, as well as the notion of leadership as exerted by people, some allowance is also made for the importance of structures and processes (Huxham and Vangen 2000; Sydow and Windeler 2003). Secondly, it acknowledges the limitations of lead organizations, thereby preventing the heroic picture implicitly conveyed by some types of leadership in interorganizational networks (e.g. Häcki and Lighton 2001).

Previous empirical research on leadership has scrutinized hierarchical networks from a variety of perspectives, including those of strategic management (e.g. Jarillo 1988), public administration (e.g. Kenis and Provan 2006) and innovation management (e.g. Doz 1996). These authors have made progress in advancing our current understanding of structural and strategic issues. Another strand of empirical research has focused on heterarchical networks, however, in which structural issues cannot fully account for how organizations 'make things happen' (Huxham and Vangen 2000). Because these arenas are not deemed to be leadership-free or egalitarian, previous authors (e.g. Boari and Lipparini 1999; Huxham and Vangen 2000) have argued that their governance is complex, and they focus on the activities that are relevant to the explanation of how leadership occurs.

Review approach

The approach used in this section was informed by previous similar reviews, especially that of Bakker (2010), in order to explain in a transparent manner how the relevant literature was selected. First, as shown in Table 1, our analysis rests on a number of different criteria for inclusion and exclusion.

This section begins with an explanation of our approach to the review of the scholarly field. We focused on double-blind peer-reviewed articles in English-speaking journals from the database EBSCOhost (http://www.ebscohost.com/). This approach is feasible because it improves transparency and replicability (Denyer and Tranfield 2009). The date of publication was unrestricted (as of July 2011). Although such a restriction of the analysis may fail to provide statistical representativeness (which was not our objective; monographs or chapters in edited volumes, for example, were intentionally omitted), it nevertheless enables a thorough and systematic review and is similar to previous approaches (e.g. Bakker 2010; Provan *et al*. 2007). It offers an adequate insight into the most important aspects of the academic discourse on interorganizational networks (Denyer and Tranfield 2009). In addition, our search terms were only applied to the title and abstract, and were obtained from the definitions of leadership and interorganizational networks given above. The application of these terms subsequently resulted in the identification of articles in the literature review.

Table 1. Review procedure

Type of criterion	Criteria	Reason for choosing the criteria	Exemplary evidence
Inclusion criteria	Search terms with truncation characters: control*, govern*, lead*, manag*, maneuv* and orchestrat* in connection with network*, allianc* and consorti*	Boolean logic with regard to leadership and network-related terms narrows down the number of articles to those that make use of the relevant key terms	Nosella and Petroni (2007)
	Electronic database (EBSCOhost)	Enables transparency and replicability	Denyer and Tranfield (2009)
	Double-blind reviewed articles in English-speaking journals	Insight into the international academic discourse	Provan *et al*. (2007)
	Whole networks/explicit constellations	The research object represents an interorganizational network of three or more organizations that reflexively agree upon a joint division of labour for pursuing joint objectives	Beyer and Browning (1999)
Exclusion criteria	Natural Sciences	Excludes articles that do not address managerial issues, e.g. related to the functioning of neural networks within the brain	Lewis and Elman (2008)
	Cluster	These studies do not address interorganizational networks as defined for this review	Tallman *et al*. (2004)
	Intraorganizational networks	These studies do not address interorganizational networks as defined for this review	Kodama (2007)
	Project networks	These studies do not address interorganizational networks as defined for this review	Grabher (2004)
	Dyadic relationships	Interorganizational relationships consisting of two partners (either as defined in the theoretical background and/or data collection/analysis)	Van de Ven and Walker (1984)

In the search, the following keywords were used as criteria for inclusion: 'control*', 'govern*', 'lead*', 'manag*', 'manoeuver*' and 'orchestrat*', all of which were run for matches with the terms 'network*', 'consort*' and 'allianc*'. These primary keywords were intentionally broad in order to cover as many articles as possible in the first search, and produced a great number of articles that were less relevant to our study. A large number of studies on alliances have targeted dyads, for example (Barringer and Harrison 2000), which became clear when reading the theoretical backgrounds and/or methodological sections (e.g. Van de Ven and Walker 1984). However, some of the authors nevertheless addressed networks as defined herein (e.g. Dittrich *et al*. 2007), which is why such an inclusive search was deemed suitable.

The first search yielded 26,825 articles (as of 22 August 2011; cf. also Figure 1). However, after checking the titles and, when appropriate, the abstracts, we narrowed the scope of the analysis to produce just 233 relevant articles. All these articles were reviewed to determine whether they met the predefined criteria. In order to increase the consistency and robustness of the findings, we also surveyed previous reviews (e.g. Provan *et al*. 2007), special issues (e.g. Parkhe *et al*. 2006), monographs (e.g. Kilduff and Tsai 2003), and edited volumes (e.g. Cropper *et al*. 2008) that had similar foci.

In line with our research questions, we further excluded those studies that did not focus on leadership in interorganizational networks using the following exclusion criteria. First, we excluded articles from unrelated fields of enquiry, for example articles from the natural sciences (e.g. Lewis and Elman 2008). Moreover, we excluded articles in the social sciences that did not meet the established criteria, for example industrial clusters (e.g. Sydow *et al*. 2011), intraorganizational networks (e.g. Kodama 2007) and project networks with limited durations (e.g. Grabher 2004). Because we assumed that dyadic relationships significantly differ from networks that consist of three or more organizations, these were excluded as well. Networks that have three or more organizations are faced with specific challenges. For instance, relationships assume a different social quality, and thus structural holes may occur where there is the possibility of a *tertius gaudens* (Simmel 1950). This implies that a network member benefits from disposing of the broker role by positioning itself between two unconnected organizations, thereby having access to two different unrelated sources of knowledge and resources (Burt 1992).

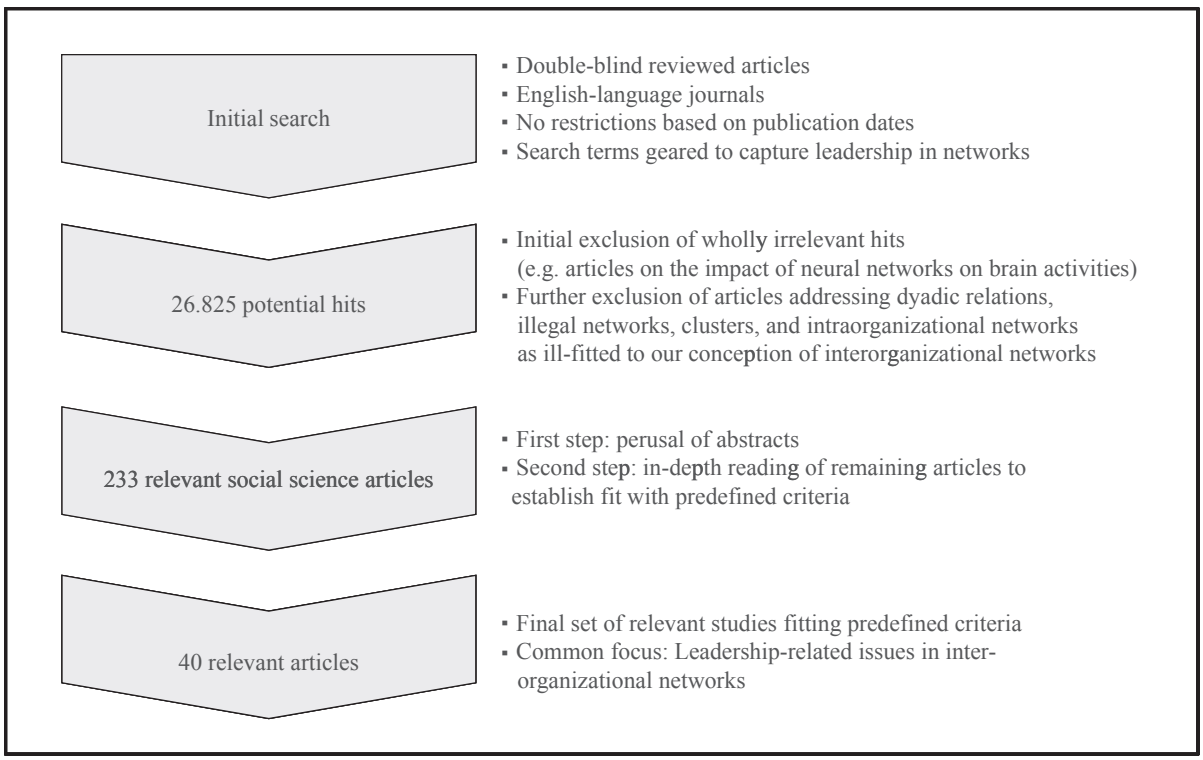

Figure 1. Review procedure

In a similar vein, we excluded work by researchers interested in network evolution. For example, the study by Rosenkopf *et al*. (2001) advanced our understanding of how networks and technology coevolve (cf. also Koka *et al*. 2006), and research targeting the evolution of dyadic relationships against a background of technology and innovation management has highlighted the role of informal mechanisms of coordination (e.g. Doz 1996; Van de Ven and Walker 1984). Although these authors advanced our understanding of the consensus-based nature of the evolution of networks or the formation of interorganizational alliances, they rarely addressed leadership issues explicitly. The same applies for the studies of Koza and Lewin (e.g. Koza and Lewin 1999) on coevolution which targeted the organization–network nexus, but remained silent on leadership issues.

Using our procedure, we identified 40 journal articles that matched the predefined search criteria, and these constituted the core of this review (see Appendix S1). We read these articles in depth and classified them according to 20 different criteria which had been generated deductively (e.g. by reverting to existing reviews with similar foci; Provan *et al*. 2007) and inductively (e.g. by reviewing the body of knowledge on this topic and refining the focus of this review). Through this analysis, we found that not all the criteria were central to our arguments, which is why only a subset is presented (the unused criteria were journal, sector, focus on innovation management, evaluation of overall network effects, level of data analysis, miscellaneous remarks, and keywords offered by authors). Appendix S1 lists the articles included in the present study in alphabetical order.

Results

In this section, we compare the existing body of knowledge with the levels of analysis and forms of network, as well as with the levels of analysis as influenced by leadership and leadership outcomes. Subsequently, we suggest further avenues of research that might stimulate progress in this field.

Leadership in interorganizational networks

The central characteristics of leadership in interorganizational networks can be summarized as follows (the numbers in parentheses indicate the

number of studies that address the respective aspects). First, previous research is relatively recent and has a strong focus on business. Our findings consist of two sources published before 1995 and 20 sources dated 2000 and afterwards. Furthermore, the majority of the publications cover the networks of private sector firms (21; e.g. Sabatier *et al*. 2010). Only 11 explicitly address public networks (e.g. Chen and Graddy 2010), whereas two papers cover networks in both arenas (i.e. Doz *et al*. 2000; Ring *et al*. 2005), and seven papers are conceptual (e.g. Connelly 2007; Grandori 1997). It is interesting to note that the opposite holds true according to the findings of Provan *et al*. (2007) on whole networks, in which public networks dominated. The main reason for this difference is that the present review targets studies that explicitly addressed leadership and includes conceptual papers.

Secondly, for the theoretical-conceptual background (where in some cases multiple options were assigned), two areas of focus were identified. Approximately half the studies centred their research on network management (18), whereas 10 were related to the discourse on public management. Apart from these definite groupings, the picture remains scattered, with authors discussing their findings against the background of technology and innovation management (8), knowledge management (5), transaction cost economics (3), alliance management (3), structuration theory (3), contingency theory (1) and a resource-based view (1).

Thirdly, most of the contributions were based on empirical data (33 vs 7 articles that were conceptually/theoretically oriented). Most of these adopted qualitative approaches (29), 26 of which explicitly used a case study design, whereas three articles took an action research approach (e.g. Huxham 2003). Only four studies were predominantly based on quantitative methods; three of these used multivariate measurements (i.e. Chen and Graddy 2010; Doz *et al*. 2000; Reuer *et al*. 2002) and one implemented a structural network analysis (Milward and Provan 1998). In the remaining studies, either no details were given at all, or a mixed methodology was applied.

Network forms and levels of analysis

Because this paper reviews the current body of knowledge on this topic, we revert to two recognized areas of focus. First, two forms of network are largely used, namely hierarchical and heterarchical, which serve as a backdrop for their respective contributions. Secondly, the level of analysis is considered, in which the focus is on the entity deemed responsible for leading the network.

Figure 2 shows that most authors have focused on the network, with some research into lead organizations using levels of analysis. At an organizational level, the studies are almost exclusively devoted to hierarchical settings and to the perspective of the lead organization. Commonly cited examples involve the discussion of 'hub firms' (Nambisan and Sawhney 2011), 'network orchestrators' (e.g. Batterink *et al*. 2010; Sabatier *et al*. 2010) or 'strategic centres' (Lorenzoni and Baden-Fuller 1995). However, the lead organizations under study vary significantly across the empirical cases considered. For instance, Boari and Lipparini (1999) and Lorenzoni and Lipparini (1999) focused on small manufacturing firms in Italy, Sydow and Windeler (1998, 2003) investigated insurance networks in Germany, and Lorenzoni and Baden-Fuller (1995) focused on large, globally operating firms such as Apple and Cisco.

In addition, the studies of lead organizations commonly targeted leadership from a governance perspective and/or they are related to structural aspects (Jones *et al*. 1997; Powell 1990; Provan and Kenis 2008). Such approaches often imply underlying assumptions of stability and linearity (Sydow 2004), for instance the 'network orchestrators' suggested in Hinterhuber's (2002) study of the networks of two agrochemical corporations. The study by Häcki and Lighton (2001) highlighted the role of so-called 'hub firms', which design their networks in line with customer needs in order to grow revenue and shareholder value (cf. also Chen and Graddy 2010). In relation to the empirical cases of eBay and Cisco, for example, this is achieved by managing access to the network or monitoring its key activities.

In contrast, those studies that conceptualize leadership in interorganizational networks against the backdrop of hierarchical and heterarchical settings seem to view the influence of the lead organization to be rather more limited (e.g. Connelly 2007; Currie *et al*. 2011). In these cases, leadership flows from the reflexive and reciprocal activities of the competent actors in the network. Moreover, conflicts tend to be reported more often, for example in the course of forming and guiding a network. For instance, Sydow (2004) explained how a medium-sized network engaged in 'reflexive monitoring' can mutually track the activities of all network partners and may even intervene in the case of conflicts of interest. Moreover,

Figure 2. Mapping the field of leadership in interorganizational networks

Beyer and Browning (1999) showed how Robert Noyce, the founding CEO of the US semiconductor consortium SEMATECH, managed to unite previous adversaries in the face of a hostile economic and regulative environment by favouring collaboration over competition. Nosella and Petroni (2007) documented the different forms of networks within which the Italian space company Carlo Gavazzi is embedded. Moreover, they elucidated how the lead organization is able to leverage its influence across these different network forms in order to generate different outcomes. Similarly, Capaldo (2007) reported how lead firms can manoeuvre network members in line with their changing interests over time.

Concerning the network level of analysis, the focus tends to rest on hierarchical network settings (e.g. Martin *et al*. 2008), although some studies have addressed heterarchical networks, or both settings (e.g. Currie *et al*. 2011; Ritala *et al*. 2009). Hierarchical network settings can differ in scope. For instance, Herranz (2008) observed networks in different sectors (governmental, non-profit and commercial or mixed-sector networks) in the Boston bay area, whereas Dyer and Nobeoka (2000) assessed the activities of the Japanese car manufacturer Toyota.

In the cases where hybrid forms of network are addressed, literature reviews, theory-building articles or comparative analyses are the approaches taken. For example, Provan and Kenis (2008) identified three forms of network governance, which are similar to our conception of hierarchical and heterarchical networks in that they discussed networks that were governed by their participants (herein heterarchical networks), a lead organization (herein hierarchical networks) and a mixed form, of a network governance administration (cf. also Kim 2008; McDermott 2007). By contrast, Doz *et al*. (2000) used longitudinal data from 53 networks across a number of industries in order to identify the distinct forms of network that result from the way in which different R&D consortia were formed. In both their papers, they reported the existence of emergent (i.e. organizations that face similar environmental conditions and join forces) and engineered (i.e. where a triggering entity is responsible for setting up the network) configurations, whereas Ring *et al*. (2005) found a third form, which they termed the 'embedded' network (i.e. where previous ties existed among the members of the R&D consortium).

Authors who have focused on heterarchical networks at the network level of analysis also tend to criticize the underlying assumptions of stability and linearity in structural approaches (often corresponding to hierarchical network settings), as have other studies of networks (Huxham and Vangen 2000; Sydow and Windeler 1998). The rationale behind this criticism is that such enquiries do not pay attention to the way in which leadership actually takes place, namely how 'making things happen' (Huxham and Vangen 2000) occurs in practice. Huxham and Vangen (Huxham 2000, 2003; Huxham and Vangen 2000) suggested embracing ambiguity and complexity and argued that leadership-exerting organizations might only be able to set the boundary conditions and might not influence their networks entirely because of their lack of formal authority. In a similar vein, Araujo and Brito (1997–98) analysed how collective action resulted in a change of network governance in the Portuguese port wine industry.

The field level of analysis has been subject to less frequent investigation. It is somewhat surprising that only four studies have addressed this theme, given that the embeddedness (Granovetter 1985) of a focal network in other social systems, such as the organizational field, might be relevant to the exercise of leadership (Nosella and Petroni 2007). For instance, mutually reinforcing activities between an insurance network and its organizational field were discussed by Sydow and Windeler (2003), who documented how trust evolved in the face of changes in the regulatory environment of the German financial services industry. In a similar vein, Sydow (2004) pointed to the role of 'reflexive monitoring', namely the mutual awareness of network members' actions as a result of regulatory changes (cf. Sydow and Windeler 1998). Finally, Soeters (1993) explained how 'Euroregional networks' in the Maas–Rhine area are influenced by the policy-related activities of the EU.

Leadership outcomes – or which things are 'made to happen'?

This section assesses the outcomes that follow from the exertion of leadership in interorganizational networks. Figure 3 shows that the reviewed literature can be categorized by the level of analysis at which leadership outcomes become effective (lead organization or network level of analysis) and by the nature of these leadership outcomes (formal or informal).[1]

[1]The studies of Doz *et al*. (2000) and Ring *et al*. (2005) are not included in this figure because in both studies the authors discuss the network form and the accompanying leadership that results.

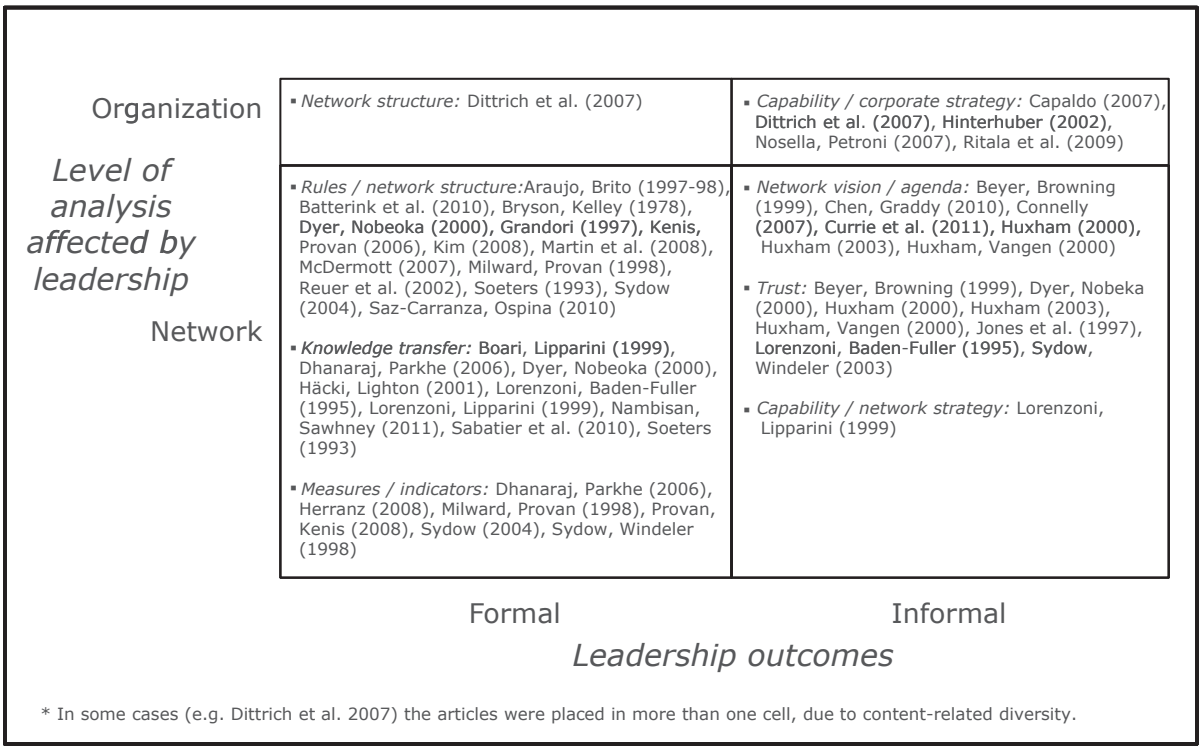

Figure 3. Leadership outcomes

First, it is striking that, in the majority of cases, the publications target the network level of analysis in considering the effects of leadership (25). Only five articles are devoted to the implications of the exertion of leadership on the lead organization itself.

Three themes seem to be relevant to the assessment of how formal leadership outcomes affect the network level of analysis. First, the key area of governance concerns the constitutive rules and/or (changes in) the network structures set out by the leading organization(s). Although some articles offer insights from in-depth case studies (e.g. Araujo and Brito 1997–98), others offer comparative case studies (e.g. Saz-Carranza and Ospina 2010) or conceptual approaches (e.g. Grandori 1997). One example of an in-depth case study is Araujo and Brito's (1997–98) report on how collective action caused changes in the institutional form of leadership which led to a restructuring of the port wine industry in Portugal. By contrast, Grandori (1997) discussed the role of different modes of coordination and how the organizations involved were likely to benefit from these. In a similar vein, Kenis and Provan (2006) used a contingency theoretical approach to point out how the role of environmental factors and network size is relevant to network structure. This finding was empirically supported by Martin *et al*.'s (2008) enquiry into two networks in the English National Health Service (cf. also Batterink *et al*. 2010).

A further line of enquiry has analysed changes in governance over time. In the study by Reuer *et al*. (2002), the authors explored the post-formation dynamics of 81 firms in the biotechnology sector. From a transaction cost theoretical and evolutionary economic stance, their arguments highlighted the role of the scope of the alliance, its division of labour, and the relevance of collaboration with parent firms.

Secondly, articles that have explored the role of knowledge-related activities have focused on enabling knowledge exchange among network partners. This theme is closely interconnected with network structure as well as measures and trust (see the respective cells in Figure 2). For instance, Dyer and Nobeoka's (2000) study of Toyota pointed to the importance of developing knowledge-sharing routines and discussing trust and other phenomena that are relevant to the reduction of costs and the prevention of free-riding. In a similar vein, Dhanaraj and Parkhe (2006) argued that the orchestration of innovation networks is supposed to stabilize them by enabling the diffusion of knowledge, and finally optimizing their innovation output. This notion is

supported by the empirical evidence of leading multinational corporations presented by Häcki and Lighton (2001) and by the study of Boeing by Nambisan and Sawhney (2011). They argued that network orchestrators should design networks that allow opportunities for knowledge exchange: for example, by installing electronic platforms for such purposes. This finding has also been confirmed for small and medium-sized enterprise networks (Sabatier *et al*. 2010).

Thirdly, measures and indicators allow the improvement of the overall network using specific items developed for different research settings. For instance, Milward and Provan (1998) discussed the role of the 'network effectiveness' of US health-care networks and argued (based on a social network analysis) that this depends on the degree of network governance. More specifically, they suggested that network governance is most effective when the network is integrated via a centralized core agency, when mechanisms of fiscal control are direct and coherent, and when the environment is resource-rich. Similar observations were made by Herranz (2008) regarding the different forms of workforce development network. By contrast, Sydow (2004) explained measures and indicators as a form of the 'reflexive monitoring' of the parties involved within networks of insurance brokers.

Informal outcomes at the network level fall into three categories. First, the establishment of a network vision or joint agenda seems to be relevant when setting up interorganizational networks. As previously described, Beyer and Browning (1999) highlighted the role of Intel founder Robert Noyce (see also Chen and Graddy 2010). Similarly, the findings of Huxham's (2000, 2003) action research-based studies suggested that even leading actors that have access to superior resources are by no means capable of actually steering the respective network entirely (this finding resonates with Currie *et al*.'s (2011) study of networked partnerships in the UK). Rather, leading actors can only 'make things happen' (Huxham and Vangen 2000) by attempting to influence structures, processes and participants.

Secondly, the establishment of trust among network participants is important in that trust is a social lubricant which plays a critical role according to the empirical studies of Dyer and Nobeoka (2000), Lorenzoni and Baden-Fuller (1995) and Sydow and Windeler (1998). Each of these studies showed that trust is necessary for joint success. Similarly, Jones *et al*. (1997) highlighted the role of social mechanisms in the coordination and safeguarding of exchanges among network partners.

Thirdly, capabilities were discussed by Lorenzoni and Lipparini (1999), who analysed three producers of automatic packaging machines in Italy. They found that, in each case, dependencies and uncertainties in the environment of the lead firm resulted in the development of a specialized network of suppliers as well as a narrower and more competitive set of core competencies. They defined this leveraging of relationships to be a relational capability which is decisive for the success of the network.

Of the four studies that addressed the organizational level of analysis, only the study by Dittrich *et al*. (2007) explicitly analysed how formal structural issues influence the lead organization. The authors discussed the changes in IBM's network partners over time, which culminated in a repositioning of IBM's scope of activities. Although formerly a hardware business, changes to its cooperating partners largely resulted in IBM's refocus in the software business sector.

Informal outcomes concerning capabilities and corporate strategy were identified in four cases in which the network was deemed to be critical. For example, changes to IBM's network structure resulted in its altering its overarching organizational strategy from being exploitative in the hardware arena to becoming explorative in software (Dittrich *et al*. 2007). In his study of furnishings manufacturers in Italy, Capaldo (2007) discussed the role of relational capabilities in leading a network by managing strong and weak ties. In a similar way to Lorenzoni and Lipparini (1999) and Ritala *et al*. (2009), he argued that leveraging network relationships is critical for the success of the lead firm. In a similar vein, Hinterhuber (2002) used the activities of two agrochemical firms, Monsanto and DuPont, to show how managing network relationships serves to allow the coordination of previously unrelated markets and the relation of these to in-house operations. Finally, Nosella and Petroni (2007) highlighted the importance of the strategic vigilance of the lead organization in relation to changes in the environment and to the different forms of networks. Table 2 summarizes the main findings of these studies.

Suggestions for future research

The aim of this section is to stimulate interest by addressing some of the issues that presently remain comparatively unexplored, but merit further attention

Table 2. Summary of the main findings

Criterion	Main findings
Basic features of previous research	The discourse is comparatively recent and concentrates predominantly upon for-profit firms.
	Previous research is primarily oriented towards the fields of network and public management.
	Most studies are empirical in nature.
Basic features of previous research	Two central network forms are commonly – and most of the time exclusively – discussed: hierarchical and heterarchical networks.
	Studies relating to the organization as the level of analysis frequently concentrate upon hierarchical network settings.
	Moreover, studies concentrating upon the organization as a unit of analysis usually adopt a governance perspective and/or relate to structural aspects.
	Research on hierarchical or alternatively hierarchical as well as heterarchical networks tends to assume that the influence of leadership-exerting organizations is more limited.
Leadership outcomes	Formal leadership outcomes at the network level of analysis represent the core concern of previous studies, focusing upon three topics: (1) changes in the governance structure (2) knowledge-related exchanges (3) measures and indicators of network development.
	Informal leadership outcomes at the network level are discussed in terms of (1) a network vision or joint agenda (2) establishing trust and (3) capabilities.
	Formal leadership outcomes at the organizational level of analysis are only addressed by one study in detail, concentrating upon how the network structure influences the scope of activities at the focal organization.
	Informal leadership outcomes at the organizational level of analysis point to the effects for the capabilities and corporate strategy.

in order that more comprehensive approaches can be undertaken. These comprise, first, levels of analysis that have previously been neglected in comparison with others, secondly, a focus on the more gradual understanding of hierarchical and heterarchical networks, especially in heterarchical settings, and thirdly, repercussions for the leading organization.

First, it is unsurprising that the organizational and network levels of analysis dominate the literature (cf. Figure 2). However, addressing the individual and field levels of analysis might also offer valuable insights, in particular across levels of analysis. As for the individual level of analysis, the six papers identified (e.g. Martin *et al*. 2008) suggested that in order to lead the network, the respective leaders must occupy senior positions both within their 'home' organizations and in the network to which they are assigned. Although they are informative, these papers leave much room for further (empirical) enquiry if research on interorganizational leadership is to become better engaged with classical research on interpersonal leadership in order to highlight commonalities and differences (Connelly 2007; Ritala *et al*. 2009).

Future research might also investigate which of the individual attributes are relevant for the successful leading of a network in the first place (e.g. the outstanding reputation and charismatic leadership style of Robert Noyce; Beyer and Browning 1999; cf. also Saz-Carranza and Ospina 2010). Besides these intrapersonal factors, it might be worth reflecting on the role of organizations within the network (cf. Ritala *et al*. 2009, who connect individual and organizational characteristics). For example, it was because he was the founder of Intel, a successful semiconductor manufacturer, that Robert Noyce was chosen to initiate and lead the SEMATECH network in the 1980s. Similarly, it might be significant to reflect on the different characteristics of networks. For instance, whether they are predominantly hierarchical or heterarchical in nature might influence how effectively they are led or how they grow. Bryson and Kelley (1978) argued that the increase in network complexity results in greater centralization and formalization. Furthermore, they found that increasing centralization, growth and formalization result in the heightened stability of the leader.

In light of the foregoing, following DiMaggio and Powell (1983), the field level of analysis might provide further valuable insights into how the lead organization and network are related to the respective fields (Sydow and Windeler 1998). For example, characteristics such as the position of the lead organization and network within the field might be relevant. For example, Intel and SEMATECH (Beyer and Browning 1999) were both the key actors in their fields, but this factor also seems to be relevant in other more hierarchical networks (e.g. Dyer and Nobeoka 2000; Häcki and Lighton 2001). Indeed, it is striking that most of the studies of hierarchical

networks discuss lead organizations that are large multinational corporations. By contrast, studies devoted to heterarchical networks – with the exception of SEMATECH – tend to address primarily regional networks (e.g. Araujo and Brito 1997–98; Capaldo 2007; Huxham and Vangen 2000). Whether this observation is generalizable or simply a result of the focus of this research remains unknown.

The embeddedness of the lead organization in other networks is also worth analysing in order to explain the opportunities that a lead organization is able to exploit that others cannot. For example, the Carlo Gavazzi Space Company is able to lead a number of networks simultaneously (Nosella and Petroni 2007). At times, it skilfully takes advantage of its membership of different networks (e.g. industrial, scientific and political) in order to manoeuvre between them by actively exploiting any imbalances. Such 'arbitrage' is possible when an organization can divert resources that are relevant to its activities from one (e.g. hierarchical or political) network to another (e.g. heterarchical or scientific). The studies of Capaldo (2007), concerning leveraging a dual network of weak and strong ties, and of Lorenzoni and Lipparini (1999), discussing the role of developing a specialized supplier network to build platforms for mutual knowledge exchange, partially address this theme as well. Hence, future research might analyse more systematically what forms of networks (e.g. hierarchical vs heterarchical) and resources (e.g. human resources or monetary) are critical for their leadership.

Secondly, in line with recent research, we suggest venturing beyond dichotomous conceptions of hierarchical or heterarchical networks (Figure 2). Although this distinction has sensitized research to the differences between both types in practice, at least two caveats remain. The first caveat concerns the widely shared notion of ideal–typical forms of governance per se (cf. Huxham and Vangen 2000). We argue that it is necessary to venture beyond this dichotomy by adopting a more gradual understanding. A similar argument was set out by Provan and Kenis (2008), who refined this dichotomous conception by introducing three different (although still generic) forms. At least two other longitudinal studies have underscored our argument by observing how leadership changes over time. The study of Boari and Lipparini (1999) traced the development of what they call a 'moderate hierarchy' over time. IMA Spa, the industrial packaging machine firm analysed as a leading firm, began with a hierarchical form of leadership and ended up with a more heterarchical form, in which the influence of the leading firm decreased (cf. Currie *et al*. 2011; Ritala *et al*. 2009 for the reverse development). Dyer and Nobeoka (2000) also traced the changing way in which Toyota, as the leading firm, shared mutual knowledge within its first-tier supplier network. Pointing to the mutual benefits for all network members including the leading firm, they reported that Toyota encouraged horizontal exchanges among suppliers.

The issues in need of further systematic enquiry include the factors that triggered these changes. For instance, in some cases changes in the organizational field might be responsible as triggers (e.g. Sydow and Windeler 1998), whereas the lead organization has also been reported to act as a catalyst of change in the network (Boari and Lipparini 1999). A systematic enquiry into the underlying types of triggers beyond their mere identification might thus be worth pursuing.

Furthermore, we argue that a focus on heterarchical networks seems to be another promising avenue. Because the organization responsible for the exertion of leadership in heterarchical networks can vary over time because of conflicting outcomes from consensus-based decision-making processes (Huxham 2000; Provan and Kenis 2008), longitudinal and more process-oriented studies are likely to be more suitable for understanding leadership in heterarchical networks. Related to this, another still poorly understood aspect concerns the question of how forms of leadership develop over time. Studies that have addressed network evolution against the backdrop of leadership issues (e.g. Doz *et al*. 2000; Ring *et al*. 2005) and post-formation dynamics (Reuer *et al*. 2002) have suggested that networks tend to become more formalized and diversified. Additionally, they ultimately become centralized following a prolonged and intensive collaboration. Thus, although leadership forms seem to become more established over time, the aforementioned studies relate to high-technology sectors, and it remains unclear whether this establishment occurs in other, less volatile contexts.

The few studies that have actually investigated heterarchical networks have tended to adopt qualitative approaches, which is a promising means of capturing the dynamics that unfold in such networks. For instance, in their longitudinal study Lorenzoni and Lipparini (1999) described the limitations of lead organizations and suggested that they rely on multi-

ple, repeated, and trust-based relationships in order to allow for mutual exchanges of knowledge (see also Das and Teng 2001). This finding sensitizes us to the potential value of paying more attention to interpersonal issues (Beyer and Browning 1999; Ritala *et al*. 2009; Saz-Carranza and Ospina 2010). It also underscores the possible value of assessing multiple levels of analysis in order to explain comprehensively how networks are led. The issues that merit investigation here might be interpersonal bonds, the length of relationships between partners, the number and history of projects jointly pursued or the composition and stability of the network.

Thirdly, the previously one-sided portrayal of how leadership in interorganizational networks affects the network while neglecting its repercussions on the lead organization(s) ought to be taken into consideration (Figure 3). Few studies have shed a critical light on this heroic conception of leadership, calling for more balanced conceptions that acknowledge the limited influence that the leadership-exerting organization(s) may have. However, the study of Huxham and Vangen (2000) did explicitly state that no leadership activities fully lie within the control of a single member and that leadership represents a collaborative effort. This is important to note, because it points to the intended and unintended consequences for the leadership-exerting organization(s).

In light of the foregoing, it might be worth investigating the repercussions in the network of changes in the leading organization. For example, assignment of personnel to lead the network may be necessary, which might also result in searching for an interim manager to fill the vacancy at the leading organization (cf. Beyer and Browning 1999). Furthermore, as Dittrich *et al*. (2007) showed for IBM, leading a network might result in an overall change in strategy and a replacement of network partners. This can represent a vital aspect of overall corporate strategy, because it may culminate in changes to the organizational field in which the respective organization operates.

Furthermore, the detrimental effects of leading an interorganizational network are seldom discussed. One of the few exceptions is the study by Capaldo (2007), who argued that there is a 'dark side' (p. 599) to leading a network that has strong links with regard to the innovative capabilities of the leading firms. Further support for this notion was offered by Sydow (2004), who reported on the continuous conflicts and drawbacks throughout the evolution of a network of insurance brokers. Aspects to consider in future research might therefore include the amount of resources invested in the network (e.g. senior personnel or monetary investments; Beyer and Browning 1999), the expertise or support offered (Sydow and Windeler 1998), the opportunity costs with regard to missed engagements with other organizations or networks (Beyer and Browning 1999), and the potential loss of know-how or capabilities (Capaldo 2007).

Concluding remarks

This systematic review has shown that previous research has focused predominantly on the network and organizational levels of analysis and the effects of leadership on organizational networks. Future research should aim to analyse multiple levels of analysis, particularly the individual and organizational field levels, in order to connect better with studies of personnel leadership (Connelly 2007). In addition, the acknowledgement that conflicts and detrimental effects sometimes occur might result in a more realistic picture of how leadership is actually made to happen.

Although the analysis presented rests solely on previous theoretical and empirical studies, the issues raised provide important practical ramifications, because the exertion of leadership in interorganizational networks occurs in manifold settings, such as public–private partnerships, for-profit organizations that innovate collaboratively, or public institutions that join forces, as hospitals frequently do. Therefore, it is essential for researchers interested in interorganizational network leadership to contribute further to the current understanding of how leadership is made to happen.

Like any review, our own analysis has limitations. One of these is the comparatively small amount of quantitative work included in this review. One reason for this absence of quantitative work is our key interest in leadership rather than in governance. However, future research should use quantitative methods to offer testable and more generalizable results.

Moreover, mutual interdependencies within the organization–network nexus should be scrutinized further. For instance, Dittrich *et al*. (2007) highlighted the substantial influence a network might have on the leading organization. Nonetheless, future studies should further assess which key areas are affected, the influence of these repercussions, and how to influence this nexus. Restricting the search to

specific key terms is also problematic, because it represents an entirely subjective endeavour. As a result, some articles might not have been included even though they might have been relevant to the present analysis. In a similar vein, although our focus on peer-reviewed journals is a common procedure, it results in the exclusion of further articles *ex ante*. We nevertheless believe that we have reviewed the majority of studies devoted to interorganizational networks, and that this approach has provided fertile ground for future research on this timely and important management topic.

References

NB Sources marked with an asterisk (*) are included in the literature review (cf. also Appendix S1).

*Araujo, L. and Brito, C. (1997–98). Agency and constitutional ordering in networks. A case study of the port wine industry. *International Studies of Management and Organization*, **27**, pp. 22–46.

Bakker, R.M. (2010). Taking stock of temporary organizational forms: a systematic review and research agenda. *International Journal of Management Reviews*, **12**, pp. 466–486.

Barringer, B.R. and Harrison, J.S. (2000). Walking a tightrope: creating value through interorganizational relationships. *Journal of Management*, **26**, pp. 367–403.

*Batterink, M.H., Wubben, E.F.M., Klerkx, L. and Omta, S.W.F. (2010). Orchestrating innovation networks: the case of innovation brokers in the agri-food sector. *Entrepreneurship & Regional Development*, **22**, pp. 47–76.

*Beyer, J.M. and Browning, L.D. (1999). Transforming an industry in crisis: charisma, routinization, and supportive cultural leadership. *Leadership Quarterly*, **10**, pp. 483–520.

*Boari, C. and Lipparini, A. (1999). Networks within industrial districts: organising knowledge creation and transfer by means of moderate hierarchies. *Journal of Management and Governance*, **3**, pp. 339–360.

Browning, L.D., Beyer, J.M. and Shetler, J.C. (1995). Building cooperation in a competitive industry: SEMATECH and the semiconductor industry. *Academy of Management Journal*, **38**, pp. 113–151.

*Bryson, J. and Kelley, G. (1978). A political perspective on leadership emergence, stability, and change in organizational networks. *Academy of Management Review*, **3**, pp. 713–723.

Burt, R.S. (1992). *Structural Holes. The Social Structure of Competition*. Cambridge, MA: Harvard University Press.

*Capaldo, A. (2007). Network structure and innovation: the leveraging of a dual network as a distinctive relational capability. *Strategic Management Journal*, **28**, pp. 585–608.

*Chen, B., and Graddy, E.A. (2010). The effectiveness of nonprofit lead-organization networks for social service delivery. *Nonprofit Management & Leadership*, **20**, pp. 405–422.

Connelly, D.R. (2007). Leadership in the collaborative interorganizational domain. *International Journal of Public Administration*, **30**, pp. 1231–1262.

Cropper, S., Ebers, M., Huxham, C. and Ring, P.S. (eds) (2008). *The Oxford Handbook of Interorganizational Relations*. Oxford: Oxford University Press.

*Currie, G., Grubnic, S., and Hodges, R. (2011). Leadership in public services networks: antecedents, process and outcome. *Public Administration*, **89**, pp. 242–264.

Das, T.K. and Teng, B.-S. (2001). Trust, control, and risk in strategic alliances: an integrated framework. *Organization Studies*, **22**, pp. 251–283.

Denyer, D. and Tranfield, D. (2009). Producing a systematic review. In Buchanan, D.A. and Bryman, A. (eds), *The SAGE Handbook of Organizational Research Methods*. London: Sage, pp. 671–689.

*Dhanaraj, C. and Parkhe, A. (2006). Orchestrating innovation networks. *Academy of Management Review*, **31**, pp. 659–669.

DiMaggio, P. and Powell, W.W. (1983). The iron cage revisited: institutional isomorphism and collective rationality in organizational fields. *American Sociological Review*, **48**, pp. 147–160.

*Dittrich, K., Duysters, G. and de Man, A. (2007). Strategic repositioning by means of alliance networks: the case of IBM. *Research Policy*, **36**, pp. 1496–1511.

Doz, Y.L. (1996). The evolution of cooperation in strategic alliances: initial conditions or learning processes? *Strategic Management Journal*, **17**, pp. 55–83.

*Doz, Y.L., Olk, P.M. and Ring, P.S. (2000). Formation processes of R&D consortia: which path to take? Where does it lead? *Strategic Management Journal*, **21**, pp. 239–266.

*Dyer, J.H. and Nobeoka, K. (2000). Creating and managing a high-performance knowledge-sharing network: the Toyota case. *Strategic Management Journal*, **21**, pp. 345–367.

Grabher, G. (2004). Temporary architectures of learning: knowledge governance in project ecologies. *Organization Studies*, **25**, pp. 1491–1514.

Grabher, G. and Powell, W.W. (2004). *Networks*. Cheltenham: Elgar.

*Grandori, A. (1997). An organizational assessment of interfirm coordination modes. *Organization Studies*, **18**, pp. 897–925.

Granovetter, M. (1973). The strength of weak ties. *American Journal of Sociology*, **78**, pp. 1360–1380.

Granovetter, M. (1985). Economic action and social structure: the problem of embeddedness. *American Journal of Sociology*, **91**, pp. 481–510.

Gulati, R., Nohria, N. and Zaheer, A. (2000). Strategic networks. *Strategic Management Journal*, **21**, pp. 203–215.

*Häcki, R. and Lighton, J. (2001). The future of the networked company. *McKinsey Quarterly*, **37**, pp. 26–39.

Hedlund, G. (1986). The hypermodern MNC – a heterarchy? *Human Resource Management*, **2**, pp. 9–36.

*Herranz Jr, J. (2008). The multisectoral trilemma of network management. *Journal of Public Administration Research and Theory*, **18**, pp. 1–31.

*Hinterhuber, A. (2002). Value chain orchestration in action and the case of the global agrochemical industry. *Long Range Planning*, **35**, pp. 615–635.

Hoffmann, W.H. (2005). How to manage a portfolio of alliances. *Long Range Planning*, **38**, pp. 121–143.

*Huxham, C. (2000). The challenge of collaborative governance. *Public Management*, **2**, pp. 337–357.

*Huxham, C. (2003). Theorizing collaboration practice. *Public Management*, **5**, pp. 401–423.

*Huxham, C. and Vangen, S. (2000). Leadership in the shaping and implementation of collaboration agendas: how things happen in a (not quite) joined-up world. *Academy of Management Journal*, **43**, pp. 1159–1175.

Jarillo, J.C. (1988). On strategic networks. *Strategic Management Journal*, **9**, pp. 31–41.

*Jones, C., Hesterly, W.S. and Borgatti, S.P. (1997). A general theory of network governance: exchange conditions and social mechanism. *Academy of Management Review*, **22**, pp. 911–945.

*Kenis, P. and Provan, K.G. (2006). The control of public networks. *International Public Management Journal*, **9**, pp. 227–247.

Kilduff, M. and Tsai, W. (2003). *Social Networks and Organizations*. London.: Sage.

*Kim, J. (2008). From consortium to e-science: an evolutionary track of organising technology development. *International Journal of Technology Management*, **41**, pp. 291–310.

Kodama, M. (2007). Innovation and knowledge creation through leadership-based strategic community: case study on high-tech company in Japan. *Technovation*, **27**, pp. 115–132.

Koka, B.R., Madhavan, R. and Prescott, J.E. (2006). The evolution of interfirm networks: environmental effects on patterns of network change. *Academy of Management Review*, **31**, pp. 721–737.

Koza, M. and Lewin, A. (1999). The coevolution of network alliances: a longitudinal analysis of an international professional service network. *Organization Science*, **10**, pp. 638–653.

Lazzarini, S.G. (2007). The impact of membership in competing alliance constellations: evidence on the operational performance of global airlines. *Strategic Management Journal*, **28**, pp. 345–367.

Lewis, J.D. and Elman, J.L. (2008). Growth-related neural reorganization and the autism phenotype: a test of the hypothesis that altered brain growth leads to altered connectivity. *Developmental Science*, **11**, pp. 135–155.

*Lorenzoni, G. and Baden-Fuller, C. (1995). Creating a strategic center to manage a web of partners. *California Management Review*, **37**, pp. 146–163.

*Lorenzoni, G. and Lipparini, A. (1999). The leveraging of interfirm relationships as a distinctive organizational capability: a longitudinal study. *Strategic Management Journal*, **20**, pp. 317–338.

*Martin, G.P., Currie, G. and Finn, R. (2008). Leadership, service reform, and public-service networks: the case of cancer-genetics pilots in the English NHS. *Journal of Public Administration Research*, **19**, pp. 769–794.

*McDermott, G.A. (2007). Politics and the evolution of inter-firm networks: a post-communist lesson. *Organization Studies*, **28**, pp. 885–908.

*Milward, H.B. and Provan, K.G. (1998). Principles for controlling agents: the political economy of network structure. *Journal of Public Administration Research and Theory*, **8**, pp. 203–221.

*Nambisan, S. and Sawhney, M. (2011). Orchestration processes in network-centric innovation: evidence from a field. *Academy of Management Perspectives*, **25**, pp. 40–57.

*Nosella, A. and Petroni, G. (2007). Multiple network leadership as a strategic asset: the Carlo Gavazzi Space case. *Long Range Planning*, **40**, pp. 178–201.

Oliver, A.L. (2009). *Networks for Learning and Knowledge-Creation in Biotechnology*. Cambridge: Cambridge University Press.

Parkhe, A., Wasserman, S. and Ralston, D.A. (2006). New frontiers in network theory development. *Academy of Management Review*, **31**, pp. 560–568.

Pittaway, L., Robertson, M., Munir, K., Denyer, D. and Neely, A. (2004). Networking and innovation: a systematic review of the evidence. *International Journal of Management Reviews*, **5**, pp. 137–168.

Podolny, J. and Page, K.L. (1998). Network forms of organization. *Annual Review of Sociology*, **24**, pp. 57–76.

Powell, W.W. (1990). Neither market nor hierarchy: network forms of organization. *Research in Organizational Behavior*, **12**, pp. 295–336.

Powell, W.W., Koput, K.W. and Smith-Doerr, L. (1996). Interorganizational collaboration and the locus of innovation: networks of learning in biotechnology. *Administrative Science Quarterly*, **41**, pp. 116–145.

*Provan, K.G. and Kenis, P. (2008). Modes of network governance: structure, management, and effectiveness. *Journal of Public Administration Research and Theory*, **18**, pp. 229–252.

Provan, K.G., Fish, A. and Sydow, J. (2007). Interorganizational networks at the network level: a review of the empirical literature on whole networks. *Journal of Management*, **33**, pp. 479–516.

*Reuer, J., Zollo, M. and Singh, H. (2002). Post-formation dynamics in strategic alliances. *Strategic Management Journal*, **23**, pp. 135–151.

*Ring, P.S., Doz, Y.L. and Olk, P.M. (2005). Managing formation processes in R&D consortia. *California Management Review*, **47**, pp. 137–156.

*Ritala, P., Armila, L. and Blomqvist, K. (2009). Innovation orchestration capability – defining the organizational and individual level determinants. *International Journal of Innovation Management*, **13**, pp. 569–591.

Rosenkopf, L., Metiu, A. and George, V.P. (2001). From the bottom up? Technical committee activity and alliance formation. *Administrative Science Quarterly*, **46**, pp. 748–772.

*Sabatier, V., Mangement, V. and Rouselle, T. (2010). Orchestrating networks in the biopharmaceutical industry: small hub firms can do it. *Production Planning & Control*, **21**, pp. 218–228.

*Saz-Carranza, A. and Ospina, S.M. (2010). The behavioural dimension of governing interorganizational goal-directed networks – managing the unity–diversity tension. *Journal of Public Administration Research*, **21**, pp. 327–365.

Simmel, G. (1950). *The Sociology of Georg Simmel*, trans. K.H. Wolff. Glencoe, IL: Free Press.

*Soeters, J.L. (1993). Managing euregional networks. *Organization Studies*, **14**, pp. 639–656.

*Sydow, J. (2004). Network development by means of network evaluation? Explorative insights from a case in the financial services industry. *Human Relations*, **57**, pp. 201–220.

*Sydow, J. and Windeler, A. (1998). Organizing and evaluating interfirm networks: a structurationist perspective on network processes and effectiveness. *Organization Science*, **9**, pp. 265–284.

*Sydow, J. and Windeler, A. (2003). Knowledge, trust, and control. Managing tensions and contradictions in a regional network of service firms. *International Studies of Management & Organization*, **33**, pp. 69–99.

Sydow, J., Lerch, F., Huxham, C. and Hibbert, P. (2011). A silent cry for leadership: organizing for leading (in) clusters. *Leadership Quarterly*, **22**, pp. 328–343.

Van de Ven, A.H. and Walker, G. (1984). The dynamics of interorganizational coordination. *Administrative Science Quarterly*, **29**, pp. 598–621.

Williamson, O.E. (1975). *Markets and Hierarchies: Analysis and Antitrust Implications*. New York: Free Press.

Supporting information

Appendix S1. Results of the literature review (in alphabetical order).

Please note: Wiley-Blackwell are not responsible for the content or functionality of any supporting materials supplied by the authors. Any queries (other than missing material) should be directed to the corresponding author for the article.